EVALUATING THE INVESTMENT BEHAVIOR OF COMMUNITY RENEWABLE ENERGY PROJECT INVESTORS AND POLICY RECOMMENDATIONS

by
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ABSTRACT

EVALUATING THE INVESTMENT BEHAVIOR OF COMMUNITY RENEWABLE ENERGY PROJECT INVESTORS AND POLICY RECOMMENDATIONS

If countries follow their stated policies it is estimated that there will be no major change in the distribution of energy resources and the share of fossil fuels will remain at a 74% level even in 2040. However, the role of communities and small size investors can play a huge role in the deployment of renewable energy and accordingly contribute to decreasing share of fossil fuels in the distribution of energy sources. This research aims to determine which motivations influence the size of the financial contribution made in community renewable energy projects and factors affecting further investment decisions of the members of the renewable energy cooperatives established in Turkey. In this context, two different frameworks were proposed based on extensive literature review and expert opinions. A questionnaire survey was developed to obtain both qualitative data and quantitative data and directed to members of renewable energy cooperatives established in Turkey. Based on 52 survey answers from 9 different renewable energy cooperatives, the Structural Equation Modeling technique was used for the analysis. The findings of the analysis and successful examples presented in the literature were used to make policy recommendations and to suggest what community renewable energy projects need. The results indicated that (i) household income and importance attached to return on investment are major factors determining the size of investment (ii) new regulation expectation is the major condition precedent for the further investment decision (iii) current policies on renewable energy cooperatives and small size investments need to be developed to increase the deployment of renewable energy and help to meet both national and international goals.

ÖZET

YENİLENEBİLİR ENERJİ KOMÜNİTELERİNDEKİ YATIRIMCI DAVRANIŞININ DEĞERLENDİRİLMESİ VE POLİTİKA TAVSİYELERİ

Ülkeler deklare ettikleri politikalarını izlerse eğer enerji kaynaklarının dağılımında dikkate değer bir değişiklik olmayacağı ve fosil yakıtların payının 2040 yılında bile %74 düzeyinde kalacağı tahmin edilmektedir. Ancak, komünitelerin ve küçük ölçekli yatırımcıların rolü yenilenebilir enerji dağılımının değişmesinde büyük bir rol oynayabilir ve buna bağlı olarak enerji kaynaklarının dağılımında fosil yakıtların payının azalmasına katkıda bulunabilir. Bu çalışma, hangi değişkenlerin komünite yenilenebilir enerji projelerine yapılan yatırım tutarını etkilediğini ve Türkiye'de kurulan yenilenebilir enerji kooperatifleri üyelerinin ilave yatırım kararlarını etkileyen faktörleri belirlemeyi amaçlamaktadır. Bu bağlamda, kapsamlı literatür taraması ve uzman görüşlerine dayalı olarak iki farklı model önerilmiştir. Hem nitel veriler hem de nicel veriler elde etmek için Türkiye'de kurulan yenilenebilir enerji kooperatiflerinin üyelerine yönelik bir anket çalışması geliştirilmiştir. Analiz için 9 farklı yenilenebilir enerji kooperatifinden 52 anket yanıtı elde edilmiş ve Yapısal Eşitlik Modelleme tekniği kullanılmıştır. Literatürde sunulan başarılı örnekler ve modellerin analiz bulguları politika tavsiyelerinde bulunmak ve komünite yenilenebilir enerji projelerinin neye ihtiyacı olduğunu analiz etmek amacıyla kullanılmıştır. Çalışmanın sonucu göstermiştir ki; (i) Hane halkı geliri ve yatırımın getirisine verilen önem yatırımın tutarını belirleyen en önemli faktörlerdir, (ii) Yeni regülasyon beklentisi yatırımcıların ilave yatırım kararları için bir ön koşuldur, (iii) Yenilenebilir enerjinin payının artırılması ve sürdürülebilirlik alanındaki hem ulusal hem de uluslararası hedeflerin yakalanabilmesine yenilenebilir enerji kooperatifleri ve küçük ölçekli yatırımların yardımcı olabilmesi için ilgili mevcut politikaların geliştirilmesi gerekmektedir.

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LIST OF ACRONYMS/ABBREVIATIONS

BAU	Business as Usual
CAGR	Compound Annual Growth Rate
CFI	Comparative Fit Index
CFO	Chief Financial Officer
CO2	Carbon Dioxide
CRE	Community Renewable Energy
EMRA	Energy Market Regulatory Authority
EU	European Union
EÜAŞ	Elektrik Üretim A.Ş.
EXIST	Energy Exchange Istanbul
FIT	Feed-in-Tariff
GHG	Greenhouse Gas
INDC	Intended Nationally Determined Contributions
IPARD	Instrument for Pre-Accession Assistance for Rural Development
MT	Megaton
OECD	Organization for Economic Co-operation and Development
PV	Photovoltaics
RESCoop	Renewable Energy Sources Cooperative
RSPV	Rooftop Solar Photovoltaic
SEM	Structural Equation Modeling
TEİAŞ	Türkiye Elektrik İletim A.Ş.
TLI	Tucker-Lewis Index
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
VCIF	Venture Capital Investment Funds

1. INTRODUCTION

Renewable energy cooperatives are formed by the local people coming together to benefit from existing local renewable energy sources to realize sustainable energy production. The main objectives of renewable energy cooperatives are to meet energy needs, to obtain economic value by selling excess energy to the grid, to reduce energy losses as a result of the installation of energy systems locally, to reduce energy prices by preventing energy monopolization and to gain a seat in the energy field of the society. Determining the factors that affect the investment behavior for the investments made in renewable energy cooperatives is essential to understand how the market performs and determine what industry needs. Two different frameworks were developed by conducting an extensive literature review to understand the dynamics of renewable energy cooperatives established in Turkey. A questionnaire survey was directed to members and proposed frameworks proposed were tested with the Structural Equation Modeling (SEM). The research is expected to contribute the body of knowledge (i) to determine which factors affect the size of the financial contribution for the investments made into renewable energy cooperatives, (ii) which factors influence the further investment decision for renewable energy cooperatives, (iii) recommend policies for increasing the deployment of renewable energy, especially for a developing country. The first chapter starts with a research background and followed by problem definition and statement, related studies, aims and objectives of the research, research methodology, scope and limitations, and finally organization of the research.

1.1. Research Background

The definition of renewable energy communities introduced by the European Union (EU) in 2001 (European Union, 2018), and the establishment of the renewable energy cooperatives were enabled in Turkey after the legislation in 2016 (Troya Renewable Energy Association, 2017). Although it has been four years past since the legislation, the development of renewable energy cooperatives stayed limited for Turkey. Several researches have investigated community renewable energy (CRE) projects such

as factors affecting willingness to be a part of the renewable energy communities was analyzed by Kalkbrenner and Roosen (2015), innovative financial methods to fund renewable energy projects were proposed by Vasileiadou *et al.* (2015) and motivations that effect size of investments made to renewable energy cooperatives was studied by Bauwens (2019). However, none of the studies that aim to identify factors that determine the size of the financial contribution and further investment decision concentrated on a developing country. Therefore, there is a great need to analyze the factors that have an influence on the size of the investment and further investment decisions and interrelations between the variables for a developing country.

1.2. Problem Definition and Statement

Considering that the "Stated Policy Scenario" will be followed, there will be no major change in the distribution of energy resources and the share of fossil fuels will remain at 74% level even in 2040 according to the report prepared by the International Energy Agency (2019). Even though "Sustainable Development Scenario" in line with the Paris Agreement will be followed, the fossil fuel ratio is expected to decrease only 58% level. Although big size renewable energy projects which contribute to decrease in the share of fossil fuel ratio are constructed and invested by private institutions, the role of communities and small size investors can play a huge a role in the deployment of renewable energy sources for countries, especially for a developing country like Turkey. However, the development of renewable energy cooperatives in Turkey stayed behind the expectations. Therefore, it is necessary to understand which factors determine the size of investments and influence further investment decision and accordingly, policy recommendations can be developed to support small size individual investments and renewable energy cooperatives by taking in to account policies followed around the world.

1.3. Related Studies

CRE projects based on different financial methods have been investigated by Derrick (1998), Vasileiadou, Huijben and Raven (2015), Horizon 2020 Prospect (2017), and

Degenhart *et al.* (2008). Moreover, incentive mechanisms for renewable energy projects have been studied by various researches Christianson (2001) emphasized government subsidies, Alizamir *et al.* (2016) analyzed FIT (Feed-in Tariff) mechanism, Bundgaard and Lexner, (2011) concentrated on tax incentives, Wieg *et al.* (2011) demonstrated the alternative incentives involves local authority participation. The motivation of people to become a member of a renewable energy community varies and has been investigated with plenty of studies. The impact of the supportive policies including the FIT has been discussed by Fleiß *et al.* (2017) and by Wierling *et al.* (2018), the effect of environmental concerns has been investigated by Gadenne *et al.* (2011) and by Kalkbrenner and Roosen (2015), and also social reasons, demographics or participating in the management factors have been studied by Holstenkamp and Kahla (2016), Prete *et al.* (2017), Ameli and Brandt (2015) and by Dóci and Vasileiadou (2015). Although most of the studies concentrated on the willingness of the participation in a CRE project, the most similar study found in literature was conducted in Belgium by Bauwens (2019) who researched which factors affect the size of financial contribution, but he did not take into account further investment motivations of the members. Besides the results are expected to be different since investment motivations and determinants of the size of investments can differ for a developed country, Belgium, and a developing country, Turkey.

1.4. Aims and Objectives of the Research

To understand the critical factors that could play a role in the deployment of renewable energy investments starting from community-based projects and small size individual investments, this research aims to determine which motivations influence the size of the financial contribution made in CRE projects and motivations affecting further investment decision of the members of the renewable energy cooperatives through developed models by using (SEM) Objectives of the study can be listed as:

(i) To determine factors affecting the size of financial contributions in renewable energy cooperatives through developed models by using SEM analysis,
(ii) To understand which factors influence further investment decision based on the

results of the developed models by using SEM analysis,

(iii) To recommend policies on how to increase the deployment of renewable energy and help to meet both national and international goals considering the results of the developed models and successful examples presented in the study.

1.5. Research Methodology

First, a literature survey was conducted to determine the main factors affecting the investment decision for renewable energy projects, and a questionnaire survey was created to direct the members of renewable energy cooperatives established in Turkey. Based on the literature review, the factors investigated in questionnaire survey include but not limited to environmental concerns, demographics, cooperative related issues, the importance attached to return on investment, electricity price, new regulation expectations of the members. For the statistical analysis SEM was used to understand relations between investigated factors obtained from literature review. The data collected through online responses and face to face interviews are analyzed by SEM analysis through the models developed in IBM SPSS AMOS software. Two different structural equation models were developed to test the suggested hypotheses and the validity of the models were tested considering the threshold values. The factors affecting the size of financial distribution and relations between the other variables were analyzed in the first model while the factors affecting further investment decision is studied in the second model. The findings of the analysis were discussed and to increase deployment of CRE projects policy recommendations were provided based on the successful examples studied in the thesis.

1.6. Scope and Limitations

The scope of the research involves renewable energy cooperatives established in Turkey based on the survey responses provided by the members of these cooperatives. Therefore, this research is limited to renewable energy cooperatives established in Turkey. The limitation of the study can be argued as a small sample size. Moreover, the survey can be directed to other developing countries with similar renewable energy

incentive mechanisms background.

1.7. Organization of the Research

This thesis consists of six chapters. The first of them provides the background of the research, problem definition and statement, related studies aims and objectives of the research, research methodology, scope and limitations, and organization of the research. The second chapter presents the global energy market and position of renewable energy in it, projections for the global energy demand and share of renewables, Turkey's energy market and share of renewables, the concept of CRE and projects based on plant type, different financial methods, incentive mechanisms for renewable energy projects and different investment motivations supporting CRE projects. The methodology used to assess investment motivations determining the size of financial contribution and further investment decision is explained in the third section. The results of the research and developed models are presented in the fourth chapter. The discussions regarding the results are provided in the fifth chapter. The main findings, observations, and recommendations are provided in the sixth chapter. Finally, the sample questionnaire survey is included in the Appendix section.

2. HISTORY-FUTURE OF RENEWABLE ENERGY AND CRE PROJECTS

2.1. Global Energy Market

One of the biggest challenges of today is to meet globally rising energy demand while trying to reduce greenhouse gas (GHG) emissions. Even though, it is not easy for countries to give up conventional energy power plants to meet their energy demand, especially for the energy exporters, to achieve both goals there must be a shifting trend towards renewable energy consistent with the targets determined in Paris Accord according to a report published by International Energy Agency (2019). On the other hand, the report states that energy-related GHG emissions hit historic high levels in 2018. Besides, you can find Figure 2.1 below that illustrates Carbon Dioxide (CO2) emissions in megatons (MT) by energy source.

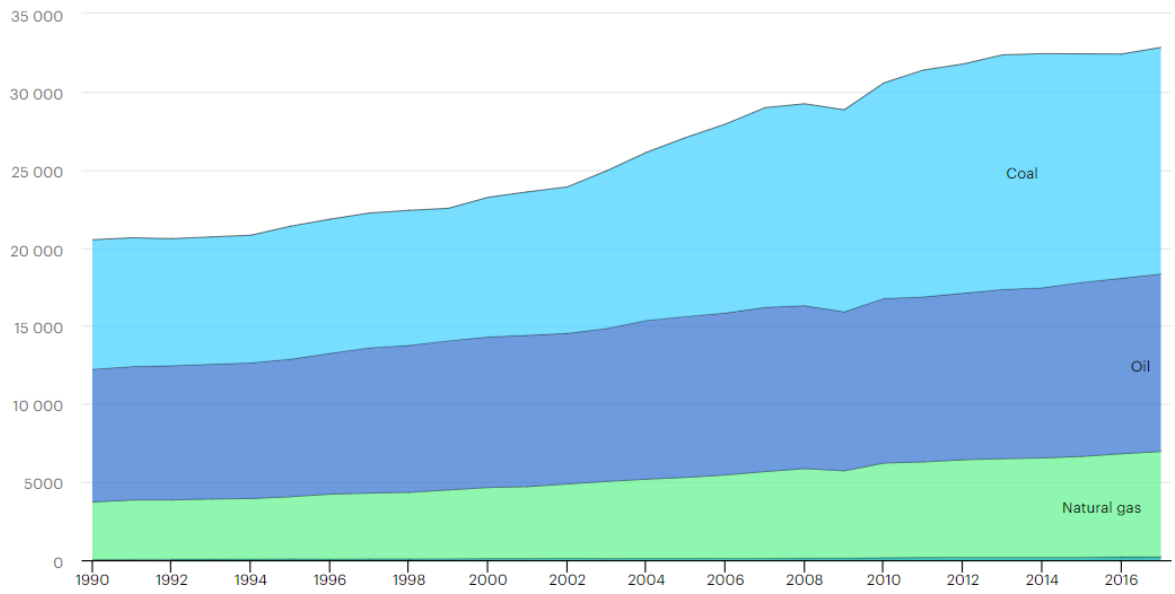

Figure 2.1. CO_2 Emissions by Energy Source, World 1990-2017 (International Energy Agency, 2019).

Based on a research of the World Energy Council (2019) which includes survey responses and reflecting the views of almost 2.300 energy leaders from 86 countries, a

global perspective on energy transition map is created as presented in Figure **??**. World Energy Issues Monitor 2019 states that commodity prices, electric storage, digitalization, economic growth, the market design have critical uncertainties. Energy leaders believe that as renewable energy becomes more cost-competitive market design rules will be updated and investments will be directed to electrical supply security, grid reliability, and resiliency with the help of innovative policies towards energy efficiency or renewables. Moreover, the leaders of energy industry also believe that global strategic competition and nationalism are among the critical uncertainties in the energy sector as experienced with the imposed tariffs and quotas for the solar panels to China by United States of America (USA). Additionally, energy leaders argue that the emergence of other sources like cobalt and lithium will play a crucial role in determining commodity prices in the near future as electric vehicles penetrate markets. The global narrative also underlies that de-carbonization cannot be achieved without renewable energy and energy efficiency which were determined as two main action priorities with the highest impact levels as shown in Figure 2.2 below.

Global energy consumption increased by 2.3% in 2018 and doubled the average growth rate between 2010 and 2018. This increase resulted from expanding the global economy and higher heating and cooling needs whereas the biggest contribution came from natural gas with covering 45% of the total energy demand. Fossil fuels still account for 70% of the total energy demand. Even though renewables increased in double digits that increase was not enough to meet the increase in global energy demand according to the report published by International Energy Agency (IEA) (2019). Moreover, the report also argues that due to an increase in total energy consumption CO_2 emissions increased by 1.7% and reached 33.1 Giga tons. Coal-fired power plants are the major carbon emitter with a 30% share in total CO_2 emissions. Moreover, China, USA, and India totaled 70% of almost 70% of the rise in energy demand and the USA accounted the largest portion of the oil and gas demand increase.

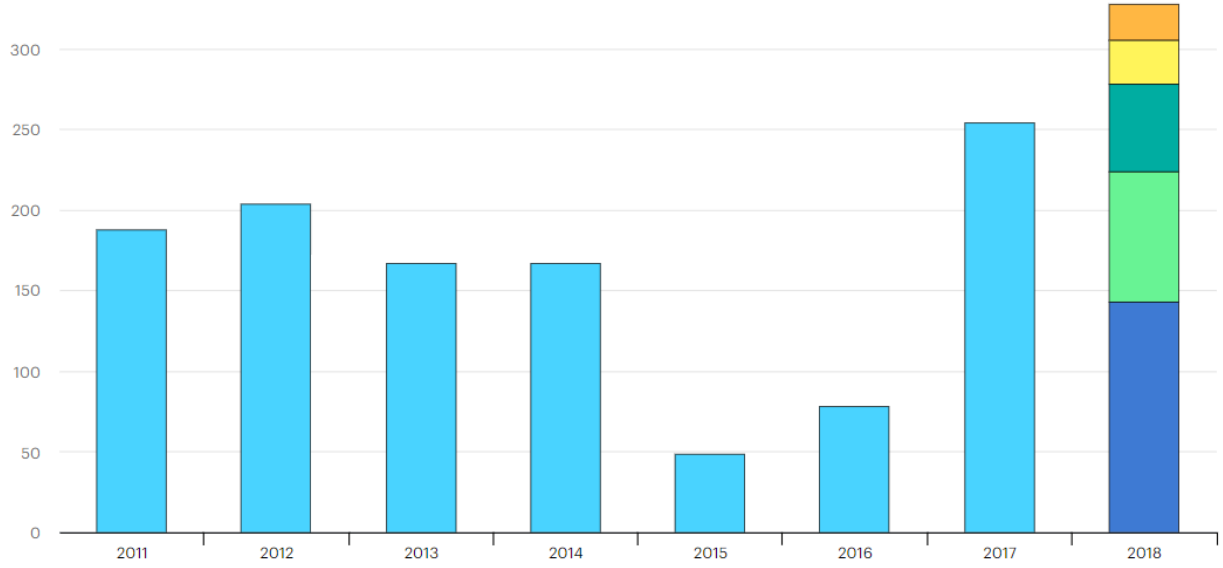

Figure 2.2. Annual Change in Global Primary Energy Demand, 2011-2018 (International Energy Agency (IEA), 2019).

On the other hand, fossil fuels constituted 79.7% of total energy consumption in 2017, whereas renewable energy could only contribute to total energy consumption with 18.1% according to report published by IEA (2019). The report also states that modern renewable energy sources accounted for 10.6% of total final energy consumption and the remaining share was supplied by the traditional use of biomass for cooking and heating especially in developing countries.

Estimated renewable energy and other energy source shares in total final energy consumption as of 2017 are provided in Figure 2.4 below based on the report published by Murdock (2019).

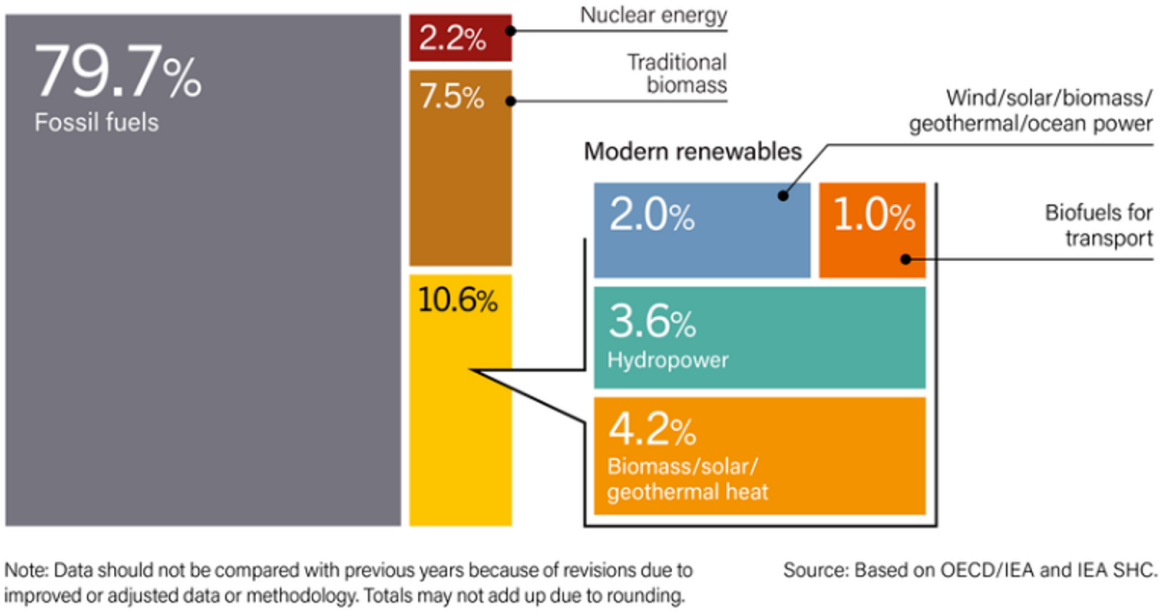

Figure 2.3. Estimated Renewable Share of Total Final Energy Consumption, 2017 (Murdock, 2019).

Moreover, Murdock (2019) also states that as of 2018 renewable energy has one-third of the total installed capacity in the electricity generation sector and it increased its capacity by 181 GW in 2018 which is 64% of the net installation. Moreover, in the power sector renewables account for providing 26% of total final energy demand and it continues to increase its share. Share of renewables in net annual additions of power generating capacity between 2008 and 2018 is illustrated in Figure 2.4 below.

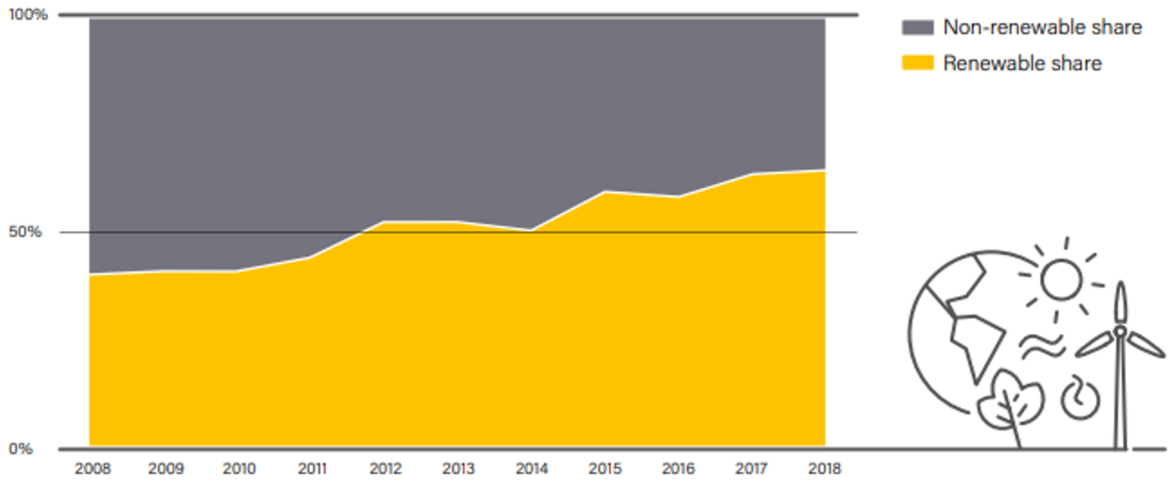

Figure 2.4. Share of Renewables in Net Annual Additions of Power Generating Capacity, 2008-2018 (Murdock, 2019).

Based on the projection of McKinsey & Company (2019), electricity consumption is expected to double until 2050 and renewables will account for 50% of the total installed capacity until 2035. On electricity consumption side this projection based on increasing electrification with the help of electrical vehicles and increasing living standards of non- Organization for Economic Co-operation and Development (OECD) countries. On the renewable side, this projection relies on renewables to become cheaper in most of the regions after 2030 and the main contributors to the installed capacity will be China and India. Furthermore, as a result of the shifting trend towards renewables, coal demand is expected to decrease by 50% between 2040 and 2050 conditional to the level of technology improvements and market structure. Changes in electricity consumption levels and their share in total final energy consumption projection and projection of the share of renewables in global power generation are shown in separate figures below (Figure 2.5 and Figure 2.6).

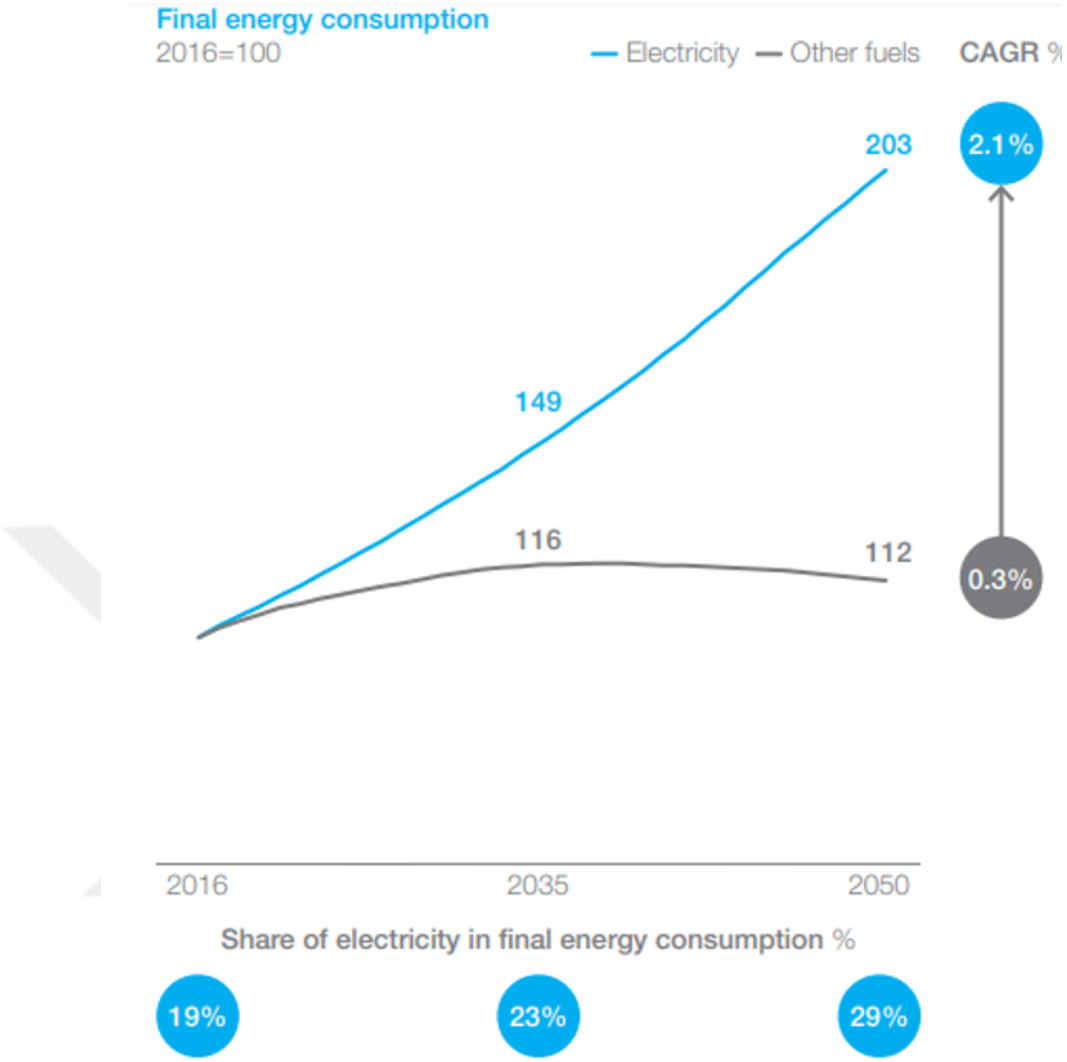

Figure 2.5. Share of Electricity in Final Energy Consumption, 2016-2050 (Mckinsey & Company, 2019).

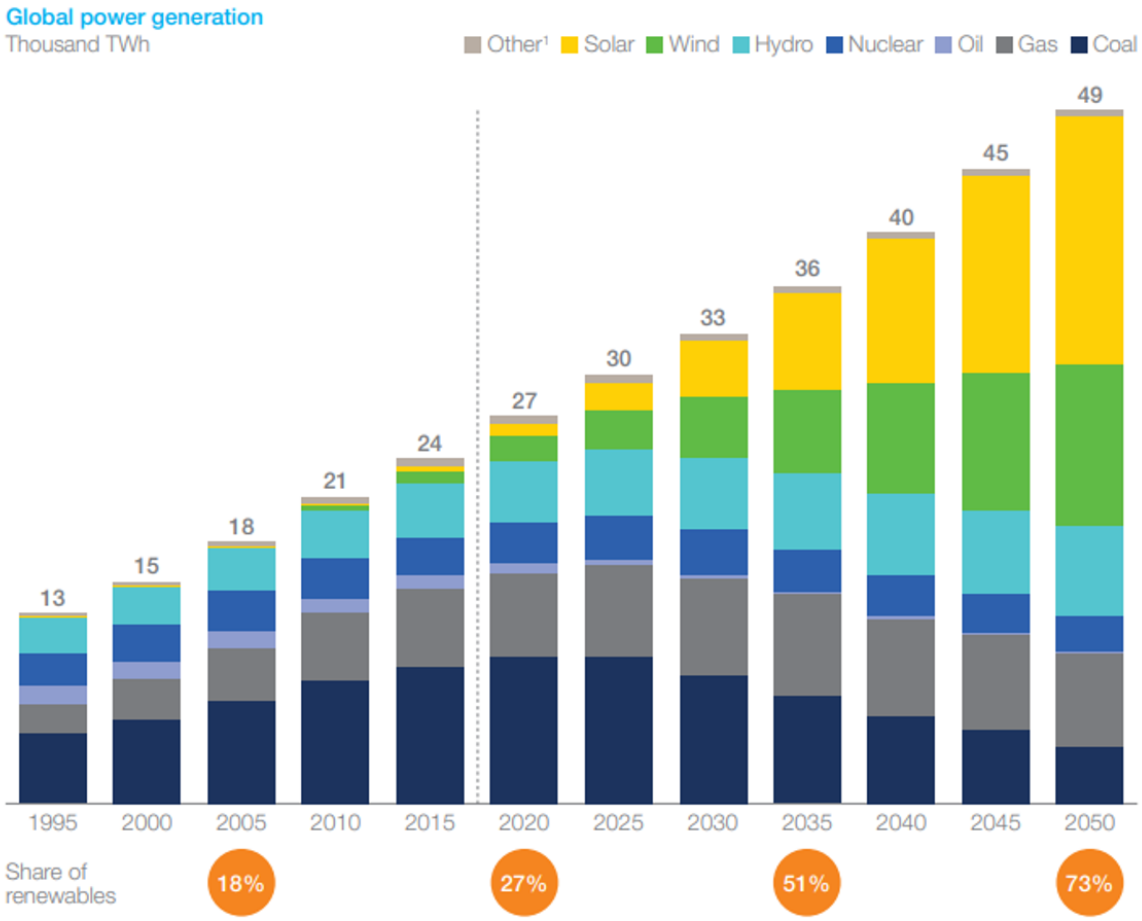

Figure 2.6. Projection and Historical Share of Renewables in Global Power Generation, 1995-2050 (Mckinsey & Company, 2019).

To accomplish such an increase in the share of renewables there is a need for a globally mutual goal as agreed upon in the Paris Accord.

2.1.1. Turkey's Energy Market

The report published by Presidency of the Republic of Turkey (2019) states that increasing economic activity and strong demographics have been supporting Turkey's need for energy and natural sources which resulted in a 5.5% electricity demand CAGR (Compound Annual Growth Rate) since the 2000s. Moreover, the report of Turkey Ministry of Foreign Affairs (2016) argues that the main characteristic of the Turkish energy market can be defined as the dependency on imports and growing energy demand. Besides, the base of Turkey's energy strategy can be summarized as priori-

tizing energy supply security by considering energy demand and import dependency, to achieve a sustainable development considering environmental issues, increasing efficiency and productivity through creating a transparent and competitive market dynamics by privatizations as advocated in the report. To achieve these Turkey has been taking the following steps as summarized in the report of Turkey Ministry of Foreign Affairs; diversification of energy portfolio, and energy supply routes, increasing the local and renewable energy mix, increasing energy efficiency, and adding nuclear to the energy portfolio.

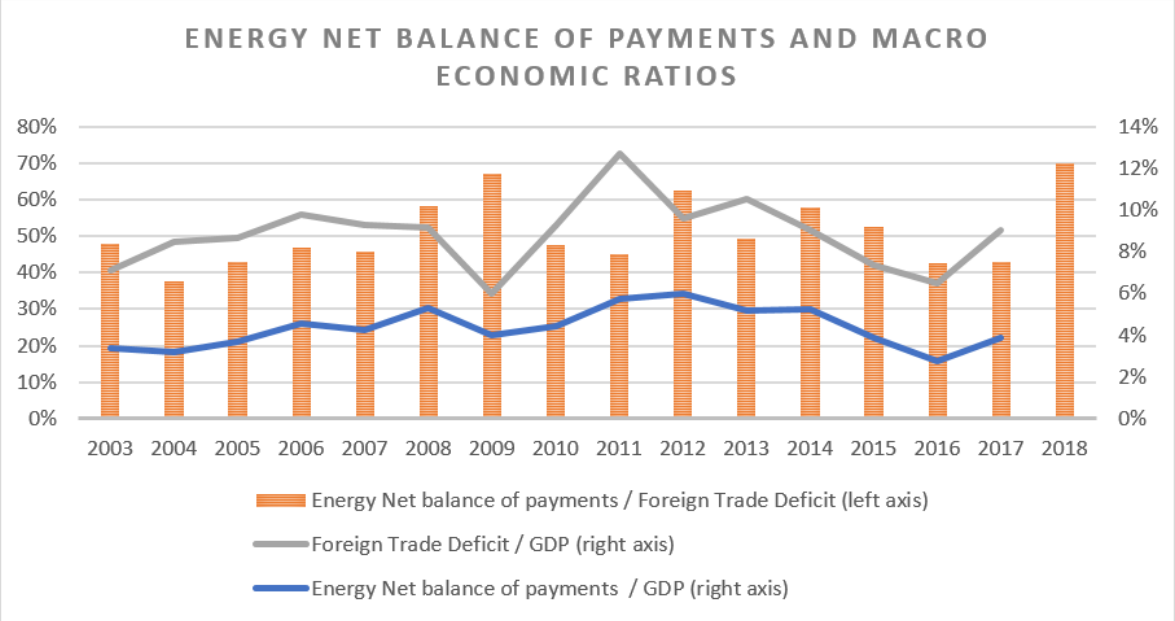

Figure 2.7. Turkey's Energy Net Balance of Payments and Macro Economic Ratios (CBRT, 2020).

According to data published by the Central Bank of the Republic of Turkey (CBRT) (2020), the balance of net energy payments ranges between 40% to 70% of Turkey's foreign trade deficit over the years.

As can be seen from the Figure 2.8 below created based on the data provided by CBRT (2020), considering the development of Brent Oil price in the last 15 years, the costs arising from the price increase did not reflect the end-users and it can be inferred that price increases are being subsidized by the state budget. Turkey's energy-

dependent position on foreign sources has led to 500 billion USD net imports over the last 15 years.

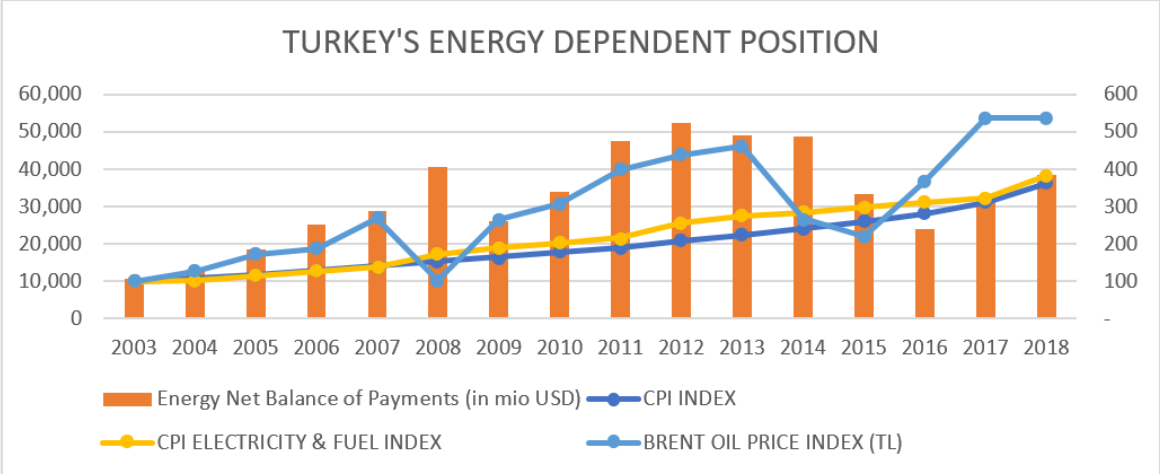

Figure 2.8. Turkey's Energy Dependent Position, 2003-2018 (CBRT, 2020).

To avoid such an energy-dependent position, Turkey continuously expands its installed capacity by diversifying its energy mix. As can be seen from the chart below Turkey's installed capacity almost quadrupled in the last 19 years.

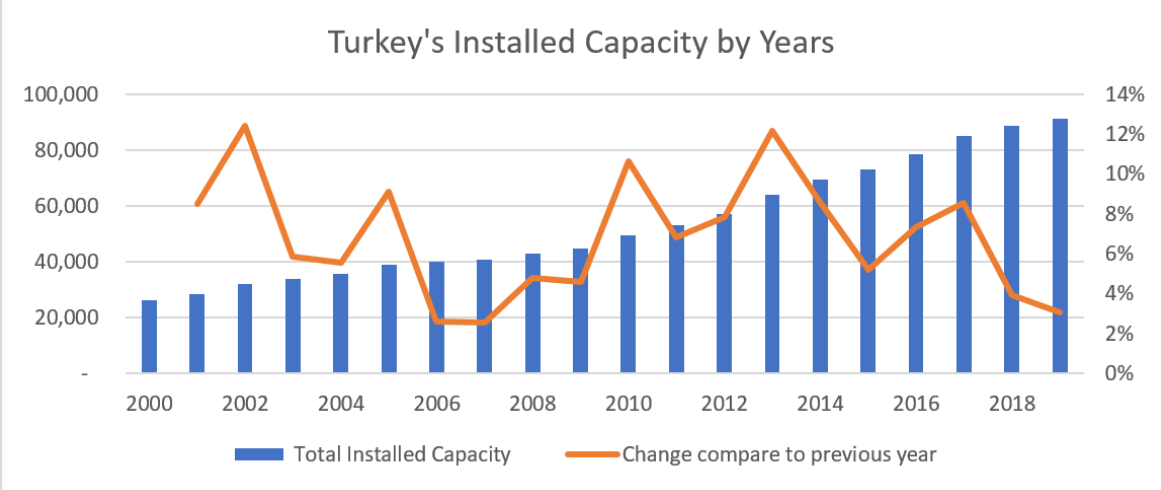

Figure 2.9. Turkey's Installed Capacity by Years, (CBRT, 2020).

Moreover, 46% of the new installed capacity added in 2018 was realized with solar projects according to a report published by Turkish Electricity Transmission Company known as Türkiye Elektrik İletim A.Ş. (TEİAŞ) (2019b) with the support

of FIT mechanism and other incentives. Increasing the installed capacity of renewable energies can reduce the energy dependency of Turkey and plays an important role in switching energy portfolio through renewable energies.

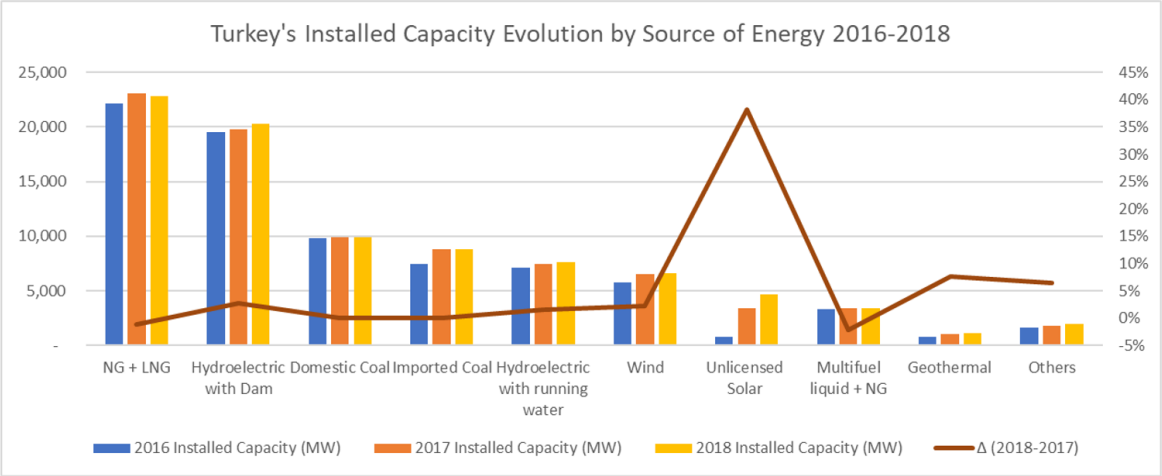

Figure 2.10. Turkey's Installed Capacity Evolution by Source of Energy, 2016-2018.

As of November 2019, there are 8,474 power plants with having 91.27 GW of installed capacity while renewables account for 49% of the total installed capacity. 78% of the total installed capacity is operated by private companies while 22% of the total installed capacity is owned by Turkey Electricity Production Company known as Elektrik Üretim A.Ş. (EÜAŞ) based on numbers provided by TEİAŞ (2019b).

Table 2.1. Turkey's Installed Capacity by Source of Energy, as of Nov 2019.

	Number of Plants	Installed Capacity (MW)	% of Total installed capacity
Naturelgas	331	25.93	28%
Dam	124	20.643	23%
Lignite	48	10.101	11%
Import Coal	15	8.967	10%
River type	556	7.858	9%
Wind	274	7.555	8%
Solar	6789	5.894	6%
Geothermal	54	1.515	2%
Bituminous coal	4	811	1%
Biomass	181	792	1%
Fuel Oil	14	439	0%
Asphaltic Coal	1	405	0%
Waste Heat	80	355	5
Naphta	1	5	0%
LNG	1	2	0%
Diesel	1	1	0%
Total	8.474	91.27	100%

Table 2.2. Turkey's Installed Capacity by Type of Plants, as of Nov 2019.

	State Owned EÜAŞ Plants	Transfer of Operational Rights Plants	Private Power Plants	BOT Plants	Unlicensed Plants	Total
River type	167	544	7.103	40	9	7.858
Asphaltic Coal	-	-	405	-	-	405
Waste Heat	-	-	156	-	199	355
Dam	12.615	913	7.015	100	-	20.643
Biomass	-	-	717	-	74	792
Naturalgas	4.993	-	20.814	-	123	25.93
Fuel Oil	-	-	439	-	-	439
Solar	-	-	163	-	5.731	5.894
Import Coal	-	-	8.967	-	-	8.967
G e othermal	-	15	1.5	-	-	1.515
Lignite	1.804	1.915	6.322	-	-	10.101
LNG	-	-	2	-	-	2
Diesel	1	-	-	-	-	1
Naphta	-	-	5	-	-	5
Wind	7		7.467	-	71	7.555
Bituminous coal	-	-	811	10	-	811
Total	19.582	3.447	61.884	151	6.206	91.27

To explore more, Turkey's gross electricity generation mostly relies on thermal sources with 56% of the total gross generation according to 11 monthly data in 2019. Renewables account for 43% of the total gross generation while imports and exports effect is not significant based on the data provided by TEİAŞ (2019a).

Table 2.3. Turkey's Gross Electricity Generation by Primary Energy Resources 2019 11M.

Turkey's Gross Electricity Generation	201911M	% in Gross Generation
THERMAL	155.234	56%
Hard Coal+Imported Coal	59.499	22%
Lignite	42.35	15%
Liquid Fuels	827	0%
Natural Gas+Lng	48.857	18%
Renew and Wastes	3.701	1%
HYDRO	83.568	30%
GEOTHERMAL+WIND+SOLAR	36.148	13%
GROSS GENERATION	274.95	100%
IMPORTS	1.912	
EXPORTS	2.599	
GROSS DEMAND	274.262	

2.2. Paris Accord

Paris Accord is an international deal signed by 195 countries, in late 2015, except Syria due to war and Nicaragua signed in late 2017 as documented by United Nations Framework Convention on Climate Change (UNFCCC) (2015). Aim of the Paris Accord is to limit global warming to 'well below' 2^oC, or 1.5^oC if possible. Intended Nationally Determined Contributions (INDCs) were introduced as voluntary pledges setting out how they plan to limit countries' GHG emissions during the 2020s. The non-binding decision text asks countries to come back before 2020 and to revisit the pledges they have made, and to then make new pledges every five years thereafter. On top of it, this agreement encourages rich nations to provide funding to poorer ones.

2.2.1. Paris Accord and Turkey

Considering that the countries that signed Paris Accord also need to build new energy plants to meet their citizen's energy needs, INDCs were mostly based on renewable energies which are consistent with the targets of the Paris Accord and also enable countries to meet their future energy demand. As agreed on UNFCCC (2015), Turkey's INDC can be summarized as up to 21 percent reduction in GHG emissions from the Business as Usual (BAU) level by 2030 which will enable Turkey to become a low carbon development pathway and will help to limit global temperature increase below 2°C. Turkey supports its INDC with both current and the new legislation which can be listed as; 10th National Development Plan, National Strategy on Climate Change, National Climate Change Action Plan, National Strategy on Industry, Strategy on Energy Efficiency, National Strategy and Action Plan on Recycling, National Legislation on Monitoring, Reporting and Verification of GHG emissions, National Smart Transportation Systems Strategy Document for years between 2014 and 2023 and its Action Plan for years between 2014 and 2016. To meet the financial needs Turkey will benefit from the international financial, technological, technical, and capacity-building support, including finance from the Green Climate Fund.

To achieve challenging up to 21 percent reduction in GHG emissions Turkey's plans and policies to be implemented divided by sectors and energy sector related major targets can be summarized as; increasing solar power capacity to 10 GW, increasing wind power capacity to 16 GW, exploiting the full hydroelectric capacity, commissioning of a nuclear power plant until 2030. As can be seen, most of the energy-related plans and policies to achieve the INDC of Turkey include increasing capacity of renewable energy as stated in UNFCCC (2015).

Emission reductions that can be achieved with a mitigation scenario can be seen from the below Figure 2.11 which also provides information about the BAU scenario.

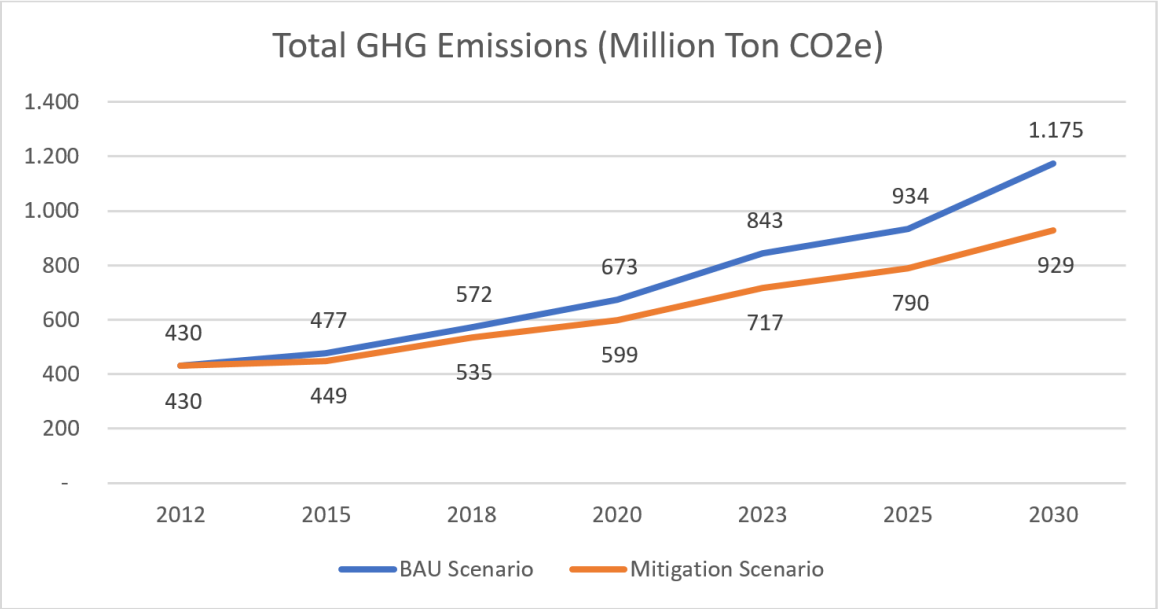

Figure 2.11. Mitigation and BAU Scenarios Total GHG Emissions, Turkey.

2.3. Global Renewable Energy Market

Last ten years there has been considerable growth in renewable energy plants due to major technological advancements and accordingly cost reductions especially for solar photovoltaics (PV) and wind power according to the report published by International Energy Agency (2019). Moreover, the report also underlines that although the power generation sector enjoyed these advancements there has been very limited growth in end-use sectors like industry and buildings. Solar PV, wind, and hydro accounted for approximately 90% of the 181 GW of newly installed renewable energy capacity in 2018.

Darby (2018) advocated that the private sector has been playing a key role in the energy transition towards renewables through procurement and investment of renewable energy technologies. Even companies that own develop or operate fossil fuels change their investment directions toward renewable energies resulted from distributing their risk, to become a player in the rapidly growing renewable energy market.

Although a total of USD 288.9 billion was invested in renewable energy power plants in 2018, this number is 11 percent less than 2017 due to a slow-down in China's economy according to the report published by Murdock (2019). The report also reviews that another reason for the decline in monetary terms might be due to the decreasing cost of renewable energies in other words more capacity can be installed with an equal amount of money as advancements in renewable energy technologies achieved and decrease its costs.

International Energy Agency created two projections for the development of renewable energy technologies under two different scenarios. The first scenario includes the outcome of the stated policies and the other one includes what is needed to achieve sustainable development. United Kingdom Energy Trends (2019) report indicated that as of 2018 total installed capacity of renewable energy is about 2,500 GW, with the implementation of stated policies this number is estimated to reach 7,250 GW whereas sustainable development scenario suggests 11,000 GW of installed renewable energy capacity. Figure 2.11 shows renewable electricity capacity by region under different scenarios between 2018-2040 is provided below.

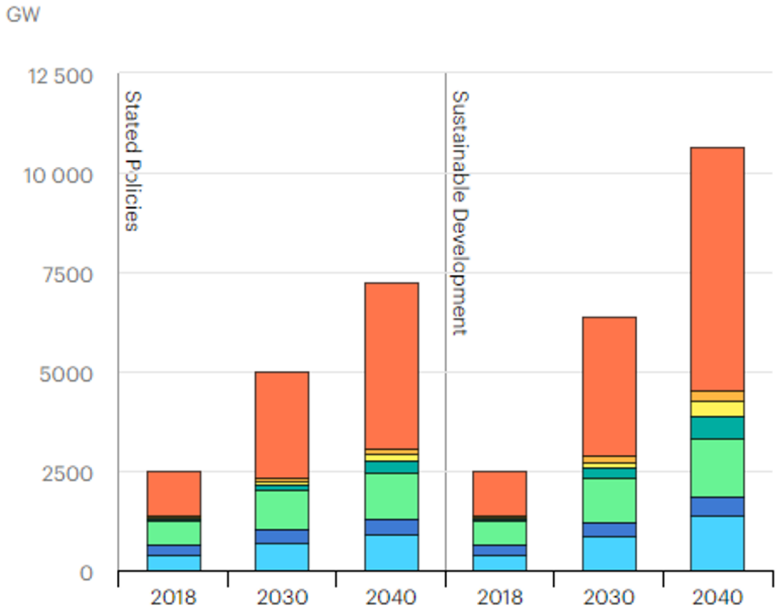

Figure 2.12. Renewable Electricity Capacity by Region and Scenario, 2018-2040 (United Kingdom Energy Trends, 2019).

Furthermore, for stated policies scenario, amount of annual average investment in renewables is projected approximately USD 10.5 trillion, whereas for sustainable development scenario this amount reaches up to USD 15.6 trillion until 2040 this major increase reflects the stronger policy support to achieve sustainable energy goals based on the report published by International Energy Agency (2019).

Table 2.4. Global Annual Average Investment in Renewables by Scenario 2019-2040 (billion USD) (Agency, 2019).

Global annual average investment in renewables by scenario (billion USD 2018)	Stated Policies		Sustainable Development		Δ	
	2019-2030	2031-2040	2019-2030	2031-2040	2019-2030	2031-2040
Renewables-based power generation	329	378	528	636	⇑ 60%	⇑ 68%
Wind	111	122	180	223	⇑ 62%	⇑ 83%
Solar PV	116	125	179	191	⇑ 62%	⇑ 53%
Other	102	131	169	222	⇑ 54%	⇑ 69%
End Use Sectors	117	139	124	145	⇑ 66%	⇑ 4%
Total	446	517	652	781	⇑ 6%	⇑ 51%
Cumulative	5352	5166	7829	7802	⇑ 46%	⇑ 51%

As can be seen from Figure **??** above sustainable development scenario advocates that the world needs more wind power than other renewable energy sources. To widen this subject, with higher capacity factors compare to wind power plants and solar PVs offshore wind energy has technically capable of providing total energy demand of the world. Therefore, in the sustainable development scenario, offshore wind energy is projected to penetrate mainly into China and USA with its success in Europe over the past years according to International Energy Agency (2019).

2.3.1. Renewable Energy Market in Turkey

Due to strong demographics and increasing energy need as a result of digitalization around the globe, Turkey's need for energy resources has been increasing inherently which resulted in installed capacity to reach 90 GW levels as of 2019 from 25 GWs in 2000. Renewable energy has contributed to this significant increase as a result of

regulations supporting renewable energy, advancements in technology, and convenient environmental conditions. As it was stated earlier, renewables account for 43% of the total gross generation as of 2019 11M data announced by TEİAŞ (2019b).

According to the report published by the Presidency of The Republic of Turkey (2019), the government stated that their dedication to increasing share of the renewables in Turkey's energy mix will continue and set the following goals;

- Increasing the share of renewables to 30 percent by 2023
- Increasing geothermal installed capacity to 3,000 MW by 2023
- Maximizing the use of hydropower
- Increasing wind installed capacity to 16,000 MW by 2027
- Increasing solar installed capacity to 16,000 MW by 2027

Considering the environmental conditions, Turkey has a great potential for renewable energy. For instance, theoretical hydroelectricity potential of Turkey is 1% of theoretical potential of the world, wind energy potential is estimated as 48 GW, total solar energy derived per year is 1,527 kWh/m2 which easily satisfies the standards according to report published by Ministry of Natural Energy and Resources (2017). Additionally, the report also argues that as the private sector involved in geothermal projects Turkey's geothermal heat capacity has increased to 35.5 GWT, and Turkey is considered to the among the top five countries in terms of geothermal potential. Finally, biomass potential in Turkey is estimated as 8.6 million TEP and started to become more popular in recent years with the help of FIT.

Presidency of The Republic of Turkey (2019) advocates that to reveal Turkey's renewable energy potential government has been following different kinds of incentives including FIT, local content support, discount for system usage fees and taxes, and investment incentives such as VAT and custom tax exemptions. Details of these incentives will be provided in the following parts.

As of November 2019, renewables account for almost half of Turkey's installed

capacity with the biggest contribution from hydropower plants based on the data provided by TEİAŞ (2019b). Considering the trend towards renewable energy, current electricity prices which is not financially feasible to operate a natural gas-fired power plant, and incentive mechanisms that support renewable energy investments both financially and bureaucratically it is expected that renewable portion in Turkey's energy mix is expected to increase. CRE projects have also a great significance to extend this change for the individuals and could directly affect Turkey's renewable energy goals.

2.4. CRE Projects

Renewable energy communities were defined in Directive (EU) 2018/2001 (the recast Renewable Energy Directive) as a legal entity based on voluntary and open participation and effectively controlled by the shareholders or members located in the proximity of the renewable energy projects according to the official journal published by European Union (2018). This official journal states that shareholders can be natural persons, SMEs, or a local authority including the municipalities. Moreover, the primary purpose of renewable energy communities can be listed to provide environmental, economic, or social community benefits for its members and shareholders rather than providing financial profits. Furthermore, Yildiz (2014) reviewed that citizen participation in a renewable energy project can be identified considering the following criteria, the form of participation by equity comes with the voting and control rights, a minimum of 50% of the voting rights held by the citizens, the investors who are also the members of the community should be located in the same geographical region of the community.

After the renewable energy communities defined in the 2018 European Union Renewable Energy Directive, and it set a supportive basis for developing national rules, REScoop (2018) underlies that directive enabled regulatory frameworks and supports renewable energy communities to enjoy national renewable support schemes. Moreover, the directive promotes the role of renewable energy communities to end energy poverty. Finally, directive claims that households who use renewable energy for their self-consumption should be exempt from grid charges. After the Directive published in

2018 renewable energy communities gain recognition and empower themselves in the energy transition.

To achieve national and international goals of countries several governments have encouraged the development of sustainable energy communities. Romero-Rubio and de Andrés Díaz (2015) argued that Germany, Denmark, and United Kingdom are leading the sustainable energy communities in the EU and although Spain offers considerable incentives like these countries, the contribution of sustainable energy communities remain very low compare to these countries. Romero-Rubio and de Andrés Díaz (2015) suggested the reasons why sustainable energy communities lacked in Spain:

- Cooperatives have not been highly favored by the Electric Sector Law which does not allow cooperatives to market electricity they generate,
- Although Germany and Spain have similar financial incentives, the people in Spain have less financial ability to invest than those in Germany,
- Spanish people might have less sensitivity to environmental issues than German people.

2.4.1. CRE Projects based on Plant Type

CRE Projects by Plant Type are described in the following items, respectively.

2.4.1.1. Wind Power Plants. Wind power plants owned by local people are being utilized to supply the electricity needs of dwellings and can be also used for public institutions such as schools, hospitals. Rynne *et al.* (2011) advocated that community wind energy projects can be realized through rural cooperatives or municipalities and helps to diversify the electricity supply of that local region. Community Wind Energy investments can also be owned by local individuals who form corporations to sell excess energy to an electricity supplier or other inhabitants of the region. Moreover, wind energy is a kind of clean energy due to its nature, it does not pollute the water nor the air and decreases the GHG emissions by substituting conventional energy generations.

Finally, he also stated that since it does not require any water to generate unlike conventional electric generation techniques, most of the community wind energy projects are located in areas where there is limited access to water.

A small community wind project is defined by Windexchange (2020) as wind projects that cost between 10,000 USD and 100,000 USD. Whereas, Orrell *et al.* (2016) stated that in the USA's capacity-weighted average cost to install a new small wind turbine was calculated as $5,900/kilowatt. In other words, small community wind projects can be defined as wind energy power plants with 2kWs to 17kWs.

National Rural Electric Cooperative Association (2020) reported that in USA there are 564 wind energy cooperatives with 7.5 GW of installed capacity in 36 states. Moreover, the study of Leuphana Universität Lüneburg (2013) stated that 50.4% of the installed wind power plant capacity is owned by the citizens in Germany.

However, there is no renewable energy cooperative founded in Turkey to invest in wind projects yet and considered to be unpreferable compare to solar because of the scalability reasons which will be explained in the following sections.

2.4.1.2. Solar Power Plants. PV panels can be used to produce energy from solar energy, those panels can be installed on buildings or constructed as a solar farm. Individual households can purchase or lease panels and provide their electricity need from solar energy, or a community can cooperate for the larger PV panel investments and even create more than their need.

With its advantages in terms of flexibility and scalability, solar capacity owned by cooperatives has tripled in the last three years in USA where there are 499 solar energy cooperatives with 950 MW of installed capacity in 43 states based on the statistics provided by National Rural Electric Cooperative Association (2020). Moreover, the study of Leuphana Universität Lüneburg (2013) stated that 48% of the installed solar power plant capacity is owned by the citizens in Germany.

There are both cooperatives and renewable energy funds established in Turkey that invest in solar power plants and will be explained in detail in the following chapters. On the other hand, according to Turkey Rooftop Solar PV Market Assessment report prepared by Tetra Tech (2018) for the World Bank, Turkey's rooftop solar PV capacity is estimated as 3,858 GW considering the grid capacity, growth in Rooftop Solar Photovoltaic (RSPV) sales, income level, creditworthiness factor. Because there is only 431 MW of rooftop solar has been installed as of 2018, Turkey has a great potential in terms of rooftop solar PV installations. 683 MW capacity is estimated for the residential segment indicates there is a great room for the expansion of solar PVs owned by the communities or individuals.

Table 2.5. Market Potential of RSPV in Turkey (Tetra Tech, 2018).

RSPV Sectors	Grid Capacity for RSPV(MW)	Income Level-Impact Factor	Creditworthiness-Impact Factor	RSPV Market Potential (MW)
Residential: Single-family	764	0.5	0.8	306
Residential: Multi-family	2.519	0.3	0.5	378
Residential: Total	3.283			683
Commercial	1.488	1	1	1.488
Industrial	1.523	1	1	1.523
Commercial & Industrial: Total	3.011			3.011
Public	291	0.7	0.8	163
Total (MW)	6.585			3.585

2.4.1.3. Hydro Power Plants. National Rural Electric Cooperative Association (2020) argued that hydroelectric power plants have also great share in the world energy mix as stated earlier and there are some small hydro and run of the river systems owned by cooperatives in USA where there are 724 hydro energy cooperatives with 708 MW of installed capacity in 43 states. However, considering the scalability, individual ownership of a hydropower plant is unlikely. Although Turkey's hydroelectric potential is high, none of the cooperatives established in Turkey aims to invest in hydropower plants.

2.4.2. CRE Projects based on Different Financial Methods

Derrick (1998) argued that there are various methods to finance a renewable energy project including revolving funds, cooperatives, renting schemes, utility schemes, hire purchase. Moreover, Vasileiadou *et al.* (2015) proposed that especially after financial crises in 2008, innovative financing approaches have been developed including crowdfunding which has already been linked to the financing of renewable energy projects. There are some examples of crowdfunding which also involves participation from governmental bodies such as a municipality. As part of the studies in Horizon 2020 Prospect (2017), a green energy cooperative in Croatia has collected investments from citizens to install a PV on a public roof which belongs to a municipality. Citizens who invested in this PV have started to gain 4,5% interest on their investment.

However, the scope of this part will be limited with the funds and cooperatives.

2.4.2.1. Cooperatives. Holstenkamp (2012) proposed that renewable energy cooperatives can be categorized into three main business fields; energy production, energy consumption, and energy services. Energy production cooperatives are organizations where citizens financially contribute to a renewable energy project. Energy consumption cooperatives' scope is the purchase and sale of renewable energies. Finally, the scope of the energy service cooperatives is wide including consulting on various topics such as energy efficiency, production, supply, and distribution. In the context of this study, only energy production cooperatives will be investigated.

Maron (2013) demonstrated that cooperative as a financing vehicle is widely used and accepted by citizens due to various reasons. Centner (1988) proposed two advantages of cooperatives, first, there is lower initial investment cost due to scalability. Second, investors became part of the cooperative since they also have voting rights and can play a role in the decision-making process. Finally, Wieg *et al.*, 2011 emphasized that in cooperative structures members' liability is limited with the equity that they invested, so there is no additional risk that can be associated with their investment.

Although the history of renewable energy cooperatives dates too back, the situation in Turkey is not the same. Troya Renewable Energy Association (2017) summarized the history and of renewable energy cooperatives in Turkey. First, the establishment of the renewable energy cooperatives was enabled through the 5th article of the Regulation on Unlicensed Electricity Generation in Electricity Market which is published in the Official Gazette No. 28783 and dated 02.10.2013. With the addition to this regulation on March 23, 2016, cooperatives with up to 100 members had up to 1 MW, cooperatives between 101 and 500 members had 2 MW, and cooperatives with 501 to 1000 members had 3 MW and cooperatives with more than 1,000 members had the right to establish a renewable energy plant to produce electricity. The regulation defines that all the members must be subscribed to the same electricity distribution region. In other words, the cooperative can only consist of residential subscribers or only commercial subscribers. Moreover, the cooperative must be established with at least 7 members which can be private individuals or legal entities.

Since there is no up to date research found on the current situation of the renewable energy cooperatives in Turkey an interview has been made with the person who is among the ones that started renewable energy cooperative studies and help the adoption of related legislation in Turkey. Mr. Oral Kaya stated that the international events attended by the Troya Renewable Energy cooperative encouraged them to take initiatives for the establishment of cooperatives. After 2014, international publications started to be translated into Turkish, while discussions were held with the ministry to include energy cooperatives in the regulation. The fact that someone has been working on energy cooperatives within the Ministry has been a great advantage for the development of renewable energy cooperatives. Energy cooperatives started to be established with the regulation in 2016, there are 51 cooperatives established as of the end of 2019. However, there is no updated list available to the public unfortunately and these numbers were obtained from Mr. Oral Kaya during the interview. While 8 of these 51 cooperatives started production, 8 of them are in the investment phase. On the other hand, the recent renewable energy cooperative numbers that are publicly available were presented by Özgül *et al.* (2019) who stated that there are 22 renewable energy cooperatives established in Turkey as of 2018.

2.4.2.2. Funds. Funds have also been preferred to raise equity capital and mainly invested by two types of investor groups; a general partner who is responsible for the business and limited partners which mostly constitute from citizens. Moreover, some financial companies invest in renewable energy funds to gain value from the project's cash flow and the enterprise itself (Degenhart *et al.*, 2008). Closed-end renewable energy funds have been preferred to finance renewable energy projects mainly for wind farms and PV large-scale PV since it offers specialization and professionalism in the renewable energy business. Compare to citizen-financed projects, the development of the project is separated from the equity contribution. The evolution of closed-end renewable energy funds derived from the demand for shares in renewable energy projects from people who have no access to renewable energy regions such as people living in the cities. Based on a research conducted in Germany in 2003, there is a minimum ticket size that the fund accepts from people to become an investor of the Fund. The author of the research stated that the minimum ticket size varies from 5.000 Euro to 25.000 Euro and the average investment is around 25.000 (Enzensberger, *et al.*, 2003).

On the other hand, Yıldız (2014) argued that the investors are not involved in decision making process and there is no control of the management of the fund. In other words, controlling local energy policy might not be achieved, if the investment is made through a fund structure.

Venture Capital Investment Funds (VCIF) has been introduced to Turkey with the Communiqué on Principles of VCIF ("Communique") numbered III-52.4 and dated July 01, 2014. This Communique regulates that, VCIFs are assets that can only be sold to qualified investors and can only be established with a bylaw and do not have legal personality. These funds can only be established by portfolio management companies that have obtained an operating license from the Capital Markets Board of Turkey. Ownership of VCIF's assets is completely separate from both the founder and the custodian of the fund and no action can be taken against the investors (CMB of Turkey, 2014).

After the Communique published, VCIFs have started to be established to invest in companies, hospitals that are built with public-private partnership models, and also renewable energy projects. Although no regulation that requires these VCIFs to declare their financial statements and portfolio distribution by making web research and searching for the investment presentations of these VCIFs it has been founded that 4 funds provide public information and invested in renewable energy projects with the equity contribution of the qualified investors as per the regulation. 2 of them invested in solar PV projects. One of the funds that invested in a solar power plant also invests in other companies since there is no limitation for these funds in terms of businesses that they can invest. As per the information shared in the investor presentation of Ak Asset Management (2019), this fund acquired 50% of the two solar projects with 11 MW and 8 MW installed capacity and benefits from the FIT. It is also noted that there is a minimum ticket size of 100,000 TL. Unlike this fund, another VCIF that invested in a solar power plant has an investment strategy that is only investing in renewable energy projects. Similar to Ak Asset Management's fund there is also 100,000 TL of minimum ticket size to become an investor to fund established by Mükafat Asset Management (2019) which already has 7.5% of IRR while investing 1.1 to 1.2 mn$ per MW of solar power plants that benefit from the FIT. Whereas one of the VCIFs in Turkey has invested in a geothermal project with 24 MW installed capacity by acquiring 51% of the company which benefits from the FIT (Public Disclosure Platform, 2017). Apart from these 3 funds, according to bylaw published on Turkey's Official Gazette (2017), Actus Asset Management has a renewable energy fund that aims to invest in renewable energy projects, however, there is not any public information available about the portfolio distribution of the fund.

However, it should be noted that these funds are not only invested by individuals, and might be invested by a small group of individuals or legal persons. In parallel with that, the fund of Ak Asset Management has 29 and Actus Asset Management's fund has 9 investors, the fund that invested into the geothermal power plant and Mükafat Asset Management's fund has only two investors, according to monthly statistical data published by Capital Markets Board of Turkey (2020).

2.4.3. Incentive Mechanisms for Renewable Energy Projects

Abolhosseini and Heshmati (2014) argued that to decrease GHG emissions by increasing the share of renewable energies, governments employ various support mechanisms including FIT and tax incentives. Moreover, the government can take place in different forms such as the Danish government did in the 1980s by offering a 30% subsidy for the installation of wind farms by local cooperatives (Christianson, 2001).

2.4.3.1. FIT. The FIT mechanism encourages the deployment of renewable energy projects since governments offer to purchase electricity generated by a renewable energy source from a pre-determined price which is mostly above the market price. Alizamir *et al.* (2016) proposed that return on investment value increases, and renewable energy investments become more feasible with the support of the FIT mechanism.

To understand the FIT mechanism, the structure created by the Ministry of Economy Trade and Industry Japan (2013) and summarized on the below Figure 2.12 can be helpful. Electricity produced by government-approved renewable energy power plants is sold to the electric utility which is supplied for the end consumers. Electricity sold by renewable energy projects is purchased by a fixed price which is determined by the government for a specific duration. However, please note that the guaranteed purchase price differs from the type of renewable energy source. The difference between the market price and the price determined under FIT is also collected from the electricity consumers.

Law No: 5346 has introduced the FIT to Turkey and renewable energy projects have started to benefit from FIT which is determined based on the source of renewable energy. The law regulated that unlicensed and licensed renewable energy projects which complete their installments and get approval from the authorities until 31 December 2020 will benefit from the FIT for 10 years with the prices provided in the below Table 2.5 for each type of facility.

As the study mostly concentrates on the unlicensed small-sized investments, detailed information regarding the legislation on unlicensed electricity production projects is provided in this section. Through unlicensed projects, real or legal persons can invest in solar power plants to meet their electricity needs. Unlicensed electricity production legislated first in 2011 in Turkey. The major changes experienced in the relevant regulations since 2011 are as follows:

- Unlicensed electricity generation right based on renewable energy resources was introduced in 2011 for real and legal persons to meet their electricity needs up to a 500 KW renewable energy for each consumption facility.
- In March 2013, the upper limit of 500 kW has been increased to 1 MW.
- Solar power applications for roof and facade applications up to 10 kW, the procedures and principles regarding the evaluation of excess energy were determined in January 2018.
- In May 2019, hourly offsetting is replaced with the monthly offsetting. The USD denominated FIT price is removed and the selling price of the excess energy is adjusted to active energy price based on customer type. In other words, the focus has been turned to roof and facade projects for the production of unlicensed electricity from solar energy, and further land investments were prevented.

As can be seen, solar power based production facilities and biomass-based production facilities have the highest FIT price with 13.3 US dollars cent per kWh whereas it is 7.3 US dollar cent per kWh for hydroelectric power plants and wind power plants (Presidency of The Republic of Turkey, 2019).

Table 2.6. FIT Prices in Turkey Based on Source of Energy (Presidency of The Republic of Turkey, 2019).

SCHEDULE I (Provision of the law dated 29/12/2020 and numbered 6094)	
Type of Production Facility Based on Renewable Energy Resources	Feed-in-tariff Prices Applicable (US Dollar cent/kWh)
a. Hydroelectric production facility	7.3
b. Wind power-based production facility	7.3
c. Geothermal power-based production facility	10.5
d. Biomass-based production facility (including landfill gas)	13.3
e. Solar power based production facility	13.3

Furthermore, there is also local content support which can increase the FIT price and accordingly return on investment. Projects with at least 55% of local content are eligible to benefit from local content support which is added to the FIT prices provided in the Table 2.5above. On the other hand, unlike the FIT which continues for 10 years, local content support is only provided for 5 years and unlicensed projects are not eligible for it. Local content contribution in US Dollar cent per kWh for each type of renewable energy facility is provided below (Presidency of The Republic of Turkey, 2019).

Table 2.7. Local Content Support for the FIT in Turkey Based on Source of Energy and Material (Presidency of the Republic of Turkey, 2019).

Schedule II (Provision of the law dated 29/12/2010 and numbered 6094)		
Type of Facility	Local Production	Local Content Contribution (US Dollar cent/kWh)
A. Hydroelectric production facility	1- Turbine	1.3
	2- Generator and power electronics	1.0
B Wind power based production facility	1- Blade	0.8
	2- Generator and power electronics	1.0
	3- Turbine tower	0.6
	4- All of the mechanical equipment in rotor and nacelle groups(excluding payments made for the blade group and the generator and power electronics)	1.3
C Photovo Itaic solar pover based production facility	1- PV Panel integration and solar structural mechanics production	0.8
	2- PV modules	1.3
	3- Cells from ing the PV module	3.5
	4- Invertor	0.6
	5- Material focusing the solar rays onto the PV module	0.5

On the other hand, there has been a major change regarding the FIT mechanism in May 2019. As it has been stated the FIT mechanism was supposed to be valid till 31 December 2020 for both licensed and unlicensed projects, but with the regulation came in to force in May 2019, unlicensed projects who had not obtained a letter of approval till May 2019 become no longer eligible to benefit from FIT (Energy Market Regulatory Authority of Turkey (EMRA), 2019). This regulation is expected to have an impact

on investor behavior for the unlicensed project investors including the members of the cooperatives.

2.4.3.2. Tax Incentives. Fischer and Newell (2008) proposed that to discourage the use of energy generated by conventional methods which increase GHG fiscal policies aims to tax fossil-fueled sources in some countries whereas to promote and increase the deployment of renewable energy tax exemptions and reductions can also be applied.

The study of Bundgaard and Lexner (2011) demonstrated an example of tax incentives can be seen in Denmark where a law has been enacted in 2011 to facilitate individual investments in renewable energy and to regulate their conditions. With this law, all renewable energy investments are covered and essentially discount has been increased to 7.000 Danish Krone from 3.000 Danish Krone for the calculation of tax base. Thus, only part of the income obtained from renewable energy sources exceeding 7,000 Danish Krone has started to be subject to tax. In addition to that, Irena (2013) stated that starting from the 1980s, taxes on oil and coal has been increased to provide a competitive advantage in favor of renewable energy resources.

In Sweden, the property tax rate for renewable energy facilities varies according to the value of the facility and the type of resource. The property tax rate is 0.5% of the facility value, excluding wind and hydro energy. The rate is 2.8% for hydro energy and 0.2% for wind energy. To diversify the energy mix, incentives for hydro energy are less since it has been utilized sufficiently so far (Vågerö, 2019).

Considering the incentives applied in Turkey Şen (2017) states that it is not possible to argue that there is a significant tax advantage compared to other countries. The tax incentives in Turkey are summarized as follows. As part of Article 43.4 of the Electricity Licensing Regulation power plants that generate electricity from either local sources or renewables are exempted from license fees for 8 years starting from the completion of the plants. Moreover, Provisional Article 4 of the Electricity Market Law No. 6446 regulates that all kinds of power plants that become operational until

the end of 2025 have a 50% discount on transmission system usage for 5 years. The same law also regulates that relevant papers will be exempted from stamp duty tax during the investment period of the power plants including the renewables.

2.4.3.3. Other Type of Incentives. Local governments can play a huge role by involving in a renewable project by providing the land or area for the installment of renewable energy production facilities. Apart from previously mentioned government subsidy in Denmark the other type of incentives can be provided with examples as follows.

Weissacher Tal Energy Cooperative was established in 2008 in Germany. Within one month of its establishment, the cooperative used the roof of the municipality's fire station, a primary school, and a warehouse to install solar panels. Citizens have put the cooperative into operation without having to invest or rent land or roof as a result of allocating an area free of charge by the municipality. More than 14,000 shares in the cooperative have been purchased by people residing in that area, each for £ 50 each. The vast majority of its investments were used in the installation of 10 PV plants on the roof of the City Hall, producing 330,000 kW of electricity annually (Wieg *et al.*, 2012).

Another example in Germany shows how municipalities involve in the establishment of cooperatives. In 2009, 8 municipalities united and found the Neue Energien West cooperative in order to gain their energy independence from fossil fuels. Since its establishment number of legal entity members has increased to 20 (Roberts *et al.*, 2014). There are two examples in Turkey where local municipalities also are one of the members of the cooperatives. The first one is in İzmir, Seferihisar, and established with 10 members including the Seferihisar municipality in 2017. Each share is 100 TL and the maximum number of shares that can be purchased by a member is limited with 5 thousand (Turkey's Official Gazette, 2017). The other cooperative is in Bursa, Nilufer which aims to reach 10 thousand cooperative members (Dere, 2016).

Furthermore, one of the "rural development" components as financial assistance

provided by the EU to EU candidate countries, has been implemented in Turkey since 2010. Studies and programs that have been carried out by the Agricultural and Rural Development Support Institution under the Instrument for Pre-Accession Assistance for Rural Development (IPARD) component are currently continuing in 42 provinces of Turkey. Renewable energy investments not covered by IPARD-I were included in the scope of support with IPARD-II (Gülçubuk *et al.*, 2016). Although this support mechanism is not limited with the cooperatives, there are some renewable energy cooperatives which benefit from IPARD-II support including the Altınoluk Renewable Energy cooperative and Çorum Renewable Energy cooperative in Çorum which got 55% of subsidy for the installment of a solar PV with a 4,4 million TL of investment budget and 600 kW capacity. The two cooperatives reached 151 members combined as of mid-2019 (TKDK, 2019).

2.5. Investment Motivations Supporting CRE Projects

Contribution to community based renewable energy projects could depend on various motivations including but not limited to financial, environmental, and social drivers. There are plenty of studies which question a different kind of motivations, enablers, and drivers behind CRE projects.

From a broader perspective, the effectiveness of public policies on renewable energy investments has been tested by analyzing the data from 29 countries for the period between 2000 and 2015. It was found out that market-based instruments such as renewable energy trading markets or green certificates have the highest impact on the deployment of renewable energy for a country. Market-based instruments are followed by research, fiscal and financial incentives such as price policy or tax and policy support such as defining strategies or outlining specific programs. If there is a 10% in these 4 major factors installed renewable energy capacity is assumed to increase by 3%, 2.1%, 1.82% and 1.63% per year on average. On the other hand, direct investments to reduce initial costs, regulatory instruments like introducing codes and standards and information and education for the workforce employed in the buildings found out to be not as crucial as previously mentioned 4 topics (Liu *et al.*, 2018).

The study of Wierling *et al.* (2018) researches that the importance of renewable energy cooperatives in the energy transition and considering the investor motivations widely preferred policies to support the deployment of renewable energy projects in European countries. A statistical analysis focusing on renewable energy cooperatives in the United Kingdom, Denmark, Germany and Austria concluded that energy cooperatives play a significant role in the Energy transition of Europe. Moreover, the historic development of renewable energy cooperatives intersects with the introduction of supportive policies especially the guaranteed FIT mechanism that can be considered under the financial support schemes. The author also argues that all countries faced slow-downs in the deployment of renewable energy when these supportive schemes were removed.

Interests of energy market actors were identified in the study of Prasad *et al.* (2016) which presents integrated community energy systems as a modern tool to reorganize local energy systems and connect local communities. Using local, affordable, clean energy, reducing energy cost, and on top of it selling energy surplus, gaining energy independence and energy supply security can be considered as the objectives of households which can be achieved through heat pumps, PVs, micro-wind, electric vehicles, home energy management system. Whereas key topics that integrated community energy systems must concentrate on divided into 4 major topics as technological issues, socio-economic issues, environmental issues, and institutional issues. The author underlines the importance of these issues for the integration of local energy systems which can also be considered as the motivating and demotivating factors for citizens to become a member of local energy communities.

Another study conducted by Bauwens *et al.* (2016) tries to identify attitudes toward renewable energy cooperatives in 4 countries. The research claims that although there is cooperative tradition dates past in Germany, negative experiences in Germany and resulted in the choice of other community energy models. Moreover, the fact that energy cooperatives are less developed in the Eastern part of Germany was linked with the socialist era's negative legacy and also worse financial conditions compare to other regions of Germany. Belgium has a cooperative tradition since the mid-19th century,

but the study argues that Belgium has forgotten the essentials of the cooperatives. Some cooperatives have been started to be established for the financing of renewable energy projects where member's money is used as a loan provided to the intermediary company as regulations allow. Correspondingly ownership of the installed renewable energy equipment does not belong to the cooperative but the intermediary company that operates the plant has also ownership. The existence of such business examples that take advantage of lower interest rates and fund its investment through cooperative members' money without providing any ownership challenges the traditional cooperatives and resulted in the establishment of Renewable Energy Sources Cooperative (RESCoop). The study also underlies that cooperatives not only adapt to changes in regulations but also aims to alter policies toward their benefits.

Based on a survey on household environmental behavior and attitudes conducted by OECD the main determinants affecting the investment decision of consumers were studied by Ameli and Brandt (2015) by using estimation of binary logit regression models. The results of the study can be summarized as homeownership, income level, social context, and household energy conservation practices increase people's chance to invest in clean energy technologies. The study also argues that credit constraints are one of the major barriers in adopting renewable energy solutions and energy efficiency investments especially for the lower-income group and suggests policies to overcome this struggle.

To define various reasons underlying the investors' motives, a survey was conducted by Bauwens (2016) for two renewable energy cooperatives in Flanders, Belgium. Quantitative data illustrated that cooperative members had a different kind of reasons when they become a part of the renewable energy cooperatives. Moreover, correlation analyses indicated that there is a positive association between pro-environmental orientation and the production of renewable energy. In parallel with this, social identification is positively correlated with pro-environmental orientation and the production of renewable energy.

The study of Broughel and Hampl (2018) investigates the profile of potential CRE

project investors in Switzerland and Austria by concentrating on socio-demographic and socio-psychological characteristics of individuals. The result of the study claims that male homeowners with higher incomes in Austria and more educated people in Switzerland have a higher probability to invest in CRE projects. Besides, a positive perception of renewable energy affects people's motivation to become a CRE project investor. Solar PV has the highest preference rate on renewable energy technologies by potential investors with 75.3% in Austria and 79.4% in Switzerland, wind power with 43.4% in Austria and 44,0% in Switzerland, hydro 32.3% in Austria and 38.8% in Switzerland and biomass 20.1% in Austria and 31.8% in Switzerland follows in order. Survey results indicated that almost half of the respondents are willing to commit up to 1.000 EUR/CHF to CRE projects. Another key finding of the study is since long term investments increase uncertainties and perceived riskiness of CRE projects is the main barrier for potential investors.

Another article researches the underlying factors of investors' decision by surveying two different Austrian community PV projects. Variables used in the survey include people's environmental, financial motives, and their personal beliefs. The result of the study indicates that financial beliefs are the major motives that incentivize people to be a part of renewable energy communities. The research underlines the importance of the FIT mechanism which makes PV projects to be preferable in a financial manner in the long run and warns by claiming people will likely to withdraw from participation as more profitable investment opportunities arise (Fleiß *et al.*, 2017).

On the other hand, the research of Kalkbrenner and Roosen (2015) questions how community identity, social norms, trust, and environmental issues determine citizens' motives to be a part of CREs based on a study conducted in Germany. The authors proposed 4 main hypotheses. First, people with higher community identity have a higher willingness to participate in a local community energy project. Second, trust positively influences the willingness to participate in a local community energy project. Third a higher level of energy-related social norms positively influences willingness to participate in a local community energy project. Fourth, environmental concern positively influences the willingness to participate in a local community energy project.

A survey is conducted to people who are responsible for energy and investment-related issues in their families and also owners of renewable energy projects. The authors differentiated people's willingness to volunteer and invest in CRE projects and found out that willingness to volunteer is higher compare to investing. Regression analysis is conducted to determine components of people's willingness to participate in CRE projects, social norms, trust, environmental concern, and community identity came out to be major factors. Another finding of the study is people who own a renewable energy system and living in a rural area are more likely to participate in renewable energy communities.

A similar study that provides insight on citizen knowledge and participation in community energy by using a socio-psychological factor analysis was conducted in the Netherlands by Koirala *et al.* (2018). A survey answered by 599 participants is used to determine how environmental, socio-economic, demographic, and socio-institutional factors influence willingness to participate in CRE systems by implementing factor and multivariate regression analyses. Results of the regression analysis indicate that age, gender, economic incentives, house-ownership, income, type of community are statistically insignificant. On the other hand, environmental concerns, community trust factors, community resistance factors, and energy education are statistically significant.

The study of Bauwens (2019) investigated the CRE projects by implementing a multivariate econometric analysis of the social, economic, environmental, and institutional factors which influence the size of financial contribution in CRE projects. In this study, a survey was conducted to over 4,000 CRE investors located in Belgium. The number of shares, defined as a dependent variable while return on investment, low electricity price, social networks, social identification, advice of other members, pro-environmental self-identity, production of renewable energy, democratic governance, set as independent variables and education, age, gender, income level and period of membership were control variables. The result of the study is the return on investment is the most dominant factor that determines the size of investment in larger societies, whereas in smaller societies environmental, social and other non-economic factors dominate the size of financial contribution. Another finding of the study is

close social networks have a significant effect as a driver of the investments. On top of it, based on regression analysis 4 different models were constructed by adding new variables starting from model 1. Model 1 argues that the return on investment is the dominant factor that determines the number of shares purchased by investors. In model 2, age, gender, and income variables were added to model 1 variables which change the status of democratic and socident variables from statistically significant to insignificant. Model 3 includes the education level of respondents which came out to be statistically significant and finally model 4 adds a period of membership which is also statistically significant in determining the number of shares purchased by investors in CRE projects. On the other hand, the same analysis conducted to a smaller society called BeauVent resulted in different outcomes. Although the return on investment is not statistically significant for the number of shares purchased by investors, the result of the analysis suggests that pro-environmental self-identity and the democratic control of the CRE projects are strong drivers for a smaller community.

The study of Holstenkamp and Kahla (2016) was conducted in Germany to understand investment behavior and the effects of policy changes for the community energy sector and 6 hypotheses were tested as part of the research. The first hypothesis is the more people invest the more they weigh the return on investment. The second hypothesis claims that members with managerial functions have different investment motives. The third hypothesis suggests that type of the legal form has an impact on the level of investment. The fourth hypothesis is about the investment motivation changes by the type of technology used in the community energy project. The fifth hypothesis is related to the geographical location of the projects and their impact on financial motivations. Finally, the sixth hypothesis claims that the year of establishment affects the motive for a financial contribution. The results of the analysis provided that the third hypothesis is valid as the author compares the average investments made to cooperatives and energy limited partnerships which are invested with considerably higher amounts per investor. The result of the analysis illustrated that there is a significant but weak relationship between the size of investment and return on investment motive. The relationship between the investment motives of members with managerial functions and ordinary members also showed significant differences but weak depen-

dency. The analysis showed that there is a high correlation between return motive and the geographical location of the projects. As suggested in the 4th hypothesis, results also showed that return on investment can have different importance for different types of projects such as wind, biogas, etc. Finally, it is concluded that the year of establishment also affects the return motives as high FIT between 2009 and 2011.

To determine how important trust is for the development of CRE projects Walker *et al.* (2010) conducted a study in the United Kingdom. A questionnaire was prepared and a sense of trust of local residents who are the members of the local renewable energy cooperative was tried to be measured. Based on the results of different case studies, it is concluded that trust between local groups and people reflect the involvement of the inhabitants to the project. On the other hand, if the project is perceived as an entrepreneurial money-making initiative rather than a community initiative and lacks consultation from the local people, it could result in lower involvement of the local people and there might be even protests against the project and polarization of inhabitants such as it happened in Moel Moelogan Wind Farm in North Wales.

The classification of countries based on their development levels is presented in the World Economic Situation and Prospects 2020 report published by United Nations (2020). According to this report, Turkey is classified as a developing economy whereas most of the studies on CRE are conducted in Germany, Austria, Belgium, Denmark, Greece, Spain, United Kingdom, United States, and Japan which are classified as developed economies.

As this study concentrates on the investment behavior, the most essential part of the literature review section is the one related with investment motivations. There are various factors that could attract individuals to become a part of the community renewable energy investments;

- Financial incentives and importance attached to return on investment,
- Socio-economic and demographic factors,
- Environmental concerns,

- Technological interests,
- Social identification and community trust,
- Educational background,
- Participation in the management,

Some of the studies that investigate investment and participation motivations to renewable energy projects are presented in Figure 2.13.

Investment / Participation Motivations & Related Studies	Liu et al. (2018)	Wierling et al. (2018)	Fleiß et al. (2017)	Bauwens (2019)	Prasad et al. (2016)	Ameli and Brandt (2015)	Broughel and Hampl (2018)	Kalkbrenner and Roosen (2015)	Holstenkamp and Kahla (2016)	Bauwens et al. (2016)	Bauwens (2016)	Koirala et al. (2018)	Walker et al. (2010)	Gadenne et al. (2011)	Ebers et al. (2018)	Dóci and Vasileiadou (2015)	Prete et al. (2017)	Dal Bó et al. (2010)	Dóci and Vasileiadou (2015)	Kastner and Stern (2015)
Financial Inventives and ROI	✓	✓	✓	✓																✓
Socio-Economic and Demographic					✓	✓	✓	✓	✓	✓					✓					
Environmental					✓			✓			✓	✓		✓						
Technological Issues					✓															
Social-Identification & Community Trust								✓			✓	✓	✓					✓	✓	
Education												✓			✓		✓			
Participation in the Management									✓							✓				

Figure 2.13. Investment / Participation Motivations & Related Studies Summary.

However, none of the studies mentioned above suggest which factors determine the size of the financial contribution and further investment decision concentrated on a developing country. Furthermore, none of the studies used the SEM analysis method to understand the motivations of people that influence their willingness to participate in a renewable energy community or the size of their financial contribution. Besides most of the studies concentrated on developed countries whereas there are limited studies that investigate the investment behavior of individuals for CRE investments. Hence, it can be argued that there is a great need to analyze the factors that have an influence on the size of the investment and further investment decisions and interrelations between

the variables for a developing country. Based on the analysis, what kind of policy recommendations can be developed will be investigated to support small size individual investments and renewable energy cooperatives by taking into account policies followed around the world and current situation in Turkey.

3. RESEARCH METHODOLOGY

3.1. Phases of Methodology

In this study, to understand the investment behavior of CRE investors in a developing country, which factors determine the size of the financial contribution, further investment decision, and interrelations between the variables two models are proposed and tested by utilizing SEM analysis. The flow of the research methodology is mainly composed of three phases: (i) development of frameworks, (ii) development of hypotheses, (iii) data collection and survey questions, and (iv) SEM analysis. In the first phase, two different frameworks were suggested to understand which factors play a role in determining the size of financial contribution and further investment decision. In the second phase, the hypotheses were developed based on the literature. In the third phase, data collection and survey questions were explained in detail and the final phase consists of SEM analysis.

3.2. Development of Hypotheses

Primarily, two frameworks were generated to conceptualize the investment behavior of the members of the renewable energy cooperatives', main dependent variables and components that might affect the size of financial contributions, and further investment decisions were added considering the possible relationship between the variables. The reason for developing two different frameworks is that the first framework's scope is limited to past investments whereas the second framework investigates the further investment decision. Hence, differences in terms of timing, previous investment conditions, and current investment conditions that might affect future investments resulted in developing two different frameworks. Initially developed frameworks were presented below in Figure 3.1 and Figure 3.2.

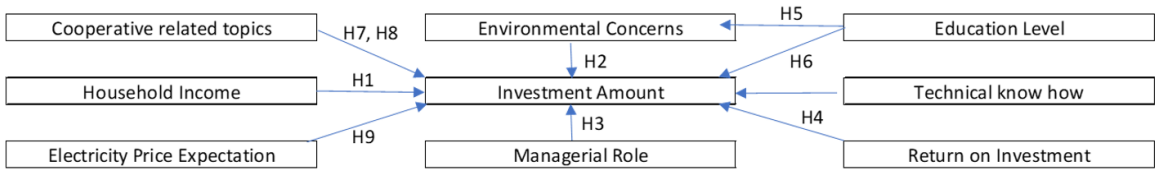

Figure 3.1. Framework 1.

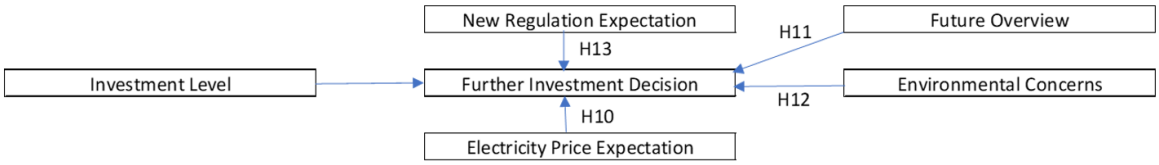

Figure 3.2. Framework 2.

Secondly, a literature survey on the main factors affecting the investment decision for the renewable energy projects was conducted to identify what kind of questions will be asked to respondents who are members of renewable energy cooperatives established in Turkey. Moreover, an online questionnaire survey was created and developed through the comments of academicians and industry professionals. The survey is directed to presidents or managing directors of 9 different renewable energy cooperatives and by their help, the survey was sent to members of these cooperatives. On top of it, to increase the response rate face-to-face interviews were performed. In the fourth phase, the data were analyzed with IBM SPSS AMOS and 2 different models were developed to test the hypothesis suggested.

Hypotheses have been developed to examine the interactions between the variables. Considering the findings of literature surveys and comments of industry professionals obtained in interviews, 13 hypotheses were developed, and tested by using SEM. The hypothesis to be tested is listed as follows including the literature survey regarding the hypothesis or point of departure itself.

Since individuals with higher household incomes are likely to spare more money for their investments, they should be able to invest more. In parallel with that, based on an OECD survey on household's environmental behavior a study on motivations

and determinants of household's investment in energy efficiency and renewable energy have been concluded that people with higher income levels have more tendency to invest than low-income households (Ameli and Brandt, 2015). Furthermore, the study conducted in Austria has shown that people with higher income levels have a higher probability to invest in CRE projects (Ebers *et al.*, 2018). Therefore, the following hypothesis is proposed;

3.2.1. H_1: Members of renewable energy cooperatives with higher household incomes tend to invest more

It can be expected a higher level of investment from people who care more about the environment and tries to do their best against climate change. Similarly, the study of Gadenne *et al.* (2011) analyzed the environmental attitude and concern factors affecting the decision making of individuals and presented that general environmental beliefs also have an impact on environmental actions and prices. Moreover, it is also argued that environmental attitudes and energy-saving behaviors are strongly associated and energy-saving behaviors are not influenced by government subsidies and policies. Additionally, the study of Kalkbrenner and Roosen (2015) argues that environmental concerns of the people are positively associated with the willingness to participate in a local community energy project. Hence, the following hypothesis is suggested;

3.2.2. H_2: Members of renewable energy cooperatives with higher environmental concerns are more likely to invest more

It can be expected that people invest in something when they have control over something, likewise, if people invest more, they tend to have managerial roles in that investment. The study of Holstenkamp and Kahla (2016) showed that there is a relationship between the investment motivations of members with managerial positions, and ordinary members have also shown significant differences but weak dependency. Moreover, another study conducted to analyze different individual motivations of members to become a part of the local energy projects and it was concluded that people with managerial roles have different investment motives (Dóci and Vasileiadou, 2015).

Therefore, the following hypothesis is posited;

3.2.3. H_3: Members who participate in the management of renewable energy cooperatives tend to invest more

Investors should have financial motivations behind the investment they make, inherently and it is expected that they weigh on return on investment as much they will invest. In parallel with that, the implementation of supportive policies, in particular the guaranteed FIT system that can be considered under the financial support schemes, has increased the demand for renewable energy projects. Moreover, it has been noted that countries have faced slowdowns in the implementation of renewable energy since such support systems have been phased out (Wierling *et al.*, 2018). Furthermore, Fleiß *et al.* (2017) suggest that financial incentives are the key driving force behind taking part in renewable energy projects, the study also argues that subsidized FITs are likely to be central to any long-term renewable energy transition strategy. Accordingly, the following hypothesis is proposed;

3.2.4. H_4: Members of renewable energy cooperatives who attach higher importance to return on investment are more likely to invest more

University graduates are expected to have higher environmental concerns as they should be more aware of the potential impacts of climate change compare to people with lesser graduation levels. Following that, the study of Prete *et al.* (2017) analyses the main factors affecting the households' willingness to pay and adopt energy-efficient measures and also argues that households' level of education and intention to adopt energy-efficient measures and willingness to pay for them are positively associated. Hence, the following hypothesis is suggested;

3.2.5. H_5: Members of renewable energy cooperatives with higher education levels have higher environmental concerns

People with higher education levels are expected to have a higher level of income and a higher level of environmental concerns, therefore they should invest more compared to people with lesser education levels. In parallel with that, the study conducted in Switzerland has shown that people with higher education levels have a higher probability to invest in CRE projects (Ebers *et al.*, 2018). Therefore, the following hypothesis is posited;

3.2.6. H_6: Members of renewable energy cooperatives with higher education levels tend to invest more

Individual's trust in the system and the importance they attach to democratic management are expected to be positively associated with the level of their investment. Similarly, Dal Bó *et al.* (2010) propose that the degree of cooperation between the parties participating in the economic exchange is influenced by democratic institutions. Accordingly, the following hypothesis is proposed;

3.2.7. H_7: Members of the renewable energy cooperatives who attach higher importance on democratic management in cooperatives are more likely to invest more

Individuals who weigh more on the philosophy of the cooperatives are expected to invest more to support the first CRE initiatives in Turkey. In parallel with that, integrating with a community was listed as one of the investment motivations for becoming a local renewable energy project with a study conducted in Germany and Netherlands by Dóci and Vasileiadou (2015). Hence, the following hypothesis is proposed;

3.2.8. H_8: Members of the renewable energy cooperatives who attach higher importance on investment is being made under cooperative scheme tend to invest more

People with higher electricity price expectation for the upcoming years is expected to have a higher willingness to invest into renewable energy cooperatives to make saving and decrease their electricity cost. Correspondingly, the study of Kastner and Stern (2015) demonstrated that current energy prices and energy price expectations are positively associated with the investment amount. Accordingly, the following hypothesis is suggested;

3.2.9. H_9: Members of the renewable energy cooperatives who expects higher electricity price expectation invested more in to renewable energy cooperatives

In parallel with the suggestion stated for Hypothesis 9 and the study of Kastner and Stern (2015), the following hypothesis is posited for the further investment decision;

3.2.10. H_{10}: Further investment decision of the existing investors of renewable energy cooperatives is correlated with higher electricity price expectation

Inherently, members who have a more positive overlook regarding the future of renewable energy cooperatives are expected to invest more compare to members with pessimistic future expectations. In parallel with that, the study conducted with the Chief Financial Officers (CFO) in the USA by Gennaioli and Bocconi (2016) proposed that CFOs who are more optimistic for the US economy invest more compare to CFOs with more pessimistic expectations. Hence, the following hypothesis is posited;

3.2.11. H_{11}: Members with optimistic future expectations for renewable energy cooperatives are more likely to decide on a further investment compare to members with pessimistic future expectations

In parallel with the argument stated in the second hypothesis, members who attach higher importance to reduce their GHG emissions and accordingly Carbon footprint are expected to still have a willingness to invest more even without the FIT mechanism. As it was stated earlier the study of the Kalkbrenner and Roosen (2015) suggested that people's willingness to participate in a local community project increases as they have higher environmental concerns. Therefore, the following hypothesis is proposed;

3.2.12. H_{12}: Members of the renewable energy cooperatives who attach higher importance on reducing their Carbon footprint still have a willingness to invest more compare to members who care less

Due to recent regulation change that removed the USD based FIT price mechanism for the further renewable energy investments and constantly changing operating procedures the member's willingness to invest has been observed to decrease as stated in the interviews conducted with the industry professionals. In other words, it can be suggested that members who expect a new regulation is not likely to invest more. Accordingly, the following hypothesis is suggested;

3.2.13. H_{13}: Members of the renewable energy cooperatives who expect a new regulation unlikely to invest more

A questionnaire survey is a commonly used method of collecting data to gather, evaluate, and interpret people's views from a given population. It's considered a fairly cheap and easy way to get vast volumes of data from a large population. Questionnaires may be administered face-to-face, by phone, or online. The design of the survey questionnaire depends in large part on the type of information to be obtained. The questions may be both qualitative and quantitative. Where exploratory information

needs to be gathered, qualitative questions are used while quantitative questions are used to evaluate established hypotheses.

3.3. Data Collection

A questionnaire survey was developed to obtain the qualitative data from the respondents and also to get quantitative data to be used in the SEM and determine the effectiveness of variables between each other (Appendix A). After creating a draft version, questions in the survey were evaluated by an academician and also one industry professional who is among the founders of a renewable energy cooperative in Turkey. Based on their evaluations, comments, and additional question suggestions the final version of the survey is formed. The questionnaire survey consists of 24 questions and aims to obtain general information of respondents like age, gender, education level, household income, to understand and measure respondents' environmental concerns, the social bond between the cooperative and the shareholders, to understand respondents' technical know-how regarding the investment itself, to get each respondent's investment level, their thought, and investment appetite after the regulation change in May 2019, the importance they attached on USD based FIT mechanism, their expectations on future including electricity prices, cooperatives and finally to identify major barriers against renewable energy cooperatives established in Turkey which prevents more cooperative to be established and growing of the existent ones. Some of the questions require yes or no answers, some of them were designed on a Likert Scale and require answers in a range from very low to very high and some questions require in ordinal responses.

The questionnaires first sent online and then to increase the number of responses two site visits were organized to directly collect answers from the respondents when they met for the annual general assembly. The questionnaires were answered by the shareholders of the 9 cooperatives established in Turkey. The respondents were requested to fill the survey based on their individual information and opinions and 52 responses were collected. Even with 50 samples, SEM models had been reported to perform very well (Iacobucci, 2010).

The collected responses were used in SEM to create a model that aims to measure which variables determine the investment level of respondents and their willingness to invest more after the regulation change in May 2019.

3.4. Survey Questions

To obtain both quantitative and qualitative data from the respondents, various types of questions were asked and can be categorized into the following subtopics. The questionnaire survey is presented in Appendix A.

3.4.1. Demographics and Socio-Economic status

Gender, age, and education level, can be listed under the demographics data collected from the respondents. For both age and education level, answerers required to fill the form from 6 different age groups and levels of education starting from primary school. Additionally, 5 different monthly household income levels were given in the survey, and respondents were asked to pick the interval which reflects their monthly household income. Gender, age and education level questions were directed in question numbers 1, 2, and 3 respectively while monthly household income is answered in question 5.

3.4.2. Cooperative Membership

To obtain which cooperative members filled the survey respondents were asked to answer in which cooperative they are a member of in question 4. Additionally, the year when they became members of the cooperative were also asked in question 6 starting from 2016 when the first renewable energy cooperative was established in Turkey. Moreover, to collect data regarding the effect of different channels how did members first know about the cooperative were also asked in question 8. Besides, if members take place in the management of the cooperative, they were also asked to state in question 12.

3.4.3. Cooperative Philosophy

The importance the respondents attach to the investment being made under the roof of a cooperative with the cooperative philosophy ranging from very low to very high is asked in question 7. Moreover, the philosophy of the cooperative includes democratic management and prefers local production (Karlyle, 2005). Therefore, the importance they attach to the democratic management and local production of solar PVs were also asked in questions 13 and 18 respectively

3.4.4. Environmental Concerns

To measure the level of environmental concern of each respondent three questions were asked. The importance they attach to decrease their Carbon footprint and the level of concern against the possible effects of climate change were required to be answered starting from very low to very high in survey questions 9 and 10 respectively. Moreover, whether the respondent's willingness to invest would change or not, even though the investment is not renewable is also asked in question 11.

3.4.5. Technical Details

For the technical details of the project, two different questions were answered by the respondents. First, the importance they attach to the technical details of the panels starting from very low to very high and second members technical literacy on the solar PVs were asked in question 16 and 17 respectively.

3.4.6. Electricity Price Expectation

The expectation for the increase in electricity prices for the following years ranging from well below inflation to well above inflation was asked to respondents in question 19.

3.4.7. Importance Attached to FIT

How would respondents' additional investment decision affected if the FIT mechanism continued in dollar terms was asked in question 21 to understand the importance attached to FIT mechanism in other words, return on equity.

3.4.8. Investment Level

6 different investment levels were provided in the survey and respondents were asked to pick the interval which reflects their investment in cooperative in question 22.

3.4.9. Willingness to Invest More

Whether respondents still want to invest more in renewable energy cooperatives or not after the Unlicensed Electricity Generation Regulation published in May 2019 was asked in question 20.

3.4.10. Need of Guidance

To understand whether respondents seek the guidance of an NGO on technical issues or stakeholdership of municipality or governmental body questions 14 and 15 were asked to derive conclusions regarding the need for guidance of the renewable energy cooperatives.

3.4.11. Future Expectations

How the surveyors forecast the future of renewable energy cooperatives is also asked whether respondents have a positive view or not for the renewable energy cooperatives in question 23. Moreover, major barriers against the growth of existing cooperatives were also asked in question 24 to understand the most common obstacles perceived by the respondents for renewable energy cooperatives.

3.5. SEM Analysis

Although Multiple Regression analysis can also be used to analyze the data obtained from renewable energy cooperatives established in Turkey, SEM is chosen due to various reasons. First, multiple regression analysis handles only the observed variables, while SEM handles unobserved latent variables. In addition to that, Multiple Regression analysis can only deal with one-directional effect while SEM enables researchers to deal with both one-directional effect and correlations between the variables. In other words, SEM allows us to develop complex path models with direct and indirect effects. As the scope of the study investigates the correlations between the latent and observed variables and also the indirect effects of the variables on the dependent variable, SEM is chosen to conduct this research.

3.5.1. Definition and General Properties

Anderson and Gerbing (1988) suggests that as the second-generation data analysis technique, SEM enables systematic and comprehensive handling of a complex research problem in a single process by modeling the relationships between many dependent and independent variables compared to first-generation statistical techniques such as regression. SEM method can be beneficial for testing many theories, and complex models while performing many analyzes at once, moreover, the model recommends new relations for the network of relationships in the model examined and helps to examine the effects of measurement and mediation for the development of new models by taking into account measurement errors. On the other hand, Anderson and Gerbing (1988) also argued that regression analysis is one of the first-generation data analysis techniques that reveal how much of the change in the dependent variable is explained by independent variables. In a multi-step model with indirect relationships as well as direct relationships between the dependent variable and independent variables, direct effects can be detected by regression analysis, while the indirect effects of variables are ignored. SEM is a statistical technique used to test models with causal relationships and correlation relationships between observed variables and latent variables. Moreover, Anderson and Gerbing (1988) stated that it is a multivariate method for estimating

dependent relationships by combining analysis such as variance, covariance analysis, factor analysis, and multiple regression.

To explore more, latent variables can be defined as variables that have hypothetical constructs and cannot be measured directly but measured indirectly through observed variables. Moreover, there need to be at least two indicators per latent variable. The basic idea is that a latent variable is an underlying cause of multiple observed behaviors. On the other hand, endogenous variables and exogenous variables can be either measured or latent variables. Endogenous variables can be defined as dependent variables affected by at least one variable in the model. Whereas exogenous variables are never dependent variables and typically, are allowed to correlate with each other and influence endogenous variables (Bollen and Noble, 2011).To provide better understanding of the shapes of different variables used in SEM analysis Figure **??** is presented by Bian (2012).

There are 8 major software tools for SEM including Amos, Mplus, Mx, Ramona of Systat, Calis/Tcalis of Sas/Stat, Eqs, Lisrel and Sepath of Statistica (Cline, 2011). To create a model and test it for this research Amos has been selected which is a statistical package of IBM's SPSS program. Amos enables researchers to draw diagrams and create a relationship between variables and suggests new relations for the network of relationships for the development of the models.

3.5.2. Model Testing

Initially, the procedure starts with the model specification based on the findings and empirical results of the previous studies. The model specification phase is followed by factor loadings and co-variances are estimated and a statistical chi-square test is conducted to analyze whether the hypothesized model fits the data or not. If chi-square value is highly significant and beyond the critical values the model is rejected (Hox and T.M. Bechger, 1999). Both dependent and independent variables can be categorical including the binary. If there is such a case, Amos's Bayesian estimation can be followed when conducting a SEM (IBM, 2013). Since there are some binary variables in the

data set, Bayesian estimation is performed by using SPSS's Amos software.

Chi-square value is an indicator of whether there is a significant difference exist between the observed values and the predicted values of the model. If Chi-square approximates the zero it implies that the model and the data perfectly fit each other. However, it should be noted that the smaller sample size also leads to lower chi-square values (Cline, 2011).

The Tucker-Lewis Index (TLI) in an incremental fit index that is used to make a comparison between the proposed model and the null model. As the number approximates 1 the better model fits with the data and TLI values above 0.95 are accepted as a good model fit. Similar to TLI Comparative Fit Index (CFI) is also an incremental fit index and enabler researchers to test whether the tested model is superior to the alternative model (Chen, 2007). CFI value also ranges between zero and one and values above 0.95 indicate an acceptable fit for the proposed model (Schermelleh-Engel, et. al 2003).

RMSEA is another index used for the model testing which provides the difference between observed covariance matrix per degree of freedom and the hypothesized covariance matrix which denotes the model (Chen, 2007). RMSEA values lower than 0.05 are accepted as a good fit, and values between 0.05 and 0.08 are considered as adequate fit, whereas values between 0.08 and 0.10 are just fair and values higher than 0.10 are not acceptable (Browne and Cudeck, 1992).

For the Bayesian analysis checking fitness of the model requires additional parameters to be tested including posterior predictive value and convergence of the model. Gelman *et al.* (2020) suggested that convergence values of 1.10 or less are suitable for many analyzes. The probability of replicated data could be more extreme than the observed data is called the Bayesian P-value and the value is expected to close to 0.5 according to Gelman *et al.* (2020) and Meng (1994) proposed that the acceptable range is between 0.3 to 0.7.

3.5.3. Model Development

Two different structural equation models were developed through IBM SPSS's AMOS software. Developed models were used to test different hypotheses and shown in Figure 3.3 and Figure 3.4. There is a latent variable in the first developed model, however, no latent variable was used in the second model. The latent variable is shown with a circle and consists of two observed variables which are shown as rectangles. Other observed variables were also illustrated as rectangles. Observed variables under the latent variable and observed variables that are directly linked with other observed variables also have residual error variables shown in elliptical forms.

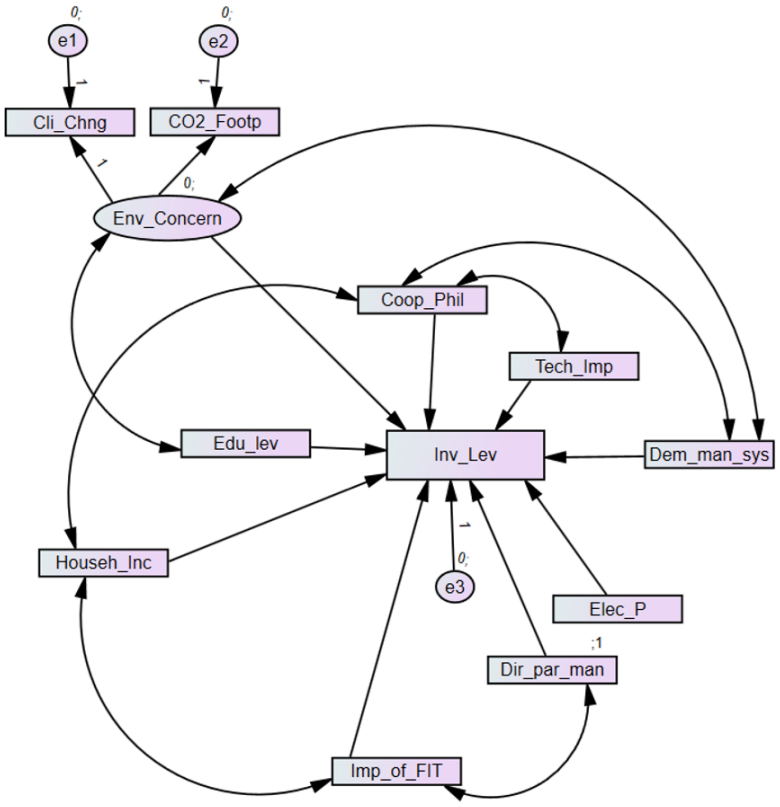

Figure 3.3. Model 1.

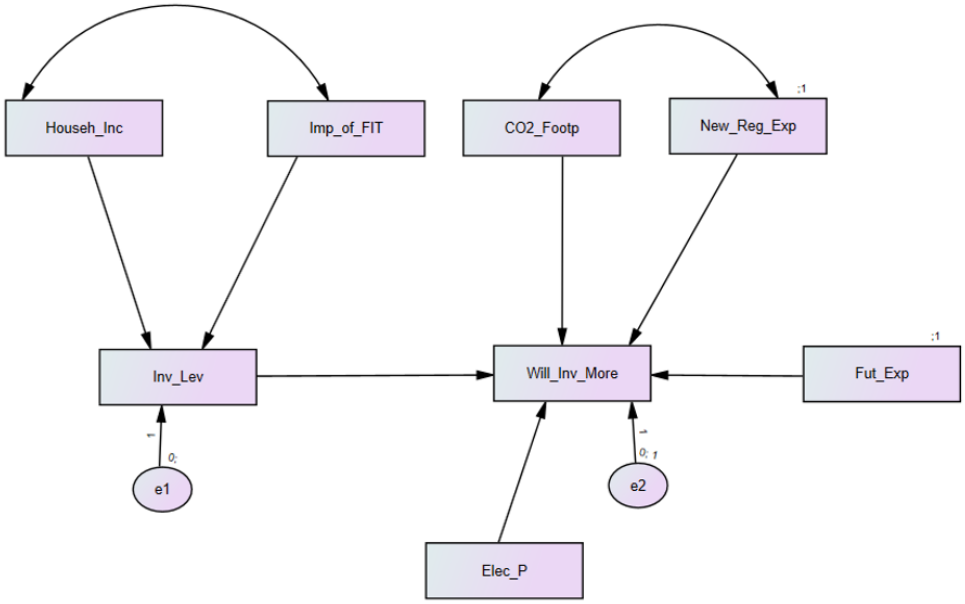

Figure 3.4. Model 2.

4. RESEARCH RESULTS

4.1. Respondent Profiles and Survey Results

The respondents of the survey are a member of 9 different renewable energy cooperative established in Turkey. A total of 52 samples were obtained from these cooperatives. 88% of the respondents are male as presented in Figure 4.1, it can be stated that males have more tendency to become a member of the renewable energy cooperative.

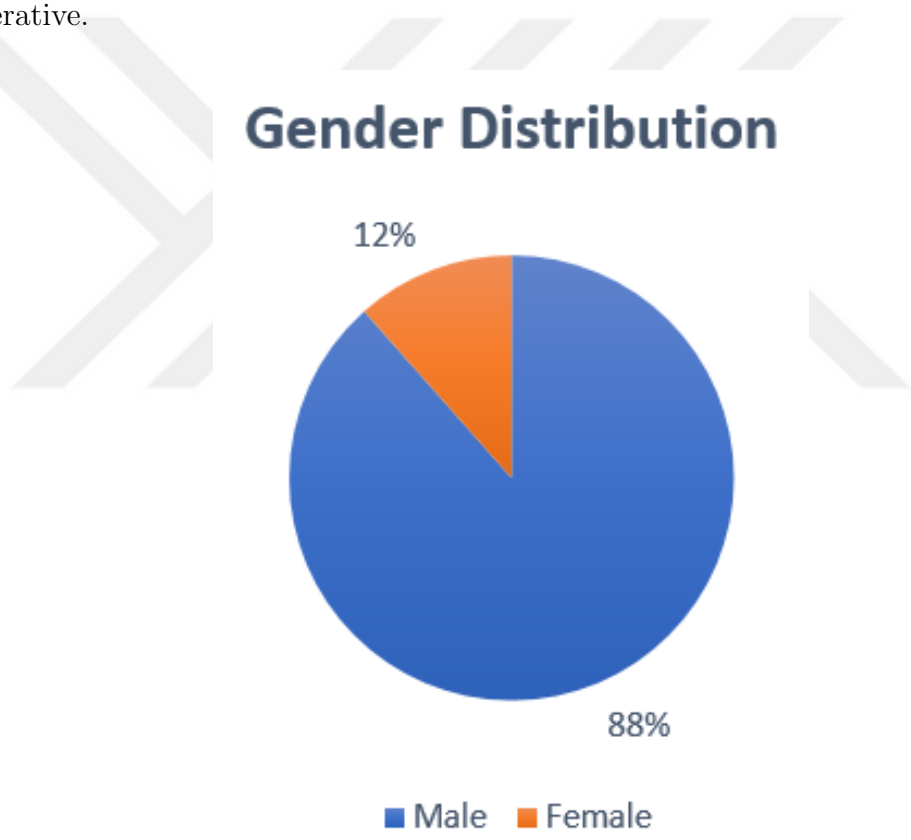

Figure 4.1. Gender Distribution.

Most of the respondents are 36 to 55 years old whereas there are only 2 respondents who are more than 65 years old. The distribution of ages of the respondents presented in Figure 4.2.

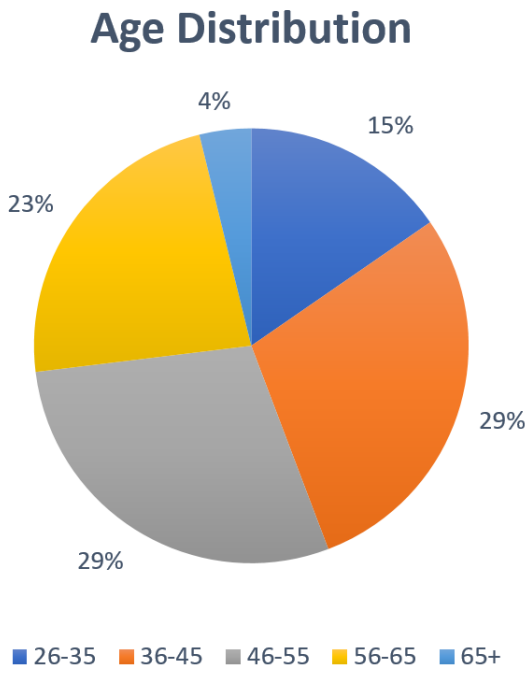

Figure 4.2. Age Distribution.

The majority of the respondents consist of university graduates whereas 8% of them did not pursue education after secondary school and 4% of them after primary school as presented in Figure 4.3.

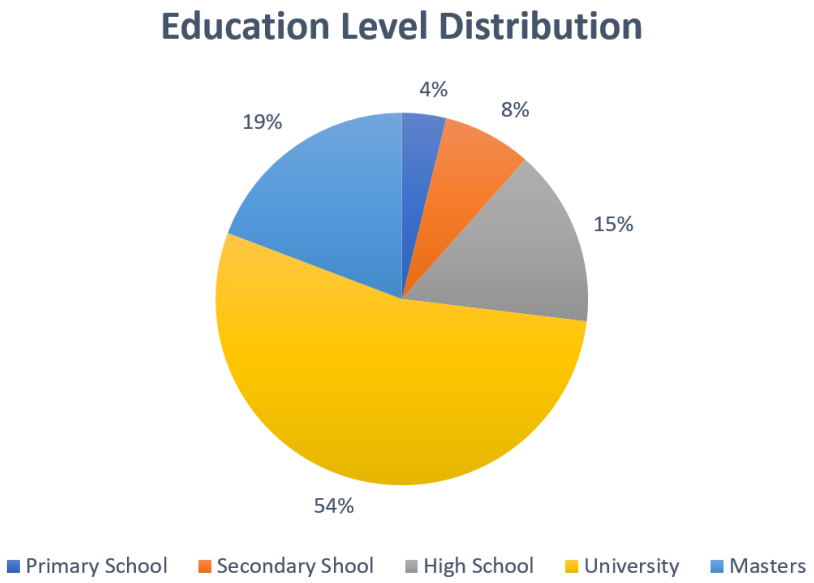

Figure 4.3. Education Level Distribution.

42% of the respondents are the member of Kayseri Furnitures Renewable Energy Cooperative which is followed by Mersin Chamber of Electricity Engineers Renewable Energy Cooperative with 15%. It can be argued that face to face interviews conducted in Kayseri lead to a high number of answers whereas other cooperative members answered online. The distribution of member's renewable energy cooperatives is presented in Figure 4.4.

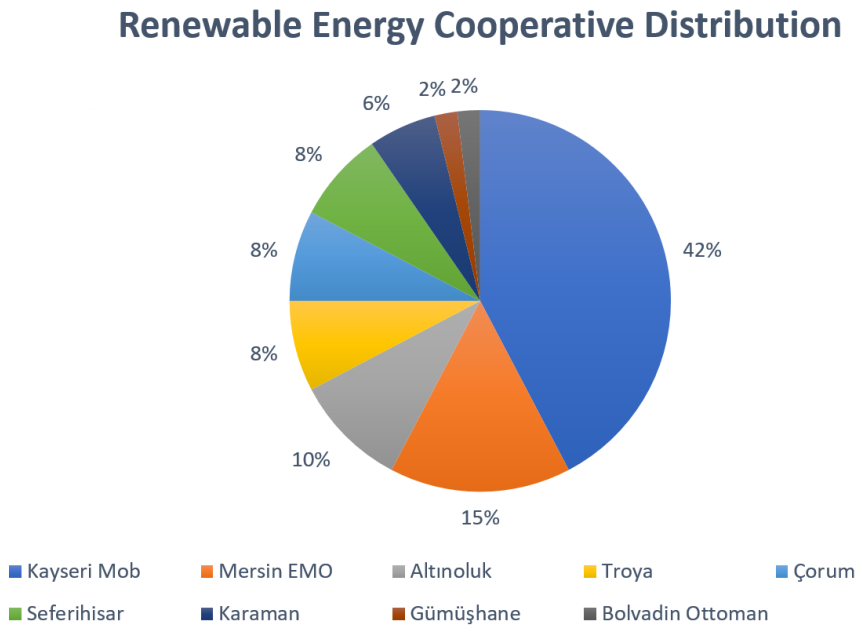

Figure 4.4. Renewable Energy Cooperative Distribution.

While 54% of respondents' monthly household income ranged from 5,000 TL to 15,000 TL, none of the respondents said that they had monthly household income of more than 50,000 TL. The distribution of the monthly household income of respondents is demonstrated in Figure 4.5. If necessary, for the following studies to calculate the net future value of these household incomes, answers obtained in the early 2020s.

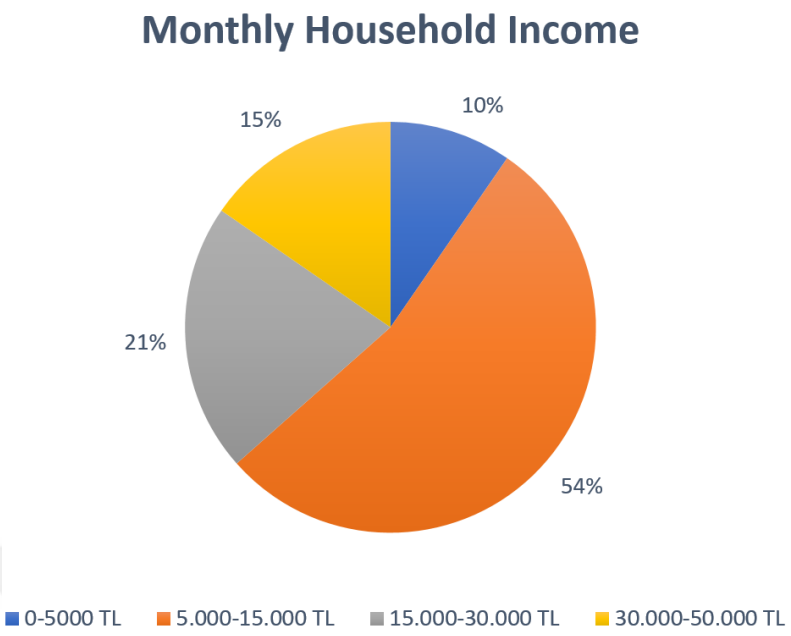

Figure 4.5. Monthly Household Income Distribution.

Most of the respondents become a member before 2018, but it should be noted that the survey was conducted in the early 2020s so it cannot be concluded that there is a sharp decrease in 2020. The distribution of the respondent's year of membership is illustrated in Figure 4.6.

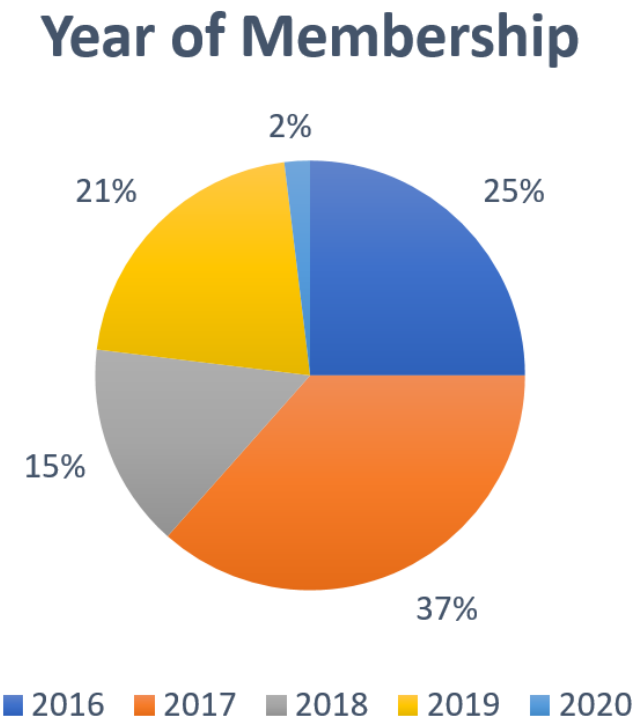

Figure 4.6. Year of Membership Distribution.

A considerable majority of the answerers value that the investment is being made under the roof of a cooperative with the cooperative philosophy. The answer of the respondents is shown in Figure 4.7.

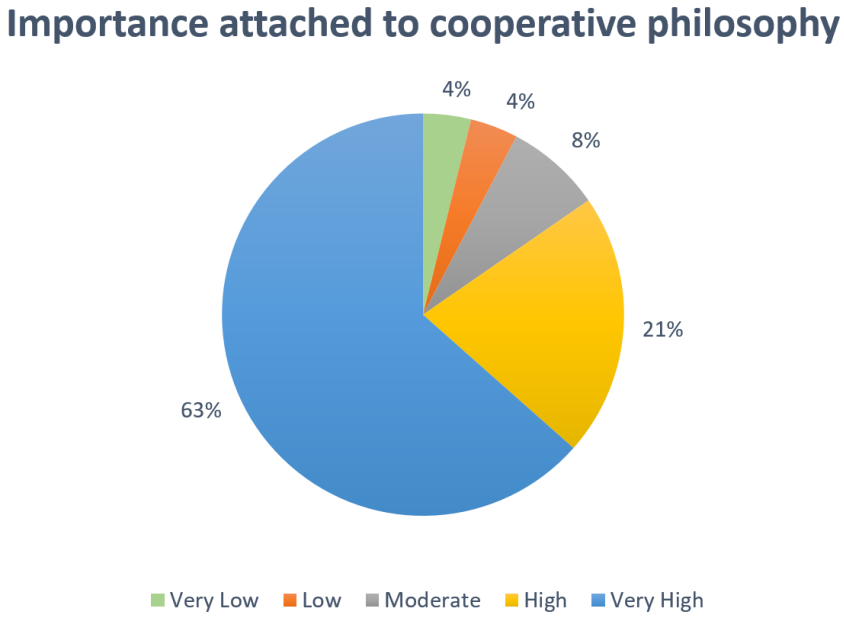

Figure 4.7. Importance Attached to Cooperative Philosophy.

Half of the respondents stated that they first know about renewable energy cooperatives via oral communication, whereas cooperatives introductory meetings also play a huge role, and the effect of social media is very limited. The distribution of channels where respondents first know about renewable energy cooperatives is presented in Figure 4.8.

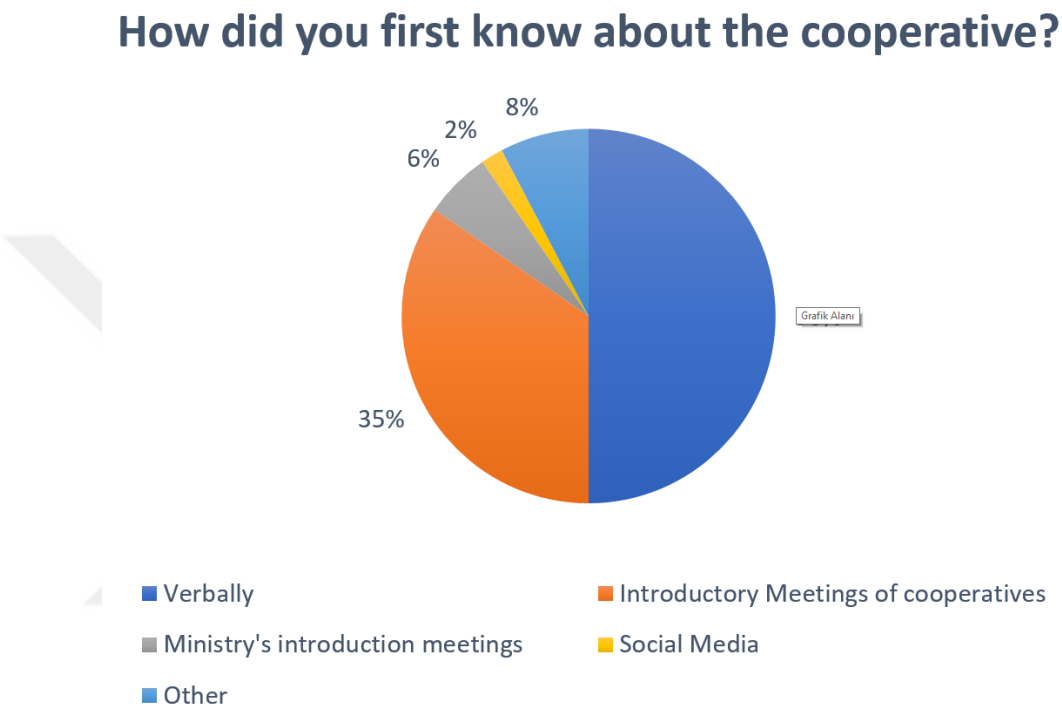

Figure 4.8. How Members First Know About the Cooperative Distribution.

In terms of environmental concerns of the respondents, it can be concluded that a significant percentage of them put high importance on reducing their carbon footprint and have concerns about possible results of climate change as shown in Figure 4.9 and Figure 4.10. It should be noted none of the answerers responded to these questions as very low.

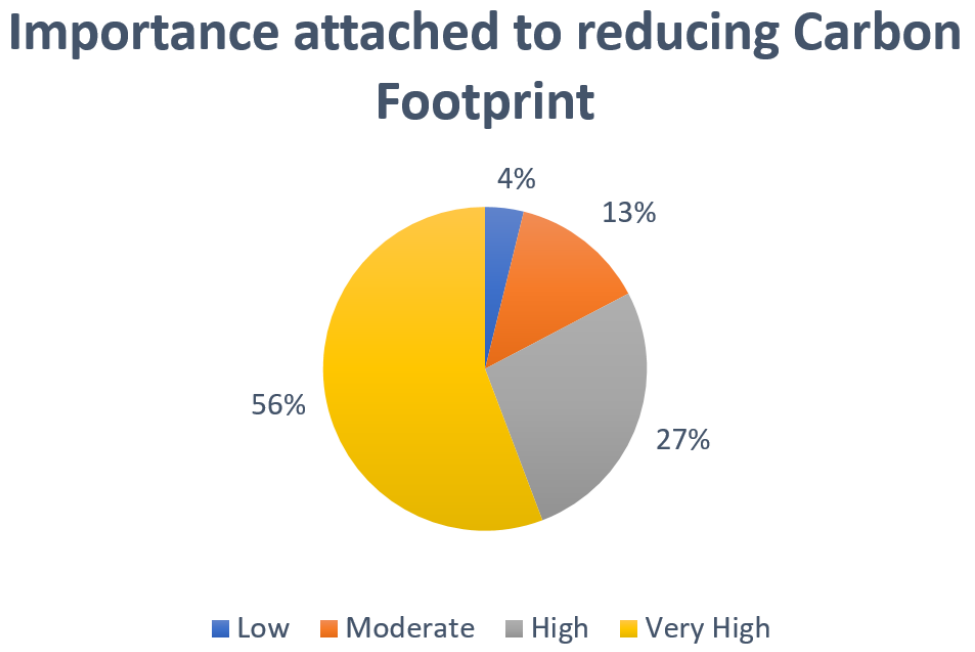

Figure 4.9. Importance Attached to Reducing Carbon Footprint.

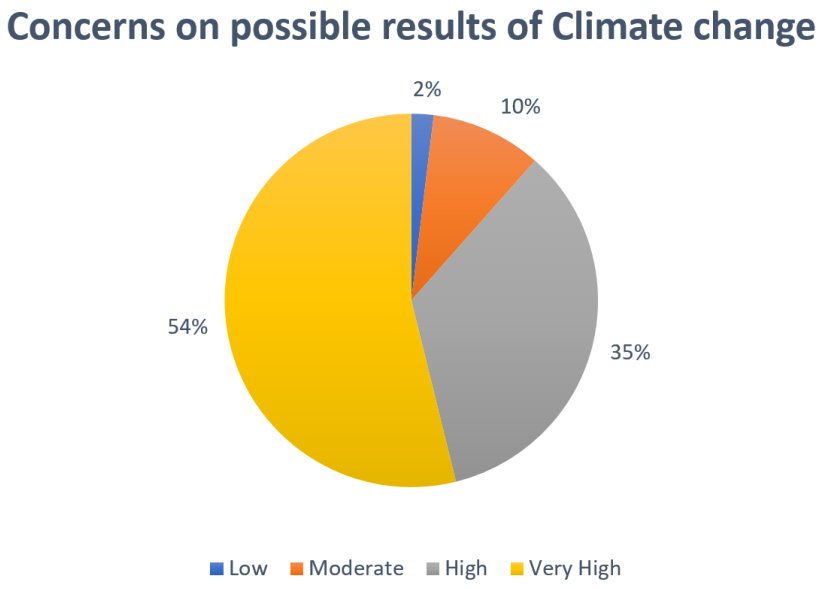

Figure 4.10. Concerns on Possible Results of the Climate Change.

In parallel with that, as illustrated in Figure 4.11, 73% of the answerers stated that they will not invest if the electricity was generated via conventional methods such as coal and natural gas.

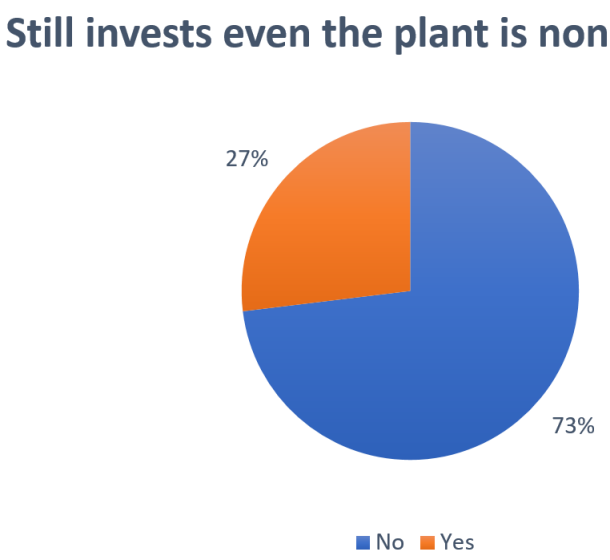

Figure 4.11. Share of Members Who Would Still Invest Even the Plant Is Non-Renewable.

Almost half of the answerers take active roles in the management of the cooperatives as demonstrated in Figure 4.12. Because the number of members can reach up to thousands as Kayseri Furnitures Renewable Energy Cooperative has and the number of managerial roles is so limited it can be concluded that members who take active roles in the management also tend to respond the survey compare to members with no managerial roles.

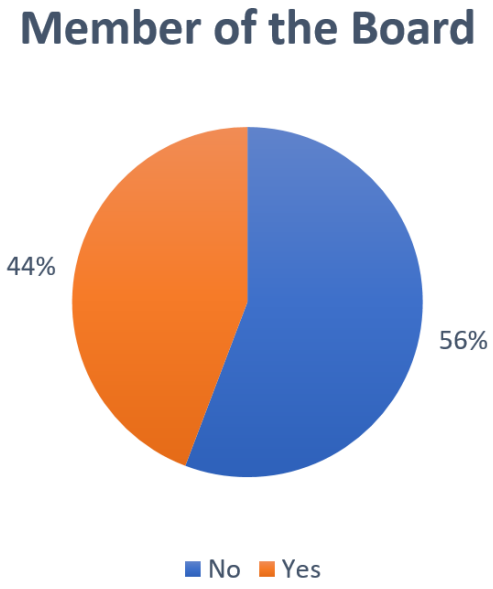

Figure 4.12. Share of Respondents with Managerial Roles.

On the other hand, as presented in Figure 4.13 38% of the answerers put very low importance for the democratic management system in cooperatives which is every member having only one vote independent from the number of shares. It might result from non-functional or for show-only voting that in some cooperatives.

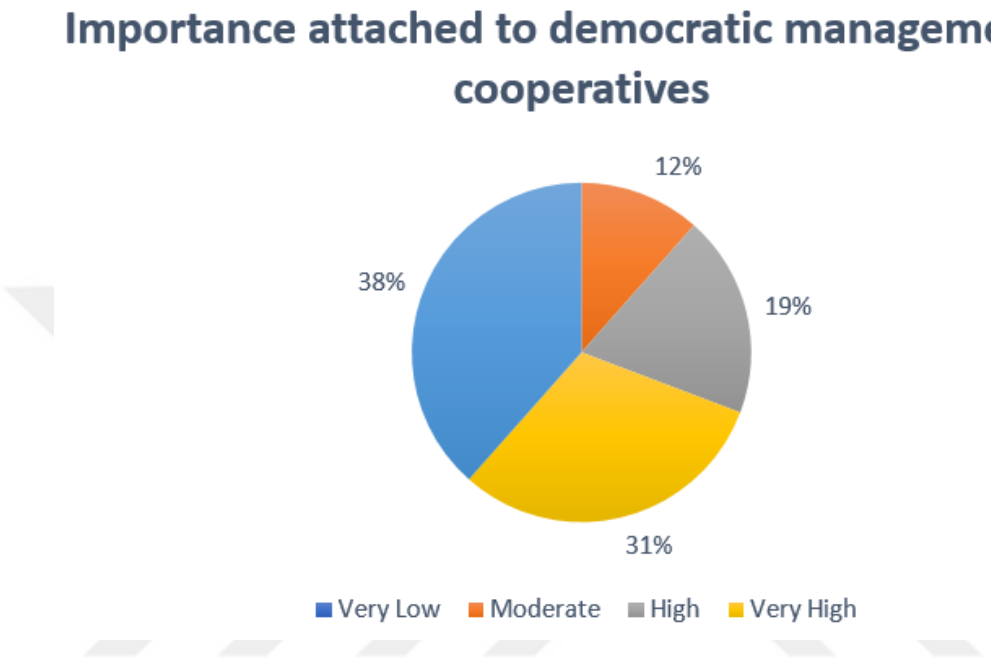

Figure 4.13. Importance Attached to Democratic Management in Cooperatives.

Furthermore, 60% of the respondents put high importance on a state/municipality stakeholdership in the cooperative from the establishment process of the cooperative to the investment process, whereas 52% of the gives high importance on stakeholdership of non-governmental organizations (Chamber of Electrical Engineers, Chamber of Civil Engineers, Günder, etc.) who can provide supervision to the cooperative from the establishment of the cooperative to the investment process and for both questions combination of low and very low answers are below 10%. The distributions of importance attached to public institution stakeholdership and NGOs consultancy are provided in in Figure 4.14 and Figure 4.15 respectively.

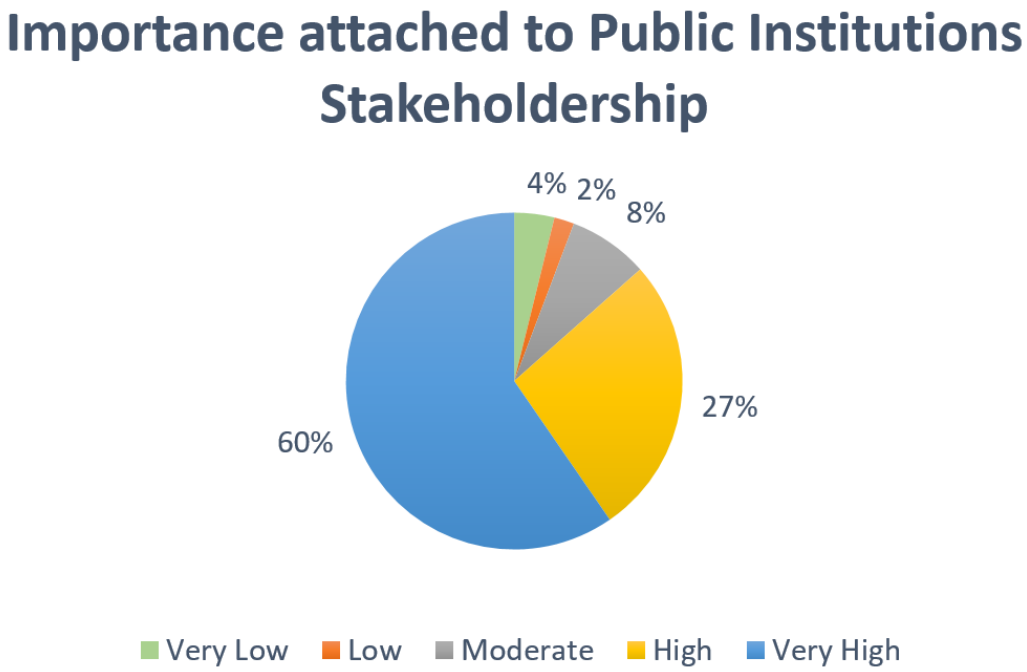

Figure 4.14. Importance Attached to Public Institutions Stakeholdership.

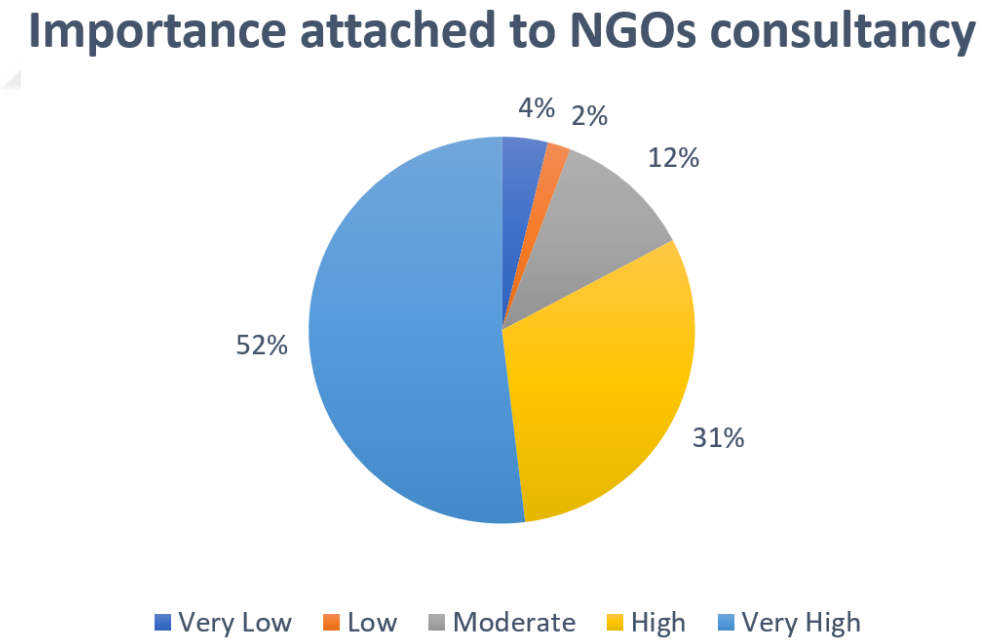

Figure 4.15. Importance Attached to NGOs Consultancy.

In terms of technical aspects, 50% of the respondents do not believe they have enough technical literacy on the PV panel as presented in Figure 4.16. Whereas 77% of them put high or above importance on the PVs as demonstrated in Figure 4.17.

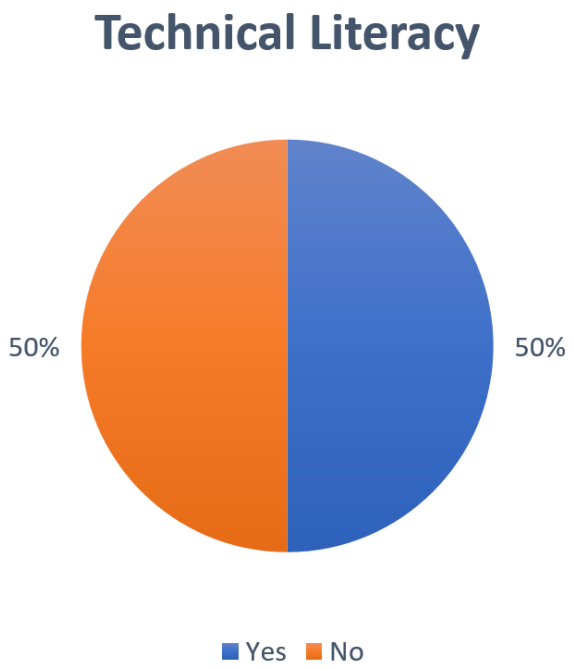

Figure 4.16. Share of Members with Technical Literacy in Solar PVs.

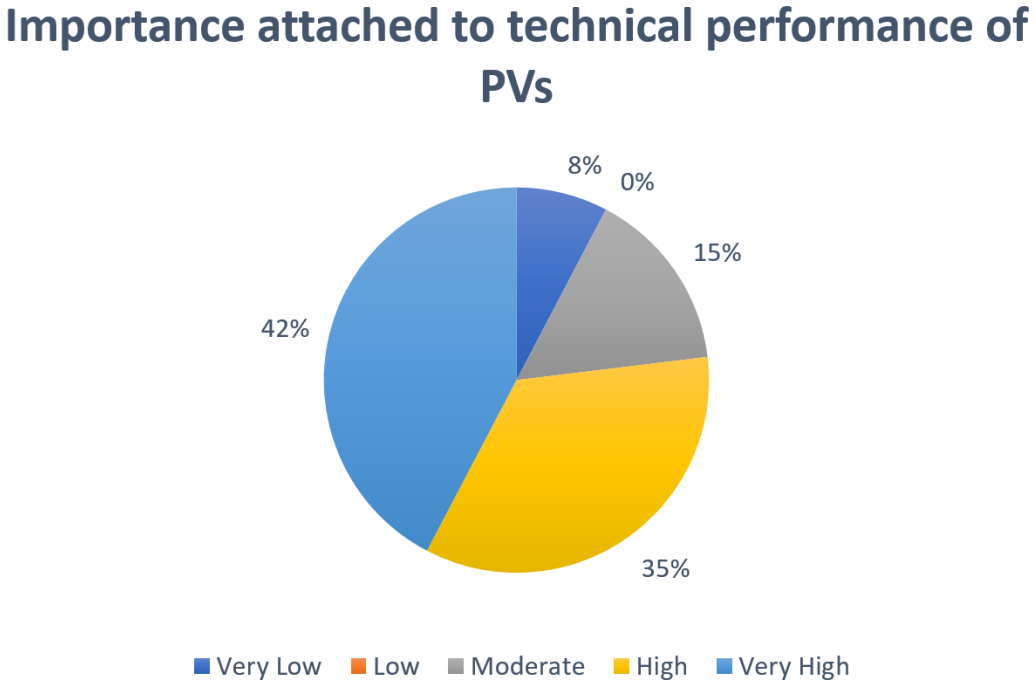

Figure 4.17. Importance Attached to Technical Performance of PVs.

Moreover, 81% of the respondents believe that local production of PVs has higher or above importance for them but none of the PVs installed in cooperatives are local production so they were imported. Figure 4.18 presents the importance attached by

respondents to local production of PVs.

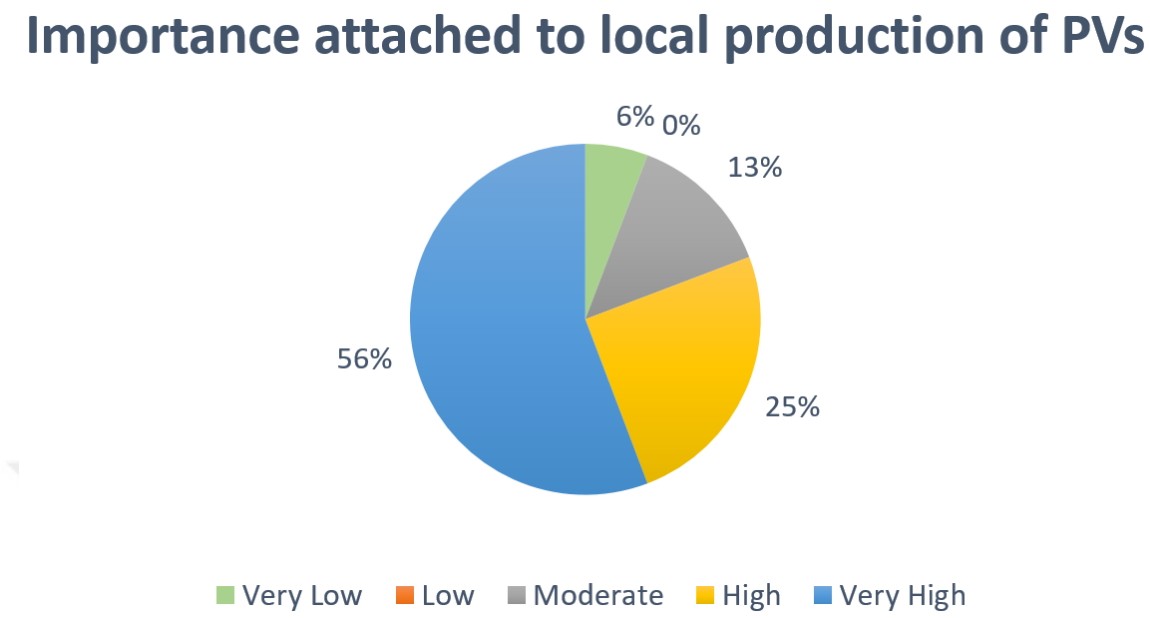

Figure 4.18. Importance Attached to Local Production of PVs.

Furthermore, as illustrated in Figure 4.19 only 6% of the respondents stated that their electricity price expectation is below inflation whereas the majority of them believe that electricity prices will increase higher than the inflation in Turkey.

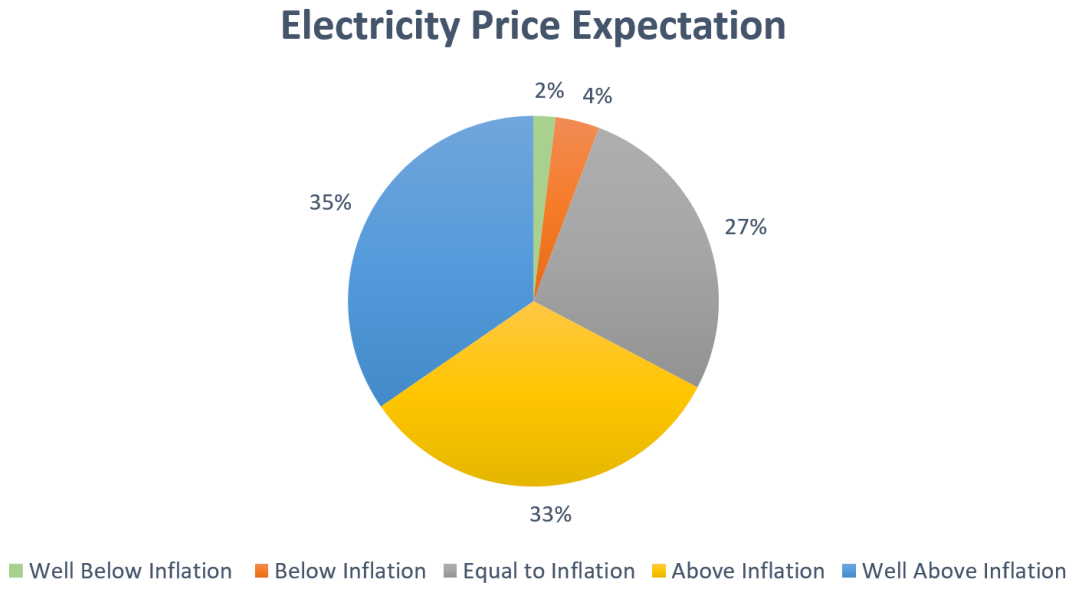

Figure 4.19. Electricity Price Expectation.

Striking numbers were obtained when asked members' willingness to invest in renewable energy cooperatives affected after the Unlicensed Electricity Generation Regulation published in May 2019 and 88% of them answered no as demonstrated in Figure 4.20 which implies the importance of the FIT mechanism.

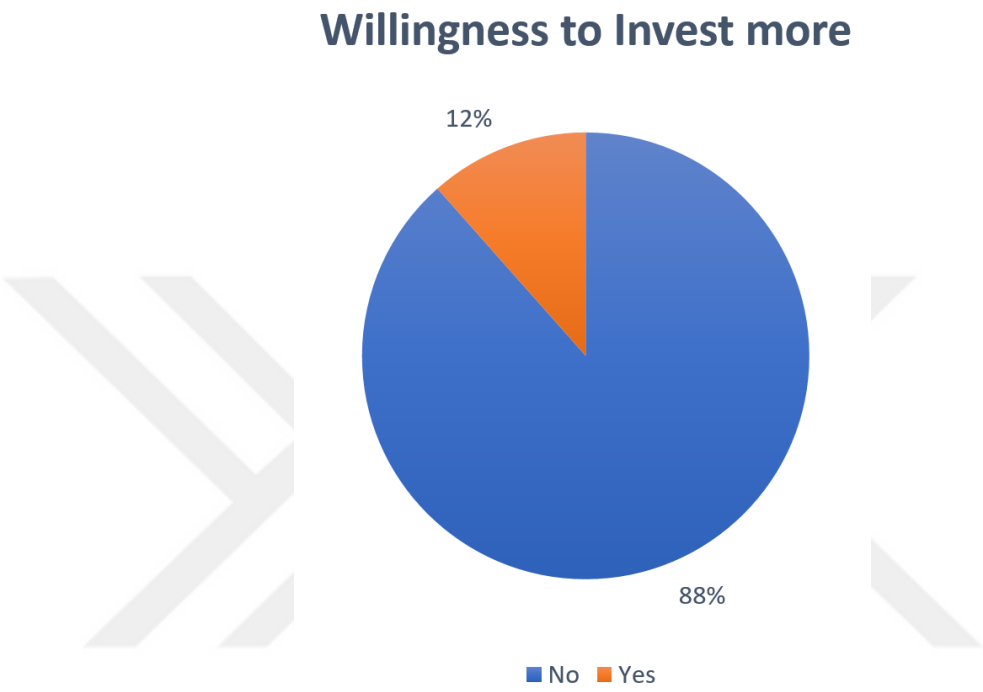

Figure 4.20. Willingness to Invest More.

For further investment, how much importance do the members put on the FIT mechanism to continue is also asked in the survey, and 10% of them answered as very low as illustrated in Figure 4.21.

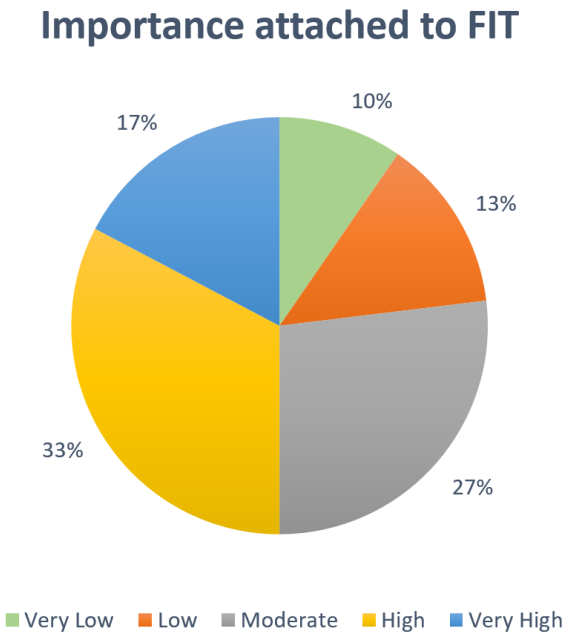

Figure 4.21. Importance Attached to FIT.

The investment level of the respondents has widespread as it can be seen from the intervals presented in Figure 4.22. The majority of the investment per respondent is below 100.000 TL and below whereas 19% of the responses are provided by members with 400.000 TL or more investment levels.

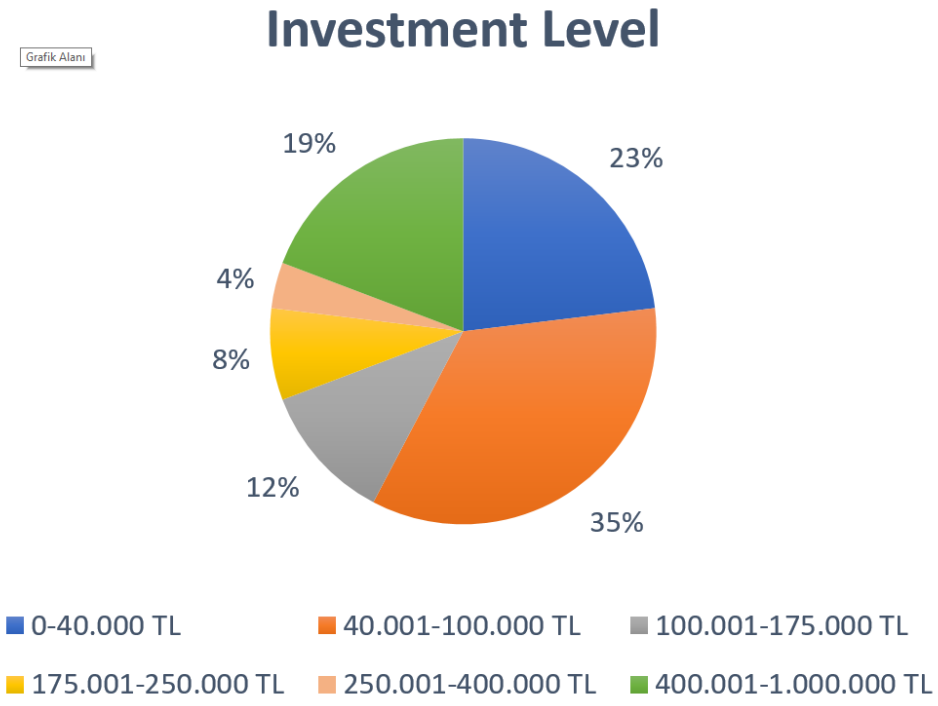

Figure 4.22. Investment Level of Respondents.

As it was stated earlier qualitative data was also obtained and respondents' future expectation on renewable energy cooperatives were also asked. As demonstrated in Figure 4.23 almost half of the answerers argue that renewable energy cooperatives will be limited existing ones whereas the other half believes that existing ones will grow with the new shareholders and new cooperatives will establish.

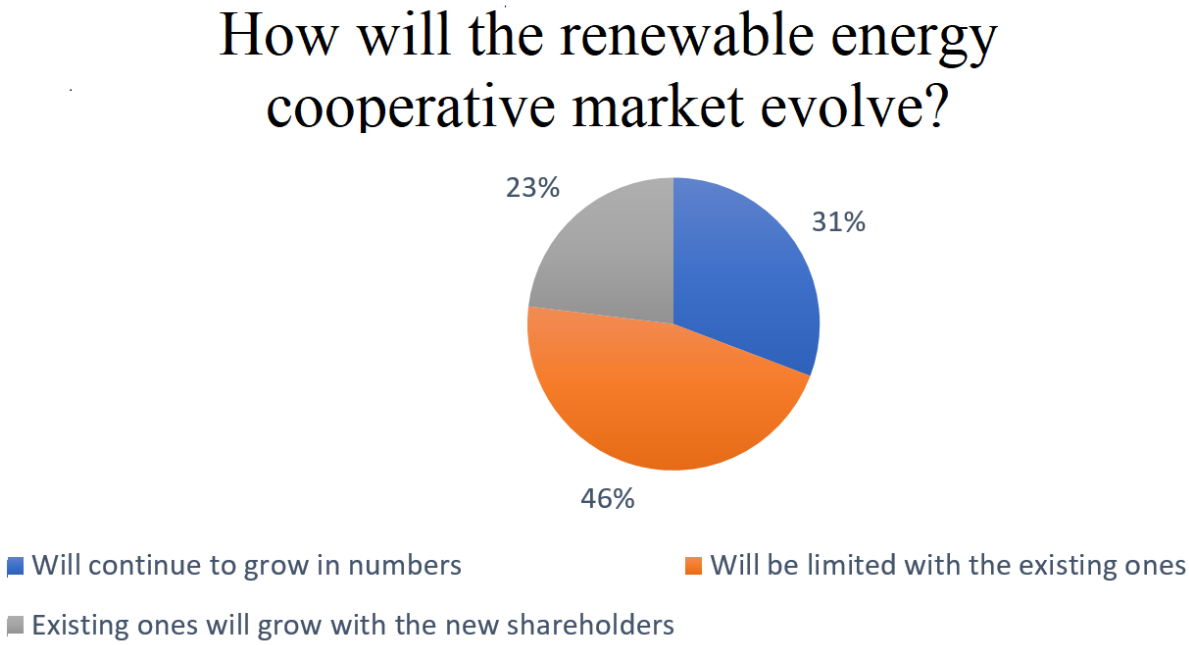

Figure 4.23. Future Predictions for the Renewable Energy Cooperatives.

Finally, regulations are evaluated as one of the major barriers to the development of renewable energy cooperatives as share of the respondents who believe regulations are one of the major barriers against Renewable Energy Cooperatives is provided in Figure 4.24. On the other hand, people's lack of environmental concerns and high initial investment costs were not evaluated as a major problem from the majority of the respondent as presented in Figure 4.25 and Figure 4.26 respectively.

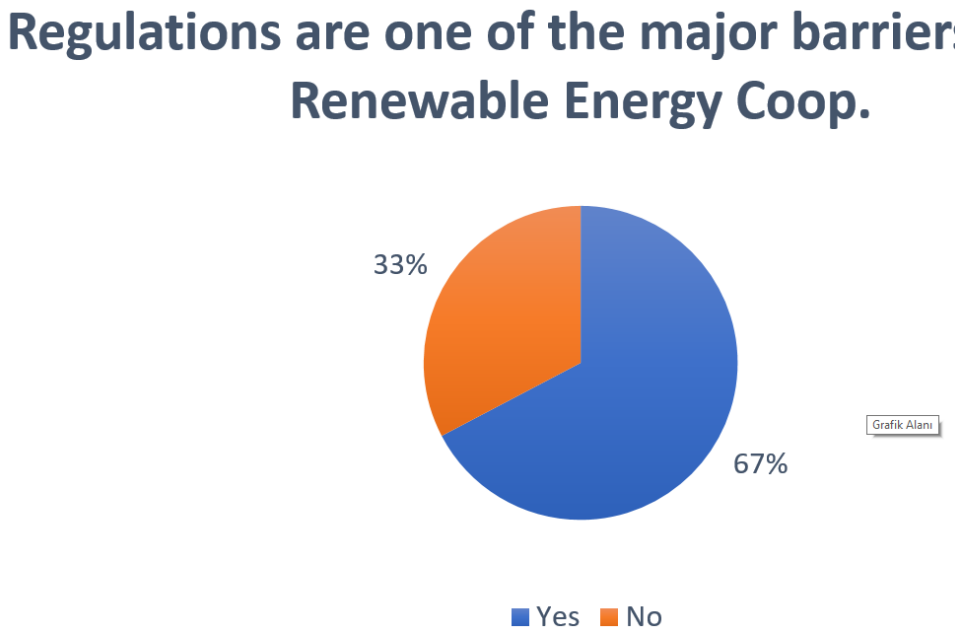

Figure 4.24. Regulations as a Major Barrier Against Renewable Energy Cooperatives.

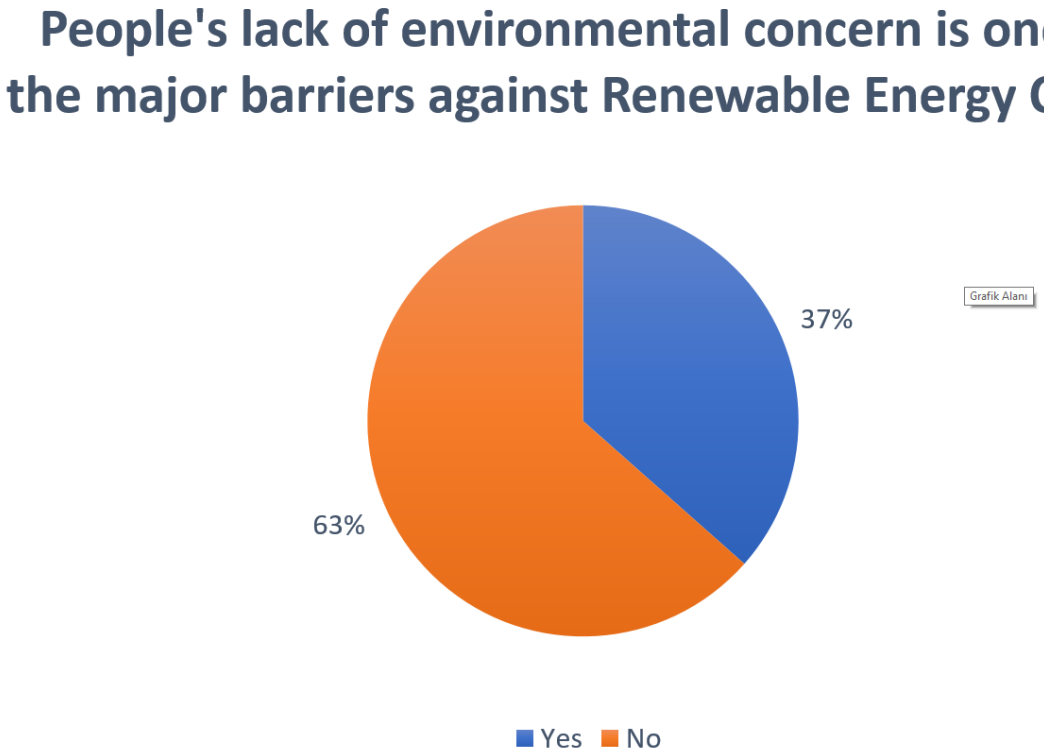

Figure 4.25. People's Lack of Environmental Concern as a Major Barrier Against Renewable Energy Cooperatives.

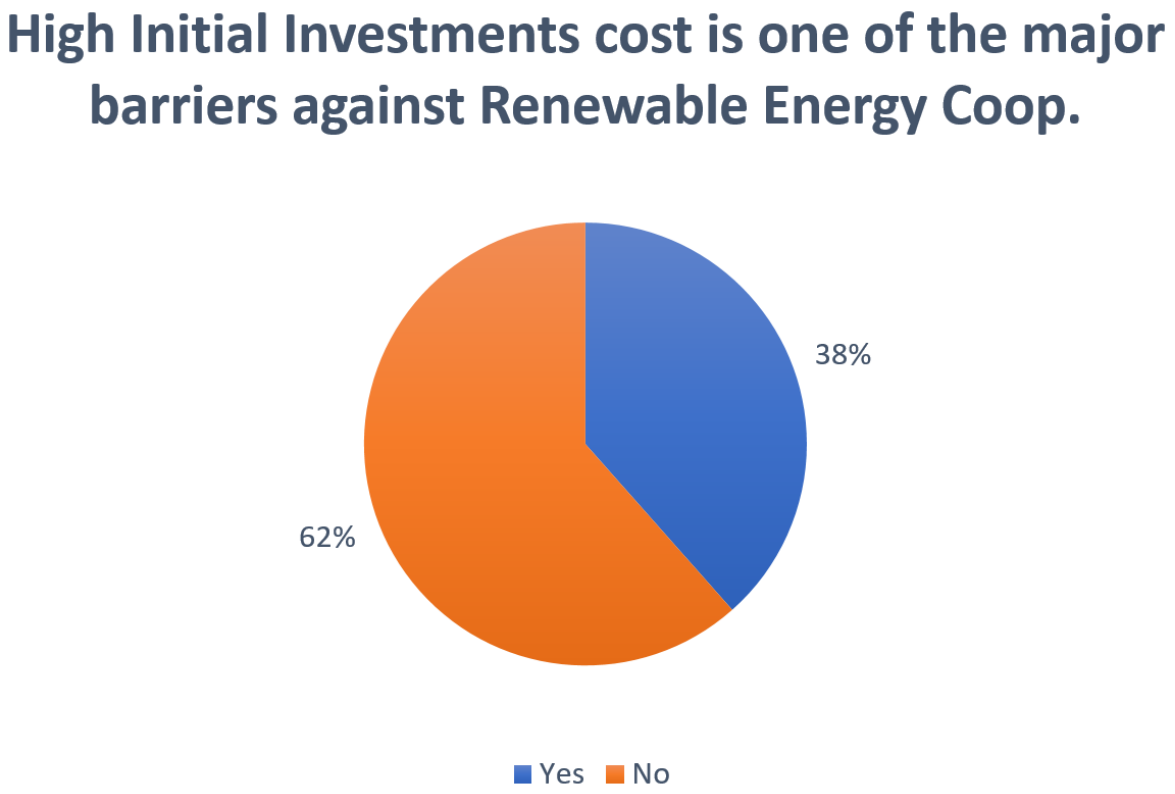

Figure 4.26. High Initial Investment Cost as a Major Barrier Against Renewable Energy Cooperatives.

4.2. Model Results

To construct both models, the relationship between the variables was mainly based on the judgment of the researcher and the feedback provided by the industry experts and an academician, moreover considering the modification indices values proposed by the software new relations were constructed between the variables. The goodness of the fit of the model was controlled by checking X2/dof, TLI, RMSEA, CFI.

4.2.1. Model 1

Model 1 is developed to test the hypothesis numbered from 1 to 8. The variables used in the model are presented in the Table 4.1 below. There are 3 observed endogenous variables, 7 observed exogenous variables, and 4 unobserved exogenous variables including 3 error terms.

Table 4.1. Model 1 Variables Summary.

Observed, endogenous variables	**Observed, exogenous variables**	**Unobserved, exogenous variables**
Cli_Chng	Imp_of_FIT	Env_Concern
CO_2_Footp	Dem_man_sys	e1
Inv_Lev	Coop_Phil	e2
	Dir_par_man	e3
	Elec_P	
	Tech_Imp	
	Househ_Inc	
	Edu_lev	

Explanations for the variables used in the model 1 is provided below.

- CO_2_Footp: The level of importance of respondents attached to decrease their Carbon footprint is measured from 1 to 5, 1 represents very low and 5 represents very high. However, no respondent answered very low so minimum value for this variable is 2.
- Cli_Chng: The level of respondents' concern against the possible effects of climate change was from 1 to 5 where 1 means very low and 5 means very high. However, no respondent answered very low so minimum value for this variable is 2.
- Inv_Lev: Based on the survey results 6 different investment levels were determined where 6 is the highest investment level and 1 is the lowest.
- Imp_of_FIT: The importance attached to FIT or return on equity is ranked from 1 to 5 where 5 is very high and 1 is very low.
- Dem_man_sys: Importance attached to the democratic management of the cooperative by the respondents was numbered from 1 to 5 where 1 is very low and 5 is very high.
- Coop_Phil: The importance the respondents attach on the investment being made under the roof of a cooperative with the cooperative philosophy ranges between 1 and 5, 1 represents very low and 5 represents very high.
- Dir_par_man: If the respondents take a role in the management of the cooperative the variables take 1 and if not, the variable takes 0.

- Elec_P: Future electricity price expectation of the respondents was ranked from 1 to 5 where 1 is well below inflation and 5 is well above inflation.
- Tech_Imp: The importance they attach on the technical details of the panels starting from very low to very high
- Household_Inc: 5 different monthly household income levels were given in the survey where 5 is the highest, yet no respondent answered that they have over 50.000 TL of monthly household income. Hence, the maximum value for this variable is 4.
- Edu_Lev: 6 different graduate levels were asked to respondents and ranked from 1 to 6. However, no respondent has a Ph.D. so the answer range was limited with 5.
- Env_Concern: This variable is a latent variable which consists of the variables CO_2_Footp and Cli_Chng.

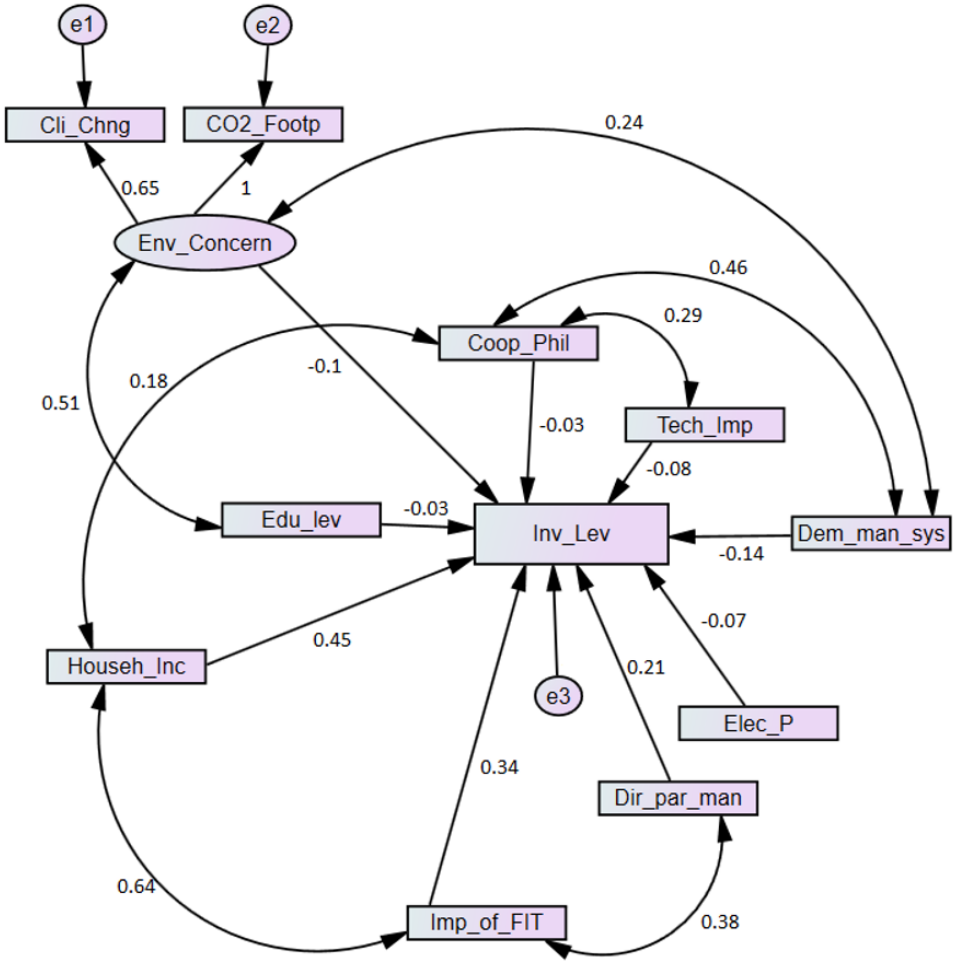

Figure 4.27. Model 1.

Table 4.2. Model 1 Variables Min Max Skewness and Kurtosis Values.

Variable	**min**	**max**	**skew**	**kurtosis**
Edu_lev	1	5	-1.029	0.918
Househ_Inc	1	4	0.508	-0.496
Tech_Imp	1	5	-1.369	1.416
Elec_P	1	5	-0.645	-0.012
Dir_par_man	0	1	0.232	-1.946
Coop_Phil	1	5	-1.804	2.603
Dem_man_sys	1	5	-1.088	0.297
Imp_of_FIT	1	5	-0.418	-0.658
Inv_Lev	1	6	0.713	-0.936
CO_2_Footp	2	5	-1.099	0.247
Cli_Chng	2	5	-1.088	0.633
Multivariate				11.508

The normal distribution of the data depends on the values of skewness to be between ± 3. (Shao, 2002) and the kurtosis values should be between ± 7. (Curran *et al.*, 1996) In this case when the related tables are examined, all variables' skewness are in between ± 3 thresholds and kurtosis' ranges in ± 7. Hence, the data can be considered to have a normal distribution.

A comparison of the recommended values and model values for the first model is provided in Table 4.3 below.

Table 4.3. Reliability and Goodness of the Fit Measures for the First Model Developed.

Index	**Recommended Value**	**Model Output**
X^2/dof	<3.00	1.14
CFI	>0.95	0.971
TLI	>0.95	0.957
RMSEA	<0.10	0.052
Posterior Predictive P	close to 0.5	0.42
Convergence Value	1.10	1.01

The developed hypotheses from 1 to 9 were tested with the SEM as shown in Figure 4.27. The direction of influence between the model variables is shown by using arrows, one-way arrow implies only one variable is influenced by the other variable, whereas two-way arrow indicates both variables have an impact on each other. The value of the path coefficients suggests the degree of influence. Murari K. (2015) suggested that a path coefficient between 0.1 to 0.3 implies a weak correlation, 0.3 to 0.5 indicates a moderate association, and path coefficients with higher than 0.5 suggest that there is a strong association.

As stated before, since there is a binary variable in model 1 Bayesian estimation analysis was used via IBM SPSS's Amos software. For a confidence interval equals to 95% Bayesian estimation analysis was run and the following results were obtained and presented in Table 4.4 below.

Table 4.4. Significance of the Constructed Paths in Model 1.

Regression weights	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Inv_Lev <– Imp_of_FIT	0.561	0.56	0.1	1.03
Inv_Lev <– Coop_Phil	-0.05	-0.05	-0.45	0.35
CO_2_Footp <– Env_Concern	1.857	1.7	1.07	3.66
Inv_Lev <– Env_Concern	-0.356	-0.35	-1.26	0.51
Inv_Lev <– Dir_par_man	0.373	0.37	-0.16	0.91
Inv_Lev <– Elec_P	-0.135	-0.14	-0.47	0.2
Inv_Lev <– Tech_Imp	-0.141	-0.14	-0.44	0.16
Inv_Lev <– Dem_man_sys	-0.214	-0.21	-0.55	0.12
Inv_Lev <– Edu_lev	-0.057	-0.06	-0.46	0.36
Inv_Lev <– Househ_Inc	0.983	0.98	0.45	1.52

In Bayesian estimation, if 0 is not contained between the 95% lower bound and 95% upper bound it can be said that there is a significant relationship between the variables. The Table 4.4 above indicates that the investment level has the only signifi-

cant relationship between the household income and the importance attached to FIT. On the other hand, as can be seen from the Table 4.5 below all co-variances satisfy the necessary condition for relations to be significant.

Table 4.5. Significance of the Covariances between the Constructed Relationships in Model 1.

Covariances	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Dem_man_sys $<->$ Coop_Phil	0.723	0.696	0.342	1.256
Dem_man_sys $<->$ Env_concern	0.166	0.155	0.02	0.375
Coop_Phil $<->$ Tech_Imp	0.385	0.37	0.071	0.787
Imp_of_FIT $<->$ Househ_Inc	0.741	0.717	0.425	1.201
Imp_of_FIT $<->$ Dir_par_man	0.457	0.456	0.175	0.746
Edu_lev $<->$ Env_concern	0.295	0.281	0.091	0.581
Coop_Phil $<->$ Househ_Inc	0.194	0.186	0.017	0.415

4.2.2. H_1: Members of renewable energy cooperatives with higher household incomes tend to invest more

The first hypothesis can be accepted as the interval between the lower bound and upper bound values do not include 0. Hence, it can be concluded that cooperative members with higher wealth will likely invest more.

4.2.3. H_2: Members of renewable energy cooperatives with higher environmental concerns are more likely to invest more

The second hypothesis is rejected since lower bound and upper bound ranges including the 0. Hence, the respondents having higher environmental concerns does not necessarily lead to a higher level of individual investments.

4.2.4. H_3: Members who participate in the management of renewable energy cooperatives tend to invest more

The third hypothesis is also rejected considering the interval between the lower bound and upper bound values. In other words, there is no significant difference in terms of the level of investment between the managers of cooperative and ordinary members.

4.2.5. H_4: Members of the renewable energy cooperatives who attach higher importance on return on investment are more likely to invest more

The fourth hypothesis can be accepted due to the same reason as stated in hypothesis 1. It can be argued that respondents' who are more aware of the financial benefit of FIT and return potential of renewable energy projects in Turkey invested more.

4.2.6. H_5: Members of renewable energy cooperatives with higher education levels tend to have higher environmental concerns

As the 95% lower bound and 95% upper bound values do not range by including 0, as it can be seen from the co-variances table, the fifth hypothesis can be accepted. Therefore, it can be concluded that there is a significant relationship between the members' level of environmental concern and education level.

4.2.7. H_6: Members of renewable energy cooperatives with higher education levels tend to invest more

The sixth hypothesis is also rejected which means higher education level does not result in a higher level of investments.

4.2.8. H_7: Members of the renewable energy cooperatives who attach higher importance on democratic management in cooperatives are more likely to invest more

As the 95% lower bound and 95% upper bound values range by including 0 the seventh hypothesis is rejected. Hence, it can be suggested that people who attach higher importance to democratic management in cooperatives do not necessarily invest more.

4.2.9. H_8: Members of the renewable energy cooperatives who attach higher importance on investment is being made under cooperative scheme tend to invest more

The eight hypothesis is rejected due to the same reason stated in hypothesis seven and other rejected hypotheses. In other words, it can't be concluded that members who attach higher importance to investment are being made under a cooperative scheme does not lead to a higher level of investments.

4.2.10. H_9: Members of the renewable energy cooperatives who expects higher electricity price expectation invested more in to renewable energy cooperatives

The ninth hypothesis is also rejected as there is no significant relationship between the electricity price expectation and the amount of investment. Moreover, there is more to explore from the results of model 1 other than the results of the hypotheses. Considering the co-variances presented in Table 4.5 it can be concluded that, people who attach higher importance to democratic management of the cooperatives also have a higher level of environmental concerns and also attaches higher importance to the investment is being made under the cooperative scheme. Furthermore, members who take a role in the management of the cooperatives likely to have higher household income and members with higher household income are likely to attach higher importance to FIT, and also the investment is being made under the cooperative scheme.

The insignificant relationships for Model 1 are demonstrated with the intermittent lines and presented in Figure 4.28.

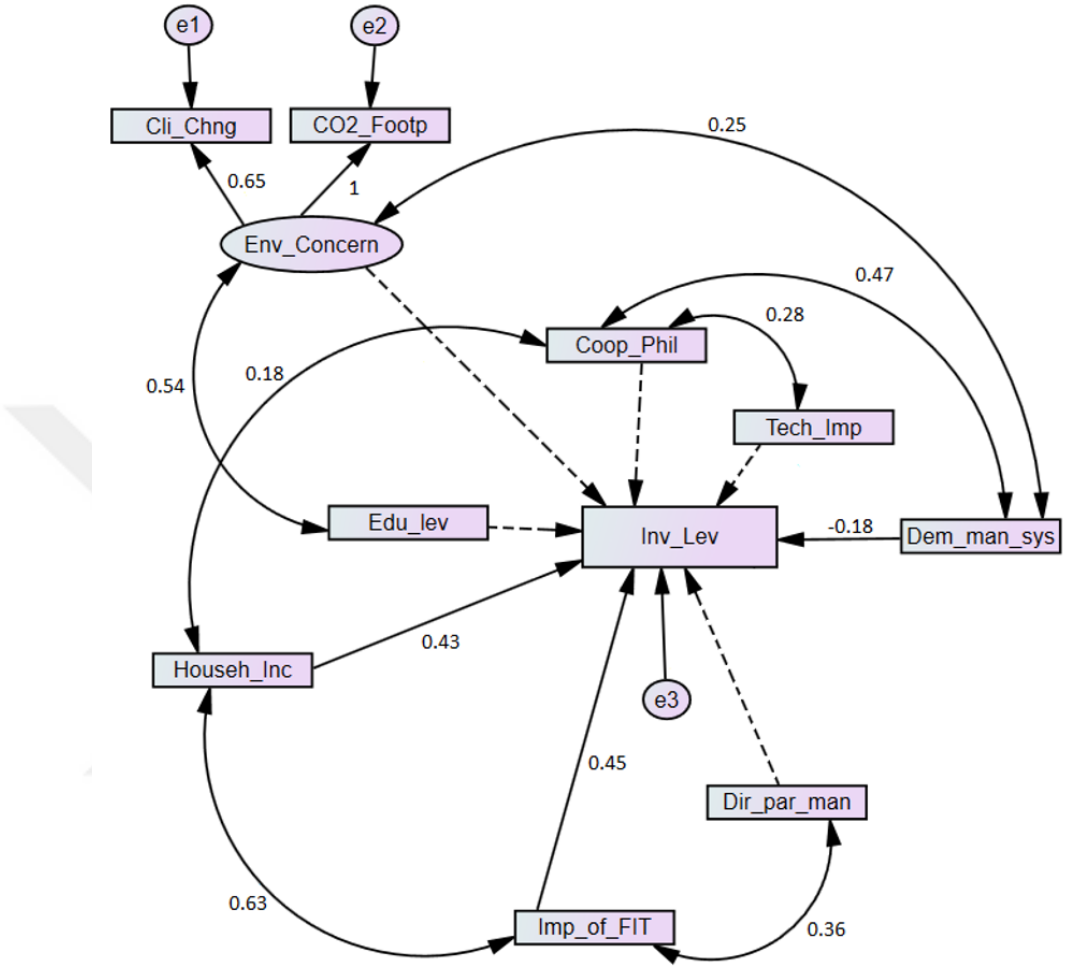

Figure 4.28. Model 1 with Insignificant Relationships.

Even though it was suggested earlier that there is no significant relationship between the importance attached to democratic management of the cooperatives and investment level, after removing insignificant paths from the model the significance increased. However, as the standardized total effect is - 0.18, it should be noted that these two variables are negatively and weakly associated.

As Elec_P variable is no longer linked with any other variable it is removed from the adjusted model 1, updated variables summary is provided below.

Table 4.6. Adjusted Model 1 Variables Summary.

Observed, endogenous variables	**Observed, exogenous variables**	**Unobserved, exogenous variables**
Cli_Chng	Imp_of_FIT	Env_Concern
CO_2_Footp	Dem_man_sys	e1
Inv_Lev	Coop_Phil	e2
	Dir_par_man	e3
	Tech_Imp	
	Househ_Inc	
	Edu_lev	

A comparison of the recommended values and model values for the adjusted model 1 is provided in Table 4.7.

Table 4.7. Reliability and Goodness of the Fit Measures for the Adjusted Model 1.

Index	**Recommended Value**	**Model Output**
X^2/dof	<3.00	1.17
CFI	>0.95	0.968
TLI	>0.95	0.956
RMSEA	<0.10	0.058
Posterior Predictive P	close to 0.5	0.41
Convergence Value	1.1	1.01

Significance of the constructed paths, standardized total effects, and significance of the co-variances between the constructed relationships are provided in Table 4.8, Table 4.9 and Table 4.10 respectively.

Table 4.8. Significance of the Constructed Paths in Adjusted Model 1.

Regression weights	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Inv_Lev <– Imp_of_FIT	0.561	0.56	0.36	1.06
CO_2_Footp <– Env_Concern	1.857	1.7	1.01	2.8
Inv_Lev <– Dem_man_sys	-0.214	-0.21	-0.5	-0.02
Inv_Lev <– Househ_Inc	0.983	0.98	0.41	1.39

Table 4.9. Standardized Total Effects for the Constructed Paths in Adjusted Model 1.

Standardized Total Effects	**Env_Concern**	**Househ_Inc**	**Dem_man_sys**	**Imp_of_FIT**
Inv_Lev	-	0.43	-0.18	0.45
CO_2_Footp	0.99	-	-	-
Cli_Chng	0.65	-	-	-

Table 4.10. Significance of the Co-Variances between the Constructed Relationships in Model 1.

Covariances	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Coop_Phil<->Dem_man_sys	0.724	0.701	0.346	1.251
Dem_man_sys<->Env_Concern	0.173	0.163	0.016	0.386
Coop_Phil<->Tech_Imp	0.388	0.369	0.065	0.812
Imp_of_FIT<->Househ_Inc	0.75	0.727	0.424	1.209
Dir_par_man<->Imp_of_FIT	0.439	0.44	0.156	0.717
Edu_lev<->Env_Concern	0.318	0.299	0.125	0.627
Coop_Phil<->Househ_Inc	0.188	0.182	0.014	0.404

4.2.11. Model 2

Model 2 is developed to test which factors influence further investment decisions and the strength of the relation between the further investment decision. Hypotheses numbered 10 to 13 were tested by using the outputs of model 2.

Table 4.11. Model 2 Variables Summary.

Observed, endogenous variables	**Observed, exogenous variables**	**Unobserved, exogenous variables**
Inv_Lev	Imp_of_FIT	e1
Will_Inv_More	Househ_Inc	e2
	New_Reg_Exp	
	CO_2_Footp	
	Elec_P	
	Fut_Exp	

Explanations for the variables used in the model 2 is provided below. Please note that Househ_Inc, Imp_of_FIT, Inv_Lev, Elec_P, CO_2_Footp have already been explained earlier.

- Fut_Exp: Whether respondents have a positive or negative overview regarding the future of renewable energy cooperatives were asked and numbered 1 if the answer is yes and 0 if the answer is no.
- New_Reg_Exp: Whether respondents expect a new regulation for the development of the renewable energy cooperatives were asked and numbered 1 if the answer is yes and 0 if the answer is no.
- Will_Inv_More: Whether respondents still want to invest more in renewable energy cooperatives or not after the Unlicensed Electricity Generation Regulation published in May 2019 was asked and 1 means they would still invest 0 represent they wouldn't.

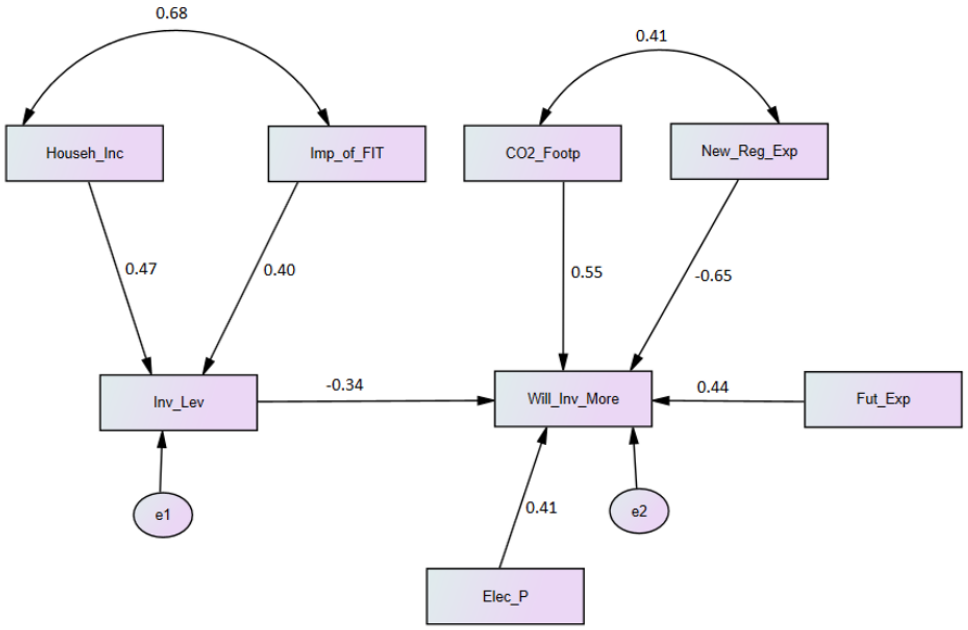

Figure 4.29. Model 2.

Shao (2002) proposed that the normal distribution of the data depends on the values of skewness to be between ± 3 and the kurtosis values should be between ± 7 according to Curran *et al.* (1996) In this case, when the related tables are examined, all variables' skewness are in between ± 3 thresholds and kurtosis' ranges in ± 7. Therefore, the data can be considered to have a normal distribution.

Table 4.12. Model 2 Variables Min Max Skewness and Kurtosis Values.

Variable	**min**	**max**	**skew**	**kurtosis**
Househ_Inc	1	4	0.508	-0.496
Imp_of_FIT	1	5	-0.418	-0.658
Fut_Exp	0	1	-0.154	-1.976
Elec_P	1	5	-0.645	-0.012
CO_2_Footp	2	5	-1.099	0.247
New_Reg_Exp	0	1	-0.738	-1.455
Inv_Lev	1	6	0.713	-0.936
Will_Inv_More	0	1	2.408	3.797
Multivariate				-0.828

Table 4.13. Reliability and Goodness of the Fit Measures for the Second Model Developed.

Index	**Recommended Value**	**Model Output**
X^2/dof	<3.00	1.067
CFI	>0.95	0.99
TLI	>0.95	0.99
RMSEA	<0.10	0.04
Posterior Predictive P	close to 0.5	0.51
Convergence Value	1.1	1.02

As stated earlier, in Bayesian estimation if 0 is not contained between the 95% lower bound and 95% upper bound it can be argued that there is a significant relationship between the variables. The model outputs presented in Table 4.14 suggest that all relationships between the variables have a significant difference except one which is investment level and willingness to invest more.

Table 4.14. Significance of the Constructed Paths in Model 2.

Regression weights	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Will_Inv_More <– Elec_P	2.049	1.968	0.352	4.195
Will_Inv_More <– Fut_Exp	1.762	1.503	0.31	4.168
Will_Inv_More <– Inv_Lev	-0.577	-0.561	-1.289	0.044
Inv_Lev <– Househ_Inc	0.97	0.969	0.517	1.423
Inv_Lev <– Imp_of_FIT	0.627	0.633	0.263	0.969
Will_Inv_More <– New_Reg_Exp	-2.699	-2.629	-5.247	-1.024
Will_Inv_More <– CO_2_Footp	2.198	2.077	0.75	3.91

Table 4.15. Standardized Total Effects for the Constructed Paths in Model 2.

Standardized Total Effects	**Househ _Inc**	**Imp_of _FIT**	**Fut _Exp**	**Elec _P**	**CO_2 _Footp**	**New_Reg _Exp**	**Inv _Lev**
Inv_Lev	0.465	0.404	0	0	0	0	0
Will_Inv _More	-0.115	-0.108	0.438	0.406	0.548	-0.646	-0.34

Table 4.16. Significance of the Co-Variances for the Constructed Paths in Model 2.

Covariances	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Imp_of_FIT <-> Househ_Inc	0.849	0.816	0.475	1.395
New_Reg_Exp <-> CO_2_Footp	0.372	0.368	0.128	0.639

4.2.12. H_{10}: Further investment decision of the existing investors of renewable energy cooperatives is correlated with higher electricity price expectation

The tenth hypothesis can be accepted as the range between 95% lower bound and 95% upper bound does not include 0. Moreover, standardized regression weight between the willingness to invest more and electricity price variables is calculated 0.462 which means there is a positive moderate association between these variables. In other words, as members expect higher electricity prices, their willingness to invest increases.

4.2.13. H_{11}: Members with optimistic future expectations for renewable energy cooperatives are more likely to decide on a further investment compare to members with pessimistic future expectations

The eleventh hypothesis is also accepted considering the lower bound and upper bound values. Members who are more optimistic about the future of renewable energy cooperatives have a higher willingness to invest more. Furthermore, 0.396 regression

weight implies that these variables are moderately and positively associated.

4.2.14. H_{12}: Members of the renewable energy cooperatives who attach higher importance on reducing their Carbon footprint still have a willingness to invest more compare to members who care less

Since the range between the upper and lower bound values contains 0 for the 95% confidence interval, and the standardized total effect is calculated as 0.484 it can be concluded that members who attach higher importance to reduce their Carbon footprint still likely to invest and standardized total effect of 0.484 indicates that there is a moderate association between the variables and therefore the eleventh hypothesis can be accepted.

4.2.15. H_{13}: Members of the renewable energy cooperatives who expect a new regulation unlikely to invest more

The thirteenth hypothesis can be accepted as the range between 95% lower bound and 95% upper bound does not include 0 and a negative regression weight over the 0.5 implies there is a strong negative correlation between the members' willingness to invest more and members who consider the current regulations are one of the major barriers against the renewable energy cooperatives.

Moreover, the output of the model 2 also indicates that there is a moderate and positive association between the level of investment and household income and also between the level of investment and importance attached to return on investment.

The insignificant relationships for Model 2 are illustrated with the intermittent lines and presented in Figure 4.30.

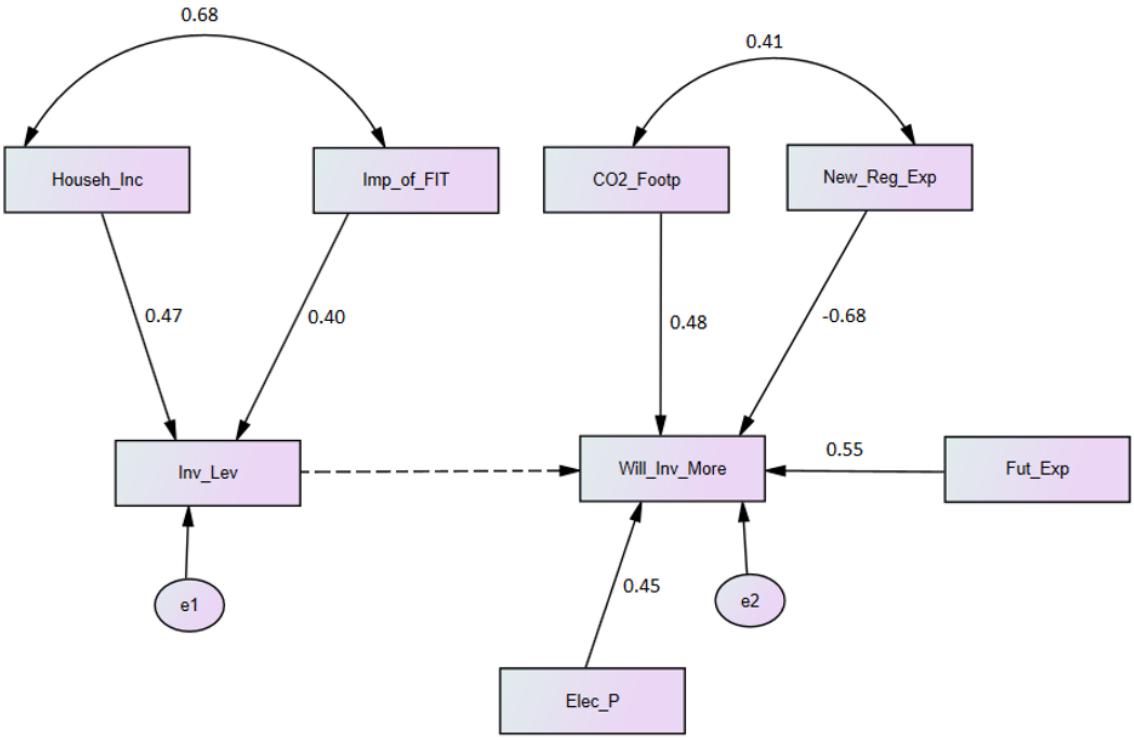

Figure 4.30. Model 2 with Insignificant Relationships.

A comparison of the recommended values and model values for the adjusted model 2 is provided in Table 4.17.

Table 4.17. Reliability and Goodness of the Fit Measures for the Adjusted Model 2.

Index	**Recommended Value**	**Model Output**
X^2/dof	<3.00	1.105
CFI	>0.95	0.98
TLI	>0.95	0.97
RMSEA	<0.10	0.04
Posterior Predictive P	close to 0,5	0.52
Convergence Value	1.10	1.02

Significance of the constructed paths, standardized total effects, and significance of the co-variances for the constructed paths in adjusted Model 2 are provided in Table 4.18, Table 4.19 and Table 4.20 respectively.

Table 4.18. Significance of the Constructed Paths in Adjusted Model 2.

Regression weights	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Will_Inv_More <– Elec_P	3.219	3.28	0.733	5.845
Will_Inv_More <– Fut_Exp	3.418	3.311	1.25	6.428
Inv_Lev <– Househ_Inc	0.986	0.987	0.499	1.487
Inv_Lev <– Imp_of_FIT	0.62	0.619	0.265	1.001
Will_Inv_More <– New_Reg_Exp	-3.364	-3.02	-6.459	-1.058
Will_Inv_More <– CO_2_Footp	3.278	3.101	0.677	6.874

Table 4.19. Standardized Total Effects for the Constructed Paths in Adjusted Model 2.

Standardized Total Effects	**Househ_Inc**	**Imp_of_FIT**	**Fut_Exp**	**Elec_P**	**CO_2_Footp**	**New_Reg_Exp**
Inv_Lev	0.471	0.404	-	-	-	-
Will_Inv_More	-	-	0.547	0.451	0.482	-0.677

Table 4.20. Significance of the Co-Variances for the Constructed Paths in Adjusted Model 2.

Covariances	**Mean**	**Median**	**95% Lower bound**	**95% Upper bound**
Imp_of_FIT <-> Househ_Inc	0.792	0.773	0.475	1.395
New_Reg_Exp <-> CO_2_Footp	0.368	0.363	0.088	0.654

5. DISCUSSION

5.1. Global and Turkey's Renewable Energy Overview and Related Discussions

The world's primary energy supply increased by 42.6% in 18 years between 2000-2018. In this period, the share of oil decreased from 36.5% to 31.4%, the share of nuclear decreased from 6.7% to 5%, while the share of natural gas increased from 20.8% to 23%, the share of coal increased from 23.1% to 26.7%, and the share of renewable energy sources, including hydraulics, increased from 6.6% to 9.7%. According to the "Stated Policy Scenario" in the World Energy Outlook 2019 Report prepared by the International Energy Agency, there will be no major change in the distribution of energy resources even in 2040. The share of fossil fuel will be around 74%, but natural gas will increase while a decrease in coal consumption is expected. However, according to the "Sustainable Development Scenario" in line with the Paris Agreement, which aims to keep the global temperature increase below 2^oC (preferably 1.5^oC), the fossil fuel ratio should be around 58% (International Energy Agency, 2019).

Based on the fact that total energy production of Turkey increased by 50.4% between 2000 and 2018, energy supply increased by 80.8%, the energy dependence of Turkey in 1990 was 52%, 67% in 2000, 70% in 2010, and 2018 it reached to 72% with a significant increase in the last 28 years. On the other hand, between 2000 and 2018 the share of the oil sources in the total energy supply of Turkey has decreased by 13% to 29.4%, the share of bioenergy and waste decreased by 6% to 2.1% and the share of coal decreased by 0.5% to 28.5%. Besides, the share of natural gas increased by 13.7% to 28.7%, while the share of geothermal, solar, and wind increased by 6.9% to 8.1%, whereas the share of the hydraulics in the total energy supply of Turkey has only increased by 0.3% and reached to 3.6% (Republic of Turkey Directorate General of Energy Affairs, 2018). The FIT mechanism introduced in the early 2010s and other regulations can be argued that it supported and had a considerable impact on the increase in the share of renewables.

On the other hand, considering the droughts, warming of the sea, decreasing groundwater, forest fires, unexpected, high and irregular precipitation, floods, etc. eliminating the negative effects of air and environmental pollution on our globe has become crucial. As stated in Paris Accord, to limit the temperature, increase well below 2^oC, or 1.5^oC which has been in a rapidly rising trend, it is obvious that the share of fossil fuels in energy production and consumption must be radically lowered.

In terms of supplying primary energy demand for electricity, Turkey's installed capacity has reached 91.267 MW and considering the ongoing projects, Turkey's installed capacity will reach around 123 thousand MW (Türkyilmaz and Bayrak, 2020). On the other hand, considering the targets and developments on providing electrical energy supply security; it is observed that Turkey's targets for 2019 installed capacity of renewable energy sources and the amount of electrical energy to be produced from domestic coal, which is specified in the 2015-2019 Strategy Plan of the Ministry of Energy and Natural Resources, have fallen behind the targets. The Strategy Plan has the following 2023 objectives regarding the evaluation of domestic and renewable energy sources: (Republic of Turkey Ministry of Energy and Natural Resources, 2020).

- Increasing the installed capacity of hydroelectric power plants to 32,037 MW corresponding to 12.3% increase as installed capacity as of 2019 is 28,503 MW.
- Increasing the installed capacity wind power plants to 11,883 MW, corresponding to 56.4% increase as installed capacity as of 2019 is 7,594 MW.
- Increasing the installed capacity of geothermal and biomass to 2,884 MW corresponding to 24.4% increase as installed capacity as of 2019 is 2,317 MW.
- Increasing the installed capacity of solar power plants to 10,000 MW corresponding to 66.8% increase as installed capacity as of 2019 is 5,995 MW.

Moreover, as it was set with the Paris Accord, these targets will also help Turkey to meet up to 21% decrease in GHG emissions target by 2030 from the BAU scenario and contribute to limit global temperature increase below 2^oC.

Based on the numbers and targets mentioned above, the major increase target in terms of percentages is aimed at solar energy. Considering Turkey's geographical location and irradiation levels there is a great room for Turkey to expand its solar energy investments. This potential can be realized with mega projects and small-sized individual or community investments. However, unlicensed small-sized individual and community investments will be discussed as part of the study.

To support the individual small-sized investments, a regulation was issued in 2018 by the EMRA that will facilitate the establishment of unlicensed solar power plants that will produce electricity and whose installed power will not exceed 10 kW. This regulation is also known as solar rooftop legislation which enabled individual investors to install rooftop solar power plants smaller than 10 kW capacity and sell the excess energy based on monthly offsetting while they benefit from the FIT. However, after the regulation came into force in May 2019, new unlicensed solar power plants will not benefit from FIT while already existing ones will continue to benefit for 10 years. The total capacity of applications for roof and facade applications has reached 622 MW in 2019 whereas 610 MW was made for industrial facilities with a total of 775 applications, and 12 MW was made for dwellings with 1,188 applications (Republic of Turkey Ministry of Energy and Natural Resources, 2019). Considering that Turkey's rooftop solar power capacity is estimated as 3,858 GW by taking into account the grid capacity, growth in RSPV sales, income level, creditworthiness factor by the report published by Tetra Tech (2018), rooftop solar PV can play a huge role for Turkey's national aim to reach 10.000 MW of installed solar power plant capacity by 2023 and also can contribute to Turkey's INDCs set in Paris Accord.

5.2. Discussions based on Model Results

Apart from individual investments, Turkey's solar energy capacity can be realized with the help of renewable energy cooperatives. Results of Model 1 indicate that the size of investment only increases with the higher household income and importance attached to the return on investment. In other words, as a member's financial motivation and wealth increases they will likely invest more. However, there is no significant

relationship between the level of investment and level of environmental concern, participation in the management, the importance attached to investment is being made under a cooperative, future electricity price, education level, the importance attached to democratic management and technical details of the solar PVs.

The study conducted in OECD countries suggested that there is a positive association between the probability of investing in energy technologies and the level of income (Ameli and Brandt, 2015). Moreover, the study conducted in Belgium by Bauwens (2019) argued that the size of investment is significantly different with the importance attached to democratic management of cooperatives and level of household income. Furthermore, the size of investment is suggested as insignificant for the importance attached to being a part of the cooperative. As presented in Model 1, although household income is significant, the importance attached to democratic management of cooperatives and being a part of the cooperative factors were found out to be insignificant. On the other hand, Bauwens (2019) suggested that the importance attached to return on investment is significant and importance attached to renewable energy production is insignificant with the size of investment. Both arguments suggested by Bauwens (2019) are in parallel with the results of the Model 1.

Although the study of Sardianou and Genoudi (2013) claimed that higher educated people are more likely to involve in renewable energy projects based on a study conducted in Greece, Bauwens (2019) argued that education is an insignificant factor in parallel with the suggestion of the researcher based on outputs of Model 1.

Furthermore, another study conducted in Germany illustrated that level of investment is associated with the importance attached to the return on investment and participation in the management (Holstenkamp and Kahla, 2016). On the contrary, the results of Model 1 surprisingly showed that participation in the management did not influence the level of investment. The study of the Prete *et al.* (2017) argued that the level of education and willingness to pay for energy efficient measures are positively associated based on a study conducted in Italy. In line with the study of Prete *et al.* (2017), the level of environmental concern and level of education is found out to be

significantly correlated as shown in Model 1.

Major factors determining the size of investment are return on investment motivations and wealth rather than environmental concern or being a part of the cooperative or education level might be explained as Turkey being the developing country. On the other hand, most of the countries where environmental concerns, social motivations, or education levels play a role in renewable energy investments are developed countries.

Although the output of Model 1 showed that electricity price expectation and level of investment are not significantly related, Model 2 indicates that as people have higher electricity price expectations for the future their willingness to invest more is higher. In parallel with that, the study of Bauwens (2019) argued that as people have higher electricity price expectations, they invest more in renewable energy cooperatives. Electricity price being significant for model 2 and insignificant model 1 might result from considerably increasing electricity prices in recent years lead to a willingness to invest more. Whereas no considerable electricity price increase was expected when members invested in cooperatives, and hence there is no significant relationship between these variables in Model 1. The development of consumer price index and electricity price index is presented with Figure 5.1 below, as it can be seen there is a considerable jump starting in mid-2019 (Turkish Statistical Institute, 2020).

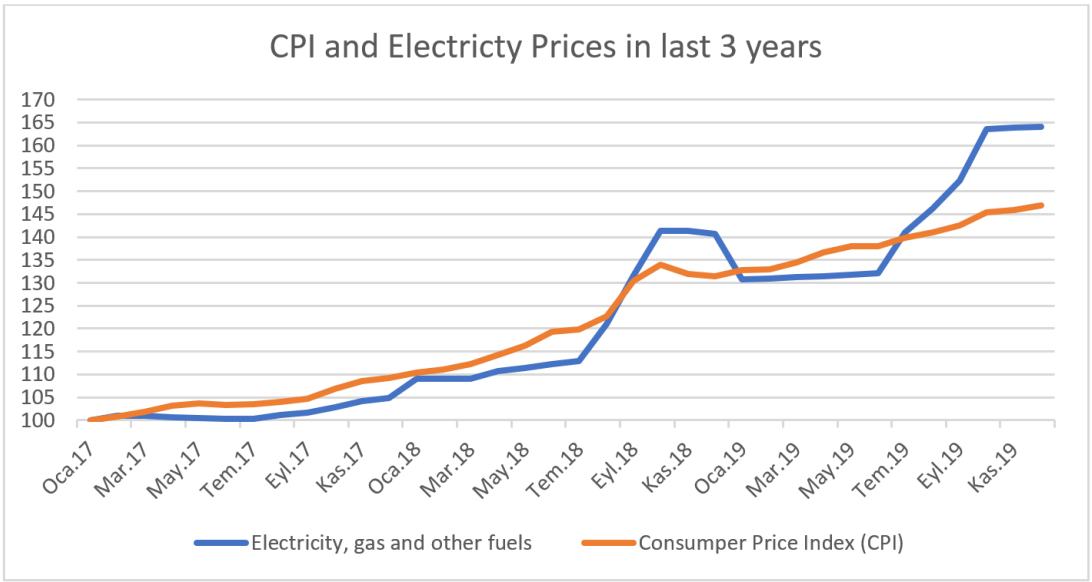

Figure 5.1. CPI and Electricity Price Development in Last 3 years.

The insignificant relationships for Model 1 are demonstrated with the intermittent lines and presented in Figure 5.2.

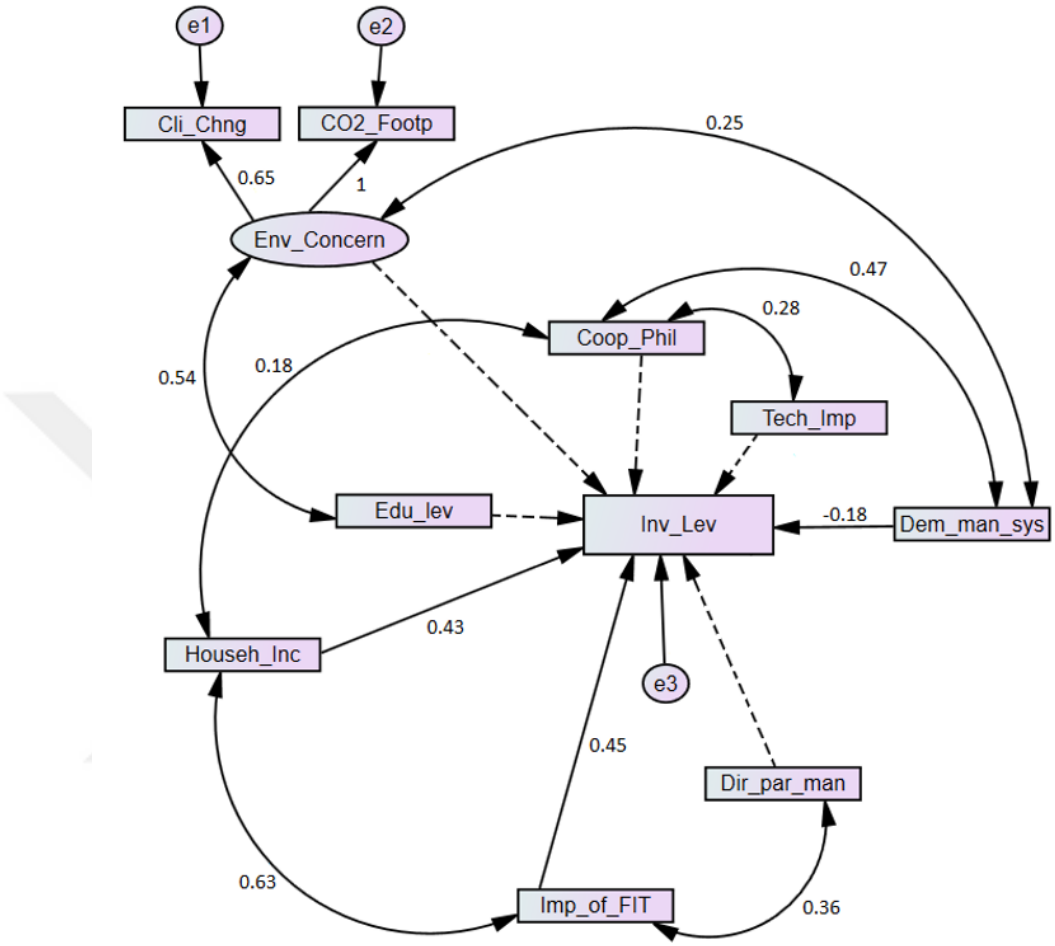

Figure 5.2. Adjusted Model 1.

Based on Model 1 results it was argued that there is no significant relationship between the level of investment and importance attached to democratic management while discussing the Hypothesis 7. However, as the insignificant relationships started to be removed by one by it was determined that the significance value for the relationship between the level of investment and importance attached to democratic management increased and become significant. On the other hand, as this relationship is negatively and weakly associated it can be argued as negligible. Detailed standardized total effect and co-variance numbers regarding the Model 1 and Adjusted Model 1 is presented in Table 5.1.

Table 5.1. Model 1 and Adjusted Model 1 Weight Comparisons.

	Relationship	**Model 1**	**Adjusted Model 1**
Standardized Total Effect	Inv_Lev <– Imp_of_FIT	0.34	0.45
	Inv_Lev <– Dem_man_sys	-0.14	-0.18
	Inv_Lev <– Househ_Inc	0.45	0.43
	Inv_Lev <– Elec_P	-0.07	NA
	Inv_Lev <– Dir_par_man	0.21	NA
	Inv_Lev <– Env_Concern	0.1	NA
	Inv_Lev <– Edu_lev	-0.03	NA
	Inv_Lev <– Coop_Phil	-0.03	NA
	Inv_Lev <– Tech_Imp	-0.08	NA
Covariance	Coop_Phil <-> Dem_man_sys	0.46	0.47
	Dem_man_sys <-> Env_Concern	0.24	0.25
	Coop_Phil <-> Tech_Imp	0.29	0.28
	Imp_of_FIT <-> Househ_Inc	0.64	0.63
	Dir_par_man <-> Imp_of_FIT	0.38	0.36
	Edu_lev <-> Env_Concern	0.51	0.54
	Coop_Phil <-> Househ_Inc	0.18	0.18

Furthermore, the study of Kalkbrenner and Roosen (2015) suggested that people with higher environmental concerns are more likely to participate in a local community energy project based on a study conducted in Germany. Although members' level of environmental concern has not a significant effect on the level of investment as suggested by Model 1, their willingness to invest more and their level of environmental concern has a significant relationship as claimed by Model 2. In other words, people with higher environmental concerns will still likely to invest in renewable energy projects even though the return on investment decreased.

Besides, due to recent regulation change in May 2019 which removed the USD denominated FIT price mechanism for the further renewable energy investments and

constantly changing application procedures, members who expect a new regulation to remove barriers for the development of renewable energy cooperatives will likely to have lower willingness to invest more. In other words, to make a further investment, the members of renewable energy cooperatives expect a new regulation or amendments in the existing regulation, especially for the FIT mechanism as they believe unlicensed renewable energy investments lost their financial feasibility.

The insignificant relationships for Model 2 are demonstrated with the intermittent lines and presented in Figure 5.3.

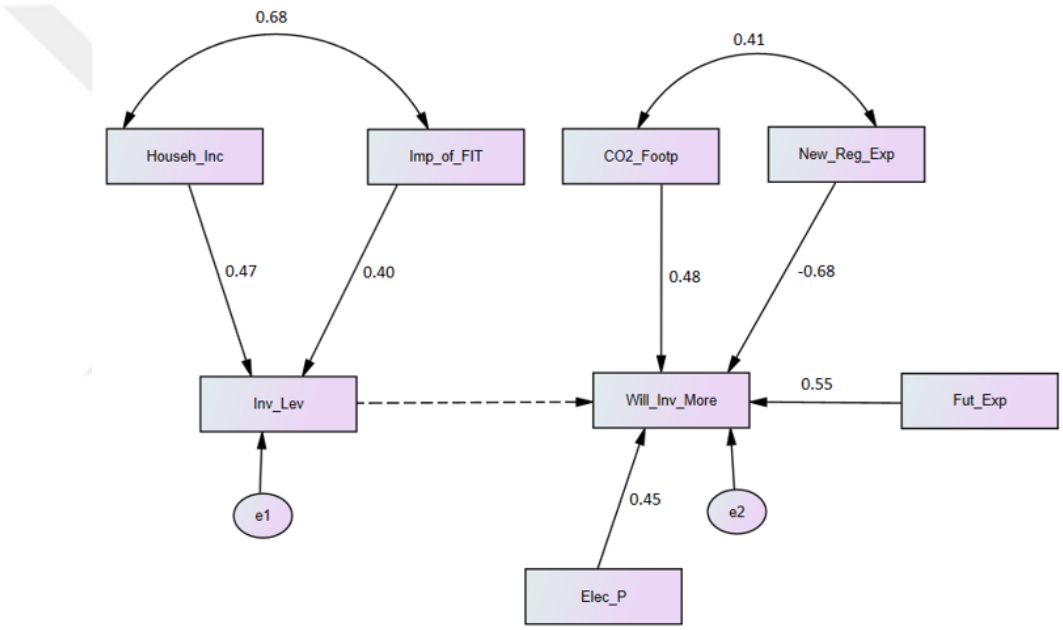

Figure 5.3. Adjusted Model 2.

After removing the path between the level of investment and willingness to invest more none of the paths' significance is affected. On the other hand, the association between the electricity price expectation and willingness to invest more stayed moderate with 0.45 standardized total effect value. However, the standardized total effect of future expectation on willingness to invest more increased up to 0.55 whereas the standardized total effect of Carbon footprint on willingness to invest more decreased to 0.48. Detailed figures are summarized in Table 5.2.

Table 5.2. Model 2 and Adjusted Model 2 Weight Comparisons.

	Relationship	**Model 2**	**Adjusted Model 2**
Standardized Total Effect	Will_Inv_More <– Fut_Exp	0.44	0.55
	Inv_Lev <– Househ_Inc	0.47	0.47
	Inv_Lev <– Imp_of_FIT	0.4	0.4
	Will_Inv_More <– New_Reg_Exp	-0.65	-0.68
	Will_Inv_More <– CO_2_Footp	0.55	0.48
	Will_Inv_More <– Elec_P	0.41	0.45
	Will_Inv_More <– Inv_Lev	-0.34	NA
Covariance	Imp_of_FIT <-> Househ_Inc	0.68	0.68
	New_Reg_Exp <-> CO_2_Footp	0.41	0.41

Finally, the survey responses were collected before the first Covid-19 case is diagnosed in Turkey. The results of the second model might have differed, if the survey is repeated during the curfew period as the investment behavior is expected to be influenced by uncertainty. Fear of investors and a tendency to behave more risk-averse due to an uncertainty may lead to the evaluation of savings in liquid assets. On the other hand, the results might differ in the long run as people might tend to become more self-sufficient with the so called new normal.

5.3. Policy Recommendations based on Model Results and Industry Needs

As it was stated before, by replacing the first article of the Council of Ministers Decision dated 18/11/2013, with the Presidential Decree, numbered 1044, published in the Official Gazette numbered 30770, dated 10 May 2019, the excess renewable energy guaranteed to be purchased for ten years from the date of operation of the facility from the retail one-time active energy price based on consumer category which removed the USD based FIT price mechanism. The reason behind the change is the volatile market conditions and highly profitable FIT prices due to technological advancements and decreasing initial investment costs. FIT cost constitutes one of the most important

agendas of electricity supply and distribution companies, especially in recent years due to volatile market conditions. FIT cost increased due to the increase in the exchange rate and the increasing capacity in the market. More importantly, due to the difficulties experienced in the long-term estimation of the production of the power plants included in the system and the fluctuation in the exchange rate, the difficulties experienced in predicting the FIT cost seriously damage the market. The prices were subject to payment determined by the daily production multiplied by the Central Bank's exchange rate. The fees paid to FIT participants are reflected in the final electricity consumers within the scope of the incentive mechanism. In other words, the financing of the incentive mechanism determined by the state is afforded by the end consumer. Energy Exchange Istanbul (EXIST) known as EPİAŞ and electricity supply and distribution companies were mediating the implementation of this system. Therefore, volatile market conditions and significantly increasing capacity resulted in a considerable increase in the final electricity price afforded by the end consumer. Moreover, due to decreasing initial investment costs due to technological advancements FIT prices stayed highly above and made unlicensed renewable energy investments highly profitable while the government could not control the installation of new unlicensed power plants. Hence, to reduce the burden on the end consumers for the following years, to eliminate currency risks and to take under the control of the renewable energy investments, it can be argued that the government decided to remove USD based FIT mechanism for unlicensed power plants and aimed to direct people to install renewable energy plants for the self-consumption purposes.

To explore more, the financial impact of the May 2019 regulation is studied for both industrial electricity consumers and a dwelling electricity consumer. Assuming that installed solar PVs will work with a capacity factor of approximately 15%, active energy price and energy purchase price for industries and dwellings does not change in USD terms over the year and excluding the taxes and based on the active energy price and energy purchase price for industries and dwellings published by EMRA in April 2020, a cash flow is created. This cash flow is used to understand the impact of the May 2019 regulation on industrial and dwelling electricity consumers by taking in to account monthly offsetting principles. Cash flow for industrial electricity consumers for

a 100% yearly production to consumption scenario is presented in Figure 5.3 and cash flow for dwelling electricity consumers for a 100% yearly production to consumption scenario is presented in Figure 5.5.

Row #	Months	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	Consumption (kwh)	21.321	21.321	21.321	21.321	21.321	21.321	21.321	21.321	21.321	21.321	21.321	21.321	**255.847**
2	Installed Capacity (kw)	200	200	200	200	200	200	200	200	200	200	200	200	**200**
3	Sunshine Duration (hour/day)	3,57	4,44	5,61	6,75	8,56	10,30	10,96	10,42	8,82	6,46	4,79	3,27	**7,00**
4	Capacity Factor	7%	9%	12%	14%	18%	21%	23%	22%	18%	13%	10%	7%	**15%**
5	Production (kwh)	11.067	12.432	17.391	20.250	26.536	30.900	33.976	32.302	26.460	20.026	14.370	10.137	**255.847**
6	Net Consumption	10.254	8.889	3.930	1.071	(5.215)	(9.579)	(12.655)	(10.981)	(5.139)	1.295	6.951	11.184	**(0)**
7	Active Energy Price for Industrials ($cent/kwh)	7,49	7,49	7,49	7,49	7,49	7,49	7,49	7,49	7,49	7,49	7,49	7,49	**7,49**
8	Energy Purchase Price for Industrials ($cent/kwh)	10,26	10,26	10,26	10,26	10,26	10,26	10,26	10,26	10,26	10,26	10,26	10,26	**10,26**
9	Net Saving and Electricity Purchase Income ($)	1.135	1.276	1.784	2.078	2.578	2.905	3.135	3.010	2.572	2.055	1.474	1.040	**25.043**
10	FIT Price ($cent/kwh)	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	**13,30**
11	Net Saving and Electricity Purchase Income under FIT ($)	1.135	1.276	1.784	2.078	2.881	3.462	3.871	3.648	2.871	2.055	1.474	1.040	**27.574**

Figure 5.4. Cash Flow for Industrial Electricity Consumers 100% Yearly Production to Consumption Scenario.

Row #	Months	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	Consumption (kwh)	213	213	213	213	213	213	213	213	213	213	213	213	**2.558**
2	Installed Capacity (kw)	2	2	2	2	2	2	2	2	2	2	2	2	**200**
3	Sunshine Duration (hour/day)	3,57	4,44	5,61	6,75	8,56	10,30	10,96	10,42	8,82	6,46	4,79	3,27	**7,00**
4	Capacity Factor	7%	9%	12%	14%	18%	21%	23%	22%	18%	13%	10%	7%	**15%**
5	Production (kwh)	111	124	174	203	265	309	340	323	265	200	144	101	**2.558**
6	Net Consumption	103	89	39	11	(52)	(96)	(127)	(110)	(51)	13	70	112	**-**
7	Active Energy Price for Dwellings ($cent/kwh)	5,13	5,13	5,13	5,13	5,13	5,13	5,13	5,13	5,13	5,13	5,13	5,13	**5,13**
8	Energy Purchase Price for Dwellings ($cent/kwh)	7,76	7,76	7,76	7,76	7,76	7,76	7,76	7,76	7,76	7,76	7,76	7,76	**7,76**
9	Net Saving and Electricity Purchase Income ($)	9	10	13	16	19	21	23	22	19	16	11	8	**187**
10	FIT Price ($cent/kwh)	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	13,3	**13,30**
11	Net Saving and Electricity Purchase Income under FIT ($)	9	10	13	16	23	29	33	31	23	16	11	8	**223**

Figure 5.5. Cash Flow for Dwelling Electricity Consumers 100% Yearly Production to Consumption Scenario.

The payback period refers to the amount of time it takes to recover the cost of an investment. Simply put, the payback period is the length of time an investment reaches a break-even point. Moreover, based on different yearly consumption to production ratios payback impact of the May 2019 regulation is calculated and presented in the Figure 5.4. To calculate payback impact of the May 2019 regulation, Net Saving and

Electricity Income under FIT ($) value, which is the sum of last row of both Figure 5.3 and Figure 5.4, is divided to Net Saving and Electricity Income ($) value which is the sum of ninth row of both Figure 5.3 and Figure 5.4.

As demonstrated in the Figure 5.4 as yearly consumption to production ratio decreases payback of the solar PV investments increases especially for dwelling electricity consumers since the margin between the active energy price and energy purchase price is higher compare to industrials. Based on the assumed monthly consumption and production figures, it can be observed that if the yearly consumption is around 1.6 times the electricity produced by the solar power plant, there is no impact in terms of return on equity. Moreover, it can be argued that this regulation discourages the people who aim to install a solar power plant to produce considerably higher than their consumption since the return on equity decreases as production to consumption ratio increases. Besides, as the managers of renewable energy cooperatives said that they are strictly against the May 2019 regulation and considering the numbers presented above it can be concluded that most of them aimed to sell the excess energy produced by renewable energy cooperatives to grid and benefit from the FIT mechanism.

Yearly Consumption/Production	75%	90%	100%	110%	125%	135%	160%
Payback Impact of May 2019 Regulation on Industrial Electricity Consumers	19%	13%	10%	8%	4%	2%	0%
Payback Impact of May 2019 Regulation on Dwelling Electricity Consumers	37%	25%	19%	14%	7%	5%	0%

Figure 5.6. Payback Change of the Solar PV Investments Based on Yearly Consumption to Production Ratios.

In other words, if new unlicensed solar power plant investments are made considering the monthly consumption and production figures, projects could still be as financially feasible as they were before. Furthermore, considering that for some regions the production might be higher than the consumption in the summer and consumption might be higher than the production in the winter, if offsetting is regulated to be annual, rooftop applications will become more financially feasible and preferred for more people.

Considering the increase in the installed capacity of renewable energy projects in Turkey, it can be argued that the FIT mechanism has been supporting the investments and FIT has always offered a valuable minimum price guarantee for financial institutions. Even in the period before 2015, when the market prices were higher than the wind FIT price level, the banks were more comfortable in renewable energy financing because they set a base level in the price and they paved the way for investments by providing financing with higher loan to equity ratios to the sector. Starting from 2021 there is a new FIT price mechanism that is expected to be announced by the Ministry of Energy and Natural Sources. Considering the current FIT prices, it should be noted that even though these prices were reasonable before, comparing the previous investment costs and declining new investment costs due to technological advancements, the new FIT prices are expected to be lower. However, it should be noted that the existence of a base price guarantee independent from the level of the minimum price is important as stated with the studies and results of model 1 suggests. Although there is a purchase guarantee for the excess renewable energy produced by unlicensed renewable energy projects from the retail one-time active energy price based on consumer category, it is open to market price risk which decreases the credibility of investments. In other words, unlicensed renewable energy projects will not be able to reach financing and required to be financed through equity. Considering that the capital resources of Turkey are limited compared to developed countries, it should be taken into consideration that without guaranteed price only a limited number of unlicensed renewable energy investments can be realized. In other words, unlicensed renewable energy investments will be limited with the investments that provide energy close to self-consumption amount since they will be more financially feasible compared to investments that have lower self-consumption to production rates as explained in Figure 5.4. Moreover, the study of Wierling *et al.* (2018) argues that when the guaranteed FIT mechanism was removed, the investments in renewable energy have faced slow-downs in United Kingdom, Denmark, Germany and Austria.

Apart from the FIT, to increase the deployment of renewable energy starting from individuals and cooperatives, independent institutions that can provide technical information considered to be needed such as the chamber of civil engineers or electrical

engineers based on the survey results. For cooperatives established by members who do not have sufficient technical knowledge, it is better to get support and guidance of such non-governmental organizations which will also help to boost individual rooftop solar installations with their guidance.

To ease the financing of renewable energy investments via cooperatives there are innovative financial methods applied by other countries which can be followed by Turkey. If the necessary regulations are legislated, the renewable energy investments can be financed through crowdfunding in Turkey and contribute the deployment of renewable energy investments as proposed by Vasileiadou *et al.* (2015).

Besides, although renewable energy funds have been commonly preferred around the globe, VCIFs established in Turkey and investing in renewable energy projects limited with only 4 funds and a total of 42 investors according to monthly statistical data published by Capital Markets Board of Turkey (2020). The reasons behind the small number of investors can be argued as minimum ticket size for the investment, limitations on the entry and exit of the fund, minimum holding period for the fund shares, investors need to prove that they are qualified investors as per the definition CMB, and there is an advertising ban on VCIFs. However, regulation on VCIFs does not date back to old, this kind of fund that invests in renewable energy projects have recently been started to be established and as people will be more aware. Moreover, to increase the penetration of VCIFs and help them to grow in size by eliminating minimum ticket size barriers, pension fund investors should be allowed to invest in pension funds which directly invests in renewable energy projects in Turkey. In other words, pensioners will be indirectly investing in renewable energy projects through the pension funds that invest in renewable energy projects through VCIFs established in Turkey.

Furthermore, Christianson, (2001) argued that the government subsidizes renewable energy investments by contributing equity to the projects in developed countries based on a study conducted in Denmark. On the other hand, that might not be possible for a country like Turkey as it is a developing country, and resources of the government

are limited compared with developed countries like Denmark. On the other hand, a renewable energy fund that aims to get foreign direct investment can be established under Turkey Wealth Fund and advantageous conditions that could attract foreign investors e.g. FIT mechanism, tax incentives, free landscapes can be offered specifically for the investments made under this fund. As a result, Turkey's renewable energy share could be increased and foreign direct investment could be attracted via this fund which will contribute to the decrease net trade deficit.

Governments can also subsidize renewable energy investments by offering tax incentives like it has been applied by Sweden (Vågerö, 2019). Real estate tax rate can be decreased or exempted for the buildings installed with solar rooftops or investment tax incentives can be offered where investors who invest in renewable energy systems in their buildings will get back some of the cost of the investment from the taxes they will pay. Governments can also play a role in the deployment of CRE investments by offering public building's roofs or land to the local people without charging any cost which will decrease the initial investment cost for people and also enable local people to become a part of the local renewable energy projects who has no space to install a rooftop solar PVs. There are various successful examples where governments provide roofs of public buildings and investors are the local people who benefit from the locally produced energy and took a step for their energy independency (Wieg *et al.*, 2011). Although there are examples in Turkey where renewable energy investments realized by municipalities itself it is doubtful that this kind of investment is benefitted from local people as they don't have a chance to directly involved in the projects (Samsun Municipality, 2017).

Besides, current regulation does not allow cooperatives to sell their excess electricity to another party that is willing to consume renewable energy even from higher prices compare to electricity supplied by the retailers. That kind of power purchase agreement can enable cooperatives to increase their financial returns and make them more financially feasible investments, while institutions willing to consume renewable energy and define themselves as sustainable will have a chance to purchase renewable energy from a cooperative. If the regulation is amended and cooperatives will be en-

abled to sell their excess electricity to another party, it will help the development of CRE investments.

Furthermore, all cooperative renewable energy investments in Turkey have been made to solar power plants so far. This situation can be explained considering the number of members who are willing to invest in uncertainty in the investment process. As the number of partners in cooperatives increases, new investments can easily be carried out for the solar investments, but there is limited opportunity to increase the capacity in wind investments, in other words changing scalability of the projects is easier for solar investments. Additionally, it is not possible to reach a huge number of members in the first stage, investments start with small capacities at the beginning. On the other hand, the capacity factor of wind projects increases with the increase in installed capacity which requires more members due to higher initial investment cost and also costs more compare to utility-scale wind systems (IRENA, 2012). Therefore, the renewable energy cooperative that invests in wind energy is not easy to establish as that has been the case for Turkey. Hence, the government can follow a policy to encourage the establishment of renewable energy cooperatives that invests in solar and concentrate on solar investments as they seem to be easier to realize.

Finally, interviews conducted with the industry professionals showed that the members of the cooperatives become a part of the renewable energy investments because they tend to become a part of the community movement without questioning in some cooperatives. In other words, the movement is top to down in some cooperatives. Therefore, it was observed that the information the members have about the renewable energy investment itself is limited and even though there is democratic management, decisions are being shaped by the managers and opinion leaders in that region for some renewable energy cooperatives. On the other hand, it is also observed that in some cooperatives there is a bottom up movement where members motivate each other to become a part of the cooperative, especially for environmental reasons.

5.4. Limitations and Future Research

Even though SEM can be performed with 50 samples, the limitation of the study can be argued as a small number of survey responses (Iacobucci, 2010). Considering that it would be better to create models with a higher number of survey answers, to increase the number of responses the researcher was aiming to participate in general assemblies of other renewable energy cooperatives like it was done in Kayseri Furnitures Renewable Energy Cooperative and via face to face interviews, the sample size was planned to be increased. However, due to the Covid-19 pandemics, the Turkish government has taken action to restrict travels around the inter-cities and also declared curfew for the weekends, national and regional holidays. Hence, the number of survey responses could not be increased through face to face interviews.

As it was stated before, answers were collected from 9 different renewable energy cooperatives established in Turkey. Since the number of responses from each cooperative was not enough to create different structural equation models it could not be analyzed whether the investment motivations differ from cooperative to cooperative and are clustering possible can be studied for future researches. Moreover, after the new regulation on the licensed renewable energy investments published there might be some changes for the renewable energy cooperatives which will shape the direction of CRE investments. Furthermore, the survey can be directed to other developing countries with similar renewable energy incentive mechanisms background.

6. CONCLUSION

To the best knowledge of the researcher a study that examines which factors determine the size of the financial contribution and further investment decision concentrated on a developing country does not exist in the literature. Furthermore, there is no study found that utilized the SEM analysis method to understand the motivations of people that influence their willingness to participate in a renewable energy community or the size of their financial contribution. Therefore, this thesis fills the gap in literature by analyzing the factors that have an influence on the size of the investment and further investment decisions and interrelations between the variables for a developing country. Furthermore, considering the policies followed around the world and current situation in Turkey, policy recommendations are provided to support small size individual investments and renewable energy cooperatives.

This thesis concentrated on the CRE projects for a developing country, Turkey. A total of 52 questionnaire survey samples were obtained from 9 different cooperatives that invested or are under the investment process in solar power plants. Based on the survey answers 2 different models were developed. The proposed model 1 was used to understand which factors determine the size of financial contribution in renewable energy cooperatives established in Turkey. Moreover, model 2 was used to propose what need to be done and which factors are effective in further investment decision which is essential for the renewable energy cooperatives to grow and contribute to both national and international targets against the effects of climate change and help the deployment of renewable energy in a developing country.

Major findings of the models can be listed as:

- The significant factors affecting the size of financial contribution found as household income level and importance attached to the return of investment
- The most significant factors influence the further investment decision are a new regulation expectation, willingness to reduce Carbon footprint and electricity

price expectation.

- People with higher income levels invest more in renewable energy cooperatives.
- People with higher environmental concerns do not necessarily invest more in renewable energy cooperatives. However, members who have a higher willingness to reduce their Carbon footprint considers positively for further investment decisions independent from the size of the investment.
- Members with managerial roles do not necessarily invest more in renewable energy cooperatives.
- As people weigh more important to return their investment, they will likely invest more in renewable energy cooperatives.
- Although people with higher education levels have higher environmental concerns, there is no relation between the education level and the investment amount they made into renewable energy cooperatives.
- Higher importance attached to the democratic management of the cooperatives or the investment is being made under a cooperative scheme that is not associated with the level of investment.
- Although there is no relation with the future electricity price expectation and the level of investment, the further investment decision is moderately associated with the future electricity price expectation.
- Finally, the further investment decision is associated with an expectation to remove barriers against renewable energy cooperatives which lead the researcher to recommend policies to pave the way for renewable energy cooperatives.

Major observations of the study and policy recommendations can be listed as:

- Even though Turkey has been performing well in terms of increasing installed capacity of renewables with the support of the FIT mechanism, Turkey has fallen behind the targets specified in the 2015-2019 Strategy Plan of the Ministry of Energy and Natural Resources.
- Considering that the FIT mechanism will be renewed in the 2020 year-end for the new investments and it is considered to be guaranteed prices will be decreased and will be in TL terms, Turkey needs to realize potential of renewable energy

cooperatives and small size investments to achieve the target of increasing the installed capacity of solar power plants to 10.000 MW corresponding to 66,8% increase which will also contribute to Turkey's INDCs.

- Even though there is still a purchase guarantee from the active energy purchase price for the electricity produced by unlicensed renewable energy investments realized after May 2019, the non-existence of a base price level exposes these investments for the market price risk. In other words, the credibility of these investments was lowered by removing the base price mechanism. Therefore, the base price should be re-introduced even in TL terms to provide confidence in these investments and ease the funding.
- Moreover, if offsetting is regulated annually which is done monthly now, the financial performance of the renewable energy investments will increase and more people will decide to install renewable energy applications or become a member of the renewable energy cooperative.
- If NGOs, independent institutions, or local authorities can provide technical assistance for the person or the cooperative who is willing to install a renewable energy power plant but no technical capability, it could contribute to the deployment of renewable energy in the country.
- The development of the VCIFs that invests in renewable energy projects is still premature and they can be invested by individual investors directly or indirectly. However, due to strict regulations, these funds have indirect investments through pension funds that could play a more significant role. If pensioners allowed to direct their investments in pension funds that invest in these VCIFs, an alternative financing method can be created for renewable energy investments.
- The government can also subsidize renewable energy investments by offering tax incentives or exemptions. Applying lower real estate tax for the properties installed with renewable energy applications of offering investment tax incentives can be counted among the subsidies that can be offered by the government.
- Moreover, local authorities can provide public buildings for the installation of renewable energy power plants which is funded by local people.
- The power purchase agreement should be allowed for the excess energy produced by renewable energy cooperatives and individuals.

The proposed models contribute the body of knowledge to determine which factors determine the size of the financial contribution for the investments made into renewable energy cooperatives for a developing country, besides which factors play major roles in the further investment decision is also presented. Considering that both models and industry professionals suggested that there is a need for a regulation change, policy recommendations were provided based on the model results and examples around the world. Similar studies can be conducted in other developing countries with renewable energy goals and results can be compared to observe differences among factors that determine the size of financial contributions and further investment decisions. Regulatory authorities are suggested to take into account the results of the developed models and policy recommendations of the researcher to achieve the national and international targets and help the deployment of renewable energy investments with the support of small size individual and community investments.

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APPENDIX A: QUESTIONNAIRE SURVEY

The purpose of this questionnaire is to support the thesis study carried out by Eray Ölmez, a graduate student under the supervision of Boğaziçi University Civil Engineering Ass. Professor Semra Çomu Yapıcı. The scope of the study is the research conducted on financing models based on public participation in renewable energy investments. Your contribution is appreciated for shedding light on the work with the answers to your questions which is asked to people who are leading citizen participation in renewable energy investments like you. It is assured that the personal information you share will remain confidential, the data collected will be statistically analyzed, and the results will only be used for academic purposes.

1. Gender?
   ☐ Male ☐ Female

2. Age?
   ☐ 15-25 ☐ 26-35 ☐ 36-45 ☐ 46-55 ☐ 56-65 ☐ 65+

3. Education Level?
   ☐ Primary School ☐ Secondary School ☐ High School ☐ University ☐ Masters ☐Phd

4. In which Renewable Energy Cooperative are your member?

   .....

5. Monthly Household Income?
   ☐1 (0-5K TL) ☐ 2 (5K-15K TL) ☐3 (15K-30K TL) ☐4 (30K 50K TL) ☐5 (50K TL+)

6. When did you become the member of the cooperative?
   ☐ 2016 ☐ 2017 ☐ 2018 ☐ 2019 ☐ 2020

7. How important is the investment being made under the roof of a cooperative with the cooperative philosophy?
   ☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

8. How did you first know about the cooperative?
   ☐ Social Media (Facebook, Twitter, Instagram)
   ☐ Magazine, Newspaper ads
   ☐ Verbally
   ☐ Introductory meetings of cooperatives
   ☐ Ministry's introduction meetings
   ☐ Other…

9. How important is it to reduce your carbon footprint?
   ☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

10. Your level of concern about the possible consequences of climate change?
    ☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

11. If the investment of the cooperative be one of the conventional electricity generation facilities (coal, natural gas) instead of renewable energy, would you still invest?
    ☐Yes ☐No

12. Are you involved in cooperative management?
    ☐Yes ☐No

Figure A.1. Questionnaire Survey 1.

13. To what extent did the democratic management style in cooperatives affect your decision to become a member?
☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

14. How important is a state / municipality stakeholder in the cooperative from the establishment process of the cooperative to the investment process?
☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

15. How important are non-governmental organizations (Chamber of Electrical Engineers, Chamber of Civil Engineers, Günder etc.) who can provide supervision to the cooperative from the establishment of the cooperative to the investment process?
☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

16. Do you think you have sufficient information about the technical details of the photovoltaic panels selected / to be selected in the project?
☐ Yes ☐ No

17. How important are the technical details (mono / poly crystalline, single axis, bifacial etc.) of the photovoltaic panels selected / to be selected in the project?
☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

18. How important is the photovoltaic panels selected / to be selected in the project to be local production?
☐ Very Low ☐ Low ☐ Moderate ☐ High ☐ Very High

19. What is your expectation for the increase in electricity prices in the coming years?
☐ Well below inflation ☐ Below inflation ☐ Equal to Inflation ☐ Above inflation
☐ Well above inflation

20. To what extent was your willingness to invest in renewable energy cooperatives affected after the Unlicensed Electricity Generation Regulation published in May 2019?
☐ Decided to suspend further investment decision
☐ Did not affect my investment decision on renewable energy cooperatives.

21. Would your further investment decision influence, if the feed in tariff mechanism continued in dollar terms?
☐ No ☐ Maybe ☐ Perhaps ☐ Most likely ☐ Definitely

22. Your Investment Level in to cooperative?
☐ 1 (0-40K TL) ☐ 2 (40K-100K TL) ☐ 3 (100K-175K TL) ☐ 4 (175K-250K TL) ☐ 5 (250K-400K TL) ☐ 6 (400K-1M TL)
☐ 7 (+1M TL)

23. What is your forecast for the future of renewable energy cooperatives?
☐ Will be limited with the existing ones
☐ Existing ones will grow with the new shareholders.
☐ Will continue to grow in numbers

24. What are the biggest obstacles for the increase in the number of renewable energy cooperatives and the growth of existing cooperatives? (You can choose multiple options)
☐ People's lack of environmental concern
☐ High Initial Investments cost
☐ Regulations and changing application procedures

Figure A.2. Questionnaire Survey 2.