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New Incentives Brighten Turkey's Rooftop Solar Sector

Further Measures Can Accelerate Household Investment in Electricity Supply

Executive Summary

Rooftop solar power has been proven worldwide as a cheap, local source of electricity, which empowers households to take control of their energy supply. By driving household investment in the energy system, it can also be a cost-effective way for countries to reduce pressure on scarce public resources. As a local power supply at the point of demand, residential solar can help avoid network losses, and thus defer wider electricity supply investments. And as an indigenous source of energy, it is especially helpful for countries that depend on energy imports.

All these motives exist in the Turkey context, where a recent economic slowdown has reduced the availability of public funds for energy sector investment, and depreciation of the currency has increased the cost of hard coal imports, jeopardising a previous pipeline of new coal-fired power plants. What is more, Turkey has among the best solar resources in Europe, far superior to market leaders such as Britain and Germany.

In May, Turkey introduced new incentives for rooftop solar power, including a net metering scheme where homeowners receive a monthly energy credit for solar exports to the grid, which they can use to offset their electricity bill. The new programme replaces a previous, ineffective net metering scheme, and complements feed-in tariffs that ended up benefiting much larger installations than solar rooftops for individual consumers. In other words, the new approach can mark the beginning of a largescale, rooftop solar market in Turkey.

In this report, we modelled the payback period for rooftop solar power, based on assumptions around these new incentives, as well as household energy use, the installed cost of solar PV, and Turkey's solar resources. We showed how the payback period changes through 2030 based on assumptions around energy price inflation, and falling solar panel costs. And we investigated the impact of a range of additional policy measures to drive faster uptake of rooftop solar power in Turkey.

Main Findings

- The new monthly net metering incentives significantly reduce solar payback periods. Before the introduction of new incentives this year, we calculate that residential solar PV in Turkey had a payback period of 16 years.[1]

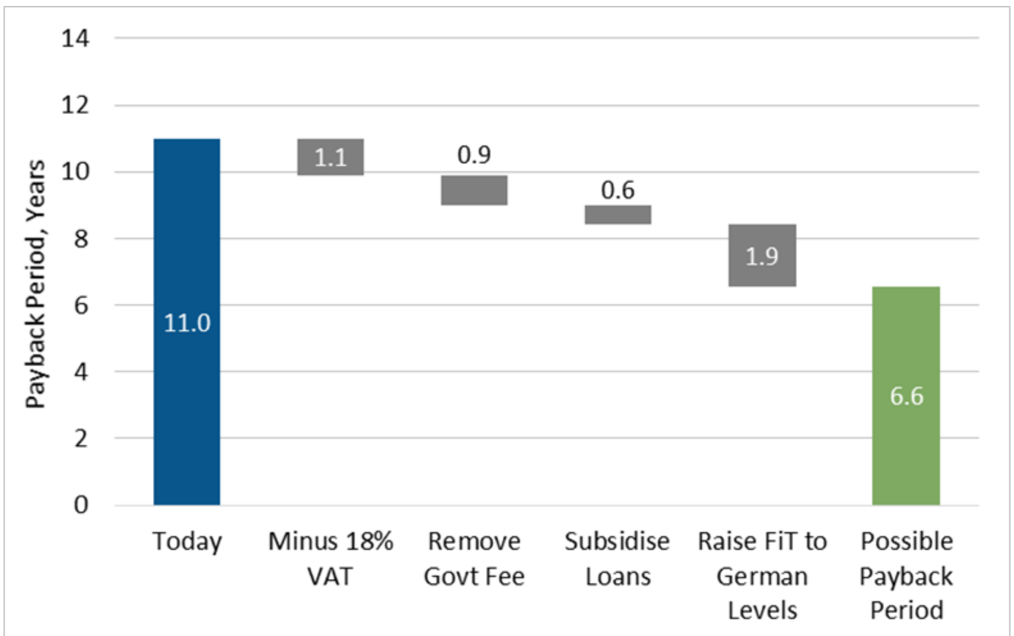
[1] Assumes zero solar export income under the previous, hourly net metering scheme.

- The new incentives increase payments for exports of solar power to the grid. This reduces payback periods by more than a quarter, to 11 years for new projects today, seven years in 2025, and 4.5 years in 2030. While beneficial, however, a 11-year payback period will still only attract highly motivated households.

- We investigated the combined impact of a range of additional measures to reduce payback periods further in Turkey (see Figure 1). These measures include: eliminating Turkey's 18% value added tax (VAT) on solar installations; removing the fixed government rooftop solar administration fee (of about 5,000 TRY + VAT); subsidising the cost of borrowing, to 5% from approximately 12% (in Turkey's recently highly inflationary economy); and increasing the net metering incentive to feed-in tariff levels seen in Germany.

    - These combined measures reduce payback periods to under seven years today, and two years in 2030. A seven-year payback period should be sufficiently low to attract more mainstream interest.

Figure 1: Reducing Payback Period for Roof-Top Solar in Turkey Today



Source: IEEFA.

Recommendations

Turkey's government has recognised the potential of the country's excellent solar resources, earlier this year adopting new monthly net metering incentives that reward households for generating and consuming their own solar power. We recommend that Turkey now takes further steps with cost-effective policies that can bring rooftop solar power within reach of mainstream customers.

These steps are:

1. Eliminate the VAT on solar systems to reduce customer's capital costs.

2. Remove the fixed fee for obtaining official government approval.

3. Subsidise the cost of household borrowing to install solar panels. This could be achieved, for example, via assistance from multilateral development banks, such as the European Bank for Reconstruction and Development, which says it has a goal in Turkey to "accelerate the shift to the green economy." Alternatively, borrowing for a solar installation could be attached to the mortgage for a property, thus reducing the lending risk and interest rate.

4. Raise the level of support being offered under the net metering scheme in line with rates being offered in Western Europe.[2]

[2] To give examples at the time of writing: German solar feed-in tariff was €0.12/ kWh; Britain was to re-introduce a scheme at c. £0.06/kWh; and Norway has a solar export tariff of NOK 0.45/kWh. Converting to USD, and allowing for purchasing power parity, the average tariff across these three countries is USD 0.09/ kWh, versus Turkey's USD 0.07/ kWh. Germany has the highest tariff, at USD 0.14/ kWh.

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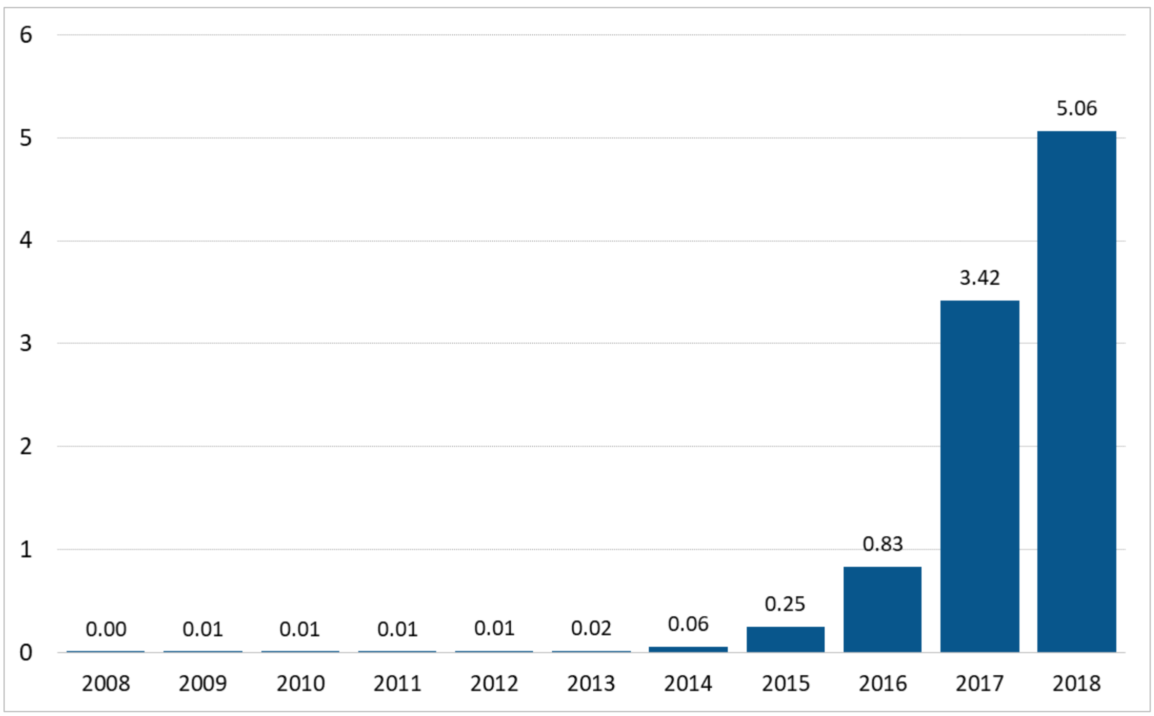
Introduction

Turkey has some of the best solar resources globally, with national average solar PV output of about 1.6MWh/kWp annually (for example compared with Germany's 1.1MWh/kWp per year).[3] However, solar power contributed only 2.6% of the country's annual electricity consumption last year, where the majority was supplied by coal and gas, much of which was imported.[4] Turkey paid $43 billion in total for energy imports in 2018, up 15% on the previous year.[5] The risk of a ballooning energy trade deficit, on the back of currency depreciation, is an important motive for Turkey to continue to drive growth in its domestic renewables market, including solar power.

Figure 2: Cumulative Solar PV Capacity in Turkey, GW



Source: IEA PVPS.

To date, Turkey has more than 5 gigawatts (GW) of solar capacity installed, mostly under 1 MW, ground-mounted solar farms. By comparison, European leader Germany has more than 45GW installed. A recent review estimated rooftop solar capacity in Turkey at 200 megawatts (MW) in 2017, with a market potential of 4 GW.[6]

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[3] Global Solar Atlas.
[4] According to BP's Statistical Review of World Energy, Turkey generated 7.9 TWh of solar power in 2018. According to the IEA's PVPS Annual Report, Turkey consumed a total of 292.2 TWh of electricity, in 2018.
[5] IEA PVPS Annual Report 2018
[6] Tetra Tech, 2018. *Turkey: Rooftop Solar PV Market Assessment.*

The Economics of Solar

We see three key factors affecting interest in residential solar: energy bill savings, government financial support and technology-related cost reductions, described in more detail below.

Savings on Energy Bills

Energy bill savings are generated by substituting grid electricity with self-generated solar power. Savings will increase as domestic energy prices climb.

- A key measure is the solar self-consumption rate. The higher the self-consumption rate, the more solar generation is being used by the household instead of being exported to the grid, and the greater the energy bill savings.

- Another key metric is total electricity consumption. The higher a household's annual consumption, the greater the potential energy bill savings from investing in solar.

- We make various other assumptions relevant to energy savings, such as residential electricity tariffs and tariff inflation (see Appendix). Households in Turkey also pay a distribution fee for electricity consumed from the grid. This fee is discounted by 50% for energy that is generated and consumed on site. As a result, rooftop solar customers benefit from savings on their electricity distribution fee, according to how much they self-consume. This currently translates to a saving of 10.4 TRY cents per kWh of self-consumed electricity.

Government-Backed Financial Support

- Net metering schemes allow households to offset demand from the grid against their solar exports to the grid, across a particular timeframe. Before May 2019, rooftop solar in Turkey was supported through a scheme that netted grid demand against solar exports on an hourly basis. This gave little or no benefit, because the household would consume their own solar power during daylight hours, leaving little demand to offset. We assume the result was an export tariff of zero.

- Turkey's new net metering scheme nets solar export and grid demand on a monthly basis. Now households can offset their solar grid exports against grid energy demand over a whole month, including during evening peaks after sunset. In this case, we assume all solar grid exports are worth the single rate power price of 0.36 TRY/kWh.

Annual Cost Reductions

- We use various published market prices for solar installations in 2019 (see Appendix for full details). We assume wholesale module prices of TRY 2.00 (USD $0.35) per watt; developer margins of 15%; balance of system (BoS) costs of TRY 3.49 (USD $0.61) per watt; labour costs at 15% of full installed cost; and annual solar operational expenditure at TRY 319 (USD $55).[7]

- We then apply annual reductions to these numbers, from 2020 to 2030, to take into account expected improvements in technology and manufacturing economies of scale. Our cost reduction assumptions include solar modules at minus 5% annually; solar BoS minus 2.5%; and solar developer margins minus 5%.

Our Method

Our analytical approach was to estimate how many years it would take ("payback period") for households to recoup their initial investment through energy bill savings and government incentives. We also calculated an initial, annualised return on investment (ROI). The models were developed using actual cost data from various online and local sources. We made cost reduction and inflation assumptions to calculate the payback periods for new projects through 2030.

To calculate payback period, we estimate the number of years it takes for total cumulative income to pay off total cumulative costs, using Excel "What-if Analysis." Costs include the capital cost, debt financing and operational costs. For the financing cost, we assume solar is 50% debt-funded, where the cost of debt is around 12%, and cost of equity is zero. Income includes government-backed financial support and energy bill savings as described above.

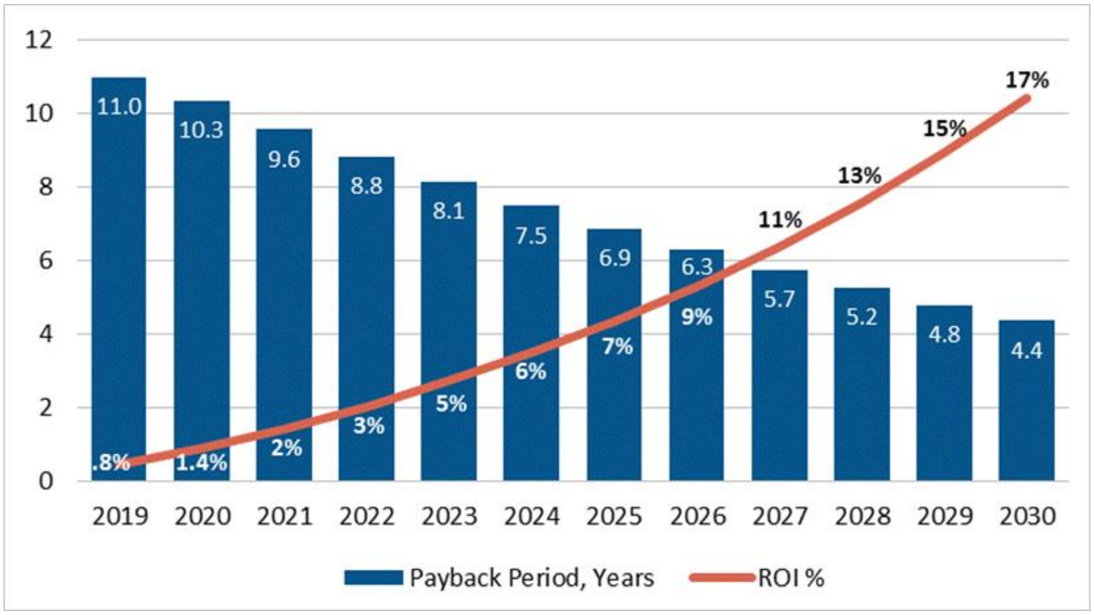
To calculate ROI, we divide initial net annual income by the upfront capital expenditure (capex). Net income includes the variables described above, such as financial support plus energy bill savings (year 1) minus costs including operational costs, financing costs and annual depreciation over 20 years (see Appendix). Upfront capex includes the full installed cost of the installation, including VAT where applicable.

Findings

We select what we consider to be a "typical" 4kW solar installation. Using our baseline assumptions for Turkey's new net metering scheme, we calculated the payback period and ROI for such a system. We find stand-alone solar presently has a payback period of 11 years in Turkey, and an ROI of 0.8% (see Figure 3). Applying our assumptions for falling solar equipment costs and falling developer margins, we calculate that payback period falls to 4.4 years in 2030, and ROI rises to 17%.

[7] Assuming a Turkish Lira/ USD exchange rate of 0.17.

Figure 3: Payback Period and ROI of Roof-Top Solar Under New Net Metering Scheme



Source: IEEFA.

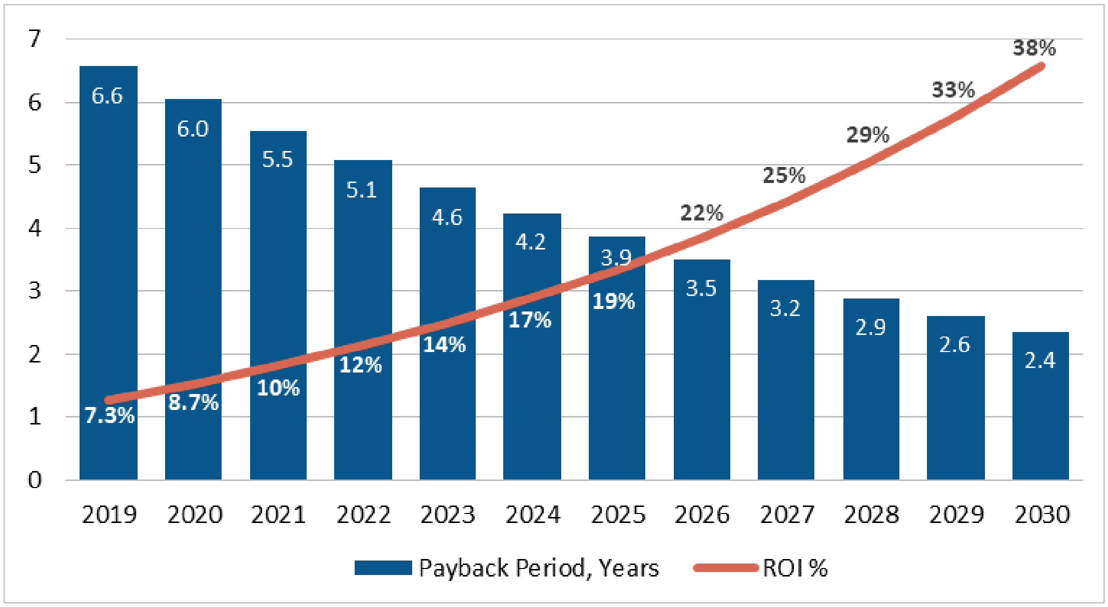
Next, we investigated the potential to reduce the payback period to less than 10 years, to bring roof-top solar power within reach of more households. We expect payback periods would have to fall to around five years or below to achieve mainstream adoption. To reduce payback periods further, we turned to policy incentives used in other European countries that have seen largescale uptake of solar power, including Britain and Germany.

Under this additional incentives scenario, first, we eliminated the 18% value added tax (VAT) on solar installations, in Turkey. At present, for example, Britain applies a 5% VAT rate on solar systems, compared with the country's standard 20% rate. Second, we removed the fixed fee for obtaining official government approval, which is currently a costly barrier to adoption, at around 5,000 TRY plus VAT. Third, we subsidised the cost of borrowing, to 5% from around 12% presently. Fourth, we increased the net metering incentive to 0.68 TRY/ kWh, from the present 0.36 TRY, bringing the Turkish incentive to the same the level of financial support as in Germany after accounting for purchasing power parity between the two countries.[8]

These four combined measures reduced payback periods to under seven years today, and around two years in 2030 (see Figure 4).

[8] Using OECD 2018 purchasing power parity (PPP) conversion rates, we find a €/TRY exchange rate of 5.7, implying that the German solar FiT of €0.12/kWh is equivalent to 0.68 TRY/kWh. This is the rate we used for our additional incentives scenario. OECD PPP currency conversions are available here.

Figure 4: Payback Period and ROI After Suggested Additional Incentives



Source: IEEFA.

We note that there are other measures Turkey might draw on. For example, we find that Turkey's solar module prices are 25% greater than those of more competitive countries, at about USD $0.35 per watt, compared with USD $0.28/W in Germany. Turkey could drive down module costs by subsidising its domestic solar module manufacturing industry or importing modules at a more competitive rate. In another example of solar incentives, Australia provides its households with a capital grant worth thousands of dollars toward the upfront cost of solar installations.

We conclude that while Turkey's new net metering program marks a significant and welcome step forward in developing its residential solar market, further cost-effective incentives can drive faster household adoption in the near term.

Appendix

Our basic input assumptions, for modelling ROI and payback periods follow.

INPUT VARIABLES (Nov 2019)		Turkey		With Additional Policies	
HOUSEHOLD		**Units**	**Value**	**Units**	**Value**
	Annual power consumption excl EV	kWh	3,036	kWh	3,036
	Domestic tariff inflation	%	9.36%	%	9.36%
	Domestic tariff	TRY/kWh	0.364	TRY/kWh	0.364
	National inflation (CPI)	%	9.71%	%	9.71%
SOLAR PV					
	Capacity	kWp	4	kWp	4
	Average load factor	%	18.25%	%	18.25%
	Self-consumption rate	%	50%	%	50%
	PV Module cost, annual change	%	-5%	%	-5%
	PV Module cost	TRY/watt	2.00	TRY/watt	2.00
	BoS materials cost, annual change	%	-3%	%	-3%
	BoS materials cost	TRY/watt	3.49	TRY/watt	3.49
	Labour cost (% of installed cost)	%	15%	%	15%
	Opex (incl. any insurance & contingency)	TRY/year	-318.53	TRY/year	-318.53
	VAT	%	18%	%	**0%**
	Distr. discount (benefit) for self-consumed power	TRY/kWh	0.104	TRY/kWh	0.104
	Solar degradation rate	%	-0.40%	%	-0.40%
	Solar export FiT	TRY/kWh	0.364	TRY/kWh	**0.684**
	Depreciation period	# years	20.00	# years	20.00
	Developer margin, annual change	%	-5%	%	-5%
	Developer margin	%	15%	%	15%
	% debt funded	%	50%	%	50%
	Cost of debt	%	12.00%	%	**5.00%**
	Cost of equity	%	0%	%	0%
	WACC	%	10.00%	%	10.00%
	Borrowing term	# years	3.00	# years	3.00

Sources: Various, including local experts and published data.

About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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