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ASSESSING THE IMPACT OF TURKIYE'S UNORTHODOX MONETARY POLICY ON THE PROFITABILITY OF UNLICENSED SOLAR POWER PLANT PROJECTS

TÜRKİYE'NİN GELENEK DIŞI PARA POLİTİKASININ LİSANSSIZ GÜNEŞ SANTRALLERİNİN KÂRLILIĞI ÜZERİNE ETKİSİNİN DEĞERLENDİRİLMESİ

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Öz

Türkiye'nin Eylül 2021 ile Haziran 2023 arasında uyguladığı gelenek dışı para politikası, enflasyon da dahil olmak üzere birçok makroekonomik göstergeyi etkilemiştir. Türkiye Cumhuriyet Merkez Bankasının (TCMB) politika faizini devamlı düşürmesi, negatif reel faizin sürekli artmasına neden olmuştur. Bu durumun sonucu olarak hane halkı, enflasyondan korunabilmek için konut, döviz ve altın da dahil olmak üzere birçok alternatif yatırım aracına yönelmiştir. Talepteki bu artış gayrimenkul fiyatlarının ciddi şekilde artmasına neden olmuştur. Güneş santralleri için önemli bir maliyet kalemi olan arazi fiyatları da yükselmiştir. Bu çalışma, arazi fiyatları ile konut fiyatları arazındaki doğrusal ilişki göz önünde bulundurularak, konut fiyatlarındaki artışın 37 lisanssız güneş santrali projesinin sermaye harcaması (CAPEX) üzerine etkisini incelemektedir. Sonuçlara göre, Türkiye'de reel faiz ile konut fiyat endeksi arasında -0,97'lik korelasyon olduğu belirlenmiştir. Ayrıca, konut fiyat endeksi ile lisanssız güneş santrallerinin CAPEX'i arasında 0,20'lik korelasyon olduğu tespit edilmiştir. Dolayısıyla konut fiyatı, real faiz oranı ile güneş enerjisi santrallerinin CAPEX'i arasında aracı değişken olarak kullanılmıştır. Bu durum, CAPEX'in karlılığı etkileyen önemli bir faktör olması nedeniyle, ağırlıklı olarak gelenek dışı para politikası nedeniyle artan konut fiyatlarının lisanssız güneş santrallerinin karlılığını olumsuz etkileyebileceğini göstermektedir. Gelenek dışı para politikasından Temmuz 2023 itibariyle vazgeçilse de, bu politikanın enflasyon başta olmak üzere ekonomiye olumsuz etkileri hâlâ devam etmektedir. Güneş santrallerinin karlılığını artıracak politika ve uygulamalar, yenilenebilir enerji yatırımcılarına ve Türkiye'nin yeşil dönüşümüne önemli katkılar sağlayacaktır. Bu bağlamda, Global Carbon Council (GCC) ve International Carbon Registry (ICR) gibi gönüllü karbon piyasası standartları altında karbon kredilerinin geliştirilmesi ve piyasaya sunulması, güneş enerjisi santrali yatırımcılarını desteklemek ve ülkenin karbon nötr olma hedefine ulaşmasına yardımcı olmak için ek bir katkı sunmaktadır.

Anahtar Kelimeler: Gelenek dışı para politikası, lisanssız güneş santrali, konut fiyatı

JEL Sınıflandırılması: E43, E52

Abstract

Türkiye's unorthodox monetary policy implemented between September 2021 and June 2023 affected many macroeconomic indicators including inflation. Turkish Central Bank's (CBRT) continuous lowering of the policy interest rate increased the negative

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real interest rate constantly. As a result, households invested in alternative assets including housing, foreign currency and gold in order to hedge against inflation. This increase in demand soared real estate prices. Besides, land is an important cost item for solar power plant investments. Considering the linear relationship between land prices and housing prices, this paper investigates the effect of the increase in housing prices on the capital expenditure (CAPEX) of 37 unlicensed solar power plant projects in Türkiye. According to the results, a correlation of -0.97 was determined between the real interest rate and housing price index in Türkiye. In addition, a correlation of 0.20 was found between housing price index and the CAPEX of unlicensed solar power plants. Hence, housing price was used as an intermediate variable between real interest rate and CAPEX of solar power plants. This situation indicates that the increase in housing prices primarily due to the unorthodox monetary policy might adversely affected the profitability of unlicensed solar power plants, since CAPEX is an important factor affecting the profitability. Although the unconventional monetary policy has been abandoned as of July 2023, the negative effects of this policy on the economy, especially inflation, still continue. Policies and practices that would increase the profitability of solar power plants will make significant contribution to the renewable energy investors and Türkiye's green transition. In this context, development and issuance of carbon development credits under the voluntary carbon market standards such as Global Carbon Council (GCC) Standard and International Carbon Standard (ICR) presents additionality to support solar power plant investors and help the country to reach her carbon neutrality target.

Keywords: Unorthodox monetary policy, unlicensed solar power plant, housing price

JEL Classification: E43, E52

Introduction

Türkiye as an emerging economy has been increasing total installed capacity to supply electricity demand of the society. Electricity generation from renewable energy sources and technologies is indispensable for mainstreaming the low emissions development strategies. Last decade, important progress was achieved in increasing overall renewable energy installed capacity of the country. One of them is solar energy, and its share and generation are significant to monitor in the electricity generation statistics of Türkiye. Besides, installed capacity of solar reached 9,691 MW (EXIST, 2023). However, it is well below total economic potential (40,000 MW) and government target (52,900 MW) by 2035. In 2023, the Ministry of Energy and Natural Resources sets for all renewable energy and electricity installed capacity targets in the National Energy Plan (EPDK, 2023). According to this plan, installed electricity generation capacity in 2035 reaches the following levels as 29.6 GW in wind energy (24.6 GW onshore and 5 GW offshore), 52.9 GW in solar energy, 35.5 GW in natural gas power plant, 35.1 GW in hydroelectric power plants, 5.1 GW in geothermal and biomass power plants, 7.2 GW in nuclear power plants, and 4.3 GW in coal power plants. The new capacity to be commissioned in the 2021-2035 period is 96.9 GW. Renewable energy sources account for 74.3% of this increase in installed capacity. The annual new capacity requirement for solar energy is 3.1 GW. Electricity consumption increases by an

average of 4.4% per annum between 2000 and 2020, from 128 to 306 TWh, reaching 510.5 TWh by 2035 with an average annual increase of 3.5%. The share of renewables increases from 42.4% in 2020 to 69.1% by 2053. The share of intermittent renewable energy sources, which accounted for 11.7% of electricity generation in 2020, gradually increases to 61.4% by 2053 (EPDK, 2023).

Among solar energy sources, solar photovoltaic (PV) projects could reduce the greenhouse gas (GHG) emissions through substituting fossil fuel-based power plants for electricity generation. Starting with the Kyoto Protocol Flexibility Mechanisms (e.g., the Clean Development Mechanism, the Joint Implementation and the International Emissions Trading), creating carbon credits have been financially supporting of renewable energy projects. These flexibility mechanisms and voluntary carbon markets provide a risk reduction tool and increase the financial sustainability of renewable energy projects. One of the crucial criteria is evidence for additionality of carbon credits of emissions reduction projects. Additionality issue of small scale renewable projects particularly could be assessed through baseline of country or corporate, discount rate, higher cost and lower technological readiness level of emissions reduction projects including renewable energy, emissions removal alternatives and sequestration projects and risk factors in a country (Sugiyama & Michaelowa, 2001). Lower diffusion rate of renewable energy technologies and their high costs were accepted as the main risk factors for increasing the capacity of these technologies. Although, the issue of market penetration rates for solar PV have been already overcome (Kartha et al., 2005) and cost of solar PV has been declining over the last decade at global scale (REN21, 2022), the utilization rate of solar PV projects are not at desired level in Türkiye. Besides, the country announced its net zero emissions target by 2053 (TCCB, 2021), and it is known that renewable energy projects are the main policy and measure for achieving this target. In Türkiye, existence of support mechanism and declining the levelized cost of electricity of the solar PV are expected as positive drivers to increase the utilization rate of economic potential of untapped solar energy. However, the low profitability of small-scale, particularly many unlicensed solar power plants have a negative impact on new investments. This situation delays reaching economic potential and impede progress of low carbon transition. The aim of this study is to determine a prominent factor influencing the capital expenditure of the unlicensed solar PV projects, and to assess impacts of monetary policies on implementation of solar PV projects in Türkiye. In the scope of this study, the situation of unlicensed solar PV projects is analyzed with Türkiye's financial risk environment such as the unorthodox monetary policy between September

2021 and June 2023. This policy adversely affected many sectors, including renewable energy, as the policy environment for supporting mechanisms and enabling factors in progress of technological improvement in solar PV, and setting targets for renewable energy utilization, creates a risk for solar PV projects due to the consequences of the monetary policy. Explicitly, Turkish Central Bank's (CBRT) continuous lowering of the policy interest rate increased the negative real interest rate gradually. As a result, households began investing in alternative areas including housing, foreign currency and commodities such as gold, in order to protect the value of their wealth. This increase in demand has led to soaring real estate prices. On the other hand, cost of land is an important component of solar power plant investments affecting profitability. Considering the linear relationship between land prices and housing prices, this paper investigates the effect of the increase in housing prices on the capital expenditure (CAPEX) of unlicensed solar power plants in Türkiye as a result of the unorthodox monetary policy.

1. Literature Review

In the literature, there are studies concentrating on determining factors effecting renewable and solar power plant investments. Besides, studies on the elements affecting profitability of solar power plants focus on scale effect, fluctuations in foreign currencies, geographical location of solar projects and political factors. Erden Topal et al. (2022) researched the factors that encourage and hinder electricity generation from solar PV and wind energy in Türkiye. The findings show that one of the key elements influencing the country's electricity production from renewable energy sources is economic factors such as investment cost. The study also found that factors affecting electricity generation differentiates among private sector and non-profit organizations. Kilinc Ata and Dolmatov (2023) concentrated on elements influencing renewable energy investments in Organisation for Economic Co-operation and Development (OECD) and BRICS[1] countries. The findings imply that investments in renewable energy have a favorable association with economic growth, energy policies and research and development (R&D) spending. The study also found that renewable energy investments have an inverse relationship with CO_2 emissions and energy use. Sisodia and Soares (2015) analyzed the elements affecting solar and wind investments in the European Union. Their results suggest that a perception of tough regulations negatively influence solar power plant investments.

[1] BRICS, an acronym for Brazil, Russia, India, China, and South Africa

Ertugrul and Saldi (2020) researched how the size of a plant and foreign currency affect the return on investment of unlicensed solar power plants in Türkiye. Results suggest that there is a very strong correlation of 0.918 between the plant size and profitability. In addition, the correlation level between USD/TRY currency and profitability was very low. Ozcan and Ersoz (2019) calculated the production and financial return of three solar power plant investments in Izmir, Ankara and Istanbul provinces of Türkiye. According to the results, Ankara has the highest return on investment with 161% and it is followed by Izmir with 153% and Istanbul with 61%. In addition, Izmir has the highest productivity level due to geographical factors such as solar radiance. Although Izmir has higher productivity level compared with Ankara, the higher profitability of the investment in Ankara is explained by the lower land prices. Brodzinski et al. (2021) investigated the economic efficiency of solar power plants in north-east Poland. The power plants are divided according to their plant size: 0-799 kWp (Group I), 800-1100 kWp (Group III) and 1980 kWp (Group III). Results show that the group III has the highest profitability. Additionally, no linear relationship was found between productivity and profitability. It is recommended that the first group should be supported primarily because of the large variations in land form, land cost and social benefits. Kim et al. (2019) developed a model for the evaluation of solar PV investments using Fuzzy Analytic Hierarchy Process. According to the results, economic factors are the most effective for investments with 71.57% directly affecting the profitability. This is followed by political factors with 16.26% and technical factors with 12.17%. Economic factors are related to the cost and profit of the investment. Within economic factors, financial ones such as profitability have higher weight in comparison to business risk factors. The fact that solar energy investments have higher costs compared to conventional energy sources has caused the policy factor to maintain its importance and to be the second most effective factor. The contribution of this working paper for the literature is to analyze the impact of Türkiye's unorthodox monetary policy on the CAPEX of unlicensed solar power plants, which can be a barrier to solar power plant investments.

2. Method and Data

The scope of the study is the effect of Türkiye's monetary policy on CAPEX of unlicensed solar power plants in Türkiye. The data used in the study can be seen in Table 1.

Table 1: The Data Used in the Study

Data	Unit	Source
1 week repo rate	Percentage	CBRT (2022a)
Consumer Price Index	Percentage	TURKSTAT (2022)
Housing price	Housing price index	CBRT (2022b)
Capital Expenditure	USD	GCC (2023), Gaia Climate (2022)
Installed Capacity	MWe	GCC (2023), Gaia Climate (2022)

While determining this relationship, first monthly real interest rate was found by subtracting monthly inflation rate from the policy interest rate. The CBRT began using the weekly repo rate as the policy interest rate since June 2018. For this reason, June 2018 was determined as the starting point in the research. The unconventional monetary policy began in September 2021 and as a result of this policy, a significant increase in inflation occurred in December 2021. For this reason, data up to November 2022 were analyzed in order to eliminate the base effect. Next, the correlation between real interest rate and Türkiye's housing price index between June 2018 and November 2022 was found.

In the second part of the analysis, correlation between CAPEX per watt and housing price index was calculated. CAPEX and installed capacity data of solar power plants were taken from the GCC portal (34 projects) and Gaia Climate (3 projects)[1]. The details of these projects can be found in Table 2. For most the projects a single CAPEX amount was calculated by bundling solar power plants located in many different regions. Since the housing price index data of CBRT covers either

[1] **Projects taken from Gaia Climate are:** "S*** Bundle", "A*** Bundle", "A*** O*** Bundle"

a single or neighboring cities, projects that include plants from distinct cities[1] were excluded from the study. In addition, projects where CAPEX amount[2] is not shared were also excluded.

As the housing price index, the proportional change in the index between the year the investment was commissioned, and the previous year was taken. It is assumed that land is bought by investors one year prior to the commissioning year. Since most of the projects involve more than one plant, the commissioning year of each plant may differ. In this case, the year in which the earliest commissioning of the plants within a project was used in the calculations.

While land is an important cost component under CAPEX of solar power plant investments, many individuals or companies make their investment on the land they already own. Since no additional land cost arises for these projects, the CAPEX and IRR of the projects become relatively lower compared to the projects which have land cost. Most of the plants under review do not specify mention whether land cost is included in the CAPEX. However, six[3] of the thirty-seven projects highlight that their CAPEX values include land cost. Therefore, the project with the lowest CAPEX per watt among these 6 projects[4] were set as the lower limit and it was assumed that no additional land cost would arise for projects below the limit. For that reason, the projects that have CAPEX per watt below the limit[5] were excluded from the study.

Solar power plants have variety of fixed costs. Land is one of the primary fixed costs of solar power plant investments. However, the land price varies according to the location (TENVA, 2017). In addition, land cost does not arise in rooftop solar power plants as the investors use the plant for

[1] **Projects which include plants from distinct cities are:** "Makascı-3", "Makascı-5", "Makascı-6", "Makascı-8", "Makascı-9", "Çiftay-2", "Bükor", "Masfen-12", "Masfen-13", "2M Solar Power Plant Bundle", "Saha Solar Power Plant Bundle", "HK Solar Bundle", "Yayla SPP Bundle", "Bundled Solar Power Project 2 by Elestaş Enerji", "Erikoğlu SPP Bundle", "Project 1 by Aloha Turistik Hizmetler A.Ş.", "Momentum Enerji Solar Power Projects Bundle 2", "Maydem Solar Power", "Okyanus Solar Power Plant", "Solar Power Project Bundle 3 by Renktaş Mimarlık", "Solar Power Project Bundle 2 by Renktaş Mimarlık", "Solar PV Project by Lilyum", "Birleşim Yeşil Enerji Bundle SPP Project", "Fit-Süzgeç Solar Power Plant Bundle", "Uğur 2 Bundle SPP", "Mer Saysun Solar Power Plant Bundle", "Gülşehir Ulupınar Solar Power Plant Bundle", "Solar Power Project Bundle 1 by Renktaş Mimarlık", "Emlak Girişim Danışmanlığı A.Ş. Solar Power Projects Bundle 1", "T-Power Solar Power Plant Bundle", "Bundled Solar Power Project 3 by Elestaş Enerji", "Astronergy Solar Turkey 3", "Emlak Girişim Danışmanlığı A.Ş. Solar Power Projects Bundle 2", "Momentum Enerji Solar Power Projects Bundle 3", "Astronergy Solar Turkey 1", "Ecogreen Bundle SPP Project-1", "Renewable Solar Power Plant Bundle by Bosphorus"

[2] **Projects that do not share their CAPEX values are:** "Teksin SPP", "Gurses Bundled SPP", "Odunpazarı SPP", "Sariturhal_Bundled SPP", "Karaman-Çumra SPP", "Lentaz_Bundle_SPP", "KDL Group Solar Bundle", "Elbistan-1 Bundled SPP", "Elbistan-2 Bundled SPP", "Tire Bundled SPP", "Bundled Solar Power Project 1 by STC Elektronik", "Bundled Solar Power Project 2 by STC Elektronik", "Elbistan-3 SPP", "Konya Bundled SPP", "Celebi SPP", "Kıvanç-2 Solar Power Project".

[3] **Projects which specifically mention land cost under CAPEX are:** "Balsuyu Karapinar Bundled Solar Power Plants", "Balsuyu Domanic Bundled SPPs", "Özkoyuncu Aktarma, Fevzipasa-2 Obakoy Bundled Solar Power Plants", "Fevzipasa-1 Bundled Solar Power Plants", "Proges Bundled Solar Power Plants"

[4] The lowest CAPEX per watt value among six projects is 0.93 (Balsuyu Domanic Bundled SPPs)

[5] **Projects which have CAPEX per watt value lower than 0.93 are:** Agah SPP Bundle (0.09), Sav-Ek Solar Power Plant Bundle (0.28), Aşağı Kaleköy (CAPEX per watt 0.81), Momentum Enerji Solar Power Projects Bundle 1 (0.87)

self-consumption (TENVA, 2017). Another important fixed cost is solar modules which account for around 52% of the total fixed cost (TENVA, 2017).

According to the data published by Endeksa (2022), there is a strong positive relationship between housing and land prices. As a result, the increase in housing prices will negatively affect the profitability of solar power plants as it will increase the costs of investments. In addition, according to the calculations made by the World Bank, at least 25% internal rate of return (IRR) is required for solar power plant investments in Türkiye to attract investors (World Bank, 2017). It was observed that none of the companies examined within this study could reach this level.

Almost all solar power plant projects under review are land based. As roof top investments do not require land cost, one exceptional project with rooftop investment[1] was excluded from the scope. Additionally, projects with numerical errors[2] were also excluded from the analysis.

[1] "Tiryaki Solar Bundle" project includes rooftop solar PV investment.
[2] **Projects with numerical errors are:** "Fernas-4 SPP" (calculation sheet and report CAPEX values are different), "Bundled Solar Power Project 1 By Fiba Yenilenebilir Enerji", (CAPEX value is written as 144,70,059), Bundled Solar Power Project 2 By Fiba Yenilenebilir Enerji (CAPEX value is written as 220,91,316)

Table 2: Unlicensed Solar PV Projects under Review

Project Name	Installed AC Power (Mwe)	CAPEX (USD)	CAPEX (USD) per Watt	Annual Increase in Housing Price Index (%)	Year	Location
Alibeyhüyüğü	18,00	24.086.000	1,34	11,85	2019	Konya
Makascı-1	10,82	10.820.000	1,00	10,29	2016	Konya-Karaman
Makascı-2	13,72	26.095.000	1,90	8,70	2017	Konya
Makascı-4	13,16	17.124.073	1,30	8,70	2017	Konya
Makascı-7	12,99	16.855.270	1,30	8,70	2017	Konya-Karaman
Solar Power Plant Bundle by Cengiz Enerji	26,68	37.700.000	1,41	11,76	2015	Konya
Çiftay-1	13,51	18.370.619	1,36	9,10	2016	Ankara
Çiftay-3	76,80	84.650.104	1,10	8,33	2017	Şanlıurfa
Masfen-11	14,90	14.940.000	1,00	12,21	2016	Isparta
S*** BUNDLE	38,27	40.023.577	1,05	9,46	2016	Manisa
A*** BUNDLE	13,42	16.060.566	1,20	8,89	2016	Kayseri
Ahat Ayvalı Göğem Solar Power Plant Bundle	43,98	57.649.594	1,31	10,89	2017	Uşak-Afyon-Kütahya
Hasanbeyli Bundled SPP	9,70	9.233.794	0,95	6,40	2018	Osmaniye-Kahramanmaraş
Difer SPP Bundle	10,83	13.020.000	1,20	12,42	2017	Erzurum
Balsuyu Karapinar Bundled Solar Power Plants	3,50	4.462.921	1,28	8,70	2017	Konya
Balsuyu Domanic Bundled SPPs	8,98	8.324.550	0,93	12,20	2019	Kütahya
Akmezra Obuz Solar Power Plant Bundle	6,93	7.796.250	1,13	10,35	2018	Elazığ
Küçükköy Solar Power Plant	18,61	25.000.000	1,34	43,91	2020	Antalya

Project Name	Installed AC Power (Mwe)	CAPEX (USD)	CAPEX (USD) per Watt	Annual Increase in Housing Price Index (%)	Year	Location
Bundled Solar Power Project 2 by Elektro Ege Elektrik	9,98	11.918.847	1,19	18,63	2017	İzmir
Bayraktar Solar Power Plant Bundle	10,98	11.696.829	1,07	8,89	2016	Kayseri
Uğur 1 Bundle SPP	10,89	16.651.000	1,53	6,27	2017	Adıyaman
Büget SPP	7,00	13.910.000	1,99	36,02	2020	Kahramanmaraş
Özkoyuncu Aktarma	33,97	40.599.922	1,20	15,13	2017	Balıkesir
Fevzipasa-2 Obakoy Bundled Solar Power Plants	13,00	21.918.203	1,69	6,27	2017	Gaziantep
Bundled Solar Power Projects by Kıvanç Enerji	12,98	16.797.749	1,29	9,40	2017	Adana
Aslan Yapı Solar Power Plant Bundle	10,96	14.610.000	1,33	11,76	2015	Konya
Eskisehir Solar Bundle	14,98	21.309.000	1,42	14,46	2017	Eskişehir-Bilecik
Emlak Girişim Danışmanlığı A.Ş. Solar Power Projects Bundle 1	10,80	11.000.000	1,02	17,11	2019	Mardin
Alamettin GHZW Solar Power Plant Bundle	13,42	16.060.566	1,20	8,89	2016	Kayseri
Fevzipasa-1 Bundled Solar Power Plants	12,00	16.023.813	1,34	1,38	2016	Gaziantep
Proges Bundled Solar Power Plants	10,20	15.043.344	1,47	3,70	2018	Diyarbakır
Solarpower Durasıl Solar Power Plant Bundle	32,46	40.023.577	1,23	10,89	2017	Manisa
Aluform Bundle SPP	5,99	7.154.000	1,19	8,73	2019	Şanlıurfa
Astronergy Solar Turkey 2	11,25	15.139.000	1,35	1,56	2018	Ankara
Gökçen BPLAS Bundle SPP	14,99	17.900.000	1,19	8,73	2019	Şanlıurfa

Project Name	Installed AC Power (Mwe)	CAPEX (USD)	CAPEX (USD) per Watt	Annual Increase in Housing Price Index (%)	Year	Location
Erciyes 1 Solar Bundle	10,08	16.663.000	1,65	8,89	2016	Kayseri
MASFEN-14 Solar Bundle	11,61	18.575.000	1,60	15,67	2017	Aydın

Prepared by authors based on data from GCC (2023) and Gaia Climate (2022)

3. Unorthodox Monetary Policy Experiences of Türkiye

Relationship between interest rate and inflation rate can be explained by the Fisher Equation (Eq-1). Nominal interest rate (i) can vary according to the real interest rate (r) and the rate of inflation (π) (Mankiw, 2009).

$$i = r + \pi \qquad \text{(Eq-1)}$$

Therefore high inflation causes high nominal interest rate**.** A fall in real interest rate will also cause capital outflows from the country and investments flowing into other areas as investors' profit diminishes because of the inflation and depositing money in the bank becomes unattractive. Changing the nominal interest rate (policy interest rate) will affect the real interest rate in the other side of the equation. As part of this conventional monetary policy, central banks limit the money supply in order to control the inflation by raising the policy interest rate (The Economist, 2021).

Contrary to this fundamental equation of macroeconomics, the Central Bank of the Republic of Türkiye (CBRT) cut the policy interest rate by 100 basis points to 18% in September 2021, arguing that the inflation will decline gradually (Kubilay, 2021). In September 2021, the consumer price index (CPI) was 19.58% year on year (TURKSTAT, 2022). Rate cuts continued until December 2021 steadily and this policy increased the negative real interest rate further. In December 2021, the policy interest rate became 14% and the CPI reached 36.08%. From December 2021 to July 2022, the interest rate was kept constant at 14%. In July 2022, the CPI reached 79.6% (TURKSTAT, 2022). More interestingly, while the experiment was tested and not successful in controlling inflation, the CBRT continued cutting the interest rate from August to November 2022. In October the inflation rate reached a record high level of 85.51%. In November the policy interest

rate became 9% (TURKSTAT, 2022). Lastly, CBRT cut the policy interest rate 50 basis points and the weekly repo rate reached 8.5%. Hence the monetary policy caused negative real interest rate to rise continuously. As a result, households and firms pulled their Turkish Lira (TRY) deposits off the bank to avoid return below the inflation rate. They invested in areas such as real estate, automobiles, foreign currencies and gold to protect the value of their wealth. In addition, this policy caused Turkish Lira to lose significant value against foreign currencies. By having more and more Turkish Lira in the economy, the policy caused the inflation rate to rise further (The Economist, 2021). The main idea of Türkiye was to support exporters by having cheaper Lira and to prop up the construction sector by providing low-interest loans (The Economist, 2021). Thus the hope was to reach current account surplus. However, the trade deficit and the current account deficit has been increasing. In July 2022, the trade deficit increased by 144.5 % year on year (Ministry of Trade, 2022). While the current account deficit was 13.4 billion dollars in the January-June period in 2021, it more than doubled in the same period of 2022 and reached 32.4 billion dollars (CBRT, 2023). According to Mahfi Egilmez (2022), CBRT's rate cuts incentivized higher demand and due to Turkish economy's high dependency on imports for production, the extra demand resulted in higher imports. Therefore, the unorthodox monetary policy was one of the factors increasing the trade deficit and thus the current account deficit.

Additionally, the rising concerns over the prospect of the Turkish economy led to rising credit default swap (CDS) premia and Eurobond interest rates. On September 20, 2021, just before the unconventional monetary policy was implemented, the Ministry of Treasury and Finance issued dollar denominated Eurobonds with a yield of 5.7%. This rate increased to 8.625% in the issuance with a similar maturity on March 17, 2022 (Ministry of Treasury and Finance, 2022). At the same time, portfolio investments of foreign investors reached historical low levels. More interestingly, this policy put into practice in an era where the most of the central banks in developed countries have begun implementing tighter monetary policy (Kubilay, 2021). Many governments put in force expansionary fiscal policies after the emergence of the Covid-19 pandemic to stimulate their economies. Besides, the war in Ukraine and sanctions against Russia disrupted the supply of fossil fuels (e.g., oil, natural gas) and crops (e.g., wheat, sunflower oil), leading to rising commodity prices. For these reasons, the global inflation rate has risen and many central banks began to take measures. For instance, US Federal Reserve (FED) increased the benchmark interest rate by 0.25% in March 2022, which was the first rate hike since 2018 (Cox, 2021; Federal Reserve, 2021)

While the Federal Funds effective rate was between 0.00% to 0.25% in September 2021, FED increased the benchmark interest rate between 4.5% to 4.75% by February 2023. Moreover, European Central Bank (ECB) increased the key interest rates by 0.5% in July 2022 and this was the first rate hike in 11 years (Amaro, 2022). ECB's rate hikes continued, and the key interest rates reached 3% by February 2023. Figure 1 illustrates the development of policy interest rates of FED, ECB and CBRT since CBRT's unorthodox monetary policy began.

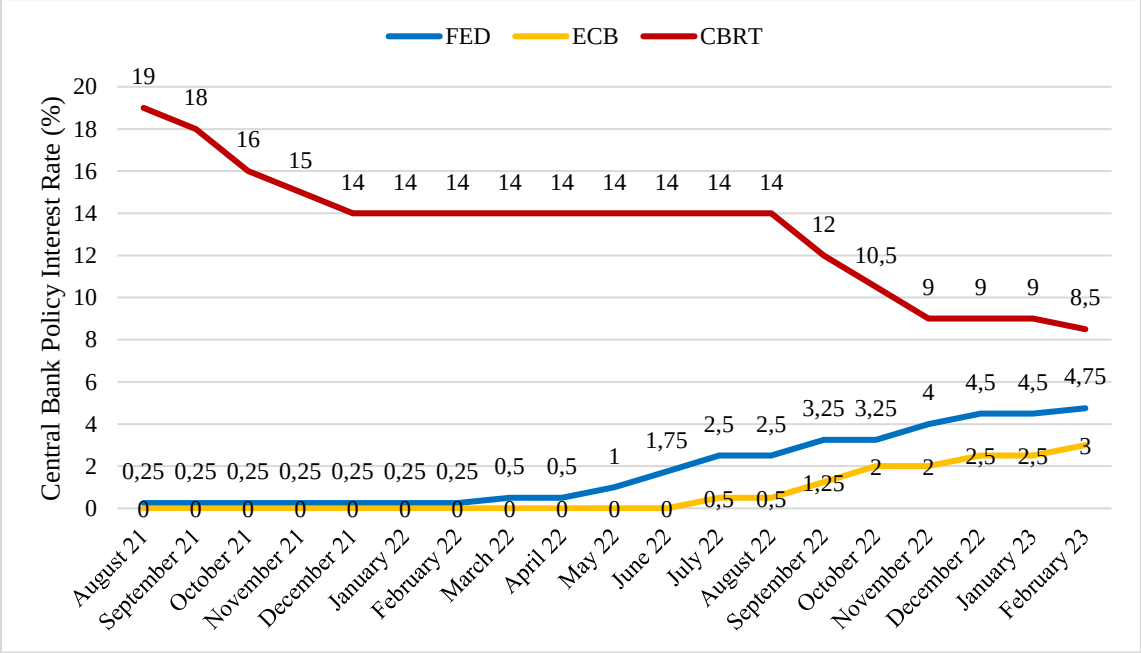

Figure 1: Policy Interest Rates of FED, ECB and CBRT, August 2021-February 2023. Prepared by authors based on data from CBRT (2023), Central Bank Rates (2023).

4. Findings

While measures of monetary policies are taken at global level, unorthodox monetary policy creates adverse impact on real estate prices. Figure 2 shows the relationship between housing price index and real interest rate in Türkiye. After the unorthodox monetary policy, the housing price index began to rise rapidly due to high demand on real estates. As shown in Figure 2, there is a strong negative relationship between the two variables and the correlation was found to be -0.97. Since land is required for solar power plant investment, the question of how this unorthodox monetary policy will affect the profitability of the power plants has come to the fore.

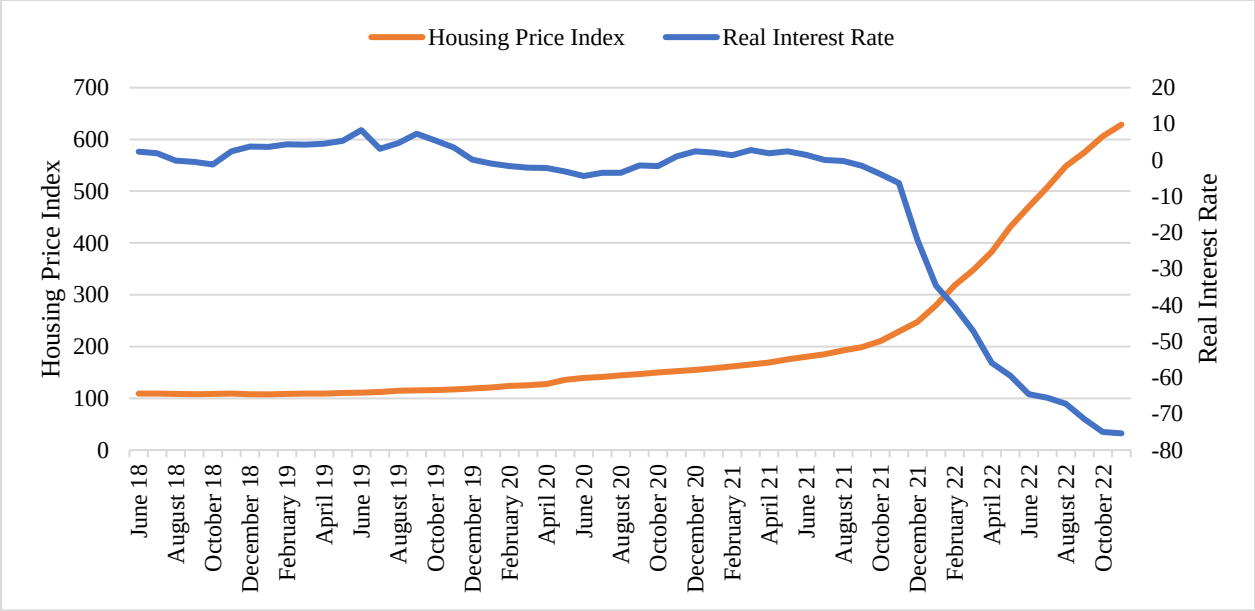

Figure 2: Relationship between Housing Price Index and Real Interest Rate in Türkiye. Prepared by authors based on data from CBRT (2022a), CBRT (2022b) and TURKSTAT (2022).

37 solar PV projects, commissioned between 2015-2020 were examined, each compromising multiple solar PV. The total installed capacity of all projects is 612.33 MW. Figure 3**Hata! Başvuru kaynağı bulunamadı.** shows the cities of the projects examined, 25 in total. Majority of the projects under review are concentrated in Central Anatolia, Aegean, Mediterranean and South Eastern Anatolia regions. The installed capacity of these projects range from 3.5 MW to 76.9 MW. Konya comes to the forefront with 8 projects among 25 cities. The limited number of investments in Marmara Region can be attributed to the high land cost. This situation is also mentioned in the Study by Ozcan and Ersoz (2019) in particular for Istanbul. In addition, Black Sea and Eastern Anatolia Regions contain uneven terrains which make it difficult to install solar power plants.

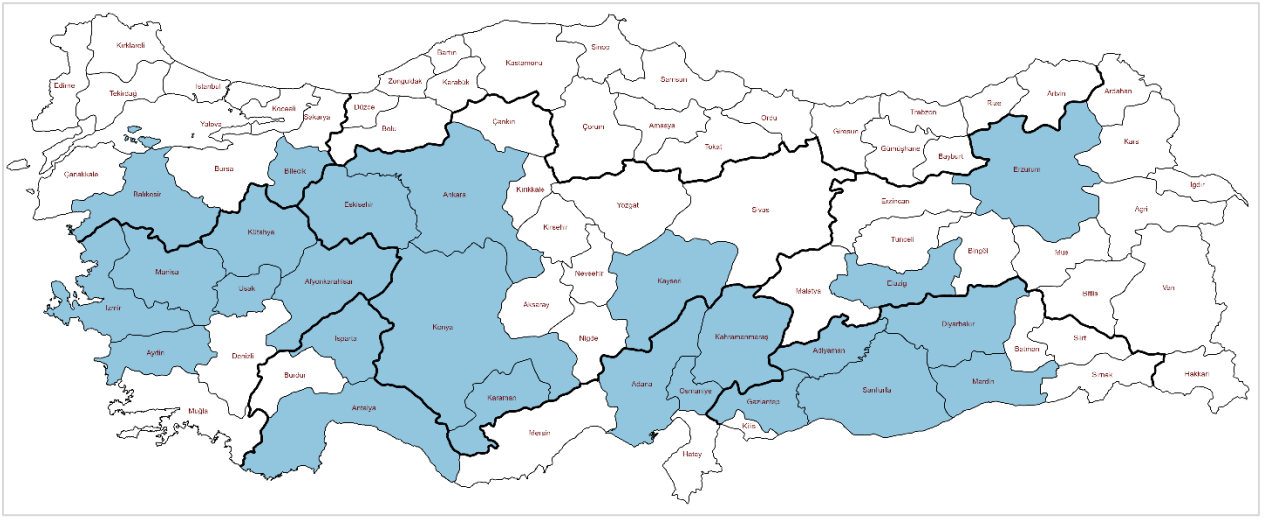

Figure 3: Cities of the Solar PV Power Generation Projects under Review. Prepared by authors based on data from GCC (2023) and Gaia Climate (2022).

As shown in Figure 4**Hata! Başvuru kaynağı bulunamadı.**, there is a positive relationship between the housing price index and CAPEX of most of the unlicensed solar power plant investments. The correlation between the two variables was found 0.20, which means that the rise in the housing price index has increased the capital expenditure of unlicensed solar PV investments in average 20% in Türkiye between 2015-2020.

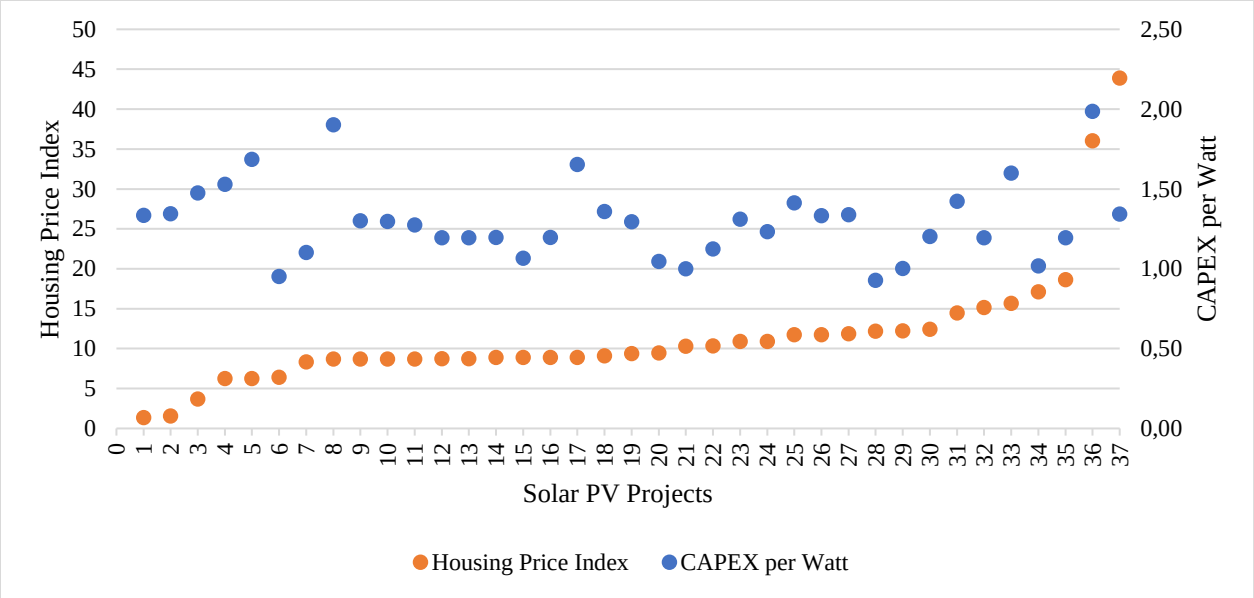

Figure 4: Relationship between Housing Price Index and CAPEX per Watt of Unlicensed Solar PV Investments in Türkiye. Prepared by authors based on data from GCC (2023) and Gaia Climate (2022).

5. Discussion

According to the Law 5346 on the Utilization of Renewable Resources to Generate Electric Energy, the feed-in-tariff for electricity generation was 13.3 US Dollar cents per kWh for unlicensed solar power plants in Türkiye. Thus, investors could also sell their self-consumption surpluses to the grid with the tariff. According to EMRA's new regulation published in Turkish Official Gazette on August 11, 2022, unlicensed solar power plants commissioned as of 2019 can only sell the amount they consumed in the previous year to the grid and the excess amount will be given to the grid free of charge (Resmi Gazete, 2022a). As a result, the new regulation reduced the investor confidence and distorted IRR predictions, as the investor made their investment plans according to the previous legislations.

One of the leading unlicensed solar power plant investors in 14 different cities between 2016-2022, reported that the new legislation brought the company to the brink of bankruptcy. Investment cost breakdown and operational costs of the projects implemented between 2016 and 2022, can be seen in Table 3.

Table 3: Solar PV Installation Costs Report 2016-2022

YEARS / EXPENDITURES	2016	2017	2018	2019	2020	2021	2022
Number of Panels	4400	4400	4400	4400	4400	4400	4400
DC Power (MW)	1.188	1.188	1.188	1.188	1.188	1.188	1.188
AC Power (MW)	999	999	999	999	999	999	999
Panel Cost ($)	688.000	589.000	563.500	443.250	326.000	399.800	497.000
Inverter - Cabling Cost ($)	35.000	34.000	30.000	24.000	21.000	21.500	26.000
Construction, Project and Other Expenses ($)	370.000	420.000	475.000	376.000	395.000	290.500	261.000
Workmanship ($)	7.000	7.000	6.500	6.750	8.000	8.200	6.000
Total Installment Cost ($)	1.100.000	1.050.000	1.075.000	850.000	750.000	720.000	750.000
O&M Cost Yearly (½$)	10.750	11.000	10.600	8.250	8.000	6.750	5.900

Source: Mavi Yeşil A.Ş. (2022)

By using those data, pre-tax project IRR can be calculated to justify that the projects' IRRs are below benchmark, which the World Bank determined as 25% for Solar PV projects (World Bank, 2017). The report demonstrates each parameter as an interval between minimum and maximum costs. The table in Annex I was prepared by the investor with the worst-case scenario, which takes into account the highest investment cost and the lowest operational cost. Total investment costs ranged between USD 1,100,000 to USD 750,000 from 2016 to 2022, with an almost linear decrease over the years, where technological improvements led to a decline in general costs worldwide. The depreciation cost calculated according to national rates announced in the Turkish Official Gazette as 10% for ten years for solar PV systems. Since unlicensed solar power plants generally benefit from the YEKDEM mechanism, the sales price was taken as 133 USD/MWh accordingly. Related

to that, yearly revenues were calculated by using average annual sunshine duration in the cities of Kahramanmaraş, Adana, Hatay, Osmaniye, Adıyaman, Ankara, Uşak, Afyon, İzmir, Kütahya, Malatya, Mersin, Çanakkale, Kırklareli which ranges between 1,700 to 1,800 hours. In a scenario where the total electricity generation of a 1 MW unlicensed power plant is taken as 1,750 MWh/year, total revenue was found as USD 232,738 since the YEKDEM mechanism has been guaranteed that the selling price would remain constant for ten years until the last regulation. As mentioned above, in the calculation based on the most favorable scenario for the investor, the electricity sale price was also assumed as the same even after the YEKDEM period, which is much higher than the spot prices, realized between the years 2016 to 2022. The pre-tax project IRR values range between 14.40% to 21.47% as seen in Table 4 below.

Table 4: Unlicensed Solar Projects Expense and Income Summary 2016-2022

Years / Parameters	2016	2017	2018	2019	2020	2021	2022
CAPEX ($)	1.100.000	1.050.000	1.075.000	850.000	750.000	720.000	750.000
Depreciation ($)	110.000	105.000	107.500	85.000	75.000	72.000	75.000
OPEX ($)	10.750	11.000	10.600	8.250	8.000	6.750	5.900
Electricity Generation Amount (MWh)	1.750	1.750	1.750	1.750	1.750	1.750	1.750
Electricity Price ($)	133	133	133	133	133	133	133
Yearly Revenue ($)	232.783	232.783	232.783	232.783	232.783	232.783	232.783
IRR	14,40%	15,03%	14,71%	18,31%	20,63%	21,47%	20,63%

Source: Mavi Yeşil A.Ş. (2022)

This result shows that Türkiye's unorthodox monetary policy not only ruined macroeconomic indicators such as inflation rate but also might adversely affect the profitability of unlicensed solar power plants, since CAPEX is an important factor affecting the profitability. On the other hand, the global rise in inflation rate increased the importance of tight monetary policy. In addition, policies and practices should be implemented to increase the profitability of the investments. In this context, carbon offsetting has the potential to be one of the primary tools to raise profitability of solar power plants in Türkiye.

State subsidies have played an essential role for promoting renewable energy investments by reducing market risks and achieving more predictability (TENVA, 2017). As the cost of electricity generation has declined with increasing investments, renewable energy technologies will at some point become competitive with fossil energy sources. Consequently, the need for state subsidies will diminish over time. However early abolishment of support mechanisms or inconsistent policies create market disruptions.

Besides the latest regulations and the optimum investment scenario in Türkiye with the purchase agreement mechanism of YEKDEM and degraded investment costs, it is expected to see an increase in the IRR values. Nevertheless, those values are still under the World Bank benchmark of 25%. Detailed calculation of pre-tax project IRR values can be found in Annex I.

Additionally, in order to limit the increase in energy costs due to the Russia-Ukraine War, a price cap of 1,200 TRY/MWh was introduced in March 2022 for electricity production from licensed renewable energy sources (Resmi Gazete, 2022b). This means that the government pays maximum 6 cents/kWh with recent exchange rates. According to IRENA (2022), cost of electricity from utility-scale solar PV was 4.8 cents/kWh for plants commissioned in 2021 globally. This figure was 5.5 cents/kWh in 2020 (IRENA, 2022). As a result, licensed renewable energy companies have been operating with low profit margins since April 2022.

Despite solar energy being central to the National Energy and Mining Policy, regulations are hindering investment and preventing the country from reaching its full solar energy potential.

Conclusion

In this study, the effect of Türkiye's unorthodox monetary policy on the CAPEX of unlicensed solar power plants was examined through their relationship with housing prices. By determining

the statistical relationship between the CAPEX of solar PV investments that began operating between 2015-2020 and the housing price index, it is estimated how the CAPEX will be affected due to the unorthodox monetary policy implemented beyond September 2021. The CBRT's increase in negative real interest rates soared housing prices. In the study, a correlation of -0.97 was found between the real interest rate and the housing price index. Considering land is an essential fixed cost for solar power plants and the linear relationship between housing and land prices, this suggests that the increase in housing prices affects the CAPEX of solar power plants negatively. According to the results, a correlation of 0.20 was found between the housing price index and the CAPEX of the unlicensed solar power plants. As a result, Türkiye's monetary experiment might affect the CAPEX of solar power plants negatively by raising housing and land prices. This effect is very likely to decrease the profitability of investments in case the policy continues. Therefore, it is necessary for the CBRT not to turn back to unorthodox monetary policies. Although the unconventional monetary policy has been abandoned as of July 2023, the negative effects of this policy on the economy, especially inflation, continue. Additionally, the free purchase of surplus electricity produced by unlicensed solar power plants and the implementation of a price cap for licensed renewable energy facilities reduced investor confidence and prevent Türkiye from reaching its solar energy potential. Implementation of policies and practices aimed at increasing the profitability of power plants will make significant contribution to the renewable energy investors and Türkiye's green transition. In this context, carbon offsetting stands out as an important tool for carbon neutrality target of the country. In addition to monetary policy, insufficient available and affordable land area for solar PV projects provide evidence for additionality of creating carbon credits in Türkiye.

Türkiye's unorthodox monetary policy might have increased the CAPEX of solar power plants. This is due not only to rise in housing prices but also due to the appreciation of the USD against the Turkish Lira and the significant increase in inflation. Most of the solar power plant components are imported in dollars and the increase in inflation blurred forecasts for investors. Therefore, it would be beneficial to examine the effects of such other factors on CAPEX and profitability of solar power plants in future studies.

Yazar Katkısı

KATKI ORANI	AÇIKLAMA	KATKIDA BULUNANLAR
Fikir veya Kavram	Araştırma fikrini veya hipotezini oluşturmak	Yazar 1
Literatür Taraması	Çalışma için gerekli literatürü taramak	Yazar 2
Araştırma Tasarımı	Çalışmanın yöntemini, ölçeğini ve desenini tasarlamak	Yazar 1 & Yazar 2
Veri Toplama ve İşleme	Verileri toplamak, düzenlemek ve raporlamak	Yazar 2
Tartışma ve Yorum	Bulguların değerlendirilmesinde ve sonuçlandırılmasında sorumluluk almak	Yazar 1 & Yazar 2

Çıkar Çatışması

Çalışmada yazarlar arasında çıkar çatışması yoktur.

Finansal Destek

Bu çalışma için herhangi bir kurumdan destek alınmamıştır.

References

Amaro, S. (2022). *European Central Bank surprises markets with larger-than-expected rate hike*. https://www.cnbc.com/2022/07/21/european-central-bank-raises-rates-by-50-basis-points-its-first-hike-in-11-years.html

Brodziński, Z., Brodzińska, K., & Szadziun, M. (2021). Photovoltaic Farms - Economic Efficiency of Investments in North-East Poland. *Energies*, *14*(8). https://doi.org/10.3390/en14082087

CBRT. (2022a). *1 Hafta Repo*. https://www.tcmb.gov.tr/wps/wcm/connect/TR/TCMB+TR/Main+Menu/Temel+Faaliyetler/Para+Politikasi/Merkez+Bankasi+Faiz+Oranlari/1+Hafta+Repo

CBRT. (2022b). *Konut Fiyat Endeksi (KFE)*. https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket/collapse_26/5949/DataGroup/turkish/bie_hkfe/

CBRT. (2023). *Ödemeler Dengesi İstatistikleri*. https://www.tcmb.gov.tr/wps/wcm/connect/TR/TCMB+TR/Main+Menu/Istatistikler/Odemeler+Dengesi+ve+Ilgili+Istatistikler/Odemeler+Dengesi+Istatistikleri/

Central Bank Rates. (2023). *Worldwide Interest Rates*. https://www.cbrates.com/

Cox, J. (2021). *Federal Reserve approves first interest rate hike in more than three years, sees six more ahead*. CNBC. https://www.cnbc.com/2022/03/16/federal-reserve-meeting.html

Egilmez, M. (2022). *İthalat Niçin İhracattan Hızlı Artıyor?* https://www.mahfiegilmez.com/2022/06/ithalat-nicin-ihracattan-hzl-artyor.html

Endeksa. (2022). *Türkiye Satılık Konut, Ev Fiyatları*. https://www.endeksa.com/tr/analiz/turkiye/endeks/satilik/konut

EPDK. (2023). *Türkiye Ulusal Enerji Planı*. https://enerji.gov.tr/duyuru-detay?id=20317

ERDEN TOPAL, Y., GÜRSOY HAKSEVENLER, B. H., & ERDİL, E. (2022). Türkiye'de Yenilenebilir Kaynaklara Dayalı Elektrik Üretimini Etkileyen Faktörler: Rüzgar ve Güneş Enerjisi Örneğinde Kar Amacı Motivasyonuna göre Farklılaşan Engeller ve Destekler. *European Journal of Science and Technology*, *32*, 901–916. https://doi.org/10.31590/ejosat.1045546

Ertugrul, M., & Saldi, M. H. (2020). Return on Investment Analysis of Unlicensed Solar Energy Projects in Turkey. *Business & Management Studies: An International Journal*, *1*, 903–923.

EXIST. (2023). *Elektrik Piyasası Günlük Raporu*. https://www.epias.com.tr/wp-content/uploads/2023/03/epias-bulten-05.03.2023.pdf

Federal Reserve. (2021). *Implementation Note issued March 16, 2022*. https://www.federalreserve.gov/newsevents/pressreleases/monetary20220316a1.htm

Gaia Climate. (2022). *Solar PV Projects*.

GCC. (2023). *GCC PROJECTS PORTAL*. https://projects.globalcarboncouncil.com/pages/submitted_projects

IRENA. (2022). *Renewable Power Generation Costs in 2021*. https://irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021

Kartha, S., Lazarus, M., & LeFranc, M. (2005). Market penetration metrics: Tools for additionality assessment? *Climate Policy*, *5*(2), 147–165. https://doi.org/10.1080/14693062.2005.9685547

Kilinc-Ata, N., & Dolmatov, I. A. (2023). Which factors influence the decisions of renewable energy investors? Empirical evidence from OECD and BRICS countries. *Environmental Science and Pollution Research*, *30*(1), 1720–1736. https://doi.org/10.1007/s11356-022-22274-8

Kim, B. C., Kim, J., & Kim, J. (2019). Evaluation Model for Investment in Solar Photovoltaic Power Generation using Fuzzy Analytic Hierarchy Process. *Sustainability (Switzerland)*, *11*(10). https://doi.org/10.3390/su11102905

Kubilay, M. M. (2021). *What's driving Turkey's early easing of monetary policy?* Middle East Institute. https://www.mei.edu/publications/whats-driving-turkeys-early-easing-monetary-policy

Mankiw, G. (2009). *Macroeconomics* (Seventh Ed). Worth Publishers. https://jollygreengeneral.typepad.com/files/n.-gregory-mankiw-macroeconomics-7th-edition-2009.pdf

Mavi Yeşil A.Ş. (2022). *Solar PV Installation Costs Report 2016-2022*.

Ministry of Trade. (2022). *2022 Yılı Temmuz Ayı Dış Ticaret Verileri*. https://ticaret.gov.tr/haberler/2022-yili-temmuz-ayi-dis-ticaret-verileri

Ministry of Treasury and Finance. (2022). *PRESS RELEASE*. https://ms.hmb.gov.tr/uploads/sites/2/2022/03/20220318_Press-Release.pdf

Ozcan, O., & Ersoz, F. (2019). Project and Cost-based Evaluation of Solar Energy Performance in

three Different Geographical Regions of Turkey: Investment Analysis Application. *Engineering Science and Technology, an International Journal*, *22*(4), 1098–1106. https://doi.org/10.1016/j.jestch.2019.04.001

REN21. (2022). *Renewables 2022 Global Status Report*. REN21 Secretariat.

Resmi Gazete. (2022a). *Elektrik Piyasasında Lisanssız Elektrik Üretim Yönetmeliğinde Değişiklik Yapılmasına Dair Yönetmelik*. https://www.resmigazete.gov.tr/eskiler/2022/08/20220811-1.htm

Resmi Gazete. (2022b). *Kaynak Bazında Destekleme Bedelinin Belirlenmesine ve Uygulanmasına İlişkin Usul ve Esaslarda Değişiklik Yapılmasına Dair Usul ve Esaslar*. https://www.resmigazete.gov.tr/eskiler/2022/03/20220330-7.pdf

Sisodia, G. S., & Soares, I. (2015). Panel data analysis for renewable energy investment determinants in Europe. *Applied Economics Letters*, *22*(5), 397–401. https://doi.org/10.1080/13504851.2014.946176

Sugiyama, T., & Michaelowa, A. (2001). Reconciling the design of CDM with inborn paradox of additionality concept. *Climate Policy*, *1*(1), 75–83. https://doi.org/10.3763/cpol.2001.0107

TCCB. (2021). *Statement of Turkey at 76. UN General Assembly*.

TENVA. (2017). *License Exempted Electricity Generation Educational Book*. https://erranet.org/download/tenva-license-exempted-electricity-generation/

The Economist. (2021). *The Intelligence: A cut-rate theory, Turkey's currency spiral*. https://podcasts.apple.com/cy/podcast/a-cut-rate-theory-turkeys-currency-spiral/id151230264?i=1000543137596&l=tr

TURKSTAT. (2022). *TÜİK Kurumsal*. Consumer Price Index. https://data.tuik.gov.tr/Bulten/Index?p=Tuketici-Fiyat-Endeksi-Temmuz-2022-45796

World Bank. (2017). *IMPLEMENTATION COMPLETION AND RESULTS REPORT*.

Özgeçmiş

İzzet ARI (Assoc. Prof.), Ankara Sosyal Bilimler Üniversitesi Enerji Ekonomisi ve Yönetimi Anabilim Dalında Doç. Dr. olarak görev yapmaktadır. Orta Doğu Teknik Universitesinde Doktorasını almıştır. İklim değişikliği ve kalkınma, sürdürülebilir enerji politikaları, enerji ve finansman, yeşil büyüme ve sürdürülebilir kalkınma amaçları konularında çalışmalar yapmakta olup bu çalışmalar ulusal ve uluslararası makale, kitap ve bildirileri olarak yayınlamıştır.

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Appendices

Annex I

IRR Calculation Solar-PV systems 2016-2022

Company: Mavi yeşil

Cities: Kahramanmaraş Adana, Hatay, Osmaniye , Adıyaman, Ankara, Uşak, Afyon, İzmir, Kütahya, Malatya, Mersin, Çanakkale, Kırklareli

Years	2016	2017	2018	2019	2020	2021	2022
Installed AC Power	999	999	999	999	999	999	999
Installed DC Power	1.188	1.188	1.188	1.188	1.188	1.188	1.188
PV Panel Costs	$ 688.000	$ 589.000	$ 563.500	$ 443.250	$ 326.000	$ 399.800	$ 457.000
Inverter,CabIe and Other Costs	$ 35.000	$ 34.000	$ 30.000	$ 24.000	$ 21.000	$ 21.500	$ 26.000
Construction, Project and Other Costs	$ 370.000	$ 420.000	$ 475.000	$ 376	$ 395.000	$ 290.500	$ 261.000
Labor Cost	$ 7.000	$ 7.000	$ 6.500	$ 6.750	$ 8.000	$ 8.200	$ 6.000

Total Investment Cost	$ 1.100.000	$ 1.050.000	$ 1.075.000	$ 850.000	$ 750.000	$ 720.000	$ 750.000

O&M Cost	$ 10.750	$ 11.000	$ 10.600	$ 8.250	$ 8.000	$ 6.750	$ 5.900
Depreciation 45.1.9 (% 10 - 10 years)	$ 110.000	$ 105.000	$ 107.500	$ 85.000	$ 75.000	$ 72.000	$ 75.000
Yearly Cost	$ 120.750	$ 116.000	$ 118.100	$ 93.250	$ 83.000	$ 78.750	$ 80.900

Electricity Generation Amount Fixed (MWh)	1750,00	1750,00	1750,00	1750,00	1750,00	1750,00	1750,00
Electricity Sale Price Fixed (YEKDEM)	$ 133	$ 133	$ 133	$ 133	$ 133	$ 133	$ 133
Yearly Revenue	$ 232.783	$ 232.783	$ 232.783	$ 232.783	$ 232.783	$ 232.783	$ 232.783

First 10 Year Cash Flow	$ 112.033	$ 116.783	$ 114.683	$ 139.533	$ 149.783	$ 154.033	$ 151.883
15 Year Cash Flow (after depreciation)	$ 222.033	$ 221.783	$ 222.183	$ 224.533	$ 224.783	$ 226.033	$ 226.883
Cash Flow							
Year 1	$ 987.967	$ 937.967	$ 962.967	$ 737.967	$ 637.967	$ 607.967	$ 637.967
Year 2	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 3	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 4	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 5	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 6	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033

Year 7	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 8	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 9	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 10	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033	$ 112.033
Year 11	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 12	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 13	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 14	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 15	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 16	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 17	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 18	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 19	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 20	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 21	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 22	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 23	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 24	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033	$ 222.033
Year 25	$ 1.322.033	$ 1.272.033	$ 1.297.033	$ 1.072.033	$ 972.033	$ 942.033	$ 972.033
IRR	14,40%	15,03%	14,71%	18,31%	20,63%	21,47%	20,63%

Source: Mavi Yeşil A.Ş. (2022)