Hacettepe University Graduate School of Social Sciences

Faculty of Economics and Administrative Sciences

Department of Economics

AN ANALYSIS OF THE OPTIMAL DESIGN OF FEED-IN TARIFF POLICY FOR PHOTOVOLTAIC INVESTMENTS IN TURKEY

Duygu KURAL

Master's Thesis

Ankara, 2018

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o **Serbest Seçenek/Yazarın Seçimi**

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Duygu KURAL

DEDICATION

This thesis is dedicated to my beloved parents.

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Even though it seems as if one person wrote this thesis, it is an effort of more than one person, just like every other thing in this world. However, this acknowledgment must be written by myself and I want to thank a couple of people through this thesis.

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Even if it is just a bit, I hope this thesis will contribute to making this world a much better place.

ÖZET

KURAL, Duygu. *An Analysis of the Optimal Design of Feed-in Tariff Policy for Phovoltaic Investments in Turkey,* Master Tezi, Ankara, 2018.

Yenilenebilir enerji kaynaklarından biri olan güneş enerjisinden faydalanarak doğrudan elektrik üretimi sağlayan sistemlere fotovoltaik sistemler denir. Son yıllarda birçok ülke enerji güvenliğini artırmak ve küresel ısınma hızını yavaşlatmak için yenilenebilir enerji kaynaklarından faydalanarak elektrik üretmeye başlamıştır. Bugün Türkiye'nin enerji alanındaki dışa bağımlılığını göz önünde bulundurursak, yenilenebilir enerji kaynaklarından özellikle güneşten, elektrik üretmesinin birçok açılardan sayısız olumlu etkisi olacağı düşünülmektedir. Karbon salınımının azalması, enerji güvenliğinin sağlanması, daha fazla ve daha güvenli iş alanlarının yaratılması güneş enerjisinden faydalanarak elektrik üretmenin sağladığı başlıca olumlu etkilerdir. Dünyada yenilenebilir enerji kaynaklarına yatırımların yapılması için birçok teşvik mekanizması uygulanmaktadır. Bu teşvik mekanizmalarının içinde en yaygın kullanılan mekanizma tarife garantisi mekanizmasıdır. Tarife garantisi, resmi makamlar ile yenilenebilir enerji kaynaklarına yatırım yapanlar arasında gerçekleşen uzun dönemli satın alım garantisi sunan bir teşvik mekanizmasıdır. Bu çalışmanın temel amacı Türkiye'deki fotovoltaik yatırımlar için en uygun ve en etkin tarife garantisi tasarımını ortaya koymaktır. Bu sebeple yatırımcıların tercihlerini ve marjinal ödeme istekliliklerini açığa çıkarmak için seçim deneyi temelinde bir anket tasarlanmıştır. Anket güneş enerjisi üzerine çalışan şirketlerin personellerine uygulanmıştır. Anketten sağlanan verilerle karma logit modeli kullanılarak yatırımcıların marjinal ödeme istekleri hesaplanmıştır. Bu bağlamda daha uzun sözleşme süresine sahip tarife garantisi tasarımlarının pozitif ödeme istekliliği yarattığı gözlemlenirken, kW saat başına düşük ödeme miktarı, güneş panellerine uygulanan gözetim vergisi ve yarışma temelli katkı payı keşfinin fotovoltaik yatırımlara olan ilgiyi azalttığı gözlemlenmiştir.

Anahtar Sözcükler

Güneş Enerjisi, Fotovoltaik Sistemler, Tarife Garantisi, Tercih Deneyi, Karma Logit Modeli, Ödeme İstekliliği.

ABSTRACT

KURAL, Duygu. *An Analysis of the Optimal Design of Feed-in Tariff Policy for Photovoltaic Investments in Turkey,* Master's Thesis, Ankara, 2018.

The system that generates electricity by directly utilizing solar energy is called photovoltaic (PV) system. In recent years, many countries started to generate electricity by utilizing renewable energy sources to increase their energy supply and to slow down global warming. Considering the current external dependence of Turkey for energy, it is thought that generating electricity from renewable energy sources, especially solar energy, could bring positive results in various aspects. These aspects consist of the reduction of carbon emissions, the provision of energy security, and the creation of new jobs that are safer. Many incentive mechanisms are being implemented around the world to enhance investments in renewable energy sources. The most common one is feed-in tariff (FIT) mechanism. FIT is the long-term agreement between governments and firms investing in solar energy, where governments guarantee to purchase the energy produced by firms. This thesis aims to reveal the optimal FIT design for PV investments in Turkey. Therefore, a questionnaire was designed on the basis of choice experiment (CE) to find out preferences and marginal willingness to pay (MWTP) of investors. The questionnaire was conducted on people working in solar energy firms. After data collection, the MWTP was calculated by using the coefficient obtained from mixed logit model. According to econometric estimations, while FIT design with longer contract duration creates positive MWTP for PV investments, low payment amount per kWh, tax policy for imported PV panels and license fee decrease the attractiveness of PV investments.

Key Words

Solar Energy, Photovoltaic Systems, Feed-in Tariff, Choice Experiment, Mixed Logit Model, Willingness to Pay.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AC	Alternative Current
CE	Choice Experiment
CLM	Conditional Logit Model
CSP	Concentrated Solar Power
CPI	Consumer Price Index
DC	Direct Current
EMRA	Energy Market Regulatory Authority
EPC	Engineering, Project, Construction
EU	European Union
FIT	Feed-in Tariff
IIA	Independence from Irrelevant Alternatives
MLM	Mixed Logit Model
MWTP	Marginal Willingness to Pay
PV	Photovoltaic
RES-E	Renewable Electricity
RESs	Renewable Energy Sources
ROI	Return of Investment
RPMs	Revealed Preference Methods
RUM	Random Utility Model
SPMs	Stated Preference Methods
TETC	Turkey Electricity Transmission Company

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INTRODUCTION

Throughout history, human beings have struggled to control their environment. This war against nature greatly favoured us after the Industrial Revolution. The name “Anthropocene” is being argued to name the epoch in which human activity visibly changes the environment. Today, the devastating effects of human activity upon nature is clear and although we have been destroying every living being on the planet for a very long time now, it only dawned on us recently, for our impact on the nature started to threaten us as well.

Since the beginning of Industrial Revolution, fossil energy sources have been preferred for their relatively lower costs of production. Externalities were mainly ignored due to lack of awareness and technological limitations. Today, disadvantages of high greenhouse gas rate cannot be ignored anymore.

It is a common belief that if the effect of human activity will not have reversed the world will become inhabitable. One of the main damages done by human activity stems from energy production and consumption. Fossil energy pollutes air, water and land while shifting the ecological balance. It is our responsibility to find and encourage new and less harmful ways to produce energy.

Solar energy comes forward as a harmless and a sustainable way of energy production. This thesis will focus specifically on photovoltaic (PV) systems that are one of the solar energy technologies and mechanisms used to stimulate private market actors to invest in PV. All incentive mechanisms used for dissemination of solar energy were examined and feed-in tariff was chosen to work with. The reason for this is that its features have stronger effects on investments.

This study was carried out for Turkey, because the country energy imports ratio is one of the main reasons disrupting foreign trade balance. Its geographical characteristics allow a high potential for solar energy production. Therefore, solar energy is crucial for Turkey. If optimal feed-in tariff design is revealed for solar energy investments for Turkey, and if this design is implemented by authorities, solar energy investments could increase. Rising investments in solar energy could potentially reduce the country’s external dependence on energy, and it could also benefit the environment.

Several studies were made on renewable energy sources, solar energy, photovoltaic systems, incentive mechanisms and feed-in tariff around the world. But the choice experiment, which is a method used within environmental economics, is used for the first time to estimate the optimal feed-in tariff design for a country. This characteristic of the research makes it unique.

The main contribution of this thesis is to reveal the optimal feed-in tariff design. In this regard, policy recommendation that would increase solar energy investments could be presented.

Chapter 1 consists of three sections. The first section presents a brief history of solar energy and photovoltaic systems. The second section explains the incentive mechanisms employed around the world. Last section includes the incentive mechanisms used for PV investments in Turkey and legal framework of the country for renewable energy.

Chapter 2 is literature review including two parts. In the first part, studies on feed-in tariff (FIT) are given. Second part focuses on studies done for this field in Turkey. Choice experiment method and mixed logit model are discussed in Chapter 3. After presenting the methodology, we discuss the survey design, used attributes and levels.

Statistical and econometric analyses of the collected data are given in Chapter 4. Moreover, we discuss the results of estimation in this part. In the last part of this thesis, Chapter 5, overall assessment for solar energy market in Turkey and policy recommendation that would increase investments in PV systems are offered.

CHAPTER I

PHOTOVOLTAIC SYSTEMS: HISTORY, TECHNOLOGY, USAGE AREAS

1.1. HISTORY

Solar energy is the most important energy source for the Earth because the sun is the main energy source for all living things. Plants and algae can photosynthesize thanks to sun rays. Different temperatures at the surface of the Earth lead to winds, in this way energy and electricity are obtained by wind energy source. The water evaporates due to heat effect of sun rays, the evaporating water rises and then falls again on the earth as rain; we benefit from this cycle and generate energy from hydroelectric power plants. Moreover, the sunshine can be used directly to generate lighting, heat, and electricity.

Today, two methods are used to generate electricity directly from solar energy: The first method is photovoltaic (PV) solar energy which generates electricity by using solar cell; the second method is the concentrated solar power (CSP) (Guney, 2016; Towler, 2014). As the thesis focuses on PV energy systems, CSP is not discussed further in this thesis.

The device that generates electricity directly from the sunlight is called PV or solar cell. Alexander Edmund Becquerel (1820-1891) discovered that certain materials generate electricity when they are exposed to sunlight. This physical process is known as photovoltaic effect. The first PV devices were invented in Bell Laboratories in 1954. The PV module developed in the Bell Laboratories included flat silicon material cells and its conversion efficiency was approximately 6%. Today, silicon is the most common material in the PV cells, and the conversion effect of the PV systems has been increased to 20% by the technological developments. The PV cell technology is basically divided into three parts, and these cells differ in terms of used materials, module efficiency and cost: First generation solar cells consist of wafer-based crystalline silicon (c-Si) and demonstrate a performance about 20%. Today, solar energy industry prefers to use the first generation solar module because of its performance. Second generation solar cells technology depends on amorphous silicon and this type is called thin film. The cost of these type of solar cells is lower but their performance rates are also lower, around 10-15%. Third generation solar cells are organic solar cells. Because of their high costs of production, organic solar cells are only produced for some commercial applications[1] (Breeze, 2014; Brooks, 2014; Denholm, Drury, Margolis, & Mehos, 2010).

The solar cells are connected in series to constitute solar panels. Solar panel generates direct current (DC), and DC must be converted into alternating current (AC), this process is accomplished by inverters (Breeze, 2014).

1.2. INCENTIVE MECHANISMS AND FEED-IN TARIFF FOR SOLAR PV INVESTMENTS

This section explains all support mechanisms for solar energy investments. The 1973 Oil Crisis led to a need for alternative energy sources. In order to increase the investments in alternative energy production, governments started to implement support mechanisms. After a while, interest in PV energy systems diminished due to various reasons. Nonetheless, renewable energy came back to life and in the last fifteen years many countries are headed towards its intensive use. This trend is associated with different objectives, such as measures for climate change and CO_2 emissions, sustainability and energy security. Figure 1.1 shows the cumulative installed PV power; today, installed PV capacity has exceeded 300 GW. Two main reasons for this rise are reduced cost due to technological improvements and the increase in support for PV systems. Figure1.2 shows the decreasing trend of PV module prices since 2010. Table 1.1 shows 10 companies that produce the most panels in 2017. Although these companies work jointly with several companies around the world, most of their headquarters are located in the Far East countries.

[1] http://www.plasticphotovoltaics.org/lc/lc-solarcells/lc-introduction.html

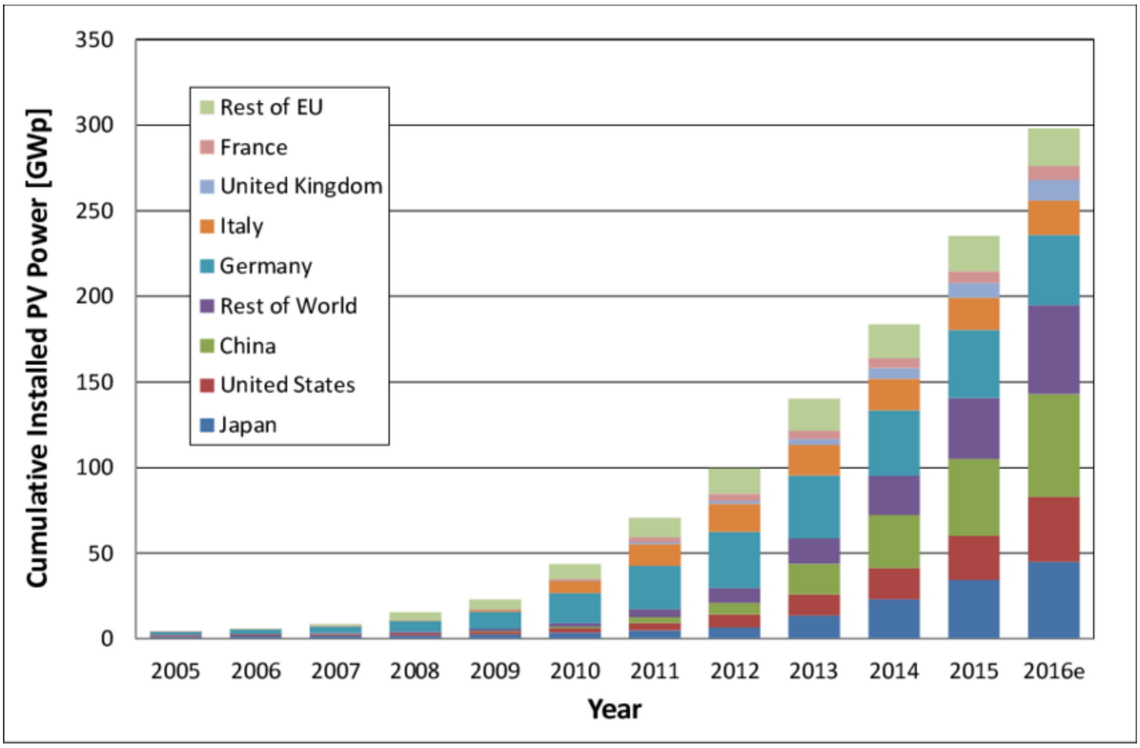

Figure 1.1 Cumulative Installed PV Power [GWp]

Source: European Commission, PV Status Report 2016.

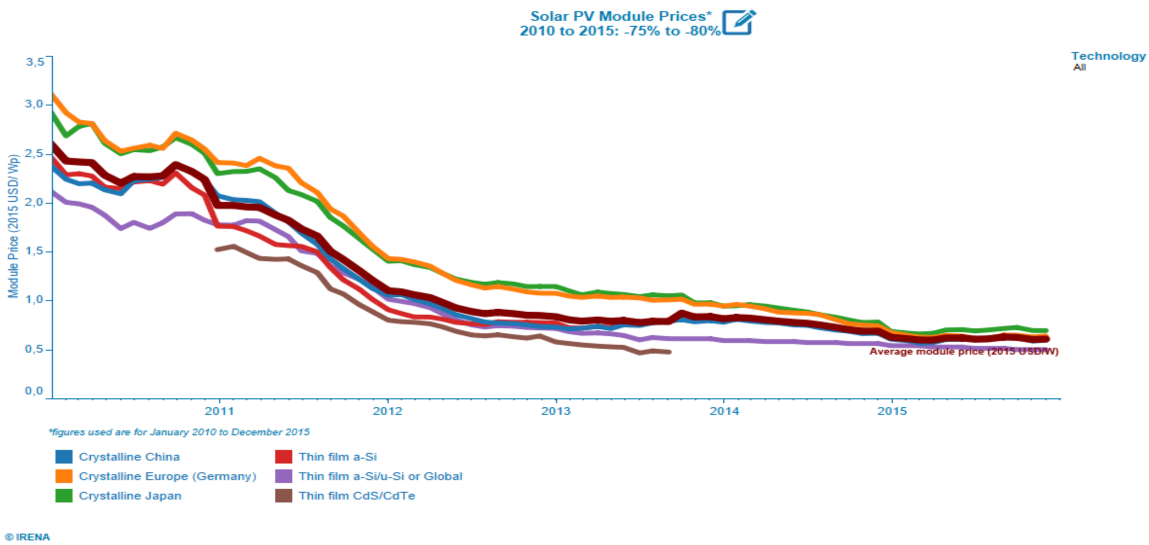

Figure 1.2 Solar PV Module Prices

Source: IRENA

Table1.1 Top Solar Panel Manufacturers in 2017

2017 Rank	Company	Headquarters
1	JinkoSolar	China
2	Trina Solar	China
3	Canadian Solar	Canada
4	JA Solar	China
5	Hanwha Q CELLS	South Korea
6	GCL-SI	Hong Kong
+7	LONGi Solar	China
8	Risen Energy	China
9	Shunfeng	China
10	Yingli Green	China

Source: pv-tech.org

Nowadays, several support mechanisms are implemented in the world in order to increase investments. Commonly used support mechanisms for PV systems are feed-in tariff, tender mechanism, quota obligations, net metering, R&D subsidies, and investment incentives. These mechanisms are classified based on price and quantity against investment and generation (Jacobs & Sovacool, 2012), (see Table 1.2).

Table 1.2 Incentive Mechanisms to Generate Electricity from Renewable Energy Sources

Support Mechanism	Price-Based Support	Quantity-Based Support
Investment Focused	Research and Development Investment Subsidies Tax Incentives Soft Loans	Tender Mechanism
Generation Focused	Feed-in Tariffs Net Metering	Tender Mechanism Quota Obligation

Source: Jacobs & Sovacool, 2012

All support mechanisms are briefly outlined in this section, and finally the feed-in tariff is described in detail.

1.2.1. Quota-Based Support

In the quota-based support mechanism, authorities set certain conditions for market actors. Market actors have to buy certain shares of electricity produced from renewable energy sources. Some countries provide flexibility for market actors and they allow required shares to be reached by trade certificates, hence this mechanism is also called tradable green certificate (TGC).

1.2.2. Tender Mechanisms

In the tender or bidding system, legislator calls for a tender. Projects for new production are distributed by auctions. Generally a financial support is provided to firms.

1.2.3. Net Metering

Net metering is used by households generating their own electricity by PV systems on the rooftop of their house. If the generated electricity exceeds the consumed level, the surplus will be transferred to a grid. At night, consumers use electricity from grid. These households are billed according to the difference between their production and consumption.

1.2.4. Tax Incentives

All other support mechanisms are usually supplemented with investment incentives which consist of capital grants, tax incentives, and soft loans. These types of promotion mechanisms aim to remove unfair competition amongst firms and to improve new technologies and new investment areas.

1.2.5. Feed-in Tariff

Feed-in tariff (FIT) support mechanism is a long-term purchase agreement between official authorities and firms for electricity generated from renewable energy sources (RESs) (T. Couture & Gagnon, 2010; T. D. Couture, Cory, Kreycik, & Williams, 2010; Jacobs & Sovacool, 2012; Klein, Held, Ragwitz, Resch, & Faber, 2008). Governments offer long-term contracts ranging from ten to twenty-five years to producers and governments also determine the price per kilowatt-hour (kWh) of electricity. Various studies show that the FIT is the best support mechanism to enhance and extend the use of RESs, for it presents more stable conditions and it reduces investors' risk perception so that firms choose to invest in RESs, and research and development (R&D). Another advantage of FIT is that every country can design its own mechanism with respect to project size, project location, resource quality, technology, inflation and interest rates.

Until now, several countries used various FIT designs and other incentive mechanisms to accompany with FIT policies to enhance RESs investments. In this thesis, because they are more suitable for Turkey's market conditions, only three different FIT options are examined. Even though FIT design options are basically divided into two parts as Market-Independent FIT policies and Market-Dependent FIT policies (T. Couture & Gagnon, 2010), only Market-Independent FIT policies are investigated for Turkey in this thesis, because Market-Independent FIT policies respond better to the needs of developing RESs markets.

The first FIT design is fixed price FIT, which offers a certain payment level per kWh electricity from produced renewable energy sources, and it presents purchase guarantee during a certain period. During this period, authorities do not take into consideration the retail price of electricity when paying relevant amount for investors, since authorities aim to improve renewable energy market. Moreover, emerging market agents generally do not have enough power to compete with each other. "The fixed price model offers the purchase price required to encourage investment in RES, leaving the tariff unchanged for the duration of contract term" (Couture and Gagnon, 2010:957). This design is used by many countries to increase the investments in the beginning. Today, it has been used by Turkey, with 10-year contract duration and payment is 13,3 USD cent/ per kWh for PV systems (Law No.5346 and 6094). The fixed price model ignores inflation and consumer price index (CPI), therefore the revenues of the firms could decline, because retail prices could exceed the FIT price. Despite this disadvantage of fixed price model, it exhibits certainty for agents. Thanks to this certainty, they can calculate a period to compensate for their investment expenses and their total revenues. In conclusion, fixed price FIT design offers stable conditions and foreseeable revenue for investors (See Figure 1.3).

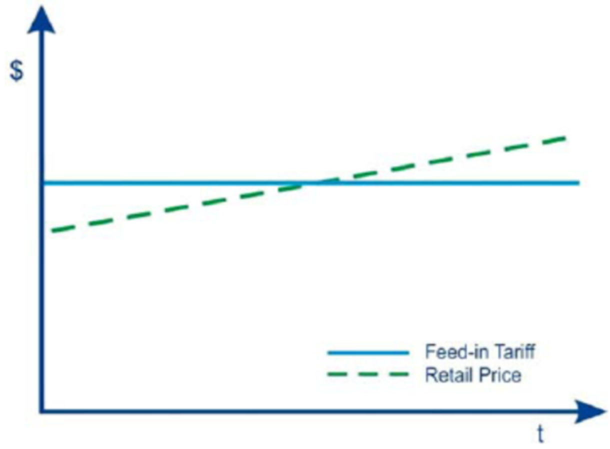

Figure 1.3 Fixed Price Model for FIT Policy Design

Source: Couture and Gagnon, 2010.

Another option is the fixed price model with full or partial inflation adjustment model. “Inflation adjustments guard renewable energy developers against decline in the real value of project revenue by tracking changes in broader economy.” (Couture et al, 2010:957). The inflation adjustment model requires periodic regulation on FIT payment amount with respect to inflation rate quarterly or annually. Even though the inflation adjustment model could offset the costs of a project, investors may not desire the model because of the uncertainty of total payment (See Figure 1.4).

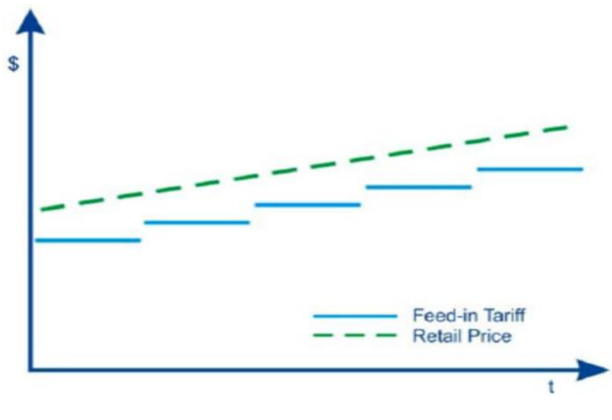

Figure 1.4 Fixed Price Model with Full or Partial Inflation Adjustment

Source: Couture and Gagnon, 2010.

The third FIT policy design option is the front-end loaded model. This model offers higher payments in the early years of FIT contract period, and then the payments begin to decline per kWh. This model is used in the USA, Iran, and Slovenia (See Figure 1.5).

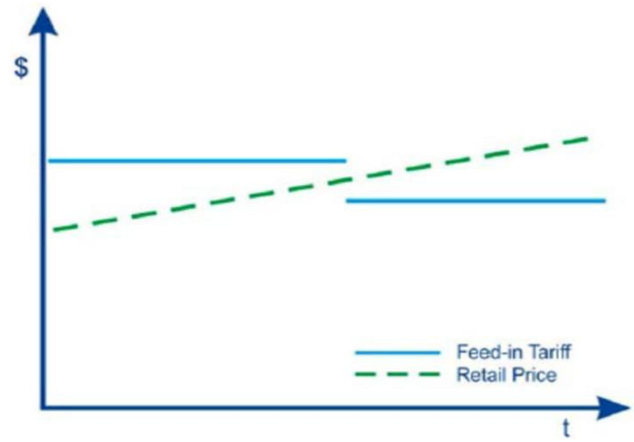

Figure 1.5 Front-End Loaded Tariff Model

Source: Couture and Gagnon, 2010.

Payment level and contract length may differ amongst different countries because of technological, geographical, economical differences. Due to the fact that FIT has a wide portfolio, it is an efficient policy for both private sector and public sector.

1.3. SOLAR ENERGY MARKET, PHOTOVOLTAIC SYSTEM INVESTMENTS AND LEGAL FRAMEWORK IN TURKEY

1.3.1. A Brief History of Solar Energy Market in Turkey

Turkey has a rising population and economic growth; hence energy demand is increasing day by day. Because of its high population, ever-growing birthrate and economic growth, energy security has always been a major problem for Turkey. As the country has to import enormous share of its energy needs, its current account is affected negatively (See Figure 1.6).

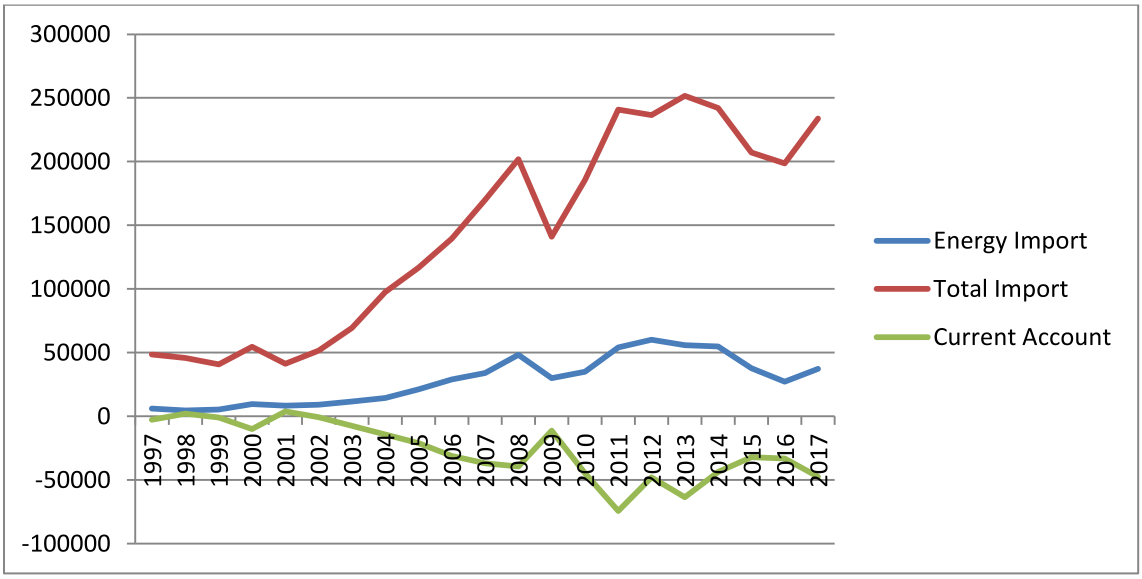

Figure 1.6 The Relationship between Current Account and Energy Import, 2002-2013, USD-million.

Source: Turkish Statistical Institute, Central Bank of the Republic of Turkey.

However, geographical characteristics of the country are very suitable to take advantage of renewable energy sources, especially solar energy by using PV systems. Turkey is located in between 36-42 northern latitude and 26-45 eastern longitude, having an average annual total insolation duration of 2640 hours and average annual solar radiation of 1311 kWh/m^2 –year. (See Figure 1.7) Therefore, solar energy and PV systems can be a good solution for Turkey’s energy security and its sustainable economic development.

Figure 1.7 Solar Energy Potential Atlas of Turkey

Source: Turkish State Meteorological Service.

Turkish Government has followed a path in energy field to be member of European Union (EU) and the government has also tried to provide energy security for about 40 years. Turkish Energy and Electricity market has undergone a big transformation since 2001. Therefore, Turkish Government established Energy Market Regulatory Authority (EMRA) and The Government endeavored to constitute a competitive energy market. Authorities drew up a new law for EMRA and electricity market which is the Law No. 4628. However, in 2013 Turkish Government introduced a new law for only electricity market, the Law No. 6446, and the Law No. 4628 explained just organizational structure of EMRA. Due to the Law No. 6446, Turkish Electricity Market has entered into the process of privatization and liberalization. Moreover, Turkish Government realized a promotion need for renewable energy sources, hence RES Support Mechanism was constituted by Official Authorities, and Turkish Government introduced the Law No. 5346 to support investors in renewable energy sources in 2005. Yet, the promotion offered in this law was not able to attract investors. Because of this, in 2011, the Law No. 5346 was amended by Law No. 6094. Today, the regulations on renewable energy sources continue, thus investments have been rising gradually. Table 1.3 shows the electricity generation rates with regard to different sources from 1970 to 2016. According to the table, renewable energy and wastes had a pretty small share in the 1970s, and in 1981 and 1982 this ratio dropped to zero. These ratios are the clearest indication that the renewable energy sources were not one of the investment areas at that time. However, the share of renewable energy and wastes has followed an increasing trend since 2007, even if the share of renewable energy sources in electricity generation is still pretty small. It is clearly observed in Table 1.3 that the amendment in 2010 makes renewable energy investments more attractive.

Table 1.3 Electricity Generation and Shares by Energy Resources

Year	Total	Coal	Liquid fuels	Natural Gas	Hydro	Renewable Energy and wastes
	(GWh)	(%)				
1970	**8.623**	32.7	30.2	-	35.2	1.9
1971	**9.781**	30.4	41.2	-	26.7	1.7
1972	**11.242**	26.0	43.9	-	28.5	1.6
1973	**12.425**	26.1	51.3	-	21.0	1.6
1974	**13.477**	28.8	44.8	-	24.9	1.5
1975	**15.623**	26.3	34.5	-	37.8	1.4
1976	**18.283**	23.7	29.6	-	45.8	0.9
1977	**20.565**	23.8	33.4	-	41.7	1.1
1978	**21.726**	25.7	30.7	-	43.0	0.6
1979	**22.522**	28.6	25.1	-	45.7	0.6
1980	**23.275**	25.6	25.0	-	48.8	0.6
1981	**24.673**	24.9	23.6	-	51.1	0.4
1982	**26.552**	24.2	22.4	-	53.4	0.0
1983	**27.347**	31.4	27.1	-	41.5	0.0
1984	**30.614**	33.0	23.0	-	43.9	0.1
1985	**34.219**	43.9	20.7	0.2	35.2	0.0
1986	**39.695**	49.0	17.6	3.4	29.9	0.1
1987	**44.353**	39.8	12.4	5.7	42.0	0.1
1988	**48.049**	26.0	6.9	6.7	60.3	0.1
1989	**52.043**	38.9	8.2	18.3	34.5	0.1
1990	**57.543**	35.1	6.8	17.7	40.2	0.2
1991	**60.246**	35.8	5.6	20.8	37.6	0.2
1992	**67.342**	36.5	7.8	16.0	39.5	0.2
1993	**73.808**	32.1	7.0	14.6	46.1	0.2
1994	**78.322**	36.0	7.1	17.6	39.1	0.2
1995	**86.247**	32.5	6.7	19.2	41.2	0.4
1996	**94.862**	32.0	6.9	18.1	42.7	0.3
1997	**103.296**	32.8	6.9	21.4	38.5	0.4
1998	**111.022**	32.2	7.2	22.4	38.0	0.3
1999	**116.440**	31.8	6.9	31.2	29.8	0.3
2000	**124.922**	30.6	7.5	37.0	24.7	0.3
2001	**122.725**	31.3	8.4	40.4	19.6	0.3
2002	**129.400**	24.8	8.3	40.6	26.0	0.3
2003	**140.581**	22.9	6.6	45.2	25.1	0.2
2004	**150.698**	22.8	5.0	41.3	30.6	0.3
2005	**161.956**	26.6	3.4	45.3	24.4	0.3

2006	**176.300**	26.4	2.4	45.8	25.1	0.3
2007	**191.558**	27.9	3.4	49.6	18.7	0.4
2008	**198.418**	29.1	3.8	49.7	16.8	0.6
2009	**194.813**	28.6	2.5	49.3	18.5	1.2
2010	**211.208**	26.1	1.0	46.5	24.5	1.9
2011	**229.395**	28.8	0.4	45.4	22.8	2.6
2012	**239.497**	28.4	0.7	43.6	24.2	3.1
2013	**240.154**	26.6	0.7	43.8	24.7	4.2
2014	**251.963**	30.2	0.9	47.9	16.1	4.9
2015	**261.783**	29.1	0.9	37.9	25.6	6.5
2016	**274.408**	33.7	0.7	32.5	24.5	8.6

Source: TETC, Electricity Generation - Transmission Statistics of Turkey

1.3.2. The History of Legal Framework for Photovoltaic Investment in Turkey

Today, Turkish Solar Energy Market is supported by the Electricity Market License Regulation, the Renewable Energy Law and its amendments. According to the Electricity Market License Regulation, Turkish Government implements the following incentives (Gozen, 2014; Simsek & Simsek, 2013; Topkaya, 2012; Tükenmez & Demireli, 2012):

1) Reduced License Fee: According to Electricity Market License Law, for investments in renewable energy sources fields, an entrepreneur pays only 10% of total license fee, and investors are exempted from annual license fee for the first eight years.

2) System Connection Priority: Connection priority has to be given to facilities based on renewable energy sources instead of non-renewable resources.

3) Purchase Obligation: All agents in retail electricity sale are required to buy electricity generated from renewable energy sources up to 40% of their annual electricity amounts.

4) Exemption from licensing and establishing company: Generation facilities based on renewable energy sources with a capacity of at most 1 MW are exempted from licensing and establishing legal assets.

In addition to above mentioned support mechanisms, the Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electrical Energy-

Renewable Energy Law No. 5346 was enacted in 2005. The first feed-in tariff support mechanism was introduced by the Renewable Energy Law No.5346 in Turkey, however the first FIT arrangement did not create any stimulation on solar energy investments. The FIT offered 5-5.5 euro cent/ kWh payment amount for 10 years, and it presented the same payment amount for all types of renewable energy plants. However, 5-5.5 euro cent/kWh payment amount was not attractive for the emerging renewable energy market in Turkey. In 2010, the Renewable Energy Law No. 5346 was amended by Law No. 6094- Amendment Law. In accordance with the amendment, different FIT payment amounts began to be applied for electricity from various renewable energy sources, but the authorities did not change contract duration. Also, the officials added new incentives in order to support domestic equipment. Thus, FIT payment amount per kWh electricity is increased. (See Table 1.4 for new FIT scheme).

Table 1.4 FIT Payment Amount with respect to Renewable Energy Type

Renewable Energy Type	FIT Payment Amount (USD cent/ kWh)	Total Supplement Amount for FIT from Usage of Domestic Equipment (USD cent/ kWh)	Total Support Amount For FIT (USD cent/ kWh)
Hydro	7,3	2,3	9,6
Wind	7,3	3,7	11
Geothermal	10,5	2,7	13,2
Biomass	13,3	5,6	18,9
Solar-PV	13,3	6,7	20
Solar-Concentrated	13,3	9,2	22,5

Source: The additional document of Law No. 6094-Amendment Law.

The last point is installed capacity of photovoltaic systems. The installed capacity of unlicensed PV investment has been 4.680,0 MW and its share in total capacity was 5.4 % by the end of May 2018. Moreover, licensed PV installed capacity reached 17,9 MW.[2] According to Electricity Market Development Report 2016 published by EMRA, total unlicensed installed capacity reached to 1.048 MW increasing by 191,95 % compared to previous year. 89,81 % of this amount was obtained from solar (photovoltaic) energy (See Figure 1.8).

[2] https://www.teias.gov.tr/sites/default/files/2018-06/kurulu_guc_mayis_2018.pdf

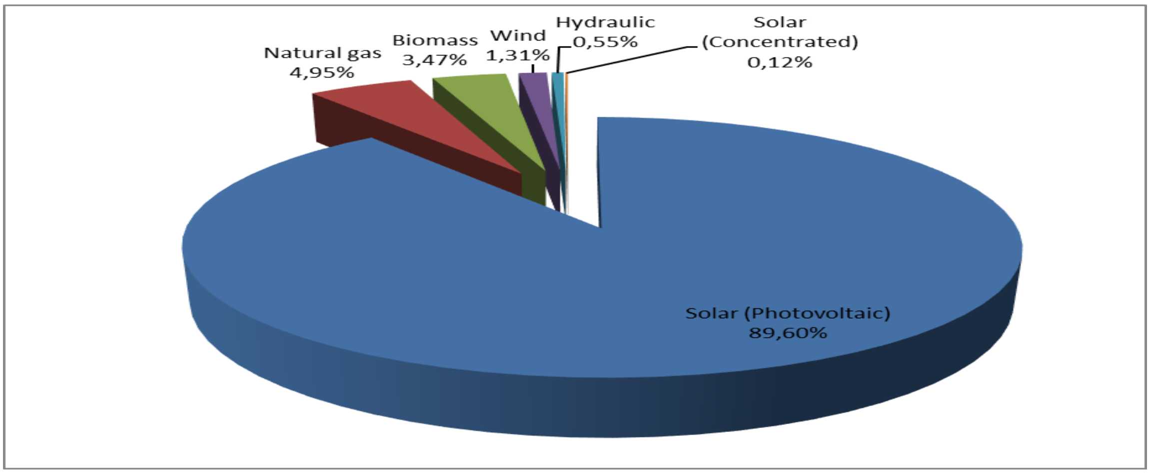

Figure 1.8 Distribution of Unlicensed Installed Capacity by Sources at the End of 2016 (%)

Source: Electricity Market Development Report 2016- EMRA

In spite of tremendous increase in PV investments and capacity, its margin is 5.4 % as of May 2018. This ratio clearly indicates that current FIT design in Turkey does not encourage investors; hence a new FIT design is crucial to increase the investments.

CHAPTER II

LITERATURE REVIEW

The questionnaire, which forms the basis of this thesis, required serious literature review; hence we focused on studies relating to FIT and solar energy market conditions in Turkey. Chapter 2 is composed of two sections. The first section presents the literature review on FIT. The second section provides the studies that describe solar energy market conditions and legal framework in Turkey.

2.1. LITERATURE REVIEW ON FEED-IN TARIFF (FIT)

All support mechanisms for renewable electricity (RES-E) are explained by Jacobs and Sovacool (2012). They discuss quota-based support, tender systems, net metering, FIT, tax and investment incentives in detail. This article offers an assessment on efficiency and effectiveness of all support mechanisms. Moreover, the study mentions about the incentive mechanism used in United States, Singapore, Germany and Spain. After we gained wide aspect on incentive mechanisms, we could compare the practices of different countries. Sovacool (2012) and Couture and Gagnon (2010) provide a precious outline for FIT mechanism, since they discuss better design options with respect to countries' conditions.

Mendonca, Jacobs, and Sovacool (2009), Couture et al. (2010), Klein et al. (2008), Ragwitz et al. (2005) and Haas (2003) aim to find the best FIT design options. They explain all design options with respect to market conditions. These studies mainly depend upon practices from other countries, therefore bad FIT design and disadvantages of FIT are shown as well as suitable design options and their advantages. They emphasize significance of policy making, and the features like technology type, project size, project location, resource quality, and situation of energy market have to be taken into consideration in order to reach policy goals. Moreover, they draw a perspective for green economy, climate change, carbon mitigation and environmental protection.

The paper involving econometric analysis on FIT was carried out by Jenner (2012). Return on Investment (ROI) was estimated for current FIT model from EU countries in the article. FIT type, cost allocation, cost containment, contract duration, tariff amount and digression rate are used as characteristics. Also, regression analysis was done for RESs and their FIT policies in order to show the power of FIT policy to stimulate investments. The results of the study show that strength of feed-in tariff (SFIT) change with regard to technologies, countries and current policy design. Moreover, according to Jenner, policy should be designed both for the development of RES-E and mitigation of climate change.

Grau (2012) examined PV technologies by using dynamic approach. After historical review, a basic model and an advanced model with simulation were used with weekly PV development data from Germany, and the results of the analysis reveal the relationship between PV installation and FIT. Another study was carried out by Grau (2014) including a comparison between FIT and tenders. It examines effectiveness of these policies on solar investments.

Müller-Mienack (2017) signs some essential points on energy transition in this research. First of all, the paper discusses European Union (EU) 20-20-20 target and the possibility of achieving this goal. Furthermore, it examines measures taken by German government to reach this target. According to the paper, Germany will reduce carbon emissions by 2020 as planned before. Therefore, Germany will reach the first target by 2020. The second goal, reaching a 20% RES share in energy generation, had already been achieved in 2012. The last target is the increase in energy efficiency by 20%. Müller-Mienack expressed challenges that encounter German government while performing energy transformation. Due to phase-out of nuclear power plants, Germany encountered an energy scarcity problem, especially in south of Germany. In relation to this, the study presents advantages and disadvantages of energy transition.

Haas et al. (2011) present a historical overview on incentive mechanisms for RES in EU countries. EU-targets and historical development in RES field are expressed. They also examined all policies and strategies so as to boost usage of RES. This paper offers detailed examination for promotion strategies on the country level. Thus, various promotions such as quota obligation system, tax exemption, tenders, FIT and their efficiencies were reviewed in Germany, Spain, UK, Sweden, Italy, Belgium, Greece, Portugal and others. In conclusion, they suggest that the governments should offer more-guaranteed promotion policies for investors to compensate uncertainty in renewable energy market.

One of the case studies for Spain was done by del Río González (2008). This research revealed the evolution of RES-E incentive policies by examining adopted regulations and reforms in Spain from 1980 to 2007. Moreover, it addresses an appropriate FIT design for Spain, hence del Río González (2008) presents an approach from two aspects, government and producers. After the comparison of some reforms of FIT system in Spain, it asserts that a good FIT design provides stability, transparency, security and predictability for RES market.

The studies showing the relationship between feed-in tariff system and solar photovoltaic power have taken a great space in the literature. While Hoppmann, Huenteler, and Girod (2014) investigate the effect of German FIT system on solar photovoltaic industry, Papadopoulos and Karteris (2009) highlight a similar relationship for Greece. According to these papers, a well-designed FIT provides sustainability in the energy sector. Another study done by Antonelli and Desideri (2014) focuses on Italian FIT program and its efficiency level on the PV market. They conclude that a powerful promotion policy for PV sector might cause unexpected results. The unexpected increase in PV investments can make FIT a burden on society. Ahmad, Tahar, Muhammad-Sukki, Munir, and Rahim (2015) discuss the relationship between FIT mechanism and solar PV sector by using system dynamic approach for Malaysia. The results of computer simulations offer two scenarios. One of the scenarios is the most favourable, where total capacity of PV might be 16 GW by 2050. Other is the least favourable scenario, where investments would be about 10 GW. Lin and Wesseh Jr (2013) execute a survey by using real option analysis for Chinese FIT and Chinese solar market. Simulation results indicate that current FIT level in China is not sufficient to increase investments. Muhammad-Sukki et al. (2014) submit an assessment on Japanese solar photovoltaic and FIT mechanisms. This research examines the effects of Fukushima incident on government incentives for RES. According to this research, FIT is expected to give positive results in the photovoltaic sector.

2.2. THE LITERATURE REVIEW ON SOLAR ENERGY MARKET IN TURKEY

Since Turkey has an emerging renewable energy market, the country has several barriers as well as many opportunities. One of the consequences of being an emerging market is that there are only a few studies. Therefore, the studies done for Turkey aim to reveal renewable energy market conditions in Turkey instead of solar energy or wind energy market. Turkish renewable energy market has a big potential due to geographical characteristics, and it is thought that this market will have specialization and rapid development rate in a short period of time. This subsection presents an overview of the research done for Turkey until now.

Highlighting the situation of PV systems both in Turkey and in the world, Dincer (2011) explained Turkey's energy market situation by using SWOT analysis. According to this paper, solar energy market in Turkey has a strong aspect due to geographical location of Turkey, but lower energy efficiency causes a weakness. High energy import rate can be decreased through renewable energy sources (RESs), and this point is the most important opportunity created by RESs. Yet, slow liberalization process in energy market is considered as one of the threats.

Solar energy has a great potential to create new and safe employment. Çetin and Eğrican (2011) focused on solar energy market's effect on the rate of employment in Turkey. Therefore, the concept of green-collar or green jobs is explained in this paper. They showed some figures of solar energy impacts on labor market. Although nowadays solar energy market has a steady effect on employment, it is considered that the impact of solar energy market on labor market will increase rapidly in the future.

Bilgen, Keleş, Kaygusuz, Sarı, and Kaygusuz (2008), Yuksel and Kaygusuz (2011), Benli (2013), and Serencam and Serencam (2013) provide a summary of the situation of renewable energy globally and for Turkey. They emphasize various issues for Turkey such as energy utilization, energy import rate, energy supply and demand, geographical characteristic, environmental issues, emission mitigation and air quality. All of these papers claim that utilization of renewable energy source will create positive results on Turkish economy, because energy import rate will decrease considerably thanks to renewable energy investments, and also Turkey will ensure energy security and sustainability. Moreover, investments in renewable energy fields will reduce carbon emissions, which will create livable environment for all species. Consequently, investments in renewable energy areas enable to fulfill many objectives at both national and global level.

A historical approach on legal regulations and reforms in Turkish electricity market and renewable energy sector is analyzed by Simsek and Simsek (2013), Tükenmez and Demireli (2012), Gozen (2014), and Topkaya (2012). In this context, the studies outline the evolution of Turkish electricity market and incentive mechanisms for renewable energy investments. Although legal regulations constituted the infrastructure of all these studies, they tried to reveal the efficiency of various incentive mechanisms and required amendments. Additionally, they discussed barriers for development of renewable energy and they assessed the importance of subsidies. In general, all these articles submit several policy recommendations for renewable energy sources, and predictable, transparent, flexible FIT and other mechanisms will increase in investments in RESs.

CHAPTER III

THEORETICAL AND METHODOLOGICAL FRAMEWORK

3.1. STATED PREFERENCE TECHNIQUES AND CHOICE MODELING

The management of the natural resources and environmental amenities has become one of the research topics of economics. Revealed Preference Methods (RPMs) and Stated Preference Methods (SPMs) are the two methods for environmental valuation and Figure 3.1 summarizes all of these research methods. Questions for actual market or actual choices are used in RPMs. Stated Preference Methods examine consumers' willingness to pay or accept for possible changes in environmental facilities. Although SPMs are criticized because of the hypothetical nature of questions, only SPMs present the viable alternative for measuring non-use values. They are used to reveal values in environmental quality change. (Adamowicz, Louviere, & Swait, 1998)

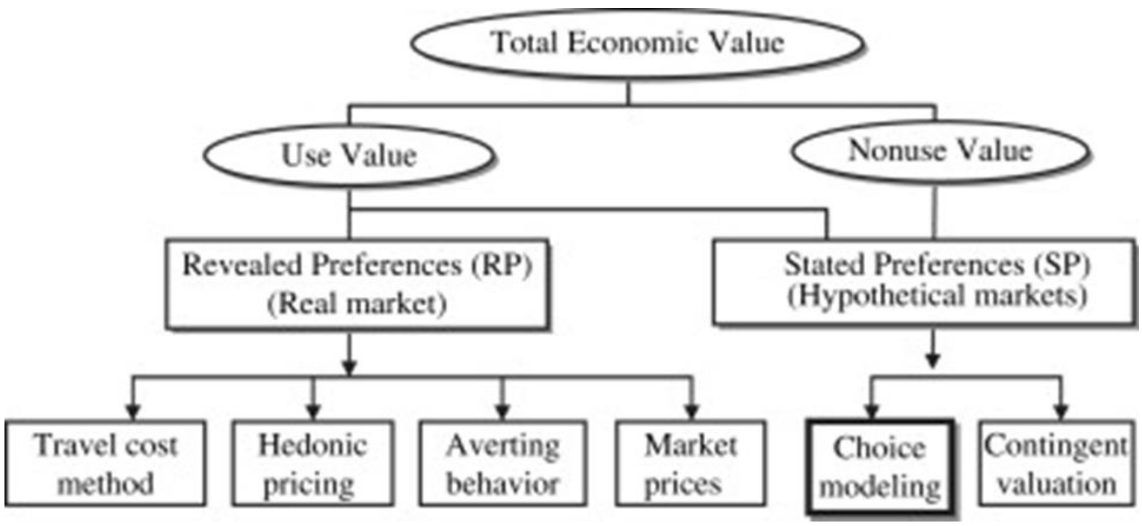

Figure 3.1 Economic Valuation Techniques.

Source: Bateman et al., 2002.

In this thesis, we used one of the stated preference methods, called choice modeling or choice experiment (CE). The purpose of choice experiment is to estimate economic values of attributes of environmental goods. The answers given by the features and the levels included in the questionnaires provide important analyzes. Better policies are being developed thanks to these analyzes. "The inclusion of price as an attribute permits a multi-dimensional valuation surface to be estimated for use in benefit-cost analysis."(Holmes, Adamowicz, Champ, Boyle, & Brown, 2003). The main advantage of this method is that the values of each characteristic of the product can be calculated separately. Moreover, if we use orthogonal design, we can predict each change without correlation. Orthogonal design provides individual-level preference heterogeneity.

A choice experiment consists of seven steps: characterizing of the decision problem, identifying and describing the attributes, developing an experimental design, developing the questionnaire, collecting data, estimating model, and interpreting results for policy analysis or decision support. In the first step, researchers should determine the main problem. As the problem is identified, they should specify related attributes and levels. In step 3, they must design the experiment by using attributes. In this part, researchers can not present all combinations of attributes and levels; hence they use fractional factorial design instead of full factorial design. While the full factorial design provides all alternatives, fractional factorial design reduces the number of alternatives. This design expels uncorrelated effects and specifies useful effects by using orthogonal polynomial codes.[3] After identifying of the best combinations of attributes and levels, researchers should prepare the questionnaire. In the choice modeling, several survey administration modes can be used such as internet-based surveys, computer-assisted surveys, telephone surveys or paper-and-pencil assisted surveys. Moreover, researchers could use verbal descriptions and graphics to clarify the questionnaire. In step 5, the questionnaire is conducted and data are collected. After this step, collected data are used for econometric estimations. Finally, researchers will interpret the results obtained from econometric analysis (Holmes, Adamowicz, Champ, Boyle, & Brown, 2003).

3.1.1. Random Utility Model

In the choice experiment, the consumer is offered a certain number of profiles and is asked to choose one of them. The consumer tries to choose an option amongst these alternatives, which gives the most utility to the consumer; hence choice experiment is made on the basis of random utility maximization (RUM). However, a person may not choose the option that is expected to be selected. These variations can be clarified with

[3] For more details see Louviere, Hensher, and Swait 2000.

a random element in consumer's utility function. (Adamowicz et al., 1998). Therefore, the RUM consists of two components, namely systematic (Vi) and random (εi) components, as shown in equation (3.1). Due to random component, Ui is unobservable but offers true utility for i. In equation (3.2), x_i is an attribute vector regarding profile i, p_i is the cost of profile i, and β shows parameters vector.

$$Ui = Vi + \varepsilon i \tag{3.1}$$

$$Ui = V(x_{i,} p_i ; \beta) + \varepsilon i \tag{3.2}$$

The presence of the random component allows for the estimation of consumers' behavior, and RUM offers the theoretical framework for empirical study of consumer choices on alternatives. In this context, we express the probability of choosing the alternative i from alternative sets, say C, that a consumer will encounter:

$$P(i|C) = Pr[Ui > Uj]=Pr[(Vi + ei) > (Vj + ej)], \forall\ j \in C. \tag{3.3}$$

Supposing that errors are distributed with respect to bivariate normal distribution, a binary probit model can be determined. Moreover, it can be generalized to the multivariate case by a multinomial probit model. A type I extreme value distribution produces the conditional logit model (CLM) or multinomial logit model (MNL). A generalized extreme value distribution generates the nested MNL model. In RUM, the standard assumption is that errors are independently and identically distributed. For this reason, the related MNL model has the restrictions that:

1- Preference is homogeneous in all respondents,

2- Choices conform to the Independence from Irrelevant Alternatives (IIA) assumption,

3- All errors have the identical scale parameter (Holmes et al., 2003).

Under these assumptions, it is possible to estimate the parameters and equation (3.4) is obtained.

$$P(i|C) = P(Vi - Vj > ej - ei), \forall j \in C. \tag{3.4}$$

Assuming that the error terms are Gumbel-distributed, the choice probability is shown as:

$$P(i|C)= \frac{\exp(\mu v_i)}{\sum_{J \in C} \exp(\mu v_J)} \tag{3.5}$$

This model is conditional logit where μ is scale parameter and standardized to one. If μ=1, the selecting profile *i* probability in the set C is shown below:

$$P(i|C)= \frac{\exp(\sum_{k=1}^{1} \beta_k x_{ik} + \beta_p P_i)}{\sum_{J \in C} \exp(\beta_k x_{jk} + \beta_p P_j)} \tag{3.6}$$

In equation (3.6), while β_p is the coefficient of price, P_i is the price of i, and P_j is the price of j, β_k is the coefficient of k and *x* implies attribute.

3.2. RANDOM PARAMETER/MIXED LOGIT MODEL

Although the conditional logit model (CLM) enables the environmental valuation, the model has some restrictions. According to the CLM, respondents have the same preferences; hence β's are same for all respondents. Another assumption is the independence from irrelevant alternatives (IIA). This means that the choice of one alternative is independent of presence of another alternative. These restrictions can be fixed by using random parameter/mixed logit model. In mixed logit model, it is assumed that parameters are randomly distributed, thanks to this assumption; preference structure is heterogeneous over respondents. "Then, the heterogeneity of the sample is captured by estimating the mean and variance of the random parameter distribution. This approach is referred to as random parameter logit (RPL) or mixed logit modeling" (Holmes et al., 2003).

$$P(j) = \frac{\exp(X_j \beta)}{\sum_{k \in C} \exp(X_k \beta)}$$

(3.7)

Equation (3.7) is the probability of the conditional logit model. According to MLM, the parameters are not fixed coefficients and equation (3.8) allows a continuous mixture.

$$P(j) = \int \pi_j(\beta) g(\beta) \partial(\beta)$$

(3.8)

Equation (3.8) shows the form of CLM probability. This equation is modified in MLM and the probabilities for the results of two alternatives are shown in equation (3.9). The ratio of probabilities between two alternatives is not affected by other alternatives.

$$\frac{P(i)}{P(j)} = \frac{\exp(V_i)}{\exp(V_j)}$$

(3.9)

For more information, see Revelt and Train (1998) Lancaster (1966) Louviere, Hensher, and Swait (2000).

The coefficients for each parameter are estimated using the mixed logit model. The ratio of the parameter of attribute (β_X) and the parameter of price (β_p) gives the marginal willingness to pay (MWTP). The MWTP for one unit increment of the attribute x is calculated as follows:

$$MWTP_x = \frac{dp}{dx} = -\frac{\frac{\partial V}{\partial x}}{\frac{\partial V}{\partial p}} = -\frac{\beta_x}{\beta_p}$$

(3.10)

3.3. SURVEY DESIGN

The survey was designed to reveal desired FIT policy and expected policy implications in solar energy market in Turkey. The survey was designed in 10 months. During the period, all FIT designs and other incentive mechanisms implemented around the world had been investigated. Renewable energy support mechanisms and legislation in Turkey were examined. In order to obtain relative information, conditions of solar energy market were discussed with people who work in solar energy firms and Ministry of Energy and Natural Sources-General Directorate of Renewable Energy.

In the light of all these information, the questionnaire design was completed in March 2017.

The questionnaire consists of four parts. In the first part, the respondents are asked to make assessments on solar energy market using 1-5 scale (1- Definitely Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Definitely Agree). Firm type (Engineering, Project, Construction (EPC) firm or Solar Energy Investors), investment plans of firms, and employee's position in the firm, and her/his experience year in both current firm and sector are also revealed. Second part includes CE questions. In this section, the respondents are expected to choose one of three alternatives –two hypothetical alternatives and a status quo option- in each CE. These questions are attempted to measure the MWTP of several attributes of unlicensed and licensed PV investments. The attributes and the attribute levels for CE questions are shown in Table 3.1. We use five attributes –FIT contract period, FIT type, Payment amount per kWh, Tax for imported PV panel and Cost per MW- for unlicensed investments. Seven attributes -FIT contract period, FIT type, Payment amount per kWh, Tax for imported PV panel, Promotion for domestic equipment, License fee and Cost per MW- are used for licensed investments. These attributes and levels are chosen based on survey targets. We use three levels for contract duration: Today, 10 year is used as FIT Contract period by the ministry; hence we set 10 year as status-quo. 12 year and 15 year might increase investments and competition in industry, but it is thought that a contract period longer than 15 years may harm the competitiveness of the market.

We prefer to use fixed, front-end loaded and inflation adjusted FIT types. While these three models are more suitable for developing solar energy markets, premium price models are recommended for developed market to increase competitiveness.[4] Fixed price model is status quo.

We researched FIT implementations of other countries, and we realized that they apply price discrimination according to scale of investments. However, Turkey use one type price model for all PV investments, $ 0.133 payment amount per kWh is used in Turkish FIT program. The authorities thought that this amount is high and it is likely to fall in the future. Therefore, we prefer two levels -0.0891$, 0.1291$ that are smaller than status-quo in order to see willingness to accept of respondents. Tax for imported panel is used in the survey. The government has been implementing this policy since 2016 and many firms complain about this practice. In order to show its negative effect on investments, we use tax for imported panel. Promotion for domestic equipment and license fee are only used for licensed investments, because the government offers more promotions for licensed investments. License fee is paid only for licensed investments.

We choose Cost per MW as price, thanks to this attribute; we calculate value of other attributes and levels. $ 850.000 is status-quo. Because the cost is increasing with respect to the equipment used, other levels have been determined by views of people working in solar energy firms.

Table 3.1 Attributes and Levels.

Attributes	Levels
FIT contract period	10-year*, 12-year, 15-year
FIT type	Fixed*, Front-end-loaded, Inflation adjusted
Payment amount per kWh	0.0891$, 0.1291$, 0.133$*
Tax for Imported PV panel	Yes* (475.000$ extra cost per MW), No
Promotion for domestic equipment	Yes*, No
License Fee	Yes* (500.000$ extra cost), No
Cost per MW	850.000$*, 1.000.000$, 1.150.000$, 1.300.000$, 1.450.000$, 1.600.000$

* indicates status quo.

[4] For more details see Couture and Gagnon, 2010

According to full factorial design, we get 324 (3*3*3*2*6) profile cards for unlicensed investments and 1296 profile cards for licensed investments. However, it was impossible to use all profiles; hence we use fractional factorial design, and this design expels uncorrelated effects and specifies useful effects by using orthogonal polynomial codes. We got 49 profiles for unlicensed investments and 52 profile cards for licensed investments with fractional factorial design by using SPSS 23. All combinations were randomly selected. We added status quo option to all choice sets. Examples of CE questions are shown in Figure 3.2 and Figure 3.3.

Attributes	**PROGRAM A**	**PROGRAM B**	**PROGRAM C**
FIT contract period	15-Year	10-Year	10-Year
FIT type	Inflation adjusted payment model	Front-end-loaded payment model	Fixed payment model
Payment amount per kWh	$ 0.1231	$ 0.1231	$ 0.133
Tax for Imported PV panel	NO	NO	YES($ 475.000 extra cost per MW)
Cost per MW	$ 1.000.000	$ 850.000	$ 850.000
Choice:	☐	☐	☐

Figure 3.2 Example of CE Question for Unlicensed Investments.

Attributes	**PROGRAM A**	**PROGRAM B**	**PROGRAM C**
FIT contract period	15-Year	12-Year	10-Year
FIT type	Inflation adjusted payment model	Inflation adjusted payment model	Fixed payment model
Payment amount per kWh	$ 0.1231	$ 0.133	$ 0.133
Promotion for domestic equipment	NO	NO	YES
License Fee	YES (1.800.000 TL extra cost per MW)	NO	YES (1.800.000 TL extra cost per MW)
Tax for Imported PV panel	NO	NO	YES ($ 475.000 extra cost per MW)
Cost per MW	$ 1.300.000	$ 850.000	$ 850.000
Choice:	☐	☐	☐

Figure 3.3 Example of CE Question for Licensed Investments.

Each respondent was asked to answer ten questions, five for unlicensed investments five for licensed investments, and we created seven different versions of the survey with respect to CE questions.

In the third part, policy options are presented to the participants in order to identify the desired or undesired policy implementations. The last part focused on the socio-demographic characteristics of the respondents, such as age, gender, educational background. We got the ethic commission approval before we start to conduct the questionnaire (See Appendix A).

Once the initial version of survey was completed in March 2017, focus group study and pre-test were conducted in April 2017. Minor revisions were made in the survey design in line with the pre-test results (except CE questions section). Data collection was finalized at the end of June 2017. 44 employees were interviewed from 33 solar energy firms in 8 cities (Ankara, Antakya, Denizli, Eskişehir, İstanbul, İzmir, Kayseri, Konya) of Turkey. Considering risk perception, cost-benefit based approach; we usually conducted the survey on business executives and people working in the sales department.

Before each interview, a statement with information about CE questions was read, and every interviewer signed a voluntary participation form (See Appendix B). All the interviews are conducted face-to-face.

CHAPTER IV

CHARACTERISTICS OF DATA, STATISTICAL AND ECONOMETRICAL ANALYSIS AND RESULTS

4.1. DESCRIPTIVE STATISTICS

The data collection was completed in June 2017. We interviewed 44 people from 33 solar energy firms. Under the assumption that EPC firms or solar power plant investors may be more sensitive on the cost of solar energy investment, the firms to be interviewed were selected among these types of companies. Before the survey was conducted, 90 EPC firms and solar power plant investors had been determined in Turkey. The 33 companies interviewed represent approximately 37% of the solar energy market. 36% of the respondents are working in micro scale, 59% in small scale and 5% in medium scale firms. We do not have any participant working from large scale companies (See Table 4.1).

Table 4.1 General Data: The Firms Scale

Firm Scale	Sample (Person)	%
Micro Scale (1-9 employees)	16	36%
Small Scale (10-49 employees)	26	59%
Medium Scale (50-249 employees)	2	5%
Large Scale (+ 250 employees)	-	-

* According to Turkish Statistic Institute, the firm of 1-9 employees is micro scale, 10-49 is small scale, 50-249 is medium scale, and +250 is large scale.

According to descriptive statistics, 37 (84 percent) of the respondents are male while just 7 of them are female (See Table 4.2).

Table 4.2 General Sample Data: Sex

Sex	Sample (Person)	Percentage
Female	7	16%
Male	37	84%

Ninety-one percent of the respondents have college degrees or higher (See Table 4.3). The average age of respondents was about 34, and 45.5 percent of data was constituted by 30-39 age group (See Table 4.4).

Table 4.3 General Sample Data: Education

Education	Sample (Person)	%
College/ University- 2 years	4	9
College/ University- 4 years	25	57
Post Graduate	15	34

Table 4.4 General Sample Data: Age of Respondents

Age	Sample (Person)	%
20-29	15	34.1
30-39	20	45.45
40-49	4	9.09
50-59	5	11.36
Average	33.97	

Another detail is that 39 of the 44 respondents are engineers, and 59% of them are electrical and electronic engineers (See Table 4.5).

Table 4.5 General Sample Data: Occupation of Respondents

Occupation	Number	%
Engineer	39	89
Others	5	11

In order to determine the areas where firms operate actively, the respondents are asked to rate on 1 to 5 scale, regarding the areas of activity; 1 implying “We are not active” and 5 implying “We are most active”. The area, which contains all steps prior to the installation of a solar energy plant, is called project. After the completion of the project phase, the plant will be built and ready to be run. This phase is called solar power plant installation. When the installation of the power plant is completed, the power plant is operated, that is, the power plant generates electricity and the generated electricity is offered for sale. This phase is the operation. Maintaining the efficiency of the plant and fixing any faults in the plant constitute maintenance phase. It was observed that firms were most active in the field of solar power plant installation with 32 votes (See Table 4.6).

Table 4.6 Areas of Activity –Person Vote

Area	1-We are not active in …	2-We are much less active in …	3-We are less active in …	4-We are active…	5-We are most active in …
Project	6	5	3	15	15
Solar Power Plant Installation	1	-	2	9	32
Solar Power Plant Operation	9	2	8	9	16
Maintenance	5	2	7	13	17

Six suggestions were presented that companies could express their plans for the next five years. The respondents evaluated by using from 1 to 5 scale, 1 implying “I strongly disagree” and 5 implying “I strongly agree”.[5] Two results were remarkable. One of them is that “We will focus on investments in rooftop PV systems over the next 5 years”. 84% of the participants state that they agree or strongly agree with suggestion-3 (See Table 4.7).

Table 4.7 Suggestion-3 for the Firms

We will focus on investments in rooftop PV systems over the next 5 years.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	1	3	3	13	24
%	2	7	7	29.5	54.5

Other suggestion is that “We will provide more services in the field of maintenance over the next 5 years”. 31 respondents said that I agree or I strongly agree with the suggestion 4 (See Table 4.8).

[5] Results with agree or strongly agree > 30 (68 percent), disagree or strongly disagree>30 (68 percent) or neutral>30 (68 percent) were selected throughout the whole section.

Table 4.8 Suggestion-4 for the Firms

We will provide more services in the field of maintenance over the next 5 years.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	3	5	5	12	19
%	7	11.3	11.3	27.2	43.1

Following suggestions for firms' plans, 11 suggestions for the sector were presented. The respondents rated them from 1 to 5 scale.

%93 of respondents did not agree with suggestion-2 for solar energy sector (See Table 4.9), while 32 (72.5%) respondents agree or strongly agree with suggestion-3 for solar energy sector (See Table 4.10).

Table 4.9 Suggestion-2 for Solar Energy Sector

Bureaucratic procedures do not cause obstacles for PV investments.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	27	14	-	3	-
%	61	32		7	

Table 4.10 Suggestion-3 for Solar Energy Sector

License fees are very high.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	2	-	10	19	13
%	4.5		23	43	29.5

Some people are involved in various initiatives to increase the value of the land on which solar power plants are planned to be installed in the project phase. However, these people do not want to make a real investment; they only try to sell the land at a higher price. When firms encounter these types of problems, many investment plans usually stay in the project phase, and this indicates the problem of indistinguishability of real investor in solar sector. According to data, 84% of people who think that the trouble caused by indistinguishability of the real investors is the biggest problem of the market (See Table 4.11).

According to the respondents, another big obstacle is that households have little knowledge about PV systems and the use of rooftop PV systems (See Table 4.12).

Table 4.11 Suggestion-6 for Solar Energy Sector

Investors who do not want to invest actually in the market are the biggest obstacle ahead of the development of the market.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	-	2	5	19	18
%		4.5	11.5	43	41

Table 4.12 Suggestion-7 for Solar Energy Sector

The fact that rooftop PV systems are not actively used and that households are unfamiliar to PV systems prevent the growth of solar energy market.					
Level	1- I strongly disagree	2- I disagree	3- Neutral	4- I agree	5- I strongly agree
Person	3	4	6	20	11
%	7	9	14	45	25

The respondents were asked to evaluate 7 policy recommendations, apart from suggestions related to their companies and the market. These recommendations were asked to be evaluated between 1-5 scale; 1 implying “Certainly reduces investments” and 5 implying “Certainly increases investments”. 3 recommendations took the highest rates. One of them presented this request for amendment: “Reduction of the tax rate for imported panel.” 41 respondents stated that when tax rate is declined, investment would increase (See Table 4.13).

Table 4.13 Policy Suggestion-3

Reduction of the tax rate for imported panel.					
Level	1- Certainly reduces investments	2- Reduces investments	3- Neutral	4- Increases investments	5- Certainly increases investments
Person	-	-	3	26	15
%			7	59	34

The other policy recommendation is that "FIT payment should be made in Turkish Lira". 21% of respondents claimed that this implementation will certainly reduce investments, 54% of them thought that it will reduce investments, and 18% is neutral. These results are shown in Table 4.14. Despite the neutral answers, the votes for "certainly reduces investments" and "reduces investments" accounted for 75.5%, and this ratio is the clearest indication that the market agents find Turkish Lira less reliable.

Table 4.14 Policy Suggestion-4

FIT payment should be made in Turkish Lira.					
Level	1- Certainly reduces investments	2- Reduces investments	3- Neutral	4- Increases investments	5- Certainly increases investments
Person	9	24	8	2	1
%	21	54.5	18	4.5	2

Lastly, the suggestion of "The obligation of establishing PV systems on the roofs of new houses" was evaluated fairly positive by the participants. 93.5 % of them picked options which are "increases investments" or "certainly increases investments" for this recommendation (Table 4.15).

Table 4.15 Policy Suggestion-6

The obligation of establishing PV systems on the roofs of new houses.					
Level	1 Certainly reduces investments	2 Reduces investments	3 Neutral	4 Increases investments	5 Certainly increases investments
Person	-	1	2	21	20
%		2	4.5	48	45.5

4.2. ECONOMETRIC ANALYSIS

4.2.1. Models

The following five models have been examined in this study to reveal the respondents' MWTP for PV investments. Table 4.16 contains definitions of the variables used in the models.

Model 1 is for unlicensed PV investments and Model 2 is for licensed PV investments. These are simple linear models.

$\boldsymbol{V} = \beta_1$COST + $\beta_2$12_YEAR + $\beta_3$15_YEARS + β_4FRONTEND + β_5INFLATION + β_6(0.0891\$perkwh) + β_7(0.1291\$perkwh) + β_8TAX

(Model 1)

In Model 1, tax for imported panel is the dummy variable. 12 years, 15 years, front-end loaded FIT type, inflation adjusted FIT type, 0.0891 per kWh payment amount, 0.1291 per kWh payment amount were used as factors. While we expected the signs of coefficients of 12YEARS and 15YEARS to be positive, we expected the signs of coefficients of COST, 0.0891$perkwh, TAX and LICENSEFEE to be negative in all models.

The coefficients of variables and price allow us to calculate the MWTP for 1 MW unlicensed investments.

$V = \beta_1$COST + $\beta_2$12YEARS + $\beta_3$15YEARS + β_4FRONTEND + β_5INFLATION + β_6(0.0891$perkwh) + β_7(0.1291$perkwh) + β_8TAX + β_9PROMOTION + β_{10}LICENSEFEE

(Model 2)

In addition to the variables used in Model 1, promotion for domestic equipment and license fee were used as the dummy variables in Model 2.

We also calculate effects of individuals' characteristics on preferences for both investment types. However, the cross terms results of unlicensed investments were not significant. In the licensed investments, only the working years in the sector as an individual characteristic is statistically significant on certain variables (0.1291 per kWh payment amount, front-end loaded FIT type, license fee).

$V = \beta_1$COST + $\beta_2$12YEARS + $\beta_3$15YEARS + β_4FRONTEND + β_5 INFLATION + β_6(0.0891$perkwh) + β_7(0.1291$perkwh) + β_8TAX + β_9PROMOTION + β_{10}LICENSEFEE + (β_{11}FRONTEND)YEARS_SECTOR

(Model 3)

β_{11} shows the relationship between experience years employed in the solar sector and front-end loaded FIT type in the Model 3. We expected β_{11} to be positive, because many respondents are familiar with front-end loaded FIT payment type, and they usually found this FIT type positive.

$V = \beta_1$COST + $\beta_2$12YEARS + $\beta_3$15YEARS + β_4FRONTEND + β_5INFLATION + β_6(0.0891$perkwh) + β_7(0.1291$perkwh) + β_8TAX + β_9PROMOTION+ β_{10}LICENSEFEE + (β_{12}0.1291$perkwh)YEARS_SECTOR

(Model 4)

Similarly, β_{12} demonstrates link between experience years employed in the solar sector and 0.1291 per kWh payment amount in the Model 4**.** We expected β_{12} to be positive.

Table 4.16 Definitions of the Variables

Variable	Definition
COST	This variable implies the cost of 1 MW solar PV investment in all models.
12YEARS	This variable implies 12-year contract duration for FIT program in all models.
15YEARS	This variable implies 15-year contract duration for FIT program in all models.
FRONTEND	This variable implies front-end loaded FIT type in all models.
INFLATION	This variable implies inflation adjustment FIT type in all models.
0.0891$perkwh	This variable implies $ 0.0891 payment amount per kWh in all models.
0.1291$perkwh	This variable implies $ 0.1291 payment amount per kWh in all models.
TAX	This variable implies the tax policy for the imported panel in all models.
PROMOTION	This variable refers to promotions offered by the government for licensed investments in model 2, model 3, model 4, and model 5.
LICENSEFEE	This variable refers to license fee for licensed PV investments in model 2, model 3, model 4, and model 5.
FRONTEND*YEARS_SECTOR	This variable refers to the cross terms of front-end loaded FIT type and individual characteristic of experience years employed in the solar sector in model 3.
0.1291$perkwh*YEARS_SECTOR	This variable refers to the cross terms of $ 0.1291 payment amount per kWh and individual characteristic of experience years employed in the solar sector in model 4.
LICENSEFEE*YEARS_SECTOR	This variable refers to the cross terms of license fee and individual characteristic of experience years employed in the solar sector in model 5.

$\boldsymbol{V} = \beta_1 COST + \beta_2 12YEARS + \beta_3 15YEARS + \beta_4 FRONTEND + \beta_5 INFLATION + \beta_6(0.0891\$perkwh) + \beta_7(0.1291\$perkwh) + \beta_8 TAX + \beta_9 PROMOTION + \beta_{10} LICENSEFEE + (\beta_{13} LICENSEFEE)YEARS\_SECTOR$

(Model 5)

Model 5 includes cross terms of individual characteristic of experience years employed in the solar sector and license fee. β_{13} demonstrates link between experience years employed in the solar sector and license fee, and we expected β_{13} to be negative.

We can calculate the effect of individual characteristic on the MWTP for 1 MW licensed PV investments in Model 3, Model 4 and Model 5.

4.2.2. Results

Table 4.17 shows mixed logit model results. The mixed logit results were obtained by using NLOGIT 4. The estimated coefficients and standard errors are presented in Table 4.17.

The sign of Cost per MW is negative and it is statistically significant at the 1% level in all models, as expected.

0.0891 $ payment amount per kWh has negative sign, it is statistically significant. Today, the government offers 0.133 $ payment amount per kWh and reducing payment amount means that decreasing investment attractiveness and extending the return of the investment (ROI).

Tax for imported panel has a negative sign and is statistically significant at the 1% level. In general, PV panels are imported from China, Korea, and Thailand. The number of factories producing PV panels is pretty small in Turkey, and the efficiency of local panel is low. Many firms prefer to import panel, hence tax on imported panel decrease attractiveness of investments. It is an undesirable policy in general.

While Cost per MW, 0.0891 $ payment amount per kWh and tax for imported panel are negative and statistically significant in every model; the sign of 15 year contract duration is positive and statistically significant at the 1% level in all models, as expected. Today, FIT implemented in Turkey offers 10-year contract period for firms.

Many firms claim that this period is insufficient and causes risk aversion. As market agents want to prolonged contract period, the WTP for this is rather high.

The results of 12 year-contract duration are significant except Model 1. As previously stated, Model 1 is for unlicensed PV investments. The government offers a few promotions for unlicensed investments and produced electricity from these type investments has to be sold in the market with FIT program. Under these circumstances, 12-year contract does not seem adequate for investors in unlicensed investments.

A large majority of participants work in micro or small-scale companies, and they cannot compete with large scale firms about bidding. Thus, license fee has negative coefficients in all, as expected and it is statistically significant at the 1% level except Model 5.

In Model 3, the cross terms of front end loaded payment type and sector experience (in years) are shown. B_{11} is the coefficient for the cross term of front end loaded payment type and sector experience, and it is statistically significant at the 5% level, and it has positive sign. Although different payment models are not desired instead of fixed payment in Model 1, Model 2, and Model 3; individuals who have spent more years in the industry lean towards front-end loaded payment type. Investors are more familiar with the front-end loaded payment type due to Iran solar energy market. Because of familiarity, they may lean toward it. Model 4 demonstrates the results of cross terms between 0.1291 $ payment amount per kWh and sector experience. B_{12} has positive sign, because investors were expecting a decline in the amount of payments while the period the survey was conducted. According to their expectation, 0.1291 $ payment amount per kWh might be acceptable, but not 0.0891 $ payment amount per kWh.

Lastly, the cross term between license fee and sector experience has negative sign, and it is statistically significant at the 1% level. This result was supported by attitudes in other models. License fee is a big obstacle for micro and small scale firms.

Table 4.17 Estimated Coefficients of Mixed Logit Model

	Model 1	Model 2	Model 3	Model 4	Model 5
COST PER MW (in 10^5)	-0.516*** (0.174)	-0.452*** (0.122)	-0.549*** (0.168)	-0.422*** (0.125)	-0.410*** (0.118)
12 YEARS	0.478 (0.625)	1.502*** (0.575)	1.770** (0.699)	1.591*** (0.597)	1.360** (0.539)
15 YEARS	2.623*** (1.023)	2.323*** (0.718)	2.346*** (0.823)	2.546*** (0.756)	2.200*** (0.647)
FRONT END LOADED FIT TYPE	-0.174 (0.643)	-1.182** (0.482)	4.983 (5.500)	-1.264** (0.529)	-1.088** (0.444)
INFLATION ANDJUSTED FIT TYP	0.980 (0.867)	-0.230 (0.519)	-0.404 (0.658)	-0.142 (0.515)	-0.345 (0.451)
0.0891 PER KWH PAYMENT	-4.747*** (1.494)	-3.475*** (1.178)	-4.068*** (1.438)	-3.457*** (1.261)	-3.058*** (1.138)
0.1291 PER KWH PAYMENT	-1.065 (0.606)	-0.479 (0.436)	-0.392 (0.480)	3.982 (3.390)	-0.501 (0.404)
TAX FOR IMPORTED PANEL	-2.987*** (0.982)	-1.915*** (0.588)	-2.348*** (0.766)	-1.917*** (0.596)	-1.786*** (0.573)
PROMOTION FOR DOMESTIC EQUIPMENT		0.969* (0.572)	1.161 (0.725)	1.109* (0.598)	0.715 (0.493)
LICENSE FEE		-2.611*** (0.696)	-2.971*** (0.845)	-2.555*** (0.739)	-2.160 (3.482)
FRONT END LOADED FIT TYPE_SECTOREXPERIENC EYEARS			0.482** (0.219)		
0.1291 PER KWH PAYMENT_ SECTOREXPERIENCEYEA RS				0.323** (0.147)	
LICENSE FEE_ SECTOREXPERIENCEYEA RS					-0.421*** (0.151)
N	220	220	220	220	220
LogL	-158.145	-153.836	-147.683	-149.951	-148.507

***, ** and * indicate that the parameter is significant at 1%, 5% and 10% level respectively. Figures in parentheses are standard errors.

The MWTP results are shown in Table 4.18. As mentioned before, the MWTP results were obtained by using coefficients in Table 4.17. MWTP formula is as follows:

$$\mathbf{MWTP} = -\frac{\beta_{Characteristic}}{\beta_{Price}} \tag{4.1}$$

Positive MWTP implies that the respondents have willingness to pay positive amount for one unit good or service.

Negative result shows that the attribute is unattractive for investors.

When Table 4.18 is well examined, it will be clearly seen that the highest MWTP belongs to 15-year contract duration in all. 0.0891 $ payment amount per kWh and tax for imported panel decrease attractiveness of investments.

As in Table 4.17, Model 1 results are for unlicensed PV investments, while others are for licensed PV investments in Table 4.18. In Model 1, 15-year contract duration has $ 508.000 MWTP. It means that the FIT scenario with 15-year contract duration brings $ 508.000 MWTP more, compared to 10-year contract duration. This means that the investors are willing to invest $ 508.000 more, if the contract is 15 year instead of 10 year. Even though 15-year contract duration has higher rate in all models, the highest MWTP belongs to Model 1 among them. It shows investors' concerns for unlicensed PV investments, because electricity produced from unlicensed plants can be sold just for 10 years in the market. If FIT contract period prolongs, the firms will be more willing to invest in PV systems.

The $ 0.0891 payment amount per kWh has negative MWTP in all. Today, the government offers $ 0.133 payment amount per kWh. Decreasing payment amount means to decrease attractiveness of investments; hence the participants have found negative this option. To be more precise, considering Model 1, the scenario with $ 0.0891 payment amount per kWh will decrease attractiveness of investments for the respondents causing a drop of $ 919.900 in investments compared to $ 0.133 payment amount per kWh for 1 MW unlicensed investments.

Tax for imported panel has negative MWTP as in $ 0.0891 payment amount per kWh in all models. It means that this feature decreases attractiveness of investments.

Table 4.18 MWTP Results [$MWTP_X=(-\frac{\beta_X}{\beta_{Cost\ per\ MW}})10^5$]

	Model 1 ($)	Model 2 ($)	Model 3 ($)	Model 4 ($)	Model 5 ($)
12 YEARS	92.600	**332.300**	**322.400**	**377.000**	**331.700**
15 YEARS	**508.000**	**513.900**	**427.300**	**603.300**	**536.500**
FRONT END LOADED FIT TYPE	-33.700	**-261.500**	907.600	**-299.500**	**-265.300**
INFLATION ANDJUSTED FIT TYP	189.000	-50.800	-73.500	-33.600	-84.100
0.0891 PER KWH PAYMENT	**-919.900**	**-768.800**	**-740.900**	**-819.100**	**-745.800**
0.1291 PER KWH PAYMENT	-206.300	-105.900	-71.400	943.600	-122.100
TAX FOR IMPORTED PANEL	**-578.800**	**-423.600**	**-427.600**	**-454.200**	**-435.600**
PROMOTION FOR DOMESTIC EQUIPMENT		**214.300**	211.400	**262.700**	174.300
LICENSE FEE		**-577.000**	**-541.100**	**-605.400**	-526.800
FRONT END LOADED FIT TYPE_SECTOREXPERIENCEYEARS			**8.770**		
0.1291 PER KWH PAYMENT_ SECTOREXPERIENCEYEARS				**76.500**	
LICENSE FEE_ SECTOREXPERIENCEYEARS					**-102.600**

Bold numbers refers to significance.

Photovoltaic investments in Turkey are divided into mainly two types, unlicensed or licensed investments. The differences between them are that electricity produced from licensed investment can be sold in the market for forty-nine years but from unlicensed investments can be sold only ten years in the scope of FIT mechanism. This situation has led to different responses in results. In Model 2, Model 3, Model 4, and Model 5 which imply licensed investments, the WTP of 15-year decreased vis-a-vis in Model 1(for unlicensed investment). Yet, in licensed investments scenarios with 12 year-period has three times more WTP than Model 1. Since the licensed investment has a longer sales period, 12 year-scenario is more acceptable for the licensed investments.

License fee which is a dummy variable has negative WTP in all licensed models. The government distributed 600 MW capacities at the first time for licensed investments by using tenders-bidding in 2015. After the tenders only big-scale firms obtained licenses. This implementation threatens the existences of micro or small scale firms that make up the majority of the market. The negative attitude in MWTP results for license fee is normal, because most of the respondents in the sample, work in micro or small scale firms (See Table 4.1). Some of the respondents have stated that they did not find this method wrong; they think that large-scale investments can be financed by firms which are financially stronger. If a firm cannot pay the license fee, it probably will not be able to complete a major investment.

The models with cross terms are in Model 3, Model 4, and Model 5 in order to reveal effects of individual characteristics on WTP.

Model 3 shows the relationship between front-end-loaded FIT type and sector experience (as years).

As the industry experience increases, individuals have taken a bright view of the scenario with front-end-loaded FIT type. It brings about $ 8.770 more WTP per MW for front-end-loaded FIT type compared to fixed FIT type in licensed investments.

Model 4 involves the cross terms of 0.1291 $ payment amount per kWh and sector experience. While surveying, there was a rumour that the payment per kWh would be decreased. Due to the rumour, 0.1291 $ payment amount is found to be more admissible, and it is positive.

In Model 5, license fee and sector experience cross terms were investigated. It has negative WTP result i.e., -102.600 $, implying that employees do not find tenders as a healthy way to improve the sector.

CHAPTER V

CONCLUSION

This study tries to reveal optimal FIT design for PV investments in Turkey by examining preferences and attitudes of employees working in solar energy firms. Although the survey study forms the basis of this thesis, it is not possible to ignore the contributions of the institutions, firms and other countries experiences. In the light of all this information, we try to provide an overall assessment and some policy implementations.

The starting point of this research is that Turkey's FIT contract period is shorter than that of many other countries. We could not reach a satisfying answer to how current FIT was designed from public sector in Turkey. However, several solar energy firms and solar energy societies claim that both FIT design is not sufficient to increase PV investments. We began to research on these claims, and prepared the questionnaire by using a CE approach. Findings from data endorsed the arguments about solar energy market of Turkey. The policy analysis became pretty strong by statistical and econometric analyses.

Firstly, we can state that 10 year contract duration FIT design is the biggest obstacle in front of the growth of solar industry. According to WTP results, the respondents showed the highest WTP amount for scenario with 15 years. It is clearly observed that investments will increase with a longer FIT. Authorities should not try to cover up this flaw in the FIT design by claiming a high payment amount per kWh (Resmî Gazete, 2005; Resmi Gazete, 2011). However, it is predicted that the increased distribution costs since the beginning of this year will decrease the attractiveness of high amount payment per kWh.

The second important hurdle is the implementation of tax for imported panel. This policy was the result of lobbying activities of domestic panel manufacturers in 2016. However, this practice almost paralyzed the PV sector. Instead of tax policy, it is recommended that authorities seek technology and *know-how* to compete with foreign products. At this point, it should be noted that the government has made an effort on local panel production, not assembly production.[6] If this panel factory provides know-how, it is considered that Turkey would benefit in the long term.

Another undesirable policy implementation is revealing license fee by using bidding. In accordance with econometric results, this method engenders negative WTP. In 2015, the authorities arranged the first auction to distribute capacities for licensed investments. However, several firms had to retreat because they could not compete with large-scale firms' biddings. This may lead to monopoly or oligopolies. When we conducted the survey, the government held a tender for the second time. They followed different procedure in order to overcome the threat of monopoly or oligopoly in the market. The minimum payment amount per kWh that firms would accept was asked, and companies offering the lowest amount earned capacities. This application did not cause an additional cost, but it has reduced the profitability ratio of PV investments. It cannot be said that the new technique has created a solution to the existing problem on competitiveness and balance in the market. Different ways should be found to distribute capacities; otherwise several small scale firms will be closed in the future.

Another drawback is that the bureaucratic processes are very slow. In addition to bureaucratic slowness, the radical amendments (such as tax policy for imported panel) cause a serious problem. Furthermore, the tense political atmosphere triggers extreme volatility in the exchange rate. Even if the payments under the FIT are made in US dollars, Turkey has import-dependent production structure, and fluctuations in the exchange rate are adversely affecting the market in general.[7]

Given the above shortcomings, the decision makers might lose confidence of investors. Individuals may avoid making long-term investments, and the willingness of private sector to invest in solar energy may decrease. It is thought that the atmosphere of instability and insecurity may deeply affect the dialogue between public sector and private sector negatively. Moreover, both sides might not believe in each other's sincerity even if they continue to negotiate. Manipulations may increase and investment decisions might be difficult to take due to above reasons.

As the market is an emerging market, many of the above mentioned shortcomings are expected to be overcome in time. There are many advantages as well as the

[6] http://yesilekonomi.com/yeka-gunes-modulu-fabrikasinin-temeli-atildi
[7] Note to show fluctuation in US dollar: at the beginning of this study 1 Turkish Lira (TL) was around $ 2.89, while surveying 1 TL fluctuated between $ 3.48 and $ 3.79; now –May,2018- 1 TL is fluctuating between $ 4.00 and $ 4.10.

disadvantages of being an emerging market. For instance, solar energy market has a young and highly dynamic structure. It is thought to be easily adaptable to innovations. Moreover, market agents often make meetings to discuss problems and necessities. They are quite open to supports and suggestions of other organizations- NGOs, NPOs. They also continue their dialogue with officials in the public sector. In addition, Turkey has geographical advantages on solar energy. If the officials continue to provide support for solar energy, solar energy investments will contribute to the reduction of energy dependency of Turkey.

In the light of the advantages and disadvantages of the market and main findings of the study, it is possible to make some policy recommendations.

Primarily, the authorities should definitely revise the FIT design. For instance, they should design FIT with regard to investment types (unlicensed, licensed investments and rooftop PV systems). Various contract periods, payment amounts should be used for each investment type. In other words, the government should give up monotype FIT implementation for all. In any case, longer contract period than 10-year is recommended. However, the contract duration should not be exceeded 15 years in order to protect the dynamic and competitive market structure. Implementation-monitoring-evaluation-revising is essential for this market due to the fact that it is an emerging industry. Given that both the solar energy market is an emerging market and exchange rate is unstable, the fixed payment type is considered to be more appropriate for the market.

Secondly, the policy makers should make decisions by focusing on their long term returns, and they tackle the problems from roots, not as temporary solutions. Before amendments, the opinions of experts from all fields of the market should be taken into consideration.

The last but not least, investing in rooftop PV systems is expected to be highly profitable in the long run. The government should offer various incentives to make it more attractive for households and firms. If households want to transfer the electricity generated from the rooftop photovoltaic systems to the grid, they can be benefit from FIT program. Therefore, households can be sold electricity and the government pays certain amount payment per kWh. However, the government cuts 20% income tax from these earnings. Longer contract period, abandonment of income tax for households;

discounts and certificates, advertisements for awareness are some policy recommendations to make PV investments more attractive.

Several studies on the solar energy market and renewable energy sources are available in Turkey. However, to the best of our knowledge, measuring the willingness to pay/ invest on the basis of CE and trying to determine the desired components of FIT design have not been examined in any previous study in the literature. By this unique characteristic it contributes to the existing literature and provides a pathway for future studies.

Finally, this study was done for the implementations which would increase PV investment. As everyone knows, the world is facing to threats of climate change and degradations of ecological balance. Unless transition to low-carbon economies achieved, the world will not be a place to live for all living things. Turkey is expected to benefit more from renewable energy sources, in particular solar energy and PV systems. This will be the healthiest attitude for both its own economy and a livable world.

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APPENDICES

APPENDIX A

THE QUESTIONNAIRE

Bu anket Hacettepe Üniversitesi İktisat Bölümü yüksek lisans öğrencisi Duygu Kural tarafından Türkiye'de güneş enerjisi ve fotovoltaik sistemler alanında yatırımlar yapan şirketlerin tarife garantisi (feed-in tariff) teşvik mekanizmasına dair tercihlerini öğrenebilmek amacıyla tasarlanmıştır. Ankette temel olarak **"Nasıl teşvik politikaları, ne ölçüde uygulanırsa güneş enerjisi alanındaki şirketlerin yatırım yapma isteği ve piyasaya dair güvenleri artar?"** ve **"Kamu sektörü ve özel sektör için optimum uygulama hangisidir?"** sorularına cevap aranmaktadır. Anketimize ilişkin cevaplar sadece akademik araştırma amacıyla kullanılacaktır ve yapacağımız çalışmaların sonuçları kamuoyu ile paylaşılacaktır, ancak hiçbir kimlik veya şirket bilgisi kamuoyuna sunulmayacaktır. Anketin sağladığı verilerle gerçekleştireceğimiz çalışmanın sonuçlarını sizlerle paylaşmamızı isterseniz, lütfen en arka sayfaya iletişim bilgilerinizi yazınız. Anketimiz yaklaşık olarak 20 dakika sürecektir. Anketi lütfen tükenmez kalem ile doldurunuz. Dürüst ve gerçek bilgiler vereceğiniz için teşekkürlerimizi sunarız.

Genel Sorular

1) Şirketinizin güneş enerjisi yatırımları yapan şirketler içerisindeki konumunu nasıl tanımlarsınız?

EPC Firması	
GES Yatırımcısı	

2) Şirket içerisindeki profesyonel pozisyonunuz nedir? ______________________________

3) Kaç senedir bu sektörde (güneş enerjisi) çalışmaktasınız? _________________________

4) Kaç senedir bu şirkette çalışmaktasınız? ____

5) Şirketinizin aşağıdaki çalışma alanlardaki faaliyet durumlarını 1-5 arasında değerlendiriniz.

	1-Aktif Değiliz.	2-Çok Az Aktif Olduğumuz Bir Alan.	3- Az Aktif Olduğumuz Bir Alan.	4-Aktif Olduğumuz Bir Alan.	5-En Aktif Olduğumuz Alan.
1)Proje Geliştirme					
2)Santral Kurulumu					
3)Santral İşletimi					
4)Bakım-Onarım					

6) Aşağıdaki önermeleri 1-5 arasında değerlendiriniz.

	1-Kesinlikle Katılmıyorum	2-Katılmıyorum	3-Nötr	4-Katılıyorum	5-Kesinlikle Katılıyorum
1) Önümüzdeki 5 yıl içerisinde proje geliştirme çalışmalarına ağırlık vereceğiz.					
	1-Kesinlikle Katılmıyorum	2-Katılmıyorum	3-Nötr	4-Katılıyorum	5-Kesinlikle Katılıyorum
2) Önümüzdeki 5 yıl içerisinde					

daha çok santral açarak elektrik üretimi yapacağız, büyük çaplı reel yatırımlara imza atacağız.					
3) Önümüzdeki 5 yıl içerisinde çatılara fotovoltaik sistemler kurarak çatılardan elektrik üretimi sağlayan projelere ağırlık vereceğiz.					
4) Önümüzdeki 5 yıl içerisinde sektöre bakım-onarım alanında daha çok hizmet sunacağız.					
5) Önümüzdeki 5 yıl içerisinde daha çok hava tahmin yöntemleri					

geliştirerek sektöre hizmet vereceğiz.					
6) Önümüzdeki 5 yıl içerisinde çalışmalarımıza aynı şekilde devam edeceğiz, herhangi bir değişiklik olmayacak.					

7) Aşağıdaki önermeleri 1-5 arasında değerlendiriniz.

	1-Kesinlikle Katılmıyorum.	2-Katılmıyorum.	3-Nötr	4-Katılıyorum.	5-Kesinlikle Katılıyorum.
1)Lisanssız yatırımlardaki 1MW'lık kota yatırımların artmasına engeldir.					
2)GES yatırımlarında -lisanslı veya lisanssız-bürokratik işlemler yatırım artmasına engel					

yaratmaz.					
3)Lisanslı yatırımlarda için yapılan yarışmalarda teklif edilen katkı payları çok yüksektir.					
4) Lisanslı yatırımlardaki teklif edilen katkı payları piyasanın dengelerini bozmamaktadır.					
5) Yenilenebilir enerji kaynaklarından elektrik üretme üzerine olan mevzuat anlaması, uygulaması zor; hata yapma olasılığı yüksek bir mevzuattır.					
	1-Kesinlikle Katılmıyorum.	2-Katılmıyorum.	3-Nötr	4-Katılıyorum.	5-Kesinlikle Katılıyorum.
6) Piyasadaki samimi olmayan					

yatırımcılar piyasanın gelişmesinin önündeki en büyük engeldir.					
7) Çatı sistemlerinin aktif bir biçimde kullanılmaması ve hanehalklarının fotovoltaik sistemlere yabancı olması piyasanın gelişmesini engellemektedir.					
8) KWH başına tarife garantisi miktarının proje büyüklüğüne göre farklılaştırılması piyasanın canlanmasını sağlayacaktır.					
9) KWH başına tarife garantisi miktarının projenin bulunduğu bölgeye göre					

farklılaştırılması piyasanın canlanmasını, yatırımcının daha fazla risk almasını sağlayacaktır.					

	1-Kesinlikle Katılmıyorum.	2-Katılmıyorum.	3-Nötr	4-Katılıyorum.	5-Kesinlikle Katılıyorum.
10) Yarışma temelli katkı payı keşfinde tavan fiyat uygulaması piyasadaki rekabeti daha canlı tutacak, piyasayı geliştirecektir.					
11) KWH başına tarife garantisi miktarı ile proje büyüklüğü arasında ters orantı olması piyasayı olumlu etkileyecektir.					

Seçim Deneyi Soruları

Anketin bu bölümü seçim deneyi sorularından oluşmaktadır. Seçim deneyi soruları lisanssız ve lisanslı yatırımlar için seçim deneyi soruları olmak üzere temel iki başlıktan oluşmaktadır. Bu bölümde her soruda katılımcıya 3 farklı program sunulmakta ve katılımcının kendisini karar mekanizması ya da GES yatırımcısı gibi düşünerek bir programı tercih etmesi beklenmektedir.

1) Lisanssız Fotovoltaik Yatırımları İçin Seçim Deneyi Soruları

Aşağıda lisanssız fotovoltaik yatırımlar için size sunulan 3 programdan programların özelliklerine bakarak hangisini seçerdiniz?

1. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	12 Yıl	15 Yıl	10 Yıl
Tarife Garantisi Tipi	Enflasyona Göre Ayarlanan Fiyat Modeli	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.133 $	0.133 $	0.133 $
Gözetim Vergisi	YOK	YOK	VAR (475.000 $, MW Başına)
MW Başına Maliyet	850.000 $	1.150.000 $	850.000 $
Tercihiniz:	☐	☐	☐

2. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	12 Yıl	15 Yıl	10 Yıl

Tarife Garantisi Tipi	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.1231 $	0.1231 $	0.133 $
Gözetim Vergisi	YOK	VAR (475.000 $, MW Başına)	VAR (475.000 $, MW Başına)
MW Başına Maliyet	1.150.000 $	1.450.000 $	850.000 $
Tercihiniz:			

3. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	12 Yıl	15 Yıl	10 Yıl
Tarife Garantisi Tipi	Başta Yüksek Ödeme Sonra Azalan Ödeme İçeren Fiyat Modeli (İlk 5 yılın ardından KWH başına bedelde %5 azalma)	Başta Yüksek Ödeme Sonra Azalan Ödeme İçeren Fiyat Modeli (İlk 5 yılın ardından KWH başına bedelde %5 azalma)	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.133 $	0.0891 $	0.133 $
Gözetim Vergisi	YOK	YOK	VAR (475.000 $, MW Başına)
MW Başına Maliyet	1.150.000 $	1.150.000 $	850.000 $
Tercihiniz:			

4. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	15 Yıl	10 Yıl	10 Yıl
Tarife Garantisi Tipi	Enflasyona Göre Ayarlanan Fiyat Modeli	Başta Yüksek Ödeme Sonra Azalan Ödeme İçeren Fiyat Modeli (İlk 5 yılın ardından KWH başına bedelde %5 azalma)	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.1231 $	0.1231 $	0.133 $
Gözetim Vergisi	YOK	YOK	VAR (475.000 $, MW Başına)
MW Başına Maliyet	1.000.000 $	850.000 $	850.000 $
Tercihiniz:	☐	☐	☐

5. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	10 Yıl	15 Yıl	10 Yıl
Tarife Garantisi Tipi	Sabit Fiyat Modeli	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.0891 $	0.133 $	0.133 $
Gözetim Vergisi	YOK	YOK	VAR (475.000 $, MW Başına)

MW Başına Maliyet	850.000 $	850.000 $	850.000 $
Tercihiniz:	☐	☐	☐

Yukarıdaki lisanssız güneş enerjisi santrali için belirlenen özellikleri program seçiminize etkisini 1-6 arasında kutucuklarda belirtilen bilgiler doğrultusunda değerlendiriniz.

	1-Hiç Önemli Değil.	2-Önemli Değil.	3-Kararsı-zım	4-Önemli	5-Çok Önemli	6-Değerlen-dirmede Göz önünde Bulundurmadım.
Tarife garantisi süresi						
Tarife garantisi tipi						
KWH başına bedel ($)						
Gözetim vergisi						
MW başına maliyet						

Yukarıdaki seçim deneyi sorularında eğer her soruda Program 3 seçtiyseniz nedeni aşağıdakilerden hangisi olabilir?

Nedenler	Seçiminiz
Yukarıdaki senaryoları anlamadım.	
Daha fazla maliyete katlanmak istemiyorum.	

Bugünün koşullarından oldukça memnunum ve bu nedenle benzer koşulların sürmesini istiyorum.	
Yukarıdaki senaryoları gerçekçi bulmuyorum ve bu senaryoların gerçekleşeceğine inanmıyorum.	
Diğer (Diğeri işaretlediyseniz nedeninizi yandaki kutucuğa yazar mısınız?)	

2) Lisanslı Fotovoltaik Yatırımları İçin Seçim Deneyi Soruları

Aşağıda lisanslı fotovoltaik yatırımlar için size sunulan 3 programdan programların özelliklerine bakarak hangisini seçerdiniz?

1. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	15 Yıl	12 Yıl	10 Yıl
Tarife Garantisi Tipi	Enflasyona Göre Ayarlanan Fiyat Modeli	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.1231 $	0.133 $	0.133 $
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için Sağlanan Destek	YOK	VAR	VAR
Yarışma Temelli Katkı Payı Keşfi	VAR (1.800.000 TL)	YOK	VAR (1.800.000 TL)
Gözetim Vergisi	YOK	YOK	VAR

			(475.000$)
MW Başına Maliyet	1.300.000 $	850.000 $	850.000 $
Tercihiniz:	☐	☐	☐

2. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	10 Yıl	10 Yıl	10 Yıl
Tarife Garantisi Tipi	Başta Yüksek Ödeme Sonra Azalan Ödeme İçeren Fiyat Modeli (İlk 5 yılın ardından KWH başına bedelde %5 azalma)	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.1231 $	0.0891 $	0.133 $
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için Sağlanan Destek	YOK	YOK	VAR
Yarışma Temelli Katkı Payı Keşfi	YOK	YOK	VAR (1.800.000 TL)
Gözetim Vergisi	YOK	YOK	VAR (475.000$)
MW Başına Maliyet	1.450.000 $	850.000 $	850.000 $

Tercihiniz:			

3. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	10 Yıl	12 Yıl	10 Yıl
Tarife Garantisi Tipi	Sabit Fiyat Modeli	Başta Yüksek Ödeme Sonra Azalan Ödeme İçeren Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.133 $	0.1231 $	0.133 $
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için Sağlanan Destek	YOK	YOK	VAR
Yarışma Temelli Katkı Payı Keşfi	YOK	YOK	VAR (1.800.000 TL)
Gözetim Vergisi	YOK	YOK	VAR (475.000$)
MW Başına Maliyet	850.000 $	1.150.000 $	850.000 $
Tercihiniz:			

4. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	15 Yıl	15 Yıl	10 Yıl

Tarife Garantisi Tipi	Sabit Fiyat Modeli	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.133 $	0.133 $	0.133 $
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için Sağlanan Destek	VAR	VAR	VAR
Yarışma Temelli Katkı Payı Keşfi	YOK	YOK	VAR (1.800.000 TL)
Gözetim Vergisi	YOK	YOK	VAR (475.000$)
MW Başına Maliyet	1.450.000 $	1.000.000 $	850.000 $
Tercihiniz:	☐	☐	☐

5. Özellikler	PROGRAM A	PROGRAM B	PROGRAM C
Tarife Garantisi Süresi	10 Yıl	10 Yıl	10 Yıl
Tarife Garantisi Tipi	Sabit Fiyat Modeli	Enflasyona Göre Ayarlanan Fiyat Modeli	Sabit Fiyat Modeli
KWH Başına Bedel ($)	0.1231 $	0.1231 $	0.133 $
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için	VAR	YOK	VAR

Sağlanan Destek			
Yarışma Temelli Katkı Payı Keşfi	VAR (1.800.000 TL)	YOK	VAR (1.800.000 TL)
Gözetim Vergisi	VAR (475.000$)	VAR (475.000$)	VAR (475.000$)
MW Başına Maliyet	1.300.000 $	1.450.000 $	850.000 $
Tercihiniz:	☐	☐	☐

Yukarıdaki lisanslı güneş enerjisi santrali için belirlenen özelliklerin program seçiminize etkisini 1-7 arasında kutucuklarda belirtilen bilgiler doğrultusunda değerlendiriniz.

	1-Hiç Önemli Değil.	2- Önemli Değil.	3- Kararsızım	4- Önemli	5-Çok Önemli	6- Değerlendirmede Göz önünde Bulundurmadım.
Tarife garantisi süresi						
Tarife garantisi tipi						
KWH başına bedel ($)						
Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik						

Aksamın Kullanılması için Sağlanan Destek						
Yarışma temelli katkı payı keşfi						
Gözetim vergisi						
MW başına maliyet						

Yukarıdaki seçim deneyi sorularında eğer her soruda Program 3 seçtiyseniz nedeni aşağıdakilerden hangisi olabilir?

Nedenler	Seçiminiz
Yukarıdaki senaryoları anlamadım.	
Daha fazla maliyete katlanmak istemiyorum.	
Bugünün koşullarından oldukça memnunum ve bu nedenle benzer koşulların sürmesini istiyorum.	
Yukarıdaki senaryoları gerçekçi bulmuyorum ve bu senaryoların gerçekleşeceğine inanmıyorum.	
Diğer (Diğeri işaretlediyseniz nedeninizi yandaki kutucuğa yazar mısınız?)	

3) Aşağıdaki politika değişikliği önerilerini bugünkü yatırımları ve piyasanın geleceğe yönelik güvenini artırması bakımından 1-5 arasında değerlendiriniz.

	1-Kesinlikle azaltır.	2-Azaltır.	3-Nötr	4-Artırır.	5-Kesinlikle artırır.
1)Çatıların fotovoltaik sistemler için kullanılmasının önünün açılması.					
2)Lisanssız yatırımlarda 1 MW sınırının yükseltilmesi.					
3)Gözetim vergisi oranının düşürülmesi.					
4)Tarife garantisi ödemesinin TL üzerinden yapılması.					
5)Lisanslı yatırımlar için yapılan yarışmalarda ödemelerin dolar üzerinden yapılması.					
	1-Kesinlikle azaltır.	2-Azaltır.	3-Nötr	4-Artırır.	5-Kesinlikle artırır.

6)Yeni yapılacak konutların çatılarına belli oranda fotovoltaik sistem kurulması zorunluluğu getirilmesi.					
7)Sektörde ithal edilen mallar için sabit döviz kurunun belirlenmesine karşılık tarife garantisi ödemesinde sabit döviz kuruna geçilmesi.					

Demografik Sorular

1) Yaşınız: ______

2) Cinsiyetiniz:

Kadın	
Erkek	

3) Eğitim Seviyeniz:

İlkokul	

Lise	
Önlisans	
Lisans	
Yüksek Lisans	
Doktora	

Üniversite mezunu iseniz lütfen hangi bölümden mezun olduğunuzu yazınız.

4) Şirketinizde çalışan toplam personelin kaçı kadın kaçı erkek aşağıdaki tabloya yazınız.

Cinsiyet	Sayı
Kadın	
Erkek	
Toplam	

Anketimiz burada bitmiştir. Katılımınız için teşekkür ederiz.

APPENDIX B

THE STATEMENT FOR CE and VOLUNTARY PARTICIPATION FORM

Lisanssız Fotovoltaik Yatırımları İçin Seçim Deneyi Soruları

Soruları cevaplamaya başlamadan sorularda yer alan özellikleri kısaca sizlere açıklamak istiyorum. Birinci özellik tarife garantisi süresi, devletin GES yatırımcısına sunduğu satın alım garantisi süresini göstermektedir. Bugün Türkiye'de 10 yıllık bir tarife garantisi süresi uygulanmaktadır, anketimiz ise 10,12,15 yıl seviyelerini içermektedir. İkinci özellik ise tarife garantisi tipidir. Bu özelliğin de amacı sunulan tarife garantisinin ödeme biçiminde koşullara göre değişiklik görülüp görülmemesinin yatırımcının kararını ne şekilde etkileyecek ortaya çıkarmaktır. Bugün Türkiye'de sabit tarife garantisi uygulanmaktadır. Ankette ise sabit tarife garantisi fiyat modelinin yanı sıra enflasyona göre ayarlanan fiyat modeli ile başta yüksek daha sonra azalan ödeme fiyat modeli de yer almaktadır. Sabit fiyat modelinde ödemeler her zaman sabit olmakta koşullar veya koşullarda yaşanan olumlu ya da olumsuz değişiklikler ödeme miktarını hiçbir şekilde etkilememektedir. Enflasyona göre ayarlanan fiyat modelinde yıllık enflasyon oranı baz alınarak KWH başına ödemede her yıl artış meydana gelmektedir, yalnız bu enflasyon oranı TL üzerinden değil $ üzerinden hesaplanan enflasyon oranıdır. Başta yüksek daha sonra azalan ödeme fiyat modelinde ise KWH başı ödeme yatırımın yapıldıktan, santral faaliyete geçtikten 5 yıl sonra %5 azaltılacaktır. Burada amaç ilk yıllarında yatırımın daha hızlı kompanse edilmesini sağlamak ve yatırımcıya bu şekilde destek olmaktır. Üçüncü özellik ise kWh başına yatırımcıya ödenen bedeldir. Türkiye'de bugün bu miktar 0.133 dolar/cent iken anketimiz kWh başına 0.133, 0.1231 ve 0.0891 dolar/cent miktarlarını içermektedir Bir diğer özellik ise gözetim vergisidir. Gözetim vergisi hiçbir öneride MW başına maliyete dâhil edilmemiştir. Programda gözetim vergisi var ise maliyet MW başına 475.000 dolar artacaktır; fakat öneride gözetim vergisi yok ise MW başına maliyet programda sunulduğu gibidir. Son olarak MW başına maliyet GEPA'nın kırmızı olarak belirlediği 1600 KWh/m2 ve üstü güneş radyasyonu alan alanlarda yapılan yatırımlar içindir. Lütfen seçimlerinizi bu açıklamayı göz önünde bulundurarak yapınız.

Lisanslı Fotovoltaik Yatırımları İçin Seçim Deneyi Soruları

Soruları cevaplamaya başlamadan sorularda yer alan özellikleri kısaca sizlere açıklamak istiyorum. Birinci özellik tarife garantisi süresi, devletin GES yatırımcısına sunduğu satın alım garantisi süresini göstermektedir. Bugün Türkiye'de 10 yıllık bir tarife garantisi süresi uygulanmaktadır, anketimiz ise 10, 12, 15 yıl seviyelerini içermektedir. İkinci özellik ise tarife garantisi tipidir. Bu özelliğin de amacı sunulan tarife garantisinin ödeme biçiminde koşullara göre değişiklik görülüp görülmemesinin yatırımcının kararını ne şekilde etkileyecek ortaya çıkarmaktır. Bugün Türkiye'de sabit tarife garantisi uygulanmaktadır. Ankette ise sabit tarife garantisi fiyat modelinin yanı sıra enflasyona göre ayarlanan fiyat modeli ile başta yüksek daha sonra azalan ödeme fiyat modeli de yer almaktadır. Sabit fiyat modelinde ödemeler her zaman sabit olmakta koşullar veya koşullarda yaşanan olumlu ya da olumsuz değişiklikler ödeme miktarını hiçbir şekilde etkilememektedir. Enflasyona göre ayarlanan fiyat modelinde yıllık enflasyon oranı baz alınarak KWH başına ödemede her yıl artış meydana gelmektedir. Başta yüksek daha sonra azalan ödeme fiyat modelinde ise tarife garantisi süresinin ilk yarısında enflasyon oranına göre hesaplanan KWH başı ödemenin daha üzerinde bir oranda ödeme yapılırken, ikinci yarısında yapılan ödeme enflasyon oranının altında olacaktır. Burada amaç ilk yıllarında yatırımın daha hızlı kompanse edilmesini sağlamak ve yatırımcıya bu şekilde destek olmaktır. Üçüncü özellik ise kWh başına yatırımcıya ödenen bedeldir. Türkiye'de bugün bu miktar 0.133 dolar/cent iken anketimiz kWh başına 0.133, 0.1231 ve 0.0891 dolar/cent miktarlarını içermektedir. Dördüncü özellik ise "Yurtiçinde İmal Edilen Mekanik veya Elektro-mekanik Aksamın Kullanılması için Sağlanan Destek"tir. Bu özellik ise kastedilen durum santrallerde yerli mal kullanımının kWh başına tarife garantisi bedeli üzerine eklenen bedeldir. Beşinci özellik ise yarışma temelli katkı payı keşfidir, lisanslı yatırımlarda santral için lisans alınmadan önce yapılan ihale ve bu ihalede MW başına devlete en fazla katkı payı ödemeyi teklif eden şirketin o bölgedeki lisansı almaya hak kazanması durumu kastedilmektedir, 1.800.000 TL maliyete neden olduğu varsayılacaktır bu çalışmada. Bir diğer özellik ise gözetim vergisidir. Gözetim vergisi hiçbir öneride MW başına maliyete dâhil edilmemiştir. Programda gözetim vergisi var ise maliyet MW başına 475.000 dolar artacaktır; fakat öneride gözetim vergisi yok ise MW başına maliyet programda sunulduğu gibidir. Son olarak MW başına maliyet GEPA'nın kırmızı olarak belirlediği 1600 KWh/m2 ve üstü güneş radyasyonu alan alanlarda yapılan yatırımlar içindir. Lütfen seçimlerinizi bu açıklamayı göz önünde bulundurarak yapınız.

Gönüllü Katılım Formu

Bu çalışma, Hacettepe Üniversitesi Bilimsel Araştırma Projelerini Destekleme Programı kapsamında yürütücülüğünü Doç. Dr. Özgür Teoman'ın gerçekleştireceği proje başvurusu için hazırlanmıştır. Çalışmanın amacı, Türkiye'deki güneş enerjisi-fotovoltaik sistemlere yatırımların artması için tarife garantisi mekanizmasına dair piyasa aktörlerinin algısını analiz edebilmek için bilgi toplamaktır. Çalışmaya katılım tamamıyla gönüllülük esasına dayanmaktadır. Ankette, sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir; elde edilecek bilgiler bilimsel yayınlarda kullanılacaktır.

Anket, genel olarak kişisel rahatsızlık verecek soruları içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda anketi uygulayan kişiye, anketi tamamlayamayacağınızı söylemeniz yeterli olacaktır. Anket sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Hacettepe Üniversitesi İktisat Bölümü'nden Doç. Dr. Özgür Teoman (Tel: (0312) 297 86 50 (155); E-posta: ozgurt@hacettepe.edu.tr) , Öğr. Gör. Dr. Shihomi Ara Aksoy (Tel: (0312) 297 86 50 (122); E-posta: sara@hacettepe.edu.tr) ve Duygu Kural (E-posta: duygu.kural@hacettepe.edu.tr) ile iletişim kurabilirsiniz. Bu çalışmaya tamamen gönüllü olarak katılıyorum ve istediğim zaman yarıda kesip çıkabileceğimi biliyorum. Verdiğim bilgilerin bilimsel amaçlı yayımlarda kullanılmasını kabul ediyorum. (Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

Katılımcı:

Adı Soyadı	Tarih	İmza	İletişim Bilgileri
	----/----/-----		

Araştımacı:

Adı Soyadı	Tarih	İmza	İletişim Bilgileri

APPENDIX C

ORİJİNALLİK RAPORU

HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
YÜKSEK LİSANS TEZ ÇALIŞMASI ORİJİNALLİK RAPORU

HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İKTİSAT ANABİLİM DALI BAŞKANLIĞI'NA

Tarih: 21/06/2018

Tez Başlığı: **AN ANALYSIS OF THE OPTIMAL DESIGN OF FEED-IN TARIFF POLICY FOR PHOTOVOLTAIC INVESTMENTS IN TURKEY**

Yukarıda başlığı gösterilen tez çalışmamın a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 90 sayfalık kısmına ilişkin, 21/06/2018 tarihinde şahsım/tez danışmanım tarafından Turnitin adlı intihal tespit programından aşağıda işaretlenmiş filtrelemeler uygulanarak alınmış olan orijinallik raporuna göre, tezimin benzerlik oranı % 17 'dir.

Uygulanan filtrelemeler:

1- ☒ Kabul/Onay ve Bildirim sayfaları hariç
2- ☐ Kaynakça hariç
3- ☐ Alıntılar hariç
4- ☒ Alıntılar dâhil
5- ☐ 5 kelimeden daha az örtüşme içeren metin kısımları hariç

Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Çalışması Orijinallik Raporu Alınması ve Kullanılması Uygulama Esasları'nı inceledim ve bu Uygulama Esasları'nda belirtilen azami benzerlik oranlarına göre tez çalışmamın herhangi bir intihal içermediğini; aksinin tespit edileceği muhtemel durumda doğabilecek her türlü hukuki sorumluluğu kabul ettiğimi ve yukarıda vermiş olduğum bilgilerin doğru olduğunu beyan ederim.

Gereğini saygılarımla arz ederim.

21/06/2018

Tarih ve İmza

Adı Soyadı: DUYGU KURAL
Öğrenci No: N12220319
Anabilim Dalı: İKTİSAT
Programı: İKTİSAT (İNG.) YÜKSEK LİSANS PROGRAMI

DANIŞMAN ONAYI

UYGUNDUR.

Doç.Dr. Özgür TEOMAN

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
MASTER'S THESIS ORIGINALITY REPORT

HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
TO THE DEPARTMENT OF ECONOMICS

Date: 21/06/2018

Thesis Title: **AN ANALYSIS OF THE OPTIMAL DESIGN OF FEED-IN TARIFF POLICY FOR PHOTOVOLTAIC INVESTMENTS IN TURKEY**

According to the originality report obtained by myself/my thesis advisor by using the Turnitin plagiarism detection software and by applying the filtering options checked below on 21/06/2018 for the total of 90 pages including the a) Title Page, b) Introduction, c) Main Chapters, and d) Conclusion sections of my thesis entitled as above, the similarity index of my thesis is 17 %.

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I declare that I have carefully read Hacettepe University Graduate School of Social Sciences Guidelines for Obtaining and Using Thesis Originality Reports; that according to the maximum similarity index values specified in the Guidelines, my thesis does not include any form of plagiarism; that in any future detection of possible infringement of the regulations I accept all legal responsibility; and that all the information I have provided is correct to the best of my knowledge.

I respectfully submit this for approval.

21/06/2018
Date and Signature

Name Surname: DUYGU KURAL

Student No: N12220319

Department: ECONOMICS

Program: ECONOMICS (English) MASTER PROGRAM

ADVISOR APPROVAL

APPROVED.

Assoc. Prof. Dr. Özgür TEOMAN

APPENDIX D

ETİK KURUL

T.C.
HACETTEPE ÜNİVERSİTESİ
Rektörlük

22 Şubat 2017

Sayı : 35853172/ 431 – 700

İKTİSADİ VE İDARİ BİLİMLER FAKÜLTESİ DEKANLIĞINA

Fakülteniz İktisat Bölümü öğretim üyesi **Prof. Dr. Hakan MIHÇI**'nın **Öğr. Gör. Dr. Shihomi ARA AKSOY** ve **Duygu KURAL** yardımcılığında yürüttüğü **"Türkiye'deki Fotovoltaik Yatırımlar İçin Optimal Tarife Garantisi Üzerine Bir Analiz/An Analysis of the Optimal Design of Feed-in Tariff Policy for Photovoltaic Investments for Turkey''** başlıklı projesi, Üniversitemiz Senatosu Etik Komisyonunun **14 Şubat 2017** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan uygun bulunmuştur.

Bilgilerinizi ve gereğini rica ederim.

Prof. Dr. Rahime M. NOHUTCU
Rektör a.
Rektör Yardımcısı

Hacettepe Üniversitesi Rektörlük 06100 Sıhhiye-Ankara
Telefon: 0 (312) 305 3001 - 3002 • Faks: 0 (312) 311 9992
E-posta: yazimd@hacettepe.edu.tr • www.hacettepe.edu.tr

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Yazı İşleri Müdürlüğü
0 (312) 305 1008