

An Investigation of Technology Portfolio Planning With Scenario Analysis: A Case Study for Turkish Renewable Energy Industry

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DECLARATION

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ABSTRACT

Renewable energy resources gained a significant importance due to increasing energy security issues and environmental concerns all over the world as well as in Turkey. Therefore, this research aims to explore future opportunities in Turkish renewable energy market by applying a methodical process of technology portfolio planning with the use of scenario analysis. After an in-depth evaluation of the scenario planning literature, this study adopts a conceptual scenario planning model and apply it to Turkish renewable energy sector. The planning process starts with derivation of decision values in the industry based numerous in-depth semi-structured interviewes with various stakeholders of the sector. Consequently, it generates, based on expert opinions and literature search, a set of major technology alternatives, which in this study include: wind energy, solar photovoltaic, biomass, and geothermal energy. Through an assesment of key driving factors in the four axes of uncertainty, the process in this study next constructs four scenarios (“Fresh Air”, “Green Forces”, “Jurassic Park”, and “Dark Clouds”) to encompass future uncertainties in the relationships between the technology alternatives and the decision values. Finally, the researcher evaluates the importance and risks of these alternative energy resources and develops coherent portfolio strategies for Turkish renewable energy sector through two in-depth intervuews with expert energy management consultants, which are responsive and robust for the future scenarios. The most important contributions of this paper are the clear explanations of the systematic process of technology portfolio planning and scenario analysis, and the profound demonstration of their application through a case study on Turkish renewable energy market.

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ABBREVIATION

CO2: CARBON DIOXIDE

EIA: ENERGY INFORMATION ADMINISTRATION

EPIA: EUROPEAN PHOTOVOLTAIC INDUSTRY ASSOCIATION

ERI: ENERGY RESEARCH INSTITUTE

EVTKB: MINISTRY OF ENERGY AND NATURAL RESOURCES

GDP: GROSS DOMESTIC PRODUCT

GHG: GREEN HOUSE GAS

GW: GIGAWATT

GWEC: GLOBAL WIND ENERGY COUNCIL

IMF: INTERNATIONAL MONETARY FUND

IRENA: INTERNATIONAL RENEWABLE ENERGY AGENCY

JISC: JOINT INFORMATION SYSTEMS COMMITTEE

KWh: KILOWATT HOUR

MSA: MULTIPLE SCENARIO APPROACH

MW: MEGAWATT

MWh: MEGAWATT HOUR

OECD: ORGANIZATION FOR ECONOMIC CO-OPERATION AND
DEVELOPMENT

OPEC: ORGANIZATION OF THE PETROLEUM EXPORTING COUNTRIES

SBP: SOUTH BALTIC PROGRAMME

SIB: SHELL INTERNATIONAL BV

SRI: STANFORD RESEARCH INSTITUTE

TDS: TECHNOLOGY DELIVERY SYSTEM

TEI: THE ECONOMIST INTELLIGENCE

TEIAS: TURKISH ELECTRICITY TRANSMISSION CO.

TETAS: TURKISH ELECTRICITY TRADING CO.

TUREB: TURKISH WIND ENERGY ASSOCIATION

TWEA: TURKISH WIND ENERGY ASSOCIATION

TWh: TERAWATT HOUR

UN: UNITED NATIONS

USA: UNITED STATES OF AMERICA

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CHAPTER ONE: INTRODUCTION

1.1. Background of the Research

As a consequence of increasing oil prices, oil dependency, and growing environmental issues, a large number of countries have begun to seek out alternative energy sources in order to diminish energy security issues as well as minimize the negative impacts of fossil-based fuels on the environment (Theyel, 2012). These investigations into alternative energy sources have led many countries to increase their interest in green energy resources, particularly wind and hydro power plants due to better feasibility and acceptability issues (Agency Group, 2012).

1.1.1. Background of Turkish Renewable Energy Industry

In regard to the approach of Turkey towards the expansion of renewable energy, Baris et al. (2012) discusses that despite the existence of abundant natural resources, Turkey has a significant energy dependency due to weak oil reserves. For instance, the country generates more than 50% of its electricity need from fossil-based fuels, of which over 90% are imported from Russia and Iran (Baris & Kucukali, 2012). However, when the current installed capacity of 53 GW, and the annual gross electricity consumption of 229 TWh are taken into account, it would be possible for Turkey to generate more than its annual electricity demand through renewable energy sources as illustrated in Table-1 ((Evrendilek & Ertekin, 2003); (TWEA, 2012)).

Renewable energy investments have just gained importance as a consequence of the establishment of the Renewable Energy Law in 2005 in Turkey. The law provides numerous supportive regulations such as feed-in tariffs, and financial

and technical priorities in order to increase market share of renewable energy resources in order to decrease oil dependency, and to comply with international standards for reducing global warming and CO2 emissions (E.V.T.K.B, 2009). Additionally, the government declared a target of renewable energy expansion for electricity generation up to at least 30% of total demand by 2023—a number which was just 11% in 2011 (TWEA, 2012).

Table 1: Techno-economic potential of renewable energy resources in Turkey (TWEA, 2012) (Evrendilek & Ertekin, 2003))

	Wind	Solar	Biomass	Geothermal	Total
Potential installation capacity (GW)	48.0	-	-	31.5	79.5
Potential production capacity (TWh/annual)	-	100.0	196.7		296.7
Existing installed capacity excluding hydro (GW)				4.0	

When it comes to the global approach to green energy sources, the popularity of the sector increased significantly as a result of OPEC’s oil embargo in 1973 (Saidinur & Islam, 2010). A large number of countries established specific laws and regulations to expand and exploit renewable energy sources in order to secure their energy supply-demand balances and decrease environmental issues such as global warming and climate change (United Nations, 2005).

1.1.2. Background of the Academic Literature

Expansion of renewable energy investments was not the only implication of OPEC's oil embargo. As a consequence of the oil crisis in 1973, a large number of organizations applied radical innovations in their long-term strategies (Malaska, 2012).

The reason is that many companies experienced great failures with their long-term strategies due to the unexpected oil shortage in 1973, whereas the Royal Dutch Shell Company accomplished an inspiring contingency strategy since the company had conducted profound scenario analysis and coherent portfolio strategies accompanied by the Stanford Research Institute (SRI), which included the possibility of global oil shortages (van der Heijden, 1996).

The new long-term planning method which was developed by the Stanford Research Institute was a six-stage scenario planning model (Chen et al., 2006). Even though a considerable number of scenario methods had been published earlier, such as Schwartz's eight-step scenario building model, Schoemaker's 10-step scenario building method, and Avin's 12-step scenario planning framework (Keough et al., 2008), SRI's six-stage scenario planning model has become highly popular, due to its success with the Royal Dutch Shell Company, which was raised into the top three energy companies, whereas the firm had been struggling in the seventh or eighth position of the top ten in earlier years (Porter & Banks, 2011).

In the contemporary marketplace, a large number of organizations benefit from scenario thinking methods in order to gain deep insights on future outcomes, to mitigate risk factors, and to exploit opportunities (Porter & Banks, 2011).

According to Shell International BV (2008), scenario thinking methods are appreciably important tools for global energy management due to increasing dilemmas such as globalization vs. security, and industrialization vs. environment.

Another factor which makes scenario planning important is the increase in unexpected events which bring critical consequences, such as the 9/11 terrorist attacks, the Enron scandal, and the global bank crisis, so the argument goes that global uncertainties increase notably in the most important fields such as economy, security, and energy (S.I.B, 2008).

1.2. Purpose of the Study

The aim of this research is to provide a deep investigation into the possible future outcomes for the Turkish renewable energy industry in order to generate coherent portfolio strategies by discovering potential risks and opportunities. Additionally, the research aims to examine the connection between scenario analysis and portfolio planning in the case of the Turkish renewable energy industry.

1.2.1. Main Research Question and Research Objectives

By taking into account the purpose of the study, the following objectives have been set:

- 1- Reviewing the key literature on scenario analysis and critically evaluating its importance in relation to portfolio planning.
- 2- Reviewing the characteristics of the Turkish renewable energy industry and identifying the key drivers of the industry.
- 3- Developing four possible future scenarios and demonstrating plausible long-term portfolio strategies based on the developed scenarios.

In accordance with the research objectives and research purpose, the main research question is determined as:

RQ1: What are the future opportunities in the Turkish renewable energy industry?

1.2.2. Importance of the Topic

The importance of this topic can be expressed by two major objects. The first object is about growing environmental issues, energy security considerations, and the oil dependency of a large number of countries.

The second object is related to the academic background of the research that this study investigates the relationship between scenario thinking methods and portfolio planning strategies in the case of the Turkish renewable energy industry. Therefore, this study is important because a similar study has not been conducted before, even though Chen et al. (2006) provided similar research for the Taiwanese renewable energy industry by implementing scenario planning tools, and Kahraman (2010) looked at the opportunities and barriers in the Turkish solar power industry.

1.3. Scope of the Research

On account of the fact that the renewable energy industry consists of a large number of fields such as heating, air conditioning, and power generation (Boyle & Everett, 2003), the scope of this study was narrowed to look at electricity generation from renewable energy resources. Furthermore, since a wide range of different renewable energy sources are available such as solar, hydro, wind, ocean, biomass, and geothermal, this research investigates solely solar, onshore wind, biomass, and geothermal (Baris & Kucukali, 2012).

1.4. Structure of the Research

The study consists of eight major sections: introduction, literature review, methodology, market report of the Turkish renewable energy sector, literature of Turkish renewable energy industry, findings, scenario planning, and conclusions.

Based on the research objectives, the literature review analyzes and evaluates the three pertinent fields: scenario thinking, portfolio planning, renewable energy in the world, and renewable energy in Turkey. This section will direct the researcher to an appropriate conceptual framework in order to accomplish the research objectives.

Under the subsections of scenario analysis and portfolio planning, the researcher will discuss in depth the existing academic literature on strategic management, scenario thinking, and portfolio planning while evaluating various academic models in order to attain to a conclusive framework.

In the next subsection, the researcher looks at the current situation of renewable energy issues, such as policies, market volume, market growth, and environmental considerations in the world as well as in Turkey.

In the methodology section, the main research design will be explained through the aspects of research philosophy, research approach, research method, research purpose, and research design. Furthermore, in this section a detailed explanation of the data collection method, sampling strategies, and data analysis methods will be provided.

In the fourth and fifth section, a concise and plausible market report of the Turkish renewable energy industry will be provided to gain a further understanding of the general condition of the market.

Subsequently, the section of findings will provide the analysis and evaluation of the collected data which were gathered through in-depth semi-structured interviews.

After findings, a comprehensive scenario analysis process will be provided. After that, the research will examine coherent portfolio strategies for Turkish renewable energy industry.

The final section will provide the main conclusion. It also includes an evaluation of the contribution of this study, and discussion of the research limitations. Finally, recommendations will be given with regards managerial implications, limitations, and further research areas.

CHAPTER TWO: LITERATURE REVIEW

The literature review section of the research evaluates the academic literature the subjects of interest in order to determine a plausible direction for the present research. For this purpose, scenario analysis, portfolio planning, and scenario planning concepts were reviewed in detail. In addition, as the research area is renewable energy industry; the characteristics of global renewable energy markets were also reviewed in order to provide a deep understanding over the outline of the industry.

2.1. Scenario Thinking and Planning

2.1.1. Emergence of Scenario Thinking

As a consequence of oil embargo of Arab Oil Exporter Countries in 1973, a large number of developed countries, such as US, Japan, Germany and Denmark, went into considerable energy crisis (Chen et al., 2009).

This unexpected incident made many organizations confront significant failures or even bankrupts with their traditional forecasting methods. However, Royal Dutch Shell Company had conducted a profound scenario analysis including potential oil shortages which were prepared by Stanford Research Institute (Chen et al., 2009). As a result of such researches, the impacts of the embargo had been minimized significantly and even these successful strategies helped the company become one of the top three in the energy sector (Porter & Banks, 2011) Consequently, from this date on, a large number of organizations have adopted scenario analysis methods in their strategic management literature, particularly the ones in the US and Western Europe (United, 2005).

This development had a significant impact in altering competition behaviours in the industrial fields. For instance, the trend of the change on the management literature sourced a critical chance for organizations to regenerate their competitive advantages (United, 2005). Besides this, such developments led former decision-making methods to lose ground since a large number of organizations experienced intolerable failures as a consequence of their traditional methods (United, 2005).

Many articles have been published to deal with scenarios as motives, which prepare organizations for uncertain future outcomes (O'Connor, 1978; Lorenz, 1980; Hamilton, 1981; Zentner, 1982; Mandel, 1982), yet the scientific use of scenarios in management literature could be counted as a new phenomenon (5).

Porter (1985) describes the scenarios as potential future outcomes which should be considered different from regular forecasts. Similarly, numerous scientists such as Wright, Cairns, Burt, Bradfield and van der Heijden (2006) discussed

scenarios as acceptable examinations which are basically good or bad future results, yet they are not predictions. As a consequence of this, it could be logical to define scenarios as narratives which demonstrate potential long-term outcomes.

However, these scenarios are needed to be obtained through well disciplined studies. Burt (2003) discusses that it is crucial to conduct a systematic process including in-depth analysis and evaluations into external and internal environment in order to create successful scenario plans. In this way, organizations could benefit from scenarios since they become able to take possible future outcomes into account for long-term strategic planning process and in order to increase their agility in case of rise of unexpected conditions.

2.1.1.1. Scenario Planning Concept

Numerous scenario planning methods have been developed for over fifty years (Willis et al. 2005). For instance, Linneman and Klein (1979; 1983; 1985) has published survey analysis scenario planning method specific to US companies whereas Multiple Scenario Approach (MSA) was introduced in 1981 by Malaska et al. (1982) for European countries.

In order to assess future threats by utilizing event based modelling, scenario process was first developed by Herman Kahn and RAND Corporation in the 1950s (Willis et al. 2005). Kahn asserted that scenarios could help leaders simulate uncertainties (Bradfield et al. 2005). According to Herman Kahn who first developed scenario process in 1950s, in times of crisis and great uncertainties, due to the fact that the ability of decision-making might be challenging, scenario analysis could facilitate the implementation of the strategies in the real life (Boyd, 1987). Similarly, Rosenberg (2012) asserts that

future is unsurprisingly unknown and it is impossible to change it. Consequently, the best thing to do for organizations is to collect as much data as possible and generate credible forecasts about possible trends in the future by refining the collected data. In this way, scenarios could help organizations obtain learning and innovation culture as well as helping them to foresee the trends in future rather than a process which tries to change the future (Yeoman et al., 2005). Moreover, Wack (1985a; 1985b) highlights the importance of scenarios for strategic planning in order to handle numerous uncertainties which arise rapidly in a business environment.

2.1.1.2. Transfer of Scenario Analysis to Management Literature

Even though the use of scenarios was first implemented for military purposes, the process was transferred to the business field by a number of thinkers such as Gues, Wack and Schwartz as a substantial part of planning process and applied by a significant number of large organizations including Royal Dutch Shell and Deutsche Bank since the early seventies (Iannella, 2010). However due to numerous misinterpretations of scenarios, a negative perception has been fostered by a number of organizations against the use of scenarios (Bradfield et al., 2005).

Bradfield et al. (2005) describes one of the reasons why organizations have not adopted scenario process until recently; the reason is that policy-makers do not wish to consider uncertainties because of the challenges which create discomfort throughout the decision progress. So the argument goes, on account of the fact that scenarios were misperceived as simple predictions rather than alternative future outcomes, organizations have undertaken more quantitative methods

which can make people more confident to discover more credible directions for decision making.

As a case in point, there are two foremost challenges that could be suggested in strategy making: one is the fact that since it is required to investigate the issued topic from a broad perspective, to consider how the information sorted and evaluated might arise difficulties for decision makers (Iannella, 2010). Secondly, since a fairly large number of factors are uncertain in strategic planning, it is extremely challenging to make variable planning for every single uncertainty (Murray & Grimsley, 1994). Therefore, Iannella (2010) suggests that scenario planning methodology for strategy and policy making in both military and non-military fields could be beneficial to handle those challenges.

2.1.2. Scenarios and Uncertainties

Clausewitz (1976) states that none of the strategies can be implemented accurately as planned on account of the unexpected outcomes, however, its targets can be attained through perseverance. Clausewitz (1976) continues the argument that because of the fact that strategies are made in a continuously changing environment, it is crucial to take into consideration the uncertainties in the contextual environment. Gray (1999) discusses that it is important to consider all external factors, such as economical, social, cultural and political roots, while working on a multidimensional strategy. Similarly, Buttell (2009) suggests that scenarios could illustrate a whole picture of uncertainties in the context and explore the linkages between those uncertainties since they might not be necessarily autonomous.

According to Taleb (2008), the connection between uncertainties as actions which might have numerous links and impacts; however, 'they might not fall in

the same line like a staked row of dominoes knocking down in the same direction'. Walker et al. (2003) defines the level of uncertainties which might source from unawareness and referred to it as stochastic uncertainty (known unknowns) and scenario uncertainty (unknown unknowns). Besides, Schoemaker (1995) adds that scenario planning could help organizations to obtain a comprehensive view-point on future possibilities.

Parallel to this concept, Porter (1985) identifies scenario planning as a tool to consider beyond the boundaries of traditional ways of planning. All in all, it could be asserted that scenarios are able to help organizations consider the future from different aspects in order to obtain the best strategic position towards the future. McWorther et al. (2008) agrees this concept as he maintains that with scenarios it is possible to derive larger number of alternatives and directions as well as it helps to demonstrate larger number of threats and opportunities which could be significantly beneficial to determine and chase the best strategy.

In other words, scenario planning is a tool which generates a large number of alternatives against dead-ends and prepares organizations to minimize risks of catastrophic consequences of unexpected incidents in both external and internal environment (Sergent, 2010). Sevaguru (2009) underlines that despite the fact that those scenarios might not come true precisely; they could supply a precious agility for organizations to manage any unanticipated outcome.

Regarding the fields in which scenarios are applied, van der Heijden (1996) suggests that scenario analysis is a crucial part of strategic management to understand future by investigating possible outcomes. Therefore, it is obvious that the organizations, which take the scenarios into account in order to gain

profound insights towards future in order to avoid from threats and exploit the opportunities in a maximum level, could achieve a valuable strategic position. Nevertheless, it is crucial for organizations to implement those scenarios within their decision-making process dynamically in order to be successful. Besides this, Mintzberg, Lampel and Ahlstrand (2005) discuss that an acceptable decision should handle several possible future outcomes.

According to Chen et al. (2009), especially from early 20th century on, organizations have needed to adopt a systematic approach to explore future outcomes and consequences as well as to generate better decisions to cope up with unforeseen outcomes.

It is obvious that scenario approach provides a valuable platform for decision-makers to experiment numerous different directions hypothetically and examine their consequences through scenarios (Wilburn et al., 2012). Similarly, Miesing et al. (2007) agreed that scenario method is a strategic planning instrument in order to generate relatively more agile long-term plans. Therefore, it could be asserted that the scenario methods provide a significant advantage in terms of exploring the future through understanding the effects and the nature of uncertainties. Furthermore, scenario planning method is based on producing a set of divergent factors through considering the uncertainties in the key drivers of an industry, such as politics, economics, social, technology, regulations and environment as described by Porter (1985) and named as 'PESTEL' analysis (JISC, 2008).

In order to reduce the future risks, Schwartz (1996) suggests that it is important to critically analyze and evaluate all the dimensions of the context by getting rid of existing prejudiced beliefs. Similarly, Kennedy et al. (2003) highlights that scenarios are not crystal balls to the future, however, they illustrate possible future outcomes and as a consequent of this, all planning progress can be

evaluated critically for a contingency strategy through these alternative future plans.

In another argument it is suggested that scenarios might be beneficial to understand the existing risks in the present and to look at the changes that might occur in the future (Iannella, 2010). Ralston (Randall, 2006) discusses this aspect of scenarios could allow decision-makers to train for the future and to get prepared to respond rapidly to extraordinary outcomes once they occur. All in all, it is clear that a wide range of researchers supports the importance of scenario analysis for long-term strategic plans of the organizations.

2.1.3. Scenario Planning Methods

In the seventies Gues and Wack (Iannella, 2010) developed the qualitative Intuitive Logics scenario planning methodology, a process based on three steps which are research, thinking and discussion. However, Van der Heijden (1996) underlines that those predominantly qualitative scenarios might not reveal precise results on account of the fact that such methods neither can be proven nor be disproved. Consequently, this raises a lack of confidence amongst a large of executives upon the use of scenarios for planning and decision making. (Benjamin, 1982). Wack (1985a) undoubtedly explains this situation by suggesting that those exact statements of the decision-makers about the future could be perceived as unprofessional or inexperienced for their position.

Ringland (1998) suggests for decision-makers that warning signs in the environment could be interpreted as upcoming changes and could enable decision-makers to move in correct directions and avoid from misperceptions. So the argument goes, it is crucial to look at the entire system both in internal and external environment during scenario planning process rather than the portions in

which uncertainties are expected to occur. In scenario thinking process, all factors are needed to be considered in the long term since what might seem as an answer for today should be evaluated for its long term consequences in various divergent future outcomes (Iannella, 2010).

Additionally, scenarios allow decision-makers link together numerous factors such as economics, politics and demographic issues throughout the process (Schwartz 1996). Therefore thinkers could manage to see relations of many diverse factors in the whole picture. According to Bernstein et al. (2007) this entire process makes scenarios considerably beneficial for decision-makers in terms of understanding the most suitable directions which are called as 'salient casual pathways' by the author.

Lastly, Schoemaker (1991) underlines that scenarios help researcher distinguish what actions are worthy of attention and what are not. As a result, it can be asserted that many thinkers agreed on that the use of scenario methodology could provide significant benefits to policy and decision-makers to assess all long term plans in all areas including energy, economy and defence.

2.2. Technology Portfolio Planning

Royal Dutch Shell has been the first organization to implement the six stage scenario planning in which the company applied scenario analysis as the preliminary work for portfolio planning (Schwartz, 1996). This model was prepared by Stanford Research Institute- SRI (1996a) for the company whereas its rivals were still into making forecasts with traditional methods. Later on, SRI (1996b) applied scenario analysis in technology portfolio planning process. As a case in point, SRI prepared a plan for transmission and distribution lines of

Pacific Gas and Electricity Company against any possible natural disaster (SRI, 1996c).

Apart from this, Chen et al. (2009) prepared a renewable energy portfolio planning for Taiwan by applying SRI's six stage scenario planning model. The study investigated three potential future outcomes and examined the risks and plausible responses in case of scenarios through a scientific process of combining scenario analysis and portfolio planning.

One of the foremost reasons for application of scenarios into the portfolio planning is the increasing instability of the contextual environment (Armstrong, 1985). Those arising issues, such as economically aggressive market place in the globe, environmental considerations to decline air and water pollution, have become key driving forces in a significant number of sectors in terms of operational costs and capital investments (Armstrong, 1985). Even though corporations are no longer willing to devote high capitals for complex long range plans, they are aware of the essential requirement for a systematic future sight to formulate operational decisions as well as major strategic decision (Porter & Banks, 2011). As in all other sectors, energy sector does not comprise only technical challenges, but also financial implementations, legal boundaries and environmental concerns (Armstrong, 1985).

2.2.1. Process of Technology Portfolio Planning

According to Porter et al. (2011) technology portfolio planning process begins with a coherent future consideration. Porter et al. (2011) explains how to derive the major challenges of technology forecasting, how to design original approaches and how the data can be collected and evaluated for a valuable decision making. In this study, Porter et al. (2011) discusses that critical

evaluation or extrapolation of the past to the future is a sensitive approach and mostly it is acceptable.

Even though contextual factors have hundreds of causal relationships, these in-depth applications of sophisticated frameworks are beneficial to foresee the relationships from historical statistics (Porter & Banks, 2011). Despite the fact that it is not adequate itself, according to Porter et al. (2011) extrapolation is crucial to be used for technology forecasting to create credible perspectives. Porter et al. (2011) asserts that there are a plenty of main topics linked with technological developments such as global climate change, restraints in the energy resources, air and water pollutions, water resources and falling birth rates particularly in technologically developed countries. In this concept, technology executives are able to learn that demographic, political and environmental drivers can have a significant impact on change of technological patterns.

Ascher (1978) pointed out that there are five issues which make those drivers more agile and consequently challenging to anticipate such as unstable human desires and socio-political situation, growing extreme social attitudes, single isolated incidents and ignoring even a single factor to relate to the socio-political context, so the argument goes, without considering those points, every single factor could become meaningless for the whole process.

In order to make technology forecasts, researchers should understand the existing data about how technologies proceed. For instance, Porter et al. (2011) suggests that life cycle of technologies is significantly influenced by socio-political characteristics with which they are integrated by and through the development of sustaining and rival technologies. In this process, for a successful result, it is

essential to understand earlier studies and approaches which were accomplished by filling available gaps by developing figures that are derived through those techniques (Porter & Banks, 2011).

Wheeler and Shelley (1987) suggested that the inadequate expertise and poor judgment in forecasting cause excessively optimistic results, which might range up to 50% or more. Ascher (1978) suggests another important point to avoid from as the volatile socio-political grounds, in which case executives are required to have some estimation of the error margins to provide accuracy.

Therefore, Cook and Campbell (1979) assert that defining and balancing the strengths and weaknesses of divergent forecasting methods could help forecasters to attain more accurate consequences. Although the researchers are fairly capable in exploring new ways and reviewing the old methods, it is obvious that numerous errors frequently arise such as oversights at contextual factors, bias and defective core assumptions.

Porter et al. (2011) discusses that errors at contextual evaluations occur due to the fact that people do not take into account the changes in the economic, social and technical contexts in which technology is embedded. Those changes in the external environment influence the consistency between past and future that is at the core of empirical forecasting. Secondly, bias is other important factor that causes errors. Those mainly come out from personal, ideological, political or corporate level conservativeness (Porter & Banks, 2011). Martino (1983) asserts that bias sometimes might occur due to overcompensation. The unconscious bias which is difficult to be recognized by the forecasters might be visible through under- or over-emphasizing present figures of the context against dreadful news,

historical outcomes, world view and confidence and their consequence in the technological context.

On the other hand, it is highlighted that setting forecast teams and using diversified methods could be the best safeguards in order to prevent bias (Porter & Banks, 2011). In his study, Porter et al. (2011) points out that being aware of a systematic rationale basis for the forecasting approaches would increase the credibility and viewpoint of the forecaster. It is possible to classify forecast methods as extrapolative or normative depending on whether they are based on current trends or using a radical point of view away from the desired future to find out possible developments (Porter & Banks, 2011).

Nonetheless, a large number of methods can be perceived either extrapolative or normative depending on the way they are applied (Porter & Banks, 2011). Porter and Rossini (1987) discuss that many forecasting methods can be constricted into five major titles which are monitoring, expert opinion, trend extrapolation, modelling and scenario thinking.

2.3. Scenario Thinking and Portfolio Planning

Forecasting is mostly seen as groundwork for planning. Therefore it is highlighted that it is crucial for organizations to have a crystal clear sight of the potential future conditions in order to plan and allocate resources successfully (Porter & Banks, 2011). Brown and Eisenhardt (1998) highlight it is impossible to control the contextual environment, so the argument goes, the context is even not predictable.

Therefore, Vanston (1985) suggests that subjects such as obstacles and the drivers must be well-defined to provide a well-developed anticipation. Ruff (2004)

agrees that technology foresight provides a broader viewpoint than technology forecasting since it takes all the external forces and their interactions into consideration. Furthermore, Taleb (2005) underlines it is risky not to look at black swans, which is very low probability but high impact possibilities, hiding in a worthless side of information.

2.3.1. Concise Comparison of TDS and Six-Stage Scenario Planning

In the TDS framework which is explained in-depth by Porter et al. (2011), there are basically three main phases. The first phase, cold phase, basically consists of strategic thinking on socio-economical forces in order to reflect the needs of decision makers in terms of the design of the project. The second phase, warm phase, mostly involves a large forecasting period about how the conditions will change in the future. In the last phase, hot phase, the most important options are selected and critically assessed with available time and resources. Additionally, scenarios could be fleshed out on the major dimensions of the sector and its context to combine findings and to communicate main potentials. Strategies about the allocation of portfolios are considered in this phase. Even though the last phase is the end of the project, forecasting does not end with this phase. It is essential to continue monitoring in order to make appropriate corrections in planning.

Even though Porter et al. (2011) developed an in-depth model for technology portfolio panning, SRI's six stage scenario planning model remains its fame due to its success with Royal Dutch Shell Company (Chen et al., 2009). However both methods differ from each other on the surface, yet they have significant similarities in the essence. For instance, the steps towards portfolio planning chase a considerably similar direction which consists of basically determination

of decision factors, writing scenario narratives and preparing portfolio plans (Porter, 2011; SRI, 1996b).

To elaborate, both methods refers to a comprehensive preliminary research, which is crucial for scenario analysis, and identifies five essential steps for building scenarios as identification of variables, creating levels of measurement, classification of key variables, generating scenarios and writing the narratives.

However, since it could generate possible conflicts whether the research implements numerous frameworks together, this paper will undertake SRI's six stage model to illustrate renewable energy technology portfolio planning in order to benefit from the wide range of existing and practically implemented portfolio plans which would be helpful to achieve research objectives in an accurate way by comparing them to the existing implementations.

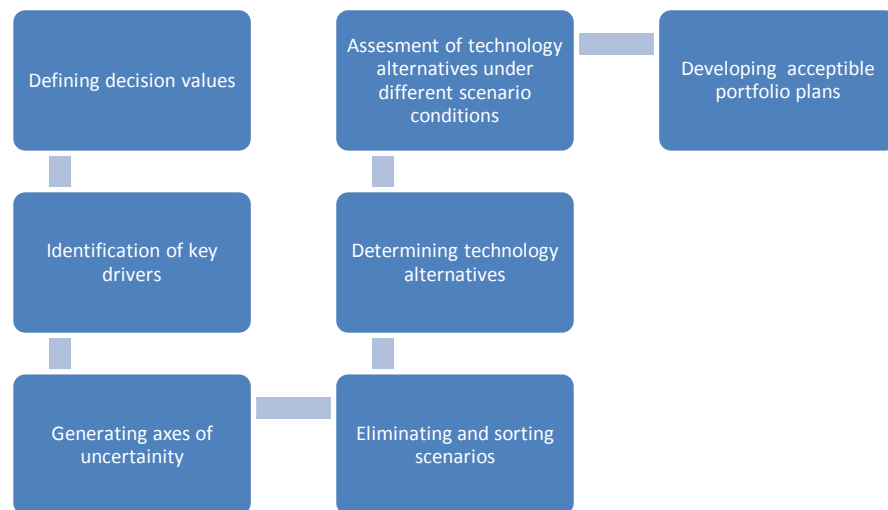


Figure 1: Stanford Research Institute's six-stage scenario planning method (Chen et al., 2006)

2.3.1.1. Sample Implementations of Technology Portfolio Planning

As an example of the applications of this framework, Chen et al. (2009) used SRI's six-stage model in order to demonstrate a detailed research for Taiwanese

renewable energy industry in 2009. In this study, the tutors firstly identified the key drivers and the uncertainties in the industry through a deep survey conducted to experts within the same industry.

Subsequently, the three scenarios were developed by taking into account the uncertainties within the key drivers of the sector. Lastly, the study provided a consistent renewable energy portfolio plan depending on the written scenarios. However the study failed to achieve collecting accurate data on account of the fact that the executives who were consulted throughout the research had a lack of sufficient technical background (Chen et al., 2009).

Therefore, the present research attempts to gather the data from significantly experienced people who have taken part in the important fields of the renewable energy industry. Apart from this, similar to Chen's research (2009), this study examines coherent scenarios for Turkish renewable energy industry in order to assess risks and exploit opportunities. Ultimately, through the association between scenario analysis and portfolio planning, the research will argue and generate consistent portfolio strategies.

To conclude, in order to accomplish scenario planning process it is crucial to follow a systematic way. For instance, firstly it is important to determine a clear and focused question (Foa et al., 2006). Secondly, key drivers and uncertainties of the industry should be identified and ordered depending on their importance (Rosenberg, 2012). Subsequently, it is essential to create coherent scenarios through key drivers and uncertainties. Finally, the most appropriate portfolio strategies will be represented by evaluating possible future outcomes (Chermack et al., 2008).

Despite the fact that these are the basic steps for scenario planning, this study will undertake SRI's six-stage planning model. However, it benefits from numerous other methods such as TDS, Schwartz's 8-step scenario building model, Schoemaker's 10-step scenario building model, Avin's 12-step planning model and generic scenario planning model (Keough, 2008) in order to increase the acceptability of the research.

2.4. Global Context of Renewable Energy

Porter et al. (2011) asserts that due to the fact that fossil based fuel sources are geographically restricted to a number of countries, especially Middle Eastern countries, it is essential to prepare contingent strategies in case of any unexpected outcomes and shortages within those supplier countries in order to reduce supply-demand risks for overwhelmingly consumer countries.

For instance, oil embargo of Organization of Petroleum Exporting Countries (OPEC) against USA's support to Israel, in other words initiation of oil supplier countries to use their 'oil weapon' against a military conflict within Middle East (MacKay, 2009), increased oil prices drastically and caused economic recessions in many countries. The oil shortage sourced large economic downturns and even numerous leader energy companies experienced great crisis in USA and Europe (Porter & Banks, 2011).

The reason of this can be explained in terms of electricity generation as the fact that many countries prefer oil or natural gas based power plants due to easy construction and operating conditions and, cost-effective production compared to many alternative energy resources (Boyle & Everett, 2003). However this causes a significant dependency on supplier countries.

On the other hand, increasing awareness in socio-cultural context particularly in developed countries upon environmental issues and sustainability creates significant pressure in order to switch to use of clean and less hazardous energy resources (MacKay, 2009). The reason is that dramatic increase in CO₂ release of fossil based plants and increasing green house gases emission (GHS) arise the consequence of considerations upon climate change which has been visible in a significant part of the earth (Boyle & Everett, 2003). As a consequence, by the establishment of Kyoto Protocol in 1997, thirty-seven industrialized countries and European Union countries committed to decrease the emission of four basic greenhouse gasses (MacKay, 2009).

2.4.1. Emergence of Renewable Energy Industry

Chen et al. (2009) contends that those rising debates against use of fossil based sources have led many countries to seek ways for alternative energy sources. As a result of all investigations it could be asserted that nuclear power and renewable energy resources have been seen as major contingent strategies against oil dependency and environmental issues (Boyle & Everett, 2003). However, amongst those, even though nuclear energy is counted as a clean energy source, under a number of circumstances it could generate great threats in where it is located. For instance nuclear power plant explosion in Japan because of an earthquake in 2011 or Chernobyl nuclear disaster in 1986 caused horrible catastrophes in a broad landscape through nuclear pollution in the environment, which caused a large number of people suffer from cancer or other dangerous illnesses (Boyle & Everett, 2003).

On the other hand, despite the fact that renewable energy sources have environmental and physical problems, compared to nuclear and other sources

these problems could be counted as minor challenges such as bird deaths, high field captures or local climate changes due to large wind farms (Evrendilek & Ertekin, 2003).

In order to reduce these political and environmental pressures, there have been numerous researches conducted to provide profound insights for long range portfolio plans regarding alternative energy resources. For instance one of the most popular of these, Shell's scenarios became significantly successful against OPEC's oil embargo in 1973 by making appropriate preparations (Chen et al., 2009). Particularly from this date on, many private and governmental institutions have made long term scenario plans for energy industry and Shell has continued its scenario researches.

Regarding the renewable energy industry, Saidur et al. (2010) mentions that many countries such as China, USA and most of the European countries, have established long term plans in order to increase the use of renewable energy sources aiming to meet growing electricity demand as well as to reduce oil dependency and environmental pollution (see Appendix-1).

However, as Porter (2011) argues, it is crucial to consider uncertainties in the key drivers of the industry in order to generate successful scenario plans, which may vary in different countries (Chen et al., 2009). Therefore the process requires a subtle investigation to find out the key drivers specific to a certain country. In one of the recent studies, De Vries et al. (2007) addressed economical, environmental, technological and demographic factors as the main global drivers in renewable energy industry.

For instance, in Beijing International Renewable Energy Conference in 2005, it was highlighted that climate change, environmental issues and energy security are counted as main drivers of renewable energy industry in developed countries whereas consumer demand and local economic development were seen as key driving factors of the industry in developing countries (United Nations, 2005).

2.4.1.1. Governmental Supports

Apart from those, reliability of renewable energy sources has been seen as another important factor which increases its popularity amongst both developed and developing countries (United Nations, 2005). Besides this, Saidur et al. (2010) contends that government support plays a significant role to expand the use of renewable energy sources. Therefore many countries established supportive regulations in order to encourage investors. For instance particularly developed countries have introduced a feed-in-tariff which guarantees to purchase generated energy for a predetermined unit price during a certain time period which changes depending on the country.

As it is obvious, there are significant efforts in favour of enhancing the contribution of renewable energy sources to the energy demand of many countries. However, in order to understand how this demand will shape in future, it is essential to gain deep insights over key driving factors of the industry and determine uncertainties carefully. Furthermore, as mentioned above since there are numerous key drivers of the industry, it is important to analyze and critically appraise the correlations between these factors (Porter, 2011).

CHAPTER THREE: RESEARCH METHODOLOGY

In the methodology, the researcher aims to design an appropriate direction to analyze and evaluate the gathered data. The researcher illustrates numerous fundamental steps of a research design such as the research philosophy, approach, strategy, and method. Furthermore, the section provides a detailed explanation of data collection and analysis instruments by taking into account the research objectives.

3.1. Research Philosophy

As it is obvious in Saunders's research onion (Saunders et al., 2009; see Appendix-2), it is essential to determine an appropriate research philosophy as the first step of research design process due to the fact that research philosophy is considerably important in terms of planning a consistent direction for the research. Levin (1988) defines the research philosophy as a direction which leads the process of data collection and analysis. Saunders et al. (2009) represents three major research philosophies as ontology, axiology and epistemology. The present research undertakes an axiological philosophy which articulates researcher's values as a ground for making judgements about the research which conducted and the way it is attempted to be achieved (Heron, 1996). As a consequence, since the researcher is a part of the research, the study can be counted as rather subjective (Saunders et al., 2009).

As far as this study concerned, contextual factors will be investigated through profound discussions by undertaking the overviews and perceptions of the ones who involved in the key positions of the Turkish renewable energy industry. Subsequently, through critical interpretations of the view-points of the key players of the sector, the research will try to discover possible future scenarios for the industry.

As a consequence, when the three main principles of axiology are examined carefully, it could be seen that the most appropriate principle for the research would be *interpretivist* approach in which it is crucial to take into account the variations among the individuals as social actors within their community. In other words, through this philosophy it is essential to interpret roles of the social actors according to researcher's set of perceptions (Saunders et al., 2009).

3.2. Research Approach

After the research philosophy, as the second step it is important to determine an appropriate approach for the study, such as deductive or inductive (Saunders et al., 2009). Saunders et al. (2009) explains the deductive approach as a process of testing an existing hypothesis or theory on which the research strategy is designed; and in an inductive approach, first the data is collected and a theory is built as a consequence of the data analysis.

This research is fundamentally designed on a basis of *deductive* approach. As far as this study is concerned, a conceptual academic framework is used which is based on the implementation of the linkage between scenario analysis and portfolio planning established by SRI (SRI, 1996a). To elaborate, the research tests the SRI's six-stage scenario planning model by applying it to the Turkish renewable energy industry.

3.3. Research strategy

As the third step of research design, it is important to determine the type of research strategy, such as experiment, survey, case study or action research, by taking into account research questions and objectives (Saunders et al., 2009). As regards to this study, future opportunities of Turkish renewable energy industry

will be investigated through implementing the connection between scenario analysis and portfolio planning.

Therefore the research investigates the external and internal conditions of the sector in details, such as evaluation of contextual factors and assessment of market dynamics. As a consequence of this, this study undertakes the case study strategy. The reason for this could be explained by the description which is represented by Robson (2002) as a strategy for conducting research which is constituted by an experimental investigation of a specific phenomenon applied to its real life context by using multiple evident sources.

3.4. Purpose of the Study

Since the major part of the research design has been clarified, it is essential to determine the aim of the study as the next step. Saunders et al. (2009) maintains that there are three most used research purpose within the research methods literature as explanatory, exploratory and descriptive.

As regards to this research, since the purpose is to discover possible future outcomes of Turkish renewable energy industry, it could be asserted that research is conducted through an *exploratory* purpose. According to Saunders et al. (2009) there are three basic ways of implementing exploratory research are literature search, interviewing experts and focus group interviews.

When it comes to the present research, clearly it is attempted to be accomplished by collecting qualitative data through semi-structured interviews in which 'why, how and what' questions are used frequently, besides an in-depth search of the literature of the academic phenomena to gain profound insights and provide a significant control to researcher upon the overall study.

3.5. Research Method

Regarding to the research method, there are two major methods which are qualitative and quantitative. While qualitative method illustrates a profound understanding upon the research question, quantitative research is rather conclusive and it quantifies the data gathered by larger samples (Malhotra, 2009).

When the research design and research objectives are taken into account, qualitative research method would best suit to the present research. Because in this research, the main data was collected through qualitative research techniques in order to gain in-depth insights upon Turkish renewable energy industry.

Apart from this, another important issue is to decide whether the research will be accomplished through mono or multiple methods. Due to the fact that both qualitative and quantitative data collection methods are applied, it could be said that the research is constituted by multiple data collection methods such as semi-structured interviews, conference observation, market reports and general statistical data regarding both contextual and industrial environment.

3.6. Data Collection Technique

As Pallant (2010) highlights the quality and the reliability of data is attributed to the research techniques and frameworks which provide a clear direction to choose appropriate methods. Therefore data collection could be counted as one of the crucial parts of the research process.

Regarding to the present research, in order to reach a successful analysis of linkage between scenario analysis and portfolio planning, both qualitative and quantitative data are used in this paper.

3.6.1. Primary Data

In terms of collecting primary data which is on qualitative basis, five executives will be interviewed through semi-structured interviews. Those executives were selected as different stakeholders of Turkish renewable industry from governmental institution to consultancy sector in order to obtain a broad insight about the industry.

Three of these interviewees who participate in the key points of the industry, such as policy making, associations and manufacturing fields, were first interviewed in order to understand the conditions in the sector as in the past and present and expectations for the future.

Subsequently, after generating the possible scenarios two other interviewees who are highly experienced in terms of renewable energy consultancy were consulted about the coherency and consistency of the developed scenarios and evaluation of prepared portfolio strategies as a response to developed scenarios. In the second session, interviewees criticized developed strategies and discussed alternative ones if there was any inconsistency in the existing strategies.

3.6.2. Secondary Data

As secondary and quantitative data a wide ranging statistical data was used in order to understand the impacts and the consequences of important incidents in the contextual environment. Those secondary and primary data are used in this paper in a significant consistency in order to criticize and critically evaluate major factors in the macro environment.

Besides this, a wide range of conference reports is used to analyze and evaluate situation of the industry and market forces. Furthermore, a self prepared report of

Turkish Wind Energy Association Conference 2012 is prepared and analyzed (see Appendix-3), which could be significantly helpful to understand current situation of the sector from view-point of different stakeholders such as regulators, creditors, investors and manufacturers.

3.7. Research Sample

According to Saunders et al. (2009) it is necessary to adopt a sampling strategy on account of the fact that it might be unfeasible to gather data from the whole population in numerous occasions. This requirement is valid whether the research will conduct interviews, observation, survey or other type of data collection methods. Moreover Henry (1990) suggests that sampling provides researcher a larger overall accuracy rather than gathering data from every possible source of evidence.

Within the research methods literature, there are basically two different types of sampling methods as probability and non-probability (Saunders et al., 2009). While probability sampling method mostly looks at survey or questionnaire based studies, it could be useful to apply non-probability sampling where choosing respondents randomly is not appropriate for research questions and objectives.

As far as the present research is concerned, external and internal factors of a certain industry will be analyzed and evaluated in order to answer research questions and objectives by examination of gathered data. Therefore it is necessary to conduct interviews with the experts who have profound knowledge and expertise upon the selected industry. As Burt (2003) discusses it is crucial to understand contextual factors, such as politics, demographics, economical drivers and environmental issues as well as market forces in order to create acceptable scenario plans.

Therefore, interviewees were selected within specifically renewable energy policy-making institute; Turkish solar energy association, private power system manufacturers, and two international renewable energy consultancy firms in order to obtain an in-depth understanding upon the industry (see Appendix-4). Furthermore, in order to discover economical and technological dimensions of the sector, a self-prepared conference report is provided in the exhibitions which was obtained through a real-time observation of 2-day long Turkish Wind Energy Congress 2012 in Istanbul on account of the fact that it was not possible to access more than five interviewees from this fields due to time restrictions. As a consequence of this, in this study *non-probability sampling* method is adopted due to explained research methods.

Furthermore, since the interviewees were selected in accordance with the research questions and research design deliberately, it could be asserted that *purposive sampling of non-probability design* will be adopted throughout the data collection process. Specifically, interviews will be conducted to the five different stakeholders of the Turkish renewable energy industry who have actively involved in the real sector. In order to access to these people, numerous channels were used, such as through educational networks, direct emails or connections of colleagues who are involved within the related industries.

3.8. Interview Design

According to Kahn and Cannell (1957) an interview can be described as a purposeful debate between two or more people. While it is possible to generate highly formalized and structured interviews for each respondent, they could be also informal and non-structured discussion (Saunders et al., 2009). Three basic interview methods could be considered as structured, semi-structured and non-

structured interviews (Saunders et al., 2009), or Healey (1991) classifies interviews into two as standardized and non-standardized interviews.

According to Cooper and Schindler (2008) if the undertaken study is exploratory or including exploratory elements, non-standardized and qualitative interviews should be used in the research design. Because of the fact that different stakeholders will be conducted in order to assess the industry from various aspects and since the study aims to achieve an exploratory purpose, the research applied non-structured interviews. Another reason to be able to provide an in-depth understanding upon contextual and industrial factors through a certain number of open questions in which there are constant and various questions depending on the participants' field (see Appendix-5). Throughout the interviews, answers of the interviewees were recorded by an audio-recording device and also note taking.

On the other hand, to elaborate regarding to data collection through interviews for scenario planning process, Gustafson et al. (1973) described three different expert opinion types as feedback, interaction and estimates. When it comes to this study, three of these interviews were utilized by implementing interaction model whereas the last two interviews were conducted through feedback method.

Apart from all, as far as the interview questions concerned, explanatory and exploratory types of questions constituted entire interviews. On one hand, explanatory questions were conducted to understand the present and past conditions of the sector in which mostly 'what' type open question word is used. To expand on that, through these questions, a large amount of data was

collected regarding the regulatory issues, supportive policies and grants, present uncertainties, current investments, licensing procedure, attitude of government, potential for growth and consumers' approach upon renewable energy in Turkey.

On the second hand, in the interviews exploratory questions were asked to participant in which mostly 'how' and 'why' type of question words were used. With this type of questions, the study attempted to collect a plenty of data in order to discover possible changes in the future such as enhancements upon licensing procedure and supportive grants, development of local expertise, future of economical factors and technological developments in the Turkish renewable energy industry. During the design of the interview questions, Porter's (2011) exploration questions in the TDS portfolio planning model were undertaken to gather necessary and suitable data in order to gain profound insights upon the contextual environment (see Appendix-6).

3.9. Data Analysis Plan

According to Saunders et al. (2009) qualitative data consists of whole non-numeric data or data which cannot be quantified. Qualitative data analysis methods allow researchers to build theory from the gathered data. These methods have either deductive or inductive approach. In other words, a certain theory could be adopted and data is analyzed to test it or the theory can be constructed through the data analysis. Bryman (1988) suggests that prior selection of a theory can be inappropriate due to possibility of undertaking a premature conclusion on the issues to be examined.

Therefore, this study will adopt inductive approach throughout the data analysis procedure which allows researcher to build specific themes. For instance, it is aimed to demonstrate key drivers of the industry which would help to build

scenarios through uncertainties within those drivers in Turkish renewable energy industry, which means instead of adopting a prior framework about the contextual environment of the industry; framework will be built through the data analysis process.

Even though the data analysis will pursue an inductive approach which dictates generating a framework through the data, Porter's PESTEL analysis will be considered as a basis throughout the process of producing the themes. Therefore it could be asserted that a hybrid approach would be more appropriate for the present research which applies the both of inductive and deductive methods to the data analysis. The reason for this is Porter's (1985) PESTEL analysis framework is significantly beneficial to discover the key drivers of the industry and the contextual environment which are crucial components of scenario building which is explained in detail within the literature review section (Johnson et al., 2008).

Another issue is the method of analysis of qualitative data which could be accomplished through either manually or computer programs such as CAQDAS which could save a significant amount of time for the researcher (Saunders et al., 2009). However, in this research manual data analysis method will be used in order to save time from interpretation of interview transcriptions since they were conducted mostly in Turkish.

To be more specific, the qualitative data will be analyzed through *thematic analysis* method (Fereday & Muir-Cochrane, 2006). Daly et al. (1997) describes the thematic analysis method as an exploration of numerous themes which emerge as being crucial to the definition of the phenomenon. Rice and Ezzy (1999) explain that thematic analysis method involves the description of various

themes through critical reading and re-reading of the data. Boyatzis (1998) represents thematic analysis approach as six stages.

In the first step, it is important to read and re-read the data in order to have a deep understanding of what data includes by creating a detailed summary and generate preliminary codes.

Secondly, a wide range of codes are provided by considering how data responds to the research question and objectives. In the third step, a list of initial themes is created by merging codes into over-arching themes which precisely give an overall picture of the data. Subsequently, the researcher should investigate how the themes sustain the data and the main theoretical framework.

As the fifth step, the researcher is supposed to define each theme by elaborating which aspects of the data are confined and which themes contribute to understand the gathered data. In the last step, the final themes, which are the most beneficial to illustrate the essence of the data, are determined to be used in the report. Furthermore, in this section it is important to explain why these specific themes have been chosen and to provide an accurate description of themes by justifying with gathered data and existing literature.

3.10. Reliability and Generalizability Issues

First of all, regarding reliability, Easterby-Smith et al. (2008) asserts that reliability refers to the fact that whether data collection and analysis techniques will attain to consistent results under different circumstances or whether similar results will be yielded by different observers. According to Robson (2002) there might be four basic threats to the reliability of the research such as participant error, participant bias; observer error and observer bias. In order to overcome these reliability issues, Saunders et al. (2009) suggests a careful preparation would

prevent likely errors and biases. This is important to demonstrate researcher's credibility and gain participants' confidence.

The preparation process is defined by Saunders et al. (2009) which consists of ten steps. The first step is referred to the level of knowledge of the researcher. Regarding to the present research, prior to the interviews a deep literature search was made and adding to this related reports and documents were investigated carefully. The second step is supplying sufficient amount of information to the interviewee. This was also applied regarding this research by sending an amount of information as regards to the interview themes in order to increase the credibility of the obtained data from the interview.

For the next steps, appropriateness of the place to conduct the interview and the appearance of researcher is important which were considered throughout the entire conducted interviews.

Apart from those, it is crucial to have an introduction session before beginning to the interview and provide clear questions in order to reduce bias. Therefore, interview questions are prepared carefully not to cause participant errors or bias. Furthermore, in order to measure the appropriateness and clearness of the interview questions, two pilot tests were conducted with the individuals who took part in the related organizations in Turkish renewable energy industry. By assessing the efficiency of these pilot tests, interview questions were reviewed and revised where necessary.

Other steps are defined as impact of interviewer behaviour, illustrating active listening skills, scoping the test understanding, approach to recording and note-

taking data. These steps were considered carefully before and during the entire course of the interviews against the possible interview errors.

Secondly, it is crucial to consider generalizability of the research which could also refer to external validity according to Saunders et al. (2009). Generalizability issues refer to the fact whether the findings are uniformly valid for other research settings, such as other industries or organizations.

Furthermore, generalizability could be a major issue if the qualitative research is conducted in a case study approach (Saunders et al., 2009). One of the arguments related to the generalizability issues within a qualitative research is pointed out by Bryman (1988) as since a wide range of different factors are invariably investigated in a case study, by contrast to the survey strategy, case study may include numerous settings which might be looking at a large organizations expanding across the country or the world. Therefore Bryman (1988) discusses that a successful case study is more likely to be transferred and beneficial to the other contexts.

A second argument is the fact that if the research is related to an existing theory, it will be possible to illustrate theoretical significance from the gathered data (Marshall and Rosman, 1999). This relationship is useful to test the feasibility of the existing theory to the research settings. However, Bryman (1988) highlights that in order to benefit from this relationship in between theory and research, it is necessary to identify the existing theory and its application methods before the data collection process is starts.

When it comes to the present research it is clearly defined in research objectives and literature review that the research will undertake SRI's six-stage scenario

planning model and will apply it to Turkish renewable energy industry. Since the fact that the theory has already been applied by numerous different organizations and countries such as Royal Dutch Shell Co. and Taiwanese renewable energy industry, it could be asserted that it is possible to test the generalizability of the research through the relationship between the theory and research.

CHAPTER FOUR: MARKET CONDITIONS

Besides contextual factors, internal indicators such as market dynamics and industrial developments could be notably helpful to perceive the future directions of the sector (Chen et al., 2006). Therefore, a concise and coherent market report is provided in order to illustrate market forces, industrial conditions and attractiveness. This research undertakes Porter's five forces analysis method in order to provide an acceptable background of the market conditions for the overall research purpose (Porter, 1985).

4.1. Industry Overview

Turkish renewable energy industry could be counted as in the introduction stage in its life cycle by contrast to the many developed countries (Nalan & Murat, 2009). The reason might be explained by numerous reasons but long term economical fluctuations and lack of supportive regulations till recently could be presented by major factors. Since the establishment of renewable energy law in 2005 in Turkey, there has been a dramatic increase in the renewable energy applications (Baris & Kucukali, 2012).

For instance, installed wind energy capacity reached to 1700 MW by 2011 from under 200 MW in 2005 (TWEA, 2012). However, there have not been significant entrepreneurial investments in order to develop local expertise especially in

terms of solar and wind energies (Nalan & Murat, 2009), even though the country is considerably developed in terms of related industries. For instance the country is capable of producing blades and towers for wind turbines, small scale wind turbines and manufacturing solar PV panels on lamination basis (AKŞİT & TOKEL, 2011).

However the industry still lags of manufacturing major technological equipments such as nacelles, inverters or solar batteries (AKŞİT & TOKEL, 2011). The reason of the absence of local equipment manufacturers is that a large number of the projects have been either for demonstration reasons or, for other reasons which were not commercialized (Nalan & Murat, 2009).

Nevertheless, the present government is highly motivated and interested in developing this specific industry (E.V.T.K.B, 2009). Therefore, the state runs numerous ongoing R&D projects with private sector and universities in order to leverage local manufacturing and expertise. Three major reasons could be represented to explain the willingness of the government as the expected contribution of the industry to the growth of national economy, to provide renewable energy technologies in a more cost-effective way and to exploit local equipment contribution bonus which makes feed-in-tariffs more acceptable (see Appendix-7).

4.2. Market Size

Since the study focuses on the electricity generation by renewable energy resources, it would be beneficial to look at the electricity market and its future directions in Turkey.

According to The Economist Intelligence (T.E.I., 2012), electricity demand of Turkey is expected to increase by approximately 50% by 2020. To expand on that, the demand is anticipated to reach to 330 TWh in 2020 (T.E.I., 2012) from 229 TWh in 2011 (TWEA, 2012). The growth in electricity demand is considerably high in Turkey compared to average growth in the world. For instance by 2008 the growth rate was recorded as slightly lower than 8% whereas the average global rate was under 2% (E.V.T.K.B., 2010). The major reasons behind the dramatic demand growth can be explained by rapid industrialization and increasing young population in the country (T.E.I., 2009).

In the Turkish electricity market, it would be useful to look at wind energy market since wind energy investments have been outweighing solar, biomass and geothermal energy investments with regards to the renewable energy investments (TWEA, 2012). When the existing installed capacity is considered, there is an existence of 4 GW including the uncompleted projects, which means the approximate market value is \$4 billion considering an average cost of \$1 million/MW for only wind energy sector at the present (AKŞİT & TOKEL, 2011). Furthermore, by taking into account that the largest share for the 2023 goals left for wind energy (E.V.T.K.B., 2009) and there is an available license stock of 10 GW for this target, it could be asserted that the market volume of the wind energy will expand to more than \$14 billion by considering the investments upon the other renewable energy resources such as biomass, solar PV and geothermal (TWEA, 2012).

4.3. Market Competitiveness

As a consequence of privatization regulations of the state with regards to the electricity market since 2001, the competition has been raised considerably with

participation of large number private manufacturers (E.V.T.K.B, 2010). Along with this step, a large number of companies have been established ranging from small scale production to large scale utility companies which work on a contract basis to the state owned electricity supplier TETAS or to the individual consumers through bilateral contracts (TWEA, 2012).

As regards to the wind energy market, thirty-three electricity manufacturers exist in the market (TUREB, 2012). However when it comes to the production of wind turbines, the market is basically captured by international players due to the absence of local production. For instance Vestas, Nordex, Enercon and GE hold the major part of the market share by 28,18%, 27,07%, 23,08%, 13,96% respectively (TUREB, 2012).

In terms of the solar energy, there is not any utility size investment at the present, even though numerous small scale applications exist, such as in highway lighting, communication stations and sea house lightings (Evrendilek & Ertekin, 2003). Similar to wind turbine industry, there is not any local manufacturer for solar PV panels at the present in Turkey, yet there are numerous manufacturers which work on a assembling or lamination basis (Kahraman, 2010). As a consequence, mostly Asian, German and Italian players enjoy high margins in the market (Kahraman, 2010; see Appendix-8). By considering the data above, two concise market evaluations could be done as below:

Once the Porter's five forces analysis (1985) taken into consideration, such as, power of suppliers, power of buyers, entry barriers, substitutes and internal rivalry, the market draws a fairly profitable figure due to increasing pressures on the substitutes such as natural gas and coal, high capital requirements for market

entry and rivalry of large number of electricity manufacturers with regards to the electricity market. Despite the fact that these factors are valid for mostly wind energy industry, it is most likely that solar energy market will confront significant increases along with the technological developments.

When it comes to the renewable energy technology manufacturers, the market has been captured by a small number of foreigner suppliers whereas number of investors is relatively larger and is expected to grow drastically in the future. Furthermore, the substitutes of renewable energy such as fossil based fuels and nuclear energy become weaker due to increasing international pressures even though they are much cheaper alternatives for renewable energy. Furthermore, growth of the industry increases the entry of new players in the sector, consequently rivalry climbs rapidly. Ultimately, the conditions draw a fairly attractive and profitable market figures by taking into Porter's (1985) five market forces.

CHAPTER FIVE: OUTLINE OF TURKISH RENEWABLE ENERGY SECTOR

The section provides a comprehensive outline of the characteristics of Turkish renewable energy industry. To expand, introduction and developmental stages of the sector are analyzed carefully to create coherent discussions in the following sections. Furthermore, the researcher investigates the general outlook of the country in order to obtain deep insights to determine key drivers of the sector.

5.1. General Conditions of Turkish Electricity Market

According to EUAS, Electricity Generation Corporation, the share of primary sources in electricity generation by 2009 was recorded as 16% lignite, 38% natural gas, 32% hydro, 8 % coal and 4% wind& geothermal (TWEA, 2012).

However, since Turkey has significantly poor oil and natural gas reserves, 90% fuel and natural gas is imported from Iran and Russia (T.E.I, 2009) which makes the country highly dependent in terms of energy.

However, over last 10 years Turkey has illustrated a significant effort to increase the use of renewable energy sources in order to minimize its energy dependency on its neighbour countries (Kahraman, 2010). However the exploitation of renewable energy sources is still around 21% of total consumption and, Turkey aims to decrease the use of fossil based fuels from 73,8% in 2010 to 65,9% by 2020 through extending the use of renewable energy sources, especially increasing operations of wind farms (T.E.I, 2012).

5.2. Characteristics of Turkish Renewable Energy Industry

Regarding the case of Turkish renewable energy industry, it is important to look at numerous different aspects, such as availability of natural sources, demand issues, external factors and competitiveness of renewable energy sources against fossil based fuels in order to obtain deep insights and provide acceptable scenario plans.

First of all, according to the industry report of The Economist Intelligent (2012), Turkey was counted as a major energy importer due to poor oil reserves. In this report it has also been mentioned that even though energy consumption ranks are fairly lower per person in comparison to developed countries, a large number of young population and increasing urban population will maintain the growth in energy consumption. As a consequence of expected demand growth, Turkey has established long term goals to increase the share of renewable energy sources in electricity generation as many other countries did as well as to increase local electricity production (E.V.T.K.B, 2009; see Appendix-9).

Therefore, as in many developed countries, Erdogdu (2009) asserts that a set of incentives have been established to encourage investments on renewable energy power plants, such as feed-in tariff, priority in building transmission and distribution lines and exemption for licensing fees for a long period.

Furthermore, as one of the key drivers of the renewable energy industry, a steady growth in Turkish economy is foreseen to remain steady (The, 2009). Apart from this, when the economic situation of Turkey is taken into account, Baris et al. (2012) claims that Turkey has achieved to be one of the largest economies in Europe over last 30 years and according to OECD (2009) Turkey ranked as 11th largest economy of the world with Gross Domestic Product-GDP of 960,1 billion dollars by 2007. To sum up, it is obvious that supportive policies, regulations and economy as key drivers of the industry have been set sufficiently in favour of accelerating and driving the growth of the industry (see Appendix-10).

On the other hand, it is crucial to have available natural sources in order to be able to rely on renewable energy sources. According to Baris et al. (2012) Turkey has large potentials regarding numerous renewable energy sources which could be exploited in medium-long term. For instance hydropower, 32% of total electricity generation, is mostly used as a renewable energy resource with approximately 15 GW installed capacity at present whereas the economically available potential is 42 GW which is approximately three times more than the existing capacity (Baris & Kucukali, 2012).

Similarly, when it comes to the use of wind energy, it can be seen there is an existing 2200 MW installed capacity whereas Turkey has economically feasible

20000 MW wind energy sources ((TWEA, 2012); (Ilklic, 2012)). Moreover, according OECD (2009) Turkey has the largest wind energy sources in Europe with a potential production of 166 TWh/year whereas the closest country is Norway with 76 TWh/year. Similar conditions are available for solar energy which has been used at significantly lower levels than expected (T.E.I, 2012) while Turkey has even larger sources than Germany and Netherlands where solar energy has been exploited mostly (Kahraman, 2010).

Even though there are significant developments in favour of growing the industry, a number of high barriers have been mitigating the development considerably and according to The Economist Intelligence (2012) Turkish renewable energy goals will not able to be achieved by 2023 due to such challenges. For instance, according to Nalan et al. (2009), high initial capital costs, lack of necessary infrastructure to extend accessibility to clean energy resources, difficulties to reach to the environment conscious customers, insufficiency of long term low cost financing and inadequate understanding upon the economical security and security benefits of renewable energy sources are major barriers against the growth of this sector in Turkey.

However there are considerable mitigating factors, Nalan et al. (2009) contends that Turkish government has been attempting to overcome these barriers by undertaking significant actions such as renewable energy law and supportive regulations, priority of building transmission lines for renewable energy plant or facilitating low cost and long-term financing for initial high capital requirements.

CHAPTER SIX: ANALYSIS & EVALUATION OF FINDINGS

After the collection of primary data by conducting in-depth semi-structured interviews to the research sample, it is essential to analyze and evaluate the findings through the adopted data analysis method. Therefore, this section first explains the process of data analysis by illustrating basic steps of the thematic data analysis method. Subsequently, the researcher analyzes and evaluates the gathered data by classifying it under seven basic themes. The findings lead the researcher to discuss and define key drivers of the industry and uncertainties in the contextual environment of the sector.

6.1. Process of Data Analysis

As explained in the data analysis section, the data was processed through six basic steps in order to create sensible themes which were perceived to capture the phenomenon in the raw data.

At the beginning of the process, Porter's (1985) PESTEL analysis framework was taken as template codes, such as politics, economics, demographics, and technological factors by taking into account the research purpose and objectives. The reason is that Porter's PESTEL analysis is significantly beneficial for exploring the key drivers of the industry which are crucial components of the scenario building and planning processes (Johnson et al., 2008).

Secondly, the theory-driven (PESTEL) codes were tested in two different scenario planning researches in order to determine applicability of codes to the raw data of this study. In this process, the researcher defined and described each code in accordance with these two research papers. In each study, template codes corresponded to similar meanings, which confirm the reliability of predefined codes (Boyatzis, 1998).

Subsequently, it is important to summarise and paraphrase each piece of gathered data after reading or listening for numerous times. Therefore, answers of the participants for the each question was summarised critically after transcription of the interviews. Throughout this process, researcher took note of potential themes such as market drivers, technological developments and public awareness.

In the next step, the raw data was segmented by undertaking the template codes. As a consequence of classification of the raw data, numerous inductive codes were generated such as regulations, licensing, investments, environment, customers, awareness, enhancement, 2023 goals, barriers, finance, and economics.

In the final section, a number of themes were defined by connecting the codes under two sets of data such as internal and external factors of the industry which are directly related to the research questions. However, the themes were further clustered with differences such as sufficient infrastructure and insufficient infrastructure. These differences were fostered from the responses of participants from different layers of the sector. Subsequently, entire process was revised in order to ensure that the themes represent the initial analysis and assigned codes.

Finally, the themes were allocated to brief phrases to illustrate the meaning that underlined the theme. As a result, seven core themes were defined to capture the essence of the raw data, such as regulatory basis, developing socio-economic situation, technological conditions, environmental awareness, creating an attractive market, industry and infrastructure, and potential barriers.

6.2. Analysis and Evaluation of Findings

6.2.1. A Regulatory Basis for a Renewable Future

As one of the most important key drivers of the renewable energy industry, Turkey adopted its first law related to the renewable energy industry in 2005, named the Use of Renewable Energy Resources for the Generation of Electrical Energy. With this law the country introduced a feed-in tariff of approximately €5.5 cents/kWh for the next seven years (TWEA, 2012).

In regard to the establishment of supportive regulations, Interviewee-2 mentions that 'Feed-in-tariff is a significantly motivating factor with regards to expansion of the market volume. However tariffs are required to be enhanced. The feed-in tariffs are significantly lower than the average feed-in tariffs in developed countries'. Similarly, Interviewee-1 points out that 'There is a significant governmental support in favour of expanding renewable energy plants', so the argument goes, 'Turkish feed-in tariff for wind energy is expected to be stable for a long time as 5.5 Euro-cent/kWh and at the moment there is not any expectation for further enhancements. Although the tariff was lower than the average market prices, it has become fairly acceptable due to recent reductions in market price '.

Even though the country established the feed-in tariff much later than many other countries such as Germany (1991) and Denmark (1993) (Saidinur & Islam, 2010), the regulations have become extremely helpful in enlarging the market volume (Nalan & Murat, 2009). For instance, the installed capacity of wind turbines rose dramatically to 2041.35 MW in 2012 from 20.1 MW in 2005 (TWEA, 2012). Even though the tariffs are lower than market prices (see Appendix-3), Carrington (2011) states that the stability of the feed-in-tariffs can be more important in long term, if the significant drops in renewable energy investments

are taken into account in developed countries due to cost reductions in feed in tariffs.

The reason behind the consistent growth of renewable energy investments could be explained by the 2023 goals of Turkey since it is the 100th anniversary of the country, as well as attempts to reduce oil dependency. The Minister of Natural Resources and Energy Affairs explains the interest of the government towards the renewable resources by mentioning the use of green resources within the three major goals of the government with regards to energy as searching for national fossil-based fuel resources, maximizing the use of renewable energy resources, and completing the nuclear power plants (E.V.T.K.B, 2009).

Furthermore, even though the government demonstrates the highest interest in wind energy compared to the other resources (E.V.T.K.B., 2009), Interviewee-2 highlights that “For the 2023 goals, the share of solar energy is determined by only 6% of overall targets. Obviously, at the moment government does not demonstrate a significant effort to exploit solar energy. However, level of the feed-in tariff for solar energy is more acceptable than the one for wind energy, which is \$13.3 cent/kWh.” Nonetheless, both Interviewee-1 and Interviewee-2 underline that there could be a sharp rise in the use of solar energy systems in medium term.

In contrast to the optimistic atmosphere in regulations and incentives, most of the investors contend that the licensing process for electricity production is excessively long and complex, consisting of approximately 15 steps and taking an average of two years (see Appendix-3). In regard to this issue, Interviewee-1 claims that that ‘Due to the fact that construction locations of the plants are

mostly in treasury areas, it is necessary to obtain permission from a large number of governmental departments, which causes a long-lasting licensing process. However, there are not any extraordinary circumstances in the procedures.

Furthermore, this issue could be mutually improved in the medium-to-long term'. In other words, Interviewee-1 assessed the complaints about the licensing process as the curiosity or exaggeration of the investors. To compare the licensing procedures to the standards in Germany; the entire licensing process might take either several months or several years due to the location where the plant is planned to be built (S.B.P., 2011).

Interviewee-1 argues further the licensing process that 'Various state and municipal organizations, and private stakeholders could be included within the planning and licensing procedure throughout the process due to numerous technical and legal requirements. As a result, by considering the case of Germany, it could be claimed that the licensing procedure in Turkey does not consist of an extraordinarily long processes as Interviewee-1 maintains.

6.2.2. Developing Socio-Economic Situation

Regarding socio-economic conditions, numerous key indicators of the industry were derived through the interviews, such as GDP, disposal income, economic stability, and growth. Additionally, the importance of the economy was highlighted significantly in the Turkish Wind Energy Congress 2012 (see Appendix-3) with regards to expansion of renewable energy investments.

On one hand, Interviewee-1 states that "Since renewable energy projects require high capital investments, economic stability is crucial to enhance financing

conditions. As one of the key drivers of the industry, we expect a steady growth in economy.” In terms of the economical stability and growth, in the long term outlook of Turkey it is claimed that as a consequence of a young demographic profile and the increasing productivity of the country, the economy is expected to grow steadily (T.E.I., 2012). For instance, The Economist Intelligence (2012) foresees an average annual growth of 4% in GDP between 2011 and 2020.

On the other hand, Interviewee-3 contends that ‘The government is excessively optimistic about the economic developments’, so the argument goes, ‘Even though there is a steadily increasing demand, especially for wind energy grid connection power systems, the industry is significantly influenced by fluctuations in the economy, which slow down investments simultaneously.

If the GDP growth of Turkey is investigated critically, it could be seen that the last economic downturns in Europe and the US within the past five years affected Turkey considerably. For instance, despite an average 7.5% GDP growth between 2004 and 2007, the growth experienced a dramatic drop in 2008 and 2009, decreasing to 1.1% and -4.7%, respectively (TWEA, 2012). As a consequence of this economic downturn, renewable energy expansion decreased to less than 500 KW in 2009 from approximately 1000 KW in 2008; however, the growth of investments remained steady (TWEA, 2012).

The reason behind the significant impact of external economic downturns in the national economic growth can be explained by the increasing exportation with growing productivity (T.E.I., 2009).

Table 2: Trade in good statistics between EU and Turkey (Comission, 2013)

	Import from EU (€BN)	Export to EU (€BN)	Balance (€BN)
2009	36.2	44.1	7.9
2010	42.3	61.3	18.9
2011	47.6	72.7	25.1

Furthermore, by taking into consideration increasing exports to and bilateral business agreements with Middle Eastern countries, the tension and unstable political situations in such countries could be a significant threat even though the country could have managed to turn these threats into opportunities in the past (Cook, 2011). Nevertheless, it is uncertain how the developments in the Middle East might affect the economic growth in Turkey.

Apart from those, another discussion could be held on the connection between the economic conditions and supportive regulations. It is considerable that the increasing trend in economic growth after the economic crisis in 2001 might have prepared a basement for the establishment of the renewable energy law. Therefore, the stability of economic growth could be crucial for further enhancements in terms of the supportive regulations and ultimately for expansion of renewable energy investments (TWEA, 2012).

Lastly, since renewable energy investments require high initial capital, low-cost and long-term financing possibilities are crucial for the growth of the sector (Nalan & Murat, 2009). In regard to this issue, Interviewee-1 asserts that 'A large

number of national and international creditors exist in the sector for long-term financing.’ However, it is clear that the sector suffers from inadequacy of capital financing, especially with regards to small scale investors in accordance with the participants of the Turkish Wind Energy Congress 2012. According to the creditors, investments which are under a certain capacity might be neglected due to high demands at the present. However, financing possibilities are being developed with the economic growth and increasing credibility of the country (see Appendix-3).

6.2.3. Conditions of Renewable Energy Technology

As an emerging industry, technology plays an important role in terms of enhancements in technical efficiency and cost effective production. Regarding this technology, Interviewee-1 points out that “renewable energy technologies have been being evolved steadily which encourages the investors in terms of cost reductions and increasing technical efficiency.” Similarly, Interviewee-2 explained the technological conditions related to solar power as “Most of the investments are on the photovoltaic (PV) panels. Even though local production of PV systems does not exist at the moment apart from lamination, investors are capable of importing the most technological products from other countries.”

Despite the expansion of renewable energy applications, the sector has still been experiencing an absence of local expertise and original equipment manufacturers (see Appendix-3). However, investors acquire the high-tech products from market leader manufacturers such as Vestas, Siemens, and GE regarding the wind energy (TWEA, 2012). On the other hand, Interviewee-2 contends that rapid improvements in the technology could leverage the market share of solar energy systems dramatically in spite of the much larger investments in wind energy at

the present. Kahraman (2010) agrees that a large number of authorities agree on the expansion of solar technologies through technological breakthroughs.

6.2.4. Environmental Awareness

Other important factors which cause the expansion of renewable investments are environmental issues such as climate change, the increasing amount of greenhouse gases (GHG), CO₂ emissions, and environmental pollution (Boyle & Everett, 2003). In regards to Turkey, Interviewee-2 mentions that “Particularly, shopping centres, local businesses and the governmental tenders have been demanding a large amount of small scale solar PV applications which are mostly related to sustainability and reduction of CO₂ emission.” Similarly, the government declared that the medium-term energy strategies of the country have been established by taking into consideration increasing GHGs and CO₂ emissions (E.V.T.K.B, 2009).

Regarding the environmental awareness of the government, Interviewee-1 and Interviewee-2 maintains that even though there is not an existing public campaign to increase the motivation of consumers in favour of renewable energy expansion, it is obvious that people tend to benefit from renewable energy resources. Apart from that there are ongoing governmental projects to introduce the Green Certificate to the market.

To sum up, it is obvious that there is visible awareness from the government and consumers on environmental issues. However, it is important to promote renewable energy applications through social communication channels in order to demonstrate a public awareness (Knott & Lund, 2011). If the explanations of the interviewees are taken into account, it is most likely that local authorities overestimate the level of public awareness. Knott et al. (2011) discuss that public

awareness is crucial especially to promote small scale applications such as household solar PV applications. Therefore, it is critical to consider social promotions to accelerate the expansion of renewable energy.

6.2.5. Creating an Attractive Renewable Energy Market

Apart from the contextual factors, it is important to look at the market and industrial conditions in order to obtain a comprehensive perspective. First of all, it is essential to look at the competitiveness of renewable energy sources against fossil-based fuels. Regarding this issue, Interviewee-1 claims that “steadily increasing natural gas prices have made renewable energy alternatives highly cost competitive. Therefore we expect a significant expansion in renewable energy applications in the medium term.” It is clear that since OPEC’s oil embargo in 1973, there have been sharp increases in oil prices all over the world (Skea & Ekins, 2011). Furthermore, supportive regulations, feed-in tariffs, and technological developments provide a significantly competitive position for renewable energy resources (E.V.T.K.B, 2011).

Secondly, it is important to look at the demand conditions in the industry. On this issue, Interviewee-2 underlines that “Particularly shopping centres, local businesses and governmental departments have been demanding a significant amount of small scale PV panels which are mostly related to sustainable systems and reduction of CO₂ emission. Besides, there is a high demand from municipalities in the middle and east sides of the country.

As regards to the individual consumers, there is a high demand in the areas where there is not an existing transmission system and there is an increasing trend in the agricultural systems.” Truly, once the geographical conditions are considered, small scale PV installations could potentially obtain a large market

share particularly in rural areas such as the northern and eastern parts of the country. Besides this, use of small scale solar PV panels has been expanded in public applications such as traffic lights and communications stations (Evrendilek & Ertekin, 2003).

Lastly, it is essential to consider the geo-political circumstances of the country since it has a unique geographical location which could be asserted as the bridge between Asia and Europe (T.E.I, 2009). Interviewee-2 contends that “developing geo-political strength over Middle Eastern markets has been contributing to the attractiveness of the Turkish renewable energy market since it is considered as a gate to Middle East. For instance, particularly there are a large number of market entries by German, Italian and Asian headquartered manufacturers.” According to Dincer et al. (2012), the country has acquired a significant trade volume over the Middle Eastern countries. For instance, the volume of exports reached \$18 billion from \$2.2 billion between 2002 and 2010. This could be another attractive factor for manufacturers to invest in the market in order to benefit from its networks and penetration over the emerging Middle Eastern markets.

6.2.6. Industrial and Infrastructural Environment

One of the most important findings of this research was the conditions of the industry and the infrastructure. A sound reason behind this could be that industry and the infrastructure are either key drivers or key barriers for the development of the sector.

For instance, with regards to the technical infrastructure, Interviewee-1 and Interviewee-3 contends that in terms of the substations and transmission lines, most of the challenges have been diminished and there are ongoing projects to extend the capacity of power systems. This issue is important because

substations and transmission lines are the key distribution channels in order to carry and transfer produced electricity.

Furthermore, this topic gains more importance if the plants are located over long distances. Therefore, for investors it is one of the essential topics to consider the availability of the infrastructure throughout the decision making process. Therefore, the state provided priority to the renewable energy power plants in terms of establishing the required technical infrastructure such as power system connections and transmission lines which has been guaranteed under the law of Energy Efficiency in 2007 (TWEA, 2012). According to the grid connection plan of TEIAS, total grid capacity for wind energy is expected to reach 20000 MW by 2020, whereas the number was 8510 MW in 2010 (TWEA, 2012). However, the activities of the government related to infrastructure projects are not rapid enough and due to this a large number of investors have preferred to establish their own power systems in order to commercialize their plants without delay (see Appendix-3).

On the same topic, Interviewee-2 asserts that “Transmission and distribution infrastructure is not sufficient, existing capacity for solar energy is solely 600 MW at the moment. However, there is an increasing demand by governmental and private sectors. For instance an increase of 10% was recorded in demand in 2012.” However, TEIAS declared that 4808 MW capacity enhancement, in accordance to the TEIAS scenario-I, is agreed due to new renewable energy power plants which are planned to be completed by 2014 (TEIAS, 2012). Therefore, it could be asserted that important steps have been taken by the state in order to facilitate the infrastructural obstacles as the use of renewable energy sources has been extended.

Secondly, it is important to improve the local know-how to develop in-house production in order to reduce unemployment while improving the national economy. This issue is discussed by Interviewee-1: "There is not a specific R&D grant for renewable energy technologies however Ministry of Science, Industry and Technology has been supporting numerous R&D projects accompanied by various universities. There are significant projects in order to start manufacturing original equipment locally." This is an important step from the government for the future of the industry in order to enhance and benefit from local know-how for the emerging markets in the future, as well as to improve the national economy. Therefore, the state has guaranteed R&D incentives under the regulation of Electricity Market Licenses, regulation no: 24836 (TWEA, 2012).

One last issue regarding infrastructure is the smart-grid systems which are especially important for small-scale investors who prefer manufacturing their own electricity and selling it if more electricity is produced than is necessary for home use (Kahraman, 2010). This could be thought also in the opposite, such as purchasing electricity from the grid if the installed system cannot generate sufficient electricity for a certain period. As far as the Turkish market is concerned, Interviewee-2 asserts that "There are continuing projects to extend smart-grid applications which could be favourable for growing the volume of the small scale investments." However, according to Sanli et al. (2009) Turkey is still in its infant stage in terms of the smart grid systems and it might take six to 10 years to reach the maturity stage (SANLI & HINÇ, 2009).

6.2.7. Existing and Possible Future Barriers

The last theme derived through analysis of the collected data is the barriers against the development of the sector in Turkey. Even though Erdogdu (2009)

identified twelve major barriers, the research illustrated two main barriers apart from the industrial and infrastructural problems.

The first barrier found throughout the data collection is project financing. Interviewee-2 explains that “Insufficiency of project financing could be a significant barrier for development of the sector. However there are ongoing interviews between creditors and consultancy firms to overcome the challenges related about financing conditions.”

Interviewee-2 further discusses that “Apart from financing issues, there is not any expected significant barrier in the legal and technological factors for medium term. By contrast the potential barriers, the regulations have been creating a notably encouraging impact as they have been improved continuously. Policy-makers have been working effectively in order to introduce better regulations and conditions.” Similarly, Interviewee-1 underlines that “For medium-long term, we do not expect risky barriers for the sector and on the opposite; the sector is expected to contribute to the national economy and unemployment besides reducing fossil-based fuel dependency of the country.” Even though there is a considerable activity by the government in favour of renewable energy sources, financing and the massive capital requirements continue to be major challenges for investors (see Appendix-3).

Nonetheless, the attitude of the creditors is not as pessimistic as that of the investors. According to the creditors, Turkey is a rapidly growing country in terms of both economy and population. Therefore, financing has been improving parallel to economic growth. However, since renewable energy investments require huge capital investments, creditors need to analyze every detail carefully,

and a number of them do not provide financing for projects which are under a certain level of production capacity (see Appendix-3).

Secondly, even though the existing supportive regulations seem fairly stable and are mostly guaranteed for the next seven to 10 years (TWEA, 2012), it is important to consider outcomes of possible economical downturns which could affect the incentives and grants negatively. For instance, Interviewee-2 suggests that decreased feed-in tariffs have been reducing the growth of the industry significantly in Europe. In Turkey, the tariffs are considerably lower compared to West European countries, for instance 10 Euro-cent/kWh and approximately 30 Euro-cent/kWh in Turkey and Germany, respectively. However the tariffs are expected to be stable in parallel to the stability in economic growth. The cost reductions in European feed-in tariffs should be considered and evaluated critically. This is an important point because especially the small scale investment decreased by more than 30% in Europe and the USA due to cost reductions in feed-in tariffs (Carrington, 2011). Therefore, stability of the supportive regulations is crucial for the sustainability of the sector.

CHAPTER SEVEN: SCENARIO PLANNING

In this section, the researcher discusses coherent portfolio strategies for Turkish renewable energy industry by applying SRI's six-stage scenario planning model. The section first provides an in-depth discussion over the key drivers of the industry. Subsequently, by illustrating plausible scenario elimination, four scenarios are selected and explained by concise narratives. Finally, the researcher evaluates coherent portfolio strategies for each scenario by undertaking overall market conditions and experts' opinions.

7.1. Determination of Key Drivers

As the first step of the scenario planning method of the Stanford Research Institute, it is crucial to determine key decision factors and key drivers of the industry. According to the gathered data, it is obvious that politics, technology, economy, and environmental issues are major decision factors in the sector. To expand on that, supportive regulations, stability of economic growth, market demand, and technological breakthroughs embody the main decision mechanism.

As a case in point, supportive regulations led to the installed capacity of wind energy increasing from 20.1 MW in 2005, when the renewable energy law was first established, to 1700 MW in 2012 (TWEA, 2012). Also, increasingly stable economic growth had a significant impact on growth by facilitating better financing conditions and trading guarantees for the next seven to 10 years through the feed-in tariff. Regarding the global drivers, increasing oil prices and climbing global warming have created considerable pressures on international associations to undertake numerous precautions in favour of national energy security and climate change.

Lastly, technological breakthroughs provided more efficient and cost effective applications both in utility and small-scale applications. As a result, these improvements in technology allowed individuals to produce their own electricity in a clean and cost effective way besides allowing large-scale investors to produce energy more efficiently.

7.2. Scenario Thinking

In order to create the scenarios, the key drivers of the industry were condensed into four axes of uncertainty: global warming, renewable energy law, economical

growth and renewable energy technology. As shown in Table-3, it would normally be possible to construct 16 scenarios by combining a mixture of extremes of the four axes of uncertainty; however, by eliminating such combinations that were excessively similar to one another or internally inconsistent, four coherent scenarios were chosen to illustrate major long-term uncertainties in the context of Turkish renewable energy sector.

For instance, those combinations that enclose the opposite extremes of economical growth and technological developments were eliminated apart from scenario-H. The reason is that in such a case, these two factors could neutralize each other and reveal similar results. However, scenario-H was not eliminated since all of the factors remain 'low' but economical growth, which makes the combination extreme itself and difficult to be neutralized.

Additionally, those combinations that includes opposite extremes of renewable energy law and global warming were eliminated since these factors need to be parallel to each other in order to be internally consistent. However, this rule was ignored in scenario-N, since the study attempted to demonstrate a chaotic external environment through this scenario.

Table 3: Scenario elimination

Potential Scenarios	Global Warming	Renewable Energy Law	Growth of Economy	Renewable Energy Technology	1 st Eli.	2 nd Eli.	Final Eli.
A	High	High	High	High	O	O	O
B	High	High	High	Low	X	X	X
C	High	High	Low	High	X	X	X
D	High	High	Low	Low	O	O	O
E	High	Low	High	High	O	X	X
F	High	Low	High	Low	X	X	X
G	High	Low	Low	High	X	X	X
H	High	Low	Low	Low	O	O	O
I	Low	High	High	High	O	X	X
J	Low	High	High	Low	X	X	X
K	Low	High	Low	High	X	X	X
L	Low	High	Low	Low	O	X	X
M	Low	Low	High	High	O	O	X
N	Low	Low	High	Low	O	O	O
O	Low	Low	Low	High	X	X	X
P	Low	Low	Low	Low	O	O	X

7.3. Scenario Narratives

7.3.1. Scenario-A: Fresh Air

Amongst the other three scenarios, ‘Fresh Air’ represents the most optimistic figure for the future of the industry. According to this scenario, economic growth remains steady; however, climate change and global warming keep their severity. As a consequence of this, international associations undertake further decisions in order to decline the use of fossil-based fuels as well as persist on the expansion of renewable energy sources. Therefore, the Turkish government establishes extra policies in order to facilitate and accelerate investments to enlarge the installed capacity of renewable energy.

Steady growth in the economy provides opportunities for the government to enhance feed-in tariffs. Furthermore, through developed know-how and local production, investors are able to exploit local equipment bonuses besides decreasing capital costs and increasing technical efficiency, which makes renewable energy highly competitive against fossil-based fuels.

7.3.2. Scenario-D: Green Forces

This scenario draws a similar figure as 'Fresh Air'; however, there is one critical difference. Same as the first scenario, growth of global warming and climate change remains and increases the pressure upon the governments and international associations to undertake extra precautions in order to decrease greenhouse gas emissions.

Similarly, in Turkey, the state keeps encouraging investors to expand renewable energy. However, stagnation in the national economy due to rising economic downturn in Europe mitigates the augmentation of feed-in tariffs. What is more important is that there are not any breakthroughs in technologic development or improvements in local expertise. As a consequence, initial capital requirements remain high due to ineffective technological developments, which hinder cost competitiveness against fossil-based fuels.

7.3.3. Scenario-N: Jurassic Park

In contrast to scenario-1 and scenario-2, environmental concerns have been reduced radically due to a decline in climate change in this scenario. Consequently, even though renewable energy investments are not included within the major energy strategies, investments are continuing in order to sustain the industry and exploit emerging markets.

Nevertheless, the absence of significant improvements in technology and the remaining cost competitiveness of fossil-based fuels are considerable challenges for investors and the growth of the investments declines drastically.

7.3.4. Scenario-H: Dark Clouds

'Dark Clouds' illustrates the most pessimistic figure. In regards to this scenario, tensions in Middle Eastern countries, and especially neighbour countries such as Iran, Iraq, and Syria, have increased drastically. As a consequence, the government shifts most of its budget to national security and the armed forces.

Due to such activities, economic growth enters into a dramatic depression which causes significant recessions in the renewable expansion. However, due to possible oil embargos, the cost of produced electricity from renewable energy resources creates high profit margins.

On the other hand, environmental concerns keep their importance due to increasing global warming. Besides growing energy demand, environmental issues create enormous pressure to continue encouraging renewable energy investments. However, lack of technological developments maintains high initial capital costs, whereas financing is considerably challenging due to the extraordinary developments around the country.

7.4. Portfolio Strategies

In the next steps of scenario planning it is essential to consider technology alternatives and assess the alternatives on the basis of importance and market risks (Chen et al., 2006).

Due to the fact that this study mainly looks at electricity generation from renewable energy sources, four foremost fields of renewable energy resources are wind, solar PV panels, bio-mass, and geo-thermal.

After determining the technology alternatives, the alternatives should be evaluated in accordance with their importance and market risks. According to Chen et al. (2006), it would be helpful to assess the importance of the technology alternatives by analysing their market value and mutual cost competitiveness such as market growth rate, cost ratio of fossil-based fuels versus renewable energy sources, and cost reduction of renewable energy technologies.

Regarding this section, market growth represents the value of the technology in the market, whereas cost ratio of fossil-based fuels versus renewable energy and cost reduction of renewable energy are considered as the key indicators of the cost competitiveness analysis. The measures of these characteristics are illustrated in Table 4.

Table 4: Measures of the technology indicators

Indicators	High Potential	Medium Potential	Low Potential
Market Growth Rate 2013 to 2020	Over 18%	9%<math>\alpha</math>18%	Less than 9%
Cost ratio of fossil-based fuels to the renewable energy resources in 2020.	Over 1.5	0,75<math>\alpha</math>1.5	Less than 0.75
Cost Reduction in Renewable Energy Technologies by 2020	Over 15%	10%<math>\alpha</math>15%	Less than 10%

For each characteristic, certain values were determined through analyzing various market forecasts. With regards to determining the roof-top value of the market volume in 2020, the renewable energy goal of the Turkish government has been undertaken which aims to reach 20,000 MW installed capacity in 2023 (E.V.T.K.B, 2009). The volume has been calculated by considering average costs of different technologies. Similarly, the top value of the market growth has been calculated by taking into account the installed capacity at the moment, which is approximately 4%, and aimed installed capacity in 2023 by 20% (E.V.T.K.B., 2010). In addition to these, in order to determine maximum predicted values of oil price and cost reduction in renewable energy technologies, oil predictions of IMF (Benes & Chauvet, 2012) were undertaken.

As the second part of this step, it is essential to appraise risk in the Turkish renewable energy industry through four major risk indicators: local expertise, industrial developments, supply chain, and construction period (Chen et al., 2006). Throughout the determination of these indicators a mix of different frameworks were reviewed and filtered critically, such as Porter’s Diamond (Porter, 1985) and Porter’s Five Forces Analysis (Porter, 1985). Since Johnson et al. (2008) these models are significantly helpful to analyze and evaluate market attractiveness and industrial dynamics. To elaborate, local expertise, industrial developments, and supply chain provide an in-depth understanding of the risks in the local industry, whereas construction period focuses on the risks in the market and commercialization period.

Table 5: Measures of risk indicators

Risk Indicators	High Potential	Medium Potential	Low Potential
Local Expertise	Industry could obtain know-how; the local original equipment manufacturers could provide fine-quality products in international standards.	A basic expertise could be achieved and quality of local products meets the international standards.	Local expertise does not meet the internal demand and products are still being imported.

Industrial Developments	Local industry has been developed significantly. Local players can compete with international market leaders and production capacity is large enough to provide more than local demand.	Local industry achieved to start production; however, still cannot beat international players. As a consequence, production is insufficient for economies of scale.	Local industry is not capable to start production
Supply Chain	A strong supply chain has been established appropriately from upstream to downstream	A large amount of the key components and raw materials can be supplied but still there is a gap in the industrial supply chain.	The gap is extremely large in the supply chain. Investors cannot benefit from Local Equipment Contribution Law.
Construction Period	Within 2 years	In 2 to 4 years	More than 5 years

Even though, in the importance assessment possible cost reduction rates were provided, it would be beneficial to look at various forecasting researches in order to generate a more credible portfolio planning.

Firstly, regarding wind energy, according to the Energy Research Institute (2011), as the production capacity has been expanded there has been a

significant reduction in production costs. Therefore, the sector has already experienced cost reduction by 10% due to the developed learning curve (E.R.I., 2011).

In this comparison, if the average forecast of GWEC-Global Wind Energy Council is considered (see Appendix-11), the overall cost of energy from wind technologies will be reduced by approximately 16.6% by 2020. By considering the 2023 renewable energy goals of Turkey and available license stock of 11 GW (TWEA, 2012), it would be a highly profitable sector with an average turnover period of five years and average wind turbine lifetime of 30 years (Callado & Junior, 2011).

Secondly, as far as the solar PV systems are concerned (see Appendix-11), global installed capacity of PV panels was expanded by approximately 50% between 2008 and 2012 (E.R.I, 2011). Even though there are a large number of different solar PV technologies, mainly two types are used in the global markets: silicon and thin film—85% and 10%, respectively (E.R.I, 2011).

In accordance with the forecast of the EPIA (European Photovoltaic Industry Association) the cost of solar PV panels is expected to decline by 60% from 250 \$/MWh to 100 \$/MWh by 2020 due to the learning curve and economies of scale (E.R.I, 2011).

Despite the smaller market share of solar PV panels compared to wind energy, which captures market share by approximately 5 MW installed capacity at the moment (Kahraman, 2010), when the abundant solar radiation reception is considered, there could be significant breakthroughs in the installed capacity of solar PV panels within next 10-20 years in Turkey (Baris & Kucukali, 2012).

Thirdly, it is important to look at future conditions of biomass for portfolio allocation. In regard to the present conditions there is only one biomass power plant in Turkey with an installed capacity of 170 MW, which is expected to reach 185 MW of installed capacity by 2021 due to ongoing projects (TEIAS, 2012). According to IRENA (2012), European countries could achieve a cost reduction of 2 to 25% in accordance with the type of biomass feedstock used. To elaborate, the largest cost reduction expected to occur is in the costs of crop and forestry wood residues, expected to be reduced by an average of 20% (IRENA, 2012).

However, by contrast to the developing solar and wind technologies, biomass energy technologies are highly mature and not expected to endure considerable technological innovations in the future. Cost reductions might occur due only to economies of scale (IRENA, 2012). Regarding biomass feedstock in Turkey, the country owns a recoverable crop and forestry residue which correspond to an annual production of 105.9 TWh (Evrendilek & Ertekin, 2003). However, Evrendilek et al. (2003) contend that it is mostly not available to obtain such massive amounts at acceptable prices since approximately 86 tons of crop residue or 860 tons of forestry residues are required to generate 1 GWh.

Lastly, as one of the countries that has the most abundant geothermal energy resources (Baris & Kucukali, 2012), Turkey has approximately 114 MW installed capacity at present (TEIAS, 2012), despite the potential of 35,000 MW (Evrendilek & Ertekin, 2003). Different to the other three renewable energy technologies, geothermal energy requires complex well construction which makes the technology highly challenging in terms of the capital requirements (Randeberg & Fordi, 2012). Randeberg et al. (2012) claims that cost reductions

in geothermal energy mainly rely on cost-effective drilling, which counts for approximately half of the entire capital requirement. According to Hayward et al. (2011), the future cost of geothermal energy is highly uncertain since cost reductions are highly dependent on technological breakthroughs in the key component technologies through R&D and learning curve, which in this case is highly mature. Despite uncertainties about geothermal energy technologies, there is an expected cost reduction of 5% due to increased efficiency (Huddleston-Holmes & Hayward, 2011).

Despite this, Interviewee-4 discusses that the cost of electricity produced from fossil-based fuels will always be cheaper than renewable energy substitutes despite the cost-reduction expectations, so the argument goes, expansion of renewable energy will continue evolving within its innovation life cycle until the technology is mature. Therefore, it could be asserted that investments will go on in the future under any circumstances; however, there might be fluctuations in growth. The reason is a large number of authorities foresee a green and sustainable future (Saidinur & Islam, 2010).

Table 6: Levelled cost of produced electricity from renewable energy resources (EIA, 2012), (E.R.I, 2011), (IRENA, 2012) and (Vasudev, 2011)

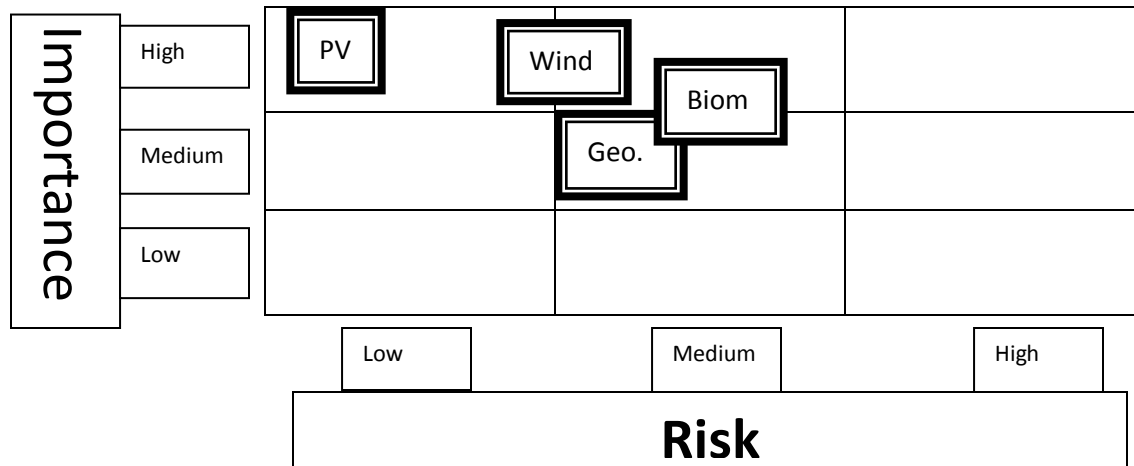
Levelled Cost of Produced Electricity (\$ cent/kWh)	
Onshore Wind	10
Solar PV	30
Biomass	12
Geothermal	10
Natural Gas	5.8

As a consequence of analysis and evaluation of the gathered data, four portfolio strategies are provided in the next sections. Portfolio strategies were first criticised by Interviewee-4 and Interviewee-5 with regards to the consistency of the strategies. A number of comments from these interviewees are cited where necessary within the explanations of the portfolio strategies.

7.4.1. Scenario-1: Fresh Air

As mentioned in the narrative of this scenario, key drivers of the industry are at highly motivating levels. As a consequence, it is obvious that cost reduction of renewable energy technologies is significantly affordable. Furthermore, significant cost-competitiveness of renewable energy against fossil-based fuels increases the attractiveness of the sector. In this scenario, due to low construction time and high cost reduction, solar PV panels and onshore wind turbines can enjoy high market shares. Despite their high importance, geothermal and biomass energy might stay medium risk due to uncertainties in the development of drilling technology for geothermal, and accessibility for feedstock residues with regards to biomass energy. As far as offshore wind energy is concerned, due to high risks for maintenance costs and higher turnover rates, investments in this technology could be still risky. Despite their high importance, Interviewee-5 asserts that “Geothermal and biomass energy might keep medium risk due to uncertainties in the development of drilling technology for geothermal and accessibility for feedstock residues with regards to biomass energy.”

Table 7: Portfolio planning for Scenario-1



7.4.2. Scenario-2: Green Forces

In this scenario, the basic difference to the first is lack of significant breakthroughs in renewable energy technologies. As a consequence of this, high risks arise with regards to construction periods and cost-competitiveness. This situation makes geothermal and biomass extensively risky due to remaining high capital requirements and long turnover periods. Furthermore, Interviewee-4 states that “Geothermal energy might lose its importance significantly due to construction challenges whereas wind and solar panels are easier and faster to build and commercialize.”

On the other hand, solar PV panels and onshore wind turbines may keep their importance and relatively low risk due to lower turnover and construction periods. Besides this, developed local expertise and supply chain would make investments more affordable on solar PV and onshore wind turbines. Furthermore, Interviewee-4 believes the growth of renewable energy investments will continue steadily against the drop in the economical growth, as “Renewable energy industry one of the foremost emerging industries at the moment. Therefore the growth will continue even though it might slow down due to

fluctuations in the economical factors. At the present the industry in a fairly early stage, however it will go on growing similar to developments of other energy resources such as coal, fuel oil, natural gas, or nuclear.”

Table 8: Portfolio planning for Scenario-2

Importance	High	PV	Wind	
	Medium		Bio.	Geo.
	Low			
		Low	Medium	High
Risk				

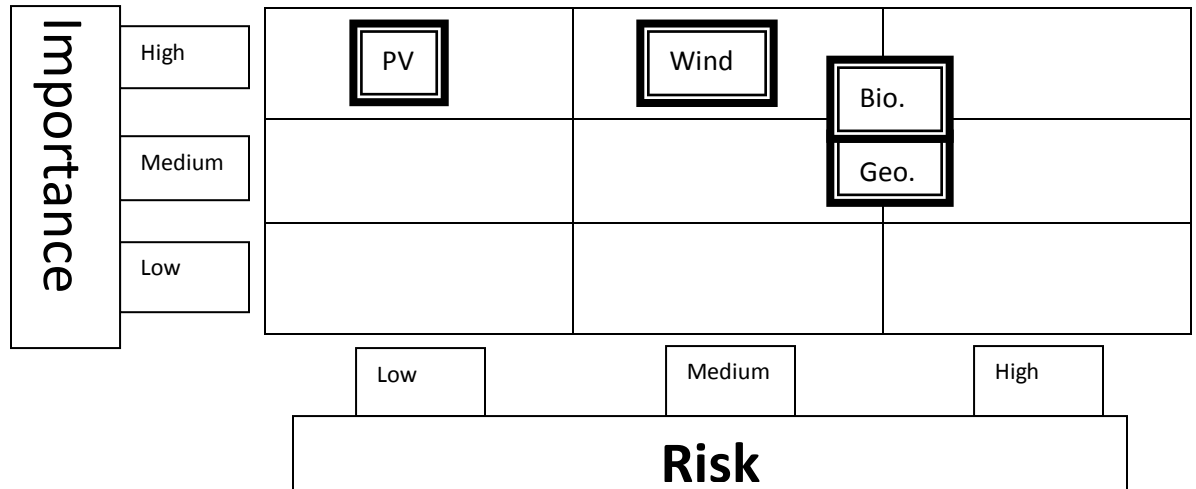
7.4.3. Scenario-3: Jurassic Park

In regard to the ‘Jurassic Park’ scenario, the industry enters into a significantly risky era in terms of technological development and ignorance of the renewable energy law. As a result there is a decline in the importance factors of renewable energy such as slowing market growth rate and cost-effectiveness. This might have a great impact on geothermal and biomass energy investments due to remaining high capital requirements and low cost-effectiveness.

Regarding the solar PV panels, Interviewee-5 argues that “Investments would continue due to remaining importance in rural areas in order to generate their own electricity on account of the lack of distribution and transmission lines from central substations.” When it comes to onshore wind turbines, investments

continue but slow down due to long turnover periods and high capital requirements.

Table 9: Portfolio planning for Scenario-3



7.4.4. Scenario-4: Dark Clouds

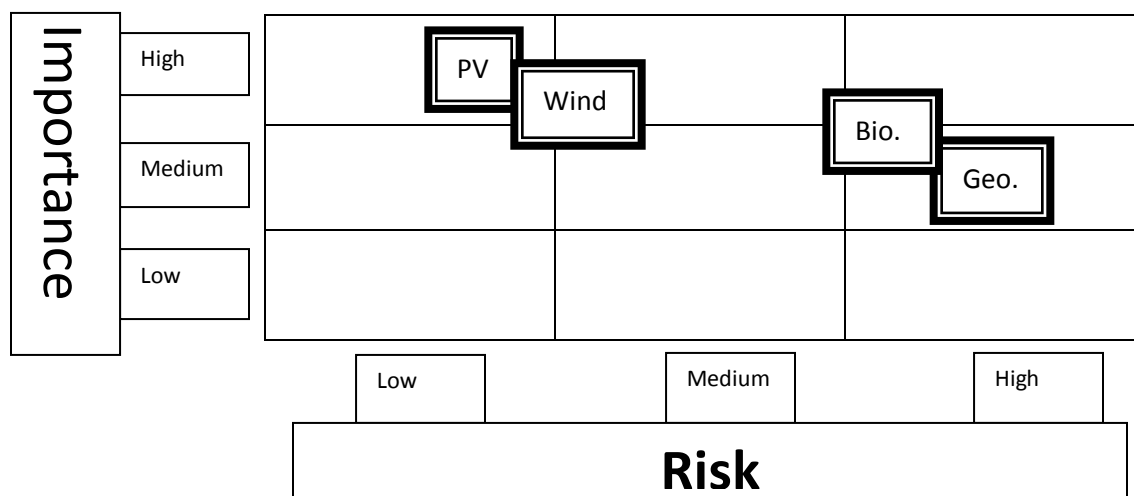
In the era of ‘Dark Clouds’, the importance of renewable energy technologies goes into a significantly negative position. For instance, due to stagnation in technological developments and lack of supportive regulations, market growth declines noticeably.

Furthermore, due to a lack of critical technological developments, cost competitiveness of renewable energy is considerably low. Furthermore, because of growing risks, such as inadequate supply chain, undeveloped local expertise, and higher turnover periods, investment becomes extensively challenging. As a consequence, investments in biomass and geothermal energy could be extremely risky.

When it comes to onshore wind energy, the risks are relatively lower due to shorter construction periods and better turnover periods. Therefore, investments in wind energy continue in order to exploit high profit margins against possible oil

shortages. Similarly, solar PV panels are likely to enjoy large investments due to lower risks in terms of acceptable turnover and construction periods. Besides this, even though it does not seem significantly competitive against fossil-based fuels, investments are significant for small-scale electricity generation (<50 KW) which could secure the electricity demands of household customers through a cost effective way in such a chaotic environment.

Table 10: Portfolio planning for Scenario-4



CHAPTER EIGHT: CONCLUSION

8.1. Main Conclusion

To conclude, this study examined the connection between scenario analysis and portfolio planning by applying SRI's six-stage scenario planning method. The research accomplished the research objectives by creating a case study over Turkish renewable energy industry.

The study first investigated the relevant academic literatures, such as scenario thinking, portfolio planning and an outline of global and Turkish renewable energy industries, in order to provide a deep insight over the content of the research. By reviewing the literature, the researcher evaluated earlier studies about scenario

analysis and portfolio planning methods. Consequently, numerous scenario planning methods were compared and SRI's six-stage scenario planning model was selected to examine the connection between scenario analysis and portfolio planning. Additionally, an outline of the sector was provided in order to obtain an in-depth understanding over the importance of the topic.

By conducting a profound examination into the literature review, a coherent direction was determined for the research. In methodology section, a detailed explanation of research design was provided. In order to provide a coherent study, the research was constructed on a qualitative basis by undertaking the case study model, which was discussed as the most appropriate methods for the present research. Consequently, five executive managers, who have broad expertise over the industry, were interviewed by conducting in-depth semi-structured interviews in order to gather necessary data to explore key drivers of the market and discuss potential scenario strategies.

Based on the data collected for this research, supportive regulations, economic growth, technology, and global warming are suggested as the foremost uncertainties in the sector. Amongst those, supportive regulations and economic growth, however, are represented as fairly stable issues; it is argued that unexpected outcomes in economic growth, such as global economic downturns or bank crises, can affect supportive regulations considerably. Despite the fact that economic growth of the country seems significantly stable, it is demonstrated that economic growth in Turkey is extensively dependant on the global economy due to increasing productivity and exportation activities, particularly with the EU and Middle Eastern countries.

After creating four axes of uncertainties, four scenarios were selected by taking into consideration consistent combinations of extreme points. As well as creating two extreme scenarios by undertaking the most optimistic and pessimistic outcomes, two other scenarios were generated to evaluate the outcomes of potential chaotic events. Among these chaotic scenarios, 'Green Forces' looked at the impact of high global warming against low economic growth and technological developments; 'Jurassic Park' examined the consequences of reduced global warming and the government's interest in renewable energy sources.

Subsequently, scenarios were critically evaluated by undertaking main importance and risk factors for portfolio allocation. Regarding the importance factors, the study undertook three major issues, such as market growth, cost competitiveness, and cost reductions in renewable energy technologies. As far as the risk factors were concerned, low, medium, and high potential risks were reckoned in four fundamental industrial characteristics: local expertise, supply chain, industrial developments, and construction period.

As a consequence of these assessments, four different portfolio strategies were provided under certain scenario conditions. The portfolio strategies demonstrated that solar PV panels and onshore wind turbines represent higher importance and lower risk in each scenario. However, biomass and geothermal energies can promise higher profitability only if significant technological breakthroughs occur in the future. The reason is complex construction requirements for geothermal energy, and availability and accessibility issues of required feedstock at acceptable prices for biomass energy. All in all, one possible conclusion could be that in particular wind and solar PV energy investments will continue despite

fluctuations due to external factors, whereas geothermal and biomass energy investments are slightly uncertain due to complex construction requirements and feedstock costs, respectively.

8.2. Contribution of the Study

The main contributions of this study could be classified into two major subjects: contributions to academic literature, and contributions to the Turkish renewable energy sector.

In regard to academic literature, firstly, this paper provides a comprehensive literature review of scenario analysis and portfolio planning, which could be helpful to gain profound insights into scenario planning theories. Furthermore, the research illustrates the feasibility and acceptability of SRI's scenario planning model by testing it on the case of the Turkish renewable energy sector.

On the other hand, this research provides an in-depth investigation into the Turkish renewable energy sector with regards to the internal and external environment of the industry in order to provide a credible understanding of the potential outcomes in the future. In terms of the context of the sector, this paper examines key drivers of the sector such as politics, technology, and economic conditions. As far as the internal factors are concerned, the research provides a detailed investigation of industrial structure and market conditions. However, the main contribution of the research for the industry is examining the potential outcomes in the key drivers in order to suggest coherent portfolio strategies.

8.3. Limitations

The research includes numerous limitations even though a comprehensive examination of the Turkish renewable energy sector is provided. One of the major limitations of the study is the research format, which restricts the word

count up to 80 pages. As a consequence of this, the research field is narrowed down solely to electricity production from renewable energy sources. Furthermore, the research only looks at wind, solar PV, biomass, and geothermal energy despite the fact that numerous other renewable energy resources are available.

Apart from this, the number of interview participants was restricted by five due to accessibility and time constraints. Besides this, two of the participants were consulted for scenario plans since they are not directly involved in the Turkish renewable energy industry in spite of the fact that they participate in the renewable energy industries of different countries. It would be beneficial to conduct a larger number of interviews if an extended time period was available.

8.4. Further Research Areas

Using the findings from this report, three further research areas are suggested.

The first research area could be the evaluation of different scenario planning methods in terms of their acceptability and feasibility. Even though this research provided a concise comparison between SRI's six-stage scenario planning model and the Technology Delivery System planning framework, further research could be conducted to compare and contrast a larger number of scenario planning models.

A second possibility for further research could be examining a broader perspective in the renewable energy industry. In other words, despite the fact that this study looks at electricity production from wind, solar PV, biomass, and geothermal, further research could be conducted to investigate heating, air conditioning, and electricity generation by including numerous other renewable

energy resources such as hydro, concentrated solar, geothermal heat pumps, and solar heating.

Lastly, it would be useful to look at consumer behaviours and motivational factors in relation to renewable energy resources in Turkey. This is an important topic since it is likely that there is a gap between governmental intentions and public awareness. Research in this field would provide in-depth insights for developing appropriate communication strategies.

8.5. Recommendations

Based on the findings of this research, numerous suggestions could be drawn for different stakeholders of the industry. For instance, regarding policy makers and the government, it would be suggested that stability and enhancements in the renewable energy laws are crucial for development of the sector. Furthermore, it is crucial for the government to seek ways to provide low-cost and long-term financing for investors. Besides this, it is essential to support R&D investments to build local industry and encourage local production, which would be helpful to prevent outward cash flow and revive local industries. Another suggestion for the government would be to conduct numerous social promotions in order to introduce and encourage small-scale renewable energy investments, particularly solar PV panels. Lastly, since the industry is in its early stages in Turkey, the state should monitor the improvement patterns in developed industries in other countries such as Germany, Denmark, and Spain.

With regard to the manufacturers, it could be suggested to invest in local production of original equipment and to become involved in the supply chain of the industry in order to exploit the growing market demands and the gap in the local manufacturing field. Therefore, one of the key actions that can be taken is

to initiate investments in local production, particularly of wind turbines and solar PV panels due to the high importance and lower risks in these fields. Furthermore, since these industries are in their developmental stage, it could be acceptable to import and acquire technological know-how from other countries rather than green field investments.

Lastly, it would be a good idea for both small- and utility-scale investors to increase their investments in renewable energy resources in order to benefit from high margins due to changing consumer behaviour with green resources and supportive regulations. Besides this, since there is a steadily increasing demand for electricity, the renewable investments would pay off profitably in any situation; even in extreme oil crisis conditions they can be perceived as a strong contingency strategy against any future oil crisis.

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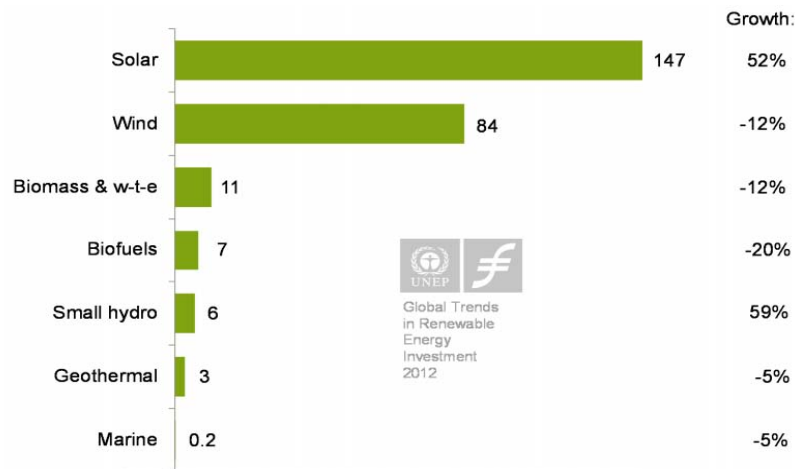
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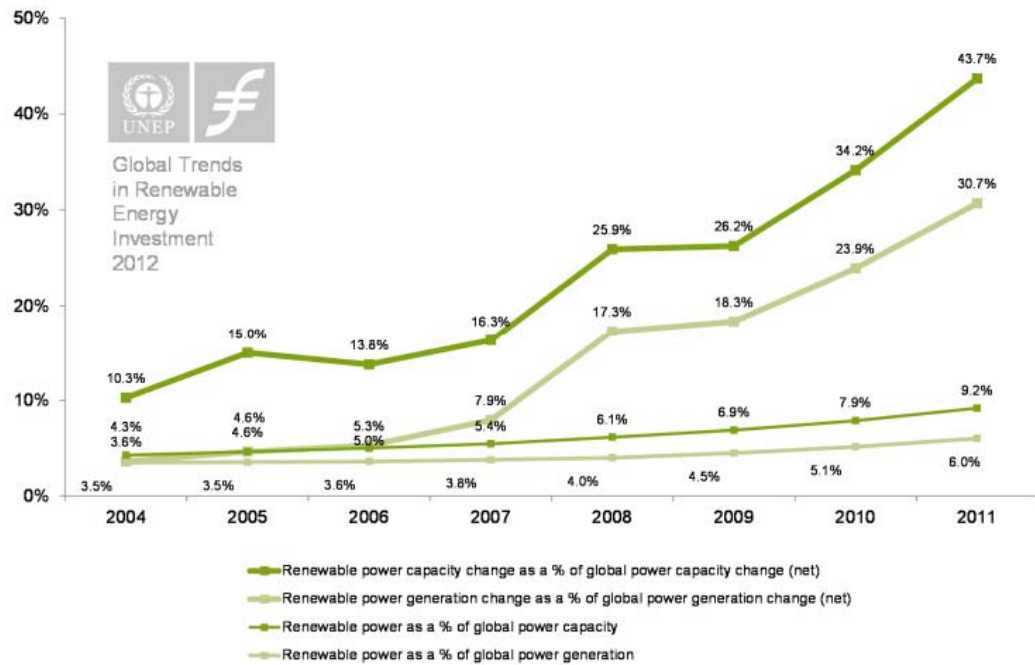
Appendices

Appendix-1-Global Renewable Energy Investments

Global renewable energy investments by 2012 (\$BN) and growth by 2010 (Frankfurt, 2012)

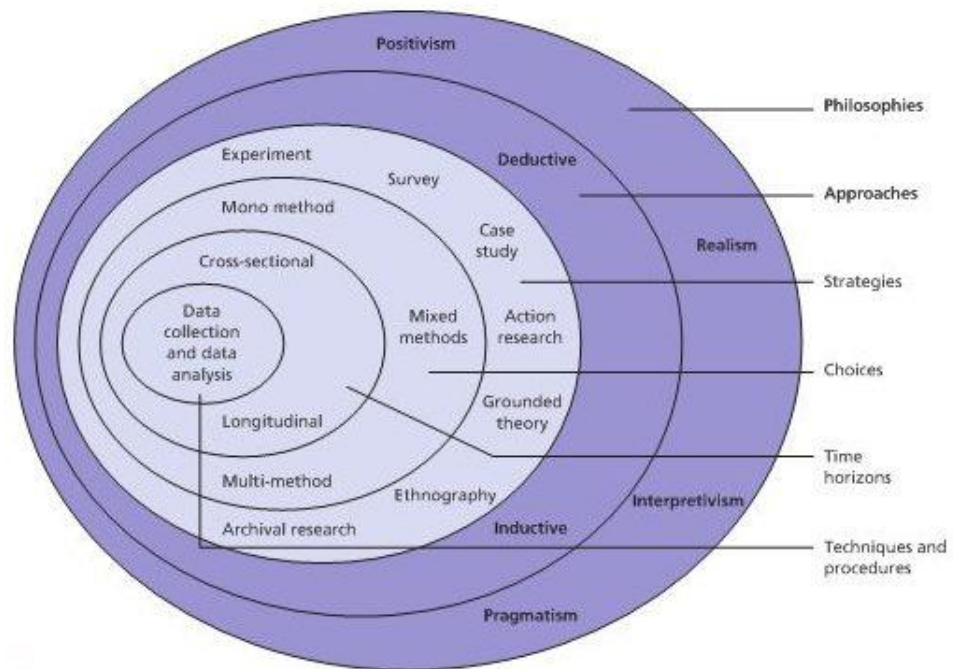


Renewable power generation and capacity ratio versus the total power generation between 2004 and 2011 (Frankfurt, 2012)



Appendix-2-The Research Onion

The Research Onion (Saunders *et al.*, 2008)



Appendix-3- Overview of Turkish Wind Energy Congress 2012

The congress was organized by Turkish Wind Energy Association in November 2012. It was an important event since it is the first broadest renewable energy conference in the country, which was a preliminary organisation since the country is candidate for the World Wind Energy Association Congress 2013.

The congress lasted two days and consisted of four major sessions such as renewable energy outlook of the country, experience of investors, capital requirements and financing and EU perspective in the Turkish wind energy market.

Renewable Energy Outlook of Turkey

In this session, all the participants were from policy-making institutes in governmental energy related departments. Foremost issues in the first session of the conference were renewable energy law, 2023 targets, local productions and basic barriers for the investments.

First, all of the participants mentioned the importance of renewable energy law and further projects to enhance existing regulations. It was discussed that the length of procedures declined by at least 50% with the enhancements. However, it was mentioned the procedure are still complex due to required permissions from a large number of authorities including army and national intelligence agency.

Secondly, numerous factors were demonstrated as potential barriers for the sector. The first factor is the availability of construction fields, which is important since particularly wind farms may capture large places in agricultural fields. Besides, the location is important to consider the routes of bird migrations in order to prevent bird deaths. Lastly, the participants mentioned the infrastructural

challenges for the plants in countryside. Due to geographical features of the country, infrastructure projects confront significant problems; therefore further projects are required to diminish such challenges.

Lastly, effectiveness of supportive regulations and local production were discussed in the session. It was discussed that with the existing tariffs it is not possible to provide considerable competitiveness against fossil fuel based production. Therefore, it is crucial to improve regulations and encourage local production in order to exploit local equipment bonuses. Besides this, importance of local production was highlighted since the target of the state was stated as developing local industry rapidly in order to exploit emerging markets.

Experience of Investors

In the second session of the congress, CEOs and chairmen of the market leader organizations discussed the challenges which are confronted by the investors and developments over the last two decades.

The first issue of the session was the stage of the sector in the life cycle. One of the participants mentioned that the sector is in its infancy stage at the moment. Therefore there are still crucial requirements regarding the regulations and procedures. However, the growth of the sector was seen as highly motivating in terms of financing and regulations. One suggestion regarding the complex procedures was re-organizing licensing process since it is a significantly mitigating factor for the growth. Apart from that, participant underlined that the current feed-in-tariffs are not acceptable, which are even less than market prices. Therefore, investors suggested that the government needs to establish a cost based feed-in-tariff for electricity production, which would leverage the growth significantly.

Secondly, the session highlighted the importance of environmental issues and cost competitiveness of fossil fuels. As regards to the fossil fuels, it was stated that the country supplies its electricity demand through natural gas and coal by over 80%, which is a considerable burden for the country since most of them are imported. For instance, for importations of natural gas, the country pays at least 1700 euro annually per person. Furthermore, it was mentioned that due to bulk use of fossil fuels, there is a significant increase in CO2 emission. As a consequence, it was suggested to expand renewable energy investments in order to save green and prevent out cash flow.

Capital Requirements and Financing

In the fourth session of the conference, numerous finance executives, as creditor in the stakeholders map, discussed the financing conditions in the sector. In this session the challenges and developments in the financing sector were discussed regarding the renewable energy market.

The first issue was the availability of banks to provide sufficient support for the investors. However, due to high demand, a number of banks neglect the applications which are under a certain limit such as investments under 15 MW. Furthermore, it is contended that most of the investors are biased due to wrong technical measurements, which causes longer turnover periods and makes the payments risky. Therefore, a number of creditors stipulate micro-citing evaluation of the wind farms, which occasionally discourage investors due to extra expenditures.

Apart from that, it was underlined that the interests are much higher compared to developed countries, and it is not expected to improve in medium term. However, for further developments stability of feed-in-tariffs is crucial.

European Perspective

In the last session of the conference, three representatives from European renewable energy associations and original equipment manufacturers evaluated the conditions of Turkish renewable energy market. The foremost issues which were underlined by the representatives were abundant renewable resources, inadequacy of supportive regulations, significant growth in the sector and GDP.

Furthermore, the representatives demonstrated the opportunities and threats over the market in long term. As regards to the threats, first they mentioned the slowness and instability of licensing process. The second challenge is claimed the insufficiency of grid capacity, whereby it is important to enhance grid capacity to meet 2023 goals. As the third threat, it was stated that current feed-in-tariffs will expire by 2015; therefore the costs must be fixed for longer periods.

When it comes to the opportunities, they highlighted the importance of market in terms of its geopolitical position. Therefore, the country can be a bridgehead to markets in Middle East and Arab Island. The second opportunity was mentioned as abundant wind and hydro energy resources available to be exploited. Lastly, they discussed the development of industry and local expertise in the country, which could leverage the sector in medium term.

Apart from that, the representatives compared Turkish renewable sector to the sector in Spain in 90s. They asserted that there are significant similarities between these two countries whereas Spain was one of the early movers. Therefore, Turkey can learn important lessons from Spanish sector. For instance, they stated that in Spain major utilities built their own wind farms and minimized the installation of fossil fuel based applications, whereas there are not significant intentions to decline fossil fuel based power plants. Secondly, it is crucial to

engage all stakeholders to participate in the sector. For instance, the government should re-organize the banking system in order to provide better financing conditions for renewable energy investments. The last lesson suggested for Turkish renewable sector is the encouraging the internationalization, which could help local industry acquire expertise and know-how rapidly.

Appendix-4 -Background of Interviewees

Interviewee-1: Working in the Ministry of Natural Sources and Energy for approximately 15 years as a policy-making authority.

Interviewee-2: General Secretary of one of the foremost renewable energy associations in Turkey. Working as a physics engineer in the private sector for approximately 20 years.

Interviewee-3: General Manager and one of the founders in one of the biggest local power systems manufacturer. The company has been providing power system solutions for generation-transmission and distribution systems for 50 years.

Interviewee-4: Working as a Energy Management Consultant for 7 years in the UK.

Interviewee-5: PhD student at one of the UK top universities. Has an approximately 5-year working experience in Boston Consultancy Group and involved numerous renewable energy projects.

Appendix-5-Interview Questions

Exploration of Contextual Factors

- 1- What is the current regulatory framework? Are there any projects for further enhancements?
- 2- How does the government/private sector involve in the development of the renewable energy industry?
- 3- What does underlie behind the complex licensing process? Are there any projects to facilitate progress?
- 4- What are the conditions of current infrastructure? How sufficient are the enhancement target regarding the grid capacity?
- 5- How does the government/private sector create public awareness? Are there social projects to promote renewable Energy?
- 6- What are the key drivers of the sector?
- 7- How competitive are the renewable energy resources against natural gas? How would the competition shape in the future?
- 8- What are the current barriers in the sector? What could be the potential barrier in the future?

Evaluation of Portfolio Strategies

- 1- How the competition between renewable energy and fossil fuel based energy will shape in the future?
- 2- Which of the investigated renewable energy resources would be more attractive in the future?
- 3- What is the level of acceptability for small scale renewable energy investments, particularly small wind and solar PV panels?

- 4- What could be the risk and importance factors for renewable energy sector?
- 5- Which of the selected renewable energy resource would be more affected by economical downturns?
- 6- What is the level of consistency between scenarios and portfolio strategies? How could they be improved?

Appendix-6-TDS Framework Exploration Questions

TDS Framework Exploration Questions (Porter et al., 2011)

1. What emerging technologies merit ongoing attention?
2. What facets of this technology are especially promising?
3. How bright are the prospects for this technology?
4. What are new frontiers for this technology?
5. What are the significant components of this technology? When will they mature?
6. How does this technology fit within the technological landscape?
7. What are the likely development paths for this technology?
8. What is driving this technological development?
9. What are key competing technologies?
10. What form of intellectual property protection relating to this technology should be pursued (e.g., patents, trade secrets, nothing)?
11. When will this technology be ready to apply?
12. How mature are the systems to which this technology applies?
13. What are the technology's commercial prospects?
14. Which aspects of the technology fit our needs?
15. What opportunities does this technology offer locally? Globally?
16. What societal and market needs do this technology and its applications address? Who are its potential users?
17. What is the competitive environment, and how is it changing?
18. What environmental hazards does the technology pose, and what are the appropriate mitigating approaches?
19. Have life cycle assessments been done? If so, what are key sustainability concerns?
20. What stances are government and stakeholders taking toward this technology or its applications and how might they encourage or oppose them?
21. What pertinent standards or regulations are in place or are being considered?
22. Which universities, research labs, or companies lead in developing or applying this technology?
23. What are the pertinent strengths and gaps within our own organization vis-à-vis this technology?
24. What companies are the present leaders in the most important markets for applications?
25. How strong and stable are the leading companies or R&D teams developing the technology?
26. How do their strengths and emphases compare to ours?
27. What strengths does each have in complementary technologies?
28. What organizations or individuals have attractive intellectual property relating to this technology and might any of them make attractive partners or acquisitions?
29. Are there existing partnerships?
30. What are each competitor's related technological and market strengths and weaknesses?
31. Which organizations should be watched?
32. To what organizations might it be possible to license intellectual property?
33. How entrepreneurial is the competitive environment?

Appendix-7-Local Equipment Bonus

Feed-in-tariffs for wind power based generation facilities (TWEA, 2012)

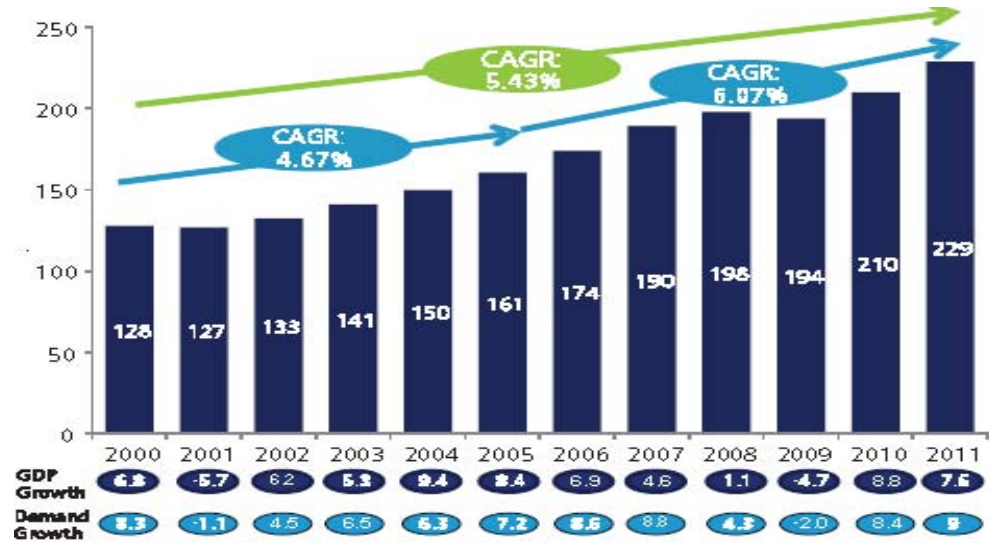
	Maximum price including the local equipment bonus (USD cent / kWh)
Feed-in-tariff	7,3
Equipment Bonus	3,7
1-Blade	0,8
2-Generator and Power Electronics	1,0
3-Turbine Tower	0,6
4- All of the mechanical equipment in rotor and nacelle groups (excluding payments made for the wing group and the generator and power electronics)	1,3
Total	11

Appendix-8- SWOT Analysis of Turkish Renewable Energy Industry

Strengths	Weaknesses	Opportunities	Threats
High growth in demand	Absence of local original equipment manufacturers (such as nacelle for turbines or inverters and silicon films for PV panels)	2023 renewable energy goals	Lack of local expertise
Stable economic growth	Absence of know-how	Large amount of available	Complex licensing bureaucracy
Existence of related industries	Low feed-in-tariffs	Available electricity exportation to the neighbour countries (wind business)	Lack of significant R&D investments
Renewable Energy Law	Inadequate low-cost, long-term financing (wind business)		

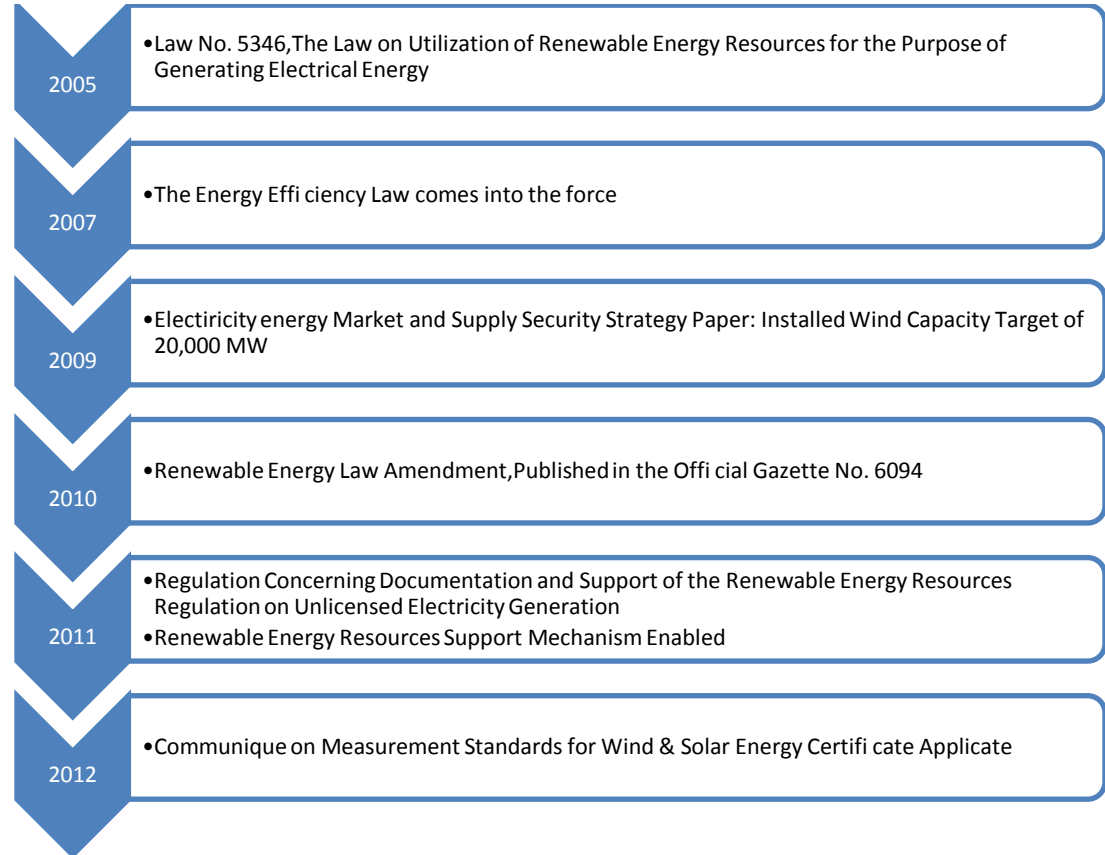
Appendix-9-GDP and Electricity Demand Growth in Turkey

Increase in the electricity demand and GDP in Turkey between 2000 and 2011 (TWEA, 2012)

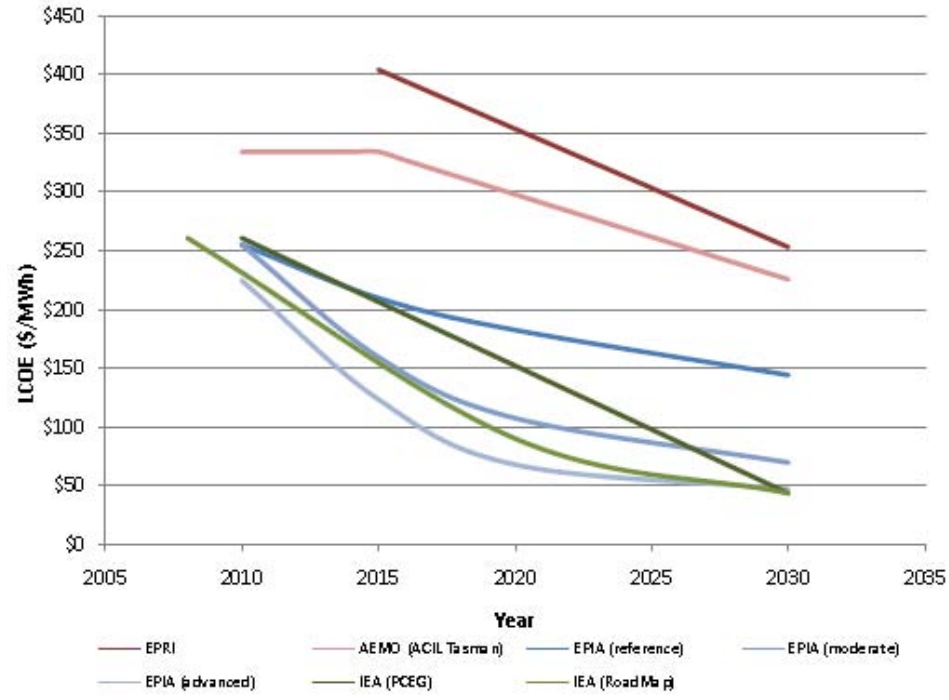


Appendix-10- Turkish Renewable Energy Law

Turkish Renewable energy regulations milestones (TWEA, 2012)



Appendix-11-Cost Reduction Forecasts for Wind and Solar Energy
PV cost reduction forecasts according to different authorities (E.R.I., 2011)



Wind cost reductions according to different authorities (E.R.I., 2011)

