THE IMPACTS OF GREEN ENERGY POLICIES

ON

RENEWABLE ENERGY STARTUPS IN TÜRKİYE

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ABSTRACT

THE IMPACTS OF GREEN ENERGY POLICIES

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This study aims to understand the effects of Türkiye's green energy policies on renewable energy startups. Green energy policies have become an important policy area in recent years (Pegels et al., 2017). In particular, the increasing effects of climate change worldwide play an important role in increasing interest in this area. Energy use and the type of energy sources used are some of the main reasons for all this. However, most countries are trying to improve the world by changing energy consumption behaviors, green energy policies, and environmentally friendly technologies. Türkiye has also taken significant steps in the green energy transition. While increasing its renewable energy capacity, Türkiye is developing new policies in line with the EU Green Deal, such as Türkiye's Green Deal Action Plan. While the country's renewable energy capacity has increased significantly to 30.642,66 MW, the ecosystem of renewable energy startups has also grown. The effects of green energy policies on renewable energy startups in Türkiye were examined through an interpretative phenomenology analysis based on inductive reasoning conducted through semi-structured interviews. As a result of the study, policy recommendations were developed focusing on policy feedback mechanisms, financial support policies, administrative difficulties, and bureaucratic delays.

Keywords: green energy, renewable energy, startups, policy, Türkiye

ÖZ

YEŞİL ENERJİ POLİTİKALARININ TÜRKİYE'DEKİ YENİLENEBİLİR ENERJİ GİRİŞİMLERİ ÜZERİNDEKİ ETKİLERİ

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Bu çalışma, Türkiye'nin yeşil enerji politikalarının yenilenebilir enerji girişimleri üzerindeki etkilerini anlamayı amaçlamaktadır. Yeşil enerji politikaları son yıllarda önemli bir politika alanı haline gelmiştir (Pegels et al., 2017). Özellikle, iklim değişikliğinin dünya genelinde artan etkileri, bu alana olan ilginin artmasında önemli bir rol oynamaktadır. Enerjideki fosil yakıt kullanımı başlıca nedenlerindendir. Ancak, çoğu ülke değişen enerji tüketim davranışları, yeşil enerji politikaları ve çevre dostu teknolojilerle dünyayı daha iyi hale getirmeye çalışmaktadır. Türkiye de yeşil enerji konusunda önemli adımlar atmıştır. Yenilenebilir enerji kapasitesini artırırken, AB Yeşil Mutabakatı ile uyumlu yeni politikalar geliştirmektedir. Ülkenin yenilenebilir enerji kapasitesi önemli ölçüde artarken, yenilenebilir enerji girişimlerinin ekosistemi de büyümüştür. Türkiye'deki yeşil enerji politikalarının yenilenebilir enerji girişimleri üzerindeki etkileri, yarı yapılandırılmış görüşmeler yoluyla yürütülen tümevarımsal akıl yürütmeye dayalı yorumlayıcı bir fenomenoloji analizi yoluyla incelenmiştir. Çalışmanın sonucunda politika geri bildirim mekanizması, finansal destek politikaları, yönetimsel zorluklar ve bürokratik gecikmeler odağında politika önermeleri geliştirilmiştir.

Anahtar kelimeler: yeşil enerji, yenilenebilir enerji, girişimler, politika, Türkiye

To my beloved family

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LIST OF ABBREVIATIONS

AFOLU	Agriculture, forestry, other land use
COP	Conference of Parties
EPDK	Energy Market Regulatory Authority
GHG	Greenhouse Gas
GTI	Green technology innovations
HSEC	Human Subjects Ethics Committee
IPA	Interpretative Phenomenology Analysis
ITA	Interpretative Theming Analysis
KOSGEB	Small and Medium Enterprises Development and Support Administration
METU	Middle East Technical University
RESM	Renewable Energy Support Mechanism
RTA	Reflexive Thematic Analysis
TUBİTAK	Scientific and Technological Research Council of Türkiye
YEKA	New Renewable Energy Resource Areas
EU	European Union
EU-ETS	The EU Emissions Trading System
UN	United Nations
UNFCCC	The United Nations Framework Convention on Climate Change

CHAPTER 1

INTRODUCTION

This chapter serves as the introduction of the study, delivering the thesis overview through its structure, introducing its research question, and explaining its rationality.

1.1. Overview and Structure

This study is a qualitative inquiry to discover the impacts of green energy policies on renewable energy startups in Türkiye based on the evidence gathered from semi-structured interviews with representatives of renewable energy startups. Renewable energy startups play a pivotal role in transitioning to a low-carbon economy and, thus, a greener world (Lin et al., 2018; Luo et al., 2019; Wu et al., 2020a; Wu & Sun, 2008). The green energy policies require supporting renewable energy alternatives (green) such as solar, biodiesel, hydrogen, wind, and hydroelectric energy and focusing on activities that reduce carbon emissions, such as reducing the use of coal, oil, and gas. In our world, where the effects of the climate crisis are increasing daily, the existence of renewable energy startups and green energy policies is deadly critical. Therefore, the interaction between green energy policies and renewable energy startups is worth examining.

The thesis, prepared with our research enthusiasm, was structured as follows: This study includes five chapters, including what is explained in the overview. Theoretical background comes as the second chapter after the introduction section. The relevant

chapter provides information about the origin of green energy policies, the definition of green energy, a brief history of green energy policies, and the history of renewable energy and green energy-related policies in Türkiye.

Methods are the subject of the third chapter. In that chapter, data analysis methodology, the research design, the profiles of participants, the data collection journey from the preparation of the interview guide to semi-structured interviews, and data analysis from coding to the proclamation of the study findings are the main subjects. To delve into the details of the codebook, please refer to Table 4.

In the fourth chapter, the findings of the study and key takeaways from the study are presented. This chapter explains the themes shared in the data analysis with coded data supporting them.

Chapter five is the section for the findings regarding green energy policies. This chapter presents the relationship between the findings and the literature. Those findings also include recommendations for the policy and further research.

1.2. Research Question

The thesis is based on two primary research questions:

How do the incentives and funds offered under green energy policies affect renewable energy startups? Are these incentives thought to contribute to startups' strategies? t

What roles do green energy policy regulations and legislation play in the development process of enterprises? How are these regulations thought to shape startups' processes?

1.3. Rationality

From 1980 to the end of the 2010s, there was a dramatic increase in the number of extreme events caused by climate change. Extreme climate events, including high

temperatures, droughts, and forest fires, have quadrupled, while meteorological events, such as extreme storms, have doubled (Reidmiller et al., 2018). Many countries started to steadily use their energy resources and internalize socially responsible technologies to significantly reduce the negative impact on nature (Umar et al., 2020a; 2020b; Su et al., 2020). The world's focus on combating climate change and building a more environmentally friendly future is increasing daily. While many factors trigger climate change, the most influential factor is the consumption of fossil fuels (Fischer et al., 2016). Conventional fuels are running out and continue to harm the environment (Malik et al., 2024). The unacceptable and irreversible damage to the natural environment caused by the use of fossil fuels can only be reduced by decoupling energy demand from economic development and the reduction of fossil fuels (Umar et al., 2021a). Green technology innovations (GTIs), including renewable energy technologies, play a fundamental role in achieving sustainable development goals as a positive achievement while causing minimal negative consequences on nature (Lin et al., 2018; Luo et al., 2019; Wu et al., 2020a; Wu and Sun, 2008). This has made renewable energy and green energy policy some of the hottest topics in the energy sector. According to Google Scholar, in the first half of 2024 alone, over 29,000 articles on renewable energy and over 17,000 on green energy policy were published. Policymakers in many countries strive to create "green" policies as seen. These policies aim to reduce greenhouse gas (GHG) emissions and lower the rise in global temperature. Many indicators cause GHG emissions. When these indicators are categorized, buildings, transport, agriculture, forestry, other land use (AFOLU), and energy systems are seen as the primary indicator groups. The energy systems have the largest share of GHG emissions (Lamb et al., 2021). This is why we see one of the most critical policies focuses as helping to develop clean, renewable, or green energy

technologies, encouraging people to invest in renewable energy projects, and making it easier for sustainable energy solutions to succeed in the market (Deloitte, 2023). Through these policies, stern environmental regulations and the development of clean energy as well as renewable energy technologies have been essential objectives of the energy strategies of many countries (Lima et al., 2020; Wolde-Rufael and Weldemeskel, 2020).

These policies affect renewable energy startups as well as organizations that are already producing energy. Through these policies, governments aim to increase production and development in the field of green energy and reduce carbon emissions through regulations, criteria to be met, and in-kind and financial incentives (Deangelo et al., 1998). This study examines the impact of green energy policies on renewable energy startups. These impacts can be considered as positive and negative effects on issues such as incentives and support programs and access to finance, access to R&D and technology, market entry and commercialization. By analyzing a wide range of articles, research papers, reports, and semi-structured interviews in the related field, it aims to provide a comprehensive overview of the impact of these policies on issues such as the establishment, viability, product development, and access to finance of startups in the renewable energy sector. This research will examine green energy policies in multiple frameworks, including regulations, laws, financial incentives, and supporting mechanisms.

The reason for focusing on renewable energy startups in this study is that renewable energy startups play a pivotal role in the transition to a low-carbon economy and, thus, a greener world (Lin et al., 2018; Luo et al., 2019; Wu et al., 2020a; Wu and Sun, 2008). These startups may create innovative technologies and systems that have the

potential to provide sustainable and green solutions to the world's energy challenges while disrupting energy systems powered by traditional non-renewable energy sources (Hakovirta, 2023). However, in their early stages, these startups may need help with numerous uncertainties and barriers, including limited access to capital, market entry challenges, competitive disadvantages in the global market, and policy uncertainties. Green energy policies can support renewable energy startups in meeting their needs and create a fertile environment that encourages them to survive, thrive, and scale.

Making sense of the impacts of green energy policies on renewable energy startups is valuable for many actors in the energy sector and entrepreneurship ecosystem, especially policymakers and entrepreneurs. This study is expected to provide beneficial insights that can facilitate the design of effective policy prescriptions based on the experiences of startups and feedback for policies already in place. By highlighting the challenges experienced, sharing best practices, and providing policy recommendations, this study aims to contribute to developing and implementing green energy policies in Türkiye.

By interviewing renewable energy startups from different fields, we pursue to discover the impact of green energy policies from various perspectives. These interviews will shed light on the effectiveness of policy instruments such as tax incentives, grants, and support during the start-up phase, growth phase, product development, and green energy targets in stimulating investment and supporting innovation. It will also explore the role of supportive, regional, and sectoral policies in stimulating technological developments and increasing the overall competitiveness of renewable energy startups.

In the following sections, we will comprehensively analyze the existing literature and share the outputs, categorizing them into different categories according to the topic focus of the study. Through this research, we aim to improve the understanding of the impact of green energy policies on the establishment, product development, growth, and sustainability of renewable energy startups and eventually contribute to paving the way for a more efficient and sustainable green energy future with renewable energy startups.

1.4. Significance of the Study

This thesis aims to explore the effects of green energy policies on renewable energy startups in Türkiye. It provides valuable contributions to academic literature and policy practices from a startup perspective.

- Effectiveness of Policies and Fields of Implication: Analyzing the effects of green energy policies on renewable energy startups in Türkiye is an essential step in evaluating the success of these policies and identifying areas that need to be improved. This study will provide valuable data to assess the effectiveness of current policies on startups through startups' perspective. The outputs of this study can be used in future policy-making processes and can be included in research based on future studies in this field.
- Strategies for the Renewable Energy Sector: The study can provide strategic roadmaps, such as the Türkiye Hydrogen Technologies Strategy and Roadmap, to entrepreneurs and other actors in the sector by revealing the challenges and needs faced by renewable energy startups. This will contribute to supporting innovation and growth in the renewable energy sector.

- Contribution to Academic Literature: The literature on the impact of green energy policies on startups needs to be more extensive. Although they only sometimes have sufficient resources, startups play essential roles in researching and developing new technologies. Their contributions to countries' economies with the technologies they develop are valuable. Therefore, it is worth investigating how much policies support or limit them and how they contribute financially. This study can fill the gap in the literature, create a new discussion ground in this field, and be a reference source for future research.

CHAPTER 2

THEORETICAL BACKGROUND

This chapter presents information about the origin of green energy policies, the definition of green energy, a brief history of green energy policies, literature on green energy policies, renewable energy, and the history of renewable energy and green energy-related policies in Türkiye.

The purpose of writing this chapter is to provide a basis for green energy policies and renewable energy startups with the information it provides and to emphasize the need for this study.

2.1. Roots of Green Energy Policies

Unfortunately, as homo sapiens, we do not start to care about the environment after the moment we have gained consciousness. Regrettably, I agree with Agent Smith's remarks about The Matrix film released in 1999. Instead of establishing an instinctual balance with nature like other members of the mammal species, we, like a virus, prefer to exploit the world's resources, which is our host (Wachowski& Wachowski, 1999, 1:37:53). We realize that our resources are not infinite. Our world is not human-proofed, but we have already planted the seeds of one of today's most significant threats: the Climate Crisis (Climate Change or Global Warming). As Emma Gattey, a historian at the University of Cambridge, stated from the perspective of history, climate change is a topic that needs to be addressed in agility (Gattey, 2021).

Even though issues on climate and human interaction have been discussed over centuries (Locher & Fressoz, 2012), the actions that need to be taken on climate change have materialized for hundreds of years. We need to underline that climate change, as it is currently experienced and theorized, dates back to the origins of capitalism in the 16th century (Bonneuil & Fressoz, 2017). From those days to 2024, its effects have been amplified (He et al., 2022). Many factors are driving climate change. But the most important of these is the use of fossil fuels in established energy systems (Lamb et al., 2021). Fossil fuels were clearly identified as the root cause of climate change at the COP (Conference of Parties) 28 summit. For the first time in the summit's more than quarter-century history, delegates representing nearly 200 countries acknowledged the role of fossil fuels in driving climate change (Bourzac, 2024). They agreed to work "to move away from fossil fuels in our energy systems in a fair, orderly, and equitable way, accelerating action in this critical decade, consistent with the science to achieve net zero by 2050 (United Nations, 2023). The United Nations (UN) also includes green energy in its Sustainable Development Goals (SDGs). In 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development. This agenda includes Sustainable Development Goal 7 (SDG 7), which focuses on energy and is determined as an independent goal. This goal calls for "access to affordable, reliable, sustainable and modern energy for all." Energy is central to the 2030 Agenda for Sustainable Development and the Paris Climate Agreement. This goal is one of the cornerstones of sustainable development and combating climate change. Achieving SDG 7 is of critical importance for the future of our world and is a vital step towards improving the well-being of all societies and ensuring the sustainability of our planet. Of course, the way to transition from fossil fuels to clean energy fuels is through clean energy sources and, therefore, green energy policies

(Borghesi & Vergalli, 2022). By supporting technologies and applications that serve green energy, green energy policies can lead the way in ensuring access to reliable, sustainable, and modern energy.

2.2. Definition of Green Energy

To understand green energy policies and their impacts on renewable energy startups, definitions of green energy and renewable energy should be internalized first. According to the Cambridge Dictionary, green energy means “energy that can be produced in a way that protects the natural environment, for example, by using wind, water, or the sun” (Green Energy, 2023.). In another source, Collins Dictionary, green energy “is power that comes from sources that do not harm the environment and are always available, such as wind and sunlight” (Green Energy, 2023). On the other hand, renewable energy is “produced using the sun, wind, etc., or from crops, rather than using fuels such as oil or coal,” according to Cambridge Dictionary (Renewable Energy, 2023). It should be understood that they are so similar, but they are not the same. While green energy is renewable, not all renewable energies are green, like nuclear energy. In order to avoid conceptual confusion in the research, from this point on, the terms "green energy" will be used for policy studies and "renewable energy" will be used for startups and energy types.

2.3. History of Green Energy Policy Actions

Although there are numerous explanations for green energy, it's an energy as green trees do not harm the environment. While fossil fuel consumption in transportation systems and energy-intensive sectors is the principal pillar of civilization and is associated with the progressive release of greenhouse gases, green energy may be the cure for a sustainable future for earthlings (Hosseini & Wahid, 2016).

With the 2030 Climate Target Plan, the European Commission proposes raising the EU's ambition to reduce greenhouse gas emissions to at least 55% below 1990 levels by 2030. This is a substantial increase compared to the existing target, upwards of the previous target of at least 40% (European Climate Law, 2021).

Indubitably, actions for green energy policy did not start with the Climate Target Plan. Green energy has previously been included in direct energy focused policies and climate mitigation policies. One of the main reasons for this is that energy production is the area that triggers the most GHG emissions that cause climate change. If the milestones of these policies are focused on, a timeline below could come out:

1. **1970s-1980s**: The first green energy policies were enacted in the 1970s and 1980s in response to the oil crisis. These policies included tax credits, loans, and grants for renewable energy production (EveryCRSReport.com, 2008).

2. **1987**: The Montreal Protocol is an international agreement signed on September 16, 1987, and adopted at a meeting in Montreal organized by the United Nations Environment Program (UNEP) that aims to phase out the production and use of substances that deplete the ozone layer. Over time, the number of signatories has increased, reaching 197, and it is considered one of the world's most comprehensive and successful environmental agreements (UN, n.d.).

3. **1992**: The United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Earth Summit in Rio de Janeiro, Brazil. The treaty aims to stabilize greenhouse gas concentrations in the atmosphere at a

level that would prevent dangerous human interference with the climate system (United Nations Framework Convention on Climate Change, 1992).

4. **1997**: The Kyoto Protocol was adopted, which requires industrialized countries to reduce their greenhouse gas emissions by an average of 5.2% below their 1990 levels. We can say that the Kyoto Protocol has given industrialized countries and economies in transition the obligation to limit and reduce their greenhouse gas (GHG) emissions in accordance with the agreed targets, thus providing a point to be achieved for the efforts of countries in this regard and making the United Nations Framework Convention on Climate Change operational (Freestone, 2005).

5. **2005**: The European Union implemented the Emissions Trading Scheme, the world's first large-scale carbon trading scheme. It allowed companies to trade carbon emissions allowances with each other (The EU Emissions Trading System (EU-ETS), 2016).

6. **2009**: The Copenhagen Accord was signed, recognizing the need to limit global temperature increase to 2 degrees Celsius above pre-industrial levels (Afterword: The Copenhagen Accord 2010).

7. **2015**: The Paris Agreement was signed, which aims to keep global warming below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius (Reins & van Calster, 2021).

8. **2019**: The European Union passed the Clean Energy for All Europeans Package, which includes targets for renewable energy use, energy efficiency,

and greenhouse gas emissions reduction (European Commission, Clean Energy for all Europeans package).

9. **2019**: The European Green Deal, a strategy and action plan, was announced on 11 December 2019. This plan aims for the European Union to reach net zero greenhouse gas emissions by 2050, ensure environmental sustainability, and stimulate economic growth in a green way.

10. **2021**: The European Commission proposes raising the EU's ambition to reduce greenhouse gas emissions to at least 55% below 1990 levels by 2030 through European Climate Law. This is a substantial increase compared to the existing target, upwards from the previous target of at least 40% with the 2030 Climate Target Plan (European Commission, Delivering the European Green Deal).

11. **2022:** Despite the fluctuations in global energy supply caused by the war between Russia and Ukraine, the European Commission has launched REPowerEU to phase out fossil fuel imports from Russia and eliminate Europe's extra-continental energy dependencies (European Commission, REPowerEU).

12. **2023:** The Green Deal Industrial Plan has been launched to increase the competitiveness of Europe's net zero industry and accelerate the transition to climate neutrality (European Commission, The Green Deal Industrial Plan).

13. **2024:** On 6 February 2024, the European Commission announced its recommendation on the 2040 target as an interim commitment towards the EU's 2050 climate neutrality target. The Commission's recommendation calls for a 90% reduction in the European Union's greenhouse gas emissions

compared to 1990 levels by 2040(European Commission, 2040 Climate Target).

It should be emphasized that the timeline has emerged from the perspective of green energy. If the perspective of environmental law is internalized, we need to go back to the days of ancient Rome.

2.4. Literature on Green Energy Policies & Renewable Energy Startups

Within the scope of the European Green Deal, according to the updated Renewable Energy Directive (RED), the aim is to increase the renewable energy share in the EU to 42.5 percent by 2030 (European Commission, 2023). In order to achieve this target, the transition to renewable energy must be ensured. The transition to renewable energy technologies is necessary and feasible to achieve sustainability goals in the long term (Edenhofer et al., 2013). However, in order to achieve this transition, it is essential to provide effective regulations and incentive mechanisms for the development and implementation of renewable energy policies, to establish the necessary energy infrastructures, and to increase investments in this area (Aklin&Urpelainen, 2018). There are many studies in this field, and although great progress has been made in the focus of green energy, the progress made is not enough (Birol & Investment Bank, 2019). It is even argued that renewable energy growth needs to accelerate sixfold to meet the 2050 targets, and therefore, enabling policy and regulatory frameworks need to be adjusted. The highest growth within this growth is predicted to be in wind and solar photovoltaic technologies, supported by high levels of energy efficiency (Gielen et al., 2019). David G. Victor, who is the Peter Cowhey Center on Global Transformation Chair in Innovation and Public Policy at the School of Global Policy and Strategy at UC San Diego, also advocates the need for reforms in the energy sector

to accelerate the transition to sustainable energy sources. While stating that international cooperation is critical to achieving global climate goals, he draws attention to the importance of developing flexible and adaptable strategies. In parallel to his studies, the need for climate policies to be practical and applicable and advocate the development of strategies compatible with current economic and political conditions is defended (Sabel&Victor 2024). It is recommended that the related policies, as well as the transition to renewable energy, be fair, sustainable, and effective and that these policies be supported by strong legal frameworks and integrated with various sectors (Mehling et al., 2017). The need for strong legal frameworks to defend these policies has also been observed in early evidence after two recent events that have had worldwide impacts. COVID-19 and the Russia-Ukraine war have affected the global economy, including the energy sector, and although it has been observed that both crises could create opportunities for low-carbon energy transitions, early evidence suggests that actions have been taken to strengthen the existing system rather than transition to more sustainable energy systems (Zakeri et al., 2022). But while the picture is bleak, there is still hope. Startups play a major role in this change, as do the policies implemented and the collaborations made. The leadership of startups in energy transformation sheds light on successful energy transformations with their innovative products and services (Singh et al., 2021).

In addition, while Avci and his colleagues stated that green energy policymaking is an important element for the transition from fossil fuels to renewable energy sources, they mentioned that the establishment of renewable energy startups by young enterprises, is an important factor for a successful transition (2021).

Due to the countries' goals of achieving sustainable energy, the transition to low-carbon energy sources and investment in climate and green technologies are expected to increase. Therefore, any initiative to achieve the SDGs will increase the demand for renewable energy. It is argued that some legally enforceable agreements, such as the Kyoto Protocol, will encourage the production and use of green energy because they reduce carbon emissions (Tariq & Xu, 2022). This incentive situation may positively affect startups developing technologies in the field of renewable energy. However, the opportunities or challenges created by the policies developed at this point for startups are critical in whether the effects are experienced positively or negatively by startups. Türkiye, which is said to have started to move towards the carbon neutrality target after the Paris Climate Conference (Paris COP Conference: 21), also highlighted the importance of green technologies and renewable energy when its carbon emissions between 1990 and 2018 were examined (Shan et al., 2021).

When Türkiye's energy policies in the last twenty years are examined, Türkiye imports approximately 76% of its energy needs. Dependence on imported non-renewable energy sources for energy production causes emission rates to increase in the energy sector, which is the main responsible for GHG emissions (Kaygusuz, 2011, 91–93, Kırlı and Fahrioğlu, 2019). It is argued that a strong energy policy should be implemented to reduce energy imports that cause environmental and air pollution and dependence on non-renewable energy types. An energy policy that focuses on environmentally acceptable new and renewable energy sources is required (Salvarli & Salvarli, 2017, 515).

In order to achieve stable, sustainable development, it is necessary to use less polluting energy sources, to make efficient technological production and to ensure harmony

between all dimensions of sustainable development. Renewable energy startups also have a key role in this harmony with the characteristics such as flexibility, agility and innovation inherent in startups. Therefore, it is important to observe the effects of policies focused on this area, which we can also call green energy focus, on renewable energy startups.

Many empirical studies also addressing the relationship between the sustainability of environmental and climate policies and economic growth in Türkiye emphasize the importance of developing sustainable policies and increasing the use of renewable energy. These studies suggest that strong policies that reduce energy dependency and minimize environmental degradation should be implemented within the framework of environmental sustainability (Zanbak et al., 2020). Although it is stated that significant progress has been made in the energy and environmental sectors in terms of green growth and sustainable development thanks to various practices such as taxation and incentives, it is stated that Türkiye needs to develop more active strategies in terms of increasing the use of renewable energy and developing green technologies (Özdemir et al. 2021).

Another area that this study can be related to could be studies on the effects of incentives on renewable energy capacities. One of the examples of studies in this field is the study conducted by Bird and Collegues in 2005. In this study, they proved that tax and financial support provided by the state improved wind energy in the USA. Apart from this study, there are studies examining the effects of different policy instruments in different countries. There are studies investigating the effects of feed-in-tariff and green energy marketing on renewable energy in Germany, Denmark and the UK, and there are studies examining the effects of renewable energy portfolio

standards (RPS) on renewable energy in general and focused on the energy type vertical (Wüstenhagen &Bilharz, 2006; Lipp, 2007). While the positive effects of the policy instruments mentioned in these studies on renewable energy are observed, the effects of FITs are more obvious (Menz & Vachon, 2006; Carlery, 2019; Dong 2012). In a recent study conducted for Türkiye and various European countries with a similar focus, it was emphasized that tax, grant and R&D focused policies are the most effective tools on installed renewable energy capacities (Bölük & Kaplan 2021). As mentioned in the relevant studies, there are many policies that countries use. These policies are shown in the table below by IRENA, specifically for the countries in the upper-middle income category, including Türkiye.

Table 1 Renewable Energy Targets, & Green Energy Related Policies (2022)

		Targets		Regulatory Policies				Fiscal Incentives and Public Financing		
	Renewable energy in INDC or NDC	Renewable energy	Net zero target	Feed-in tariff/ premium payment	Net metering/billing	Biofuel blend, renewable	Renewable heat, obligation/mandate,	Reduction in sales, energy CO2, VAT or other tax	Investment or Production Tax Credits	Public investment, loans, grants, capital subsidies or rebates
Upper-Middle Income Countries										
Albania	C	E, HC, T		+	+			+	+	+
Algeria	C	E, P		-						+
Armenia	C	E, P, P[6]	C	+	+					+
Azerbaijan	C	E(N), P		+			+			+
Belarus	C	E		+				+		+
Belize	C	P, P[6]	C							
Bosnia and Herzegovina	C	HC		+						
Botswana	C	E		+	+		+	+		+
Brazil		E, P, P[6]	(R)	-	+	A+	S	+	+	+
Bulgaria	C	E, P, HC, T	C	+		+	+ -		A	+
China	(R)	E(R), P, P(N)[6]	C	S-		+	A+	+	+	+-
Chinese Taipei		E, P, P[6]		+		-			+	
Colombia	C	E, P, P[6]	(R)			A+		+	A+	+
Costa Rica	C	E, P	C	-	+	+	+	+		
Cuba	C	E, P								
Dominica	(R)									
Dominican Republic	C	P	C	+	+			+	+	+
Ecuador	C	P, P[6], T	C	-		+	+	+		+
Equatorial Guinea	(R)									
Fiji	(R)	E, P	(R)					+	+	
Gabon	(R)		A							
Grenada	C	P	C		+			+		
Guatemala	(R)	P	A		+			+	+	
Guyana	C	E, P	C					+		

Table 1 (cont'd)

Iran	C			+				+	+	+
Iraq	C	P, P[6]		-						
Jamaica	C	E(N), P	C		M	+		+	+	
Jordan	C	E(R), P		-	+		+	+		+
Kazakhstan	C	E, P	(R)	-			+			+
Lebanon	C	E, P, HC	(R)		+			+		+
Libya		P(R)						+		
Macedonia, North	C	E, P, HC, T	A	+				+	+	+
Malaysia	C	P	C	M	+			+		+
Maldives	C	E, P	(R)	+	+		+			
Marshall Islands	C	E	C					+		
Mauritius	(R)	P	C	M	+		+	+		+
Mexico	(R)	P, HC	A		+	A+		+	+	+
Montenegro	C	HC		-	+			+		
Namibia	C	E, P	C	-	+		+			
Nauru	C	E	C							
Paraguay	C					+		+		
Peru	-	P	(R)	+	+	-		+		+
Romania	C	P(R), P6, HC, T	A		M	+	+		A+	+
Russian Federation	C	P	(R)	+	+					+
Samoa	C	E, P	C							
Serbia		P, HC(N)		+						+
South Africa	C	P	C	M		+	+	+	A+	+
St. Lucia	C	P	(R)					+		
St. Vincent and the Grenadines	C		C	+	+					
Suriname	C	P	C							
Thailand	(R)	E, P, HC	(R)	+	+	A+		+		+
Tonga	C	P	C							
Türkiye	M	P, HC	C	+	+	+	A+			+
Turkmenistan	(R)									
Tuvalu	(R)	E, P	(R)							
Venezuela	C									

Targets: E Energy, **P** Power, **HC** Heating and cooling, **T** Transport, **(R)** Revised, **(N)** New, **C** Continue,

Policy: : + Already Exist, **S** Sub-national Exist, **A** newly added, **-** Removed

Source: IRENA Renewables 2023, Global Status Report

When looking at the supportive policy mechanisms in this table, it can be said that Türkiye has a diverse range of policies within the country group it is in. It is the only country in its category that has five out of seven policy categories. However, we can't observe how diverse the policy tools are for startups in the table above.

2.5. History of Green Energy-Related Policies in Türkiye

Today, Türkiye ranks 11th in the world and 5th in Europe in terms of renewable installed capacity. It ranks 1st in geothermal and 2nd in hydroelectricity in Europe. Moreover, the share of electricity generation from wind and solar energy in total

generation has exceeded 15.5%, the highest in Asia. When looked at separately, Türkiye ranks 12th in the world and 5th in Europe in wind energy, and 14th in the world and 7th in Europe in solar energy in 2023.. In addition, Türkiye ranks second globally in terms of the intensity of energy recovery systems according to the International Energy Agency 2022 Renewable Energy Statistics.

Türkiye's current position in the renewable energy sector did not happen in a day. As in many countries, Türkiye's energy sector leads the GHG emission share compared to other sectors. According to the Turkish Statistical Institute, 71.3% (402.5 Mt CO2 eq) of the total GHG emission value, which reached 564 Mt CO2 eq, originates from the energy sector. In 2015, the situation was no better than it is now.

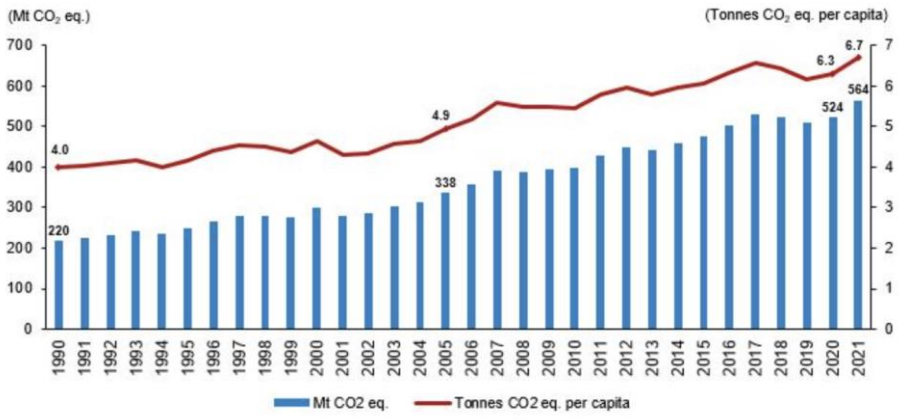

Figure 1: TSI Türkiye's Greenhouse Gas Emissions 1990-2021

Therefore, the country has emphasized investments in the renewable energy sector to reduce GHG emissions and its dependence on foreign energy supply. Türkiye's main mitigation policy in the energy sector for 2030 is to maximize the use of energy efficiency and renewable potential, taking into account feasibility, market conditions, and energy security.

The Renewable Energy Resources Support Mechanism (YEKDEM) and the Regulation on Renewable Energy Resource Areas (YEKA) have contributed significantly to the acceleration of renewable energy investments, particularly wind and solar energy. Various policies and legislation have also energy efficiency in buildings and industry. In light of these investments and policy efforts, today, Türkiye's total installed renewable energy capacity has reached 29,578.99 MW. Of this capacity, 41.7% is solar, 24.6% wind, 21.6% hydroelectricity, 12% biomass, geothermal, and other renewable energy sources. The country also prepared its hydrogen energy roadmap and national energy plan. (Republic of Türkiye, Ministry of Environment, Urbanization and Climate Change, 2022). Türkiye's current renewable energy installed capacity and ranking in this field are not coincidental. In addition to examining the recent studies in this field, it may be helpful for us to go back a little in the history of renewable energy in this land, where renewable energy has been used for more than a century, to understand the development in this field.

2.5.1 History of Renewable Energy in Türkiye

Türkiye is considered a country with an excellent capacity for renewable energy sources. It has a fertile geographical location for most of the renewable energy sources. Its lands remain within the subtropical zone and on the warm climatic belt. In addition to that, being surrounded by the sea on three sides and the position of the mountains to the waters prepare the environment for various climates. When the diversity of landforms is added, having an excellent capacity for renewable energy sources is inevitable (Ediger & Kentel, 1999). In Türkiye’s advantageous lands for renewable energy, the first small hydroelectric power plant with a capacity of 88 kW was installed in 1902 during the Ottoman Empire. In addition to that, the first hydroelectric power

plant of the Republic of Türkiye was established in 1929, Trabzon, as a Visera power plant with a capacity of 1MW (Tasdemiroglu, 1993; Erkaya, 2002; Sen, 2002). As of 2023, Türkiye's installed capacity of hydroelectric power plants has reached 31,680 MW, with an average total generation potential of 66,980 GWh per year. (General Directorate of State Hydraulic Works, 2023). Geothermal energy followed hydroelectric power in 1963 with the first geothermal borehole in Izmir. In 1984, the first geothermal power plant was established in Denizli (Atalay, 2004). Solar energy followed them by producing solar water heaters in 1975 (Enerji Ekonomisi, 2019). The first solar power plant was established in 2011 in Istanbul. (Yeşil Ekonomi, 2018). In addition, the first electricity was generated by a wind turbine in 1986 in Izmir. The first wind power plant was established in 1998 in Izmir (Pinar et al., 2019).

Of course, there are other renewable energy sources in Türkiye, such as biomass. When considering dung burning, we can say that the history of using biomass for energy dates back to very old times in Türkiye. However, when we consider the installation of a professional biomass power plant, the calendar shows 2016 in Balikesir. Although there are studies on hydrogen and wave energies, which are other renewable energy sources, there is no installed energy production plant yet. As of the end of June 2024, Türkiye’s installed power reached 107.594 MW. Distribution of Türkiye’s installed capacity by resources as of the end of May 2024: 29.2% is hydroelectric energy, 22.4% is natural gas, 19.8% is coal, 11.1% is wind, 13.6% is solar, 1.5% is geothermal, and 2.4% is from other sources (Electricity - Republic of Türkiye Ministry of Energy and Natural Resources, 2024). When we analyze the distribution of installed renewable energy resources among themselves, we reach the following graph.

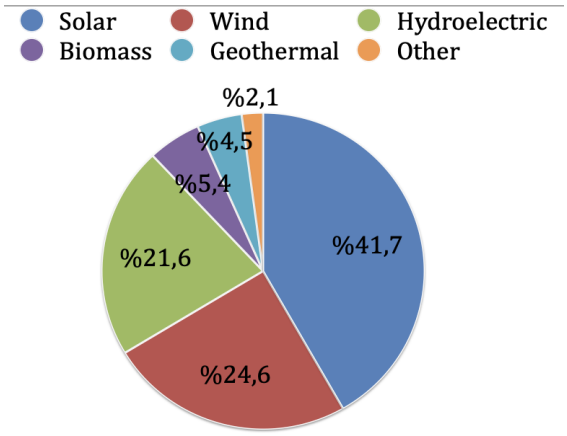

Figure 2: Renewable energy power plants of Türkiye according to EPIAS 2024

As can be seen in the graph, the majority of renewable energy production in Türkiye comes from solar energy, wind energy and hydroelectricity. It can be said that the geopolitical characteristics of the country play a supporting role in the prominence of these energy types. When comparing the share of renewables in the electricity production of Türkiye with that of the world, Europe, and Asia, Türkiye displayed significantly more shares of renewables in electricity production than others. The share of renewable energy was higher in the country's history because serious steps were taken regarding industrialization after the 1990s. The reason why the share of renewable energy was higher in the country's history at the beginning is that serious steps were taken between 1980 and 2000 regarding industrialization. These industrialization movements increased the demand for energy and, therefore, led to interest and need for different types of energy other than renewable energy. However, investments in solar and wind energy and the cheapening of renewable energy technologies in the following years increased the share of renewable energy here.

While this rate reached 42% by 2024, it is aimed to increase to 69% by 2053, in line with net-zero targets.

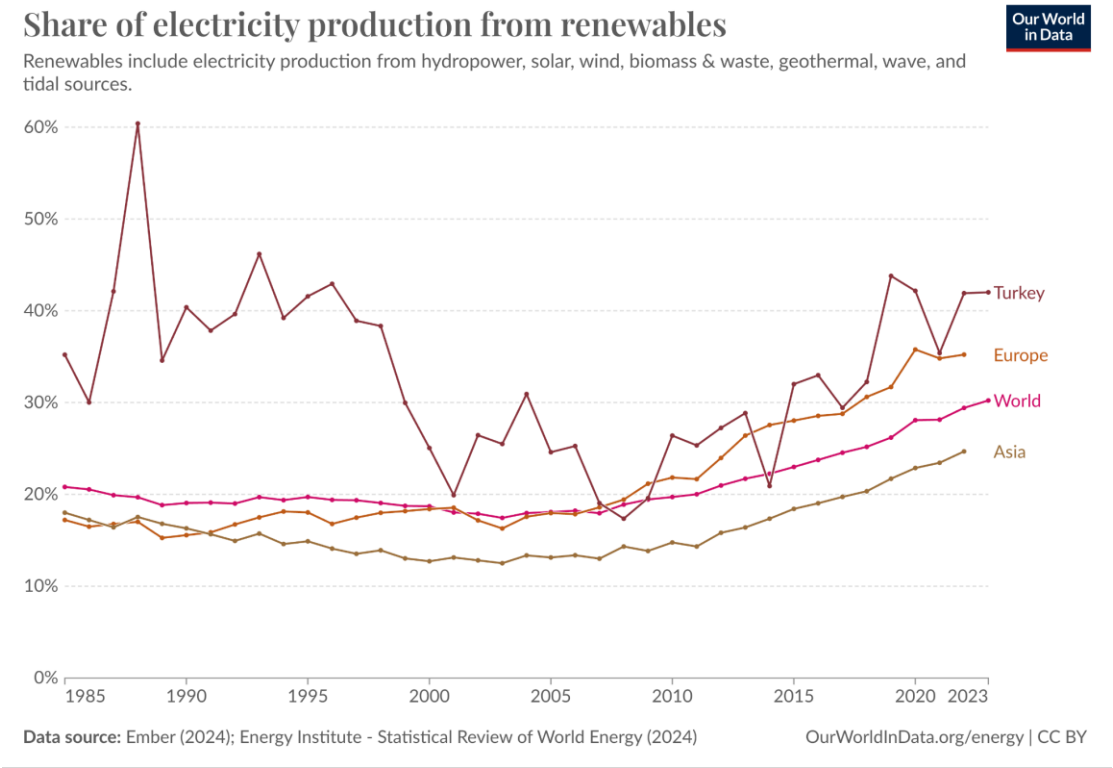

Figure 3: Türkiye's Renewable Energy Share vs. Global, Europe, and Asia
Source: Our World in Data, 2024

2.5.2 History of Renewable Energy Startups in Türkiye

After detailed academic and internet research, we were unable to find any clear information on the history of renewable energy startups in Türkiye. However, based on the databases we used, we see that the first private investment in renewable energy in Türkiye was made by Aydem Energy, founded in 1991. The company laid the foundations of Bereket, Türkiye's first private hydroelectric power plant, in 1995 and put the plant into operation in 1997.

Although Altintas Isı, an energy company founded in 1990 before Aydem Energy, appears in the same database, studies focusing on renewable energy could not be found.

2.5.3 History of Green Energy-Related Policies in Türkiye

Naturally, when there are developments in essential issues for countries, such as energy, it is inevitable for the political studies here to be placed legally. However, we can consider that Türkiye was a bit late in establishing a legal basis for green energy. Even though renewable energy sources started to be used more than a century ago (1902) in Türkiye, the first moves to legalize renewable energy sources for energy production were taken in 2005 (Law on the Use of Renewable Energy Resources for the Purpose of Generating Electricity, 2005).

Before the legalization of renewable energy sources for energy production, Türkiye became a part of the United Nations Framework Convention on Climate Change in 2004. In 1992, Türkiye actually joined the United Nations Framework Convention on Climate Change (UNFCCC). However, it refrained from signing the UNFCCC for a long time due to obligations related to emission reductions and financial support to developing countries and only ratified it in 2004 (Kat et al., 2018). The agreement specifies the responsibilities of three categories of states. Developed countries are called Annex I countries. Annex I countries must adopt national policies and take measures to limit greenhouse gas emissions. They must also report on steps taken, jointly or individually, to return to 1990 greenhouse gas emission levels. (Jacobson, 2001). Then, at first, a law for using renewable energy sources in energy production was created on May 10th, 2005. The purpose of this law is to expand the use of renewable energy sources for the purpose of generating electricity, to provide these

resources to the economy in a reliable, economical, and high-quality manner, to increase resource diversity, to reduce greenhouse gas emissions, to recycle waste, to protect the environment and to develop the manufacturing sector needed to achieve these goals (Law on the Use of Renewable Energy Resources for the Purpose of Generating Electricity, 2005). Another political move has been taken on geothermal resources. A related law on the usage of geothermal resources in energy production was published in 2007. The purpose of this law is to regulate the procedures and principles regarding the effective search, exploration, development, production, and protection of geothermal and natural mineral water resources, the acquisition of rights over these resources and the transfer of rights, their economic evaluation and abandonment in an environmentally compatible manner. (Geothermal Resources and Natural Mineral Waters Law, 2007). As another regulation on renewable energy, a law on establishing and operating nuclear power plants and energy sales was published in 2007 (Law on the Establishment and Operation of Nuclear Power Plants and the Sale of Energy, 2007). The purpose of this law is to determine the procedures and principles regarding the establishment, operation, and energy sales of nuclear power plants that will produce electrical energy in accordance with energy plans and policies. The country also became a part of the Kyoto Protocol in 2009. The significance of the Kyoto Protocol is that it is the first international agreement to set a quantitative emissions reduction target for Annex I parties. Policy studies in this area continued in the following years. A by-law that focuses on increasing productivity in the use of energy resources and energy, which includes decisions on renewable energy, was entered into force in 2011. The purpose of this regulation is to regulate the procedures and principles regarding the efficient use of energy, prevention of energy waste, alleviation of the burden of energy costs on the economy and increasing efficiency in

the use of energy resources and energy for the protection of the environment (The By-Law on Increasing Efficiency in the Use of Energy Resources and Energy, 2011). Furthermore, the by-law that aimed to enhance documentation and support of electricity manufacturing from renewable energy resources (YEKDEM) entered into force in 2013. This regulation aims to encourage the generation of electricity based on renewable energy resources by granting Renewable Energy Resource Certificates to legal entities holding generation licenses for generation facilities based on renewable energy resources and establishing the Renewable Energy Support Mechanism (RESM). RESM is a program that provides price guarantees and various incentives for a certain period of time to facilities generating electricity from renewable energy sources in Türkiye (The By-law on Documentation and Support of Electricity Manufacturing from Renewable Energy Resources, 2013).

Türkiye did not stop these actions and signed the Paris Agreement 2016 with 175 country representatives (Kat et al., 2018). Energy Efficiency Strategy Paper and National Energy Efficiency Action Plan also published for 2017-2023. Through this plan, it is envisaged to achieve cumulative savings of 23.9 MTOE by 2023 and, it is envisaged that cumulative savings of 23.9 MTOE by 2023 will be achieved, and an investment of 10.9 billion US dollars will be made for these savings. With the activities carried out and projects implemented in the 2017-2023 period, 24.6 MTOE of cumulative energy savings were achieved, and an investment of 8.5 billion US Dollars was made for these savings.

On the other hand, the target of reducing Türkiye's energy intensity by 20% compared to 2011 with the Energy Efficiency Strategy Document (2012-2023) was achieved before 2023, and as of 2022, Türkiye's energy intensity was reduced by 20.4%

compared to 2011 (Electricity - Republic of Türkiye Ministry of Energy and Natural Resources, 2024). Then, Türkiye was involved in the European Green Deal in 2021. It led to the creation of the Türkiye Green Deal Action Plan, another significant policy document for renewable energy policies. The Green Deal has led Türkiye to prioritize renewable energy sources and energy efficiency in its energy policies according to the Türkiye Green Deal Action Plan (Republic of Türkiye Ministry of Commerce, 2021). This contributes to ensuring the country's energy supply is sustainable, safe, and economical. Another important policy document published is Türkiye's Hydrogen Technologies Strategy and Its Roadmap (Republic of Türkiye, Ministry of Environment, Urbanization and Climate Change, 2022). The relative regulations have been updated many times until today—all of those policies accumulated in time. However, recent times have taken into consideration some aspects of the history of green energy-related policies in Türkiye. The law published in 2005 for the use of renewable energy resources for the purpose of generating electricity, ratification of the Paris Agreement, and the European Green Deal have had significant impacts on Türkiye's policy studies on green energy. The law, which was published in 2005, legalized and recognized renewable energy sources as a source of electricity manufacturing. Even today, SMEs and large corporations are liable to this law. The ratification of the Paris Agreement is another milestone for policy studies in green energy subjects. Türkiye's Intended Nationally Determined Contribution INDC (a proposal to reduce greenhouse gas emissions by 21% by 2030 compared to BAU levels) prepared after the Paris Agreement is the first step towards low-carbon development. Those INDCs contain an installed capacity of 10 gigawatts (GW) of solar power, 16 GW of wind power, and full utilization of hydro plants, which sums up to 36 GW targets, which are highly related to green energy targets (Kat et al., 2018).

The European Green Deal (EGD), which is an implication of the Paris Agreement, has far-reaching implications for energy. Cooperation efforts in energy policies are currently concentrated, especially on the expansion of renewable energies such as onshore and offshore wind. Türkiye's energy source diversification aligns with Turkish and European interests and includes geopolitical factors (Raimondi et al., 2023). Another policy is the 12th Development Plan, published in 2023. Within the framework of this plan, it was stated that various studies supporting green energy would be carried out, such as increasing consumer awareness, R&D studies on green hydrogen production and hydrogen storage and increasing incentives for the widespread use of renewable energy in buildings.

In addition to these policy studies and legislations, the Climate Change Adaptation Strategy and Action Plan and the Climate Change Mitigation Strategy and Action Plan were published in 2024. In the light of those policies, Türkiye has leading mitigation policies for 2030. Such as considering feasibility, market conditions, and energy security to maximize energy efficiency and renewable potential, according to Türkiye's National Energy Plan of 2022, Türkiye aims to reach approximately 33 GW of installed solar power capacity, 18 GW of installed wind power capacity, 35 GW of installed hydroelectric power capacity and 4.8 GW of installed nuclear power capacity, 2.1 GW of battery capacity and 1.9 GW of electrolyzer capacity by 2030, respectively, establishing a GHG trading system in emission-intensive sectors based on cap-and-trade and market principles will be one of the mitigation tools. By 2030, the share of renewable energy sources in total energy consumption will increase to 20.4%. In 2030, primary energy intensity is estimated to be 0.113 TOE/thousand $2015 and final energy intensity 0.08 TOE/thousand $2015.

The abovementioned legislation and policies are based on the following laws and policy documents.

Table 2: Basic legislation related to green energy policies in Türkiye

Legislation	Purpose & Scope
Electricity Market Law (Law No. 6446)	In order to provide sufficient, high-quality, continuous, low-cost and environmentally friendly electricity to consumers, it is aimed to create a financially strong, stable and transparent electricity market operating in accordance with private law provisions in a competitive environment and to ensure that independent regulation and supervision are carried out in this market.
Law on the Use of Renewable Energy Resources for the Purpose of Generating Electricity (Law No. 5346)	It aims to expand the use of renewable energy sources for electrical energy production, to provide these resources to the economy in a reliable, economical and high-quality manner, to increase resource diversity, to reduce greenhouse gas emissions, evaluate waste, to protect the environment and to develop the manufacturing sector needed to achieve these goals.
Energy Efficiency Law (Law No. 5627)	It aims to increase efficiency in the use of energy resources and energy to use energy effectively, prevent waste, relieve the burden of energy costs on the economy and protect the environment.
Regulation on Certification and Support of Renewable Energy Resources	Encouraging the production of electricity based on renewable energy sources; It is aimed to grant Renewable Energy Resource Certificate to legal entities that hold a production license for production facilities based on renewable energy sources.
Regulation on Renewable Energy Resource Areas	It aims to create large-scale renewable energy resource areas (YEKA) in public and treasury real estates and privately owned real estates and to produce domestically the advanced technology components used in electrical energy production facilities based on renewable energy resources.
Regulation on Electricity Market License	It is aimed to determine the procedures and principles regarding pre-license and licensing practices in the electricity market and the rights and obligations of pre-license and license holders.
Regulation on Unlicensed Electricity Production in the Electricity Market	It aims to ensure that consumers meet their electricity needs from their production facilities, to contribute small-scale production facilities to the national economy in ensuring supply security and to ensure the efficient use of small-scale production resources; and to determine the procedures and principles to be applied to real or legal persons who can produce electrical energy.

Table 2 (cont'd)

Regulation on Renewable Energy Source Guarantee Certificate in the Electricity Market	In order to popularize the use of renewable energy sources in electricity production and consumption and to protect the environment, it is aimed to establish a renewable energy source guarantee system that enables the supply of electrical energy produced from renewable energy sources to consumers by documenting the supply, by monitoring, proving and disclosing that a certain amount or rate of electrical energy supplied to consumers is produced from renewable energy sources by licensed legal entities, and to determine the procedures and principles regarding the operation of this system in a non-discriminatory, objective and transparent manner.
Regulation on Storage Activities in the Electricity Market	Within the scope of the Electricity Market Law No. 6446 dated 14/3/2013, it aims to determine the procedures and principles regarding establishing electricity storage units or facilities, their connection to the transmission or distribution system and the use of these units or facilities in market activities.

Source: Climate Change Mitigation Strategy and Action Plan (2024-2030)

Table 3: Policy Documents related to green energy in Türkiye

Policy Documents	Purposes & Targets
12th Development Plan (2024-2028)	The main objective is to reach a competitive structure that maximizes its self-sufficiency in energy by evaluating domestic and renewable energy resources, using nuclear technology in electricity generation, increasing energy efficiency, prioritizing localization in energy technologies, integrating new technologies, and strengthening our strategic position in international energy trade, taking the continuous, high-quality, sustainable, safe and affordable supply of energy, resource diversification in energy supply and the 2053 net zero emission target as a basis. The following measures are included within the scope of the development plan: Efforts efficient use of energy in all areas will continue. Akkuyu Nuclear Power Plant (NPP) will start electricity production with all its units. Efforts to increase the installed capacity of the nuclear power plant will be continued. Studies will be conducted on new technologies such as small modular reactors, fusion technologies and advanced generation reactors. Within the scope of the 2053 net zero emission target, in order to meet the increasing electrification with cleaner resources, renewable energy-based electricity production will be increased and integrated into the grid. New Renewable Energy Resource Areas (YEKA) tenders with local component obligations will be held, and studies will be conducted to

Table 3 (cont'd)

Energy Efficiency Strategy Document (2012-2023)	The efficiency in electricity production, transmission and distribution will be increased; energy losses and harmful environmental emissions will be reduced; by 2023, the average total cycle efficiency of coal-fired thermal power plants across the country, including waste heat recovery, will be increased to over 45%. Methods will be developed regarding demand side management in order to reduce electrical energy density by at least 20% by 2023.
Türkiye National Energy Plan (2022)	By 2035, Primary energy consumption will be 205.3 MTEP, and Electricity consumption will be 510.4 TWh. Electricity / final energy consumption share will be 24.9%. Energy intensity will be reduced by 35.3%. The electricity installed capacity will be 189.7 GW (52.9 Solar, 29.6 Wind, Nuclear 7.2), and the additional installed capacity will be 96.9 GW. Renewable energy will reach 54.7%, of total electricity production and 64.7% of installed capacity. Battery (7.5 GW), electrolyzer (5 GW), and Demand side (1.7 GW) installed capacity will be created.
National Renewable Energy Action Plan (2013-2023)	The fundamental policy document reflecting Türkiye's renewable energy vision was published with the aim of aligning Türkiye's clean energy strategy with the EU's Renewable Energy Directive (2009/28/EC). This plan includes the expected development of renewable resources in electricity generation, heating-cooling and transportation by determining national targets for 2023. Among the 2023 targets, it is envisaged that 30% of electricity production will come from renewable energy sources. According to the plan, 22% of electricity produced in 2023 will come from hydroelectricity and 16% from other renewable sources. Wind energy is targeted to reach 20 GW from 3 GW, and solar energy to 5 GW.
Türkiye Hydrogen Technologies Strategy and Roadmap	Based on local and national technologies, it is aimed to create a compelling value chain from the production of green hydrogen to its final use and to contribute to the 2053 Net Zero target. In this context, it is aimed to reduce the green hydrogen production cost to 2.4 USD/kgH_2 in 2035 and below 1.2 USD/kgH_2 by 2053 and to ensure that the electrolyzer installed power capacity reaches 2 GW in 2030, 5 GW in 2035 and 70 GW in 2053.
National Climate Change Strategy Document (2010-2020)	Considering the energy supply security of renewable energy sources and climate change issues, clean production technologies and techniques will be used at the highest level within the framework of financing (internal and external) opportunities; the use of zero-emission technologies will be encouraged, and R&D studies will be supported. The improvement of existing thermal power plants will be

Table 3 (cont'd)

	completed; economic tools for alternative fuels will be developed.
Climate Change Action Plan (2011-2023)	Energy intensity will be reduced; the share of clean energy in production and use will be increased; greenhouse gas emissions resulting from the use of coal in electricity generation will be limited by implementing clean coal technologies and efficiency-enhancing measures; losses and thefts in electricity distribution will be reduced.

Source: Climate Change Mitigation Strategy and Action Plan (2024-2030), Greening the Türkiye's Economy, The Policy Perspective (GREET) 2023

2.6. Supporting Governmental Institutions in Türkiye

There are many mechanisms supporting entrepreneurship in Türkiye. The institutions within these mechanisms carry out activities supporting green energy. These can be divided into two groups: private institutions and government structures. The prominent government structures are the Ministry of Environment, Urbanization and Climate Change, the Ministry of Energy and Natural Resources, the Ministry of Industry and Technology, TUBITAK (Scientific and Technological Research Council of Türkiye), KOSGEB (Small and Medium Enterprises Development and Support Administration), EPDK (Energy Market Regulatory Authority), Development Agencies, and the EU Presidency. Of course, other private and governmental institutions may also have activities supporting green energy, but these institutions take a more active role in green energy policies.

They carry out activities such as encouraging renewable energy projects, preparing legislation on energy efficiency and saving, determining tariffs for renewable energy sources, ensuring competition in the energy market, supporting R&D projects on renewable energy technologies and energy efficiency, providing financial support and training programs to SMEs operating in the field of renewable energy, supporting

renewable energy projects, providing consultancy and financial support to local businesses, financing green energy projects by utilizing EU funds, encouraging R&D activities for the development of renewable energy technologies, and making regulations to increase energy efficiency.

This chapter covers the policy landscape related to green energy in the global and Turkish context and the role of renewable energy startups in achieving green energy transformation. Although there are studies in the literature on the effects of green energy-related policies on installed energy capacities, there is a gap in the literature that needs to be investigated regarding the effects of green energy policies on startups, which are stated to have a critical role in the energy transformation.

This study aims to contribute to the literature by focusing on the relevant gap, and the methodology used in this study is explained in the next chapter.

CHAPTER 3

METHODS

This section describes the methodology used in the study. It includes the research design, research ethics, data collection and recording process, data analysis processes, research limitations, and reliability, which form the basis of the methodology.

3.1. Research Methodology

This study focuses on the effects of green energy policies on renewable energy startups in Türkiye. The fact that qualitative research methods are primarily inductive can be considered a suitable match for examining the phenomena that are newly focused on and targeted to be investigated and forming hypotheses that will form the basis for future research (Creswell, 2003). In addition, qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that discover a social or human problem. The researcher builds a holistic and complex picture, analyzes words, reports detailed information, and conducts the study in a natural setting, according to Creswell (2014).

From this perspective, semi-structured interviews are an appropriate tool for learning about people's thoughts and approaches to complex issues, such as entrepreneurs' attitudes and reflections on the policy impacts, they experience (Barriball, K. L., & While, A. 1994). Accordingly, we conducted semi-structured interviews with

renewable energy startup founders and managers to discover the effects of green energy policies on them, a newly focused and targeted phenomenon.

3.2. Research Design

Creswell (2014, pp.22) states that

"Research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. This plan involves several decisions, and they need to be taken in a different order than the order in which they make sense to me and the order of their presentation here. The overall decision involves which design should be used to study a topic. ”

As Creswell stated, we should have taken the order that he offered. This study’s research design is based on inductive reasoning with interpretative phenomenology. It aims to observe the effects of green energy policies on renewable energy startups in Türkiye, based on the experiences of renewable energy startups in Türkiye, which were part of the study, as a result of semi-structured interviews with interpretative phenomenology based on inductive reasoning. Interpretative theming analysis and reflexive theming analysis methods will be used to reveal the themes of the study. The purpose of using these two thematic analysis methods is to present a compact analysis output where the theoretical framework (Smith et al., 2009) meets the inferences made by the researcher from the data obtained (Braun & Clarke, 2006).

3.2.1. Inductive Reasoning

According to Sauce and Matzel (2017), “Inductive reasoning is often used to generate predictions or to make forecasts. Inductive reasoning differs from deductive reasoning in that while the conclusion of a deductive inference is certain, the truth of the

conclusion of an inductive inference is only probable, where the degree of certainty is based upon the strength (or consistency) of the evidence." Unlike deductive reasoning, inductive reasoning has a bottom-up and data-driven approach (McAbee et al., 2017). In this study, the impacts of green energy policies on renewable energy startups in Türkiye aimed to be explored by semi-structured interviews. Since it is based on the experiences and observations of representatives of the startups, inductive reasoning is suitable for the subject of the study.

3.2.2 Interpretative Phenomenology Analysis (IPA)

This study is based on interpretative phenomenology. Interpretational Phenomenology Analysis (IPA) aims to deeply understand individuals' experiences and discover the meanings underlying these experiences. This method allows the interpretation of individual experiences and their meanings and offers a careful approach when making generalizations. Smith and his colleges (2009) also stated that IPA is an established qualitative method of inquiry examined on its terms and with a focus on participants' interpretations in the light of their personal experiences.

Interpretative Phenomenology Analysis includes six steps. These steps are 1) Reading and Re-Reading, 2) Initial Noting, 3) Developing Emergent Themes, 4) Searching for connections to a cross-emergent theme, 5) Moving to the following cases, and 6) Looking for patterns across issues (Engward & Goldspink, 2020). We applied the relevant steps in data analysis.

3.2.3 Thematic Analysis

Thematic analysis is one of the data analysis methods frequently used in qualitative research.

The thematic analysis aims to identify recurring themes in a data set and examine these themes' meanings and relationship networks (Patton, 2002). This method increases the researcher's in-depth understanding of a particular topic and highlights essential points in the data set. As Rubin and Rubin (1995) noted, thematic analysis is extremely useful for a research project that aims to uncover themes and concepts in qualitative data.

In our research, we choose to use interpretative theming and reflexing theming. The interpretive thematic analysis (ITA) approach aims to obtain important patterns or ideas that appear repeatedly in accurate data, and in order to conduct such an analysis, the researcher must have a high level of familiarity with the data and a profound interpretation of the data (Peterson, 2017). In addition to that, reflexive theming (RTA) positions researchers as active individuals in the process and requires reflection on the assumptions they bring to their interactions with data analysis, according to Braun & Clarke (2019). The subjectivity of researchers is seen as an integral part of the analysis rather than a problematic dynamic for data analysis (Campbell et al., 2021).

The combined use of reflexive and interpretative theming provides a richer and more balanced understanding by considering both subjective and objective elements in qualitative data analysis (Creswell & Poth, 2017). Reflexive theming incorporates the researcher’s personal experiences and perspectives into the analysis process, while interpretative theming interprets the data within a theoretical and analytical framework. This combination increases the depth and breadth of the data, as well as the flexibility and reliability of the analysis process (King, 2004; Fereday & Muir-Cochrane, 2006).

3.3. Sampling

The sampling procedure used two sampling methods: purposive sampling and snowball sampling. These methods are used for trying to reach a representative sample. In purposive sampling, the researcher deliberately chooses individuals, believing that they have the most pertinent information about the characteristics studied, without resorting to probabilistic methods (Guarte, J. M., & Barrios, E. B. 2006). The purpose of this study is to reach renewable energy startups that may be experiencing the effects of green energy policies. Various digital databases and platforms were used to find the startups related to the sample group. Through databases, startups were found and validated as still alive. We also tried to increase our coverage by using snowball sampling. Snowball sampling is a convenience sampling method (Naderifar et al., 2017). Subjects gave references about possible other subjects. In the light of these sampling methods, through platforms and emails, 17 renewable energy startups were reached and selected. To ensure randomization, we created a sample of people from different cities, different types of energy, different genders of managers, different lengths of experience, and different educational levels. Table 1 summarizes the profiles of representatives of renewable energy startups. Because of the participants' privacy, their names were disclosed, and their ID numbers were referred to them (Aurini et al., 2022). Through whole sections of the study, their name or their startups' names will not be revealed.

Table 4: Participants

ID	Gender	City	Education Level	Years of Experience	Renewable Energy Type	Product Type
1	Female	İzmir	Undergraduate	7	Solar	Hardware
2	Male	Ankara	Undergraduate	5	Solar	Software
3	Male	İstanbul, Stuttgart	MSc	6	Wind	Hardware
4	Male	Kütahya	MSc	2	Solar	Hardware
5	Female	Izmir	Undergraduate	6	Hydrogen	Software
6	Male	Istanbul	MSc	16	Solar	Software
7	Female	İstanbul	Undergraduate	7	Bioenergy	Hardware
8	Female	Eskişehir	PhD	14	Hydrogen	Hardware
9	Male	Ankara	Undergraduate	3	Wind	Software
10	Female	Ankara	Undergraduate	4	Hydrogen	Hardware
11	Male	İstanbul	Undergraduate	2	Wave	Hardware
12	Male	İstanbul, Ankara	MSc	16	Wind	Hardware, Software
13	Male	Konya	PhD	9	Solar	Hardware, Software
14	Male	İzmir	MSc	12	Solar, Wind	Software
15	Male	İzmir	Undergraduate	2	Hydrogen	Hardware
16	Female	İzmir	MSc	4	Renewable Energy Supporter	Hardware
17	Male	Eskişehir	PhD	10	Renewable Energy Supporter	Hardware

In Figure 4 and Figure 5, the distribution of gender and renewable energy types can be seen more clearly. Solar and wind energy startups take the lead on my own. Hydrogen energy startups are in third position in the number of interviews. Bioenergy, wave, and energy storage solutions make up the “others” title.

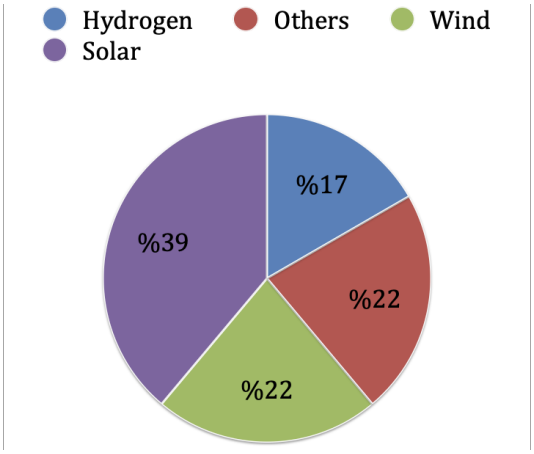

Figure 4: Distribution of renewable energy sources among interviewed startups.

We aimed to maintain the balance between men and women in our meetings and contacted startups to hold meetings with this approach. However, as a result of communication and meetings, we faced the reality of the market. Unfortunately, the number of women representatives in renewable energy startups in Türkiye is very low.

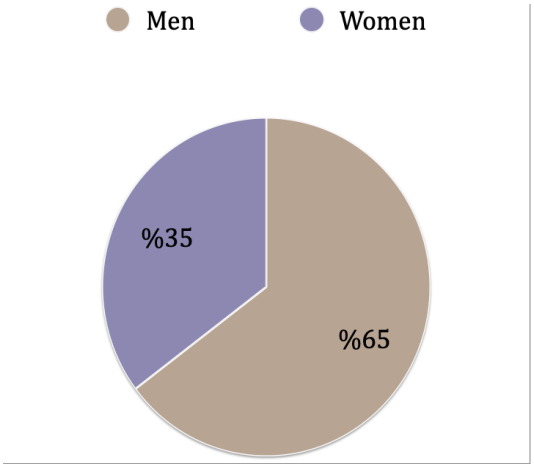

Figure 5: Gender distributions of interviewed representatives

In fact, this data is directly proportional to the Turkish Statistical Institute's employment data for August 2023. While the employment rate was 65.6 percent for men, it was only 31.5 percent for women.

3.4. Development of Interview Questions and Implementation

Our interview methodology consisted of multiple stages. Literature related to green energy policies and renewable energy startups guided the development of interview questions. In the first stage, a list of interview questions to differentiate various aspects of effects in different stages of startups is prepared. Prior to the interviews, we conducted tests of the interview guide using different techniques to ensure the scope and applicability of the prepared questions and to identify any possible need to revise them. Those techniques were expert assessment and in-field testing. The appraisal of two academics who have an excellent background in data analysis was helpful in assessing the relevance and coverage of interview guide content relative to the focus and subjects of the study. Academicians provided feedback regarding the reliability, clarity, understandability, and wording of the questions.

As a result of the academicians' feedback, we revised the interview guide. After that revision, another test we used for our semi-structured interviews was field testing. This is the most widely used testing technique to test a real interview situation with a potential study participant (Turner, 2014). This testing confirmed the questions' inclusiveness and relevance in reaching their real addressees' views and experiences. By the nature of semi-structured interviews, we did not strictly follow them during the interviews (The interview guide can be found in Appendix D) (Kallio et al., 2016).

3.5. Data Collection

For data collection, selected startup representatives were contacted via professional online platforms, mail, and phone. Online meetings are planned between July 2023 and July 2024, depending on the availability of participants.. Interviews lasted an average of 30 minutes. After completing the voluntary participation form, data was collected through semi-structured interviews. At the beginning of the interview, representatives of the startups were asked about demographic characteristics, including years of experience and age of their startups. Additionally, the interaction of the startups with the government and policy from the typical startup's interaction and green energy startups' interaction perspectives in the different stages of startups were asked to startup interaction and green energy startup interaction perspectives in the different stages of the startup were asked of startups. These stages can be categorized as the establishment of the startups, product development of the startups, and scaling of the startups (according to the startups' current situation). In parallel to their life cycle, their financial sustainability were also asked in the aspect of access to funding and cost management. In accordance with the nature of semi-structured interviews, we did not strictly follow the questions, or we changed the order of the questions for the natural flow of conversation during the interviews (The interview guide can be found in Appendix D) (Kallio et al., 2016). This enabled us to explore the uncovered perspectives of participants. Video recording and audio transcription technologies were used for data collection and transcription.

3.6. Data Analysis

According to Savage (2020), data analysis, despite being a complex and multi-aspect field within the qualitative research process, has received little attention on theoretical grounds. In fact, data analysis is the core of qualitative analysis (Gomes et al., 2023). There are many methods in qualitative research. Each method and their use together have different benefits. Among these methods, the ones we chose are IPA and RTA. As we stated in the research design (Section 3.2.3), the main purpose of using these two together is to increase the depth and breadth of the data and the flexibility and reliability of the analysis process (King, 2004; Fereday & Muir-Cochrane, 2006). After the selection of methods, the order of the data analysis takes an important place in the study. In order to perform data analysis comprehensively and efficiently, it basically consists of the following topics: data cleaning, data coding, data reduction, and data interpretation (Babbie, 2020; Creswell & Poth, 2017; Miles et al., 2014; Saldana, 2016).

When we combine this basic approach and our research design, our data analysis will proceed in the following order: preparing the data for analysis (1), preparation of the researcher for analysis (2), coding the data (3), and theming the data (4).

3.6.1 Preparing the Data for Analysis

In this section of the analysis, the data is prepared for analysis. The preparation here includes recording the raw data with semi-structured interviews, transcribing the recorded data, and cleaning the data as specified in the basic structure.

As mentioned in the data collection section, through online meetings data is recorded with the permission of the participants. Those online meetings with 17 participants

were organized have times that the researcher and the participant had available and flexible times. The reason we state this is that allocating ample time allows for trust to be established in interviews (Seidman, 2013), responses to be given comfortably and thoughtfully (Patton, 2015), unexpected or non-interview guide information to be collected (Rubin&Rubin, 2012), in short, more in-depth and detailed data to be collected (Kvale&Brinkmann, 2009). Through auto-transcribing technologies, data is transcribed. However, since auto-transcription technologies do not work with hundred percent efficiency or because we use languages outside the rules in a way that technology cannot yet understand, just as someone who does not know the language we speak would not understand, the transcription process was not completed with auto-transcription. After auto-transcription, the researcher listened to the audio recordings over and over again in an iterative manner and manually edited the parts that were incorrectly transcribed or could not be transcribed at all in a way that was appropriate for the recording (Roulstan,2010). Although the data cleaning process took a long time, the researcher eventually became very familiar with the data, and transcribed interview documents suitable for coding were obtained.

3.6.2. Preparation of the Researcher for Analysis

After the researcher prepares the data for research, their own preparation for analysis consists of two stages: becoming familiar with and understanding the data and preparing the codes to analyze it.

In fact, the first stage develops while preparing the data. The memos taken while listening to the recordings over and over again and the foundations of the codes to be used in the research are laid while preparing the data for analysis because during data

preparation, the intersection sets of the data and the research questions become more apparent as the familiarity with the data increases.

In the second stage, based on Creswell's (2013) suggestion, a code list was prepared before the analysis. However, the content of this code list increased or decreased during the process with the repeated examination of the data, and some codes or developed sub-codes were combined. In other words, a priori and a posteriori coding methods were used (Miles et al.,2013). More than one coding method was used to obtain high efficiency from the data (Leavy, 2017; Saldana, 2016; Silverman 2016). Content coding, descriptive coding, and sub-coding are examples of the coding methods used for cod creation. As a result of these processes and the mentioned methods, the following codes emerged: policy motivation (1), global trends (2), economic conditions (3), business strategies (4), startup operations (5), policy implementation (6), technology challenges (7), market barriers (8), market opportunities (9), cost management (10), access to funding (11). These parent codes contain subcodes underneath them. Emergent themes also came to be seen in this stage and revised during the data analysis process for their final versions.

Table 5: Code Book

Code Book		
Theme	Code	Sub-code
Financial Sustainability	Access to Funding	Foreign Programs
		Adequacy of Grants
		Increased Funding
		Bank Loans
		Venture Capital
		Government Grants

Table 5 (cont'd)

	Cost Management	Tax
		Cost of Technology
		Operational Cost
Market Dynamics and Business Operations	Market Opportunities	New Market Entry
		Community Engagement
		Competitive Advantage
		Market Expansion
	Market Barriers	Consumer Awareness
		Market Saturation
		Competition
	Business Strategies	Partnership and Collaborations
		Marketing Strategies
	Start-up Operations	Scaling
		Initial Set-up
	Technology Challenges	Infrastructure Issues
		Technical Expertise
		Technology Adaption
	Policy Development	Stakeholder Involvement
		Policy Formulation
		Policy Suggestions
	Policy Implementation	Green Specific Support
		Policy Support
		Regulatory Challenges
		Bureaucratic Delays

Table 5 (cont'd)

		Policy Uncertainty
		Monitoring and Evaluation of Policy
		Policy Enforcement
	Policy Motivation	Environmental Policies
		Common Policies
		Green Energy Policies
	Global Trends	Global Economic Trends
		International Policies
	Economic Conditions	Economic Uncertainty

3.6.3 Coding the Data

Coding data is a complex process. Various approaches can be used for detailed analysis of data during this process. The more transparent the process is, the greater its trustworthiness and reliability. From this perspective, simultaneous coding and holistic coding methods were also used to code the data. The main reason for using these methods was to handle the data more conveniently (Elliot,2018). The systematic execution of the coding was carried out using a qualitative analysis program called MAXQDA. We observed many advantages of using First Cycle Coding and subcoding methods in our research process. First Cycle Coding allowed us to assign initial codes to our data and determine basic themes and categories. This stage was a critical step for understanding the general structure of the data. Determining the codes allowed us to consider our data from a broad perspective and to obtain our first impressions about this data.

However, it became clear that our data needed to be analyzed comprehensively. Therefore, we preferred the subcoding method. Subcoding allowed us to add more detailed and specific categories under the general codes. This allowed us to examine our data more deeply and create detailed themes. In particular, the detailed analysis provided by sub-coding provided us with necessary information to understand the different dimensions and complexities of the data (Miles et al., 2013). We also used the interpretative coding method in our data analysis. This approach helped us to understand the meaning and context of the data in depth. Interpretive coding allowed us to evaluate our data also superficially in terms of content and context. This helped us to reveal the thematic depth of the data and obtain more meaningful results (Saldaña, 2013).

In addition, we applied the reflexive coding method. Reflective coding allowed us to conduct a more transparent and conscious analysis by taking into account our own thoughts, biases, and influences on the analysis process. Understanding how our own subjective perspectives and biases affected the data analysis helped us obtain more objective and valid results (Finlay, 2002).

The combination of these methods allowed for a comprehensive analysis of our data and increased the quality of the analysis process. In other words, First Cycle Coding and sub-coding strengthened the structural analysis of the data, while interpretative and reflexive coding methods provided in-depth meaning and transparency. Therefore, using these coding methods in our research process allowed us to analyze our data more effectively.

3.6.4 Theming the Data

As in coding, two different approaches were used together in theming. There are several important reasons why we used interpretative theming and reflexive theming methods in data analysis. First of all, interpretative theming helps to understand the data in depth. We chose this method because it allows us to go beyond a superficial analysis of our data to a detailed examination at a thematic and conceptual level. To understand the impact of green energy policies on renewable energy startups, we needed to focus on the main themes in the data and the meanings behind these themes. Interpretative theming allowed us to analyze the data in more depth and to identify meaningful themes in this context (Braun & Clarke, 2006).

On the other hand, using the reflexive theming method was also a critical step. This method allows us as researchers to incorporate our own thoughts and biases into the data analysis. Taking our subjective influences and perspectives into account during the analysis process ensured that our analysis was transparent and valid. Reflexive theming helped us to understand how we reflect our personal influences in the analysis process, which led to a more informed analysis (Finlay, 2002; Mauthner & Doucet, 2003).

The advantages of using these two methods together are quite evident. Interpretative theming reveals the thematic depth of the data, while reflexive theming allows us to consider our personal influences on the analysis of these themes. This combination allowed for a multidimensional and comprehensive analysis of the data and increased the validity of our results (Saldaña, 2016). Using these methods to understand the impacts of green energy policies on renewable energy startups allowed us to obtain

more meaningful and credible results. The themes obtained as a result of the research are listed as follows:

Table 6: Themes of Study Acquired by Analysis

Themes	**Related Subjects**
Government & Policy Interaction	Interpretative: Under this theme, we analyzed how policies are perceived and implemented to understand and interpret participants' interactions with government policies deeply. Reflexive: When analyzing this theme, we examined how policies are shaped and implemented by including our experiences and perspectives. We interpreted the impact of policies on startups using our own subjectivity.
Financial Sustainability	Interpretative Theme: Under this theme, we examined how renewable energy entrepreneurs ensure their financial sustainability through their experiences with in-policy and non-policy factors. Reflexive Theme: Under this theme, we've taken into account our own experience and knowledge while examining how renewable energy entrepreneurs ensure their financial sustainability through in-policy and non-policy factors.

Table 6 (cont'd)

Market Dynamics & Business Operations	Interpretative Theme: Under this theme, we examined the experiences of renewable energy entrepreneurs in the market and in company processes through their experiences with internal and external policy factors. Reflexive Theme: Under this theme, we examined the experiences of renewable energy entrepreneurs in the market and in company processes through internal and external policy factors and our own experience and knowledge.
Global Trends & Country Economic Conditions	Interpretative Theme: Under this theme, we examined the views and experiences of renewable energy entrepreneurs on global trends and economic conditions and interpreted how they understand and experience these issues with internal and external policy factors. Reflexive Theme: Under this theme, we examined the effects of renewable energy entrepreneurs on global trends and country economic conditions on startups by including our own perspective and experiences with with internal and external policy factors.
Technology	Interpretative Theme: Under this theme, we examined and interpreted the experiences of renewable energy entrepreneurs in technological issues with intra-political and extra-political factors. Reflexive Theme: Under this theme, we examined the experiences of renewable energy entrepreneurs in technological issues with intra-political and extra-political factors by including our own perspectives and experiences.

3.7. Research Constraints

The most fundamental and obvious limitation of the study is that the green energy policies in Türkiye, which we focused on, are still at a very early stage and have only recently been developed. It has only been three years since we ratified the Paris Agreement and signed the European Green Deal. Although policies supporting green energy were made in Türkiye before these developments, they have gained momentum with these developments. It has also been frequently observed in the transcribed content that the participants share newly announced policy content. Therefore, although it may seem like a limiting factor for this study, this study will shed light on the effects of green energy policies in the early stages of green energy polices' effects on renewable energy startups for future studies. Another limitation is that the study is unsuitable for global generalization since it only focuses on measuring the effects of green energy policies in Türkiye on renewable energy startups. In addition to that, another possible limitation is that the selected methods, such as interpretative phenomenology and interpretative coding, may have greatly affected the study outputs within the framework of subjectivity. However, it should still be noted that other researchers may come up with various interpretations with the same data and different methods. Finally, another limitation is that the study was conducted with a small sample group in the area accessible to the researcher, which is a potential limitation of qualitative studies. However, in order to minimize the effects of this limitation, the startup profile accessible with snowball sampling was expanded, and data was obtained from participants with three different education levels from 6 different cities and 5 different renewable energy vertical startups developing software and hardware.

3.8. Research Ethics

We conducted this research in the light of ethical guidelines and principles and obtained approval from the METU Human Subjects Ethics Committee (HSEC). Our study was included in human research because we wanted to conduct our research with data from semi-structured interviews with representatives of renewable energy startups. On December 1, 2023, the ethics committee permission required to conduct our research was deemed appropriate to be granted to us as a result of the METU HSEC evaluation. Following the ethics committee's approval, interviews were planned and conducted. In these interviews, participants were first informed about the study. Their requests for voluntary participation were received in writing using a voluntary participation form prepared with a sample voluntary participation form prepared by METU HSEC.

We also gave tremendous and equal importance to the confidentiality of the participants in our study (Orb et al., 2001). In addition to presenting how their data would be confidential in the voluntary participation form, we also did not include individual or company names in the labelled data displayed in the study content. Participants' privacy was given importance in the study document as well as in the storage of data (Lin et al., 2009). While access to all data was within the authority of the researcher and supervisor, participants' data was also shared with them upon their request. Data is stored in electronic format in a secure storage area with double authentication.

CHAPTER 4

FINDINGS

Before starting our findings section, we would like to re-present our research questions and themes. Our research questions are: Do green energy policies offer efficient incentives and funds for renewable energy startups that promote a green economy? Are the regulations and legislation of green energy policies restrictive or encouraging for renewable energy startups? Following these research questions, our themes are Government and policy Interaction, Financial Sustainability, Market Dynamics and business Operations, Global Trends and country Economic Conditions, and Technology. Our findings will be examined with an approach that forms the basis of these themes and research questions.

In this chapter, each theme will first be explained, and then the participants' direct quotes will be used to shed light on it, followed by the researcher's comments.

4.1. Government & Policy Interaction

This theme attacks the research question, "Are the regulations and legislation of green energy policies restrictive or encouraging for renewable energy startups?" The restrictive or encouraging nature of the regulations and legislation of green energy policies for renewable energy startups in Türkiye has been examined. This examination was conducted in three strands: Policy implementation; the effects of

green energy policies and technology entrepreneurs on policies developed or not developed for entrepreneurs; policy development: policy suggestions from entrepreneurs and the extent to which they are included in the policy development process; policy motivation: whether green energy policies or foreign policies motivate entrepreneurs to start businesses or advance their existing startups. As can be seen in the section where direct quotes are shared following this section, the green energy policies of the sample group where the study was primarily conducted caused stress in renewable energy startups with their unclear steps, deficiencies, or not being in the relevant vertical, in accordance with the order of the amount of coded content. Fifteen out of seventeen participants have explicit arguments to support this judgment. However, not all of them were included in the quotation section, considering the length and readability of the thesis. The order of the examined branches in the previous sentence shows a decreasing trend according to the number of coded sections.

4.1.1. Policy Implementation

When we look at the topics examined under policy implementation, the first three places were policy uncertainty, regulatory challenges and bureaucratic delays. The non-existence of policies, their lack of clarity, experiences made difficult by regulations and the length of bureaucratic processes were shared many times. Green energy specific supports were at the last place. Shared experiences were about awareness that studies were carried out here and supports that have recently started to be provided. It should be shared that TUBİTAK was mentioned in many times here. In the following part, direct quotations from entrepreneurs about focused subjects are shared.

Table 7: Policy Implementation Quotations

Subject	Quotations
Policy Uncertainty	"This is really a sad thing. I mean, we hesitate to say this, but why the regulations that are currently in front of us are at the level of instant and hourly change. "Participant 6 "We have struggled with this situation for a very long time since we had to examine it legally with about 10 lawyers because of the subject of our startups is not included in the legislation. Because there is neither legislation in the legislation about the area we are addressing the problem in the name of the area nor legislation on the way to a solution. " Participant 1 "Because, unfortunately, there is nothing that we can call a policy in the true sense yet. "Participant 5
Regulation Challenges	" The transformer distributor has its own transformer investments. But the capacity is not coming out. What else could it be? It cannot be connected to its own transformer. We cannot do anything in this area right now. The regulations are in front of us; you need to get permission on many issues. All of them are like obstacles in front of us. In other words, we are trying to solve a problem with many unknowns." Participant 5 "TUBITAK processes, reports every six months, then of course the financial processes, the payments coming much later, these things are compelling factors." Participant 13 "Well, frankly, the policies were still against us. However, we see that this will change. When we look at our own sector, that is, our company's own area of individual use. Regulations are usually in the hands of large lobbies, that is, large manufacturers or large installations. In other words, the application of a small wind turbine is currently subject to the legislation of large wind turbines." Participant 3
Bureaucratic Delays	"At that time, because there was no production, or I was going to export or import machinery from abroad. Even that was supported by TUBITAK and got stuck at customs. Despite my providing all those documents. It's a disgrace no matter how you look at it." Participant 17 "I mean, a delay of one day, one week, one month would not hurt anyone that much if it was based on TL, but since it is based on foreign currency, it is a point where investors are financially triggered a lot." Participant 5

Table 7 (cont'd)

Green Energy Specific Support	"In fact, of course we can connect these to the green agreement. Because thanks to the green agreement, there were calls like the newly opened thanks to me, so this also contributed to us, so frankly, as a startup, we can talk about such a contribution." Participant 13 "Because, you know, the green agreement was signed. As you know, our country also needs to be included in this, or we joined the Paris Agreement in the past years. Therefore, we need to take action in this area. When we say that hydrogen is also an important factor in this respect, it constitutes a very important factor in supporting our projects. Therefore, supporting our projects is already a very key point for us to continue our R&D studies in the field of hydrogen." Participant 10 "I think KOSGEB is currently benefiting. Because KSOGEB currently has a program. They did it together with the Ministry of Industry, and they will choose 20 products for companies, and they will start implementing it in companies. and here is the program that is a member of this program, both companies and startups that are members will benefit from these and with this, this is actually a very big point." Participant 7 "Are there any specialized supports for your focus here? A category within an existing program focused on green energy or a call from TUBİTAK or KOSGEB directly focused on green energy. (Researcher) Actually, there are not only TUBİTAK, you know, not KOSGEB, but also İZKAs, in fact, İzmir Development Agency or Istanbul Development Agencies, these supports are opened in agencies as well" Participant 16
Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations, we can say that startups feel the lack of green energy policies in many areas. For example, the necessary infrastructure and legislation for hydrogen-powered vehicles to realize their potential in Türkiye is lacking. The lack of sufficient regulations on the production, distribution, and storage of hydrogen prevents the widespread use of this technology. This situation shows that legal regulations must first be made for the use of hydrogen energy. In addition, we observed that one of the most stressful issues for entrepreneurs is not

Table 7 (cont'd)

	financial or customer relations but rather regulatory processes. We observed that the solutions they developed were met with uncertainty by authorized units because they were in developing areas, and they were worried that new regulations that would arise from these uncertainties could suddenly block their path and prevent their work. It is critical that startups are informed about the developing policy processes and that the impact periods of these policies allow renewable energy startups adaptation time in a way that does not cause any disadvantage in the market. We observed that bureaucratic delays also affect entrepreneurs. We found that there were significant difficulties in financing projects due to the length of processes experienced with funders such as TUBİTAK. We observed that the financing provided deviated from the initially anticipated value during the period from project writing to the deposit of funds. We have seen that attention is drawn to both the length of the evaluation process and the approved budget amounts in moving away from this value. We concluded that such processes should be managed more quickly and effectively, and that perhaps small but fast and easily accessible funds would be more appropriate. Although they are supported by policies that trigger existing entrepreneurship incentives, the late development of green energy policies and the slowdown effects of existing regulations create dissatisfaction in the sector. However, as many participants emphasized and we have observed, developments are being observed in the incentive mechanisms of green energy policies and are being followed with excitement.

4.1.2. Policy Development

Under policy development, there are the headings stakeholder involvement, policy formulation and policy suggestion. These headings include how much entrepreneurs are involved in policy development, their observations on policy development, and suggestions on how policies or governmental organizations would approach the process positively. All 17 of the 17 entrepreneurs interviewed are aware of the existence of policy developments.

They try to follow them with interest within their means. Each of them has different policy suggestions, but the most prominent suggestions are that studies should be conducted focused on their own verticals, and that policy planning should be planned in a way that can be productive for both the state and the startups. No consensus has been reached on stakeholder involvement, there are different views, but it is accepted by the startups that an iterative process is progressing and should progress in policy formulation. They are only waiting for their needs to be better understood and for policy formulations to be made that are compatible with the global situation.

Table 8: Policy Development Quotations

Subject	Quotations
Policy Suggestions	"Where can they support this? It could be consultancy. It could be project support in this area. It could be training, mentoring, I mean can I explain? Instead of just supporting me in the R&D part, my process after R&D. Because I think this is a problem in many R&D companies. Since we always focus on the part of making this product, for example, our work outside of hydrogen is based on orders, so our experience in productization is a bit limited. Therefore, how should productization be? How can this be marketed abroad? Before abroad, I can carry out the negotiations for this product domestically, according to my own network. Apart from this, I think we should also be supported in terms of what actions we should take, how I should take them and how I can take these actions." Participant 10 "Until this agreement I mentioned was signed last year. Along with this, our state prepared a regulation but as I said, it is still very young and only mentioned the name wave energy. It determined a sales price. Of course, agreements can be made on this; energy can be supplied to the grid. Work on this is still ongoing.**"** Participant 11

Table 8 (cont'd)

Stakeholder Involvement	"We actually presented our views to the Ministry of Energy when the strategic planning for hydrogen was published." Participant 5 "Even before this process started, TUBITAK asked us for our opinion. If such a loan were to be found, then such projects could be carried out and distributed." Participant 13 "The Indonesian Ambassador in Ankara came to us. The man had just been appointed to Ankara and came to Kütahya. He asked us what we could do to visit, but of course, we had no interaction. We had no communication with the Ministry of Energy or the Energy Market Regulatory Authority or anything like that. However, while it was okay for those guys to find us and come here, I think it is a problematic situation for the authorities of any institution in our own state to come here and, I don't know, not even reach a consensus or exchange information with us. Frankly, we have not expressed any opinion or had any meetings with the state." Participant 4
Policy Formulation	" So, okay, let's not fall behind; these EU countries are doing things, but let's not fall behind either, he says. Then, when the time comes for the light legislation, people start using and exploiting it very quickly. First, it starts with a good use, users increase. Then the lawmakers say, stop, champion, there is a problem here, these guys are doing it like crazy. They stop and change the capacities, they say if it happens, do it like this, if not, do it like this, then they look and say. They say, we have stepped on everyone's throat. Nobody can do anything, they say, but we need to do green energy. Then they open it up a little from there, when they open it up a little, new exploits come out, no, they establish an association, they get the village legal entity from the association, they leave the village legal entity, they make an OIZ, they give solar power plant license to the OIZ and then they regulate it again." Participant 6 "This means there are big lobbies, that is, big lobbies that change policies. In other words, they sell systems in the large segment. Since there is no such lobby of big companies in the small segment, no one felt the need to change them." Participant 3

Table 8 (cont'd)

Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations, startups have policy recommendations on a wide range of issues they need. For example, entrepreneurs have mentioned more than once how valuable it is to have access to the data they need for free or at a reasonable price, and some have even advocated that it should be mandatory through policy to communicate the data they need to reach them. While we know that data security is important, we also advocate that startups should be made easier to access the resources they need through policy. Otherwise, as entrepreneurs support, they may not be taken seriously by institutions because they are startups. As another example, we observe that attention is drawn to physical clusters. They draw attention to how beneficial cluster-like structures where entrepreneurs from similar verticals come together and benefit each other can be. In our observations in this area, we have also witnessed startups that feed each other in common working areas. Please review section 5.2 for more policy recommendations. Although entrepreneurs often claim that they can share these policy proposals, there are also statements from other startups that government bodies do not reach out to them or that they should. According to our own observations, startups can be part of policy-making processes, but the measurability of their contributions to the policies developed can be assessed implicitly. The reason for this is the lack of a structured, inclusive and transparent policy feedback mechanism. A structure that can show the connection between the policies created and the policy proposals of the entrepreneurs and where entrepreneurs can share their policy proposals freely and anonymously without being judged would be useful. As we have observed, there are back and forth process experiences in policy formulations. There are also those who argue that it is very natural for policies to develop as the number of startups in the relevant
	vertical increases. The fact that policies initially form the basis for developing ecosystems, but in the process, they calibrate themselves with developing technologies and startups is a good example of how policies resemble living organisms. Our perspective here is that it would be healthier to develop more agile policies, away from bureaucratic slowness, to digitalize processes, to reduce the complexity and steps of regulations, to take into account policy proposals that include the needs of startups, and to take place in parallel with the developments in the renewable energy market. Together with entrepreneurs, we would like to remind policymakers that if policies that are considered successful abroad are to be implemented in our country, it is important to modify them by taking into account the country's dynamics. Otherwise, the policies developed may go down in history as a waste of resources, unsuccessful support processes, unmeasurable support and a dissatisfied group of entrepreneurs.

4.1.3. Policy Motivation

The interactions between the motivations of renewable energy startups and policies were investigated for two separate time periods: the startup establishment period and the product development period, and the types of motivating policies were divided into three groups: environmental policies, green energy policies, and basic policies that support startups. As a result of the interviews, it was observed that only two out of seventeen startups were motivated by green energy policies during their establishment. There were two startups motivated by environmental and basic policies during the establishment phase. The effect of green energy policies and other policies on startups during the product development period is present, but it is more implicit.

Table 9: Policy Motivation Quotations

Subject	Quotations
Foundation of Startups	"Legislation motivated us. In May 2019, legislation came. There were some developments regarding the installation of solar energy on roofs for self-consumption. After that, it was clear that the market would accelerate. That actually became something for us. In other words, when we started writing the software in 2020, we started working in line with that legislation, and we carried out our work by foreseeing that the market would be active here, and we were right there. The market became very active. We also had a ready product." Participant 2 "After 2012, with the development of renewable energy and energy efficiency legislation, we also joined the sector from the energy efficiency side and received a license. At that time, it was issued as an energy efficiency, consultancy license by the Ministry of Energy." Participant 14 "Another point that motivated us here was the zero waste policies that our state put into effect in 2017." Participant 1
Product Development of Startups	"International policy developments that also support green energy, such as the COP 21 Paris Climate Agreement, the European Green Deal and the COP 28 summit held in November and December, have led to important steps in reducing emissions and using sustainable technologies. As a result of these

Table 9 (cont'd)

	developments, the Ministry of Finance will begin collecting emission taxes in Türkiye as of next year. The Energy Market Regulatory Authority (EMRA) has also made call letters more accessible by facilitating the processes of energy distribution companies. Such developments in legislation, along with the increase in incentives, especially for storage systems, motivate us even more in this area." Participant 3 "In January 2023, a roadmap was published for us for the hydrogen strategy, and this was something I have been eagerly waiting for in this country for 14 years, and it was very important. The 12th 64evelopent plan was announced with that roadmap. As you know, in the past months, hydrogen was included again, green hydrogen, together with other renewable energy sources, as I said, since hydrogen is not currently available, it needs to be produced, and we cannot think of this alone. In other words, we need to think together with renewable energy sources. When this is the case, of course, our motivation increased at this point." Participant 8
Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations show two separate experiences under two separate headings. First of all, with our observations, experiences and entrepreneurs' sharing, there are many basic supports aimed at supporting established entrepreneurs. The most important of these are TUBITAK's programs such as 1812 (formerly 1512), 1507, 1501, and tax exemption provided by technoparks. Entrepreneurs benefit from these and appreciate the existence of these supports. In particular, it is clearly observed that these programs and supports motivate startups in establishing and developing products. However, when we look at the green energy focus, we cannot observe the same clarity. To put it more clearly, policy developments in the field of green energy have mostly indirectly motivated startups in establishing and developing products. Rather than directly solving the needs of entrepreneurs, entrepreneurs have been motivated because policies have been developed that will contribute to the development of policies that will solve these needs. According to our observations, while there are green policies that support sectors other than energy that contribute to the development of products of renewable energy startups in newly developing policies, there are few policies focused on green energy. The entrepreneurs interviewed also stated that the support they receive for green energy comes mostly from policies that can be expressed as an umbrella. They also mentioned that policies directly focused on green energy may have factors that will motivate them more. Examples of these factors include sector-specific tax reductions and facilitations and the policy

Table 9 (cont'd)

	budget being allocated only for green energy. In summary, while it is more explicitly observed that the country's basic entrepreneurship policies motivate entrepreneurs in the startup establishment and product development processes, it is much more implicit that green energy policies are positioned as a motivation factor in these processes.

4.2. Financial Sustainability

Like living beings, startups are born, grow and die or transition to another world (to be acquired, or merged with another business). Sometimes, they die before they can grow. We can divide the life cycle of startups into six steps: explore, validate, build, launch, growth and maturity. This life cycle has many challenging dynamics. The most challenging of these is financial sustainability. These processes are especially challenging for startups that develop hardware technologies such as renewable energy. Many expenses, especially R&D expenses, can become a burden that is difficult to carry. Since startups can hardly make a profit between launch and growth, they constantly spend money until this time. In fact, this period is called the valley of death. Because there are many startups that cannot overcome this valley and die (Auerswald & Branscomb, 2003). For this reason, startups want to reach money, overcome this valley and enter the growth phase in many ways, such as VC investments, crowdfunding, grants, and refundable incentives. This theme includes information on how renewable energy startups access money and through which channels, their cost-related issues and also traces of answers to another research question related to this topic, "Do green energy policies offer efficient incentives and funds for renewable energy startups that promote a green economy?"

We sought answers to whether renewable energy startups benefit financially from green energy policies in what they shared in the interviews. We divided our search for answers to the question into two headings: access to funding and cost management.

4.2.1. Access to Funding

Under the title of access to funding, various focal points were focused on, such as the sources that renewable energy startups access in order to access money, the share of policy-based grants and incentives in the country, and the adequacy of policy-based budgets in the eyes of entrepreneurs. Foreign programs, venture capital, and finally, government grants were the prominent sources of financing here. On the bank's side, mostly negative criticisms were shared. While negative comments on the adequacy of local support are dominant due to reasons such as the long time it takes to obtain it and the deductions, there is a positive tendency in comments on the adequacy of international support due to the rapid acquisition and the difference between foreign and local exchange rates.. Some quotations from what entrepreneurs shared in the interviews are given below.

Table 10: Access to Funding Quotations

Subject	Quotations
Government Grants	"All 4 projects I applied for were accepted there, we were already established with support from TUBITAK. After that, we received its continuation with KOSGEB R&D innovation support program. Its last period. Then, there is a 1507 green transformation call in both the call. We applied in both the call and after finishing TUBITAK 1512, you can apply to 1507 again within 2 years. With the continuation of the same project. And I applied to that. Of course, these were very similar periods. It was extended due to the earthquake situation we experienced last time. That's why the applications were very close and we received acceptance from both projects one week later." Participant 8 "The support we received from the state was most intense in the detailed project. We received support from TUBITAK under 1512. We couldn't get as much as we wanted. It coincided with a period when the dollar was also rising. Frankly, these budgets are not flexible here, so they don't change anything. Then the pandemic was this and that, it made it very difficult. Since we are also located in the technopark, we benefit from the advantages of the technopark branch as a branch, but I can't say that the technopark contributed a lot to our financial situation at that time. Rents increases and such have been very high in technoparks." Participant 14
Venture Capital	" A recent government incentive provides special advantages to companies that invest in renewable energy and invest 1 billion TL over 10 years. This incentive is leading many companies to form partnerships with companies operating in the field of renewable energy, like us. This has yielded positive financial results and many companies want to cooperate with us. Companies traded on the stock exchange in particular aim to increase their share values by forming partnerships with renewable energy companies. This incentive has increased investor interest and we are holding partnership talks with many companies." Participant 3 "So we are talking to VCs both in Türkiye and abroad. We are talking to one about the same rate for pre-seed. We are talking to the other about the same rate for series A. So it is something that there are a lot of gaps between. I think there is a lack of regulation here as well. So investment in Türkiye, I think we are in a period where we need to stop entrepreneurship education and start investment education." Participant 5 "So we do vertical class business. Investors don't know much about that vertical. They watch from a distance. Therefore, it is a bit difficult to explain our problem, and it is difficult to find investment. We are closing a type of investment now. We are closing with people in the sector." Participant 2

Table 10 (cont'd)

Bank Loans	"Maybe we'll talk about it in more detail in a moment, but due to regulations, the credit rate of green hydrogen investments by banks is very low. If you ask me right now, and if my means allow it, would I build a solar power plant in Türkiye or Romania? I would build it in Romania. Because the country has 70% credit financing support with zero interest." Participant 5 "So even the banks are not giving loans right now. They used to give more loans to renewable energy companies." Participant 3 "If you go to the bank right now and say you're going to set up a business, the bank won't give you money." Participant 6 "When you see the TUBITAK project approval letter, the credit process can be positive on the banks' side." Participant 12
Foreign Programs	In your opinion, from which channel should green energy entrepreneurs obtain sufficient financing? (Researcher) From Europe, that is. It is a bit difficult to talk about Türkiye. There is a lot of support in Europe on this subject. When you make any initiative, especially when you make an initiative on green energy, their path is actually more open than yours. They are opening more programs in Europe because as I said, how long is it until the 2030 targets? I mean, they want to meet 100% of all their energy from green energy. That is why they are taking significant steps. Participants 11 "Because we are addressing a very niche area, as you said, competition and grant programs abroad can be beneficial for a startup. Because when we win a foreign currency award here, it becomes a situation that can support your financial sustainability here." Participant 1 "We have seen better results in startups that apply to accelerators abroad. I mean, even if they don't give money, they just follow up. The accelerator follows up on things. I mean, what did the startup do? Did it finish what it did, did it do that, did it finish that, etc. and they constantly pressure us. I mean, I have never seen such a proactive approach from us this time." Participant 14

Table 10 (cont'd)

Adaquacy of Grants	"When we applied for TUBITAK's support with our project, it was about a year and a half ago. Yes, when we first applied, it was about a year and a half ago, we entered a request for an incentive of 2,000,000 TL. This was approved as 1,000,000 TL after a year and a half. Of course, I am not even going into the inflation, exchange rate, etc. issues of this year and a half." Participant 6 "But of course it is not possible to survive with these supports. So yes, these supports are like a balm to the wound but they do not heal it completely. Therefore, they may be of partial help." Participant 13 "I mean, all the equipment and technological devices cost maybe 30,000-40,000 dollars to go from one city to another to a fair, so the money given by TUBITAK was probably 900 thousand. In the face of inflation. It is completely useless. It is definitely insufficient, much larger budgets are needed." Participant 17
Author Reflection	Our experience and observations from our interviews with renewable energy startups in Türkiye show that entrepreneurs actively try to use many channels to access financing. The most prominent and frequently mentioned of these channels are TUBITAK, KOSGEB and the Ministry of Industry and Technology. TUBITAK's 1512 program stands out in this area as one of the basic entrepreneurial supports. On the other hand, the Türkiye Green Industry Project, which KOSGEB, TUBITAK and the Ministry of Industry and Technology recently implemented together with a focus on green technologies, is a prominent program in green energy. The existence of state support for entrepreneurs cannot be ignored. The support provided is very valuable and precious. However, two things should be underlined for entrepreneurs. First, in the eyes of entrepreneurs, the support is not sufficient and needs to be increased. Some of the indirect reasons for this need for an increase can be shown as the increase in the cost of living in the country, the cost of technological materials purchased from abroad, the fact that the economy of scale at the enterprise level has not yet reached the level of large companies, fluctuations in the country's economy, the development of new technologies by many renewable energy enterprises, and the fact that the materials they need have not yet been produced and become cheaper. Entrepreneurs have stated that the financial support provided, especially during the pandemic period, has lost its adequacy due to the long time it takes to reach them and melting against foreign exchange rates until it reaches them, and is not enough to get out of the area referred to as the "valley of death". Another issue that should be underlined is that the support for renewable energy enterprises has not yet been specialized enough, that is, the vast majority of the relevant support is provided not by green energy policies, but by general policies supporting technology entrepreneurship. We observe an increase in the support provided by green energy policies with programs such as HIT-30 and the 1833

Table 10 (cont'd)

SAYEM Green Transformation Call, but this support needs to increase exponentially. We also observe that it would be beneficial to have flexibility integrated with changes in the country's economic conditions in both policies supporting technology entrepreneurship and policies focused on green energy. On the venture capital side, encouraging policies that direct investors to green energy startups have been shared by entrepreneurs. The $1 billion incentive for increasing renewable energy use, agreed upon between the World Bank and Türkiye, can be given as an example. It has been observed that these developments have caused renewable energy startups to attract more interest in terms of investment, but many investors also want more than they deserve in the eyes of entrepreneurs. Therefore, in addition to the support that encourages investment, support and programs that will ensure that the investment is realized in a way that will not kill startups can be developed. No clear contribution or development has been observed in bank loans, which are another channel of access to finance. The financial support provided by foreign programs, compared to banks and local support, has been emphasized and appreciated in terms of issues such as adequacy and process efficiency. It can be argued that one of the main reasons for this approach is that the support mechanisms are designed to be less tiring for entrepreneurs and that the financial support is provided in foreign currencies. In summary, it has become clear that green energy-focused financial supports should be increased, support mechanism processes should be designed in an entrepreneur- friendly manner, and work should be done to ensure that the supports are sufficient.

4.2.2 Cost Management

Another pillar of financial sustainability is cost management. In order for startups to ensure their financial sustainability, they need to make money and receive investment, as well as successfully manage costs. Since they develop new technologies, especially hardware-based renewable energy startups can have high R&D and material costs. However, many costs, such as basic operational costs, taxes, and insurance premiums stemming from company management, can be a burden to entrepreneurs. Therefore, in this perspective of the theme, we observe the experiences of renewable energy startups in the framework of cost management and the existence or need for policy-based support.

From a cost management perspective, the majority of entrepreneurs who were granted a grant shared their satisfaction with the exemptions in technology development zones. Regarding the cost of technology, six of the interviewed entrepreneurs drew attention to the high cost of renewable energy technologies, especially the hardware. Regarding operational costs, the difficulty of cost management as a startup was highlighted, and two startups particularly drew attention to the increase in technopark rents. Three entrepreneurs also drew attention to the need for fair taxation through the support and investments received. Direct quotes that will shed light on the experiences of entrepreneurs are included in the following section.

Table 11: Cost Management Quotations

Subject	Quotations
Operational Cost	"In other words, it is impossible to establish a company to get a project or manage a company with a project. Let's say you wrote a TUBITAK project, and everything went very well. TUBITAK pays you every 3 or 4 months. What are you going to do in the meantime? Are you not going to pay anyone a salary?" Participant 12 "I founded a company after I earned a certain amount of capital. Because this is the real critical point. I mean, everyone thinks that a startup will grow by being established from scratch, but it's not like that. You can't bring it to a certain level without spending money from your own pocket. So, you have to ride the bike yourself first." Participant 17 "I think it would be a good solution to put these companies in certain special categories and give them tax breaks, in other words, not to take them, rather than giving them. Because it is very difficult to take what they give, but we pay taxes every month, for example. I mean, we pay our taxes, our insurance, etc." Participant 9

Table 11 (cont'd)

Cost of Technology	"The price of one of our units is extraordinary." Participant 11 "I will go again specifically for hydrogen. It requires expensive work. Especially since it is R&D, it has to be products coming from abroad. Sometimes reverse engineering is required. We have waiting periods. During these periods, the exchange rate difference already affects us very badly." Participant 10 "Each of them has expensive materials and therefore all the trick pieces we will bring are a bit expensive on their own. For example, we want to bring a valve and the prices start at $1,000. We want to bring a fuel cell, fuel cells prices go from $2,000 to $5,000, I mean 500 watts, not even kilowatts." Participant 15 "I am sure that getting data from the General Directorate of Meteorology or from a source abroad is not a cheap thing to do." Participant 9
Tax	"We say let's increase the company's share ratios and maybe the shares. Then there is such a tax that we say let's not increase it, in other words we can't do it. Because then 45% of what we increase falls into the tax bracket. Increasing my share value as a startup and increasing the share value of a large company are subject to the same regulation. How can I do it?" Participant 5 "So if we answer this specifically in terms of technology development zones, of course, technology development zones have various tax exemptions. We all know that." Participant 13 "Because for example, if I receive an incentive and pay the incentive part to tax, because it comes to the asset side. That doesn't make sense either. Because I will have to deal with accounting for it. Because that's an example, let's say I received an incentive or a grant, if I pay the tax on this grant, the tax may not be a valid item for the grant. In that case, I have to close it from the capital, so it's risky." Participant 14

Table 11 (cont'd)

Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations show that cost management is really challenging for green energy startups in Türkiye in many ways. While the operational costs of a technology development startup, such as the already challenging salaries and rent, are mentioned, the expensive prices of regularly used materials and the fact that they are brought from abroad can also be challenging in the sector. The tax reductions provided by the state in taxes such as customs duty and value-added tax and the exemptions provided for startup employees are really valuable for startups, but in the eyes of many startups, these are not enough, and they need to develop policies. For example, the scope of these tax reductions may not cover the chemical materials used by the entrepreneurs, but the chemical substance used is indispensable for the relevant entrepreneur and is also expensive since it is brought from abroad. Or, being subject to the same taxation as large companies in an investment process may also make their approach to investment hesitant. While touching on the opportunities offered by technology development zones, it is emphasized that the increases in costs, especially rent, here also create dissatisfaction among entrepreneurs. Startups demand discounts and exemptions that facilitate cost management, especially for green energy startups. What we have observed is that startups benefit from many supports in technology development zones, but cost increases have become much more challenging, especially in recent years.

4.3. Market Dynamics & Business Operations

Startup operations are operations that are highly affected by market dynamics and can also be shaped according to these dynamics. Therefore, it is quite natural for startup operations and market dynamics to come together under a theme. The topics focused on under this theme are given in the next paragraph.

On the market dynamics side of the market dynamics & business operations theme, the market barriers experienced and observed by renewable energy startups were examined under the titles of consumer awareness, competition, market saturation, and market opportunities under the titles of new market energy, community engagement, competitive advantage, and market expansion while consumer awareness becomes

more prominent in barriers, community interactions become more prominent in opportunities. The Ministry of Commerce's support for events that bring international communities together was also mentioned by more than one participant. On the business operations side, business strategies and startup operations focus were the observed themes among the experiences of renewable energy institutions in Türkiye. On the business strategies side, partnerships, and the startup operations side, the TÜBİTAK 1512 (with its new code 1812) program, which is in the establishment phase, was mentioned many times.

Direct quotes from startup representatives regarding these experiences are provided below.

Table 12: Market Dynamics & Business Operations Quotations

Subject	Quotations
Startup Operations	"Later, we are a company established with TUBİTAK 1512. TUBİTAK's individual entrepreneurship support at the same time. These were actually being promoted in the technopark. We came across this support during that promotion and said, "We actually have such an idea. While we were thinking about how we can implement this, we came across this support and that's how we founded the company." Participant 16 "We were founded with the support of TUBITAK." Participant 11 "Our company was established within the METU Technopolis with the support of TUBITAK. Its field of expertise is artificial intelligence software systems, and its focus and target sector is the renewable energy sector." Participant 9 "After that, there was TUBITAK 1512 support. Now, the code may have changed. I received it through distance education. While in China, the pandemic was already closed, we were at home, doing our doctorate. After winning that, I founded the company here with my brother." Participant 17

Table 12 (cont'd)

Business Strategies	"There is also a difficulty in reaching the end user, the customer, I can talk about that as well. Now, potential customers in the energy sector, if it is production or consumption, in other words, distribution companies. You and I are consumers, but there is a big company that gives us electricity. Customers are either very big companies or state institutions. They are not people that a startup, in other words young entrepreneurs, can suddenly come across easily. I see it. I follow it. I have also participated in it in the past. You also organize events that bring together the sector, customers and entrepreneurs. I see that different institutions do it anyway, but I have not seen very high efficiency from them. Personally, this observation is my opinion. It may be wrong, but I have never heard of a state institution meeting with a unit of the Ministry of Energy in such a meeting and really entering into a serious project with a state. Or I have never heard of a big energy company meeting with the capital electricity distribution and starting a really significant project. Why? Because the company across the street is very big. You are very small, no matter how good your vision or knowledge is, it is not very easy to convince. There can be 2 solutions. Of course, I'm talking very simply. These customers can be entrepreneurs, people who want to do projects, they can be students. We can open more channels to bring these people together, more tolerable channels can be opened." Participant 9 "Apart from that, this is a situation that we also have a little difficulty with within the companies themselves, but it is also something that is necessary to increase awareness. The efforts that these companies make and give within themselves, or whether it is technological developments or the areas they work in, their ability to show themselves and explain themselves and increase their visibility should be supported." Participant 10

Table 12 (cont'd)

Market Barriers	"First, awareness needs to be created throughout the country, both with these policies and by highlighting the work done by companies like us, so that when I come to the investor, I don't have to explain it from scratch. He should come knowing something already so that I don't confuse him. Such awareness needs to be created." Participant 10 "I have witnessed that an extra air conditioner was installed in every room in a factory. Just so that the energy produced would be consumed. In other words, before this consciousness is established, or awareness is established, what is our purpose in the world right now? First, let's reduce the energy we consume to a minimum. Then, let's supply that remaining energy with renewable energy sources, but we are unconsciously installing renewable energy sources." Participant 8 "So we do vertical class work. Investors don't know much about our vertical. They watch from a distance. Therefore, it is a bit difficult to explain our problem and it is difficult to find investment. We are closing an investment round now. We are closing it with people in the sector. Because when we go out and tell the problems here, that is, when we say power plants, electricity grids, etc., investors are already sitting at the table in fear, so since there are no investors who know this vertical, it is a bit difficult for us to find investment." Participant 2 "In order for us to be able to do this process here, first of all, we need to extract the water from there and look at the components in it, and many people reject this. Because they say, you will find something now. If you find toxic substances, the Ministry of Environment catches it. They say, it will be sealed, for example, there were groups that did not allow us to do this." Participant 7

Table 12 (cont'd)

Market Opportunities	" On the government side, the Ministry of Industry, as you know, provides support for going to fairs. I find those fairs very useful. Going there and introducing ourselves to that customer, creating a marketing strategy there is actually a cost for us, we reduce those costs to the lowest with these fairs and the fact that this is supported is very special. For example, a startup, when it is on the verge of bankruptcy, takes out a loan and goes to this fair and at that fair, it actually receives a product order that is 5, 6 times the size of the loan it took. That is actually why we always think that these fairs are important. That is why we actually want these supported fairs to be a little more diversified" Participant 16 "Clustering. In other words, if there were 100 of our companies in this city, 100 factories like this and they opened up to the world in a city. Because each company actually opens up markets to each other and also creates its own sector. We would be much happier. Frankly, there would be a competitive environment." Participant 13 "TUBITAK has support on this issue. It says, as long as you get accepted abroad, I am behind you, I will provide you with financial support, as long as you give me the assurance that you can open that door there. We are supported on this point as well. In other words, TUBITAK really needs to do research. I mean, I didn't know either, but you need to do research and learn. At this point, TUBITAK supports. There is support from the state, but unfortunately, things in our country are not supported like that." Participant 8

Table 12 (cont'd)

Author Reflection	Our experiences and observations from our interviews with renewable energy startups in Türkiye show that while startups receive policy support in areas such as market barriers, market opportunities, startup operations, and business strategies, they also need a lot of support in many areas. Support from supporting institutions, especially TUBİTAK and the Ministry of Industry and Technology, is observed and welcomed in areas such as the establishment of the startup and the startup's access to new markets. However, within the framework of basic entrepreneurship policies, there are also policy expectations such as commercialization of the startup, raising awareness of the technology the startup focuses on, and developing policies that provide support focused on green energy. These needs should not be addressed only in terms of new technologies. As stated in the quotes shared, even solar energy startups that have been around for a relatively longer time have expressed that they have difficulty explaining what they do to investors and finding investments. They have also stated that they have made investment rounds within the sector for this reason. This example may actually pose a risk to the growth of the sectors by remaining limited in their own money cycles and communities. In addition, interviews conducted with hydrogen or bioenergy startups also show that potential customers have difficulty explaining their technologies to potential customers due to their lack of sufficient awareness in the relevant technology areas. Another awareness problem is that the support received is received by some different institutions without considering the purpose it serves and that they take actions that are contrary to the purpose of the support. In order to prevent this, the follow-up of the support provided should be done more meticulously. Another issue that needs to be focused on is how efficiently startups and supporting institutions come together. Because there are events in this field that are carried out with the strategy of triggering cooperation between institutions and startups, but the efficiency of these events is questioned by startups and emphasis is placed on providing more support that will contribute to their commercialization for market dynamics. Information has been shared about the productive bringing-together structure and events, but these are not policy-related dynamics. To summarize, in order for startups to realize their strategies within the market dynamics, they are expected to develop policies focused on bringing together activities and raising awareness among potential customers. Although the support provided for accessing new markets is appreciated, policies for foreign markets are insufficient.

4.4. Global Trends & Country Economic Conditions

In this theme, it is observed how renewable energy startups are affected by the country's economic conditions and global trends and what experiences they gain. Local and global dynamics can affect startups that develop and produce technology in a wide range, as well as renewable energy startups. These effects are examined within the framework of global market trends, international policies and economic uncertainties. The positive effects of global trends and the negative effects of local economic conditions were given more space in the interviews. It was shared that global market trends developed against renewable energy startups and the local market followed the global, and the same follow-up developed positively in policies. In the shared experiences regarding economic conditions, it was mentioned how the economic conditions in the country can be challenging for the establishment and development of startups, how much the fluctuations in the economy can affect startups, especially the incentives received and, the effects of these incentives against foreign exchange. Direct quotes that will constitute examples of these experiences are included in the following passage.

Table 13: Global Trends & Country Economic Conditions Quotations

Subject	Quotations
Global Market Trends	"In other words, we see those developments in Japan, in the field of materials and systems, are slowly dominating the world, but in the future, they will dominate to a great extent. Therefore, an equation that does not include China does not make much sense to us. Therefore, we have the will to follow the developments there, but as far as we can see from experience, Asia is advancing very, very quickly in this regard." Participant 13 "Forty percent of the world's hydrogen market is currently in Europe. It has a large market. That's why we are trying to produce more compatible with there, and I don't think we will have much trouble here later. In fact, it seems to me that way, but for example, Europe currently also cares about the environment in the concept of sustainability. It has banned certain things, such as fluoride. The new things it will produce should not have fluoride in them. I think we may not go that far at the first stage, we can say in our own legislation that if there is fluoride, do it, but at least we will be producing fluoride-free." Participant 8 "I went to one of the very good teams again on lithium-ion batteries. The reason I went there is that you see in the market today. You know, when Chinese cars started coming, BYD, a billion-dollar factory, I saw that in 2015, as someone involved in the business." Participant 17 "I said, I wonder how you grew the business to this extent? He says the state supports it to a high extent. I don't think any European manufacturer can compete with China. Ultimately, everyone will have a Chinese partner" Participant 12
International Policies	"When we look at this, the impositions in Europe, at least in energy storage, the concept of battery passport, people creating a little more awareness, the companies here are actually affected by them.. Since the energy sector is one of the sectors where carbon comes the most in order to implement net-zero, the Paris Agreement, they are trying to reduce this sector and these solutions, technologies, and startups are becoming important." Participant 16 "Of course, not only in our country, but also in Europe, especially the developments regarding the Green Deal directly concern and affect us." Participant 13 "Frankly, when the green agreement was signed, we thought that it would create a lot of noise and that it would be followed by many breakthroughs, but when you look at the current situation,

Table 13 (cont'd)

	unfortunately, we do not think that it has had the impact we expected." Participant 1
Economic Uncertainty	"Many startups in Türkiye have no branches abroad, so they can't get investment. So, I think the biggest obstacle to sustainable startups is economic." Participant 7 "Due to the economic conditions in Türkiye, it is quite difficult for start-ups in Türkiye to develop and or do this." Participant 11 "This is a situation that is detrimental to the state. But after the elections, they will probably increase the mains electricity prices, stimulating our sector. It directly increases our demand. This is a good thing for us, but of course, it is a bit problematic for the people or Türkiye, in other words, for the people's economy." Participant 4
Author Reflection	Our experiences and observations from our interviews with renewable energy startups in Türkiye show that the impact of global changes has led to parallel developments in Türkiye, and that there are initiatives that, while mostly positive, have not seen the expected impact. Both China's production capacity in the market, the support and incentives it provides, and the technological leaps of Asian countries such as Japan and China show that Asia's presence in the renewable energy sector is moving towards dominance, both from the perspective of the interview participants and from our observations. Although policies integrated with Europe are being developed in Türkiye and actions are being taken in the market that follows the European market, it is important not to ignore Asia's production power and developing technology and to closely follow Asian trends in both policy developments and market movements. An example of Türkiye's adaptation to global policies is Türkiye's inclusion in the Green Deal and the establishment of the Green Deal Action Plan in order to achieve the goals it has set as a country or, the TUBİTAK programs designed with support from the budgets created by the European Union in line with the goals it wants to achieve can be given as an example. While many entrepreneurs are aware of these developments and follow this process with pleasure, some argue that the developments are not fast enough. It is important to review the focal points and development speeds of policy developments within this framework. While the processes

4.5. Technology

The technology theme focuses on the technological challenges experienced by startups. The main reason for this focus in this study is to shed light on the challenges experienced by many renewable energy startups due to their newly developed technologies. This theme can also guide renewable energy startups in areas where policies can be attacked from a techne perspective. Here, the technology theme is followed in 3 different focuses: technology infrastructure, technology expertise and technology adaptation. As can be observed in the direct quotes examined under these focuses and in the views that the author will share, the need for technical expertise comes to the fore. The needs under the technology infrastructure and technology adaptation headings are observed, although more frequently than technology expertise.

4.5.1. Technical Expertise

Renewable energy technologies require complex engineering and scientific principles. Technical knowledge and skills of those working in this field are critical for the effective development and implementation of technologies (Dincer, 2020). Based on this, it is not unusual for renewable energy startups in Türkiye to have needs for technical expertise. However, their experiences in accessing this technical expertise may be areas where positive or negative policies can be addressed. Therefore, it is as important for renewable energy startups to have their voices heard on this issue as many of the topics covered in the previous theme. In eleven out of seventeen interviews, it was mentioned that it is not easy to obtain technical expertise in renewable energy technologies, especially in relatively new verticals in Türkiye, and to find professionals who have it.

Table 14: Technology Quotations

Subject	Quotations
Technology Expertise	"I mean, there's not even anything at the university; I mean, I'm an energy systems engineer. They teach us almost all energy systems, but they don't teach us anything, including wave energy. That's why finding a professor or doctor who has worked in the country is very difficult. It's also very difficult to find a teacher. When we first asked, we usually got feedback like, you go to America and do your master's degree, etc., come here and become a teacher and professor." Participant 11 "Well, know-how is needed, because you need to know that sector so that something can be produced. For example, for us, you released your first product one year. It was a learning process from the moment we started releasing it. Without knowing it, you can neither produce nor sell a product. In other words, you need to understand the customer well." Participant 2 "Actually, we are having difficulty because when we look at it, as I said, even in Türkiye, lithium is actually something that has just been done; it has just started to be researched and considered, while we are in a completely different technology as I mentioned at the beginning, we are one of the first producers. Therefore, we are also having a bit of difficulty reaching technical support, to be honest." Participant 16
Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations clearly show that the necessity and importance of technical expertise to establish and sustain a renewable energy startup is evident. When we examine the responses we received in the interviews, it was emphasized that this necessity and importance was emphasized once again in renewable energy verticals that have been around for a longer time, such as solar energy and wind, but there was no difficulty in accessing expertise. Since there are already technologies that have been worked on for a long time both globally and locally, it has taken a certain amount of time for expertise to develop. However, not all entrepreneurs who establish startups in this field establish their startups with the necessary technical expertise, and sometimes they acquire that expertise in the process. The fact that one of the entrepreneurs interviewed said that they devoted the first year after establishing their startup to learning the field is evidence of this. However, the difficulties experienced by startups focusing on relatively new technologies such as hydrogen, wave energy and the storage of these energies in accessing technological expertise are supported by our communications and observations in the Turkish entrepreneurship ecosystem, as well as research interviews. The fact that wave energy has recently been included in legislation can actually give an idea of how new the technology is in the country. Policy developments to increase technological expertise would be welcome.

4.5.2 Technology Adaptation & Technology Infrastructure

Since technology adaptation and technology infrastructure in a country are necessary factors for each other's existence, we wanted to cover the relevant topics together. Renewable energy sources, unlike fossil fuels, significantly reduce greenhouse gas emissions. This plays a vital role in slowing down global warming and climate change (Owusu & Asumadu-Sarkodie, 2016). However, in order to provide these benefits against climate change, renewable energy technologies must be adapted, and these technologies must be widespread. However, ensuring technological adaptation cannot be considered in a scenario where the technological infrastructure does not exist.

Technological infrastructure is a critical issue in many technology fields, as well as in technologies developed by renewable energy startups. Deficiencies in the R&D process, test areas, and technological equipment required for a newly developed technology to become a product may prevent startup solutions from becoming products and developing. Therefore, it is essential to have the relevant technological infrastructure in the locations where startups are located. Another important reason for this issue is that startups depend on foreign countries due to the lack of technological infrastructure in their locations, which is not sustainable technologically as much as financially. In six of the interviews, the importance of technology adaptation in developing renewable energy technology was mentioned, and in four of them, the importance of infrastructure needs for renewable technology was mentioned. Direct quotes from entrepreneurs on their experiences and observations on these related issues are provided below, drawing attention to the needs and deficiencies here.

Table 15: Technology Adaptation & Technology Infrastructure Quotations

Subject	Quotations
Technology Adaption	"Because there is no real field. That's why we are having a hard time with PoC studies. We are working on a feasibility study, but it seems like there is still a long way to go before real fields are established. That's why there is already one field in Türkiye. The Bandırma field that Enerjisa built as a demo. Because the country does not have such an energy infrastructure or those open capacities have already been closed for different people and investments are expected to be made one day." Participant 5 "They will pass legislation, but we(the country) do not have the infrastructure for hydrogen production, distribution, storage and transportation." Participant 8 "There are some practical difficulties in the implementation of incentives. In other words, what is written is good, but we do not have that infrastructure, or there is no one responsible for it on the company side." Participant 14
Technology Infrastructure	"If we look at it from our perspective, even now, while the world is now avoiding lithium batteries and lead-containing batteries, we(the country) are just entering lithium batteries. While lithium batteries are just entering, we are currently anticipating that we will have difficulty entering the market with sodium-ion batteries. There are barriers, such as trying to introduce a new technology to a local market that has just gotten used to lithium. This is actually not just ours. It also makes it difficult for other types of batteries, namely other types of energy storage, to enter the market." Participant 16 "They have taken something with TUBITAK, done a project, and completed that project, and the ones who did this are mostly projects and professors. When we tried to contact them, we did not get any feedback. In other words, projects are actually being done and shelved, projects are being done and shelved. They are all projects that have remained at the prototype stage. In other words, projects that have not yet gone into production." Participant 11 "The hydrogen part is a completely different part. I mean, hydrogen is really a type of energy that is feared. Because you say the explosion is ours, it still comes to us with that hydrogen bomb. It is both an energy type that needs to be secured and a completely different system from the ones currently used in terms of energy conversion systems, so let me tell you the names of the things I have seen on my behalf and in my environment. There are still those who resist this. But in the last 2 years, people are a little

Table 15 (cont'd)

	warmer, not because of necessity or their desire, but because there is no other choice; they are trying to look at it more broadly." Participant 8
Author Reflection	Based on our interviews with renewable energy startups in Türkiye, our experiences and observations show that entrepreneurs provide certain information in the interviews about the need for adaptation to technologies developed by renewable energy startups and the need for technological infrastructure. In terms of technological adaptation, entrepreneurs are expected to develop supportive policies for the implementation of studies that support dissemination activities both for their usability and their benefits, and for this to happen. In the field of infrastructure, infrastructure needs, especially in the field of hydrogen, were shared in more than one interview. The limited test areas required for testing technologies can be given as an example. The validity of these needs has also been reflected on the government side. Legislation is being developed and major investment moves are being made to meet the infrastructure needs of renewable energy technologies. The planned actions in the Hydrogen Valley and Climate Change Mitigation Strategy and Action Plan are examples of steps taken to meet these needs.

4.6. Interpretation of the Findings

In this section, the findings from the interviews will be summarized and shared. There may be ideas that come to the fore in the focused themes and opinions expressed separately from these ideas. So what could be the reasons for these different ideas? We examined the existence of different ideas under themes.

4.6.1. Government & Policy Interaction

Policy needs are a common theme for all startups discussed. Startups at different levels, from early-stage startups to startups that sell their products, have different needs. While those at an early stage are looking for more support to develop their products, those that have developed their products are waiting for support to commercialize them. However, only some have the same opportunity to convey these expectations to policy makers.

4.6.2. Financial Sustainability

Almost all the startup representatives interviewed accept the financial support of different state institutions and structures, especially TUBİTAK and technoparks. However, there are different comments on the adequacy of the support here and the applicability of the incentives.

4.6.3. Market Dynamics & Business Operations

In market dynamics, the answers vary greatly depending on the energy vertical. For example, while relatively new technologies such as hydrogen energy, bioenergy, wave energy, and energy storage have difficulty in terms of consumer awareness, startups working in areas such as solar energy and wind energy talk about difficulties such as accessing data, falling behind the global market, and scaling under country conditions. We also encounter different dynamics in market opportunities. When viewed from a local perspective, it is argued that renewable energy should have down-to-earth legislation for it to be attractive, while it is argued that if it is to be global, it should not be worked on in a very integrated manner with legislation. The underlying reason for this situation may be the difference in the development of the renewable energy sector between the country and the world and the perspectives on innovation and R&D.

4.6.4. Global Trends & Country Economic Conditions

When looking at trends in global markets, in addition to the European Union, which stands out with its incentives and initiatives in this area, there is an emerging Chinese dominance that the vast majority of entrepreneurs observe. On the other hand, there are also entrepreneurs that say they need to develop products in an integrated manner with Europe. There is a stress that startups share in terms of country economic

conditions as well. Startups stated issues on fluctuations of country's economy, related exchange rate volatility.

4.6.5. Technology

In the technology theme, the focus was more on technological challenges experienced by renewable energy startups. It was observed that the challenges shared here were shared by relatively new renewable energy technology startups, and that technology startups such as solar energy and wind energy shared much more less challenges in terms of technological adaptation, technological infrastructure or technological experience.

CHAPTER 5

DISCUSSION

This chapter consists of 3 sections: discussion of the findings, policy recommendation, and limitations. The first section discusses the research findings in relation to a theoretical background. In the second section, implications are suggested to enhance the experience of renewable energy startups in Türkiye in the light of green energy policies. Then, suggestions for future research are shared based on the limitations.

5.1. Discussion of the Findings

This study examined the impact of green energy policies on renewable energy startups using the interpretative phenomenology analysis method based on inductive reasoning through reflexive and interpretative theming. The analysis of the interviews conducted with startups resulted in the following themes: Government and policy Interaction, Financial Sustainability, Market Dynamics & Business Operations, Global Trends, & Country Economic Conditions and Technology. The outputs focused on the relevant themes are as follows:

- Government & Policy Interactions: In line with the data examined, important observations were made on the policy development, regulatory challenges, and motivation sources of renewable energy startups in Türkiye.

Entrepreneurs stated that they had difficulties in running their businesses due to uncertainties in current regulations and that this situation negatively affected their entrepreneurial processes. In addition, it was stated that the process of implementing innovative projects slowed down significantly and even stopped completely in some cases due to policy uncertainties.

It was also stated that bureaucratic delays were also a significant obstacle for entrepreneurs, making it difficult to obtain financial support. It was emphasized that more specific support mechanisms were needed, especially in the field of green energy. Regarding developing green energy policies, entrepreneurs said they expected more incentives and support in this field. While international agreements such as the Paris Agreement and the Green Deal were expected to increase the mechanisms to encourage projects in this field, in the eyes of entrepreneurs, current regulations still need to reach a sufficient level.

As a result, renewable energy entrepreneurs in Türkiye, in light of their experiences, see current regulations as insufficient and experience significant difficulties due to bureaucratic delays and regulatory challenges. However, it was observed that they had a common view that future policies in this area should be developed with a more flexible and innovative approach. We observed that one of the main reasons for the dissatisfaction experienced by renewable energy startups in Türkiye may be that they compare the policy processes in Türkiye with the policy processes in green energy in the world, especially in Europe, through their own experiences and observe that many processes in Türkiye can be improved.

We also believe that another of the main reasons why startups think this way is that they are looking for the agility and flexibility they have, in the policy structures. Also, in the digitalizing world, we believe that slowing down processes due to being physical, communication channels and process steps that are not clearly stated enough may be other reasons that feed startups' dissatisfaction. In summary, contrary to the work of Singh and his colleagues (2017), startups do not feel that they are positioned in a critical role within the policy framework. Even though, in line with the literature (Sabel & Victor, 2024; Mehling et al., 2017,), in fact, policy studies are being conducted in the country focusing on green energy, but policy communication with startups may not be taking place healthily. Therefore, interfaces where startups can clearly communicate what they expect from policies on the basis of feasibility, what they can achieve with what they expect and in what time, what they can bring to the country with what they have achieved, and how policymakers have worked and will work to meet the needs in this area, and within what limits and resources they work while developing relevant policies, can reduce the dissatisfaction experienced.

- Financial Sustainability: Based on the interviews, the difficulties experienced by renewable energy startups in Türkiye in terms of accessing financing, cost management and government support are summarized:
    - Government Grants: Entrepreneurs state that the grants provided by government institutions such as TUBİTAK, KOSGEB and the Ministry of Industry and Technology are quite valuable. However, they think these supports are insufficient and should be increased. They emphasize that these supports are insufficient due to reasons such as increasing operational costs, economic factors such as inflation, the cost of technological materials supplied from abroad and the fact that they have

not yet reached economies of scale. In addition, it is emphasized that support specific to green energy should be increased.

- Venture Capital: Problems such as insufficient regulations and the dominance of old methods in investment processes in Türkiye were mentioned. It was stated that startups operating in the field of renewable energy have difficulties with investors who do not have sufficient knowledge and experience and, therefore, prefer to cooperate with foreign investors. It was also emphasized that investment training should be widespread in Türkiye rather than entrepreneurship training.
- Bank Loans: It has been stated that the credit rates of banks in Türkiye for green energy investments are very low and this situation creates a major obstacle for entrepreneurs. For this reason, some entrepreneurs state that they may prefer to invest in other countries instead of Türkiye.
- International Programs: Entrepreneurs stated that programs in Europe provide more support for green energy entrepreneurs and that this support increases financial sustainability. It has been stated that participation in European Union projects offers other advantages as well as being attractive in terms of budget. Support provided for fairs and international programs abroad is appreciated but is expected to increase due to exchange rate differences.
- Cost Management: Renewable energy entrepreneurs state that in addition to high R&D and material costs, operational costs, taxes and insurance premiums also make their financial sustainability difficult.

In particular, it has been stated by entrepreneurs that tax reductions offered in technology development zones are valuable, but more support is needed. Entrepreneurs demand special discounts and exemptions that will facilitate cost management.

Overall, from the perspective of renewable energy entrepreneurs in Türkiye they need for increased government support, improved investment processes and more support in cost management. Our observation here is that the dependence of renewable energy startups on materials related to the technologies they develop abroad, the difference in purchasing power between supports abroad and those found globally, the fact that renewable energy is included as a subheading in general startup-focused calls due to the absence of technology-focused calls, and the fact that the share that can fall into this area is considered small, and the expectation of direct financing-focused support are the reasons that form the basis of the dissatisfaction of renewable energy startups. In fact, the investment that startups expect to make in green energy policies parallels the literature (Akin & Urpelain, 2018; Gielen et al., 2019). In this context, it can also be considered that, aside from hard policy tools, they cannot observe the sufficient effects of soft policy tools or do not have sufficient awareness about soft policy tools (TTGV, 2023, pp. 143–147).

- Market Dynamics & Business Operations

  Based on interviews with renewable energy startups in Türkiye, our experiences and observations show that startups have experienced the effects of relatively more obvious policy supports in terms of market barriers and market opportunities and much less obvious policy supports in terms of startup

operations and business strategies. They have stated that they need more support, let alone existing support. Support from institutions such as TUBİTAK has been observed and welcomed in terms of startups' establishment and access to new markets. However, within the framework of basic entrepreneurship policies, apart from the commercialization of startups, the technology that startups focus on also shows that they need support in many areas. Startups have expectations regarding increasing awareness of the technology they focus on and studies on green energy policies. Some even share that they can be part of awareness-raising activities as part of soft policies, where they convey that startups can be positioned as ambassadors to disseminate policies.

These needs should be addressed in more than just relatively new renewable energy technologies. As stated in the quotes shared, even solar energy startups that have been around for a relatively long time have stated that they have difficulty in getting investors to understand what they are doing and to come to the table without fear, and that they have difficulty in finding investments. For this reason, they stated that they carried out investment tours within the sector. This example poses a risk to the growth of the sector by remaining limited within their own money cycles and communities.

- Global Trends & Country Economic Conditions

  Interviews and observations with renewable energy startups reveal that Türkiye has made developments in parallel with the changes in global energy markets, but that both positive and negative experiences have been experienced in this process.

According to the participants ' observations, the production capacity and technological advances in the renewable energy sector in Asia, especially China and Japan, show that these regions are increasingly gaining dominance in the sector. China's production power, state support and incentives, and Japan's development of innovative materials and systems increase Asia's influence in the global market. Therefore, it is necessary not only to develop policies integrated with Europe for energy startups in Türkiye, but also to follow trends in Asia closely.

The development of policies in line with the European Union in Türkiye, especially the regulations made within the framework of the Green Deal and the Paris Agreement, affects the Turkish market and action is taken in this direction. The participants state that green energy-focused policies implemented in Europe are also reflected in Türkiye, but the expected impact of these policies is not always achieved. In line with the studies of Ozdemir and colleagues (2021), Türkiye’s progress in energy sector for renewable energy is undeniable. As shared by the International Energy Agency (IEA), Türkiye has tripled its renewable energy production in the past decade. However, many different dynamics, including energy imports, adversely affect Türkiye’s economy (Uysal, et al., 2015; Zanbak et al, 2020). Economic uncertainties stand out as one of the biggest challenges for renewable energy startups in Türkiye. Türkiye’s current economic conditions make it difficult for startups in this field to develop. In particular, changes in exchange rates make it difficult to use funds obtained from governmental bodies’ support efficiently.

As a result, in order for renewable energy startups in Türkiye to compete in global markets, they need to closely follow developments in both Europe and Asia and increase their resilience against economic uncertainties by making the most of focused state support. The main reason for not believing this is that the policies and policy instruments developed with a focus on green energy are just starting to come to life and the existing ones can touch the verticals under the calls for general entrepreneurship focus on startups. While it is seen that global trends have positive effects on the processes of the startups interviewed, the negative effects of the country's economic factors have been mentioned many times by the startups. Startups can be used effectively both to benefit better from global trends and to change the country's economic conditions. Although they cannot be a changing factor on their own, their positive effects can be observed.

- Technology

  Interviews and observations with renewable energy startups reveal that entrepreneurs in Türkiye face difficulties in technological expertise, technology adaptation and infrastructure.

  - Technological Expertise: Participants emphasized that it is very difficult to achieve expertise in new technologies such as hydrogen in Türkiye. In particular, the inability of knowledge and experience that remain at an academic level to be sufficiently integrated with industry makes progress in this field difficult.

    In addition, high dependency abroad necessitates applying to foreign companies for technological consultancy, which, when combined with

factors that increase costs such as exchange rates, creates a major obstacle.

- Technology Adaptation and Infrastructure: Technology adaptation and infrastructure deficiencies stand out as one of the biggest factors preventing the spread of renewable energy technologies. It was stated that infrastructure in Türkiye is insufficient in areas such as hydrogen production, distribution and storage, and this situation will create practical difficulties in the implementation of projects in this field.

For renewable energy startups in Türkiye to be successful, technological expertise and infrastructure must be strengthened. Legislation is being developed and major investment steps are being taken by the state to meet the needs in this area. For example, projects such as the "Hydrogen Valley" are considered important steps towards meeting these needs. However, for these startups to be sustainable, the development of local expertise and infrastructure, both technologically and financially, is of critical importance.

We see the problems experienced by startups in the technology center as solid areas that need to be solved with policies. The lack of technology infrastructure, therefore the procurement of basic materials for technology from abroad, the high cost of these products, the scarcity of test areas for the technologies produced, and the scarcity of human resources with technology experience are areas that can be developed with policies and are not easy for startups to solve on their own. Although entrepreneurs can educate themselves for technology experience, producing basic materials for technology and creating test areas are areas that require high investment. Studies of Ucgul and

Elıbuyuk (2017) also give importance to need of investment on renewable energy technologies, to use Türkiye's geopolitics advantages more effective.

5.2. Policy Recommendation

When looking at the effects of green energy policies in Türkiye on renewable energy startups, it is quite necessary to make policy proposals on issues that are promised in existing policy documents or not mentioned in these documents. Increasing the experiences related to green energy policies and ensuring that the existing experiences are more positive is essential for Türkiye to achieve energy freedom, sustainability, and development in the energy vertical. When looking at the European and World averages, although Türkiye has made significant progress, it still has a long way to go. In this path that needs to be progressed, it is important to develop new policies for renewable energy startups to develop their technologies and to commercialize and globalize.

5.2.1. Developing policy accessibility and awareness-raising activities

The existing policy documents include targets for increasing the use of renewable energy and raising awareness about energy efficiency. However, no study on the interaction of startups with policies was expressed in the interviews. On the contrary, it was stated that it can be difficult to follow policies, that the activities of many policy implementing institutions should be followed separately, and that people may need help accessing their own studies on the website interfaces of these institutions.

For this reason, it is important to establish a database that can easily access policies and practices focused on sustainability policies or more directly under green energy policies as a policy proposal.

Although the Strategy and Budget Presidency and Legislation Information System under the Presidency of the Republic of Türkiye, the Climate Change Presidency under the Ministry of Environment, Urbanization and Climate Change, the Ministry of Energy and Natural Resources, TUBİTAK, KOSGEB, development agencies and many institutions not mentioned here have separate sharing areas, there is no consolidated, easy-to-access and explanatory policy database. It would be very valuable and easier for startups, which are mostly established with small teams, to have such a database to access their policies and practices while they are in the midst of R&D, commercialization and administrative processes. Startups may have low policy awareness due to lack of policy communication, lack of effective policy database, intensity of work and lack of policy implementation from the perspective of startups. This lack of awareness may lead to renewable energy startups addressed by the policies not benefiting sufficiently from the relevant policies and the policies being inefficient. Therefore, it is very valuable to have effective communication channels through which policies can be conveyed to startups and to carry out policy awareness-raising activities.

5.2.2. Policies on transparency and uncertainties

Another area of focus for policy makers highlighted by renewable energy entrepreneurs could be policy uncertainties and transparency and follow-up of policy implementations. Policy uncertainty is meant to highlight policy gaps in renewable energy technologies, especially in relatively new renewable energy technology areas such as wave energy and hydrogen energy. In renewable energy technologies, while policy studies and policy promises develop and advance along with technologies, it is valuable to respond to the policy needs of entrepreneurs.

In terms of transparency and follow-up of policy implementations, entrepreneurs' posts mentioned the deficiencies in the follow-up and transparency of policy implementations. Therefore, if areas that need intervention are discovered, it may be useful to examine the relevant policy processes and conduct policy improvement studies. Therefore, policy makers should come together with startups. They should listen to the needs of startups, what they can do if their needs are met, and the demands of startups. We can also use Abraham Lincoln's words for democracy, "Democracy is the government of the people, by the people, for the people." for policy making. For renewable energy startups, green energy policies are by the people, for the people. Communication is essential for this to happen.

5.2.3. Policies on renewable energy focused supports

Türkiye currently has ambitious and challenging sustainability-focused goals. While 42% of electricity produced last year came from renewable energy sources, it is aimed to increase this to 65% in 2030. In 2053, it needs to reach higher rates due to the net 0 target. It is a necessity to create focused supports such as more focused financial support, tax reductions, rapid project reviews within programs and reducing bureaucracies for renewable energy startups that serve these goals. In interviews with entrepreneurs, attention is drawn to the scarcity of focused support in the field of renewable energy and the fact that it is an area that is mostly positioned in more comprehensive programs. This is a situation that causes the share of support for renewable energy startups attacking the energy sector, which is currently the largest source of carbon emissions, to be low. While Türkiye positions the studies that will support renewable energy startups as a subheading within different umbrella programs, it needs to increase the gear while observing the Russia-Ukraine war, which

provides an understanding of how critical energy independence is. It is necessary to reduce the time between policy creation and implementation and to conduct focused studies such as the focused studies conducted for health startups during the pandemic period caused by the coronavirus for renewable energy verticals.

5.3. Limitation

It should be noticed that this study has some limitations. However, examining these limitations may provide valuable contributions to future research.

First of all, the sample size of the study may be a limitation in itself. Although efforts were made to conduct random and homogeneous sampling, the participants' shares, years of experience, the energy vertical they are in, their level of following green energy policies and their interaction rates with these policies, the cities where the startups are located and the areas where they are established may have affected the study results. However, with a higher sample size, standard distribution can be better provided, and the results can shed light on the experiences and policy needs where the startups reach more consensus. Another limitation may be the timing of the study. Green energy policies are still developing in Türkiye, and it should not be forgotten that important steps that will form the basis of future policies have been taken recently. The fact that the 12th Development Plan, which includes green energy policies that will contribute to renewable energy startups, has not yet completed its first year during the period this thesis was written can be given as an example of this situation. This situation may leave the level of green energy policy experience of startups that produce solutions in many important verticals of renewable energy, the importance of which will increase in the future, more primitive compared to the results to be obtained in future studies.

However, since it is foreseen that green energy policies will develop further, more policy instruments that affect renewable energy startups can be found in future studies. In addition, this study can provide a basis and comparison for future studies on the early effects of green energy policies on startups.

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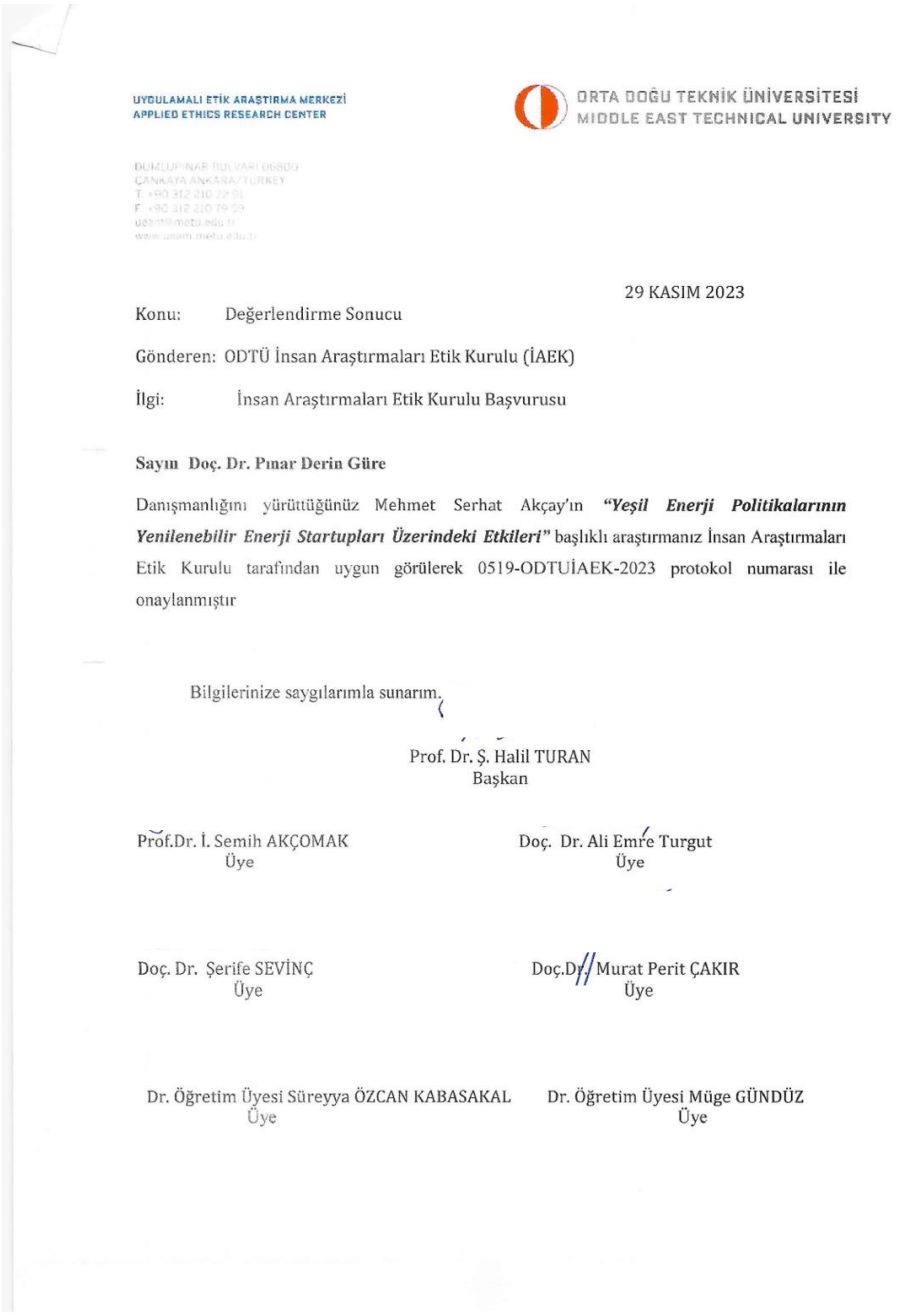
APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE



UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç. Dr. Pınar Derin Güre

Danışmanlığını yürüttüğünüz Mehmet Serhat Akçay'ın ***"Yeşil Enerji Politikalarının Yenilenebilir Enerji Startupları Üzerindeki Etkileri"*** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek 0519-ODTUİAEK-2023 protokol numarası ile onaylanmıştır

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan

Prof.Dr. İ. Semih AKÇOMAK
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Doç. Dr. Ali Emre Turgut
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Doç. Dr. Şerife SEVİNÇ
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Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
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Dr. Öğretim Üyesi Müge GÜNDÜZ
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B. CURRICULUM VITAE

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EDUCATION

Degree	**Institution**	**Year of Graduation**
BS	METU Business Administration	2020
High School	Aydem Science High School, Denizli	2015

WORK EXPERIENCE

Year	**Place**	**Enrollment**
2022- 2024	Beko-Innovation Directorate	Expert
2019-2022	METU Technopolis – Entrepreneurship Programs	Assistant Expert

C. TURKISH SUMMARY / TÜRKÇE ÖZET

Bu çalışmada yeşil enerji politikalarının yenilenebilir enerji startupları üzerindeki etkisi incelenmiştir. Çalışmanın yanıt aradığı araştırma soruları aşağıdaki gibidir:

Yeşil enerji politikaları kapsamında sunulan teşvikler ve fonlar yenilenebilir enerji girişimlerini nasıl etkiliyor? Bu teşviklerin girişimlerin stratejilerine katkıda bulunduğu düşünülüyor mu? t

Yeşil enerji politikası düzenlemeleri ve mevzuatı işletmelerin gelişim sürecinde hangi rolleri oynuyor? Bu düzenlemelerin girişimlerin süreçlerini nasıl şekillendirdiği düşünülüyor?

Yeşil enerji politikaları son yıllarda ilgi duyulan bir politika alanı olmuştur (Pegels et al., 2017). Özellikle iklim değişikliğinin tüm dünyada artan etkileri (He et al., 2022)., bu alana olan ilginin artmasında önemli bir role sahiptir. İklim değişikliği ile birlikte yükselen deniz seviyeleri ve kuraklık, orman yangınları, kasırgalar ve şiddetli yağmurlar gibi doğal afetler dünyayı çevrelemiştir. 1980'li yıllardan 2010'lu yıllara kadar kuralık, yüksek sıcaklık, orman yangını gibi iklim olaylarının sayısı dört katına çıkarken ekstrem seviyede fırtınalar ve yağışlar gibi meteorolojik olayların sayısı iki katına çıkmıştır (Reidmiller et al., 2018). Bu denli etkilere sahip iklim değişikliğinin birçok nedeni olmakla birlikte, başlıca nedenlerinden biri enerji sektörünün neden olduğu yüksek miktardaki sera gazı emisyonlarıdır. Diğer bir deyişle, enerji sistemlerinde kullanılan fosil yakıtlar iklim krizin başlıca nedenlerindedir (Fischer et al., 2016; Lamb et al., 2021). Birleşmiş Milletler 'in 28. Taraflar Konferansı'nda da

sayıları iki yüze yakın ülkenin temsilcisi fosil yakıtların iklim değişiklinin gerçekleşmesindeki tetikleyici rolünü açıkça kabul etmiştir. (Bourzac, 2024).

Dünyanın birçok sorununa çözüm bulmayı hedefleyen Birleşmiş Milletler, içerisinde erişilebilir temiz enerji, iklim aksiyonu gibi sürdürülebilirliğe birçok pencereden yaklaşan 17 Sürdürülebilir Kalkınma Amacı'nı 2030 yılına kadar destekleyeceğini taahhüt etmiştir. Bu amaçlar aynı zamanda Birleşmiş Milletler Çerçeve Sözleşmesi ile 2016 yılında yürürlüğe giren Paris Anlaşması'nın getirdiği sıcaklık artışını 1,5 °C ile sınırlı tutmak için de sera gazı salımını 2030'a kadar %45 azaltmak, 2050'ye kadar ise net sıfırlama hedefine ulaşmaya hizmet etmektedir. Bu amaç ve hedeflerin gerçekleşmesinde düşük-karbon ekonomisine dolayısıyla da düşük-karbon enerji sistemlerine geçilmesinin önemi büyüktür. Bu doğrultuda hükümetler düşük-karbon enerji sistemlerini destekleyecek politikalar, yeşil enerji politikaları geliştirmekte daha yeşil bir dünya için çaba sarfetmektedir (Borghesi & Vergalli, 2022). Collins Sözlüğü 'ne göre yeşil enerji "çevreye zarar vermeyecek ve güneş ile rüzgar gibi her zaman ulaşılabilir kaynaklardan elde edilen güç" olarak tanımlanmaktadır (Green Energy, 2023). Yeşil enerji politikaları ise yenilenebilir enerji gibi kaynağı çevreye zarar vermeyen enerji türlerinin geliştirilmesini ve yaygınlaştırılmasını, teşvik eden, ilgili enerji sektörlerini yapılandıran ve regüle eden politikalar bütünüdür. Bu çalışma çerçevesinde ise yeşil enerji politikalarının Türkiye'deki yenilenebilir enerji startupları üzerindeki etkisi araştırılmaktadır. Çalışmada yenilenebilir enerji startuplarına odaklanılmasının sebebi yenilenebilir enerji startuplarının düşük-karbon enerji sistemlerine dolayısıyla da düşük-karbon ekonomilere geçişte önemli rol oynamasıdır (Lin et al., 2018; Luo et al., 2019; Wu et al., 2020a; Wu and Sun, 2008).

Çalışma içeriğine odaklanılmadan önce global ve Türkiye'deki yeşil enerji ile ilişkili politika gelişmelerine yer vermek istenilmiştir. Ancak unutulmamalıdır ki insanoğlu olarak yeşil enerji veya sürdürülebilir, çevre bilinçli politikalarını geliştirmek hususundaki tarihimiz çok uzun bir geçmişe sahip değildir. Hatta iklim krizine tarih perspektifinden inceleyen Cambridge Üniversitesi'nden tarihçi Emma Gattey, tohumlarını sanayi devrimi ile attığımız ve aslında iklim-insan ilişkilerinin yüzyılları aşkın süredir tartışıldığı dünyamızda iklim değişikliğinin ivedilikle ilgilenilmesi gereken bir başlık olduğuna dikkat çekmiştir (Gattey, 2021; Locher & Fressoz, 2012; Bonneuil & Fressoz, 2017).

Ancak karanlık bir tablo ile karşı karşıya olsak da yeşil enerji çerçevesinde insanoğlu olarak hiçbir adım atmamış da değiliz. 1973 Petrol krizi ile dünya tarihinin en büyük ekonomik krizlerinden birinin tetiklendiği dönemde, yenilenebilir enerji kaynaklarını teşvik amaçlı, vergi indirimleri, banka kredileri ve hibeler gibi destekleyici mekanizmaları içeren ilk politikalardan bazıları Amerika Birleşik Devletleri'nde yürürlüğe girmiştir. 1987 yılında ise ozon tabakasını incelten maddelerin üretimini ve kullanımını aşamalı olarak durdurmayı amaçlayan 16 Eylül 1987'de imzalanmış ve Birleşmiş Milletler Çevre Programı (UNEP) tarafından düzenlenen Montreal'deki bir toplantıda kabul edilmiş Montreal Protokolü imzalanmıştır. Zaman içerisinde taraf olan ülkelerin artması ile imzalayan ülke sayısı 197'ye ulaşmıştır ve dünyanın en geniş kapsamlı ve en başarılı çevre anlaşmalarından biri olarak kabul edilen protokol tüm taraflar farklı ozon delici materyaller (ODS) gruplarının aşamalı olarak kaldırılması, ODM ticaretinin kontrolü, verilerin yıllık olarak raporlanması, ODS ithalat ve ihracatını kontrol etmek için ulusal lisanslama sistemleri ve diğer konularla ilgili belirli sorumluluklara sahiptir.

Bu alanda atılan bir diğer önemli adım ise Brezilya'nın Rio de Janeiro kentinde düzenlenen Dünya Zirvesi'nde kabul edilen Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi'dir (UNFCCC). Anlaşmanın, atmosferdeki sera gazı konsantrasyonlarını, iklim sistemine tehlikeli insan müdahalesini önleyecek bir düzeyde sabitlemeyi amaçlamıştır. (Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi, 1992). Yeşil enerjiye hitap eden bir diğer önemli kilometre taşı olan protokol ise Kyoto Protokolü'dür. Sanayileşmiş ülkelerin sera gazı emisyonlarını 1990 seviyelerinin ortalama %5,2 altına düşürmelerini gerektiren Kyoto Protokolü 1997'de kabul edildi. Kyoto Protokolü'nün sanayileşmiş ülkelere ve geçiş ekonomilerine sera gazı (GHG) emisyonlarını kararlaştırılan hedeflere uygun olarak sınırlama ve azaltma yükümlülüğü verdiğini, böylece ülkelerin bu konudaki çabaları için ulaşılması gereken bir nokta sağladığını ve Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi'ni işler hale getirdiğini söyleyebiliriz (Freestone, 2005). Takvimler ilerlerken Avrupa Birliği, dünyanın ilk büyük ölçekli karbon ticareti planı olan Emisyon Ticareti Planını 2005 yılında uyguladı. Şirketlerin birbirleriyle karbon emisyonu izinlerini takas etmelerine izin veren, en büyük karbon piyasalarından biri olarak kabul edilen EU ETS, AB'nin iklim politikalarının temel taşlarından biridir ve karbonu fiyatlandırarak, 2030 yılına kadar sera gazı emisyonlarını 1990 seviyelerine göre %55 azaltma hedefine önemli ölçüde katkı sağlar. (AB Emisyon Ticareti Sistemi (EU-ETS), 2016). Bir diğer dikkate alınması gereken belge ise Kopenhag Mutabakatı, Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi'nin 15. Taraflar Konferansı'nda (COP 15) delegelerin, 18 Aralık 2009'da gerçekleştirilen son genel kurulda dikkate almayı kabul ettikleri bir belgedir.

Tüm büyük ekonomilerin (ilk kez Çin ve diğer büyük gelişmekte olan ülkeler de dahil) açık emisyon taahhütleri sağlaması öngörüldü ancak bağlayıcı taahhütleri olan bir anlaşmaya doğru net bir yol haritası çizilmedi.

2015 yılında ise günümüze kadar olan yeşil enerji ve iklim ilişkili atılmış adımların en önemlilerinden biri olan Paris Antlaşması imzalandı. Küresel sıcaklık artışını 1,5 C^{O} sınırlama hedefi, net 0 hedefleri, ülkelerin kapasiteleri ile uyumlu ulusal katkı beyanları (NDC), bu alandaki finansmana yönelik bağlayıcı yaklaşımlar sergilemesi ve yapılandırılmış süreç takibi ile çok önemli bir anlaşmadır. Fosil yakıt kullanımlarının azaltılmasını, yenilenebilir enerjiye geçişin hızlandırılmasını, yeşil enerji alanındaki yatırımların arttırılmasını teşvik etmesi ile de ön plana çıkmaktadır.Paris Anlaşması'ndan sonraki ilerleyen yıllarda Avrupa Birliği, Avrupa Birliği iklim ve enerji politikasını uygulamak amacıyla yenilenebilir enerji kullanımı, enerji verimliliği ve sera gazı emisyonlarının azaltılması hedeflerini içeren Tüm Avrupalılar için Temiz Enerji Paketini (Avrupa Komisyonu, Tüm Avrupalılar için Temiz Enerji Paketi) 2019 yılında kabul etmiştir. Binalarda enerji performansı, enerji verimliliği, yenilenebilir enerji, elektrik piyasası tasarımı ve Enerji Birliği'nin yönetişim yapısını kapsayan 2021-2030. Bu paket Avrupa Birliği genelinde nihai enerji tüketiminde değiştirilen enerji tüketiminde en az %32 oranında kullanılması hedefini belirlemede ve üye devletlerin 2030 yılına yönelik çabalarına temel teşkil etmektedir. Aynı yıl içerisinde 11 Aralık 2019'da bir strateji ve eylem planı olan Avrupa Yeşil Mutabakatı açıklanmıştır.

Bu plan, Avrupa Birliği'nin 2050 yılına kadar net sıfır hedefine ulaşmasını, çevresel sürdürülebilirliği sağlamasını ve ekonomik büyümeyi yeşil bir şekilde teşvik etmesini amaçlarken, iklim değişikliğiyle mücadeleye yönelik uzun vadeli bir çerçeve sunar ve

enerji ile birçok alanda köklü değişiklikler öngörmektedir. Avrupa Yeşil Mutabakatı Avrupa Birliği'ni sürdürülebilir ve döngüsel bir ekonomiye dönüştürmeyi hedefleyen kapsamlı birçok politika ve aksiyon içerir. Türkiye ve Avrupa'daki birçok politika ve aksiyon planını tetikleyen Paris Anlaşması'nın aksiyona döndürülmesine yönelik kritik bir plandır. Sonraki yıllarda, Yeşil Mutabakatı gerçekleştirmek adına Avrupa Komisyonu, Avrupa İklim Yasası aracılığıyla AB'nin sera gazı emisyonlarını 2030 yılına kadar 1990 seviyelerinin en az %55 altına düşürme hedefini yükseltmeyi önermiştir. Bu mevcut hedefe kıyasla önemli bir artış olup, 2030 İklim Hedef Planı ile en az %40 olan önceki hedeften yukarı doğru bir artıştır (Avrupa Komisyonu, Avrupa Yeşil Mutabakatı'nı Gerçekleştirmek). Ertesi yıl ise Rusya ve Ukrayna arasındaki savaşın neden olduğu küresel enerji arzındaki dalgalanmalara karşın, Avrupa Komisyonu, Rusya'dan fosil yakıt ithalatını aşamalı olarak kaldırmak ve Avrupa'nın enerji bağımlılıklarını ortadan kaldırmak için REPowerEU'yu başlatmıştır (Avrupa Komisyonu, REPowerEU). Takibindeki yıllarda ise Avrupa'nın net sıfır endüstrisinin rekabet gücünü artırmak ve iklim nötrlüğüne geçişi hızlandırmak için Yeşil Mutabakatı Endüstriyel Planı başlatıldı (Avrupa Komisyonu, Yeşil Mutabakatı Endüstriyel Planı) ve Avrupa Komisyonu, 6 Şubat 2024'te AB'nin 2050 iklim nötrlüğü hedefine yönelik geçici bir taahhüt olarak 2040 hedefiyle ilgili tavsiyesini duyurdu. Komisyonun tavsiyesi, 2040 yılına kadar Avrupa Birliği'nin sera gazı emisyonlarında 1990 seviyelerine kıyasla %90'lık bir azalma çağrısında bulunuyor (Avrupa Komisyonu, 2040 İklim Hedefi).

Globalde etkileri geniş olan yeşil enerji politikaları ile ilişkili önde gelen gelişmeleri bu şekilde özetleyebiliriz. Bu alana yönelik çalışmalarda önde gelen politika bilimcilerin yaklaşımları ise aşağıdaki gibidir:

Avrupa Yeşil Mutabakatı kapsamında, güncellenen Yenilenebilir Enerji Direktifi ’ne (RED) göre, AB’de yenilenebilir enerji payının 2030 yılına kadar %42,5’e çıkarılması hedeflenmektedir (Avrupa Komisyonu, 2023). Bu hedefe ulaşmak için yenilenebilir enerjiye geçişin sağlanması gerekmektedir. Yenilenebilir enerji teknolojilerine geçiş, uzun vadede sürdürülebilirlik hedeflerine ulaşmak için gerekli ve uygulanabilirdir (Edenhofer vd., 2013). Ancak bu geçişi sağlamak için yenilenebilir enerji politikalarının geliştirilmesi ve uygulanması için etkili düzenlemeler ve teşvik mekanizmaları sağlamak, gerekli enerji altyapılarını kurmak ve bu alana yatırımları artırmak esastır (Aklin&Urpelainen, 2018). Bu alanda çok sayıda çalışma bulunmaktadır ve yeşil enerji odağında büyük ilerleme kaydedilmiş olsa da kaydedilen ilerleme yeterli değildir (Birol & Investment Bank, 2019). Hatta yenilenebilir enerji büyümesinin 2050 hedeflerine ulaşmak için altı kat hızlanması gerektiği ve bu nedenle etkinleştirici politika ve düzenleyici çerçevelerin ayarlanması gerektiği ileri sürülmektedir. Bu büyüme içinde en yüksek büyümenin, yüksek enerji verimliliği seviyeleriyle desteklenen rüzgar ve güneş fotovoltaik teknolojilerinde olması öngörülmektedir (Gielen vd., 2019). UC San Diego Küresel Politika ve Strateji Okulu'nda Peter Cowhey Küresel Dönüşüm Merkezi Yenilik ve Kamu Politikası Kürsüsü Başkanı olan David G. Victor da sürdürülebilir enerji kaynaklarına geçişi hızlandırmak için enerji sektöründe reform yapılması gerektiğini savunmaktadır. Küresel iklim hedeflerine ulaşmak için uluslararası iş birliğinin kritik öneme sahip olduğunu belirtirken, esnek ve uyarlanabilir stratejiler geliştirmenin önemine dikkat çekmektedir. Çalışmalarına paralel olarak, iklim politikalarının pratik ve uygulanabilir olması ve mevcut ekonomik ve politik koşullarla uyumlu stratejilerin geliştirilmesini savunması gerekliliği savunulmaktadır (Sabel&Victor 2024).

İlgili politikaların ve yenilenebilir enerjiye geçişin adil, sürdürülebilir ve etkili olması ve bu politikaların güçlü yasal çerçevelerle desteklenmesi ve çeşitli sektörlerle bütünleştirilmesi önerilmektedir (Mehling vd., 2017). Bu politikaları savunmak için güçlü yasal çerçevelere duyulan ihtiyaç, dünya çapında etkileri olan iki yakın tarihli olaydan sonra erken kanıtlarda da gözlemlenmiştir. COVID-19 ve Rusya-Ukrayna savaşı, enerji sektörü de dahil olmak üzere küresel ekonomiyi etkilemiştir ve her iki krizin de düşük karbonlu enerji geçişleri için fırsatlar yaratabileceği gözlemlenmiş olsa da erken kanıtlar, daha sürdürülebilir enerji sistemlerine geçişten ziyade mevcut sistemi güçlendirmek için eylemlerde bulunulduğunu göstermektedir (Zakeri vd., 2022). Ancak resim kasvetli olsa da hala umut vardır. Girişimler, uygulanan politikalar ve yapılan iş birlikleri gibi bu değişimde önemli bir rol oynamaktadır. Enerji dönüşümündeki girişimlerin liderliği, yenilikçi ürün ve hizmetleriyle başarılı enerji dönüşümlerine ışık tutmaktadır (Singh vd., 2021).

Globalde gerçekleştirilen politika çalışmaları ve bunlar üzerindeki akademik araştırmalar ile ülkelerin gelişmeleri ilerlerken Türkiye de önemli bir pozisyonda yer almakta ve kendi politika geliştirmelerini ve iyileştirmelerini sürdürmektedir.

Bugün Türkiye, yenilenebilir enerji kurulu gücü açısından küresel olarak 12. sırada yer alırken Avrupa'da 5. sırada yer almaktadır. Jeotermal enerjide lider, hidroelektrik enerjide ise Avrupa'da 2. sıradadır. Ayrıca, rüzgar ve güneş enerjisinin Türkiye'nin toplam elektrik üretimine katkısı %15,5'i aşarak Asya'daki en yüksek payı oluşturmaktadır. Ayrıca, Uluslararası Enerji Ajansı'nın 2022 Yenilenebilir Enerji İstatistikleri'ne göre Türkiye, enerji geri kazanım sistemi yoğunluğunda dünya çapında 2. sırada yer almaktadır. Türkiye'nin yenilenebilir enerji sektöründeki mevcut konumu, zaman içinde sürdürülen çabaların sonucudur. Diğer birçok ülkede olduğu gibi,

Türkiye'deki enerji sektörü de diğer sektörlerle karşılaştırıldığında sera gazı emisyonlarına en fazla katkıda bulunan sektördür.

Bu sebeple, Türkiye, sera gazı (GHG) emisyonlarını azaltma ve yabancı enerji kaynaklarına olan bağımlılığı azaltma stratejisinin bir parçası olarak yenilenebilir enerji sektörüne yatırımlara öncelik vermiştir. Ülkenin 2030 yılına yönelik temel enerji sektörü azaltma politikası, fizibilite, piyasa dinamikleri ve enerji güvenliğini göz önünde bulundurarak enerji verimliliğini ve yenilenebilir enerji potansiyelinden tam olarak yararlanmayı amaçlamaktadır. Yenilenebilir Enerji Kaynakları Destekleme Mekanizması (YEKDEM) ve Yenilenebilir Enerji Kaynak Alanları Yönetmeliği (YEKA) gibi girişimler, özellikle rüzgar ve güneş enerjisi olmak üzere yenilenebilir enerji kaynaklarına yapılan yatırımların hızlanmasında önemli bir rol oynamıştır. Ayrıca, binalarda ve sanayide enerji verimliliğini artırmak için çeşitli politikalar ve düzenlemeler uygulanmıştır. Bu yatırımlar ve politika önlemleri sayesinde, Türkiye'nin toplam kurulu yenilenebilir enerji kapasitesi artık 29.578,99 MW'a ulaşmıştır. Bunun %41,7'si güneş, %24,6'sı rüzgar, %21,6'sı hidroelektrik ve kalan %12'si biyokütle, jeotermal ve diğer yenilenebilir kaynaklardan gelmektedir. Ülke ayrıca bir hidrojen enerjisi yol haritası ve ulusal bir enerji planı da geliştirmiştir. (Türkiye Cumhuriyeti, Çevre, Şehirleşme ve İklim Değişikliği Bakanlığı, 2022). Bu alandaki gelişmeyi tam olarak anlayabilmek, yenilenebilir kaynakların kullanımının bir asırdan fazla süredir devam ettiği Türkiye'deki yenilenebilir enerji tarihine bakmak faydalıdır.Türkiye, elverişli coğrafi konumu nedeniyle yenilenebilir enerji kaynaklarındaki önemli potansiyeli ile tanınmaktadır. Ülke, subtropikal bir iklimden yararlanmaktadır ve sıcak bir iklim kuşağında yer almaktadır.

Üç tarafı denizlerle çevrili ve iklimi ve hava modellerini etkileyen dağlarla çevrili olan Türkiye'nin çeşitli arazi şekilleri, yenilenebilir enerji için mükemmel kapasitesine katkıda bulunmaktadır. Bu doğal avantajlar göz önüne alındığında, yenilenebilir enerjinin geliştirilmesi neredeyse kaçınılmazdı (Ediger & Kentel, 1999). Yolculuk, 1902'de Osmanlı İmparatorluğu döneminde 88 kW kapasiteli ilk küçük hidroelektrik santralinin kurulmasıyla başladı. Daha sonra, 1929 yılında Türkiye Cumhuriyeti, 1 MW kapasiteli Visera santrali olarak bilinen ilk hidroelektrik santralini Trabzon'da kurdu (Taşdemiroğlu, 1993; Erkaya, 2002; Sen, 2002). 2023 yılı itibarıyla Türkiye'nin hidroelektrik santral kapasitesi 31.680 MW'a ulaşmış olup, yıllık üretim potansiyeli 66.980 GWh'dir (Devlet Su İşleri Genel Müdürlüğü, 2023). Hidroelektrik enerjinin ardından, jeotermal enerji 1963 yılında İzmir'de ilk jeotermal sondajın açılmasıyla kullanılmaya başlandı. İlk jeotermal santral daha sonra 1984 yılında Denizli'de kuruldu (Atalay, 2004). Güneş enerjisi, 1975 yılında güneş enerjili su ısıtıcılarının üretimiyle ilk kez ortaya çıktı (Enerji Ekonomisi, 2019) ve Türkiye'nin ilk güneş enerjisi santrali 2011 yılında İstanbul'da açıldı (Yeşil Ekonomi, 2018). Rüzgar enerjisi de 1986 yılında İzmir'de bir rüzgar türbini tarafından ilk kez elektrik üretildiğinde sahneye çıktı. İlk rüzgar enerjisi santrali 1998 yılında yine İzmir'de kuruldu (Pınar vd., 2019). Türkiye'deki biyokütle gibi diğer yenilenebilir enerji kaynaklarının da uzun bir geçmişi vardır. Örneğin, biyokütlenin enerji için kullanımı Türkiye'de çok eski zamanlara, özellikle de tezek yakma yoluyla, dayanır. Ancak, ilk profesyonel biyokütle enerji santrali 2016 yılına kadar Balıkesir'de kurulmadı. Hidrojen ve dalga enerjisi gibi diğer potansiyel yenilenebilir kaynaklar üzerinde çalışmalar devam etse de Türkiye bu alanlarda henüz operasyonel enerji üretim tesisleri kurmadı. 2024 yılı Haziran ayı sonu itibarıyla Türkiye'nin kurulu gücü 107.594 MW'a ulaşmıştır.

Türkiye’nin yenilenebilir enerjisine ilişkin tarihi bu şekilde ilerlemeye devam ederken yenilenebilir bu tarihin bir parçası ve tezin odak konusu olan yenilenebilir enerji startuplarına da değinmek gerekir. Yapılan kapsamlı akademik ve çevrimiçi araştırmalara rağmen, Türkiye'deki yenilenebilir enerji girişimlerinin kapsamlı bir tarihsel genel görünümü hala belirsizliğini korumaktadır. Ancak araştırmamız, yenilenebilir enerji sektöründeki en erken kayda değer özel yatırımın 1991 yılında kurulan Aydem Enerji tarafından yapıldığını ortaya koymaktadır. Bu şirket, 1995 yılında Türkiye'nin ilk özel mülkiyetli hidroelektrik santrali olan Bereket'in geliştirilmesine başlayarak sektöre öncülük etmede etkili olmuş ve santral 1997 yılında faaliyete geçmiştir. 1990 yılında kurulan Altıntaş Isı da ilgili veri tabanlarında listelenmesine rağmen, yenilenebilir enerjiye ilişkin yaptığı herhangi bir atılıma erişilememiştir.

Günümüzde ise Türkiye’de yeşil enerji odağında çalışan birçok yenilenebilir enerji startup’ı bulunmaktadır. Bu startupları etkileyebilecek birçok yasa ve politika bulunmaktadır. Türkiye 2005’ten bu yana yenilenebilir enerjiyi etkileyebilecek yasa ve politikalar geliştirmektedir. Günümüzde geliştirdiği yasaların ve politikaların sonucunda temel oluşturan çalışmalar aşağıdaki şekilde özetlenebilir:

Temel Mevzuat	Amaç ve Kapsamı
Elektrik Piyasası Kanunu (Kanun No 6446)	Elektriğin yeterli, kaliteli, sürekli, düşük maliyetli ve çevreyle uyumlu bir şekilde tüketicilerin kullanımına sunulması için, rekabet ortamında özel hukuk hükümlerine göre faaliyet gösteren, mali açıdan güçlü, istikrarlı ve şeffaf bir elektrik enerjisi piyasasının oluşturulması ve bu piyasada bağımsız bir

	düzenleme ve denetimin yapılmasının sağlanması amaçlanmaktadır
Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Amaçlı Kullanımına İlişkin Kanun (Kanun No 5346)	Yenilenebilir enerji kaynaklarının elektrik enerjisi üretimi amaçlı kullanımının yaygınlaştırılması, bu kaynakların güvenilir, ekonomik ve kaliteli biçimde ekonomiye kazandırılması, kaynak çeşitliliğinin artırılması, sera gazı emisyonlarının azaltılması, atıkların değerlendirilmesi, çevrenin korunması ve bu amaçların gerçekleştirilmesinde ihtiyaç duyulan imalat sektörünün geliştirilmesi amaçlanmaktadır
Enerji Verimliliği Kanunu (Kanun No 5627)	Enerjinin etkin kullanılması, israfının önlenmesi, enerji maliyetlerinin ekonomi üzerindeki yükünün hafifletilmesi ve çevrenin korunması için enerji kaynaklarının ve enerjinin kullanımında verimliliğin artırılması amaçlanmaktadır.
Yenilenebilir Enerji Kaynaklarının Belgelendirilmesi ve Desteklenmesine İlişkin Yönetmelik	Yenilenebilir enerji kaynaklarına dayalı elektrik enerjisi üretiminin teşvik edilmesi; üretim lisansı sahibi tüzel kişilere yenilenebilir enerji kaynaklarına dayalı üretim tesisleri için Yenilenebilir Enerji Kaynak Belgesi verilmesi amaçlanmaktadır.
Yenilenebilir Enerji Kaynak Alanları Yönetmeliği	Kamu ve hazine taşınmazları ile özel mülkiyete konu taşınmazlarda büyük ölçekli yenilenebilir enerji kaynak alanları (YEKA) oluşturulması, yenilenebilir enerji kaynaklarına dayalı elektrik enerjisi üretim tesislerinde

	kullanılan ileri teknoloji içeren aksamın yurt içinde üretilmesi amaçlanmaktadır.
Elektrik Piyasası Lisans Yönetmeliği	Elektrik piyasasındaki önlisans ve lisanslandırma uygulamalarına ilişkin usul ve esaslar ile önlisans ve lisans sahiplerinin hak ve yükümlülüklerinin belirlenmesi amaçlanmaktadır.
Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliği	Tüketicilerin elektrik ihtiyaçlarını kendi üretim tesisinden karşılaması, arz güvenliğinin sağlanmasında küçük ölçekli üretim tesislerinin ülke ekonomisine kazandırılması ve küçük ölçekli üretim kaynaklarının etkin kullanımının sağlanması; elektrik enerjisi üretebilecek, gerçek veya tüzel kişilere uygulanacak usul ve esasların belirlenmesi amaçlanmaktadır.
Elektrik Üretim ve Elektrik Depolama Tesisleri Kabul Yönetmeliği	Elektrik üretim ve elektrik depolama tesislerinin kabul işlemlerinin ilgili mevzuat ve standartlara uygun olarak yapılması; tesislerin iletim veya dağıtım şebekelerine uyumlu olarak bağlanması ile kabul işlemleri yetkisine ilişkin usul ve esasların belirlenmesi amaçlanmaktadır
Elektrik Piyasasında Yenilenebilir Enerji Kaynak Garanti Belgesi Yönetmeliği	Elektrik üretimi ve tüketiminde yenilenebilir enerji kaynaklarının kullanımının yaygınlaştırılması ve çevrenin korunması amaçlarıyla tüketicilere tedarik edilen elektrik enerjisinin belirli bir miktarının veya oranının, lisans sahibi tüzel kişiler tarafından yenilenebilir enerji kaynaklarından üretildiğinin takip, ispat ve ifşa edilmesi ile tüketicilere yenilenebilir enerji kaynaklarından üretilen elektrik

	enerjisinin belgelendirilmek suretiyle tedarik edilmesine imkân sağlayan bir yenilenebilir enerji kaynak garanti sisteminin oluşturulması ve bu sistemin ayrım gözetmeyen, objektif, şeffaf bir şekilde işletilmesine ilişkin usul ve esasların belirlenmesi amaçlanmaktadır.
Elektrik Piyasasında Depolama Faaliyetleri Yönetmeliği	14/3/2013 tarihli ve 6446 sayılı Elektrik Piyasası Kanunu kapsamında, elektrik depolama üniteleri veya tesislerinin kurulmaları, iletim veya dağıtım sistemine bağlanmaları ile bu ünite veya tesislerin piyasa faaliyetlerinde kullanılmalarına ilişkin usul ve esasların belirlenmesi amaçlanmaktadır.

Kaynak:İklim Değişikliği Azaltım Stratejisi ve Eylem Planı

Politika Belgeleri	Amaçlar ve Hedefler
12. Kalkınma Planı (2024-2028)	Enerjinin sürekli, kaliteli, sürdürülebilir, güvenli ve karşılanabilir maliyetlerle arzını, enerji temininde kaynak çeşitlendirmesini ve 2053 yılı net sıfır emisyon hedefini esas alarak yerli ve yenilenebilir enerji kaynaklarını değerlendirerek enerjide kendine yeterliliğini en üst seviyeye yükselten, nükleer teknolojiyi elektrik üretiminde kullanan, enerji verimliliğini artıran, enerji teknolojilerinde yerlileşmeyi önceleyen, yeni teknolojileri entegre eden, uluslararası enerji ticaretinde stratejik konumumuzu güçlendiren rekabetçi bir yapıya ulaşılması temel amaçtır. Kalkınma planı kapsamında aşağıdaki tedbirler yer almaktadır: Enerjinin her alanda verimli kullanımına yönelik çalışmalar sürdürülecektir. Akkuyu Nükleer Güç Santrali (NGS) bütün üniteleri ile elektrik üretimine başlayacaktır. Nükleer santral kurulu gücünün artırılmasına yönelik çalışmalara devam edilecektir. Küçük modüler reaktörler, füzyon teknolojileri ve ileri nesil reaktörler gibi yeni teknolojilere yönelik çalışmalar yapılacaktır. 2053 yılı net sıfır emisyon hedefi kapsamında artan elektrifikasyonun daha temiz kaynaklarla karşılanması amacıyla yenilenebilir enerji kaynaklı elektrik üretimi artırılacak ve şebekeye entegrasyonu sağlanacaktır. Yerli aksam yükümlülüğü olan yeni Yenilenebilir Enerji Kaynak Alanları (YEKA) ihaleleri yapılacak, deniz üstü YEKA projeleri geliştirilmesine yönelik çalışmalar yürütülecektir. Elektrik şebekelerinin, potansiyel yenilenebilir kaynak alanları ile yenilenebilir

	enerji ve elektrikli araçların gelişim hızı da dikkate alınarak geliştirilmesine yönelik planlama ve yatırım çalışmaları yürütülecektir. Kesintili yenilenebilir enerji kaynaklarından sağlanan üretimin şebeke üzerinde oluşturduğu olumsuz etkilerin azaltılması amacıyla elektrik şebekelerinin esnekliği artırılacaktır. Pompaj depolamalı HES'ler de dâhil olmak üzere enerji depolama sistemleri tesis edilecektir. Yeşil hidrojen üretiminin sağlanabilmesi için yerli elektrolizör geliştirilmesine yönelik çalışmalar yapılacaktır. Hidrojenin taşınmasına ve depolanmasına yönelik Ar-Ge çalışmaları sürdürülecektir. Enerji sektöründe ihtiyaç duyulan nitelikli personel sayısının artırılmasına yönelik çalışmalar yürütülecektir.
NDC 2023	NDC belgesinde enerji sektörü ile ilgili yer alan politikalar şunlardır: Enerji verimliliği ve yenilenebilir enerji potansiyelinden mümkün olan en üst düzeyde faydalanılacak; 33 GW güneş enerjisi kurulu güç kapasitesine, 18 GW rüzgar enerjisi kurulu güç kapasitesine, 35 GW hidroelektrik kurulu güç kapasitesine ve 4,8 GW nükleer kurulu güç kapasitesine ulaşılacak; 2,1 GW batarya ve 1,9 GW elektrolizör kapasitesine ulaşılacak; yenilenebilir enerji kaynaklarının birincil enerji tüketimindeki payı 2030 yılına kadar %20,4'e çıkarılacak; birincil enerji yoğunluğu 2030 yılında 0,113 TEP/bin $2015 ve nihai enerji yoğunluğu 0,08 TEP/bin $2015 olacak; emisyon yoğun sektörlerde azaltım araçlarından olan Emisyon Ticaret Sistemi kurulacaktır.

Ulusal Enerji Verimliliği Eylem Planı (2017-2023)	Kojenerasyon ve bölgesel ısıtma-soğutma sistemlerinin potansiyelinin belirlenmesi ve yol haritası hazırlanacak; tüketiciye kıyaslanabilir ve daha detaylı bir fatura bilgisi sunulacak, ölçüm bilgisinin akıllı yönetimi için enerji veri platformu oluşturulacak; akıllı sayaçlar yaygınlaştırılacak; transformatörlerde asgari performans standartları uygulanacak; genel aydınlatmada enerji verimliliği artırılacak; elektrik iletim ve dağıtım faaliyetleri verimlilik artışının geliştirilecek; mevcut elektrik üretim santrallerinde verimliliği artırılacak; talep tarafı katılımı (demand side response) uygulaması için piyasa altyapısı oluşturulacaktır.
Enerji Verimliliği Strateji Belgesi (2012-2023)	Elektrik üretim, iletim ve dağıtımında verimliliği artıracak; enerji kayıplarını ve zararlı çevre emisyonları azaltılacak; 2023 yılına kadar, ülke genelindeki kömürlü termik santrallerin atık ısı geri kazanımı dahil ortalama toplam çevrim verimleri %45 üzerine çıkarılacaktır. 2023 yılına kadar, elektrik enerjisi yoğunluğunu en az %20 azaltmak amacıyla talep tarafı yönetimi konusunda tedbirler geliştirilecektir.
Türkiye Ulusal Enerji Planı (2022)	2035 yılına kadar: Birincil enerji tüketimi 205,3 mtep, Elektrik tüketimi 510,4 TWh olacaktır. Elektrik / nihai enerji tüketimi payı %24,9 olacaktır. Enerji yoğunluğu %35,3 azaltılacaktır. Elektrik kurulu güç 189,7 GW (52,9 Güneş, 29,6 Rüzgar, Nükleer 7,2) ve ilave kurulu güç 96,9 GW olacaktır. Yenilenebilir enerji toplam elektrik üretimininde %54,7 ve kurulu güç olarak %64,7'ye ulaşacaktır. Batarya (7,5 GW), elektrolizör (5 GW), Talep tarafı (1,7 GW) kurulu gücü oluşturulacaktır.

Türkiye Hidrojen Teknolojileri Stratejisi ve Yol Haritası	Yerli ve milli teknolojileri temel alarak, yeşil hidrojenin üretiminden son kullanımına kadar etkin bir değer zinciri oluşturmak ve 2053 Net Sıfır hedefine katkı sağlamak amaçlanmaktadır. Bu kapsamda; yeşil hidrojen üretim maliyetini 2035 yılında 2,4 ABD doları/kgH_2 ve 2053'e kadar 1,2 ABD doları/kgH_2 altına düşürmek ve elektrolizör kurulu güç kapasitesinin 2030 yılında 2 GW, 2035 yılında 5 GW ve 2053 yılında 70 GW'a ulaşmasını sağlamak hedeflenmektedir.
Ulusal İklim Değişikliği Strateji Belgesi (2010-2020)	Yenilenebilir enerji kaynaklarının enerji arz güvenliği ve iklim değişikliği konuları göz önünde bulundurularak finansman (iç ve dış) imkanları çerçevesinde temiz üretim teknoloji ve tekniklerinin en üst düzeyde kullanılacak; Sıfır emisyon teknolojilerinin kullanımın özendirilecek ve Ar-Ge çalışmalarının desteklenecektir. Mevcut termik santrallerinin iyileştirilmesinin tamamlanacak; alternatif yakıtlar için ekonomik araçlar geliştirilecektir.
İklim Değişikliği Eylem Planı (2011-2023)	Enerji yoğunluğu düşürülecek; temiz enerjinin üretim ve kullanımdaki payı artırılacak; temiz kömür teknolojileri ve verimlilik artırıcı önlemler uygulanarak elektrik üretiminde kömür kullanımından kaynaklanan sera gazı emisyonları sınırlandırılacak; elektrik dağıtımında kayıp ve kaçaklar azaltılacaktır.

İklim Şurası (2022)	Yenilenebilir enerji desteklenmeye devam edilecek ve sistem altyapısı gerek üretim gerekse öz tüketim için daha esnek hale getirilecek ve tüm amaçlar için Ar-Ge ile destek mekanizmaları geliştirilecektir; 2053 NSE hedefi doğrultusunda elektrik üretimi kaynaklı emisyonların azaltılması için yol haritası ve alternatif yakıt kullanımının değerlendirilmesi doğalgaz arama ve üretim faaliyetlerinin, iletim altyapılarının geliştirilmesi; atık ısının kullanımının teşvik edilmesi ve ısıtma-soğutmada ısı pompası, bölgesel ısınma ve güneş kollektörlü uygulamaların yaygınlaştırılması; kömürden elektrik üretiminde karbon yakalama, kullanım ve depolama teknolojilerinin de değerlendirileceği şekilde elektrik üretimi kaynaklı emisyonun düşürülmesi; enerji sektörünün dönüşümü için eğitim, yeşil istihdam, dijital dönüşüm, depolama ve talep bazlı uygulamaların artırılması sağlanacaktır.

Kaynak: İklim Değişikliği Azaltım Stratejisi ve Eylem Planı

Özetin devam eden bölümünde, araştırma sürecinin omurgasını oluşturan araştırma tasarımı, etik, veri toplama, veri analizi, sınırlamalar ve güvenilirliği kapsayan çalışmada kullanılan metodoloji özetlenmektedir.

Çalışma, Türkiye'deki yenilenebilir enerji girişimleri üzerindeki yeşil enerji politikalarının etkilerini araştırmaktadır ve nitel araştırma yöntemlerini uygun bir eşleşme haline getirmektedir. Tümevarımsal yapıları göz önüne alındığında, bu yöntemler yeni ortaya çıkan olguları incelemek ve gelecekteki araştırmalara rehberlik edebilecek hipotezler oluşturmak için oldukça uygundur (Creswell, 2003). Creswell (2014) tarafından tanımlanan nitel araştırma, farklı metodolojik gelenekler aracılığıyla

sosyal veya insani sorunları anlamaya yönelik bir sorgulama sürecidir. Bütünsel ve karmaşık bir resim oluşturur, kelimeleri analiz eder, ayrıntılı bilgiler raporlar ve doğal bir ortamda yürütülür. Bu bakış açısından, yenilenebilir enerji girişim kurucularının ve yöneticilerinin yeşil enerji politikalarının kendileri üzerindeki etkisine ilişkin tutumlarını ve düşüncelerini keşfetmek için bir araç olarak yarı yapılandırılmış görüşmeler seçilmiştir.

Araştırma tasarımı, Türkiye'deki yenilenebilir enerji girişimlerinin deneyimlerine odaklanan yorumlayıcı fenomenoloji ile tümevarımsal muhakemeye dayanmaktadır. Bu yaklaşım, Creswell'in araştırma tasarımının geniş varsayımlardan ayrıntılı veri toplama ve analiz yöntemlerine kadar uzanan kararları içerdiği görüşüyle tutarlıdır (Creswell, 2014). Bu çalışmada, verilerden ortaya çıkan temaları ortaya çıkarmak için yorumlayıcı ve refleksif tematik analiz yöntemleri kullanılmıştır. Bu iki yöntemi birlikte kullanmanın amacı, teorik çerçevenin araştırmacı tarafından yapılan çıkarımlarla kesiştiği kompakt bir analiz sunmaktır (Smith vd., 2009; Braun ve Clarke, 2006). Kesin sonuçlar yerine olasılıksal sonuçlar sunması bakımından tümdengelimli akıl yürütmeden farklı olan tümevarımsal akıl yürütme, özellikle startup temsilcilerinin deneyimlerine ve gözlemlerine dayalı olarak yeşil enerji politikalarının etkilerini keşfetmek için uygundur (Sauce ve Matzel, 2017). Bu veri odaklı, aşağıdan yukarıya yaklaşım, yarı yapılandırılmış görüşmelerden içgörüler elde etme amacına uygundur.

Yorumlayıcı Fenomenoloji Analizi (IPA), bireysel deneyimlerin derinlemesine anlaşılmasını sağlama ve bunların ardındaki anlamları ortaya çıkarma kapasitesi nedeniyle seçildi.

Altı adımı içeren bu yöntem -Okuma ve Tekrar Okuma, İlk Not Alma, Ortaya Çıkan Temaları Geliştirme, Bağlantıları Arama, Bir Sonraki Vakaya Geçme ve Vakalar Arasında Desenleri Arama- veri analizine uygulandı (Smith ve diğerleri, 2009; Engward ve Goldspink, 2020). IPA'ya ek olarak nitel araştırmalarda sıklıkla kullanılan tematik analiz, verilerdeki tekrar eden temaları belirlemek ve bunların anlamlarını ve karşılıklı ilişkilerini incelemek için kullanıldı (Patton, 2002). Verilerdeki öznel ve nesnel unsurları dikkate alarak daha zengin bir anlayış sağlamak için hem yorumlayıcı temalama hem de refleksif temalama kullanıldı. Yorumlayıcı temalama, verilerdeki önemli kalıpları veya fikirleri ortaya çıkarmaya odaklanırken, refleksif temalama araştırmacının kişisel deneyimlerini ve bakış açılarını içermede ve böylece analiz sürecinin derinliğini, esnekliğini ve güvenilirliğini artırmada katkı sağladı (Braun & Clarke, 2006; Creswell & Poth, 2017; King, 2004; Fereday & Muir-Cochrane, 2006).

Örnekleme prosedürü, yeşil enerji politikalarının etkilerini deneyimleyebilecek yenilenebilir enerji girişimlerinin temsili bir örneğine ulaşmak için hem amaçlı hem de kartopu örnekleme yöntemlerini içeriyordu. Amaçlı örnekleme, ilgili bilgilere sahip kişileri kasıtlı olarak seçmek için kullanılırken, kartopu örneklemesi, ilk deneklerden referanslar alarak örneği genişletmeye yardımcı oldu. Sonunda on altı yenilenebilir enerji girişimi seçildi ve katılımcılar çeşitli şehirleri, enerji türlerini, cinsiyetleri, deneyimleri ve eğitim seviyelerini temsil etti. Gizliliği korumak için katılımcıların isimleri anonimleştirildi ve çalışma boyunca kimlik numaralarıyla anıldı. Katılımcılarla yapılan görüşmelerde kullanılan mülakat soruları, yeşil enerji politikaları ve yenilenebilir enerji girişimleri hakkındaki ilgili literatürün rehberliğinde aşamalar halinde geliştirildi. Mülakat kılavuzu, alakalılığını ve uygulanabilirliğini sağlamak için uzman değerlendirmesi ve saha testleri kullanılarak test edildi.

İki akademisyenden alınan geri bildirimler, daha sonra gerçek mülakat durumlarında test edilen mülakat kılavuzunun iyileştirilerek son halini almasını sağladı. Veri toplama, profesyonel çevrimiçi platformlar, mail ve telefon aracılığıyla iletişime geçilen startup temsilcilerinin müsaitliğine göre düzenlenen çevrimiçi toplantılarla, gerçekleştirildi. Katılımcılar gönüllü katılım formunu doldurduktan sonra yarı yapılandırılmış mülakatlar yürütüldü ve doğal bir konuşma akışını sürdürmek için soruların sırası ve içeriğinde esneklik sağlandı. Verileri toplamak ve yazıya dökmek için video kaydı ve ses transkripsiyon teknolojileri kullanıldı.

Veri analizi süreci birkaç temel adım etrafında esas alınarak yapıldı: verileri analize hazırlama, araştırmacıyı analize hazırlama, verileri kodlama ve verileri temalandırma. Hazırlık aşaması, mülakatlardan gelen ham verileri kaydetmeyi, yazıya dökmeyi ve verinin temizlenmesini içeriyordu. Bu otomatik transkripsiyon ve takibinde manuel düzenleme süreci, araştırmacının verileri derinlemesine tanımasını sağladı ve transkriptleri tamamlanmış mülakatları kodlanmaya hazır hale getirdi. Araştırmacı analize hazırlanırken, tekrarlanan veri incelemesinden yeni içgörüler ortaya çıktıkça süreç boyunca gelişen bir kod listesi şekillendi. Verilerden yüksek düzeyde verimlilik elde etmek için içerik kodlama, tanımlayıcı kodlama ve alt kodlama gibi çeşitli kodlama stratejileriyle birlikte a priori ve a posteriori kodlama yöntemlerinin bir kombinasyonu kullanıldı. Verileri kodlarken, MAXQDA nitel analiz programı tarafından kolaylaştırılan eş zamanlı kodlama ve bütünsel kodlama yöntemleri kullanıldı. Birinci döngü kodlama ve alt kodlama yöntemleri yapısal analiz sağlarken, yorumlayıcı ve refleksif kodlama yöntemleri tematik derinlik ve şeffaflık sundu.

Bu yöntem kombinasyonu, verilerin kapsamlı bir şekilde analiz edilmesini sağlayarak politika motivasyonu, küresel eğilimler, ekonomik koşullar, iş stratejileri ve daha fazlası dahil olmak üzere birkaç temel kodun ortaya çıkmasına yol açtı. Son olarak, verilerin temalandırılması süreci yorumlayıcı ve refleksif temalandırma yöntemlerinin kullanımını içeriyordu. Yorumlayıcı temalandırma, verileri tematik ve kavramsal düzeyde incelemek için kullanıldı ve yeşil enerji politikalarının yenilenebilir enerji girişimleri üzerindeki etkisinin ayrıntılı bir şekilde incelenmesine olanak sağladı. Öte yandan, refleksif temalandırma, araştırmacının öznel etkilerini ve bakış açılarını dahil etmeyi, analizin şeffaflığını ve geçerliliğini artırmayı içeriyordu. Her iki yöntemin kullanımı, verilerin çok boyutlu ve kapsamlı bir analizini sağladı ve çalışmanın hedefleriyle ilgili anlamlı ve güvenilir temaların belirlenmesiyle sonuçlandı. Çalışma araştırmanın doğası olarak sınırlamalar içermektedir. Çalışmanın birincil sınırlaması, Türkiye'de yeşil enerji politikası geliştirmenin nispeten erken bir aşamada olmasıdır. Ancak, titiz araştırma tasarımı, ayrıntılı veri analizi ve öznel etkilerin dikkatli bir şekilde değerlendirilmesinin birleşimi, bulguların yeşil enerji politikalarının ülkedeki yenilenebilir enerji girişimleri üzerindeki etkilerine ilişkin değerli içgörüler sunmasını sağlar. Bunun yanı sıra, bir diğer olası sınırlama, yorumlayıcı fenomenoloji ve yorumlayıcı kodlama gibi seçilen yöntemlerin öznellik çerçevesinde çalışma çıktılarını büyük ölçüde etkilemiş olabileceğidir. Ancak yine de diğer araştırmacıların aynı veriler ve farklı yöntemlerle çeşitli ve farklı yorumlara varabileceği unutulmamalıdır. Son olarak bir diğer sınırlılık, çalışmanın araştırmacının erişebildiği alanda küçük bir örneklem grubu ile yürütülmüş olmasıdır ki bu da nitel çalışmaların potansiyel bir sınırlılığıdır.

Ancak bu araştırma sınırlamasının etkilerini en aza indirmek için kartopu örnekleme ile erişilebilen girişim profili genişletilmiş ve 6 farklı şehirden 3 farklı eğitim düzeyine sahip katılımcılardan ve yazılım ve donanım geliştiren 5 farklı yenilenebilir enerji dikey girişiminden veriler elde edilmiştir. Elde edilen verilerin analizinin sonuçları bulgular bölümünde paylaşılmaktadır. Analiz, ortaya çıkan temalar etrafında yapılandırılmıştır: Hükümet ve Politika Etkileşimi, Finansal Sürdürülebilirlik, Piyasa Dinamikleri ve İşletme Operasyonları, Küresel Trendler ve Ülke Ekonomik Koşulları ve Teknoloji. Bulgulara yaklaşım, her bir temayı açıklamayı, temel noktaları göstermek için katılımcılardan doğrudan alıntılar kullanmayı ve araştırmacının düşüncelerini sunmayı içermektedir. Hükümet ve Politika Etkileşimi teması, yeşil enerji politikalarının düzenlemelerinin ve mevzuatının kısıtlayıcı mı yoksa teşvik edici mi olduğu sorusunu ele almaktadır. Bu tema 3 ana odakta anlatılmaktadır: politika uygulama, politika geliştirme ve politika motivasyonu. Katılımcılar, özellikle belirsizlik, düzenleyici zorluklar ve bürokratik gecikmeler konusunda politika uygulamaları konusunda önemli endişeler dile getirmişlerdir. Birçok girişim, belirsiz veya var olmayan politikalar nedeniyle stres yaşamakta ve 17 katılımcıdan 15'i bu nedenle yaşadıkları zorlukları dile getirmektedir. Örnekler arasında hidrojen altyapısını işaret eden ilgili zorluklar ve ilerlemeyi engelleyen yavaş bürokratik süreçler de yer almaktadır. Politika geliştirme alanında, çalışma girişimcilerin politika formülasyonuna nasıl dahil olduklarını ve iyileştirme önerilerini araştırmaktadır. Bazı katılımcılar görüşlerinin dikkate alındığını kabul etseler de hükümet organlarının onlara ulaşma ya da girişimlerin sürece dahil edilmeleri olumsuz deneyimlerini paylaşmaktadırlar.

Araştırmacıların düşünceleri, hızla gelişen yenilenebilir enerji pazarına ayak uydurmak için daha çevik ve duyarlı politika geliştirmeye duyulan ihtiyacı vurgulamaktadır. Politika motivasyonunu incelerken, araştırma, girişim kuruluş aşaması ve ürün geliştirme aşaması sırasında politikaların etkisini birbirinden ayırır. Bulgular, yeşil enerji politikalarının girişimler üzerinde kuruluş aşamasında sınırlı bir motivasyon etkisine sahip olduğunu, 17 girişimden yalnızca ikisinin bu politikaları temel bir itici güç olarak gösterdiğini ortaya koymaktadır. Ancak, ürün geliştirme aşamasında, Avrupa Yeşil Mutabakatı ve Paris İklim Anlaşması gibi politikalar ve politikaların Türkiye'de tetiklediği politika gelişmeleri, daha örtük olsa da bir miktar motivasyon sağlamıştır. Araştırmacı, genel girişimcilik politikalarının açık bir motive edici etkiye sahip olmasına karşın, yeşil enerji politikalarının etkisinin daha az belirgin olduğunu belirtmektedir. Özetle, bulgular Türkiye'deki yeşil enerji politikalarının olumlu yönleri olmasına karşın, araştırmaya katılan girişim temsilcileri tarafında var olan gelişmelerin olumlu sinyaller olarak karşılandığı ancak güncel durumun belirsiz, kısıtlayıcı ve uygulanması yavaş olarak algılandığını göstermektedir. Girişimciler, paydaşlarla iş birliği içinde geliştirilen daha şeffaf ve destekleyici politikalar için bir istek ifade etmektedir. Araştırma, yalnızca teşvik edici değil, aynı zamanda çevik ve yenilenebilir enerji sektöründeki girişimlerin ihtiyaçlarına duyarlı politikalar oluşturmanın önemini vurgulamaktadır. Girişimlerin finansal sürdürülebildiklerin incelemek istediğimizde ise canlı organizmalar gibi girişimlerin de doğum, büyüme ve satın alma veya birleşme yoluyla potansiyel düşüş veya dönüşüm aşamalarını içeren bir yaşam döngüsü yaşadıklarını gözlemleyebiliriz. Özellikle finansal sürdürülebilirliği ulaşmada birçok zorlukla karşılaşırlar. Yenilenebilir enerji gibi çoğunlukla donanım teknolojileriyle uğraşan girişimler için bu zorluklar belirgindir.

Önemli araştırma ve geliştirme (Ar-Ge) harcamaları, hızla kâr elde edilmeden uzun süreli finansal harcamalarla birleştiğinde, girişimleri genellikle "ölüm vadisi" olarak tanımlanan yerden çıkamamasına neden olmaktadır. Bu birçok yenilenebilir enerji girişiminin büyüme ve olgunluğa ulaşamadığı kritik bir aşamadır. Sonuç olarak, girişimler bu zor dönemde yol almak için risk sermayesi, kitle fonlaması, hibeler ve iade edilebilir teşvikler dahil olmak üzere çeşitli finansman yolları ararlar. Bulguların devamında, yenilenebilir enerji girişimlerinin fonlara nasıl eriştiğini, maliyetleri nasıl yönettiğini ve yeşil enerji politikalarının yeterli finansal teşvikler sağlayıp sağlamadığını nasıl değerlendirdiğini paylaşılmaktadır. Finansman arayışı, yenilenebilir enerji girişimleri için temel bir endişe kaynağıdır. Ana kaynaklar arasında devlet hibeleri, risk sermayesi, banka kredileri ve yabancı programlar yer almaktadır. Röportajlar bu finansman kanallarıyla ilgili karışık deneyimler ortaya koymaktadır. TÜBİTAK ve KOSGEB gibi kaynaklardan gelen hükümet hibelerine girişimciler tarafından değer verilmektedir. Ancak girişimciler, özellikle artan maliyetler ve ekonomik dalgalanmalarla karşı karşıya kaldıklarında, bu hibeleri genellikle yetersiz bulmaktadır. Risk sermayesi, ortaklıklar ve artan görünürlük için fırsatlar sunar, ancak girişimciler Türkiye'de erken aşama yatırımları için düzenleme ve destek eksikliğine dikkat çekmektedir. Yenilenebilir enerji projeleri için banka kredileri elde etmek zordur ve birçok girişim bunları yetersiz veya erişilemez bulmaktadır. Buna karşılık, Avrupa programlarının daha yeterli destek ve fırsatlar sunarak, çoğunlukla finansal istikrar arayan girişimler için daha faydalı olduğuna dikkat çekilmektedir. Finansal sürdürülebilirliğin bir diğer önemli konusu ise maliyet yönetimidir.

Etkili maliyet yönetimi, özellikle yüksek Ar-Ge ve malzeme maliyetlerine sahip yeni teknolojiler geliştiren yenilenebilir enerji girişimlerinin finansal sürdürülebilirliği için kritik öneme sahiptir. Girişimciler, maaşlar, sigorta primleri ve vergiler gibi finansal kaynakları zorlayabilen önemli operasyonel maliyetlerle karşı karşıyadır. Girişimlerden alınan doğrudan alıntılar, mevcut ekonomik koşullar altında maliyetleri yönetmenin zorluklarını vurgulamaktadır. Pahalı ekipman ve malzemeler de dahil olmak üzere yüksek teknoloji maliyetleri bütçeleri daha da zorlamaktadır. Girişimciler ayrıca vergi politikalarıyla ilgili zorluklarla karşı karşıya kalıyor ve bazıları finansal baskıyı hafifletmek için vergi indirimleri ve muafiyetleri savunmaktadır. Teknoloji geliştirme bölgelerinin sunduğu vergi indirimleri ve muafiyetler takdir edilirken, girişimciler bu tarz maliyet azaltıcı teşviklerin artmasını ve belki de COVID-19 döneminde saklık girişimleri için olduğu gibi yeşil enerji girişimleri için de dönemsel odaklı destekler olabileceğini paylaşmaktadırlar. Türkiye'deki yenilenebilir enerji girişimleriyle yapılan görüşmeler, hükümet hibeleri ve diğer fon kaynaklarının faydalı olsa da girişimlerin tam finansal ihtiyaçlarını karşılamaktan uzak olduğunu ortaya koymaktadır. Yeşil enerji girişimlerinin finansal sürdürülebilirliğini etkili bir şekilde desteklemek için daha fazla desteğe ve politikalara ihtiyaç vardır. Girişimciler, finansal istikrarı artırmak ve yenilenebilir enerji sektöründe büyümeyi teşvik etmek için daha hedefli ve önemli politika geliştirmelerinin gerekli olduğunu öne sürmekte ve geliştirilen politikaları heyecanla takip etmektedir. Ayrıca yenilenebilir enerji girişimleri, girişim faaliyetlerinin hem piyasa engellerinden hem de fırsatlardan büyük ölçüde etkilendiği piyasa dinamikleri ve iş operasyonları arasında karmaşık bir etkileşimle karşı karşıyadır.

Piyasa engelleri arasında tüketici farkındalığı ve maliyetler bulunurken, fırsatlar genellikle topluluk etkileşiminden ve uluslararası destekten kaynaklanır. Örneğin, birçok katılımcı girişimlerini kurmada TÜBİTAK 1512 desteğinin rolünü vurgulayarak, politika desteğinin ilk operasyonları üzerindeki önemli etkisini göstermektedir. Küresel trendlerin ve yerel ekonomik koşulların kesişimi, uluslararası dinamiklerin Türkiye'deki yenilenebilir enerji manzarasını nasıl şekillendirdiğini ortaya koymaktadır. Girişimler, hidrojen teknolojisindeki ilerlemeler ve Avrupa'nın hidrojen pazarındaki liderliği gibi küresel trendlerin stratejilerini ve beklentilerini etkilediğini gözlemlemektedir. Ancak, döviz kurlarındaki dalgalanmalar ve ekonomik istikrarsızlık gibi yerel ekonomik belirsizlikler, girişimlerin büyümesi vefinansal yönetimi için zorluklar oluşturmaktadır. Küresel eğilimlerin Türkiye'deki politika geliştirme üzerindeki olumlu etkilerine rağmen, bazı girişimler uluslararası anlaşmalardan ve eğilimlerden beklenen faydaların henüz tam olarak gerçekleşmediğini düşünmektedir. Teknoloji tarafında ise teknik uzmanlık, altyapı ve adaptasyonun yenilenebilir enerji girişimlerinin gelişiminde önemli bir rol oynamaktadır. Girişimler özellikle görece yeni yenilenebilir teknoloji alanlarında yetersiz altyapı ve sınırlı uzmanlık nedeniyle uzmanlaşmış teknik bilgiye erişmede zorluk yaşadıklarını paylaşmışlardır. Örneğin, hidrojen teknolojisi gibi yeni ortaya çıkan alanlarda teknik uzmanlık bulmadaki zorluklar, Türkiye içinde gelişmiş bilgiye erişimin daha geniş sorununu vurgulamaktadır. Ek olarak, gelişmekte olan teknolojik altyapı girişimlerin kavram kanıtı çalışmaları oluşturma ve enerji teknolojilerinin pratik uygulamasını yavaşlatmaktadır.

Genel olarak, Türkiye'deki yenilenebilir enerji girişimlerinin deneyimleri ve gözlemleri, politika desteğinin, finansal süreçlerin, pazar dinamiklerinin, küresel eğilimlerin ve teknolojik zorlukların kesiştiği bir manzarayı gösteriyor. Politikalar ve global eğilimler girişimlere bazı avantajlar sunarken, girişimler tüketici farkındalığı, ekonomik belirsizlik, finansa erişim, market bariyerleri ve teknik altyapı gibi önemli önemli zorlayıcı faktörleri aşmak mecburiyetindedir. Bu çalışma, Türkiye'deki yenilenebilir enerji girişimleri üzerinde yeşil enerji politikalarının etkisini araştırmak için yorumlayıcı fenomenoloji analizini kullanmış ve beş temel temaya odaklanmıştır: Hükümet ve Politika Etkileşimleri, Finansal Sürdürülebilirlik, Pazar Dinamikleri ve İşletme Operasyonları, Küresel Trendler ve Ülke Ekonomik Koşulları ve Teknoloji. Analiz, Hükümet ve Politika Etkileşimleri' ndeki önemli zorlukları vurgulamıştır. Girişimciler, düzenlemelerdeki belirsizliklerin ve bürokratik gecikmelerin iş operasyonlarını ve inovasyon süreçlerini engellediğini paylaşmaktadır. Daha net ve daha esnek politikalara ihtiyaç duyduklarını ifade ederek, Paris Anlaşması gibi uluslararası anlaşmalar ile birlikte Türkiye'de birçok politika geliştirmesi olduğunu belirtmiş ancak yeterli seviyelere henüz ulaşmadığını vurgulamışlardır. Finansal Sürdürülebilirlik, bir diğer kritik alan olarak ortaya çıkmıştır. Girişimciler, TÜBİTAK ve KOSGEB gibi kurumlardan gelen devlet hibelerinin değerli olsa da artan operasyonel maliyetler, enflasyon ve pahalı teknolojik malzemeler nedeni ile yeterli bulmadıklarını belirtmişlerdir. Ayrıca, yeterli seviyede regüle olmadığını düşündükleri yatırım süreçleri ve bilgili yatırımcı eksikliği nedeniyle risk sermayesine erişimde zorluklar yaşandığını ve bunun da yabancı yatırımcılara bağımlılığa yol açabileceğine vurgu yapmışlardır.

Yeşil enerji projeleri için banka kredileri de yeterince destekleyici görülmediğinden, bazıları yurtdışına yatırım yapmanın daha mantıklı olduğunu paylaşmıştır. Ek olarak, Avrupa'daki uluslararası programların daha etkili finansal destek sunarak, artan yerel ve uluslararası finansmana olan ihtiyacın altı çizilmektedir. Pazar Dinamikleri ve İş Operasyonları altında başlangıçta şirket kurulumu ve Ar-Ge odağında desteklerin, değerli olduğu paylaşılırken, yenilenebilir enerji girişimleri özellikle farkındalığı artırma, teknolojilerine ilişkin anlayışı iyileştirme ve ticarileşme konusunda daha kapsamlı bir desteğe ihtiyaç duyduklarını ifade etmişlerdir. Sektördeki sınırlı yatırım ve destek, büyümeyi ve inovasyonu hızını düşürebilme potansiyeline sahiptir. Küresel Trendler ve Ülke Ekonomik Koşulları çerçevesinde bakıldığında, Türkiye'nin küresel enerji piyasası gelişmeleriyle uyumlu olmasına rağmen, hem olumlu hem de olumsuz deneyimlerinin olduğu girişimler tarafından paylaşılmıştır. Asya'nın yenilenebilir enerji pazarında öngörülen hakimiyeti, girişimciler tarafından örnek gösterilerek paylaşılmıştır. Döviz kuru dalgalanmaları da dahil olmak üzere enflasyon gibi Türkiye'nin ekonomik koşulları, girişimciler için finansal sürdürülebilirliği daha da zorlayıcı hale getirmektedir. Rekabetçi kalınabilmesi için, yenilenebilir enerji girişimleri ekonomik belirsizliklerin azaltılırken hem Avrupa hem de Asya trendlerine uyum sağlanmasının önemine vurgu yapmışlardır.

Teknolojiyle ilgili zorluklar da girişimlerin paylaştığı gündemler arasındadır. Girişimciler, akademik bilginin endüstri ihtiyaçlarıyla gerekli olan entegrasyonu, özellikle görece yeni yenilenebilir enerji teknolojileri alanında yabancı danışmanlığa yüksek bağımlılık nedeniyle teknolojik uzmanlık edinme ve hidrojen gibi yeni teknolojilere uyum sağlama konusunda zorluklarla karşılaşılabilindiğini paylaşmışlardır.

Ayrıca, hidrojen üretimi ve depolaması gibi alanlardaki henüz gelişmekte olan altyapılar, yenilenebilir teknolojilerin yaygın olarak benimsenmesine karşı engelleyici unsur olarak çıkmaktadır. Türkiye'deki yenilenebilir enerji girişimlerinin sürdürülebilirliği ve başarısı için yerel teknolojik uzmanlığın ve altyapının güçlendirilmesi yüksek önem arz etmektedir. "Hidrojen Vadisi" projesi gibi yatırımlar girişimciler tarafında memnuniyetle karşılanmakta, bu tarz yatırımların yaygınlaşması talep edilmektedir.

Yapılan araştırma sonucunda sunulan çeşitli politika önerileri geliştirilmiştir. Türkiye'deki yenilenebilir enerji girişimleri üzerinde yeşil enerji politikalarının etkisini iyileştirmek için çeşitli politika iyileştirmeleri şarttır. Önemli ilerlemelere rağmen Türkiye'nin hala ilerlemesi gereken uzun bir yolcuğu bulunmaktadır. İlerlemek için yeni yeşil enerji politikaları ile yenilenebilir enerji teknolojilerinin geliştirilmesini, ticarileştirilmesini ve küreselleşmesini desteklemelidir. Öncelikle, yeşil enerji politikaları için merkezi bir veri tabanı oluşturmak girişimlere büyük fayda sağlayacaktır. Mevcut politika belgeleri yenilenebilir enerji ve enerji verimliliği için hedefler koymaktadır, ancak girişimciler konsolide bilgi eksikliği nedeniyle bu politikalara erişme ve bunlarda gezinme konusunda zorluklarla karşılaşmaktadır. Kullanıcı dostu, kapsamlı bir politika veri tabanı, genellikle küçük ekiplere sahip girişimlerin ilgili düzenlemeler ve destek fırsatları hakkında bilgi sahibi olmalarına yardımcı olacaktır. Girişimlerin mevcut politikalardan tam olarak yararlanmasını sağlamak için etkili iletişim kanalları ve politika farkındalık yaratma faaliyetleri çok önemlidir. Ek olarak, kapsayıcı ve yerlemiş bir politika geri bildirim mekanizması geliştirmek gereklidir.

Mülakatlarda bazı girişimcilerin politika uygulamaları hakkında geri bildirim verebildiklerini iletirken, diğerlerinin bu tarz etkileşimlerde yer almadığı farkındalığı ortaya çıkmıştır. Bu durumda da etkili bir politika geribildirim sistemine dikkat çekmektedir. Girişimcilerin sorunları ve önerilerini politika yapıcılara iletebileceği yapılandırılmış bir geri bildirim mekanizması, politika-ihtiyaç uyumunu ve etkinliğini artırabileceği düşünülmektedir. Finansal destek politikalarının da iyileştirilmesi gerekmektedir. Girişimciler mevcut hibe ve teşvikleri takdir ederken, artan operasyonel maliyetleri ve ekonomik zorluklarla başa çıkabilmek için daha fazla destek gerektiğini savunmaktadırlar. 1833 SAYEM, Yeşil Dönüşüm, HIT-30 ve İkiz Dönüşüm gibi programların sayısını artırmak ve yenilenebilir enerji girişimleri için özel vergi düzenlemeleri getirmek daha odaklı destekler sağlanılmasına ön ayak olabilir. Ayrıca, hibe miktarlarının esnek yapılması ekonomik koşullardaki dalgalanmalarına karşı koymaya yardımcı olacaktır. Ticarileştirme ve küreselleşmeye destek, geliştirilmesi gereken bir diğer alandır. TÜBİTAK 1512 gibi programlar ilk aşamalar için değerli olsa da ticarileştirme ve uluslararası genişlemeye odaklanan ek destek hayati önem taşımaktadır. Var olan destekler ve mevcut programlar yararlı olsa da yenilenebilir enerji girişimlerinin gözünde ihtiyaçları tam olarak karşılamamaktadır. Küreselleşme ile ilgili desteklerde özellikle döviz kuruna bağlı olumsuz deneyimler dikkate alınmalıdır. Etkili ve odaklanmış enerji kümeleri de bu alanda fayda sağlayabilmektedir. Girişimciler, mevcut küme yapılarını verimsiz ve maliyetli oldukları için eleştirdiler. Girişimler arasında fiziksel ve çevrimiçi etkileşimleri kolaylaştırmak için yeni kümeler oluşturmak veya mevcut olanları canlandırmak iş birliğini ve inovasyonu artırabilir. Çin'in politikalarını incelemek değerli içgörüler sağlayabilir.

Çin'in yeşil enerjideki güçlü desteği ve kümeleme faaliyetleri, Türkiye'nin bağlamına göre uyarlanmış benzer politikaların benimsenmesinin ve uyarlanmasının faydalı olabileceğini göstermektedir. Avrupa Birliği standartlarıyla uyumlu olurken, Çin ile entegrasyonu araştırmak ek fırsatlar sunabilir. Son olarak, düzenleyici ve bürokratik zorlukları azaltmak çok önemlidir. Proje değerlendirmelerini kolaylaştırmak, prosedürel gecikmeleri azaltmak ve dijital süreçleri iyileştirmek, girişimcilerin karşılaştığı verimsizlikleri giderebilir. Başta hidrojen enerjisi gibi görece yeni ortaya çıkan yenilenebilir enerji teknolojileri olmak üzere bütün ilgili teknolojiler için politika uygulamasında lık ve netlik, girişimler adına destekleyici bir ortam yaratmak için de önemlidir.

Bu çalışmanın, sonuçları yorumlarken ve gelecekteki araştırmaları planlarken dikkate alınması gereken belirli sınırlamaları vardır. Öncelikle, örneklem büyüklüğü bulguları etkileyebilir. Rastgelelik ve homojenliği sağlama çabalarına rağmen, katılımcıların deneyim yılları, enerji sektöründeki sektörleri, yeşil enerji politikalarına katılımları ve coğrafi konumları gibi faktörler sonuçları etkilemiş olabilir. Daha büyük bir örneklem büyüklüğü daha doğru bir temsil sağlayabilir ve girişimler arasında deneyimleri ve politika ihtiyaçları konusunda daha fazla fikir birliği ortaya çıkarabilir. İkinci olarak, çalışmanın zamanlaması bir sınırlama sunmaktadır. Türkiye'deki yeşil enerji politikaları hala gelişmektedir ve son gelişmeler bu çalışmada tam olarak yansıtılmamış olabilir. Örneğin, önemli yeşil enerji politikalarını içeren 12. Kalkınma Planı, bu araştırmanın yapıldığı tarihte henüz ilk yılını tamamlamamıştır. Sonuç olarak, girişimlerin bu politikalarla ilgili deneyimleri gelecekteki araştırmalara kıyasla daha az gelişmiş görünebilir.

Yeşil enerji politikaları ilerlemeye devam ettikçe, gelecekteki çalışmalar daha gelişmiş ve yerleşmiş politika araçlarından faydalanabilir ve girişimler üzerindeki etkilerine dair daha kapsamlı bir görüş sunabilir. Bu çalışma, gelecekteki çalışmalara karşılaştırma için bir temel oluşturabilir ve yeşil enerji politikalarının yenilenebilir enerji girişimleri üzerindeki erken etkilerine ilişkin fikir verebilir.

D. SEMI-STRUCTURED – INTERVIEW GUIDE

1. How many years have you been working on renewable energy?

2. What are the developmental aspects of your startup when you look at it from a renewable energy perspective?

3. Are there any barriers in the renewable energy sector that prevent other startups from getting involved? If so, what are they? (Taxes, labor market, investment costs, regulations, low return on investment, etc.)

4. Were there any policies that motivated you at the beginning when you established a renewable energy startup? If there are other motivating factors, please share them.

5. Do regulations support or limit the development of green energy startups?

6. What are the direct or indirect effects of country policies when developing your products? What are the direct or indirect effects of country green energy policies when developing your products?

7. How should renewable energy startups provide sufficient financial resources? How do you see the benefit of policy support in creating financial resources for these startups?

8. If a renewable energy startup has concerns about high investment costs, how can it overcome this? How do policies affect investor approaches in your opinion? How do green energy policies affect investor approaches in your opinion?

9. What other institutions and organizations would you recommend we talk to about renewable energy startups? Are there any associations? Are you a member of these associations? (If so) What is the return to you as a benefit?

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