EVALUATION OF TURKEY'S STATUS USING ENERGY INDICATORS FOR SUSTAINABLE DEVELOPMENT AND SUSTAINABILITY ASSESSMENT OF A HYDROPOWER PROJECT: A CASE STUDY OF ÇETİN DAM AND HEPP

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

BERNA VURAL ÖZÜNLÜ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
CIVIL ENGINEERING

SEPTEMBER 2013

Approval of the thesis:

EVALUATION OF TURKEY'S STATUS USING ENERGY INDICATORS FOR SUSTAINABLE DEVELOPMENT AND SUSTAINABILITY ASSESSMENT OF A HYDROPOWER PROJECT: A CASE STUDY OF ÇETİN DAM AND HEPP

submitted by **BERNA VURAL ÖZÜNLÜ** in partial fulfillment of the requirements for the degree of **Master of Science in Civil Engineering Department, Middle East Technical University** by,

Prof. Dr. Canan Özgen
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Ahmet Cevdet Yalçıner
Head of Department, **Civil Engineering** _____

Assoc. Prof. Dr. Elçin Kentel
Supervisor, **Civil Engineering Dept., METU** _____

Examining Committee Members:

Prof. Dr. Zuhal Akyürek
Civil Engineering Dept., METU _____

Assoc. Prof. Dr. Elçin Kentel
Civil Engineering Dept., METU _____

Assoc. Prof. Dr. Nuri Merzi
Civil Engineering Dept., METU _____

Assoc. Prof. Dr. Burcu Altan Sakarya
Civil Engineering Dept., METU _____

Asst. Prof. Dr. Emre Alp
Environmental Engineering Dept., METU _____

Date: 04.09.2013

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name : BERNA, VURAL ÖZÜNLÜ

Signature :

ABSTRACT

EVALUATION OF TURKEY'S STATUS USING ENERGY INDICATORS FOR SUSTAINABLE DEVELOPMENT AND
SUSTAINABILITY ASSESSMENT OF A HYDROPOWER PROJECT:
A CASE STUDY OF ÇETİN DAM AND HEPP

Vural Özünlü, Berna
M. Sc., Department of Civil Engineering
Supervisor: Assoc. Prof. Dr. Elçin Kentel
September 2013, 199 pages

One of the crucial problems of the new millennium is increasing energy demand due to development of technology. This energy demand is supplied by new power plants all over the world. In our time, just generating energy is not sufficient; it has to be realized in a sustainable manner from domestic resources as well. Any type of renewable energy that supports healthy environment, economic wealth, and social justice simultaneously for today's usage without compromising future generations' well-being and quality of life is valued to be sustainable. Hydropower plays the major role in Turkey's renewable energy market. The undeveloped part of hydropower potential should be put in use since the country's energy demand and dependency on foreign sources are rapidly increasing. On the other hand, environmental and social issues should be given high importance to enhance sustainability while implementing and operating hydroelectric power plants (HEPPs). International Atomic Energy Agency has suggested Energy Indicators for Sustainable Development (EISD) to assess a country's sustainability status. Moreover, International Hydropower Association has developed Sustainability Assessment Protocol (SAP) to assess HEPPs in terms of sustainability. The scope of this study is to visualize sustainable development status of Turkey by using EISD, and sustainability assessment of Çetin Dam and HEPP by using SAP. Suggestions are made (i) to improve sustainable development status of Turkey using results of the EISD analysis, (ii) to improve the SAP as a practical global tool, and (iii) to promote and ease its applicability in Turkey's hydropower sector based on the analysis conducted for Çetin Dam and HEPP.

Keywords: Energy Indicators for Sustainable Development, Hydropower, Sustainability Assessment Protocol

ÖZ

TÜRKİYE'NİN DURUMUNUN SÜRDÜRÜLEBİLİR GELİŞME İÇİN ENERJİ GÖSTERGELERİ İLE DEĞERLENDİRİLMESİ VE BİR HİDROELEKTRİK PROJESİNİN SÜRDÜRÜLEBİLİRLİK DEĞERLENDİRMESİ: ÖRNEK OLARAK ÇETİN BARAJI VE HES PROJESİNİN İNCELENMESİ

Vural Özünlü, Berna
Yüksek Lisans, İnşaat Mühendisliği Bölümü
Tez Yöneticisi: Doç. Dr. Elçin Kentel
Eylül 2013, 199 sayfa

İçinde bulunduğumuz bin yılın en önemli sorunlarından biri gelişen teknolojiye bağlı olarak artan enerji talebidir. Bu enerji talebi tüm dünyada yeni enerji santralleri tarafından karşılanmaktadır. Zamanımızda sadece enerji üretmek yeterli değildir; bunun yerli kaynaklardan sürdürülebilir bir şekilde gerçekleşmesi gerekmektedir. Sağlıklı çevre, ekonomik bolluk ve sosyal barışı aynı anda koruyabilirken bugünün kullanımına sunulan ve gelecek nesillerin refahını ve hayat kalitesini tehdit etmeyen her türlü yenilenebilir enerji türü sürdürülebilir olarak değerlendirilir. Türkiye yenilebilir enerji pazarında en büyük rolü su enerjisi oynamaktadır. Ülkenin enerji talebinin ve dış kaynaklara bağımlılığının hızla artması nedeniyle henüz geliştirilmeyen yerel hidroelektrik potansiyelin kullanılması gerekmektedir. Öte yandan, hidroelektrik santralleri (HES'leri) uygularken ve işletirken sürdürülebilirliği geliştirmek için çevresel ve sosyal konulara çok önem verilmelidir. Uluslararası Atom Enerjisi Kurumu bir ülkenin sürdürülebilirlik durumunu değerlendirmek için Sürdürülebilir Gelişme için Enerji Göstergeleri'ni (EISD) önermiştir. Ayrıca, Uluslararası Su Enerjisi Birliği HES'leri sürdürülebilirlik açısından değerlendirmek için Sürdürülebilirlik Değerlendirme Protokolü'nü (SAP) geliştirmiştir. Bu çalışmanın amacı EISD'yi kullanarak Türkiye'nin sürdürülebilir gelişme durumunu, SAP'yi kullanarak Çetin Barajı ve HES'in sürdürülebilirlik değerlendirmesini ortaya çıkarmaktır. Bu çalışmada (i) EISD analizi sonuçları kullanılarak Türkiye'nin sürdürülebilir gelişme durumunu iyileştirmek, (ii) SAP'yi pratik uygulanabilir küresel bir araç olarak geliştirmek, teşvik etmek ve (iii) Çetin Barajı ve HES'ten hareketle Türkiye'deki uygulanabilirliğini kolaylaştırmak üzere tavsiyelerde bulunulmuştur.

Anahtar Kelimeler: Sürdürülebilir Gelişme için Enerji Göstergeleri, Su Enerjisi, Sürdürülebilirlik Değerlendirme Protokolü

To My Family,

ACKNOWLEDGEMENTS

First and foremost, I am heartily thankful to my supervisor, Assoc. Prof. Dr. Elçin Kentel for her insightful comments, suggestions, supervision, and guidance. Without her motivation support, encouragement and endless patience, this study would never come to an end.

I would also like to express my gratitude to my committee members Prof. Dr. Zuhal Akyürek, Assoc. Prof. Dr. Nuri Merzi, Assoc. Prof. Dr. Burcu Altan Sakarya and Asst. Prof. Dr. Emre Alp for their valuable comments and contribution to finalize this study.

I profoundly offer my regards and blessings to Dolsar Engineering Limited managers, İrfan Aker, Sinan Aker, Adil Bacak and Sadettin Zorlutuna, who supported me in any respect during the completion of my master's thesis. Furthermore, I am grateful to all my colleagues from Dolsar, who gave motivation support during my hard thesis writing stage.

Moreover, I am also thankful to my friends from Water Resources Laboratory thesis meetings; Mehmet Akın Çetinkaya, Ece Boyacıoğlu and Mehmet Kayra Ergen for their friendship and helps during this study.

I would like to give a special gratitude to one of my best friends and colleague Selay Pekmezci who was always with me throughout my graduate adventure. I offer my thanks to my colleague Özge Küreksiz for her valuable friendship from the beginning of lovely university times to our experience in being the design engineers of Çetin Dam and HEPP in Dolsar. I would like to thank my research assistant friend from Water Resources Laboratory, Meriç Selamoğlu, for her support on literature review stage; and help and photographing during my thesis presentation. My colleague Tümay Çelikkol Koçak is obviously thanked for always being with me and sharing the same story and feelings during our graduation history from high school to METU. My childhood friends from Trabzon, Mehmet Ali Kumaş, Yeşer Genç, Ayşegül Durmuş, and Seda Kahraman are also heartedly thanked for being with me in all my best and worst days during past decades.

Besides, my special thanks go to Celalettin Erdem and Cemalettin Erdem, absolutely having the best uncles ever degree, for their love, support and guidance from birth to today. My cousins Ezgi Erdem, Özge Erdem and Özlem Erdem will always be the beauties of my life to whose I am grateful for being my little sweet sisters. Moreover, I am doubtlessly thankful from heart to my dear parents-in-law Nurgül Özünlü and İlhan Özünlü for their invaluable love and support during this study.

At first, I will dedicate this degree to my long-awaited grandma Semiye Erdem who came together with my dear deceased grandpa and first mathematics teacher Mehmet Faruk Erdem three years ago; and couldn't see the completion of this study. My grandparents are wholeheartedly still with me in all my ways by their valuable presence as well as previous.

Secondly, I would like to devote this study to my precious parents Müşerref Vural and Celal Vural, and my dearie brother Erdem Vural for being the best family in any aspect throughout my life. Without them, not only this thesis but also what I own at all would be worthless and meaningless.

Lastly, I dedicate end of my thesis to my everything, -sweetheart husband- Özcan Mutlu Özünlü for his awesome patience, endless sacrifice, incredible support, individual effort and real love during both my undergraduate and graduate degrees at METU. 25th of August 2013 will never be forgotten honey, congratulations to us for both.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATION

ACGIH	American Congress of Government Industrial Hygienists
AQI	Air Quality Index
CSD	Commission on Sustainable Development
DSİ	State Hydraulic Works
EIA	Environmental Impact Assessment
EİE	General Directorate of Renewable Energy
EİEİ	Electrical Affairs Studies Administration General Directorate
EISD	Environmental Indicators for Sustainable Development
EPDK	Energy Market Regulatory Authority
GDP	Gross Domestic Product
TÜİK	Turkish Statistical Institute
GHG	Greenhouse Gas
goe	Gram Oil Equivalent
HEPP	Hydroelectric Power Plant
HSE	Health Safety Environment
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IHA	International Hydropower Association
IUCN	International Union for Conversion of Nature
NGI	Norwegian Geotechnical Institute
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PPP	Purchasing Power Parity
SAP	Sustainability Assessment Protocol
TCDD	Turkish State Railways
TEDAŞ	Turkish Electricity Distribution Company
TEİAŞ	Turkish Electricity Transmission Company
TEMA	The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats
TFC	Total Final Consumption
TMMOB	The Union Of Chambers Of Turkish Engineers And Architects
toe	Ton Oil Equivalent
TPES	Total Primary Energy Supply
TÜİK	Turkish Statistical Institute
UNDESA	United Nations Department of Economic and Social Affairs
UNFCCC	United Nations Frame Work Convention on Climate Change
WCED	World Commission on Environment and Development
WHO	World Health Organization
WWF	World Wildlife Fund

CHAPTER 1

INTRODUCTION

Industrial development increases energy demand every day. This energy demand is mostly supplied by thermal and hydroelectric power plants (HEPPs) all over the world. HEPPs are the major renewable sources of Turkey's energy generation, which should be developed. Turkey has a total hydroelectric potential of around 216 billion kWh and 140 billion kWh of that is economically feasible (www.eie.gov.tr). In 2012, Turkey used 38% of its hydroelectric potential (www.dsi.gov.tr). The undeveloped part of this domestic potential should be used as soon as possible since the country's energy demand is rapidly increasing. On the other hand, environmental and social issues should be given high importance to enhance sustainability while implementing and operating HEPPs.

Different institutions suggested different indicators to assess sustainable energy. International Atomic Energy Agency (IAEA) has suggested Energy Indicators for Sustainable Development (EISD) to assess a country's sustainability status. Moreover, International Hydropower Association (IHA) has developed Sustainability Assessment Protocol (SAP) to assess HEPPs in terms of sustainability. The scope of this study is to determine sustainability status of Turkey by using EISD, and sustainability status of Çetin Dam and HEPP by using SAP.

EISD suggests a list of indicators to assess sustainability of a country under three dimensions: Social, Economic, and Environmental. Since each individual country has different priorities, important and relevant indicators change from country to country. Assessor is responsible for selecting appropriate indicators for the country. Availability of required information is an indicator of the country's statistical archive quality. In this study, some of the required data cannot be obtained. A list of unavailable and partially available data is prepared as a result of this study and collection of these data is recommended for better EISD assessments. The assessment is conducted to visualize the general sustainability status of the country. According to the results obtained from the assessed indicators, it is clearly seen that Turkey is in need of domestic energy resources and utilization of domestic renewable sources should be maximized to decrease dependency on foreign sources. Since the major renewable energy source of the country is hydropower, sustainable hydropower implementations should be promoted.

SAP is an implementation tool which assesses hydropower projects. SAP consists of five dimensions, Integrative, Technical, Financial, Social and Environmental; and they are evaluated in terms of topics. Each topic has some subjects to be evaluated against

the basic good practice and the proven best practice. Main purpose of the SAP assessment in this thesis is to review the applicability, content, practicability and effectiveness of the protocol, and to obtain sustainability profile of Çetin Dam and HEPP as a case study. Some suggestions are proposed, and the complexities in practice are identified to improve and ease applicability of the Protocol in assessing hydropower projects of Turkey.

Çetin Dam and HEPP has a total design discharge of 347.2 m^3/s and 420 MW installed capacity (Dolsar, 2012). Çetin Dam, which is in its implementation stage, will be Turkey's first asphalt core rock-fill type dam (Dolsar, 2012). Since Çetin Dam and HEPP will be one of the biggest dams of the country, enhancing a sustainable implementation in this individual HEPP is important and it is selected as the case study.

According to SAP assessment results, Çetin Dam and HEPP guarantees a score between the basic good practice and the proven best practice. In SAP assessment scoring strategy all topics are weighted equally. However, according to conclusions of Chapter 3 some topics need to be stressed more for Turkey: Project Benefits (Topic 7), Project Affected Communities and Livelihoods (Topic 9), Labour and Working Conditions (Topic 12), Cultural Heritage (Topic 13), and Biodiversity and Invasive Species (Topic 15). However, it is seen that, due to restrictions of data availability and publicly available reports in Turkey, it is not possible to use the suggested form of the implementation tool to perform the assessment in Turkey. Basic data and information requirements that are missing or partially available for SAP evaluation are identified during this study. One other problem with the application of SAP in Turkey is identified to be the language of the protocol. Clear explanations are not provided to distinguish between different scores. This made utilization of SAP for Çetin Dam and HEPP very difficult.

In Chapter 1, general information and objectives of the study are given. Chapter 2 is a literature review of EISD, SAP and hydropower potential of Turkey. EISD is used to assess Turkey's sustainable development status in Chapter 3. In Chapter 4, brief information about IHA, SAP, and SAP's score assigning methodology is given. In Chapter 5, evaluation results of SAP assessment for Çetin Dam and HEPP are provided. Finally, conclusions of both assessments are given in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

Within the scope of this thesis, EISD procedure was implemented to Turkey to assess country's status in terms of sustainability. EISD assessment demonstrated the country's lack of energy, and urgent need of developing energy sources' sustainable management. IHA's SAP was used to assess a case study in Turkey, Çetin Dam and HEPP, to determine the project's sustainability profile and contribute to sustainability development of the country based on this individual project. Background information about the two documents, both in the aim of assessing and promoting sustainability, will be given in this chapter.

2.1 EISD Review

International Atomic Energy Agency (IAEA) is an organization having the mission of contributing safe, secure and peaceful uses of nuclear science and technology. The agency was set up in 1957 within the United Nations as world's "Atoms for Peace" organization (www.iaea.org).

After the decisions taken by the United Nations (UN) Commission on Sustainable Development (CSD) in 1995, the UN Department of Economic and Social Affairs (UNDESA) started working to generate a set of indicators for sustainable development. In 2001, with contributions of UNDESA, IAEA established an indicator project to provide information on current energy-related trends in a format that helps countries to develop efficient energy policies in national level (IAEA, 2005).

In the first phase of the studies (2000-2001), a set of 41 energy indicators is produced. After first phase results were obtained, the set of indicators were published to implement them in following countries: Brazil, Cuba, Lithuania, Mexico, Russian Federation, Slovak Republic, and Thailand. These countries selected most relevant indicators of EISD for their countries and applied them in analyses of their current and future energy policies. After this implementation program concludes, the new EISD document was published in 2005 including second phase set of energy indicators. The new set of indicators has 30 indicators in 3 main dimensions; comprising 4 social, 16 economical and 10 environmental energy indicators (IAEA, 2005).

The document is result of IAEA's energy indicator project study in cooperation with various international organizations (UNDESA, International Energy Agency, Eurostat and European Environment Agency).

The indicators guide the probable assessors to take sustainable actions in various aspects (IAEA, 2005):

- By integrating energy into socio-economic programs
- By guiding developing countries to develop their energy services
- By establishing national programs on efficiency
- By reducing gas emissions
- By improving transparency of information in market
- By increasing renewable energy share
- By developing renewable energy, energy efficiency, and advanced energy technologies to meet the increasing need of energy
- By decreasing energy market distortions

EISD assesses a country in terms of sustainable energy generation in guidance of statistical qualitative data required in the themes of three main dimensions. Sustainability goals supported by deterministic and statistical goals, demonstrated future risks, correlation between indicators, and stated basic social needs of EISD can be benefited by an individual country to give right decisions at the planning stage of HEPPs.

According to EISD, each indicator is seen in the context of a given country's individual circumstances (IAEA, 2005). Economic status, changing energy technologies, and energy supply opportunities that change from country to country can lead a country's priorities for energy generation. A country's own economy, geography, range of energy sources, expertise and priorities should be taken into account while analyzing an indicator whether shows a development in terms of sustainability or not. EISD is implemented to Turkey to define the country's sustainability status, the indicators which lack of information and the most relevant and critical ones for Turkey.

2.2 Progress and Applications of the SAP

IHA is a non-profit organization in the aim of promoting water policy, minimizing climate change effects, contributing energy market and investments, and developing sustainability. IHA has developed SAP as a new global tool to advance sustainable hydropower energy.

In 2004, IHA produced the Hydropower Sustainability Guidelines. In 2006, IHA generated first version of Sustainability Assessment Protocol as a result of continuing studies. A multi-stakeholder Forum was established to make recommendations and provide support for the on-going development of the Protocol. The Forum included social and environmental NGOs (Oxfam, The Nature Conservancy, Transparency International, WWF), governments (China, Germany (observer), Iceland, Norway, Zambia), commercial and development banks (members of the Equator Principles

Financial Institutions, The World Bank (observer)), and the hydropower sector represented by IHA. The assessors are guided in the light of sustainability guidelines to ensure that environmental and social impacts are avoided, or compensated while positive outcomes are maximized. Guidelines were exposed to adaptation throughout the improvement of SAP tool studies. IHA's aim of promoting sustainability guidelines is to provide a greater assessment of environmental, social and economic aspects in hydropower projects.

- IHA Board recommended IHA to update protocol tools periodically in order to develop SAP continuously and benefit from ongoing process and its applications. IHA encourages its members to participate in training and capacity building workshops to support the application of SAP and popularize its usage in hydropower sector. There had been field application in 16 countries and several thousand individuals from 28 countries contributed to Forum process as further stakeholder engagement. On 16th November 2010, IHA Forum officially adopted the last version of SAP as a result of 30 months (2007-2010) sector engagement and revisions on IHA's previous sustainability tools (IHA Sustainability Guidelines, 2004 and Sustainability Assessment Protocol, 2006). There are four documents published by IHA for different stages of a HEPP project. Early Stage Assessment Tool, Preparation Stage Assessment Tool, Implementation Assessment Tool and Operation Assessment Tool are the four advised documents. Different topics assigned for different stages at the tools are available at IHA's web site (www.hydrosustainability.org)

- Hydropower Sustainability Assessment Forum's mid-reports, the pilot assessment and official assessments published at IHA's web site are used as guidelines throughout this study. Information about some related reports and assessment samples similar to this thesis are given below:

- In January 2008, draft report of "IHA Sustainability Protocol Audit Assessment of Dabuashui Hydropower Project" was published (Norwegian Water Resources and Energy Directorate, 2008). The project is located in China. It is in operation stage and has 180 MW installed capacity. Comments included in the report contributed to on-going development of the SAP.

- In May 2008, "Review of Norwegian Experience in the use of the IHA Sustainability Assessment Protocol" report was published (Sustainability Assessment Forum, 2008). As one of the leader energy companies in Norway, Çetin Project's owner Statkraft was included in contacted companies list that worked about the subject. Statkraft used SAP to assess some projects which are in final project, implementation and operation stages. After the studies, Statkraft found the SAP useful for promoting their vision, policy, and

principles to contribute green energy. Moreover, the SAP is assessed as a useful communicative tool to improve communications between NGOs and other stakeholders. Statkraft recommended assigning different weights to subjects of SAP considering the related nation's priorities. Within the conclusions of this thesis, Project Benefits (Topic 7), Project Affected Communities and Livelihoods (Topic 9), Labour and Working Conditions (Topic 12), Cultural Heritage (Topic 13), and Biodiversity and Invasive Species (Topic 15) subjects are recommended to be weighted with a larger coefficient than the other subjects for Turkey related with the conclusions of EISD implementation to Turkey and the experiences gained from the country's past HEPP applications.

- In October 2009, audit report of "HPP Salvador Assessment based on the Sustainability Assessment Protocol from IHA" was published (Bvqi Do Brasil Soc. Certificadore Ltda, 2009). The project is located in Brasil and has an installed capacity of 243.2 MW. The assessors granted the project a high sustainability performance.

- In December 2009, Sustainability Assessment Report of Shuibuya Hydropower Project located in China was published (Assessment Panel for Shuibuya Hydropower Project, 2009). According to Panel's assessment with the Draft SAP published in 2008, Shuibuya Project obtained scores mostly at levels of 3 to 4. According to Panel's test and conclusions on Draft Protocol, the protocol's objectivity and language comprehensibility had to be improved.

- On 4th of April 2012, Sustainability Assessment Report of one of IHA sustainability partners Hydro Tasmania's pilot assessment Trevallyn Power Station was published (Rydgren, 2012). According to the assessment team's consideration, Trevallyn exceeds basic good practice on all topics for the operation stage and meets a high level of performance proven by evidences. The pilot assessment was an opportunity to test the SAP, and encouragement for the hydropower sector to do the same. The procedure and methods used in the pilot assessment formed the general framework of implementation of SAP to Çetin Dam and HEPP in early stages of this thesis.

- Hvammur Hydropower Project in Iceland, which is at preparation stage and has 82 MW installed capacity, has been assessed by SAP (Rydgren, 2012). The official report was published by IHA in 10th of May 2013. The owner of the project, Landsvirkjun, is the country's largest electric generator, producing 75% of Iceland's electricity by operating 13 hydropower plants and 2 geothermal stations. According to the official assessment, the score of the HEPP is somewhere near to the proven best practice.

- On 10th of May 2013, the SAP assessment of Walchensee Hydropower Plant (Rydgren, 2012) which is located in Germany was published in IHA's web site. The project has 124 MW installed capacity and it is in the operation stage. The official sustainability profile prepared by the assessors showed that the stated hydropower plant has a score near to the proven best practice.

- On 10th of May 2013, the SAP assessment of Jostedal Hydropower Project (Smith, 2012) which is at operation stage was published. The storage type project having 288 MW installed capacity is located in western Norway. According to assessors' consideration, Jostedal exceeds the basic good practice on all topics for operation stage and provides a high level of performance proven by evidences. The Project's owner is Statkraft. The official assessment of Jostedal Project gave the author the opportunity to see Statkraft's governance in a different country other than Turkey.

- On 17th of May 2013, Jirau Hydropower Project in Brazil which is at implementation stage, has been assessed by SAP and official report was published by IHA (Locher, 2013). This report formed the base framework of the sustainability assessment of Çetin Dam and HEPP with SAP tool. The assessment results showed that Jirau meets a high sustainability performance proven by objective evidences. The official assessment report was helpful for the author to detect some objective evidences which are not very clear in SAP's Implementation Stage tool. The same methodology and reporting algorithm is preferred during the assessment of Çetin Dam and HEPP.

2.3 Hydropower Potential of Turkey

The hydroelectric potential of Turkey is around 216 billion kWh, 140 billion kWh of which is economically feasible and corresponds to about 16% of Europe's capacity (www.eie.gov.tr). This potential comprises of hydroelectric projects that are in preliminary survey, survey, feasibility, final project or commissioning stages. In Table 2.1 Turkey's hydroelectric potential situation is summarized. As can be seen from Table 2.1, Turkey utilized around 38% of its potential in 2012.

Table 2.1 Turkey's HEPP Potential Situation by the year 2012 (www.dsi.gov.tr)

HEPP Potential	Number of HEPPs	Installed Capacity (MW)	Production Capacity (GWh/year)	Ratio (%)
Operating	303	17372	62000	38
Implementation stage	256	10590	35000	21
Planning stage	1084	19535	67000	41
Total	1643	47497	164000	100

CHAPTER 3

ENERGY INDICATORS FOR SUSTAINABLE DEVELOPMENT

3.1 Background

World faces many crucial problems related with impacts of technological developments that lead to climate change. The use of nuclear energy created some problems such as storage or disposal of radioactive wastes. In some developing countries non-commercial use of biomass leads to desertification and biodiversity loss. Yet 1.7 million people in the world do not have access to electricity. About one third of the world's population relies on animal power and non-commercial fuels (IAEA, 2005). To ensure socio-economic development, the need for access to energy sources should be met. If the negative environmental impacts, that developed countries were subjected to while developing, can be clearly identified and understood, today's developing countries' transition from agricultural to industrial economy will be less damaging by taking the necessary precautions (IAEA, 2005).

Sustainable economic development should be achieved in global scale. To contribute to world's sustainable development, some NGOs study on this subject with the aim of determining globally applicable criteria to evaluate sustainable development. These criteria or indicators comprise of regular monitoring activities, and strategic policy planning to assess a country's lack of or progress of development in terms of sustainability.

Since none of the energy production or conversion technologies is possible without risk or waste, policymakers' awareness about the negative impacts and implementation of sustainable development applications should be increased. Policymakers must know the country's energy and sustainable development status, demands to be supplied, and how these goals can be achieved. The implications of selected energy, environmental and economic programs, policies and plans, and their impacts, and feasibility status of a project when sustainability is conserved, must be clearly understood (IAEA, 2005).

In 2005, IAEA published EISD document in cooperation with UNDESA, International Energy Agency, Eurostat and European Environment Agency. EISD document was prepared with the aim of (i) meeting the need for a consistent set of globally applicable energy indicators, (ii) guiding countries to improve their energy services and their statistical archiving capacity to contribute national sustainable development, (iii) to improve the study of general energy indicators of CSD (IAEA, 2005).

EISD is an assessment in which quantitative evidences are evaluated based on 3 main dimensions. Each dimension is divided into themes and each theme has a number of sub-themes under it. Each sub-theme is evaluated in terms of indicators. The indicators provide a deeper understanding of the major themes by extending beyond basic statistics and emphasizing important relations between policymakers and public. According to EISD document, energy indicators are grouped with respect to social, economic and environmental dimensions. EISD implementation aims to give a clear picture of the sustainable development status of a country as a whole by evaluating the most relevant indicators for that country (IAEA, 2005). In this chapter, it is aimed to (i) assess Turkey's sustainable development in terms of energy using EISD, (ii) determine the indicators, which lack information and monitoring, and (iii) define the most relevant and critical indicators for Turkey.

30 indicators are specified in EISD document. However, every country should individually choose the related indicators to be assessed. Availability of data and relevance of each indicator are the main parameters of the selection process. The way of selecting and using indicators is explained in the following section.

3.2 Selecting and Using Energy Indicators

Significance of different indicators varies from country to country depending on the countries national energy priorities, specific conditions, development status and goals. Therefore interpretation of EISD is unique for each country. National policy goals, existing statistical capabilities, availability of expertise, quality of energy and available relevant data will guide the implementation process (IAEA, 2005).

During the implementation of EISD, countries may find out about their lack of statistical programs, data archiving capacity, and the quality and range of energy data. EISD gives a country the opportunity of reviewing the agencies that gather statistical data, and assessing the quality of available data. Required data comprises of results shown in tables and graphs that cover energy, demographics, environment, economics and economic sectors that affect environment such as residential, agricultural, industrial, commerce and transportation (IAEA, 2005).

At first, organization, which is responsible for each type of required data should be determined. Statistical data used in EISD should be consistent. Secondly, availability, quality and reliability of the data should be checked. Thirdly, energy indicators already in use in the country should be identified and checked for their compatibility with the indicators suggested by EISD (IAEA, 2005). Application of EISD helps countries to determine lack of their data, to improve monitoring, to guide data collection and compilation and to generate related statistics archives. Generating statistical data that shows changes over time is compulsory to evaluate past and today, and define goals and effectiveness of strategies for future. Time series provide a more

comprehensive monitoring for the indicators and an opportunity of using scenarios developed with modeling tools and advancing different policies.

Each indicator reflects a country's individual situation and the same result may have different meanings for different countries. One country's results and conclusions can't be assigned as a standard since different countries face different situations. For example, if a country changes from agricultural economy to industrial economy, or if changes its electricity sources etc., these changes should be taken into account. With changing circumstances, assessors may give different relative importance to different indicators (IAEA, 2005). While making decisions experts should perform the following activities (IAEA, 2005):

- Major energy priority fields should be determined.
- Related indicators should be selected from the given sub-themes.
- Available time series data should be reviewed and more data should be collected if needed.
- Data should be analyzed, effectiveness of past and future policies should be assessed and progress should be evaluated.
- Different energy policies should be considered for future using energy models that give the opportunity of learning from the past.
- If possible, different future scenarios might be developed with modeling tools.

In this chapter, Turkey's sustainability status is assessed using publicly available data of governmental institutions. First, Turkish Statistical Institute (TÜİK)'s web-site is used for information gathering. TÜİK continues its studies on sustainable development indicators suggested by the European Statistical Office's (Eurostat) 2007 list (www.tuik.gov.tr). It is observed that Turkish statistical data has good quality for the available data. However, required data for some of the indicators are not available from TÜİK or any other governmental web-sites and other data that can be found in official web sites are not recent. Some of these missing data can be found at international statistical institutions' web pages, however some of them cannot be found and assessed at all. Unavailability of data is a major deficiency and it should be overcome. Turkish Statistical Institute should collect necessary data required to assess EISD and make them publicly available.

Main themes and most of the indicators of sub-themes are assessed in the following chapter. Although there are a total of 30 indicators in the assessment set, EISD producers guide the experts and assessors to define more relevant indicators and assess only those. Here assessed indicators are not selected according to their relevance, but according to data availability. It is believed that, since Turkey is a developing country, all the indicators are relevant for the country. With the available data a total of 20 indicators; 4 indicators of social dimension, 10 indicators of economic dimension, and

6 indicators of environmental dimension are assessed. In some of these assessments since recent data was not available, the assessment is performed using past data.

3.3 Social Energy Indicators and Their Assessment for Turkey

Themes, sub-themes and energy indicators of social dimension are given in Table 3.1. All indicators of social dimension are assessed one by one for Turkey in the following paragraphs.

Energy availability has direct impact on a country in all development aspects like poverty, education, employment, productivity, health, pollution etc. In rich countries electricity is available just by a switch whereas considerably expensive fuel takes large portion of monthly income in areas where coal and wood is commercially used for energy. Using these fuels for cooking and heating in the house, causes some health and pollution problems. Use and Production Patterns theme reviews the stated issues in a country. Energy use shouldn't induce injuries, maims or diseases; on the contrary it should promote human health by improving public welfare. Health theme has the safety sub-theme assessing accident fatalities.

Energy should be fairly distributed all over the country to provide equity. To provide accessibility and affordability of energy services, prevent disparities, and ensure safety and health of public are the rights a social government has to assure for the public.

SOC1: Share of households (or population) without access to electricity or commercial energy, or heavily dependent on non-commercial energy

SOC1 indicator of Accessibility sub-theme and Equity theme is concerned with the total number of households with and without electricity or commercial energy, or heavily dependent on non-commercial energy in the country. The aim of this assessment is to monitor the progress in availability of energy services. It is estimated that 1.7 billion people are without electricity in the world and one-third of the world's population depends on traditional biomass sources (IAEA, 2005). Reliable affordable energy service is one the most important necessities to guarantee sustainable development.

According to Turkish Electricity Distribution Company's statistical data for year 2011; there are not any villages in Turkey without electricity in 2010 (TEDAŞ, 2011). The development of the country in terms of electricity distribution is given in Figure 3.1. As can be seen in Figure 3.1, after 1986 more than 90% of all the villages have access to electricity and after 2010 all of the villages in the country have electricity.

Table 3.1 Energy Indicators for Social Dimension (IAEA, 2005)

Theme	Sub-Theme	Energy Indicator		Components
Equity	Accessibility	SOC1	Share of households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy	– Households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy – Total number of households or population
	Affordability	SOC2	Share of household income spent on fuel and electricity	– Household income spent on fuel and electricity – Household income (total and poorest 20% of population)
	Disparities	SOC3	Household energy use for each income group and corresponding fuel mix	– Energy use per household for each income group (quintiles) – Household income for each income group (quintiles) – Corresponding fuel mix for each income group (quintiles)
Health	Safety	SOC4	Accident fatalities per energy produced by fuel chain	– Annual fatalities by fuel chain – Annual energy produced

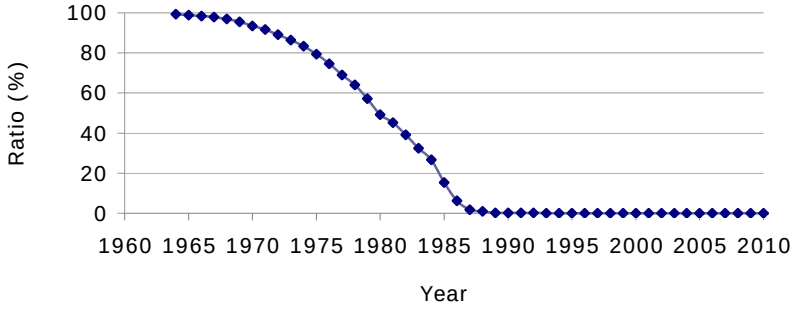

Figure 3.1 Ratio of Villages and Towns without Electricity in Turkey (TEDAŞ, 2011)

In addition to availability of electricity, dependency on non-commercial energy sources such as crop wastes, animal dung and fuel wood has to be assessed. In Ethiopia around 90% of total energy consumption, and in Asia around 80% of residential energy and 35% of total energy demand is met by non-commercial energy sources. In OECD countries this amount is around 3 to 7 % (OECD, 1999). Animal and plant wastes are obvious non-commercial fuels but wood can be both commercial and non-commercial since it is available on the market as well.

In Table 3.2, fuel consumption in residences for heating and lighting purposes for 1998 is given. The data is based on a questionnaire conducted in 1998 (www.tuik.gov.tr). This is the most recent data available to the author. It gives general information about types of fuels used in the country but does not serve as a relevant statistical data to assess this indicator. As can be seen from Table 3.2 commercial and non-commercial wood shares are not given separately. For a reliable evaluation, this data is needed. Since required information is not available, Turkey's status cannot be determined for this indicator.

Electricity distribution problem is already solved. However, statistical data should be collected for commercial and non-commercial energy separately.

SOC2: Share of household income spent on fuel and electricity

SOC2 indicator of Affordability sub-theme and Equity theme is concerned with the total share of household money spent on fuel and electricity for the 1st 20% of the population with the lowest income. The indicator aims to measure energy affordability for the average and poorest segment of the public.

It can be seen from Table 3.3 that, 1st 20% group with the lowest income spends 36.59% of their money on house, water, electricity, gas and other fuels, whereas the

share is 19.66% for the 5th 20% with the highest income. In available expenditure statistics of each income group shown in Table 3.3, it is seen that house and water expenditures are not separated from a number of other costs. Thus, required data is not available. Collection of fuel end electricity expenditures for each income group is necessary to be able to evaluate Affordability sub-theme of EISD. Available data is not sufficient for evaluating Turkey's energy status; thus collection of energy expenditure data by TUİK is recommended.

It is obvious in Table 3.3 that poor people mostly spent their money on basic needs like food and electricity whereas the rich can spend their money on luxuries such as entertainment, clothing, etc. To support social and economic sustainability in developing countries, the burden of expenditure on energy in lower income groups should be decreased which can be possible by supplying cheaper energy.

SOC3: Household energy use for each income group

SOC3 indicator of Disparities sub-theme and Equity Theme is concerned with the energy use of representative households for each income group in the country. The indicator is a measure of energy disparity. In a country which has high per capita gross domestic product (GDP), there may not be a fair distribution of sources. GDP measures the monetary value of final goods and services produced in a country in a given period of time (www.imf.org). Most of the population may not have the opportunity to meet their needs for commercial energy at current energy prices, but the rich minority may increase GDP value of the country. In SOC2 assessment, it is seen that lower income group spend nearly twice of the percentage of their incomes for energy and household costs when compared with the percentage that the highest income group spend on energy and household costs. Increasing availability of energy and decreasing the energy burden on lower income groups' budget are necessary for sustainability.

Per household consumption evaluation is important. For instance, in developed countries percentage of living alone is considerably high, whereas average household population is 3.76 in 2011 in Turkey (www.tuik.gov.tr). High amount of household population is a value that increases energy efficiency. Although SOC3 assessment is concerned with energy use per household, the information is available in per capita basis for Turkey. Turkey's energy consumption per capita is lower than one third of the Organization for Economic Co-operation and Development (OECD) countries' average and lower than one fourth of that of USA's average (Table 3.4).

Table 3.2 Fuel consumption in the Residences for Heating and Lighting Purpose for the Year 1998 (www.tuik.gov.tr)

	Region		Total	Marmara	Eagean	Mediterranean	Central Anatolia	Black Sea	Eastern Anatolia	Southeastern Anatolia
	Electricity	kWh	18641110172	7396888271	2426086089	2750503583	3033169523	1470487516	674253490	889721701
	Natural Gas	m^3	1545640041	1026182650	-	-	519457391	-	-	-
Gas Fuel	LPG		42967	19857	6269	11119	4756	273	-	693
	Hard Coal		4077999	1303195	1332136	173684	530641	376902	130970	230471
	Coal		5290631	2561342	100504	97359	1686570	411528	281616	151713
	Coke		984096	86583	7892	24596	123157	235091	435984	70794
	Coal		2868106	822852	409196	7426	1070788	308872	217277	31696
	Lignite		4686273	1210723	1424128	454299	1164970	253979	82940	95234
	Wood		12493872	4072811	1694558	1769669	1522477	1781411	855015	797931
Solid fuel	Wood Dust		262097	82929	2699	64981	8604	16821	5771	80292
	Fuel Oil	ton	1043398	115559	35612	231189	242572	183191	78420	156854
	Kerosene		6786	-	6051	-	-	734	-	-
Liquied Fuel	Diessel Oil		150174	49002	39705	5157	21319	25899	9092	-
	Plant Waste		337984	59467	10568	69288	21625	133342	24724	18969
Animal and Plant Waste	Animal Waste		191123	6567	2512	567	89067	5821	53577	33013
	Other		3204674	394929	8671	6181	2055495	74	1596	737727

Table 3.3 Shares of household consumption (%) of Turkey by types of expenditure (www.tuik.gov.tr)

Percentage of Expenditures (%)	1st 20%	2nd 20%	3rd 20%	4th 20%	5th 20%	Average
Food and Non-Alcoholic Beverages	31.69	27.42	24.82	22.39	14.61	20.72
Alcoholic Beverages, Cigarette and Tobacco	5.26	5.30	5.20	4.69	2.95	4.14
Clothing and Footwear	3.32	4.39	4.91	5.45	5.64	5.17
House, Water, Electricity, Gas and Other Fuels	36.59	33.11	30.45	26.90	19.66	25.81
Furniture, Household Appliances, and Home Care Services	4.15	5.35	5.75	6.83	6.98	6.35
Health	1.73	1.65	1.81	2.00	1.95	1.89
Transportation	6.17	8.03	10.07	12.72	26.69	17.24
Communication	3.15	3.89	4.62	4.39	3.77	4.01
Entertainment and Culture	1.12	1.83	2.06	2.65	3.48	2.70
Educational Services	0.46	0.77	1.29	1.69	3.01	1.99
Restaurants, Food Services, and Hotels	4.22	5.42	6.05	6.30	5.62	5.71
Various Good and Services	2.13	2.83	2.98	3.99	5.64	4.26

Table 3.4 Averages of Annual Energy Consumption per capita for Selected OECD Countries (www.energyrealities.org)

OECD Countries (2010)	Energy Consumption (toe)
Australia	5.9
Austria	3.9
Belgium	5.3
Canada	7.6
Chile	2.0
Czech Republic	4.3
Denmark	3.4
Finland	6.0
Germany	4.0
Greece	2.6
Hungary	2.6
Ireland	3.2
Israel	3.1
Italy	2.7
Japan	3.7
Mexico	1.6
Netherlands	4.8
New Zealand	4.1
Norway	5.4
Poland	2.6
Slovak Republic	3.2
Sweden	5.0
Turkey	**1.3**
United Kingdom	3.3
USA	7.3
Average	4.0

Percent of expenditures given in Table 3.3 is given in a graphical format in Figure 3.2. As can be seen in Figure 3.2, total of house, water, electricity and other fuels expenditures has the biggest share in poor people's budget in Turkey as a warning of Turkey's social disparities. The disparities between different income groups should be eliminated to achieve sustainable development.

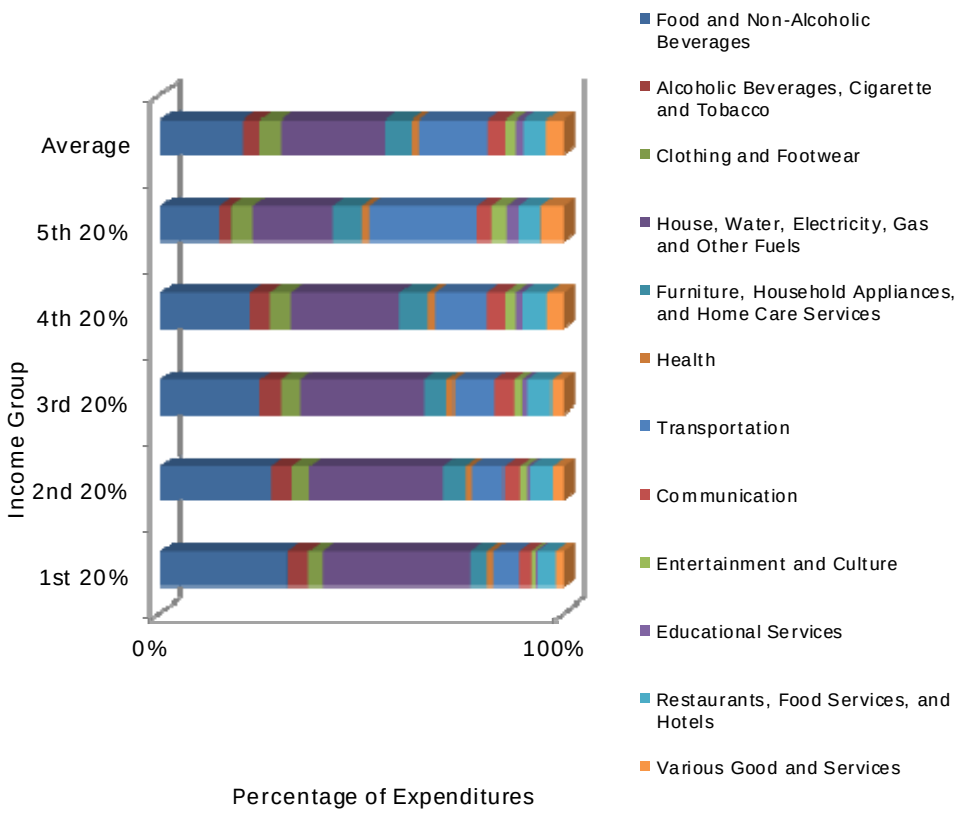

Figure 3.2 Household consumption expenditure of Turkey by types (www.tuik.gov.tr)

SOC4: Accident fatalities per energy produced

SOC4 indicator of Safety sub-theme and Health theme is concerned with accident fatalities per energy produced by fuel chain to assess the risk to human health derived by energy systems. This information in required units (fatalities per energy) is not available from Turkish Statistical Institute (www.tuik.gov.tr). Collection of fatality per energy statistics is recommended.

Number of fatalities per 100000 workers caused by work accident statistics is given in Table 3.5 as a general view of country's safety position of working conditions compared with developed countries. According to Table 3.5, Turkey's work fatalities statistics seem very high compared to those of developed countries. Turkey's work fatalities ratio is only smaller than India and very near to Russia which are famous about insecure work conditions in the world (Ceylan, 2011). Risk of accidents and fatalities must be minimized taking international requirements of safety precautions and obeying the rules in all sectors including the energy sector.

Table 3.5 Number of Fatalities per 100000 workers in Different Countries (Ceylan, 2011)

	2005	2006	2007	2008
Turkey	**15.8**	**20.5**	**12.3**	**9.8**
European Union (Average of 15 countries)	2.3	2.4	2.1	
England	0.6	0.7	0.7	
Finland	2.4	2.2	1.7	
Germany	2.4	2.5	2.2	2.04
France	2.7	3	3.4	
USA	4	4	4	4
Spain	4.7	4.4	3.8	3.3
Mexico	11	10	9	10
India	30	38	27	
Russia	12.4	11.8	12.4	10.9

Additional information about accidents and fatalities in the energy sector are searched and fatalities caused by work accidents in different hydropower plants are found and given in Appendix A. Data given in Appendix A is collected from two different web pages: www.sendika.org and forumkaradeniz.wordpress.com. This unofficial data only includes accidents reflected in the media. It is stated by social media that most of the accident news is hidden due to some political reasons or because of the owners' using their power on free media.

As can be seen in Appendix A, from September 2006 to April 2012, at least 104 people died in hydropower plant construction sites. When fatality reasons are examined, it is seen that most of them could have been prevented by taking necessary precautions and obeying global safety standards. In 24th of February 2012, a tragic work accident happened in Adana caused by the failure of diversion tunnel gates resulting in 10 workers' death. This accident is one of the milestones in the sector that made authority to take action to improve controlling of HEPPs for ensuring security.

3.4 Economic Energy Indicators Assessment by EISD

Themes, sub-themes and energy indicators of economic dimension are given in Table 3.6. Indicators of economic dimension for which required data can be obtained are assessed one by one for Turkey in the following paragraphs.

In the modern century, all services of economy depend on reliable and sufficient energy supply. Energy supply feeds residential, transport, commercial and agricultural services and in turn increases productivity, employment and development. To meet the sustainability requirements energy should be available at all times, in adequate

amounts and with affordable prices (IAEA, 2005). Net energy imports and availability of critical fuel reserves is crucial to provide energy security.

ECO1: Energy use per capita

ECO1 indicator of Overall Use sub-theme and Use and Production Patterns theme is concerned with energy use per capita. It is a measure of energy use level reflecting the energy use patterns such as total primary energy supply, total final consumption, and electricity use. Energy is a vital requirement of a country's development. Since improper management of energy sources disturbed earth irreversibly by depleting sources and causing pollution in the past; energy management and energy efficiency should be improved. As can be seen from Figure 3.3, from 1990 to 2011 total installed capacity and net consumption per capita rapidly increased in Turkey indicating a continuous increase in energy demand. In Figure 3.3, domestic supply corresponds to the sum gross consumption and imports minus exports. Gross demand corresponds to the sum of gross generation and imports minus exports. Net consumption corresponds to supply minus network losses. Data points in Figure 3.3 belong to years in which population censuses were conducted.

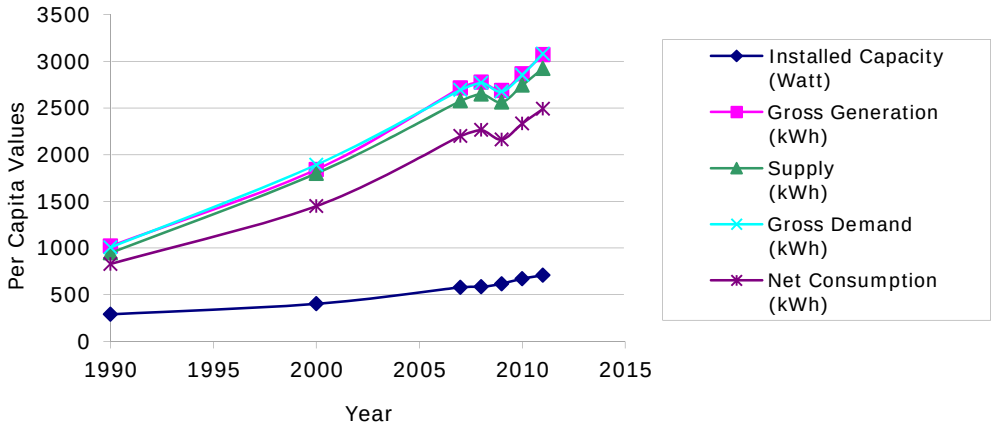

Figure 3.3 Annual Development of Installed Capacity, Gross Generation, Supply, Gross Demand and Net Consumption per Capita in Turkey (www.teias.gov.tr)

In EISD document it is stated that limited access to energy is a vital problem of developing countries where per capita use of energy is less than one sixth of that of the industrialized world (IAEA, 2005). In Table 3.4 of SOC3 assessment, energy use per capita values of OECD countries are given. Annual energy use per capita value of Turkey (1.3 toe) is less than one third of that of developed countries (4.0 toe) (Table 3.4). Table 3.4 shows that Turkey uses less energy per capita than developed countries' average, since technological and industrial development of the country have not been completed yet.

Table 3.6 Energy Indicators for Economic Dimension (IAEA, 2005)

Theme	Sub-Theme	Energy Indicator		Components
Use and Production Patterns	Overall Use	ECO1	Energy use per capita	– Energy use (total primary energy supply, total final consumption and electricity use) – Total population
	Overall Productivity	ECO2	Energy use per unit of GDP	– Energy use (total primary energy supply, total final consumption and electricity use) – GDP
	Supply Efficiency	ECO3	Efficiency of energy conversion and distribution	– Losses in transformation systems including losses in electricity generation, transmission and distribution
	Production	ECO4	Reserves-to-production ratio	– Proven recoverable reserves – Total energy production
		ECO5	Resources-to-production ratio	– Total estimated resources – Total energy production
	End Use	ECO6	Industrial energy intensities	– Energy use in industrial sector and by manufacturing branch – Corresponding value added
		ECO7	Agricultural energy intensities	– Energy use in agricultural sector – Corresponding value added
		ECO8	Service/commercial energy intensities	– Energy use in service/commercial sector – Corresponding value added

Table 3.6 (Continued)

		ECO9	Household energy intensities	– Energy use in households and by key end use – Number of households, floor area, persons per household, appliance ownership
		ECO10	Transport energy intensities	– Energy use in passenger travel freight sectors and by mode – Passenger-km travel and tonne-km travel and by mode
	Diversification (Fuel Mix)	ECO11	Fuel shares in energy and electricity	– Primary energy supply and final consumption, electricity generation and generating capacity by fuel type – Total primary energy supply, total final consumption, total electricity generation and total generating capacity
		ECO12	Non-carbon energy share in energy and electricity	Primary supply, electricity generation and generating capacity by non-carbon energy – Total primary energy supply, total electricity generation and total generating capacity
		ECO13	Renewable energy share in energy and electricity	– Primary energy supply, final consumption and electricity generation and generating capacity by renewable energy – Total primary energy supply, total final consumption, total electricity generation and total generating capacity

Table 3.6 (Continued)

	Prices	ECO14	End-use energy prices by fuel and by sector	– Energy prices (with and without tax/subsidy)
Security	Imports	ECO15	Net energy import dependency	– Energy imports – Total primary energy supply
	Strategic Fuel Stocks	ECO16	Stocks of critical fuels per corresponding fuel consumption	– Stocks of critical fuel (e.g. oil, gas, etc.) – Critical fuel consumption

Less energy use per capita may indicate very high-energy efficiency when developed countries are considered (IAEA, 2005), but it is known that this is not the case for Turkey. In long-term the primary concern of sustainability is decreasing the use of per capita by increasing the efficiency. This indicator is important for Turkey since energy use per capita rapidly increases.

ECO2: Energy use per unit of GDP

ECO2 indicator of Overall Productivity sub-theme and Use and Production Patterns theme is concerned with energy use per unit of GDP. Trends in overall energy use relative to GDP are reflected by this indicator. Energy intensity is the ratio of energy use to economic output. The indicator searches energy intensities; generally the relationship between energy use and economic development. Improving energy efficiency is an important sustainable development objective. Energy efficiency is defined as "using less energy to provide the same service" (Lawrence Berkeley National Laboratory). Energy intensity results address different meanings for different economy structures, geography, climate, or different sectors. A country having cold climate may consume more energy per capita for heating, whereas a country having hot climate consumes for air conditioning. A country that has banking and trading based economy uses less energy per unit of GDP than one which has economy based on industry (IAEA, 2005). While monitoring the energy intensity, structure of the economy of a country should be taken into account.

Total primary energy supplies per unit of GDP for OECD countries are used in this study. Figure 3.4 shows total primary energy supply (TPES) per thousand US dollars of GDP (www.oecd-ilibrary.org). The ratios are calculated by dividing each country's annual TPES by each country's annual GDP expressed in constant 2000 prices and converted to US dollars using purchasing power parities for the year 2000 (www.oecd-ilibrary.org). Purchasing Power Parity (PPP) is a theory which states that exchange rates between currencies are in equilibrium when their purchasing power is the same in each of the two countries (fx.sauder.ubc.ca). Decrease in energy consumption per GDP values all over the world (except Iceland in Figure 3.4) from 2000 to 2010 indicates that energy efficiency increased in the industry in the past 10 years. Since Luxembourg is a banking country; it has a small amount of industrial generation even if public welfare status is high. Germany, as an industrialized country has a similar ratio to Turkey but for different reasons. Germany’s GDP value is high as well as energy supply so the energy use per unit of GDP is around 0.15 toe per thousand 2000 US dollars which is similar to that of Turkey’s. On the other hand, in Turkey, GDP value is low as well as energy supply due to its still developing industry.

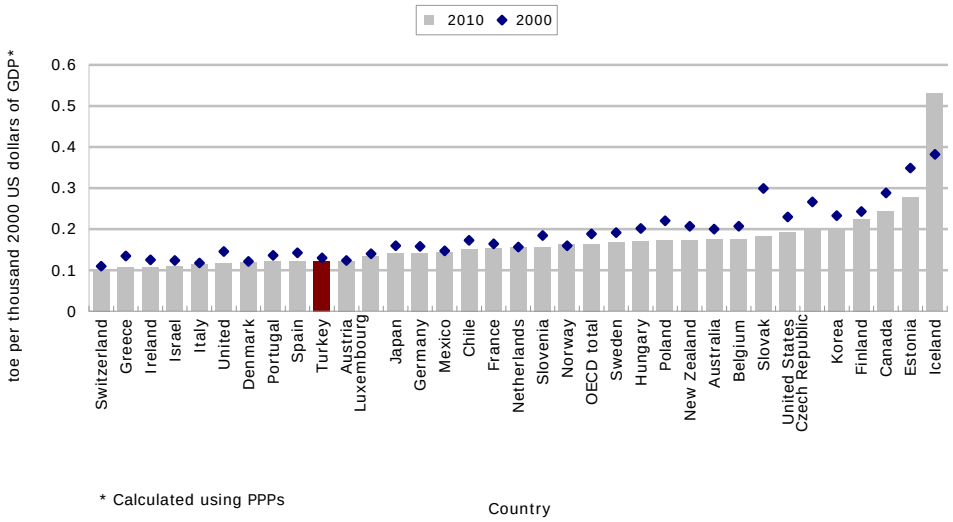

Figure 3.4 Total Primary Energy Supply per unit of GDP for OECD Countries (www.oecd-ilibrary.org)

Monitoring electricity use per GDP is another indicator of efficiency. In Figure 3.5 ratio of electricity use to GDP for OECD countries are given. Turkey seems to stay somewhere near the average in terms of electricity consumption per GDP. As a developing country, at first both values of Turkey, GDP and electricity consumption are expected to be high as a result of technological development. Then, electricity consumption per GDP should decrease causing efficiency to increase to maintain sustainable development. All over the world, decreasing energy intensity and increasing efficiency is one of the most crucial goals emphasized for sustainable development.

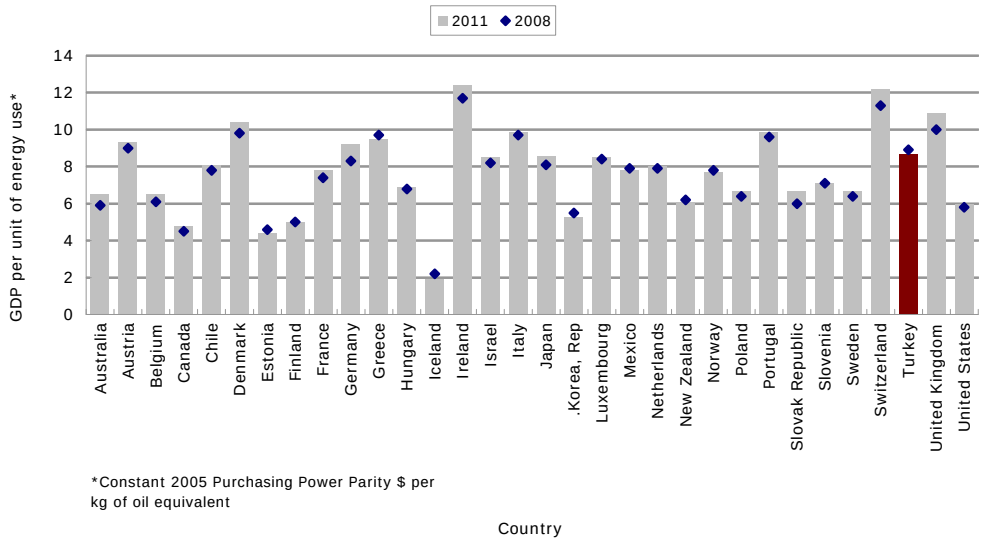

Figure 3.5 Electricity use to GDP for OECD Countries (data.worldbank.org)

ECO3: Efficiency of energy conversion and distribution

ECO3 indicator of Supply Efficiency sub-theme and Use and Production Patterns theme is concerned with efficiency of energy conversion and distribution. The indicator assesses the efficiency of energy conversion and distribution systems for various energy supply systems. Losses occur during electricity transmission and distribution, which should be minimized. Eurostat, International Energy Agency (IEA), International Atomic Energy (IAEA), World Bank, and United Nations collect reliable national data internationally. Energy conversion should be evaluated considering different economy types that are unique to the country. For instance, neolithic communities having energy conversion efficiency of 100% does not mean anything since they don't have any energy transformation processes.

Electricity conversion and distribution efficiency is defined as the ratio of final electricity consumption to electricity supply (IAEA, 2005). Electric power transmission and distribution losses (% of output) given in Figure 3.6 include losses in transmission between sources of supply and consumers (data.worldbank.org).

In Figure 3.6 it is seen that electric conversion and distribution losses of Turkey have an increasing trend. However, electric conversion and distribution losses tend to decrease between 2010 and 2012. Decrease in electric conversion and distribution losses is an expected effect of developing technology. However, Turkey's electricity conversion and distribution losses are still highly above world's and OECD countries' losses. Improvements in the efficiency of energy supply systems and decreasing losses are very important for effective utilization of resources. Energy intensities for different sectors (industrial, residential, construction, transport, agricultural etc.) should be developed. To decrease high distribution losses and illegal utilization, government should take necessary precautions. This indicator is important as one of the most important goals of developing countries is using energy in the most efficient manner.

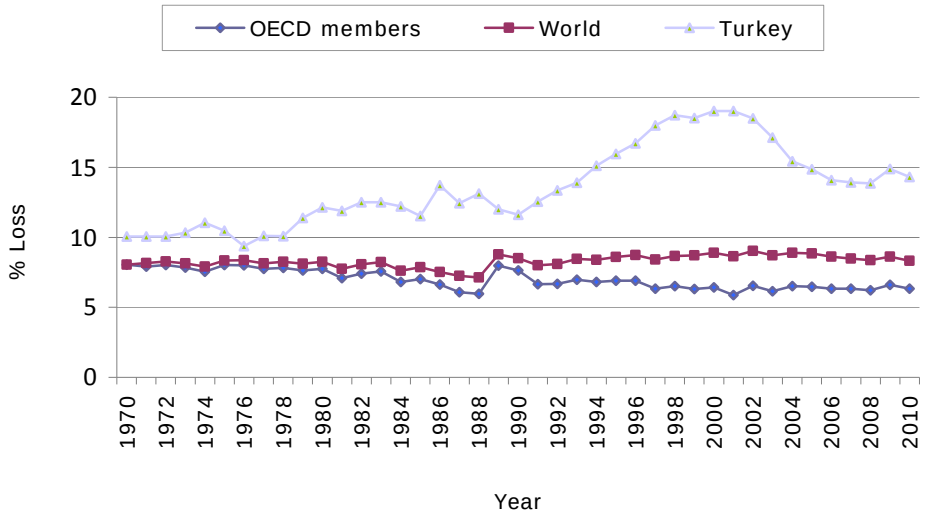

Figure 3.6 Electric power transmission and distribution losses (% of output) (data.worldbank.org)

ECO4: Reserves-to-production ratio

ECO4 indicator of Production sub-theme and Use and Production Patterns theme is concerned with reserves to production ratio. Identified resources that are economically recoverable at the time of assessment are defined as reserves (IAEA, 2005). The indicator aims to measure the availability of national energy reserves with respect to fuel production. In Figure 3.7 ratio of yearly development of installed capacity reserves of Turkey's electricity system for continuing years is given.

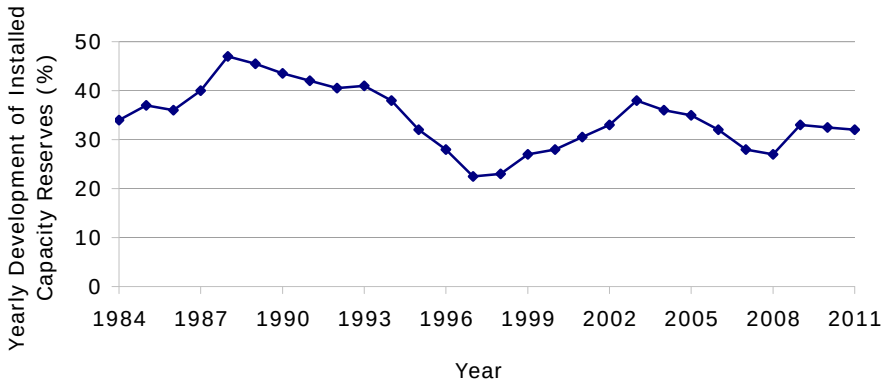

Figure 3.7 Yearly Development of Installed Capacity Reserves of Turkey (www.epdk.gov.tr)

In Table 3.7, Turkey's yearly reserve to production ratio values are given for 2010 and 2012. It can be seen from Table 3.7 that while the average ratio is 19% in 2010, the

value decreased to 15% in 2012. This indicator emphasizes the importance of regular management of energy reserves as a guarantee of estimating future supplies with respect to current availability.

Table 3.7 Turkey's Energy Demand Reserves Values and Reserves to Production Ratio (www.epdk.gov.tr)

2010			2012		
Turkey's Demand (10^6 kWh)	**Energy Reserves (10^6 kWh)**	**Reserves to Production Ratio**	**Turkey's Demand (10^6 kWh)**	**Energy Reserves (10^6 kWh)**	**Reserves to Production Ratio**
202730.00	38789.74	0.19	244026.28	35765.32	0.15

ECO9: Household energy intensities

ECO9 indicator of End Use sub-theme and Use and Production Patterns theme is concerned with amount of total residential energy used per person or household or unit floor area (IAEA, 2005). Although no international standards are set for energy efficiency in houses, thermal standards for new homes are in effect in almost all OECD and East European countries, and colder climate countries. Home energy standards for home appliances, efficiency standards for new electric appliances are some other precautions taken in the world (IAEA, 2005).

In Table 3.8, it is seen that Turkey's energy consumption per capita by households was considerably below that of developed countries in 2005 (smaller than one tenth of United States and Canada). More recent data of energy consumption per capita by households for Turkey is not available to compare them with those of different countries. The highest energy consumption per household is seen in Norway, which has cold climate conditions. In colder countries, the space-heating component has been the basis of energy saving policies whereas in almost all countries electric appliance and lightning component are the main items for energy saving. As can be seen in Table 3.8, India, as an undeveloped country has the smallest energy consumption per capita by household. Mexico, as a developing country has a similar value to Turkey's.

Household population is another important value that affects the resultant household consumption per capita value. As the number of house population decreases, energy use per household decreases, whereas energy use per capita increases (IAEA, 2005). In Turkey household population decreased from 4.5 to 3.76 between 2000 and 2011 resulting in a larger energy use per capita value for the country (www.tuik.gov.tr).

Table 3.8 Electricity Consumption by Households (per capita) of Different Countries (www.nationmaster.com)

Country Name	Electricity Consumption by Households (kWh per capita)
United States	4,585.63
United Kingdom	1,939.53
Canada	4,674.63
Germany	1,719.43
Greece	1,519.72
India	94.436
Mexico	413.506
Norway	7,246.77
Turkey	**429.265**

Energy used for households is usually recorded by governmental statistical institutes. Household sector should be separated from commercial sector; and non-commercial fuel use of households should also be recorded. According to TÜİK, energy consumption per household rapidly increased to 7364000 toe from 392700 toe from 2000 to 2010 (www.tuik.gov.tr). The statistical data may include information such as number of meals cooked, kilograms of clothes washed, liters of hot water provided, meter squares of the houses, area and time heated etc. (IAEA, 2005). This type of statistical information is not available for Turkey. It is recommended that energy consumption by household related data should be collected and made publicly available.

ECO10: Transport energy intensities

ECO10 indicator of End Use sub-theme and Use and Production Patterns theme is concerned with energy consumption per unit of passenger-km and freight-km. Transportation is a major use of energy as it serves for economic and social development by distributing goods and services. The measurement of how much energy is used for transportation services of people and goods is important to evaluate sustainable development.

Energy use for transport leads to air pollution and in return to climate change. United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol are indirectly ordering transportation energy usage limitations (IAEA, 2005). For the new produced automobiles, the European Union commitments of European, Korean and Japanese car manufacturer associations require reductions of CO_2 emissions per kilometer (IAEA, 2005). Many developed countries have targets for reducing energy intensity to decrease energy utilization and carbon emissions.

Reducing the energy intensity in transport should be a global goal to reduce the environmental impacts of transport.

In Figure 3.8, general energy use per person in goe/passenger-km for all types of passenger transportation is given. Cars require about four times more energy per passenger-km than public transport (trains, bus), and five times that of rail transport (trains, metros, tramways) (ODYSSEE). In Figure 3.8, it can be seen that public transport should be developed (especially railway and bus) in order to decrease utilization of individual cars as a precaution to increase sustainability score of any country.

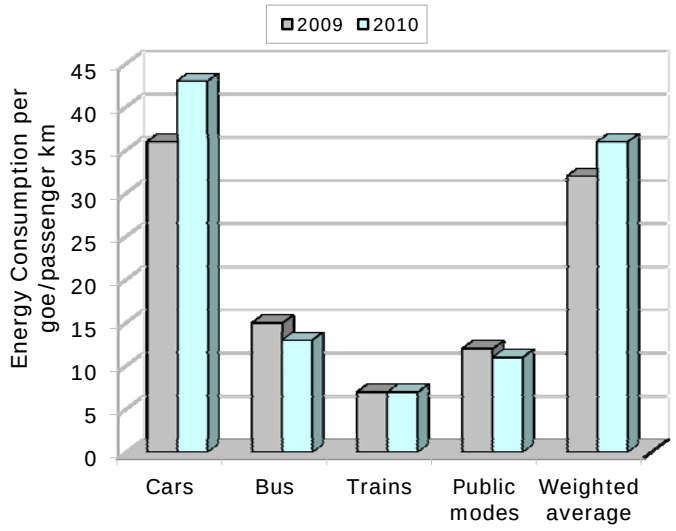

Figure 3.8 Energy Consumption per Unit Transporting in different Passenger Transportation Types (ODYSSEE)

Freight and passenger road traffic has increased very rapidly since 1990 in Turkey (OECD, 2008). In Figure 3.9 and Figure 3.10, index of relative change since 1990 based on values for freight transportation and passenger transportation for Turkey are given, respectively. For cars, the specific energy consumption per passenger-km has decreased by 0.9%/year since 1990 whereas it has slightly increased for public transportation in Turkey (OECD, 2008). As can be seen in Figure 3.9 and Figure 3.10, freight and passenger road traffic has increased more than 150% or twice the rate of increase in GDP since 1990. However, road traffic volume per capita (800 vehicle-km/person in 2004) of Turkey was still one-tenth of the OECD average in 2005 (TCDD, 2005). In Turkey, the railway network has been extended slightly since 1990, to 11 000 km, and the length of electrical railway has increased to about 2 500 km (TCDD, 2005). Freight traffic by rail has slightly increased (Figure 3.9), while passenger traffic by rail (and bus) has decreased (Figure 3.10). On the other hand, air traffic doubled between 2003 and 2006; and reached to around 60 million passengers in 2006 (OECD, 2008).

.

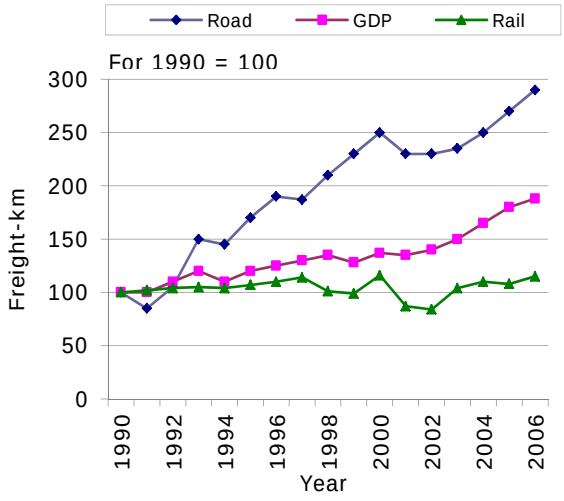

Figure 3.9 Freight Transportation for Turkey (tonne-km) (OECD, 2008)

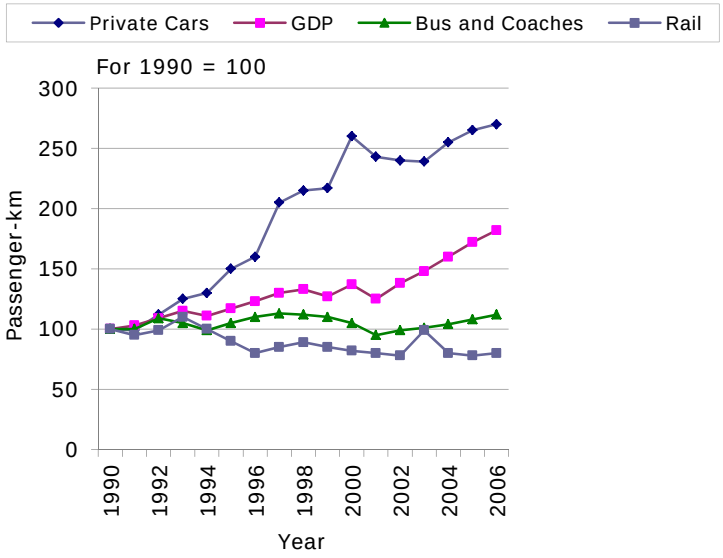

Figure 3.10 Passenger Transportation for Turkey (passenger-km) (OECD, 2008)

In Figure 3.11, private car ownership status of Turkey is compared with selected OECD countries. Motor vehicle ownership per capita (8 vehicles/100 persons) is one-sixth of the OECD average (OECD, 2008). Although private car ownership of the country is less than OECD countries due to country's considerably poor economical welfare capacity, 80% of energy consumption is due to road transportation (OECD, 2008).

As can be seen in Figure 3.9 and Figure 3.10, freight transportation and passenger transportation has tripled since 1990 in Turkey, which is an alert. Public transport

should be encouraged to decrease energy used per passenger-km. Rail transport opportunities should be increased to reduce energy used per freight-km. Environment friendly automobiles usage should be promoted both for protecting the environment and saving energy.

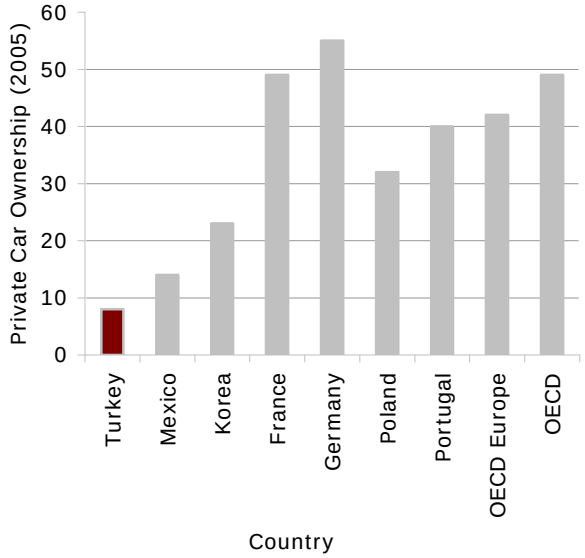

Figure 3.11 Private Car Ownership for selected OECD Countries (OECD, 2008)

ECO11: Fuel shares in energy and electricity

ECO11 indicator of Diversification sub-theme and Use and Production Patterns theme is concerned with fuel shares in energy and electricity supply. The indicator searches total primary energy supply and total final consumption of a country. The indicator assesses shares of energy from different sources and provides a useful picture of the primary energy supply mix of the country and shows the extent of energy diversification. Proper energy supply mix for an individual country is a key determinant of energy security that affects energy intensities.

Energy supply mix has a major effect in terms of environmental dimension since each source has different impacts including: (i) local and atmospheric pollution caused by burning of fuels, (ii) climate change caused by emission of GHGs, (iii) land use as a result of hydroelectric reservoirs etc., and (iv) risks of fuel chain cycles such as radioactive emissions, fires, explosions etc. (IAEA, 2005).

In some of the countries, supplying 21% of electricity from renewable sources is set as a target according to European Union's suggestion in 2010 (europa.eu). Turkey generated 26.4% of its electricity from renewable sources in 2010 (www.tuik.gov.tr). The ratio shows that Turkey meets the limits in that aspect. Although Turkey meets

21% target, renewable energy supply share was only 7% (Figure 3.12) in 2011 (www.enerji.gov.tr). As a developing country, Turkey encourages investments of renewable energy sources to enhance sustainable development (www.eie.gov.tr).

As can be seen from Figure 3.12, natural gas had the largest share of energy sources very closely followed by solid fuel and petroleum for Turkey in year 2011; followed by 7% share of renewable energy (in toe).

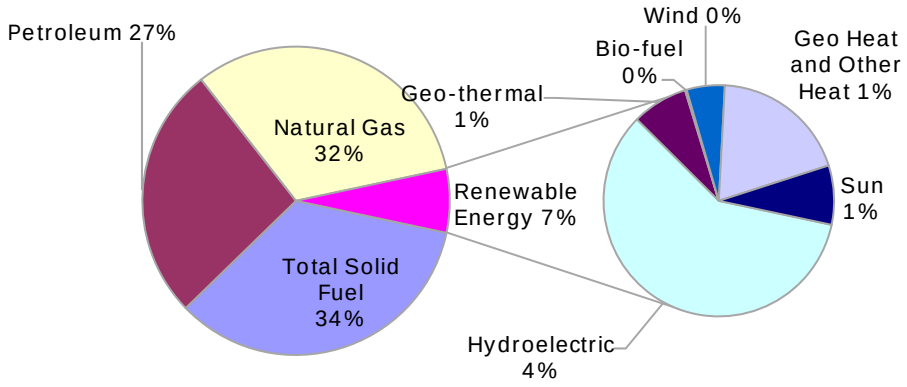

Figure 3.12 Turkey's Primary Energy Sources Distribution according to Supply for year 2011 (www.enerji.gov.tr)

In Figure 3.13, it is seen that renewable energy share in total consumption is 7% for year 2011. Hydroelectric's share out of 7% is negligible (in toe).

As a developing country, Turkey has to supply reliable, inexpensive, and high quality energy. As can be seen in Figure 3.12, main energy sources of Turkey are solid fuel, natural gas and hydropower. Since almost all the natural gas and coal is imported, hydropower is the main domestic source (Kentel, 2013; Alp, 2013). In 2012, Turkey has 140,000 GWh/year viable hydroelectric potential, 35% of which is used (www.enerji.gov.tr). To conclude, increasing the share of hydropower in Turkey's energy supplies will reduce dependency on foreign energy sources.

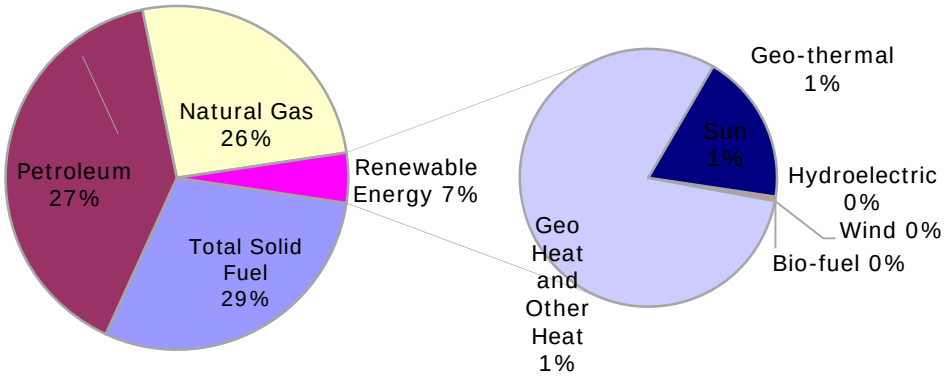

Figure 3.13 Turkey's Total Final Consumption of Energy for year 2011 (www.enerji.gov.tr)

ECO13: Renewable energy share in energy and electricity

ECO12 indicator of Diversification sub-theme and Use and Production Patterns theme is concerned with non-carbon energy share in energy and electricity. Increasing the share of non-carbon fuels reduces GHG emissions. Since non-carbon energy types are hydropower, biomass, wind, solar, geothermal, and ocean energy which are also renewable energy types (Nature, 2008), both ECO12 and ECO13 sub-themes are linked to each other and analyzed under ECO13.

Share of non-carbon fuels reduces the rate of greenhouse emissions and other pollutants that positively affect air quality as well as regional acidification (IAEA, 2005). White Paper sets a target of 12% of gross inland energy consumption from renewable energy types (European Union, 1997). At the World Summit on Sustainable Development in Johannesburg in 2002, it was agreed that global share of renewable energy sources should be increased urgently (Doran, 2002). European Union set an objective for increasing electricity production from renewable energy sources to 21% in 2010 (europa.eu). As stated before in ECO11 assessment, Turkey meets this target.

In Figure 3.12, it can be seen that only 7% of the total supply consisted of renewable energy sources in Turkey in 2011. Approximately 4% of this share is from HEPP. General Directorate of Renewable Energy states that Turkey's most important and largest renewable energy source is hydroelectric energy (www.eie.gov.tr). In order to increase sustainability score of Turkey, renewable energy supplies must be increased especially by utilizing hydroelectric capacity of Turkey as much as possible.

Turkey faces the challenging problem of maximizing hydropower utilization while minimizing its environmental impacts. To enhance sustainable development, especially environmental concerns should be strictly taken into consideration in implementation and operation stages of HEPPs.

ECO14: End-use energy prices by fuel and by sector

ECO14 indicator of Prices sub-theme and Use and Production Patterns theme is concerned with energy prices. Energy prices have crucial economic importance. Suitable prices and taxes of energy can encourage efficient energy usage and improve access levels. If the commercial energy prices are very high and a secure and reliable energy supply is not available, investors will not be attracted. For developing countries, it is necessary to increase energy availability and encourage industry sector for sustainable investments.

Two types of energy consumption is reviewed; for industry and for households. Electricity prices for industry are given in Figure 3.14, whereas electricity prices for household in some of OECD countries, average of OECD countries and Turkey are given in Figure 3.15. As can be seen from Figure 3.14, Turkey has the highest cost of energy for industry when compared to OECD countries, with an exception of United Kingdom between years 2006 and 2008. It can be concluded from Figure 3.14 that, energy is very expensive for industry sector in Turkey and these prices may discourage investors.

As a result, it is seen that, using appropriate pricing policies to overcome inefficiencies, increase energy availability and affordability for the lowest income groups, and encourage investment of alternative renewable energy options to promote social and economic development are very important for developing countries, like Turkey.

In Figure 3.15, electricity prices for households of Turkey are compared with OECD countries. As can be seen, Turkey stands at average in terms of energy prices for household.

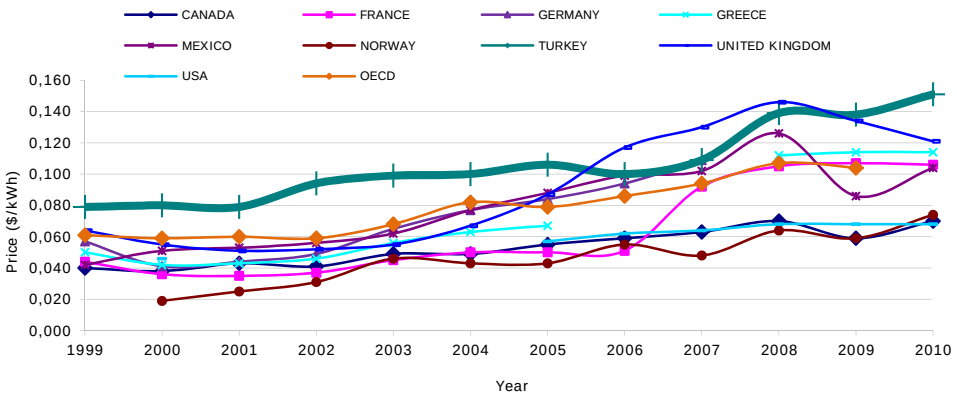

Figure 3.14 Electricity Prices for Industry in selected OECD Countries (www.teias.gov.tr)

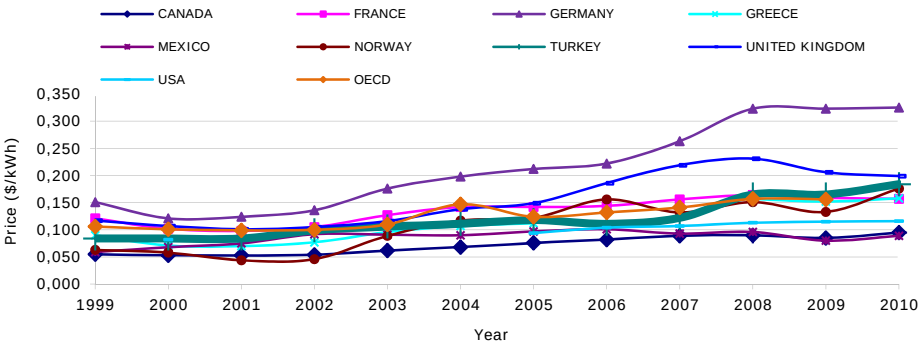

Figure 3.15 Electricity Prices for Households in selected OECD Countries (www.teias.gov.tr)

ECO15: Net energy import dependency

ECO15 indicator of Imports sub-theme and Security theme is concerned with net energy import dependency. A stable supply in a country should be maintained to ensure sustainable development. The indicator measures a country's percentage of relying on imports to meet its energy demand. Meeting the energy requirement, decreasing import dependency, increasing national production, increasing energy efficiency, optimizing fuel mix, and diversifying fuel sources are among important goals of energy policy (IAEA, 2005). There is no international standard assigned; but in some countries there is a restricted level to which a country can rely on import (IAEA, 2005).

A country that relies on imported energy faces two main problems: the quantity risk and price risk. To overcome the risks, import dependency should be limited with the

policies of increasing domestic energy production. In Figure 3.16, it can be seen that Turkey's energy import and consumption amount increases year by year whereas production amount has a more stable look restricted in a range giving an alert of quantity risk. It is seen that, Turkey lost its capability of producing its own energy in 1989.

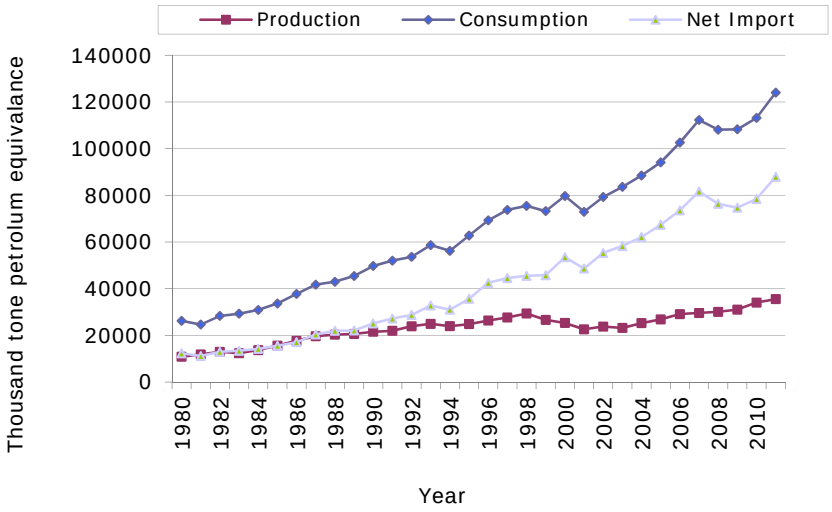

Figure 3.16 Turkey's thousand tone petroleum equivalence view of Production, Net Import and Consumption (www.eia.gov)

Energy import to consumption ratio for Turkey is given in Figure 3.17. This indicator is marked as important for Turkey since dependency rapidly increases according to Figure 3.17. Urgent precautions must be taken to minimize dependency to enhance sustainable development.

Decreasing dependency can be achieved by increasing domestic energy usage. As a precaution, the following items are identified by the Ministry of Energy and Natural Resources of Turkey (www.enerji.gov.tr):

- Utilization of domestic resources should be prioritized to reduce dependency on imported energy sources.
- Renewable energy share should be increased.
- Adverse environmental impacts of production and utilization of natural resources should be minimized.

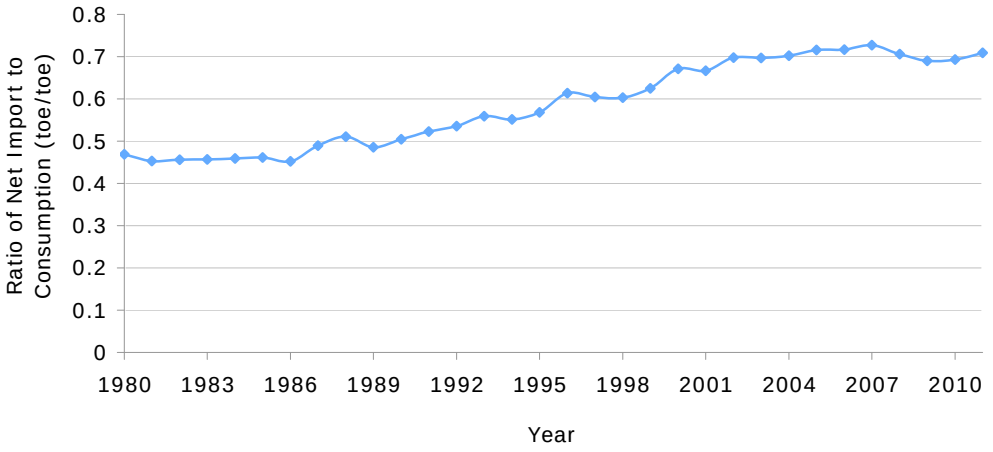

Figure 3.17 Turkey's Net Import to Consumption Ratio (www.eia.gov)

3.5 Energy Indicators for Environmental Dimension

Themes, sub-themes and energy indicators of environmental dimension are given in Table 3.9. Indicators of environmental dimension for which required data can be obtained are assessed one by one for Turkey.

The production, distribution and usage of energy create a pressure on the environment. The generation and consumption of energy, the fuel mix, the structure of the energy systems have environmental impacts on the public, workplace and city in regional, national and global levels (IAEA, 2005). Some of the environmental problems that depend on "how energy is produced and used" are listed as follows (IAEA, 2005):

- Burning of fossil fuels causes air pollution as a result of gas emissions.
- Large dams cause silting.
- Radiation is emitted and waste is generated by coal and nuclear fuel cycles.
- Wind turbines ruin the pure countryside.
- Firewood gathering leads deforestation and desertification.

Table 3.9 Energy Indicators for Environmental Dimension (IAEA, 2005)

Theme	Sub-Theme	Energy Indicator		Components
Atmosphere	Climate Change	ENV1	Green House Gas (GHG) emissions from energy production and use per unit of Gross Domestic Product (GDP)	– GHG emissions from energy production and use – Population and GDP
	Air Quality	ENV2	Ambient concentrations of air pollutants in urban areas	– Concentrations of pollutants in air
		ENV3	Air pollutant emissions from energy systems	– Air pollutant emissions
Water	Water Quality	ENV4	Contaminant discharges in liquid effluents from energy systems including oil discharges	– Contaminant discharges in liquid effluents
Land	Soil Quality	ENV5	Soil area where acidification exceeds critical load	– Affected soil area – Critical load
	Forest	ENV6	Rate of deforestation attributed to energy use	– Forest area at two different times – Biomass utilization
	Solid Waste Generation and Management	ENV7	Ratio of solid waste generation to units of energy produced	– Amount of solid waste – Energy produced
		ENV8	Ratio of solid waste properly disposed of to total generated solid waste	– Amount of solid waste properly disposed of – Total amount of solid waste
		ENV9	Ratio of solid radioactive waste to units of energy produced	– Amount of radioactive waste (cumulative for a selected period of time) – Energy produced
		ENV10	Ratio of solid radioactive waste awaiting disposal to total generated solid radioactive waste	– Amount of radioactive waste awaiting disposal – Total volume of radioactive waste

Environmental indicators of EISD are grouped into three as: atmosphere, water and land. Climate change and air quality are the problems related with air pollution. GHG emissions are the main reasons of climate change. Acidification and emission of pollutants impact air quality negatively. High concentration of sulphur oxides, nitrogen oxides, carbon monoxide, particulates and tropospheric ozone in the air damages human health and leads cancer etc. (IAEA, 2005). Water and land quality are also important indicators of sustainable development. Water quality is disturbed due to solid wastes or discharge of contaminants in liquid effluents of energy plants (IAEA, 2005). Land is a natural resource compulsory for food growing and as a habitat for plants and animal communities. Deforestation of land causes erosion and soil loss.

ENV1: Greenhouse gas emissions from energy production and use, per capita and per unit of GDP

ENV1 indicator of Climate Change sub-theme and Atmosphere theme is concerned with greenhouse emissions amount from energy production and use assessing their impacts on climate change. During 20th century, earth's surface temperature increased around 0.6ºC and most of this warming is caused by increasing amounts of GHGs in the atmosphere (IAEA, 2005). The concentration of CO_2 has increased more than 30% since pre-industrial times, and continues at an increasing rate of 0.4% per year (IAEA, 2005). Increasing CH_4, N_20, NO, CO and non-methane volatile organic compounds concentration in the air changes atmospheric chemistry leading to an increase in tropospheric ozone, which is a GHG. GHG emissions lead some extreme weather changes, such as some areas being exposed to rainfalls and storms, and some to droughts. It is still uncertain when and where those changes will happen but especially developing countries are predicted to suffer from the impacts since they are not capable of dealing with and preparing for them (IAEA, 2005).

Turkey accepted an agreement at United Nations Framework Convention on Climate Change in 2004, and accepted the Kyoto Protocol in 2009. The Kyoto Protocol, adopted in 1997, has the target of decreasing emission of the sum of six main GHGs (CO_2, CH_4, N_2O, HFC, SF_6, PFC) by at least 5% below 1990 levels in the commitment period 2008-2012 (UNFCC, 1997).

In Table 3.10, total greenhouse emissions, and sectorial contributions for Turkey are given. It can be seen in Table 3.10 that between years 1990 to 2009 total greenhouse emissions in the energy sector increased nearly two times, which can be identified as an alert. In year 2009, greenhouse emissions caused by the energy sector is responsible for 75.3% of the total emissions. CO_2 emissions increased a lot, whereas N_20 and CH_4 emissions have not changed a lot during the same period. These results show that the country has to take immediate precautions. Some of the precautions to be taken are given below (www.emo.org.tr):

- To use all renewable energy potential and increase production capacity
- To revise current production systems and promote new technologies
- To increase efficiency
- To increase public awareness on saving energy

Table 3.10 Total Greenhouse Emissions according to Sectors (www.tuik.gov.tr)

	Total Greenhouse Emissions according to Sectors (million ton CO_2 equivalent)							
	1990	**1995**	**2000**	**2005**	**2006**	**2007**	**2008**	**2009**
CO_2	141.36	173.90	225.43	259.61	276.72	307.92	297.12	299.11
CH_4	33.50	46.87	53.30	52.38	53.33	55.58	54.29	54.37
N_2O	11.57	16.22	16.62	14.18	15.55	12.35	11.57	12.53
HFCs	0.00	0.00	0.82	2.38	2.73	3.17	2.67	2.84
PFCs	0.60	0.52	0.52	0.49	0.40	0.00	0.00	0.00
SF_6	0.00	0.00	0.32	0.86	0.91	0.95	0.84	0.80
Total (except field usage)	187.03	237.51	297.01	329.90	349.64	379.98	366.50	369.65
Energy	132.30	160.	212.55	241.75	258.56	288.69	277.71	278.33
Industrial Processes	15.44	24.21	24.37	28.78	30.70	29.26	29.83	31.69
Agriculture	29.78	28.68	27.37	25.84	26.50	26.31	25.04	25.70
Waste	9.68	23.83	32.72	33.52	33.88	35.71	33.92	33.93
Field Usage and Field Usage Changes	-44.87	-61.84	-67.56	-69.53	-75.94	-76.27	-80.58	-82.53
Change according 1990 (except field usage)	100.00	126.99	158.80	176.39	186.95	203.16	195.96	197.64

ENV2: Ambient concentrations of air pollutants in urban areas

ENV2 indicator of Air Quality sub-theme and Atmosphere theme is concerned with ambient concentrations of air pollutants in urban areas. High population, industrial regions, and traffic causes air pollution affecting human health and vegetation. This indicator should be used to improve air quality policies to save humanity from health

problems caused by ambient air pollution as a result of energy use in households, transportation, power stations, industry, etc.

In Figure 3.18, annual average particulate matter concentrations of OECD countries are given. Particulate matter concentrations have a decreasing tendency in all countries within recent years. It is seen that Turkey performs very bad compared to other OECD countries.

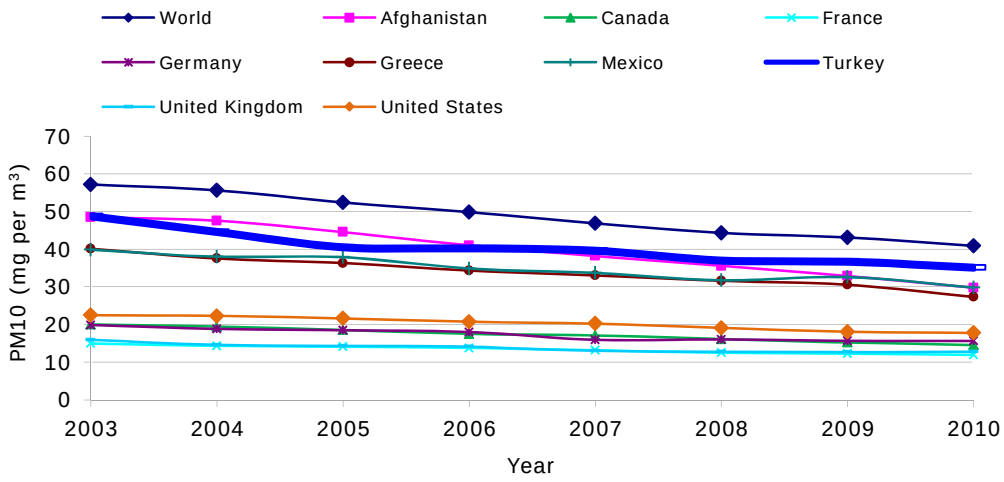

Figure 3.18 Annual Average Particulate Matter Concentrations (data.worldbank.org)

In Table 3.11 Turkish ambient air quality standards (from 2014 on) which are regulated under the Air Quality Assessment and Management Regulation (Official Gazette dated 06th of June 2008 and numbered 26898) are given. When the values given in Figure 3.18 are compared with PM10 standards in Table 3.11, it is seen that Turkey satisfies its requirements. Moreover in the following ENV3 assessment, it is seen that Turkey is near to meet its target values using the average values in Appendix B.

Table 3.11 Turkish Ambient Air Quality Standards (www.eib.org)

Substance	Concentration of Hourly Average ($\mu g/m^3$)	Concentration of Daily Average ($\mu g/m^3$)	Concentration of Annual Average ($\mu g/m^3$)
CO	-	10000 (daily and also for 8 hours periods)	10000
NO_2	300 (200 from 2024 on)	-	60 (40 from 2024 on)
SO_2	500 (350 from 2019 on)	250 (125 from 2019 on)	150 (no long-term standard from 2019 on)
PM10	-	100 (50 from 2019 on)	60 (40 from 2019 on)

ENV3: Air pollutant emissions from energy systems

ENV3 indicator of Air Quality sub-theme and Atmosphere theme is concerned with air pollutant emissions from energy systems. Pollutants of concern are acidifying substances (SO_x, NO_x), ozone-farming gases (VOCs), CO and fine particulates. This indicator evaluates the national policy of the country in terms of air pollution caused by transportation and power generation.

This indicator tells about the impact of human activities on earth. These activities include (IAEA, 2005):

- SO_x and NO_x acidification causes soil and water pollution.
- Buildings sensitive to the acidifying materials are damaged in case of bad air quality index.
- VOCs, NO_x and CO forms tropospheric ozone directly affecting human and animal health and vegetation.
- High atmospheric concentrations of particulates and VOCs affect human health and ecosystem.

Air Quality index (AQI) is used to identify a region's situation in terms of air quality. AQI is an indicator of air quality, based on air pollutants that have adverse effects on human health and the environment (www.airqualityontario.com). In Table 3.12, assessment range values and colors of AQI are given in six categories from very good to very bad (www.havaizleme.gov.tr). In Appendix B, a table of air pollutants for all stations of Turkey for 19th of March 2013, 22:00 is provided (www.havaizleme.gov.tr). Associated AQI values are calculated and given in Table

3.13. As can be seen from Table 3.13, all pollutants score "Good" to "Very Good" for Turkey for the selected time in 2013.

Table 3.12 Air Quality Index Values for Air Pollutants (www.havaizleme.gov.tr)

	SO_2	NO_2	CO	O_3	PM10
Air Quality Index	**Average of an hour (µg/m³)**	**Average of 24 hours (µg/m³)**	**Average of 24 hours (µg/m³)**	**Average of an hour (µg/m³)**	**Average of 24 hours (µg/m³)**
1 (Very Good)	0-50	0-45	0-1.9	0-35	0-25
2 (Good)	51-199	46-89	2.0-7.9	36-89	26-69
3 (Satisfactory)	200-399	90-179	8.0-10.9	90-179	70-109
4 (Moderate)	400-899	180-299	11-13.9	180-239	110-139
5 (Bad)	900-1499	300-699	14.0-39.9	240-359	140-599
6 (Very Bad)	>1500	>700	>40.0	>360	>600

Table 3.13 Evaluation of Turkey's Air Quality (for the given time: 19.03.2013, 22:00)

Average	**PM10**	**SO_2**	**NO_2**	**O_3**	**CO**
Air Quality Index	2.62	1.21	1.76	2.00	1.06
Range	Satisfactory -Good	Very Good -Good	Good -Very Good	Good	Very Good -Good

In Figure 3.19 average AQI Map of Turkey is given for 2013. Turkey's overall AQI map is more or less similar to the results obtained from the selected time (i.e. 19th of March 2013, 22:00). As green color symbolizes "good" score, Turkey's average is good. However, at the industrialized parts of the country in the west (İstanbul, İzmir etc.) the score is bad (grey color). Looking at the overall score, it can be said that this indicator is critical for only the industrialized parts of the country, provided that similar AQI maps are expected for different years. In industrialized cities such as İstanbul and İzmir, air quality should be improved.

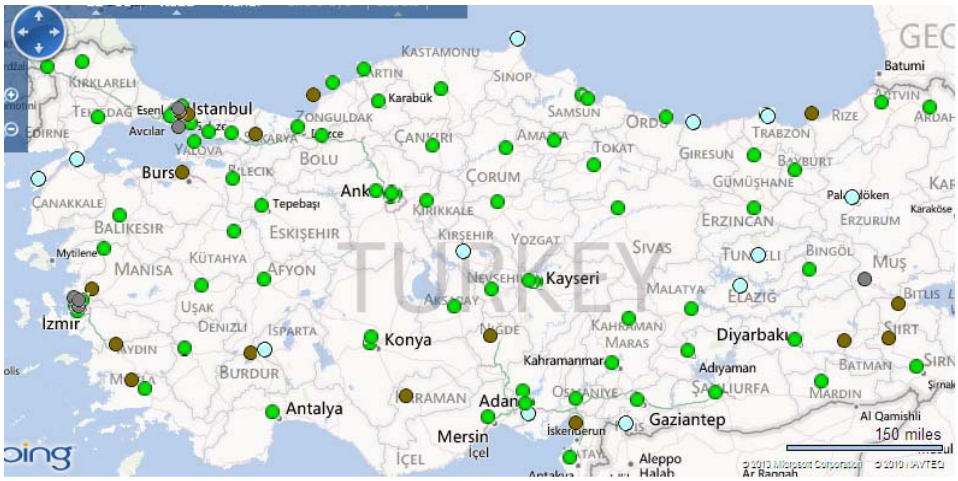

Figure 3.19 Air Quality Index Map of Turkey (www.havaizleme.gov.tr)

ENV4: Contaminant discharges in liquid effluents from energy systems

ENV4 indicator of Water Quality sub-theme and Water theme is concerned with contaminant discharges in liquid effluents from energy systems. Fresh water is vital for living things since it serves as drinking water source for human beings and farm animals, is used for crop irrigation, and provides habitat for plants and fish species and wildlife. Discharges of harmful pollutants into rivers, lakes and marine waters from energy industry, oil extraction, and coal mining should be monitored since water pollutants directly affect living beings' health.

Between 1992 and 2008, industrial wastewater discharges without treatment decreased by 10% in Turkey (OECD, 2008). During this period, out of 638 million m^3 of wastewater generated by manufacturing industry, about 36% is treated by industry, 7% by municipal wastewater treatment plants; 6% is released to rivers without treatment and 49% is discharged to the sea (OECD, 2008).

In Table 3.14, wastewater discharges of various sectors in Turkey are given for 2010. It is seen that thermal power plants have the largest contribution to overall wastewater discharges and this is an indicator of high water pollution due to energy sector. Although Turkey's wastewater discharges without treatment reduced within the years (OECD, 2008), wastewater treatment capacity is still limited in the country.

Table 3.14 Wastewater Amount for all Sectors for Year 2010 (www.tuik.gov.tr)

	Amount ($1000m^3$/year)	Share of Wastewater According to Sectors (%)
Total	9 097 001	100
Municipalities	3 500 230	38.5
Villages	191 163	2.1
Production Industry	1 040 828	11.4
Thermal Power Plants	4 163 475	45.8
Organized Industrial Zones	159 728	1.8
Pit Minings	41 577	0.5

ENV6: Rate of deforestation attributed to energy use

ENV6 indicator of Forest sub-theme and Land theme is concerned with the rate of deforestation for energy use. Forests have many ecologically, socio-economically and culturally crucial roles since they serve many resources, such as wood products, recreational areas, and as a habitat for wildlife. Forests have many beneficial functions such as filtering pollutants, supporting biodiversity and conserving water and soil.

It is estimated that between 1980 and 1990 the global forest area decreased by 180 million hectares (IAEA, 2005). Deforestation is a vital problem especially in developing countries, whereas in developed countries volume of fuel wood consumption is negligible (IAEA, 2005).

Moreover, deforestation is one of the most important problems associated with HEPPs in Turkey. During the implementation stage of some of the HEPP projects, forests are cut down more than predicted (TMMOB, 2012).

Figure 3.20 shows the deforestation amount for fuel wood in Turkey. Forest degradation due to unsustainable practices in the past was a crucial issue threatening the country's forest possessions (www.tema.org.tr). Deforestation shows a decreasing tendency within the given 22 years, which can be assessed as a good development in terms of sustainability for Turkey. However, rural communities' dependency on wood for heating and cooking continues. Deforestation should be properly controlled and managed by legislations and law. For instance, some countries have limits for deforestation and targets for the extent of forest area. Forests must be protected by the government for the sake of supporting today and future generations' sustainable lives.

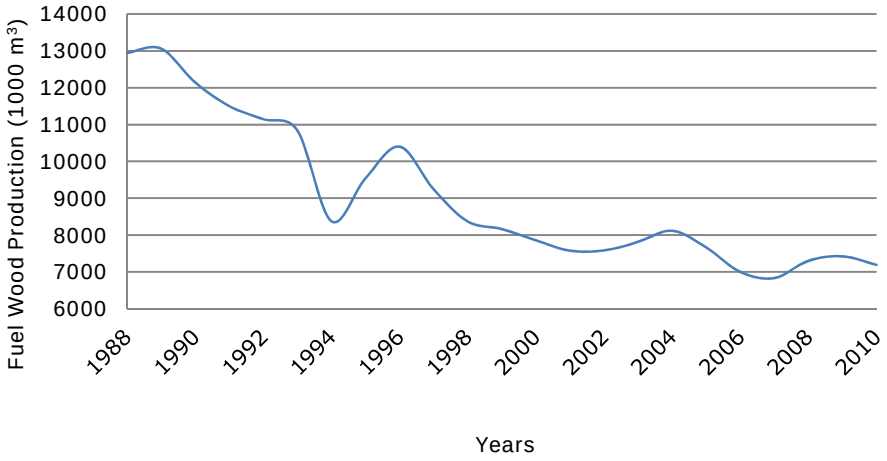

Figure 3.20 Fuel Wood Production in Turkey (web.ogm.gov.tr)

ENV9: Ratio of solid radioactive waste to units of energy produces

ENV9 indicator of Solid Waste Generation and Management sub-theme and Land theme is concerned with the solid radioactive waste generation per units of energy produced. Since there is no existing nuclear power plant in Turkey, this indicator is marked as irrelevant for today. However, the Turkish government is planning construction of nuclear power plant in the country. It means the indicator will be crucial in near future.

3.6 Assessment Results of Turkey according to EISD Application

Turkey is a developing country and it is in need of energy while transforming to an industrial economy. Turkey's energy sources should be utilized in a sustainable manner. In this chapter, Turkey is assessed using EISD indicators. During the assessment, official data obtained from governmental web-sites or documents and data obtained from international institutions are used. Only the indicators for which required data is available or partially available are assessed.

As a result of this analysis a general view of Turkey's status in terms of sustainable development is obtained. The most critical indicators that are marked as important according to Turkey's individual conditions as a result of EISD assessment are given and summarized below:

- SOC1: Share of households without electricity commercial energy, or heavily dependent on non-commercial energy
- SOC2: Share of household income spent on fuel and electricity

- SOC3: Household energy use for each income group and corresponding fuel mix
- SOC4: Accident fatalities per energy produced
- ECO1: Energy use per capita
- ECO2: Energy use per unit of GDP
- ECO3: Efficiency of energy conversion and distribution
- ECO9: Household energy intensities
- ECO10: Transport energy intensities
- ECO11: Fuel shares in energy and electricity
- ECO13: Renewable energy share in energy and electricity
- ECO15: Net energy import dependency
- ENV1: Greenhouse gas emissions from energy production and use, per capita and per unit of GDP
- ENV6: Rate of deforestation attributed to energy use

In SOC1 assessment, accessibility of electricity is identified as successful since there are no villages without electricity in the country in 2010 (TEİAŞ). However, validity of this information is questionable. There are some news on social forum sites in the Internet, media and social media (www.surmenehaber.com, www.yenibursa.com) about villages of Turkey that do not have electricity. Although author is aware of such inconsistencies, evaluations of EISD indicators are based on official data available at governmental web sites and published documents.

SOC2 assessment investigates percentages of expenditures on different items for different income groups. As a result, it is advised that burden of energy on poor people's budget should be decreased by supplying cheaper energy in the country.

SOC3 assessment is concerned with household energy use for each income group. Required data is not available. However, an overall assessment of the available information revealed that Turkey's energy consumption per household is much lower than those of developed countries' average. This might be interpreted as an indicator of the country being in the process of development. During the development phase energy use per household is expected to increase as utilization of technology will be more widespread in lower income groups.

SOC4 assessment is found to be very important for Turkey. In Turkey's history, there had not been any dam failures up to now which is a positive indicator of hydraulic engineers' and government's placing very high importance on dam safety. This approach sometimes leads to utilization of very high factor of safeties (i.e. more than required) and consequently increased construction costs. On the other hand, the same sensibility is not shown for labour conditions and prevention of work accidents. In SOC4 assessment, worker safety conditions are evaluated. The author can't access official number of fatal accidents per energy occurred in hydropower projects in

related official web sites or documents. However, it is followed from the Turkish media and NGOs' press statements that (ex: www.sendika.org and forumkaradeniz.wordpress.com), lots of accidents with injuries or fatalities occurred at HEPP construction sites due to carelessness and weaknesses of following related regulations. Fatal accidents occurred in HEPPs are collected from various sources and summarized in Appendix A. In SOC4 assessment, it is identified that work accident risks are estimated to be much higher than those of developed countries. Implementation of the HEPP projects accelerated in the last decade in Turkey as a governmental policy to utilize renewable energy potential as soon and as much as possible. Implementation of many projects within a limited time caused some problems regarding control mechanisms. Government's studies on controller practices for HEPPs still continue to ensure safety of workers and local people. Worker safety issues must be improved according to global standards and applied in a more responsible manner.

ECO1 assessment indicates the country's rapidly increasing energy use per capita as a developing country. If domestic energy sources are not used as much as possible, Turkey is expected to face a crucial energy deficiency problem according to the indicator.

ECO3 assessment indicates high percentage of conversion and distribution losses for the country when compared to those of developed countries. As a result, it is identified that, government must take some precautions to increase efficiency; and decrease high amount of distribution losses and illegal utilization.

In ECO4 assessment, Turkey's reserves-to-production ratio change is searched throughout the years to estimate future supplies with respect to current availability. As a result, it is seen that Turkey's reserves show a decreasing trend and better management of the reserves is necessary.

ECO9 assessment shows that Turkey's energy consumption per capita by households was considerably below that of developed countries in 2005 (i.e. smaller than one tenth of United States and Canada). Since the development of the country still continues, it is estimated that energy use per households will increase as household sector is one of the major energy consumers. Necessary precautions should be taken to promote green energy utilization in the household sector.

ECO10 assessment is an indicator of transport energy intensities. As a result of the assessment, it is advised that Turkey should take necessary precautions in compliance with international commitments. Turkey accepted Kyoto Protocol in 2009 (www.dsi.gov.tr), which should be followed. Some governmental precautions to be taken are encouraging public transport and utilization of environmental friendly automobiles.

ECO11 assessment indicates that Turkey has to supply reliable, inexpensive, and high quality renewable energy. Since HEPPs are identified as the most important renewable energy sources of Turkey by the General Directorate of Renewable Energy (www.eie.gov.tr), sustainable development of hydropower energy should be improved. In Turkey, sustainability of HEPP projects are assessed in EIA reports. However, preparation of EIA reports is disputable, and they are criticized for being unfair and unreliable by NGOs (www.tema.gov.tr). The companies that prepare EIA reports are accused of not including real negative impacts on the nature and local people or reporting all of the negative impacts as if they can be compensated even if this is not the real case. For instance, Ilısu Dam is one of the most problematic projects at its implementation stage in Turkey, which takes strong opposition from the environmentalists since construction site includes a very valuable cultural heritage area. A considerable part of Hasankeyf district, having 10000 years history will be relocated, and some unmovable parts will be flooded after impounding. This solution is not acceptable for some Turkish and global environmentalist groups so that they are still continuing to fight against the government about this project while it is currently being implemented at this problematic site (www.dsi.gov.tr).

ECO13 assessment indicates that renewable energy share in energy and electricity must be increased. Improvement of sustainable hydropower is very important to enhance this.

ECO15 indicates net energy import of the country. To decrease dependency, utilization of domestic sources in a sustainable manner is a must. Increasing the share of hydropower in Turkey's energy mix will reduce dependency on foreign sources.

ENV1 assessment of EISD is interested in the climate change issue. Environmental problems such as deforestation, soil erosion, biodiversity loss and climate change are major problems Turkey faces. The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats (TEMA) was founded in 1992 as an environmentalist NGO for increasing awareness on these topics (www.tema.org.tr). According to TEMA, at the Mediterranean Sea impacts of climate change are already seen (www.tema.org.tr). Since Turkey is not a water rich country, strong policies should be developed to mitigate and adapt to climate change impacts. Otherwise, droughts and water shortage are expected in the very near future.

ENV4 assessment indicates that thermal power plants have the largest contribution to overall wastewater discharges and this is an indicator of high water pollution due to energy sector which is important. Some crucial problems related with water are water pollution caused by industry and chemicals. TEMA, as Turkey's largest and leading environmental NGO, states the need for a water framework law to ensure fair solutions and penalize unsustainable practices. Some suggestions of TEMA related with ENV4 indicator are as follows (www.tema.org.tr):

- Legal regulation should be re-prepared as “Water Laws” concerning water rights, use and management in a transparent manner recognizing water as a basic living being right.

- Water inventory on ecological basins of Turkey should immediately be conducted to assess the current status with the measures and to conserve water assets.

- “Integrated basin management” should be respected and no HEPP should start without an obvious and proven approval from local people and other stakeholders. High attention should be given to big projects to identify all negative effects of those projects on catchment areas and water assets.

These items can be used as guidelines to develop necessary legal regulations in Turkey. EISD assessment provides general framework for evaluation of sustainable development. Specific indicators for Turkey can be identified using these suggestions.

In ENV6 indicator assessment, rate of deforestation attributed to energy use is evaluated. It is seen that wood utilization as fuel decreased through years in Turkey which is positive in terms of sustainability. However, another significant problem associated with the main renewable energy source of Turkey, hydropower, exists. Especially run-of river HEPPS cause high deforestation in the construction zone. Black Sea Region is the forest and river rich region of the country globally known for its natural beauties. In the Black Sea Region of the country many run-of river projects have been implemented and are being implemented. After the acceleration of HEPP projects in the last decade, many unsustainable implementations have been realized. NGOs have oppositions mainly against the run-of river projects whose installed capacities are smaller than 25 MW and don’t legally require EIA reports (www.dsi.gov.tr). Using all of the legal gaps, some HEPP license owners tend to implement projects that disturb the environment in an irreversible manner. Generating energy from a domestic resource such as hydropower will decrease electricity prices and average non-commercial use of wood by villagers. However, an irresponsible HEPP implementation results in too much deforestation damaging the nature. Optimum solutions for energy generation should be identified considering environmental and social issues.

The picture obtained from accessible data obviously shows that the country’s sustainable development status must be improved. In Table 3.15, evaluation capability of Turkey using EISD is summarized. Some of the required information to assess EISD cannot be found during the study. In Table 3.15, availability of data and the sources of these data can be seen. Unavailable and partially available data are advised to be improved. All related governmental institutions should compile recent data

related with required statistics for a more detail review of sustainable development. Moreover, it is advised to make all this data public on Turkish Statistical Institute's web page. Moreover, comparisons with other countries, both developed and developing, should be provided.

In this chapter EISD is used to evaluate sustainability status of Turkey. Based on the suggestions summarized above, EISD analysis is conducted and the indicators that should be given higher importance for Turkey are identified. One of the significant outcomes of the analysis is that to improve sustainability status of Turkey, renewable energy share must be increased in energy generation. Moreover, hydropower is verified to be the most important renewable energy source of the country. Since hydropower is the basic renewable energy resource of the country, it is also identified to be important to assess sustainability of HEPPs. To assess sustainability of hydropower projects more detailed studies need to be conducted using different indicators. SAP is a sustainability assessment tool used for assessing sustainability performance of HEPP projects. In Chapter 5, SAP is used to obtain sustainability profile of a hydropower project, Çetin Dam and HEPP. Topics of SAP, related with the indicators detected as important for Turkey in EISD assessment, are recommended to be given higher weights.

Table 3.15 Evaluation Capability of Turkey for different Indicators according to EISD Assessment

Indicator	Availability	Source
– Households (or population) without electricity or commercial energy, or heavily dependent on non-commercial energy – Total number of households or population	Partially available (Share of households without electricity is available. Share of Households heavily dependent on non-commercial energy is not available.)	Turkish Electricity Distribution Company (www.tedas.gov.tr)
– Household income spent on fuel and electricity – Household income (total and poorest 20% of population)	Partially available (Share of house, water, electricity, gas and other fuels is available.)	Turkish Statistical Institute (www.tuik.gov.tr)
– Energy use per household for each income group (quintiles) – Household income for each income group (quintiles) – Corresponding fuel mix for each income group (quintiles)	Partially available (toe per capita is available)	www.energyrealities.org
– Annual fatalities by fuel chain – Annual energy produced	Partially available (Number of fatalities per 100000 workers is available)	International Journal of Engineering Research and Development
– Energy use (total primary energy supply, total final consumption and electricity use) – Total population	Available	Turkish Electricity Transmission Company (www.tedas.gov.tr)
– Energy use (total primary energy supply, total final consumption and electricity use) – GDP	Available	www.oecd-ilibrary.org
– Losses in transformation systems including losses in electricity generation, transmission and distribution	Available	World Bank (data.worldbank.org)

Table 3.15 (Continued)

– Proven recoverable reserves – Total energy production	Available	Energy Market Regulatory Authority (www.epdk.gov.tr)
– Total estimated resources – Total energy production	Not available	
– Energy use in industrial sector and by manufacturing branch – Corresponding value added	Not available	
– Energy use in agricultural sector – Corresponding value added	Not available	
– Energy use in service/commercial sector – Corresponding value added	Not available	
– Energy use in households and by key end use – Number of households, floor area, persons per household, appliance ownership	Available	www.nationmaster.com
– Energy use in passenger travel freight sectors and by mode – Passenger-km travel and tonne-km travel and by mode	Partially available (toe per Unit Transporting in different Transportation Types is available. Freight (tonne-km) and passenger (passenger-km) transportation is available.	ODYSSEE OECD
– Primary energy supply and final consumption, electricity generation and generating capacity by fuel type – Total primary energy supply, total final consumption, total electricity generation and total generating capacity	Available	Ministry of Energy and Natural Sciences (www.enerji.gov.tr)

Table 3.15 (Continued)

– Primary supply, electricity generation and generating capacity by non-carbon energy – Total primary energy supply, total electricity generation and total generating capacity	Available	Ministry of Energy and Natural Sciences (www.enerji.gov.tr)
– Primary energy supply, final consumption and electricity generation and generating capacity by renewable energy – Total primary energy supply, total final consumption, total electricity generation and total generating capacity	Available	Ministry of Energy and Natural Sciences (www.enerji.gov.tr)
– Energy prices (with and without tax/subsidy)	Available	Turkish Electricity Transmission Company (www.teias.gov.tr)
– Energy imports – Total primary energy supply	Available	US Energy Information Administration (www.eia.gov)
– Stocks of critical fuel (e.g. oil, gas, etc.) – Critical fuel consumption	Not available	
– GHG emissions from energy production and use – Population and GDP	Available	Turkish Statistical Institute (www.tuik.gov.tr)
– Concentrations of pollutants in air	Available	World Bank (data.worldbank.org)
– Air pollutant emissions	Partially available ($\mu g/m^3$)	www.havaizleme.gov.tr

Table 3.15 (Continued)

– Contaminant discharges in liquid effluents	Partially available (m^3/year)	Turkish Statistical Institute (www.tuik.gov.tr)
– Affected soil area – Critical load	Not available	
– Forest area at two different times – Biomass utilization	Partially available (1000 m^3/year)	General Directorate of Forestry (web.ogm.gov.tr)
– Amount of solid waste – Energy produced	Not available	
– Amount of solid waste properly disposed of – Total amount of solid waste	Not available	
– Amount of radioactive waste (cumulative for a selected period of time) – Energy produced	Not available	
– Amount of radioactive waste awaiting disposal – Total volume of radioactive waste	Not available	

CHAPTER 4

INTERNATIONAL HYDROPOWER ASSOCIATION'S SUSTAINABILITY ASSESSMENT PROTOCOL

4.1 General Information about International Hydropower Association

International Hydropower Association is a non-profit organization founded in 1995 under the auspices of United Nations Educational, Scientific and Cultural Organization (UNESCO). IHA's key initiatives are expressed as water policy, climate change, markets and investments, energy policy and sustainability (www.hydropower.org). Applicability of IHA's sustainability initiative for Turkey is the scope of this study. Sustainable development is defined as the development that supports economy as well as environment and social life for today's usage without violating future generations' ability to meet their needs (WCED, 1987). IHA aims advancing sustainable development in hydropower sector in relationships with governments, organizations, scientists, and hydropower industry. IHA members work in more than 80 countries to raise public awareness about the benefits of hydropower as a renewable energy source and help to ensure that implementers of the sector satisfy requirements of sustainability (www.hydropower.org). IHA has developed SAP as a new tool, which improves and promotes use of sustainable hydropower energy.

4.2 General Information about Sustainability Assessment Protocol

A multi-stakeholder consensus-based structure develops and governs SAP, involving NGOs (WWF, The Nature Conservancy, Transparency International, Oxfam etc.), governments (China, Germany, Iceland, Norway, Zambia), commercials (banks signatory to the Equator Principles, The World Bank), and the hydropower sector (IHA). Hydro4LIFE, a European Commission funded project is established to support application of SAP in the European Union. It aims to increase awareness of SAP and sustainability performance knowledge (www.hydrosustainability.org).

Eleven international hydropower organizations and companies have agreed to be sustainability partners of SAP; by approving implementation of the Protocol at least in one of the projects they are involved. IHA Sustainability Partners are: EDF, E.ON, GDF Suez, Itaipu Binacional, Hydro Equipment Association, Hydro Tasmania, Landsvirkjun, Manitoba Hydro, Odebrecht, Sarawak Energy, and Statkraft (www.hydrosustainability.org).

In the development process, field trials were conducted in 16 countries by stakeholder engagement with 1933 individuals from 28 countries. Products of SAP are assessment tools that are used as a framework to guide stakeholders in developing appropriate strategies that support sustainable development (www.hydrosustainability.org).

In 2004, Hydropower Sustainability Guidelines were produced by IHA. In 2006, as a result of continuing studies on sustainability guidelines, first version of Sustainability Assessment Protocol was published. It is improved in the following six years and the last version of SAP, which is used in this thesis was published in 2010 by IHA (www.hydrosustainability.org).

IHA's SAP is a continuously progressing global tool to help measuring and guiding performance in hydropower sector. SAP is not a standard or pass/fail mark, but a tool that improves specific topics of sustainability in a project. It does not serve as a mechanism to supply "sustainable hydropower" or "certified stamp of approval". It replaces neither national nor local regulatory requirements. It does not replace Environmental Impact Assessment reports required for a project or meet international regulations. It mainly aims to assess single projects based on globally applicable criteria. It is an evidence-based objective assessment tool of an individual project's performance prepared by an expert assessor (www.hydrosustainability.org).

Four main stages of a hydropower project, Early Stage, Preparation, Implementation and Operation can be assessed by SAP. SAP comprises of five tool documents: the background document and four additional documents, one for each stage (early stage, preparation, implementation, operation) of the project life cycle as shown in Figure 4.1 (IHA, 2010). Since Çetin Dam and HEPP Project is at its implementation stage, only implementation tools of IHA's SAP are used in this thesis.

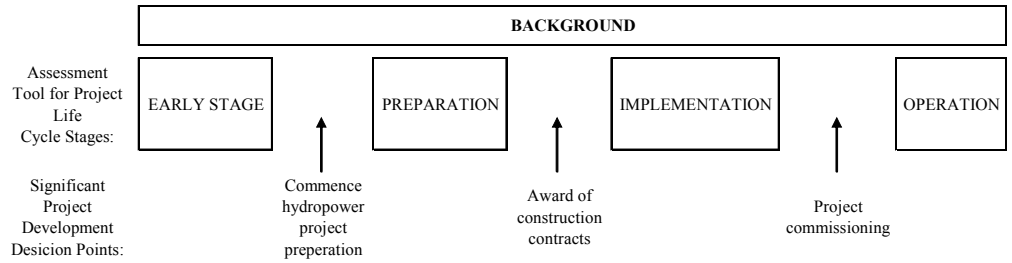

Figure 4.1 Assessment Tools and Major Decision Points (IHA, 2010)

4.2.1 Implementation Stage Assessment Tool

The implementation stage assessment tool is used for assessing hydropower projects at construction, and resettlement stages. This stage of assessment is performed while environmental and other management plans and commitments are implemented at site.

According to SAP, sustainability profile of a project is obtained based on objective evidences on three dimensions: Environmental, Social, and Financial (IHA, 2010). However, in some of the official assessment samples (Locher, 2013), technical and integrative dimensions are added as new dimensions to the assessment. In this thesis, separate grouping approach (totally 5 dimensions) is preferred for the assessment. Topics of dimensions differ according to project's stage. Implementation stage of SAP covers 20 topics under 5 dimensions Table 4.1 illustrates all dimensions and topics covered by the implementation stage tool of SAP.

Table 4.1 Topics of Sustainability Covered by Implementation Stage of SAP (IHA, 2010)

INTEGRATIVE	TECHNICAL	FINANCIAL	SOCIAL	ENVIRON-MENTAL
Communication and Consultation (Topic 1)	Infrastructure Safety (Topic 5)	Financial Viability (Topic 6)	Project Affected Communities and Livelihoods (Topic 9)	Biodiversity and Invasive Species (Topic 15)
Governance (Topic 2)	Reservoir Preparation and Filling (Topic 19)	Project Benefits (Topic 7)	Resettlement (Topic 10)	Erosion and Sedimentation (Topic 16)
Environmental and Social Issues Management (Topic 3)		Procurement (Topic 8)	Indigenous Peoples (Topic 11)	Water Quality (Topic 17)
Integrated Project Management (Topic 4)			Cultural Heritage (Topic 13)	Waste, Noise and Air Quality (Topic 18)
Labour and Working Conditions (Topic 12)			Public Health (Topic 14)	Downstream Flow Regimes (Topic 20)

4.2.2 Scoring

Implementation Assessment Tool (IHA, 2010) guides the assessor to develop a sustainability profile for the project. Each topic is evaluated with respect to a number of subjects. Most of the topics have the following subjects: assessment, management, stakeholder engagement, stakeholder support, conformance and compliance, and

outcomes. Scoring statements define what should be exhibited by the project to assess sustainability issue for each subject.

4.2.2.1 Scoring Levels

SAP assessor assigns a score ranging from 0 to 5 for topic; 0 being the lowest, and 5 being the highest. A more detailed explanation of scores is provided below (IHA, 2010):

Score 1: corresponds to poor/very limited performance. There are major gaps against basic good practice. Performance is poor/very limited.

Score 2: corresponds to a performance less than satisfactory. It indicates a significant gap meeting SAP tool's basic good practice criteria. Performance is less than satisfactory but most relevant elements of basic good practice are undertaken.

Score 3: corresponds to the basic good practice for a given topic and considered as satisfactory. Ratings lower than 3 indicate significant gaps in terms of sustainability and/or poor performance while ratings higher than 3 are considered as satisfactory.

Score 4: corresponds to an exceedance of basic good practice in one or more subjects. It meets all critical targets of basic good practice. There are only minor gaps according to the assessment tool's proven best practice criteria. Performance is between good and very good.

Score 5: corresponds to being at or very near to the proven best practice. It meets and exceeds requirements of objectives based on evidence. Performance is outstanding and proven to be the best practice.

Not relevant: corresponds to irrelevant topics for that individual project. For example, if no settlement is required, or if no cultural heritage exists in project region; the topics are assessed as not relevant.

Not assessed: corresponds to topics or subjects, which are relevant to the project but due to lack of information or the project's progress level, these topics or subjects cannot be assessed. For instance, if no activity about reservoir preparation and filling has started at the site, the topic related with the reservoir is not assessed. Moreover, if the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in the SAP tool, these subjects are marked as "Not assessed". If there is a gap or are gaps in a subject's basic good practice analysis then there is no need to carry out the proven best practice analysis.

4.2.2.2 Score Assigning Methodology

Each subject guides the assessor with scoring statements that identify SAP requirements of related topics. Scores are assigned by the assessor based on observations, interviews with relevant stakeholders, and review of objective evidence (IHA, 2010).

At first, audit objective evidence is collected. Audit objective evidence is based on documents or verbal communications. It is supported by qualitative and quantitative information, records, observations, measurements, tests, reports, documents, criteria, requirements, regulations etc. It has to be reproducible and recoverable. Audit objective evidence cannot be under the influence of emotions or prejudices (IHA, 2006).

Three types of audit objective evidence exist according to SAP. These are explained below (IHA, 2006):

1. **Document Review:** Procedures, plans, records, documents etc.
2. **Interviews:** Interviews conducted with experts, responsible stuff, contractors, and managers.
3. **Direct observation:** Observations of physical locations and activities.

In Chapter 5, Implementation Assessment Tool (IHA, 2010) is used to assess Çetin Dam and HEPP project. Official assessment samples are the ones that are assessed by IHA's official implementers and published by IHA. Official samples stated before in Section 2.2 (ex: Jirau Dam and HEPP) are used as guidelines as well. Topics are primarily assessed against the basic good practice and the proven best practice with respect to all the subjects of a topic.

Score 3 corresponds to the basic good practice. For a topic to score 3, it has to satisfy basic good practice requirements of all subjects. So, "Is the basic good practice met?" question is answered for all the subjects first. Then the following guidelines are used to assign the final score:

1. If "Is the basic good practice met?" question receives all "Yes" answers from all the subjects then a score of 3 is guaranteed and "Is the proven best practice met?" question is answered for all the subjects. If all the answers are "Yes", then the topic receives a score of 5. If one or more of the subjects received "No" because of significant gaps, then the number of gaps are counted and subtracted from 5. If there is just one gap in a subject then the topic receives a score of 4. If there are two or more gaps in one or more subjects, then the topic receives a score of 3. Even if there are more than two gaps, the topic does not receive a score below 3 since it has already passed basic good practice criteria. If "Is the proven best practice met?" question received "Not

assessed" for one or more answers then the score becomes uncertain and may range between 3 and 5.

2. If one or more of the subjects received "No" answer for "Is the basic good practice met?" question because of significant gaps, then the number of gaps are counted and subtracted from 3. If there is just one gap in a subject then the topic receives a score of 2. If there are two or more gaps in one or more of the subjects then the topic receives a score of 1.

3. If one or more of the subjects received "Not assessed" to "Is this basic good practice met?" question, the score becomes uncertain and may range between 1 and 5.

The flowchart of score assigning methodology is given in Figure 4.2. More detailed explanation of IHA on the scoring approach is given in Appendix C.

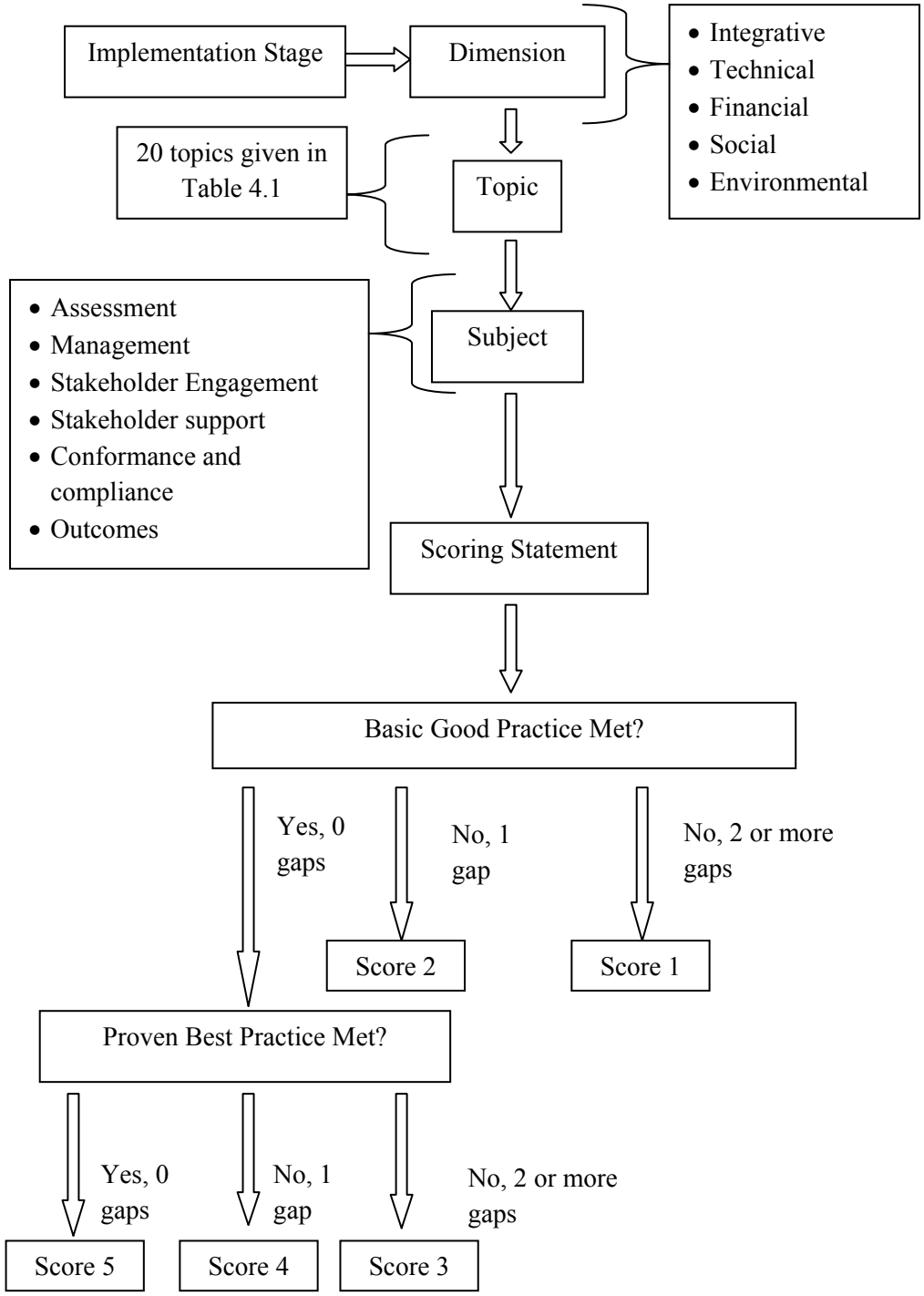

Figure 4.2 SAP Implementation Assessment Tool Score Assigning Methodology

CHAPTER 5

IMPLEMENTATION OF IHA'S SAP TO ÇETİN HYROELECTRIC POWER PLANT PROJECT

5.1 General Information about Çetin Dam and HEPP Project

There are 6 dams proposed to be constructed on the main tributary of Botan Stream between 525 m and 1370 m elevations from downstream to upstream in the "Tigris River Botan Stream Reconnaissance Survey Report" issued in 1986 by the General Directorate of Electrical Power Sources Survey and Development Administration (Dolsar, 2012): Alkumru, Çetin, Pervari, Keskin, Oran and Narlı Dams and HEPPs. Among all these proposed dams, Alkumru Dam and HEPP construction located at the downstream of Lower Çetin Dam and HEPP is completed. The profile of Main Çetin Dam and HEPP, Lower Çetin Dam and HEPP, and Alkumru Dam Reservoir are illustrated in Figure 5.1. Moreover, Figure 5.2 shows HEPPs along Botan stream.

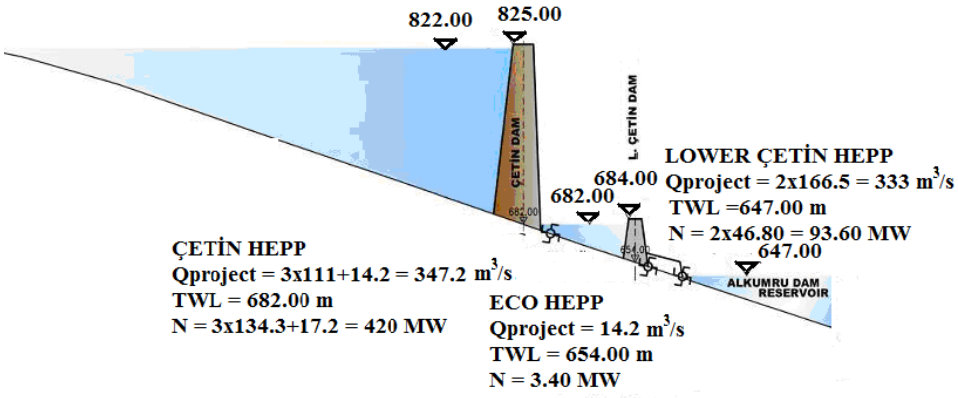

Figure 5.1 Profile View of Main Çetin Dam and HEPP, Lower Çetin Dam and HEPP, and Alkumru Dam Reservoir (Dolsar, 2012)

In 2011, Temelsu Engineering prepared the Feasibility Report of Lower Çetin and Main Çetin Dam and HEPPs (Temelsu, 2011). Due to some main change requirements in Lower Çetin Dam and HEPP, feasibility report had to be revised as a whole. Temelsu's Feasibility Report was revised by Dolsar in 2012. At first verbal communications with Statkraft and Dolsar, Lower Çetin Dam and HEPP were to be exposed to main changes but Main Çetin's layout was to be conserved. However, Main Çetin Dam and HEPP required many changes as well the Lower Çetin Dam and HEPP within the upcoming design activities.

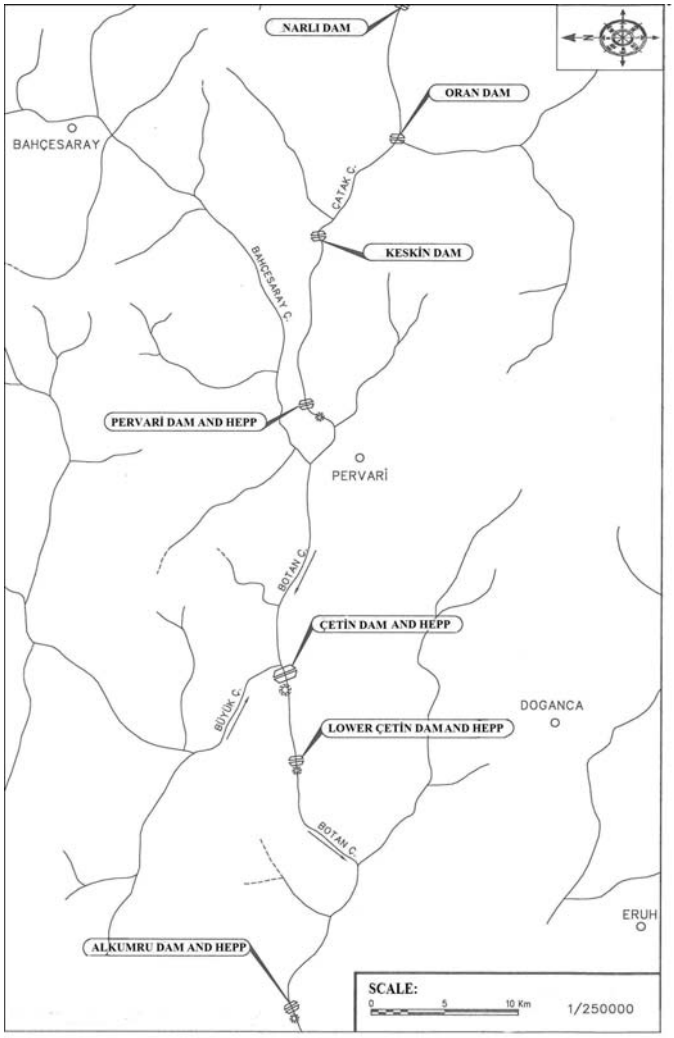

Figure 5.2 HEPPs along Botan Stream (Dolsar, 2012)

Çetin Project consists of two dam projects named Main Çetin Dam and HEPP and Lower Çetin Dam and HEPP, which are studied separately in the same feasibility report and licensed to Statkraft. Dolsar Engineering is the designer, Yüksel-İlci Cooperation is the contractor and En-Çev Investment Consultancy is the EIA reporter of both projects. These two projects are developing synchronously. Since only Main Çetin Dam and HEPP Project is assessed in this thesis, Main Çetin Dam and HEPP is called as "Çetin Dam and HEPP" for the sake of simplicity throughout the study. Çetin Dam and HEPP is located in the Southeastern Anatolia Region of Turkey. It is within the borders of Siirt Province's Şirvan District, and is being constructed on Botan Stream - the largest tributary of Tigris River - between 682 m thalweg elevation and 822 m reservoir level (Dolsar, 2012). Site location map of Çetin Dam and HEPP is given in Figure 5.3.

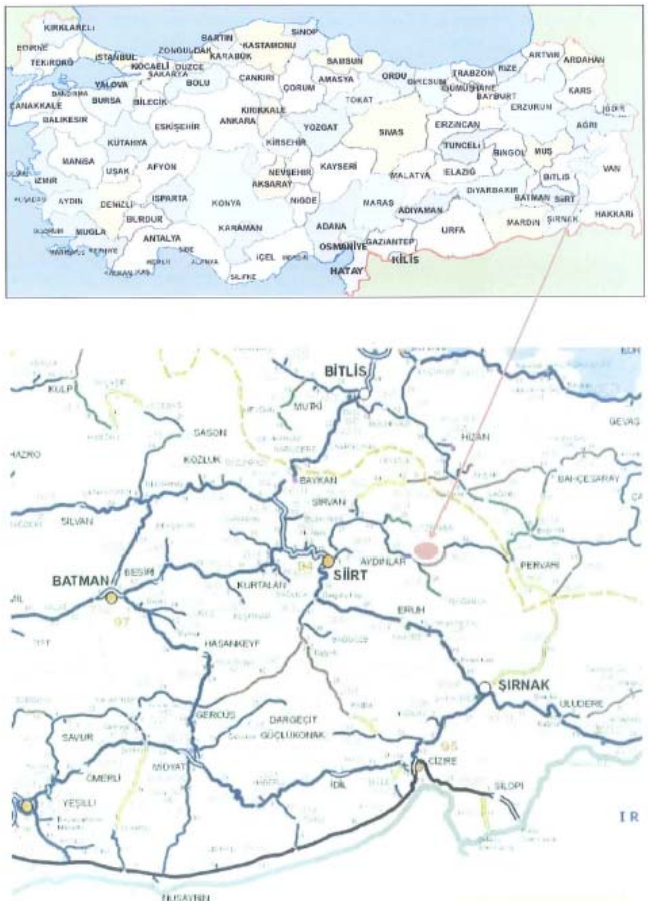

Figure 5.3 Site Location Map of Çetin Dam and HEPP

Çetin Dam and HEPP Project is a hydroelectric power plant project developed by legal entities within the provisions of the "Legislation Relating to the Procedures and Principles for Signing an Agreement on Water Usage Rights for the Purpose of Undertaking Production Activities in the Electric Market" under the framework of Electricity Market Law, Law No 4628 (Dolsar, 2012). As part of this regulation, Çetin Dam and HEPP Project is published as item no. 89 in Table 1 of DSİ's (State Hydraulic Works) internet web site (www.dsi.gov.tr). The resource contribution-sharing meeting was held on 7th of May 2007 and water usage agreement was signed on 15th of May 2009 (Dolsar, 2012). Environmental Impact Assessment (EIA) Report of Çetin Dam and HEPP Project was prepared by En-Çev in 2011.

Çetin Dam and HEPP's installed capacity is 420 MW (Dolsar, 2012). The project has a total design discharge of 347.2 m^3/s; 111 m^3/s for each of the 3 turbines, and 14.2 m^3/s for the ecological turbine (Dolsar, 2012). According to Dolsar's Feasibility Report, dam body will be asphalt core rock-fill type. It will be Turkey's first asphalt core type dam (Dolsar, 2012).

In Dolsar's Feasibility Report, the hydraulic head between the elevations of 822.00 m and 682 m for Çetin Dam and HEPP based on water usage rights agreement is studied (Dolsar, 2012). The technically feasible formulation was identified during feasibility studies. Çetin Dam and HEPP axis location on Botan Stream can be seen in Figure 5.4.

Figure 5.4 Dam Axis Location of Çetin Dam and HEPP (Dolsar, 2012)

Çetin Dam and HEPP is planned to generate electricity. Having a 420 MW installed capacity, this project is evaluated as an important renewable energy source (Dolsar, 2012). Since the project is under construction, it corresponds to the implementation stage of SAP and is assessed by the implementation tool of SAP (IHA, 2010). Dolsar's Feasibility Report (Dolsar, 2012) and En-Çev's EIA Report (En-Çev, 2011) are main sources of objective evidences used for SAP evaluation.

5.2 Çetin Dam and HEPP Assessment using IHA's SAP Implementation Stage Tool

As a case study, Çetin Dam and HEPP Project is assessed in terms of sustainability using IHA's Implementation Assessment Tool of SAP (IHA, 2010). In May of 2013, a sample protocol assessment report for Jirau Hydropower Project was published as an official implementation of SAP (www.hydrosustainability.org). Jirau Hydropower Project is a 3750 MW run-of river type HEPP at its implementation stage and it is located in Brazil (Locher, 2013). Since Çetin Dam and HEPP Project is at its implementation stage, in the assessment of Çetin Dam and HEPP Project, Jirau Hydropower Project assessment (Locher, 2013) is used as a guidance document. In this thesis, the unofficial SAP assessment of Çetin Dam and HEPP Project is conducted in an academic scope limited with the author's access to project documents, restricted information on contracts between stakeholders and official requirements checked by governmental regulations of Turkey.

Topics of SAP were given in Table 4.1 and the scoring methodology was explained in Section 4.2.2. For each of the 20 topics, an assessment is conducted and given in the following sections. Although all the topics are equally weighted in SAP assessment, the most important topics according to author's results in relation with EISD assessment are identified and suggested to be weighted higher during the assessment.

5.2.1 Topic 1: Communication and Consultation

"Communication and Consultation" topic of "Integrative" dimension assesses engagement, communication and consultation between project stakeholders, within the company and between the company and external stakeholders (e.g. governments, affected communities, contractors). Four subjects of "Communication and Consultation" topic are assessment, management, stakeholder engagement, conformance and compliance; and each of these subjects is evaluated below.

5.2.1.1 Assessment

This subject addresses relations between the project's stakeholders throughout the life of the project.

Analysis against the basic good practice:

Scoring statement: Are communications and consultation requirements identified through an assessment process that consists of stakeholder mapping supported by ongoing monitoring?

"Stakeholders are those who are interested in or affected by the HEPP and related activities" (IHA, 2010). SAP criteria require stakeholder mapping supported by ongoing monitoring. In stakeholder mapping, stakeholders are grouped and identified in a meaningful way and the rights, risks and responsibilities are clearly identified.

Çetin Dam and HEPP Project stakeholders are identified as follows:

- Dolsar Engineering is the designer,
- Yüksel-İlci Cooperation is the contractor,
- Statkraft is the owner and operator of the project,
- Andritz Hydro is equipment supplier of the project,
- Hidrodizayn Engineering is the controller from private sector,
- Technical University of Vienna Hydraulics Laboratory is the modeler of the spillway and the flushing tunnel structures,
- En-Çev Energy is the preparer of the Environmental Impact Assessment (EIA) Report of the project,

- Local people.

Stakeholder mapping requirements are met for the project for all stakeholders and they are assessed through ongoing processes. Local people are included as stakeholders in the stakeholder mapping. Social Working Group of Statkraft employed for social relations with public is always in communication with directly affected people at site to mitigate any unresolved problems as can be seen in Appendix D (Appendix D, Q2).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does stakeholder mapping take care of broad considerations?

SAP criteria require broad considerations taken into account. Statkraft, as the owner, is a sustainability partner for SAP (www.hydrosustainability.org). The owner takes broad considerations into account in stakeholder mapping.

Is the proven best practice met?: Yes

5.2.1.2 Management

This subject addresses the plans, processes, needs and in place management of communications and consultation ongoing with project stakeholders, and external stakeholders.

Analysis against the basic good practice:

Scoring statement: Are communication and consultation needs for various stakeholder groups met?

Communications and consultation responds, emerging risks and needs and consider cultural sensitivities. Related subject is mainly concerned with promoting communication means between the project implementers and directly affected people. Social working group of Statkraft is always in communication with directly affected people in order not to violate their rights in any aspect. In stakeholder mapping of the project, communication and consultation needs for project implementers are met.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do communications and consultation processes show a high level of sensitivity to stakeholder groups and are processes in place for emerging risks?

A sustainability forum to create dialogue between the stakeholders of the project is one of the key communication mechanisms. It is stated by official SAP assessors that constituting a sustainability committee to hold periodic meetings and workshops with national and regional institutions, workers, and residents to integrate stakeholders and promote sustainability is beneficial (Locher, 2013). However, no international institute is included as sustainability committee in stakeholder mapping of the project.

In Turkey, only relevant action taken regarding social rights is the preparation of environmental impact assessment report, which is prepared according to Official Gazette issued 26939 dated 17th of July 2008. Although the owner shows high sensitivity on social issues and there exists a social work group, a special sustainability committee is not established, and a sustainability forum is not conducted for the project. This is **a significant gap** against the proven best practice that may represent a risk in terms of sustainability.

Is the proven best practice met?: No

5.2.1.3 Stakeholder Engagement

This subject addresses ongoing relations between stakeholders throughout the project life.

Analysis against the basic good practice:

Scoring statement: Do an appropriately timed and scoped engagement with directly affected stakeholders exist; and are feedbacks of activities provided to all stakeholders in good faith?

Feedbacks of activities are provided daily to all stakeholders via e-mails, telephones or reports. Social working group informs affected people.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, is engagement participatory, are negotiations undertaken in good faith, and are feedbacks on raised issues urgently taken into consideration?

Establishing a sustainability committee is a way of managing appropriately timed and scoped engagement between directly affected stakeholders. Negotiations, agreements on settlement, cultural heritage issue management are some of the activities of the committees. A Sustainability Committee is not established for this project. However, engagement is participatory, negotiations are undertaken in good faith and feedbacks on raised issues are urgently taken into consideration by the remaining stakeholders. Social working group of Statkraft is always in communication with directly affected people.

Is the proven best practice met?: Yes

5.2.1.4 Conformance and Compliance

This subject addresses processes and objectives related to communications and consultation and reviews if the commitments are met.

Analysis against the basic good practice:

Scoring statement: Are commitments related with communications and consultation, processes and objectives met without any major gaps?

The owner Statkraft, as one the world's spearhead renewable energy firms, ensures to prevent its projects from non-conformance and non-compliances by ongoing communications and consultation studies at site. Dolsar, as a designer company establishes transparent dialogues with stakeholders in Turkey's Energy Market. The owner is always in communication with the designer and contractor to avoid any application that violates the commitments.

Some of the monthly responsibilities fulfilled by Dolsar include arranging design meetings at Dolsar's office in Ankara, reviewing working schedule breakdowns in the meetings and reporting the progress to the owner. The stakeholders communicate with each other every day via e-mails and telephone calls. Also site-meetings are held monthly with the contractor. As the designer's representative, a geological and civil engineer from Dolsar also works at the site to support communication between design office, site and the owner.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

A meeting was held on 12th of January 2010 in Pervari Town of Siirt in order to inform public about the project for ensuring public participation (En-Çev, 2011). The meeting was conducted in accordance with 9th clause of the EIA regulation. The meeting was announced and needed declarations were made in local and national papers. Monitoring reports and communications protocols exist. No additional evidence of non-conformances and non-compliances are found.

Is the proven best practice met?: Yes

Score: Communication and Consultation topic is evaluated for four subjects and basic good practice are met for these subjects. However, since 1 gap is identified, the proven best practice is not met for Management subject. Thus, an overall score of **4** is assigned to this topic.

Relevant Evidence: www.statkraft.com, stakeholder mapping of the project, personal knowledge and experience, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), EIA Report

5.2.2 Topic 2: Governance

"Governance" topic of "Integrative" dimension assesses the owner/operator's business structures, policies and experiences, management, transparency and accountability issues. It checks if governance measures are effective and corporate governance requirements are satisfactory. Five subjects of "Governance" topic are assessment, management, stakeholder engagement, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.2.1 Assessment

This subject addresses corporate governance and monitoring issues.

Analysis against the basic good practice:

Scoring statement: Are emerging political and public sector governance issues controlled by ongoing processes in place, and are corporate monitoring measures and requirements effective?

Owner's ways of handling political and public sector issues are highly standardized. All governmental requirements related with legal commitments are overcome in the guidance of lawyers as well as experienced Turkish engineers from private sector.

Is basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there any opportunities to improve the assessment of political and public sector governance issues?

The shareholder companies are experienced in sector with highly developed corporate governance approaches. They all follow ISO Certification Standards such as ISO 9001 and ISO 14001 (Contract, 2011). The most important issue relating with external governance is getting the operation license. This operation license certificate for investment is taken from EPDK (Dolsar, 2012). There are no identified significant gaps related with the subject.

Is the proven best practice met?: Yes

5.2.2.2 Management

This subject addresses corporate management of social and environmental responsibility, ethical business practices, policies and transparency of the governor.

Analysis against the basic good practice:

Scoring statement: Does the owner have high sensitivity of sustainability issues related with management?

This subject addresses the owner's management capabilities, transparency, policies and practices. Governance and management of Statkraft is of a high international standard. Being one of the major players on the European energy exchanges, Statkraft develops and generates hydropower, wind power, gas power and district heating (www.statkraft.com). The group, which has more than 34000 staff in more than 20 countries, acts to be the Europe's leader in renewable energy (www.statkraft.com).

Statkraft is one of the sustainability partners of SAP (www.hydrosustainability.org). A sustainability partner of SAP is a hydropower industry member that promotes the ongoing development of hydropower sustainability by working with IHA. Sustainability partners are the ones that lead the mission of completing the first assessments of SAP. They took the necessary training in order to conduct unofficial and official assessments of SAP.

Between 12th and 15th of June 2012, the owner of Çetin Project, Statkraft staff was trained on SAP in Oslo. After the training, Statkraft stated that, since almost all electricity is supplied by hydropower in Norway, it is quite inevitable that Statkraft as the representative of Norway supports European Commission's Hydro4LIFE program as a strong partner to advance the common language provided by SAP (www.hydrosustainability.org). Statkraft's supporting Hydro4LIFE program is an evidence of its studies to contribute sustainable management as a governor.

Statkraft is known for its expertise in hydropower sector and has high standards of environmental sensibility and stakeholder engagement (www.statkraft.com). Statkraft follows requirements of ISO 9001 in its projects to satisfy Health, Safety and Environment (HSE) management. Designers of Statkraft are required to meet the requirement of the "Requirements for HSE in the Design of Hydroelectric Power Plants" document (Contract, 2011), which is attached to the contract by Statkraft. This specification document has to be followed both by Statkraft and Dolsar teams. The document mainly comprises of the following topics:

- HSE Management and Quality Management
- Environmental Care
- Layout and Arrangements
- Safety of Dams and Waterways
- Safety in Tunnels, Caverns and on Roads
- Fire and Explosion Protection
- Escape, Evacuation and Rescue
- Working Environment and Human Factor
- Technical Appliances-Mechanical Equipment
- Hygiene and Facilities
- Security

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do all contractors have consistent sustainability goals?

Contractors are also required to meet the owner's sustainability policy. Yüksel-İlci Cooperation is the contractor of Çetin Dam and HEPP Project. However, cooperation has consistent policies and appreciable experience in civil engineering sector of Turkey (www.yuksel.net). In Yüksel Group's web site their sustainability report (www.yuksel.net) is given. In the report, it is seen that the company is awarded many times for its contribution to society in terms of sustainability (www.yuksel.net).

Equipment suppliers of Çetin Dam and HEPP Project, Andritz Hydro is also included in SAP development studies of IHA (www.hydrosustainability.org). Andritz Hydro received training on SAP, in Vienna, Austria, in September 2012. Representatives from the hydropower equipment manufacturer evaluated the sessions as a "big step forward into a more sustainable future for hydropower" after the completion of the training (www.hydrosustainability.org).

In May 2007, Dolsar representatives attended International Training Course on Hydropower Sustainability Assessment of IHA (www.dolsar.com.tr). Stakeholders that actively contribute and attend international sustainable development studies are marked as an objective evidence of sustainable management. Those are evidences of stakeholders' goal of advancing sustainable energy as well as the governor's preference of stakeholders that pay attention to sustainability issues.

Is the proven best practice met?: Yes

5.2.2.3 Stakeholder Engagement

This subject addresses directly affected stakeholders' clear understanding of the issues interesting them.

Analysis against the basic good practice:

Scoring statement: Does the owner interact with directly affected communities and do publicly available project reports on project performance regarding sustainability issues are published?

According to SAP criteria, interest issues for all directly affected stakeholders should be clearly identified in publicly available reports. All benefits of the project for the stakeholders were clearly clarified to respondents in publicly available reports.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does business prepare publicly available reports of highly interested sustainability areas to stakeholders?

Minutes of the meetings and some crucial issues like the project's climate change effect status are not published as publicly available reports. This is **a significant gap** according to SAP criteria. However, minutes of the meetings are being prepared regularly after each meeting, and it is not required in national commitments of Turkey to publish them publicly. In some aspects governors of HEPPs may totally meet national responsibilities, but not all of SAP requirements.

Is the proven best practice met?: No

5.2.2.4 Conformance and Compliance

This subject addresses project's non-compliances and non-conformances related with governmental requirements, all relevant laws, policies and agreements.

Analysis against the basic good practice:

Scoring statement: Are there non-compliances and non-conformances related with governmental requirements, commitments and laws?

A Report on Water Utilization Rights had been prepared for Çetin Dam and HEPP Project and submitted to DSİ 10th Regional Directorate (Dolsar, 2012). After the review and assessment of DSİ 10th Regional Directorate, the report was accepted.

EIA Report was submitted to the Ministry of Environment and Forestry and "EIA Positive Decision" was taken by the letter No. 1648 dated 19th of August 2011 of the Ministry of Environment and Forestry (amended by Ministry of Environment and Resettlement) (Dolsar's Archive). Production license certificate for investment is secured from EPDK. All required official documents are in compliance with the country's requirements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

All the important compliance requirements of the country given above are met, the project do not have any identified non-compliances. However, since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool, this analysis cannot be performed.

Is the proven practice met?: Not assessed

5.2.2.5 Outcomes

This subject addresses unresolved corporate and external governance issues.

Analysis against the basic good practice:

Scoring statement: Do any unresolved corporate governance issues exist?

Governance related issues are listed as follows (Dolsar, 2012):

- Operation license had been taken.
- Delays caused by problems related to directly affected people and cultural heritage do not exist in the project's implementation stage.

- A Water Usage Right Report has been prepared in the content of the Çetin Dam and the HEPP Project and approved by DSİ 10th Regional Directorate.
- As a result of strong opposition from local people and governmental organizations, Turkish government pays more attention to social and environmental issues more than before for HEPP projects. Sustainability appears as a crucial criterion for today's HEPP projects.

Looking at the bullets given above, there are no gaps regarding the subject.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are any unresolved corporate and external issues identified?

No unresolved governance issues can be identified.

Is the proven best practice met?: Yes

Score: Governance topic is evaluated for five subjects and basic good practice is met for all of these subjects. However, since 1 gap is identified, the proven best practice is not met for Stakeholder Engagement subject. Moreover, since analysis against the proven best practice cannot be performed for Conformance and Compliance subject, an overall score of **minimum 3, maximum 4** is assigned to this topic.

Relevant Evidence: www.statkraft.com, www.dolsar.com.tr, Dolsar's Feasibility Report, En-Çev's EIA Report, Yüksel Group's Sustainability Report, Statkraft's "Requirements for HSE in the Design of Hydroelectric Power Plants" document, operation license given by the government, Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.3 Topic 3: Environmental and Social Issues Management

"Environmental and Social Issues Management" topic of "Integrative" dimension assesses the plant's management of negative social and environmental impacts and avoidance, minimization capacity of negative impacts during the implementation stage. Obtained score addresses the success of the plans and processes of environmental and social issues management. Five subjects of "Environmental and Social Issues Management" topic are assessment, management, stakeholder engagement, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.3.1 Assessment

This subject addresses environmental and social issues relevant to project implementation. Associated facilities and cumulative impacts should be evaluated through an assessment process.

Analysis against the basic good practice:

Scoring statement: Is appropriate expertise used and does monitoring continue during implementation to ensure environmental and social issues management?

EIA report is in compliance with Turkish EIA Regulation (www.mevzuat.gov.tr). "EIA Positive Decision" was taken by the letter No. 1648 dated 19th of August 2011 of the Ministry of Environment and Forestry (amended by Ministry of Environment and Resettlement). The approved EIA Report comprises of 11 main chapters (En-Çev, 2011): (i) Definition and objective of the project, (ii) Position of the location selected for the project, (iii) Economic and social dimensions of the project, (iv) Identification of the area to be affected under the project and explanation of present environmental characteristics inside this area, (v) Effects of the project on the area defined by part iv and measures to be taken thereof (This part extensively and individually explains the effects of the project on the physical and biological environments and any legal, administrative and technical measures to prevent, minimize, and improve these effects.) (vi) Possible and lasting effects after the closure of the operation and precautions against these effects (vii) Alternatives of the project (viii) Monitoring program (ix) A non-technical summary of the information given above under titles (Explanation of all of the activities in the content of the project during the construction and operation stages, precautions against the environmental impacts as clear and basic as possible to be understood by the public,) (x) Participation of the public (xi) Results (En-Çev, 2011). Contents of the EIA report given above are the objective evidences related with the subject. The monitoring program is included and environmental and social impacts issues are reviewed in detail in the EIA report (En-Çev, 2011). The processes at site are continuing according to commitments.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring during implementation take emerging risks, opportunities and interrelationships among environmental and social management issues into consideration?

Monitoring activities continue at site in compliance with commitments. In Statkraft's "Requirements for HSE in the design of Hydroelectric Power Plants" document (Contract, 2011), there is information about target of reduction, monitoring plan or

management of GHG emissions caused by the project. Therefore, no significant gaps are identified.

Is the proven best practice met?: Yes

5.2.3.2 Management

This subject addresses processes at management. Environmental and social issues should be managed meeting the commitments and as stated in EIA results.

Analysis against the basic good practice:

Scoring statement: Are environmental and social commitments met and environmental impact assessment and key associated plans publicly available?

"EIA Positive Decision" was taken by the letter No. 1648 dated 19th of August 2011 of the Ministry of Environment and Forestry. EIA report is publicly available. An Environmental Monitoring Program is prepared before starting the activities of the project, for detailed examination. All the activities are performed according to the Environmental Monitoring Program at site. The expropriation, reservoir cleaning, all construction activities, all waste materials, dust - nose etc., environmental effects, accidents, and disasters are included in the Environment Monitoring Program. The content of the program comprises of monitoring the activities that may be harmful for environment and health, and all the activities are following all the legal obligations as stated in the EIA Report (En-Çev, 2011). After monitoring activities the audits are reported. Construction process is monitored to determine whether the effects stay within the limits provided in the EIA Report. Targets of Çetin Dam and HEPP's Monitoring Program are defined as follows (Dolsar, 2012):

- To determine environmental impacts and guarantee the necessary monitoring activities as stated in the EIA Report,

- To make the necessary arrangements according to monitoring results of construction works in compliance with regulations, laws and rules as determined in the EIA Report,

- To define the general and site specific measures that are needed to be taken to reduce environmental impacts as stated in the EIA Report and ensure fulfillment of these measures,

- To generate a detailed and regular monitoring program implemented by experts responsible for timing, scope, control forms and so on. To monitor methods and revise the program if needed,

- To keep the records regularly during the studies and submit them to relevant authorities as a report,

- To ensure reliable water and waste water, noise, air analysis and measurements in the site and to report their impacts,

- To inform the managers of the contractor company, local people and construction personnel about the environmental impacts expected as a result of site activities.

A total of about 1000 people from various disciplines are employed at site, and social issues related with them are to be managed (Dolsar, 2012). A central site was set up at the former camping area owned by Renewable Energy General Directorate (former EİEİ) for meeting social requirements amenities and basic needs of the staff. It is estimated that 50 people will be employed at site during operation stage (Dolsar, 2012). Their domestic wastewater should be treated by a treatment system. The treatment system has not been constructed yet. Currently there is a package treatment system at the site. But a permanent treatment plant is planned to be constructed according to Design Approval Communiqué No 2005/5 requirements (Dolsar, 2012). The package treatment system established during implementation stage will also be used during the operation stage.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes followed with an internationally accepted environmental management system, such as ISO 14001?

According to SAP requirements, an internationally accepted environmental management system such as ISO 14001 should be followed. According to Statkraft's "Requirements for HSE in the design of Hydroelectric Power Plants" document, the firm follows Quality Management System Requirements (ISO 9001) (Contract, 2011).

Is the proven best practice met?: Yes

5.2.3.3 Stakeholder Engagement

This subject addresses the stakeholders' getting feedback about raising issues and ongoing processes.

Analysis against the basic good practice:

Scoring statement: Can stakeholders get feedback about raising issues as a result of ongoing processes?

All contractors can easily get feedback about raising issues. All stakeholders are daily informed about new occurrences via e-mails and phones.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are directly affected stakeholders informed about how the issues raised on time?

A small number of local people are included within the borders of the project area. They are frequently informed about the raising issues by the social working group of Statkraft.

Is the proven best practice met?: Yes

5.2.3.4 Conformance and Compliance

This subject addresses the ongoing processes in compliance with social and environmental commitments.

Analysis against the basic good practice:

Scoring statement: Are processes and objectives of environmental and social management plans met without any major non-conformances and non-compliances?

Mixing different types of waste and absence of regulations to transport chemical substances are the most frequent non-conformances at site. These issues are assessed in Section 5.2.18 and they are strictly implemented by the owner at site without any violations of EIA Report (En-Çev, 2011). En-Çev's reports are submitted to Ministry of Environment and Forestry every 3 months. No gaps are identified associated with environmental and social issues management.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there any other non-conformances and non-compliances identified?

Statkraft prepares HSE internal audits schedule regarding environmental and social issues management. This schedule is an objective evidence of the proven best practice. There are no non-conformances or non-compliances about license, water rights, or legal requirements other than the ones evaluated under previous topics.

Is the proven best practice met?: Yes

5.2.3.5 Outcomes

This subject addresses the capability of minimizing, avoiding and mitigating negative social and environmental impacts.

Analysis against the basic good practice:

Scoring statement: Are negative social and environmental effects of the project minimized and avoided without significant gaps?

Adverse effects such as release of heavy metals, interference with fauna should be monitored and required precautions should be taken (En-Çev, 2011). Social working group is working at the region to detect, avoid, and mitigate any social impacts on society (Appendix D, Q2).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are environmental and social contributions beyond the negative impacts are achieved, or to be achieved?

Since just diversion tunnel inlet and outlet construction at site is finished yet, it is quite early to observe contributions beyond the negative impacts. However, social contributions have already been seen (employment opportunities and using local suppliers).

Is the proven best practice met?: Yes

Score: Environmental and Social Issues Management topic is evaluated for five subjects and basic good practice are met for all these subjects. Moreover, the proven best practice is met for all of the subjects. Thus, an overall score of **5** is assigned to this topic.

Relevant Evidence: EIA Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), Statkraft's "Requirements for HSE in the design of

Hydroelectric Power Plants" document, Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.4 Topic 4: Integrated Project Management

"Integrated Project Management" topic of "Integrative" dimension assesses the developer's ability of managing all project components, coordinating project construction and planning future operation activities at the areas affected by the project. Score's intent is to address the project's capability of meeting milestones, any delays of one component without affecting one another. Four subjects of "Integrated Project Management" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.4.1 Assessment

This subject addresses monitoring of project progress, milestones, budget and interface issues etc.

Analysis against the basic good practice:

Scoring statement: Is project progress monitored to check construction management plans' being carried out on a regular basis without violating the milestones?

According to Statkraft's program from the completion of the trials and starting operation, including the out of site activities and possible delays, the total construction period is estimated as nearly 5 years. Construction started in 2012. The author, a hydraulic engineer at Dolsar, is one of the updaters of the designer's work schedule, which is prepared for Çetin Dam and HEPP Project in Primavera program. All the milestones including delay reasons, and also progress percentages are available in the mentioned program. The construction process enclosing budgets, milestones, progress, and effectiveness is strictly monitored by Statkraft's individual management program.

According to Statkraft's Management requirements, implementation of HSE issues in design and development has to be in accordance with ISO 9001. Meeting ISO requirements ensure that planning and design is performed in a controlled and internationally acceptable manner; and review and verification activities of inputs and outputs are managed properly.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the monitoring of overall project implementation take the inter-relationships among issues, risks and opportunities into consideration?

Monthly progress reports are prepared by Dolsar and sent to Statkraft. Monthly meetings are held; minutes of meetings are written comprising of the issues covered, compliance with target dates, the delayed activities, the reasons of the delays, and expected new submission dates in detail. Delays related with any arising risks are compensated in the program. No significant gaps are marked.

Is the proven best practice met?: Yes

5.2.4.2 Management

This subject addresses the requirements of an integrated management and a construction management plan in place.

Analysis against the basic good practice:

Scoring statement: Are integrated management plan and construction management plan taken into account including all project components without significant gaps?

Statkraft's requirements which are signed as contract's attachment comprise of meeting some international standards (Contract, 2011). ISO 9001 is the standard about Integrated Project Management to which the facilities should be designed in accordance with. The owner has "Basis for Plant" documentation that covers standards and regulations to be met additional to "Design Specification" (Contract, 2011). The owner follows HSE Activity Plan.

The site work schedule of the contractor prepared by Primavera includes more than 10000 activities. Primavera software assists integrated project management on scheduling and interface targets. A professional documentation management system is available both in designer's and owner's side that ensures storage and accessibility of all project documents.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the integrated management plan identify interface and delay issues without violating overall timetables, and are waste generation activities managed properly?

At site, monthly project directors meetings are held, monthly performance analyses against scheduling are conducted as well monthly meetings conducted at Dolsar's

office. Integrated Project Management Plan manages interface and delay issues without violating overall project timetables and budgets as much possible. Processes are in place to respond emergency risks ensuring that waste disposal activities and land disturbance is controlled and managed efficiently. Waste management issue is evaluated in detail in Section 5.2.18 and no significant gaps are marked.

Is the proven best practice met?: Yes

5.2.4.3 Conformance and Compliance

This subject addresses the achievement of the processes and objectives conducted in compliance and conformance with project management and construction management plan.

Analysis against the basic good practice:

Scoring statement: Are the processes conducted in compliance with management plans?

Management plans are strictly followed by the stakeholders and in case of disturbance of the milestones caused by a stakeholder's individual fault, penalties identified by the contract will be applied (Contract, 2011).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are other non-compliances and non-conformances detected?

Feasibility, final design, and implementation projects for Çetin Dam and HEPP are conducted by the same team of Dolsar engineers. In accordance with owner's preferences designer was strictly faithful to the layout of Temelsu's Feasibility Report (Temelsu, 2011) in early layout studies of Çetin Dam and HEPP since it was not expected to be exposed to many changes. Latest General layout plan of Çetin Dam and HEPP prepared by Dolsar as a revision of Temelsu's layout can be seen in Appendix E. According to final design drawings, diversion tunnel inlet and outlet construction have already been completed. After diversion tunnel construction started, some important revisions in final layout were required as a result of newly obtained geological data and information. However, implementation of the diversion tunnels restricted the designer in layout boundaries which were at first assigned in Temelsu's Feasibility Report. Relocation of any facility, and changing axis or slopes of dam body is not possible due to those restrictions. In Appendix D, Project Manager of Çetin Dam and HEPP defines the restriction of the boundaries as the most important

handicap of the project (Appendix D, Q5). This handicap is marked as **a significant gap**.

Many revision requirements were the basic reasons of work schedule violation for this project. Fortunately, mentioned delays have not caused any milestones' violation yet. Since there are some non-conformances and non-compliances related to this subject, work progress at site has the risk of getting behind the targets. This is marked as **a significant gap**.

Is the proven best practice met?: No

5.2.4.4 Outcomes

This subject addresses the project's capability of meeting overall budget and timing goals.

Analysis against the basic good practice:

Scoring statement: Are overall budget and timing targets met, and construction risks avoided without any significant gaps?

Although many minor delays occurred till August 2013, there are no violating evidences on overall timing and budget targets of the project. No significant gaps are identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are any additional gaps identified related with avoiding construction risks?

Construction risks are avoided or minimized during the implementation of the project by the owner's integrated project management program. No significant gaps are marked.

Is the proven best practice met?: Yes

Score: Integrated Project Management topic is evaluated for four subjects and basic good practice are met for these subjects. However, since 2 gaps are identified, the proven best practice is not met for Conformance and Compliance subject. Thus, an overall score of **3** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, Temelsu's Feasibility Report, Dolsar's work schedule prepared by Primavera, Yüksel-İlci's work schedule prepared by Primavera, Statkraft's "Requirements for HSE in the design of Hydroelectric Power Plants" document, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.5 Topic 5: Infrastructure Safety

"Infrastructure Safety" topic of "Technical" dimension assesses dam and other structures' safety management during project application and operation. The intent is to evaluate dam failure and other infrastructure safety risks and ensure life, environment and property safety. Four subjects of "Infrastructure Safety" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.5.1 Assessment

This subject addresses dam and other structures safety risks as a result of ongoing implementation processes in place.

Analysis against the basic good practice:

Scoring statement: Are safety of construction issues ensured regularly, is safety monitoring being carried out during implementation?

According to Statkraft's basic requirements signed with the designer, following standards should be met ensuring the safety of constructions (Contract, 2011):

- BS EN 1997-1:2004 Eurocode 7 Geotechnical Design, General rules
- BS 6164 Code of Practice for Safety in Tunneling in the Construction Industry
- EN 1838 Lightning Application – Emergency Lightning
- IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety Related Systems
- ISO 1201 Safety of Machinery – Basic Concepts, General Principles for Design
- ISO 6385 Ergonomic Principles in the Design of Work Systems
- ISO 11161 Safety of Machinery - Integrated Manufacturing Systems
- ISO 14121 Safety of Machinery – Principals of Risk Management
- ISO 14122 Safety of Machinery – Permanent Means of Access
- NFPA 851 Recommended Practice for Fire Protection for Hydroelectric Generating Plants

Statkraft recommends the following as informative references (Contract, 2011):

- EN 54 – Fire Detection and Fire Alarm Systems (NFPA72 National Fire Alarm Code)
- IFC – General Environmental, Health and Safety (EHS) Guidelines
- ISO 11064 Ergonomic Design of Control Centers
- ITA – Guidelines for Good Occupational Health and Safety Practice in Tunnel Construction
- NFPA 72 – National Fire Alarm Code

Çetin Dam and HEPP Project is being designed, approved and delivered to site with a strong engineering expertise by a set of consultants, regulators, developers and contractors. Globally accepted standards that have been and are being applied in all stages in terms of infrastructure safety are given above.

Up to August 2013, no critical problems related with safety issues are marked. Dam body is asphalt core rock-fill type, which will be the first application of this type in Turkey (Dolsar, 2012). Asphalt core rock-fill dam body final design calculations are started in detail at this stage of the design. Prof. Dr. Kaare Høeg, who is an experienced professional for asphalt core type from Norwegian Geotechnical Institute (NGI) and University of Oslo, guides and advises Dolsar's engineering design team for design calculations of dam body. Also for the spillway and flushing tunnel facilities, hydraulic model experiments are being conducted in Technology University of Vienna as can be seen in Appendix F. For the spillway, scouring at the downstream calculations is checked by hydraulic model tests to avoid any instability at the downstream.

It is guaranteed that all measurement equipment will be established within the official requirements of DSİ during impounding stage.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are safety issues taken into consideration within broad range of scenarios?

All hydrological and seismic data was provided to designer till the early stages of design activities. According to Seismic Zonation Map of Turkey prepared by Public Works and Housing Ministry, project area is located on 1st degree earthquake zone (Dolsar, 2012). All potential dam failure modes (overtopping, structural instability, earthquakes, leakages) were analyzed using the required factor of safeties during preparatory studies. There are no significant gaps against the proven best practice.

Is the proven best practice met?: Yes

5.2.5.2 Management

This subject addresses safety management issues of dam body and other infrastructures.

Analysis against the basic good practice:

Scoring statement: Are safety related commitments met, is a quality control program in place for implementation, are public safety measures performed?

As objective evidence, Statkraft's HSE Activity Plan ensures the following actions (Contract, 2011):

- Plant and Overall Safety and Security: A coarse and detailed fire and explosion risk (Hazard Identification) evaluations are performed. As a basis for the design of the security barriers and systems of the facilities, security risk assessment is performed. For the design, road/transport safety measures should be performed.

- Safety of Dams and Waterways: Dams and waterways were classified in the feasibility study considering types of failure. A coarse risk assessment is conducted during the feasibility stage, and an updated risk assessment is performed during pre-construction stage. A coarse Hazard and Operability Study is performed coarsely in pre-construction stage and in detailed during the next step.

- Instrumented Safety Functions: Safety Requirement Specification is established and Safety Integrity Level requirements according to IEC 61508 are implemented in the feasibility stage. The Safety Analysis Report is prepared in detail at the engineering phase (Dolsar, 2013). Safety Requirement Specification is being exposed to updates according to the Safety Analysis Report depending on Prof. Dr. Kaare Høeg's guiding (Dolsar, 2013).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond to emerging risks and public safety measures?

One work incident occurred at site till August 2013 due to a lack of proper excavation support systems application in diversion tunnel outlet. Some photos taken from site after the incident can be seen in Appendix G. Fortunately, there wasn't any injured workman or machinery loss. Although all required precautions were taken after the incident, this is marked as **a significant gap**.

Is the proven best practice met?: No

5.2.5.3 Conformance and Compliance

This subject addresses the realization of objectives related with safety issues in compliance and conformance with related safety and risks commitments.

Analysis against the basic good practice:

Scoring statement: Are all the actions taken in place in compliance with the related safety commitments?

Statkraft's Safety Management Plan and Safety Risk Assessment are objective evidences (Contract, 2011). All processes and relating goals are ongoing in compliance with mentioned safety requirements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are any other non-conformances and non-compliances identified?

Emergency Preparedness Plan of the owner is an objective evidence of the proven best practice. No other non-conformances and non-compliances are identified with respect to public safety.

Is the proven best practice met?: Yes

5.2.5.4 Outcomes

This subject addresses the avoidance, minimization and mitigation of safety risks.

Analysis against the basic good practice:

Scoring statement: Are the safety risks mitigated without any significant gaps and are safety issues addressed?

Çetin HEPP has positive impact on public safety through new roads and fire work brigade. Since the nearest settlements are Çukurköy Village located 875 m southwest and Üçoyuk Village located 1000 m west of construction site, public is away from the project site and do not have risks related with construction works. Employers' safety in the area is conserved; risks have been avoided and minimized. In Appendix H, photos taken from site can be seen including objective evidences about safety caution signs and safety clothes of workers.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are the safety risks beyond the risks caused by the project itself addressed?

Moreover, the project may have a positive impact on public safety assisting with its own sources such as to fire work brigade outside the site. Flood control will be another safety benefit (Dolsar, 2012).

Is the proven best practice met?: Yes

Score: Infrastructure Safety topic is evaluated for four subjects and basic good practice are met for these subjects. However, since 1 gap is identified, the proven best practice is not met for Management subject. Thus, an overall score of **4** is assigned to this topic.

Relevant Evidence: Statkraft's "Requirements for HSE in the design of Hydroelectric Power Plants" document, Çetin Dam and HEPP Design Criteria Report (Dolsar, 2012), Photos taken from Çetin Dam and HEPP site, Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar, Çetin Dam and HEPP Dam Body Safety Analysis Report (Dolsar, 2013), Spillway hydraulic model constructed by Technical University of Vienna

5.2.6 Topic 6: Financial Viability

"Financial Viability" topic of "Financial" dimension assesses the success of the project's economical management. The aim is to evaluate the project's sound financial basis, ability of generating the required financial returns, and capability of satisfying social and environmental measures including the delivery of project benefits to project affected communities and resettlement funding. Four subjects of "Financial Viability" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.6.1 Assessment

This subject addresses monitoring of the financial situation during implementation and general project financial issues such as costs and models including risk assessment.

Analysis against the basic good practice:

Scoring statement: Are project costs and revenue streams undertaken using models that comprise of risk assessments, is sensitivity analysis performed; and is financial status monitored during implementation?

Benefit-cost ratio is an indicator showing whether a project is commercially viable or not. Benefit-cost ratio calculation was performed in feasibility study and project was found beneficial. Scenario testing and sensitivity analysis were performed by the owner including risk assessments (Appendix D, Q8). Financial status is strictly followed by the owner during implementation.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, is the project optimized by using risk assessments, sensitivity analysis and extensive scenario testing?

More detailed economic models, scenario testing, risk analysis, and monitoring of the financial situation during implementation are conducted by the owner. There is no objective evidence against the proven best practice (Appendix D, Q8).

Is the proven best practice met?: Yes

5.2.6.2 Management

This subject addresses the in place measures and future operating management for financial management.

Analysis against the basic good practice:

Scoring statement: Are financial measures in place, and plans for future management available during implementation?

Necessary financing sources are met by both own resources of the activity owner and loans, which are locally and internationally secured. Caused by the complexity of the project, some delays, cost increases or target changes may occur but the project is guaranteed by contractors. Financial management of the project is under Statkraft's

responsibility. Determining the major costs clearly is very vital for a proper financial management. Measures of financial management are made at site at the implementation stage and plans are revised according to the future operating hydropower facility. For Çetin Project, the major costs in owner's responsibility determined in Dolsar's Feasibility Report are given (Dolsar, 2012):

- Project Costs (Dam body, spillway-bottom outlet structures, cofferdams, energy tunnel, powerhouse and the cost related to other technical equipment)
- Costs of access roads
- Costs of the personnel to be employed and working machines
- Environmental regulations and costs related to the security
- Infrastructure costs
- Although the economic life of the project is foreseen as 50 years, this period can be extended up to 100 years in case an electro-mechanical equipment renewal is made every 35 years and necessary rehabilitation activities are conducted in hydraulic structures

Statkraft's experience in sector is an objective evidence of the company's financial management capabilities. Moreover, in Çetin Dam and HEPP Project, ecologic turbine of the powerhouse will guarantee full capacity energy production without any loss from residual water while preventing riverbed from drying in compliance with environmental requirements. Ecological turbine usage is advantageous in terms of economy as well as it guarantees downstream flow requirements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do financial management plans respond to emerging risks and opportunities?

Financial management plans respond to emerging risks and opportunities for environmental and social issues under the responsibility of the owner. Financial modeling reports, financial risk analyses and annual financial reports for the company are prepared by the owner. No objective evidences are identified against the proven best practice.

Is the proven best practice met?: Yes

5.2.6.3 Conformance and Compliance

This subject addresses the processes continuing in compliance and conformance with funding commitments.

Analysis against the basic good practice:

Scoring statement: Are the financial ongoing activities in compliance with the funding commitments?

The requirement of additional civil works and equipment, some site incidents, and vandalism can be some reasons for financial uncertainties, cost increases and delays. The financial management is guaranteed with funding commitments by Statkraft without any non-conformances and non-compliances (Dolsar, 2012).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are other non-conformances and non-compliances identified?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and the author's access is limited to financial documents of the owner, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.6.4 Outcomes

This subject addresses the project's capability of paying its debts included with range of scenarios, all commitments about social and environmental issues, etc.

Analysis against the basic good practice:

Scoring statement: Is the project capable of paying all requirements of the commitments including risk scenarios?

The financial management team is responsible for considering different range of scenarios, and servicing debts and payments for all plans and commitments about planned and unplanned environmental and social issues including the construction and operation stages. The financial model of the project managed by Statkraft ensures its ability to finalize the project regarding the mentioned issues.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, can project owner manage all financial issues under a broad range of scenarios?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and the author's access is limited to financial documents of the owner, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

Score: Financial Viability topic is evaluated for five subjects and basic good practice are met for these subjects. However, since analysis against the proven best practice cannot be performed for Conformance and Compliance and Outcomes subjects, an overall score of **minimum 3, maximum 5** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna)

5.2.7 Topic 7: Project Benefits

"Project Benefits" topic of "Financial" dimension assesses the sharing of additional benefits of the project to ensure that benefits are delivered to project affected communities. Sharing of benefits should be beyond one-time compensation payments or resettlement support. Four subjects of "Project Benefits" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.7.1 Assessment

This subject addresses assessment of benefit sharing.

Analysis against the basic good practice:

Scoring statement: Do opportunities increase with the contribution of the project and are additional benefits shared if it is required in the commitments?

The economic life of the project is taken as 50 years. The project has power generation purpose. It is predicted that construction and operational activities will provide economic benefits directly and indirectly.

The benefits of the project are (Dolsar, 2012):

- It will contribute to "Green Energy" as well as supporting Turkey in energy market. Both regional and national economy will be supported.

- It will control flood in high flood seasons and prevent the near settlements from being flooded.
- Dam lake will be used for recreation and fishing purposes.
- Reforestation and environmental regulations will prevent the possible occurrence of erosion events.
- Tourism activities will appear around the reservoir of the dam.
- Access roads will be constructed; current ones will be improved contributing to the region's transportation.
- Landscaping will be carried out as part of project applications and quality of lives of people living in the vicinity of the project site is expected to increase.

As can be seen some additional benefits are expected for the region as a result of project implementation. No additional benefit sharing is required in the commitments.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are delivery of project benefits taken into account considering risks and opportunities?

Since many of the benefits are expected in proceeded stages of the project, they are not observed yet. There are no marked significant gaps against the proven best practice regarding ongoing activities conducted at site yet.

Is the proven best practice met?: Yes

5.2.7.2 Management

This subject addresses measurements in place related with the delivery commitments of additional benefits.

Analysis against the basic good practice:

Scoring statement: Are additional benefits shared regularly, and commitments to project benefits publicly available?

According to SAP criteria, local employment and income should be generated by a HEPP project. This criterion is met as the project enhances local employment. All of the unqualified personnel at site are from the local people living in the vicinity of the project site (Appendix D, Q9). Timber wastes will be collected separately and given to nearby villagers in case of demand. However, most of the benefits will become distinguishable in long-term. Commitments of project benefits are publicly available.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do processes in place respond emerging risks and additional opportunities?

The author cannot find any objective evidences about a Social Compensation Program that will serve additional opportunities to region. Social compensation programs include construction of new schools, health centers, security centers, strengthening local associations, increasing cultural value etc. to promote local people's welfare (Locher, 2013). Those could be some of the additional benefits for region. Moreover, the sponsorships policy is a political, institutional instrument that aims to associate the company branding with sustainable development actions (Locher, 2013). This can be supplied to local businesses in the vicinity by giving sponsorships in owner's web site (www.statkraft.com). Since Siirt province is located at an undeveloped region of country, no commercials exist in the vicinity of the project site that may really benefit from sponsorships. Presently, there are no planned economic, social and infrastructure activities other than the implementation of the project. Absence of Social Compensation Program that may supply additional opportunities is marked as **a significant gap**.

Is the proven best practice met?: No

5.2.7.3 Conformance and Compliance

This subject addresses the processes at site are ongoing in compliance with benefit sharing commitments.

Analysis against the basic good practice:

Scoring statement: Do objectives of benefit sharing are met in compliance with the commitments?

Statkraft's sustainable social corporate policies require complete conformance and compliance with approved standards and signed national specifications regarding share of benefits of the project with directly affected communities. Commitments are strictly met in applications.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and the author's access is limited to related documents of the owner, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.7.4 Outcomes

This subject addresses the local people's receiving benefits issue.

Analysis against the basic good practice:

Scoring statement: Are directly affected communities receiving any benefits?

Being in a developing country, this project is expected to bring economic and social dynamism to the region. The project is a useful one and no critical adverse impacts of physical, biological and social environment are pending (Dolsar, 2012). The project also contributes to income levels of local people as well as promoting national economy. Many job opportunities appeared in the vicinity of the project site. 1000 people are employed in the implementation stage and 50 people are to be employed in operation stage (Dolsar, 2012). The project contributes to the reduction of local unemployment and improvement of living standards. The project provides job opportunities to local people among Siirt province, Şirvan town and surrounding villages. All of the unqualified labourers are employed from vicinity. Siirt province, for which commercial activities are vital, is one of the poorest cities with lowest income in Turkey as discussed in Section 5.2.11. Yet, workers employed at site are the only realized benefits for local people of Siirt due to stage of the project being at its implementation stage.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are the benefits significant and sustained for directly affected people?

Siirt is located at an undeveloped region of the country and any additional benefit is very crucial for local people's welfare. Local people of Siirt are very poor compared with country's average (Table 5.1). EISD assessment emphasizes the disparities between different income groups (In affordability assessment of SOC2 indicator), which should be overcame. To enhance sustainable development, local people's

benefits should be increased in HEPP projects. The burden of energy in their budget should be decreased. After expropriation and resettlement activities are realized, local people do not benefit directly from energy generation projects in Turkey. Sharing of benefits is one-time compensation payments or resettlement support, which should not be the case. One of the benefits for the local people may be government's reflecting cheaper energy unit price to decrease their expenditures on energy by means of sharing the generated energy. In Turkey, requirements of benefit sharing with local people issue should be promoted. This topic is suggested to be weighted higher for Turkey, related with country's individual conditions. Absence of additional benefit sharing is marked as **a significant gap**.

Is the proven best practice met?: No

Score: Project Benefits topic is evaluated for four subjects and basic good practice are met for these subjects. However, since 2 gaps are identified, the proven best practice is not met for Management and Outcomes subjects. Moreover, analysis against the proven best practice cannot be performed for Conformance and Compliance subject. An overall score of **3** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna)

Table 5.1 Development Status for the Province of Siirt (En-Çev, 2011)

	Year	Unit	Siirt	South East Anatolia Region	Turkey	Grading out of 81 cities
DEMOGRAHIC INDICATORS						
Total population	2000	People	263376	6608619	67803927	64
Urbanization rate	2000	Percent	58.22	62.69	64.9	29
Annual average population increase rate	1990-2000	Per mille	7.98	24.79	18.28	54
Population density	2000	People/km^2	48.18	88	88	56
Fertility rate	2000	Children Population	6.05	4.86	2.53	3
Average household size	2000	People	7.48	6.55	4.5	9
EMPLOYMENT INDICATORS						
Ratio of employees in the agricultural labour branch to total employment	2000	Percent	56.87	61.35	48.38	54
Ratio of employees in the industrial labour branch to total employment	2000	Percent	2.58	7.06	13.35	68
Ratio of employees in the commercial labour branch to total employment	2000	Percent	4.04	6.21	9.67	69
Ratio of employees in the financial institutions labour branch to total employment	2000	Percent	0.68	1.17	3.11	75
Ratio of paid employees to total employment	2000	Percent	39.33	33.21	43.52	21

Table 5.1 (Continued)

Ratio of paid female employees to total employment	2000	Percent	2.52	3.72	8.81	69
Ratio of employers to total employment	2000	Percent	0.62	1.51	2.61	77
EDUCATIONAL INDICATORS						
Rate of literate population	2000	Percent	68.66	73.22	87.3	77
Ratio of literate females to the total female population	2000	Percent	52.15	60.16	80.62	78
Ratio of university graduates to the graduates	2000	Percent	5.16	4.99	8.42	63
Primary education schooling rate	2000-2001	Percent	105.72	94.12	98.01	18
High schools schooling rate	2000-2001	Percent	22.4	27.32	36.92	71
Vocational schools schooling rate	2000-2001	Percent	8.1	6.6	20.49	71
HEALTH INDICATORS						
Infant mortality rate	2000	Per mille	63	48.33	43	4
No of doctors per ten thousand people	2000	People	4	5	13	73
No of dentists per ten thousand people	2000	People	0	1	2	74
No of pharmacies per ten thousand people	2000	No	3	2	3	22
No of hospital beds per ten thousand people	2000	No	11	13	23	70
INDUSTRIAL INDICATORS						
Organized Industrial Zone Parcel No	2000	Parcel	81	1733	28726	50
Small Industrial Zone No of Workplaces	2000	No	128	7044	81302	71
Manufacturing industry No of Workplaces	2000	No	1	359	11118	76
Manufacturing industry annual average of employees	2000	People	-	31576	1130488	72
Manufacturing industry installed output capacity volume	2000	Horsepower	-	381183	13478078	71
Per capita manufacturing industry electricity consumption	2000	kWh	-	196	550	49

Table 5.1 (Continued)

Per capita manufacturing industry added value	2000	Million TL	-	73	350	58
AGRICULTURAL INDICATORS						
Agricultural production value per rural population	2000	Million TL	751	883	1.124	64
Share of agricultural production value in the national value	2000	Percent	0.31	8.14	100	73
CONSTRUCTION INDICATORS						
No of flats	2000	No	30244	946373	16235830	70
Rate of flats having piped water installation	2000	Percent	92	94	97	64
FINANCIAL INDICATORS						
Share in the Gross National Product	2000	Percent	0.19	5.06	100	69
Per Capita Gross National Product	2000	Million TL	880	954	1.837	64
No of bank branches	2000	No	12	301	7786	77
Per capita bank deposit	2000	Million TL	57	115	939	77
Share in the total bank deposits	2000	Percent	0.02	1.2	100	80
Share in the total bank loans	2000	Percent	0.02	1.8	100	79
Amount of agricultural loans per rural population	2000	Million TL	11	35	138	75
Per capital amounts of industrial, commercial and tourism loans	2000	Million TL	25	68	392	77
Per capita municipal revenue	2000	Million TL	21	44	82	79
Per capita general budget revenue	2000	Million TL	34	63	464	78
Per capita income and corporate tax amounts	2000	Million TL	18	28	165	76
Per capita public investment amount	1995-2000	Million TL	35	213	248	80

Table 5.1 (Continued)

Per capital volume of investments based incentive certificates	1995-2000	Million TL	224	2030	2668	72
Per capital export amount	1995-2000	US Dollars	0	347	2249	74
Per capita import amount	1995-2000	US Dollars	0	197	3967	74
INFRASTRUCTURE INDICATORS						
Asphalt road rate in the rural settlements	2000	Percent	26.93	36.24	45.23	63
Rate of population for which adequate drinking water is made available	2000	Percent	80.63	74.44	84.98	55
Asphalt road ratio	2000	Percent	77.62	84.65	91.28	74
OTHER INDICATORS						
Personal automobile number per ten thousand people	2000	No	119	208	652	71
Motor land vehicles number per ten thousand people	2000	No	234	505	1056	74
Electricity Consumption per capita	2000	MWh	1	1	1	45
Telephone credit amount per capita	2000	No	859	837	1852	65
Ratio of people with green card	2000	Percent	31	23	15	12

5.2.8 Topic 8: Procurement

"Procurement" topic of "Financial" dimension assesses project procurement including goods, services and works. The aim is to evaluate transparency and equitability of procurement processes, success of achieving project timeline and financial milestones and developer's sustainability performance, and support opportunities for local industries. Four subjects of "Procurement" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.8.1 Assessment

This subject addresses procurement plans and processes. Major supply needs and sources should be provided in relation with legislations.

Analysis against the basic good practice:

Scoring statement: Are major supply needs and sources obtained in accordance with legislations including supply chain risks, and does monitoring continue to check effectiveness of procurement plans and procedures?

Related legislations are followed to supply major needs and sources. All of the major needs which are available in local suppliers are supplied from them. The other needs and sources are obtained by bidding according to regulations. Risks and opportunities assessment include labour, materials and services issues. Contractors meet the required services with respect to labour laws, and work health and safety No objective evidences violating the requirements are identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the assessment include opportunities for local suppliers and local capacity development?

The fuel needed for trucks and construction machinery is obtained from local gas stations. All types of board and lodging services are taken from the region. The commercial life in the surrounding regions is promoted due to the shopping; and income rates increased in the region (Appendix D, Q9). By getting services from local suppliers, increasing the welfare of local people criteria is met.

Is the proven best practice met?: Yes

5.2.8.2 Management

This subject addresses meeting the requirements of commitments related with procurement.

Analysis against the basic good practice:

Scoring statement: Are measures to guide procurement of goods, works and services in place to address risks and to meet procurement commitments?

Potential risks are carefully monitored by Statkraft's procurement of goods, works and services. Procurement commitments comprise using local suppliers and employing local workers. Measurements are in place to meet the commitments. Local suppliers and employers are used at site.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Are sustainability and anti-corruption criteria assigned in the pre-qualification screening?

Sustainability requirements are strongly emphasized with "Requirements for HSE in the design of Hydroelectric Power Plants" document (Statkraft) attached to the contract (Contract, 2011). International standards to be followed by the designers, contractors and sub-contractors are mentioned in the earlier sections of SAP assessment. Statkraft has a high sensitivity on corruption issues. However, no special sustainability criterion is included for market research of companies by the owner as pre-qualification screening in bidding process. In Turkey, this lack of requirement can be marked as **a significant gap**.

Is the proven best practice met?: No

5.2.8.3 Conformance and Compliance

This subject addresses meeting the requirements of commitments of any processes related with procurement.

Analysis against the basic good practice:

Scoring statement: Does any significant non-conformances and non-compliances exist against the commitments related with procurement?

Unqualified labourers are hired and board, lodging and fuel services are taken from local suppliers in compliance with the commitments. No non-conformances and non-compliances with related procurement commitments have been identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are any additional non-conformances and non-compliances identified?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.8.4 Outcomes

This subject addresses equitability, efficiency, transparency, and accountability of procurement of works and services.

Analysis against the basic good practice:

Scoring statement: Is procurement of works and services continuing in an equitable, transparent and ethic manner?

Statkraft has a strategic approach to mitigate risks, ensure efficiency and obeying milestones identified in the work schedule. In procurement bidding periods, processes were transparent, ethical and equitable. Communications about procurement processes between the contractors were fair so that standard processes were accepted and signed after all stakeholders' views were discussed. All the services are guaranteed with contracts including the penalties for all stakeholders in case of any violations (Contract, 2011).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Are there any opportunities for local suppliers including initiatives for local capacity development?

No minimum-fix-percentage of local workers was assigned in EIA or Dolsar's Feasibility Report. However, all of the unqualified workers at site are from local

people (Appendix D, Q9). On the other hand, no training courses were conducted to develop local supplier's capacity. This is marked as **a significant gap**.

Is the proven best practice met?: No

Score: Procurement topic is evaluated for four subjects and basic good practice are met for these subjects. However, since 2 gaps are identified, the proven best practice is not met for Management and Outcomes subjects. Moreover, analysis against the proven best practice cannot be performed for Conformance and Compliance subject. Thus, an overall score of **3** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.9 Topic 9: Project Affected Communities and Livelihoods

"Project Affected Communities and Livelihoods" topic of "Social" dimension assesses the effects of the project on livelihoods and living standards of nearby communities. The aim is to compare pre-project conditions with long-term conditions of project affected communities and evaluate the project's capability of managing risks, rights, and opportunities of those. Six subjects of "Project Affected Communities and Livelihoods" topic are assessment, management, stakeholder engagement, stakeholder support, conformance and compliance, outcomes; and each of these subjects is evaluated below.

The topic is very important regarding Turkey's situation according to EISD evaluation conducted in Section 3.3. As stated in Section 5.2.7, project benefits for local people are not aimed to be maximized in Turkey. In many projects, after resettlement and expropriation costs are paid, the publics' partnership ends. Since most of HEPP projects are established at undeveloped and rural parts of the country, local people form the lowest income group most of the time. Thus, a fair benefit sharing may contribute to regional economy and sustainable development. According to EISD analysis of the country (SOC2 assessment given in Section 5.2.7), it is seen that lowest income group pays a large portion of their income for energy and basic needs. Their expenditure burden of energy should be decreased to enhance sustainable development in the country. This topic is suggested to be weighted higher in Turkish HEPP projects considering the specific situation in Turkey.

5.2.9.1 Assessment

This subject addresses assessment of issues related with directly affected people. Local knowledge usage, monitoring of impacts and effectiveness of management during implementation issues are checked.

Analysis against the basic good practice:

Scoring statement: Are issues related with directly affected people clearly identified utilizing local knowledge, assessed and being monitored?

Residential areas/settlements located by the riverbed are to be affected upon the formation of the dam lake. The Villages of Güleçler, Narsuyu and Ayvalıbağ and Darıcık Quarter will be partially affected by the lake area. Garden houses and gardens used by local people in summer months as well as a number of houses at Darıcık Quarter will remain under water. Expropriation and settlement activities of directly affected people will be performed according to regulations. Native language of some of the local people is Kurdish. Thus, some of the personnel know Kurdish to ensure clear communication with directly affected people, monitor their thoughts and immediately act in case of a problem.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring of project affected communities take inter-relationships among issues, risks and opportunities into consideration?

Çetin Dam and HEPP Project Socio-economic Status Study is conducted by Dr. Nilay Çabuk Kaya in 2010 (Çabuk Kaya, 2010). Interviews were conducted with household heads of the Dişlinar and Yalkaya villages which are located in the vicinity of the project site and are directly affected by Lower Çetin Dam and HEPP. Since a few people are directly affected from Çetin Dam and HEPP, the same study is valid and used for both projects (En-Çev, 2011). The summary of the results is given in Table 5.2. As can be seen, the villagers are extremely poor and local people expect some positive effects.

Table 5.2 Interview Summaries Conducted with Household Heads (Çabuk Kaya, 2010)

	Dişlinar Village	**Yalkaya Village**
Number of Households communicated	**20**	**6**
In how many houses at least one person worked at civil works?	45%	33%
What is the percentage of the person worked at site who are younger than 30?	10%	-
At what type of civil works do they have abilities?	Painting, plastering, formworking, plumbing, boring	Painting, plasting
How many people are available for unqualified civil works?	24	5
What can they do at site?	General civil works, road constructions, cutting trees, security services, cooking, welding, bonding, driving etc.	General civil works, road constructions, bonding, driving
What is the percentage of using wood?	76%	75%
What is the percentage of using medical plants?	24%	25%
What is the percentage of being aware of the project?	95%	87.50%
What is the percentage of using the region and river at site location?	75%	57.1
Using the site location purposes:		
Fishing	24.50%	25%
Drinking water	14.30%	12.50%
Drinking water for farm animals	18.40%	25%
House and cleaning	6.10%	
Using grassland	8.20%	12.50%
Plants and trees	8.20%	12.50%
Using for entertainment and swimming	20.40%	12.50%

Table 5.2 (Continued)

What is most liked at project site:		
Physical environment and location	65%	42.90%
Current cost-of living condition	10%	42.90%
Cost-of living opportunities	10%	
Houses	10%	14.30%
Family, relatives and neighbors	5%	
Why site region is liked:		
Region's air, water, and nature	35%	42.90%
Place attachment, having pomegranate gardens, being born-and grown place	65%	57.10%
Social services that are thought to be at very bad condition:		
Transportation	80%	80%
Health	50%	57.10%
Entertainment	45%	42.90%
Telecommunication	40%	57.10%
Environment and cleanness	40%	57.10%
Education	40%	57.10%
Fuel potentiality	36.80%	
Electricity and energy sources	45%	57.10%
Drinking water	60%	85.70%
Retired salaries/social welfare	40%	
Law order	50%	71.40%
Worries about the HEPP project before implementation:		
Can I work at site?	50%	57.10%
Will drinking water be impacted?	15%	28.60%
Will irrigation be impacted?	30%	42.90%
Will wastes become a problem?	15%	0%
Will life styles be impacted?	35%	42.90%
Safety worries	40%	28.60%
Coming foreigner worries	21.10%	28.60%
Decrease in grassland worries	40.90%	75.00%
Expected outcomes:		
Increasing welfare and incomes	93.30%	85.70%
Increasing region's economy, and employment opportunities	73.70%	
Promoting transportation facilities	73.70%	85.70%

Table 5.2 (Continued)

Improving health condition	65%	42.90%
Increase in population and decrease in mitigation	85.70%	57.10%
Main problems of local people:		
Health	20%	23.80%
Income for enough food	16.70%	19.00%
Education	15%	
Housekeeping conditions		9.50%
Unemployment		9.50%
What is the percentage of local people that had positive changes in living conditions at last 5 years?	25%	28.60%
Top three services that may promote living conditions:		
Transportation	27.10%	
Health	23.70%	19.00%
Employment opportunities	16.90%	28.60%
Education		23.80%

Gain of public from project implementation will be improved job opportunities and improved economy by utilization of local services during the implementation stage. As ecological turbine will always supply residual water for the river, this release of water at all time can be marked as the permanent gain of public, which is not satisfactory. However, the goal of maximizing possible positive impacts is not assessed and promoted by a special support program. This can be marked as **a significant ga**p.

Is the proven best practice met?: No

5.2.9.2 Management

This subject addresses publicly disclosed formal agreements with project affected communities, and management of the issues related with project affected communities and livelihoods.

Analysis against the basic good practice:

Scoring statement: Are measures in place to address identified issues that affect communities and are commitments met?

Social issues are managed in a proper way taking public's demands and needs into consideration by the social working group of Statkraft. Expropriation and resettlement

activities have not come to an end yet, but there are no oppositions from public. No significant gaps are identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond to emerging risks or opportunities?

Social working group of Statkraft is always in relationship with public to take actions immediately. On the other hand, since the public are settled in an area away from the construction site, no risks are expected for local people due to construction activities.

Is the proven best practice met?: Yes

5.2.9.3 Stakeholder Engagement

This subject addresses ongoing processes to supply feedback to project affected communities.

Analysis against the basic good practice:

Scoring statement: Are processes in place to give feedback to project affected communities about raising issues?

Social working group of Statkraft supplies feedback about raising issues to public. The phone number of social representative of Statkraft is distributed to local public. Household visits are conducted. Some of the employees know Kurdish for effective communication with public whose native language is Kurdish.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, is the feedback about raised issues timely and affected communities are included in decision-making options?

Feedback is immediately supplied to public. Since construction activities are far away from the settlement area, local people's thoughts do not require any changes in decision making.

Is the proven best practice met?: Yes

5.2.9.4 Stakeholder Support

This subject addresses directly affected people's opposition on project.

Analysis against the basic good practice:

Scoring statement: Do affected communities support plans that affect their community?

Almost all of the project area is in forest land. A few number of summer houses and gardens of Güleçler, Narsuyu, and Ayvalıbağ villages and a few number of houses in Darıcık Quarter will be flooded. There is no major opposition from villagers against the project.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are formal agreements with almost all directly affected people reached?

There are no oppositions published on newspapers or broadcasted on TVs against the project like other HEPP projects opposed by local people and by environmentalists. This is an objective evidence of non-existence of public opposition. Legal agreements are not signed with directly affected people yet. However, since they are a few people and have no major oppositions on ongoing agreement processes, this is not marked as a significant gap.

Is the proven best practice met?: Yes

5.2.9.5 Conformance and Compliance

This subject addresses ongoing issues related with project affected communities in conformance and compliance with commitments.

Analysis against the basic good practice:

Scoring statement: Are the processes about directly affected people continuing in conformance and compliance with commitments?

The resource contribution sharing meeting was hold on 7th of May 2007 and water usage agreement is signed on 15th of May 2009. On 12th of January 2010 in Pervari Town of Siirt, a meeting was hold in order to inform public about the project (En-Çev,

2011). There is no opposition of public, informal agreements are reached and all processes are ongoing in compliance with the commitments (Appendix D, Q9).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are any additional non-conformances and non-compliances identified?

Additionally, no non-conformances and non-compliances are identified. Very few people are directly affected from the project and this is an advantage.

Is the proven best practice met?: Yes

5.2.9.6 Outcomes

This subject addresses improvement on directly affected people's lives and livelihoods. Economic displacement should be fairly compensated.

Analysis against the basic good practice:

Scoring statement: Are there any improvements in directly affected communities' livelihoods, and is economic displacement fairly compensated?

The construction of the dam creates employment opportunities for the local public with the construction of the new roads, improvement of the current ones and other uses. All of the unqualified employees at site are from local people (Appendix D, Q9). The project influences economic and social life of the local people in the nearest villages positively as discussed before in detail in Section 5.2.7.

All types of board and lodging and fuel services are taken from local suppliers. The commercial life in the surrounding regions is promoted due to the shopping activities as discussed in detail in Section 5.2.8.

Besides, the lake sight will create a recreation area for the local public. Since the dam site is located in one the least developed cities of Turkey (Table 5.1), a recreational area will improve local people's lives. Social life opportunities will arise and touristic activities may start.

Moreover, although it is not legally required and is not among the contractor's responsibilities, contractor repairs the roads and water pipes of the villagers etc. (Appendix D, Q4).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Are the measures in place to improve livelihoods in long-term?

There is not satisfactory objective evidence of a measurement for long-term improvements in directly affected people's lives. This is marked as **a significant gap**.

Is the proven best practice met?: No

Score: Project Affected Communities and Livelihoods topic is evaluated for six subjects and basic good practice are met for these subjects. However, since 2 gaps are identified, the proven best practice is not met for Assessment and Outcomes subject. Thus, an overall score of **3** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna)

5.2.10 Topic 10: Resettlement

"Resettlement" topic of "Social" dimension assesses physical displacement of project affected communities in terms of sustainability. The aim is to ensure that the rights of affected people are protected in a fair manner without compromising the citizens' living standards and commitments. Livelihoods and standards of resettled people and hosts should be improved.

Since the author does not have access to Statkraft's Resettlement Action Plan and management details, and resettlement activities have not started yet; resettlement topic will be evaluated as a whole under the assessment subject only to avoid repetition.

5.2.10.1 Assessment

This subject addresses commitments made with people to be resettled and host communities in a fair manner.

Analysis against the basic good practice:

Scoring statement: Is assessment of the resettlement implications undertaken in a fair manner for the people to be resettled and host communities supported by commitments?

After Çetin Dam body is constructed and water impounding stage ends; a lake having 610 hm^3 volume will be formed (Dolsar, 2012). The lake will influence the residential

areas near the side of the riverbed. The settlement areas at Güleçler, Narsuyu, Ayvalıbağ villages and Darıcık Quarter will be partially affected from the reservoir (En-Çev, 2011). Garden houses and gardens used by local people in summer months as well as a number of houses at Darıcık Quarter will be flooded.

Obtained information about resettlement procedures in Turkey from EIA Report which Statkraft ensures to obey at Çetin Dam and HEPP Project area is given below (En-Çev, 2011):

- As required by sub-clause c of Article 15 of Law No 4628 on the Electricity Market amended by Law No 5496, expropriation operations are carried out by EPDK. Any expropriation decisions adopted should serve public benefit and immovable properties expropriated should be registered to the Treasury (En-Çev, 2011).

- The procedures for expropriation of any area, which will be flooded, are carried out in accordance with Law No 2942 on Expropriation and Law No 4650 on Expropriation amending this law, issued in the Official Gazette dated 5th of May 2001 (En-Çev, 2011).

- The final area of agricultural land to be affected is determined during the mapping and expropriation operations carried out before the construction started. Quality of the agricultural land will be determined during expropriation of the agricultural land. Action will be taken in compliance with Law No 5403 on Land Preservation and Land Use, which was issued in the Official Gazette Issue No 25880 of 19th of July 2005 as well as with Law No 4342 on Pastures issued in the Official Gazette Issue No 23272 of 28th of February 1998. Any necessary permission will be obtained for use of the agricultural land and pasture areas prior to commencement of construction works.

- Some impacts on the social structure are expected to occur. It is ensured by the owner that the negative impacts will be compensated, and expropriation costs will be paid. At first, a valuation is made and experts ask the residents if they would like to resettle or be paid. Statkraft offers the residents both expropriation payment or resettlement choices. However, problems may emerge in the following stages of the project. Beneficiaries who preferred to take expropriation costs before may request the owner to take the given expropriation money back and resettle them. This may lead a period of courts as this is the case in many of the HEPP projects in Turkey (Dolsar, 2012).

Resettlement and paying rights of public stage has not started yet. Social working group continues their studies always in relationship with directly affected communities. It is guaranteed by the owner that, all the commitments will be satisfied.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Do commitments, related with people that are going to resettle and host communities, take risks and opportunities into consideration?

The assessment of delivery of commitments is another important issue. The risk and opportunities to people that are going to resettle and host communities should be considered. Since few houses need to be relocated because of Çetin Dam an HEPP reservoir, there will not be any impact on host communities. No studies are conducted about host communities, since this aspect is irrelevant for Çetin Dam and HEPP. However, assessment is performed for people who are exposed to resettlement. No measures are put in place to improve the resettled communities' opportunities and living standards in the long-term. This is marked as **a significant gap**.

Is the proven best practice met?: No

Score: Resettlement topic is evaluated for assessment subject and basic good practice is met for this subject. However, since 1 gap is identified, the proven best practice is not met for Assessment subject. Thus, an overall score of **4** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report

5.2.11 Topic 11: Indigenous Peoples

"Indigenous Peoples" topic of "Social" dimension assesses the rights, risks and opportunities arisen by the implementation of the project for indigenous peoples. Indigenous peoples are defined as social groups who are distinct from dominant groups in national societies and often the most marginalized and vulnerable segments of the population (IHA, 2010). The aim is to evaluate the respect of the project implementers to indigenous peoples' rights, culture, lands and resource based livelihoods throughout project life.

Based on SAP's indigenous peoples definition, no indigenous people live in the project area. According to SAP Criteria, if no indigenous peoples live in the project area, than the subject is assessed as irrelevant. Thus, Indigenous Peoples topic of Çetin Dam and HEPP is evaluated as irrelevant.

Score: Irrelevant

Relevant Evidence: Dolsar's Feasibility Report, EIA Report

5.2.12 Topic 12: Labour and Working Conditions

"Labour and Working Conditions" topic of "Integrative" dimension assesses the working and labour conditions in terms of fairness, equity, health, security, and diversity. Five subjects of "Labour and Working Conditions" topic are assessment, management, stakeholder engagement, conformance and compliance, outcomes; and each of these subjects is evaluated below.

According to the results of EISD assessment (SOC4 indicator evaluated in Section 3.3, since work accidents occurrence is higher than that of developed countries' averages, labour and working conditions should be given higher importance in Turkey. It is recommended to give higher weight for this subject in the assessments of Turkey's HEPP projects.

5.2.12.1 Assessment

This subject addresses meeting human resources and labour management requirements in place.

Analysis against the basic good practice:

Scoring statement: Do requirements of human resources and labour management identify labour and working conditions through an assessment process including occupational health and safety?

The intent of the assessment is to ensure that workers are protected and treated fairly. It comprises of working conditions, equity, health, safety, labour and contractor opportunity.

About 1000 people are employed at the implementation stage of the project (Dolsar, 2012). About 500 workers are employed at mine site and crusher facility, about 20 workers at concrete plant, about 10 workers at construction site, and about 470 workers at other works (Dolsar, 2012). Mainly unqualified workers are employed from nearby villages in the District of Şirvan (Appendix D, Q9).

The job site accommodation area includes the mass hall, kitchen, dressing room, showers, toilets, lavatories, warehouse and administrative and technical offices for all kinds of technical and social infrastructure. Requirements of the staff, employed at the implementation stage, are being meet at the camping site formerly owned by EİEİ.

Requirements for HSE of Statkraft consist of some subjects related with labour rights (Contract, 2011). These rights are important to provide hygiene, safety, and sickness absenteeism. According to International Finance Cooperation requirement accepted by Statkraft, water target should be 100 liters per day per person (Contract, 2011). The water quality should meet World Health Organization (WHO) standards. Latrines and urinals, accommodation, and canteens opportunities are to be served in accordance with national standards. There is no objective against the proven best practice violating labour rights.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the assessment take broad considerations into account including risks and opportunities?

Statkraft has its Emergency Action Plan with the aim of minimizing the life and property losses in extraordinary cases such as flood, fire, earthquake etc. (Contract, 2011). The first stage of the emergency planning includes the detection of the events possible to occur in or out of the plant. These detections are the definitions of the accidents causing emergency situations. The effects of the accidents and events on the environment, people and the plant are determined with these detections.

In Section 5.2.5, the specifications to be followed related with safety are given. Statkraft ensures "adequate precautions are taken to promote a satisfactory HSE quality and performance during the operation and maintenance of the plants" also in its own specifications. These specifications also aim to ensure the constructability of design to avoid risks during construction stage. Each work activity has been evaluated in safety and risk assessment. Some possible risks at site are working at heights, traffic, electric shock, lifting load, landslides, etc. No significant gaps are identified.

Is the proven best practice met?: Yes

5.2.12.2 Management

This subject addresses all labour management components including policies, plans and processes in place.

Analysis against the basic good practice:
Scoring statement: Are human resources and labour management policies, plans and processes including all stakeholders in place?

Human resources policies, plans and processes should comprise of labour management components of contractors, subcontractors and intermediaries without

significant gaps. A central job site was set up at the former camp area owned by EİEİ with the aim of meeting any social requirements, amenities, and basic needs of the staff to be employed. In order to protect the health of the employees throughout the works at site, necessary measures are being taken by the company as per Labour Law No 4857 and relevant regulations. Workers are provided proper protective aids and gadgets such as helmets, earsets or earplugs so that they are not affected from the noise (Appendix H). In addition, labourers are prevented from being exposed to noise for extended periods. The construction machines are kept in a well-maintained condition all the time and there are in strict compliance with the provisions of the "Regulation on Assessment and Management of Environmental Noise and Labour Health and Worker Safety Ordinance" which was issued in the Official Gazette Issue No 14765 dated 11th of January 1974 (Dolsar, 2012).

Some hazardous and risky incidents that can take place from land preparation stage to the operation stage are jobsite traffic accidents, injuries, material spills, falling down of workers, construction machine accidents, etc. which can be detected at any civil works site. As a precaution, warning plates are put at the work site (Appendix H) and employees are educated with labour safety training. Staff and workers are equipped with labour safety gadgets. All staff wears labour clothes, gloves, goggles, and masks when their jobs require according to health specifications. It is ensured that workers work under conditions meeting the health and labour safety requirements (Appendix D, Q6).

Communicable diseases are biggest potential risk in terms of workers' health. In order to mitigate this risk, workers undergo periodical checkups. Contact between the construction workers and local communities are kept at minimum so that the risk of communicable diseases is minimized. Facilities in the nearest hospital are used in case of major diseases or injuries. There is a sickroom at the work site that is used during the implementation stage of the project.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond to emerging risks and opportunities?

Emergency Action Plan is applied at site and all the required HSE precautions are taken by the managers. No significant gap is marked against the proven best practice.

Is the proven best practice met?: Yes

5.2.12.3 Stakeholder Engagement

This subject addresses supplying feedback for the raising issues to all stakeholders.

Analysis against the basic good practice:

Scoring statement: Are ongoing processes in place for employees and contractors for the raising human resources, labour management issues, and getting feedback?

Topic is about ongoing processes in place for contractors and labourers to promote human resources and labour management issues. No significant gaps are identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the feedback supplied and taken into consideration timely about raising issues?

Feedback is supplied immediately to all related stakeholders and issues are taken into consideration.

Is the proven best practice met?: Yes

5.2.12.4 Conformance and compliance

This subject addresses meeting the commitments relating human resource and labour management.

Analysis against the basic good practice:

Scoring statement: Are processes and objectives related to human resource and labour management made meeting the commitments?

According to EIA Report, there should be strict compliance with the provisions of Labour Law No 4857 and "Labour Health and Worker Safety Ordinance" enacted pursuant to this law. In addition, a jobsite safety and accident prevention plan should be prepared and implemented meeting the regulations and legislation presently in force (En-Çev, 2011).

Statkraft's "Requirements for HSE in design of Hydroelectric Power Plants" document ensures some extra rights to labourers. It provides indoor climate quality differing for different seasons (>22 C for cold periods, < 20 C for warm periods) (Contract, 2011). It takes some precautions to prevent labour from direct glare

sunshine, and reflecting surfaces. It limits maximum exposure to noise level during a 12 h working day to 83 dB, and maximum allowable level at any time to 130 dB (Contract, 2011). The atmospheric concentration of hazardous substances should not exceed 1/3 of the allowed limits of the country (Contract, 2011). In case of absence of the limits for country, American Congress of Government Industrial Hygienists (ACGIH)'s limit value should be applied. All of the requirements regarding labour health and safety are being strictly implemented at the site.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

No fatal accidents or serious injuries are reported at site till now. One small excavation landslide incident happened in diversion tunnel outlet construction due to non-conformances in the implementation of supporting systems. Fortunately no one was injured and there was no equipment loss. Photos taken at site after the incident can be seen in Appendix G. Required precautions were taken after the incident but this is detected as **a significant gap** in terms of compliance.

Is the proven best practice met?: No

5.2.12.5 Outcomes

This subject addresses the consistency of labour and working conditions management.

Analysis against the basic good practice:

Scoring statement: Are there any identified inconsistencies of labour management policies, plans, practices with internationally recognized labour rights?

No inconsistency of labour management at Çetin Dam and HEPP Project is identified. All management activities are ongoing in accordance with Turkish Labour Laws and accepted international regulations.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are labour management policies, plans and practices demonstrated to be consistent with internationally accepted labour rights?

Labour management policies are supported by internationally accepted labour rights as stated in Section 5.2.5 which assesses Infrastructure Safety.

Is the proven best practice met?: Yes

Score: Labour and Working Conditions topic is evaluated for five subjects and basic good practice are met for these subjects. However, since 1 gap is identified, the proven best practice is not met for Conformance and Compliance subject. Thus, an overall score of **4** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), some photos taken from site, Statkraft's "Requirements for HSE in design of Hydroelectric Power Plants" document, Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.13 Topic 13: Cultural Heritage

"Cultural Heritage" topic of "Social" dimension assesses if all cultural resources in project area are identified, given high importance and essential precautions are taken to protect them. In the results of the EISD analysis, it is stated that especially HEPP projects that include cultural heritage areas take strong oppositions by national and international environmentalists (ex: Ilısu Dam and HEPP). This topic is suggested to be weighted higher to assess a HEPP in Turkey in terms of sustainability.

Çetin Dam and HEPP Project area does not include any national parks, cultural sites, hunting wild life and hunting animals' reproduction areas, touristic areas, special environmental protection zones, military prohibited zones or archeological preservation sites having "cultural heritage" or "natural heritage" status given by the Culture Ministry as per Articles 1 and 2 of "the Convention on the Preservation of Global Culture and Natural Heritage" issued in Official Gazette No 17959 dated 14th of February 1983 (Dolsar, 2012).

There are no areas listed in the "List of 100 Coastal Historical Sites of Common Significance in the Mediterranean Sea" published by the United Nations Environmental Program (Genoa Declaration, 1985) inside the project area and its vicinity (Dolsar, 2012).

According to SAP Criteria, if no cultural heritage problem exists within a project, than the subject is assessed as irrelevant. Thus, Cultural Heritage topic of Çetin Dam and HEPP is evaluated as irrelevant.

Score: Irrelevant

5.2.14 Topic 14: Public Health

"Public Health" topic of "Social" dimension assesses if the project creates and deteriorates any health issue. It checks if commitments about public health measures are fulfilled or not.

Some health issues of Çetin Dam and HEPP related with labour health are assessed under Section 5.2.12 of labour and working conditions. Moreover, environmental health issues are assessed under Section 5.2.18. The nearest settlements are Çukurköy Village located 875 m southwest and Üçoyuk Village located 1000 m west of construction site. These villages are out of impact distance of site activities according to dust and noise modeling (En-Çev, 2011). Thus, "Public Health" subject is marked as irrelevant.

Score: Irrelevant

Reference: Dolsar's Feasibility Report, EIA Report.

5.2.15 Topic 15: Biodiversity and Invasive Species

"Biodiversity and Invasive Species" topic of "Environmental" dimension assesses the project's respect on ecosystem values, and endangered species of downstream and reservoir areas. Biodiversity impacts arising from project activities should be overcome by a responsible management. Four subjects of "Biodiversity and Invasive Species" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

Within the results of the EISD assessment, deforestation rate attributed to energy is found as a crucial indicator (ENV6 evaluated in Section 3.5). Thus, this topic is suggested to be weighted higher when SAP tool is used in Turkey's HEPP projects.

5.2.15.1 Assessment

This subject addresses the assessment of biodiversity and invasive species issue during implementation.

Analysis against the basic good practice:

Scoring statement: Are biodiversity issues relevant to project implementation and operation identified using appropriate expertise and monitoring during implementation?

A survey on aquatic fauna has been conducted on Botan Stream, which is the major source of water supply for the project. The bio-diversity research was carried out by

the Bio-Diversity Research Team of Van Yüzüncü Yıl University. As a result of the studies the "Ecological Resources and Diversity Report of Botan Stream, Siirt" report (Van Yüzüncü Yıl University, 2010) was prepared. However, later, the subjected report was revised to "Eco-System Assessment Report" (Özgökçe, 2011; Ünal, 2011) in line with a decision adopted by the General Directorate for Nature Preservation and National Parks about the HEPP projects. The report (Özgökçe, 2011; Ünal, 2011) analyses the potential effects of the project on terrestrial and aquatic flora and fauna. Some photos from study on the determination of the fish species for Çetin Dam and HEPP can be seen in Appendix I.

Almost whole project site is located inside the forest land. For the mentioned forestry, publicity is not in question in the content of the project and it is stated in Law No 6831 that "In case there is public interest to build defense, transportation, power, communication, water, waste water, petroleum, natural gas, infrastructure and solid waste disposal plants as well as sanatoriums, dams, artificial lakes, and cemeteries; and public health, training, sports plants and every kind of buildings related to these are located on the state forests or they are obliged to be constructed, the Ministry of Environment and Forestry can give permission in the name of the real and judicial people". Within the content of the project, for the activities to be performed in the forest, the needed permission is obtained from the Ministry of Environment and Forestry (En-Çev, 2011). During the activities in the forestry, waste materials will not be left or dumped in the work site.

According to EIA (En-Çev, 2011), the planned activities will not affect the environment in a negative way since emission or chemical waste is not expected. Only solid and liquid wastes of people employed at site have to be disposed. With the taken precautions which are reviewed in detail in 5.2.18, all the harmful effects are minimized at site. Wastes which are not recyclable are disposed of at a site designated by Şirvan Municipality (Dolsar, 2012)

Moreover, a treatment plant is planned to be constructed at the powerhouse and solid waste will be transferred to a suitable location identified by the municipality (Dolsar, 2012). No significant gaps are identified.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring of biodiversity issues take interrelationships among issues, risks and opportunities into account?

Since the basic good practice is not met under conformance and compliance subject, analysis against the proven best practice is not assessed.

Is the proven best practice met?: Not assessed

5.2.15.2 Management

This subject assesses management of biodiversity and invasive species topic at site that also comprises of ongoing biodiversity issues management for the operation stage.

Analysis against the basic good practice:

Scoring statement: Are processes in place to ensure management of biodiversity issues, and to meet commitments including the plans of operation stage?

According to the owner's Environmental Care Program (Contract, 2011), Environmental Management and Action Plan is implemented with Monitoring Program. Some specific requirements guaranteed by the owner are given (Contract, 2011):

- Release of ecological flow should be carefully identified in order to safeguard biodiversity.
- Emissions to the air should be carefully identified to minimize GHG impacts.
- Landscape interference should be given high priority.
- Pollution of ground, rivers or lakes should be controlled and minimized by taking precautions such as using barriers and collection systems for oil to prevent accidental discharge to the environment. Waste storage should be given importance for recycling and to minimize waste. Mass balance should be established for fuels, chemicals, oils, and greenhouse gases.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond emerging risks and opportunities?

Since the basic good practice is not met under conformance and compliance subject, analysis against the proven best practice is not assessed.

Is the proven best practice met?: Not assessed

5.2.15.3 Conformance and Compliance

This subject addresses the conformance and compliance of the implementation activities at site with commitments related to biodiversity and invasive species.

Analysis against the basic good practice:

Scoring statement: Are biodiversity issues managed in place without any non-compliances and non-conformances to commitments?

28 fish taxons were detected in the area according to 100. Yıl University's Report. The black cod, goatfish, pearl fish are the mostly encountered species in the region (Özgökçe, 2011; Ünal, 2011). In EIA Report, fish elevator was planned to be constructed (En-Çev, 2011). In Turkey, no fish elevator has been constructed yet. It is stated in EIA Report that, economical and functional methods will be searched and the most appropriate alternative of fish elevator will be selected for Çetin HEPP in the final design stage (En-Çev, 2011).

Fish passage construction in the basin is one of the objective evidences of a sustainable implementation to ensure a healthy, functional and viable aquatic ecosystem in the project affected area. Since fish passages are usually not implemented in big dams in Turkey, fish elevator design is not performed although project is in its implementation stage (Appendix D, Q7). Although it is included in EIA Report, fish elevator is absent. Lack of fish elevator is marked as **a significant gap** against the basic good practice.

Is the basic good practice met?: No

Analysis against the proven best practice:

Scoring statement: Moreover, are there any non-conformances and non-compliances?

Since the basic good practice is not met under conformance and compliance subject, analysis against the proven best practice is not assessed.

Is the proven best practice met?: Not assessed

5.2.15.4 Outcomes

This subject assesses handling way of negative biodiversity impacts arising from project implementation.

Analysis against the basic good practice:

Scoring statement: Are negative biodiversity impacts of project activities avoided, minimized and mitigated?

The residual water for the eco-system of river will always be guaranteed with ecologic flow turbine, which also saves economy. Downstream is completely protected from drying since ecological turbine will always operate.

Due to water impounding, the invertebrated species in the river will become extinct and therefore their current population will get lost (En-Çev, 2011). However, none of the stated invertebrated species is included in the International Union for Conservation of Nature (IUCN)'s Red List or addendum of the Bern Convention so that a special protection measure is not required for them (En-Çev, 2011). Thus, it is not marked as a significant gap.

In Clause 18 (3) of the EIA Regulation; it is stated that "The project owner or the authorized representative is responsible for submitting the monitoring reports related to the start of investment, construction, operation and after operation stage after obtaining the 'Environmental Impact Assessment Positive' approval to the Ministry". En-Çev, who has prepared the EIA Report, monitors and prepares the monitoring reports of the project every 3 months; and submits them to Ministry of Environment and Forestry. Processes and goals about biodiversity issues are met and going to be met on site. There is no objective evidence violating basic good practice requirements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Are pre-project biodiversity conditions enhanced as a result of the contributions of project implementation on biodiversity issues?

Since the basic good practice is not met under conformance and compliance subject, analysis against the proven best practice is not assessed.

Is the proven best practice met?: Not assessed

Score: Biodiversity and Invasive Species topic is evaluated for four subjects and basic good practice are met for these three subjects. However, since 1 gap is identified, the basic good practice is not met for Conformance and Compliance subject. Thus, an overall score of **2** is assigned to this topic.

Relevant Evidence: Ecological Resources and Diversity Report of Botan Stream, EIA Report, Dolsar's Feasibility Report, Design drawings, interview with Çetin Dam and HEPP Project Manager (Sadettin Zorlutuna), Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.16 Topic 16: Erosion and Sedimentation

"Erosion and Sedimentation" topic of "Environmental" dimension assesses the management of erosion and sedimentation caused by the project. The aim is to ensure that impacts are responsibly managed and commitments to apply necessary measures are fulfilled. Four subjects of "Erosion and Sedimentation" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.16.1 Assessment

This subject addresses assessment of erosion and sedimentation issues at site. They should be managed responsibly to ensure that they do not present problems violating social, environmental and economic objectives. The impacts of erosion and sedimentation should be monitored and related commitments should be implemented.

Analysis against the basic good practice:

Scoring statement: Are erosion and sedimentation issues relevant to project implementation identified through an assessment process using expertise; and being monitored in place?

All the scenarios were analyzed by the designer to clearly define the outcomes and it is concluded that even in the worst scenario (Existing Situation) sedimentation problems can be handled. Possible scenarios are (Dolsar, 2012):

- Pervari Dam is not present on the upstream of Çetin Dam (Existing Situation)
- Commissioning of Pervari Dam in 10 year time (Upstream Development Situation)
- Commissioning of Pervari Dam before commissioning of Çetin Dam (Upstream Development Situation)

The third scenario is the most probable case when the present developments of the two dams are compared. However, the worst scenario (Existing Situation) is analyzed (Dolsar, 2012) and it is concluded that even for that situation the water intake structure is capable of handling 50 years of sediment accumulation. The report identifies that sediment and erosion originated problem will not occur.

Sedicon performed "Çetin Reservoir Sediment Handling Study" in 2011. Sediment observations were carried out in Botan Stream in order to calculate the annual sedimentation quantity in the cascade system on Botan Stream (Sedicon, 2011). To minimize erosion and sedimentation impacts for the project to accomplish sustainability are listed in the scope of the project. It will be ensured that sedimentation impacts will be avoided for keeping the upstream of the powerhouse

clean; for protecting fish eggs and larvae; and for keeping the live storage active as much as possible.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring of erosion and sedimentation issues take interrelationships among issues into account?

Sediment transport on daily basis sampling is studied and the deposits in Lower Çetin Dam Reservoir, at the downstream of Çetin Dam and HEPP, are surveyed. Moreover, flushing tunnel hydraulic model was constructed in Technical University of Vienna. In March and June of 2013 hydraulic model experiments to which representatives of the owner, and designers including the author have attended were conducted in Vienna. In Appendix F some of the photos taken in model experiments can be seen. It was checked by the experiments that flushing tunnel discharge capacity calculated by the designer is in compliance with the hydraulic model. Designer revises both flushing tunnel and spillway in accordance with hydraulic laboratory of Technical University of Vienna's recommendations. Academically conducted hydraulic experiments support is objective evidence of proven best practice.

Is the proven best practice met?: Yes

5.2.16.2 Management

This subject addresses ongoing management of erosion and sedimentation issues in place.

Analysis against the basic good practice:

Scoring statement: Are processes for implementation and plans for operation stage in place to ensure management of erosion and sedimentation issues?

Çetin reservoir is located in highest sediment yield region of Turkey, and high sediment loads varying from year to year are expected. The reservoir is expected to lose its volume equivalent to dead storage capacity in 15-56 years (Dolsar, 2012). If no precautions are taken, back surge deposits in the river upstream will cause sedimentation problems such as: filling the active storage volume with sediment resulting in reduced peak volume capacity, and raising the riverbed resulting in flood problems at upstream sections.

Sedimentation in Çetin reservoir is suggested to be controlled by the following measures and precautions (Dolsar, 2012):

- Upstream catchment area measures and trapping of sediments behind check dams will prevent the sediments from entering.
- Annually and after high floods free surface flushing of the reservoir should be conducted.
- During flood seasons reservoir water level should be decreased in order to avoid deposition in live storage.
- In the lower parts of the reservoir, in front of the intake and flushing tunnel, hydraulic gravity dredging can be used.

Two diversion tunnels' construction has started. One of the diversion tunnels will be used later as the flushing tunnel and was designed accordingly. To manage reservoir sedimentation, the water level will be decreased when inflow rate or riverbed carrying force is high. Water intake structure is located at a lower level in order to control sediment flushing (Dolsar, 2012). The sediment particles will be removed from the reservoir in each flood season with the flushing tunnel. Flushing gate operation, necessary time for flushing and flushing efficiency calculations are also conducted as part of the flushing tunnel hydraulic studies.

Despite the challenges, it is concluded for Çetin Dam and HEPP that, sediment handling is feasible and Çetin Reservoir can operate in the desired manner if necessary precautions are taken. Statkraft, as the owner and operator ensures to take all required precautions, meet recommendations and conduct the measurements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond emerging risks and opportunities?

Plants compatible with nature shall be planted after completion of construction works. To prevent erosion, some parts of earth should be grassed to develop landscaping areas (Dolsar, 2012). According to "Report on the Ecological Resources and Diversity in Botan Stream (Siirt)" (Özgökçe, 2011; Ünal, 2011) planting of "Geven" which easily adapts to various climatic conditions and soil composition of the area retaining down on rocks with 3 to 5 m roots should be given priority. In coordination with Elazığ Forestry Regional Directorate, planting will be carried out. (Dolsar, 2012)

Processes will be in place to ensure sediment and erosion management when the construction of related facilities start. The use of Technical University of Vienna's hydraulic model in combination with ongoing monitoring of the bathymetry of the reservoir, serves a dynamic management tool for early indications of emergency cases.

The physical scale model developed by the Technical University of Vienna in order to plan the reservoir area is an evidence of best sediment management practice.

Is the proven best practice met?: Yes

5.2.16.3 Conformance and Compliance

This subject addresses conformance and compliance of processes in place related with the commitments on erosion and sedimentation issues.

Analysis against the basic good practice:

Scoring statement: Are processes in place to manage erosion and sedimentation issues without any non-conformances and non-compliances with commitments?

At the regions apart from the road and areas not remaining under water where the diversion tunnels and powerhouse are located, improvement studies will be performed to comply with the original topography and regain floristic formation. No significant non-compliances or non-conformances are detected till this stage of the project. Processes, commitments and objectives are ensured to be met at site in the future to manage sedimentation related problems.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

Erosion and sedimentation assessment reports and sedimentation plans for construction are available. Since impounding stage have not started, records of monitoring of surface waters do not exist. In addition, no non-compliances and non-conformances are marked against the proven best practice.

Is the proven best practice met?: Yes

5.2.16.4 Outcomes

This subject addresses avoidance and minimization of erosion and sedimentation issues in place.

Analysis against the basic good practice:

Scoring statement: Are erosion and sedimentation issues avoided, minimized and mitigated during implementation?

Flushing tunnel utilization ensures minimization and mitigation of sediment related problems during implementation.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are pre-project erosion and sedimentation conditions enhanced or will be enhanced with any contributions?

After the completion of dam construction and reservoir filling, sediment issue will be controlled by flushing tunnel, and upstream developed condition will be beneficial for Lower Çetin Dam and HEPP, which is located at the downstream. This is marked as a contribution on sediment issues.

Is the proven best practice met?: Yes

Score: Erosion and Sedimentation topic is evaluated for four subjects and basic good practice are met for these subjects.. Moreover, the proven best practice is met for all of the subjects. Thus, an overall score of **5** is assigned to this topic.

Relevant Evidence: Sedicon's Çetin Reservoir Sediment Handling Study, Eco-System Assessment Report, Ecological Resources and Diversity Report of Botan Stream, EIA Report, Dolsar's Feasibility Report, Flushing Tunnel hydraulic model constructed by Technical University of Vienna

5.2.17 Topic 17: Water Quality

"Water Quality" topic of "Environmental" dimension assesses the management of water quality issues related with the HEPP. The aim is to ensure that water quality in the vicinity is not negatively impacted in implementation stage and issue is handled in compliance with commitments. Four subjects of "Water Quality" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.17.1 Assessment

This subject addresses assessment of negative impacts of project activities on water quality in the vicinity, monitoring of water quality issues, and meeting water quality fulfillments.

Analysis against the basic good practice:

Scoring statement: Are water quality issues relevant to project implementation and operation identified utilizing appropriate expertise?

To meet water quality requirements, the direction of the flow should not be changed, and riverbed should not be dried. Water taken to the ecological turbine will be released into downstream to prevent the riverbed from drying. The water used for electricity generation will return to Botan Stream in the same amount, to the same place (Dolsar, 2012).

According to the letter received from DSİ General Directorate the project area is not located in any drinking water supply basin (En-Çev, 2011). The settlements in the vicinity of the project area are obtaining their domestic and drinking water from other sources located around the region.

No irrigation project that may affect the inflow values of the basin is currently operating or expected to be commissioned in the future is identified at the upstream of the dam (Dolsar, 2012).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring of water quality issues take risks and opportunities into account?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and due to restrictions of data availability, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.17.2 Management

This subject addresses ongoing water quality issues management including the plans related with operation stage.

Analysis against the basic good practice:

Scoring statement: Are processes in place to ensure management of identified water quality issues and meet commitments?

The project should be properly managed in terms of water quality issues in order not to threat nature's continuity. The owner should not violate approved water usage rights. Residual water amount was calculated according to Ecosytem Assessment and Hydrological Assessment Report (Statkraft, 2011). According to mentioned report, the residual water discharge of Çetin Dam and HEPP Project will be 12% of the annual average (Statkraft, 2011). All designs were performed according to this amount (Dolsar, 2012). Ecological turbine will always residual water to riverbed preventing it from drying; and will continuously generate energy saving economy at the same time. It is stated in Çetin and Lower Çetin Dams and HEPPs Water Usage Rights Report (DSİ, 2011) which is approved by DSİ that, 14.2 m^3/s water should be released from Çetin Dam reservoir for the pomegranate gardens spreading to 80 ha area at the downstream of Çetin Dam. The released water will be measured continuously with a flowmeter and results will be submitted to Siirt Provincial Directorate of Environment and Forestry every 6 months. In case the detected flow amount does not meet the required water amount, it will be regulated. Statkraft as the owner ensures to respect all water rights, meet all requirements and conduct related measurements.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond emerging risks and opportunities?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and due to the project's upcoming stage at site, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.17.3 Conformance and Compliance

This subject addresses the ongoing water quality processes and monitoring in conformance and compliance with commitments.

Analysis against the basic good practice:

Scoring statement: Are processes performed in conformance and compliance with commitments?

The water quality determination studies for Çetin Dam are continuing at Botan Stream Billoris Flow Observation Station No 2633 which is available since 1983 (Dolsar, 2012). Since water release stage has not come yet, there is no evidence of violating or respecting water rights. On the other hand, final design was performed in compliance

with the commitments (Dolsar, 2012). In addition, no surplus excavation materials and construction debris will be disposed of into the rivers or river beds (En-Çev, 2011).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

Since the difference between "against the basic good practice" and "against the proven best practice" requirements are not clear in SAP tool and due to the project's upcoming stage at site, this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.17.4 Outcomes

This subject addresses how the owner deals with impacts on water quality arising from project implementation.

Analysis against the basic good practice:

Scoring statement: Are negative water quality impacts minimized and avoided?

The population of the fish species may be affected to some extent. Due to changes in the quality (turbidity, pH, etc.), or velocity of the water (especially during impounding) the species would escape to other branches of the river which are appropriate for them to live (En-Çev, 2011). Depending on the hydrodynamic and ecologic modeling of the reservoir, necessary temperature variations are provided for fish species at different ages during the operation stage by thermal stratification and annual mixing cycle. Besides, reservoir serves appropriate living and breeding conditions for the fish species. No negative influence of ammonia is expected in the long-term (En-Çev, 2011).

Water resources of Çetin Dam and HEPP are given in "Dicle River Botan Stream Reconnaissance Survey" (EİE, 1986) and "Botan-Alkumru Dam and Hydroelectric Power Plant Feasibility Report" (EİE, 1991). Mostly used groundwater resource of Siirt Province is the spring water known as Hesko in Şirvan town (En-Çev, 2011). The city center, Şirvan and Aydınlar towns obtain drinking water from Botan Stream (En-Çev, 2011). There is no serious pollution source threatening the groundwater in Siirt by the construction activities of the project. No major groundwater problems are expected in the tunnel works except for the points of water infiltrations along the

joints and cracks. Necessary drainage measures will be taken and they will overcome the problem (Dolsar, 2012).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are pre-project water quality conditions enhanced with any contribution?

Since water quality related activities have not started at site yet, this subject is not assessed.

Is the proven best practice met?: Not assessed.

Score: Water Quality topic is evaluated for five subjects and basic good practice are met for these subjects. However, since analysis against the proven best practice cannot be performed for Assessment, Management, and Conformance and Compliance and Outcomes subjects, an overall score of **minimum 3, maximum 5** is assigned to this topic.

Relevant Evidence: License of Water Rights signed by State Hydraulic Works, Çetin and Lower Çetin Dams and HEPPs Water Usage Rights Report, Ecosystem Assessment and Hydrological Assessment Report, EIA Report, Dolsar's Feasibility Report

5.2.18 Topic 18: Waste, Noise and Air Quality

"Waste, Noise and Air Quality" topic of "Environmental" dimension assesses the waste, noise and air quality issues with the aim of responsible management to protect project affected area from negative impacts. Four subjects of "Waste, Noise and Air Quality" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.18.1 Assessment

This subject addresses identification of waste, noise and air quality issues through an assessment process using appropriate expertise during implementation and ongoing monitoring activities.

Analysis against the basic good practice:

Scoring statement: Are waste, noise and air quality issues identified through an assessment utilizing appropriate expertise?

Waste, noise and air quality issues should be properly managed within the project to ensure that negative impacts are minimized and mitigated. The total construction period of the project is 5 years including any possible delays of construction, completion of tests and putting the facilities into operation. Environmental impacts such as dust, noise, etc. will be generated in the implementation stage and will terminate synchronously with the completion of construction. Waste, noise and air quality issues reviewed by both Dolsar's Feasibility Report (Dolsar, 2012) and EIA Report (En-Çev, 2011) to overcome them are accepted and implemented at site by the owner. Handling of waste, air and noise quality issues are explained in the following paragraphs.

Waste Quality:

Waste management is ensured in compliance with "Regulation on the Control of Hazardous Wastes" published in the Official Gazette Issue No 25755 of 14th of March 2005 and "Regulation on the Control of Waste Oils" issued in the Official Gazette Issue No 26952 of 30th of July 2008 (En-Çev, 2011).

Air Quality:

During loading, transport and unloading of the excavation material, air pollution problem is encountered.

Dust and dust effects are minimized by strictly complying with the provisions of "Regulation on Air Quality Assessment and Management" issued in the Official Gazette Issue No 26898 of 6th of June 2008, "Regulation on the Control of Industrial Originated Air Pollution" issued in the Official Gazette No 27277 of 3rd of July 2009 and "Regulation on the Control of Excavated Soil, Construction and Demolition Wastes" issued in the Official Gazette No 25406 of 18th of March 2004 (En-Çev, 2011).

Noise Quality:

Noise quality is ensured in compliance with "Regulation on Assessment and Management of Environmental Noise" published in the Official Gazette Issue No 27601 of 4th of June 2010 (Dolsar, 2012). Necessary measures are taken and reported to ensure the compatibility with the limits and licenses (En-Çev, 2011).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does monitoring waste, noise and air quality takes risks and opportunities into account?

The emerged excavation material during land preparation is temporarily stored on topographically suitable areas. Excessive excavation waste that emerges during the implementation stage will be used in filling, landscaping works and asphalting process of the stabilized road.

The waste water formed during the operation stage will be disposed with the water treatment system in the structure of the plant. The treated water will be discharged into the Botan Stream after taking the needed permissions in accordance with the "Law on Aquaculture and Regulation on the Water Pollution Control".

In case of any recyclable solid wastes such as glass, plastic bottles and nylon inside domestic wastes, it will be ensured that they are sorted and treated in accordance with "Regulation on the Control of Packaging Wastes" issued in the Official Gazette Issue No 26562 of 24th of June.2007. They will be collected in containers separately and supplied to licensed recycling companies accordingly.

The medical wastes of sickroom will be separated from the other wastes and disposed in accordance with the terms of "Regulation on the Control of the Medical Wastes" issued 22nd of July 2005 dated and 25883 numbered in Official Gazette. Çukurköy located 875 m southwest of site is the nearest residential area to project site (En-Çev, 2011). According to paragraph of Article 23 of the "Regulation on Assessment and Management of Environmental Noise", the day limit value for the activity has been determined as 70 dBA (En-Çev, 2011). According to the calculations, the noise level which would generate at 500 meters and 1000 meters due to construction activities would be 66 dBA and 59 dBA respectively (En-Çev, 2011).

The construction activities are carried out during day time (07:00 - 19:00) in compliance with "Environmental Noise Limits for the Work Site". The vehicles and equipment will be periodically maintained and controlled to prevent the noise. Speed limitation will be brought to the vehicles, in order to keep the noise at minimum level.

The turbines will generate a considerable noise while operating. However, the equipment will be kept in a closed platform in the HEPP building and environmental noise will not occur. Local residents are informed about the time of blasting via announcements and notices. All risks are handled and monitored according to Turkish regulations. No significant gaps are identified.

Is the proven best practice met?: Yes

5.2.18.2 Management

This subject addresses processes in place to ensure waste, noise and air quality management and ongoing waste management.

Analysis against the basic good practice:

Scoring statement: Do processes and plans in place to ensure management of waste, noise and air quality at implementation and operation stages meeting the commitments?

Statkraft employs experts at site to apply Environmental Monitoring Program regarding the subject during the implementation stage. Monitoring program demonstrates the environmental impacts that occur during implementation stage. Before starting the activities of Çetin Dam and HEPP, a detailed Environmental Monitoring Programme (Dolsar, 2012) was prepared; monitoring was performed and is still being performed accordingly for detailed examination and detection. The Environmental Monitoring Programme conducted at site includes items given below (Dolsar, 2012):

- Monitoring the liquid wastes: Domestic waste water caused by labourers, rain water management, etc.
- Monitoring the Solid Wastes: Domestic wastes, the storage of these wastes, recycling issues, etc.
- Monitoring the emissions: Dust emissions and exhaust emissions
- Monitoring the noise : Equipment noise
- Monitoring the sickroom wastes: The medical wastes
- Monitoring the dangerous wastes: The waste oil, grease, contaminated grease and fuels

The monitoring reports and monitoring of the planned project is performed by EN-ÇEV, and submitted to the Ministry of Environment and Forestry every 3 months. No gaps are marked.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place to respond emerging risks and opportunities?

As discussed in Section 5.2.18.1, all risks and opportunities are taken into consideration and they respond emerging risks. There are no additional significant gaps against the proven best practice.

Is the proven best practice met?: Yes

5.2.18.3 Conformance and Compliance

This subject addresses the continuing processes related to waste, noise and air quality.

Analysis against the basic good practice:

Scoring statement: Do processes in place handle waste, noise and air quality issues in conformance and compliance with commitments?

All the accepted regulations given in Section 5.2.18.1, and also Statkraft's own "Requirements for HSE in the Design of Hydroelectric Power Plants" are applied at site in conformance and compliance (Contract, 2011).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

Monitoring reports are submitted to Ministry of Environment and Forestry every 3 months, in compliance with the regulations. There are no additional significant gaps against the proven best practice.

Is the proven best practice met?: Yes

5.2.18.4 Outcomes

This subject addresses how the owner deals with waste, noise and air impacts.

Analysis against the basic good practice:

Scoring statement: Are negative impacts arising from noise, air quality and wastes avoided, minimized and mitigated?

The contractor is responsible for taking care of environmental elements such as dust control, storage of excess excavation materials, collection of solid and waste water created by the construction activities, crushers, the concrete facility and material

quarries. The contractor undertakes all necessary investment in order to prevent environmental pollution and comply with limit values and rules issued in the "Regulation on Solid Waste Control", "Regulation on Air Quality Evaluation and Management", "Regulation on Evaluation and Management of Environmental Noise, and Controlling of Water Pollution" (En-Çev, 2011). The contractor obtains all necessary permissions from the municipalities and related institutions.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, does the project contribute to address waste management issues beyond the impacts of noise and air quality?

Negative noise, air quality effects, and waste problem arisen by construction activities are avoided, minimized, and mitigated in compliance with commitments No gaps are identified.

Is the proven best practice met?: Yes

Score: Waste, Noise and Air Quality topic is evaluated for four subjects and basic good practice are met for these subjects. . Moreover, the proven best practice is met for all of the subjects. Thus, an overall score of **5** is assigned to this topic.

Relevant Evidence: Dolsar's Feasibility Report, EIA Report, Statkraft's "Requirements for HSE in the Design of Hydroelectric Power Plants" document, Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar

5.2.19 Topic 19: Reservoir Preparation and Filling

"Reservoir Preparation and Filling" topic of "Environmental" dimension assesses environmental, social and financial management of reservoir area during the implementation stage and planning of the operation stage. The aim of this topic is to ensure qualified management of reservoir preparation and filling based on sustainability requirements.

Environmental, social and economic issues within the reservoir area during implementation should be monitored. Rate, timing and duration of filling, and the water quality impacts resulting from decomposition of flooded biomass and soil monitoring are important for pre-impounding and impounding stages. However, since filling preparation activities have not started at site yet, no sufficient information is

available for a detailed assessment. Thus, "Reservoir Preparation and Filling" topic of "Technical" dimension is not assessed by the author using SAP tool.

Score: Not assessed

Reference: EIA Report

5.2.20 Topic 20: Downstream Flow Regimes

"Downstream flow Regimes" topic of "Environmental" dimension assesses the flows downstream of the project construction area during the implementation stage. Downstream flow regimes of project infrastructure should be planned. Residual water should be determined considering environmental, social and economic impacts. Four subjects of "Downstream Flow Regimes" topic are assessment, management, conformance and compliance, outcomes; and each of these subjects is evaluated below.

5.2.20.1 Assessment

This subject addresses assessment of effectiveness of downstream flow management supported by ongoing monitoring.

Analysis against the basic good practice:

Scoring statement: Are issues in relation with downstream flow regimes identified and assessed and being monitored in place?

Downstream flow regimes should be assessed during the implementation stage. Monitoring should continuously be undertaken in high flood seasons. A monitoring program should be established in pre-impounding, impounding and operational stages (Dolsar, 2012).

Aquatic life on downstream will be affected positively due to sedimentation control and flood control of upstream dam. As the owner guarantees residual water, ecosystem of downstream will be protected. Licensed residual water right approved by DSİ, and details about its monitoring are given in more detail in Section 5.2.17. It is guaranteed by the owner that, 14.2 m^3/s environmental flow will always be provided by the ecological turbine to ensure pomegranate gardens continuity that are spread to 80 ha area at the downstream (Dolsar, 2012). Ecological water calculation was performed according to "Ecosystem Evaluation Report" and "Hydrologic Evaluation Report" prepared by the owner (Statkraft, 2011).

Long-term discharge values have been taken into consideration to prevent flood problems in case of emergency for the designs of the bottom outlet and spillway

structures. For instance, in the first design of the spillway conducted by Dolsar, some portion of the flow was released through the flushing tunnel in case of probable maximum flood to maintain an economic spillway design. However, in accordance with Technical University of Vienna's recommendations, spillway was redesigned to be capable of discharging probable maximum flood itself. New design was verified in March 2013 dated hydraulic model experiments conducted at Vienna (Appendix F).

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do monitoring downstream flow regimes take risks and opportunities into consideration?

The implementation stage maintains natural flow until reservoir filling starts. After filling the reservoir, management plan will be implemented to respond unexpected issues. The project has monitoring programs for water quality in the reservoir itself (Dolsar, 2012). No major groundwater problems are expected (Dolsar, 2012). There are no significant gaps against the best practice.

Is the proven best practice met?: Yes

5.2.20.2 Management

This subject addresses taken actions in case of need related with downstream management and publicly disclosed commitments.

Analysis against the basic good practice:

Scoring statement: Do measures in place ensure satisfactory management of identified downstream flow regimes issues?

This topic is in connection with Section 5.2.17. Water quality and groundwater in the vicinity of the project site will influence the management of impounding. Water quality management of Çetin Dam and HEPP meets the requirements related with downstream flow regimes.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are processes in place respond emerging risks and opportunities?

Due to upcoming stage of the project (only diversion tunnels are constructed at site), this analysis cannot be performed.

Is the proven best practice met?: Not assessed

5.2.20.3 Conformance and Compliance

This subject addresses the conformance and compliance of taken actions with the commitments arising from downstream flow regimes issue.

Analysis against the basic good practice:

Scoring statement: Are requirements of commitments met in the issues related with downstream flow regimes?

The residual water will be monitored and reported to Siirt Provincial Directorate of Environment and Forestry every six months (En-Çev, 2011). In case of any non-compliance in the measurements, it will be ensured by the authority that water rights are not violated.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, are there other non-conformances and non-compliances?

At the downstream of Çetin Dam and HEPP, Lower Çetin Dam and HEPP is located. Both of the projects are licensed to Statkraft at the same time, and analyzed in the same feasibility study (Dolsar, 2012). Since Lower Çetin Dam and HEPP is synchronously continuing with Çetin Dam and HEPP with the same designer, contractor, owner and operator team, there will be no problems related with reservoir level rights between two HEPPs. In case of any small non-conformances or non-compliances in reservoir water levels other than the design, it will be tolerated by both HEPPs having the advantage of being operated by the same company.

Is the proven best practice met?: Yes

5.2.20.4 Outcomes

This subject addresses environmental, social and economic objectives taken into account when there is a need related with downstream flow regimes. Accepted transboundary objectives should also be met.

Analysis against the basic good practice:

Scoring statement: Do agreed transboundary objectives taken into consideration related with commitments when needed?

Commitments about downstream flow regimes were made for Çetin Dam and HEPP. The subject is taken into consideration in terms of environmental, social and economic targets. Transboundary water rights issue does not exist since the project region including river reach dam at the downstream is located within Turkey's boundaries. Flood protection is superfluous in Çetin Dam and HEPP which is a gain for local public.

Is the basic good practice met?: Yes

Analysis against the proven best practice:

Scoring statement: Moreover, do commitments represent an optimal fit among environmental, social and economic objectives within practical constraints of the present conditions?

In Turkey, residual water issue is quite problematic. Some experts state that, residual water with a fixed percentage of the annual average discharge of the river for different HEPPs at different regions is not logical in terms of environmental requirements. Since residual water amount is questionable in Turkey, residual water amount of the dam may not represent an optimum fit among environmental, social end economic issues.

Is the proven best practice met?: Not assessed

Score: Downstream Flow Regimes topic is evaluated for five subjects and basic good practice are met for these entire subjects. However, since analysis against the proven best practice cannot be performed for Management and Outcomes subjects, an overall score of **minimum 3, maximum 5** is assigned to this topic.

Relevant Evidence: Letter received from DSİ General Directorate in connection with the subject, Çetin and Lower Çetin Dams and HEPPs Water Usage Rights Report, EIA Report, Dolsar's Feasibility Report

5.3 Summary of the Results for SAP of Çetin Dam and HEPP

In Jirau Dam and HEPP official assessment; Reservoir Filling Communications Plan, Newspapers, media analysis, sustainability committee presentation, institutional affairs monthly report, program for affected infrastructure recovery are some of various objective evidences used for the assessment (Locher, 2013). However, during

the SAP assessment of Çetin Dam and HEPP, EIA report is the mostly and mainly used reference as objective evidence since most of the objective evidences used in official SAP assessments are not available and most of the topics are covered by EIA reports in Turkey. In Table 5.3, list of topics which are assessed by SAP and if they are covered or not covered by EIA reports in Turkey are given.

Table 5.3 Topics assessed by SAP Implementation Tool which are also covered in EIA report format in Turkey

SAP Implementation Tool Topic	Is the Topic covered in EIA Reports in Turkey?
Communication and Consultation (Topic 1)	No
Governance (Topic 2)	No
Environmental and Social Issues Management (Topic 3)	Yes
Integrated Project Management (Topic 4)	No
Infrastructure Safety (Topic 5)	No
Financial Viability (Topic 6)	Yes
Project Benefits (Topic 7)	Yes
Procurement (Topic 8)	Yes
Project-Affected Communities and Livelihoods (Topic 9)	Yes
Resettlement (Topic 10)	Yes
Indigenous Peoples (Topic 11)	Yes
Labour and Working Conditions (Topic 12)	Yes
Cultural Heritage (Topic 13)	Yes
Public Health (Topic 14)	Yes
Biodiversity and Invasive Species (Topic 15)	Yes
Erosion and Sedimentation (Topic 16)	Yes
Water Quality (Topic 17)	Yes
Waste, Noise and Air Quality (Topic 18)	Yes
Reservoir Preparation and Filling (Topic 19)	Yes
Downstream Flow Regimes (Topic 20)	Yes

As can be seen from EISD assessment of Turkey in Chapter 3, sustainability should be ensured in hydropower projects of Turkey to enhance sustainable development. However, the priorities of sustainability topics may change from country to country due to a country's individual conditions. In the EISD assessment, important indicators are identified for Turkey and summarized in Section 3.6. According to these results, social and environmental dimensions are identified to be given higher importance. In Turkey, environmental and social dimensions cause strong opposition by the environmental organizations and local people since they are not given necessary

emphasis in their feasibility stages. In Appendix J, some protests against HEPPs in Turkey are summarized.

Using SAP implementation tool, sustainability assessment of Çetin Dam and HEPP is performed as a case study for Turkey. Almost all of the topics and subjects are evaluated during the assessment restricted with the author's access to necessary information. In some of the subjects the evaluation cannot be performed since differences between "analysis against the proven best practice" and "analysis against the basic good practice" are not clearly specified in the SAP tools. The author was not sure for which objective evidences to search for additionally. Such issues are summarized below.

Since no Indigenous Peoples (Topic 11) live in the vicinity, the topic is assessed as irrelevant. Moreover, Cultural Heritage (Topic 13) is evaluated as irrelevant since no cultural heritage exists in the project area (En-Çev, 2011). The nearest resettlement to the construction area is Çukurköy Village which is located 875 m away (En-Çev, 2011). Thus Public Health (Topic 14) is also assessed as irrelevant. Reservoir preparation and filling activities have not started yet, and there are no activities at site regarding this topic. Thus, Reservoir Preparation and Filling (Topic 19) topic is not assessed due to irrelevance of the project's stage and it is evaluated as "Not assessed". Moreover, some of the subjects are also not assessed due to irrelevance or lack of information. All the detected significant gaps, which are used to form sustainability profile of the project are shown in Table 5.4. Among all topics, 16 of them are scored. 15 of the topics meet the basic good practice and evaluated against the proven best practice. As can be seen in Table 5.4, biodiversity and invasive species topic does not meet the basic good practice due to the significant gap of fish elevator absence. Due to "Not assessed" scores both a minimum and a maximum sustainability profile are obtained for Çetin Dam and HEPP and given in Figure 5.5.

Table 5.4 List of Significant Gaps for Çetin Dam and HEPP

	Level 3: Significant Gaps against the basic good Practice	Level 5: Significant Gaps against the proven best Practice
Assessment	No significant gaps	**Topic 9:** The goal of maximizing possible positive impacts is not assessed and promoted by a special support program.
		Topic 10: No measures are put in place to improve the resettled communities' opportunities and living standards in long-term.
Management	No significant gaps	**Topic 1:** Not any international institute is included as sustainability committee and no sustainability forum is conducted.
		Topic 5: One work incident occurred at site due to a lack of proper excavation support systems application in diversion tunnel outlet.
		Topic 7: Social Compensation Program in implementation absence is a significant gap. It requires construction of new schools, health centers etc. to increase local people's welfare.
		Topic 8: No special sustainability criterion was included for market research of companies by Statkraft in bidding process. In Turkey, this lack of requirement can be marked as a significant gap.

Table 5.4 (Continued)

		Topic 11: There are no planned economic, social and infrastructure activities other than the inclusion of the Project to be conducted by the investing company or the other stakeholders.
Stakeholder Engagement	No significant gaps	**Topic 2:** Minutes of the meetings, some crucial issues like the project's climate change effect status are not published as publicly available reports.
Stakeholder Support	No significant gaps	No significant gaps
Conformance and Compliance	**Topic 15:** Absence of fish elevator is significant evidence against the basic good practice.	**Topic 4:** After diversion tunnel construction has started, some important revisions in lay-out were required. However, lay-out boundaries restricted the project to a very limited area which prevents the designer from relocating any facility when any revision is compulsory.
		Topic 4: Work schedule milestones are exposed to many updates because of delays related to revisions. Since there are some non-conformances related to this subject, work progress at site is behind the targets.
		Topic 12: One small excavation landslide incident happened in diversion tunnel outlet construction due to non-conformances in the implementation of supporting systems.

Table 5.4 (Continued)

Outcomes	No significant gaps	**Topic 7:** Absence of additional benefit sharing for directly affected people is marked as a significant gap.
		Topic 8: No training course activity has been conducted to identify local public's skills. Some more advantages supporting local people's welfare should have been included to guarantee a best sustainability practice when outcomes of the local public are considered.
		Topic 9: There is no satisfactory objective evidence of a measurement for long-term improvements in directly affected people's lives.
		Topic 16: There is no evidence of contribution or contribution goal to pre-project sediment situation.

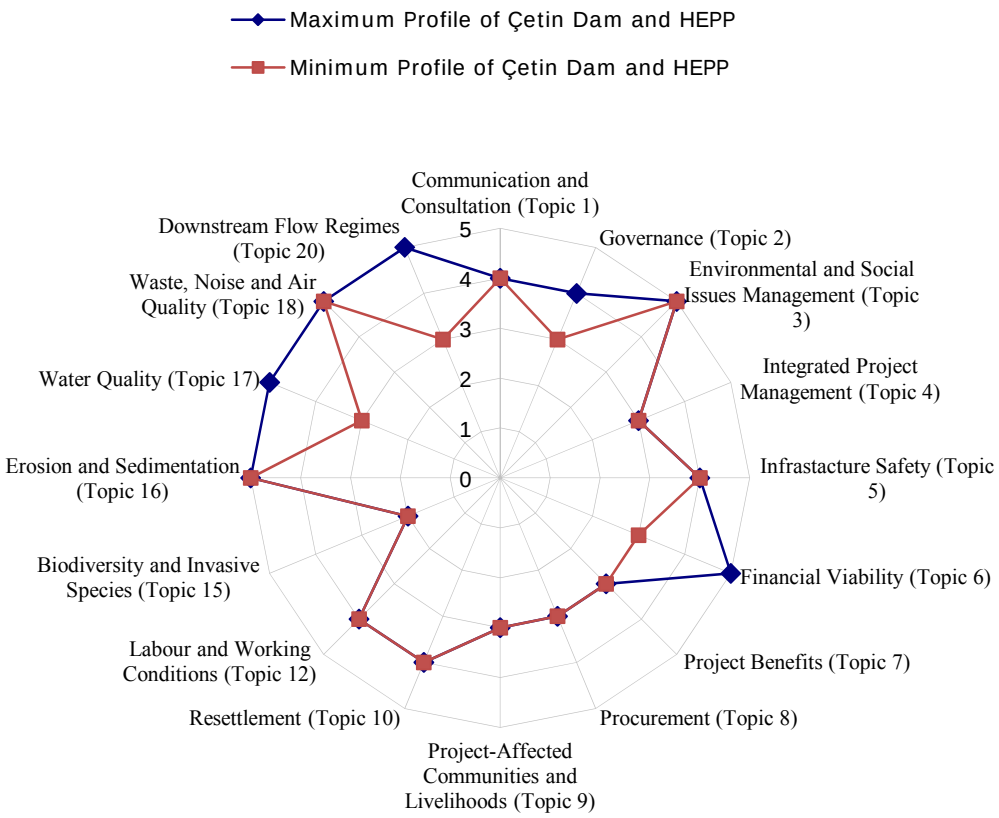

Figure 5.5 Minimum and Maximum Sustainability Profiles of Çetin Dam and HEPP

In Table 5.5, the score summary of Çetin Dam and HEPP according to the evaluated dimensions are given. Although it is not included in score assigning methodology of SAP tools, the overall average score and dimensional scores are calculated. As can be seen, dimensional scores differ from each other. A HEPP having a high overall score may have a low average score for one of the dimensions. A limit may be assigned for specific dimensions to ensure a country's priorities. As specified before, the topics included by environmental and social dimensions should be given higher importance.

Table 5.5 Score Summary of the Assessment Results for Çetin Dam and HEPP According to Dimensions

INTEGRATIVE	Topic Score	TECHNICAL	Topic Score	FINANCIAL	Topic Score	SOCIAL	Topic Score	ENVIRON-MENTAL	Topic Score
Communications and Consultation (Topic 1)	4	Infrastructure Safety (Topic 5)	4	Financial Viability (Topic 6)	3-5	Project Affected Communities and Livelihoods (Topic 9)	3	Biodiversity and Invasive Species (Topic 15)	2
Governance (Topic 2)	3-4	Reservoir Preparation and Filling (Topic 19)	Not assessed	Project Benefits (Topic 7)	3	Resettlement (Topic 10)	4	Erosion and Sedimentation (Topic 16)	5
Environmental and Social Issues Management (Topic 3)	5			Procurement (Topic 8)	3	Indigenous Peoples (Topic 11)	Irrelevant	Water Quality (Topic 17)	3-5
Integrated Project Management (Topic 4)	3					Cultural Heritage (Topic 13)	Irrelevant	Waste, Noise and Air Quality (Topic 18)	5
Labour and Working Conditions (Topic 12)	4					Public Health (Topic 14)	Irrelevant	Downstream Flow Regimes (Topic 20)	3-5
Integrative Dimension Score	3.8-4	**Technical Dimension Score**	4	**Financial Dimension Score**	3-3.7	**Social Dimension Score**	3.7	**Environmental Dimension Score**	3.3-4.0
OVERALL SCORE OF ÇETİN DAM AND HEPP: min=3.6, max=4.00									

The following recommendations are developed as a result of the SAP assessment:

- Establishment of a Sustainability Committee for the HEPP project is critical and may be very beneficial. The committee may inform local people and public about the project and work on compensation of local oppositions (Topic 1).

- Sustainability criterion can be assigned for the companies during market search to avoid corruptions (Topic 8).

- Some legal arrangements may be implemented to improve directly affected people's long-term living conditions and benefit sharing (Topic 7 and Topic 10). To promote directly affected people's welfare various additional economic, social and infrastructure activities in the region may be supported. The activities should be managed by special support programs to maximize their positive impacts (Topic 11).

- Labour and working conditions should be given higher importance and should be implemented at site strictly in conformance and compliance with the commitments, standards and labourer rights. Labour and working conditions may be regulated by laws (Topic 12).

- For Biodiversity and Invasive Species (Topic 15), it is seen that fish passages are not constructed even for big dams in Turkey, although they are included in EIA reports. The necessity and suitability of fish passage issue have to be cleared in the country. If utilization of fish passage is not suitable in terms of environment as the Project Manager of Çetin Dam and HEPP said (Appendix D, Q7), then they must not be included in EIA reports.

- For Reservoir Preparation and Filling, it is stated in the EIA Report that since "none of the invertebrate species is included in the International Union for Conservation of Nature (IUCN)'s Red List or addendum of the Bern Convention, a special protection measure is not required" (En-Çev, 2011). It is suggested to take protection measures for all species although they are not in Red List, to respect their living rights and to ensure the continuity biodiversity in the region.

Recommendations to increase SAP's applicability and utilization in Turkey are given below:

- During the assessment, author experienced some difficulties. The language of the SAP tool is very difficult to understand since it comprises of too long,

repetitive and hard to follow sentences. The language should be simplified. Also, score assigning methodology is quite difficult to understand. A flowchart similar to the one given in Figure 4.2 may be helpful and ease scoring process. Scoring statements may be provided as short questions as done in this thesis.

- Some of the topics are repetitively searched for the same subjects (ex: Topic 7, Topic 9, Topic 11) and this results in repetitive answers for these overlapping issues. Similar topics may be grouped together and different weights may be used if necessary.

- Most of the objective evidence reports, commitments used in official SAP assessments are available in Turkey. However, they are not publicly disclosed. Thus if SAP evaluation will be used in Turkey, the assessors should be given full access to all these documents. Otherwise the assessment becomes quite subjective since the same objective evidences are used for most of the subjects.

- In Turkey, no authorized team or person has access to all required evidences of SAP. Only personnel of stakeholders can apply SAP if she/he is supported by her/his company and all the other stakeholders. However personnel of one of the stakeholders will not be suitable as an assessor; an independent expert should carry out the assessment. The stakeholder must supply all necessary documents and information (i.e. Feasibility Report, minutes of meetings, resettlement plan, signed commitments, followed standards, and monitoring reports etc.) to this assessor.

- The differences between "analysis against the proven best practice" and "analysis against the basic good practice" are not clear. For instance, to check "analysis against the proven best practice for "Conformance and Compliance" subject under "Downstream Flow Regimes" topic, "In addition, there are no non-compliances and non-conformances (IHA, 2010)" scoring statement is used which is not sufficient. What additional evidence or information is needed to be searched for should be clarified. Moreover, differences between most of the subjects' goals are hard to understand. The objective evidence based score values should rely on more clear and solid requirements supported by quantifiable parameters or absence or existence of facilities or services. For example, absence or existence of a fish passage may be assigned as a critical facility for habitat protection. More documentary evidence, plans, statistical data etc. should be specified as evidences. Moreover, minor or major gaps used to verify the score are not clear enough to guide the assessor.

- IHA representatives and chosen experts from the country should form a list or related national and international laws, regulations and guidelines which should be used in the SAP evaluation process. This list should be updated every year. Such a list will ease the process significantly. All of the topics are assumed to have equal weights in the SAP assessment. Based on the analysis conducted in Chapters 3 and 5, it is seen that some subjects need to be stressed more and studied in more detail considering the country's specific needs and conditions. These topics are Project Benefits (Topic 7), Project Affected Communities and Livelihoods (Topic 9), Labour and Working Conditions (Topic 12), Cultural Heritage (Topic 13), and Biodiversity and Invasive Species (Topic 15) for Turkey. Careful attention should be given to these subjects in order to improve sustainability status of HEPPs in Turkey.

•

CHAPTER 6

CONCLUSION

Energy is crucial for a civil life. To supply increasing demand of energy, new energy opportunities are searched. Since fossil fuel fired power plants are the main sources of greenhouse gas emissions, countries search for green energy supplies as a precaution for climate change. In this century, only supplying the demand is not sufficient; energy generation has to be supplied from domestic sources in a sustainable manner. In this thesis, firstly, Turkey's status of sustainability is investigated using EISD indicators, which are developed by IAEA. As a result of this evaluation, the following conclusions are reached:

- Sustainable development status of Turkey must be improved. Renewable energy utilization from domestic sources should be promoted and energy dependency should be decreased.

- One of the most significant outcomes of EISD analysis is that renewable energy share should be increased in the energy generation. Since hydropower is the major renewable energy source of the country, it is identified to be one of the most potential candidates. To decrease dependency on foreign sources, hydropower potential of the country should be developed.

- While utilizing the country's HEPP potential, sustainability has to be maintained. As a developing country, Turkey accelerated HEPP constructions in the last decade to increase domestic electricity generation. This acceleration in commissioning and implementation of HEPPs caused some auditing problems and implementation of many unsustainable HEPPs. These HEPPs raised strong opposition from local people and environmentalists and many HEPPs, especially run-of-river types are carried to courts. Thus it is very important to access HEPPs in terms of sustainability. Protecting environmental and social dimension is a must for a country as well as generating energy.

- Official data obtained from governmental web sites or documents, and data obtained from international institutions are used for the EISD assessment. During the assessment, it is realized that some of the required data is unavailable or partially available for Turkey. A list of unavailable and partially available data is prepared as a result of the EISD assessment. To be able to conduct a detailed review of sustainable development of Turkey, such

statistical data need to be collected and made available to public. Moreover these data may be used for comparisons with developed and other developing countries to better assess sustainability status of the country.

- Some of the topics are marked as relatively more important than the others in EISD analysis. For instance, SOC2 assessment, which is concerned with percentages of expenditures on different items for different income groups, is a critical indicator for Turkey. It is found that energy burden on lowest income group is considerably high and this results in unfair access to energy. One remedy for this problem may be providing additional benefits, such as cheaper energy, to directly affected people from power plants. Other relatively important topics are explained in detail in Chapter 3 and are not repeated here.

After EISD evaluation, the importance of the hydropower, which is the major domestic source of Turkey, became apparent. There are many discussions about HEPPs in Turkey. Necessary importance is not given to environmental and social dimensions of HEPPs, and to their implementation in a sustainable manner. IHA developed the SAP to evaluate sustainability status of HEPPs. In the second part of this thesis, the SAP is applied to a HEPP at its implementation stage, namely Çetin Dam and HEPP as a case study. As a result of this evaluation, the following conclusions are reached:

- IHA representatives and national experts should form a list of related national and international laws, regulations and guidelines which should be used in the SAP evaluation process. Such a list, updated annually will ease the process.

- Although all the topics are assumed to have equal weights in the SAP assessment, it is seen that some subjects need to be stressed more and studied in more detail based on the analysis conducted in Chapter 3 and Chapter 5. These topics are Project Benefits (Topic 7), Project Affected Communities and Livelihoods (Topic 9), Labour and Working Conditions (Topic 12), Cultural Heritage (Topic 13), and Biodiversity and Invasive Species (Topic 15). Mentioned topics should be given high attention in order to improve sustainability status of HEPPs in Turkey.

- In Turkey, inadequate assessment of social and environmental dimensions of HEPP projects is the main problematic issue that carries HEPPs to the courts. During the assessment of Çetin Dam and HEPP, it is seen that some requirements included in EIA reports are not performed properly in practice. For example, fish passage is designed and appeared in the EIA report of Çetin Dam and HEPP; however it is not implemented in practice. These types of inconsistency between EIA reports and practice need to be audited and punished if necessary. If construction of a fish passage is required for

continuation of the aquatic life, then the owner should be forced to construct it. If not, it should not be included in the EIA report. Commitments given in the EIA reports need to be implemented in practice and audited by the government.

- In Turkey, local people do not continuously benefit from energy generation projects. Sharing of benefits is realized through a one-time compensation payment or resettlement support. The benefits of HEPPs may be shared with local people who are the most effected ones. For instance, electricity may be provided to local people with cheaper prices to decrease the share of energy expenditures in their income. Requirements of benefit sharing with directly affected people should be promoted.

- Most of the objective evidence reports, and commitments used in official SAP assessments are available in Turkey. However, if the author was not a member of the design team of Çetin Dam and HEPP Project, she would not have access to any of the objective evidences other than the EIA Report, and it will not be possible to use SAP to access the sustainability profile of the project. If SAP evaluation will be used in Turkey in the future, assessors should be given full access to all necessary documents by the owner of the project.

- SAP's scoring statements have many overlaps and most of the subjects receive repetitive answers. Moreover, the sentences are too long and guidance of the scoring statements is very poor. Although some examples of objective evidences are identified, the assessor is not guided properly. Objective evidence based scores are only possible if clear and solid requirements are specified. The assessor should know what type of information and quantitative evidence to search for, otherwise the evaluation turns out to be a very subjective one. SAP may benefit from EISD analysis in various dimensions. EISD utilizes statistical information as objective evidences. SAP indicators may be rearranged using EISD as guidance.

- The language of SAP is very difficult to understand. French, Portuguese, Spanish, Chinese and Russian are the languages that SAP has been translated to up to now (www.hydrosustainability.org). However, no Turkish version is available yet. It is suggested that the language of the original protocol is simplified. Since IHA's target is to develop SAP as a certification standard in addition to national certification and licensing systems, its comprehensibility is very important. To introduce it to Turkish energy market and increase its utilization in Turkey, SAP is recommended to be translated into Turkish.

- Çetin Dam and HEPP has an overall score somewhere between the basic good practice and the proven best practice. Since all of the subjects cannot be

evaluated due to lack of data and scoring statements are not very clear to check the project against the proven best practice in some subjects, a minimum and a maximum profile of the HEPP is obtained. The score is evaluated as good according to SAP implementation. However, using the detected significant gaps through the evaluation process, sustainability of the project can be improved by the owner.

REFERENCES

Assessment Panel for Shuibuya Hydropower Project, *Sustainability Assessment Report of Shuibuya Hydropower Project*, 2009

Bvqi Do Brasil Soc. Certificadore Ltda, *HPP Salvador Assessment based on the Sustainability Assessment Protocol from IHA*, 2009

Ceylan H., *General View of Work Accidents in Turkey and Comparison between Developed Countries*, International Journal of Engineering Research and Development, Vol.3, No.2, 2011

Çabuk Kaya N., *Main Çetin Dam and HEPP Project Socio-economic Status Study*, Siirt, 2010

Dolsar Engineering Ltd. Co., *Main Çetin Dam and HEPP Dam Body Safety Analysis Report*, Ankara, 2013

Dolsar Engineering Ltd. Co., *Main Çetin Dam and HEPP Design Criteria Report*, Ankara, 2012

Dolsar Engineering Ltd. Co., *Main Çetin Dam and Hydroelectric Power Plant (H=between 822,00 & 682,00 m) and Lower Çetin Dam and Hydroelectric Power Plant (H=between 682,00 & 647,00 m) Revised Feasibility Report*, Ankara, 2012

Doran, P., *World Summit on Sustainable Development (Johannesburg)-An assessment for IISD*, 2002

En-Çev Environmental Investment and Consultancy Services Ltd. Co., *Final Environmental Impact Assessment Report for Main Çetin Dam and HEPP and Lower Çetin Dam and HEPP Project*, Siirt, 2011

Contract, *Engineering & Consultancy Services Contract for Final and Detail Design and Design Coordination of Çetin Dam and Hydroelectric Power Plant between Çetin Enerji (Statkraft) and Dolsar*, 2011

European Union, *Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action Plan*, 1997

General Directorate of Renewable Energy (EİE), *Botan-Alkumru Dam and Hydroelectric Power Plant Feasibility Report*, 1991

General Directorate of Renewable Energy (EİE), *Dicle River Botan Stream Reconnaissance Survey*, 1986

International Atomic Energy Agency (IAEA), *Energy Indicators for Sustainable Development Guidelines and Methodologies*, Vienna, 2005

International Hydropower Association (IHA), *Hydropower Sustainability Assessment Protocol*, 2006

International Hydropower Association, *Hydropower Sustainability Assessment Protocol*, 2010

International Hydropower Association, *IHA Sustainability Guidelines*, 2004

Kentel, E., Alp, E., *Hydropower in Turkey: Economical, social and environmental aspects and legal challenges*, pp 34-43, 2013

Locher, H., *Hydropower Sustainability Assessment Protocol Application of Jirau Hydropower Project*, Brasil, 2013

Nature, *Electricity without Carbon*, Vol. 454, Macmillan Publisher Limited, 2008

Norwegian Water Resources and Energy Directorate, *IHA Sustainability Protocol Audit Assessment of Dabuashui Hydropower Project*, 2008

Organization for Economic Co-operation and Development (OECD), *Environmental Performance Reviews: Turkey*, 2008

Özgökçe, F., Ünal, M., *Eco-System Assessment Report of Botan Stream*, Siirt, 2011

Rydgren B., *Official SAP Assessment of Walchensee Hydropower Plant*, Germany, 2012

Rydgren, B., Hydro Tasmania, *Pilot Assessment Trevallyn Hydropower Development*, Australia, 2012

Sedicon, *Çetin Reservoir Sediment Handling Study*, 2011

State Hydraulic Works (DSİ), *Main Çetin and Lower Çetin Dams and HEPPs Water Usage Rights Report*, 2011

Smith D., Statkraft, *Official SAP Assessment of Jostedal Hydropower Project*, Norway, 2012

Temelsu Engineering Ltd. Co., *Çetin Dam and Hydroelectric Power Plant (H=between 822,00 & 682,00 m) and Lower Çetin Dam and Hydroelectric Power Plant (H=between 682,00 & 647,00 m) Feasibility Report*, Ankara, 2011

Turkish Electricity Distribution Company (TEDAŞ), *Turkey Electricity Distribution and Consumption Statistics*, 2011

Turkish State Railways, *Railways Sectorial Report*, 2005

Turkish Statistical Institute (TÜİK), *International Greenhouse Inventory Report, 1990-2009*

United Nations Frame Work Convention on Climate Change (UNFCC), *Kyoto Protocol*, 1997

Van Yüzüncü Yıl University, *Ecological Resources and Diversity Report of Botan Stream*, Siirt, 2010

World Commission on Environment and Development (WCED), Report of the World Commission on Environment and Development: Our Common Future, 1987

ABB Group, *Turkey Energy Report*, www.abb.com, last visited on August 2013

Aegean Region Chamber of Industry, www.ebso.org.tr, last visited on August 2013

Bursa Newspaper, www.yenibursa.com, last visited on August 2013

Dolsar Engineering Ltd. Co., www.dolsar.com.tr, last visited on August 2013

Energy Market Regulatory Authority, www.epdk.gov.tr, last visited on August 2013

Energy Realities, www.energyrealities.org, last visited on August 2013

Europa – EU, www.europa.eu, last visited on August 2013

European Investment Bank, www.eib.org, last visited on August 2013
General Directorate of Forestry, web.ogm.gov.tr, last visited on August 2013

General Directorate of Renewable Energy, www.eie.gov.tr, last visited on August 2013

Hydropower Sustainability Assessment Protocol, www.hydrosustainability.org, last visited on August 2013

International Atomic Energy Agency, www.iaea.org, last visited on August 2013

International Hydropower Association, www.hydropower.org, last visited on August 2013

International Monetary Fund, www.imf.org, last visited on August 2013

"Karadeniz İsyandadır" Platform, www.forumkaradeniz.wordpress.com, last visited on August 2013

Labour Union, www.sendika.org, last visited on August 2013

Lawrence Berkeley National Laboratory, www.lbl.gov, last visited on August 2013

Legislation of Turkey, www.mevzuat.gov.tr, last visited on August 2013

Ministry of Energy and Natural Resources, www.enerji.gov.tr, last visited on August 2013

Nation Master, www.nationmaster.com, last visited on August 2013

ODYSSEE, www.odyssee-indicators.org, last visited on August 2013

Ontario Ministry of the Environment, www.airqualityontario.com, last visited on August 2013

Organization for Economic Co-operation and Development, www.oecd-ilibrary.org, last visited on August 2013

“Siirt İl Gıda, Tarım ve Hayvancılık Müdürlüğü”, www.siirttarim.gov.tr, last visited on August 2013

State Hydraulic Works, www.dsi.gov.tr, last visited on August 2013

Statkraft, www.statkraft.com, last visited on August 2013

Sürmene Newspaper, www.surmenehaber.com, last visited on August 2013

The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats, www.tema.org.tr, last visited on August 2013

The Turkish National Air Quality Observation Network, www.havaizleme.gov.tr, last visited on August 2013

The University of British Columbia Sauder School of Business, fx.sauder.ubc.ca, last visited on August 2013

The Union of Chambers of Turkish Engineers and Architects (TMMOB), www.tmmob.org.tr, last visited on August 2013

TMMOB The Chamber of Electrical Engineer www.emo.org.tr, last visited on August 2013

TMMOB The Chamber of Mechanical Engineer, www.mmo.org.tr, last visited on August 2013

Turkish Electricty Transmission Company, www.teias.gov.tr, last visited on August 2013

Turkish Statistical Institute, www.tuik.gov.tr, last visited on August 2013

US Energy Information Administration, www.eia.gov, last visited on August 2013

World Health Organization, www.who.int, last visited on August 2013

Yüksel Holding Company, www.yuksel.net, last visited on August 2013

World Bank, data.worldbank.org, last visited on August 2013

APPENDICES

APPENDIX A

Table A.1 Fatalities Caused by Work Accidents in Hydropower Plants (compiled from www.sendika.org and press statement of "Karadeniz İsyandadır" Platform, forumkaradeniz.wordpress.com)

Province	District	HEPP	River	Date	Reason of Accident	Number of Fatalities
İzmir		Beydağ		08 Sep 2006	Platform failure	1
Artvin		Borçka		18 Oct 2006	Receiving electric shock	1
Trabzon	Hayrat, Taflancık Village	Sarmaşık-1		24 Nov 2006	Landslide	1
Kahramanmaraş	Andırın, Emirler Village			20 Mar 2008	During test works	4
Amasya	Taşova, Ilıca Village		Yeşilırmak	20 Apr 2008	Equipment accident	1
Trabzon	Maçka	Atasu	Galyan	16 May 2008	Equipment accident	1
Trabzon	Maçka	Atasu	Atasu	17 May 2008	Equipment accident	1
Mersin	Anamur		Dragon Stream	15 Oct 2008	Work accident	1
Ordu	Mesudiye	Topçam		19 Apr 2009	Equipment accident	1
Giresun	Güce	Gökçebel	Gelevera	27 Jun 2009	Explosion and landslide	3

Table A.1 (Continued)

Giresun		Akköy 2		28 Jun 2009	Work accident	1
Adana				30 Jun 2009	Getting trapped under rock	1
Karaman				8 Jul 2009	Receiving electric shock	1
Karabük	Yenice			12 Aug 2009	Equipment accident	1
Siirt		Alkumru	Botan	18 Sep 2009	Explosion and landslide	1
Karaman		Ermenek		14 Oct 2009	Falling from a height	1
Şırnak		Siyahkaya		2 Nov 2009	Traffic accident	1
Sinop	Karapınar Village				Landslide	1
Aydın		Çine			Work accident	1
Gümüşhane	Torul	Torul		14 Feb 2010	Traffic accident	2
Antalya		Kürce		23 Mar 2010	Work accident	1
Erzurum	Tortum			24 Mar 2010	Landslide	1
Trabzon	Çaykara			21 Apr 2010	Falling from formwork	1
Siirt	Aydınlar	Alkumru	Botan	05 May 2010	Work accident	1
Giresun	Güce, Tekkeköy Village	Akköy		22 May 2010	Landslide	1

Table A.1 (Continued)

Artvin	Yusufeli		Çoruh	30 May 2010	Traffic accident	2
Artvin	Yusufeli		Çoruh	15 Jun 2010	Failure of iron formwork	1
Batman	Kozluk	Garzan	Garzan	21 Jun 2010	Landslide	2
Giresun	Yağlıdere			30 Jun 2010	Failure of retaining wall	1
Aydın	İncirliova	İkizdere		4 Aug 2010	Releasing water test	1
Muğla	Fethiye	Eşen		17 Aug 2010	Work accident	1
Çorum	Ortaköy	İncesu		29 Aug 2010	Receiving electric shock	1
Sivas	Koyulhisar			16 Sep 2010	Falling from a height	1
Adana	Feke		Göksu	17 Sep 2010	Traffic accident	2
Artvin	Yusufeli			07 Oct 2010	Falling from a height	1
Giresun	Bulancak			09 Oct 2010	Timber falling to head	1
Siirt	Aydınlar	Alkumru		17 Oct 2010	Falling from a height	1
Giresun	Yağlıdere	Melemoğlu		28 Oct 2010	Falling from a height	1
Adana	Kozan	Menge		28 Nov 2010	Traffic accident	1
Mersin	Anamur, Çaltıbükü Village	Otluca		11 Dec 2010	Landslide	3

Table A.1 (Continued)

Elazığ		Beyhan		22 Dec 2010	Equipment accident	1
Bilecik		Darca		10 Jan 2011	Receiving electric shock	1
Artvin		Deriner		14 Jan 2011	Being crushed by construction equipment	1
Giresun	Güce, Tekkeköy Village			23 Jan 2011	Poisoning of high amount of dust and fog exposure	1
Samsun	Muşçalı Village	Çarşamba	Yeşilırmak	24 Jan 2011	Falling down from construction	2
Kahramanmaraş	Near Ekinözü	Hacınınoğlu	Ceyhan	06 Feb 2011	Failure of formwork	1
İzmir	Bergama	Çaltıkolu		06 Mar 2011	Getting trapped under excavation	1
Şırnak	İdil			15 Mar 2011	Traffic accident	1
Kahramanmaraş	Near Ekinözü			08 Apr 2011	Falling down to power tunnel	1
Adana		Aladağ		26 Apr 2011	Receiving electric shock	1
Muş	Varto	Alparslan II		18 May 2011	Gone adrift	1
Karabük		Karabük		24 May 2011	Falling down from construction	1

Table A.1 (Continued)

Batman	Kozluk	Garzan		30 May 2011	Being crushed by construction equipment	1
Erzurum	İspir	Arkun	Çoruh	12 June 2011	Getting trapped under rock during explosion activities	1
Adana	Karaisalı			25 Jul 2011	Getting trapped under rock	1
Erzurum	İspir	Arkun	Çoruh	12 Sep 2011	Falling down to river	1
Gümüşhane	Kürtün	Süme Fındık		15 Sep 2011	Work accident	1
Adana	Kozan			29 Sep 2011	Falling down to river	1
Kahramanmaraş	Ekinözü			27 Oct 2011	Traffic accident	1
Erzincan	İliç	Bağıştaş II		25 Nov 2011	Failure of concrete formwork	1
Şırnak	Uludere	İnceler		04 Dec 2011	Landslide	3
Mersin	Anamur, Çaltıbükü Village	Otluca		11 Dec 2011	Landslide	2
Erzincan	İliç	Bağıştaş II		12 Dec 2011	Cement trailer gate strike	
Sinop	Boyabat			12 Dec 2011	Failure of concrete formwork	1

Table A.1 (Continued)

Elazığ		Beyhan		22 Dec 2011	Equipment accident	1
Kahramanmaraş	Ekinözü	Kandil	Ceyhan	12 Jan 2012	Being crushed by sliding rock	1
Şırnak				27 Jan 2012	Traffic accident	1
Adana	Kozan	Gökdere		24 Feb 2012	Failure of diversion tunnel gate	10
Nevşehir	Avanos, Bozca Village	Hasankale	Kızılırmak	04 Mar 2012	Construction equipment accident	1
Adana	Kozan	Menge		15 Mar 2012	Falling down to river	1
Erzurum	Olur	Ayvalı		22 Mar 2012	Construction equipment accident	1
Gaziantep	Nizip	Hancağız		26 Mar 2012	Coal gas explosion	2
Erzurum	İspir	Arkun	Çoruh	11 Apr 2012	Work accident	1
Van		Muradiye		12 Apr 2012	Receiving electric shock	1
Tokat	Near Niksar	Niksar	Kelkit	21 Apr 2012	Being sucked into a vortex	1
Erzurum	Aşkale			4 Apr 2012	Falling down into reservoir	5

Table B.1 Table of Air Pollutants for all Stations of Turkey taken at 19.03.2013, 22:00 from Governmental Air Measurement web site (www.havaizleme.gov.tr)

	PM10 (µg/m³)	AQI	SO_2 (µg/m³)	AQI	NO_2 (µg/m³)	AQI	O_3 (µg/m³)	AQI	CO (µg/m³)	AQI
ADANA (CATALAN)	17	1	2	1			37	2		
ADANA (DOGANKENT)	116	4	0	1	80	2	8	1		
ADANA (METEOROLOJI)	43	2	6	1	35	1	1062	6		
ADANA(VALILIK)	100	3	7	1	62	2	299	5	640	1
ADIYAMAN	55	2	17	1						
AFYON			172	2						
AGRI	19	1	5	1						
AKSARAY	57	2	18	1						
AMASYA	68	2	92	2						
ANKARA (BAHCELIEVLER)	33	2	30	1	31	1			1157	1
ANKARA (DEMETEVLER)	158	5	20	1	137	3				
ANKARA (DIKMEN)	36	2	3	1	40	1				
ANKARA (KAYAS)	123	4	32	1	104	3				
ANKARA (KECIOREN)	89	3	4	1	167	3	1	1		
ANKARA (SIHHIYE)	99	3	6	1	175	3			662	1
ANKARA (SINCAN)	184	5	9	1	55	2	6	1		
ANKARA (CEBECI)	32	2	32	1	32	1	17	1	2505	2
ANTALYA	170	5	3	1						

Table B.1 (Continued)

ARDAHAN	90	3	53	2						
ARTVIN	27	2	6	1						
AYDIN	58	2	19	1						
BALIKESIR	53	2	21	1						
BARTIN	257	5	95	2						
BATMAN	99	3	23	1						
BAYBURT	63	2	5	1						
BILECIK	89	3	13	1						
BINGOL	22	1	8	1						
BITLIS	83	3	51	2						
BOLU	92	3	5	1						
BURDUR	27	2	11	1						
BURSA	22	1	5	1						
BURSA (NILUFER)			70	2	2	1			416	1
BURSA (YILDIRIM)			60	2					1727	1
CANAKKALE	18	1	14	1						
CANAKKALE (BIGA ICDAS)	29	2	4	1	2	1			78	1
CANKIRI	148	5	31	1						
CORUM	118	4	121	2						
DENIZLI1	168	5	10	1						
DENIZLI2	80	3	7	1						
DIYARBAKIR	59	2	26	1						

Table B.1 (Continued)

DUZCE	324	5	41	1						
EDIRNE	82	3	126	2						
ELAZIG	41	2	4	1						
ERZINCAN	41	2	12	1						
ERZURUM	110	4	34	1						
ESKISEHIR	24	1	6	1						
GAZIANTEP	132	4	15	1						
GIRESUN	68	2	21	1						
GUMUSHANE	52	2	46	1						
HAKKARI	125	4	266	3						
HATAY1	136	4	15	1						
HATAY2 (ISKENDERUN)										
ICEL	58	2	1	1						
IGDIR	242	5	19	1						
ISPARTA	77	3	30	1						
ISTANBUL (AKSARAY)	60	2	13	1	46	2			482	1
ISTANBUL (ALIBEYKOY)	39	2			43	1	47	2	546	1
ISTANBUL (BESIKTAS)	74	3	8	1	84	2			623	1
ISTANBUL (ESENLER)	57	2			107	3			909	1
ISTANBUL (KADIKOY)	40	2	12	1	23	1	25	1	540	1
ISTANBUL (KARTAL)	30	2	10	1						
ISTANBUL (SARIYER)	19	1	5	1						

Table B.1 (Continued)

ISTANBUL (UMRANIYE)	84	3	8	1	61	2				
ISTANBUL (USKUDAR)	46	2	13	1						
ISTANBUL (YENIBOSNA)	47	2	8	1					790	1
IZMIR (ALSANCAK)	20	1	5	1						
IZMIR (BAYRAKLI)	42	2	9	1						
IZMIR (BORNOVA)	29	2	5	1						
IZMIR (CIGLI)	10	1	1	1						
IZMIR (GAZIEMIR)	11	1	13	1						
IZMIR (GUZELYALI)	25	1	3	1						
IZMIR (KARSIYAKA)	5	1	3	1						
IZMIR (SIRINYER)	125	4	9	1						
KAHRAMANMARAS	40	2	11	1						
KAHRAMANMARAS (ELBISTAN)	95	3	32	1						
KARABUK	97	3	18	1						
KARAMAN	45	2	46	1						
KARS	86	3	19	1						
KASTAMONU	45	2	7	1						
KAYSERI1 (OSB)	36	2	38	1						
KAYSERI2 (MELIKGAZI)	42	2	3	1						
KAYSERI3 (HURRIYET)	74	3	12	1	9	1			1624	1
KILIS	15	1	3	1						

Table B.1 (Continued)

KIRIKKALE	4	1	22	1						
KIRKLARELI	44	2	9	1						
KIRSEHIR	36	2	7	1						
KOCAELI (DILOVASI)	61	2	24	1	41	1	24	1	1311	1
KOCAELI	80	3	9	1						
KOCAELI (OSB)	10	1	14	1	25	1				
KONYA (MERAM)	20	1	6	1						
KONYA (SELCUKLU)	22	1	10	1						
KUTAHYA	39	2	3	1						
MALATYA	68	2	4	1						
MANISA	58	2	17	1						
MANISA (SOMA)	171	5	67	2	64	2	69	2	31	1
MARDIN	4	1	62	2						
MUGLA1	101	3	138	2						
MUGLA2 (YATAGAN)	35	2	8	1						
MUS	97	3	25	1						
NEVSEHIR	19	1	10	1						
NIGDE	94	3	5	1						
ORDU	209	5	40	1						
OSMANIYE	164	5	42	1						
RIZE	85	3	13	1						
SAKARYA	166	5	64	2						

Table B.1 (Continued)

SAMSUN1	139	4	46	1						
SAMSUN2 (TEKKEKOY)	82	3	20	1	28	1			1689	1
SANLIURFA	52	2	8	1						
SIIRT	298	5	163	2						
SINOP	31	2	55	2						
SIRNAK	67	2	681	4						
SIVAS	37	2	36	1						
TEKIRDAG	47	2	10	1						
TOKAT	30	2	14	1						
TRABZON1	410	5	146	2						
TRABZON2 (MEYDAN)	290	5	86	2						
TUNCELI	18	1	4	1						
USAK	210	5	47	1						
VAN	105	3	117	2						
YALOVA	20	1	11	1						
YOZGAT	38	2	99	2						
ZONGULDAK	213	5	181	2						
ZONGULDAK (KARADENIZ EREGLI)	110	4	2	1	97	3	10	1	1680	1
Average Values	**72.3**	**2.5**	**25.1**	**1.1**	**63.6**	**1.8**	**152.6**	**2.1**	**934**	**1.1**

Table C.1 Understanding the Protocol's Gradational Approach (IHA, 2010)

Level	Assessment	Management	Stakeholder Engagement	Stakeholder Support	Outcomes	Conformance / Compliance
5	• Suitable, adequate and effective assessment with no significant opportunities for improvement; • In addition to basic good practice (Level 3), the assessment are likely to take a relatively broader, external or regional view or perspective; emphasise opportunities; and show a high level of examination of interrelationships amongst relevant sustainability issues	• Suitable, adequate and effective management processes with no significant opportunities for improvement; • In addition to basic good practice (Level 3), management plans and processes are likely to show excellent anticipation of and response to emerging issues or opportunities; senior management and/or executive decisions are likely to be timely, efficient and effective in response to monitoring data, investigations and issues arising; and in cases commitments in plans are public, formal and legally enforceable.	• Suitable, adequate and effective stakeholder engagement processes with no significant opportunities for improvement; • In addition to basic good practice (Level 3), the engagement is likely to be inclusive and participatory with the directly affected stakeholders; • thorough feedback is likely to be available on how directly affected stakeholder issues are taken into consideration; • In cases there is likely to be directly affected stakeholder involvement in decision-making; and • Information identified through engagement processes to be of high interest to stakeholders is released publicly in a timely and easily accessible manner	• There is support of nearly all directly affected stakeholder groups for the assessment, planning or implementation measures for that topic, or no opposition by these stakeholders; • In cases formal agreements or consent with the directly affected stakeholder groups have been reached for management measures for that topic	In addition to basic good practice (Level 3), there may be exhibited enhancements to pre-project conditions; contributions to addressing issues beyond those impacts caused by the project; leveraging of opportunities; or significant contribution to capacity building	• No non-compliances or non-conformances
4	• Suitable, adequate and effective assessment with only a few minor gaps; • In addition to basic good practice (Level 3), the assessment is likely to exhibit some recognition of broader, external or regional issues; opportunities; and interrelationships amongst relevant sustainability issues	• Suitable, adequate and effective management processes with only a few minor gaps; • In addition to basic good practice (Level 3), management plans and processes are likely to exhibit good anticipation of and response to emerging issues or opportunities; and in cases commitments in plans are public and formal.	• Suitable, adequate and effective stakeholder engagement processes with only a few minor gaps; • In addition to basic good practice (Level 3), there is likely to be good feedback on how directly affected stakeholder issues have taken into consideration; and information on sustainability topics understood to be of high interest to stakeholders is voluntarily released publicly	• There is support of a large majority of directly affected stakeholder groups for the assessment, planning or implementation measures for that topic, or only very low opposition by these stakeholders	• In addition to basic good practice (Level 3), there may be exhibited full compensation of negative impacts; some positive enhancements; or evidence of capacity building associated with the project	• Very few minor non-compliances and non-conformances that can be readily remedied
3	• Suitable, adequate and effective assessment with no significant gaps. This would typically encompass (as appropriate to the topic and life cycle stage) identification of the baseline condition including relevant issues, appropriate geographic coverage, and appropriate data collection and analytical methodologies; identification of relevant organisational roles and responsibilities, and legal, policy and other requirements; appropriate utilisation of expertise and local knowledge; and appropriate budget and time span. At level 3 the assessment encompasses the considerations most relevant to that topic, but tends to have a predominantly project-focused view or perspective and to give stronger emphasis to impacts and risks than it does to	• Suitable, adequate and effective management processes with no significant gaps. These would typically encompass (as appropriate to the topic and life cycle stage) development and implementation of plans that: • integrate relevant assessment or monitoring findings; • are underpinned by policies; • describe measures that will be taken to address the considerations most relevant to that topic; • establish objectives and targets ; • assign roles, responsibilities and accountabilities; • utilise expertise appropriate to that topic; • allocate finances to cover implementation requirements with some contingency; • outline processes for monitoring, review, and reporting; and • are periodically reviewed and improved as required.	• Suitable, adequate and effective stakeholder engagement processes with no significant gaps. These would typically encompass (as appropriate to the topic and life cycle stage): • Identification of directly affected stakeholders; • Appropriate forms, timing, frequency and locations of stakeholder engagement, often two-way; • Freedom for affected stakeholders to participate; • Attention to special stakeholder engagement considerations relating to gender, minorities, cultural sensitivities, level of literacy, and those who might require particular assistance; • Mechanisms by which stakeholders can see that their issues are recognised and acknowledged, and how they have been or are being responded to; and • disclosure of information on significant sustainability topics (in cases this may be on request)	• There is general support amongst directly affected stakeholder groups for the assessment, planning or implementation measures for that topic,or no significant ongoing opposition by these stakeholders	As appropriate to the topic and the life cycle stage, there may be exhibited avoidance of harm; minimisation and mitigation of negative impacts; fair and just compensation; fulfilment of obligations; or effectiveness of implementation of plans	• No significant non-compliances and non-conformances
2	• A significant gap in assessment processes relative to basic good practice (Level 3).	• A significant gap in management processes relative to basic good practice (Level 3).	• A significant gap in stakeholder engagement processes relative to basic good practice (Level 3).	• There is support amongst some directly affected stakeholder groups for the assessment, planning or implementation measures for that topic, with some opposition.	-A significant gap relative to basic good practice (Level 3), for example some deterioration in baseline condition	• A significant non-compliance or non-conformance
1	• Significant gaps in assessment processes relative to basic good practice (Level 3).	• There are significant gaps in management processes relative to basic good practice (Level 3).	• There are significant gaps in stakeholder engagement processes relative to basic good practice (Level 3).	• There is low support amongst directly affected stakeholder groups for the assessment, planning or implementation measures for that topic, or a majority oppose	• Significant gaps relative to basic good practice (Level 3), for example deterioration in baseline condition with delay or difficulties in addressing negative impacts	• Significant non-compliances and non-conformances

APPENDIX D

Interview with Çetin Dam and HEPP Project Manager, Mr Sadettin Zorlutuna, conducted in 11th of April, 2013

Question (Q1): For how many years do you work in Dolsar Engineering, and how many years as a dam engineer in the sector? Can you please summarize your experience?
Answer (A1): I work for Dolsar for 17 years. I am a dam engineer since 1982. I work as project manager for about 18 years. Till now I worked for design of 66 dams and regulators.

Q2: Is the owner sensitive in social issues? Do they have any group working at site to learn about indigenous peoples' thoughts and wishes about the project?

A2: It is known that, Turkish companies are not very sensitive to social issues. They only obey the commitments and do not pay so much care about local people's individual rights that are not supported by law. If government gives a Turkish company expropriation right, then they use it even if public opposes.

As you know, the owner of Çetin Dam is a Norwegian company. There is not considerable expropriation or resettlement problem in Çetin Dam and HEPP since there is few number of houses in the vicinity. However, in Lower Çetin Dam Project which continues synchronously with Çetin Dam, the owner pays too much to not disturb small population of villagers. In fact the company has the right of expropriating the small pomegranate gardens in Dişlinar Village. However, the company prefers to look for much more expensive solutions since the public is too sensitive on their pomegranate gardens. If the owner of the project was a Turkish company, it will most probably not care about the small hectares of gardens.

There is a social working group at site employed just to conserve social relations with public. Today, more than 1000 people work at site. All of the unqualified personnel is chosen from local people. Some of the employed engineers and workers know Kurdish to be in good relations with public. When looked at the owner's manner, I guess this dam should be one of the most sustainable applications of Turkey in terms of social issues.

Q3: How does the owner chooses its stakeholders in a project? Does it assign any sustainability criteria while bidding?
A3: As far as I know, it does not assign any sustainability criteria. There is not any special sustainability requirement in Turkey's applications. The social, environmental and economic issues are considered separately by different governmental organizations in Turkey's HEPP applications. They are not connected in sustainability topic. However, owner chooses its stakeholders according to some social and environmental issues. For example, İlci Company from Yüksel-İlci Cooperation is managed by the owners from the region and they know the public in the vicinity very well. They choose a local contractor to ensure the social relations in the site.

Q4: Is the contractor sensitive in social issues?
A4: Yes, they are. They always try to be in good relations with the indigenous peoples. Although it is not obliged legally, they repair the roads or water pipes of the villagers etc., even if they are not in their responsibility. In fact this type of recovery is in Provincial Special Administration's responsibility. However they undertake the responsibility so that bureaucracy requirements are not waited by public.

Q5: What are the most important handicaps of this project according to you?
A5: The geology of the area is too complex. Calculation of the diversion tunnels is so difficult that they include four different geological formations. Due to geological challenges, the layout had to be revised. However, the diversion tunnels' implementation at site restricted the project area. Now, there is no place to change the dam body side slopes. There is no place to change dam axis. Due to restrictions of the layout, penstock cannot go above ground. So that, we designed the penstock as a tunnel; which is expensive when compared.

Q6: What are your observations at your site visits? Do they obey safety rules?
A6: They are very strict in safety rules. Everywhere required warning tables are established. All the personal wear safety clothes at all time. In one of my visits, I didn't have my safety shoes with me, so that they didn't let me enter in the construction site as the project design manager.

Q7: Why fish passage design is not included in final projects of Çetin Dam and HEPP although it exists in EIA report?
A7: It is a significant gap in terms of legal requirements. However, constructing a fish passage is not appropriate in big dams. That's way they are not included in final designs, although they are included in EIA reports. The temperature of the downstream of the river is 10-15 C□ higher than the water temperature in huge reservoirs especially at deep sections. If fishes use any fish passage constructed, they will die due to temperature changes. Constructing a fish passage in big dams is not logical in the aim of protecting living beings in the river.

Q8: Does sensitivity analysis including extensive scenario testing, risk assessment and sensitivity analysis?
A8: As you know, optimization studies are performed by Dolsar. However, sensitivity analysis and extensive scenario testing and risk assessment studies are performed by the owner. They are all performed and being monitored by Statkraft.

Q9: What is the local people's observed benefit up to date? Do public have any opposition against the project?
A9: All of the unqualified personnel are employed from the local people in the vicinity. Only local suppliers are used for services when available. Economy is promoted due to shopping. Affected local people number is very few and verbal agreements have been conducted. They do not have any opposition, and they are waiting for legal agreements.

APPENDIX E

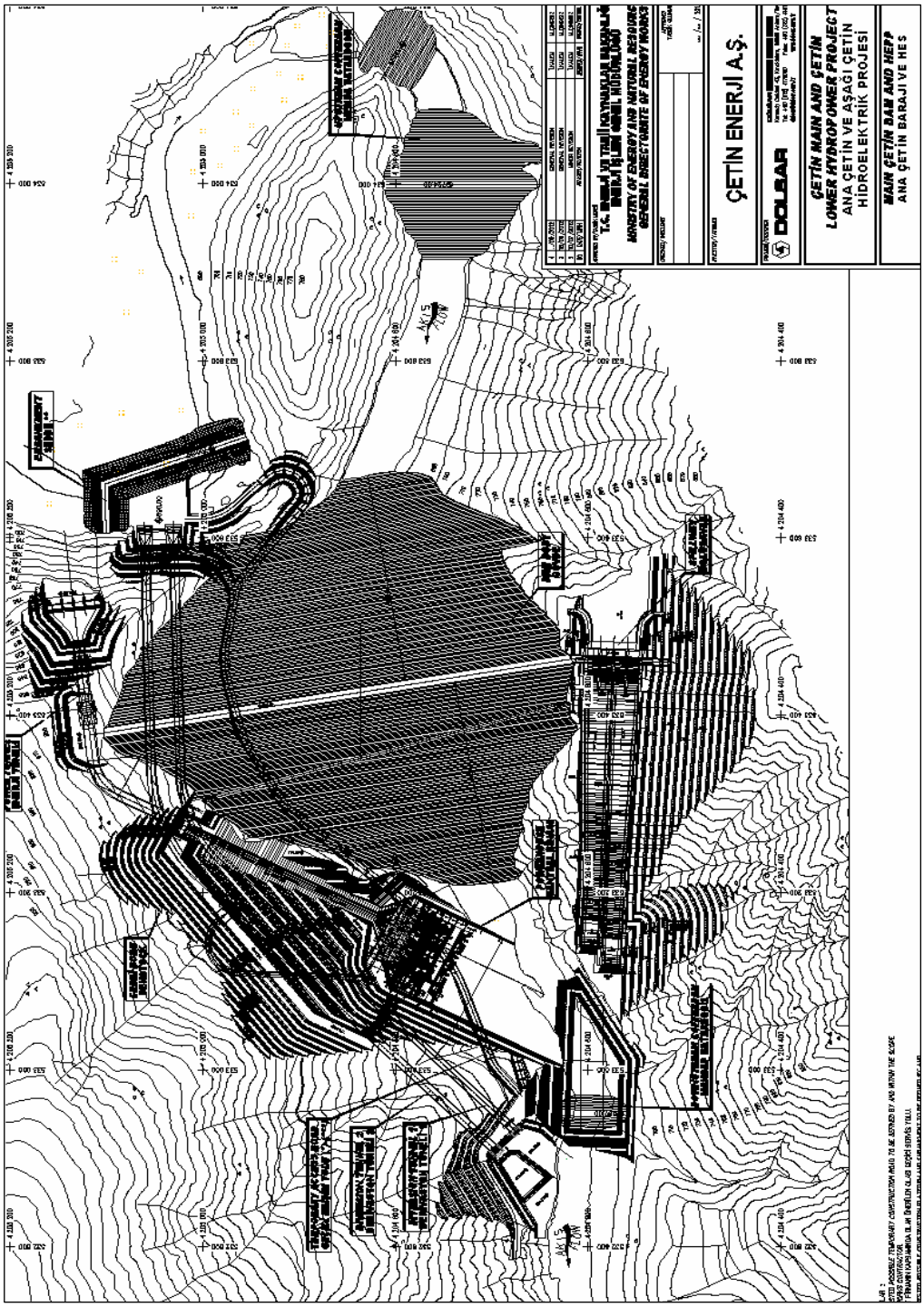

Figure E.1 Çetin Dam and HEPP General Layout Plan (Dolsar, 2013)

APPENDIX F

Figure F.1 Çetin Dam and HEPP Flushing Tunnel Model Hydraulic Experiments at Technical University of Vienna Conducted in April 2013 (Photos taken by the author)

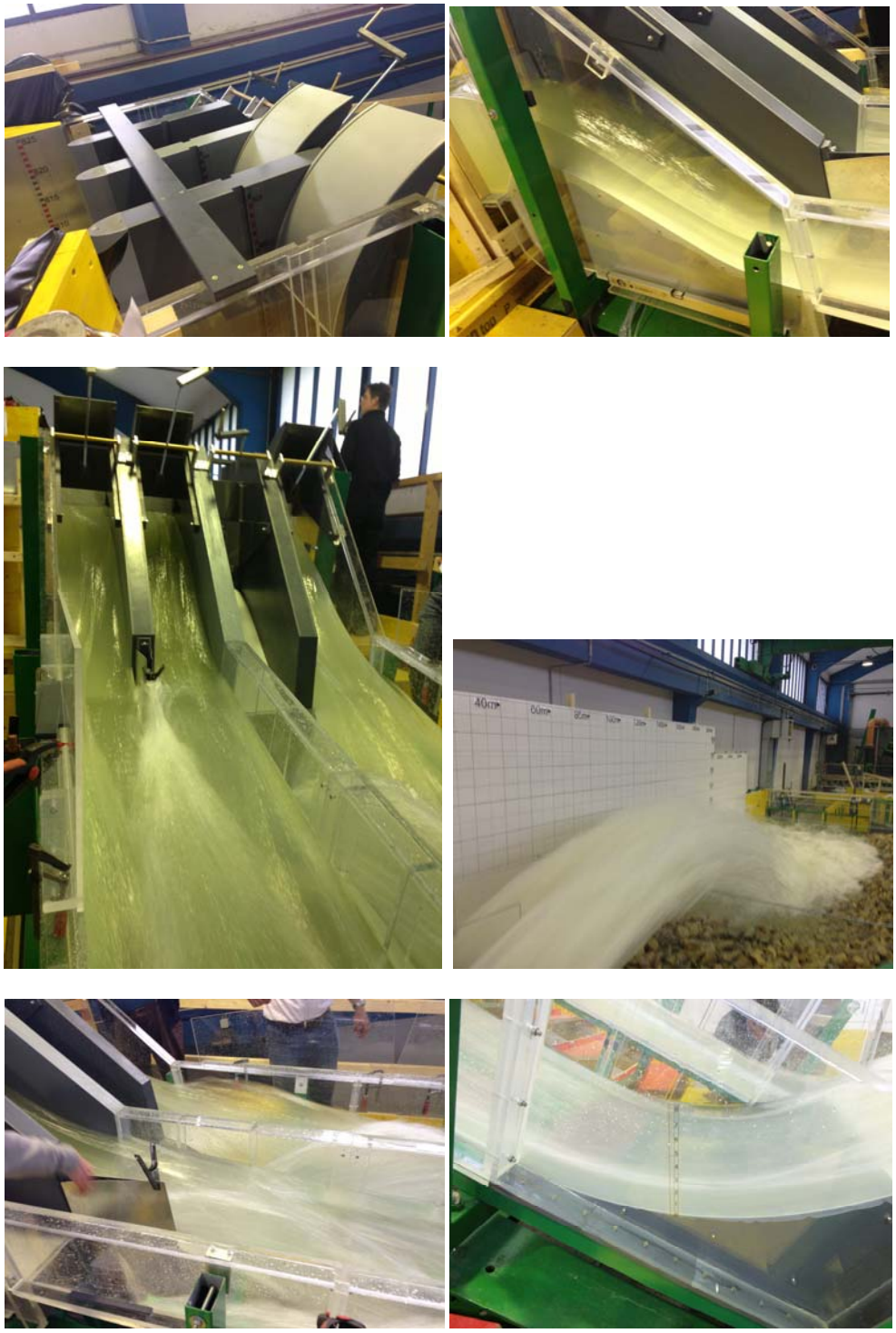

Figure F.2 Çetin Dam and HEPP Spillway Model Hydraulic Experiments at Technical University of Vienna Conducted in June 2013 (Photos taken by the author)

APPENDIX G

Figure G.1 Çetin Dam and HEPP Diversion Tunnel Outlet Incident

APPENDIX H

Figure H.1 Safety Caution Signs at Çetin Dam and HEPP Site

Figure H.2 Workers Wearing Safety Clothes at Çetin Dam and HEPP Diversion Tunnel

APPENDIX I

Figure I.1 Çetin Dam and HEPP Study on the Determination of the Fish Species (Photos taken from EIA Report)

APPENDIX J

Figure J.1 Some Protests against HEPPs in Turkey (forumkaradeniz.wordpress.com)

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Vural Özünlü, Berna
Nationality: Turkish (TC)
Date and Place of Birth: 23.05.1983, Trabzon
Marital Status: Married

EDUCATION

Degree	Institution	Year of Graduation
M.S.	Middle East Technical University	2013
B.S.	Middle East Technical University	2009
High School	Trabzon Kanuni Anatolian High School	2001

PROFESSIONAL EXPERIENCE

Year	Place	Enrollment
(2009-2010)	Yolsu Engineering Ltd	Hydraulic Design Engineer
(2010-still)	Dolsar Engineering Ltd	Hydraulic Design Engineer