A POLICY DESIGN MODEL FOR
MARKET FORMATION OF SOLAR AND WIND ELECTRICITY GENERATION
IN TURKEY

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Approval of the Graduate School of Social Sciences

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ABSTRACT

A POLICY DESIGN MODEL FOR
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IN TURKEY

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The aim of this study is to design technology policies for diffusion of solar and wind electricity generation technologies by analyzing the market formation dynamics from the perspective of key actors in the framework of technological innovation system approach. For this purpose, qualitative data is collected through 57 face-to-face semi-structured interviews with the key actors from private and non-private sectors who are engaged in economic activities of electricity generation, regulation of the market, consultancy to the actors, and equipment supply.

The study proposes a policy design model to formulate policy recommendations based on three pillars of policy aim, policy tool and policy target. To build this model, first, the energy problems that can be solved by solar and wind electricity generation are determined to find out policy problems and policy aims. Second, obstacles and facilitators which affect solar and wind electricity generation are specified to determine policy tools. Third, the market formation dynamics are examined to formulate policy targets. By combining these three analyses, policy recommendations are formulated based on the proposed policy design model.

The policy problems are found to be about import dependency for the energy sources and governance of the renewable energy sector. The policy tools are formulated based on the administrative, economic, institutional, physical, political, psychological and technological obstacles and facilitators. The market in solar and wind electricity generation forms as two market segments of licensed and unlicensed electricity generation. The policy targets are specified for this market formation process. To conclude, policy recommendations at macro, meso and micro levels are formulated by using policy design model.

To solve import dependency problem, the policy recommendations at macro level are *considering complementarity relationship between energy sources* and *modelling a domestic technology development strategy*. The policy recommendation at micro level is *promoting self-consumption.* To solve the governance problem, the policy recommendation at macro level is *preparing clear roadmaps and plans about solar and wind electricity generation.* The policy recommendations at meso level are *formulating manuals for renewable energy investment, changing the role of government in energy sector* and *introducing a governance mechanism to include renewable electricity generation in industrial production.* The policy recommendation at micro level is *rehabilitating electricity infrastructure.*

Keywords: Solar energy, wind energy, technological innovation system, market formation, policy design.

ÖZ

TÜRKİYE'DE GÜNEŞ VE RÜZGAR ENERJİSİNE DAYALI ELEKTRİK ÜRETİMİNDE PİYASA OLUŞUMU İÇİN BİR POLİTİKA TASARIM MODELİ

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Bu çalışmanın temel amacı; Türkiye'de güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin yayılmasına yönelik teknoloji politikalarını, kilit aktörlerin bakış açısından ve teknoloji yenilik sistemi yaklaşımı çerçevesinde piyasa oluşum dinamiklerini inceleyerek tasarlamaktır. Bu amaçla yarı yapılandırılmış mülakat yöntemiyle, özel sektörden ve özel sektör dışından elektrik üretimi, piyasanın düzenlenmesi, aktörlere danışmanlık yapılması ve ekipman tedariği ekonomik faaliyetlerini gerçekleştiren kilit aktörlerle 57 adet yüzyüze mülakat gerçekleştirilmiştir.

Bu çalışma; politika amacı, politika aracı ve politika hedefi olmak üzere üç ayak üzerine kurulmuş politika önerileri geliştiren bir politika tasarım modeli önermektedir. Bu modeli geliştirmek için, ilk olarak politika sorunlarını ve politika amaçlarını belirlemek amacıyla güneş ve rüzgar enerjisine dayalı elektrik üretimi ile çözülebilecek enerji sorunları saptanmıştır. İkinci olarak, politika araçlarını belirlemek için güneş ve rüzgar enerjisine dayalı elektrik üretimini etkileyen engelleyici ve destekleyici faktörler tespit edilmiştir. Üçüncü olarak politika hedeflerini belirlemek için piyasa oluşum dinamikleri incelenmiştir. Bu üç analiz birleştirilerek, politika tasarım modeli ile politika önerileri geliştirilmiştir.

Politika sorunlarının, enerji kaynaklarındaki ithalata bağımlılık ve yenilenebilir enerji sektörünün yönetişimi ile ilgili olduğu saptanmıştır. Politika araçları, yönetimsel, iktisadi, kurumsal, fiziksel, siyasi, psikolojik ve teknolojik engelleyici ve destekleyici

faktörlere dayanarak formüle edilmiştir. Güneş ve rüzgar enerjisine dayalı elektrik üretimindeki piyasanın, lisanslı ve lisanssız olmak üzere iki pazar segmenti şeklinde oluştuğu sonucuna varılmıştır. Politika hedefleri, belirtilen piyasa oluşum süreci için belirlenmiştir. Sonuç olarak, önerilen politika tasarım modeli ile makro, meso ve mikro seviyelerde politika önerileri geliştirilmiştir.

İthalata bağımlılık sorununu güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin yayılmasına yönelik teknoloji politikaları ile çözmek için makro seviyedeki politika önerileri *enerji kaynakları arasında tamamlayıcılık ilişkisinin ön plana çıkarılması* ve *yerli teknoloji geliştirme stratejisinin modellenmesi*dir. Mikro seviyedeki politika önerisi ise *öztüketimin desteklenmesi*dir. Yönetişim sorununun çözülmesi için makro seviyedeki politika önerisi *güneş ve rüzgar enerjisine dayalı elektrik üretimi için yol haritaları ve planların hazırlanması*dır. Meso seviyedeki politika önerileri, *yenilenebilir enerji yatırımları için el kitaplarının hazırlanması, enerji sektöründe devletin rolünün değişmesi* ve *sanayi üretimine güneş ve rüzgar enerjisine dayalı olarak üretilen elektriğinin entegre edilmesi*dir. Mikro seviyedeki politika önerisi ise, *elektrik iletim ve dağıtım altyapısının rehabilite edilmesi*dir.

Anahtar kelimeler: Güneş enerjisi, rüzgar enerjisi, teknoloji yenilik sistemi, piyasa oluşumu, politika tasarımı.

Dem'e...
Can Dem'ime...
her dem, hemdemle, hep bir...

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CSB: Ministry of Environment and Urbanization of Republic of Turkey

EPC: Engineering Procurement Construction

EPDK: The Energy Market Regulatory Authority

EPIA: European Photovoltaic Industry Association

EPİAŞ: Energy Markets Operation Company

ETKB: Ministry of Energy and Natural Resources of the Republic of Turkey

EUROSTAT: Statistical Office of the European Union

GENSED: Solar Energy Businessmen and IndustryAssociation

GÜNDER: International Solar Energy Society -Turkey Section

GTHB: Ministry of Food, Agriculture and Livestock of the Republic of Turkey

GW: Gigawatt

GWh: Gigawatt-Hour

IEA: International Energy Agency

Int.: Interviewee

KW: Kilowatt

LİDER: Unlicensed Electricity Generation Association

MGM: Turkish State Meteorological Services

MW: Megawatt

NGO: Non-Governmental Organization

OSIB: Ministry of Forestry and Water Affairs of the Republic of Turkey

RES: Renewable Energy Sources

R&D: Research and Development

SW-EG: Solar and Wind Electricity Generation

TEİAŞ: Turkish Electricity Transmission Company Inc.

TETAŞ: Turkish Electricity Trading and Contracting Company Inc.

TIS: Technological Innovation System

TWh: Terawatt-hour

TÜREB: Turkish Wind Energy Association

TÜBİTAK: Scientific and Technological Research Council of Turkey

QDA: Qualitative Data Analysis Software

YEGM: General Directorate of Renewable Energy

YEKDEM: Renewable energy support mechanism

CHAPTER 1

INTRODUCTION

1.1. Background Information

In the growth phase of globalized economies, the rapid supply of increasing energy demand is emerging as an important problem. With this problem, the debate on sustainable and clean energy provision comes to surface. As a result, increasing energy demand arises as an issue in parallel to environmental problems and climate change. Climate change motivates global movement of research for sustainable energy production and consumption (Dewald and Truffer, 2011). Especially, the dominance of fossil fuels in primary energy consumption and electricity generation increases the concerns about environment and climate change (Jacobsson and Bergek, 2004). This claim is supported by the energy figures. According to IEA (2015a), as of 2013, the share of fossil fuels in global energy mix is 81% and the share of non-fossil fuels is 19%, and in last 30 years this share has not changed very much. In this report it is asserted that "in all energy scenarios, fossil fuels remain the dominant source of energy supply to 2040" (IEA, 2015a: 56). In such a manner, energy problem can be seen from a different perspective if energy production and energy consumption are considered in terms of sustainability, cleanness, availability and abundance of energy sources.

Environmentally clean alternative energy resources are alternative solutions to meet the increasing energy demand in a sustainable manner. Kamat (2007: 2835) asserts that there are three major clean energy options; *carbon neutral energy (fossil fuel in conjunction with carbon sequestration), nuclear power, and renewable energy*. Besides other alternatives, renewable energy can be generated from available and domestic resources such as hydroelectric resource, geothermal land area, wind power, tidal energy, biomass and solar energy striking the earth. Moreover, in terms of sustainability, renewable sources are more advantageous as compared to other clean sources. Especially for the countries where the dominant energy sources are imported fossil fuels, like Turkey, energy production from domestic and clean renewable sources becomes a promising solution for energy problems.

Renewable sources are used for the purposes of *electricity generation, heating* and *lighting*. Electricity generation from renewable sources is very common and seen as an important alternative for solving energy problem (Jacobsson and Bergek, 2004). Moreover, in Turkey increasing electricity consumption rates and electricity prices, the dominance of fossil fuels in electricity generation and abundant renewable energy sources motivate electricity generation by using renewable sources. Building on these pillars, in this dissertation I propose that increasing electricity generation based on renewable sources can be a promising option for Turkey to solve the energy problem. But how? This is the starting point of the dissertation.

1.2. Problem Definition

Both electricity prices and electricity consumption rate are increasing in Turkey. Since 2008, electricity prices for domestic and industrial consumers have increased annually at 5.5% (EUROSTAT, 2015a) and 2.7% on average (EUROSTAT, 2015b) respectively. In addition to electricity prices, electricity consumption rates are also rising. The average annual growth rate of total electricity consumption in Turkey has been approximately 6% for the last decade (IEA, 2015b).[1] In 2013, the share of electricity consumption in total energy consumption is 19% (Figure 1.1). By looking at this small rate, the role of electricity in energy scheme may be underestimated; however this would be a mistake. Despite the fact that the share of electricity consumption is smaller than the shares of solid fuels[2] (23%), petroleum (34%) and natural gas (20%) in total energy consumption, most of these fossil fuels are used in electricity generation (Figure 1.1).

[1] This statistics is calculated by using the raw data of electricity consumption of Turkey (GWh) from IEA Database for the time period of 1999-2012.

[2] According to Ministry of Energy and Natural Resources Data Sources (ETKB, 2013), group of "solid fuels" is the total of mineral coal, lignite, asphaltite, coking coal, wood-fuel, plant and animal waste.

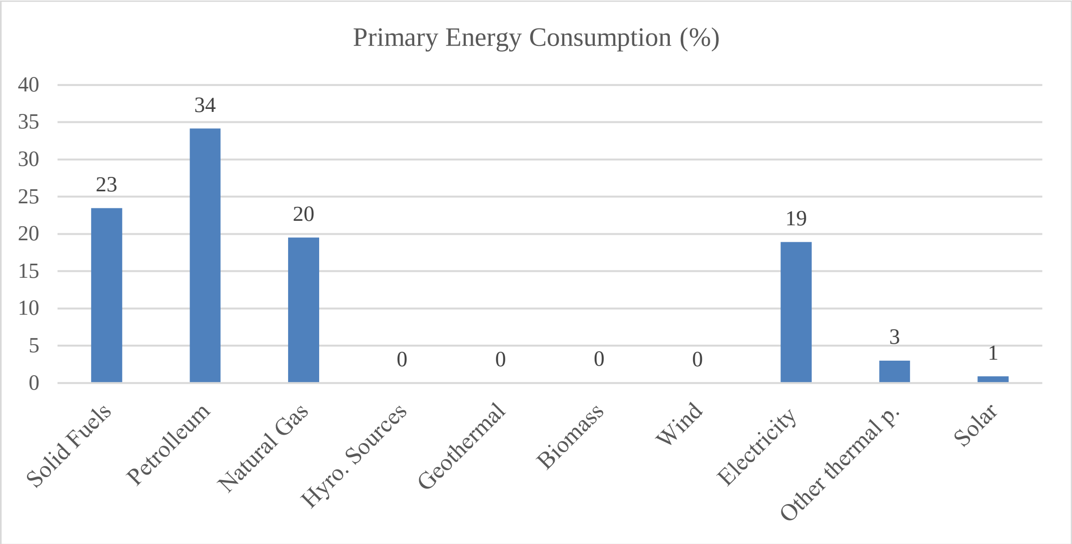

Figure 1. 1. Primary Energy Consumption of Energy Sources, 2013
Source: ETKB (2013).

According to ETKB (2013), the share of natural gas in electricity generation is 44%, the share of solid fuels in electricity generation is 27%, and the share of petroleum in electricity generation is 1% (Figure 1.2).[3] Hence in 2013, 72 % of electricity is generated from fossil fuels (ETKB, 2013). In the analysis of Turkish General Energy Equilibrium Table for 2013[4], Energy Production and Conversion figures point out that "electricity" is the leading form of energy for what the other sources are used to produce. 46% of primary solid fuels supply is consumed in energy production and, the rate of solid fuels used in electricity generation is 91% of all the solid fuels used in energy production (ETKB, 2013). Additionally, 53 % of primary natural gas supply is consumed in energy production, and the rate of natural gas used in electricity generation is 94% of all the natural gas used in energy production (ETKB, 2013).

[3] These energy figures are calculated by using ETKB (2013) raw data, and cross checked with TEAİŞ (2015) "Annual development of Turkey's gross electricity generation by share of primary energy resources" Table. The figures are almost the same. In this data source, these statistics are calculated as: The share of natural gas is 43.8%, the share of solid fuels is 27.3% and the share of hydropower is 24.7% (TEİAŞ, 2015: 38).

[4] This is the most recent available data in Turkish Ministry of Energy and Natural Resources database.

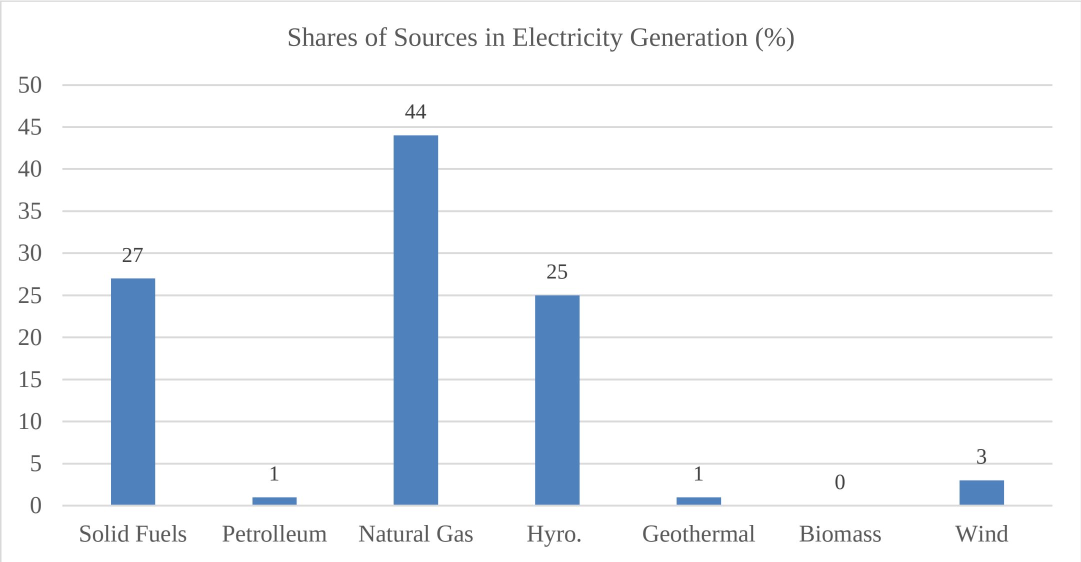

Figure 1. 2. Shares of Energy Sources in Electricity Generation, 2013
Source: ETKB (2013)

In Turkish Energy Sector, as seen from the energy figures, electricity is mainly generated from fossil fuels, and most of these fossil fuels are imported. In addition to the dominance of fossil fuels in electricity generation, import dependency is arising as another problem. According to the Turkish General Energy Equilibrium Table for 2013, Energy Import Figures point out that most of the fossil fuels are imported. The import rates of natural gas, petroleum and solid fuels in total imported amount of energy sources import 39%, 40% and 21% respectively (ETKB, 2013). By looking at these figures, it is seen that 72% of total electricity consumption is generated by the fossil fuels mostly imported.

On the other hand, the rate of renewable sources[5] in total electricity generation is 29% in 2013 (Figure 1.2).[6] Apart from the hydraulic power (25%), the individual rates of

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[5]According to the "The Law on the Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy (No: 5346)", which regulates the renewable energy sources for the purpose of electricity generation, renewable energy sources are defined as the *non-fossil energy resources such as hydro (less than 15 km^2 of reservoir area and run-of-the-river hydroelectric), wind, solar, geothermal, biomass, biogas (including landfill gas), and wave, current and tidal energy*. For calculating the share of renewable sources in electricity generation, I benefitted from the available databases of Ministry of Energy and Natural Resources and Energy Market Regulatory Authority. In these databases there is no separate data for renewable hydropower (less than 15 km^2 of reservoir area and run-of-the-river hydroelectric) and non-renewable hydropower. As a result, while calculating the rate of hydroelectric power in installed capacity, both renewable and non-renewable hydro power plants are taken into account. This is also used in that manner in National Renewable Energy Action Plan (ETKB, 2014) and explicitly stated in that document (in footnote no: 19, pg: 52). Due to this reason, it must be emphasized that the rate hydraulic power in electricity generation which is calculated as 25% for the year 2013 is an over calculated value due to the limitations in databases.

clean and domestic sources such as wind power (3%) and solar power (0%) are very small in electricity generation (ETKB, 2013). To increase the shares of these sources in electricity generation, The Energy Supply Security Strategy Document (ETKB, 2009) sets the targets of 20.000 MW for wind power installed capacity (which is 3500 MW in 2013) and 3000 MW for solar power installed capacity (which is 0 MW in 2013) for 2023 (ETKB, 2014).[7] Moreover, the target rate of domestic and renewable power in total electricity generation is set to be 30% in 2023 (including hydropower, geothermal in addition to solar and wind energy). The rate of hydropower in electricity generation is very high (about 25%) and increasing, and geothermal power has reached the 1% with installed capacity limit of 2000 MW (ETKB, 2013). However the same pace is not valid for solar power and wind power. In such a framework, to reach the renewable and sustainable energy targets successfully for solving the energy problem (increasing import dependency for energy production), the same trend must be provided in electricity generation based on solar power and wind power. This can be accomplished by technology policies that promote diffusion of emerging solar and wind electricity generation (SW-EG) technologies.

This dissertation attempts to analyze the diffusion of SW-EG technologies in Turkey by a systematic approach from the perspective of key actors. To increase electricity generation based on renewable sources, policy makers should design technology policies to stimulate diffusion of emerging renewable energy technologies such as solar photovoltaic applications and wind turbine engines. To design these policies, policy makers should understand the dynamics of renewable electricity market formation. The focus of analysis in this dissertation is adopted to be key actors' perceptions about market formation process. Accordingly, this dissertation seeks to answer the following research questions:

- What are the main energy problems in Turkey that can be solved by renewable electricity generation?
- How can the policy maker solve these problems by using solar and wind energy sources?

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[6] 25% of electricity is generated from hydropower sources, 3% from wind energy and 1% from geothermal sources. The sum of these rates is 29% of total electricity consumption (Figure 1.2).

[7] These targets are updated by "National Renewable Energy Action Plan for Turkey" released in December, 2014 and only the target for solar energy is changed as 5000 MW for 2023, other targets are same (ETKB, 2014).

- What should be the focus of analysis in policy making to promote diffusion of SW-EG technologies?
- How do the key actors understand and affect the market formation in renewable electricity generation to promote diffusion of emerging renewable electricity generation technologies?

1.3. Objective of the Study

The main aim of this dissertation is to design technology policies for diffusion of SW-EG technologies. In this process, I claim that it is more appropriate to detect systemic failures and to fix them during the development of the system rather than doing this after the system is completely developed; at least the market is formed. Markets are socially constructed institutions of the systems and, the systemic failures that hinder the market formation are embedded in the system and evolve with it. To promote market formation, the systemic failures should be detected and fixed by designing policies for diffusion of emerging renewable energy technologies. This should be done by revising the policy making process in Turkish Energy Sector taking into account the legitimation, political stability, flexibility, consistency and externality in (renewable) energy decisions and defining the new role of public authority clearly (being a governor and initiator rather than an investor and energy producer).

1.4. Scope of the Study

1.4.1. Theoretical Framework

For the purpose of this dissertation first of fundamental theories of technology policy design, the Evolutionary Theory and the Neoclassical Theory, are briefly examined. Then, for the policy analysis, to find out the problems that hinder diffusion of SW-EG technologies, the Market Failures Approach (based on the Neoclassical Theory) and the System Failures Approach (based on the Evolutionary Theory) are elaborated. Subsequently, to design the policies, it is claimed that "Technological Innovation System" Approach (based on the Evolutionary System Failures Approach) should be adopted for emerging technology cases like SW-EG technologies in Turkey.

For the focus of policy analysis, one of the functions of Technological Innovation System is chosen for designing technology policies specifically. This function is identified as "the market formation" by preliminary analysis. Hence, in following section of the theoretical framework, the details of market formation (specifically in emerging renewable energy case) are discussed.

1.4.2. Research Design

In this dissertation, a qualitative research strategy is adopted to collect and analyze the data. Data is collected in two stages: The Preliminary Analysis and the Field Research. The preliminary analysis is conducted to establish a connection with the renewable energy sector and to determine the research question of the dissertation. The field research is conducted to collect the main data of the dissertation.

The research method is decided as "conducting qualitative semi-structured interviews" with the key actors (experts), since the unit of analysis in this research is identified as the experiences, perceptions, opinions, feelings, and knowledge of key actors in SW-EG in Turkey.

Interviewees are selected according to two criteria which are detected in preliminary research: (i) Economic profit motive (direct motive of profit making in renewable energy sector) and (ii) Economic activity motive (economic activity to perform in the renewable energy sector). Sampling strategy is a combination of purposeful sampling (Patton, 2002), snowball sampling (Patton, 2002) and information oriented selection (Flyvbjerg, 2006).

For the systematic analysis of the data, analytical framework approach (Patton, 2002) is adopted to clarify the processes, the key issues and the sensitizing concepts that are critical for SW-EG in Turkey by organizing the analysis of raw data question by question.

A semi-structured interview guide that is designed by the general interview guide approach (Patton, 2002) is used to collect the data. The interview guide has 5 sections and 25 open-ended questions. The sections of the interview guide are: (i) Introduction / warm up (ii) current situation of Turkish Energy Sector (iii) the inducement and blocking mechanisms for diffusion of renewable energy technologies (iv) the market formation in SW-EG (v) public policies and market formation.

1.4.3. Conceptual Framework

In the field research I collected the data using the main concepts derived from the theoretical and empirical literature about the diffusion of renewable energy technologies and market formation. The conceptual framework is made up of the following main concepts:

- ✓ Structural components of the system – actors, networks, institutions

- ✓ System failures-problems
- ✓ Facilitators and obstacles (inducement and blocking mechanisms) in policy design
- ✓ Market formation dynamics in renewable energy technologies (structural analysis, process analysis and functional analysis)
- ✓ Technology policies for diffusion of emerging renewable energy technologies

1.4.4. Empirical Context

In the preliminary research, I made a background study to describe the existing situation in the Turkish Energy Sector, to define basic problems and to examine the perceptions about solutions addressing renewable energy. In this preliminary analysis, a desk research was done to evaluate current energy situation from figures and then 6 in-depth interviews were conducted with the experts from the private sector, academy and public sector in 2012.

In field research, for analyzing the market formation process, I conducted 57 semi-structured interviews with the key actors involved in SW-EG on a face-to-face basis. These interviews were conducted between December, 2013 and February, 2015. The interviewees are from the group of (i) potential and real licensed electricity generators in solar energy (ii) licensed electricity generators in wind energy (iii) the actors involved in unlicensed SW-EG (iv) bureaucrats, public servants and researchers involved operations related to SW-EG. The interviewees were from the companies, governmental organizations, non-governmental organizations and academic organizations. I travelled to different cities of Turkey such as Ankara, Istanbul, İzmir, Antalya, Denizli, Balıkesir, Kayseri, and Gaziantep. All the expenditures for each trip were financed by the TUBITAK-1002 Short Term R&D Funding Program-Project (No: 114K070) Budget.

1.5. Main Contribution

This dissertation is the first study that aims to design policies for the market formation to promote diffusion of emerging SW-EG technologies in Turkey. The concepts for the SW-EG market segmentation are determined as *licensed electricity generation* and *unlicensed electricity generation* in compatible with the legal framework and these conceptual frameworks is also new for such a market formation analysis. The empirical context of conducting the in-depth interviews with the key actors in SW-EG strengthens the grounds of the policy making endeavor, since all group of actors are represented in the interviewee sampling. The profiles of actors represent most of the important stakeholders in the market formation process. Hence, the collection of the data directly from them increases the explanatory power of the field research to understand the patterns of SW-EG market formation in Turkish energy sector.

The conceptual novelty of the dissertation is its standpoint of analyzing the market formation process from producers' (electricity generators) perspective. Other studies about market formation in renewable energy (such as Wüstenhagen and Bilharz, 2006, Gan et. al., 2007; Möllering, 2009; Aspers, 2009; Huang and Wu, 2009; Dewald and Truffer, 2011, Dewald and Truffer, 2012) investigate the market formation process mainly shaped by end users. In this study, the market formation process is examined from the electricity generators' perspective rather than the users' perspective, since the actors are included in the process as being directly or indirectly related to the electricity generation and the only user profile is the *government.* There is no user variety in Turkish SW-EG and the only user is the government that buys the commodity product of renewable electricity generated in renewable power plants.

The other contribution of the dissertation is its attempt to construct a model of policy design for new/emerging technologies. By investigating the SW-EG in Turkey and benefitting from the Technological Innovation System Perspective, a policy design model is developed for constructing policy recommendations on three pillars of policy aim, policy tool and policy targets. The policy aims are formulated based on the relationship between the focus of analysis and the environment/landscape in which the new technology flourishes and diffuses. In this dissertation, the focus of analysis is *the market formation in Turkish SW-EG* and the environment/landscape is *the Turkish energy sector*. To determine the nature of this relationship, it is claimed that policy maker should examine the current situation of the general landscape/environment. By this examination, the policy problems/failures are identified to be solved by policy recommendations. The policy aims are determined specifically is to solve these problems/failures. The policy tools are the policy instruments to be used to reach the policy targets. In the framework of policy design model suggested in this dissertation, the policy tools are identified by the analysis of inducement mechanisms (facilitators) and blocking mechanisms (obstacles) which are derived from the field research. The policy targets are determined as measurable objectives by elaborating the focus of analysis. Based on these three pillars, the policy recommendations constructed by the policy design model are determined at macro, meso and micro levels to make them applicable by the policy makers.

1.6. Thesis at a glance:

The story in this dissertation is presented in Figure 1.3. by a visual summary. According to background study of Turkish Energy Outlook, it is seen that electricity consumption and electricity prices are increasing and the fossil fuels are the dominant energy sources in electricity generation. However, Turkey is not self-sufficient for supplying these energy sources and import dependency is alarming. This scheme motivates a change in energy sector. By considering sustainability, cleanness, availability and abundance of energy sources, increasing the share of renewable energy sources in electricity generation is decided to be the focus of this change. This can be achieved through technology policies for SW-EG technologies. Therefore, technology policies should be design. To design these policies, the focus of policy analysis is determined as the "market formation" by the preliminary analysis. The conceptualization of policy analysis is based on the theoretical framework of "Theories of Technology Policy Design, Technological Innovation Systems Approach and Market Formation in Emerging Technologies". Through the interaction of the conceptualization and the preliminary analysis, the research focus is identified as "to formulate technology policies for market formation". To search for this focus, a qualitative data is generated by investigating key actors' perceptions, experiences, approaches, beliefs and functions about the market formation process. In the field research on which the technology policies are designed, to operationalize the policy design process, I asked questions about current situation of Turkish Energy Sector, obstacles and facilitators, market formation dynamics and effects of public policies on market formation. To model the policy design process, I identified the policy problems and aims, policy tools, policy targets and policy recommendations. From the overall conclusions derived from the data analysis, the policy recommendations for diffusion of SW-EG technologies in Turkey are formulated.

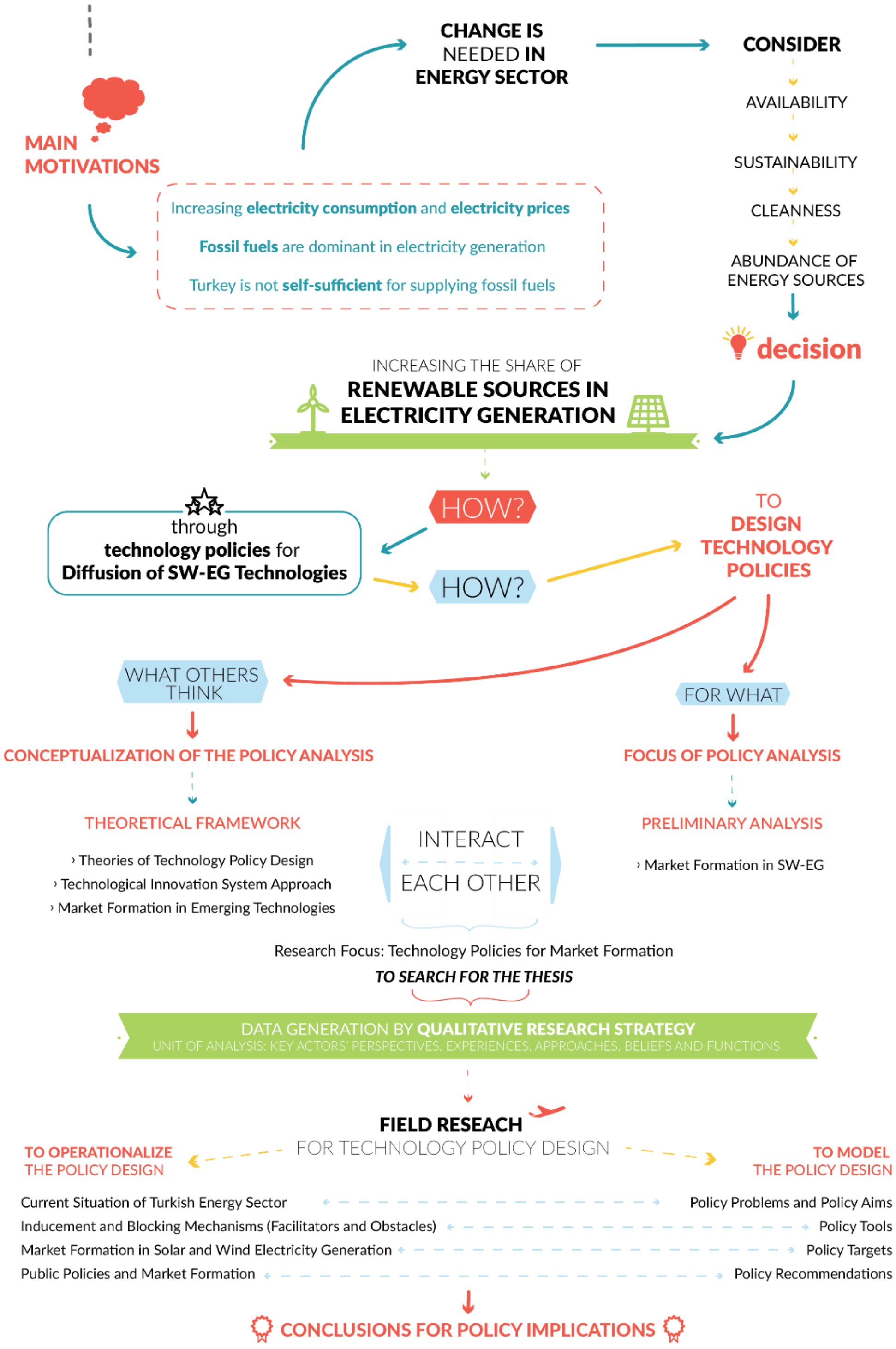

Figure 1. 3. Visual Summary of the Dissertation

1.7. Plan of the Dissertation

This dissertation includes five chapters of introduction, theoretical framework of technology policy design and market formation in emerging renewable energy technologies, methodology, empirical analysis about the diffusion of renewable electricity generation in Turkey, and conclusions and policy implications.

The first chapter is the introduction of the dissertation. At the beginning, the background information is presented to set the scene for the research. Then the research questions are specified to define the research problem of the dissertation. Following, the research objectives are indicated and the scope of the research is determined. Introduction chapter is completed by the main contributions of the dissertation.

The second chapter is about the theoretical framework. In this chapter, first of all, Evolutionary and Neoclassical Theories of Policy Making are elaborated to examine the economic foundations of technology policy design which are required to understand the basis for market formation dynamics in renewable electricity generation. Second, Technological Innovation System Approach is reviewed to present the analytical framework of the technology policy design process suggested in this dissertation. Third, the market formation dynamics in emerging renewable energy cases are investigated to understand how the market is formed in SW-EG in Turkey.

The third chapter reveals the methodology for the data generation. First, foundations of qualitative and quantitative research strategies are described to explain the reasons of choosing a qualitative research strategy in this dissertation. Second, I explained the data generation process made up of the preliminary analysis and the field research. Third, the design of the interview guide is elaborated for operationalization of the theoretical framework. Fourth, I described how I collected the data and what the data sources are. At last, the procedures used in the data analysis are described.

The fourth chapter is the analysis of field research results. First, the interviewees are introduced by the profile study about the key actors in SW-EG in Turkey. Second, the current situation of the Turkish Energy Sector is clarified to detect the policy problems. Third, inducement and blocking mechanisms (facilitators and obstacles) for SW-EG are interpreted. Fourth, market formation dynamics in Turkish SW-EG are examined. This chapter is closed with the policy proposals for market formation compiled from the field research as an example for policy analysis.

The fifth chapter is to conclude the dissertation and to present the policy implications. The conclusions derived from each subsection of the empirical analysis chapter are presented subsequently. Afterwards, by using these conclusions, the policy implications for diffusion of SW-EG technologies in Turkey are formulated using policy design model proposed in this dissertation.

CHAPTER 2

TECHNOLOGY POLICY DESIGN and MARKET FORMATION in EMERGING TECHNOLOGIES

In this chapter the theoretical framework is presented to explain the foundation of the technology policy design model suggested in this dissertation. For this purpose, first of all, the theories of technology policy making are elaborated. In this first sub-section, Evolutionary and Neoclassical Theories of Policy Making are examined focusing on the economic foundations of technology policy design process. These foundations are important to investigate the market formation dynamics in renewable electricity generation. Second, Technological Innovation System Approach is reviewed to present the analytical framework to understand the diffusion of SW-EG technologies specifically for designing the technology policies and modelling this design process[8]. Third, the market formation dynamics in emerging renewable energy technology cases are reviewed to understand how the market is formed in SW-EG in Turkey.

2.1. Theories of Technology Policy Design for Emerging Renewable Energy Technologies

In this section, neoclassical and evolutionary theories of technology policy design are elaborated by focusing on the economic foundations of technology policy design. This theoretical analysis is done to decide which theory of technology policy is more appropriate for designing technology policies for diffusion of emerging renewable energy technologies in Turkey. The focus in this analysis is the economic foundations of technology policy

[8] In this dissertation, the focus of analysis is on the technology policy design process for diffusion of emerging renewable energy technologies, rather than the diffusion process itself. For this purpose, theoretical framework does not directly touch upon the diffusion of emerging technologies and is limited to theories of technology policy design, technological innovation system approach for analytical framework of technology policy design and market formation as the focus of technology policy design. In further studies, as the effect of these policies are investigated on diffusion of SW-EG technologies, the theory of technological diffusion would be examined in detail.

design since the main aim of this dissertation is to design technology policies for SW-EG market formation.

2.1.1. Economic Foundations of Technology Policy Design

Technology policies aim at influencing the nature, pace and direction of technological change. By designing technology policies, policy makers strive to reach a desired future by considering current capabilities and technological trends. To design technology policies on these trends, policy makers clarify the goals to reach and the problems to address.

The main goals of technology policies are to support the appropriate conditions for creation and/or diffusion of technology, to allow for static efficient allocation or dynamic structural change of all components involved in the technology development process, to find the ways to utilize technological knowledge, and to subsidize the adoption of these policies (Mowery, 1995). This complex process of designing technology policies requires a multidisciplinary approach and a set of specialized analyses.

Technology policy design lies at the crossroads of different disciplines such as political science, law, sociology and economics (Yıldız and Sobacı, 2013). The economic analysis of policy design is an important component of the policy design process. The economic foundations of technology policy originate in the Neoclassical Economic Theory and Evolutionary Economic Theory. These economic frameworks provide a general rationale for policy intervention to improve the operation of the economy after the new technology has started to emerge (Metcalfe, 1995).

During the diffusion of new technology, the basic assumptions and foundations of the Neoclassical and the Evolutionary Economic Theories form the actors'[9] economic motives for the technology choice and the technology policy design.[10] The main concern is to provide the allocation of economy-wide resources for the diffusion of new technology by

[9] The actors are the units of analysis, involved in economic activities and interactions in economic environment.

[10] In this disseration context, for a brief explaination about the economics foundations of technology diffusion, I benefitted from the general theories of the Neoclassical and Evolutionary Approaches. For a detailed analysis of the economics of technological change and technology diffusion, see Stoneman (1983). For different aspects of technological diffusion, see: Gold (1981), Colombo and Mosconi (1995), Kapur (1995), Escot (1998), Siverberg et. al (1998), Baptista (1999), Eaton and Korum (1999), Geroski (2000), Cowan (2004), Antonelli (2006).

equilibrium analysis in the Neoclassical Economic Theory, while the central concerns are interactions such as learning, diversity creation and selection mechanisms in the Evolutionary Economic Theory (Chaminade and Edquist, 2006). The Neoclassical Economic Theory basically assumes that the actors behave rationally in their economic decisions and have full information about all existing conditions in economic environment. Moreover, the markets are assumed to be competitive. Metcalfe (1995) clearly states that market prices are measured by valuations of inputs and outputs identified by consumers, producers and suppliers. These prices determine the competitive equilibrium which ensures the efficient allocation of resources for welfare to overall society. After the introduction of new technology, the rational actor tries to maximize the benefits of new technology. As a result, the supply of and demand for this new technology accumulate and relative prices start to change. These price movements determine the individual technology choice, and the market is formed with new prices where supply meets demand at equilibrium (Jacobsson and Johnson, 2000).

On the other hand, the Evolutionary Economic Theory does not directly deal with equilibrium and optimization; rather it aims to understand the economic development and structural change as a result of endogenous factors that arise from the technological change (Metcalfe, 1995:418). Economic behaviors of the actors resting on institutional foundations and different institutional set-ups may end up with differences in economic behavior and outcome (Smith, 2000). The central concern is not to reach the equilibrium; it is to understand the process of change after the new technology emerges. Hence, the technological knowledge is generated by interactive learning (Smith, 2000). In the Neoclassical Economic Theory, all external factors that hinder this equilibrium are accepted as the market failure, and a policy intervention aims to eliminate this market failure to reach the equilibrium in new conditions (Jacobsson and Bergek, 2011). The neoclassical policy maker is accepted as *fully informed social planner* who is optimizing in policy making (Metcalfe, 1995:417) On the other hand, in the Evolutionary Economic Theory the actors are bounded rational[11] because they know only a part of their economic environment and they cannot acquire full information. Actually, imperfect information is indispensable in

[11] In this context, the term bounded rationality refers to neurophysical and language limits that make the human behaviour intendedly but limitedly rational (Williamson, 1975). According to Williamson (1975: 21-22), the physical limits are "the rate and storage limits on the powers of individuals to receive, store, retrieve, and process information without error" and the language limits are related to "inability of individuals to articulate their knowledge or feelings by the use of words, numbers or graphics in ways which permits them to be understood by others".

technological change and it is the main source of profit making in the technological development process. In such a scheme, economy wide optimum positions do not exist. The opportunities and the benefits that the new technology induces are gradually appropriated by the learning society and the markets as the dynamic socio-technical systems evolve continuously to absorb these opportunities and benefits, and to adjust to new economic conditions. The policy problem for evolutionary policy maker, *who adapts rather than optimizes*, is to establish appropriate environment for creativity, and patterns of adaptation to the new technology *by taking the innovation system as the central concern* (Metcalfe, 1995:418)

To sum up, the problems that the technology policy addresses mainly originate in the failures of the environment in which the new technology flourishes. The technology policy design process is based on the analysis of the problems in economic activities, the weaknesses of the institutional structure and deficiencies in performance of the overall system that hinder the diffusion of new technology (Weber and Rohracher, 2012). In this analysis, the policy makers need guidance for policy making process.

2.1.2. The Evolutionary System Failure Approach vs. the Neoclassical Market Failure Approach

For technology policy design in emerging technology case, there are two main rationales: The Market Failure Approach and the System Failure Approach (Kemp, 2011). Theoretically, the economic foundation of the Market Failure Approach originates in the Neoclassical Economic Theory, whereas the economic foundation of the System Failure Approach originates in the Evolutionary Economic Theory. Therefore, the neoclassical guidance for policy makers is the Market Failure Approach whereas the evolutionary guidance for policy makers is the System Failure Approach (Jacobsson and Bergek, 2011).

The Neoclassical Theory of Technology Policy Design deals with the market failures which hinder the formation of competitive equilibrium (the point where the economy-wide supply equals to economy-wide demand). In the formation of this equilibrium, the most critical violations are related to *missing and distorted markets* (Metcalfe, 1995: 412). In the case of emerging technologies, these kinds of markets emanate from asymmetric information and externalities. Asymmetric information is the unequal distribution of knowledge about new technology between the actors in the economy; and externalities are the factors that hinder the valuation of economic goods and services by market prices. Hence, the Market Failure Approach is pointing towards *positive knowledge externalities* and *negative* *environmental externalities* as the main reasons that urge technology policy makers to intervene in the economy during the emergence of new technologies (Jacobsson and Bergek, 2011: 41-42). Both the concepts of "asymmetric information" and the "externalities" are directly related to the nature of technological knowledge and research and development (R&D) activities. Therefore, main neoclassical arguments for the technology policy design process are "*public good nature of knowledge", "uncertainty about the outcomes of the research process, cost and benefits of innovation"*, *"inappropriability of the benefits derived from new technology",* and "*market entry barriers and monopoly power working against innovation from challengers"* (Kemp, 2011; Chaminade and Edquist, 2006). These influences create external costs which are not valuated by the economic activity (not reflected in market prices) but transferred to society and environment. Consequently these costs cause the market failure of underinvestment in R&D activities, and subsequently problems in the dissemination of new technology (Chaminade and Edquist, 2006).[12] To alleviate the negative effects of these market failures, Jacobsson and Bergek (2011) state that widespread and well-known generic technology policy tools are to fund basic R&D activities, and to co-fund industrial R&D activities. Additionally, the market based economic incentives (such as feed in tariffs in energy sectors) are other policy tools for the market failures arising from environmental externalities.

However, the explanation of problems in the diffusion of new technologies, especially the emerging technologies in energy sector, are not just related to the factors which appear in the creation of technological knowledge and R&D activities, and which violate the conditions of competitive markets as described by the Neoclassical Economic Theory (Melcalfe, 1995). In the case of emerging technology, all the failures related to asymmetric information and environmental externalities may exist but there are more. Therefore, the market failure based technology policies such as "R&D Support" and "market

[12] In addition to market failure, Neoclassical Theory points out government failure, which can be defined as the deficiencies in government's regulation performance, as the main motivations of policy intervention. Stiglitz (1998) asserted that some failures that damage the equilibrium in the economy have roots in "inability of government to make commitments"(pg.9). According to Stiglitz (1998), the problem of commitment emerges from the nature of government as being the monopoly to use the regulatory power. Government, as being the guardian, is not regulated by any other guardian (Stiglitz, 1998:10). As a result, the inability of governent to its commitments causes additional inefficiencies in the economy that lead to extra government interventions. However, in this dissertation context, the economic foundation of the technology policy design is the main starting point of the policy interventions for designing technology policies for market formation. Due to this reason, only the market failures in Neoclassical Approach are elaborated as the alternative of system failures in Evolutionary Approach.

based economic incentives (like feed-in tariff)" are not enough and technology-specific policies are required (Jacobbson and Bergek, 2011: 42).

Technology-specific policies are designed by the System Failure Approach and the unit of analysis in this approach is the "Innovation System". As a reaction to the Neoclassical Economic Theory that locates the "market" at the core of the technology policy design, the Evolutionary Economics Theoreticians develop "Innovation System" as a policy concept in the mid-1980s, and describe the innovation process as a dynamic system for the diffusion of a new technology (Edquist, 1999, 2011; Jacobsson and Bergek, 2011; Dewald and Truffer, 2012). The fundamental assumptions of innovation system approach strongly contradict with the Neoclassical Economic Theory that is relying on optimization behavior, competitive markets, deterministic environments, perfect information, and constant returns to scale. By addressing "the core features of reality[13], innovation system approach creates a promising arena for policy analysis" (Smith, 2000: 75). The main idea behind the system approach is that innovation is both an individual and a collective act, and it cannot be understood solely by the dynamics of independent decision making at firm level (Jacobsson and Johnson, 2000; Smith, 2000; Jacobsson and Bergek, 2011). The innovation process involves complex and multi-directional interactions between firms and its environment.[14] In innovation systems, the adoption of a new technology is embedded in whole system which is shaped by innovative capabilities of the actors in a macroeconomic and regulatory context (Kemp, 2011:5). The determinants of innovation process are not only found in individual firms, because "firms are embedded in innovation systems that guide, aid and constrain the individual actors within them, hence technological change becomes endogenous to economic system" (Jacobbson and Bergek, 2004: 817). The system as "a model of reality designed for analytical purposes" is characterized by its structure including system borders, the number and type of system elements, their interrelations, and the relations between the system and its environment (Markard and Truffer, 2008: 598). An innovation system includes all institutions and economic structures that affect both the rate and direction of technological

[13] These features are strategic interdependence between firms, uncertainty, asymmetric information, increasing returns, all kind of institutional issues such as national and international level policies, the options and conditions for creation of technological knowledge, and social factors shaping firm behavior (Smith, 2000: 75).

[14] This environment involves factors shaping the behavior of firms such as social and cultural context, the institutional and organizational framework, infrastructures, and the processes which create and distribute scientific knowledge (Smith, 2000: 73).

change in society (Hekkert et al, 2007). The system problems (systemic failures) are the explanation of low performance of innovation system, which is related to the level and quality of the output; new technology (Edquist, 2011).

The concept of system failure mainly refers to the problems of the technology infrastructure, technology capabilities acting as technology rigidities, and institutional inadequacies (Kemp et al, 2007). The system failures are the weaknesses in the organization and the operation of the innovation system, and these failures greatly hamper the diffusion processes of new technology (Hekkert et. al, 2011). According to Smith (2000), the innovation process does not only suffer from under-supply of technological knowledge as asserted by the Market Failure Approach to technology policy design. Instead the overall system of development and dissemination processes of new technology may generate systematically weak performance that brings about system failures. Policy makers design technology policies to identify the system failures that result in weaknesses and the problems in innovation process. In the System Failure Approach, policy makers design technology policies to take the advantage of inducement mechanism such as *cooperation and collaboration between firms to facilitate knowledge flows, government regulation* and *the creation of financial, cultural and sociological incentives for development and diffusion of new technologies* (Smith, 2000: 94). Another purpose of the technology policy is to weaken and/or eliminate the blocking mechanisms and, hence to solve systemic failures that appear as weaknesses in system performance.

Systems may fail to develop or may retard due to the weaknesses originated from the components of the innovation system (infrastructure, institutions, actors/markets or networks) and these weaknesses may lead to system failures. The *physical infrastructure* is one of these components. The failures in the provision of and the investment for physical infrastructure are important motivators to design technology policies. The large and indivisible constitution of science and technology infrastructure, the longtime horizons of these infrastructure constructions, and inability to produce adequate returns of the infrastructural investments mainly create problems related to infrastructures; hence require policy intervention (Smith, 2000).

The other source of weaknesses in the system is *institutional failures* which are related to legal frameworks, regulations such as technical standards, risk-management rules, health and safety regulations, general legal system relating to contracts, employment, intellectual property rights, educational system, marketization of the new technology, and political, cultural and social values (Smith, 2000; Jacobsson and Bergek; 2004, Woolthuis et. al, 2005). In such a scheme, difficulties may appear in disarrangement and rearrangement of the existing institutional set-up, and hence may end up with the system failures that hinder innovation system performance.

In the case of new technology, whether a minor technological innovation or a major technological regime shift, problems about the actors of the system may exist. For example, firms may have difficulties in adaptation to new technology due to insufficiencies in essential capabilities and know-how about the technological knowledge, and organizational incompatibilities during internalization of this technology. This dimension of new technology may create *transition failures* for the actors in adaptation to the development and dissemination of new technology (Smith, 2000). The transition failures may lead the markets not to form properly due to the mismatch between supply and demand, increasing returns to adoption and/or direct/indirect subsidies in favor of incumbent technology (Jacobsson and Bergek; 2004). Therefore, the impediment and the bottleneck in the formation of new technology markets may hinder additional firms to enter the realm of new technology because these firms prefer to work on existing technologies safely instead of searching for new opportunities to benefit from new technological knowledge (Huang and Wu, 2009). Additionally, if the linkages between the actors are loose and, hence connectivity in the system is poor, the problems in networks of system actors may come to surface. Therefore, the *network failures* appear and hinder the accurate performance of the innovation system and, may impoverish the system as a whole to establish its sustainability and self-sufficiency (Jacobsson and Bergek; 2004, Woolthuis et al., 2005).

In addition to the identification of these failures, Bergek et al. (2008) make a contribution to system failure approach by classifying these failures. Bergek et al. (2008) claim that all types of system failures such as infrastructural failures, institutional failures, capability failures and network failures are mainly attributed to structural components of innovation systems. However, for identifying policy issues in an innovation system, the structural focus should be supplemented by process focus and hence functional dynamics analysis (Bergek et al., 2008). The overall target of innovation system is to accomplish the emergence and dissemination of new technology. For achieving this target, policy makers should focus on the key processes which have direct effects on overall performance of the system, and then they should design policies to intervene the system to solve also these system failures.

To complement the identification and classification of the system failures in emerging technology, by combining the system failures analyses of Smith (2000), Woolthuis et al. (2005), and Bergek and Jacobsson (2008), Weber and Rohracher (2012: 1045) define a new class of transformational *system failures* (such as directionality failure, demand articulation failure, policy coordination failure and reflexivity failure) in addition to structural system failures (Table 2.1).

Table 2. 1. Overview of systemic failures

Structural system Failures	Infrastructural failure	Lack of physical and knowledge infrastructures due to large scale; Long time horizon of operation; Ultimately too low return on investment for private investors
	Institutional failures	*Hard institutional failure:* Absence, excess or shortcomings of formal institutions such as laws, regulations, and standards create an unfavorable environment for innovation *Soft institutional failure:* Informal institutions (e.g. social norms and values, culture, entrepreneurial spirit, trust, risk-taking) that hinder innovation
	Interaction or network failure	*Strong network failure:* Intensive cooperation in closely tied networks leads to lock-in into established trajectories and a lack of infusion of new ideas; inward-looking behavior; lack of weak ties to third actors and dependence on dominant partners *Weak network failure:* Too limited interaction and knowledge exchange with other actors inhibits exploitation of complementary sources of knowledge and processes of interactive learning
	Capabilities failure	Lack of appropriate competencies and resources at actor and firm levels prevents the access to new knowledge, and leads to an inability to adapt to changing circumstances, to open up novel opportunities, and to switch from an old to a new technological trajectory.
Transformational system failures	Directionality failure	Lack of shared vision regarding the goal and direction of the transformation process; Inability of collective coordination of distributed agents involved in shaping systemic change; Insufficient regulation or standards to guide and consolidate the direction of change; Lack of targeted funding for research, development and demonstration projects and infrastructures to establish corridors of acceptable development paths.
	Demand articulation failure	Insufficient spaces for anticipating and learning about user needs to enable the uptake of innovations by users; Absence of orienting and stimulating signals from public demand; Lack of demand-articulating competencies.
	Policy coordination failures	Lack of multi-level policy coordination across different systemic levels; Lack of horizontal coordination between research, technology and innovation policies on the one hand and sectoral policies (e.g. transport, energy, agriculture) on the other; Lack of vertical coordination between ministries and implementing agencies leading to a deviation between strategic intentions and operational implementation of policies; No coherence between public policies and private sector institutions; No temporal coordination resulting in mismatches related to the timing of interventions by different actors.
	Reflexivity failure	Insufficient ability of the system to monitor, anticipate and involve actors in processes of self-governance; Lack of distributed reflexive arrangements to connect different discursive spheres, provide spaces for experimentation and learning; No adaptive policy portfolios to keep options open and deal with uncertainty.

Source: Weber and Rohracher (2012)

2.2. Analytical Framework of Technology Policy Design: Technological Innovation System

2.2.1. Fundamentals of Technological Innovation System

Innovation systems perspective provides policy makers a tool to identify system weaknesses and problems for which the policy intervention is needed. The main legitimation of the intervention to the system is the possibility of weaknesses in any of the components and/or the functions of the system which hinder the development of the system as a whole (Carlsson and Jacobson, 1997; Edquist, 2011). The Technological Innovation System (TIS) is the innovation system for analyzing the emergence and dissemination of a specific technology in a society (Jacobsson and Johnson, 2000; Jacobsson and Bergek, 2004). Hence as one of the system approaches to innovation, the TIS Approach is used to study the *emergence of new technologies* such as renewable energy technologies (Jacobsson and Bergek, 2011: 42). The development and dissemination processes of emerging renewable energy technologies can be understood by analyzing the whole innovation system that all actors are embedded in and constrained by, and evolve with (Jacobsson et al., 2004). Therefore, the general landscape for the focus of analysis (emerging renewable energy technologies) is the beginning of the analysis, and to understand the dynamics of the renewable energy sub-sector, the main features of the energy sector should be examined first.

The energy sector has unique peculiarities. For the emergence and dissemination processes of renewable energy technologies, these peculiarities legitimize the use of technology specific policies in innovation systems to improve the system as a whole (Jacobsson and Bergek, 2004; Sanden and Azar, 2005; Jacobsson and Lauber, 2006; Jacobsson and Bergek, 2011). “Long term perspective” is one of these peculiarities. The Energy Sector is huge and the renewable energy sub-sector is just a small part of the whole sector. It must be considered that the renewable energy sub-sector as a unit and a part of energy sector and, in relation to other parts of the energy sector. Hence, for the emergence and dissemination processes of new technologies in the renewable energy subsector, renewable energy technology policies must be designed with very *long term perspective in a large context*. However in this context, the energy sector does not evolve as a close structure, and other energy sub-sectors are interrelated and interdependent. The technology policy design process must encompass all possible relationships between other energy sub-sectors. Moreover, the nature of policy design process is another specificity. Policy making is a highly political business, and highly dependent on circumstances. Hence, lobbying over policy goals and the design of institutional framework should be emphasized in energy sector. Especially, for emerging renewable energy technologies, the environment and the circumstances are changing and evolving continuously, since the technologies are improving continuously. Hence, for designing policies, dynamic and flexible rather than static policy making is needed. TIS is the policy framework that evaluate all these peculiarities of the sector. Therefore, in this dissertation context, the TIS Approach is used to design technology policies for the diffusion of emerging renewable energy technologies.

The TIS Approach is made up of three specific analysis: (i) *The Structural Analysis* is to define the system and to determine the actors, networks and institutions involved in the system, (ii) *The Functional Dynamics Analysis* is to understand how the system works, and (iii) *The Policy Analysis* is to find the main problems in the system and to design policies to eliminate these problems.

2.2.2. Definition of Technological Innovation System: Structural Analysis

Technological Innovation System is a *socio-technical system focused on the development, diffusion and use of a particular technology* (in terms of knowledge, product or both) (Bergek et. al., 2008: 408). TIS is also valid for technology-specific cases in energy sector, such as emerging solar and wind electricity generation (SW-EG) technologies (Huang and Wu, 2009; Jacobsson and Bergek, 2004). Among the other system approaches (such as national, regional and sectoral), the TIS Approach is the most appropriate analytical framework to design technology policies for emerging renewable energy technologies, since it is better equipped to analyze the state of emergence and it consists a particular interest for explaining how the policy intervention can foster and diffuse the emerging technology (Coenen and Lopes, 2010).

The Structural Analysis of TIS determines the components of the system. A TIS is a network of actors interacting in a specific technology area/technological field under a particular institutional infrastructure for the purpose of generating, diffusing and utilizing variants of a new technology and/or a new product (Carlsson and Stankiewicz, 1991; Galli and Teubal, 1997; Bergek, 2002; Carlsson et al., 2002; Bergek et al., 2008; Markard and Truffer, 2008). This system is made up of three main groups of structural components: *actors (and their competencies), networks and institutions* (Jacobsson and Bergek, 2004: 817). The identification of these components is defined as structural analysis by Carlson et al. (2002), Jacobsson and Bergek (2004), Bergek et al. (2008) and Wieczorek and Hekkert (2012). Following them I define the **actors** as the operating parts of the system such as individuals, civil society, companies, knowledge institutes, government, public policy bodies, NGOs and other parties such as legal organizations, financial organizations/banks, intermediaries, knowledge brokers, and consultants. Different actors settle different innovation strategies and control different resources, and there is a certain division of labor, such as "innovation value chain" or "innovation networks" among the actors (Markard and Truffer, 2008). The other structural components of the system are **networks/relationships** (the links between components that build channels for knowledge transfer), and **institutions/attributes** (the intermediaries that form the properties of the components and the relationships between them, such as culture, norms, laws, regulations and routines). According to Markard and Truffer (2008: 611), a TIS is characterized by a variety of institutions such as *internal institutions* that have emerged as a result of activities of system actors (such lobbying, expectation management, negotiation of internal standards) and *external institutions* that are independent of the system and not initiated by actors in the system, but affect the stabilization of the system (such as international energy agreements). To promote the emergence and dissemination of renewable energy technologies, the policy maker should strengthen the policy design process by complementing this structural analysis by functional analysis.

2.2.3. Operation of Technological Innovation System: Functional Dynamics Analysis

For diffusion of renewable energy technologies in energy sector, new technological systems should emerge as equipped by powerful functions around new technology (Bergek and Jacobsson, 2003). The functional approach originates in the study of Johnson (2001) that aims to see whether there is any agreement between different innovation system approaches about the functions in the system. Johnson (2001) identifies key processes which are the basic functions that contribute to the overall operation of the TIS. These functions are accepted as the intermediate level between the components of the system and this system's performance. Jacobsson and Bergek (2004) claim that these functions affect each other mutually and a change in one function may lead to changes in others.

The main contribution of the functional analysis is the systematic identification of policy problems (the system failures/weaknesses) expressed in functional terms (Bergek et al., 2008). The structure of the TIS may differ depending on actor variety, institutional arrangements and network diversity. However the categorization of functional patterns is almost the same in all TISs, since the overall function of the system is to support technological change. Hence, the functional analysis of the TIS makes the comparison of different innovation system performance possible and allows mutual learning in policy design process. Another important advantage of the TIS is the systemic mapping of determinants of technological change. Hekkert et al. (2007: 421) recognize that this advantage "increases the analytical power of the TIS Approach". Through the functional approach, the policy maker can analyze the *external dynamics* of the system by assessment of functional patterns in the system over time, and the *internal dynamics* of the system by evaluation of *cumulative and circular causation* between the functions of the system. Moreover, the approach offers a useful ground for policy design process by clarifying policy targets in functional terms, and by indicating policy tools for the accomplishment and the enhancement of these functions' performance, hence the overall operation of the system.

In functional analysis, the aim is to understand the overall performance of the TIS in functional terms. Through empirical analyses of Bergek and Jacobsson (2003), Jacobsson and Bergek (2004), Jacobsson et al. (2004), and Hekkert et al (2007), Bergek et al. (2008) revised the list of functions as:

i. **Knowledge development and diffusion:** The generation and diffusion of different types of knowledge (technological, production, market, logistics and design knowledge) through different sources of knowledge development (R&D, learning from new applications, production, etc. and imitation)

ii. **Influence on the direction of search**: The mechanisms and factors influencing the direction of search within TIS (visions, expectations and beliefs in growth potential, actors' perceptions of the relevance of different types and sources of knowledge, actors' assessments of the present and future technological opportunities, appropriability conditions, regulations and policy, articulation of demand from leading customers and technical bottlenecks, crises in current business)

iii. **Entrepreneurial experimentation:** The source of uncertainty reduction in TIS. This function is mapped in terms of the breadth of technologies used, the character of the complementary technologies employed and the experiments done by new entrants, diversifying established firms, different types of applications.

iv. **Market formation**: In the emerging TIS, markets may not exist or be underdeveloped; market places may not exist; potential demand may not be articulated and price/performance of new technology may be poor. Institutional change (ex: formation of standards) is often a prerequisite for market to evolve. The market formation evolves through three phases: nursing, bridging and mass markets. For an analysis of market formation, a policy maker needs to analyze actual market development, the drivers of market formation, the users, their purchasing processes, the articulation of the demand, and institutional changes in need for market formation.

v. **Legitimation:** Social acceptance and compliance with relevant institutions

vi. **Resource mobilization**: The extent to which TIS is able to mobilize competence/human capital, financial capital and complementary assets,

vii. **Development of positive externalities** : Generation of positive external economies through entry of new firms into the emerging TIS, external economies in the form of resolution of uncertainties, political power, legitimacy, combinatorial opportunities, pooled labor markets, emergence of specialized intermediate goods and service providers, information flows and knowledge spill-overs. This function is an indicator for the overall dynamic of the system.

2.2.4. Enhancement of Technological Innovation System: Policy Analysis

The Functional analysis is conducted for and followed by the policy analysis. In this stage of technology policy design, the linkages between the functions are examined for the overall functionality and the success of the TIS. The linkages between functions may be circular and prove a process of cumulative causation (Bergek and Jacobbson, 2003; Jacobsson et al., 2004). Favorable results of the linkages may create **virtuous circle** which means "a beneficial cycle of events or incidents, each having a positive effect on the next." On the other hand, detrimental results of the linkages may create **vicious circle** which means "a situation in which effort to solve a given problem results in aggravation of the problem or the creation of a worse problem." In the policy analysis, the functionality of TIS is assessed by achieved functional patterns; and policy goals are set to reach the overall target of emergence and the dissemination of new technology. By functional analysis, the policy maker assesses how well the system is functioning through how the functions are filled in. Following this step, the policy maker identifies the inducement and blocking mechanisms to determine key policy issues to solve the systemic problems, and hence to enhance the functionality of the system. Policy Analysis mainly aims to strengthen/add inducement mechanisms and to weaken/remove blocking mechanisms to solve systemic problems.

2.2.5. Development of Technological Innovation System

For analyzing the development of technological innovation system, Jacobsson and Bergek (2004) propose two main phases in the evolution of TISs: Formative Period and

Market Expansion. In formative period, the institutions adjust for the formation of variety in knowledge creation, markets of exchanges and legitimation of new technology. Formative period is an experimentation phase for the development and dissemination of a new technology. It is followed by the market expansion period in which the initial markets enlarge, hence production volume and scale advantages can be reaped, additional firms can enter the value chain and further learning is stimulated.

Huang and Wu (2009) describe these two phases with their core features. The formative period is characterized by high risk environment. Additionally, niche and nursing markets are the gates for firms to enter the market. Institutional change occurs towards adaptation to new technology and the advocacy coalitions are formed to alter institutions. In market expansion period, a cycle of positive feedback among the major functions appears and by the development of this cycle the TIS becomes self-sustainable in the long run.

In the analysis of the conditions and context in which TIS develops, Jacobsson and Bergek (2004: 819) emphasizes four processes: "market formation, the entry of firms and other organizations, institutional change and the formation of technology specific advocacy coalition". Following formative period, in transition to development phase the system should connect to technological and market opportunities. This can be achieved by a process of *cumulative causation through positive and circular feedback loops* between the components and the functions of the system. However some factors, which exist directly in the system and operate in formative stage, may hinder the development of a self-sustained technological system such as failure in institutional alignment for new technology, deficiencies in market formation, shortage of new entrants of the market and inadequacies in networks' role in supporting new technology.

The stages of the TIS's development are *experimentation* and then *market growth* phases. According to Bergek and Jacobsson (2003: 200-201) in first phase, "experimentation" and "variety creation" are key processes. In this phase, (new) firms search for new products and try to create external economies in a highly uncertain environment. These firms frequently enter into and exit from the market, different technological alternatives are competing and small markets exist. In the second phase, the key processes are "diffusion" and "firm expansion" and the cost reductions for new technologies are common. This can be achieved by economies of scale through the creation of mass markets. Therefore, Bergek and Jacobsson (2003: 201) claim that "functionality of innovation system may be assessed in terms of how it supports firm's entry, variety and niche markets in the first phase and market expansion and supply of resources to exploit that market in the second phase."

According to the analysis of wind turbine industry in Germany, the Netherlands and Sweden, variety creation in the early period of industry evolution is recommended to reduce high technological uncertainty. In Germany and the Netherlands, variety creation is supported by various mechanisms such as R&D policy. At the end of 1980s, different designs are developed by firms and universities. On the other hand, in Sweden, technology policy subsidizes the firms intensively for the production and dissemination of large-size turbines. In this example, Germany and the Netherlands can create variety in terms of knowledge and the actors exploiting this knowledge; however the Swedish technological knowledge is limited to larger turbines. Hence the overall performance of the German and Dutch TISs are better than the Swedish system. In Germany and the Netherlands, it is reported that "early legitimacy of wind turbines" is the key to variety creation process (Bergek and Jacobsson, 2003: 221). In 1980s, two critical points for the success of TIS are achieved: *the political consensus about the support of wind turbines* and *legitimacy of exploiting wind turbine technology for private capital*. However in Sweden, due to the lack of legitimacy rooted in nuclear trauma, actors in wind turbine industry face limitations in accessing to resources, partners, markets and government support. In Sweden, nuclear power has been discussed since the 1970s and in 1980 there was a referendum that was resulted in the decision dismantling of Swedish nuclear power plants in 2010. However energy intensive industries did not support this decision. There occurred two camps: anti-nuclear power camp and opposing of dismantling nuclear power camp. Over time, this nuclear power issue became a trauma because all energy issue reduced to the dismantling nuclear plants or not. In such an environment, renewable energy technology was attached to a mission of substituting nuclear power and the programs to support renewable energy were designed in that manner. This brought two main problems: (1) absolute evaluation of renewable energy in terms of nuclear energy substitution power, and hence abolishing of small scale turbines and favoring large scale turbines. (2) The perception of renewable energy as a betrayal of the Swedish industry benefitting from nuclear power. Hence, renewable energy cannot gain legitimacy under these conditions and as a consequence the supply of resources was constrained, the market did not grow and just few firms entered the renewable energy industry (Jacobsson and Bergek, 2004: 127). Hence, the legitimacy is another key concept for the explanation of the German and the Dutch Innovation Systems' higher performance compared to the Swedish System.

The legitimacy of wind turbine technology in Germany creates the appropriate grounds for market formation in the second phase. The German case is characterized by virtuous circles, in which the functions influence each other in a self-reinforcing process (Bergek and Jacobsson, 2003: 212). The 100 MW and 250 MW programs[15], the Electricity Feed in Law (EFL)[16] initially induce the market formation and lead to rapid market expansion from 12 MW in 1989 to 490 MW in 1995 (Bergek and Jacobsson, 2003: 213). In the Netherlands, the virtuous circle of market growth, growing political strength and increased industry resources do not appear because (i) the market expansion locks into local market and domestic market does not grow very fast as expected in the 1990s and (ii) the Dutch industry failed to exploit growing German renewable energy market (Bergek and Jacobsson, 2003: 215). Dutch firms largely focus on the local market and the Dutch turbines were not demanded in global markets due to inappropriate choice of technology. According to Bergek and Jacobsson (2003: 222), the main reason behind the failure in market formation is the "insufficiency in developing strong legitimacy". In Sweden, virtuous circles for wind turbine industry are not started because the industry is claimed to be weak to respond to growing demand.

2.2.6. Inducement and Blocking Mechanisms (Facilitators and Obstacles) for Development of Technological Innovation Systems

The main application of the Technological Innovation System Approach is the identification of "system failures" or weaknesses expressed in functional terms. By explaining the nature of these system failures in terms of a balance between various inducements and blocking mechanisms, the functional analysis is used as a focusing device for policy makers to identify the key policy challenges and to carry the TIS towards policy goals (Bergek et al, 2008). For this purpose, in this section the examples of blocking mechanisms and the inducement mechanisms are presented to solve the system failures and to improve the overall performance of the TIS by policy analysis.

[15] As reported by Bergek and Jacobsson (2003: 212), these programs were initiated in 1989 firstly with the aim of reaching 100 MW installed capacity then the amount was increased to 250 MW. This program involved a guaranteed payment per KWh electricity generated. Additionally, the private operators, such as farmers, had the possibility to obtain an investment subsidy.

[16] EFL came into force in 1991. According to EFL, utilities had to accept (i) independent wind turbines to deliver the electricity to the grid and (ii) to pay 90 percent of the average consumer electricity price.

For the analysis of inducement and blocking mechanisms in emerging renewable energy technologies and their effects on the market formation, Jacobsson and Bergek (2004) present an empirical analysis of the selected TISs in Germany, the Netherlands and Sweden. In some of these technological systems, the same mechanism may work differently for the overall performance of the system. Hence, the roles of inducement and blocking mechanisms may change and they may work differently in different contexts.

Government Policies in the form of R&D funding, investment subsidies, demonstration programs and legislative changes are the major inducement mechanisms in Germany and Netherlands, but their effects are different in Sweden. In German wind and solar electricity generation cases, the German federal R&D policy emphasizes variety creation in wind turbine and solar cell technologies, and tries to support the creation of knowledge in a broad area of renewable energy technologies. Besides in the Dutch wind electricity generation case, government policies support the R&D activities for developing different wind turbine technologies. However in the Swedish wind energy case, R&D funding is intensified in large turbines. Directing the R&D funding towards one specific design hinders variety creation. Therefore in the Swedish wind electricity case, the government policies turn into a blocking mechanism that hinders the market formation, and hence weakens the overall functionality of the TIS. Moreover in Swedish SW-E generation cases, inconsistent and changing government policies increase the level of uncertainty, hence result in mistakes in demand expectations and misguide the search away from the renewable technologies.

Lack of legitimacy is another important blocking mechanism, especially for the Swedish renewable energy sector. In Sweden, after 1970s the opposition to nuclear power accumulates and renewable energy is presented as a substitute for nuclear power. However, the tendency to see renewable power as a substitute for nuclear power weakens the legitimacy of renewable energy technologies. Additionally, the growth of renewable energy technologies industry is perceived as a threat to the part of Swedish industry benefiting from nuclear energy technologies. Hence, these agenda creates a lack of legitimacy, and inevitably wind turbine industry cannot develop in 1980s. On the other hand, in the Dutch wind electricity case and the German solar electricity case, strong legitimacy supports the development of these renewable energy technologies. In Germany, the roots of legitimacy are in the negative German public opinion towards nuclear power after the Chernobyl Accident in 1986. All political parties in the parliament support more R&D in renewables and "1000 roof top program for solar electricity" and "250 MW program for wind electricity" come into force. The strong legitimacy in the Dutch wind electricity generation during 1970s supports demonstration projects and leads to new prototypes and new turbines. Moreover, new investment subsidies come after the crisis of energy prices in 1984 and hence a large wind electricity market is formed in the second half of the 1980s. By this broad legitimacy, the German parliament can easily pass the first electricity feed in law (EFL) in 1991. This law gives massive incentives for wind and solar electricity technologies industry, and results in huge market growth in the first half of the 1990s. Small utilities and farmers prefer to buy turbines from local machinery firms, and hence during the programs of 1000 roof top for solar electricity and 250 MW for wind electricity much of the market are created by means of domestic firms.

On the other hand, the Dutch and Swedish wind electricity cases and the Swedish Solar collector cases are characterized as undersized technological systems. In the Dutch wind electricity case, **institutional reasons** slow down the development and diffusion of new wind electricity technologies. The main problem is about receiving building permits from local governments. To solve this problem the central government in collaboration with provincial governments initiates a large investment program targeting 1000 MW capacity of wind electricity. However, the agreement excludes local government – the authority that is responsible from building permits. Hence, the local authority does not have strong reasons to support wind electricity. Besides, the central government does not impose any directives about the land use on local authorities. Hence this position of the central government weakens the development of a strong legitimacy earlier, hence weakening the advocacy coalition for wind electricity generation. In the Swedish wind turbine case, an advocacy coalition is never materialized due to hesitant government policies. Additionally, the funds for wind industry are always limited (unlike the funds provided by German Renewable Energy Law, EFL). Institutional blocking mechanisms such as *building permit* in the Netherlands case, and *hesitant and inefficient policies* in the Swedish case are the main obstacles which create weak advocacy coalition and hence hindered the development of renewable energy sector for these countries. As a result of weak legitimacy and uncertainty in government policies, a vicious circle emerges in the Swedish renewable energy technologies sector where high costs, poor division of labor and weak adaptation to new technologies impede the development and dissemination of renewable energy technologies.

The **"one-size-fits-all" approach to technology policy making** is another blocking mechanism for the development of renewable energy technology innovation systems. The policy maker cannot be indifferent to decisions about policy tools and policy aims for different renewable energy technologies. The specificities of each renewable energy technology should be considered carefully; the emergence and dissemination of renewable energy technologies should be evaluated by its peculiarities in its own context. Therefore, support rates should be determined for each renewable energy technology at different levels. A single support rate for all renewable electricity technologies (like in the case of Germany renewable energy law (EFL) which was taken into force in 1991 and modified in 2000) may be cost efficient. However, it may not be effective in reaching the targets of renewable energy technology policy (Jacobsson and Bergek, 2004). For example in Germany, SW-EG technologies are subsidized at the standard support level; however this is little to stimulate technologies with high cost, such as solar electricity generation technologies. Hence, the impact of EFL is restricted to wind electricity generation. Therefore Jacobsson and Bergek (2004: 837) claim that "single supports can be cost efficient but not effective" in the sense of reaching the overall target of this policy*; transformation the energy sector.* The firms need to experience an extensive learning period by means of joining the value chain in the TIS. Hence policy makers should design a regulatory framework that considers the specificities of different renewable energy technologies.

Huang and Wu (2009) made a similar technological system analysis for wind energy sector in Taiwan and identified inducement and blocking mechanisms by associating them with the functions in the system. In this study for Taiwan's wind energy system, the main inducement mechanism is claimed to be "subsidies for wind power" including installation subsidies, the electricity purchase programs and financing incentives. These mechanisms stimulate the functions of "market formation" and "the creation of new knowledge" and "guidance of the direction of search". Other inducement mechanisms are: (i) *government run research and development (R&D) program* to stimulate the function of "creation of new knowledge", (ii) *formation of alliances/building networks to* stimulate the function of "creation of positive external economies" and (iii) inter-ministry coordination to benefit from technological system. On the other hand, blocking mechanisms are (i) *institutional impediment* that may hinder the "market formation" function and (ii) *financial instruments unfamiliarity with renewable energy technologies* that may hinder "supply of resources" function.

Additionally, Tsoutsos and Stamboulis (2005: 757) identified the main barriers (blocking mechanisms) to the sustainable diffusion of renewable energy technologies as: (i) *Technological factors* (technological immaturity, complexity, variety in installation sites, skills) (ii) *Government Policy* and *Regulatory Framework* (unclear messages from the government about renewable energy (RE), regulatory barriers to deployment of new technologies, risk aversion for change in face of political costs of vested interests) (iii) *Cultural and Psychological Factors* (low social acceptance, electricity and oil based civilization identified by comfort and ease that can be abolished by RE, unfamiliarity with new technology, uncertainty) (iv) Demand Factors (risk aversion of consumers and users about the use of RE, user preferences to adjust in favor of new technology, willingness to pay) (v) *Production Factors* (the possibility of devaluation of existing facilities of producers in case of investment in new RE technologies, the possibility of devaluation of the competence in existing technologies when adopting new technologies) (vi) *Infrastructure and Maintenance* (network incompatibility, needs of change in maintenance of the system, high sunk costs) (vii) *Undesirable societal and environmental effects* (conflicts about the aesthetic or environmental concerns) (viii) *Economic Factors* (changing economic rationale from growth of consumption to minimization of environmental impact, sailing ship effect – sailing the ship of existing incumbent technologies with short term improvements instead of investments in new technology, delay of adopting new technologies due to high initial cost in the case of absence of financial mechanism, slow take off – of new technologies which reduces the impact of economies of scale and accelerated learning on the unit cost, hence inevitably resulting high prices and low diffusion)

In comparison between the cases of the United Kingdom and Germany in TISs for micro-generation, Praetorius et al. (2010) identified inducement and blocking mechanisms. For the UK TIS of micro-generation, main inducement mechanisms were "high legitimation provided by strong networks, new business opportunities created in liberalized energy markets" and main blocking mechanisms were "institutional adjustment and political will (in terms of hesitancy to implement micro-generation strategy), low level of public funding and passivity despite declared will to support distributed energy systems" *(*Praetorius et al., 2010: 753-754). In Germany, the main inducement mechanisms for electricity generation for micro-generation system are "strong networks, reliable and advantageous remuneration scheme for electricity from small-scale sources, the early institutional alignment, high levels of legitimation, and lobbying and strong advocacy coalition *(*Praetorius et al., 2010: 757).

By elaborating all these inducement and blocking mechanisms, the main aim is to assess the main factors that affect the development of TISs in different cases. By using these factors and case studies as a guide to policy design process analysis, I formulated my interview guide section in which I asked questions about the facilitators (to find out inducement mechanisms) and obstacles (to find out blocking mechanisms) to design technology policies for the diffusion of emerging SW-E generation technologies in Turkey. I listed all these factors during the interview guide design and used these factors as hints (if necessary) for making the interviewees talk about the Turkish case in detail.

2.3. Focus of Policy Analysis for Emerging Renewable Energy Technologies: Market Formation

In the formation of the TIS, the constitution of structural elements and early development of a specific technology are emphasized. In market expansion phase, for maturing the TIS and long term success, the development of market related structures are highlighted. Therefore, market formation function is elaborated to understand the development of TIS and to formulate technology policies to reach a mature SW-E generation TIS in Turkey.

The theoretical and empirical studies of market formation in emerging renewable energy technologies start with Möllering's (2009) market constitution analysis. Möllering (2009) presents an integrative framework for market formation in emerging technology case and its application to the German solar electricity generation market. This study aims to develop a method for understanding how individual markets are formed, and how the actors contribute to this formation.

According to Möllering (2009), *markets* are systems of discrete but related economic exchanges between self-interested actors who are in competition with each other. *Market exchanges* are characterized as economic exchanges performed voluntarily among self-interested, intendedly rational actors who are in peaceful, non-violent competition with each other over the arrangement and conditions of exchanges. Markets are constituted when market exchanges are regularly performed. Market exchanges are possible when certain *constitutive elements* are in market place such as products, actors, exchanges, networks, institutions and information. These elements undergo transformative processes to acquire market formation potential. These processes are *innovating, commodifying, communicating, competing, associating, institutionalizing.*[17]

To understand the actual market formation in TIS, Möllering (2009) points out that, first of all the policy maker should pay attention to the nature and dynamics of market exchanges which arise when certain constitutive elements of market exchange are in place. Secondly, the policy maker should carefully consider the debate on "uncertainty" as the critical and indispensable characteristics of the market formation process. Thirdly, the policy maker should investigate the processes which shape the constitutive elements of markets. Möllering (2009: 7) asserts that these processes are triggered and driven by three constitutive mechanisms: *spontaneous emergence, endogenous coordination, and exogenous regulation*.

Spontaneous emergence is based on the desire to make exchanges without the vision of establishing a full market; **exogenous regulation** is undertaken by the actors outside the system to create a market; and **endogenous coordination** presumes that the actors have an interest in the existence of particular markets subordinated to larger exchange systems in which they are directly involved (Möllering, 2009: 15-16). These processes are mediated by *uncertainty and tensions,* which shape the constitutive elements of the markets. Then the markets are constituted, and this process produces individual and collective outcomes that shape the resources and interests in the society which in turn begin the market formation mechanism again. Basic framework is presented in Figure 2.1.

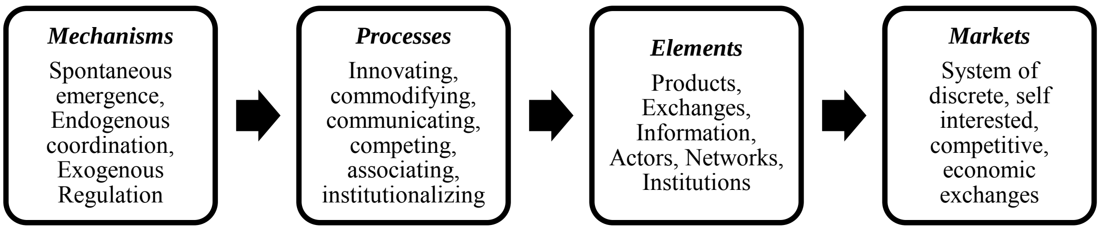

Figure 2. 1. Basic Framework for Market Constitution Analysis
Source: Adapted from Möllering (2009: 6)

[17] Möllering (2009: 13) defines these processes: *Innovating* denotes the process that turns objects and inventions into new products. *Commodifying* is the process that increases the similarity of exchanges, making them market exchanges. *Communicating* is transformative process that makes facts relevant and available to market actors, who then interpret and act on them. *Competing* captures the structural condition of competition (i.e. multiple actors' interest in making exchanges) and the spirit in which market exchanges are initiated and performed. *Associating* denotes the process of establishing relationships between actors that constitute networks, convey status, and work against the anonymity of markets. *Institutionalizing* means that certain rules of exchange and the sanctions attached to them are applied across many exchanges and become taken for granted.

In the TIS framework, the market formation is described as passing through the steps from nursing over bridging then to mass markets. In this conceptualization, the driving forces of the market are still considered as “exogenously given and typically lead to linear growth patterns” (Dewald and Truffer, 2011: 287). However, the market formation process has endogenous dynamics and for elaborating this process, “potential interactions and co-dynamics between technological, institutional, political and user-related aspects of a new technology” should be taken into account (Dewald and Truffer, 2011: 286). Instead of a linear and exogenous conceptualization of the market formation, Dewald and Truffer (2011) introduce the concept of *market segments* as the sub-system structures that serve for specific user segments and that are characterized by specific product forms. Dewald and Truffer (2011) specialize the market formation analysis in market segmentation, and make an empirical study on the formation and maturation of different market segments for photovoltaic applications in Germany. In that manner they identified four major market segments in German PV market (2011: 290-293) summarized in Table 2.2.

Table 2. 2. Market Segments in German PV Market

Segment Name	Main Features	Scale	Central Actors
MS1: Centralized PV Power Systems:	- Large scale volumes with low relative transaction costs -Strong interaction with producers	100 KWp-several MWp	-Project developing companies for construction, financial planning and operation - Private investment firms -PV system suppliers and module producers -Independent project developers (for turn-key power systems)
MS2: Small Scale Home-Owner Systems	-Grid connected decentralized roof mounted systems	1 – 10 KWp	-Back end group of PV system production chain (PV Modules and cable suppliers, inverters and mounting system supplier) - Private homeowners - Municipal public climate agencies - Locally focused initiatives (such as Local utilities and Local Government) - Architects
MS3: Large Scale Roof Mounted Systems	Planning and financing of PV applications in farm context	Up to 100KWp	-Farmers who mounted roof-integrated solar systems on their barns - Supermarkets and official building - Machinery rings, who offer manifold services for farmers (Corporate unions of farmers to finance machinery equipment) - Special marketing staffs of PV System Suppliers - Specialized firms that offer the refurbishment of barn roofs if they are allowed to run the mounted PV systems afterwards
MS4: Civic Corporate Solar Systems	Combines benefits of large scale and decentralized applications	Up to 100 KWp	- Solar initiatives networks - Civil law associations - Inhabitants of larger communities

Source*:* Prepared by the author based on Dewald and Truffer (2011)

In their analytical framework, Dewald and Truffer (2011: 289) propose a more explicit analysis of market formation dynamics by (i) identifying actors, networks and institutions at the level of more or less self-contained market segments (*structural analysis*), (ii) assessing the different market segments' stage of development and their mutual interdependence (*process analysis*) and (iii) analyzing the contribution of specific market segments (MS) to the overall TIS performance (*functional analysis*). By this conceptualization, Dewald and Truffer (2011) show that the dynamics of different market segments exhibit different structural profiles and their interrelations create a synergy which shape overall development of the TIS.

To produce a more comprehensive conceptual and explanatory framework for explaining the market formation process in TISs, Dewald and Truffer (2012) add the conceptualization of market formation sub-processes to Dewald and Truffer's (2011) explicit market formation analysis by using Möllering's (2009) general framework of market constitution analysis. Dewald and Truffer (2012: 400) detail the process analysis and propose a framework that arranges the market formation function into three complementary sub-functions of: *1) formation of market segments 2) formation of market transactions and 3) formation of user profiles*. Following Möllering's (2009) clarification of the market formation in six key processes, Dewald and Truffer (2012: 402) group these processes into two sub-functions of "formation of market segments" and "formation of market transactions". Möllering's (2009) processes of "innovating, associating and institutionalizing" shape the sub-function of "formation and differentiation of market related TIS sub-structures (market segments)" and the remaining three processes, "commodifying, communicating and competing" shape the "formation of market transactions" (Dewald and Truffer, 2012: 402). In addition to these two sub-functions, the "formation of user profiles" is added to the market formation analysis to emphasize the constructive part on the user side, determining consumer images, use patterns and preference structures. These three sub-functions are accepted to co-evolve in relationship during the entire market formation process in any TIS.

According to Dewald and Truffer (2012: 403), **the sub-function of formation of market segments** focuses on the specific actor, network and institutional structures established for selling a specific product variant to end-user groups. New market segments emerge when specific actors with appropriate capabilities and resources are already located in the market place, and prevalent networks supporting innovative activities exist in an appropriate institutional framework. Moreover the specific consumer groups should be available and open for innovative products. All these preconditions should be formed and favored by the institutional context, which determines the landscape conditions for emerging technology. This sub-function is shaped by Möllering's (2009) processes of *innovating* (turning objects and inventions into new products), *associating* (establishing relationships between the constitutive elements of the system), *institutionalizing* (routinizing the certain rules of exchange and the sanctions attached to them).

The **sub-function of formation of market transaction** is related to "the exchange relationship between supply and demand for the end-products" (Dewald and Truffer, 2012: 403). *Commodifying* (to allow the product to be comparable and tradable through repeated exchanges between buyers and seller governed by formal and informal rules), *communicating* (interaction between the actors) and *competing* (co-presence of different producers and suppliers in a given market context) are the key processes that shape market transactions formation.

The **sub-function formation of user profiles** is another sub-function of market formation in emerging technologies (Dewald and Truffer, 2012: 404). User profiles are formed if consumers develop preferences when exposed to new technology products and start to use these products. The flexibility in interpreting the usage conditions of a new artefact is the key to internalize the new technology.

By combining the sub-functions of market formation and the phases of market formation (nurturing phase, bridging phase and mass market) in TIS, Dewald and Truffer (2012) examine the contribution of each specific market segments to the overall performance of the TIS. Dewald and Truffer (2012: 405-406) claim that in the nurturing phase (which is characterized by uncertainty, openness to variety creation in technological design and pioneering prime movers), the sub-function of market segment formation is predominant. With the shift toward bridging markets, market transactions become clear where the new user segments and product variants appear. In maturing into a mass market, the overall market becomes homogeneous and the market transactions are formed concretely.

At first stage the structural analysis of market formation is made to identify actors, networks and institutions at the market segments level of licensed and unlicensed SW-E generation. At second stage, the process analysis of market formation is made to assess formation of market segments (by processes of innovating, associating, and institutionalizing), formation of market transaction (by processes of commodifying, communicating, and competing) and formation of user profiles. At the final level, the functional analysis of market formation is made to evaluate the contribution of specific market segments to the overall TIS performance.

2.4. Conclusion: Revisiting Theoretical Framework for Operational Definitions

The diffusion of SW-EG technologies is elaborated in this dissertation. For this purpose, it is claimed that policy makers should design technology specific policies. There are two main theoretical approaches to design technology policies: the "Evolutionary Theory" and the "Neoclassical Theory". First of all, these theories are elaborated to explain the foundations of technology policy making. For these theories, the starting point for the policy analysis is to find out the problems/failures that hinder this process. These problems are identified by the Market Failures Approach (based on the Neoclassical Theory) and the System Failures Approach (based on the Evolutionary Theory). Therefore, in the following sub-section, these approaches are compared and discussed since in the data generation process, I search for the main problems/failures in SW-EG in Turkey in relation to the whole energy sector.

For practical purposes to design technology policies, this dissertation uses the systemic perspective of the "Technological Innovation System (TIS)" approach based on the Evolutionary Theory since it is proposed as the most appropriate systems of innovation for emerging technology case like SW-EG technologies in Turkey. This step-by-step framework provides an analytical tool to analyze the formation and development phases of a TIS for SW-EG through detecting problems/failures and, then by designing appropriate policies to solve these problems. TIS framework is clarified in detail by its sub-steps of structural analysis (definition of the system; actors, network, institutions), functional analysis (detailed analysis of how the system works) and policy analysis (to enhance the system as a whole).

For assessing the functionality of the whole system, according to the TIS framework, the policy maker should identify inducement and blocking mechanisms. To reach the overall aim of diffusing SW-EG in Turkey, the policy maker should set the policy targets and propose policy implications to remedy poor functionality of TIS focusing on the bottleneck function by strengthening/adding inducement mechanisms (facilitators) and weakening/removing blocking mechanisms (obstacles). Therefore, to determine these mechanisms (factors), I briefly discuss empirical literature about inducement and blocking mechanisms to use the examples from country experiences in the Turkish case.

For the focus of policy analysis, in this dissertation, it is claimed that one of the functions of TIS should be chosen. To find out the function, a preliminary analysis was made and the *market formation* is proposed as the key function for policy intervention to diffuse SW-EG technologies in Turkey. For the creation and maturation of the market in emerging technology case, a framework is detailed by elaborating three complementary market formation sub-functions of 1) formation of market segments 2) market transactions and 3) formation of user profiles. This analysis is made to understand the market formation in SW-EG in Turkey for which the technology policies are designed to support the diffusion of emerging SW-EG technologies.

This dissertation contributes to the theoretical literature by doing this analysis from the producer's (electricity generators') perspective as different than the studies in the literature that examine market formation dynamics from users' perspective.

CHAPTER 3

METHODOLOGY

3.1. Introduction

The aim of this chapter is to explain the research organization of this dissertation. This chapter describes the process of data generation to answer the research question of the dissertation. The technique used in data generation is qualitative semi-structured interviews. These interviews were conducted with the key actors from solar and wind electricity generation (SW-EG) in Turkey. In the Turkish case, market formation is the critical factor that influences the diffusion of those emerging renewable energy technologies. Therefore, to generate the most useful data to answer the research question and achieve the goal of technology policy design, the key actors are selected from the group of actors directly involved in the market formation process. In this sense, the sampling strategy is purposeful sampling to talk to those actors who are likely to have the most information about market formation.

In the first section, a brief introduction to the foundations of research strategies explains the main tenets of qualitative and quantitative research strategies. In the second section, I discuss the reasons to choose a qualitative research technique. In the third section, the design of the interview guide is elaborated and the question groups in the guide are presented. The fourth section is about the data generation process and the data sources. In the last section, the procedures used in the data analysis are described.

3.2. Foundations of Research Method: Quantitative vs. Qualitative Research Strategies

Research strategy is the plan of action that guides the inquiry to examine and explore the subject of research interest (Bryman, 2008). In the research process, the researcher tries to understand “the reality” in the research field, and tries to explain and to describe. For this purpose, there are two distinct research strategies including quantitative and qualitative research to be employed, depending on the *theoretical considerations* or the role of theory in research, *ontological considerations* or the reality in the social world of research field, and *epistemological considerations* or the relationship between the knower (inquirer) and the known (Guba, 1990; Guba and Lincoln, 1994; Bryman, 2008).

In term of theoretical considerations, in quantitative research, the researcher starts with the theory and formulates hypotheses based on this theory. Nevertheless, in qualitative research, the researcher starts with the "findings and observations" and derives "generalizable inferences out of observations" (Bryman, 2008:11). The role of theory is deductive[18] in quantitative research, whereas it is inductive[19] in qualitative research. In quantitative research, the researcher collects data, deduces findings by observing the reality outside him/her and test hypotheses. In this kind of research to verify or falsify hypotheses, the hypotheses formulation process must be independent from the data collection process (Guba and Lincoln, 1994). In contrast to quantitative research, in qualitative research the data to understand the research subject are accepted to be theory-laden, and the data and reality are considered to be interdependent (Guba, 1990; Guba and Lincoln, 1994). In qualitative research, the researcher derives context-dependent outcomes to explain and understand the reality (Corbin and Strauss, 2008). This derivation process is also context-dependent and changes during the research. In other words, in qualitative research facts are independent from neither the theories nor the values.

The ontological concerns of research strategy deals with the examination of the social world and the organization of social entities as the components of this world during the research process (Patton, 2002; Bryman, 2008). A researcher uses quantitative research strategy when s/he assumes that the social entities exist independently from the research process. In such a process, indifferent researcher keeps her/his distance to the social entities for the sake of objectivity. On the other hand, qualitative researcher assumes that the reality is constructed by the perceptions and actions of the actors in a relationship. Therefore the researcher, rather than being objective, chooses to be *sensitive* to data generation and analysis processes (Strauss and Corbin, 2008; Patton, 2002). The researcher, as an instrument of research process, is influenced by the *worldview*; the beliefs and attitudes about the world s/he lives in (Corbin and Strauss, 2008). For this reason, the researcher

[18] Brewer et al. (2003: 67) defines Deduction as "...the process of reasoning by which logical conclusions are drawn from a set of general premises.

[19] Brewer (2003: 155) defines Induction as "... an approach in social research which argues that empirical generalizations and theoretical statements should be derived from the data."

chooses to be "sensitive to grasp the meaning and respond intellectually to what is being said in the data" in order to reach the facts derived from data (Strauss and Corbin, 2008:41). This interaction improves the research process by enriching the data through depth, breadth, and openness (Patton, 2002).

Epistemological considerations of the research strategy are related to the researcher's perception of the acceptable knowledge in the research area (Bryman, 2008), hence the relationship between the knower (inquirer) and the known (Guba, 1990). In this respect, the researcher decides what the satisfactory and adequate knowledge in the research field is (Bryman, 2008). The quantitative research seeks for the universal knowledge, whereas the qualitative research explores the particular knowledge (Hattaway, 1995). By quantifying the answer to the research question through numerical data, the quantitative research strategy aims to determine and predict the causal relationships between the issue to be explained (dependent variable) and the factors to explain this issue (independent variables). On the other hand, the qualitative research strategy aims to describe and explain the relationships between all the social entities in the research field to understand their approach.

3.3. Research Strategy and Data Generation Process

3.3.1. Why a qualitative method?

In this dissertation, the focus of research interest is to understand the role of market formation in diffusion of emerging renewable energy technologies and to design technology policies to promote this process. The role of theory in field research is inductive. The ontological concerns about the reality are shaped by social construction. In line with this focus, the research addresses the dynamics of collective generation of meaning attached to market formation by key actors in the field of renewable electricity generation. Hence the knowledge generated in this dissertation is context dependent.

Theoretical framework of the dissertation is made up of the *Economic Foundations of Technology Policy Design* and the *Technological Innovation System Perspective* (as the analytical framework of technology policy design). The scope of the research is framed by these theoretical foundations, and the role of theory in this research is inductive rather than deductive. Instead of formulating hypotheses which are derived from the theories of technology policy design and then testing them by the data, by following Brewer (2003:154), I try to "base empirical generalizations and theoretical statements about the social world (renewable electricity generation in Turkey) on the data themselves free of preconceptions, allowing subjects' perceptions, ideas and social meanings not only to speak for themselves but to speak in a broader way by generalization”. Instead of interpreting the data by apriori assumptions and theoretical generalizations, the aim is to understand the meaning inherent in the data. Such kind of data collection and data analysis processes are required especially for technology policy design due to the fact that renewable electricity generation technologies are emerging technologies in Turkey. In this context, I interpret the data in theoretical framework of technological innovation system perspective focusing on market formation and try to enrich this theoretical framework by new inferences derived from the Turkish case based on the collected data.

In the research process, the researcher tries to understand *the reality* in the research field and, to explain and describe it. The reality in this research is the market formation in the Turkish SW-EG. The role of actors and the meaning they attach to this reality are continuously constructed and reconstructed during the research process. Hence, the reality becomes *socially constructed* and the researcher tries to construct the knowledge about reality (rather than to construct the reality itself) as a “consensus among constructors” (Patton, 2002:96). Social construction of reality enables the “collective generation (and transmission) of meaning” by multiple perspectives of constructors (Crotty, 1998:58). The source of these multiple perspectives lies in social entities that are active components of this construction process and manipulate this process by learning.

As a result of theoretical and ontological concerns, the knowledge produced in such a research process becomes context dependent. This knowledge is generated by complex and continuous interaction between all constructors. Hence the reality, shaped by the mental constructs of the known and knower, becomes socially constructed and experience based, not something out there (Guba, 1990). Qualitative research do not accept the realist assumption which dictates *the reality external to known and knower,* hence the research mainly concerns with the meaning which is collectively generated, transmitted, and acted upon by the social entities in the research field (Guba and Lincoln, 1994; Patton, 2002). Therefore, the Turkish SW-EG market is accepted as a socially constructed reality that is investigated in the theoretical framework of Technological Innovation System by generating context dependent data through qualitative research method.

3.3.2. Data Generation Process

The data generation process addresses the basic research question of “How do the key actors understand and affect the market formation in renewable electricity generation to promote diffusion of emerging renewable electricity generation technologies in Turkey?" The data of the dissertation is generated in two phases: "Preliminary Analysis" and "Field Research".

Preliminary Analysis

The preliminary study was made to answer the question of "What should be the focus of analysis in policy making to promote diffusion of SW-EG technologies in Turkey? It further determined what the purpose of using renewable energy is, which renewable sources are to be chosen, and how the interviewees should be chosen in the second stage of data generation (field research) (Table 3.1.). The preliminary analysis enabled me to narrow down the research topic, and (as a bridge to the field research) it shaped the direction of data collection in the next stage.

In this stage, I began with documentary data or "written materials" (Patton, 2002:4) to understand the current trends in energy sector from secondary data. These secondary data sources were the legal framework documents about electricity generation[20] and the statistical databases. The legal framework documents included the laws about electricity generation and utilization of renewable sources (Law No: 5346 and Law No: 6446), Council of Ministers decisions, resolutions-court decisions, official proclamations, and the Energy Market Regulatory Authority Board Decisions. The statistical databases were (1) The Statistical Database of Republic of Turkey Ministry of Energy and Natural Resources (ETKB), (2) The Statistical Database of International Energy Agency and (3) The Statistical Database of Eurostat (The statistical office of the European Union). These data sources provided the statistics about the primary energy production and consumption, the electricity generation and consumption, the distribution of energy sources to primary energy consumption and electricity generation and electricity prices. By this statistical analysis, the fundamental features of the general energy outlook are examined. The results of this desk research is presented as the current situation of Turkish Energy sector in Introduction Chapter for defining the research question of the dissertation.

Afterwards, I conducted preliminary expert interviews with the actors in the energy sector and asked them question about their reflections on the current situation of the Turkish energy sector, main energy problems, and their suggestions for solutions and their

[20] See Energy Market Regulatory Authority webpage for the detailed legal framework of electricity generation (in English): http://www.emra.org.tr/index.php/electricity-market/legislation. Last access: 21.10.2015

perceptions about the diffusion of renewable energy as an alternative solution to energy problems. The expert interviewees were among the managers of private companies, bureaucrats from governmental organizations related to energy sector, and academics from the universities. The interviews were conducted with two academics, two private company managers, and two bureaucrats between June-December, 2012. These experts were selected by purposeful sampling. The selection criterion was to choose an experienced representative for each group of actors. The interviewees were actually the most active and knowledgeable key actors in the energy sector from these three groups.

In the desk research, it was found that fossil fuels are the dominant energy sources in energy production and electricity generation in Turkey. Parallel to the desk research, in expert interviews, it was found that the fundamental energy problem in Turkey was increasing energy consumption, insufficiency of energy production to supply this consumption due to lack of domestic sources and increasing import dependency for energy sources. These factors have become the main motivations for choosing renewable energy sources (RES) as the research area for this dissertation. For Turkey has rich renewable energy sources, as mentioned by the interviewees in preliminary study, renewable energy technologies can create an alternative for the using these rich sources.

From the preliminary study it is seen that the renewable electricity generation is in its initial phase of development; in the formative period of experimentation for development and dissemination of a new technology. The key actors direct this formative period and then carry the technology diffusion process to a market expansion period (in which the initial markets emerge, production volume increases, scale advantages are reaped, new firms enter the value chain, and further learning is stimulated). Therefore, the "market formation" should be the focus of analysis to promote diffusion of emerging renewable electricity generation technologies.

There are different renewable energy sources such as solar energy, wind energy, tidal energy hydropower, and geothermal power. Among these renewable energy sources, the expert interviews pointed out that for diffusion of renewable energy technologies, this study should focus on the solar and wind energy sources, specifically for the purpose of electricity generation since these technologies are emerging renewable energy technologies and this dissertation is a policy-oriented dissertation that aims to propose technology policies.

Cost was one of the issues elaborated in preliminary interviews. The bureaucrats in preliminary expert interviews asserted that due to high initial investment cost, renewable energy cannot be considered as a proper solution. On the other hand, the experts from private sector do not agree with them about this cost issue. According to them, the cost of renewable energy technologies is decreasing very fast and if the targets for renewable energy sources are to be clearly programmed and the diffusion process is supported by well-designed technology policies, then renewable energy can be a proper solution. Another issue of preliminary interviews was the role of the government in energy sector. Bureaucrats, academics and private sector representatives all agreed on the new role of the government. They all implied that the government should change its role from the energy producer to the regulator and the policy maker in energy sector. Moreover, according to the analysis of the current situation in Turkish energy sector, all interviewees claimed that the structure of the market and the market formation should be the basic issue to focus. These findings showed that diversification in actor profile may change their perceptions about diffusion of new technologies and market formation. As presented in literature review chapter, such kind of differences do not play any role in country cases. However in Turkish case, I came across such kind of diversifications as mentioned above. As a contribution to Technological Innovation System perspective, I claim that these diversification should be considered in technology policy design for a complete analysis of the diffusion process and market formation dynamics. To take these diversifications into account, interviewees in second stage of data collection are chosen from different groups according to specific criteria that are crucial for market formation. The patterns asserted by both of the expert groups complement each other in Turkish case and give a proper picture for the market formation dynamics and diffusion process.

As a result, by the preliminary analysis, the focus of analysis is determined as "market formation in electricity generation based on solar and wind energy sources in Turkey" and the interviewees should be chosen by considering their differences in their perceptions about the research subject.

<u>Field Research</u>

In the second step of data collection, the "Field Research" phase, I have conducted interviews with the key actors in SW-EG in Turkey (Table 3.1). The data collected from this research field is dependent on the theoretical framework (parallel to the foundations of qualitative research strategy). Hence, in data collection process I search for the theory-laden facts and context dependent outcomes. For example, in the first part of the field research, informed by the theories of technology policy design, I asked questions to detect the factors including blocking mechanisms, obstacles, and failures affecting the diffusion of SW-EG technologies. It is important to understand the nature of these factors in the broader context of Turkish Energy Sector. To grasp this "broader context from key actors' perspective" I begin the data collection process of interviewing by asking questions about the current situation of the Turkish energy sector and the status of renewable energy in this sector. This helps better understand the emergence and dissemination of renewable electricity generation technologies in relation to whole energy sector.

In this qualitative study, I examine the approaches and perceptions of active and influential key actors in renewable electricity generation in Turkey. According to the results of the data analysis, I design technology policies to solve the problems and to incorporate the recommendations indicated by these actors. This kind of data analysis practice is compatible with this dissertation's ontological position of "social constructionism" as the assumption is that the reality of renewable energy sector in Turkey is constructed by the meanings and actions of the key actors (social entities) through their relations and interactions. In this process, the contribution of the researcher, is to comprehend the key actors' perspectives, perceptions and experiences in their own contexts. In this process, the researcher presents this socially constructed reality as derived from data.

The choice of research method, *the technique for collecting data*, depends on the researcher's position about justification of knowledge and reality (Hathaway, 1995). In this dissertation, fundamental research motivation is to find out the meaning attached to market formation and to its role in the diffusion of a new technology. In Turkey, diffusion of emerging renewable energy technologies are accelerating by the personal attempts which are coming as a bottom-up initiative. These personal attempts are mainly the endeavors of key actors and they are essential for a successful diffusion. Therefore, the main sources of data are the key actors' perspectives, experiences, approaches, beliefs, functions and discourses on the market formation of SW-EG in Turkey. This kind of qualitative data can be collected through interviews because "open ended questions and probes yield in-depth responses about people's experiences, perceptions, opinions, feelings, and knowledge (Patton, 2002:4)."[21] For this purpose, conducting semi-structured interviews are used as data collection technique. This interview technique is useful because it helps us to situate all these

[21] Other kinds of data collection methods are "direct observations" and "documents" (Patton, 2002:4)

perspectives, experiences and approaches within their cultural and social context (McCracken, 1988), which is implicitly or explicitly referred to by the actors during the interview or whose relation to the data can be analyzed by the researcher, and to understand the overall picture from the worldviews of key actors. Moreover, it is the most appropriate interviewing strategy among the interviewing strategies that Silverman (2006) offered[22]. In doing semi structured interviews, the researcher should build the rapport with the interviewee and to make the interviewee to understand the aims of the research accurately (Silverman, 2006). In our research field, the method of semi structured interviews enables us to build this relationship and encompass various perspectives held by different interviewees to understand the basic dynamics of diffusion of renewable electricity generation in Turkey through market formation. This multi-dimensional and rich data is especially required for policy formulation to support diffusion of renewable electricity generation in Turkey.

Table 3.1. Summary of the Data Generation Process

	Preliminary Analysis
Main question:	What should be the focus of analysis to promote diffusion of emerging renewable energy technologies in Turkey?
Data sources:	✓ Secondary sources of legal framework documents and the statistical databases ✓ Preliminary expert interviews (6 interviews)
Results:	✓ The focus of analysis is "market formation in SW-EG in Turkey" ✓ The interviewees should be chosen by considering their differences in their perceptions about the research subject.
	Field Research
Main Question:	How do the key actors understand and affect the market formation in Turkish Case?
Data source:	✓ Interviews with key actors (57 interviews)
Results:	✓ Policy Implications by the policy design analysis

3.4. Operationalization of the Theoretical Framework: Interview Guide

The design of the interview guide formats the questions to operationalize the theoretical framework. This guide enables the researcher to practically utilize the conceptual

[22] According to Silverman (2006:110), there are four main interviewing strategies including "structured interviews, semi-structured interviews, open ended interviews, and focus groups".

framework[23] of the study in the field. To prepare the interview guide, Patton (2002:342) offers three basic approaches including "the informal conversational interview, the (general) interview guide approach and the standardized open ended interview".

Informal conversation interviews are unstructured interviews that offer maximum flexibility in data generation. The interview guide consists of the questions that emerge immediately in the natural flow of conversation. On the other hand, standardized open ended interviews are composed of carefully formulated and detailed questions that must be asked in the same order with the same wording to each interviewee. Informal conversation interview guide is too loose whereas the standardized open ended interview guide is too strict for the field research of this dissertation.

The target groups of actors in this study have different worldviews and perspectives on the same subject of the technology policy design in renewable electricity generation. This indicates that the wording of the questions should be modified during the interviews to make the questions meaningful for each group even though the essence of the questions should be preserved. Thus, I choose the general interview guide approach which "ensures same basic lines of inquiry with each interviewee" and "provides topics or subject areas within which the interviewer is free to explore, probe and ask questions that will elucidate that particular subject with each interviewee" (Patton, 2002:343). In this kind of interviews, the subject areas to be covered and the extent of the collected data are specified by the interview guide (Patton, 2002). The interviewer may change the wording of the questions, but the interview process should always be framed by predetermined subject areas in the guide (Patton, 2002).

By following this approach, I began the interview guide [24] with the introduction/warm up to recognize the interviewees. Then, I organized the interview guide into four main subject areas based on the theoretical framework of the dissertation. These subject areas form the contents of the main sections in the interview guide and in the data analysis process (Figure 2.2.). The sections of the interview guide are:

1) Introduction /Warm up for study profile

2) Current Situation of Turkish Energy Sector

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[23] Maxwell (2013: 39) defines the conceptual framework as "the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs the research".

[24] Interview guide (in Turkish) can be seen in Appendix C.

3) The inducement and blocking mechanisms for diffusion of renewable energy technologies

4) Market Formation in solar and wind electricity generation

5) Public Policies and Market formation

In the first section, I asked questions about personal and organizational information. The second section was about *the Current Situation of Turkish Energy Sector* to understand the diffusion process of renewable electricity generation in relation to whole sector and to find out the failures in the sector as mentioned literature review chapter. For this purpose, I asked questions about current situation of Turkish Energy Sector. These questions were about the problems of the energy sector and renewable energy as a solution, reasons for using fossil fuels and optimal bundle for electricity generation.

In the third section, I asked about *the inducement and blocking mechanisms for diffusion of renewable energy technologies.* Smith (2000) asserts that policy makers design technology policies to take advantage of inducement mechanisms. Bergek et. al. (2008) add that it is also important to explain the role of blocking mechanisms that shape the dynamics of diffusion process. Therefore, in this section I specifically ask questions about inducement and blocking mechanisms. In the literature review, I identified examples of these mechanisms from the case studies and country experiences. Some of these mechanisms support the diffusion of renewable electricity generation whereas some others impede it in the Turkish Case. The literature thus already provides some examples of these mechanisms, against which I can identify and compare other effective mechanisms, which facilitate or hinder the diffusion of renewable electricity generation in the context of market formation.

In the fourth section, the questions were about *The Market Formation.* The evidence from the preliminary analysis indicates that the main problem for diffusion of renewable energy technologies lies in market formation, and to understand the dynamics of market formation the focus of analysis should be market formation conditions as formulated by Technological Innovation Systems Approach. Dewald and Truffer (2011) claim that, for the success of diffusion of emerging technologies in Technological Innovation System framework, the structures and processes that are behind the market formation have important roles. Hence, in this part of the interview guide, specific questions were asked to explain the structural and processual forces of market formation in the Turkish SW-EG. The questions were thus about the constituents for renewable energy markets and actual market development /the dynamics of market formation in SW-EG.

In the fifth section of *Public Policies and Market formation*, I ask questions about the role of policies in market formation for the diffusion of renewable electricity generation technologies in Turkey. In the analysis of local sources of market formation, Dewald and Truffer (2012) advocate that if "institutional and organizational preconditions that guaranteed the effectiveness of the support mechanism" are lacking, this mechanism cannot be successful to lead to market formation (pg. 416). In this dissertation context, it is claimed that these preconditions can be provided by particular policies for market formation. Moreover, the policies that achieve a successful integration of policy aim, policy tool and policy target are critical for identification and solution of problems in the diffusion of emerging renewable energy technologies. Such policies are decisive for establishing an institutional framework by an organic collaboration of system actors, and producing related knowledge and technologies. For this purpose, key actors' perceptions and ideas were asked about the relationship between the public policies and market formation. In this section of the interview guide, the questions were specifically about the interaction of public policies and market formation, purpose of renewable energy policies, characteristics of policy makers, and policy proposals of the interviewees.

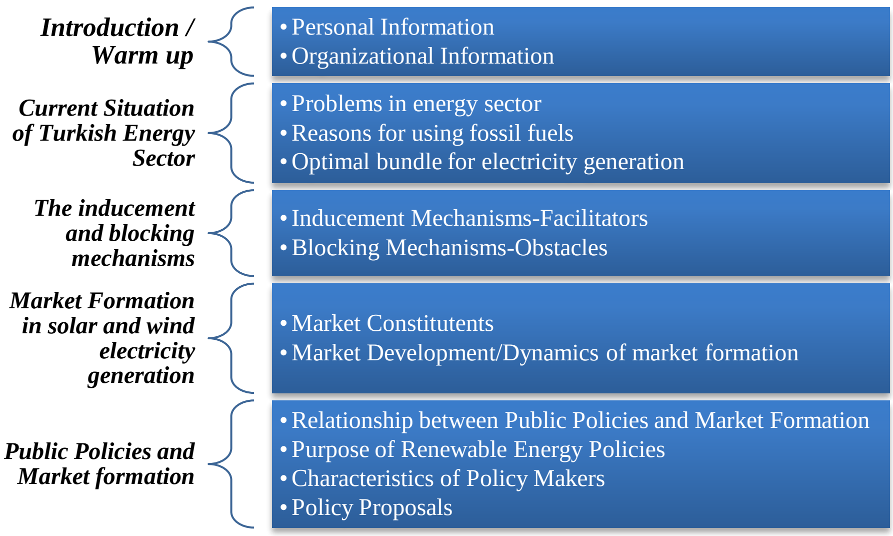

Figure 2. 2. Sections of interview guide
(Higher order categories and Sub-categories)

3.5. Data Sources and Data Collection

The data is collected by the qualitative data generation method of semi-structured interviews. The data sources are mainly the key actors in SW-EG in Turkey. In this section the details of interviewee selection criteria used to choose the interviewees, the interviewees profile in the field research and the sampling strategy are given to elaborate the data sources and data collection process.

Interviewee Selection Criteria

The main data in this dissertation is collected by a qualitative method in "Field Research". In this stage of data collection, I directly contacted with the key actors in electricity generation based on solar and/or wind energy sources in Turkey. To understand and explain different dimensions of market formation in SW-EG and diffusion, I conducted interviews with the actors who are directly involved in or related to renewable electricity generation in Turkey. To consider the diversification between the actors, that is pointed out in preliminary analysis, two criteria were used for selecting the interviewees:

(i) Direct motive of profit making (from electricity generation) - economic profit motive and

(ii) Economic activity to perform in the renewable energy sector (in relation to market formation) - economic activity motive.

Direct motive of profit making (economic profit motive) refers to whether the interviewees are a member of a private sector organization or not. Economic profit motive is an important determinant of the participants' perspectives and attitudes. Accordingly, the interviewees represented two categories: a *for-profit-organization* or a *non-profit-organization*. The for-profit-organizations are companies in *private sector*, and profit making is their primary economic motive in SW-EG. The non-profit organizations are governmental organizations, NGOs (non-governmental organization) and academic organizations. All these organizations can be categorized under *non-private sector*, and these organizations and actors have other priorities more critical than profit.

The economic activity of the interviewees is the other selection criterion. Four main activity types were determined in the structural analysis of the both private and non-private sectors including *generation* (of electricity from solar and wind energy sources), *regulation* (to provide the order for the overall renewable electricity generation sector), *consultancy* (to establish a network of organizations for the adaptation of the private sector to economic and technological conditions, and for the support for the investors), *supply* (to provide all kinds of establishment and maintenance equipment and services for electricity generation). In the sampling process, the focus of analysis is the perspective of the active actor depending on his/her profile and economic activity in electricity generation based on solar and wind energy sources in Turkey. The collected data is analyzed in terms of whether the perspectives of the actors from private sector and non-private sectors (in pursuit of one of the four types of economic activities) are changing, differing, conforming to, or conflicting with market formation, what affects the diffusion process of renewable electricity generation technologies and, how the policy makers can manage these dynamics by technology policy design.

Private Sector - For-profit organizations
(34 Interviews)

- *Generation*..............17 interviews from companies
- *Regulation*...............Not applicable
- *Consultancy*............10 interviews from consultancy companies
- *Supply*..................... 7 interviews from equipment suppliers

Non-Private Sector - Non-Profit organizations
(23 Interviews)

- *Generation*..............Not applicable
- *Regulation*.............8 interviews from Governmental Organizations
- *Consultancy*............6 Interviews from Govenental Org.
  ....6 interviews from Non-Governmental Organizations
  ....3 interviews from Academic Organizations
- *Supply*.....................Not applicable

Figure 2. 3. Details of the Interviews in Field Research

I conducted 57 semi structured interviews with the actors in private and non-private sectors on a face-to-face basis. 34 of the interviewees were from private sector and the remaining 23 interviewees were from non-private sector (Figure 2.3). I made interviews with the key actors whose organizational responsibilities are directly related to SW-E generation. The interviewees from the companies and governmental organizations were the general manager, the manager of a SW-EG unit, or the project engineer in a SW-E power plant. In the NGOs and academic organizations, the interviewees were the directors or the board members. I conducted all the interviews on one-on-one in the participants' own offices. The appointment date and time were determined by e-mail and then phone for each interview through direct contacts with the interviewees. First of all, I sent them e-mails briefly stating the details of the study as well as their (and their organizations') critical importance for the study and asking for an appointment. After confirmation, I called them by phone to determine the exact time and date of appointments. For the interviews I travelled to different cities of Turkey such as Ankara, Istanbul, İzmir, Antalya, Denizli, Balıkesir, Kayseri, and Gaziantep. All the expenditures for each trip were financed by the TUBITAK-1002 Short Term R&D Funding Program-Project (No: 114K070) Field Research Budget.

Interviewees Profile

The interviewees[25] from private sector represented the companies which were actively generating electricity from solar and/or wind energy sources or had application for electricity generation license (Renewable Energy Resource Certificate-RES Certificate). The methods to be employed for electricity generation based on renewable energy sources are clarified by legal framework documents of "Electricity Market Law" numbered 6446 (which was adopted in March 14th, 2013) and "Law on Utilization of Renewable Energy Sources for The Purpose of Generating Electrical Energy" numbered 5346 (which was adopted in May 10th, 2005[26]). According to these documents, real and legal entities establishing an isolated or grid connected power plant with maximum installed capacity of 1.000 KW (1 MW) for meeting solely their own needs do not need to apply for a license, and hence they do not pay application and service fees for the license granting process. These entities are generating electricity based on renewable energy sources by building unlicensed power plants. The company which has a power plant with maximum installed capacity of 1 MW is called an "unlicensed electricity generator". This company[27] can use all the electricity

[25] "Interviewee" is abbreviated as "Int.". The quotations are reported by using this abbreviation at the beginning of the interviewee code (For. ex. The interviewee from company 1 is reported as Int. C1).

[26] English Versions of these laws can be found in Energy Market Regulatory Authority Web page, http://www.emra.org.tr/index.php/electricity-market/legislation. Last access: 26.03.2015

[27] In 5346, Law on Utilization of Renewable Energy Sources; it is said that "real persons and entities" can generate electrical energy from Renewable Energy Resources within the scope of this law. Hence, not just companies but also real persons can generate electricity from renewable sources by building an unlicensed renewable energy power plant. However, in the scope of this dissertation, we excluded real persons from the group of "electricity generation economic activity". Due to the fact that this dissertation has a (electricity) supply side perspective, I grouped this activities based on the criteria of economic profit motive and in Turkey (for now) real persons do no generate electricity from renewable energy sources for earning profit.

generated in this power plant for its own consumption and can export its surplus production (remaining amount after consumption is subtracted from generation) to the distribution system with the prices in Schedule I for a term of ten years[28]. This electrical energy is purchased by the distribution company holding the retail sales license in the region. It is given to the system by the distribution company within the scope of the Renewable Energy Support Mechanism.

On the other hand, the company which builds a power plant with installed capacity exceeding 1.000 kW (1 MW) must apply for a license. First of all, this company must apply for a pre-license for the power plant. In the licensed electricity generation, for predetermined regions and/or substations, the capacities of power plants are announced and the applications of the companies are collected. The applicants that fulfill the necessary conditions for the license are identified as a result of the technical evaluation made by the General Directorate of Renewable Energy. If there are more than one application for the same region or substation, eligible applications are sent by the Energy Market Regulatory Authority to the Turkish Electricity Transmission Co. Inc. The Turkish Electricity Transmission Co. Inc. calls for tenders from the applicants which have to bid for the pre-license to build a (solar or wind) power plant. The applicant offering the highest contribution fee[29] in its bid is identified as the winner of the competition. The results of the competition are sent to EPDK. EPDK grants this winner an electricity generation license entitled as "Renewable Energy Resource Certificate" (RES Certificate) to allow the winner to purchase and sell electricity generated from renewable energy resources in the domestic and international markets. Hence real and legal entities can generate electricity based on renewable sources by holding the license of the power plants that have an installed capacity exceeding 1 MW, and they are called “licensed electricity generators”. In summary, real and legal entities that generate electricity based on solar and wind energy sources are “unlicensed electricity generator (by the power plants of installed capacity at maximum 1 MW)” or “licensed electricity generator (by the power plants of installed capacity exceeding 1 MW)”. Hence, the interviewees are from licensed and unlicensed electricity generator companies whose main activity is electricity generation in private sector in Turkey. I conducted 17 interviews with electricity

[28] To see Schedule I and the English version of The Law: http://www.emra.org.tr/index.php/electricity-market/legislation Last access: 10.10.2015

[29] This contribution is a monetary contribution per each kWh to be generated for wind energy and it is monetary contribution per each MW to be installed for the term for solar energy.

generators (Figure 2.3). Among them, there were pre-license holders (in solar energy[30]), license holders (in wind energy), unlicensed electricity generators, solar license applicants, and wind license applicants. These interviews were conducted in Ankara, Denizli, Istanbul, İzmir, and Kayseri.

Another economic activity performed by for-profit organizations in private sector is *consultancy*. Consultancy service is provided mainly by The Engineering Procurement Construction (EPC) Companies. These companies offer turn-key solutions to solar and wind energy power plant investors. They establish the network between the power plant equipment suppliers and the investors, and follow and complete the legal procedures on behalf of the investors. They are a kind of buffer between private sector and non-private sector. I completed 10 interviews with these EPC company representatives in Ankara, İzmir and Antalya (Figure 2.3.). The last activity group in private sector was *supply*. These companies provide all kinds of establishment and maintenance equipment and services for electricity generation, and some of them are domestic producers. I completed 6 interviews with the suppliers in Ankara, Istanbul, Balıkesir, and Gaziantep (Figure 2.3).

The activity of interviewees from non-private sector was mainly regulation and I conducted most of the interviews with them in Ankara, the capital of Turkey as the center of governmental organizations. These actors were selected from the governmental organizations (public institutions) directly related to electricity generation in Turkey such as Ministry of Energy and Natural Resources (ETKB), General Directorate of Renewable Energy (YEGM), Turkish Electricity Transmission Company Inc. (TEİAŞ), Turkish Electricity Trading and Contracting Company Inc. (TETAŞ), The Energy Market Regulatory Authority (EPDK), and Turkish State Meteorological Services (MGM). Also I conducted interviews with representatives from 6 NGOs and 3 academic organizations whose main responsibility is to provide consultancy in the market formation process (Figure 2.3).

Sampling Strategy:

I followed purposeful sampling strategy (Patton, 2002) to "select specific type and number of information rich cases strategically and purposefully depending on the purpose of research" (p: 243). Moreover, this was a mixed strategy in which the researcher relied on the knowledge and contacts of the interviewee so that purposeful sampling was combined with

[30] There is no license owner in solar energy in Turkey yet in November, 2014.

snowball sampling[31] (Patton, 2002) and information oriented selection[32] (Flyvbjerg, 2006). Patton (2002) asserts there is no rule of thumb in sampling for qualitative research. To select and decide on the informant with the richest information, the researcher must focus on the issue that s/he wants to draw inferences about (Patton, 2002). In my case, I wanted to analyze the effects of market formation in the diffusion of renewable electricity generation technologies. Depending on the criteria of profit motive and economic activity, I elaborated the perspectives of different profiles on the diffusion process, and developed suggestions for technology policies to support this diffusion process. Hence, I reached the key actors that are directly related to market formation in renewable electricity generation in Turkey.

I started data generation process by making contacts with the NGOs of solar and wind energy sources, which gave me information about the overview of the renewable energy sector within the Turkish energy sector and economic environment in general. I intended to use the networks of these NGOs and their connections with the actors in the renewable energy sector. I thought if they would have led me to meet the key informants they knew, I would have had more accurate information about the sector. However, they chose not to help me directly with privacy concerns about their members' information. This caused the sampling process to take longer than I planned. Thus, I changed the sampling strategy to purposeful sampling. Moreover, to make all the sampling by myself and to choose the information rich individuals, I had to gain much more background information and details about SW-EG and energy sector in general. I had to make personal contacts with all the interviewees one by one, and I did not get any institutional and professional support in this sampling process. This was also a valuable observation (one of the sources in qualitative data generation) that taught me more about the SW-EG Sector. I realized that the renewable electricity generation is a bottom-up movement in Turkey. Rather than powerful lobbies or critical masses, the key actors are more effective in the diffusion of these technologies. This fact emerged as another justification for my research focus on the key actors as the data

[31] Patton (2002: 243) defines snowball (or chain) sampling as "to identify of interest from sampling people who know people who know people who know what cases are information rich, that is good examples for study, good interview participants"

[32] Flyvbjerg (2006: 230) states the purpose of information oriented selection is "to maximize the utility of information from small samples and single cases."

source. Hence, the purposeful sampling strategy followed after this observation can be said to have increased the authenticity[33] and credibility[34] of this field research.

To reach the interviewees and to make appointments, I made contact with each interviewee and I used the networks and references provided by the previous interviewee (snowball sampling). Among the references and with the help of the information the interviewee provided me, I selected the next interviewee by evaluating whether the person would be a rich informant case. The data generation process took more than one year, between December, 2013 and February, 2015. The duration of the interviews ranged from one hour to two hours. All the interviews were tape recorded and transcribed verbatim by professional service which was financed by TUBITAK 114K070 Project.

3.6. The Framework for Analyzing the Qualitative Data

Patton (2002) describes the analytical framework for data analysis under two main intellectual works of *description* and *interpretation* of the raw data. "Rich, detailed and concrete *description* forms the bedrock of all qualitative reporting to open up the world to the reader" says Patton (2002: 438). This is to organize the qualitative data in a systematic manner for reporting purpose. In the interpretation part, the analyst is expected to "explain the findings, answer "why" questions, attach significance to particular results, and put patterns into an analytic framework" (Patton, 2002:438).

Three main approaches serve for the description and thus organizing and reporting the raw data: "Story telling approach, Case study approach and Analytical framework approach" (Patton, 2002:439). For story telling approach, the origin of the description is to clarify the story chronically from the beginning to the end. For case study approach, the unit of data analysis is the cases (such as people, critical incidents or the setting like places, sites or locations) of the data generation process. Analytical framework approaches describe *the*

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[33] For authenticity James (2008) asserts that researchers seek reassurance that both the conduct and evaluation of research are genuine and credible not only in terms of participants' lived experiences but also with respect to the wider political and social implications of research. Authenticity involves shifting away from concerns about the reliability and validity of research to concerns about research that is worthwhile and thinking about its impact on members of the culture or community being researched.

[34] According to Guba and Lincoln (1994) credibility criteria of qualitative research asserts that the results of qualitative research are credible or believable from the perspective of the participant in the research. Hence, the purpose of qualitative research is to describe or understand the phenomena of interest from the participant's eyes and the participants are the only ones who can legitimately judge the credibility of the results.

processes, the key issues or the *sensitizing concepts* which are critical for the research area. The analytical framework approach to describe the data is "to organize the responses to interviews *question by question*, especially where a standard interview format is used" (Patton, 2002:439).

In this dissertation, the data analysis section incorporates the description of the raw data by the analytical/theoretical framework to facilitate the interpretation of the data and to better embed the finding and results within the analytical/theoretical framework of the dissertation. Hence, to clarify the data analysis process of the dissertation, in this section I explain how I described the raw data for reporting and how I interpreted the reported data.

In the data generation process, I conducted semi-structured interviews and followed an interview guide. Therefore, reporting the raw data was based on the sections of the interview guide and the questions in those sections. The interview guide sections represented the main description categories for reporting the data analysis and thus the section headings were identified as the *higher order categories.* The responses to the interviews were organized by the questions within each main section. The questions were asked specifically about sub-sections of these main sections and they were identified as the *sub-categories* in the data analysis. The codes derived from the open coding were grouped under these sub-categories to present the raw data. Hence, the smallest unit of data analysis was identified as the *codes*. Among these codes, most frequently stated codes by the groups of key actors (such as for-profit and non-profit organizations) were reported in the data analysis. Therefore, the reporting criterion in this dissertation is the number of quotation attached to each code.

In the interview guide, there was an introduction/warm up section and four main sections. In the introduction, I asked questions about the profiles of the interviewee and his/her organization. Hence, the codes were divided into two subcategories of "Personal Information" and "Organizational Information". For personal information, I asked interviewee's educational background, experience in the energy sector, and expertise about renewable electricity generation. For organizational information, I investigated the economic activity performed in the organization related to renewable electricity generation, organizational plans and strategies, future projections and expectations about renewable electricity generation. This section was used to categorize the interviewee's organization according to the selection criteria of "economic activity" (generation, regulation, consultancy, and supply) and "economic profit motive" (for-profit or non-profit). The answers in this section gave me some clues about the mindsets of the key actors, which guided the subsequent analysis interpreting the answers in the four main sections as well as helped develop policy suggestions for the diffusion of emerging renewable energy technologies specifically addressing different organizational cases or conditions.

In the second section, I asked questions about *Current Situation of Turkish Energy Sector* to understand the diffusion of renewable electricity generation in relation to whole energy sector in Turkey. In this section, the answers gave details about the main problematic areas in the Turkish energy sector, the sources of those problems, the potential of renewable energy as a solution to those problems, the role of fossil fuels as compared to renewable energy sources, and the optimal bundle for electricity generation in Turkey. Hence, the sub-categories derived from the interpretation of the answers to the questions were the problems in the energy sector, reasons for using fossil fuels in electricity generation and the optimal bundle of sources in electricity generation. The data in this section was used to determine the failures (whether being systemic or market) which hinder the diffusion of emerging renewable energy technologies in Turkey and hence the problems to solve by technology policy design.

In the third section, I asked what the *facilitators of and obstacles to diffusion of renewable energy technologies* are. In this section, main *inducement mechanisms* which support the diffusion of renewable electricity generation in Turkey were identified to be enhanced by technology policies to accelerate the diffusion process. Moreover, *blocking mechanisms* which hinder the diffusion of renewable electricity generation in Turkey were determined to be abolished through new technology policies. In line with the focus of the section, the answers were grouped under two critical issues of the facilitators and obstacles as indicated by the key actors. This categorization further highlighted the facilitators to utilize and the obstacles to overcome in the diffusion process to be discussed in more detail at the policy analysis part. Afterwards, I grouped these facilitators and obstacles under seven sub-categories of *Administrative, Economic, Institutional, Physical, Political, Psychological and Technological Factors* to present the data analysis in this section

In the fourth section of *Market Formation*, the main constituents of renewable electricity markets and the market development process were examined to make structural analysis and process analysis for renewable electricity market formation in Turkey, respectively. The answers in the first part of this section, the sub-category of *main constituents,* were analyzed to identify the structural elements of the renewable electricity market for more or less self-contained market segments of licensed and unlicensed electricity generation based on solar and wind energy sources. In the second part of this section, the sub-category of *market formation,* the actual dynamics of market formation were investigated to make a process analysis. The aim was to assess these market segments' stage of development and their mutual interdependence. I elaborated the analysis on the sub-functions of market formation function such as *formation of market segments* (by processes of innovating, associating, and institutionalizing), *formation of market transaction* (by processes of commodifying, communicating, and competing) and *formation of user profiles*. For this purpose, the current development and characteristics of licensed and unlicensed electricity generation market segments in renewable energy sector, the experiences of the key actors in the license application period, and the peculiarities of renewable electricity generation markets in Turkey were analyzed in detail.

In the fifth section of *Public Policies and Market formation*, I asked questions about the role of policies in market formation in the Turkish renewable energy sector, purpose of renewable energy policy as perceived by the key actors in the sector, current and ideal features of policy makers, and policy proposals recommended directly by the key actors to improve the diffusion of renewable electricity generation technologies. In this section, mainly the governance of emerging renewable electricity generation was investigated by focusing on the effects of public policies on the diffusion process, institutional framework made up of the renewable energy legislation and policies, and policy making process itself. Hence, the purpose in this section was to understand the relationship between the policy framework and renewable electricity generation sector in Turkey, and to formulate policy recommendations to promote the diffusion of renewable electricity generation technologies in Turkey.

These sectional divisions referred to and formed the higher-order categories, which had actually emerged from the existing theory and whose analytical relevance were then supported by the data. Next, in the analysis, I coded the data by thoroughly reading the transcripts of each interview. In this coding process, I benefitted from a software program which is a computer-assisted qualitative data management and analysis tool called "QDA-Qualitative Data Analysis Miner" Software. First of all I uploaded the transcripts to the software. By following the interview guide, as the higher order category labels mentioned above[35], I created 13 sub-categories derived from the five main sections of the interview

[35] The details of the categories and descriptions of the codes are given in Appendix A.

guide. The higher order categories were determined before the analysis but the codes emerged during the analysis process as I read and coded the interview transcripts line by line. In the first reading I followed "open coding to break the data apart and delineate concepts to stand for blocks of raw data" (Corbin and Strauss, 2008:198)[36]. In the following sections I derived codes by elaborating the answers to the questions. The codes were then clustered in the sub-categories. For describing and reporting the data, these sub-categories were presented as the sub-sections of the five main sections.

3.7. Conclusion

In this dissertation, the fundamental research motivation is to find out the meaning attached to market formation in the diffusion of a new technology. In general, the choice of research method and the data collection technique depend on the researcher's position about the relationship between knowledge and reality. For this reason, in this dissertation a qualitative method of data collection was used since it was assumed that knowledge is context dependent and produced by actors.

The data was collected by a two-stage-data collection process: "Preliminary Analysis" and "Field Research". The preliminary analysis was made by documentary research on secondary data sources (such as statistical databases and legal framework documents), and preliminary expert interviews in the energy sector. The main aim of this stage was to understand the current structure of the Turkish energy sector and to narrow down the research topic into a theoretically and practically meaningful research question. By this analysis, the research subject was determined as "electricity generation based on solar and wind energy sources in Turkey". The focus of analysis was identified as the market formation in renewable electricity generation and the role of policies for market formation in the diffusion of emerging renewable energy technologies.

In the second stage of data collection, qualitative data generation method was used. The technique used in data generation was qualitative semi-structured interviews. These interviews were conducted with the key actors from SW-EG sector in Turkey, since the main sources of data were the key actors' perspectives, experiences, approaches, beliefs, functions and discourses on the market formation. The sampling strategy was purposeful sampling to

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[36] Open coding is used throughout all the analysis except the first section of "key actors' profile". In this profile section, I directly asked questions about interviewees' and organizations' profile. Hence, I did not make open coding for this section.

pick the information rich-cases in the population. Two criteria were used for selecting the interviewees: (i) economic profit motive (ii) economic activity motive. According the economic profit motive, the interviewee was from either the group of *private sector organizations* such as business companies or from *non-private sector organizations* such as governmental organizations, non-governmental organizations, and academic organizations. According to economic activity motive, the interviewee was engaged in an economic activity of *electricity generation, regulation of the market, consultancy to the actors,* or *equipment supply* in renewable electricity generation sector. All these actors were in the licensed and/or unlicensed renewable electricity generation market segments.

With the actors from private and non-private sectors, 57 semi-structured interviews were conducted on face-to-face basis in the interviewees' own offices. For this purpose, an interview guide was prepared by using general interview guide approach to ask the questions about the same subject areas and topics with minor modifications in wording to make the questions meaningful for each actor while keeping the focus of the study. This interview guide was made up of five main sections: 1) Introduction/Warmup, 2) Current Situation of Turkish Energy Sector, 3) The inducement and blocking mechanisms for diffusion of renewable energy technologies, 4) Market Formation in SW-EG and 5) Public Policies and Market formation.

To analyze the raw data, the analytical framework approach was used to organize the responses in the interviews question by question. For practical purposes, I benefitted from a software program called "QDA-Qualitative Data Analysis Miner" Software by uploading verbatim transcripts of the interviews. The higher category labels were determined by following the interview guide; as a result, thirteen sub-categories were derived from the five main sections of interview guide. The categories were determined before the analysis but the codes emerged during the analysis process since open coding was used to delineate the raw data. Each code was derived by elaborating the answers to the questions. The codes were clustered in sub-categories. For describing and reporting the data, these sub-categories were presented as the sub-sections of the five main analysis sections.

CHAPTER 4

THE EMPIRICAL ANALYSIS ABOUT THE DIFFUSION OF RENEWABLE ELECTRICITY GENERATION IN TURKEY

4.1. Introduction

The diffusion of renewable electricity generation technologies in Turkey is investigated by an analysis of SW-EG in Turkey. For this purpose, an empirical analysis is conducted by a qualitative method. In this chapter, I present the results of this empirical analysis. The main aim is to answer the research questions of “What are the main energy problems in Turkey that can be solved by renewable electricity generation?” and “How do the key actors understand and affect the market formation in renewable electricity generation to promote diffusion of emerging renewable electricity generation technologies in Turkey?”. For this purpose, the data is analyzed in five sections. The first section is a descriptive analysis of the interviewees. This section introduces the interviewees and gives a profile study about the key actors in SW-EG in Turkey. In the second section, the current situation of the Turkish Energy Sector is summarized. This section detects the failures/problems in the sector in parallel to literature review of Technological Innovation System Perspective. In the third section inducement and blocking mechanisms (facilitators and obstacles) of diffusion process are determined. To accelerate the diffusion process, the inducements mechanisms are enhanced and blocking mechanisms are abolished by technology policies. In the fourth section, market formation dynamics in the SW-EG are examined. This section is the core of the data analysis for which the technology policies are designed. In the fifth section, the policy proposals for market formation compiled from the field research are introduced as an example for policy analysis.

4.2. Actors in Solar and Wind Electricity Generation: The Profile Study

In the field research 57 interviews were conducted with the key actors in SW-EG. This profile study gives information about these interviewees and the organizations of the interviewees. The codes derived in this section are divided into two sub-categories of

"Personal Information" and "Organizational Information". For personal information, I asked interviewee's education, experience in energy sector, and expertise in renewable electricity generation. For organizational information, I asked interviewee's organizational activity related to renewable electricity generation and organization's plans, projections, strategies and expectations about renewable electricity generation.

This section is to categorize the interviewees according to this dissertation's selection criteria of "economic activity" and "economic profit motive" in renewable electricity generation. The economic activities performed by the interviewees are *electricity generation*, *regulation*, *consultancy* and *supply*. The economic profit motive is considered primarily as search for profit during the economic activity. This motive varies whether the interviewee is in the private sector or not. If the interviewee is in private sector (or non-private sector), s/he works in a for-profit organization (or non-profit organization). The for-profit organizations are the companies. The non-profit organizations are the governmental organizations, non-governmental organizations and academic organizations. The answers in this section give information about the mindsets of key actors shaped by their economic activity and economic profit motive.

In the field research I conducted 17 interviews with the experts from economic activity group of "generation" (Table 4.1). All these interviewees are working in the for-profit organizations[37] (Table 4.2). 11 interviewees are in the licensed and 3 are in the unlicensed renewable electricity generation market segments, and 3 interviewees in both market segments. In the licensed market segment, 4 of the interviewees are in solar energy, 1 of them is in wind energy and 6 of them are in both sectors. In the unlicensed market segment, all 3 interviewees are in solar energy sector. In both licensed and unlicensed market segments 1 interviewee is in solar energy sector and the other 2 are in solar and wind energy sectors.

In electricity generation, most of the interviewees have engineering education. The interviewees have undergraduate degrees of electrical & electronics engineering (8 experts), mechanical engineering (3 experts), industrial engineering (2 experts), computer engineering (1 expert), petroleum engineering (1 expert), and geomatics engineering (1 expert). 6 of these experts also have graduate degrees (2 Ph.D. degrees and 4 M.Sc. Degrees). In this group of economic activity, most of the of interviewees have experience in energy sector for 1-10 years (13 interviewees) and almost all of them have experience in renewable energy

[37] The details of all experts and the organizations they belong to are given in Appendix B.

sector for 1-10 years (16 interviewees). Only 3 interviewees have experience in energy sector for 20-30 years and just one of them has spent almost all his career in renewable energy sector (15 years)[38].

Table 4. 1. Experience of the interviewees in energy and renewable energy sectors

		Economic activity in Solar and Wind Energy Sectors							
		Generation (17 int.)		**Consultancy (25 int.)**		**Regulation (8 int.)**		**Supply (7 int.)**	
		Energy	R. Energy	Energy	R. Energy	Energy	R. Energy	Energy	R. Energy
Length of experience (years)	1-10 (%)	13 (76%)	16 (94%)	12 (48%)	18 (72%)	0 (0%)	7 (88%)	5 (71%)	5 (71%)
	10-20 (%)	1 (6%)	1 (6%)	13 (52%)	7 (28%)	8 (100%)	1 (13%)	1 (14%)	2 (29%)
	20-30 (%)	3 (18%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (14%)	0 (0%)

In the field research, I conducted 25 interviews with the experts from economic activity group of "consultancy" (Table 4.1). 10 of these interviewees are from the for-profit organizations of EPC (engineering procurement construction) companies and remaining 15 interviewees are from the non-profit organizations; 6 governmental organizations, 6 non-governmental organizations and 3 academic organizations (Table 4.2). There are 1 interviewee in the licensed market segment, 8 interviewees in the unlicensed market segment and 16 interviewees in both licensed and unlicensed market segments. In the licensed market segment, 1 interviewee is from a wind energy company. In the unlicensed market segment 3 interviewees are from companies, 2 in solar energy and 1 in both solar and wind energies. In this market segment, 5 interviewees are from governmental organizations and non-governmental organizations. 1 of these organizations is in solar energy and 4 in both solar and wind energies. In both licensed and unlicensed market segments, 6 interviewees are from companies, 2 in solar energy, 1 in wind energy and 3 of these organizations both in solar and wind energies. In this market segment, 10 interviewees are from the non-profit organizations (1 governmental organization, 6 non-governmental organizations and 3 academic organizations). 4 of these organizations are in solar energy, 2 in wind energy and 4 in both solar and wind energies.

In consultancy, most of the interviewees (18 experts) have engineering education. The interviewees have undergraduate degrees of electrical & electronics engineering (11 experts), computer engineering (2 experts), chemical engineering (2 experts), mechanical engineering (1 expert), aerospace engineering (1 expert), and agricultural engineering (1

[38] He is the general manager of one of the oldest companies in wind energy sector.

expert). The other interviewees have undergraduate degrees of physics (2 experts), city and regional planning (2 experts), law (1 expert), international relations (1 expert), economics (1 expert). 13 of these experts also have graduate degrees (6 Ph.D. degrees and 7 M.Sc. Degrees).

In this group of economic activity, almost half of the interviewees have experience in energy sector for 1-10 years (12 interviewees) and the other half have experience for 10-20 years (13 interviewees). Almost three fourths of the interviewees have experience in renewable energy sector for 1-10 years (18 interviewees) and the remaining have 10-20 years of experience (7 interviewees). In the field research, most of the interviews were conducted with the experts from economic activity group of "consultancy". This large number of interviews indicated that consultancy is the most critical economic activity for the SW-EG market formation. Engineering is the most influential education background in this economic activity group since most of the consultants are engineers. This is an expected finding because almost all of these experts (22 experts) have spent their previous career in energy sector and they have the expertise in the construction of at least one kind of power plants. Most of the interviewees have less than 10 years of experience in renewable energy sector. Especially after 2007, solar and wind energy investments have been accelerated and consultancy has become necessary. The consultancy service provided by companies (the for-profit organizations) is to congregate the power plant investor and equipment suppliers in order to facilitate the construction of the plant. On the other hand, the consultancy service provided by governmental organizations (the non-profit organizations) is to regulate the application of legal framework throughout the investment process (from the application to the operation of the plant). Moreover, academic consultancy indirectly supports the electricity generation and market formation by science and technology development activities.

In the field research I conducted 8 interviews with the experts from economic activity group of "regulation" (Table 4.1). All of these interviewees are from the governmental organizations, since the regulation is the economic activity of the public sector organizations (Table 4.2). Due to the fact that the regulation encompasses all activities to provide the order in renewable electricity generation, the interviewees have economic activity in both licensed and unlicensed market segments. One of these interviewees has education in law, one in business management, and the remaining in engineering (of electrical & electronics, chemical and mining). Two interviewees have also graduate degrees of Ph.D. All of these experts have experience in energy sector for 10-20 years. For the last ten years they have also been in renewable energy sector.

In the field research, I conducted 7 interviews with the experts from economic activity group of “supply” (Table 4.2). All of these interviewees are companies (Table 4.2). 2 interviewees are in the licensed, 3 interviewees in the unlicensed and 2 both in licensed and unlicensed market segments. In the licensed market segment, both interviewees are in solar energy. In the unlicensed market segment, 1 interviewee is in wind energy and the other 2 are in solar energy. In both licensed and unlicensed market segments, 2 interviewees are in solar energy. The interviewees have undergraduate degrees of electrical & electronics engineering (2 experts), civil engineering (2 experts) and mechanical engineering (2 experts) and physics engineering (1 expert). One of them has Ph.D. degree. 5 of the interviewees have 1-10 years’ experience in energy sector and all of them gained this experience in renewable energy sector. 1 interviewee has an experience of 10-20 years and 1 interviewee experience of 20-30 years in energy sector and these two interviewees have 10-20 years’ experience in renewable energy sector. Most of these experts are involved in domestic technology development, and they emphasized this topic during interviews. They stated that domestic technology production is supported by the government, but the method of this support is questionable as well. It may be expected that their policy recommendations are to improve the methods of supporting renewable energy technology development in Turkey.

Table 4. 2. The summary of details about the interviewees

Economic Activity	Market Segment	Sector	Energy Source (In which the interviewee has specialized)	Educational Backgrounds (Profession)	Graduate Degrees
Electricity Generation (G)	Licensed	Private	**Only Solar:** G5 (C), G9 (C), G15 (C), G16 (C) **Only Wind**: G3(C) **Solar& Wind**: G1 (C), G2 (C), G6 (C), G7 (C), G10 (C), G17(C)	8 electrical &electronics engineers; 3 mechanical eng., 2 industrial engineers 1 computer engineer 1 petroleum engineers 1 geomatics engineer 1 cinema and TV	6 graduate degrees (2 Ph.D.s and 4 MSc).
	Unlicensed	Private	**Only Solar:** G8 (C), G11 (C), G14 (C)		
	Licensed & Unlicensed	Private	**Only Solar:** G12 (C) **Solar& Wind**: G4 (C) ,G13 (C)		
Consultancy (C)	Licensed	Private	**Only Wind**: C13 (C)	11 electrical &electronics eng. 2 computer engineers 2 chemical engineers 1 mechanical engineers 1 aerospace engineers 1 agricultural engineers 2 physicist 2 city and regional planner 1 Lawyer 1 international relations expert 1 economist	13 graduate degrees (6 Ph.D. and 7 M.Sc.).
	Unlicensed	Private	**Only Solar:** C18 (C), C24 (C) **Solar& Wind**: C8 (C)		
		Non-Private	**Only Solar:** C2 (NGO) **Solar& Wind**: C3 (GO), C11 (GO), C15(GO), C16 (GO)		
	Licensed & Unlicensed	Private	**Only Solar:** C4 (C), C10 (C) **Only Wind**: C23 (C) **Solar& Wind**: C5 (C), C7 (C), C21 (C)		
		Non-Private	**Only Solar:** C1 (NGO), C9 (NGO), C14 (ACAD), C22 (ACAD) **Only Wind**: C17 (GO), C20 (ACAD) **Solar& Wind**: C6 (NGO), C12 (GO), C19 (NGO), C25 (NGO)		
Regulation (R)	Licensed & Unlicensed	Non-Private	**Solar& Wind Energy**: R1 (GO), R2 (GO), R3 (GO), R4 (GO), R5 (GO), R6 (GO), R7 (GO), R8 (GO)	1 lawyer, 1 business manager, 4 elec.& electronics eng.,1 chem. eng.,1 mining eng.	2 graduate degrees (2 Ph.D.)
Supply (S)	Licensed	Private	**Only Wind Energy**: S4 (C), S7 (C)	2 electrical& electronics engineer, 2 Civil Eng., 2 Mechanical Eng., 1 Physical Engineer	1 graduate degrees (1 Ph.D.)
	Unlicensed	Private	**Only Wind Energy**: S1 (C) **Only Solar Energy:** S2 (C), S6 (C)		
	Licensed & Unlicensed	Private	**Only Solar Energy:** S3 (C), S5 (C)		

Organization Types are C: Company GO: Government Organization NGO: Non-governmental organization ACAD: AcademicEconomic Activities are G: Electricity Generation C: Consultancy R: Regulation S: Supply

4.3. Current Situation of Turkish Energy Sector

In the second section, I asked questions about *Current Situation of Turkish Energy Sector* to understand the diffusion of renewable electricity generation in relation to the whole energy sector. In this section, the answers give details about the main problematic areas in Turkish energy sector, the sources of these problems, renewable energy as a solution, the role of fossil fuels in relation to renewable energy and the optimal electricity generation bundle. Hence, the categories derived from the analysis of the answers construct the topics of the main analysis. These topics are the problems in energy sector, reasons for using fossil fuels in electricity generation and the optimal bundle of electricity generation. This section identifies the failures in the system. It is elaborated that why they are called as system failures by touching upon the economic foundations of the technology policy making explicated in theoretical frameworks chapter.

Each topic is analyzed by focusing on the economic profit motive of the interviewees. The groups of interviewees consolidated by the economic profit motive are composed of the *for-profit organizations* and the *non-profit organizations*. In each group, the answers are reported depending on the economic activities of the interviewees (*generation, consultancy* and *supply* in for-profit organizations group, and *regulation* and *consultancy in non-profit organizations group)*.

Table 4. 3. Most frequently stated problems in Interviews

Problems for	Problem Code	Frequency of Statement[39]
For Profit Organizations	Import Dependency	17
	Lack of standardization	10
	Privatization	9
	Accountability	6
	Lack of Long term energy planning	3
Non-Profit Organizations	Import Dependency	9
	Privatization	8
	Lack of governance	7
	Interventionist Government	5
	Insufficient domestic sources	3
	Lack of long term planning	2

Open coding of the interview transcriptions give a list of 15 key issues as the main problematic areas and 9 key issues as the reasons for the dominance of fossil fuels in electricity generation. According to the for-profit organizations group, the most frequently

[39] This frequency is calculated as the number of quotations attached to each code during the interviews.

stated problems are *import dependency, lack of standardization, (problems about) privatization, accountability* and *lack of long-term planning* (Table 4.3). On the other hand, according to the non-profit organizations group, the most frequently stated problems in energy sector are *import dependency (and insufficient domestic sources), problems in privatization, lack of governance, interventionist government and lack of long term energy planning* (Table 4.3). Hence, as indicated by the preliminary study, import dependency is signified as the most important problem in Turkish energy sector.

According to the **for-profit organizations group**, the most important problem in Turkish energy sector is **"import dependency"**. Import Dependency problem is defined as t*he problem of being dependent on imported energy sources for energy production and electricity generation*. The interviewees from the for-profit organizations addressed different aspects of import dependency problem and their effects on their own business. Financial difficulties and high current deficits are signified as leading aspects of import dependency problems by these interviewees. Int. G13[40] claimed that in the long run, such an import dependency might create unsustainability in Turkish energy supply, because that much money spent for imported fossil fuels imposed higher burden on the government budget. He said "Turkey is not a rich country to spend such budgets to imported sources." Int. C24 agreed on this issue with Int. G13 and indicated that "current deficit originated from import dependency is Turkey's most terrible headache." According to Int. C24, import dependency is also a result of not generating electricity based on Turkey's domestic sources. He said "we have hydroelectric sources and Turkey reached to its limits for construction of hydroelectric power plants. Turkey has wind, solar, domestic coal and lignite sources as domestic resources but does not benefit these resources effectively". In such a scheme, Int. G13 proposed that "Turkey should transform this energy structure to a new one in which indigenous sources are used intensively, because the burden becomes more unsustainable day by day". For emphasizing these huge burdens, Int. G13 further mentioned that

> In 2012 80% of current deficit originates in import dependency for energy supply, and this energy outlook is getting worse as import dependency becomes higher for energy supply. Import dependency in supplying natural gas, in addition to petroleum, creates extra higher current deficit for Turkey.

[40] The abbreviation "Int." is used to shorten the word "Interviewee". From now on the names of the interviewees are used with this abbreaviation and the abbreviations of the economic activities (such as G for Generation, C for Consultancy, R for Regulation and S for Supply.)

Increase in electricity prices is another aspect of import dependency problem. Int. G2 pointed out that as the rate of imported natural gas becomes higher in electricity generation, electricity prices will become more expensive due to increasing production costs. He claims that "Overall Electricity prices will become more expensive in the following years as the electricity consumption increases, and the price of imported natural gas has an enormous share in this high electricity prices".

"Energy supply security" is another aspect of import dependency problem signified by the for-profit organizations. Int. G2 emphasized that import dependency must be considered together with energy supply security. He claimed that "Energy supply security is becoming a serious issue for Turkey due to import dependency problem for energy sources." He continued with the energy figures as:

> As I remember, energy demand is about 230 TWh (terawatt hours) in Turkey as of 2013, and expected to be approximately doubled in 2023. Also 44% of electricity is generated by natural gas, mostly imported. Besides, for supplying petroleum, Turkey is dependent on imports at a rate of approximately 90%. Therefore, the dominance of fossil fuels such as natural gas, petroleum and coal increases the dependency on imported fuels; hence this energy outlook threatens the energy supply security.

Int. G1 added that not only energy supply security, but also electricity supply security is also affected from import dependency problem. His remarks about this issue are:

> We are highly dependent on imported natural gas, especially in winter time. Import dependency, especially on Russia, may create another indirect threat for electricity supply security, since natural gas is also intensively used for heating purposes in Turkey[41]. In case of an unexpected natural gas shortage, natural gas power plants may shut down and hence natural gas supply for electricity generation is also endangered. This means a kind of blackout for Turkey. This is a critical problem and cannot be eliminated by an urgent solution in the short run. Because natural gas storage facilities are not also well established in Turkey, and to build such facilities require extensive investments. Hence import dependency on natural gas is increasingly endangering Turkey's energy supply security as well as electricity security.

As seen from this quotation, dependency, especially on Russia for importing energy sources, is another aspect of import dependency problem. Int. C10 made a joke about this dependency and said "Today Putin sneezes, Turkey gets flu". According to him, this kind of dependency gives extra manipulation power to Russia. If Russia changed the natural gas exporting strategy, and decided to export electricity generated based on natural gas, rather

[41] In 2013, 59% of total natural gas consumption is used for heating purposes at homebased consumption (ETKB, 2013)

than the raw natural gas; this might change all energy import balances for Turkey. In such a scenario, Turkey would become incapable of electricity generation.

According to the for-profit organizations, the second most frequently stated problem is "**Lack of standardization**". This problem can be defined as the *lack of clear standards, rules and regulations applied to all agents in the sector*. According to Int. G7 the energy (especially renewable energy) investment process does not have clearly defined and standard procedure. This makes investors uncomfortable, and the investments more risky. He complained about this issue and mentioned that:

> A manual for energy investors may be prepared to guide the energy investment process, but there is nothing like this, unfortunately no standards! Two wind energy investors applying for different plants may come across different procedures for the same kind of investment. One of them can complete the paperwork in 30 days; for the other this procedure may take 50 days. Also the implications of the rules are not the same, and the workload of an energy expert in a governmental organization is not clearly defined. It depends on the expert himself.

He gave the example of construction permits taken from municipalities. For wind energy investments, municipalities are involved in the pre-license process and they also issue construction permits. Int. G7 claimed that this permit process changes from one municipality to another and depends on the municipalities' own conditions and demands. Moreover, sometimes investors may come across unexpected demands from municipalities. In such situations, to complete the investment takes longer time than expected. As a result he concluded that such a procedure should not be left to municipalities and should be standardized.

Int. G16 emphasized the lack of standardization problem by touching upon the wind energy licensing regulations. According to existing legal framework, wind energy investors who cannot complete pre-construction phase obligations can apply to be granted additional six months in addition to their remaining license term to complete these obligations. Int. G16 associated this extra time demand with lack of standardization problem and asserted that:

> This demand for additional six months are becoming too frequent, because investor cannot complete these obligations in time due to the bureaucratic processes that change from one governmental organization to other. For example the permit process may take a week in the Turkish State Meteorological Services (MGM), while another permit may take a month in the Ministry of Forestry. This also has roots in lack of standardization in investment process as a whole.

Moreover, Int. C13 called attention to lack of technical standards in energy sector. He asserted that to connect wind energy power plants to Turkish Grid System, technical rules specific to these plants are defined in "Electricity Grid Regulations" document[42]. However, such kind of technical standards are not valid for solar power plants. The applications for solar plants are made without such technical standards. According to him, this may create problems that cannot be solved when the investments are completed. Int. C10 further added that not only technical standards but also the sanctions for the applicants that do not complete the obligations are lacking. Time schedules for completing the application and license procedures are not predetermined. According to Int. C13, all these problems have roots in lack of standardization problem.

Int. C18 claimed that due to lack of standardization, personal relations shape the investments processes. Hence, they become harder to complete. About solving this problem, Int. S7 pointed out "learning by doing (or learning by crashing the wall)". He reported that:

> Especially distribution companies' regulations for unlicensed electricity generation applications are not standard and well defined. These companies are trying to standardize the procedure through learning by doing. However, the government as the regulator, should formalize the standards to guide the sector in the right direction.

According to the for-profit organizations, the third most frequently stated problem is "**privatization**". This problem can be defined as *the transfer of ownership, property or business from the government to private sector especially in electricity distribution companies*. Rather than the privatization itself, the process of privatization and experiences of the actors in this process are seen as problematic. Int. G3 indicated that privatization process has been a recent phenomenon of Turkish energy sector as the government has withdrawn from the sector. As a result, private sector is in a learning period to improve itself. As Int. G3 stated:

> Private sector has also been learning the details and the working of the sector recently, and sometimes neglects technical details due to lack of information. This creates problems towards the end of the investment.

The same criticism is made by Int. C8. According to him distribution system is privatized but the companies in charge do not recognize the system yet. He claimed that "In

[42] "Appendix 18: Connection Criteria for Wind Energy Power Plants to Grid System" are explicitly stated in "Electricity Grid Regulations" (Only Turkish version of this document is valid and can be reached from http://www3.epdk.org.tr/index.php/elektrik-piyasasi/mevzuat?id=1533 Last Access: 06.01.2016). In this document technical standards such as "electricity frequency regulations for wind power plants" or "reactive power equilibrium after connection of wind power plants to the grid system" "technical standards of transformators of wind power plants" or " regulations for monitoring wind power plants" are explicitly defined in this document. As stated by Int.C13 this document was prepared by an expert group in the sector.

such an uncertain environment, new kind of investments such as solar and wind energy are becoming harder to adapt to the system".

On the other hand, Int. G7 defended that privatization should be constructed in parallel to liberalization to create positive results. However, Turkey has not realized it in that manner due to the fact that, as Int. C23 pointed out, "energy sector continues to be dominated by heavy bureaucracy". Therefore, according to Int. G7 and Int. C23, for a successful privatization of Turkish energy sector, privatization should be succeeded in parallel to liberalization. Int. C21 defined such kind of privatization as a structural change in electricity generation and distribution system. To achieve this structural change, Int. C21 referred to "regulation and formulation of powerful legal framework to solve the problems in implications of privatization and electricity distribution activities". Int. G15 further added that "government should have regulated the privatization process instead of intervening it directly". Int. G15 went on to say that:

> Liberalization is the target for privatization process in energy sector, but government intervention to process brings about serious problems that hinder to reach this target. We are trying to form the energy market robustly, but some manipulations in privatization tender documents (for example in privatization of distribution companies) impede this formation by harming competition conditions.

According to the for-profit organizations, the fourth most frequently stated problem during the interviews is "**accountability**". This problem can be defined as *government's accountability to follow the policies and legal framework; the state of being obliged to report, explain, or justify its operations in energy sector, to be responsible and answerable*. This can be seen as an issue of trust relationship between government and the other actors in the energy sector. About accountability, Int. G7 indicated that:

> Pre-license obligations in wind energy investment must be completed by permissions from different governmental organizations. The investor is restricted by time limitations but those governmental organizations are not. Hence, if these obligations are not completed, the investors are punished and the governmental organizations are not. Unfortunately, my company is in this situation now. We have applied to be granted an additional six months. But as can be seen from this example, the other governmental organizations (such as the EPDK or the Ministry of Forestry) do not have a responsibility, or punishment.

Int. G14 added that accountability problem in licensing process is a result of authorization-responsibility complementarity. According to him, governmental organizations have authorization but do not have responsibility. Therefore, they do not need to be accountable because this is not an obligation. According to Int. G14, time limits must be applied to all the stakeholders in licensing process.

Int. C10 pointed out that we, as citizens, are also responsible for accountability. According to him, energy regulations are required to be transparent and government must be obliged to report about the implications of regulation. As a result, it is seen that accountability of the government must be guaranteed to build trust relationship between the for-profit organizations and the government.

According to the for-profit organizations, fifth most frequently stated problem during the interviews is "**lack of long term planning**". This problem emerged due to the fact that *Turkish energy policies are not clearly defined for the long run and the targets are not clearly determined*[43]. It is pointed out as a critical issue by both groups of the for-profit and the non-profit organizations. Int. G14 claimed that due to the lack of coordination and division of labor between governmental organizations, the long term planning cannot be realized. He further mentioned that:

> Lack of long term planning makes the sector unpredictable, for example, wind license application in 2007. There was no target for wind energy installation capacity. About 78.000 MW applications were collected and only 10.000 MW licenses were granted, but today, in 2014, the installed power reached to just 3000 MW. If there were planning, the situation may have been different. The same scenario repeated for solar energy license applications. The capacity for solar energy applications was 600 MW but approximately 8000 MW applications were collected. The investors really wants to invest in energy sector but the policy makers do not set targets for them, hence the investor cannot foresee the future.

According to him, 5 years-plans or 10 years-plans (20-years as better but 50-years as utopic) can be a solution. Int. G16 added that even the policy makers do not have target for their projections in the sector.

> In April, 2015 new solar power license applications are planned, now we are in July, 2014 and the last application has been in June, 2013 are not finalized yet. That this

[43] For an evidence based discussion of this problem, I can refer to the Turkish Basic energy policy documents. In examiniation of these documents, it is seen that the energy plans and programs are not specified for long-term periods such as 10, 20 or 30 years. For example, The Strategic Plan of Ministry of Energy and Natural Resources are announced for 5 years time period and the last one is released in December 2014, for the time period of 2015-2019. The most solid energy policy document is this strategic plan and it is for only 5 years period. Another example is the Energy Supply Security Document released in 2009. It has the targets at most for the year 2023. The other policy document entitled as "The Reform of Electricty Energy Sector and Strategy Document for Privatization" released in 2004 has the long term plans at most for the year 2012. (All of these document can be reached from ETKB Web site of http://www.enerji.gov.tr/ in Turkish).

> timeline is not appropriate, now it is realized. These are all results of the lack of the long run policies. Temporary and populist policies are being followed to save the day now but this is not sustainable for energy sector.

For the optimal energy bundle, experts from the for-profit organizations insisted on variety of energy sources supply in a balanced energy bundle. In a balanced energy bundle, the installed power of renewable sources should reach at least to 25 % of total installed power. According to Int. G13, variety of energy sources in energy bundle must be provided to minimize the risk in energy supply. Additionally, Int. G13 claimed that continuous transfer of energy source to power plants is very important for large energy companies. Hence the ownership of the source becomes critical. Turkey does not have natural gas, but have solar and wind sources. Therefore, energy companies strategically increase the share of renewable sources in energy bundle to guarantee the transfer of energy source to power plants. Int. G13 asserted that increasing the shares of renewable sources in energy bundle is a method of decreasing the risk in energy supply. For this purpose, the ownership of the source becomes critical. Turkey does not have natural gas, but have solar and wind sources, hence energy companies strategically choose to increase the share of renewable sources in energy bundle. Therefore, the optimal bundle according to the for-profit organizations is a balanced bundle in which the share of natural gas is minimized and the shares of renewable sources are increased at least to 25 % of total installed power.

According to the **non-profit organizations group,** the most stated problems in energy sector are *import dependency (and insufficient domestic sources), and regulatory problems such as lack of governance, problems in privatization, interventionist government, and long term energy planning and policies.* Like the experts in the for-profit organizations, experts in the non-profit organizations also pointed out "**import dependency"** as the most important energy problem. Furthermore, about import dependency problem, the non-profit organizations emphasized the same critical reasons. Both Int. R7 and Int. C25 claimed that import dependency is a problem, since Turkey is dependent on fossil fuels. Due to the fact that fossil fuel sources are insufficient, import dependency is inevitable. Int. C25 also added that "for such a dependent country for supplying energy sources, it is really hard to talk about economic independence". To change this energy outlook, Int. C17 suggested that "first of all Turkey must decrease import dependency rates and should be self-sufficient in energy supply." Int. R5 highlighted energy supply security issue by referring to import dependency problem as in the case of the for-profit organizations. Int. R6 examined this problem from a different perspective. According to him, Turkey is dependent on imported fossil fuels since necessary energy investment, such as nuclear power plants, was not accomplished earlier and Turkey cannot create diversity in energy sources supply. Int. C3 also emphasized the lack of diversity in supplying energy sources and focused on energy supply security as another byproduct of import dependency problem. Int. C3 asserted that:

> We need electricity and we do not generate it by our own sources. We do not have good quality coal mines and nuclear power plant. We benefit from our hydroelectric sources at maximum level. In such a scene, generating electricity by imported natural gas is the easiest and fastest way, but not a long-standing solution.

Int. R1 highlighted the construction advantage of natural gas as another reason of fossil fuel based electricity generation and asked: “In the case of energy supply deficit, which one do you prefer? Easily constructed and controllable natural gas power plants or the renewable power plants with long investment periods and low efficiency?” Her answer is the first option and her reason is the same as the experts from the for-profit organizations: the construction advantage of fossil fuel power plant.

High capacity factor as an indicator of high energy efficiency, as asserted by Int. C9, is another advantage of imported fossil fuels as compared to renewable sources. He mentioned that “for wind power the capacity factor is approximately 30%, but for imported coal it is about 90%. That much difference makes fossil fuels more advantageous in energy production.”

The other problems mostly stated by non-profit organizations are “**regulatory problems such as lack of governance, problems in privatization, interventionist government, and long term energy planning and policies”.** According to the non-profit organizations, regulatory problems have roots in organization of governmental bodies. Int. R2 gave an example about these organizational problems. According to him, the structure of the regulatory organization in Turkish Energy Sector (EPDK) is incomplete to guide the sector comprehensively. Most of the bureaucrats in EPDK have expertise on law and administrative issues, but the technical expertise and field experience are missing. Therefore, they cannot comprehensively understand the sector and communicate with the actors to figure out the energy issues. Int. R2 claimed that “they are slowing down the sector for the sake of control.” Moreover, in this situation, the Ministry does not have an active role since the regulatory organization has to be independent. This issue remarks the difference between the concepts of “control” and “regulation”. Instead of regulating the sector, the governmental organizations are trying to control the sector. Such an attitude leads government to intervene in the sector rather than regulating it. According to Int. R1, the government intervenes in renewable energy sector to control the investments and to protect the grid system from negative effects of renewable power. However, Int. R2 claimed that this hysteria of control is unnecessary and damages investment environment in renewable energy sector. Moreover, this interventionist motives create uncertainty. Instead of formulating long term policies and clear targets, the government prefers to intervene in the sector. As a result, energy sector becomes unpredictable since it is highly dependent on the government. As Int. C19 put forward, an action of the government may impede the sector very quickly, and this creates uncertainty and makes the sector unpredictable.

Unpredictability and uncertainty are the results of the problems in the long-term energy planning. Int. R1 proposed that in Turkey, planning is a remarkable weakness in the governmental organizations. Long term and detailed planning cannot be achieved. The aims should be clarified, the targets should be determined, and the tools should be chosen for long term planning. Moreover, according to Int. R1, a multidimensional approach is needed. The price policy and market dynamics, and their reflections on production and industry must be taken into account. However, such a mentality is missing in Turkey. According to Int. C1, the problem is the same: missing long-term energy policies. According to him, Turkey does not have a long term and consistent energy policy. He asserted that:

> For the last 3 years we have been talking about solar energy. Since the beginning of 2014, we are planning to finalize the feasibility projects of nuclear power plants. Nowadays, energy efficiency is the hot topic for the government organization. Maybe, 2-3 years later we may have a different agenda, who knows? This is not normal. All developed countries such as Germany, England, and USA have 30-40 years energy plans, and hence the investors in those countries are more comfortable because they know what happens when. However, we do not.

Summary:

From the analysis of the current situation in Turkish Energy Sector, it is seen that experts from the for-profit and the non-profit organizations confirmed that *import dependency* is the most critical problem of Turkish Energy Sector. According to the experts from the for-profit organizations, the other problems are *lack of standardization, (problems in the process of) privatization*, *accountability* and *lack of long-term planning and energy policies*. On the other hand, according to experts from non-profit organizations, the other problems are *regulatory problems, government to be interventionist* and *lack of long term energy planning and policies*.

It is seen that for both of the expert groups, the most critical problem is the problematic situation of Turkish energy sector that should be changed urgently. However, it is apparent that this problem is becoming more embedded to the sector due to systemic features of Turkish energy sector[44] and if the structure of the energy sector does not change radically, it will become a more chronic problem.

The other most frequently stated problems by the experts in both groups are the regulatory problems (mostly about the governance of energy sector). For example, the problems about standardization have roots in the definition of standard governance procedures in renewable energy investment process. Moreover, it is seen that in privatization process, the most critical reason of the problems is emerging from the role of the government in energy sector. The problem of accountability directly refers to the deficiency in trust relationship between government and the other actors. Long term energy planning and policies are another aspect of legitimation of energy governance approach in Turkey. Moreover, regulatory problems originate directly in the operation of government in energy sector. The government to be interventionist is the most obvious feature of governance model in Turkish energy sector that results in over-control on sectoral actors. Therefore, these problems are all related to governance of energy sector and can be solved by structural changes that target the systemic features of Turkish energy sector. In this dissertation, the diffusion of emerging renewable energy technologies are proposed as one of these structural changes. For this purpose, technology policies are to be designed to achieve this structural change.

4.4. Inducement and Blocking Mechanisms (Facilitators and Obstacles)

The questions of inducement and blocking mechanisms for the diffusion of renewable electricity generation in Turkey were asked in the third section of the interview guide. Open coding of the interview transcriptions give a list of 40 factors indicated by the interviewees as the main facilitators that induce diffusion of renewable electricity generation, and 40 factors indicated by the interviewees as the obstacles that block the diffusion of renewable electricity generation in Turkey. These factors are analyzed by grouping them in specific classes, and their effects on diffusion process are assessed through these classes.

[44] From the field research, these features are detected as increasing energy demand and electricity consumption, insufficient domestic sources, easy construction of fossil fuels based energy plants compared to renewable energy based plants, seeking for the urgent solution for the energy problems, and problems about domestic technology development.

Tsoutsos and Stamboulis (2005) criticize technology policy design approaches that ground diffusion process on simply substitution behavior (substitution of new technology for the old one). Instead of these approaches, Tsoutsos and Stamboulis (2005), by taking off from Kemp et.al (1998) that aims to understand the obstacles to the diffusion of sustainable technologies, classifies the blocking mechanisms (obstacles) that hinder diffusion of emerging technologies. In this dissertation, by considering Tsoutsos and Stamboulis (2005)'s classification, not only obstacles to diffusion process but the facilitators for the process are elaborated by a comprehensive classification method. The facilitators (as the inducement mechanisms) and the obstacles (as the blocking mechanisms) are allocated to seven classes of Administrative, Economic, Institutional, Physical, Political, Psychological and Technological Factors (Table 4.4). The obstacles and facilitators are discussed under the same classes for discussing policy proposals in terms of both positive and negative aspects.

Table 4. 4. Inducement and Blocking Mechanisms derived from Interviews

	Inducement Mechanisms (Facilitators)	**Blocking Mechanisms (Obstacles)**
Administrative Factors	• Peak shaver effect of Renewable Energy • Reduction in electricity losses during transmission and distribution	• Bureaucracy • Changing rules • Construction plan-permits • Existence of License traders • Field Problems • Unequipped consultancy • Mistakes in application process • Negative Experience (of government) in different renewable energy sources • Self-Consumption Requisite • Tenders
Economic Factors	• Cost-Competitiveness • Eager investors • Feedbacks from Market Formation • High Electricity prices • Increasing electricity consumption • Renewable energy investments as long term investments • Low operation costs • New Investment Opportunities • No input cost • Active Subcontractors • Substitution effect • The electricity purchase program • Job creation opportunity	• Deficiencies in Market Formation • High (initial) costs • High storage costs • Lack of financial model • Long pay back periods • Project Finance
Institutional Factors	• Contracts and collaboration with experts • Lobbying and advocacy Coalition • Networking and collaborative structures • Priority to Renewable Electricity Generation • World trends (increasing attention to renewable energy sources)	• Problems about Cooperation • Lack of Coordination between governmental organizations • Counter Lobby • Failure in institutional alignment to new technology • Lack of Critical mass • Problems about networking

Table 4. 4. Inducement and Blocking Mechanisms derived from Interviews (continued)

	Inducement Mechanisms (Facilitators)	Blocking Mechanisms (Obstacles)
Physical Factors	• Abundant source • Being Domestic Energy Source • Deficiency in Fossil Fuels • Improved Health and Environmental conditions	• Dependency on natural physical conditions • Infrastructural Deficiencies
Political Factors	• Bundle Effect • Country experiences • Direct support for investment • Energy Supply Security • Experience in other RS • Financial supports for Renewable Energy Technologies • Government Subsidies • Reduced import dependency • Rural development	• Precautions issued by legal framework • Transparency • Lack of technology development vision
Psychological Factors	• Neighborhood Effect	• Awareness • Make something up as you go along • Psychological Barriers • Uncertainty
Technological Factors	• Key actors' Technology Development Strategies • Knowledge transfer channels • Prosumer (Producer and Consumer) Effect • Simplicity of the technology • Technology development trajectories • Transmission of sectoral knowledge	• China effect • Imported technology, • Inefficiency of the technology • Lack of (Technical) Information • (Ren. En.y) Not a base energy load • Nuclear Power • Problems in electricity generation • Qualified technical personal • Technological immaturity

4.4.1. Administrative Factors:

Administrative factors group encompasses the effects of facilitators and obstacles related to administration of renewable electricity generation. In this group, there are 2 facilitators and 10 obstacles derived from the open coding of the interviews (Table 4.5). According to the for-profit organizations, most frequently stated administrative facilitator is *peak shaver*[45] *effect of renewable energy* in electricity generation and most frequently stated administrative obstacle was *bureaucracy* in renewable electricity generation. According to the non-profit organizations, most frequently stated administrative facilitator was *reduction in electricity losses during transmission and distribution*. According to the non-profit

[45] Peak shaving is defined as "....the process of reducing the amount of energy purchased from the utility company during peak hours (in which the demand for electricity is maximum) when the charges are highest". (http://www.northernpacificpower.com/commercial/peak-shaving/ Last access: 08.11.2015)

organizations, most frequently stated administrative obstacle is the organization of *tenders* to grant the licenses for renewable electricity generation.

Table 4. 5. Administrative Factors affecting Diffusion Process

	Administrative Factors	Frequency of Statement by	
		For -profit Org.	Non-profit
Facilitators	Peak shaver effect	**2**	0
	Reduction losses during	1	**1**
Obstacles	Bureaucracy	**40**	12
	Construction plan-permits	15	4
	Field Problems	11	12
	Negative Experience in diff. ren. en.sources	10	10
	Changing rules	7	2
	Tenders	7	**14**
	Self-Consumption Requisite	4	0
	Mistakes in application process	3	0
	Existence of License traders	2	1

According to the **for-profit organizations**, most frequently stated administrative facilitator is "**Peak shaver effect of renewable energy**". Int. G15 asserted that in peak hours of energy consumption, renewable electricity generation can feed the grid and balance the peak rates. Especially solar energy can do this in mid-day when the industrial electricity consumption is the highest. Int. G15 implied that "the pricing in electricity markets is made according to electricity consumption in peak hours. Hence, the electricity prices will decrease if it is possible to decrease electricity consumption in peak hours". According to him, in peak hours, if a renewable electricity generation power plant owner uses the electricity generated in his power plant in addition to using electricity from the grid, his electricity consumption from the grid will decrease in peak hours. As a result, electricity prices in markets will decrease automatically[46]. Due to its impact on general electricity pricing mechanism in energy markets, peak shaving effect is represented as an administrative facilitator.

[46] At this point the existence of smart grid in electricity transmission and distribution system is assumed implicitly by the interviewee, since he offers to use renewable electricity at peak hours by on-grid consumption. Smart grid is one of the prerequisites for this facilitator to support renewable electricity generation, since there is an intermittency problem of renewable sources. Due to the fact that renewable sources are not base loads and cannot secure electricity supply (at least for today with the existing storage technologies), electricity consumption in peak hours of industry cannot be supplied by just renewable electricity continuosly. Therefore, for peak shaver effect of renewable energy, smart grid is a prerequisite.

According to the **non-profit organizations**, most frequently stated administrative facilitator was "**reduction in electricity losses during transmission and distribution**". Int. R4 mentioned that renewable electricity generation can be a solution for eastern part of Turkey where transmission and distribution losses are highest. He mentioned a government-led technology development project for renewable electricity generation (MILGES-National Solar Energy Plant Technologies Project). In this project, the eastern region has been purposefully chosen to construct the pilot power plant. The target is to decrease transmission and distribution losses by using high renewable energy potential in the region through the diffusion of these technologies. Moreover, he underlined that renewable power plants can also reduce transmission losses, since the power plant's local position is closer to consumption units.

According to the **for-profit organizations**, most frequently stated administrative obstacle is "**bureaucracy**[47]" in renewable electricity generation. Int. C7 asserted that the measures taken for the configuration of power plants in the construction field are emphasized more than technical measures. He went on to say that "…actors spend massive time and effort on the paper work in applications for unlicensed electricity generation. These procedures should be simplified to reduce bureaucratic burden and to increase the number of applications". Int. C13 also touched upon the bureaucratic burden for unlicensed electricity generation (specifically roof-top small scale home-based systems) and called it as "administrative problem". According to him, "…electricity generated in home-based systems (which is consumed in the production unit) must simply be integrated to the grid. This can be possible by simplifying the administrative procedures".

Int. G11 underlined the bureaucratic obstacles that an unlicensed electricity generator came across during the construction of power plant. Int. G11 gave the example of his own experience. He said that for application he spent approximately one month to prepare the paper work. However, after completing the paper work, Distribution Company still has right to reject the application. It is risky to waste that much time if the application is to be rejected. Int. C24 underlined the same issue and mentioned that "to construct the power plant takes at most one month but to complete the administrative procedures takes almost six months. It is too much". Int. S3 added that "for unlicensed electricity generation, an

[47] In the interviews, the obstacle of "bureaucracy" mainly refers to "red tape" which is defined as "excessive formality and routine required before official action can be taken" (http://dictionary.reference.com/browse/red-tape?s=t).

applicant should get permission from 17 different institutions and this makes whole procedure more difficult".

Similar administrative burden is also valid for licensed electricity generation. Int. G12 claimed that since 2005 legal framework for renewable electricity generation has been systematized, however bureaucracy cannot adapt to these developments. According to him, "bureaucracy cannot take the measures to prepare operation procedures soundly; to distribute the responsibilities fairly, to train the decision makers and to transform the system from the centralized to the decentralized."

Int. G15 revealed that the bureaucracy retards his company's renewable electricity investments. His company decided to invest in solar energy in 2012. It was granted a solar energy license in 2013. However, in November, 2014 at least nine months are needed to complete the power plant[48]. He said that "that much time has passed just to start the investment. If I have to spend 3 years to construct 7 MW power plant, it is an unsustainable investment for my company." He confessed that it is reasonable to construct a natural gas power plant in one year instead of a solar power plant that takes too long to construct and overwhelms the investor with the bureaucratic burden.

Int. G16 claimed that bureaucracy is seen as a governmental control mechanism on renewable energy sector. On the other hand, Int. G13 referred bureaucracy as a part of "government's learning process". According to him, due to the fact that renewable energy sector has recently developed, bureaucratic operations are detailed and slow. As the government becomes familiar with renewable energy sector and as the other actors fulfil their duties and responsibilities, the problems emerging from bureaucracy can be solved. On the other hand, Int. G1 did not agree with Int. G13. According to him, renewable electricity power plants can be constructed very fast but the administrative procedures are not well organized and tasks to be completed are distributed too much. The investment process becomes difficult to complete. Int. G8 considered bureaucracy as radars on the new highways built by governments[49]. As these new highways are opened, it is possible to drive

[48] It has not been completed in December, 2015.

[49] It should be noted that speed does kill on highways thus it is legitimate to limit it. Whereas in case of aministrative red-tape, it might hinder the adoption and dissemination of SW-EG like the case in Turkey. To some extent, the red-tape is acceptable but the limits should be determined by the regulation of the government not to hinder the adoption and dissemination processes.

faster but too much radars do not allow drivers to go fast. It is the same for bureaucracy in renewable energy sector. As the new regulations are established to enable the investment in renewable energy sector; bureaucracy, like a radar, slows down the investments in the sector. Int. C10 claimed that bureaucrats cannot reduce bureaucratic burden, only the policy makers are able to re-organize bureaucratic operations if the actors can use political channels to make policy makers change the bureaucracy.

According to the **non-profit organizations**, most frequently stated administrative obstacle is the organization of renewable electricity license "**tenders**". For granting solar and wind licenses, applications[50] are collected in predetermined periods for predetermined capacities. For solar energy, if there are more than one application, tenders are organized and the applicant who offers the highest contribution fee per 1 MW wins the tenders[51]. The expert from non-governmental organizations presented tenders as an administrative obstacle that hinders diffusion of renewable energy technologies. According to Int. R2, in renewable electricity generation, closing the capacities (to connect the grid system) and opening the tenders in specific time periods give privileges to the license holders to trade these licenses in the market. In such a situation, in second hand markets licenses are exchanged by the traders[52] and the cost of investment rises by license trading costs. This becomes an extra burden for investor. Therefore, according to Int. R2 solar and wind licensing procedures should be reorganized. Rather than opening the applications in predetermined periods, these applications should be open in any time of the year. Int. C11 asserted that he cannot understand why the procedures are different for different energy sources and mentioned that:

> An investor, that finds the appropriate region and capacity and makes the potential measurement in that field for his own investment, should not be subject to tenders. If he is the first applicant for that region and his offer is seen as profitable by the government, that license should be granted to him. If government is not satisfied with the offer, tenders can be seen as a solution to decide the license holders.

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[50] For example in June 11-14, 2013, applications for 600 MW solar licenses in 27 regions were collected and in the regions in which there were more than one application, tenders were organized until May, 2015.

[51] For wind energy, contribution fee offers are collected per KWh electricity generation.

[52] License traders are called "çantacılar" in Turkish and this word has a negative meaning to refer their jobs in renewable energy sector.

Int. R2 said that tenders were made as "a specific solution to specific problem" during the wind energy license applications in 2007. In that year, to eliminate too many applications, tender was preferred as a method. He said that to use the same method in each licensing procedure is not appropriate and is not performed in other countries. According to Int. R2, this method of administration for licensing process is an extra burden for investors and should be re-organized.

4.4.2. Economic Factors:

The group of economic factors include the obstacles and facilitators that create macro and micro economic effects on the diffusion of renewable energy technologies through the supply and demand of renewable electricity and economic activities of the actors (generation, consultancy, regulation and supply). In this group, there were 13 facilitators and 6 obstacles (Table 4.6). According to the for-profit organizations, most cited economic facilitator is *cost competitiveness* of SW-E generation technologies and, most cited economic obstacle is *project finance* in renewable electricity generation. According to the non-profit organizations, most frequently stated economic facilitator is *new investment opportunities* brought about by diffusion of renewable energy technologies and, most cited economic obstacle is the *high (initial) costs* in construction of renewable energy based power plants.

Table 4. 6. Economic Factors affecting Diffusion Process

	Economic Factors	**Frequency of Statement by**	
		For -profit Org.	**Non-profit Org.**
Facilitators	Cost-Competitiveness	**6**	4
	High Electricity prices	5	0
	Increasing electricity Consumption	4	3
	Job creation Opportunity	4	1
	New Investment Opportunities	4	**6**
	Feedbacks from Market Formation	3	2
	Low operation costs	3	0
	No input cost	3	0
	Active Subcontractors	3	0
	The electricity purchase programs	3	0
	Eager investors	2	2
	Substitution effect	2	4
	Renewable energy investments as long	1	0
Obstacles	Project Finance	**15**	4
	Deficiency in Market Formation	5	0
	Lack of financial model	5	0
	High (initial) costs	2	**5**
	High storage costs	2	1
	Long pay back periods	1	0

According to the **for-profit organizations**, most frequently stated economic facilitator is "**cost competitiveness**" of SW-EG technologies as compared to other energy technologies. For Int. G13, cost competitiveness of renewable energy technologies originates in zero-input cost of resources. Int. G13 also pointed out that investment costs are decreasing and hence the competitive power of these technologies is increasing. Int. G13 mentioned that:

> The assumptions about costs which were valid five years ago, are not accepted anymore. Wind and solar energy technologies were expensive but they are not now. Construction costs of 1 MW solar power is approximately same as 1 MW of natural gas. In natural gas plants, also additional expenditures are being made for resource input to operate the plant.

According to Int. C24, decreasing equipment costs of renewable electricity generation (such as panels, invertors, and wind turbines) cause renewable energy technologies to be cost competitive in energy sector. On the other hand, according to Int. S1 this is not the case for Turkish equipment suppliers. As being a domestic technology developer and domestic product supplier, Int. S1 claimed that cost competitiveness in this sector is achieved by suppliers' motivation to sustain production through decreasing the profit margins rather than decreasing electricity generation costs. Hence, the cost competitiveness should be interpreted carefully from the perspectives of actors' economic activities.

According to the **for-profit organizations**, most critical economic obstacle is "**project finance**". According to Int. S1, project finance is a double-sided issue since it is affecting and is being affected by diffusion process. As the sector develops, there should be a large variety of project finance opportunities. Additionally, to find project finance easily the sector should be developed. With his own words, "...it is unreasonable to ask *which comes first. Chicken or egg?* However, its importance must be acknowledged by banks and financial organizations to develop renewable energy projects". On the role of financial organization, similarly, Int. S1 claimed that financial organizations should elaborate renewable energy sector and should develop specific financial mechanisms for renewable electricity generation. As the banks continue to use the same financial tools for all energy investments, project finance cannot be maintained for the long term. On the same issue, Int. C7 criticized banks and financial organizations. He implied that banks offer conventional financing methods such as leasing but their requirements and terms are not suitable for renewable energy investors. According to Int. C8 project finance is a problem because it did not exist in Turkey. He mentioned that:

> There are no project finance for renewable energy technologies in Turkey. Instead, the projects are financed by assignable loans; the loan in return of your belonging's disposition, not in return of your income from investment. Therefore, if your firm and capital accumulation are strong, you can use loans but your projects are not financed.

On the other hand, the consultancy firms (intermediaries) do not have a priority of capital accumulation and disposition of assets. Therefore, such a financial model that is based on assignable loans does not work especially for the consultancy firms. According to Int. C8, banks ask for the guarantee to give loans, but this guarantee cannot be provided by the disposition of assets in renewable electricity generation investments at the beginning. Int. C4 remarked that long pay back periods of renewable energy investments are seen as a structural factor that endangers project finance, therefore he said:

> There is no support from banking sector. Today, only two or three established power plants could be financed by bank loans, but at very high interest rates. According to my feasibility studies, if I cannot find loans with interest rates lower than 5%, I cannot finish the project due to 10 years payback period, because it is very risky.

Int. C7 reported another aspect of project finance in renewable electricity generation: the finance of unlicensed small scale self-consumption power plants. According to him, these plants do not diffuse due to difficulties of finding loans for investment. He said that:

> For example, a factory owner wants to construct a small scale renewable energy system on its roof for self-consumption. He has to go to bank for borrowing loan. Bank says "Ok, I will give, but it must be assignable or it must be in your firm's credibility limit". In this situation, firm does not want to use the credibility limit for solar energy investment (instead of his own business) and hence does not construct the roof top system and continues to pay its electricity bill every month.

According to the **non-profit organizations**, most frequently stated economic facilitator is "**new investment opportunities**" brought about by diffusion of renewable energy technologies. Int. R1 indicated that with increasing electricity demand, new opportunities come into question to supply this demand and there is a huge potential in renewable energy sector. Moreover, it is seen that to realize these potential, there are also excessive demand from the sector. Int. C17 supported this claim by re-asserting 8000 MW of solar energy license applications for 600 MW capacity and 1500[53] wind masts for new wind energy applications in 2015. Int. C12 stated that renewable energy sector is a continuously developing and profit making sector and electricity generation based on renewable sources ensures income. By touching upon these features of the sector that bring new investment opportunities, he said:

> It is also my dream. I hope I will have 20% share of a renewable energy power plant. I really want this too much. Just because of earning guarantees income for 10 years. It is not a small amount of money. Think about it; you are producing a commercial product but you do not have a problem of marketing. The consumer is ready to buy all your product at a constant price, also in terms of dollars.

According to the non-profit organizations, most frequently stated economic obstacle is "**high (initial) costs**" in construction of renewable energy based power plants. As asserted by Int. R1, "due to the fact that building renewable energy power plants is difficult and the technologies are expensive, renewable energy investments become more risky and less competitive as compared to other energy investments". For Int. C19, high initial construction costs and low efficiency rates are disadvantages of renewable energy investments, hence he claimed that these investments are "rich man's job". Int. C16 indicated that high initial investment costs are the critical reason of long pay back periods as compared to other energy sources and, this long pay back periods hindered the impatient investors who want to earn money very quickly. Int. C3 asserted that five years ago for 1 MW of solar energy power plant, initial investment cost was approximately 5 million euro, but today it is 1 million euro. He thought that the government is right in strategic decision of moving slowly in the sector due to high initial costs. If renewable energy investments had been made in those years, the financial burden of these investments would have become very high, and would have slowed down development of the sector more.

4.4.3. Institutional Factors:

The group of institutional factors includes the obstacles and facilitators that are related to institutions of the environment where the new technology diffuses such as culture, norms, laws, regulations and routines and their alignment to new technology (Bergek et. al. 2008). In this group, there are 5 facilitators and 6 obstacles derived from the open coding of the interviews (Table 4.7). According to experts from **both for-profit and non-profit**

[53] For licenses in wind energy, investors must put up wind masts to meet the wind measurement requirement for 12 months by the project submission date. For the application in 2015, approximately 1500 wind masts were put up. Moreover, the new wind energy license application for 3000 MW that were taken in April 24-30, 2015 and approximately 42.000 GW applications were made (source: http://www.tureb.com.tr/tr/duyurular/487-ruzgar-enerjisi-basvurulari. Last access: 12.11.2015)

organizations, most frequently stated institutional facilitator is "**lobbying and advocacy coalition"** for the diffusion of SW-EG technologies and, most frequently stated institutional obstacle is the "**coordination between governmental organizations"**.

Table 4. 7. Institutional Factors affecting Diffusion Process

	Institutional Factors	Frequency of Statement by	
		For -profit Org.	Non-profit Org.
Facilitators	Lobbying and advocacy	**17**	**7**
	Contracts and collaboration with	3	0
	Priority to Renewable Electricity	1	2
	World trends (Increasing Attention to	1	0
	Networking and collaborative	0	2
Obstacles	Lack of Coordination Between	**17**	**16**
	Failure in institutional alignment for	7	2
	Counter Lobby	6	4
	Problems about Cooperation	3	3
	Lack of Critical mass	0	1
	Problems about networking	0	2

Experts from the for-profit organizations emphasized the role of lobbying activities of associations and social networks in the diffusion of renewable energy technologies. Int. S5 asserted that:

> Instead of personal relationships, I really appreciate lobbying activities of associations that set up and regulate the rules of the game. I think there should be a powerful solar energy association in Turkey. This association should talk to all government organizations, should be in relation to universities, and should easily cooperate with the producers in the sector. Such an association exists in wind energy sector: Turkish Wind Energy Association (TÜREB). It is very active and powerful. A similar one must be established in solar energy as well.

According to Int. C5 lobbying activities are "to build the common sense". For wind energy sector Int. C5 mentioned that "TÜREB is a powerful association that can carry all issues of wind energy to any platform. In the sector, there are too many common problems of all investors' which must be taken into agenda urgently to solve". According to both Int. C5 and Int. C7, TÜREB is a powerful lobbying activity since development level of wind energy sector has reached to a certain point. Int. C28 implied that the purpose of associations' lobbying activities is to act on behalf of the sector, hence these activities require specialization and professionalization instead of individual endeavor. At that point, Int. C10 offered lobbying for development of the sector to improve our power for collective action instead of individual endeavor. According to Int. C1, an expert from the non-profit organizations, lobbying is the role of associations that can be defined as "to support government strongly if association acknowledges its practices, and to criticize it if association regards its practices with disfavor. For this purpose, there must be an objective management mentality in associations". Int. C14 further added that association's management must also be transparent.

For experts from the **for-profit organizations**, most frequently stated institutional obstacle is "**lack of coordination between governmental organizations**". According to Int. G2, in renewable energy investment the procedures of governmental organizations are not arranged as a follow-up process due to the lack of coordination between them. Hence the investments do not follow a cumulative progress and subsequently they decelerate due to this incoordination. For Int. G13 unsystematic participation of each governmental organization to the investment process, and for Int. G2 communication problem between governmental organizations are still the main obstacles of realizing the license approvals in RES.

According to Int. G1, there are many governmental organizations included in licensing permit process and this creates a coordination problem. For Int. G5 the huge number of organizations is normal, because each organization has a specific expertise in the procedure. The unexpected is the effort of governmental organizations to complete this procedure without a well-defined coordination and task distribution. Int. C23 gave the example of EPDK and the Ministry of Forestry which's buildings are side-by side, but the lack of coordination between them affects whole investment process. He claimed that "In EPDK there are many projects waiting to be completed due to the fact that the Ministry of Forestry has not approved them on time".

Moreover, according to experts from the **non-profit organizations,** most frequently stated institutional obstacle is also "**lack of coordination between governmental organizations**". Int. R3 conceptualized coordination problem as the "lack of cooperation between regulations of governmental organizations." He said that:

> In the sector, the relationships are well organized; hence tasks can be completed fast by constructing networks. I think there is cooperation between organizations but the cooperation between the regulations of the organizations are poor. For example, the Ministry of Energy implements support mechanism to diffuse renewable energy technologies, but the Ministry of Forestry levies a tax in permission period and slows down the process.

Int. C6 dealt with another aspect of this coordination problem as "miscommunication". He mentioned that his company applied to EPDK to take permission for constructing a power plant in a field. According to the EPDK regulation, if there is a license for this field taken beforehand, the application is to be rejected. However before making that application, investors cannot check from any information source whether in that field there is a license or not. He asked EPDK directly, EPDK answered as “We do not have technical infrastructure to answer this question.” As understood from this experience, the coordination problem has also roots in communication problems. Communication channels between all actors are not open, which results in miscommunication. Int. R7 claimed that the lack of coordination also originated from the problems about clear definitions of responsibilities and authorization of the governmental organizations (such as distribution of roles of YEGM and the ETKB in licensed and unlicensed renewable electricity generation).

Int. C17, a bureaucrat in YEGM exemplified this coordination problem as:

> During the solar energy license applications, we, as the members of the license applications work team in YEGM, worked on the evaluation of license application and reviewed approximately 800 projects. While we were about to finish this process, EPDK made a change in legal framework and we had to make a second review from the very beginning.

Due to the lack of coordination, YEGM team had to work twice on the same process and it took longer than they expected. Not to encounter the same problem again, he asserted that they are planning to make methodological re-arrangement in license evaluation process and wanted to design a process which is managed by unique coordination mechanism.

4.4.4. Physical Factors:

Physical Factors are related to Turkey’s current physical conditions. In this group, 4 facilitators and 2 obstacles derived from the open coding of the interviews (Table 4.8). According to both for-profit and non-profit organizations, the most frequently stated physical facilitators are *abundant (renewable energy) sources in Turkey* that can be used in electricity generation and *renewable energy sources as domestic sources*, and the most frequently stated physical obstacle is *infrastructural deficiencies* in the electricity distribution and transmission system which lead to insufficiencies to connect the renewable electricity to grid system.

Table 4. 8. Physical Factors affecting Diffusion Process

Physical Factors		Frequency of Statement by	
		For -profit	Non-profit
Facilitators	Abundant source	**5**	**2**
	Being Domestic Source	**5**	**2**
	Improved Health and Environtl conditions	4	1
	Deficiency in Fossil Fuels	0	2
Obstacles	Infrastructural Deficiencies	**15**	**15**
	Dependency on natural physical conditions	8	6

According to for-profit organization, the most critical physical facilitators are the features of renewable energy sources (especially solar and wind energy) of being **abundant and being domestic sources**. Int. G2 claimed that in Europe after Spain Turkey is the second richest country in terms of solar energy. Int. C24 indicated that compared to other countries, amount of electricity generation can be doubled especially in Konya Region thanks to this region's high solar energy potential. He claimed that it is not possible to use Konya Region with another purposes than energy production and said:

> Turkey can be self-sufficient in energy production, even can export electricity to other countries by constructing large scale solar energy power plants and special transformation stations for these power plants in Konya Region.

Int. C4 and Int. S5 emphasized that solar energy is an endless source. Especially Int. S5 touched upon development of domestic energy technologies and said "We should develop renewable energy technologies in our country as much as possible and we should benefit from these endless sources at maximum level." Int. G9 indicated that increasing energy consumption in Turkey should be supplied by domestic sources (although its potential to supply all needed energy was questionable) and said "Major advantage of renewable sources is to be totally domestic." Int. G5 expressed that in addition to being domestic, renewable energy sources are also free and using free sources can contribute Turkish economy. As advocated by Int. G7, using domestic sources can guarantee energy supply security by reducing import dependency

For the expert from for-profit and non-profit organizations, the most frequently stated physical obstacle is "**infrastructural deficiencies**" to transport renewable electricity to consumers. Experts from the for-profit organizations examined infrastructural problems in terms of their power plant investments. According to Int. C13, these problems are based on insufficiencies and malfunctions in electricity distribution system. Int. C13 reported that as the renewable energy power plants are integrated to the grid system, "new equipment requirements and transformer requirements" will emerge and these requirements must be provided by distribution companies. Related to problems in distribution system, Int. G1 exemplified his company's wind energy investment. He said that his company took the wind power plant license in 2002, but still has not completed the construction and not generated electricity due to the fact that TEİAŞ (Turkish Electricity Distribution Company) has not finished building transmission lines in that region. Int. G1 mentioned that to solve this problem TEİAS collected money from the investors in that region and built three transformers and transmission lines. The cost of these companies were re-paid by subtracting their shares from investment amounts. On the other hand, to solve such an infrastructural problem, Int. G17 said that his company built 55 km extra transmission line to complete a wind energy power plant. This expenditure became an extra cost item for their renewable energy investment and increased initial costs.

As another infrastructural problem; capacities of transformers are pointed out. Int. S3 gave the examples of Konya and Karapınar Regions and Int. C24 gave the examples of Burdur, Isparta and Antalya Regions. In these regions, capacities of transformers are overloaded and hence new application cannot be accepted mainly due to overloaded transformers capacity. According to Int. C24, this problem is the most critical physical obstacle that hinders unlicensed renewable electricity generation. Int. G1 asserted that before unlicensed electricity generation, very long and detailed preparation procedures are to be completed, especially for the construction field the investor must make serious agreements with the field owner (such as to rent or to buy the field area). After such a preparation, the possibility of rejection due to "overloaded transformer capacity" is a risk that cannot be controlled by the investor. Therefore, according to Int. G1 the transformers capacities should be announced transparently[54].

According to non-profit organizations, physical obstacles originate in the nature of renewable electricity. Int. R6 advocated that in renewable energy investments, it is normal to make additional transmission line investments. As asserted by him "each additional investment to increase the number of transmission line can be seen as a contribution to supply security." Int. R1 claimed that due to the locations of renewable energy power plants, to reach the grid system becomes an infrastructural deficiency as compared to fossil fuels (for which the location was not a problem). Int. C17 put forward that planning is made to

[54] TEAİS took the sectoral feedbacks about capacities and in January, 2015 TEAİS started to announce transformator's capacities allocated for unlicensed SW-EG monthly in TEİAS Web sites (http://www.TEİAŞ.gov.tr/).

improve infrastructure but to realize these plans and to take a quick action are difficult. He talked about Kayseri Yahyalı Region and asserted that for that region there is a huge demand for constructing wind energy plants but there is no transformer. TEİAŞ has started to plan for an infrastructure investment but to realize such investment will take time. Int. R6 discussed another aspect of infrastructural deficiency and claimed that if the connected amount of renewable electricity increased, connection of this electricity to the grid system will become more difficult. Int. C11 claimed that after the integration of renewable electricity to the grid system, this system must become bi-directional and hence the need for smart grid increases. In such a situation, to protect the grid system from the damages of unexpected power loads becomes critical for the stability of the grid. Int. C3 offered that if the distribution companies want to solve infrastructural problems, this new way of electricity generation must be taken into account very seriously. For that reason, the grid system needs enhancements, capacity increases and additional investments.

4.4.5. Political Factors

Political factors are the obstacles and facilitators that are the results of political administration's role in the diffusion of renewable energy technologies. In this group, there were 9 facilitators and 3 obstacles derived from the open coding of the interviews (Table 4.9). According to both for-profit and non-profit organizations, the most frequently stated political facilitator is "**government subsidies"** (in forms of direct incentives) used to support renewable electricity generation[55], and the most frequently stated political obstacle is *precautions issued by the legal framework* to be taken before application for renewable energy licenses (such as measurement prerequisite before solar license applications).

[55]Dijk et. al.(2003:9) indicates that direct incentives address the renewable energy sector, whereas indirect incentives adress the removal of barriers outside the sector. Direct incentives are *financial supports* such as subsidies, loans and grants for R&D, investment, production and consumption and *non-financial supports* such as quota obligation for energy production (Dirk et al., 2003:10). On the other hand, indirect incentives are designed for "policy fields other than renewable energy, such as environmental impact or employment" (Dijk et al., 2003:14). In this context, the government subsidies in Turkey are given as direct incentives in monetary terms by support mechanism of YEKDEM. It is the only support mechanism given by government and includes only direct incentives such as monetary supports of 13.3 dolarcent/KWh for solar energy and 7.2 dolarcent/KWh for wind energy (For details of this mechanism: http://www.eie.gov.tr/yenilenebilir/YEKDEM.aspx, Last access: 06.01.2016)

Table 4. 9. Political Factors affecting Diffusion Process

Political Factors		Frequency of Statement by	
		For -profit Org.	**Non-profit Org.**
Facilitators	Government Subsidies	**17**	**5**
	Financial supports for RE Technologies	7	2
	Reduced import dependency	6	2
	Bundle Effect	5	0
	Country experience	5	5
	Energy Supply Security	2	3
	Experience in other Renewable Sources	2	0
	Direct support for investment	1	1
	Rural development	1	1
Obstacles	Precautions issued by legal framework	**15**	**11**
	Transparency	6	2
	Lack of technology development vision	3	4

According to the for-profit organizations, the most frequently stated political factor is government subsidies which are direct monetary subsidies given for renewable electricity generation such as 13.3 dollar cent/KWh solar electricity. Int. G12 claimed that the government subsidies make renewable energy investments (especially solar energy investments) more profitable. On this issue he mentioned that:

> 1 MW solar power plant's installation cost is 1 million euro. In this power plant, you can generate 1600 MWh electricity on average. If you multiply this amount with the subsidy prices of 13.3 dollar cent/KWh, the investment payback period becomes 7 years. Payback period of 7 years means 13% annual interest rate (for 1 million euro). Is there anything like this? Very profitable! No investment gives annual interest in terms of dollars. This means, today subsidy rates (feed in tariffs) for solar energy is high.

In determination of government subsidies, Int. C24 referred to the European Union integration for the target of increasing renewable energy consumption. He claimed that feed-in tariff rates[56] are determined according to this target. Int. C18 expressed that due to feed-in tariffs, unlicensed electricity generation in roof-top systems in industry becomes very profitable. He mentioned that:

> In industry the price of electricity is 0.2 TL/KWh and the government's purchase price of renewable electricity is approximately 0.33 TL / KWh[57]. Therefore, if the (unlicensed electricity generation power plant) investor sells generated electricity to

[56] These tariff rates are 13.3 dollar cent/ KWh for solar energy and 7.2 dollar cent/ KWh for wind energy.

[57] During the interview, Int. C18 made a calculation to find out Turkish lira conversion of 13.3 dollar cent/ KWh (feed in tariff rate for solar energy) in that day's exchange rate and found 0.33 TL / KWh.

> government, he can earn approximately twice more than his one unit of electricity consumption. In such a situation he prefers to consume electricity at industry prices and sell all electricity generated in the unlicensed power plant.

On the other hand, Int. C18 expressed that feed-in tariffs for domestic renewable energy technologies are not profitable due to subsidy method. For domestic production, government subsidies are indirect subsidies given to users of domestic products rather than to domestic producers. Therefore, domestic production supports do not directly support producers and hence domestic production. Domestic technology developers, Int. S6 and Int. S1 criticized this method. Int. S1 indicated that main reason behind the malfunction of subsidies is the lack of an economic model for applying subsidies. On this issue he mentioned that:

> If an economic model continues to survive with the subsidies, this means it is not an economic model; it is done because of the government's obligation. The government can do this purposefully. If a machine is produced in a country, in a framework of economic model (specific to that country), you can sell it as your own domestic product proudly. On the other hand, if this machine pays its cost back in 20 years and this payback period is shortened to 10 years in the case of government subsidies, this is not an economic model and this does not fit with the liberal economy conditions.

According to the experts from **non-profit organizations**, government subsidies contribute to the diffusion of renewable energy technologies. Int. R1 mentioned that to support renewable energy sources, the government does not only give subsidies but also applies specific support mechanisms. For example, if renewable energy power plant owners cannot generate committed amount of electricity due to physical conditions (such as not blowing of wind), these electricity generators can buy electricity from another plant and balance their supply equilibrium. Also, this right is not applicable for any other energy sources than renewable energy.

Int. R4 reported that the number of investors benefitted from YEKDEM [58] (Renewable Energy Sources Support Mechanism) especially in wind energy increased recently. Domestic contribution rate to benefit from YEKDEM decreased from 80% to 55% by an amendment in law and after this re-formulation, the number of applicants increased

[58] In YEKDEM, the price support applied to solar energy is determined as 13.3 dolarcent/KWh and this price is determined by RES Law. In case of using domestic product in power plants, this price is increased to at most 20 dolarcent/KWh for 5 years according to

more. He reported that in 2014 the total amount of applications to YEKDEM was 1900 MW and 900 MW of this amount was wind energy[59]. Int. C22 underlined that support rates are sufficient, but criticized their capacity to create results. He said that:

> Supports are sufficient and feed-in tariff rates are not so low. No more support is needed but the applicability of these supports are poor. To reach 55% contribution rates of domestic production, cell production must include wafer slicing. Both cell production and wafer slicing are very costly investments therefore it is not easy to reach 55% contribution rate to apply for additional feed in tariff.

For the **for-profit organizations**, the most critical political obstacle is "**precautions issued by legal framework"** such as measurement prerequisite. According to the legal framework, applicants have to measure solar and wind potential for 6 months in the power plant field and have to deliver at least 1 year measurement data with their application. However, this prerequisite is seen as a meaningless burden for investors. Int. G8 asserted that it is a time-consuming activity. Moreover, Int. C24 claimed that measurement for 6 months cannot be enough and these data should be provided by a professional and central measurement unit (such as Turkish State Meteorological Services). Int. C5 expressed that measurement prerequisite is seen as a prerequisite for investors to prove his capital accumulation is sufficient for such an investment. However, Int. C5 added that any investor who has money can build measurement masts and that investor may be the one who does not have capability to complete the investment. According to Int. G16, measurement prerequisite is a policy mistake and the data generated from each mast cannot be accurate to complete the investment. Int. G5 remarked that the cost of each solar mast is 20.000 euro and complained about it as being an unnecessary cost. Int. C23 calculated the total cost of 1300 wind masts built for 2015 wind energy applications as 30 million euro and this amount is equal to construction cost of 10 MW solar power plant. Moreover he added that all these money goes to abroad because these masts are imported equipment. Int. G5 and Int. C23 concluded that measurement prerequisite is used as an indicator of financial power and the ability to make such an expenditure at the beginning of the investment. However to see that, any other methods can be found.

According to experts from the **non-profit organizations**, the most critical political obstacle is "**precautions issued by legal framework"** such as measurement prerequisite.

[59] For the detailed list of application in 2014, see: http://www.eie.gov.tr/yenilenebilir/document/yekdem_2014_nihai.pdf (in Turkish) (Last access: 16.11.2015)

Int. C12 claimed that calculating measurement data before license applications especially in solar energy is necessary to prevent the problems that may occur due to false data or lack of data. On the other hand, he also mentioned about his concerns about the accuracy of the data. According to Int. C12, the data generated in each measurement mast reaches to the Turkish Meteorological Services and it is not possible to distinguish which data source provides accurate and well-processed data. Int. C22 pointed out that investors are not measurement professional and potential should be measured by professionals instead of investors. He went on to say that:

> For measurement, investor has to find a field and measure potential for six months. This is totally ridiculous. Solar energy potential in any point of the world is known today. We can reach NASA data sources, EU data sources and the data generated by universities. Moreover, investors' measurement data is most probably wrong since measurement is not an easy job. You have to keep the calibration of the equipment, the position, and wind speed under control. Measurement necessitates specialization.

Both Int. C17 and Int. R5 implied that the "real investors" would measure the potential even if it was not a prerequisite. However, instead of measurement before taking the license, the license owner would prefer to do it after taking it. Int. R5 claimed that the measurement prerequisite is also an obligation asked by financial organizations. Int. R5 stated that "even if measurement data is not delivered in application process, I am sure financial organizations will ask for that data to fund a feasible project." Int. C17 agreed on the advantage of providing measurement data for funding the project and said that "after taking the license, measurement is needed to find financial resources. The financial organization wants to see the data to fund the investment." However, he reported that TEAIS announces the capacities and many people build measurement masts before application. These measurement areas collide with one another and hence the evaluation process takes longer time. Int. C17 asserted that measurement is a need but criticized the method of measurement and said that "after winning the tender, the measurement data can be asked from the license holder."

On the other hand, Int. C1 was very rigid and angry about measurement prerequisite. He said it is totally unnecessary and if the government was to announce this requisite for new solar energy license applications, he would sue for the sake of public interest. However, he reported that, the government announced that measurement would be removed and the fields were provided by the government for solar energy licenses.

4.4.6. Psychological Factors:

Actors are experiencing to use new renewable energy technologies and to be intermediaries to use new renewable energy technologies in their own milieu (environment). Psychological factors are the obstacles and facilitators that cause the actors' reactions to this environment. In this group, there are 1 facilitator and 4 obstacles derived from the open coding of the interviews (Table 4.10). By the for-profit and non-profit organizations, the most stated psychological facilitator is "**neighbor effect"** and the most stated psychological obastacle is "**uncertainty"** felt by the actors especially in investment and electricity generation processes.

Table 4. 10. Psychological Factors affecting Diffusion Process

Psychological Factors		Frequency of Statement by	
		For -profit Org.	**Non-profit Org.**
Facilitators	Neighbor Effect	**6**	**5**
Obstacles	Uncertainty	**17**	**9**
	Make something up as you go along	8	1
	Awareness	7	6
	Psychological Barriers	3	3

In the diffusion of renewable energy technologies, "**neighbor effect**" plays an important an important role for both the **for-profit and non-profit organizations**. It is defined as learning by seeing. By neighbor effect, a firm owner sees the (renewable) power plant in the next firm located near his firm and wants to construct the same plant in his own firm. Int. S3 asserted that to see renewable energy plants constructed for self-consumption in roof-tops affects the community and the investors positively and, hence supports the diffusion of unlicensed renewable electricity generation. Moreover, he noted that many people ask him why they have not constructed a power plant on their roof-tops as being a renewable electricity generation equipment supplier. He complained that unintentionally his company creates a negative perception about using renewable electricity (but he said they could not construct because their factory's roof-top is not suitable). Int. C7 indicated that if more people start to use renewable electricity and talk about the advantages of this electricity, this positive feedback may affect actors to use more renewable electricity. Int. G4 asserted that neighbor effect has both positive and negative results. As the sector (especially solar energy) is in its initial phase, an entrepreneur's negative experience due to an unpleasant preparation period for investment might affect the other investors negatively.

According to experts from the **non-profit organizations**, "**neighbor effect**" is again an important psychological factor. According to Int. C15, in our society, there exists a structure based on "perception by seeing" and, hence his organization gives subsidies to increase the number of renewable power plants to set good examples for the diffusion of renewable energy technologies. Int. C16 justified the same effect after he observed the same tendency during the approval of unlicensed power plants. He claimed that when he goes to approval of the self-consumption power plants in the factories, too many people from neighbor factories are coming to observe the approval and the power plant. He said that "in our society there is a mentality of *let my neighbor makes and I can see whether he can earn or not.*" Int. C11 advocated that neighbor effect is a critical facilitator especially for his region, Kayseri. He mentioned that if an investor can earn money by constructing unlicensed electricity generation power plants, other investors will be convinced that renewable energy investments are profitable. Due to this reason, Int. C12 offered that in diffusion process, the public organization can play a leading role and make renewable energy investments (even being symbolic) to be good examples for the society.

For the experts from the **for-profit organizations**, **uncertainty** felt by the actors in investment and electricity generation processes is the most frequently stated psychological obstacle. Int. C21 claimed that uncertainty is the biggest problem for the investors. Legislators are changing the legal framework after the electricity generation process has begun and this creates uncertainty for the investors, then affect the development of the sector negatively. Int. C13 argued that uncertainty in investment environment startles distribution and transmission companies as well as investors, because technical results of new development cannot be estimated.

Int. G15 underlined the uncertainty about the future of unlicensed solar and wind energy power plants. Many power plants of 1 MW installed capacity were constructed side by side to generate electricity for commercial purposes. However it is not clear whether there will be a self-consumption requisite again or what will happen to these power plants after 10 years of purchase guarantee. Moreover, both Int. G11 and Int. G15 underlined the uncertainty about self-consumption requisite for unlicensed power plants. Int. G15 asserted that, just due to this uncertainty, despite having pre-license for solar energy power plant, his company does not plan to enter unlicensed electricity generation. Both Int. S6 and Int. C7 pointed out "uncompleted tenders in solar energy" as another uncertainty issue for renewable electricity generation. Int. C7 said that not to complete the license tenders increases uncertainty and creates insecurity especially for foreign investors. He added that "in this sector the most important issue is to find cheap financial sources, with low interest rates. However, as the uncertainty increases, the chance to find out the resource becomes more difficult." Int. G13 asserted that in such an uncertain environment, foreign investors do not want to stay in the sector anymore. Int. G2, as being a member of a foreign company, admitted that he cannot report the current situation of RES to the foreign managers of the company.

Experts from the **non-profit organizations** also stated "**uncertainty**" as the most critical psychological obstacle for diffusion of renewable energy technologies. They expressed most of the issues mentioned by experts from the for-profit organizations and added *dependency on natural conditions* for solar and wind energy sources as an additional uncertainty item. Int. R6 asserted that in the system wind energy forecasts must be given before 36 hours of electricity generation. However, this might create additional disadvantage for renewable energy sources because these sources are highly dependent on natural conditions and the forecasts might be false. Int. R4 underlined the same uncertainty issue which creates extra burden for the mechanism of energy markets equilibrium. He elaborated the mechanism of Market Financial Settlement Centre (PMUM)[60] operated under TEİAŞ (Turkish Electricity Transmission Company) in which the energy prices and the equilibrium between supply and demand are determined through the day-ahead market, the balancing power market and the ancillary services market. Int. R4 remarked that in such a mechanism, uncertainty emerging from the dependency on natural conditions becomes a critical obstacle for renewable electricity generation. Int. R6 asserted that after the introduction of intraday markets (a new market mechanism in which the forecast period is shorter), the effect of uncertainty due to dependency on natural conditions will decrease.

4.4.7. Technological Factors:

Technological factors are the obstacles and facilitators that are related to development and utilization of renewable energy technologies. In this group, there are 6 facilitators and 9 obstacles derived from the open coding of the interviews (Table 4.11).

[60] Int. R4 summarized the mechanism such as: To make any transaction in PMUM, the electricity generator must inform the system for next 24 hours until 11.30 am. The generator must provide the guaranteed amount of electricity and must sell it to energy markets. If he cannot provide this amount, he has to pay a punishment for the missing amount, if he provide more than guaranteed amount, he will sell this excess amount at the lowest prices in energy market.

According to the profit organizations, the most frequently stated technological facilitator is "**key actors' technology development strategies"** and most frequently stated technological obstacle is "**lack of (technical) information"** in the actors of the sector. According to the non-profit organizations, most frequently stated technological facilitator is *prosumer effect* that means consumer being the producer of the electricity at the same time. The most frequently stated technological obstacle by the non-profit organizations is *lack of (technical) information* in the actors of the sector.

According to experts from the **for-profit organizations**, **key actors' technology development strategies** are pointed out as the most critical technological facilitator. Most of the key electricity generators and the suppliers are conducting their own R&D activities for new renewable energy technologies. One of them is Int. C24 whose company has a research project for solar energy and this technology development activity is in a research area different than main stream technology development activities about solar cells. TUBITAK granted funding for this project and his company is planning to commercialize the product and to start production in 2018. For the financial funding, TUBITAK made cuts and reduced the total budget but the company has not removed any of the tasks in the project and has continued to fund the project. As being a technology development strategy, this is seen as an important contribution for the diffusion of renewable energy technologies.

Table 4. 11. Technological Factors affecting Diffusion Process

Technological Factors		Frequency of Statement by	
		For -profit Org.	**Non-profit**
Facilitators	Key actors' TD Strategies	**11**	3
	Technology development trajectories	7	4
	Knowledge transfer channels	5	2
	Prosumer Effect	5	**5**
	Transmission of sectoral knowledge	1	3
	Simplicity of the technology	0	1
Obstacles	Lack of (Technical) Information	**12**	**7**
	Qualified technical personal	9	3
	Inefficiency of the Technology	5	1
	China effect	3	2
	Nuclear Power	3	2
	Imported technology	1	1
	Problems in electricity generation	1	0
	(Renewable Energy) Not a base load	0	1
	Technological immaturity	0	1

Int. S6 asserted that his company is doing an R&D project with three partners. He mentioned that after the project has started, his company is granted a TUBITAK funding. He said that, by this project, his company can develop the quality of the products (PV panels) and also can increase the rate of using domestically manufactured equipment in the PV panels produced in this project by taking technical support from a domestic raw material supplier (Şişecam). He asserted that the project team is still experimenting the prototypes of the project to improve the product quality.

Int. S1 is also conducting R&D activity to develop domestic renewable energy technology and to produce 100% domestic wind energy turbine. In technology development activities, he asserted that his company is following "market segment focused technology development strategy" and in line with this strategy his company focuses on producing small scale wind turbines that targets unlicensed electricity generation. He argued that it is more appropriate to make production through consortiums to develop domestic technologies for licensed electricity generation market segment and to gain competitive power in world markets. He said that:

> The domestic firms that have the technological know-how and produce medium scale turbines may come together with large industrial firms to build consortiums for producing large scale wind turbines in Turkey with the target of gaining global competitive power.

Int. S1 added that the only way to achieve this target is to be supported by government policies. According to him, due to the fact that R&D is a risky activity in which sunk costs are also possible, it must be constructed as a learning process for which both positive and negative results are evaluated as the inputs. The only way to achieve this is "active government policies". Int. S6 also indicated the common sense (shared wisdom) as the source of development of domestic technologies in renewable electricity generation. According to Int. S6 with "common sense and shared roadmap", it is possible to develop a high quality and competitive product. Int. G15 emphasized the role of potential markets for technology development activities and asserted that if it is difficult to forecast the commercialization of new technology, the target of the technology development activity will be ambiguous. In Turkish SW-EG market, domestic renewable energy technology developers mentioned these technology development strategies and the sector is dominated by these strategies. On the other hand, the foreign equipment suppliers, Int. S7 and Int. S3, do not have any technology development strategy in Turkey.

According to experts from the **non-profit organizations**, the most frequently stated technological facilitator is the technology that makes "**prosumer effect"** possible. Int. C17 asserted that especially for solar energy, it is possible to generate electricity at the consumption unit, and by this way it is easy to decrease losses and to spread the risks in distribution. He also added that a prosumer can generate his electricity consumption by not creating an extra burden for distribution system. Int. R4 also touched upon the effect of reducing losses in distribution if the electricity is generated in the consumption unit. Int. C11 talked about the project of "City of Mannheim in Germany" and asserted that in this project (that was built upon the prosumer concept), sustainable production and consumption of energy could be diffused by managing electricity consumption in different periods of day. Int. C11 also claimed that production of his own consumption makes the consumer more conscious about energy issues. Int. C25 asserted that, in old system of energy production, electricity is generated in one unique place and similar to the water coming from the roots of the tree and spreading to the branches; electricity is also coming from this unique source and being distributed to consumption units. However, it has changed with the inclusion of renewable electricity generation in which the consumption and production units can be the same. Int. C25 said that this will change the electricity distribution and generation system. Int. C3 added that by integration of renewable electricity generation to whole energy system, the conventional grid planning has changed from uni-directional to multidirectional planning. In this new mentality, the grid system should be planned by considering the effects of volatile electricity consumption and generation on the grid system as a whole. In such a system, the smart grid should be integrated countrywide.

According to experts from the **for-profit organizations**, the most frequently stated technological obstacle is the "**lack of (technical) knowledge in the sector**". Int. C13 asserted that there is a deficiency in technical and theoretical knowledge base in wind and solar energy, and recommended to suppress this deficiency in first phase of market development. According to Int. C13, in licensed market segment lack of information is the main reason of determining a low cap for licensing solar power plants (as of 600 MW) and completion of the evaluation process of solar license applications in the long time. According to Int. C18 lack of information is also a reason for cost increases in renewable energy investments. He mentioned that his company performed a subcontracting activity for a public organization. During the work, he realized that some imperatives of the tender increased the costs of the project and hence he wanted to change them. However this was not allowed by the employer public organization due to lack of information. Despite increasing the cost, his company performed the work as it was. Slow adaptation of renewable electricity to whole system is another result of lack of information. Int. C10 asserted that despite technical infrastructure is completed totally in distribution companies, there is a slow movement in renewable electricity generation integration to the whole system due to lack of information. Lack of information also makes diffusion process a risk averse process. Int. C5 stressed that the cost of insufficient technical knowledge creates a huge burden especially for wind energy sector and increased the sanctions. On this issue, Int. C20 gave the example of an investor who completed the construction of the unlicensed power plant without taking connection permit from TEİAŞ. Such a problem in renewable power plant constructions endangers the electricity generation in this plant and hence slows down the diffusion process. Int. C8 claimed that the need of consultancy in renewable energy sector is a direct result of lack of information in the sector. He pointed out that one of his clients made two separate agreements with different wind turbine suppliers for the same power plant investments and due to his missing technical knowledge about the equipment's, the same terms of trade cost higher in one agreement than the other. In such a situation, technical experts as consultants become more important for the establishment of power plants. Moreover, Int. C5 added that wind energy investments are risky investments and lack of technical knowledge has more dangerous and harmful results both for the grid system and the power plant. For this purpose, importance of technical knowledge and expertise become more

According to the **non-profit organization**, "**lack of technical knowledge**" was also the most critical technological obstacle for diffusion of renewable energy technologies in Turkey. Int. R2 claimed that "fast decision making without having deep knowledge in the sector makes you (the investor) to start a way without knowing the troubles that you may come across." Int. R2 asserted that the lack of knowledge may also hinder investors to solve the problems. Int. C1 claimed that "society's and public's knowledge about the solar energy sector is at low levels, and additionally there is information pollution." He stated that due to this lack of knowledge, there is great interest in his social media platform about solar energy and according to him the platform improves very fast as a result of the demand coming from the society about the solar energy topic. Int. C3 expressed that lack of knowledge is more than before and some people are asking even the question of "is it possible to generate electricity from the sun?" But nowadays the awareness has increased. According to him, despite increasing awareness, the sector is still at the beginning.

Summary:

In this section, the facilitators of and obstacles to diffusion of SW-EG technologies are identified from the perspectives of for-profit and non-profit organizations. Through this analysis, the main target is to find out the *inducement mechanisms* which support and the *blocking mechanisms* which hinder the diffusion of renewable electricity generation in Turkey. The inducement mechanisms are to be enhanced and blocking mechanisms are to be abolished by new technology policies to accelerate the diffusion process.

To evaluate the answers to the questions for identifying facilitators and obstacles, I made a categorization by benefitting from Tsoutsos and Stamboulis (2005) and grouped these facilitators and obstacles under seven sub-categories of *Administrative, Economic, Institutional, Physical, Political, Psychological and Technological Factors* to present the data analysis in this section. I presented the factors in these categories from the perspectives of for-profit and non-profit organizations to design technology policies by considering profit motive in economic activity.

From the analysis it is seen that **according to for profit organizations**, the administrative facilitator is *to benefit from the peak shaver effect of renewable electricity generation*. The economic facilitator is the *cost competitiveness of renewable electricity generation technologies*. The institutional facilitator is *the existence of lobbying and advocacy coalitions*. The physical facilitator is *existence of abundant and domestic renewable sources*. The political facilitator is *government subsidies*. The psychological facilitator is t*he neighbor effect*. The technological facilitator is *the existence of key actors' technology development strategies.* On the other hand, **according to non-profit organization**, the administrative facilitator is *reduction in electricity losses during transmission and distribution*. The economic facilitator is *the new investment opportunities brought about by renewable electricity generation.* The institutional facilitator is *the existence of lobbying and advocacy coalitions*. The physical facilitator is *the existence of abundant and domestic renewable energy sources*. The political facilitator is *government subsidies*. The psychological facilitator is *the neighbor effect.* The technological facilitator is *the prosumer (Producer and Consumer) Effect.*

4.5. Market Formation in Solar and Wind Electricity Generation

Market formation in SW-EG is analyzed by using Dewald and Truffer (2011)'s analytical framework. The framework is about the market formation in renewable energy technologies and includes structural analysis, process analysis and functional analysis as stated in literature review. It is to be detailed by using Möllering's (2009) market constitution analysis and by benefitting again from the work of Dewald and Truffer (2012).

At the first level, structural analysis is made to identify actors, networks and institutions at the level of (more or less) self-contained market segments of licensed and unlicensed SW-EG[61]. In structural analysis, the actual market formation is examined. To understand the actual market formation in licensed and unlicensed renewable electricity generation market segments, an analytical approach is constructed by using Möllering's (2009) three constitutive mechanisms of *spontaneous emergence, endogenous coordination,* and *exogenous regulation* that shape certain constitutive elements of market exchange in case of uncertainty in market formation process.

At the second level, process analysis is made to assess licensed and unlicensed renewable electricity generation market segments' stage of development and their mutual interdependence. In this stage, I utilized from Dewald and Truffer's (2012) sub-functions of market formation, (i) formation of market segments (ii) formation of market transaction and (iii) formation of user profiles, and from Möllering's (2009) processes of market constitution, innovating, commodifying, communicating, competing, associating, institutionalizing. One of the contributions of this dissertation becomes explicit in this section. Different than other studies, here market formation dynamics are analyzed from the supply side by the perspective of actors directly related to renewable electricity generation, rather than from the demand side by the perspective of actors directly related to renewable electricity consumption.

At the third level, functional analysis is made to evaluate the contribution of each market segments to overall Technological Innovation System of Turkey for the diffusion of renewable electricity generation.

In this section for the data analysis I used the code categories of "Market Constituents" and "Market Development" which are derived from the answers of the questions asked in the third section of the interview guide titled as the "Market formation in SW-E generation in Turkey". In the category of market constituents, there are 24 codes and in the category of market development there are 7 codes.

4.5.1 First Stage: Structural Analysis of Market Formation

In Turkey, the structure of the solar and wind energy market is shaped by the methods to be employed for electricity generation based on renewable energy sources. These

[61] In the context of this dissertation, it is accepted that there are two market segments of SW-EG: licensed electricity generation market segment and unlicensed electricity generation market segment.

methods are clarified by the legal framework documents of "Electricity Market Law" numbered 6446 and "Law on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy" numbered 5346. Based on this legal framework (detailed in chapter 3), licensed and unlicensed SW-EG market segments. In each market segment, the amount of electricity generation supply and the price of that electricity are determined in accordance with the legal framework. These market segments diverge from each other by the installed power threshold of 1 MW. Up to 1 MW for each power plant, electricity generator constructs unlicensed renewable energy power plant, and after 1 MW the power plant becomes a licensed one. Unlicensed electricity generators can use all the electricity generated in this power plant for their own consumption or can export its surplus production (remaining amount after consumption is subtracted from generation) to electricity distribution system. This electrical energy given to the distribution system must be purchased by the relevant distribution company (that is holding the license of the retail sales) for ten years at prices of 13.3 US Dollar cent/KWh for electricity generated in solar power based plant and 7.3 US Dollar cent/KWh for electricity generated in wind power plant. In licensed electricity generation, the licenses are issued for a term of up to forty-nine years, at once. The minimum term for generation license is ten years. For this time period, the license owners are obliged to Renewable Energy Support Mechanism that pays the prices of 13.3 US Dollar cent/KWh for electricity generated in solar power based plant and 7.3 US Dollar cent/KWh for electricity generated in wind power plant[62]. If the license holders use the mechanical and/or electro-mechanical equipment manufactured domestically; these prices are increased by the amounts of 3.7 US Dollar cent/KWh for wind energy and 6.6 US Dollar cent/KWh for solar energy at most depending on the contribution of domestic equipment[63]. This additional support for the license owners using domestically manufactured equipment is given for a term of five years as from the commissioning of the production facility in which electrical energy is produced and given to the distribution system[64].

[62] These prices are determined in Law No: 5346 Schedule I.

[63] To benefit from this additional support, domestic part of the equipment must be at least 55% of overall equipment. If this contribution rate of domestic part increases, additional support also increases too.

[64] These additional prices are determined in Law No: 5346 Schedule II.

In summary, in Turkey there are two methods of electricity generation from solar and wind energy sources such as licensed and unlicensed electricity generation. The structural analysis of these market segments formation is made to understand the occurrence process of the constitutive elements of actors, networks and institutions at each market segment in Turkey. For this purpose the mechanisms that shape these constitutive elements are defined and then the operation of these mechanisms in each market segment is analyzed by using field research data.

Three mechanisms of *spontaneous emergence, endogenous coordination, and exogenous regulation* shape constitutive elements of market segments in case of uncertainty and tensions in the formation process (Möllering, 2009). *Spontaneous emergence* is based on the desire to make exchanges without the vision of establishing a full market; *exogenous regulation* is undertaken by the actors outside the system to create a market; and *endogenous coordination* presumes that the actors have an interest in the existence of particular markets subordinated to larger exchange systems in which they are directly involved (Möllering, 2009:15-16). According to Möllering (2009) these constitutive mechanisms lead actors, networks and institutions to be a part of exchange relationship in market segments. In the structural analysis framework of the overall market formation, Dewald and Truffer (2011) benefit from these mechanisms to understand the occurrence of the structural components (actors, networks and institutions) in each market segment.

Möllering (2009) claims that actors become a part of exchange relationship in market structure by being subject to *policies on antitrust and entrepreneurship* in exogenous regulation, or by being included in *strategic management* of the market exchanges in endogenous coordination or by benefitting from *entrepreneurial opportunism* in spontaneous emergence (Table 4.12). Networks emerge as a result of *policies on cartels, consortia and association* in exogenous regulation, *relationship management* in endogenous coordination and *recurrent interaction with known partners* in spontaneous emergence (Table 4.12). On the other hand, institutions become market institutions as a result of *general legislation and cultural-political development* in exogenous regulation, or as a result of *contracting and institutional entrepreneurship* in endogenous coordination or as a result of *normalization, repetition and objectivation* in spontaneous emergence (Table 4.12).

Table 4. 12. Structural Elements and mechanisms of market constitution

		In Constitutive Mechanisms of		
		Exogenous regulation through:	**Endogenous coordination through:**	**Spontaneous emergence through:**
Constitution of Structural Elements:	*Actors*	Policies on entrepreneurship and antitrust	Strategic management	Entrepreneurial opportunism
	Networks	Policies on cartels, consortia, associations	Relationship management	Recurrent interaction with known partners
	Institutions	General legislation and cultural-political development	Contracting and institutional entrepreneurship	Normalization, repetition, and objectivation

Source: Möllering (2009), pg. 12

By the analysis of the interviews, it is seen that in licensed electricity generation market the structural elements are shaped by the mechanism of *exogenous regulation*[65]. In unlicensed electricity generation market there are two phases of market formation and in the first phase *exogenous regulation* is the dominant mechanism and in the second phase *spontaneous emergence*[66] is the dominant one that shapes constitutive elements. In the following sub-sections of structural analysis of Turkish SW-E generation market formation, first of all, the structural elements of actors, networks and institutions are determined at each market segment level and then, the effects of constitutive mechanisms on the occurrence of structural components are analyzed.

Constitution of Actors in Licensed and Unlicensed Market Segments

Bergek et.al (2008) define actors as one group of the structural components of the Technological Innovation System that is composed of the firms along the value chain, universities and research institutes, public bodies, influential interest organizations (such as industry associations and non-commercial organizations), venture capitalists, organizations deciding on standards. Carlsson et. al. (2002) identifies actors as one of the components (operating parts of a system) such as individuals, business firms, banks, universities, research institutes, and public policy agencies. On the other hand, Edquist (2011) defines actors as the organizations such as innovating firms, internal capital markets, stock exchanges, venture

[65] Exogenous regulation is the mechanism to create a market by the actors outside the system (Möllering, 2009).

[66] Spontaneous emergence is the mechanism to establish market exchanges without the vision of creating a full market (Möllering, 2009).

capital funds and firms, banks, individuals, business angels, research organizations and public organizations. According to Wieczorek and Hekkert (2012), actors are individuals, civil society, companies (such as start-ups, SMEs, large firms, multinational companies, and transnational companies), knowledge institutes (universities, technology institutes, research centers, and schools), government, public policy bodies, NGOs (industry associations) and other parties such as legal organizations, financial organizations/banks, intermediaries, knowledge brokers, and consultants. All these specifications about actors are identifying them as the operating component of the system but their functions in the system and their contribution to system are not determined clearly. Especially in market formation, each actor's contribution is very crucial to understand this formation process in detail for defining their roles in this process and imposing policy implications. Therefore, in this dissertation, the economic activity of the actor defines this contribution to market formation process and the actors are defined through their economic activities in the renewable energy market formation to understand each actors' function and contribution in market formation. Economic activities performed in Turkish SW-E market are *electricity generation, consultancy*, *supply* and *regulation,* and these economic activities are performed by specific actors in each market segment. To identify these actors in each market segment, Bergek et al (2008: 413) offer the methods of "to talk to industry associations, making a patent analysis, making bibliometric analysis and interviews and discussions with technology or industry experts". In Turkish solar and wind energy case, I used the method of interviews with industry experts to determine the actors and to define their contribution to system through their economic activities.

In **licensed electricity generation,** by focusing on their economic activities, the actors that come together to form the market segment are mainly consolidated in three groups (Figure 4.1):

(i) *Companies*: The actors in this group that take part in the value chain of electricity generation.

- One of the company group is composed of the capital owners that apply for licensed electricity generation based on renewable sources – *electricity generator companies* (economic activity: electricity generation).

- The other company group is the suppliers that provide needed equipment to the electricity generators – *equipment supplier companies* (economic activity: equipment supply).
- Relevant distribution company that issues official opinion concerning the connection to the grid – *electricity distribution companies* (economic activity: regulation of renewable electricity generation in behalf of government).

(ii) *Consultancy organizations:* Actors in this group are engaged in companies, the government organizations and academic organizations that help licensed electricity generators to reach the goal of electricity generation in specific ways

- Actors in consultant companies assist the license applicant to mediate the application for the license and construction of the power plants – intermediary consultant company workers (economic activity: consultancy).
- Actors in the government organizations make the laws and regulations clearer and more applicable in the license application and granting – consultant bureaucrats in government organizations (working in below mentioned public organizations) (economic activity: consultancy).
- Actors in academic organizations (such as research center and universities) are engaged in research and development activities that may contribute the license owner by increasing the efficiency of the technology in power plant - consultant academics for renewable electricity generation technologies (economic activity: consultancy).

(iii) *The public organizations*: Actors in this group directly involved in collection, evaluation and approval processes of the license application (economic activity: regulation of renewable electricity generation). These public organizations are:

- Turkish Electricity Transmission Company (TEİAŞ): TEİAŞ announces the available capacity of the transmission system to connect solar and wind power plants to the national grid, evaluates the license applications’ compatibility to the announced capacities, allocates transmission capacities to licensed power plants, and signs connection and/or use of system agreements with license holding legal entities
- Energy Market Regulatory Authority of the Republic of Turkey (EPDK): The EPDK accepts and evaluates pre-license applications for wind and solar energy power plants and signs the pre-license agreements with the winning participant of the license tender.

- General Directorate of Renewable Energy (YEGM): The YEGM evaluates the pre-license applications before tender according to compatibility to the announced power plant construction field region.
- Ministry of Energy and Natural Resources of the Republic of Turkey (ETKB): The ETKB makes the acceptance of the licensed power plants and issues renewable energy resource certificate to the power plant owner
- Ministry of Environment and Urbanization of Republic of Turkey (CSB): Management of the procedures of Environmental Impact Assessment (assessment of positive and/or negative effects of the energy projects on environment)
- Ministry of Forestry and Water Affairs of the Republic of Turkey (OSIB): Management of solar and wind energy potential measurement procedures
- Ministry of Food, Agriculture and Livestock of the Republic of Turkey (GTHB): Evaluation of the power plant construction field whether being cultivation area or not.

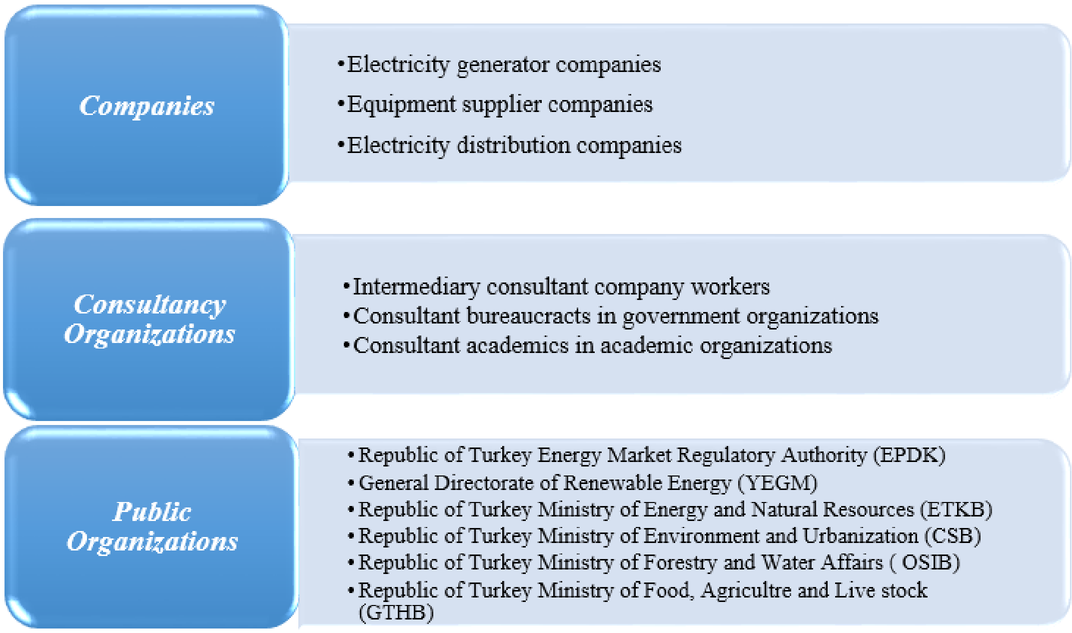

Figure 4. 1. Actors in Licensed Electricity Generation

In licensed electricity generation, the actors become a part of exchange relationship in market structure by being subject to *policies on antitrust and entrepreneurship* through the mechanism of exogenous regulation (Möllering, 2009). In this market constitution mechanism, actors emerge as competing agents in the market space. As in case of German PV market exemplified by Möllering (2009) in which “outstanding motor of market constitution” was the laws and regulations related to renewable energy (pg. 24); in licensed

SW-EG market segment in Turkey, the details of market constitution mechanism are attributed to the policies detailed in the legal framework. These *policies on entrepreneurship and antitrust* have roots in the implication of the legal framework as asserted by the interviewees about constitutions of actors in this market segment.

One of the policies on entrepreneurship in licensed renewable electricity generation market segment was "promoting entrepreneurship for solar energy in energy specialization zones". Int. G8 touched upon this policy and pointed out the execution of Konya-Karapınar Region for this energy specialization zone. Int. G8 is one of the large scale electricity generators and a distribution license owner in Turkey in addition to being an investor in technology development activities in solar energy. He indicated that his company decided to enter this sector via large investment in licensed solar energy market segment due to government policies to support entrepreneurship in technology development in Konya-Karapınar Region. According to him, 600 MW solar energy license application in 2013 is just a beginning and due to the fact that government policies are supporting entrepreneurship in solar energy, government will announce additional connection capacities in near future. His company's main motivation to invest in renewable energy technology development is to benefit from these new opportunities (for example) in Konya-Karapınar Region[67]. On this issue, Int. G8 asserted that:

> Large firms have no other options than growing in licensed renewable electricity generation. Especially in Konya-Karapınar Region Zone, most of these large firms bought lands to make investments. Therefore, these firms also have targets to obtain more than first party of 600 MW solar energy license application. Government has policies (that are not declared yet) to diffuse renewable electricity by promoting the entrepreneurial activities in the sector.

According to Int. C18, another policy of entrepreneurship is to facilitate the emergence of resilient investors in RES. Int. C18 talked about the profile of the actors in license applications and solar energy tenders in licensing process. According to him, these actors are real entrepreneurs who have strong financial resources and want to be the first movers in the sectors. Due to this reason, these actors make detailed calculations to figure out their offers in the tenders not to make mistakes. Int. C18 defended that government policies and steps lead such entrepreneur profile to emerge in license electricity generation.

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[67] In September 09, 2015 in The Official Gazette 27.186.031 m2 are in Konya – Karapınar is declared as "Karapınar Renewable Energy Resource Area" and in this area approximately 1300 MW solar power plant can be constructed.

Int. C18 claimed that in the sector, high participation fees for solar license applications is seen an obstacle for the construction of power plants, however this is not reasonable for the sector because:

> The investors in renewable energy do not enter the market without making detailed financial analysis. These high participation fees are given by resilient and well-known capital owners in the sector and I am sure, if no one wants to hinder the construction process intuitively, these power plants will be constructed very quickly. I talked to two-three of these investors and they are planning to start construction as quickly as possible.

On the other hand, Int. G5 criticized one of government policies (measurement prerequisite in license applications) that is claimed to be put to legal framework with the target of supporting the emergence of resilient entrepreneurs in RES. According to Int. G5, this target is implicitly justified by government authorities, however it is not needed and other methods can be found to facilitate entrepreneurs to be resilient. As asserted by Int. G5:

> Government authorities acknowledge that they are using measurement prerequisite to distinguish determined investors from hesitant ones. However, to understand this, different methods can be found, measurement prerequisite is not needed. Even the government can directly take the money (that is spent for measurement) from the investor, at least it becomes income for the government, rather than wasted in imported measurement technologies.

On the other hand, for the policies of antitrust, most of the interviewees mentioned government policies of decreasing the share of imported fossil fuels in electricity generation and abolishing their monopolistic power in energy bundle. Int. G13 directly pointed out the import dependency rates on fossil fuels in electricity generation and claimed that government policies to increase the rate of renewable energy sources in electricity generation is to change the dominance of fossil fuels in electricity generation and to abolish the monopolistic power of fossil fuels in electricity generation. As referring to Turkish Energy Minister, Int. G13 mentioned that "as solar and wind energy licenses are granted at (high amount of such as) 6000 MW at once and they are constructed quickly, Turkey will be less dependent on imported fossil fuels".

Moreover, Int. C5 emphasized a different aspect of licensing process. In contrast to other energy sources in which the power plant capacities are declared at large amounts (for example one natural gas power plant is 600 MW), in renewable energy the connection capacities are declared at small amounts in licensed electricity generation and according the

Int. C5 this is a result of government policies that aimed to develop the sector very slowly on strong bases and to prevent the sector to be dominated by monopolistic structures.

As seen from these quotations on the emergence of actor profile, as claimed by Möllering (2009), the actors in licensed SW-EG market segment, actor profiles are shaped by policies *on antitrust and entrepreneurship* through the mechanism of exogenous regulation.

In **unlicensed electricity generation,** as understood from the data analysis, the actors come together to form the market segment in two phases and by focusing on their economic activities, these actors are mainly consolidated in four groups (Figure 4.2):

(i) Companies - The actors in this group take part in the value chain of electricity generation.

- One of the company group is composed of the electricity subscriber legal entities that apply for unlicensed electricity generation based on renewable sources - electricity generator companies (economic activity: electricity generation).
- The other company group is the suppliers that provide needed equipment to the electricity generators – equipment supplier companies (economic activity: equipment supply).
- The last company group is the relevant distribution companies that collect the unlicensed electricity generation applications and evaluate these applications according to predetermined criteria (of feasibility of the power plant, to be included in legally permitted areas, eligibility for generation and to be connected to the relevant system connection point in accordance with eligibility of transformation capacity). After evaluation, the distribution company decides to accept or reject the application. If application is approved, the distribution company sends "Connection Invitation Letter" to the applicant and signs "connection agreement" with the investor of unlicensed electricity generation [68] - electricity distribution companies (economic activity: regulation of renewable electricity generation in behalf of government)

[68] To define the role of relevant distribution company, I benefitted from Herdem Attorney's detailed analysis of unlicensed electricity generation entitled as "Turkey's Unlicensed Solar, Investment Opportunities and Application Procedures" (http://herdem.av.tr/turkeys-unlicensed-solar-investment-opportunities-application-procedures/)

(i) *Consultancy Organizations:* Actors in this group are engaged in companies, the government organizations and academic organizations that help unlicensed electricity generators to reach the goal of electricity generation in specific ways.

- Actors in consultant companies assist the unlicensed electricity generation applicants to mediate the application for and construction of the power plants – *intermediary consultant company workers* (economic activity: consultancy).
- Actors in the governmental organizations make the laws and regulations clearer and more applicable in the unlicensed electricity generation applications-*consultant bureaucrats in government organization* (working in below mentioned public organizations) (economic activity: consultancy).
- Actors in academic organizations (such as research center and universities) are engaged in research and development activities that may contribute indirectly to the investor by increasing the efficiency of the technology in power plant - *consultant academics for renewable electricity generation technologies* (economic activity: consultancy).

(ii) *The public organizations* directly involved in connection of unlicensed power plant to the grid (economic activity: regulation). These public organizations are:

- Turkish Electricity Transmission Company (TEİAŞ) The TEİAŞ takes the power plant projects from unlicensed electricity generation investors who holds Connections Invitation Letter and evaluates these projects.
- General Directorate of Renewable Energy (YEGM) - The YEGM makes technical evaluation of unlicensed electricity generation applications that are coming from relevant network operator (This operator can be the TEİAŞ, relevant distribution company or organized industry zone electricity distribution license owner)
- Ministry of Environment and Urbanization of the Republic Turkey (CSB) Directorate of Environment and Urbanizations in each city issues the document of "Exemption from Environmental Impact Assessment (assessment of positive and/or negative effects of the energy projects on environment) for unlicensed electricity power plant"
- Ministry of Food, Agriculture and Livestock of the Republic of Turkey (GTHB) – Directorate of Forestry and Water Affairs in each city assesses the

appropriateness of the power plant construction field whether being cultivation area or not.

- Municipalities (in the related power plant application field) approves the applications for physical and weather conditions for the power plant area

(ii) Real persons: Electricity subscriber individuals that apply for unlicensed electricity generation based on renewable sources- *electricity generator real persons* (economic activity: electricity generation).

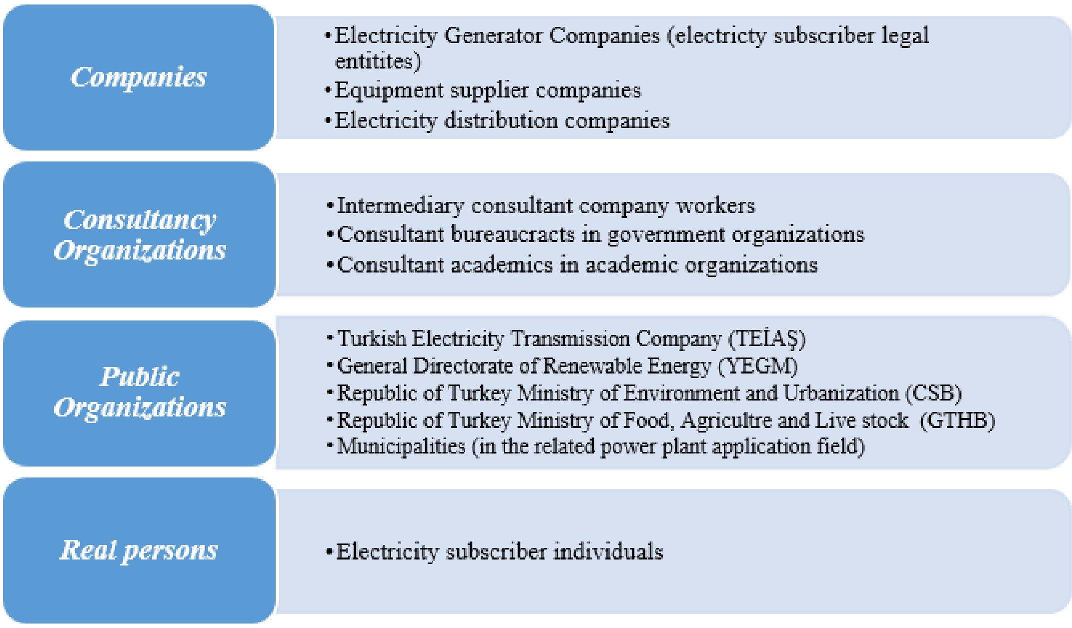

Figure 4. 2. Actors in Unlicensed Electricity Generation

According to our interviewees; unlicensed electricity generation market segment formed in two phases. In the first phase, market was formed directly by the policies as asserted by exogenous regulation. This phase was ended by again a political intervention of increasing the limit of unlicensed electricity generation from 500 KW to 1 MW. This intervention created an entrepreneurial opportunity for unlicensed electricity generators such as to build 1 MW (especially solar energy) power plants side by side and to sell all amount of generated electricity to related distribution company for commercial purposes (to earn money) rather than to generate own electricity consumption. By this intervention the second phase of market formation was started and market formation in this phase was shaped by spontaneous emergence.

According to Int. G7, unlicensed electricity generation was supported for self-consumption at the beginning of the legal framework construction; but due to the lags in licensed electricity generation and increasing limits of unlicensed electricity generation, "the goal of unlicensed electricity generation changed and investors have started to construct several 1 MW power plants to sell the electricity rather than being committed to the main goal of consumption". In this following phase, each 1 MW power plant was built as an unlicensed power plant, but side by side construction format made them to be treated as one large scale (up to 10 MW) power plant.

During the interview, Int. C21 summarized the development of unlicensed electricity generation by referring to legal framework (due to her expertise in energy law and regulations) and asserted that unlicensed electricity generation from renewable sources was started (realized in the field) in 2007 by the amendment in Electricity Market Law (enacted in 2001)[69]. By this amendment, the limit for unlicensed electricity generation was determined as 500 KW[70] and self-consumption requisite was excluded from the law. In October, 2012, "Unlicensed Electricity Generation Regulation" was enacted and this regulation defined the details of power plant construction process. After this date unlicensed renewable electricity power plants were started to be constructed in the field and realized to generate electricity. However, as emphasized by Int. C21:

> Unlicensed electricity generation is a market segment transformed to a different form mainly due to obstacles in bureaucracy to substitute licensed electricity generation.

According to LİDER (2015) database about unlicensed electricity generation power plants, first projects were realized in 2013. Most of these power plant projects were small scale power plants mostly constructed for self-consumption. Our interviewee from LİDER (Unlicensed Electricity Generation Association), Int. C25 mentioned that the first regulation

[69] About the limits and regulations for unlicensed electricity generation, this statement takes part in law: "The natural and legal persons who establish a production plant with installed power maximum at 500 kilowatts based on renewable energy sources, and a micro-cogeneration plant are exempted from the obligation to obtain licenses and establish companies".

[70] Adopted in February 2001 and published in the Official Gazette on March 03, 2001, the first version of Electricity Market Law: 5346 expresses about unlicensed electricity generation that "the real and legal persons who establish a production plant, in order to meet **self-requirements only**, with installed power maximum at **200 KW** based on renewable energy sources, and a micro-cogeneration plant are exempted from the obligation to obtain licenses and establish companies." Therefore, at this version, the limit was only 200 KW and exemption from license was just to meet self-requirements (self-consumption of generated electricity).

on unlicensed electricity generation was enacted in December, 2010 but the bureaucracy in this process hindered the sectoral development until the new regulation was enacted in October, 2013. After this regulation, according to Int. C25, the real milestone for unlicensed electricity generation was the enactment of Electricity Market Law (No: 6446) in March 2013 by which the limit for unlicensed electricity generation was increased to 1 MW. This new regulation was perceived as an entrepreneurial opportunity for investors who wanted to earn money from renewable electricity generation[71] and new power plants construction format (that is side by side 1 MW power plants) started to diffuse in Turkish SW-EG. Int. C25 emphasized this enactment and mentioned:

> Electricity Market Law (No:6446), that was enacted in last year (2013), brought many changes that smooth the way for development of the sector, and this law completed the details of the unlicensed electricity application process. Compared to 2012 and 2013; in 2014 the applications have exploded, I can say and by November 2014, the number of applications reached to 5000 in unlicensed electricity market.

After these changes in the legal framework, comparatively large scale power plants started to be constructed for commercial purposes rather than to generate electricity for self-consumption in unlicensed electricity generation market segment. Therefore, after October 2013 the second phase of market formation in unlicensed electricity generation market segment was started through the mechanism of spontaneous emergence of market constitution. Int. C25 claimed that "the limit for unlicensed electricity generation was increased from 500 KW to 1 MW and this made electricity investments more feasible."

In this second phase, in addition to small scale roof-top systems (preferred by factories on their own roofs), on-field solar power plants started to diffuse[72]. Main motivation of investors in renewable energy field constructions was to use this new entrepreneurial opportunity. Side by side 1 MW power plants brought a new era in unlicensed electricity generation market. In this second phase, new actors entered the market

[71] According to the Law on Utilization of Renewable Energy Sources for The Purpose of Generating Electrical Energy (No: 5346), real persons and entities generating electrical energy from renewable energy resources may export their surplus electricity generation to the distribution system and can benefit from the prices in the Schedule I for a term of ten years. To this end, the electrical energy given to the distribution system must be purchased by the relevant distribution company holding the retail sales license.

[72] According to most of the interviews, wind energy is not very suitable for unlicensed electricity generation, hence in Turkey it is not very popular. But unlicensed electricity generation in wind energy is also supported by government and for this purpose the rate of VAT for wind turbines (up to 500 kW) is decreased to 1% in January, 2015.

and become a part of exchange relationship by benefitting from *entrepreneurial opportunism*.

In unlicensed electricity generation, the actors become a part of exchange relationship by being subject to *policies on antitrust and entrepreneurship* through the mechanism of exogenous regulation in first phase, and by benefitting from *entrepreneurial opportunism* through the mechanism of spontaneous emergence in the second phase (Möllering, 2009).

According to Int. G16, unlicensed electricity generation is proposed consciously by the government to support each actor to generate its own electricity consumption. This strategic decision was valid not only for homebased consumption but also for commercial organizations' (such as factories) consumption until the exemption limit was increased from 500 KW to 1 MW. However, after this intervention, a new model of electricity generation arose. According to him, before this amendment in the Electricity Market Law, electricity generation was made for mainly self-consumption purposes, but after this change that was perceived as an entrepreneurial opportunity and a new actor group emerged to export the surplus electricity generation to distribution system and earn money. According to Int. G16, due to the lags in licensing process in solar and wind energy sectors and new limit for exemption, unlicensed electricity generation was seen as a substitute for licensed electricity generation.

Int. G3 mentioned the parallel claims with Int. G16. According to him, before 2013 the development of unlicensed electricity generation was supported by government policies to facilitate actors to invest in renewable electricity generation, but after 2013 with the increasing limits of license exemption, unlicensed generation created a new entrepreneurial opportunity and these power plants were seen as a kind of new medium of investments in renewable electricity generation.[73] Furthermore, Int. G6 emphasized self-consumption was the strongest motive in unlicensed electricity generation at the beginning of the market formation and claimed that unlicensed market segment was channel to that direction by

[73] Here I presented the increasing limits of license exemption from 500KW to 1 MW as an "entrepreneurial opportunity", since the construction of 1 MW renewable power plants has increased fast after this limit change. Therefore, first effect of this change is the increase in number of renewable power plants constructed for commercial purposes (to sell all generated electricity in the power plant). On the other hand, it must be noted that other types of opportunities (such a job creation) or negative effects (such decreasing the investment in renewable power plants for self-consumption) should also be elaborated in further studies by investigation of the effects of this limit increase put into force by amendement in Law No: 6446 in October, 2013.

public policies, however as the licensed market segment progressed slowly, first of all the exemption limit was increased then large scale power plants started to substitute power plants of self-consumption. Int. G6 expressed that:

> In unlicensed electricity generation, self-consumption was promoted at the beginning and this market segment did not start to develop in that way (to substitute licensed electricity generation). Now, the unlicensed electricity generators construct 1 MW power plants and sell all the generated electricity to market to earn money. We would prefer roof-top systems in unlicensed electricity generation but this market segment develops in different direction. Unlicensed electricity generation has recently started to impede the development of licensed generation. Because, in an appropriate field for licensed electricity generation, due to the lack of power plant construction plan and projections, unlicensed electricity generation projects are being developed and this field is wasted by (comparatively) small scale unlicensed power plants.

Moreover, Int. S6 underlined that approximately 80 % of new unlicensed electricity generation power plants were on field power plants constructed for commercial purposes. According to him, such investments should have been treated as a licensed power plant. One of the consultant firm's representative, Int. C18 expressed that his firm, which entered into renewable energy market in 2011, grew four times recently due to the dynamism in unlicensed electricity market segment especially after 2013. According to him as the license applications taken in 2013 were not finalized, in their portfolio there was no licensed power plant project. He mentioned that this high speed of growth had bases in unlicensed electricity generation format which substituted licensed one.

According to Int. G13, unlicensed renewable electricity generation was seen as the beginning and learning phase of renewable electricity generation in other countries such as Germany, and large scale power plants were constructed following the small ones. However, in those cases, small scale systems (like unlicensed electricity generation power plants in Turkey) were seen as the fundamental power plant construction format, but in Turkey unlicensed power plants are constructed the lands in the form of large scale solar and/or wind fields like the ones in licensed power plants. Int. C25, from one of the non-profit organizations, emphasized the cost of power plant construction as the reason for the small number of rooftop-homebased small scale renewable electricity generation plants. According to him, a consumer who wanted to generate his own electricity (self-consumption) had to follow the same application procedure with the large scale unlicensed on field power plant. So to say, application procedures for 200 KW and 1 MW were the same but due to economies of scale, the construction cost of large power plants was not that much as small one comparatively. According to Int. C25, the approval cost of 200 KW power plants was almost same with that of 1 MW, and this fact also increased the overall construction cost of small scale homebased power plants. Int. C3 asserted that as the public organization in charge of assessing unlicensed electricity application, they were working on a new regulation that would simplify the application procedure up to power plant capacity of 30 KW and after this new regulation was enacted, unlicensed electricity generation would again support self-consumption rather than field application[74].

As seen from these quotations, as claimed by Möllering (2009), in the first phase the actors in unlicensed SW-EG market segment are shaped by policies *on antitrust and entrepreneurship* through the mechanism of exogenous regulation (by direct governmental policies to support self-consumption in unlicensed electricity generation) and in the second phase they are shaped by the motivation of entrepreneurial opportunity (brought about by increasing the license exemption limit from 500KW to 1 MW and construction of 1 MW power plants side by side.)

Constitution of Networks in Licensed and Unlicensed Market Segments

Bergek et.al (2008) claims that there are informal and formal networks in Technological Innovation System with different tasks such as to solve specific problems about technology diffusion, public private partnership, supplying the needed equipment, university industry relations, influencing institutional set–up and market formation. Carlsson et. al. (2002) identify networks in the group of relationships (the links between components). Considering the interdependence between the components of the system, Carlsson et.al (2002: 234) claim that "system is more than the sum of the components" and these relationships make the system more adaptable to be set in different circumstances in similar systems. Edquist (2011) points out networking as one of the key activities in system of innovation that enables interactive learning among the organizations. Wieczorek and Hekkert (2012) define "interactions" as one of the structural dimensions of Technological Innovation System as cooperative relationship between actors and these relationships can be at network level or individual level. All these network specifications are about the interactions and relationships between actors in systems. In the context of market formation, networks link the actors in exchange relationship and in Turkish SW-EG market, the main structural components that build networks are the associations. Therefore, in this dissertation, the

[74] On August 27, 2015 a new regulation for unlicensed power plant up to 50 KW is enacted and the procedure for small scale power plants are simplified by this regulation.

emergence of networks are defined through emergence of associations and cooperative organizations in SW-EG.

In both licensed and unlicensed electricity generation market segments, networks are common and constituted by the mechanism of exogenous regulation and spontaneous emergence (especially for the second phase of market formation in unlicensed electricity generation). In both market segments, most of the networks emerged as a result of *policies on cartels, consortia and association* as mentioned by the mechanism of exogenous regulation. Some exceptions of networks occurred in especially solar energy market segments (as the second phase of market formation started in unlicensed electricity generation) which emerged by *recurrent interaction with known partner* as asserted by the mechanism of spontaneous emergence.

In SW-EG, the building blocks of networks are the associations. The leading associations, GÜNDER (International Solar Energy Society -Turkey Section) in solar energy and TÜREB (Turkish Wind Energy Association) in wind energy were both founded by the decision of the Board of Ministers at the beginning of 1990s (1992) in the period of political rise of renewable energy in Turkey[75]. Due to the fact that these association are both founded by a Minister's Board Decision, this can be accepted as an evidence for emergence of networks as a result of policies on cartels, consortia and association. Moreover, these two associations are in close relationship with the policy makers and they both declare in their websites that they are working in coordination with the public organizations of the Ministry of Energy and Natural Resources (ETKB), the Directorate of Renewable Energy (YEGM), the Turkish State Meteorological Services (MGM) and the Scientific and Technological Research Council of Turkey (TUBITAK). The interviewee from GÜNDER, Int. C9 asserted that GÜNDER represents the International Solar Energy Society by the direct delegation of ETKB. Representatives from public organizations, research institutions and from industry are in the administrative board of GÜNDER (like TÜREB). Int. C9 mentioned that:

> We are organizing coordination meeting for industrialist, researchers and public organizations by the direct initiative of the governmental organizations. Especially these coordination meetings become the milestones of roadmaps for the development of renewable electricity generation policies and act as a part of cohesive links between the actors.

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[75] The details of the foundation of TÜREB is given here: http://www.tureb.com.tr/en/twea/about-twea (in English, Last access: 07.01.2016) and of GÜNDER is given here: http://www.gunder.org.tr/tarihce/ (in Turkish, Last access: 07.01.2016).

Another association in unlicensed electricity generation, LİDER (Unlicensed Electricity Generation Association) was founded in 2012 after the legal framework about unlicensed electricity generation was completed. This association is also closely supported by the public organizations. The representative from LİDER, Int. C25 emphasized this direct link with the policy makers and said:

> Even the name of LİDER is given by the President of the EPDK. The opening ceremony was made in the EPDK Building and, the Minister of Energy and Natural Resources, the Director of the YEGM and the Director of the Turkish Assembly Energy Board also attended to this ceremony. Our first aim is to find out the solutions via direct contact with policy makers rather than to complain about RES. We are organizing city events to explain the advantages of unlicensed electricity generation and to develop the market. We are going to these organizations with policy makers from the EPDK, the ETKB and the TEDAŞ, and explain the technical details of this market segment to the actors with these policy makers.

Therefore, it is clearly seen that these associations were also supported by political authority as to improve networking activities in SW-EG. These mentioned associations were founded as a result of direct policies on association in renewable energy. On the other hand, there were two active networking facility in renewable energy sector apart from these organizations. One of them is another active association in solar energy, GENSED (Solar Energy Industrialist Association), and it was founded in 2009 by a specific actor group of solar energy industrialists. GENSED is the Turkish Representative of the European Photovoltaic Industry Association (EPIA). This association's networking facilities are related to the activities of a monotype member profile made up of industrialists and capital owners as related to solar electricity generation and the main motivation behind the establishment of this association is the interactions between the industrialist partners that know and work with each other.

In addition to associations, another networking activity was founded by a social media platform, the SolarBaba Platform. The SolarBaba Platform is the most active social media network that is followed by approximately 200 thousand people and it is a totally civil society initiative. By this platform, the members could communicate with each other concurrently about any current agenda of the solar energy sector and come together by formally organized events (such as conferences, workshops, seminars) and informal organizations (such as dinners). The founder and the director of this platform is one of the interviewees (Int. C1) who has had approximately 20 years of experience in renewable energy sector. Due to this experience, he can establish *recurrent interaction with the known* *partners* in solar energy sector as asserted by him in construction of the platform as "feedbacks and demand from the followers and the partners". The main aim of the platform is to establish such interactions. By his personal contact, he can establish direct interactions and links with the actors in the sector and can enlarge the platform. Int. C1 explained the mission and foundation process of this platform as:

> This platform is founded as a company. The title company seems a little bit unpleasant but it is just for the advertisements. For advertisements, an invoice is needed and invoices can be issued by companies. Such kind of companies are called non-profit company in English. There are too many examples of them in other countries, but not in Turkey. The SolarBaba Platform's commercial identity is not an association, it is a non-profit company. But legally it is not valid now in Turkey. In 2007-2008 we were followed by 10 people, in 2014 number of followers reached to 100 thousand. At the beginning, there was info-pollution and now it is 20-30 times more. To inform the actors in the sector, I preferred to share the knowledge with an independent identity and I founded this platform because it is needed. This platform is followed by almost all groups in the sector (such as companies, government organizations, researchers). I am directly involved in solar energy sector since 1996 but the platform has reached to this level very recently. This is a result of feedbacks and demand from the followers and the partners of the SolarBaba Platform.

Therefore, in Turkish solar and wind energy sectors, networks are built on the associations that are directly founded by the mediation of government policies on networking activity as claimed by the market constitution mechanism of exogenous regulation. Moreover, civil society initiatives (such as social media platforms[76]) complete the lack of these associations in communication directly with the active actors and establish interactions with the known partners in the sector and take instant feedbacks from these actors about changing circumstances and regulations, drafts of laws and regulations and technological developments as asserted by the interaction with the known partners as claimed by the market constitution mechanism of spontaneous emergence.

Constitution of Institutions in Licensed and Unlicensed Market Segments

Bergek et.al (2008) identify institutions as culture, norms, laws, regulations and routines that "need to be adjusted (aligned) to a new technology if it to diffuse" (pg. 413).

[76] It should be noted that the role of social media may not be always supportive, since social media instruments (such as platforms) and digital technologies sometimes may "enclose people in information cocoons" (Gossart, 2014). Due to the fact that there is a risk of information closure which is defined as the "reduction of the capacity of the agent to search, locate, sort out, filter, and select information that might be useful and relevant for him/her" (Gossart, 2014: 149), the limitation of social media's positive impact on diffusion of emerging technologies should also be taken into account.

According to Bergek et.al (2008), this institutional alignment is not an automatic process and come in various forms such as policies, standardizations, regulations and directives. Carlson et. al. (2002) do not directly touch upon the institutions but label attributes as one of the structural components of the systems. They (2002:234) define attributes as the "properties of the components and relationships between them which characterize the system". Edquist (2011) defines institutions as the rules of the game that draw the borders to the actors in the system. Edquist (2001:5) identifies institutions as "common habits, routines, established practices, rules, or laws that regulate the relations and interactions between actors" and points out patent laws as an example of institutions. According to Wieczorek and Hekkert (2012:77), institutions are divided into two groups of "hard institutions (rules, laws, regulations, instructions) and soft institutions (customs, habits, routines, established practices, traditions, norms, expectations)". In Turkish SW-E generation sector, the institutions are rules, laws, regulations and instructions, like the hard institutions pointed out by Wieczorek and Hekkert (2012), and the legal framework enables institutional alignment to the emergence of new SW-E generation technologies.

In both licensed and unlicensed electricity generation market segments, institutions are common and constituted by the mechanism of exogenous regulation (for the unlicensed electricity generation these constitutive elements emerge in the first phase[77]). In both market segments, institutions become market institutions as a result of *general legislation and cultural-political development* in exogenous regulation. Therefore, in SW-E generation in Turkey, general legislation is the dominant framework to form institutions and institutional alignment. For this market segments' formation, institutional alignment is provided by laws, regulations and communications given in Table 4.13.

[77] In second phase of market formation in unlicensed electricity generation, amendments in legal framework documents existed but the main body of these documents has not changed.

Table 4. 13. Legal Framework for Institutional Alignment in SW-EG in Turkey

Laws	✓ Law on Utilization of Renewable Energy Sources for The Purpose of Generating Electrical Energy (No: 5346), ✓ Electricity Market Law (6446)
Regulations	✓ License Regulation, ✓ Certification and Support of Renewable Energy Sources Regulation, ✓ Regulation on Unlicensed Electricity Generation in Electricity Market, ✓ Regulation for Technical Assessment of Solar Energy License Applications, ✓ Regulation about Solar Energy Based Power Plants, ✓ Regulation for Domestic Production of Equipment used in Solar Energy Based Power Plants.
Communications	✓ Communication of Pre-License Applications for Construction of Wind and Solar Energy Based Power Plants, ✓ Communication about Enforcement of Unlicensed Electricity Generation, Communication of Solar and Wind Potential Measurement, ✓ Communication of Environmental Impact Assessment, ✓ Communication on Wind Electricity Generation Applications' Technical Assessment, ✓ Communication For Measurement in SW-E License Applications

According to the interviewees, institutions in SW-E generation are constituted and modified in the course of the market development. As the general legislation sets the framework condition, the rules and regulations are being modified according to mainly cultural motives and political developments as in the case of exogenous regulation. According to the interviewees, the most prominent cultural motive that shaped the legislation process is "to make something up as you go along[78]". This idiom was frequently used by the interviewees to emphasize the changing rules and regulations in the course of the market development. Int. G15 gave the example of their pre-licensing process in solar energy. Int. G15 claimed that the EPDK constructed the details of pre-licensing procedures simultaneously by Int. G15's pre-license experience. Int. G15 said that:

> For the EPDK to confirm the renewable energy power plant projects, there should be a procedure; but it has not been formalized yet. For this reason we are waiting to take the pre-license. They have noticed that they need such kind of procedures as they come across with such needs. For example, we delivered needed documents to take the pre-license but they wanted them for the second time because the license regulation changed after our procedures started. The rules are not determined from the beginning and they are changing with our experience.

Int. C7 also underlined the same cultural motive that resulted in changing rules during the process. According to him, due to the fact that the procedures were not completely

[78] In Cambridge Dictionary, this idiom is defined as "to invent a story or a tune without thinking before about how it will end"(http://dictionary.cambridge.org/dictionary/english/make-sth-up-as-you-go-along). This definition is used to express the English version of Turkish idiom "Kervan yolda düzülür."

designed at the beginning, the government established regulations as the problems were experienced. As the operations are being practiced and problems are seen; malfunction are being fixed. According to him, due to this reason “the regulations were changed three times since 2010 and the last version of unlicensed electricity generation is the third version. The government is adapting the regulations as the problems are solved.” Int. C10 said that his company constructed the first small scale power plant and a large group of experts came to visit their plant to see how they accomplished the technical details of the plant. According to him, as the bureaucrats saw the details in field on the constructed plant, they could eliminate the deficiencies in the regulations. Int. G9 indicated that this was a cultural code that Turkish people were making something up as they were going along. According to him “sometimes, we are starting without predetermined rules and as time goes by the legislation is being established”.

On the other hand, Int. C5 underlined the role of political developments in establishment of institutions during market formation process. She indicated that she has been in energy sector for 16 years and since 2006 she has been in renewable energy sector and, during her career the names and the functions of governmental organizations had changed many times. She claimed that the authority to apply for wind energy licenses changed four times and its authorization and responsibilities changed as well. These modification shaped the procedures and regulations. Int. C7 also put emphasis on the same issue of effects of political developments on constitution of institutions. According to him, the regulations are changed by political decisions and as a result investors suffer from these frequent changes in the regulations asserted by the governmental organizations.

Therefore, in Turkish SW-EG, institutions are formed by the legal framework shaped by general legislation and cultural-political developments as asserted by the market constitution mechanism of exogenous regulation. The Legal Framework is made up of laws, regulations and communications. The cultural code of “to make something up as you go along” is the other factor that shapes institutions in SW-E generation sector. The political developments that shape institutions are the frequent changes of political authority for Turkish Renewable Energy Sector.

4.5.2. Second Stage: Process Analysis of Market Formation

In process analysis of market formation, Dewald and Truffer (2012) conceptualize market formation sub-functions to elaborate the market formation dynamics in

Technological Innovation Systems by an example from renewable energy sector. In this study, Dewald and Truffer (2012) identify sub-functions by benefitting from Möllering's (2009) processes of market constitution such as *innovating, commodifying, communicating, competing, associating,* and *institutionalizing*.

Following Möllering's (2009) clarification of market formation dynamics in six key processes, Dewald and Truffer (2012:402) group these processes into two sets of sub-functions of "formation of market segments" and "formation of market transactions". Möllering's (2009) processes of *innovating, associating and institutionalizing* shape sub-function of "formation and differentiation of market related to Technological Innovation System sub-structures (formation of market segments)". The remaining three processes, *commodifying, communicating and competing* shape the sub-function of "formation of market transactions" (Dewald and Truffer, 2012: 402). In addition to these two sub-functions, "the formation of user profiles" is added to the market formation analysis to highlight the constructive part on the user side, determining consumer images, use patterns and preference structures. These three sub-functions are accepted to co-evolve during the entire market formation process in technological innovation systems.

For process analysis of market formation in SW-E generation in Turkey, I described these sub-functions of *formation of market segments*, *formation of market transaction* and formation *of user profiles* by analyzing the field research. In this description I used the processes determined by Möllering (2009) such as *innovating, commodifying, communicating, competing, associating,* and *institutionalizing.* The main contribution of this study was to analyze market formation dynamics from the supply side by the perspective of renewable electricity generators, rather than from the demand side by the perspective of renewable electricity users as in above mentioned studies.

Formation of Market Segments:

According to Dewald and Truffer (2012: 403), the sub-function of formation of market segments focuses on "the specific actor, network and institutions structures established for selling a specific product variant to an end-user group*"*. Therefore, the prerequisites for formation of new market segments are specific actors (including consumers, producers, consultant, bureaucrats and researchers) involved in market transactions, networks to support innovative and market transaction activities and appropriate institutional framework. New market segments emerge when specific actors with appropriate capabilities and resources are already located in the market place and perform market exchanges as to be included in the process of *associating*, and necessary legal framework is completed by the process of *institutionalizing*.

In Turkish case, the field research corroborated that dominant processes that shaped the formation of licensed and unlicensed electricity generation market segments were *institutionalizing and associating*, and innovating as a process does not directly contribute to market segments formation. Möllering (2009:13) defines institutionalizing as "certain rules of exchange and the sanctions attached to them are applied across many exchanges and become taken for granted" and associating as "the process of establishing relationships between actors that constitute networks, convey status, and work against the anonymity of markets". The analysis of the field research give hints about the formative roles of institutionalizing and associating processes in market segments formation.

Institutionalizing is one of the dominant processes that shape the sub-function of market segments' formation in Turkish SW-E generation. One dimension of institutionalizing process, in which the rules of exchange are applied across market exchanges repeatedly and become standardized, is learning by doing. According to Int. G3, SW-EG market segments undergo a process of formation in which the actors are deliberately moving to become acquainted with the renewable energy sector and to develop a growth strategy compatible with the government's growth strategies. Due to the fact that entrepreneurs are acting to form the market with limited information in an uncertain environment, Int. G3 defined market segments formation as a "learning process in which the repeated practices of rules and regulation and recurrent interactions and exchanges between the actors shape the general framework of the market segment". Int. G12 also defined the period since 2007 (when first wind energy license applications were collected), as the learning process. According to Int. G12, the government chooses to step forward deliberately not to repeat the same mistakes made in 2007 and to make the rules and the sanctions taken for granted. According to Int. G12, these deliberate (and sometimes slow) steps are to institutionalize renewable electricity generation market segments through repeating certain rules and regulations in renewable energy sector.

Moreover institutionalizing, which formalizes the sector by repeated and certain rules and sanctions, was pointed out as a requisite for reliable development of renewable energy sector through analyzing energy sector as a whole. Int. G17, who is one of the most experienced electricity generators in wind energy sector, put forward that for development of the sector, the "big picture" should be examined in detail. By analyzing the big picture, he meant that specific regulations for renewable energy has to be formulized by taking into account the specific characteristics of renewable energy in general energy framework. According to him, standard regulations for all energy sources are not appropriate and a specific institutional framework should be designed for renewable energy sources by considering this framework's effects on general energy outlook. Int. G17 mentioned about institutionalizing:

> The problem is not just to supply increasing electricity demand, or the solution is not directly to supply the electricity demand by increasing the number of natural gas power plants. Policy makers should see the big picture and must formulate policies specific to each energy source. For example to determine the amount of electricity generation, a natural gas power plant is more accurate than a wind power plant, but wind energy is domestic source and natural gas is imported. All aspects of energy balance should be taken into account in energy policy making for the institutionalization of each energy sub-sector.

Institutionalizing is crucial also for enhancing the role of domestic technology development in the formation of market segments. Int. G1 and Int. G12, domestic technology producers, and Int. G2, technology producer with foreign partners, underlined the institutionalizing process for the robustness of market segments formation. According to Int. G1, as the rules and regulation became certain and applied in all renewable energy investments, his company could be more aggressive about domestic technology development for wind electricity generation. Int. G12 pointed out the same necessity for their technology development projects. He told that his company's technology development team is working on two different technology development projects (one of them is about solar energy technology called "tracker systems" and the other one is about storage technologies). For these projects, they can find different financial sources of national funds (such as TUBITAK grants) and international funds (such as EU grants). However, for commercialization of these projects, he has some reservations because he cannot predict the sector's future by looking at the repetition of rules and regulations. According to him, for this purpose institutionalization efforts are still going on but more achievements are needed (such as finishing the solar license applications evaluations and certifying small and large scale unlicensed electricity generation process) to make the rules and the sanctions taken for granted. Int. G2 indicated the similar points for his company's growth strategy in Turkish SW-E generation. Int. G2 mentioned that due to his company's growth strategy in Turkish Renewable Energy Sector, in addition to wind energy, the foreign managers of the company decide to apply for solar energy licenses which was taken in 2013. They put renewable energy targets to fulfill in the company's energy portfolio. However, due to the lags in licensing process, the local team of the company (including. Int. G2) cannot construct new power plants to reach the portfolio targets. For this purpose Int. G2 proposed a new strategy in renewable energy as:

> To reach the company's renewable energy targets, as the local team we decided to apply for unlicensed solar electricity generation. However, it was difficult to persuade the foreign managers because they are not used to substitute licensed electricity generation in renewable energy with unlicensed one. We have waited so long to report institutionalization efforts to the head of the company especially. But the sector is stagnating and time passes against us. Hence we decided to apply for unlicensed electricity generation. These two models (unlicensed and licensed) of electricity generation are different than each other. However, we chose to enter unlicensed electricity generation by necessity. If the process and exchanges were standard and precise, we would not enter unlicensed electricity generation to reach our company's energy portfolio targets.

Associating is the other dominant process that shapes the sub-function of market segments' formation in Turkish SW-E generation. Especially in unlicensed electricity generation market segment that formed in two phases; actors established more intense relationships to realize the market transactions in an uncertain environment. As mentioned before, unlicensed electricity generation was carried to the second phase due to malfunctions in licensing process and as a result of an amendment in law about limits. Int. G13 claimed that during the emergence of the second phase in unlicensed electricity generation, relationships between actors played a crucial role. In unlicensed electricity generation, due to the need for increasing the limit from 500 KW to 1 MW and the need for regulations specific to small scale home based electricity generation plants, the consultancy companies and NGOs started to give feedbacks to policy makers. In this process the close relationships between actors yielded strong synergy that created desirable results of such changes and regulations in the sector. Int. C15 particularly noted the benefits of these feedbacks from the actors and these feedbacks' reflection on their development plans and projections. Int. C15 said:

> We have supported many SW-E generation projects. In these financial supports, our first aim is to facilitate the diffusion of renewable electricity. The support mechanism can promote increasing awareness but the main motivation comes from the interaction between the actors and "learning by seeing from each other". Universities, public organizations and companies in organized industrial zones hear the advantages of renewable electricity generation from each other. By this communication and

> interaction, renewable electricity attracts more attention and the market is getting larger.

Int. C3 also emphasized the same motivation of interaction for the formation of market segments. Int. C3 is a technical expert and is going to the acceptance protocols of unlicensed power plants on factory roof-tops or on fields in organized industrial zones. In his visits, he noticed, besides the plant owner, many other people are coming from near factories to learn more about the renewable energy power plant. According to him, these interactions teach the advantages and benefits of renewable electricity generation to the potential investors in renewable energy. Int. C3 asserted that:

> The old limit for unlicensed electricity generation, 500KW, is seen as insufficient, but as the limit is increased to 1 MW investors started to apply to construct the power plant for commercial purposes. As they heard from each other, more investors started to be interested in renewable energy. This was a learning process for us, for all actors in the sector. The consultancy companies, public organizations, distribution companies and investors are all learning in this process and they are learning from each other. By this way, the market is forming.

Therefore, from the field research it is seen that institutionalizing and associating are the main constitutive processes of market segments formation in Turkish SW-EG. Especially licensed electricity generation market segment is shaped by institutionalizing and unlicensed electricity generation market segment is shaped by associating. The significant dimensions of institutionalizing process for the market segment's formation are found to be learning by doing, analyzing the energy sector as a whole and supporting domestic technology development by decreasing uncertainty through determining rules and regulations clearly. On the other hand, associating mainly emerges by the interaction between the actors (especially the investors) and feedbacks taken from the sector.

Formation of Market Transactions:

The other sub-function of market formation is the "formation of market transaction" which is related to "exchange relationship between supply and demand for the end-products" (Dewald and Truffer, 2012: 403). In this sub-function, the key processes of Möllering (2009) are *commodifying* (to allow the product to be comparable and tradable through repeated exchanges between buyer and seller governed by formal and informal rules), *communicating* (interaction between the actors) and *competing* (co-presence of different producers and suppliers in a given market context).

The field research corroborated that in Turkish solar and wind energy based licensed and unlicensed electricity generation market segments, market transactions are being formed by the dominance of *competing* and *communicating* processes respectively. Möllering (2009:13) defines *competing* as "the structural condition of competition (i.e. multiple actors having a vying interest in making exchanges) and the spirit in which market exchanges are initiated and performed" and *communicating* as "making facts relevant and available to market actors, who then interpret and act on them".

According to the field research, market transactions in licensed electricity generation was formed through the process of competing. Renewable energy based licensed electricity generation stands on the legal framework that regulates the licensing process in Turkish energy sector. According to the legal framework, for granting SW-EG licenses, tenders are performed if there are more than one application to the same electricity connection point. The tenders are the structural cornerstones of competing process in license granting and principally tenders shape the market transactions in this market segment. As detailed before, tenders are performed by the contribution fee offers of license applicants and these offers were very high especially in solar energy license tender made in 2015. In the field research, especially interviewees from the for-profit organizations expressed that the competition between the license applicants shape the market transactions, due to the fact that contribution fees constitute large part of the power plant investment costs.

According to Int. C4, during the collection of the wind electricity generation license applications in 2007 and collection of solar electricity generation license applications in 2013, there was excess demand[79] and this demand prepared the competitive environment in license tenders. Specifically high levels of contribution fee[80] offers (the highest contribution

[79] In 2007, there was no cap and about 78.000 MW applications were collected for wind energy. In 2013 the cap was 600 MW for solar energy and about 9000 MW applications were collected for solar energy.

[80] In solar energy, the applicant who offers to pay highest contribution fee per MW of constructed power plants is chosen as the winner, in wind energy the applicant who offers to pay highest contribution fee per KWh electricity generated in power plant is chosen as the winner. Therefore, participation fees are different for SW-EG.

fee was given in Van Region and Malatya Region and it was 2,960,000 TL[81] per MW) in solar energy license tenders underpinned the competition in market transactions of licenses.

Int. G1 implied that, due to the fact that his company had also license application, he was following the tenders and he was surprised about the participation fee offers. According to him the investor, who had made feasibility studies before application, would not have increased the offers to that levels. High participation fees extended the pay-back periods of renewable energy investments and they were not rational. However, Int. C21 did not agree with Int. G1 on this issue. According to her, these participation fees determine the real values of the renewable energy based electricity generation projects and, whether seen as irrational or rational from outside, these are determined by the preferences of investors in the sector. Therefore, according to Int. C21 this behavior of the investor shaped the market transactions in licensed electricity generation. At that point, more important than the fees, Int. C21 claimed that the government must take all needed measures to guarantee the construction of these power plants at the end of the day and to ensure the market transactions are carried out in a competitive market environment.

Int. G12 agreed on this issue with Int. C21. His company won one of the first tenders in solar energy with a reasonable participation fee offer (67,000 TL per MW) in Erzurum Region. However, according to him, the participation fee offered in the second tender (827,000 TL) in Elazığ Region was more representative than his offer. He said:

> In other solar energy tenders, I think the participation fee offers may reach to 1 million TL, because in those regions more powerful investors like Sabancı, Zorlu and Çalık Groups will enter the tenders and the competition between them will determine the nature of transactions in solar licensing process.

Int. C1 also judged participation fee offers from the perspective of competitiveness and explicitly asserted that he could talk many of the applicants[82] that planned to offer high fees and that had strong feasibility studies and could find cheap investment credits to finance

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[81] To see the contribution fees offered by the winners in solar energy license tenders, check: http://www.TEİAŞ.gov.tr//duyurular/GES_YARISMA_TUM_PAKETLER.pdf (Last Access: 20.10.2015)

[82] As I followed from the platform, after the tenders finished he could talk to winners. Examples of short interviews with the winners of the tenders can be reached from http://www.solarbaba.com/haber/res-anatolia-guneste-ne-hedefliyor and http://www.solarbaba.com/haber/ges-yarismasini-kazanan-baltech (Last Access: 30.10.2015)

power plant construction. Int. C1 expressed that "approximately 9000 MW application for 600 MW solar license granting is a proof itself for the importance of competitiveness in renewable energy market".

According to the field research, in unlicensed electricity generation market segment, market transactions were formed through the process of *communicating*. Market formation of unlicensed electricity generation in two phases is a direct result of this finding. According to the actors from non-private sector responsible for regulation and from private sector responsible for electricity generation), the improvements in SW-E generation market segments[83] carried unlicensed electricity generation from first phase to second. During this change, close interaction and communication between the actors led unlicensed electricity generation market transactions to form in this way. According to Int. G7, this communication started by the steps taken by the government such as increasing unlicensed electricity generation limit and retarding licensing process; and the actors in the sector took the messages and repositioned themselves as to make new investments. Int. R1 asserted that the energy regulation authority is steering the energy sector by using incentives. She asserted that re-arrangements in legal framework are made after taking feedbacks from the market and this could be possible by close communication with the actors in the sector. Int. R1 mentioned that:

> Regulation means giving signals to sector and steering the investors rather than giving directions to them. For the sake of argument, the regulatory authority strategically can support wind energy primarily, and can choose to wait for technological advancement to support solar energy. For this strategic choice to be understood by the sector, the authority can use incentives as tools to direct the investors to wind energy instead of solar energy.

Int. C3 noted that the re-arrangement in legal framework created the expected feedback in the sector and increased demand for unlicensed electricity generation for commercial purposes. He claimed that rather than supplying self-consumption of electricity,

[83] These improvements aforementioned in other chapters can be summarized as follows: The need for electricity generation was increasing and solar and wind based electricity generation became alternative to supply increasing electricity demand. Due to the fact that solar and wind energy based electricity generation technologies were emerging technologies, investors prefer to wait for construction costs to decrease at the beginning of the market formation. Moreover, license granting processes could not be finished in accordance with the expectations of the actors and as a result the actors started to search for new alternatives to benefit from the new opportunities in renewable electricity generation. Additionally, there are also changes in legal framework that increased unlicensed electricity generation limit from 500 KW to 1 MW and no obligation for self-consumption in unlicensed electricity generation.

the actors would start to construct the power plants for selling all electricity generated in the sector. He said that:

> As I can see, the regulatory authority allowed unlicensed electricity generation to be formed by commercial purposes. The authority does not block side by side 1 MW application in unlicensed generation and does not put any criteria not to accept such applications. Yes, this is not compatible with the purpose of unlicensed electricity generation but the government led the investors who want to construct unlicensed power plants for commercial purposes and the actors took the message and saw this investments profitable. Due to the fact that investors can benefit from the feed-in tariffs of 13.3 US Dollar cent/KWh for the first 10 year of operation under current legislation, these investments become profitable for the actors who want to be active in renewable electricity generation sector.

Therefore, from the field research it is seen that in licensed electricity generation market segment, the process of *competing* shapes market transactions through the method of licensing. In this method, licenses are granted to the winner of the tenders and this winner is the one that offers the highest contribution fee to the government. For this reason, the tenders necessitate competition between the applicants and this competition shapes the nature of market transactions in licensed electricity generation. On the other hand, in unlicensed electricity generation market segment, the process of *communicating* shapes market transactions. The feedbacks taken from the actors, and reactions given to the feedbacks shape the market transactions in two phase development of market formation.

Formation of User Profiles:

In renewable energy sector, specific consumer groups are more available and open for innovative products than the rest of the society. For this reason, the demand side is also very critical for market formation in the development and dissemination of emerging technologies. Therefore, *formation of user profiles* is denoted as another sub-function of market formation in this context (Dewald and Truffer, 2012). User profiles are formed when the technology users develop preferences as exposed to new products or as they domesticate new technologies.

The user profiles formation is based on preferences that influence renewable energy market formation. In literature, there are examples of renewable energy cases such as German solar energy case in which the user preferences and profiles shape the market formation process through the formation of market segment (Dewald and Truffer, 2011)[84].

[84] As can be seen in theoretical framework, by focusing on user preferences and profiles; Dewald and Truffer (2011:290-293) identify different market segments for photovoltaic applications in Germany

On the other hand, Turkish renewable electricity generation sector is following a different path than the examples in the literature. According to field research, Turkish energy sector is experiencing a transition period in which the role of government is becoming "a regulator" rather than "an energy producer". Most of public sector's responsibilities about energy production are being transferred to private sector. In such an environment, energy supply side is under construction and due to this transition, consumption side is still under control of government. Therefore, in this dissertation, the focus of analysis is to elaborate market formation from the supply side with renewable electricity generation perspective rather than from the demand side with renewable electricity consumption perspective.

In this respect, the diffusion of renewable energy technologies in Turkish SW-E generation sector is examined different than other cases of renewable energy technologies diffusion that mentioned in the theoretical framework. Due to the fact that the re-structuration of the government's role in energy sector is onset, it has reflections on renewable energy sector as becoming dominated by government's activities on electricity generation. Therefore, by a supply side analysis, the only user profile of renewable energy based electricity generation (in general electricity generation) seems to be the government, because only the government buys electricity generated based on renewable sources.

For the generation of renewable electricity, there are two methods, licensed and unlicensed electricity generation. In licensed renewable electricity generation, the government grants licenses to renewable energy power plant owners. In unlicensed electricity generation, if the power plant owner generates electricity more than his consumption, he exports this surplus amount to the distribution system and can benefit from the prices determined in Law No: 5346 for a term of ten years. Unlicensed electricity generators cannot sell their surplus electricity to third parties other than the government due to the fact that, bilateral agreements (such as power purchase agreements) are not possible for unlicensed generators according to the Law No. 6446 and the Law No. 5346 (Gözen, 2015). Int. R5 summarized the basic pillars of licensed and unlicensed renewable electricity generation and expressed the formation process of the user profiles by touching upon the electricity trading in these two market segments:

> In licensed electricity generation, a legal entity must apply to the EPDK to hold a generation license called "Renewable Energy Resource Certificate" (RES Certificate)

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such as *MS1: Centralized PV power systems, MS2: Small scale homeowner systems, MS3: Large scale roof mounted system, MS4: Civic Corporate solar systems.*

> to purchase or sell the electricity generated from renewable energy resources in the domestic and international markets. In unlicensed electricity generation, both legal and real entities can apply to generate electricity in renewable energy power plant. In licensed electricity generation, electricity generated in the power plant can be traded in the energy market. There are many trading ways such as to sign bilateral agreements with third parties to sell the generated electricity, or to make electricity trading in day-ahead markets, daily markets or stabilization & reconciliation markets, or by being subject to RES Support Mechanism. However the last consumer, as the user of electricity, does not know the source of electricity (whether it is natural gas or solar power). Therefore in licensed electricity generation, the user consumes the electricity generated by the energy producer who has renewable electricity power plants in his energy portfolio and that user does not use directly the electricity generated in renewable energy power plant. In unlicensed electricity generation, the alternatives are not that much various. Policy makers say that you can establish unlicensed power plant for your own electricity consumption and if you export your surplus electricity generation to the distribution system, you can benefit from the RES Support Mechanism. There is no trading and no marketing for this excess electricity. This excess electricity is bought by the suppliers in energy market and this is regulated by law.

As summarized by Int. R5, in licensed electricity generation, user profiles are being formed during the electricity trading in above mentioned trading options. However, it must be noticed that as the smart grid is not available in Turkey and the electricity system is constructed as a “network system” as called by Int. R5, the user profile is shaped by the government’s preferences due to the direct control of the government on energy production and distribution system. Int. R5 asserted that in licensed electricity generation, on behalf of government, the private sector-owned power plants generated electricity and government bought all electricity generated from these power plants and transfers to privatized distribution companies to transmit the end-users (electricity consumers). Therefore, in both of these methods of renewable electricity generation, the only electricity user (which could directly buy from the power plant) is the government.

As mentioned by Int. C1, Int. C4 and Int. C21, due to the fact that bilateral agreements between the electricity generator and end-user in unlicensed electricity generation are not legal, the user-profiles, likewise in solar energy case of Germany, could not be formed in Turkish SW-E generation and the only user becomes the government. Int. C1 complained about the absence of bilateral agreements in unlicensed electricity generation and pointed out the government as the only user:

> There are many 1 MW unlicensed electricity generation application and the investors want to construct the power plant. For 10 years, they want to earn money for 13.3 dollar cent/KWh per month by charging bill for the income. But to whom they are

> charging? To distribution company. Where does the distribution company take money? From government. Government gives the permission for construction of power plant, the government supports renewable electricity generation and again government buys the electricity generated in the power plant. Due to the fact that there is no bilateral agreements in Turkey (it is called power purchase agreement in USA), the only user becomes the government. However, if there were bilateral agreements, an investor and the hotel owner could sign an agreement. Investor could construct 1 MW power plants to finance a power plants in the roof of the hotel. Hotel owner could generate electricity for the investor and investor could pay more than 13.3 dollar cent/KWh (the price of electricity paid by the government under normal regulation) to hotel owner and hotel could sell more electricity to the investor. Transaction could become more profitable for both parties in this situation. So, the government shall be removed from unlicensed electricity generation.

Accordingly, as the renewable electricity generation sector in Turkey is examined by a supply side analysis, it can be seen that the user profiles do not mature yet and are not diversified much. The only user is the government due to the lack of bilateral agreements.

4.5.3. Third Stage: Functional Analysis of Market Formation

Bergek et. al. (2008) defines “market formation” as one of the functions that determine the overall performance of emerging technologies diffusion in Technological Innovation System. The market formation is described in Technological Innovation System framework as passing through steps from nursing over bridging then to mass markets. In this dissertation context, as identified by Bergek et. al. (2008:416), for the functional analysis of market formation, I assessed the phase of market formation whether being nursing, bridging or mass market phases by examining these phases’ main features to understand how market formation contributes overall performance of Technological Innovation System in Turkish SW-E generation sector.

For this purpose, by touching upon the features of each market formation phase, I identified phases of Turkish market formation. Dewald and Truffer (2012: 405-406) claim that in nurturing phase the sub-function of market segment formation is predominant and the processes of market transactions formation are at the beginning. They argue that learning and coordination depend on close interaction between actors (associating) and communication between the actors is critical for success of new technology. Markets are dominated by uncertainty. In this market formation phase, pioneering movers and intermediary actors play important role to make new technological developments more meaningful. The environment is open for variety creation in technological design.

When the markets shift toward bridging markets, market transactions become clear where the new user segments and product variants appear. In this phase, the processes of commodifying and competing become regular and start to change the market formation as a whole. As a result, market volume expands and product configurations diversify. In maturing into a mass market, the diffusion of new technology becomes apparent and the overall market becomes homogeneous. In this phase, market transactions are formed concretely, and broader consumer segments and price-based competition are prevalent.

In Turkey, SW-EG market formation has basic peculiarities that match with the main features of nurturing phase in market formation. First of all, from the field research it is seen that in Turkish SW-E generation, market segments are still forming and this formation process has not been accomplished yet. License process in solar energy has just been completed in May, 2015 and the pre-licenses have not been granted yet. In wind energy, for the granted licenses in 2007, all power plants have not been completely established yet. Unlicensed electricity generation regulation is still under construction[85]. As can be seen from the above mentioned section of market segments formation, unlicensed and licensed electricity generation markets are still under construction due to the uncompleted institutionalization effort. Int. C21 gave an example about this construction efforts and asserted that:

> In Turkey, for example a free consumer[86] can choose his supplier and this eligibility limit will be decreased to 0 by compatibility with the EU laws. However, giving this right to consumer is not enough, the application procedure must be regulated and clarified for free consumer to be institutionalized. Therefore, appropriate conditions must be provided for free consumers to choose their suppliers in renewable energy sector.

Moreover, in Turkish solar and wind energy sectors, learning and coordination depend on close interaction between actors as in the nurturing phase of market formation.

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[85] The last modification was announced in October 2015 to change Electricity Markets Unlicensed Electricity Generation Regulation. The announcement to take the feedbacks can be reached http://www3.epdk.org.tr/index.php/tum-duyurular/18-elektrik-duyurular/2040-elk-taslak-ynt-lisanssizelkuretim26102015 (Last access: 03.11.2015)

[86] Free consumer is the consumer that consumes electricity more than an eligibility limit and can select his electricity supplier. According to Gözen (2015), for 2014 eligibility limit is set to 4500 KWh by EPDK.

Due to this reason, the formation of unlicensed market segment has been shaped by the process of “associating”. In the second section (process analysis of market formation), by the examples from the field research, I claimed that especially in unlicensed electricity generation market segment; actors establish more intense relationships to realize the market transactions in an uncertain environment. In this two-stage market formation, particularly during transition from the first phase to the second, such learning and coordination, which depend on close relationship between actors, played a crucial role. As asserted in process analysis, the breakthrough from one phase to other mainly emerges from the interaction between the policy makers and the electricity generators who demand large scale unlicensed electricity generation. As a result, after amendments in Renewable Energy Law and Electricity Market Law, this became possible. Therefore, this could be accepted as another evidence for Turkish SW-EG market to be in nurturing phase.

Another prominent feature of Turkish SW-E generation market formation is the existence of uncertainty. This uncertainty was created by recent developments in renewable energy sector. In 2007 wind electricity generation license applications were collected and approximately 10 GW of wind power plant licenses were granted. However, as of January, 2015 about 3.5 GW of power plant has been established[87] and the remaining power plants have not established yet. Moreover, some of the licenses were cancelled for the project that could not meet the requirements by the deadline of May, 2014., It is still unclear whether, instead of these cancelled license capacities, there will be new license capacities to be announced or whether these licenses are to be granted to other projects. Int. G17 explicitly mentioned that in 2007, his company applied for a wind power plant license in the Aegean Region, but could not win the tender because his company’s contribution fee offer was less than the winner. As expressed by him:

> In wind energy licensing process, we apply according to our financial strength and feasibility studies. However, the only criteria for winning the tender is to give the highest offer. No one asks for the financial strength, a substantive feasibility study, the technical workers profile, past experience in RES. Nothing! Only tender criteria is the contribution fee. For example our company entered a tender in 2007 for a power plant in the Cunda Island, but another company won the tender. Today, its license has been

[87] Turkish Wind Energy Statistics Report (2015) was published by TÜREB (Turkish Wind Energy Association). This report can be reached from file:///C:/Users/user/Downloads/turkish%20wind%20energy%20statistic%20report%20%20january%202015.pdf (Last access: 02.11.2015)

> cancelled and that power plant cannot be established now due to the capacity inconvenience for the region. Moreover, the future of that capacity is still unclear. However, this should have been organized differently. The criteria should have been determined before the applications were collected. If these applications had been organized better, these power plants may have been established and electricity could have been generated. That much uncertainty is very bad especially for foreign investors in Turkey. For 2023, the target of 20 GW of wind power has been determined but the investors cannot foresee that this target can be reached or not. It is the same for solar energy. In 2013, applications were collected for 600 MW and according to Renewable Energy Law; these applications would have been finalized until the end of 2013. However, they could not be finalized. In December, 2014 3000 MW solar energy capacity was declared but there is no roadmap for that construction. That much uncertainty is harmful for the diffusion of the technologies.

Int. G7 also pointed out the uncertainty in unlicensed solar energy market. He said that his company cannot plan to enter the sector, because the managers cannot be sure whether the obligation of self-consumption[88] will be imposed to unlicensed power plants or not. Moreover, he mentioned that "…after 10 years what will happen to generated electricity is not also very clear. Therefore, we cannot dare to enter unlicensed renewable electricity generation."

As the last feature of nurturing phase, Dewald and Truffer (2012) claimed that intermediary actors play important role to make new technological developments more meaningful, and communication between the actors is critical for the success of new technology. This was also valid for the Turkish case, because the role of consultancy actors is critical especially in technology development activities. As clearly seen from the first section of the profile study, these intermediaries are very active in market formation and hence in the diffusion of SW-E generation technologies. These intermediary actors are namely the *EPC firms* that bring together the equipment suppliers and investors, the *bureaucrats* as the source of knowledge for application of rules and regulations, *NGOs* and *civil society representatives* as the bridge between the actors in network building, *the academic organizations* that were directly involved in renewable energy technology development activities. The role of the government as the primary renewable electricity user was the last property that showed the market formation was in nurturing phase.

Therefore it is seen that, market formation of SW-E generation in Turkey is in the nursing phase. By looking at this, I can claim that the diffusion of emerging SW-E

[88] If it is legalized by law, renewable energy power plant owner must consume some part of electricity generated in the plant.

generation technologies is at the beginning and mainly is being shaped by each market segments' formation.

Summary:

Market formation in SW-EG is analyzed in this section. The framework which is used in this analysis includes structural analysis, process analysis and functional analysis. At the first level, *structural analysis* is made to identify actors, networks and institutions at the level of self-contained market segments of licensed and unlicensed electricity generation based on solar and wind energy sources. At the second level, *process analysis* is made to assess licensed and unlicensed SW-EG market segments' stage of development and their mutual interdependence by market formation sub-functions. Different than other studies, here market formation is analyzed from the producers' perspective rather than from the users' perspectives. At the third level, functional analysis is made to evaluate the contribution of each market segments to overall Technological Innovation System of Turkey.

At the first level, structural components (actors, networks and institutions) of market segments are determined. In licensed electricity generation market segment, **actors** are *companies* (electricity generator companies, equipment supplier companies and electricity distribution companies), *consultancy organizations (*Intermediary consultant company workers, consultant bureaucrats in government organizations and consultant academics in academic organizations) and *public organizations* (EPDK, YEGM, ETKB, CSB, OSIB and GTHB). In unlicensed electricity generation market segment, actors are *companies* (electricity generator companies-electricity subscriber legal entities, equipment supplier companies and electricity distribution companies), *consultancy organizations* (Intermediary consultant company workers, consultant bureaucrats in government organizations and consultant academics in academic organizations), *public organizations* (TEİAŞ,YEGM, CSB, GTHB and Municipalities in the related power plant application field) and *real persons* (electricity subscriber individuals). **Networks** in both market segments are *associations and cooperative organizations in SW-E generation* (such as GÜNDER, TÜREB, GENSED, LİDER, and SolarBaba Platform). **Institutions** in both market segments are *general legislation* (made up of laws, regulations and communications), *cultural code* of "to make something up as you go along" is the other factor that shapes institutions in SW-EG sector and the *political developments* of the frequent changes of political authority for Turkish Renewable Energy Sector. These structural elements are constituted through the mechanism

of *exogenous regulation* in licensed electricity generation market segment. On the other hand, unlicensed electricity generation market segment is formed in two stages and the structural components are constituted through the mechanism of *exogenous regulation* in first stage and *spontaneous emergence* in the second stage.

At the second level, processes (innovating, commodifying, communicating, competing, associating, and institutionalizing) that constitute market formation sub-functions (of formation of market segments, formation of market transaction and formation of user profiles) are elaborated. **For the formation of market segments**, from the field research it is seen that **institutionalizing** is the main constitutive process in **licensed electricity generation**, and **associating** is the main constitutive process in **unlicensed electricity generation**. Institutionalizing process encompasses learning by doing, analyzing the energy sector as a whole and supporting domestic technology development by decreasing uncertainty through determining rules and regulations clearly. On the other hand, associating encompasses the interaction between the actors (especially the investors) and feedbacks taken from the sector. **For the formation of market transactions,** from the field research it is seen that **competing** is the main constitutive process in **licensed electricity generation,** and **communicating** is the main constitutive process in **unlicensed electricity generation.** Competing mainly refers to the tender regulations in licensed market segment. Communicating mainly refers to the formation dynamics of unlicensed electricity generation in two phases of market development. **For the formation of user profiles**, it is seen that in Turkish renewable electricity generation, the user profiles do not mature yet and are not diversified much. The only user is the government due to the lack of bilateral agreements.

At the third level, by the functional analysis it is seen that market formation of SW-EG in Turkey is in the **nursing phase.** Hence, the diffusion of emerging SW-EG technologies is at the beginning and shaped by sub-function of market segments formation. In this phase, Turkish market is dominated by uncertainty, learning and coordination depend on close interaction between actors, government as prime mover is dominant, the product variation is not much (but the environment is open for variety creation in technological design) and commercialization has not be succeeded in established market structure.

4.6. Public Policies and Market Formation

For the end of public policies and market formation, during the interviews I ask questions about the effects of policies in market formation, purposes of these policies and policy proposal of the key actors. The data in this section is collected and reported as an example for policy design process. In this section, the effects of public policies on market formation are examined to find out the policy aims. The purposes of the policies are asked to determine the policy targets for diffusion process. Policy proposals recommended directly by the key actors are compiled to determine the policy tools to reach the targets of the policies.

4.6.1. Public Policies and Market Formation Relationship

In the investigation of the renewable energy policies' effects on market formation process, there were 21 different answers derived from the open coding of the interviews. Among these answers, the most frequently stated factors that were indicated by both for-profit and non-profit organizations were "the effects of policies on domestic production of renewable energy technologies", "interaction between the construction of legal framework and market formation" and "the effects of renewable energy policy making process on market formation".

In most of the interviews, **domestic production of renewable energy technologies** used in the construction of renewable energy power plants especially during the first phase of market formation process was mentioned most frequently. It was emphasized that if domestic production is the priority for development of renewable energy sector and the market formation in renewable electricity generation is intended to be built upon the construction of renewable energy power plants by using domestically produced technology, such model of market formation based on domestically produced equipment must be designed by government policies with clear targets like in China or Germany. Int. G7 mentioned that China prioritizes the development of domestic renewable energy technologies and for this purpose the Chinese government makes technology firm acquisitions to transfer know-how and starts to produce domestic technology in China. Int. G7 expressed that "by firm acquisitions and hence know-how transfer, China started to produce domestic renewable energy technologies, then became a global power in renewable energy sector." Int. G8 emphasized the role of government policy for developing domestic renewable energy technologies and mentioned that last year his company started a research and development project with three partners and has been granted a government funding for this project. He asserted that at the end of this project, the project consortium will construct a power plant in which 100% domestically produced equipment are used and this power plant will be constructed by public procurement. As being the private sector partner that makes the investment for domestic technology production factory, Int. G8 noted that, his company puts domestic renewable energy technologies development as a strategic target in company's business plan mainly due to this government support. In parallel to this strategic target, Int. G8 expressed his company's preparations as:

> For the development of domestic renewable energy technologies, we bought a foreign firm's production lines and we have established the factory. In the next step we will increase the production capacity and our factory will be the biggest one in Turkey. Our first target is to produce the equipment we need for our projects and then we will supply the equipment demand of domestic producers. And then we will export to abroad, to countries in the South Africa or MEA (Middle East and Africa) Region.

Int. S6, as another domestic equipment supplier, stated that supportive government policies are very critical to increase the role of domestic products in renewable electricity market formation. He also mentioned that, as being an active member of a non-governmental organization (of a solar energy association) he struggles to mold public opinion about increasing the rate of domestic equipment in new power plant constructions. Int. S6 also added that new announcement for licensed solar electricity generation in Konya-Karapınar Region will also support this trend. Int. C1, an expert who has been following the RES for a long time, claimed that for designing the government policies to support the usage of domestic technology in the renewable electricity market formation, the targets must be determined very clearly and the factors of *competitiveness, using good quality products in the power plants* and the *research and development for new products.* On the other hand, Int. C1 criticized the method of existing domestic production support policies by which technology developers are indirectly supported.[89] According to him, if domestic production is put as a policy priority for Turkey, the method of support must be designed by directly considering domestic technology producers, as well as their competitiveness in the sector. As experiencing domestic technology development, Int. S1 reported that his company is developing 100% domestic wind energy turbine and to be successful in emerging technology case domestic production should be supported by the long term and target-oriented policies. He exemplified this target-oriented policies such as the use of domestically produced equipment at certain amounts in each new renewable energy power plant or in the demonstration projects of renewable power plants in governmental organizations' buildings.

[89] According to the Law on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy (No: 5346), if an equipment used in the renewable energy power plants of license holders is produced domestically at a rate of minimum 55% of the whole equipment, electricity purchase price is to be increased by 5% in addition to 13.3 dollar cent /KWh for a term of five years.

Int. S1 further claimed that if these policies are not designed in this fashion, they do not work well and might affect market formation negatively.

The second topic that was most emphasized in the interviews was **interaction between the construction of legal framework and market formation**. As elaborated in market formation; preparation and application of legal framework play critical role especially as an emerging technology case (Jacobsson and Lauber, 2006). Int. C12 and Int. G4 asserted that the deficiencies in the preparation of a legal framework affect market formation in renewable electricity generation negatively. Int. C12 gave the example of putting measurement prerequisite for solar energy in the Renewable Energy Law and claimed that this prerequisite is put there due to the lack of reliable information about the solar energy potential in Turkey. He explained the preparation period of the GEPA (Solar Energy Potential Atlas) that shows the solar energy potential in Turkey. The data in this atlas was generated by using a software rather than the real data accumulated in Turkish Meteorological Services. Therefore, according to him, due to the fact that solar energy potential in Turkey was not worked scientifically in preparation of the GEPA, measurement was put as a prerequisite to law. On this issue, he further added that:

> The GEPA is a map prepared by the YEGM. It is a synthetic data generated by R-Sun module of ArcGIS software. Hence, as declared by the map itself, the variation is about 20-30 percent. One of the independent variables to calculate the potential was the altitude, and hence the places in high altitudes are seen as the places with high solar energy potential. However, this is not the real potential. For example, Çukurova and Hatay regions are seen as the low solar energy potential areas in the GEPA due to low altitudes. Another example was Iğdır. It is one of the places that receives lowest amount of rain in Turkey. However, due to low altitude, Iğdır is seen as a low solar energy potential area and for Iğdır solar energy capacity was not announced in solar license applications. Like Iğdır, there are many places such as Bartın, Balıkesir, Ankara, and Kırıkkale.

Int. C8 claimed during the application of the legal framework, actors in the sector cannot position themselves in front of the legal framework sustainably due the fact that the rules and regulations are changing very frequently for adapting the dynamism in the sector and the civil servants cannot absorb these changes and react immediately. In this subject Int. C8 expressed that:

> With a typical civil servant mentality in a governmental organization, it is not possible to solve the problems in the sector. In case of the sectoral actors come across with a civil servant who does not know anything about (the renewable energy) subject, to solve a problem takes longer time, since this civil servant does not know how to cope with the problems and he even comes across that subject for the first time.

Moreover, about the effects of the legal framework on market formation, Int. C4 examined joint action of market formation and the legal framework. Int. C4 asserted that the developments in the market formation cannot be followed by the parallel changes in legal framework, and this negatively affects renewable electricity generation market formation. As the last issue in this topic, bureaucracy came to the fore again. Bureaucracy is pointed out as the most critical source of problem for market formation in field research and most of the experts from electricity generators (such as Int. G1, Int. G4, Int. G5, Int. G9 and Int. G10) and consultants (such as Int. C5, Int. C8, Int. C10, Int. C18 and Int. C21) claimed that the bureaucratic obstacles had roots in the construction of legal frameworks.

The third topic that was the most emphasized in the interviews was **policy making process itself.** The blocking mechanisms that were pointed out as the obstacles in the field research such as (i) the lack of coordination between governmental organizations, (ii) insufficiency in lobbying and advocacy coalition activities (mainly due to the fact that sector was still developing), (iii) emphasis on increasing the role of renewable sources in electricity generation as a result of substitution effect[90] rather than increasing the variety of energy sources in country's energy bundle are all identified as the effect of policy making process on market formation and hence diffusion of renewable electricity generation in Turkey. About *Lack of coordination,* in above sections many examples are given and these are all connected to policy making process itself. On the other hand, in this section main quotations are derived for the other two issues of lobbying activities and substitution effect. As asserted by Int. C23, due to the fact that wind energy sub-sector is an older and more settled sector as compared to solar energy sub-sector, in wind energy the lobbying activities are more powerful and hence affect policy making process more than that activities in solar energy. Int. C1 criticized solar energy subsector that there are too many civil society organizations and due to this multi-unit structure, powerful lobbying activities cannot be accomplished to affect policy making process.

As most of the interviewees, Int. C23 identified solar energy sub-sector as a late comer as compared to wind energy sub-sector and connected the problems in lobbying

[90] Energy sources such as nuclear energy, thermal energy, natural gas or renewable energy can be used in electricity generation as being the substitutes for each other. By supporting the substitution effect between the energy sources during electricity generation means that one of the energy sources can be used instead of the other for targets specified in country's energy policies (for example, renewable energy can be supported instead of natural gas for increasing the sustainability in supply of energy sources.)

activities to being a developing sector. Therefore, by considering its sui-generis structure, Int. C1 proposed a new model of lobbying activity that is established as a platform rather than an association and that platform is intended to work as a non-profit company. In policy making process, it is very important to determine the place of renewable energy sources in overall energy sector and the relationship between the renewable sources with other sources to understand the relationship between policy making and market formation. Int. G12 and Int. G13 underlined that complementarity relationship between energy sources and emphasized that renewable energy sources should take place in country's energy bundle as completing (rather than substituting) each other. According to Int. G13, policy making for the diffusion of renewable energy sources should prioritize this complementary relationship for supporting renewable electricity generation market formation.

4.6.2. Purposes of Renewable Energy Policies

For this section, I asked questions about the purposes of renewable energy policies in Turkey and 9 different topics were derived from the open coding of the interviews. For the for-profit organizations, the most frequently stated purposes were "to be deliberate in building renewable energy sector on solid bases" and "to solve infrastructural problems that hinder integration of renewable sources to whole energy sector". For the non-profit most frequently stated purposes were "to promote production of domestic renewable energy technologies", "to reach the 2023 target of Turkey (especially in renewable energy)" and "to promote storage technologies."

For the for-profit organizations, the primary purpose of renewable energy policies in Turkey was **to be deliberate in building renewable energy sector on solid bases**. Int. G12 and Int. S2 reported that renewable energy policies (especially for solar and wind energy sectors) have been designed since the 2000s and the legal framework of these policies have been constructed since 2005. According to these experts, the studies for policies and the legal framework are deliberately performed by policy makers to develop the sector on solid bases and to protect its development from unexpected and uncalculated results. According to Int. C18, these deliberate (and sometimes slow) steps are taken to find the best strategy for development of renewable energy sector. However, that much deliberate steps and precautions (such as measurement prerequisite in licensed electricity generation, requirement of detailed static calculations for roof-tops in unlicensed electricity generation, environmental impact assessment for unlicensed power plants) increase the bureaucratic burden for the investors and slow down the improvement of the sector. Moreover, according to Int. C23, actors in the sector perceive some of these steps as to be done for slowing down the development of the sector. Int. C18 indicated that in the first phase of market formation in renewable electricity generation, the deliberate movement of policy makers were helpful to develop the sector, however, as the sector has grown, the actors have become familiar with the sector and started to take their responsibilities in the division of labor; control mechanism ensured by policies must be replaced by regulation and auditing.

The other primary purpose of renewable energy policy was **to solve infrastructural problems that hinder integration of renewable sources to whole energy sector**. Due to the fact that renewable energy sources have different characteristics as compared to conventional energy sources (such as production and consumption at the same unit, sustainability problems in feeding the grid due to dependency on natural conditions, bi-directional use of the grid system for both to feed the grid with electricity and to take electricity from the grid, possibility of off-grid electricity generation), integration of renewable electricity generation might create infrastructural problems. Therefore, one of the primary purposes of renewable energy policies was claimed to be to solve that infrastructural problems. Int. C13 recommended that the technical evaluation for the unlicensed electricity generation must be made in advance of feeding the grid with generated electricity to prevent the problems during that feeding process. He asserted that this technical evaluation exists in wind energy, but the procedure for technical evaluation must also be prepared for solar energy too. As another infrastructure component, Int. G2 mentioned transformer capacities. He asserted that the transformer capacities which are critical for unlicensed electricity generation should be declared regularly and hence this infrastructural information should be transparent for an easy integration of renewable electricity generation to the grid system. On the other hand, Int. G11 believed that new electricity regimes might be designed if the infrastructural problem can be solved. According to him, by benefitting from the specific features of renewable energy sources, system operators would design various electricity generation and consumption regimes and to accomplish these new regimes, the grid system and the whole energy infrastructure must have become compatible with the integration of renewable electricity.

For the non-profit organizations, the primary purpose of renewable energy policies in Turkey was **to promote production of domestic renewable energy technologies**. The role of domestic technology production was mainly highlighted by the experts in governmental organizations. Int. R1 incorporated domestic technology production and electricity generation based on domestic sources and asserted that the government was paying attention to the use of domestic technology in renewable electricity generation for the diffusion of renewable energy technologies. Int. R1 said that:

> Manufacture of (renewable electricity generation) equipment in Turkey is also very important. By planning renewable electricity generation, the investments in technology development are also motivated. This is a value chain. The support mechanism is to motivate the production of technologies in Turkey and to deliver the equipment of good quality at cheap price to the electricity generation investors.

For domestic technology production, Int. R6 emphasized the role of equipment costs. He asserted that most of the equipment are imported and the costs of the equipment take a large part of total cost of renewable energy power plants (including initial investment cost, operation costs and input costs). He claimed that if these equipment can be produced domestically instead of importing from abroad, the total cost of power plants can be decreased and the construction of renewable energy power plants will be easier. Therefore, Int. R6 labeled domestic production as a primary policy purpose to diffuse renewable electricity generation in Turkey. According to him, the manufacturing of domestic renewable energy equipment should be supported by policies. Int. R6 further argued that:

> Now, the establishment cost of wind energy power plants is higher than that of a conventional energy power plant. Therefore, to decrease this cost and to increase the number of renewable energy power plants, the target is to develop these technologies in Turkey and to support both manufacturing of equipment and electricity generation in Turkey.

For domestic production policy, Int. R2 emphasized the role of research and development and Int. C3 touched upon the possibility of a new import dependency problem that may come to surface by imported equipment in renewable energy power plants. Int. R2 asserted that the manufacturing of equipment in Turkey is important but it is more important to support domestic production with a long term research and development policy to build the production of renewable energy technologies and manufacturing of these equipment on solid bases. On the other hand, Int. C3 revived import dependency problem and claimed that for Turkey, renewable electricity generation will be very important in the future; however, using imported equipment in construction of power plants is a disadvantage for this sector. According to him, renewable energy can solve the import dependency problem for sources, but might create another import dependency problem for imported technology, hence domestic technology production in addition to domestic energy production should also be supported by policies.

The other policy purpose stated by experts from the non-governmental organizations was **to reach the 2023 target of Turkey especially determined for renewable energy**. The first targets for 2023 were determined in the Energy Supply Security Strategy Document (ETKB, 2009). The target to reach for the rate of renewable sources in total electricity generation is determined as 30%. In this document, the target for constructed power of wind energy power is 20.000 MW. For solar energy, there is no target in this document, however in National Renewable Energy Action Plan for Turkey released in 2014 (ETKB, 2014) the target for constructed power of solar energy is determined as 5000 MW. Int. R1 implied that one of the primary purpose of policies is to reach the targets; however especially for solar energy, a target cannot be determined due to the fact that technology is an emerging technology and as the technology develops, the targets will change. For the targets, Int.R2 claimed that a high (somehow unrealistic) target is set for wind energy. To reach this target, new power plants must be built within the next ten years as three times large as the existing power plants are. Despite these criticisms, when I asked the purpose of renewable energy policies, one of the first things that come to mind is reaching those targets as in the cases of Int. C17 and Int. R5. Int. C17 claimed that "Turkey has already targets for renewable energy policy; such as 20.000 MW for wind energy. Now we should think about the ways of reaching those targets and how realistic they are." Int. R5 added that "The targets for the renewable energy are set by the Ministry of Energy and Natural Resources and we have already targets such as to rise the share of renewable energy sources in electricity generation to 30%."

To promote storage technologies is the third most frequently stated policy purpose for the experts from the non-governmental organizations. As underlined by Int. R7 and Int. C12, one of the major problems of renewable energy is the inability to use the renewable energy sources as the base load for electricity generation, which means insufficiency of feeding the grid uninterruptedly. Therefore, to overcome this inadequacy, the development of storage technologies is seen as a solution and hence as one of the primary purposes of renewable energy policies. Int. C3 claimed that renewable energy sources will be a more powerful alternative for conventional energy sources if the storage technologies are developed parallel to renewable energy technologies. Int. C1 emphasized that the development of storage technologies is the greatest motivator for using renewable energy sources in electricity generation and as the storage technologies develops, the price of the renewable electricity is decreasing and hence renewable electricity becomes more accessible. Int. R2 added that if Turkey wants to be one of the authorities in renewable energy technologies, a strategy encompassing both renewable energy technologies and storage technologies must be developed to have a competitive power in this sector.

4.6.3. Policy Proposals for diffusion of renewable electricity generation technologies:

In the field research, I asked for suggestions of the interviewees about the policy proposals for the diffusion of renewable electricity generation technologies in Turkey and 46 different policy proposals were derived from the open coding of the interviews. Among them, I reported the most frequently stated policy proposals by the interviewees. For the for-profit organizations, the mostly stated policy proposals are "promoting self-consumption", "redefinition of government's role in energy sector" and "construction of a new governance model-mechanism in Renewable Energy Sector". For the non-profit organizations, the mostly stated policy proposals are "promoting self-consumption", "raising awareness in society about renewable electricity generation" and "redefinition of licensing procedures".

For the for-profit organizations, the most frequently stated policy proposal for the diffusion of renewable electricity generation technologies was **to promote self-sufficiency (especially for home based small scale systems).** Interviewees reported the benefits and advantages of self-consumption to bring it into the agenda of policy makers. Int. C10 stated that by promoting self-consumption, most of the electricity generated is consumed by the owner of the power plant. In this situation, electricity generation and consumption at the same unit become possible and hence the transmission costs can be decreased. As a result, both electricity consumption and generation become more cost-effective. Int. C13 emphasized self-consumption due to the fact that peak periods of electricity consumption coincides with the time period of the day in which the potential of electricity generation (especially from solar energy) is abundant[91]. Moreover, Int. G15 referred to the modular structure of renewable electricity generation technologies (especially photovoltaic panels in solar energy) as another advantage of renewable energy technologies that enables small scale self-consumption electricity generation power plants. Additionally Int. C23 pointed out that the financial possibilities for self-consumption can make renewable electricity generation

[91] Int. C13 gave the example of the summer times in which the solar energy potential is highest during the time period of using air conditioning that increases electricity consumption.

more distributed. Int. C23 claimed that financial models designed for supporting self-consumption (for example bank credit specific for home based self-consumption) will also promote self-consumption in renewable electricity generation. Int. S6 further added that self-consumption is the key for diffusion of renewable electricity generation as in the case of Germany. According to him, as the self-consumption is promoted, it will be easier to generate and consume renewable electricity, and hence the diffusion will be faster. Int. G15 advocated that if the last consumers are informed about the advantages and benefits of self-consumption (such as cost advantage of generating electricity in consumption unit in periods of high electricity prices, low operation cost of the power plant due to the absence of input cost, decreasing construction costs in a short span of time), self-consumption will be promoted easily and renewable energy technologies will diffuse easily. For a method of self-consumption, Int. C21 revealed that "cooperation system that enables unification of different actors' consumptions" will be a candidate to support self-consumption if this cooperation system is legalized by laws and regulations in Turkey.

The other policy proposal stated frequently by the experts from the for-profit organizations was **redefinition of government's role in energy sector.** Int. G8 identified the government's new role of "regulating and monitoring the energy sector as being positioned above all the organizations and institutions rather than directly being the energy producer". According to him, this definition emerges after the liberalization efforts of subcontracting construction of power plants to private sector, privatization of distribution and trade of electricity, and then (not yet but is planning to be) the privatization of TEİAS (Turkish Electricity Transmission Company). In this new role of government, it is emphasized that the government should not be responsible from energy production. At this point Int. C10 criticized government to maintain the control strictly together with the privatization efforts. According to him these two strategies of strict control and privatization contradict with each other and impede the restructuration of government's role in energy sector. Int. G7 revealed that the government must be far from all actors at equal distances and Int. G5 added that if the government can redefine its role as the regulator rather than the controller, then the actors will be more responsible about their activities by increasing self-control. Int. G15 asserted that the government should be the "system operator and the anchor for the manipulations to regulate the market"

The third most stated policy proposal by experts from the for-profit organizations was **construction of a new governance model-mechanism** *in Renewable Energy Sector*.

For this new mechanism, interviewees proposed different sub-structures to construct this model. For example Int. G17 offered a new governmental organization that positions above the Ministry of Energy. He asserted that this organization must consider electricity as an input for industry and a consumption good for the last consumer rather than being a mere commodity. Int. G7 proposed the establishment of an energy investment agency as a substructure of this new governance model-mechanism. According to him, this investment agency should have different specializations for different energy sources to mediate energy investments. This is specifically pointed out for this new model since he believes that each energy source has different characteristics and energy investments should be supported by considering these characteristics. On the other hand, according to Int. G13, this new governance mechanism should include specific regulations for determining energy investment areas for renewable energy power plants. In these areas, all infrastructural investments and needed preparations must be made by the government itself, and then all conditions and circumstances will become equal for all actors in the sector to make them competitive under equal circumstances. Int. C8 incorporated "separate and specific regulation sub-mechanism for each renewable energy source with respect to each sources' features" to this new governance mechanism. Int. G1 specifically signified this sub-mechanisms for solar and wind energy sources and pointed out them to regulate the application and permission processes for licensed and unlicensed separately. According to him, a new organization as the head of this sub-mechanism should be unique application unit for all renewable energy investors. Int. C5 conceptualized this new unit as "the coordination center for renewable energy" and claimed that the operation of this new center will accelerate the renewable energy investments.

According to experts from the non-profit organizations, **promoting self-consumption** was the most frequently stated policy proposal. According to them, some prerequisites should be ensured to promote self-consumption in renewable electricity generation. For example, Int. C1 put forwarded "decrease in costs" as one of these prerequisites. According to Int. C1, as the construction cost decreases self-consumption will become more attractive, and it is explicitly seen that costs are decreasing very fast. Int. C6 asserted that if the construction becomes easy, self-consumption can be promoted more powerfully. According to Int.C6, unlicensed power plants are constructed for commercial purposes and self-consumption is not the main purpose of unlicensed electricity generation recently. However, he advocated that self-consumption is the most powerful aspect of renewable electricity generation and if construction of power plants becomes as easy as the construction of modular and portable systems, self-consumption will be preferred more. Int. C1 announced the amount of consumption as one of the factors that affect promotion of self-consumption. According to him, if electricity consumption is at high amounts for an actor, self-consumption can be more attractive. The actors that consume electricity at high amounts such as factories, hotels, industrial zones, shopping malls, must be supported to become renewable electricity generators to supply at least some part of their own consumption. For this purpose, Int. C1 also offered a new method for the valuation of the electricity generated based on renewable sources and he claimed that if this method becomes legitimate, self-consumption can diffuse easily. According to him, the method of "net metering"[92] would be a good alterative of current method of earning money from unlicensed self-consumption power plants. If net metering can be used for feeding the grid and using renewable electricity, due to the fact that there is no money exchange, the valuation of the electricity becomes easier and using of renewable electricity generated by self-consumption power plants is promoted. According to Int. C1, another prerequisite for promoting self-consumption is to shorten and to ease permission process for self-consumption. Int. C1 advocated that in self-consumption, the permission process is expected to become easier and then the equipment will become "commodity products that can be bought from supermarkets and be constructed like portable systems similar to desk-top computers". Moreover, Int. C25 expressed that if an obligation is applied for the production facilities in industrial zones even to generate some part of their electricity consumption from renewable sources (in case of having appropriate places for renewable power plants), self-consumption can be facilitated. Therefore, according to Int. C25, for any production facility that is established in industrial zones, construction of a self-consumption renewable energy power plant must be taken to agenda. One step further, Int. C25 proposed that for the power plants in which all electricity generated is used for self-consumption, additional support schemes can be applied if the domestically manufactured equipment are used in this power plant's construction. In this self-consumption model, Int. C25 offered to support using domestically manufactured renewable energy technologies in the facilities (such as factories) whose electricity consumption is higher as compared to others and who will use all the generated electricity in

[92] In this method, the amount of excess electricity (the amount of electricity that is calculated by subtracting consumption from generation) is given to the grid to earn credit of using KWh of electricity (rather than earning money)

self-consumption. The alternatives for these support schemes can be to provide financial supports like low interest rate credits and grants without repayment.

Raising awareness in society about renewable electricity generation is the other most frequently stated policy proposal by the experts in the non-profit organizations. According to Int. C1, raising awareness about the benefits of renewable electricity generation is very critical for supporting the diffusion process. He mentioned that awareness will definitely increase if it is known by most of the actors that the construction costs are decreasing at an increasing rate. Compared to putting the money equal to the amount of initial power plant investment into bank, the rate of return is higher if the power plant is constructed and the electricity is sold to the government to earn money. On the other hand, Int. R5 emphasized the role of increasing awareness by touching upon electricity generation and distribution system. According to Int. R5, if the consumer is a conscious one who is sensitive to the source of electricity generation, he will be consuming electricity in a more energy efficient fashion in a decentralized system that he can generate his own electricity as compared to buy that electricity from the central electricity generation and distribution system in which he does not know the source of electricity. According to him, this kind of awareness will make the consumers to choose the electricity suppliers in whose energy bundle also includes renewable energy sources. In such a situation, increasing awareness will be more visible to motivate the diffusion process if the limit of free consumer will decrease and home-based consumers can also be free consumers.

Redefinition of licensing procedures is the third most frequently stated policy proposal by the experts from the non-profit organizations. Int. R2 indicated that in the current situation, taking license application at a certain period of time (for example in one week period) increases the possibility of making mistakes in application procedures since the officers take all applications at a limited time period. To change this, Int. R2 proposed that license procedures must be changed by secondary legal frameworks such as making changes in license regulations. Int. C19 asserted that instead of taking license applications in a limited time periods, periodical transformer capacities should be announced for license applications and willing investors will apply for that capacity. Int. C6 also criticized license application procedures and suggested a new method of licensing that is given for certain energy specialization zones and searches for certain capabilities and competences in applicants to make the elimination from the very beginning. According to Int. C6's proposal, in certain regions determined by the government, applications are collected for well-defined energy production areas; for this application, some technical, financial and monetary criteria are required. According to Int. C6 these criteria would be giving a guarantee letter, having sufficient technical infrastructure for investment, the feasibility of the projects, making efficient projections for electricity generation, the certification of the guarantee for being bankable of having necessary capital. For an applicant, to meet all these criteria would be better than giving the highest contribution offer for KWh.

Summary:

In this section, policy and market formation relation, purpose of policies and policy proposals of the key actors are analyzed as an example for the policy analysis. Policies and market formation relation is investigated to determine the policy aims to affect market formation process. These factors are asserted as the main problems to be solved by the policy analysis. From the field research, for both for-profit and non-profit organization, the policy aims are identified as the *domestic production of renewable energy technologies, construction of related legal framework* and *improving renewable energy making process.* The purposes of renewable energy policies are asked to interviewees to determine the policy targets to reach by the policies for market formation and diffusion. For for-profit organizations these targets are identified as *to be deliberate in building renewable energy sector on solid bases* and *to solve infrastructural problems that hinder integration of renewable sources to whole energy sector*. For non-profit organizations, these targets are identified as *to reach the 2023 target of Turkey (especially in renewable energy)* and *to promote storage technologies*. Policy proposals are asked to determine the policy tools to use for reaching the policy targets. For-profit organizations, policy proposals (hence the policy tools) are *promoting self-consumption (especially for home based small scale systems), redefinition of government's role in energy sector* and c*onstruction of a new governance model-mechanism in RES*. For non-profit organizations, policy proposals are *promoting self-consumption, raising awareness in society about renewable electricity generation* and *redefinition of licensing procedures*.

4.7. Conclusion of the Analysis

In this chapter, the diffusion of SW-EG technologies in Turkey is analyzed by an empirical analysis. In this analysis, the key actors reflected their experiences, perceptions, opinions, feelings, and knowledge about this process, so I can analyze how these key actors understand the diffusion dynamics to construct policy implications for policy makers. In this context, the focus of the policy analysis is the market formation SW-EG. Therefore, I elaborated the market formation dynamics in detail by structural, process and functional analysis. Then, for designing policy implications I derived a policy design model by benefitting from the technological innovation perspective and the empirical analysis made here.

In this policy design model, first of all I detected the failures/problems in energy sector in relation to renewable electricity generation (Table 4.14). These problems are analyzed to find out the systemic problems/failures in energy sector to be solved by diffusion of renewable electricity generation technologies. For this purpose, these problems are elaborated to find out their *reasons*, the *results* that come together with the problems and the *threats* that the policy maker may come across if these problems cannot be solved. This analysis is used to find out the policy aims in the policy design model. Secondly, I detected the facilitators and obstacles. For each group of organizations, these factors are selected and reported under seven headings of administrative (ADM.), economic (ECON.), institutional (INS.), physical (PHY.), political (POL.), psychological (PSY.) and technological (TECHN.) factors (Table 4.14). These factors are used to form the policy tools in the policy design model. Thirdly, I examined the market formations dynamics in Turkey to find out the policy targets to reach for diffusion of SW-EG technologies in Turkey.

As an example for the application of this framework, I benefitted from the last section of the analysis chapter; Public Policies and Market Formation. The comments on the relationship between the policies and market formation are examined as the policy aims of the policy implications compiled from the field research, since they are asserted as the main problems/failures that should be solved by the policies. The purposes of renewable energy policies are examined to determine policy targets for the policy recommendations. The policy proposals asserted by the interviewees are presented as the policy tools. In this example:

Table 4. 14. Summary of the analysis chapter

	Problems (For Failures in the system)	**Facilitators** (For Inducement Mechanism to be enhanced to solve the problems)	**Obstacles** (For Blocking Mechanisms to be abolished to solve the problems)
For profit-organizations	✓ Import dependency ✓ Lack of standardization, ✓ Problems about privatization ✓ Accountability ✓ Lack of long-term planning and energy policies	ADM: Peak shaver effect ECON: Cost-Competitiveness INST: Lobbying and advocacy coalition PHY: Abundant and domestic Renewable energy sources POL: Government Subsidies PSY: Neighbor Effect TECH: Key actors' TD Strategies	ADM: Bureaucracy ECON: Project Finance INST: Lack of Coordination Between Governmental Organizations PHY: Infrastructural Deficiencies POL: Precautions issued by legal framework PSY: Uncertainty TECH: Lack of (Technical) Information
Non-profit organizations	✓ Import dependency (and insufficient domestic sources) ✓ Problems about privatization ✓ Regulatory problems (lack of governance, interventionist government and lack of long term energy planning and policies)	ADM: Reduction in electricity losses during transmission and distribution ECON: New Investment Opportunities INST: Lobbying and advocacy coalitions PHY: Abundant and domestic renewable energy sources POL: Government Subsidies PSY: Neighbor Effect TECH: Prosumer (Producer and Consumer) Effect	ADM: Tenders ECON: High (initial) costs INST: Lack of Coordination Between Governmental Organizations PHY: Infrastructural Deficiencies POL: Precautions issued by legal framework PSY: Uncertainty TECH: Lack of (Technical) Information

The policy aims are:

- ✓ to promote domestic production of renewable energy technologies,
- ✓ to construct the legal framework compatible with market formation and
- ✓ to improve the policy making process.

The policy targets are:

- ✓ to be deliberate in building renewable energy power plants on solid bases,
- ✓ to solve infrastructural problems that hinder integration of renewable energy sector to whole energy sector,
- ✓ to reach the 2023 target of Turkey (especially in renewable energy) and
- ✓ to promote storage technologies.

The policy tools are:

- ✓ promoting self-consumption (especially for home based small scale systems),

- ✓ redefinition of government’s role in energy sector and construction of a new governance model-mechanism in renewable energy sector,
- ✓ construction of a new governance model-mechanism for renewable energy sector investments,
- ✓ raising awareness in society about renewable electricity generation and
- ✓ redefinition of licensing procedures.

CHAPTER 5

CONCLUSIONS and POLICY IMPLICATIONS

In this chapter, the main findings of the analysis chapter are summarized and interpreted. Afterwards in accordance with these findings and overall conclusions, the policy implications are determined to support the diffusion of SW-EG technologies in Turkey. For this purpose, policy recommendations are suggested and elaborated by a policy design model that is constructed on three pillars of policy aim-policy tool-policy target (as described in Chapter 4). In first section, I summarized the conclusions derived from the current situation of Turkish Energy Sector to find out the policy problems which are the main energy problems that can be solved by renewable electricity generation and the policy aims. In second section, I summarized the conclusions derived from the analysis of the facilitators and obstacles to formulate the policy tools. In third section, I examined the conclusion derived from the market formation dynamics in SW-EG in Turkey to construct the policy targets. The policy recommendations are reported at macro, meso and micro levels (Geels, 2005; Smith et al., 2005; Markard and Truffer, 2008). The policy recommendations at macro level target the changes in socio technical landscape (environment) in which the diffusion of SW-EG technologies take place. At meso level, the policy recommendations are designed to manipulate the dynamics at socio-technical regimes that is made up of the regulation mechanism for the diffusion of SW-EG technologies. At micro level, the policy recommendations are for the smallest unit of the focus of analysis such as the system's constitutive elements (actors, networks and institutions).

For this purpose, first of all overall conclusion are reported under three main sub-sections of the *Current situation of the Turkish Energy sector*, *Facilitators and Obstacles* and *Market Formation in Turkish SW-EG.* Then the policy implications are proposed by using the policy design model.

5.1. Conclusions derived from the Analysis of Current Situation of Turkish Energy Sector

The current situation of Turkish Energy is analyzed by the field research to understand the diffusion of renewable electricity generation technologies in relation to the whole energy sector. For this purpose, the main problems in Turkish energy sector are evaluated by the sources of these problems, renewable energy as a solution, the role of fossil fuels in relation to renewable energy and the optimal electricity generation bundle. According to both groups of economic profit motive, "import dependency" is the most critical problem in Turkish energy sector. Experts from the non-profit organizations elaborated *the reasons of import dependency problem* in Turkey (Table 5.1). They see import dependency as an inescapable problem since Turkey does not have enough domestic source to be self-sufficient. Moreover, necessary energy investments (such as nuclear power plants) were not accomplished on time to supply increasing electricity consumption. In such a situation, with the construction advantage of fossil fuel based power plants, it is easy to generate electricity based on fossil fuel. Furthermore, capacity factor is higher in fossil fuels and this makes them more energy efficient. As a result, import dependency becomes inevitable. Experts from the for-profit organizations emphasized *the results of import dependency problem* that have effects on their own business and pointed out *the threats that import dependency brings about.* The critical results of import dependency are the financial difficulties such as high current deficits, huge financial burden and increases in electricity prices. The threats that import dependency brings about are especially about the energy supply security as a critical issue on Turkey's macro-energy environment.

Both groups of the economic profit motive stated different *problems about governance of energy sector* as the factors shaping the current situation of Turkish energy sector (Table 5.1). According to the for-profit organizations, these problems are related to the lack of standardization, problems in privatization, deficiencies in accountability and the lack of the long term energy planning and policies. For the non-profit organizations, these problems are related to regulatory problems, interventionist approach of the government and the lack of the long term energy planning and policies. As the field research proceeds, it is seen that the *reasons of problems about governance* are regulatory problems (according to the non-profit organizations) and the lack of standardization (according to the for-profit organizations). The *results of problems about governance* are problems about privatization (according to the for-profit organizations), the interventionist approach of the government (according to the non-profit organizations) and the lack of the long term energy planning and policies (according to both the for-profit and non-profit organizations). Finally, according to the for-profit organizations, the *threat that problems about governance bring about* is pointed out as the accountability problem (Table 5.1).

Table 5. 1. Current Situation of Turkish Energy Sector

***Import Dependency Problem**- An inescapable reality of Turkish Energy Sector*		
Reasons	*Results*	*Threats*
• Domestic sources are insufficient. • Needed investments were not made in time. • Fossil fuel based power plants are easily constructed. • Energy Efficiency of imported fossil fuels is high.	• Financial difficulties such as ✓ High current deficits ✓ Huge financial burden for production (due to increasing energy input costs) ✓ Increase in electricity prices.	• Energy supply security problems, • Electricity supply security problems, • Dependency on other countries.
***Governance Problem**-Rooted in standardization, changing role of government, trust relationship and legitimation*		
Reasons	*Results*	*Threats*
• Lack of standardization ✓ No clearly defined and standard procedures in renewable energy investment process (ex. construction permits from municipalities) ✓ Lack of technical standards ✓ No definite sanctions and punishments ✓ No predetermined time periods for completing the license procedures ✓ Dependency on private individual relationships in investment process • Regulatory problems ✓ Deficiencies in organization of governmental bodies ✓ Control motive slowing down the sector hence makes the government interventionist	• Privatization Problems ✓ Privatization cannot be achieved as a structural change due to heavy bureaucracy ✓ Government intervenes privatization instead of regulating it • Interventionist government ✓ Excess control on renewable energy investments due to protect the grid system from negative effects of renewable power ✓ Energy sector becomes unpredictable due to the excess control • Lack of the long term energy planning ✓ Unpredictability and uncertainty in energy sector ✓ Lack of coordination and division of labor between governmental organization ✓ Over applications for wind and solar installed capacities (78 MW for 10 GW Wind and 80 GW for 6 GW solar) ✓ Even the policy makers do not have projections	• Accountability Problems ✓ Problems about the government to be obliged to report, explain or justify its operations in energy sector, ✓ Not to be responsible and answerable. ✓ Deficiencies in trust relationship between the government and other actors.

The overall conclusions derived from the analysis of the current situation of the Turkish energy sector are:

- ✓ For solving import dependency problem to provide energy (and electricity) supply security and to be independent from other countries, the rate of using abundant domestic sources of solar and wind energy should be increased and the bundle of energy sources for electricity generation must be optimized to increase the roles of renewable energy sources[93].
- ✓ The standard procedures of renewable energy investments should be clearly defined. In the permission processes, the task should be decisively distributed, authorization and responsibilities should be clearly determined, and the sanctions must be defined before the process starts. This is beneficial for the coordination and division of labor between governmental organization and hence to provide trust relationship between the actors.
- ✓ The government should have a role of regulator rather than an energy producer and direct controller of the sector. By this regulator role, the government should solve regulatory problems rooted in the organization of the governmental bodies and the hysteria of control embedded in the interventionist approach, should provide the standardization of the procedures, should lead actors to learning by doing on the job and hence the government can lead these actors to recognize and internalize the processes[94].

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[93] The rate of technological development is emphasized throughout the dissertation since the targets for increasing the usage of renewable energy are all about the rates of technological development such as 20.000 MW for wind energy and 5000 MW for solar energy. On the other hand, direction of technological development (so to say decision about the type of technology that will be developed and used) is not determined in these targets and how to achieve these targets are not specified in the policy documents. Direction of technological development is another important aspect of the technological development in SW-EG and the technology policy design process. It must be elaborated since one of the main energy problems is import dependency and to solve this problem, in addition to rate, the direction of technological change should also be taken into account for technology policy design. However the targets asserted in this dissertation are limited to the targets specified in policy document and due to this reason, the debate about the direction of technological change is left to further studies.

[94] Mazzucato (2013), in her book "The Entrepreurial State" examines the wind and solar power industries in China, US and Germany and referred to "prior investments of active public sector and clear market signals proclaimed by progressive government policies about the desired change and availability of support for clean technology industrial growth" as the source of these industries'

- ✓ Privatization process should be redefined as a long term structural change and must be elaborated as a multidimensional issue including the price policy, market size, energy production and electricity generation and all these factors' effects on industry, consumption and production.

5.2. Conclusions derived from the Analysis of Facilitators and Obstacles

In the analysis of the field research, the obstacles and facilitators are reported according to the expert groups of economic profit motive and classified under seven headings of: Administrative, Economic, Institutional, Physical, Political, Psychological and Technological Factors. The factors are used to determine inducement mechanisms to be enhanced and blocking mechanisms to be abolished.

According to the for-profit organizations, the most critical **administrative** facilitator for renewable electricity generation is *peak shaver effect of renewable energy* which means decreasing the peak load and to balance the peak rates, hence to provide easier and more efficient operation of the grid system. Especially solar electricity has this potential for midday-peak hours of electricity consumption in industry. Moreover, electricity prices can be decreased indirectly by decreasing electricity consumption (used from the grid) in peak hours by renewable electricity generation. According to the non-profit organizations, the most critical administrative facilitator for the diffusion of renewable is *reduction in electricity losses during transmission and distribution*. Renewable electricity generation technologies allow on-site electricity generation and consumption, hence facilitate the efficient operation of electricity transmission and distribution system. As a result, losses during transmission and distribution can be reduced. For this reason, the diffusion of

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success in clean technology development and formation of renewable energy markets (pg.158). She further adds that "Government must reduce the risk of commercializing energy innovations and managing the risk of competing in global energy markets" (Mazzucato, 2013: 159). Here, according to the conclusion derived from the field research of Turkey's SW-EG, the interventionist government is seen as one of the sources of problems in renewable energy sector and the policy recommendation is about to change the role of government from energy producer to regulator. Despite the fact that the policy recommendation to change the role of government (based on the critics about role of government as energy producer) seems like the opposite of Mazzucato (2013)'s examination about China's and US's source of success (which is the government policies), it is not direclty the opposite. Since the government subsidies are seen as the most effective political facilitator for adoption and dissemination of SW-EG technologies in Turkey, in this disseration, it is not stated that government should withdraw from the energy sector totally and leave everything to firms or entrepreneurs. Quite the opposite, the role of goverment should be determined clearly to be the regulator rather than the energy producer to reduce such risks asserted by Mazzucato (2013).

renewable energy technologies, especially in regions with a high rates of transmission and distribution losses should be supported (Table 5.2).

According to the for-profit organizations, the most frequently stated administrative obstacle is *the bureaucracy* both for licensed and unlicensed renewable electricity generation. Bureaucratic burden arises because of the time-consuming paper work, extra permission requirements for roof-top small scale home based systems and unnecessary measures taken for configuration of renewable power plants. Bureaucracy is perceived as the government's control mechanism on energy sector by the for-profit organizations. According to them, by slowing down the sector with bureaucratic burden, the government tries to learn and recognize the sector. On the other hand, according to the non-profit organizations, *tender regulation* is the most critical administrative obstacle on the way of renewable electricity generation technologies diffusion. The tenders are adopted as the compulsory method to be followed in all the licensing process but there is no such requirement. Because tender is a screening method to be used in case of too many applicants. To build all licensing process on it might mislead the government to choose the most suitable investor.

Table 5. 2. Summary of the Administrative Factors

	For-profit Organizations	***Non-profit Organizations***
Facilitator	**Peak shaver effect of renewable energy** ✓ Renewable electricity can feed the grid and balance the peak rates (esp. solar energy in midday-peak hours of industrial production) ✓ Electricity prices will decrease if electricity consumption in peak hours decrease.	**Reduction in electricity losses during transmission and distribution** ✓ Renewable power plants in high potential regions can reduce losses. ✓ Close position of plant to consumption unit (on site electricity generation and consumption unit) can reduce losses.
Obstacle	**Bureaucracy** ✓ Emphasizing configuration measures of power plants more than technical measures. ✓ Spending time and effort on paper work. ✓ Red-tape for unlicensed electricity generation (esp. roof-top small scale home based systems) ✓ Too much permission from different institutions. ✓ It takes too long to construct licensed power plants. ✓ Bureaucracy is seen as governmental control mechanism on RES and learning process (like putting radars on the new highways built by governments)	**Tenders** ✓ Closing the capacities to connect the grid system and opening the tenders in specific time periods mean giving privileges to license holders. ✓ Trader exchanges license in second hand markets and the cost of investment rises by license trading costs. ✓ Tenders are specific solutions to specific problems (in 2007, it is used but not anymore); it is not a general method of all renewable energy sector investments

As seen from these factors, the for-profit organizations emphasize the administrative facilitators and obstacles that directly affect electricity consumption and costs in industrial production. On the other hand, the non-profit organizations indicate the management and rehabilitation of transmission and distribution system after including renewable electricity generation into the system. Therefore, I can claim that the for-profit organizations put forward the micro effects of renewable electricity generation by touching upon its direct effects on their own business. On the other hand, the non-profit organizations put forward macro effects of renewable electricity generation, by its effects on macro electricity generation and consumption system.

The overall conclusions derived from the analysis of administrative factors:

- ✓ In peak hours of electricity consumption in factories (especially the midday hours when the industrial production is at highest level), renewable electricity generation (specifically electricity generation based on solar energy) should be increased by specific support mechanisms for factories making industrial production. Especially construction of solar electricity generation power plants should be supported since the solar energy potential is also at its highest level in middays.
- ✓ Bureaucracy is a real burden for renewable electricity generation. To decrease bureaucratic burden, the government should take the measures to prepare licensed and unlicensed electricity generation procedures soundly, to distribute the responsibilities fairly, to train the decision makers and to transform the system from the centralized to the decentralized. It must be remembered that bureaucrats cannot reduce bureaucratic burden. Only the policy makers are able to reorganize bureaucratic operations if the sectoral actors can use political channels to make policy makers reduce bureaucratic burden.
- ✓ The diffusion of renewable electricity generation is an effective means of reducing losses in transmission and distribution system especially for the electricity consumption units which are far from the electricity generation units since both on-site electricity generation and consumption are possible by renewable electricity generation. For this purpose, prosumer model (being the producer and the consumer is the same unit or person) can be supported. Moreover, to realize such a model, the grid system should also be improved and converted to a smart grid system.

- ✓ Terms of tenders should be revised by taking into account the experiences in wind and solar license competitions, and tenders should be implemented as long as it is really a requirement (for example in case of many applications for a small application area).

According to the for-profit organizations, the most critical **economic** facilitator is *cost competitiveness* of SW-EG technologies and, economic obstacle is *project finance* in renewable electricity generation. According to the non-profit organizations, the most critical economic facilitator is *new investment opportunities* brought about by the diffusion of renewable energy technologies and, the economic obstacle is the *high (initial) costs* in construction of renewable energy based power plants. As can be seen from these statements, economic factors are evaluated by touching upon the cost, finance and investment opportunities, but these two economic profit motive groups emphasized different aspects of the cost issue in renewable energy investments (Table 5.3).

According to the for-profit organizations, the most frequently stated economic facilitator is *cost competitiveness* of SW-EG technologies. Solar and wind energy sources are for free, hence zero input costs to run the power plants is a cost advantage for renewable electricity. Moreover as the equipment costs decreases, renewable electricity generation becomes more cost competitive, hence diffusion becomes easier. On the other hand, the non-profit organizations assessed the cost issue from the other side and pointed out *high (initial) costs* in the construction of renewable energy based power plants as the most critical economic obstacle. Due to the fact that SW-EG technologies are developing technologies, equipment and construction costs are still high as compared to conventional electricity generation technologies. Additionally, the long pay-back periods (due to the fact that all investment cost are made at the initial stage of investment) makes the initial cost of renewable energy power plants as an economic obstacle for diffusion. For the economic facilitator, the non-profit organizations referred *new investment opportunities* as the most critical economic facilitator, since electricity demand is increasing very fast and new opportunities such as renewable energy sector with its huge potential to supply this demand come into the question. Renewable electricity generation is a continuously developing and profit making sector. Due to the government guarantee to purchase generated electricity, renewable energy sector means also a guaranteed income for the investors. Moreover, as Turkey can improve renewable electricity generation and can develop domestic technologies, the region around the country would yield new investment opportunities. As the last economic factor, the for-profit organizations pointed out *project finance* as the most critical economic obstacle that hinders the diffusion of renewable electricity generation. In Turkey, project finance is not designed specific to renewable energy investments, hence it becomes a critical economic obstacle for renewable energy investments. Assignable loans are preferred instead of project finance in renewable energy investments, but this finance method is not very appropriate for renewable energy investments. As a result, diffusion is getting harder.

Table 5. 3. Summary of the Economic Factors

	For-profit Organizations	*Non-profit Organizations*
Facilitator	**Cost-competitiveness** ✓ Zero-input cost for resources**.** ✓ Decreasing equipment costs of renewable electricity generation (BUT not the case for Turkish equipment suppliers since cost competitiveness is achieved by suppliers' motivation to sustain production through decreasing the profit margins).	**New Investment Opportunities** ✓ To supply increasing electricity demand, new opportunities come into question due to high potential in renewable energy sector. ✓ Renewable energy sector as a developing and profit making sector. ✓ Guaranteed income.
Obstacle	**Project finance** ✓ Two-sided issue which is affecting and affected by the diffusion process. ✓ Project finance mentality does not settle down in Turkey. ✓ Financial model based on assignable loans are not appropriate for RES investments. ✓ Diffusion of unlicensed small scale self-consumption power plants is slow due to difficulties in finance.	**High (initial) costs** ✓ Renewable energy technologies are still expensive as compared to conventional electricity generation technologies. ✓ Renewable energy investments are more risky and less competitive as compared to other energy investments. ✓ Pay back periods are long as compared to other energy sources.

The overall conclusions derived from the analysis of economic factors:

- ✓ The investment costs of SW-EG investments should be evaluated multi dimensionally by considering zero input costs, guaranteed income, and high initial costs due to be emerging technologies but the possibility of sharp decreases in equipment costs. Comparison between renewable energy investments costs and other sources investments costs must be made by taking all these cost items into account.
- ✓ Project finance mechanisms should be designed specifically for SW-EG. As the banks do not improve them and continue to use the same financial tools for all energy investments, project finance cannot be maintained for the long term. Therefore, power plant construction options (such as 1 MW on-field application for commercial purposes, or small scale roof-top home based systems or self-consumption systems for factories in industrial zones) should be specifically examined to design finance mechanisms.

According to the experts from both for-profit and non-profit organizations, the most critical **institutional** facilitator is *lobbying and advocacy coalition* for the diffusion of SW-EG technologies and, the most critical institutional obstacle is *coordination between the governmental organizations*. Lobbying activities, based on the common sense of the sectoral actors, are very useful to develop the sector on solid grounds. The relationship between the sectoral development and lobbying is a two-way relationship. As the sector develops, lobbying activities intensify. As the lobbying activities intensify, sector may develop fast. Among the institutional factors, the most critical obstacle for the diffusion is the lack of coordination between the governmental organizations (Table 5.4).

Table 5. 4. Summary of the Institutional Factors

	For-profit Organizations	*Non-profit Organizations*
Facilitator	**Lobbying and advocacy coalition** ✓ A powerful solar energy association in Turkey is required to talk to all government organizations, be in relation to universities, and easily cooperate with the producers in the sector. ✓ Building common sense is a requisite. ✓ Lobbying activity would be powerful if sectoral development level has reached to a certain point. ✓ Instead of individual endeavor, lobbying depending on specialization and professionalization is needed.	**Lobbying and advocacy coalition** ✓ Objectivity is need in both support and criticism. ✓ Lobbying should be transparent. ✓ Objective management mentality should exist in associations.
Obstacle	**Lack of Coordination between governmental organizations** ✓ The procedures of governmental organizations are not arranged as a follow-up process. ✓ Participation of each governmental organization to the investment process is not systematic. ✓ Communication problem exist between governmental organizations. ✓ To complete renewable energy investments without a well-defined coordination and task distribution is difficult.	**Lack of Coordination between governmental organizations** ✓ Cooperation between the regulations of the governmental organizations is missing. ✓ Miscommunication exists. ✓ Problems occur about clear definitions of responsibilities and authorization of governmental organizations.

The overall conclusions derived from the analysis of these institutional factors:

- ✓ Lobbying activities should be intensified as to provide the specialization and professionalization instead of individual endeavor to build common sense. For this purpose, the benefits of lobbying activities (such as the diffusion of unbiased information, creating public opinion, neutral and unbiased auditing mechanism) must be carefully explained to all stakeholders.

- ✓ For coordination between the governmental organizations, a methodological re-arrangement should be made in license evaluation process through a unique coordination mechanism.

According to both for-profit and non-profit organizations, the most critical physical facilitator is *abundant and domestic (renewable energy) sources in Turkey* that can be used in electricity generation, and the most critical physical obstacle is *infrastructural deficiencies* in the distribution and transmission systems of electricity which lead to insufficiencies to connect the renewable electricity to the grid system (Table 5.5). High renewable energy potential in specific regions, such as Konya and the surrounding region for solar energy and Aegean Sea Shores for wind energy, enables regional diffusion of renewable electricity generation technologies. Moreover, these renewable energy sources are domestic sources and due to this physical facilitator, energy supply security issue is again addressed under this heading. Infrastructural deficiencies are indicated as the most critical physical obstacles and to weaken these blocking mechanisms, problems in the integration of renewable electricity to the grid should be solved urgently.

Table 5. 5. Summary of the Physical Factors

<table>
<tr><th></th><th>For-profit Organizations</th><th>Non-profit Organizations</th></tr>
<tr><td>Facilitator</td><td colspan="2">Abundant and domestic solar and wind energy sources
High renewable energy potential (esp. in specific regions such as Konya region for solar energy)
✓ Solar energy: Endless source
✓ Domestic rather than imported source</td></tr>
<tr><td>Obstacles</td><td colspan="2">Infrastructural deficiencies
✓ Insufficiencies and malfunctions in electricity distribution system (as the renewable energy power plants are integrated to the grid system, new equipment and transformers are needed)
✓ Capacity problems--overloaded transformers capacities (for ex. Konya, Karaman, Burdur, Isparta, Antalya) ---a critical obstacle for unlicensed renewable electricity generation.
✓ Local position of renewable power plants--Due to the locations of renewable energy power plants, to reach the grid system becomes an infrastructural deficiency as compared to other sources, hence infrastructural deficiencies originate in the nature of renewable electricity generation
✓ Instability to feed the grid-discrete sources</td></tr>
</table>

The overall conclusions derived from the analysis of these physical factors:

- ✓ The solar and wind energy potentials should be determined definitely and accurately. Then to realize these potential in their local areas, regional support mechanisms should be designed.

- ✓ To connect renewable electricity to the grid successfully, the transformer capacities should be announced and updated periodically. Necessary infrastructural investments for renewable power plants (such as building new grid lines and transformers) must be made urgently, and as in some cases of wind energy investments, these grid lines investments should not be left to the investor. For this issue, distribution companies must assume more responsibility.

According to both for-profit and non-profit organizations, the most critical **political** facilitator is *government subsidies*, and the most critical political obstacle is *precautions issued by the legal framework* to be taken before the application for renewable energy licenses (Table 5.6). Government subsidies are direct monetary subsidies given for renewable electricity generation and domestic production of renewable energy technologies. The application for government subsidies is indicated as an inducement mechanism; however, the design and method of the subsidized are criticized. The policy proposals of interviewees are a redesign of these subsidies. Precautions issued by the legal framework (especially the measurement prerequisite) are indicated as political obstacles due to the same reasons: criticism of method and design. According to interviewees, without measurement prerequisite, all specific targets can be still achieved. Due to this reason, it is proposed to change this prerequisite.

Table 5. 6. Summary of the Political Factors

	For-profit Organizations	*Non-profit Organizations*
Facilitator	**Government Subsidies** ✓ Direct monetary subsidies make renewable energy investments more profitable by decreasing costs (especially in case of roof-top systems in industry). ✓ BUT domestic production supports are not profitable due to the subsidy method (an economic model is missing for applying subsidies) ✓ Amendment for YEKDEM increased number of applicants and users of support	
Obstacle	**Precautions issued by legal framework** (mainly measurement prerequisite) ✓ Accuracy of measurement data is problematic to complete the investment. ✓ Measurement is a time consuming activity. ✓ Measurement for six months is not enough. ✓ Each measurement mast is an extra costs for investors. ✓ All masts are imported (all money goes to abroad). ✓ It is seen as an indicator of financial power and ability to make such an expenditure at the beginning of the investment but other methods can be found. ✓ Measurement masts are erected before application and collide, hence, the evaluation process takes longer. ✓ BUT financial organizations ask for that data to fund a feasible project.	

The overall conclusions derived from the analysis of these political factors:

- ✓ Government subsidies should be designed in a framework of economic model and domestic production subsidies should be given directly to domestic producers instead of the users of domestic products

- ✓ Precautions issued by the legal framework (such as measurement prerequisite) should be replaced by more efficient methods which can be applied more easily and can give the same results (such as measurement can be made by a professional and central measurement unit instead of individual efforts, or measurement can be made by license owner if he prefers to do it after taking the license rather than in the application process or after winning the tender, the measurement data can be asked from the license holder.)

Table 5. 7. Summary of the Psychological Factors

<table>
<tr><th></th><th>For-profit Organizations</th><th>Non-Profit Organizations</th></tr>
<tr><td>Facilitator</td><td colspan="2">Neighbor Effect
✓ Learning and perceiving by seeing (let my neighbor make and I can see whether he can earn or not.)
✓ Positive effects of self-consumption of renewable energy plants on community and the investors-directly affect unlicensed electricity generation
✓ Positive feedbacks (more people use renewable electricity and talk about its advantages)
✓ Also negative effects - As the sector (especially solar energy) is in its initial phase, an entrepreneur’s negative experience due to an unpleasant preparation period for investment might affect the other investors negatively.</td></tr>
<tr><td>Obstacle</td><td colspan="2">Uncertainty
✓ Frequently changing rules after the electricity generation process has begun
✓ Startles distribution and transmission companies - the technical results of new development cannot be estimated
✓ Uncertainty about the future of unlicensed renewable power plants (not clear that whether there will be a self-consumption requisite again or what will happen to these power plants after 10 years of purchase guarantee
✓ Uncompleted license tenders in solar energy applications
✓ As uncertainty increases, the chance to find out the resource becomes more difficult (cheap funds with low interest rate)
✓ Dependency on natural conditions and hence forecasts might be false
✓ Renewable energy creates extra burden for the mechanism of energy markets equilibrium</td></tr>
</table>

According to both for-profit and non-profit organizations, the most critical **psychological** facilitator is neighbor effect, and the most critical psychological obstacle is uncertainty felt by the actors in investment process (Table 5.7). Neighborhood effect helps actors observe a pattern of the successful renewable energy power plant constructions or to look up to the experiences of successful renewable energy investors. Positive feedbacks taken as a result of neighborhood effect support the diffusion process, since the Turkish people, are learning (or perceiving) by seeing. On the other hand, uncertainty is a critical psychological obstacle in renewable energy investments. This uncertainty is a result of frequently changing rules during the investment process, unclear short and long-term future of licensed and unlicensed electricity generation practices, the inability of investors to make plans about financial conditions and the dependency of renewable energy sources on natural conditions. Each uncertainty factor that can be prevented by policies will have positive psychological influence on producers and investors.

The overall conclusions derived from the analysis of these psychological factors are:

- ✓ As learning by seeing has an impact on society, successful demonstrative constructions should be diffused, the public organization should play a leading role and make renewable energy investments (even if being symbolic) good examples for the society.
- ✓ All uncertainty factors must be eliminated by policies. The principal responsibility here belongs to the government as the regulator of the renewable electricity generation and market formation.
- ✓ Renewable energy may create an extra burden for the equilibrium between energy supply and demand, hence instability in energy market equilibrium. For this purpose, new mechanism should be designed in energy markets

According to the for-profit organizations, the most critical **technological** facilitator is *key actors' technology development strategies* and the most critical technological obstacle is *lack of (technical) information* in the actors of the sector. According to the non-profit organizations, the most critical technological facilitator is *prosumer effect* and the most critical technological obstacle is *lack of (technical) information* in the actors of the sector. Key actors' prominent technology development strategies are (i) to be consistent in making R&D projects and not to give up in case of financial problems, (ii) to determine technology strategies by considering Turkish renewable energy market conditions, and (iii) to organize manufacturing process as a prototype production stage of the R&D project. Technological development that enables "prosumer effect" is the other factor that supports the diffusion of renewable energy technologies. The prosumer effect is a result of on-site production (electricity generation and consumption at the same place) and enables reduction in transmission and distribution losses, reduction in overload on the grid system. It leads the prosumer to use generated electricity more efficiently and increases the need for smart grids and these positive aspects of on-site production. On the other hand, lack of (technical) knowledge hinders the diffusion process according to both for-profit and non-profit organizations. Lack of (technical) knowledge causes making renewable energy investment with wrong motives, an insufficient understanding of the technical details of renewable electricity generation, unawareness about the temporary nature of renewable electricity, and misrecognition of the stages of renewable electricity generation from equipment supply to electricity generation (Table 5.8).

Table 5. 8. Summary of the Technological Factors

	For-profit Organizations	*Non-profit Organizations*
Facilitator	**Key actors' technology development strategies** ✓ Key electricity generators and the suppliers are conducting their own R&D activities for new renewable energy technologies. ✓ Despite cuts in project funds, key actors continue to finance the R&D project to complete the tasks. ✓ Domestic producer uses national funding with many partners to develop the quality of the products and to increase domestic contribution of the product. ✓ Key actors organize manufacturing process as a prototype production stage of R&D project. ✓ Market segment focused technology development strategies: • Individual production of small scale energy technologies for unlicensed electricity generation market segment • Consortiums for large scale production in licensed market segment	**Prosumer Effect** ✓ Possible to generate electricity at the consumption unit. ✓ Not a burden for the distribution system. ✓ To decrease losses and to spread the risks in distribution. ✓ Sustainable production and consumption of energy by managing electricity consumption in different periods of day. ✓ Production of own electicity consumption made the consumer more conscious about energy issues. ✓ New grid system by considering effects of volatile electricity consumption and generation on the grid system.
Obstacle	**Lack of (Technical) Information** ✓ Deficiencies exist in technical and theoretical knowledge base. ✓ It is the main reason of determining a low cap for licensing solar power plants (as of 600 MW) and completion of the evaluation process of solar license applications in long time. ✓ The investors do not know the investment process completely (Some license holders do not know the tenders regulation). ✓ Slow integration of renewable electricity generation to the whole system due to lack of information.	**Lack of (Technical) Information** ✓ Fast decision making without having deep knowledge makes the investor to start investment without knowing the troubles that he may come across. ✓ Lack of knowledge hinders investors to solve the problems. ✓ Society's and public's knowledge about the solar energy sector are at low levels, and additionally there is information pollution

The overall conclusions derived from the analysis of these technological factors are:

- ✓ Technology developers and researchers should be supported by considering local conditions and specificities of Turkey. These specificities are the marketing potential in domestic market space, domestic producer and consumer behaviors, commercialization conditions, and capabilities that yield competitiveness in local conditions. The technology strategy for SW-EG should have a growth focus from domestic markets to global markets.
- ✓ Market segment focused technology development strategies should be adopted. The suggested market segment focused technology development strategies are (i) individual production of small scale energy technologies which can be used in unlicensed electricity generation market segment and (ii) Consortiums for production of large scale energy technologies which can be used in licensed market segment.
- ✓ "Prosumer model" should be supported in small scale home based electricity generation in unlicensed market segment.
- ✓ Government policies to target learning by doing in renewable electricity generation to abolish lack of technical information to diffuse common sense and a shared roadmap

5.3. Conclusions derived from the Analysis of Market Formation in SW-E Generation

Market formation in SW-EG is analyzed by an analytical framework that is made up of three levels of analysis: structural analysis, process analysis and functional analysis (Table 5.9). This analytical framework is applied to the formation of licensed and unlicensed electricity generation market segments. In structural analysis, emergence of constitutive elements of market is described. In process analysis, sub-functions of market formations are analyzed by market formation processes of innovating, commodifying, communicating, competing, associating, and institutionalizing. In functional analysis, the contribution of market formation to overall performance of Turkish SW-EG Technological Innovation System is elaborated.

Table 5. 9. Summary of Market Formation Analytical Framework

Level of Analysis	Unit of Analysis (Formation of)	In Licensed Market Segment via:	In Unlicensed Market Segment via:
Structural	Actors	Policies on entrepreneurship and antitrust	Policies on entrepreneurship and antitrust & Entrepreneurial opportunism
	Networks	Policies on cartels, consortia, associations	Policies on cartels, consortia, associations & Civil society initiatives
	Institutions	General legislation; cultural-political development	General legislation & cultural-political development
Process	Market segments	Process of institutionalizing	Process of associating
	Market transactions	Process of competing	Process of communicating
	User profiles	Legal framework (Only user: Government)	
Functional	Overall contribution to TIS	At nursing stage of market formation dominated by: Uncertainty, Prime movers, To be open to variety creation	

In structural analysis, it is found that in licensed electricity generation constitutive elements (actors, networks, and institutions) are shaped by the mechanism of *exogenous regulation* (Table 5.10). In unlicensed electricity generation, these elements are shaped in two phases by the mechanisms of *exogenous regulation* and *spontaneous emergence* respectively (Table 5.11). Emergence of actors in licensed electricity generation and in first phase of unlicensed electricity generation is supported by *policies on entrepreneurship and antitrust*. It is supported by *entrepreneurial opportunism*[95] in second phase of unlicensed electricity generation. Emergence of networks in licensed and unlicensed electricity generation market segments is supported by the *policies on cartels, consortia and association* as mentioned by the exogenous regulation mechanism. Some exceptions of networks occurred in especially solar energy markets (as the second phase of market formation started in unlicensed electricity generation) which emerged by *recurrent interaction with known partner* as asserted by the mechanism of spontaneous emergence. Institutions in this sector are formed by legal framework shaped by general legislation and cultural-political development as asserted by the market constitution mechanism of exogenous regulation i**n** both market segments.

[95] This opportunity came up with the political intervention of increasing the limit of unlicensed electricity generation from 500 KW to 1 MW. This intervention created an entrepreneurial opportunity such as to build 1 MW power plants side by side and to sell all amount of generated electricity to related distribution company for commercial purposes rather than self-consumption.

Table 5. 10. Summary of Structural Analysis for Licensed Electricity Generation

Group of Organizations:	Actors:	Contribution of Economic Activity to Market Formation:	Constitutive Mechanisms:
Companies	Electricity generators	apply for licensed electricity generation based on renewable sources and generate electricity in this market segment	Exogenous regulation via the policies on entrepreneurship and antitrust that have roots in legal framework ***Policies on entrepreneurship:*** 1. Entrepreneurship for solar energy in energy specialization zones (referred to ETKB decision in 08.09. 2015 Official Gazette about Konya-Karapınar Renewable Energy Source Region) 2. To facilitate entrepreneurial actor profile in renewable energy sector- resilient and well-known capital owners enter the tenders (Tender regulation in Law on Utilization of Renewable Energy Sources for The Purpose of Generating Electrical Energy) 3. Additional connection capacities to motive more entrepreneurs (To realize 5GW of PV was announced in National Renewable Energy Action Plan released in December 2014 (ETKB, 2014)) 4. Measurement prerequisite (in Law on Utilization of Renewable Energy Sources for The Purpose of Generating Electrical Energy)-not needed, it is criticized! ***Policies on antitrust*** 1. To abolish monopolistic power of imported fossil fuels in electricity generation (stated in Energy Supply Security Document (ETKB, 2009)) 2. Announcement of small capacities to hinder monopolistic structures (600 MW announced for solar energy in 2013 and 3000MW announced for wind energy in 2014 by ETKB)
	Equipment suppliers	supply needed equipment to the electricity generators	
	Electricity distributors	issue official opinion concerning the connection to the grid	
Consultancy Organizations	Intermediary consultants	assist the license applicant and construction of the power plants	
	consultant bureaucrats in government organizations	make the laws and regulations clearer and more applicable in the license application and granting	
	consultant academics in academic organizations	engaged in research and development activities that may increase the efficiency of the technology in power plant	
Public Organizations	TEIAS	• announces the available capacity of the transmission system to connect solar and wind power plants to national grid, • evaluates the license applications' compatibility to the announced capacity, • allocates transmission capacity to licensed power plants, • signs connection and/or use of system agreements with license holding legal entities	
	EPDK	• accepts and evaluates pre-license applications for wind and solar energy power plants • signs the pre-license agreements with the winning participant of the license tender.	
	YEGM	• evaluates the pre-license applications before tender	
	ETKB	• makes the acceptance of the licensed power plants • issues renewable energy resource certificate	
	CSB	Responsible from Environmental Impact Assessment	
	OSIB	Management of energy potential measurement procedures	
	GTHB	Evaluation of the power plant construction field whether being cultivation area or not.	

Table 5. 11. Summary of Structural Analysis for Unlicensed Electricity Generation

Group of Organizations:	Actors:	Contribution of Economic Activity To Market Formation:	Constitutive Mechanisms:
Companies	Electricity Generators (electricity subscriber legal entities)	apply for unlicensed electricity generation based on renewable energy sources	**First Phase: Exogenous regulation Policies on entrepreneurship and antitrust** - Self consumption motivation: to support each actor to generate his own electricity consumption (not only the homebased consumption but also commercial organizations' (such as factories) consumption -The beginning and learning phase of renewable electricity generation
	Equipment suppliers	supply needed equipment to the electricity generators	
	Electricity distributors	collect the unlicensed electricity generation applications and evaluate these applications	
Consultancy Organizations	Intermediary consultants	assist the unlicensed electricity generation applicants to mediate the application and construction of the power plants	
	consultant bureaucrats in government organizations	make the laws and regulations clearer and more applicable in the unlicensed electricity generation applications	
	consultant academics in academic organizations	engaged in research and development activities that may contribute indirectly to the investor by increasing the efficiency of the technology in power plant-	
Public Organizations	TEIAS	takes the power plant projects from unlicensed electricity generation investors who holds Connections Invitation Letter and evaluates these projects.	**Second phase: Spontaneous Emergence Entrepreneurial opportunism** -Entrepreneurial opportunity: increasing exemption limit from 500 KW to 1 MW -To benefit from increased limit of unlicensed electricity generation -a new actor group emerged to export the surplus electricity generation to distribution system - large scale power plants started to be constructed for commercial purposes rather than to generate electricity for self-consumption - Unlicensed power plants (a kind of new medium of investments in renewable electricity) for commercial purposes substitutes licensed electricity generation
	YEGM	makes technical evaluation of unlicensed electricity generation applications that are coming from relevant network operator	
	CSB	Directorate of Environment and Urbanizations in each city issues the document of "Exemption from Environmental Impact Assessment for unlicensed electricity power plant"	
	GTHB	Directorate of Forestry and Water Affairs in each city assesses the appropriability of the power plant construction field whether being cultivation area or not.	
	Municipalities (in the related power plant application field)	approves the applications for physical and weather conditions for the power plant area	
Real Persons	Electricity subscriber individuals	apply for unlicensed electricity generation based on renewable sources	

In process analysis, sub functions of market formation (formation of market segments, formations of market transactions and formation of user profiles) are analyzed by processes. In Turkish case, two market segments are formed: Licensed and unlicensed electricity generation (Table 5.12). In licensed electricity generation, the field research corroborated that the dominant process that shaped the formation of market segment is *institutionalizing*. The dominant process that shaped the formation of unlicensed market segment is *associating*.

Table 5. 12. Formation of market segments

	Market segment is formed by constitutive elements of:	Market segment is formed by the process of:	Market segment is formed through the mechanisms of:
Unlicensed	• Specific actors (consumers, producers, consultant, bureaucrats, and researchers) involved in market transactions • Networks supporting innovative and market transaction	• Associating (certain rules of exchange and the sanctions attached to them are applied across many exchanges and become taken for granted)	• Interactions • Feedback mechanisms
Licensed	• Appropriate institutional framework	• Institutionalizing (the process of establishing relationships between actors that constitute networks, convey status, and work against the anonymity of markets)	• Institutionalization (in the meaning of repeated and certain rules and sanctions) of the energy sector • Learning by doing • Analyzing the big picture (energy sector as a whole) • Enhancing the role of domestic technology development

For the formation of market transactions, the field research corroborated that in Turkish case, in licensed and unlicensed electricity generation market segments, market transactions are formed by the dominance of *competing* and *communicating* processes respectively (Table 5.13). Due to the tender regulation to choose the license holders, the market transactions emerge through the process of competing in licensed electricity generation market segment. This market segment is shaped by competing since the government aims to establish a competitive market structure in this market segment. On the other hand, in unlicensed electricity generation market segment, market transactions are formed through the process of *communicating* to make facts relevant and available to market actors, who then interpret and act on them. Communicating as the process of market transactions formation shows that in unlicensed market segment, market formation is a bottom-up development that is based on communication between the sectoral actors rather than top-down development managed by the government. The analysis of third market formation sub-function of user profiles formation showed that in Turkish case, only user profile is the government in both licensed and unlicensed electricity generation.

Table 5. 13. Summary of Formation of Market Transactions

	Market transaction is formed by:	**Market transaction is formed by the process of:**	**Market segment is formed through the mechanisms of:**
Licensed Market Segment	• Exchange relationship between supply and demand for the end-products	• Competing (co-presence of different producers and suppliers in a given market context and multiple actors having a vying interest in making exchanges)	• Tenders • Competition on contribution fees (since contribution fees constitute large part of the power plant investment costs) • Government regulation (to guarantee the construction of licensed power plants and to ensure that market transactions are carried out in a competitive market environment) • High competition (high number of applications)
Unlicensed M. Segment		• communicating (making facts relevant and available to market actors, who then interpret and act on them)	• Market formation in two phases (as a result of communicating) • Intervention to carry the market formation from one phase to another • Feedbacks from actors

The results of functional analysis proceed that market formation in Turkish SW-EG Technological Innovation System is in the nursing stage that is open to variety creation in technological development and is dominated by uncertainty (Bergek et.al. 2008). As asserted by Dewald and Truffer (2012), in this stage, market formation affects overall performance of the Technological Innovation System on sub-function of market segments formation. In this sector, product variation in renewable electricity generation is not much, informal and continuously evolving relationships between the actors are dominant and commercialization has not be succeeded in established market structure. Due to these reasons, it is concluded that market formation in this innovation system is in nursing stage.

The overall conclusions derived from the analysis of market formation in Turkish SW-EG are:

- ✓ To design policies for production of domestic renewable energy technologies, the targets should be clarified carefully. Especially for market formation; competitiveness, R&D mentality and the quality of the inputs for the production should be taken into account. If the development of domestic renewable energy technologies is the main policy aim, it should be designed in the context of support mechanism focused on commercialization of the domestic product.
- ✓ Roadmaps for implementation of policies should be prepared with a sound legal framework infrastructure. A qualified expert group that recognizes the sector should lead this process. These roadmaps should be elastic to adapt to changes in the sector immediately. The responsibilities of each institutions and the task distribution between them should be clarified in these roadmaps.
- ✓ For designing renewable energy policies, current situation of energy sector and the relationship between the energy sector and renewable energy sub-sector should be elaborated carefully. The complementarity (rather than the substitutability) relationship between the energy sources in the energy bundle must be provided and the market formation should be supported by this way.
- ✓ Energy system and electricity distribution and transmission networks should be rehabilitated to integrate renewable electricity to the whole system smoothly.
- ✓ Self-consumption should be supported since on-site electricity generation is promoted, transmission and distribution losses can be reduced and hence electricity generation and consumption become more efficient.
- ✓ The role of government should be redefined as “a governor and regulator above the institutions and private sector”. Government should give up electricity generation, distribution and sales, but must be responsible from the regulation of the sector and construction of the legal framework. This reorganization will require a structural change and all requirements should be satisfied to succeed this structural change.
- ✓ A new governance model must be adopted by taking into account the industrial production and consumption relationship.

5.4. Policy Implications

The policy implications are determined by formulating policy recommendations to solve the policy problems. For this purpose, the policy design model proposed in Chapter 4 is used. In this model, to solve policy problems, policy recommendations are specified at different levels of macro, meso and micro level based on three dimensions of policy aim-policy tool-policy target. Therefore, policy implications are determined to solve the policy problems by formulating policy recommendations which has specific policy aims, policy tools and policy targets.

First of all, the policy problems are specified. In the context of this dissertation, there are two main policy problems which can be solved by diffusion of SW-EG technologies: *Import Dependency Problem* and *The Governance Problem*. For solving these problems, the policy recommendations are formulated at macro, meso and micro levels. The market formation is accepted as a key to diffusion of the SW-EG technologies. Therefore, policy recommendations are formulated by the examination of the market formation dynamics in SW-EG in Turkey. For each policy recommendation, policy aims, policy tools and policy targets are specified. Policy aim is to clarify the purpose of each policy recommendation. Policy tool is the way that defines how to achieve the policy recommendation. Policy target is to measure the success of policy recommendation.

To solve import dependency problem:

To solve import dependency problem by the policies for diffusion of SW-EG technologies, two policy recommendations are formulated at macro level and one policy recommendation is formulated at micro level. The policy recommendations at macro level are *considering complementarity relationship between energy sources* and *modelling a domestic technology development strategy*. The policy recommendation at micro level is *promoting self-consumption* (Table 5.14).

At macro level, first of all, it is recommended that *complementarity relationship (instead of substitutability relationship) between all energy sources should be considered in designing renewable energy policies* (Table 5.14). In the data analysis, it is found that electricity supply security problem in Turkey can be solved by formulating a balanced electricity generation bundle in which the rates of energy sources in electricity generation are equally distributed. This electricity generation bundle is recommended to be an optimized bundle and it should not be neither a fossil energy sources dominant nor renewable energy sources dominant. Therefore, main purpose of this policy recommendation (the policy aim) is *to solve electricity supply security problem by formulating a balanced electricity generation bundle* (Table 5.14). For this purpose, *multidimensional cost evaluation for* *renewable electricity generation* can be used as a policy tool. In addition to monetary costs, this cost evaluation must be made by taking into account the opportunity costs of each renewable energy source in comparison to other energy sources. The policy target to achieve by this policy recommendation is *to reach the target of 30% of overall electricity generation supplied by renewable sources in 2023* as implied in Energy Supply Security Strategy Document (ETKB, 2009). According to the data analysis, this rate should be distributed equally between renewable energy sources. This multidimensional cost evaluation would enable policy maker to compute specific numerical targets for each renewable energy source to reach in 2023 and such kind of policy targets would be more accurate to clarify the complementarity relationship on solid bases and to measure the success of this policy recommendation.

At macro level, secondly, it is recommended that *the domestic SW-EG technology development strategy in Turkey should be modelled clearly*. By this policy recommendation, it is aimed *to decrease import dependency in supplying renewable electricity generation equipment*. In the field research, it is asserted that most of the equipment used in renewable electricity generation power plants are imported from abroad and not to create another import dependency problem (which emerges from using imported technology in renewable energy power plants), technology development activities of domestic renewable electricity generation equipment suppliers should be supported. In current situation, domestic technology developers are supported indirectly. Instead of this indirect support mechanism, two policy tools can be used to model the domestic SW-EG technology development strategy in Turkey: (i) direct monetary subsidies for domestic technology producers and (ii) market segment focused technology development strategy. In current situation, the electricity generator who uses domestic product in renewable power plant is supported by extra feed-in tariff. In this model, the domestic technology producer is not supported directly for his technology development activity. In the field research, especially the equipment suppliers criticized such kind of support mechanism. Instead of this indirect support, direct monetary subsidies can be formulated to promote domestic technology developers. Therefore, this policy recommendation can be realized by using *direct monetary subsidies for domestic technology developers* as a policy tool. Moreover, *market segment focused technology development strategy* can be used as another policy tool to realize this policy recommendation. In this strategy, for unlicensed electricity generation market segment, small scale renewable electricity generation technologies (such as small wind turbines) can be produced and commercialized by individual technology producers. On the other hand, if the projected market segment is licensed electricity generation market segment, domestic technology developers should come together to establish consortiums to produce large scale energy technologies by gaining competitive power and benefitting from economies of scale. The main policy target to reach by this policy implication is *to realize 3000 MW of solar installed capacity in Konya-Karapınar Energy Specialization Zone in which domestic products are required to be used*. This target has roots in decision of ETKB announced in 08 September, 2015 Official Gazette about Konya-Karapınar Renewable Energy Source Region. For this region, the usage of domestic products is a prerequisite, but there is no specific emphasis on domestic technology development activities. However, domestic technology development strategy should mainly focus on the technology development activities by domestic producers. As a result, to realize this policy recommendation, specifically to support domestic producers (rather than foreign technology producers who manufacture equipment in Turkey) should be supported.

At micro level, it is recommended *to support self-consumption (which means on-site electricity generation and consumption) by renewable energy source.* By this policy recommendation, it is mainly aimed to increase unlicensed electricity generation based on small scale (mainly roof-top) power plants. In current situation, self-consumption is not very easy and common in Turkey. Instead of self-consumption, in unlicensed market segment 1 MW renewable power plants are constructed side by side to sell all amount of generated electricity for commercial purposes (to earn profit) rather than to generate the electricity for own electricity consumption. Due to this reason, to disseminate the self-consumption based on renewable energy, *the prosumer model* (in which the electricity generator consumes all generated electricity in the electricity production unit-for example the house or the factory) can be used as a policy tool to support self-consumption. In this model, the electricity producer is supported to be electricity consumer at the same time (due to this reason his name is prosumer: producer and consumer). This can be achieved by facilitating the procedures of unlicensed electricity generation for small scale production, or legalizing bilateral agreements between electricity consumers (whether being the individual consumers or industrial consumers) and the electricity generator companies through by-passing distribution companies. Moreover, *establishing demonstrative renewable energy power plants in the buildings of public organizations* would be another policy tool to realize self-consumption based on renewable energy sources. If the public organizations (such as ministries, municipalities, schools, hospitals) are supported to construct small scale power plants on the buildings' roof-tops to generate some of their electricity consumption, these demonstrative projects would be beneficial for building public opinion about small scale power plants for self- consumption since "learning by seeing" has an important impact on society and neighbor effect is an influential psychological facilitator for diffusion of SW-EG technologies. To realize the policy recommendation of supporting self-consumption by renewable energy source, the policy targets are to reach *1000 roof top power plants construction (like in Germany) in pilot regions with highest renewable energy potential* and *1000 roof top power plants construction for public organizations' buildings (such as ministries, municipalities, schools, hospitals buildings).* These targets are not specified in any renewable energy policy documents in force, however these targets can be easily put by ETKB to diffuse SW-EG technologies. Roof-top programs are very common and effective in other cases in the world (such as Germany as detailed in Chapter 2) and would be also very beneficial for Turkish SW-EG Case.

To solve the governance problem:

To solve the governance problem by the policies for diffusion of SW-EG technologies, one policy recommendation is formulated at macro level, three policy recommendations are formulated at meso level and one policy recommendation is formulated at micro level (Table 5.14). The policy recommendation at macro level is *preparing clear roadmaps and plans/projections about SW-EG*. The policy recommendations at meso level are *formulating manuals for renewable energy investment, changing the role of government in energy sector* and *introducing a governance mechanism to include SW-EG in industrial production* (Table 5.14). The policy recommendation at micro level is *rehabilitating electricity distribution and transmission infrastructure.*

At macro level, it is recommended that *clear roadmaps and plans / projections about SW-EG in Turkey should be prepared for SW-EG specifically to reach 2023 targets in Turkey.* The policy aim of this recommendation is *to make long term energy planning* in renewable electricity generation sector. In field research, lack of long term energy planning is indicated as a result of governance problem which leads unpredictability and uncertainty in energy sector and lack of coordination and division of labor between governmental organizations. Hence, this policy recommendation is formulated for the purpose of making long term energy planning to solve governance problem brought about by lack of long term planning. For this purpose two specific policy tools to use are *to prepare 5 to 10 years plans for each renewable energy source separately by taking into account each source's specificity* and *to determine realistic and clear actions for solar and wind electricity generation based on accurate solar and wind energy potential analysis on regional base (for example a solar energy action plan for Mediterranean Region or a wind energy action plan for Aegean Region).* Each renewable energy source has different features[96]. By taking these features into account, for each renewable energy source (specifically for solar energy and wind energy) 5-10 years plans should be prepared. As indicated by the analysis of field research, the actors from both for-profit and non-profit organizations pointed out that lack of long term planning is a chronic problem as the energy sector and this problem created additional deficiencies in renewable energy sector as well. Therefore, renewable energy action plans for each energy source can be prepared and used as a policy tool to realize this policy recommendation. Moreover, accurate potential analysis for each renewable energy source should be made to determine realistic and clear actions to realize these 5 to 10 years plans. To make the accurate potential analysis is the basics of this policy tool, since realistic and clear actions can only be achieved by evaluating the renewable energy potential clearly and certainly. Today, for solar and wind energy potentials GEPA (Solar Energy Potential Map) and REPA (Wind Energy Potential Map) are used, however as asserted in field research these maps do not give precise values for solar and wind energy potential. According to field research, it is asserted that, due to such data problems in GEPA and REPA maps, for each license application measurement become a prerequisite and regarded as a requirement for at least 6 months. To abolish this measurement prerequisite (which is criticized by most of the key actors in the sector as indicated in the field research), an *accurate potential analysis* can be used as a policy tool to realize this policy recommendation. It is proposed in field research that this analysis should be made by an expert group of actors including technical experts from governmental organizations (such as TEİAŞ, EPDK and TEDAŞ) and academics from the related departments and research units (such as GUNAM, RUZGEM, ITU Energy Institute) also by benefitting from international data bases (such as NASA data sources, EU data sources and the data generated by universities). The policy targets to measure how the policy makers are successful in implementing this policy recommendation are *to reach the*

[96] For example, solar energy is more appropriate for small scale home based electricity generation as compared to wind energy due to modularity of the photovoltaic panels. On the other hand wind energy is more appropriate for large scale electricity generation since the economies are scale becomes more advantageous as the number of wind turbines increases in the power plant area.

2023 targets of 5000 MW in solar energy and 20.000 MW in wind energy. These numerical targets are announced in National Renewable Energy Action Plan (ETKB, 2014). These targets are specifically determined for the rate of SW-EG technologies dissemination and to reach these targets, the policy recommendation of clears roadmaps and plans should be formulated specifically for solar and wind energy sources by taking each sources' specificity into account after preparing an accurate potential analysis.

At meso level, first policy recommendation is *to prepare manuals for renewable electricity generation investments* mainly with the aim of *solving lack of standardization problem in these investments*. According to the field research, lack of standardization is one of the reasons of governance problem since there is no clearly defined and standard procedures in renewable energy investment process [97] . To realize this policy recommendation, two main regulations which are the basic legal framework documents that regulate solar and wind electricity generation investments, *Electricity Market License Regulation* and *Unlicensed Electricity Generation in Electricity Market Regulation* must be prepared separately for solar and wind energy sources. The procedures, timetables, roles of actors in the investment process, cost of investments, the equipment supply used in investments are all specific for each energy source. Due to this reason, licensed and unlicensed market segments for each energy source should be regulated separately. To measure the success of this policy recommendation, the installed capacity targets should be determined separately for each market segment. For example, 5000 MW of solar installed capacity to reach in 2023 can be distributed to licensed and unlicensed market segments such as 4000 MW of installed capacity in licensed market segment and remaining 1000 MW of installed capacity in solar unlicensed market segment. By this policy target, the effectiveness of policy tools can be evaluated more accurately.

At meso level, second policy recommendation is *to change the government's role in energy sector from energy producer to sectoral regulator*. The policy aims behind this recommendation are to *reduce bureaucratic burden in renewable energy investments, to solve accountability problem of government in renewable energy sector* and *to remove deficiencies in trust relationship between the government and other actors*. In field research, bureaucracy (the red-tape) is said to be the most important administrative obstacle for diffusion of SW-EG technologies. This obstacle hinders the operations in licensed and

[97] For example, construction permits taken for establishing solar and wind electricity generation power plants change from one municipality to another mainly due to the fact that its procedures and time tables are not standard and depend on the private individual relationships in investment process.

unlicensed SW-EG market segments separately due to time consuming paper work, too many permissions to take from different institutions and detailed and unnecessary procedural obligations in application for and construction of solar and wind power plants. As asserted in field research, bureaucracy is seen as governmental control mechanism on renewable energy sector and said to be a part of government's learning process of renewable energy sector. This brings about one of the results of governance problem: *Government to become more interventionist to increase the control on renewable energy investments*. According to the field research, government intervenes the sector to protect the grid system from negative effects of renewable energy (such as intermittency problem of renewable sources). Due to these interventionist motivations of government, renewable energy sector becomes more unpredictable since government may change the rules and regulations frequently to protect the overall energy system. Key actors from governmental organizations claimed that renewable energy investments are a part of learning process for government. As a result, according to them, in this learning process, interventions and frequently changing rules are expected. Moreover, in the field research, it is asserted that government's unprecise position in the energy sector creates accountability problem. Government as being the regulator of the energy sector is expected to report, explain, and justify its operations and to be responsible and answerable about its all activities in the sector. However, according to key actors from renewable electricity generation and non-governmental organization (such as sectoral associations), government is not accountable in that manner. This problem additionally creates deficiencies in trust relationship between the government and other actors. Therefore, with the aims of reducing bureaucratic burden, solving accountability problem and removing deficiencies in trust relationship, it is recommended to change the government's role in energy sector from energy producer to the sectoral regulator. To realize this policy recommendation, policy tools are to e*stablish a unique coordination mechanism for renewable energy investments* and *to define roles, responsibilities and duties of each actor (including government) in addition to sanctions in case of negligence/failure clearly in energy sector by legal framework.* The policy target of this recommendation is *authorization of YEGM (General Directorate of Renewable Energy) as the unique coordination mechanism and organization for all renewable electricity generation activities*. YEGM, as being the unique coordination mechanism, would control all procedures related to application for and construction of licensed and unlicensed solar and wind energy power plants. In this situation, the conflicts which resulted from the bureaucratic burden and accountability problem would be solved by defining YEGM as the unique coordination mechanism. Moreover, authorization-responsibility complementarity for YEGM and the sanctions in case of actors' failures must be determined specifically before new applications are collected in solar and wind electricity generation in Turkey. If this can be achieved as the policy target before the new solar and wind energy applications, this policy recommendation is said to be a successful recommendation.

At meso level, third policy recommendation is *to introduce a new governance model for industrial production including SW-EG* (Table 5.14). This policy recommendation depends on most cited administrative facilitator, *peak shaver effect of renewable energy*, asserted by for-profit organizations. The policy aim behind this recommendation is *to increase the usage of domestic renewable energy sources at the midday* in addition to consuming electricity from the general grid system. In field research, it is asserted that in midday industrial production is at highest level and the renewable energy potential (esp. solar energy) is also at highest level. The electricity cost of the factory, which is highest at midday due to peak hour of industrial production, can be decreased if some amount of electricity consumption can be supplied by renewable electricity generated in solar or wind power plant constructed in roof-top of the factory or near the factory, since the renewable electricity generation potential (especially the solar energy potential) is also at highest level at midday. To achieve this policy recommendation, the policy tools are *support mechanisms (such as extra feed-in tariff) for using renewable electricity generation in peak hours, specific project finance mechanisms for construction of renewable power plants in industrial production facilities* and *bilateral agreements between renewable electricity generators and the factories.* For instance, in Organized Industrial Regions, the factories can be supported to construct their own renewable power plants to generate renewable electricity to use in industrial production's peak hours. Moreover, government or financial organizations (such as banks or TURSEFF[98]) can formulate specific project finance mechanisms for construction of renewable power plants in industrial production facilities for midday to increase renewable electricity generation usage. Bilateral agreements (which are not legal for renewable electricity generation now in Turkey) can be legalized and used as another policy

[98] "Turkey Private Sector Sustainable Energy Finance Facility (TurSEFF)" is a framework operation with up to USD 265 million under which credit lines will be provided by EBRD (European Bank for Reconstruction and Development) to eligible commercial banks for on-lending to private sector borrowers for energy efficiency and small-scale renewable energy investments (http://www.turseff.org/en/page/what-is-turseff, Last Access: 29.01.2016)

tool to realize this policy recommendation. Moreover, infrastructural re-arrangement should be made to adapt the electricity grid system to smart grid in Turkey, since benefitting from renewable electricity at specific hours of the day (such as middays) without cutting the connection with the grid (so to say for on-grid renewable electricity generation power plants) is not possible unless the grid system is converted to smart grid. The policy target can be formulated by putting a specific numerical target of renewable electricity usage in industrial electricity consumption. At the beginning this target can be specified for pilot regions such as Organized Industrial Regions. For example, for a pilot organized industrial region, at the end of 2016 1% of total electricity consumption can be supplied by renewable energy power plants. To reach this target, TEİAS also take pilot smart grid applications into the new infrastructural investment agenda for this specific organized industrial region with high renewable energy potential.

At micro level, only policy recommendation is *to rehabilitate overall electricity distribution and transmission infrastructure* (Table 5.14). The policy aim behind this recommendation is *to increase electricity supply security and to improve the physical infrastructure to adapt the renewable electricity generation to overall electricity distribution and transmission system.* In the field research, it is found that most cited physical obstacles that hinder diffusion of SW-EG is "infrastructural deficiencies" to transport renewable electricity to consumers. These deficiencies mainly originate in new equipment requirements and transformer requirements to integrate renewable electricity generation to overall electricity distribution and transmission systems. Moreover, in the field research, it is asserted that, in the regions with high renewable energy potential (such as Mediterranean Region) capacities of transformers are overloaded and hence new applications cannot be accepted mainly due to these overloaded transformers capacity. As a result, unlicensed renewable electricity generation slows down due to these infrastructural problems. To solve such problems, rehabilitation of electricity distribution and transmission infrastructure is recommended. The policy tools to realize this recommendation are *periodical announcement of transformer capacities (reserved for solar and wind energy sources), new infrastructure investments by TEİAŞ and distribution companies,* and *establishing a team in TEAİŞ which is responsible from infrastructural rehabilitation during renewable power plant construction*. If the transformer capacities and the share of these capacities reserved for renewable energy power plants are announced periodically, the renewable power plant investors can make detailed feasibility plans for each investment project by evaluating these capacities. TEİAŞ made first capacity announcement in January, 2015[99]. After January, 2015 TEİAŞ declared that at the beginning of each month, these capacities are updated by new infrastructure investments. Therefore, periodical announcement of transformer capacities (reserved for solar and wind energy sources) is used in this way to achieve the policy recommendation of infrastructural rehabilitation. For the announcement of new capacities periodically and new infrastructure investments by TEİAŞ and distribution companies, a team in TEAİŞ which is responsible from infrastructural rehabilitation must be established. If transformer capacities are announced at the beginning of each month, this can be accepted as an achieved policy target to realize this policy recommendation. Since January 2015, TEİAŞ has been announcing transformer capacities[100]. These announcements are good sources for renewable energy investors and can be accepted as an indicator for rehabilitation of electricity distribution and transmission infrastructure to integrate the renewable electricity to overall system.

[99] For detailed capacities reserved for solar and wind energy sources can be seen here: http://www.teias.gov.tr//Duyurular/Lisanss%C4%B1z%20Tahsis%20Edilen%20GES-RES%20Kapasiteleri.pdf (in Turkish). Last access: 22.01.2016

[100] For these announcement, check TEİAŞ website "Announcement" via http://www.teias.gov.tr/Duyurular.aspx. (in Turkish).

Table 5. 14. Policy Implications for Diffusion of SW- EG Technologies in Turkey

Policy Problem: *Solving import dependency problem*

At	Policy Recommendations	Policy Aims:	Policy Tools:	Policy Targets:
Macro Level	Complementarity (rather than substitutability) relationship between energy sources should be considered.	-To solve electricity supply security problems by a balanced electricity generation bundle	-To make multidimensional cost evaluation for renewable electricity generation by taking into account the opportunity costs of each energy source.	To reach the target of 30% of overall electricity generation supplied by renewable sources in 2023 as implied in Energy Supply Security Document (ETKB, 2009). According the data analysis, this rate should be distributed equally between renewable energy source
	The domestic SW-EG technology development strategy in Turkey should be modelled clearly.	-To decrease import dependency in supplying renewable electricity generation equipment -To support technology development activities of domestic renewable electricity generation equipment suppliers	-To provide direct monetary subsidies for domestic technology developers and producers -To use market segment focused technology development strategies such as: (i) individual production of small scale energy technologies in unlicensed electricity generation market segment (ii) consortiums for large scale production in licensed market segment	-To reach the targets of 3000 MW of solar installed capacity in Konya-Karapınar Energy Specialization Zone in which domestic products are required to be used.
Micro Level	Self- Consumption (on-site electricity generation and consumption) should be promoted.	-To increase unlicensed electricity generation based on small scale (mainly roof-top) power plants	-To support “prosumer model” in unlicensed electricity generation market segment through bilateral agreements. -To establish demonstrative renewable energy power plants in the buildings of public organizations.	-To formulate 1000 roof top program that can be applicable for the pilot regions with highest renewable energy potential. -To formulate 1000 roof top program (like in Germany) that can be applicable for public organizations’ buildings

Table 5. 15. Policy Implications for Diffusion of SW- EG Technologies in Turkey (continued)

Policy Problem: *Solving governance problem*

At	Policy Recommendations	Policy Aims:	Policy Tools:	Policy Targets:
Macro Level	Clear roadmaps and plans about SW-EG in Turkey should be prepared to reach 2023 targets.	-To make long term energy planning.	-To prepare 5 to 10 years plans for each renewable energy source. -To determine realistic and clear actions for SW-EG based on potential analysis on regional base.	-To reach 5000 MW installed solar power solar in 2023 (specific target announced ETKB (2014)) -To reach 20.000 MW installed wind power in 2023 (specific target announced in National Renewable Energy Action Plan)
Meso Level	Manuals for renewable electricity investments should be prepared.	-To solve the problem of lack of standardization in renewable electricity generation investments.	-To prepare "Electricity Market License Regulation" and "Unlicensed Electricity Generation in Electricity Market Regulation" separately for solar and wind energy sources.	-To reach specific installed capacity targets in each market segment (For. ex. in solar energy 4000 MW of installed capacity in licensed market segment and remaining 1000 MW of installed capacity in unlicensed market segment in 2023)
	The government's role in energy sector should be changed from energy producer to sectoral regulator.	-To reduce bureaucratic burden. -To solve accountability problem. -To remove deficiencies in trust relationship.	-To establish unique coordination mechanism in renewable energy investments. -To define the roles, responsibilities, duties of each actor and the sanction of each failure by legal framework	-YEGM as a unique coordination mechanism and organization must be authorized for renewable electricity generation activities especially before new applications are collected in solar and wind electricity generation in Turkey.
	A new governance mechanism should be introduced for industrial production including SW-EG.	-To increase the usage of domestic renewable energy at the midday when both the industrial production and renewable energy potential are at highest level.	-To support using renewable electricity in peak hours of industrial production. -To formulate specific project finance mechanisms for renewable energy in industrial production facilities. -To legalize bilateral agreements between renewable electricity generators and the factories.	-To put a specific target of renewable electricity usage in industrial electricity consumption -TEİAS should take pilot smart grid applications into the new infrastructural investment agenda for the regions with high renewable energy potential in industrial districts.
Micro Level	Electricity Distribution and Transmission Infrastructure should be rehabilitated.	-To secure electricity supply and to improve the physical infrastructure to adapt the renewable electricity to overall grid system.	-To announce transformer capacities and infrastructure investments periodically -To make new infrastructure investments by TEİAŞ and distribution companies -To establish a team in TEAİŞ responsible for infrastructural rehabilitation	-Announcement of transformer capacities at the beginning of each month in TEİAŞ website.

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APPENDICES

A: Sections (Higher Order Categories), Sub-Categories, Codes and Code Definitions Used in Data Analysis

Table A. 1. Details of Data Analysis Framework

SECTION 1: INTRODUCTION / WARM UP (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
1. Personal Information:	Education	Education level-completed undergraduate and graduate degrees
	Experience	Accumulated work experience in energy sector
	Expertise in Energy Sector	The total working years in energy sector (including the years spent in any subsector other than renewable energy sector if the interviewee has that expertise)
	Expertise in Renewable Energy Sector	The total working years in renewable energy sector
	Org. Tasks	Organizational tasks performed by interviewee in the organization s/he works
2. Organizational Information	Organization Activities	Organization's overall activities performed in renewable energy sector
	Plans/Projections / Expectations	Organization's short and long term plans, projections /targets in Renewable energy sector and expectations about the outputs of the plans/projections
	Strategies in Renewable Energy Sector	Organization's business and R&D strategies in renewable energy sector
SECTION 2: CURRENT SITUATION OF TURKISH ENERGY SECTOR (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
3. Problems in energy sector	Accountability	The problems about government's accountability to follow the policies and legal framework, the state of being obliged to report, explain, or justify its operations in energy sector, to be responsible and answerable.
	Energy Efficiency	Neglecting energy efficiency in energy consumption
	Import Dependency	To be a country that is dependent on imported energy sources for energy production and electricity generation
	Infrastructural Problems	Problems about the physical infrastructure used in electricity generation
	Insufficient Domestic Sources	Domestic resources of the country are not enough to supply energy demand - not to be self-sufficient

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 2: CURRENT SITUATION OF TURKISH ENERGY SECTOR (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
3. Problems in energy sector	Interventionist Government	Government is extremely intervening the energy sector and hindering the sector to function completely
	Lack of Capabilities	Lack of bureaucratic capabilities to support diffusion of renewable energy technologies
	Problems about Governance	Lack of a governing system in the energy sector to exercise the authority, lack of managerial capabilities and lack of planing abilities of the governmental actors
	Lack of Standardization	Lack of clear standarts, rules and regulation applied to all actors in the sector
	Lack of Long Term Energy Policies	Turkish energy policies are not clearly defined for long run and the targets are not determined definitely
	No Prioritization	The lack of prioritization in determination of the targets in energy sector
	Predictability	To predict the future of the energy scene of the country is not possible due to unclearity of policies
	Prejudices about Businessman	Negative prejudices (esp. in bureaucracts) about businessmen in energy sector
	Privatization	Problems experienced in the process of transfering ownership, property or business from the government to the private sector especially in electricity distribution companies in Turkey
	Problems in Education System	Problems in general education system that hinders the actors to build needed capabilities
4. Reasons for using fossil fuels:	Easily Constructured Plants	Construction of fossil fuels power plants and electricity generation in that plants are easier as compared to other energy sources
	Efficiency	Electricty power plant efficiency as the ratio between useful electricity output and the energy value of the energy source
	Energy Supply Deficit	General energy equilibrium where the energy demand exceeds energy supply
	Institutional Support	Current institutional framework of the country supports electricity generation based on fossil fuels.
	Not supporting Renewable Energy Technologies	Renewable electricity generation is not supported by government policies hence fossil fuels substitute renewable electricity generation
	Political Legitimacy	Fossil fuel based electricity generation is politically legitimate as compared to other sources
	Social Acceptance	These sources are easily accepted by society and are widely used due to positive externalities created by using fossil fuels
	Subsidies	Direct and indirect subsidies for supporting fossil fuel based electricity generation
5. Optimal Bundle:	Balanced	The share of fossil fuels and renewable sources are balanced in country's energy bundle
	FF (Fossil Fuel) dominant	The share of fossil fuels is higher than the share of renewable sources in country's energy bundle
	RS (Renewable Sources) dominant	The share of renewable sources is higher than the share of fossil fuels in country's energy bundle

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 3:INDUCEMENT AND BLOCKING MECHANISMS (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
6. Facilitators:	Subcontractor	The company at lower level in production value chain hired for the production in main company
	Abundant source	Renewable sources are abundant and easily reached energy sources in Turkey
	Being Domestic Source	Renewable sources are totally domestic energy sources in Turkey.
	Bundle Effect	Big energy firms' strategy to include renewable sources to balance the shares of energy sources in energy production bundle
	Contracts and Collaboration with Experts	At the first pace of entering the sector, the consultancy firms prefer to works on contract based with experts to benefit their experience in sector
	Cost-Competitiveness	Renewable energy technologies are becoming cost-competitive as compared to conventional energy technologies (such as fossil fuel based electricity generation technologies)
	Country Experience	Positive country experiences that can be used for learning the diffusion of renewable energy technologies
	Deficiency in Fossil Fuels	Fossil fuels are not enough to generate electricity demand in Turkey
	Direct Support for Investment	Direct support by government for building renewable energy power plants
	Eager Investors	Investors are ambitious to benefit from new invesment opportunities in renewable energy sector
	Energy Supply Security	Ensuring the availability of energy sources to sustain the supply of energy consumption
	Experience in other Renewable Sources	Accumulated experience in other renewable energy technologies diffusion (such as hyroelectric energy)
	Feedbacks from Market Formation	Firms take feedbacks from the early market formation process and reflect them to carry the market formation one step further
	Fixed Price for electricity	Government guarantees the investor to purchase solar electricity from the highest fixed price for next 10 years (Now this period is extended to 49 years in unlicensed electricity generation, like licenced generation)
	Financial Supports for Renewable Energy Technologies	Financial supports given by government and by financial organization to promote the energy investments
	Government Subsidies	Direct government subsidies in monetary terms (such as 13.3 dolar cent/ KWh for electricity generated by solar power)
	High Electricity Prices	Electricity consumption prices are high in Turkey
	Improved Health and Environmental Conditions	Diffusion of renewable energy technologies may improve health and environmental conditions, prevent of biodiversity loss and reduce greenhouse gas emissions
	Increasing Electricity Consumption	General electricity consumption is rising and the exisiting power plants are not enough so Turkey needs additional power plants such as renewable energy based electricity generation plants

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 3:INDUCEMENT AND BLOCKING MECHANISMS (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
6. Facilitators:	Job creation	New employment opportunities are created by economic activities of the actors in the renewable energy sector
	Knowledge Transfer Channels	Technical and technological knowledge are transferred from one actor to another via these channels
	Lobbying and advocacy coalition	To influence the decision makers in the energy sector to improve the existing conditions for structural changes in the sector and to adapt the policies to these changes
	Long term Investments	Wind and solar power plant investments are long term investment that the investor earns money for 25-30 years
	Low opex	Sustainability and operation of solar and wind power plants are low mostly due to zero input costs for electricity generation (low operation expenditures)
	Neighbour Effect	A firm owner sees the renewable power plant in the next firm located near his firm and wants to construct the same power system in his own firm, learning by seeing
	Networking and collaboration	Networking and collaboration between the actors in the sector
	New Invesment Opportunities	Electricity generation based on renewable sources creates new investment opportunities in the economy
	No Input Cost	The inputs of renewable energy power plants are solar and wind. They are domestic sources and free of charge, hence there is no input cost.
	Peak Shaver Effect	Renewable sources (especially solar power) can decrease electricity consumption when the electricity demand riches to maximum point (especially at midday)
	Priority to Renewable Energy Sector	Some priorities and privalages are given to renewable energy sources to motive the diffusion process
	Prosumer Effect	Renewable sources can be benefitted in small scale systems and the electricity consumer can generate (produce) his own electricity consumption, hence the producer and the consumer can be the same actor
	Reduced Import Dependency	By using domestic renewable energy sources, import dependency can be reduced
	Reduction in electricity losses in transmission and distribution	During the transmission and distribution of electricity, some of generated electricity is lost on the way to reach final consumption point. These loses can be reduced by shortening the distance between electricity generation plant and consumption point.
	Rural development	Renewable energy power plants create new opportunities for rural development such as increasing employment in the local area of power plant.
	Subtitution Effect	Renewable sources may substitute the fossil fuels in electricity generation
	Technology Development Trajectories	The routines and ways followed in the society to develop technology
	The Electricity Purchase Programs	Generated electricity is purchased by the government for the predetermined prices for ten years (for unlicensed electricity generation)

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 3:INDUCEMENT AND BLOCKING MECHANISMS (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
6. Facilitators:	Transmission of Sectoral Knowledge	Transmission of the accumulated knowledge in a sector that is indireclty related to renewable energy (such as semiconductors) to renewable energy sector
	World Trends	In the world, renewable electricity generation is also a rising energy subsector and economic activity
7. Obstacles:	Awareness	Consciousness about the benefits of electricity generation based on renewable sources
	Bureaucracy	Heavy work burden due to lack of the systemic governmental organizations those follow clearly defined procedures in an organized manner
	China Effect	China produces renewable energy equipments very cheaply as compared to Turkey (and other countries) and this hinders technology development in Turkish Renewable Energy Sector.
	Construction plan-permits	In renewable power plant applications, too many permits must be taken, and detailed and time consuming contruction plans must be prepared.
	Cooperation	Due to the gains are very different for different actors in the sector, the motivations of the actors do not match at the same point and hence cooperation becomes an obstacle rather than a facilitator
	Coordination between Governmental Organizations	There is no coordination between the governmental organizations which are direclty related to renewable electricity generation in Turkey
	Counter Lobby	Counter lobby of conventional embedded technologies to slow down the diffusion of renewable electricity generation technologies.
	Deficiency in Market Formation	Imperfections in market formation in renewable electricity generation
	Dependency on Natural Conditions	Solar and wind energy sources are highly dependent on natural conditions (such as weather, construction field)
	Failure in institutional alignment for new technology	Institutional framework (such as the legal framework) is not adapted to changes in new technology (of SW-EG)
	Field Problems	Problems about renewable power plants fields (such as high prices for renting the needed land, difficulties in finding the appoprate land)
	High (initial) Costs	Installation cost of renewable power plants are high as compared to conventional sources
	High Storage Costs	Energy storage makes renewable energy investments more advantageous but storage technologies are very expensive for today, because they are emerging and developing technologies
	Imported Technology	Technological equipments used in renewable power plants are imported and not produced in Turkey at competitive prices

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 3:INDUCEMENT AND BLOCKING MECHANISMS (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
7. Obstacles:	Inefficiency	The ratio of electricity output to energy value of renewable source is lower as compared to other energy sources
	Unequipped consultancy	Consultancy firms which play an intermediary role between the suppliers and power plant investors are not well-informed and sometimes they do not facilitate this intermediary process
	Infrastructural Deficiencies	Distribution and Transmission Infrastructure for electricity is not sufficient in Turkey to encompass the renewable electricity into the system
	Make something up as you go along	Needed changes and adaptations are made during the market formation process, and this is typical for Turkish society ("Kervanı yolda düzmek" in Turkish)
	Lack of (Technical) Information	Technical information needed for construction of renewable power plants (esp. Accumulated in the workers of this construction process) are not sufficient and this slows down the diffusion process
	Lack of Critical Mass	Lack of an amount of installed power (such as 1GW in solar power) to announce that there is an critical mass in that renewable power.
	Lack of Technological Development Vision	Lack of technological development vision in the companies/capital owners in private sector
	Lack of Financial Model	Lack of financial model for new technology developed by Turkey (domestic renewable energy technologies). In technology development activity, financial models and commercialization of new technology are neglected
	Long pay-back periods	Pay back periods of renewable energy investments are longer as compared to other energy sources and this makes renewable energy investment less attractive
	Mental Barriers	Such as Inferiority complex, lack to self- confidence
	Mistakes in process	Structural mistakes are made at the construction of the licencing process for granting the renewable energy licences
	Negative Experience	Negative past experience in renewable energy sector (especially in wind energy licence application in 2007 in Turkey)
	Not a Base Load	Renewable sources are not base load energy sources (base load power plant is the energy plant which can generate dependable power to meet energy demand consistently)
	Nuclear Power	Establishment of nuclear power plants in Turkey
	Precautions issued by Legal Framework	Legal framework necessitates some precautions to be taken before application for renewable energy power plants licences (Such as measurement prerequisite before solar licence applications)

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 3:INDUCEMENT AND BLOCKING MECHANISMS (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
7. Obstacles:	Problems in Electricity Generation	Problems in the process of renewable electricity generation in the power fields(such as "dust" in solar panels, or logistic problems in wind farms)
	Problems about Networking	Problems in construction of networks especially due to personal interests and ambitions
	Project Finance	To find financial resources for power plant project is very difficult
	Qualified technical personnal	There is not enough qualified technical personal in the sector
	Self-Consumption Requisite	For unlicenced electricity generation based on solar and wind power, there is a possibility of establishing self-consumption requisite which dictates the owner of the power plant to consume some amount of generated electricity
	Technological Immaturity	Renewable energy technologies are emerging technologies and yet immature technologies in the world
	Tenders	When there are more than one firm applies to build a solar/wind power plant for the same plant field, TEIAS organizes competitions to choose the project that will connect to the grid. ETKB accepts the licence applications for limited capacity in predetermined application period. This regulation slows down diffusion of renewable energy technologies.
	Transparency	All the regulations are not clear and well defined hence the sector is not informed well
	Uncertainity	The rules and regulation are not certain and well defined in the sector and this violates standardization and tasks to be completed at determined time period
	Changing rules	Rules are changing during the process and this creates extra burdens for the investor
	License Traders	Some people are active in the sector, they are trying to make money by buying the licence and sellig them at high prices and makes profits
SECTION 4:MARKET FORMATION in RENEWABLE ELECTRICITY GENERATION (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
8.Market Constituents:	Certification-Standardization	Determined and standardized rules and regulations of the market transactions
	Competitiveness	Competitive power of the actors in the renewable electricity market
	Complementary Good	Complementary goods are goods which are used together to maximize utility of buying and using one of them (Electricity generated based on renewable sources is a complementary good for electricity generated based on other sources)
	Competing Technologies	In renewable energy systems, new technologies are competing to each other to be developed further and to dominate the sector

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 4:MARKET FORMATION in RENEWABLE ELECTRICITY GENERATION (*Higher order category*)		
Sub-Category:	***Code:***	***Code Definition:***
8.Market Constituents:	Credit for investment	Financial credits for establishment of the projects for electricity generation based on renewable sources
	Demand	Demand for electricity generated based on renewable sources
	Emerging actor profile	Emerging actor profile in renewable energy sector (mainly consolidation)
	Economic Value of the Good	Economic value of the electricity generated based on renewable sources
	Field Decision Criteria	The standard and constant criteria for determination of the field for renewable electricity generation power plants
	Generation	Electricity generation based on renewable sources
	Institutional change for Market Formation	Institutional change made for market formation in renewable electricity generation in TR
	Insurance	Insurance for the renewable power plants sustanability and guranteed electricity generation, managing risk of breaking down of the power plant equipment
	Investment conditions	Investments conditions for establishing renewable power plants
	New Market Structure	Energy trade in Turkey should be reformulated again
	One final good: electricity	All resources (such as solar, wind, hydroelectricity, nuclear, thermal power..) generate the same final product of electricity, hence they are all substitutes for each other
	Opportunity cost	If the government invests in renewable energy, the excess money that is not spent for power plants are transferred to other government expenditures such as health expenditures
	Production conditions	Electricity generation facilities in a power plant
	Purchasing process	Electricity trading in Turkey
	Rant Income	Extra profits and income generated in renewable electricity generation
	Trasmission	Transmission of generated renewable electricity from one point to another
	Actual Market Development	Actual situation of renewable electricity market development in Turkey
	Auditing	Auditing of the renewable electricity generation power plants construction and electricity generation processes
	Licence applications	Licence application for obtaining the right of constructing renewable electricity generation power plants
	MS_Licensed EG	Market structure of licenced electricity generation market segment

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 4:MARKET FORMATION in RENEWABLE ELECTRICITY GENERATION (*Higher order category*)		
9.Market Development	MS_Unlicensed EG	Market structure of unlicenced electricity generation market segment, decentralized, small scale, home based generation, rooftop systems (rather than 1+1+1...MW systems for profit making)
	Support by politics	Direct political support and initiative (top down authority) for diffusion of renewable electricity
	Domestic-foreign market penetration	Domestic production is whether for domestic markets or foreign markets
SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
10.Interaction of Public Policies and Market Formation	Clarity of Policies & Targets	Public policies and future targets for renewable electricity generation in Turkey must be clarified and well defined to support market formation, hence diffusion of renewable electricity generation
	Consistency of Policies	Consistency of renewable energy policies and regulation in the sector
	Demostration Projects-Showcase	There are demonstration projects and showcases as examples for renewable power plants in Turkey to explain and present the society the benefits of renewable electricity generation in Turkey
	Direct Public Provision	Direct public provision for construction of renewable power plants to supply government's electricity demand, hence supports diffusion of renewable electricity
	Domestic production	Domestic resources are not enough to supply demanded energy - not to be self sufficient
	Elasticity of policies	RES policies should be elastic to adapt the instant changes in the sector to support market formation
	Firm entry activity	New firms enter and exist the renewable energy sector due to some specificities of the sector
	Industrial Policies	Industrial policies should be established in parallel to energy policies and hence renewable energy sector may be affected by them
	Legislation and MF	The laws and regulations in renewable energy sector must be made and enacted to reach the target of market formation (MF) in the sector
	Legitimacy	The activities of the actors must be in accordance with established rules, regulations and laws in the renewable energy sector for market to be formed
	Policy making process	The process of renewable energy policy making is directly related to market formation in Turkish renewable energy sector
	Policy priorities	Market formation in renewable energy sector should be determined as a policy priority for renewable energy policies in Turkey
	Policy-Aim-Tool Compatibility	Policies, aims to establish these policies and tools to reach the targets by this policies should be incompatible to each other
	Renewable Energy Policy implications and MF	Examples of renewable energy policy implications and their effects on renewable enerhy market formation (MF)

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
10.Interaction of Public Policies and Market Formation	Risks and Problems in Application Process	Risks and problems in licence application process for the firms included in the whole process.
	Role of Interest Group in Policy Design	Interest groups have impacts (positive or negative) on renewable energy policy design
	Sanctions-Punishments	Abuse of policy implications must be punished and sanctions must be clear and pretermined for misfunctions of the actors in the sector
	Strategies to promote MF	Actors in the sector should have strategies to promote renewable energy market formation
	Vision and mission in policy design	Vision and mission in renewable energy policy design should be incompatible with renewable energy market formation
11.Purpose of REP	To solve Infrastructure Problems	The purpose of renewable energy policy is to solve infrastructural problems such as inefficiency in electricity transmission power lines, country wide grid system or transformers-power distribution units rehabilition in physical infrastructure
	To be Deliberate (Consciosly slowing)	The purpose of renewable energy policy is to be deliberate in building renewable energy sector on solid bases (and indispensibily slowing the growth of the sector systematically and consciously and diffusion of renewable energy technologies to be precautious)
	To Decrease Import Dependency	The purpose of renewable energy policy should be "to decrease import dependency"
	To Promote Domestic Production	The purpose of renewable energy policy is to promote domestic production of renewable energy technologies
	To Promote Energy Efficiency	The purpose of renewable energy policy is to promote energy efficiency in industrial and home based energy consumption
	To Promote Storage Technologies	The purpose of renewable energy policy is to develop domestic storage technologies in Turkey
	To reach 2023 targets	The purpose of renewable energy policy is to reach 2023 energy targets
	To Secure Supply	The purpose of renewable energy policy is to secure the sustainability of energy supply
12.Features of Policy Makers	Ability to Coordinate the System	Ability to coordinate the renewable energy technological innovation system in the country
	Ability to determine Technological Knowledge Base	Ability to know the details of the technological change in the energy sector and following the updates and innovative activities
	Ability to Evaluate System Dynamicss	Ability to understand and perceive the renewable energy system from inside and outside
	Ability to Analyse Financial Conditions	Ability to analyze the financial opportunities and conditions about renewable energy project finance
	Ability to Detect the System Specific Features	Ability to understand sui generis-system specific features of renewable electtricity generation in Turkey and to take into account these features while designing policies

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
12.Features of Policy Makers	Ability to Foresee and Plan	Ability to foresee the coming events and the results of policy actions and make plans according to these expectations and the targets of policy actions
	To be Multifaceted	To be versatile and to understand and analyze different aspects of the energy debate instantly
	To have International Relations Abilities	To have capabilities and accumulation about the international relations and to be active in international energy and technology development area
	To have Sectoral Knowledge and Experience	To have renewable energy sector specific knowledge and experience in Turkey
	To have Good Consultancy	To have a consultancy team that includes wise and sophisticated energy experts and to benefit from this team during policy making process
13. Policy Proposals	Clear Plans and Roadmaps	Turkey should have clear renewable energy plans and targets, and to reach this target Turkey must design well-prepared and detailed roadmaps
	Decreasing Tariff Rates	Tariff rates for renewable electricity prices should be decreased in long run to normalize the renewable electricity prices and to include renewable electricity to the market as a normal good
	E-application	E-application for renewable electricity generation (licenced or unlicenced) should be formulated to fasten the process
	Educational Facilities	New educational opportunities should be established to clear the uncertainities in the system
	Electricity Transformers capacity	TEIAS should increase electricity transformers capacities-power distribution units allocated for renewable electricity generation
	Energy Mix Report	Plans and projections about a country's energy decisions and bundle choices should be made in collaboration between different public institutions in the country in a multifaced fashion
	Energy Specialization Zones	Government should determine specific areas eligiable for renewable electricity generation, should clarify the rules, regulations and standarts about the construction of the fields and renewable electricity investments should be made to this specific areas
	EPC Network	A leading energy EPC (Engineering Procurement Construction) firm should manage a network of EPC firms to increase the efficieny of the EPC work especially in distant areas and to transfer the acculated knowledg to the new firms in the sector to increase the expertise and technical knowledge in overall sector
	Expert groups-project based working	While generating reneawable electricity, the actors should work project based with sophisticated expert groups about different aspects of new investment (a kind of specialization should be promoted)
	Field regulations	Specific regulations and rules should be clarified for predetermined fields of renewable electricity generation

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
13. Policy Proposals	Foreign partnership	To produce domestic renewable energy technologies, foreign partnership must be provided to transfer technology and to benefit from their expertise and knowledge accumulation
	Government led technology production	For technological development of domestic renewable electricity generation, the government should lead and manage this technological development process
	GIS-Geographical Information Systems	In Turkey, to determine appropriate fields for renewable energy investments, Geographical Information Systems should be loaded
	Impact Assesment	Impact assessment of renewable electricity generation policies and regulations should be made periodically and reported to public to increase the lessons learned
	Marketing in Renewable Electricity	New marketing strategies should be implemented (especially in small scale-home based solar systems) to promote diffusion of renewable electricity generation technologies
	Measuring Potential	Measuring the renewable electricity generation potential by a central scientific organization and by government led facilities
	Net-Metering	Net-metering is a billing mechanism that credits renewable energy system owners for the electricity they add to the grid.
	New Governance Model-Mechanism	For simplfying the procedures for licenced and unlicenced electricity generation, a new governance model for organization of the governmental institutions must be determined.
	New Role of Government	The role of government in energy sector and renewable electricity should be redefined to hinder the government direclty intervening and manupulating the sector
	No Application Period	Predetermined and time restricted licence application procedures in renewable electricity generation should be abolished and application should be taken any time in the year (like the licence application for fossil energy)
	Power Purchase Agreement	For renewable electricity generation, A power purchase (PPA) is not legally possible now, but for rapid diffusion of renewable electricity generation technologies, it is very crucial and necessary (A PPA is a contract which defines the details of a commercial electricity sale direclty between the actor, who generates electricity to sell the consumer, and the consumer, who purchases electricity for his own needs.)
	Powerpack for Self-Consumption	Power packs are the packs that include necessary equipments for portable and easily constructed renewable electricity generation systems.
	Pre-Licence Structure	Before licence applications, a pre-licence process should be clearly defined to simplify the licencing process and to solve the problems of bureacracy

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
13. Policy Proposals	Price discrimination	To support using renewable electricity, price of the electricity generated from renewable sources may be differentiated than the electricity generated by other sources
	Support by Politics	Liceced and unlicenced electricity generation processes can be managed by a systematic process management mentality
	Promoting Self-Consumption	Self consumption in renewable electricity generation should be promoted and small-scale (esp. Rooftop systems in solar energy) prosumers should be increased
	Protective Measures-Regulations	For protecting domestic renewable energy technology producers, protective measures (such as auditing mechanism for imported electricity generation equipment) should be applied
	Raising Awareness	Awareness for clean and renewable electricity generation should be raised and disseminated
	Renewable Energy Requisite in New Buildings	Renewable electricity generation should be made an obligation for new buildings in Turkey (such as the obligation of thermal insulation for new buildings)
	Redefinition of Licence Procedures	Licence application for obtaining the right of constructing renewable electricity generation power plants should be redefined (as described by the interviewees)
	Reduction in VAT	Reduction in VAT (value-added tax) of renewable energy technologies produced in Turkey
	Rehabilitation in Physical Infrastructure	To adapt the overall grid system after the introduction of new renewable power systems to the grid
	Renewable Energy Research Center	A specific country wide centre for renewable energy technology development and diffusion should be established
	Setting Targets-Long Term Planning	For supporting diffusion of renewable energy technologies, well defined long term plans should be formulated and targets should be determined
	Shorten Permission Periods	For licenced electricity generation, permissions should be taken from various governmental organizations and each permission takes a long time. This extends the licencing periods and creates extra burdens for investors. Hence this procedures should be simplified and permission periods should be shortened
	Smart Grid	Physical infrastructure for transmission of electricity in Turkish grid system should be converted to smart grid to control more effectively (especially after including renewable electricity into the system)
	Specialized Governmental Organizations	Specialized governmental organization that has direct control on all renewable electricity may be established to control the sector from one central intermediary authority
	Specialized Regulations	Regulations specific for renewable electricity generation should be formulated to fasten diffusion of renewable electricity generation technologies

Table A. 1. Details of Data Analysis Framework (continued)

SECTION 5:PUBLIC POLICIES AND MARKET FORMATION (*Higher order category*)		
Sub-Category:	***Code:***	***Definition***
13. Policy Proposals	Substituting Fosil Fuels with Renewable Energy	Whereever possible, fossil fuels should be subtituted by renewable sources in electricity generation
	Suporting R&D activities	Policy should support R&D activities of academic units (ex. Speacialized research centers)
	To decrease Bureaucracy	Bureaucracy in renewable electricity generation applications and power plant construction and realization processes should be reduced to fasten new investments
	Undersecretariat for Energy	Specific undersecreriat for energy should be established
	Planning for Renewable Energy Field	Most appropriate field should be determined and planned by a scientific study and then should be announced to take the applications
	White list	White list should be published to prevent the sector from using bad quality products and equipments in power plant construction

B: Personal and Organizational Information About the Interviewees

Table B. 1. Detailed Information about Interviewees

Interviewee Code (with Int.)	Energy Source	Education	Graduate Degree	Work Experience (Years)	Experience in Energy (Years)	Experience in Renewable Energy (Years)	Organization Name	Title	Economic Activity	Organization Type	Sector (depending on profit motive)	Market Segment	City of interview
C1	Only Solar	Chemical Engineering	Msc.	10 to 20	10 to 20	10 to 20	Solarbaba Platform	Manager	Consultancy	Non-governmental Org.	Non-Private Sector	Both	İstanbul
C2	Only Solar	International Relations	-	10 to 20	1 to 10	1 to10	Aegean Foresty Foundation	Head of Unit	Consultancy	Non-governmental Org.	Non-Private Sector	Unlicensed	İzmir
C3	Solar+Wind	Electrical& Electronics Eng	Msc.	10 to 20	10 to 20	10 to 20	TEDAŞ	Head of Departme nt	Consultancy	Governmental Org.	Non-Private Sector	Unlicensed	Ankara
C4	Only Solar	City and Regional Planning	Msc.	10 to 20	10 to 20	10 to 20	Motif Co.	Manager	Consultancy	Company	Private Sector	Both	Ankara
C5	Solar+Wind	City and Regional Planning	-	10 to 20	1 to 10	1 to10	ARI-ES Energy	Manager	Consultancy	Company	Private Sector	Both	İzmir
C6	Solar+Wind	Electrical& Electronics Eng	-	10 to 20	10 to 20	1 to10	GENSED and Polat Holding	Head of Unit	Consultancy	Non-governmental Org.	Non-Private Sector	Both	İstanbul
C7	Solar+Wind	Electrical& Electronics Eng	Msc.	1 to 10	1 to 10	1 to10	Akademi Energy	Manager	Consultancy	Company	Private Sector	Both	İzmir
C8	Solar+Wind	Physics	-	10 to 20	10 to 20	1 to10	EDH Energy	Manager	Consultancy	Company	Private Sector	Unlicensed	Ankara
C9	Only Solar	Electrical& Electronics Eng	-	1 to 10	1 to 10	1 to10	GÜNDER	Board Member	Consultancy	Non-governmental Org.	Non-Private Sector	Both	Ankara
C10	Only Solar	Economics		10 to 20	1 to 10	1 to10	IBC Solar	Managing Director	Consultancy	Company	Private Sector	Both	İzmir
C11	Solar+Wind	Electrical and Electronics Eng.	Msc.	10 to 20	10 to 20	1 to10	Kayseri Electricity Distribution Company	Head of Unit	Consultancy	Governmental Org.	Non-Private Sector	Unlicensed	Kayseri
C12	Solar+Wind	Agricultural Eng.	Phd	20 to 30	1 to 10	1 to10	Turkish State Meterology Services	Expert	Consultancy	Governmental Org.	Non-Private Sector	Both	Ankara
C13	Only Wind	Electrical& Electronics Eng.	Msc.	10 to 20	10 to 20	1 to10	EPRA Co.	Project Engineer	Consultancy	Company	Private Sector	Licensed	Ankara

Table B.1. Detailed Information about Interiewees (continued)

Interviewee Code (with Int.)	Energy Source	Education	Graduate Degree	Work Experience (Years)	Experience in Energy (Years)	Experience in Renewable Energy (Years)	Organization Name	Title	Economic Activity	Organization Type	Sector (depending on profit motive)	Market Segment	City of interview
C14	Only Solar	Electrical& Electronics Eng.	-	10 to 20	1 to 10	1 to10	Ege University Solar Energy Institute	Academic s	Consultancy	Academic Organisation	Non-Private Sector	Both	İzmir
C15	Solar+Wi nd	Computer Engineering	-	10 to 20	1 to 10	1 to10	İZMİR Development Agency	Head of Departme nt	Consultancy	Governmental Org.	Non-Private Sector	Unlicensed	İzmir
C16	Solar+Wi nd	Electrical& Electronics Eng	-	1 to 10	1 to 10	1 to10	TEDAŞ	Head of Departme nt	Consultancy	Governmental Org.	Non-Private Sector	Unlicensed	Ankara
C17	Only Wind	Mechanical Engineering	-	10 to 20	10 to 20	10 to 20	YEGM	Project Engineer	Consultancy	Governmental Org.	Non-Private Sector	Both	Ankara
C18	Only Solar	Electrical& Electronics Eng	-	10 to 20	10 to 20	1 to10	ELSE Energy	Manager	Consultancy	Company	Private Sector	Unlicensed	Ankara
C19	Solar+Wi nd	Chemical Engineering	Msc.	10 to 20	10 to 20	10 to 20	Istanbul Chamber of Industry	Board Member	Consultancy	Non-governmental Org.	Non-Private Sector	Both	İstanbul
C20	Only Wind	Aerospace Engineering	Ph. D.	10 to 20	1 to 10	1 to10	METU	Director	Consultancy	Academic Organisation	Non-Private Sector	Both	Ankara
C21	Solar+Wi nd	Law	Ph.D.	10 to 20	10 to 20	10 to 20	Döğerlioğlu Law. Co.	Head of Unit	Consultancy	Company	Private Sector	Both	İzmir
C22	Only Solar	Physics-Phd	-	10 to 20	10 to 20	10 to 20	GÜNAM	Director	Consultancy	Academic Organisation	Non-Private Sector	Both	Ankara
C23	Only Wind	Computer Engineering	Ph.D.	20 to 30	10 to 20	1 to10	HS Energy and ETC Energy	Manager	Consultancy	Company	Private Sector	Both	Ankara
C24	Only Solar	Electrical& Electronics Eng	-	1 to 10	1 to 10	1 to10	Telefunken Semiconductors	Head of Unit	Consultancy	Company	Private Sector	Unlicensed	Antalya
C25	Solar+Wi nd	Electrical& Electronics Eng	-	10 to 20	1 to 10	1 to10	LİDER	Director	Consultancy	Non-governmental Org.	Non-Private Sector	Both	İstanbul
G1	Solar+Wi nd	Industrial Engineering	-	10 to 20	10 to 20	1 to10	Enda Energy	Manager	Generation	Company	Private Sector	Licensed	Ankara
G2	Solar+Wi nd	Mechanical Engineering	Msc.	1 to 10	1 to 10	1 to10	RES Anatolia Co.	Expert	Generation	Company	Private Sector	Licensed	İstanbul
G3	Only Wind	Electrical& Electronics Eng.	-	1 to 10	1 to 10	1 to10	Borusan EnBW Enetgy Investments	Head of Unit	Generation	Company	Private Sector	Licensed	İstanbul
G4	Solar+Wi nd	Mechanical Engineering	-	10 to 20	1 to 10	1 to10	Zenit Energy	Manager	Generation	Company	Private Sector	Both	İzmir
G5	Only Solar	Mechanical Engineering	Msc.	10 to 20	1 to 10	1 to10	Çalık Energy	Project Engineer	Generation	Company	Private Sector	Licensed	Ankara
G6	Solar+Wi nd	Geomatics Engineering	-	1 to 10	1 to 10	1 to10	Borusan EnBW Energy Investments	Head of Unit	Generation	Company	Private Sector	Licensed	Ankara

Table B.1. Detailed Information about Interiewees (continued)

Interviewee Code (with Int.)	Energy Source	Education	Graduate Degree	Work Experience (Years)	Experience in Energy (Years)	Experience in Renewable Energy (Years)	Organization Name	Title	Economic Activity	Organization Type	Sector (depending on profit motive)	Market Segment	City of interview
G7	Solar+Wind	Electrical& Electronics Eng.	-	1 to 10	1 to 10	1 to10	AKÇA Holding	Manager	Generation	Company	Private Sector	Licensed	İstanbul
G8	Only Solar	Electrical& Electronics Eng.	Msc.	10 to 20	1 to 10	1 to10	Bereket Energy	Sales Manager	Generation	Company	Private Sector	Unlicensed	Denizli
G9	Only Solar	Electrical& Electronics Eng.	Msc.	10 to 20	1 to 10	1 to10	Akfen Holding	Manager	Generation	Company	Private Sector	Licensed	Ankara
G10	Solar+Wind	Electrical& Electronics Eng.	-	20 to 30	20 to 30	1 to10	Mehmet Solar Energy Co.	Project Engineer	Generation	Company	Private Sector	Licensed	Ankara
G11	Only Solar	Electrical& Electronics Eng.	-	1 to 10	1 to 10	1 to10	Beşler Textixe Co.	Head of Unit	Generation	Company	Private Sector	Unlicensed	Kayseri
G12	Only Solar	Computer Engineering	Ph.D.	10 to 20	1 to 10	1 to10	Halk Energy	Manager	Generation	Company	Private Sector	Both	Ankara
G13	Solar+Wind	Petrolleum Engineering	Ph.D.	20 to 30	20 to 30	1 to10	T-Dinamik Energy Co.	Manager	Generation	Company	Private Sector	Both	İstanbul
G14	Only Solar	Electrical& Electronics Eng	-	10 to 20	1 to 10	1 to10	Nurol Energy	Head of Unit	Generation	Company	Private Sector	Unlicensed	Ankara
G15	Only Solar	Cinema -Television	-	1 to 10	1 to 10	1 to10	Ciner Holding-Part Teknik Group	Head of Unit	Generation	Company	Private Sector	Licensed	Ankara
G16	Only Solar	Electrical& Electronics Eng	-	1 to 10	1 to 10	1 to10	Nurol Energy	Project Engineer	Generation	Company	Private Sector	Licensed	Ankara
G17	Solar+Wind	Industrial Engineering	-	20 to 30	20 to 30	10 to 20	Polat Holding	Mana	Generation	Company	Private Sector	Licensed	İstanbul
R1	Solar+Wind	Law	-	10 to 20	10 to 20	1 to10	EPDK	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R2	Solar+Wind	Electrical& Electronics Eng	-	10 to 20	10 to 20	10 to 20	TEİAŞ	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R3	Solar+Wind	Electrical& Electronics Eng	-	10 to 20	10 to 20	1 to10	ETKB	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R4	Solar+Wind	Electrical& Electronics Eng	-	1 to 10	10 to 20	1 to10	YEGM	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R5	Solar+Wind	Mining Eng.	Ph. D.	10 to 20	10 to 20	1 to10	EPDK	Expert	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R6	Solar+Wind	Electrical& Electronics Eng.	-	20 to 30	10 to 20	1 to10	TEİAŞ	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara

Table B.1. Detailed Information about Interiewees (continued)

Interviewee Code (with Int.)	Energy Source	Education	Graduate Degree	Work Experience (Years)	Experience in Energy (Years)	Experience in Renewable Energy (Years)	Organization Name	Title	Economic Activity	Organization Type	Sector (depending on profit motive)	Market Segment	City of interview
R7	Solar+Wind	Chemical Eng.	Ph. D.	10 to 20	10 to 20	1 to10	ETKB	Head of Department	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
R8	Solar+Wind	Business Administration	-	1 to 10	10 to 20	1 to10	EPDK	Expert	Regulation	Governmental Org.	Non-Private Sector	Both	Ankara
S1	Only Wind	Electrical& Electronics Eng.	-	30 to 40	20 to 30	10 to 20	Northel Energy	Manager	Supply	Company	Private Sector	Unlicensed	Balıkesir
S2	Only Solar	Physical Engineering	-	1 to 10	1 to 10	1 to10	ALFA SOLAR-ProErk Engineering	Project Engineer	Supply	Company	Private Sector	Unlicensed	Ankara
S3	Only Solar	Civil Engineering	-	10 to 20	1 to 10	1 to10	CSUN Co.	Head of Unit	Supply	Company	Private Sector	Both	İstanbul
S4	Only Wind	Mechanical Engineering	-	20 to 30	10 to 20	10 to 20	Alstom CO.	Expert	Supply	Company	Private Sector	Licensed	Ankara
S5	Only Solar	Mechanical Engineering	-	10 to 20	1 to 10	1 to10	Şişecam Co.	Head of Unit	Supply	Company	Private Sector	Both	İstanbul
S6	Only Solar	Civil Engineering	-	30	1 to 10	1 to10	Solarturk Co.	Board Member	Supply	Company	Private Sector	Unlicensed	Gaziantep
S7	Only Wind	Mechanical Engineering	-	10	1 to 10	1 to10	Alstom Co.	Head of Unit	Supply	Company	Private Sector	Licensed	Ankara

C: Interview Guide (In Turkish)

YENİLENEBİLİR ENERJİ KAYNAKLARINA DAYALI ELEKTRİK ÜRETİMİ PİYASASININ OLUŞUMU: RÜZGÂR VE GÜNEŞ ENERJİSİ BAĞLAMINDA TÜRKİYE ÖRNEĞİ

BİLGİLENDİRME:

Bu çalışma, ODTU İktisat Bölümü Öğretim Üyesi ve ODTÜ-Bilim ve Teknoloji Politikaları Araştırma Merkezi Müdürü Prof. Dr. Erkan Erdil danışmanlığında, Ar. Gör. Yelda Erden-Topal tarafından yürütülen doktora tezinin alan araştırmasıdır. Temel amacı, Türkiye'de rüzgâr ve güneş enerjisine dayalı elektrik üretimi piyasasının oluşma ve gelişme sürecini incelemek ve yenilenebilir enerji kaynaklarının (YEK)[♣] elektrik üretiminde kullanılmasının yaygınlaştırılmasına yönelik politikalar tasarlamak için veri toplamaktır.

Çalışma boyunca, sizden kimlik belirleyici, kurumsal olarak gizlilik içeren ve kamuya açık olmayan hiçbir bilgi/belge istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir; elde edilecek bilgiler bilimsel yayımlarda kullanılacaktır.

SORULAR:

GİRİŞ:

1. Kısaca sizi tanıyarak başlayalım. Eğitiminiz, uzmanlığınız ve deneyimizden bahseder misiniz?
2. Şu anda YE sektöründe hangi görevleri yürütmektesiniz?
3. Kurum/kuruluşunuz enerji ve yenilenebilir enerji alanındaki faaliyetlerinden kısaca bahseder misiniz?

MEVCUT DURUM

4. Türkiye'deki enerji sektörünü genel olarak baktığınızda sizce en önemli sorunlar nelerdir?
5. Yenilenebilir enerji kaynaklarının, Türkiye'nin enerji sorunlarının çözümündeki yeri sizce nedir? Ne olmalıdır?
6. Türkiye'deki YE sektörünü genel olarak değerlendirir misiniz? Önemli olduğunu düşündüğünüz olumlu ve olumsuz yönleri nelerdir?

[♣] YEK (Yenilenebilir enerji kaynakları), özellikle rüzgar ve güneş enerjisi kastedilerek kullanılmıştır. Sorulara, sizin faaliyet alanınız özelinde daha da dar kapsamlı (örneğin sadece güneş enerjisi veya rüzgar enerjisi) olarak cevaplar vermeniz mümkündür.

7. Sizce Türkiye'de fosil yakıtların elektrik üretiminde baskın kaynak olmasının sebepleri nelerdir?
8. Sizce Türkiye için elektrik üretiminde ideal kaynak çeşitlemesi nasıl olmalıdır?
9. Yenilenebilir enerjinin elektrik üretiminde kullanımının Türkiye için faydaları nelerdir?

YENİLENEBİLİR ENERJİ TEKNOLOJİLERİNİN (RÜZGAR VE GÜNEŞ ENERJİSİ'NE DAYALI ELEKTRİK ÜRETİMİ TEKNOLOJİLERİNİN) YAYILMASI

10. Türkiye'de yenilenebilir enerji teknolojilerinin yayılmasını kısaca değerlendirir misiniz?
11. Sizce Türkiye'de rüzgâr ve güneş enerjisi teknolojilerinin elektrik üretiminde yaygın kullanımını engelleyen faktörler nelerdir?
12. Sizce Türkiye'de rüzgâr ve güneş enerjisi teknolojilerinin elektrik üretiminde yaygın kullanımını destekleyen faktörler nelerdir?

PİYASA

13. Türkiye'de rüzgâr ve güneş enerjisine dayalı elektrik üretimi piyasasının gelişimini değerlendirir misiniz?
14. Lisanslı ve lisanssız elektrik üretimi yapılarının oluşumunun, YEKe dayalı elektrik üretiminin yayılmasına etkisini değerlendirir misiniz?
15. Sizce önümüzdeki dönemde piyasa hangi yönde gelişecektir? Neden?
16. Piyasa gelişiminin önündeki kritik engeller nelerdir?
17. Piyasa gelişimini destekleyen faktörler nelerdir?
18. Sizce, piyasanın hangi yönde gelişmesi için ne tür stratejiler izlenmelidir?
19. Sizce piyasanın sağlıklı gelişimi için neler yapılmalıdır? Hangi noktalar yerindedir, hangi noktalarda eksikler/yanlışlar vardır?

POLiTiKA

20. Mevcut YE politikalarının, mevzuatının ve uygulamaların, piyasa yapısına etkisini değerlendirir misiniz?
21. Sizce Türkiye'deki yenilenebilir enerji politikasının amacı ne olmalı?
22. Bu amaçlara ulaşmak için hangi araçlar kullanılmalıdır?
23. Sizce politika yapıcıların hangi birikim, yetenek ve kaynaklara sahip olmaları gerekir? Neden?
24. YEKe dayalı lisanslı / lisanssız elektrik üretimi konusunda mevcut kurumların işleyişi ve yapısı ile ilgili deneyiminizden bahseder misiniz?

D: Turkish Summary

1. Giriş ve Teorik Çerçeve

Enerji konusu. Artan enerji talebini hızla karşılama sorununun ortaya çıkmasıyla, enerjinin sürdürülebilir ve temiz olarak sağlanması gündeme gelmektedir. Çünkü enerji talebinin hızla ve yoğun olarak karşılanması, iklim değişikliği gibi çevresel sorunları beraberinde getirmektedir. İklim değişikliği ise enerji sistemlerinde sürdürülebilir üretim ve tüketim konusunda araştırmaları ve çalışmaları teşvik etmektedir (Dewald veTruffer, 2012). Özellikle karbon salınımının artmasında büyük payı olan fosil kaynakların, birincil enerji tüketiminde ve elektrik üretiminde baskın kaynak olarak öne çıkması, çevre ve iklim değişikliği konusundaki kaygıları tetiklemektedir (Jacobsson ve Bergek, 2004). IEA (2015a) verilerine göre, 2013 itibarıyle fosil yakıtların küresel enerji üretiminde %81 paya sahip olması ve bu tablonun son 30 yıldır çok fazla değişmemesi bu kaygıları destekler niteliktedir. Bu bağlamda, enerji üretimi ve tüketimine kaynak açısından yaklaşıldığında, enerji kaynaklarının temiz, kolay erişilebilir, bol ve sürdürülebilir olmaları konusundaki hassasiyet enerji sorununa başka bir boyut kazandırmaktadır.

Artan enerji talebini sürdürülebilir olarak karşılayabilmek için çevreyle dost temiz enerji kaynaklarının gündeme alınması gerekir. Kamat (2007: 2835) üç tip temiz enerji kaynağı olduğunu iddia etmektedir: *karbon açısından nötr enerji (karbon depolama teknolojileriyle birlikte kullanılan fosil yakıtlar), nükleer enerji ve yenilenebilir enerji*. Yenilenebilir enerji; su, jeotermal, rüzgâr, dalga, biokütle ve güneş gibi yerli ve bol bulunan çok çeşitli kaynaklardan elde edildiği için, hızla artan enerji talebinin karşılanmasında sürdürülebilirlik açısından diğer enerji türlerine nazaran avantaj sağlamaktadır (Kamat, 2007). Özellikle enerjisinin büyük bir bölümünü ithal fosil yakıtlardan üreten Türkiye gibi ülkeler için yerli ve temiz kaynaklardan faydalanmak, enerji sorununun çözüm alternatifleri arasında öne çıkmaktadır.

Yenilenebilir enerji kaynakları ısınma, elektrik üretimi ve aydınlatma amaçlarıyla kullanılmaktadır. Bu kaynakların elektrik üretiminde kullanılması ise oldukça yaygındır. Yenilenebilir enerji kaynaklarının elektrik üretiminde kullanılması enerji sorunun çözümünde önemli bir alternatif olarak değerlendirilmektedir (Jacobsson ve Bergek, 2004). Türkiye'de ise artan elektrik tüketimi ve elektrik fiyatları, elektrik üretiminde ithal fosil kaynakların yoğun olarak kullanılması ve yenilenebilir kaynaklar (özellikle güneş ve rüzgâr) açısından ülkenin zengin oluşu, yenilenebilir kaynakların elektrik üretiminde kullanılmasını teşvik etmektedir (Neidlein, 2013).

Türkiye'nin elektrik tüketimi son on yılda yıllık ortalama % 6 artmıştır (IEA, 2015b). Bu oldukça yüksek bir orandır. Elektrik fiyatları ise yine 2008 yılından bu yana mesken tüketicileri için ise yıllık ortalama % 3,2; sanayi tüketicileri için yıllık ortalama % 2 artmıştır(EUROSTAT, 2015a). Türkiye'deki toplam nihai enerji tüketiminde elektrik enerjisini payı ise 2013 yılında % 19 olarak gerçekleşmiştir. 2013 yılı verilerine göre, Türkiye'de elektriğin yaklaşık % 72'si fosil kaynaklardan üretilmektedir. 2013 Yılı Genel Enerji Dengesi (Bin TEP) Tablosu-Çevrim ve Enerji Sektörü[101] verileri incelendiğinde elektrik enerjisi, birincil enerji kaynaklarının en çok dönüştürüldüğü diğer enerji kaynağı olarak dikkatimizi çekmektedir. Nihai katı yakıt tüketiminin %46'sı enerji üretiminde kullanılmakta, bu miktarın %91'i ise elektrik enerjisi üretiminde tüketilmektedir (ETKB, 2013). Buna ek olarak, nihai doğalgaz tüketiminin %53'ü enerji üretiminde kullanılmakta, bu miktarın %94'ü ise elektrik üretiminde tüketilmektedir (ETKB, 2013).

Bir diğer çarpıcı veri ise, elektrik üretiminde ağırlıklı olarak kullanılan fosil kaynakların önemli bir bölümünün ithal edilmesidir. Bu durum yerli ve temiz kaynakların kullanımını gündeme getirmektedir. 2013 Yılı Genel Enerji Dengesi (Bin TEP) enerji ithalatı açısından incelendiğinde, enerji kaynakları toplam ithalatı içinde doğalgazın payının %39, petrolün payının %40, katı yakıtların payının ise % 21 olduğu göze çarpmaktadır (ETKB, 2013). Kısacası, Türkiye'de üretilen elektriğin %72'si, yoğun olarak ithal edilen fosil kaynaklara (doğalgaz, katı yakıt ve petrol) dayalı olarak üretilmektedir. 2013 verilerine göre yerli ve temiz kaynaklardan olan rüzgâr enerjisinin payı %3 ve güneş enerjisinin payı ise henüz %0'dır (ETKB, 2013). EMO (2015) raporunda belirtilen ve Temmuz 2015 itibarıyla güncellenen verilere göre 2015 yılında 4100 MW olan rüzgar kurulu gücünün, 2023 yılında 20.000 MW'a; 142 MW olan güneş kurulu gücünün 2023 yılında 5000 MW'a çıkarılması ve elektrik enerjisi üretiminde yenilenebilir kaynakların payının en az %30'a ulaştırması 2009 yılında yayımlanan "Enerji Arz Güvenliği Strateji Belgesi'nde belirtilmiştir (ETKB, 2009).

ETKB tarafından yenilenebilir enerji kaynaklarından sayılan hidrolik kaynakların ise payı oldukça yüksek görünmektedir ve hızla artmaktadır. Fakat benzer bir artışın güneş ve

[101] Çevrim ve Enerji Sektörü, birincil enerji kaynakları kullanılarak nihai olarak piyasaya arz edilen enerjinin üretildiği sektördür.

rüzgâr enerjisinde de sağlanması, hedeflere başarıyla ulaşılabilmesi için gereklidir. Bu bağlamda, Türkiye'deki enerji üretim ve tüketimi değerlendirilirken elektrik kaleminin incelenmesi ve elektrik üretiminde rüzgâr ve güneş enerjisi kullanımının teşvik edilmesi, hızla artan enerji talebinin yerli kaynaklarla, temiz ve sürdürülebilir olarak karşılanması açısından oldukça anlamlıdır. Buradan hareketle, Türkiye'de elektrik üretiminde güneş ve rüzgâr enerjisinin kullanılmasının teşvik edilmesi ve yaygınlaşması ve buna yönelik politikalar tasarlanması, bu tezin temel amacıdır. Bu amaçla, politika yapıcıların, fotovoltaik uygulamalar ve rüzgar turbinlerinden elektrik üretimi gibi gelişmekte olan teknolojilerin yayılmasına yönelik teknoloji politikası geliştirmesi gerekmektedir. Söz konusu politikaları geliştirmek için, politika yapıcıların yenilenebilir enerjiden elektrik üretimi piyasasının oluşum ve gelişim dinamiklerini analiz etmesi önerilmektedir. Bu analizin odak noktası ise, kilit aktörlerin piyasa oluşum süreci hakkındaki algıları, görüşleri ve fikirleri olarak belirlenmiştir. Bu bağlamdan hareketle, bu tez çalışması aşağıdaki araştırma sorularına cevap bulmayı hedeflemektedir:

- Türkiye'de güneş ve rüzgar enerjisine dayalı elektrik üretimi ile çözülebilecek temel enerji sorunları nelerdir?
- Bu enerji sorunları, güneş ve rüzgar enerjisi kaynaklarını kullanarak nasıl çözülebilir?
- Güneş ve rüzgar enerjisine dayalı elektrik üretiminin Türkiye'de yayılması için politika tasarımında analizin odağı ne olmalıdır?
- Türkiye'deki rüzgar ve güneş enerjisine dayalı elektrik üretimi alanındaki kilit uzmanlar yenilenebilir enerji kaynaklarına dayalı elektrik üretimi piyasasının oluşumunu nasıl anlamakta ve etkilemektedir?

Bu soruları yanıtlayabilmek için; rüzgâr ve güneş enerjisine dayalı elektrik üretiminin yayılmasını incelemek ve bu teknolojilerin yayılması için piyasa oluşumuna yönelik teknoloji odaklı politikalar tasarlamak için öneriler geliştirmek amaçlanmıştır. Politika analizimizin odak noktası piyasa oluşumu olduğu için; çalışmanın başlangıç noktası teknoloji politikası yapmanın iktisadi temellerini incelemek olmuştur. Teknoloji politikasının iktisadi temelleri Neoklasik İktisat Teorisi ve Evrimci İktisat Teorisi'ne dayanmaktadır ve bu iktisadi çerçeveler, yeni teknolojiler ortaya çıkmaya başladıktan gerekli görülen politika müdahaleleri için meşru bir zemin sağlarlar (Metcalfe, 1995). Temel vurgu, Neoklasik İktisat Teorisinde yeni teknolojinin yayılması için gerekli kaynakların dağılımının denge analizi ile sağlanmasında iken, Evrimci İktisat Teorisinde öğrenme, çeşitliliğin yaratılması ve seçilim mekanizmaları gibi etkileşimlerdedir (Chaminade ve Edquist, 2006).

Teknoloji politikaların işaret ettiği sorunlar ise, yeni teknolojinin ortaya çıktığı çevredeki aksaklıklardan kaynaklanmaktadır. Politika yapma konusundaki neoklasik rehber Piyasa Aksaklıkları Yaklaşımı iken, evrimci rehber ise Sistem Aksaklıkları Yaklaşımıdır (Jacobsson ve Bergek, 2011). Neoklasik yaklaşımda piyasaların arz ve talebin birikimi ve dengeye gelmesi ile oluştuğu varsayılırken, evrimci yaklaşımda piyasalar sürekli devinim halinde olan ve evrilen sosyo-teknik sistemler olarak kabul edilmektedir (Jacobsson ve Johnson, 2000). Neoklasik yaklaşımda bu dengenin oluşumunu engelleyecek her türlü dışsal etki piyasa aksaklığı olarak kabul edilirken, politika müdahalesi bu eksiklikleri ortadan kaldırmak amacıyla kurgulanmaktadır (Jacobsson and Bergek, 2011). Piyasa aksaklıklarının temelinde (özellikle bilginin kamu malı olarak kabul edilmesinden dolayı) bilginin yarattığı pozitif dışşallıklar, teknolojinin ortaya çıktığı çevreye uyum sağlayamamasından kaynaklanan negatif dışsallıklar, yeni teknolojinin fayda ve maliyetleri konusundaki belirsizlikler ve yeni teknolojilerin aleyhinde çalışabilecek tekel güçler olduğu varsayılmaktadır (Kemp, 2011). Bu aksaklıkların ortadan kaldırılması için, neoklasik yaklaşım temel Ar-Ge ve sanayi Ar-Ge faaliyetlerine doğrudan mali kaynak sağlamak ve piyasa fiyatını rekabetçi hale getirebilecek piyasa temelli teşvik destekleri sağlamak gibi politika araçları kullanılmasını önerir (Jacobsson ve Bergek, 2011). Öte yandan evrimci yaklaşımda ise yeni teknolojilerin ortaya çıkışında piyasaların oluşma süreci; ilgili teknolojik, kurumsal, politik ve kullanıcı odaklı girdiler içsel kabul edilip, bu girdiler arasındaki mevcut/potansiyel ilişkiler ve ortak dinamikler göz önünde bulundurularak incelenmekte ve politikalar buna göre tasarlanmaktadır. Sistem aksaklıkları, teknolojik altyapı, yeni teknolojiye uyumlu olmayan kurumsal yapı, aktörler arası etkileşimde yaşanabilecek sorunlar veya teknolojik olarak tutukluklara neden olabilecek yetenek ve bilgi birikiminden kaynaklanan sorunlar olarak tanımlanmaktadır (Woolthuis vd., 2005; Kemp, 2011). Smith (2000)'e göre, sistem performansının düşmesine sebep olacak kurumsal aksaklıklar, yeni teknolojiye geçiş aşamasında yaşanabilecek sorunlar, eski teknoloji konusunda ısrar edilmesine sebep olan dışsallıklar, ağ yapılarındaki işbirliği sorunları, firmaların öğrenme ve adapte olma sorunları gibi sistemin bütününü ilgilendiren sistem aksaklıklarına yönelik politikalar geliştirilmesini öneren evrimci yaklaşımı benimsemek yeni teknolojinin yayılmasını anlamak için daha yerinde olacaktır. Bu noktada sistem temelli aksaklıkların giderilmesi için genellikle yapısal olan sorunların süreçsel ve dinamik bir bakış açısıyla ele alınmasını, bu sorunların çözümünde ise sistem fonksiyonları içinde odaklanılması gereken fonksiyon tespit edilip ona göre politikalar geliştirilmesini öneren Bergek vd.(2008)'nin çalışmasını baz alarak, Türkiye örneğinde yenilenebilir enerji kaynaklarına dayalı elektrik üretiminin yaygınlaşabilmesi için piyasa oluşumu fonksiyonuna odaklanarak olası sistemik sorunlara çözüm getirebilecek politikalar önerilmesi bu çalışmanın kapsamını oluşturmuştur.

Bu bağlamda, Türkiye'de yenilenebilir enerji kaynaklarına dayalı elektrik üretimi piyasasının oluşma ve gelişme süreci incelenirken evrimci yaklaşım benimsenmiş, sistem eksiklikleri tespit edilerek bunların giderilmesi için politikalar tasarlanması amaçlanmıştır. Yenilenebilir enerji teknolojilerinin Türkiye'de hali hazırda yeni ortaya çıkan teknolojiler olması, bu yaklaşımı benimsememizin ilk nedenidir. Alan araştırmamızın kapsamını, ilgili literatürde yeni yenilebilir enerji sektörüne konu olan güneş ve rüzgar enerjisi olarak belirlemememizin sebebi de özellikle bu alanlardaki teknolojilerin; yenilenebilir enerji teknolojileri içinde gelişmekte olan teknolojiler olmasıdır. Öte yandan, yenilenebilir enerji sanayinin oluşum sürecinin devam etmesi, bu sebeple tüm etkenleri mutlak anlamda sisteme içsel veya dışsal olarak sınıflandırmanın mümkün olmaması, piyasadaki arz ve talebin bir dışsal müdahale olmaksızın (en azından yeni oluşmaya başlayan kurumsal altyapının henüz tamamlanmamış olmasından dolayı) şekillenmeyeceğinin düşünülmesi diğer etkenlerdir.

Bu noktada, teknoloji politikası tasarımını operasyonelleştirmek için, politika tasarımını teorik bir çerçeveden analitik bir boyuta taşıyan ve sistem aksaklıkları kuramını temel alan yenilik sistemi yaklaşımlarından birisi olan Teknoloji Yenilik Sistemi Yaklaşımı kullanılmıştır. Yenilik Sistemi yaklaşımları (Ulusal Yenilik Sistemi, Teknoloji Yenilik Sistemi, Sektörel Yenilik Sistemi) politika yapıcılara, politika ile bir müdahalenin gerekli olduğu sorun alanlarını ve sistemdeki zayıf yönleri saptamak için bir araç sağlar. Bu müdahalenin ardındaki temel dayanak noktası, sistemin bir bileşeninde ve/ya bir fonksiyonunda, sistemin bütün olarak gelişmesini engelleyecek zafiyetlerin olma ihtimalidir (Carlsson ve Jacobson, 1997; Edquist, 2011). Teknoloji Yenilik Sistemi, yeni bir teknolojinin ortaya çıkışını ve yayılmasını toplumsal boyutlarıyla bir bütün olarak inceleyen bir yenilik sistemidir (Jacobsson ve Johnson, 2000; Jacobsson ve Bergek, 2004). Bu yüzden, yenilenebilir enerji teknolojileri gibi "yeni teknolojilerin ortaya çıkmasını ve gelişmesini incelemek için" kullanılır (Jacobsson ve Bergek, 2011:42).

Tüm yenilik sisteminin fonksiyonel olarak işleyip işlemediğini incelemek için, Teknoloji Yenilik Sistemi Yaklaşımı'na göre politika yapıcı teknolojinin yayılmasını engelleyen ve destekleyen mekanizmaları belirlemekle mesuldur. Ülke örneklerinin incelendiği yazın taramasında; yenilenebilir enerji teknolojilerinin yayılmasını destekleyen faktörler Ar-Ge faaliyetlerinde çeşitliliğin desteklenmesi, teknoloji odaklı lobi faaliyetlerinin yaygınlaştırılması, yenilenebilir enerji teknolojilerin meşruiyetinin güçlendirilmesi, Ar-Ge faliyetlerinin kurumsal olarak desteklenerek sürdürülmesi, enerji sektöründe güçlü bir düzenleme mekanizması olması, yenilenebilir enerjiyi destekleyen gruplardan oluşan bir kritik kütlenin varlığı,yenilenebilir enerji konusunda ilgi ve bilgi sahibi politikacıların politika yapma sürecinde aktif olması, politika amaçlarının açık, tutarlı ve anlaşılabilir ve sürdürülebilir olması, ülke koşulları göz önünde bulundurularak farklı Ar-Ge modelleri (uluslar arası ve/ya bölgesel işbirlikleri gibi) tasarlanması, politika araçları seçiminde politika amaçları dikkate alınması ve politika yapıcılar ve uygulayıcılarda birikimin ve yeteneklerin oluşması, hükümetin Ar-Ge ve örnek kurulum programlarına yoğun kaynak sağlaması, paydaşlar arasında bilgi akışını sağlayan işbirliklerin kurulması, piyasa oluşumunu sağlayan garantili elektrik satın alımı uygulamasının yapılması ve yerel yenilenebilir enerjisi üreticilerini destekleyen sanayi stratejilerinin geliştirilmesi olarak bulunmuştur (Jacobsson ve Bergek, 2004; Lauber, 2006; Wüstenhagen ve Bilharz, 2006; Gan vd., 2007; Marinova ve Balaguer, 2009; Huang ve Wu, 2009). Engelleyici faktörler ise; yeni gelişmekte olan teknolojilere yönelik politikaların net olmaması, enerji sektöründeki yerleşik teknolojileri destekleyen güçlü lobilerin dönüşüm sürecini engellemeleri, sektördeki tedarikçi firmaların akademi ve kamu Ar-Ge desteğinin önemli bir bölümüne sahip büyük üreticiler ile bağlantı kuramamaları, iş bölümü ve ölçek ekonomisinin gelişmemesi, geleneksel yerleşik kurulum endüstrisinin yeni endüstriye uyum sağlayamaması, piyasanın oluşum sürecinin yeterli performans gösterememesi ve rüzgar enerjisi ile ilgili sanayi politikalarının olmaması, yenilenebilir enerji teknolojilerini destekleyen aktörlerin ve etki gruplarının kurumsal altyapıyı bu teknolojiler lehine değiştirmek konusunda güçlü olmaması olarak belirlenmiştir (Jacobsson ve Bergek, 2004; Wüstenhagen ve Bilharz, 2006; Huang ve Wu, 2009).

Ülke örnekleriyle incelenen literatürden hareketle, yenilenebilir enerji teknolojilerinin yayılmasının; ülkelerin izledikleri politikalara, bu politikalarla sağladıkları teşvik mekanizmalarına ve bunların uygulama sonuçlarına referansla anlatılmakta olduğu görülmektedir. Örneğin Almanya ve İspanya'daki güneş enerjisi gelişimini inceleyen

Dewald and Truffer (2011), iki ülkenin de yenilenebilir kaynaklara dayalı elektrik üretiminde temel destekleyici mekanizma olarak devlet teşvikini kullanmalarına rağmen İspanya'nın başarısız, Almanya'nın ise başarılı olduğu sonucuna ulaşmışlardır. Bu yüzden sadece politikalar tasarlamanın, yenilenebilir enerji teknolojilerinin yayılması açısından yeterli olmadığı sonucuna varılabilir. Politikaların, sistemin bütününde aksaklığa yol açan nokta belirlenerek onun geliştirilmesi amacıyla tasarlanması gerekir. Piyasa oluşumu bu anlamda odaklanılması gereken ana sorun alanlarından biri olarak görülebilir.

Bu noktadan hareketle, yenilenebilir eneri teknolojilerinin yayılmasını desteklemek amacıyla politikalar geliştirebilmek için, Dewald and Truffer (2011)'ın da önerdiği gibi yenilenebilir enerji kaynaklarından elektrik üretme piyasalarının oluşum sürecine yakından bakmanın faydalı olacağı sonucuna varılmıştır. Bu yargıya varmamızdaki en büyük etken, alan araştırmasının ilk ayağı olan "Öncül Analizi" aşamasında elde edilen bulguların, Türkiye'de yenilebilir enerji teknolojilerinin yayılması sürecini desteklemek için tasarlanacak politikaların piyasa oluşumuna yönelik olması gerektiği konusundaki vurgusudur. Destek mekanizmaları ve bu mekanizmaların etkilerinden ziyade, bu mekanizmalar sayesinde oluşturulan/oluşan piyasalar ve bu piyasaların oluşma süreçleri; yenilenebilir enerji kaynaklarının kullanılmasının yaygınlaştırılmasına yönelik politikalar tasarlamamıza yardımcı olacaktır. Weber ve Rohracher (2012)'in dediği gibi, teknoloji ve yenilik politikalarının temelinde, sistem yapısının güçlü ve zayıf yönlerini ortaya koyarak, sisteminin bütünün performansının analiz edilmesinin ve istenen yönde desteklenmesi için politikalar tasarlanmasının yattığı savından hareketle, Türkiye'de yenilenebilir enerji kaynaklarından elektrik elde edilmesini bir sistem olarak kabul ederek; yenilenebilir enerji teknolojilerinin yayılmasını desteklemek amacıyla piyasanın oluşmasına yönelik politikalar tasarlamak çalışmanın temel amacını oluşturmaktadır.

Gelişmekte olan yenilenebilir enerji teknolojilerinin yayılmasında piyasa oluşum dinamiklerinin incelendiği teorik ve ampirik çalışmalar Möllering (2009)'un piyasa oluşumu analizi ile başlamıştır. Çalışmanın temel amacı piyasaların nasıl oluştuğunu, aktörlerin piyasadaki ekonomik faaliyete nasıl dâhil olduklarını ve piyasanın oluşma sürecini nasıl şekillendirdiklerini anlamak için bir yöntem geliştirmektir. Möllering (2009) piyasayı, birbirleriyle rekabet halinde olan ve kendi çıkarlarını gözeten aktörler arasındaki birbirine bağlantılı iktisadi mübadele ilişkileri sistemi olarak tanımlamaktadır. Piyasadaki mübadele ilişkileri ise, kendi çıkarlarını gözeten ve basiretli olan aktörler arasında gönüllü olarak yapılan iktisadi değişim faaliyetleridir. Piyasalar, mübadele ilişkileri düzenli olarak gerçekleştiği zaman oluşur. Mübadele ilişkileri ise ürünler, aktörler, mübadele faaliyeti, ağ yapıları ve bilgi birikimi gibi belli kurucu unsurlar bir araya geldiğinde mümkün hale gelir. Bu unsurlar, piyasanın kurulma potansiyelini gerçekleştirmek için belli dönüşüm süreçlerine tabi olurlar ve bu süreçler yenilik yapma (*innovating), metalaşma (commodifying), iletişim kurma (communicating), rekabet etme (competing), ilişkilendirme (associating) ve kurumsallaşma (institutionalizing)*[102] süreçleridir.

Teknoloji Yenilik Sistemi'ndeki mevcut piyasa gelişimini anlamak için, Möllering (2009) politika yapıcıların, piyasanın kurucu unsurlarını şekillendiren süreçleri incelemelerini önermektedir. Möllering (2009:7) bu süreçlerin "kendinden ortaya çıkma , içsel koordinasyon ve dışsal düzenleme" olarak adlandırılan üç mekanizma tarafından ortaya çıkarıldığını ve yürütüldüğünü iddia etmektedir. Möllering (2009:15-16)'e göre; *kendinden ortaya çıkma* bir piyasa oluşturma vizyonu olmaksızın gerçekleştirilen iktisadi mübadele ilişkisine dayanırken, *dışsal düzenleme* sistemin dışındaki aktörlerin piyasa oluşturmak amacıyla gerçekleştirdikleri faaliyetler bütününü, *içsel koordinasyon* mekanizmasında ise aktörlerin doğrudan dahil oldukları büyük mübadele sistemleri içinde yer alan belli piyasa yapılarını oluşturmak amacıyla bir araya geldikleri varsayılır.

Teknoloji Yenilik Sistemi yaklaşımda ise piyasa oluşumu, başlangıç pazarlarından köprü pazarlarına, oradan da kitle pazarlarına geçişi tarif etmektedir (Bergek vd. 2008). Dewald ve Truffer (2011: 287)'a göre bu kavramsallaştırma hala "dışardan verili olarak ele alınmaktadır ve doğrusal gelişme paternleri" izlemektedir. Fakat piyasa oluşum sürecinin içsel dinamikleri vardır ve bu süreci ele almak için; "yeni teknolojinin kurumsal, politik, teknik ve kullanıcı odaklı dinamikleri arasındaki potansiyel etkileşimler"in dikkate alınması gerekir (Dewald and Truffer, 2011: 286). Teknolojik Yenilik Sistemi yaklaşımında piyasa oluşumunu doğrusal ve dışsal olarak kavramsallaştırmak yerine, Dewald ve Truffer (2011) belli kullanıcı gruplarına hitap eden, belli ürünler ve ilgili piyasa aktörleri, kurumları ve ağ yapıları tarafından şekillendirilen alt-sistem yapıları olan "pazar segmentleri" kavramını

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[102] Möllering (2009) bu süreçleri şu şekilde tanımlamaktadır: Yenilik yapma (*Innovating) icatların yeni ürünlere dönüşmesi, Metalaşma (Commodifying) değiş tokuş ilişkilerinin birbirine benzerliklerini artırarak onların piyasa mübadele ilişkisi haline gelmesi, iletişim (Communicating)* piyasadaki olguların, onları yorumlayarak ve kullanarak hareket eden aktörler tarafından daha anlamlı ve daha açık hale gelmesi, rekabet etme (*Competing) rekabet etmenin yapısal koşullarının ve mübadele ilişkilerinin gerçekleştiği ortamın oluşması, ilişkilendirme (Associating)* ağ ilişkilerini oluşturan, statü sahibi olan ve belirsizliği ortadan kaldırmak amacıyla çalışan piyasa aktörleri arasındaki ilişkilerin kurulması ve kurumsallaşma (I*nstitutionalizing*) mübadele kurallarının ve onları bağlayan yaptırımların tüm mübadele ilişkilerinde geçerli olması ve garanti altına alınması

ortaya atmışlar ve piyasa oluşumu için üç aşamalı olarak şu şekilde kurguladıkları bir analitik çerçeve önermişlerdir: (i) her bir pazar segmenti seviyesindeki aktörlerin, ağ yapılarının ve kurumların belirlenmesi (yapısal analiz) (ii) farklı pazar segmentlerinin gelişme aşamalarının ve birbirleriyle bağlantılarının değerlendirilmesi (süreç analizi) (iii) belli pazar segmentlerinin bütün Teknolojik Yenilik Sistemi'ne katkısının analiz edilmesi (Fonksiyonel analiz) (Dewald ve Truffer, 2011:289)

Teknoloji Yenilik Sistemi'nde piyasa oluşumu dinamiklerini incelemek için daha kapsamlı ve detaylı bir çerçeve üretmek için Dewald veTruffer (2012), Möllering (2009)'in piyasa oluşumuna süreç bazlı yaklaşımını kullanarak, piyasa oluşumunun alt süreçlerini inceledikleri bir yaklaşım geliştirmiştir. Dewald ve Truffer (2012:400) bu çalışmada, 2011'de önerdikleri süreç analizini aşamasını detaylandırmış ve piyasa oluşumunu birbirini tamamlayan üç alt fonksiyonla tanımlamışlardır: (i) Pazar segmentlerinin oluşması (ii) piyasa işlemlerinin oluşması (iii) kullanıcı profillerinin oluşması. Piyasa oluşum dinamiklerini altı alt süreçte inceleyen Möllering (2009) çalışmasını izleyerek, Dewald ve Truffer (2012:402) bu alt süreçleri "Pazar segmentlerinin oluşması" ve "piyasa işlemlerinin oluşması" alt fonksiyonlarının oluşması olarak iki grupta toplamışlardır. Dewald and Truffer (2012)'a göre, "pazar segmentlerinin oluşması" alt fonksiyonu, belli aktörlerin, ağ yapılarının ve kurumların belli bir ürünü belli bir son kullanıcı grubuna satmak için bir araya gelmeleri olarak tanımlanır. Bu durum, "kullanıcı profillerinin oluşması" alt fonksiyonu da beraberinde getirmektedir (Dewald ve Truffer, 2012: 404). "Piyasa ilişkilerinin oluşması" alt fonksiyonu ise arz ve talep arasındaki mübadele ilişkisini temsil eder (Dewald ve Truffer, 2012: 403).

Möllering (2009)'un yenilik yapma, ilişkilendirme ve kurumsallaştırma süreçleri, Teknolojik Yenilik Sistemi'ndeki pazar segmentlerinin oluşması ile, kalan üç süreç olan metalaşma, iletişim kurma ve rekabet etme Süreçleri ise piyasa işlemlerinin oluşması alt fonksiyonunun oluşmasını sağlamaktadır (Dewald ve Truffer, 2012:402). Bu iki alt fonksiyona ek olarak, "kullanıcı profillerinin oluşması" alt-fonksiyonu ise tüketici profilini, kullanım patenlerini ve tercih yapılarını belirlemek için eklenmiştir. Bu üç alt fonksiyonun, Teknoloji Yenilik Sistemi'nde piyasa oluşumu sürecinde birlikte everildikleri kabul edilir.

Teknoloji Yenilik Sistemi Yaklaşımı'nda piyasa oluşumunun alt fonksiyonları ve piyasa oluşumunun fazlarını (başlangıç pazarı, köprü pazar, kitle pazar) birleştiren Dewald ve Truffer (2012) çalışması, her bir Pazar segmentinin yenilik sisteminin bütününün performansına etkisini incelemiştir. Dewald ve Truffer (2012:405-406) ‘a göre, belirsizlik, teknolojik gelişmede çeşitlilik yaratılmasına açık olma ve öncü kullanıcıların varlığı ile göze çarpan başlangıç pazarı aşamasında, pazar segmentlerinin oluşması alt fonksiyonu baskındır. Köprü pazara geçişle birlikte, yeni kullanıcı gruplarının ve ürün çeşitlerinin ortaya çıkması ile pazar işlemleri daha görünür hale gelir. Kitle piyasalarına olgunlaşma evresinde ise, tüm Pazar homojen hale gelir ve piyasa işlemleri somut olarak oluşur.

2. Yöntem ve Bulgular

Bu çalışmanın temel veri kaynağı, yenilenebilir enerjiye dayalı elektrik üretimi alanındaki kilit aktörlerin, piyasa oluşumuna atfettikleri anlamdır. Bu bağlamda, iki aşamada veri toplanmıştır: “Öncül Analiz” ve “Alan araştırması”.

İlk aşamada, enerji sektöründeki mevcut durumu ve eğilimleri anlamak için istatistiki veri tabanlarından ve ikincil niteliksel yazılı kaynaklardan yararlanılarak masa başı çalışması ve ön mülakatlar yapılmıştır. Masa başı çalışmasında kullanılan ikincil kaynaklar *elektrik üretimi alanındaki yasal dokümanlar* (6446 sayılı Elektrik Piyasası Kanunu, 5346 sayılı Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Amaçlı Kullanımına İlişkin Kanun, Bakanlar Kurulu Kararları, Mahkeme Kararları, Yönetmelikler, Tebliğler ve Enerji Piyasası Düzenleme Kurumu Kurul Kararları) *ve istatistiksel veri tabanlarıdır* (Enerji ve Tabi Kaynaklar Bakanlığı Bilgi Merkezi ve Yayınları, Ulusal Enerji Ajansı Veri Tabanı ve EUROSTAT-Avrupa Birliği İstatistik Ofisi Veri Tabanıdır). Ön mülakatlar kapsamında ise; Haziran-Aralık 2012 tarihleri arasında enerji sektöründe yenilenebilir enerji konusunda çalışan kamu görevlileri, şirket temsilcileri ve akademisyenlerle 6 adet ön görüşme gerçekleştirilmiştir.

İkinci aşama olan “Alan Araştırması”nda Türkiye’de güneş ve rüzgâr enerjisine dayalı elektrik üretimindeki uzmanlarla görüşmeler yapılmıştır. Türkiye’de yenilenebilir enerji teknolojilerinin yayılması, özellikle tabandan tavana doğru büyüyen ve kişisel çabalarla şekillenen bir harekettir. Bu sebeple temel veri kaynağı, kilit aktörlerin rüzgâr ve güneş enerjisine dayalı elektrik üretimi konusundaki bakış açıları, deneyimleri, yaklaşımları, inançları ve söylemleridir. Buna imkân tanıyan niteliksel veri, mülakat yöntemiyle toplanır çünkü “açık uçlu sorular, insanların deneyimleri, algıları, fikirleri, hisleri ve bilgileri hakkında derinlemesine cevaplar almamızı sağlar” (Patton, 2002:4)”. Bu sebeple, yarı-yapılandırılmış mülakatlarla veri toplama yönteminden yararlanılmşıtır. Kullanılan mülakat formu 5 ana başlık üzerine kurgulanmıştır: 1) Giriş / Mülakat Adayının Tanıma 2) Türkiye

Enerji Sektörü'nün mevcut durumu 3)Yenilenebilir enerji teknolojilerinin yayılmasını engelleyen ve destekleyen faktörler 4) Rüzgâr ve güneş enerjisine dayalı elektrik üretiminde piyasa oluşumu ve 5) Kamu politikaları ve piyasa oluşumu.

İlk bölümde, Türkiye'de rüzgar ve güneş enerjisine dayalı elektrik üretimi alanında aktif olarak çalışan aktörleri tanımak için kişisel ve organizasyonel bilgilere dair sorular sorulmuştur. İkinci bölümde, yenilenebilir kaynaklara dayalı elektrik üretiminin enerji sektörünün bütünü ve diğer alt sektörlerle (özellikle elektrik üretiminde baskın kaynaklar olan fosil yakıt sektörü ile) etkileşimini inceleyebilmek için Türkiye Enerji Sektörünün Mevcut Durumu ile ilgili sorular sorulmuştur. Bu bölüm sonucunda, tasarlanacak politikalarla çözülmesi hedeflenen temel sorun alanlarının ve politika amaçlarının belirlenmesi hedeflenmiştir. Üçüncü bölümde, yenilenebilir enerji teknolojilerinin yayılmasını engelleyen ve destekleyen faktörler sorgulanmıştır. Bu mekanizmaların ve etkilerinin belirlenmesi, engelleyici mekanizmaları zayıflatmaya ve destekleyici mekanizmaları güçlendirmeye yönelik politika araçları tasarlayabilmemize imkân sağlamaktadır. Dördüncü bölümde piyasa oluşuma yönelik sorular sorulmuştur. Bu bölümde, özellikle yenilenebilir enerji piyasalarının temel bileşenleri ve piyasa oluşumunun mevcut durumu ve gelişimi incelenmiştir. Son ana başlığımız ise, piyasa oluşumunda politikaların rolüdür. Bu bölümde, yenilenebilir enerji teknolojilerinin yayılmasının amaç-araç-hedef bütünlüğü içinde tasarlanan politikalarla desteklenmesinin yerinde olacağı savından yola çıkarak elde edilen veriler, tez sonucunda önerilen politika tasarım modelinin örnek bir uygulaması olarak değerlendirilmiştir.

İkinci aşama olan alan araştırmasında, Türkiye'de güneş ve rüzgar enerjisine dayalı elektrik üretimi alanındaki kilit aktörlerle doğrudan bağlantıya geçilmiştir ve görüşme yapılacaklar aktörler belirlenirken iki kriter kullanılmıştır:

(i) Yenilenebilir kaynaklara dayalı elektrik üretiminden kar elde etme amacı - iktisadi kar motivasyonu

(ii) Yenilenebilir enerji sektöründe piyasa oluşum ile ilişkilendirilen iktisadi faaliyet alanı - iktisadi faaliyet motivasyonu

Mülakat yapılan uzmanlar iktisadi kar motivasyonuna göre, özel sektör kuruluşu olmaları (özel sektörde faaliyet göstermeleri) veya olmamalarına göre iki gruba ayrılmışlardır: *Kar amacı güden kuruluşlar ve kar amacı gütmeyen kuruluşlar*. Kar amacı güden kuruluşlar özel sektördeki şirketlerdir. Kar amacı gütmeyen kuruluşlar ise öncelikli amaçları kar elde etmek olmayan, özel sektörle bağlantılı olan ama doğrudan özel sektörde faaliyet göstermeyen kamu kurumları, sivil toplum örgütleri ve akademik kuruluşlardır. Mülakat yapılan uzmanların iktisadi faaliyetleri ikinci seçim kriterimizdir. Ön mülakatlardan toplanan veriye ve sektörün yapısal analizine göre dört adet iktisadi faaliyet mevcuttur: *üretim* (rüzgar ve güneş enerjisine dayalı elektrik üretimi), *düzenleme* (yenilenebilir kaynaklara dayalı elektrik üretiminin regüle edilmesi), *danışmanlık* (sektörün yeni teknoloji ve iktisadi koşullara adapte olması için ağ yapıları kurmak ve yatırımcıları teknik olarak destelemek) ve *tedarik* (yenilenebilir kaynaklara dayalı elektrik üretimini sağlamak için her türlü ekipman ve servis desteği sağlamak).

Alan araştırması kapsamında, Aralık 2013 ve Şubat 2015 tarihleri arasında toplam 57 adet yarı yapılandırılmış mülakat gerçekleştirilmiştir. Bu mülakatlardan 34 tanesi özel sektörde, 23 tanesi ise özel sektör dışında faaliyet gösteren aktörlerle yapılmıştır. Özel sektörden görüşülen aktörlerin iktisadi faaliyetleri elektrik üretimi (17 mülakat), danışmanlık (10 mülakat) ve tedarik (7 mülakat); özel sektör dışından görüşülen aktörlerin iktisadi faaliyetleri düzenleme (8 mülakat) ve danışmanlıktır (15 mülakat). Tüm mülakatlar yüz yüze görüşme yöntemiyle, birebir olarak Ankara, İstanbul, İzmir, Antalya, Denizli, Balıkesir, Kayseri ve Gaziantep illerinde gerçekleştirilmiştir. Bu mülakatların masrafları, 114K070 no'lu TÜBİTAK Projesi'nin alan araştırması bütçesinden karşılanmıştır.

Mülakat yapılacak adayları seçerken, "araştırmanın amacına bağlı olarak stratejik olarak bilgi açısından zengin ve spesifik vakaların seçilmesi"ni sağlamak için *amaçlı örnekleme* (purposeful sampling) yöntemi kullanılmıştır (Patton, 2002: 243). Örnekleme sürecinde, *kartopu* (Patton, 2002) ve *bilgi-edinmeye yönelik seçim* (Flyvbjerg, 2006) yöntemlerinden de yararlanmıştır.

Verinin analiz edilmesinde; Patton (2002)'nın "Analitik Çerçeve Yaklaşımı"ndan faydalanılmıştır. Patton (2002) veri analizi için analitik çerçeveyi, ham verinin betimlenmesi (description) ve yorumlama (interpretation) olmak üzere iki çalışma ile özetlemektedir. Bu tezde, veri analizi bölümü ham verinin analitik çerçeve yöntemi ile betimlendiği ve araştırma sorusunu cevaplamak için bulgu ve sonuçların teorik çerçeveye yerleştirilmesiyle yorumlandığı bir veri analiz sistematiği benimsenmiştir.

Veri üretim sürecinde, yarı yapılandırılmış mülakat formu takip edilmiştir. Bu sebeple, mülakat formunun bölümleri veriyi raporlarken üst-kategoriler olarak benimsenmiştir. Cevaplar, mülakat bölümlerindeki sorulara göre organize edilerek raporlanmıştır. Patton (2002: 463), niteliksel veriyi analiz ederken “verinin kodlanması, örüntülerin bulunması, temaların etiketlenmesi ve kategori sistemlerinin geliştirilmesi”ni önermektedir. Kodların ve kategorilerin belirlenmesi ve ortaya çıkan ilişkilerin çalışmanın teorik çerçevesi içinde yerlerine oturması ile “örüntülerin tanımlanması ve açıklanması”na olanak sağlar (Patton, 2002:468). Örüntüler ve örüntülerin gruplandığı temalar, çalışmanın asıl bulgularına ulaşılan bölümlerdir ve veri analizi kategori sistemlerinin yani örüntü ve temaların altında toplandığı bilgi parçalarının üretilmesi ile son bulur.

Alan araştırmamız kapsamında kodlar, Corbin ve Strauss (2008)’in açık kodlama yöntemi kullanılarak, tek tek deşifrelerin okunması ve satır satır incelenmesi ile belirlenmiştir. Kategori sınıflandırması ise mülakatlarda izlenen yöntem baz alınarak başta belirlenmiştir. Bu kodlama sürecinde, bilgisayar yardımlı bir nitel veri yöntimi ve analizi aracı olan ““QDA-Qualitative Data Analysis Miner” Yazılımı kullanılmıştır. Analiz sürecinde, yukarıda belirtilen 5 ana kategori başlığı takip edilerek, 13 alt kategori belirlenmiş ve kodlar bu alt-kategoriler altına eklenerek, bu kodları karşılayacak mülakat bölümleri (alıntılar) kodlarla eşlenmiştir. Kategori başlıkları analize başlamadan önce taslak haline belirlenmiş fakat kodlar, mülakat deşifreleri okundukça süreç içinde ortaya çıkmıştır.

<u>Türkiye’deki Enerji Sektörünün Mevcut Durum Değerlendirmesi:</u>

Yenilenebilir enerji kaynaklarına dayalı elektrik üretimi teknolojilerinin yaygınlaştırılması için politikalar tasarlanırken, enerji sektöründeki genel çerçeveyi anlamak ve politika sorunlarını ve amaçlarını belirlemek için yapılan mevcut durum analizinden çıkan sonuçlara göre, özel sektörde faaliyet gösteren kuruluş temsilcilerine göre en çok öne çıkarılan sorun alanları “ithalata bağımlılık, standartların olmaması, özelleştirmelerle ilgili sorunlar, hesap verilebilirlik ve uzun dönemli planlama olmaması”dır. Özel sektör dışında faaliyet gösteren kuruluş temsilcilerine göre en çok öne çıkarılan sorun alanları “ithalata bağımlılık, yerli kaynakların yetersiz olması, düzenleme sorunları, müdaheleci bir kamu yönetimi ve uzun dönemli planlama olmaması”dır. İthalata bağımlılık iki grup uzmanlarımız tarafından da en çok ifade edilen sorun alanıdır. Özel sektör kuruluş temsilcilerimiz bu sorunun yarattığı finansal zorlukları (artan bütçe açığı ve elektrik fiyatlarındaki artışlar gibi) ve bunun kendi faaliyetleri üzerindeki etkilerini vurgularken; özel sektör dışında faaliyet gösteren kuruluş temsilcileri bu sorunu makro enerji dengeleri bağlamında ele almış ve ithalata bağımlılığın enerji arz güvenliğine olumsuz etkilerini dile getirmişlerdir. İki grup tarafında da yönetişimle ilgili farklı sorun alanları, enerji sektörünün mevcut durumunu etkileyen diğer unsurlar olarak vurgulanmıştır. Özel sektör temsilcileri tarafından öne çıkarılan bu yönetişim sorunları "standartların olmaması, sektörle ilgili özelleştirmelerde yaşanan sorunlar ve hesap verebilirlik konusunda eksiklikler olması" şekilde özetlenmişken; özel sektör dışında faaliyet gösteren kuruluş temsilcilerine göre yönetişimle ilgili sorunlar "düzenleme faaliyetleri sırasında ortaya çıkan sorunlar ve müdaheleci bir kamu yönetimi yaklaşımının benimsenmesi"dir. "Uzun dönemli planlamanın olmaması" şeklinde ifade edilen sorun ise iki grubun da üzerinde durduğu ortak yönetişim sorunudur.

Yenilenebilir Enerji Teknolojilerinin Yayılmasını Engelleyen ve Destekleyen Faktörler:

Yenilenebilir enerji teknolojilerinin yayılmasını engelleyen ve destekleyen faktörler ise ekonomik, fiziksel, kurumsal, psikolojik, teknolojik, siyasi ve yönetimsel faktörler olarak yedi ayrı başlık altında gruplanmıştır.

Özel sektördeki kilit uzmanlar tarafından en çok öne çıkarılan destekleyici ekonomik faktör "Yenilenebilir enerji teknolojilerinin maliyet açısından diğer teknolojilerle rekabet edebilir olması"; en çok öne çıkarılan engelleyici faktör "Proje Finansmanı" iken özel sektör haricindeki kilit uzmanlar tarafından en çok öne çıkarılan destekleyici ekonomik faktör "Yenilenebilir enerji teknolojilerinin getirdiği yeni yatırım olanakları", en çok öne çıkan engelleyici faktör "Yüksek başlangıç yatırımı maliyetleri"dir. Bu unsurlarda görüldüğü üzere, ekonomik faktörler içinde maliyet, finansman ve yatırım olanakları başlıkları ön plana çıkmış, fakat iki grup tarafından da özellikle maliyet konusunda birbirinden farklılaşan değerlendirmeler olmuştur. Özel sektördeki uzmanlar; yenilenebilir enerji teknolojilerinin yayılmasında kaynak maliyetinin olmamasını ve sürekli büyük hızlarda düşen teknolojik yatırım maliyetlerini gerekçe göstererek yenilenebilir enerji teknolojilerinin diğer teknolojilerle rekabet edebilir olmasını ekonomik olarak en önemli destekleyici faktör olarak öne çıkarmışlardır. Yenilenebilir enerji teknolojilerinin maliyet boyutunu diğer yönden değerlendiren özel sektör haricindeki uzmanlar ise; gelişmekte olan teknolojiler oldukları için henüz pahalı olan ekipmanları ve tüm yatırımın başta tek seferde yapılıyor olmasından dolayı yatırım geri dönüş sürelerinin uzun olmasına sebep olan kurulum giderlerini gerekçe göstererek, yüksek başlangıç yatırımı maliyetlerini en çok öne çıkarılan ekonomik engelleyici faktör olarak değerlendirmişlerdir. Finansman konusu ise iki grup tarafında da öne çıkarılmış bir engelleyici unsurdur. Proje finansmanının yenilenebilir enerji projeleri özelinde değerlendirilmemesi, bu alandaki en bariz neden olarak gösterilmiştir. Yenilenebilir enerji lisans başvurularının büyük bir ilgiyle takip edilmesi, bu yatırımların garantili gelir getiren yatırımlar olması ve özellikle cografi olarak bulunduğumuz bölgede etrafımızdaki ülkelerin teknoloji geliştirmemiz durumundada yeni yatırım sahaları sağlayabilecek olmaları gerekçe gösterilerek öne çıkarılan "yeni yatırım olanakları" ise, ekonomik olarak yenilenebilir enerji teknolojilerinin desteklenmesini sağlayan unsurlardan birisidir.

Fiziksel faktörler içinde; özel sektördeki ve özel sektör haricindeki uzmanlar aynı engelleyici ve destekleyici faktörleri vurgulamışlardır. İki grup tarafından öne çıkarılan destekleyici faktörler "Türkiye'de Yenilenebilir Enerji Kaynaklarının (özellikle rüzgar ve güneşin) bol olması" ve "Yenilenebilir Enerji kaynaklarının yerli kaynak olması"dır. İki uzman grubumuz tarafından da öne çıkarılan fiziksel engel unsuru ise "Yenilenebilir enerji kaynaklarına dayalı olarak üretilen elektriğin son kullanıcıya ulaşmasında gerekli altyapı olanaklarındaki yetersizlikler"dir. Yenilenebilir enerji kaynaklarının, özellikle rüzgar ve güneşin, bol olan yerli kaynaklar olmaları en çok öne çıkan fiziksel unsurdur. Konya ve altındaki bölgelerde güneşin yoğun olması ve özellikle Ege'de rüzgarın yoğun olması bölgesel olarak bu teknolojilerin yayılmasını kolaylaştıracaktır. Altyapı sorunları ise, en büyük fiziksel engel olarak işaret edilmiştir.

Kurumsal faktörler içinde, hem özel sektördeki hem de özel sektör haricindeki uzmanlar tarafından en çok öne çıkan destekleyici faktör "Olumlu lobi ve savunma grubunun faaliyetleri"dir. İki grup için de öne çıkan engelleyici kurumsal faktör ise "Kamu kurumları arasında koordinasyon olmaması"dır. Özellikle dernekler eliyle yürütülen lobi faaliyetleri sektörün daha da büyümesini sağlayan unsurlardır. Olumlu lobi faaliyetleri, tüm paydaşların biraraya gelerek oluşturdukları ortak aklı temel aldığı için; sektörün daha sağlam temeller üzerinde gelişmesine imkan sağlayacaktır. Sektörün gelişmesi ve lobi faaliyetleri arasındaki ilişki çift yönlü bir ilişkidir ve sektör geliştikçe lobi faaliyetleri artmakta, lobi faaliyetleri arttıkça da sektör gelişmektedir. Bunun yolu da da bireysel olmak yerine toplumsal olarak hareket etmekten geçmektedir. Kurumsal faktörler içinde yayılmayı engelleyen en önemli unsur ise kurumlar arası koordinasyon olmamasıdır.

Psikolojik faktörler içinde her iki uzman grubu tarafından da en çok öne çıkarılan destekleyici faktör "Komşu etkisi", en çok öne çıkan engelleyici faktör ise özellikle yatırım ve üretim sürecinde "Hissedilen belirsizlik" olmuştur. Komşu etkisi, kurulum deneyimi olan kuruluş/kişilerin deneyimlerini örnek almak olarak tanımlanmaktadır. Olumlu deneyimlerin etkileri bu teknolojilerin yayılmasını da olumlu etkileyecektir. Özellikle yatırım sürecinde belirsizlik yaratan faktörler ise, yayılma sürecini olumsuz etkilemektedir. Kuralların sürekli değişmesi, lisanslı ve lisanssız uygulamaların kısa ve uzun vadeli geleceğinin net olmaması, yatırımcıların finansman koşulları konusunda planlama yapamamaları ve doğa koşullarına bağlılıktan dolayı oluşabilecek stabilite sorunları bu belirsizliği yaratan unsurlardır.

Teknolojik faktörler arasında, özel sektördeki uzmanlar tarafından en çok üzerinde durulan destekleyici faktör "Kilit Aktörlerin Teknoloji Geliştirme Stratejileri"; engelleyici faktör ise "Sektördeki aktörlerde (özellikle teknik) bilginin eksik olması"dır. Özel sektör haricindeki kilit uzmanlara göre en çok öne çıkan destekleyici teknolojik faktör "Üretentüketici (Prosumer) Etkisi", engelleyici faktör ise "Sektördeki aktörlerde (özellikle teknik) bilginin eksikliği"dir. Ar-Ge yatırımları konusunda ısrarcı olmak ve yatırımı yarım bırakmamak, teknoloji geliştirme faaliyetlerinde Türkiye'ye özgü pazar koşullarından yola çıkarak strateji belirlemek ve bir yandan imalat yaparken bir yandan da bu imalat sürecini prototip üretimi olarak kurgulamak, kilit aktörlerin teknoloji geliştirme stratejileri arasındadır. "Üretentüketici" profiline imkan tanıyan teknolojik gelişme ise yenilenebilir enerji teknolojilerin yayılmasını destekleyecek diğer unsurdur. Elektriğin üretildiği yerde tüketilmesinin mümkün olması, iletim ve dağıtım kayıplarının azalması, şebekeye binen yükün azalması, üreten tüketicinin elektriği daha verimli kullanması ve akıllı şebeke sistemine daha fazla ihtiyaç duyulması; üretentüketici kavramı ile gündeme gelen olumlu etkilerdir. Teknik bilginin eksikliği ise, bu alanda teknolojilerin yaygın kullanılmasının önündeki en büyük engellerden birisi olarak ifade edilmiştir. Teknik bilginin eksik olması ise; yatırımların yanlış saiklerle yapılmasına, bu teknolojilerle elektrik üretmenin tüm inceliklerinin idrak edilmemesine, bazen kesikli olan ve stabil olamayan nitelikte elektrik üretileceğinin farkında olunmamasına, ekipman tedarik ve kurulumundan elektrik üretiminden son kullanım noktasına aktarıma kadar geçen tüm süreç basamaklarının tanınmamasına sebep olmakta ve yaşanan bu olumsuz deneyimler yenilenebilir enerji teknolojilerinin yayılmasını engellemektedir.

İki gruptan uzmanlar tarafından en çok ifade edilen destekleyici siyasi faktör "Devlet tarafından verilen teşvikler", engelleyici faktör ise "Yasal Mevzuat Kapsamında alınan önlemler"dir. Devlet tarafından verilen teşvikler, fiyat üzerinden alım garantisi ve yerli ürün kullanan elektrik üreticilerine verilen yine fiyat üzerinden ek teşviklerdir. Siyasi olarak en fazla öne çıkarılan unsur olmasına rağmen yöntemi ve kurgusu eleştirilmiş, çalışma kapsamındaki politika önerisi de yöntemsel olarak teşviklerin yeniden düzenlenmesine yönelik olmuştur. Yasal mevzuat kapsamında alınan önlemlerin en çok bilinen ve en çok şikayet edileni olan ölçüm zorunluluğu da tam olarak aynı nedenle eleştirilmiştir.

Özel sektördeki kilit aktörlere göre en dikkat çekici destekleyici yönetimsel faktör yenilenebilir enerji kaynaklarından üretilen elektriğinin "Puant Azaltma Etkisi", engelleyici faktör ise "Bürokrasi"dir. Özel sektör haricindeki uzmanlara göre en çok öne çıkan yönetimsel faktör, "Kayıp kaçak oranını azaltıcı etki"dir. Engelliyici yönetimsel faktörler ise "Yarışma Süreci"dır. Yenilenebilir enerji kaynaklarının, özellikle güneş enerjisinin, en önemli yönetimsel katkısı, şebekedeki puant yük değerlerini azaltarak şebekenin daha kolay ve verimli çalışmasını sağlamaktır. Çünkü puant yük değerleri, gün içinde elektrik tüketiminin en fazla olduğu dönem aralığında belirlenmektedir ve bu dönem güneş enerjisinin en yoğun olduğu dönemdir. Bu aralıkta güneşe dayalı olarak üretilen elektriğin tüketiminin artırılması şebekenin daha kolay yönetilmesini sağlayacaktır. Yerinde üretime ve tüketime imkan veren yenilenebilir enerji kaynaklarının elektrik üretimde kullanılması, iletim ve dağıtım sisteminin daha verimli işletilmesine imkan verdiği için kayıp kaçak oranlarını azaltacaktır. Bu nedenle kayıp kaçak oranlarının yüksek olduğu bölgelerde özellikle yenilenebilir enerji teknolojilerinin yayılması desteklenmelidir. Yarışma süreci ise, tüm lisanslama sisteminde takip edilmesi zorunlu bir yöntem olarak gündemdedir fakat böyle bir gereklilik yoktur. Çünkü yarışma çok fazla başvuru olması durumunda kullanılacak bir eleme yöntemidir. Tüm lisanslama sürecini bunun üzerine kurmak yöntemsel olarak en iyi kurulumu yapacak yatırımcının bulunmasını sağlamayabilir.

Güneş ve Rüzgâr Enerjisine Dayalı Elektrik Üretiminde Piyasa Oluşumu:

Türkiye'deki güneş ve rüzgar enerjisine dayalı elektrik üretiminin piyasa oluşumu, bu çalışma kapsamında yapısal analiz, süreç analizi ve fonksiyonel analizden oluşan bir analitik çerçeve ile incelenmiştir. Yapısal analizde piyasanın kurucu unsurların ortaya çıkışı incelenmiş, süreç analizinde piyasa oluşumunun alt fonksiyonları olan piyasa segmentlerinin ve piyasadaki mübadele ilişkilerin oluşumu süreçler üzerinden analiz edilmiş, fonksiyonel analizde ise piyasa oluşumunun tüm yenilenebilir enerji yenilik sisteminin performansına etkisi değerlendirilmiştir.

Yapısal analizde; lisanslı elektrik üretimi pazar segmentinin oluşması sürecindeki kurucu unsurların tüm piyasa oluşum süreci boyunca dışsal düzenleme mekanizmasına tabi olduğu görülmüştür. Lisanssız pazar segmenti ise iki ayrı fazda oluştuğu için, ilk fazda kurucu unsurların dışsal düzenleme mekanizması ile, ikinci fazda ise kendinden ortaya çıkış mekanizması ile oluştukları sonucuna ulaşılmıştır. Lisanslı pazar segmentinin ve lisanssız pazar segmentinin ilk fazının oluşumundaki aktörlerin ortaya çıkışı, piyasada oluşabilecek tekel yapıyı engellemeye ve girişimciliği desteklemeye yönelik politikalarla desteklenmiştir.

Lisanssız elektrik üretiminin ikinci fazı ise, lisanssız elektrik üretimi üst sınırının 1MW'a çıkarılması ile ortaya çıkan yeni girişimcilik fırsatını [103] yatırımcılar tarafından değerlendirmesi sonucunu doğuran kendiliğinden ortaya çıkış mekanizması ile oluşmuştur. Lisanslı ve lisanssız elektrik üretimi pazar segmentlerindeki ağ yapılarının oluşması, dışsal düzenleme mekanizmasında tarif edildiği gibi derneklerin ve konsorsiyumların oluşmasını destekleyen politikalara dayanmaktadır. Fakat özellikle sosyal medya üzerinden örgütlenen ağ yapıları olan platformlar, doğrudan bu politikalar aracılığıyla değil, dolaylı olarak politikaların sektör üzerindeki etkileri ile yapılanmış ve geniş kitlelere ulaşmaya başlamışlardır.

Süreç analizinde, piyasa oluşumunun alt fonksiyonları olan "pazar segmentlerinin oluşması, mübadele ilişkilerinin oluşması ve kullanıcı profillerinin oluşması" alt fonksiyonları süreçler üzerinden incelenmiştir. Lisanslı elektrik üretimi pazar segmentinin oluşmasında baskın olan ana süreç Möllering (2009) tarafından mübadele kurallarının ve onları bağlayan yaptırımların tüm mübadele ilişkilerinde geçerli olması ve garanti altına alınması olarak tanımlanan *kurumsallaşma* süreci iken; lisanssız elektrik üretimi pazar segmentinin oluşmasındaki ana süreç ağ ilişkilerini oluşturan, statü sahibi olan ve belirsizliği ortadan kaldırmak amacıyla çalışan piyasa aktörleri arasındaki ilişkilerin kurulması olarak tanımlanan *ilişkilendirme*dir. Lisanslı pazar segmentinin oluşumunda kurumsallaşma sürecinin mübadele ilişkilerini standartlaştırması ön plana çıkarılmışken, lisanssız pazar segmentinin oluşumunda ilişkilendirme sürecindeki, sektöre hakim olan belirsizlik unsurlarını tarif etmek ve ortadan kaldırmak için çaba sarf eden aktörler arasında ilişkiler kurulması ön plana çıkarılmıştır.

Süreç analizi kapsamında, lisanslı pazar segmentindeki piyasa işlemlerinin oluşmasında baskın olan ana sürecin *rekabet etme süreci* olduğu, lisanssız pazar segmentindeki piyasa işlemlerinin oluşmasında baskın olan ana sürecin ise *iletişim kurma* olduğu, alan araştırmasının bulgularıyla desteklenmiştir. Rekabetçiliğin lisanslı pazar segmentindeki piyasa işlemlerini şekillendirmesi, devletin bu alanda oluşturmak istediği piyasa yapısının rekabetçi olmasını amaçlamasından kaynaklanmaktadır. Lisanssız pazar segmentindeki piyasa işlemlerinin oluşmasındaki sürecin iletişim olması ise bu işlemlerin, aktörler arası iletişim ve işbirliği ile geliştiğinin ve tabandan tavana yayıldığının göstergesidir.

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[103] Bu fırsat yanyana farklı aboneliklerle 1er MWlık tesis kurarak üretilen elektriğin tamamının devlete satarak para kazanabilme olanağıdır.

Üçüncü piyasa oluşum alt fonksiyonu olan "kullanıcı profillerinin oluşması" konusunda ulaşılan sonuç ise, Türkiye'deki yenilenebilir enerji kaynaklarına dayalı elektrik üretiminde (lisanslı veya lisanssız pazar segmenti birbirinden ayrılmadan) tek kullanıcı profilinin devlet olduğu ve başka bir kullanıcı profilinin henüz oluşmadığıdır.

Fonksiyonel analiz sonucu, Türkiye'deki Yenilenebilir Enerji Teknoloji Yenilik Sistemi'ndeki piyasa oluşumunun; başlangıç pazar, köprü pazar, kitle pazarı (Bergek vd. 2008) aşamaları arasında başlangıç pazarı aşamasında olduğu sonucuna varılmıştır. Bu aşamada belirsizlik, teknolojik gelişmede çeşitlilik yaratılmasına açık olma özellikleri ve öncü kullanıcı(lar)ın varlığı ile göze çarpar. Dewald ve Truffer (2012)'in işaret ettiği gibi bu aşamada piyasa oluşumu fonksiyonunun Türkiye'deki Yenilenebilir Enerji Teknolojik Yenilik Sistemi'nin performansına etkisi, pazar segmentleri oluşumu altfonksiyonu üzerinden olmuştur. Türkiye'deki rüzgar ve güneş enerjisine dayalı elektrik üretimi piyasasında henüz ürün çeşitliliğinin çok fazla olmadığı, aktörler arasında sürekli evrilen organik ve enformel ilişkilerin baskın olduğu ve metalaşmanın henüz oturmuş bir piyasa yapısında gerçekleşmediği görülmüş ve bu sebeplerle piyasanın başlangıç aşamasında olduğu sonucuna ulaşılmıştır.

3. Politika Önerileri:

Politika önerileri, alan araştırması kapsamında belirlenen politika sorunlarını çözmek için tasarlanmıştır. Bu süreçte politika amacı, politika aracı ve politika hedefi ayakları üzerinde kurgulanan bir politika tasarım modeli kullanılmıştır. Politika amacı, güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin yayıldığı çevre olan enerji sektörü ile politika analizinin odak noktası olan piyasa oluşumu arasındaki ilişkiden yola çıkarak; politika sorununun çözümündeki motivasyonları işaret etmektedir. Politika aracı, politika hedefine ulaşmak için kullanılan enstrümandır. Politika hedefi ise, politika önerinin başarısını değerlendirebilmek için konan ölçülebilir kriter olarak tanımlanmıştır. Bu üç ayak üzerine kurulan politika önerileri ise makro, meso ve mikro seviyelerde kurgulanmıştır. Makro seviyedeki politika önerileri güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin yayıldığı sosyo-ekonomik çevredeki değiklikler için, meso seviyedeki öneriler bu sosyo-ekonomik çevredeki dinamikleri kontrol etmek için kullanılan düzenleme mekanizması için, mikro seviyedeki öneriler ise sistemin en küçük birimi olan kurucu unsurlarını (aktörler, ağ yapıları ve kurumları) şekillendirmek için kurgulanmıştır.

Türkiye'deki enerji sektörünün mevcut durum analizinden çıkarılan ve güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin benimsenmesi ve yaygınlaştırılmasını desteklemek için piyasa oluşumuna yönelik tasarlanan teknoloji politikaları ile çözülmesi hedeflenen politika sorunları; *ithalata bağımlılık sorunu* ve *yönetişim sorunudur*.

İthalata bağımlılık sorununu çözmek için makro seviyede iki, mikro seviyede ise bir politika önerisi geliştirilmiştir. Makro seviyedeki politika önerileri *enerji kaynakları arasında tamamlayıcılık ilişkisinin ön plana çıkarılması* ve *yerli teknoloji geliştirme stratejisinin modellenmesi*dir. Mikro seviyedeki politika önerisi ise *öztüketimin desteklenmesi*dir.

Makro seviyedeki politika önerilerinin ilki *enerji kaynakları arasında tamamlayıcılık ilişkisinin ön plana çıkarılması*dır. Alan araştırmasının bulgularına göre, Türkiye'deki elektrik arz güvenliği sorunu, kaynakların dengeli olarak kullanıldığı bir elektrik üretim sepeti ile çözülmelidir. Bu sebeple, söz konusu önerinin politika amacı *elektrik arz güvenliği sorunu dengeli bir elektrik üretim sepeti formule ederek çözmek* olarak belirlenmiştir. Bunu başarabilmek için *yenilenebilir elektrik üretiminde çok boyutlu bir maliyet analizi yapılması*, politika aracı olarak kullanılabilecektir. Bu önerinin başarısını ölçmek için koyulacak politika hedefi ise, 2009 yılında yayımlanan Enerji Arz Güvenliği Strateji Belgesi'nde yer alan *2023 yılında elektrik üretiminin %30'unun yenilenebilir enerji kaynaklarından karşılanması* olarak belirlenmiştir.

Makro seviyedeki ikinci politika önerisi ise *yerli teknoloji geliştirme stratejisinin modellenmesi*dir. Bu öneri ile amaçlanan *yenilenebilir enerji ekipmanlarının tedariğindeki ithalata bağımlılığı düşürmek*tir. Alan araştırmasında en çok öne çıkarılan konulardan birisi de, yenilenebilir enerji santrallerinin inşaatında kullanılan ekipmanın yurtdışından ithal edilmesinden dolayı yeni bir ithalata bağımlılık sorununun gündeme gelmesini engellemek için, yerli yenilenebilir enerji ekipmanının üretilmesinin desteklenmesidir. Bu amaçla yerli yenilenebilir enerji teknolojilerinin geliştirilmesi için iki politika aracı kullanılması önerilmektedir: (i) yerli teknoloji üreticilerinin doğrudan parasal teşviklerle desteklenmesi (ii) pazar segmenti odaklı teknoloji geliştirme stratejisi kurgulanması. Mevcut durumda, yenilenebilir enerji santralinde yerli ekipman kullanan elektrik üreticisi fazladan parasal teşvik verilerek desteklenmektedir. Bu modelde yerli teknoloji üreticisi değil, bu teknolojiyi kullanan elektrik üreticisi desteklendiği için bu teşvik dolaylı bir teşviktir. Alan araştırmasında bu dolaylı teşvik çok eleştirilmiş ve bu politika önerisinin gerçekleştirilmesinde kullanılabilecek politika aracı olarak *yerli üreticilere doğrudan verilecek parasal destekler* dile getirilmiştir. Öte yandan diğer politika aracı *pazar segmenti odaklı teknoloji geliştirme stratejisi*dir. Bu stratejide lisanssız pazarda küçük ölçekli yenilenebilir enerji teknolojilerinin bireysel teknoloji üreticisi tarafından geliştirilmesi; lisanslı pazardaki büyük ölçekli yenilenebilir enerji teknolojilerinin ise rekabetçi güç kazanmak ve ölçek ekonomisinden faydalanmak isteyen küçük üreticilerin biraraya gelerek oluşturdukları konsorsiyumlar aracılığyla geliştirilmesi önerilmektedir. Bu politika önerisinin başarısının ölçülmesi için konulan politika hedefi ise *Konya-Karapınar Enerji İhtisas Endüstri Bölgesi'nde yerli olarak üretilen teknolojilerin kullanımının zorunlu olduğu 3000 MW güneş enerjisi kapasitesinin başarıyla kurulması* olarak belirlenmiştir. Bu hedef, 8 Eylül 2015 tarihinde Resmi gazetede yayımlanan ETKB kararına dayanır. Bu bölgede yerli ürün kullanımı bir önkoşul olarak belirlenmiş, fakat yerli teknoloji geliştirme faaliyetlerine herhangi bir vurgu yapılmamıştır. Yerli ürün geliştirme stratejisindeki kritik nokta ise ürünün yerli üreticilerin teknoloji geliştirme faaliyetleri sonucunda geliştirmesidir. Bu sebeple, Türkiye'de üretim yapan yabancı üreticilerin ürettikleri ve yerli ürün sayılan yenilenebilir enerji ekipmanları yerine, yerli üreticilerin teknoloji geliştirme faaliyetleri sonucu geliştirilen yerli ekipmanın üretiminin desteklenmesi, bu politika önerisinin odak noktasıdır.

Mikro seviyede ise, *yenilenebilir kaynaklara dayalı olarak üretilen elektriğin öztüketiminin desteklenmesi* önerilmiştir. Bu önerinin politika amacı, *öztüketim amacıyla kurulan küçük lisanssız elektrik üretim santrallerinin artırılması*dır. Mevcut durumda Türkiye'de öztüketim çok kolay ve yaygın değildir. Onun yerine, lisanssız pazarda üretilen elektriğin tamamının satılması ile ticari bir kazanç sağlanmak için yanyana kurulan 1 MW'lık santrallerin kurulumu yaygındır. Bu sebeple, öztüketimin desteklenmesi için *üreten tüketici modeli* politika aracı olarak önerilmektedir. Bu modelde yenilenebilir enerjiye dayalı olarak üretilen tüm elektriğin, üretildiği birimde tüketilmesi yani elektrik tüketicisinin aynı zamanda elektrik üreticisi de olması öngörülmektedir. Bu model, küçük ölçekli lisanssız elektrik üretim santrallerinin kurulum prosedürlerinin kolaylaştırılması ile mümkündür. Öte yandan, *kamu binalarında tanıtım amaçlı yenilenebilir enerji santrallerinin kurulması,* öztüketimin desteklenmesi için kullanılabilecek diğer politika aracıdır. Çünkü bakanlık, belediye, okul, hastane gibi kamu binalarında yapılacak bu tür tanıtıcı kurulumlar, görerek öğrenen ve komşu etkisi altında kalan Türk toplumunda yenilenebilir enerji teknolojilerinin yayılması için olumlu etki yaratacaktır. Bu politika önerisini gerçekleştirmek için *yenilenebilir enerji potansiyeli yüksek pilot bölgelerde gerçekleşecek 1000 çatı kurulumu* *projesi* veya *Kamu kurumlarının binalarında gerçekleşecek 1000 Çatı kurulumu projesi* politika hedefi olarak belirlenmiştir.

Yönetişim sorununun çözülmesi için ise, makro seviyede bir, meso seviyede üç ve mikro seviyede bir politika önerisi geliştirilmiştir. Makro seviyedeki politika önerisi *rüzgar ve güneş enerjisine dayalı elektrik üretimi için yol haritaları ve planların hazırlanması*dır. Meso seviyedeki politika önerileri, *yenilenebilir enerji yatırımları için el kitaplarının hazırlanması, enerji sektöründe devletin rolünün değişmesi* ve *sanayi üretimine güneş ve rüzgar enerjilerine dayalı olarek üretilen elektriğinin entegre edilmesi*dir. Mikro seviyedeki politika önerisi ise, *elektrik iletim ve dağıtım altyapısının rehabilite edilmesi*dir.

Makro seviyedeki politika önerisi *rüzgar ve güneş enerjilerine dayalı elektrik üretimi konusunda 2023 hedeflerine ulaşmak için açık yol haritalarının ve planların hazırlanmasıdır.* Bu önerideki politika amacı *yenilenebilir enerji sektöründe uzun dönemli planlar yapmak*tır. Alan araştırmasında, uzun dönemli enerji planlamasının olmaması, belirsizliğe neden olan ve kamu kurumları arasındaki iş bölümü ve koordinasyonun olmasını engelleyen yönetişim sorununun bir sonucu olarak işaret edilmiştir. Bu amaçla kullanılabilecek politika araçları ise *kaynakların spesifik özellikleri göz önünde bulundurularak her kaynak için ayrı ayrı 5 ila 10 yıllık planların hazırlanması* ve *bölgesel bazda doğru hesaplanmış güneş ve rüzgar enerjisi potansiyelini değerlendirerek gerçekçi ve açık eylemler belirlemek*tir (örneğin Akdeniz Bölgesi için bir güneş enerjisi planı ve Ege Bölgesi için bir rüzgar enerjisi planı hazırlamak gibi). Bu politika önerisinin uygulanmasında politika yapıcıların başarısını ölçmek için kullanılabilecek politika hedefleri *güneş enerjisinde 5000 MW ve rüzgar enerjisinde 20.000 MW olarak belirlenen 2023 hedeflerine ulaşmak*tır. Bu sayısal hedefler, son olarak 2014 yılı Aralık ayında yayımlanan Ulusal Yenilenebilir Enerji Eylem Planı'nda belirtilmiş hedeflerdir.

Meso seviyedeki ilk politika önerisi *yenilenebilir enerji yatırımları için el kitaplarının hazırlanması*dır. Bu önerinin amacı *söz konusu yatırımlarda standartların olmaması sorununu çözmek*tir. Standartların olmaması, yönetişim sorunun sebeplerinden bir tanesidir çünkü yenilenebilir enerji yatırım sürecinde açıkça tanımlanmış standart prosedürler mevcut değildir. Bu politika önerisinin gerçekleşebilmesi için yenilenebilir kaynaklara dayalı elektrik üretimi yatırımlarını düzenleyen temel iki mevzuat dokümanı olan "Elektrik Piyasası Lisans Yönetmeliği" ve "Elektrik Piyasasında Lisanssız Elektrik Üretimine İlişkin Yönetmelik" dokümanlarının güneş ve rüzgar enerjileri için ayrı ayrı yeniden hazırlanması önerilmektedir. Her bir kaynağa dayalı elektrik üretimi yatırımı için takip edilen prosedürler, aktörlerin yatırım sürecindeki rolleri, yatırım maliyetleri, kullanılan ekipmanların tedariği birbirinden farklıdır. Bu sebeple lisanslı ve lisanssız pazar segmentlerinin de ayrı ayrı regule edilmesi önerilmektedir. Bu politika önerisinin başarısını ölçmek için kullanılabilecek politika hedefi *her bir pazar segmenti için kurulu kapasite hedeflerinin de ayrı ayrı belirlenmesi*dir. Örneğin 2023te ulaşılması hedeflenen 5000 MW güneş kurulu gücünün, 4000 MW'ının lisanslı 1000 MW'ının lisanssız pazarda gerçekleştirilmesi bu şekilde kullanılabilecek bir politika hedefidir.

Meso seviyedeki ikinci politika önerisi ise *enerji sektöründe devletin rolünün enerji üreticisinden sektörel düzenleyiciye dönüştürülmesi*dir. Bu önerinin politika amacı, *yenilenebilir enerji yatırımlarında bürokratik yükün azaltılması, devletin yenilenebilir enerji sektöründe hesap verilebilirliği konusundaki sorunun çözülmesi* ve *hükümetle diğer aktörler arasındaki güven ilişkisinde oluşan açıkların giderilmesi* olarak belirlenmiştir. Alan araştırmasında bürokratik işlemlerin yoğunluğu, güneş ve rüzgar enerjisine dayalı elektrik üretim teknolojilerinin yayılmasının önündeki en büyük yönetimsel engel olarak işaret edilmiştir. Bu engel, çok vakit alan evrak işleri, başvuru ve kurulum süreçlerindeki aşırı detaylı prosedürel zorunluluklar ve farklı kurumlardan alınan izin sayısının fazlalığı ile lisanslı ve lisanssız pazardaki faaliyetleri engellemektedir. Öte yandan, bürokrasi devletin yenilenebilir enerji sektörü üzerindeki kontrol mekanizması olarak görülmekte ve devletin sektörü öğrenme sürecinin bir parçası olarak adlandırılmaktadır. Bu durum da, yönetişim sorunun sonuçlarından biri olan *yenilenebilir enerji sektöründe aşırı müdaheleci devlet yapısını* getirmektedir. Alan araştırmasına göre, devlet şebeke sistemini yenilenebilir enerjinin olumsuz etkilerinden korumak için sektöre bu şekilde müdahele etmektedir. Fakat devletin bu aşırı müdaheleci tutumu, sektörün daha da belirsiz bir yapıya sahip olmasına neden olmaktadır. Çünkü devlet hızlı önlem alabilmek için, kuralları ve uygulamaları çok sık değiştirmektedir. Öte yandan, devletin enerji sektöründeki bu kestirilemez pozisyonu hesap verilebilirlik sorununa da neden olmaktadır. Devletin enerji sektöründeki faaliyetleri hakkında rapor verebilmesi, bu faaliyetleri açıklayabilmesi ve meşrulaştırabilmesi, bu faaliyetlerden sorumlu davranması beklenmektedir. Fakat yenilenebilir enerji sektöründeki kilit aktörlere (özellikle sivil toplum temsilcilerine) göre devlet bu anlamda hesap verebilir değildir. Bu sorun da güven ilişkilerinde aksaklıklara neden olmaktadır. Bu sebeplerle bürokratik yükün azaltılması, hesap verebilirlik sorunun çözülmesi ve güven ilişkilerinde yaşanan aksaklıkların giderilmesi için devletin enerji sektöründeki rolünün değişmesi önerilmektedir. Bu politika önerisinin gerçekleştirilmesi için kullanılabilecek politika araçları *yenilenebilir enerji yatırımlarında tek bir koordinasyon mekanizmasının kurulması* ve *enerji sektöründeki (devlet de dahil) her bir aktörün görevlerinin, rollerinin ve sorumluluklarının yanısıra görevlerini ihmal etmeleri durumunda uygulananacak yaptırımların belirlenmesi*dir. Politika hedefi ise *YEGM'nin koordinasyon merci olarak yetkilendirilmesi*dir. YEGM'nin yenilenebilir enerji kaynaklarına dayalı elektrik üretimi alanındaki tek koordinasyon mekanizması olması ile, lisanslı ve lisanssız pazardaki tüm yatırım süreçlerini tek elden kontrol edilebilmesi ve böylece bu süreçlerin hızlanması ve daha etkin işlemesi sağlanabilecektir. Bu önerinin politika hedefi ise; yeni güneş ve rüzgar enerjisi başvuruları alınmadan, YEGM için yetki ve sorumlulukların birbirini tamamlar şekilde tanımlanması ve gerekli durumlarda uygulanacak yaptırımların da açıkca belirlenmesidir.

Meso seviyedeki üçüncü öneri *sanayi üretimine güneş ve rüzgar enerjisine dayalı elektrik üretiminin dahil edilebilmesi için yeni bir yönetişim modelinin benimsenmesi*dir. Bu politika önerisi özel sektör kuruluşları tarafından en sık ifade edilen yönetimsel destekleyici faktör olan yenilenebilir enerjinin puant azaltma etkisine dayanmaktadır. Bu önerinin politika amacı ise, şebekeden kullanılan elektriğe ek olarak *gün ortasında yenilenebilir enerji kaynaklarına dayalı elektrik üretiminin artırılmasıdır.* Alan araştırmasında, gün ortası hem sanayideki üretimin hem de (özellikle güneş enerjisi açısından) yenilenebilir enerji potansiyelinin en yüksek olduğu zamandır. Üretim yapan bir fabrikanın gün içindeki en yüksek elektrik tüketim maliyeti olan gün ortası maliyetini, elektrik tüketiminin bir kısmının fabrika çatısına (veya yakınına) kurulabilecek yenilenebilir enerji santralinden karşılanması ile düşürülebilmesi mümkündür. Bu öneriyi gerçekleştirmek için kullanılabilecek politika araçları ise *puant saatlerde kullanılan yenilenebilir elektriğe fazladan teşvik (ek maddi destek) verilmesi, sanayi üreticilerinin yenilenebilir enerji santrali kurabilmesi için spesifik bir proje finansman mekanizması geliştirilmesi* ve *yenilenebilir enerji üreticileri ile fabrika sahipleri arasında ikili anlaşmaların serbest bırakılması*dır. Örneğin Organize Sanayi Bölgelerindeki fabrikalar, kendi yenilenebilir enerji santrallerini kurmaları ve puant saatlerde kullanmaları için desteklenmelidir. Ayrıca devlet veya TURSEFF gibi finansal kuruluşlar, özellikle gün ortasında yenilenebilir enerjinin de kullanımının desteklenmesi için, proje finansman mekanizmaları kurgulayabilirler. Halihazırda yapılması yasal ikili anlaşmaların yasal hale getirilmesi ise diğer politika aracıdır. Bu konudaki bir diğer önemli nokta ise, Türkiye'deki şebeke sisteminin yeniden düzenlenmesi ve akıllı şebekeye geçiş çalışmalarının başlamasıdır, çünkü belli saatlerde tüm bağlantıyı şebekeden koparmadan belli kaynaklardan üretilen elektriğin tüketiminin sağlanması için akıllı şebeke şarttır. Politika hedefi ise, sanayideki elektrik üretiminin bir bölümünün yenilenebilir enerjiden karşılanması için konulabilecek sayısal hedefler olarak belirlenebilir. Örneğin bu tür hedefler öncelikli olarak organize sanayi bölgeleri için konulabilir. Yenilenebilir enerji potansiyelinin yüksek olduğu pilot bölgelerdeki organize sanayi bölgelerinden birinde, 2016 yılı sonunda tüketilen elektriğin %1'inin yenilenebilir enerjiden karşılanması örnek bir politika hedefi olarak önerilebilir. Söz konusu bölge için TEİAŞ'ın öncelikli olarak şebeke altyapısına destek vermesi ve yeni altyapı yatırımlarını gerçekleştirmesi ise, bu politika hedefinin bir parçası olarak kurgulanmalıdır.

Mikro seviyedeki tek politika önerisi ise, *elektrik dağıtım ve iletim sisteminin rehabilite edilmesi*dir. Bu önerinin ardındaki politika amaçları, *elektrik arz güvenliğinin garanti altına alınması* ve *yenilenebilir kaynaklara dayalı elektrik üretiminin tüm iletim ve dağıtım sistemine sorunsuz entegre edilmesi için fiziksel altyapının güçlendirilmesi*dir. Alan araştırmasında "altyapı konusundaki aksaklıklar" en çok öne çıkan fiziksel engel olmuştur. Bu aksaklıkların temelinde ise, yenilenebilir enerji kaynaklarına dayalı olarak üretilen elektriğin tüm iletim ve dağıtım sistemine entegre edilmesi için gerekli trafo kapasiteleri ve yeni ekipman ihtiyaçları ile ilgili sorunlar yatmaktadır. Öte yandan, yenilenebilir enerji potansiyeli yüksek bölgelerde (Akdeniz Bölgesi gibi) trafo kapasitelerinin şimdiden dolmuş olması, yeni başvuruların kabul edilememesine sebep olmaktadır. Bu aksaklıklardan dolayı, özellikle lisanssız elektrik üretiminin yavaşlaması söz konusudur. Bu önerinin gerçekleşmesi için kullanılabilecek politika araçları, *trafo kapasitelerinin (güneş ve rüzgar enerjisine ayrılan bölümlerinin) periyodik olarak açıklanması, TEİAŞ ve dağıtım şirketleri tarafından (trafo kapasitelerini artırmak için) yeni altyapı yatırımları yapılması* ve *yenilenebilir enerji santrallerinin kurulumu sırasındaki altyapı iyileştirme gerekliliklerini belirlemek için TEİAŞ'ta uzman bir ekip oluşturulması*dır. Bu araçlar yerinde kullanılırsa, yenilenebilir enerji yatırımcılarının detaylı fizibilite çalışmaları yapabilmeleri mümkün olabilecektir. TEİAŞ, periyodik olarak trafo kapasitelerini açıklamaya 2015 Ocak ayında başlamıştır[104] ve yine aynı dönemde, her ayın başında bu trafo kapasitelerini ilan edeceğini ve kapasitelerin yeni altyapı yatırımları ile artırılacağını bildirmiştir. Bu şekilde atılan adımlarla, altyapı güçlendirilebilecektir. Trafo kapasitelerin düzenli açıklanması, bu politika önerisinin

[104] Rüzgar e güneş enerjisi için belirlilen detaylı kapasiteye takip eden linkten ulaşılabilr: http://www.teias.gov.tr//Duyurular/Lisanss%C4%B1z%20Tahsis%20Edilen%20GES-RES%20Kapasiteleri.pdf Son erişim: 22.01.2016

başarısını ölçebileceğimiz bir politika hedefi olarak kabul edilebilir. Ocak 2015'den beri yapılan açıklamalar TEİAŞ internet sitesi Duyurular sayfasından takip edilebilmektedir. Trafo kapasitelerinin bu şekilde artırılarak ilan edilmesi, yenilenebilir kaynaklara dayalı olarak üretilen elektriğin; elektrik üretim ve dağıtım sistemin entegre edilmesi için altyapı iyileştirmelerine örnek olarak gösterilebilir.

E: Curriculum Vitae

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FOREIGN LANGUAGES

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PUBLICATIONS

Erden, Y. , C. Durukan, A. Ertan, M. Doğan and S. Karaata. (2014). *Ulusal Inovasyon Girişimi 2006-2013 Dönemi Değerlendirme Raporu* (in Turkish), TUSIAD Sabancı Üniversitesi Rekabet Forumu, http://ref.sabanciuniv.edu/sites/ref.sabanciuniv.edu/files/ulusal_inovasyon_2006-20013.pdf

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F: Tez Fotokopisi İzin Formu

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

Uygulamalı Matematik Enstitüsü ☐

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YAZARIN

Soyadı :

Adı :

Bölümü :

TEZİN ADI (İngilizce) :

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: