

***Turkey:***

***Rooftop Solar Market Assessment***

**Summary Note**

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**WORLD BANK GROUP**

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## Acknowledgements

This report presents a summary of the main findings from the technical assistance activity “Turkey: Rooftop Solar PV Assessment,” which was financed by the Energy Sector Management Assistance Program (ESMAP) together with the World Bank’s Europe and Central Asia Region. The activity included a market questionnaire, estimation of the technical and market potentials, site visits to 18 buildings with representatives from the Ministry of Energy and Natural Resources (MENR), a market assessment report, a prefeasibility study report for the 18 site visits, development of a roadmap and implementation plan, a roundtable discussion and a final report. This document is a summary of the final report. (The full final consultant report is available upon request.)

The full technical report was prepared by the Tetra Tech team, which included Ujjwal Bhattacharjee, Rakesh Kumar Goyal, Apoorv Nagpal, Sugandha Chauhan, Shahab Alam from Tetra Tech ES India Pvt. Ltd.; Wietze Lise, Mehmet Kocaoglu, Gokhan Tosun, Duygu Kucukbahar-Beygo and Ismail Ozdamar from AF Mercados Turkey; Shirish Garud and Alekhya Datta from TERI India. The Tetra Tech team acknowledges the close cooperation and support from MENR, including Mr. Oguz Can, Ms. Dilan Kavruk, Mr. Mustafa Caliskan and Mr. Sebahattin Oz. The Bank team was led by Jas Singh and Yasemin Örüçü, and included Almudena Mateos Merino and Pranay Kohli (Solar Consultant).

The roundtable discussion was held on December 14, 2017 in Ankara to discuss and debate some of the report’s preliminary findings and recommendations. The Bank team appreciated the comments and feedback received from the many government and private sector participants.

## Summary of Activity and Final Report

### Introduction

Turkey has significant renewable energy (RE) potential, including solar, mainly as a result of its geographic location. Taking advantage of this potential will decrease the country's dependence on imported fossil fuels as well as reduce greenhouse gas emissions. Recognizing this, the government has established a target of at least 30% (or 127.3 TWh) of the total electricity generation from RE by 2023. In addition, it has set targets of 3 GW of installed solar power by 2019 and 5 GW by 2023. As a result, the solar market in Turkey has grown exponentially over the last few years, with installed solar capacity growing from 40 MW in 2014 to about 3,421 MW at the end of 2017.

The solar boom in Turkey to date has been primarily limited to larger, ground-based projects. Most of them are, however, under 1 MW in size in order to take advantage of the unlicensed feed-in-tariff (FiT) schemes. In contrast, in countries with more developed solar markets, such as Germany, the United States and Japan, a significant portion of solar capacity is produced by rooftop solar photovoltaic (RSPV) applications with 1 kW to 10 MW capacities. Given the fast pace of urbanization and corresponding residential, commercial and industrial markets, the study concluded that there is a significant potential for RSPV deployment in Turkey. A first-order assessment of the RSPV market potential has been carried out at the request of the Ministry of Energy and Natural Resources (MENR) and its Directorate General for Renewable Energy (DGRE) with financial and technical support from the World Bank and ESMAP. The report also presents a roadmap for the development of the RSPV market in Turkey.

The market assessment included four main consumer sectors: (i) residential buildings including single-family and multifamily apartment buildings (MABs); (ii) commercial buildings; (iii) industrial facilities; and (iv) government buildings. The assessment included a number of components, including: (a) a review of existing solar-related policies and regulations; (b) an assessment of solar radiation resources; (c) estimates of the usable rooftop areas; and (d) a market survey of key stakeholders. Field visits to representative buildings were then conducted to collect detailed site data in order to carry out financial and economic analyses for these sites. The study also benefited from inputs from the DGRE and World Bank teams. Finally, a workshop was conducted on December 14, 2017 in Ankara to share findings and gather feedback from stakeholders on the draft findings and recommendations.

### Status of RSPV in Turkey

As of the end of 2017, roughly 200 MW of RSPV had been installed in Turkey. The installations are mainly in large industrial and commercial establishments, which seek to benefit from the FiT and for environmental and corporate social responsibility reasons. The FiT for renewable energy generation, including solar photovoltaics (PV), was introduced in 2010. For solar PV, the FiT was set at US\$133/MWh with the potential to go up to US\$196/MWh with use of locally produced equipment. The FiT is applicable to both licensed and unlicensed projects up to 1 MW capacity, but only licensed projects with capacities above 1 MW can benefit from the local FiT premium. As of the end of 2017, only about 17.9 MW of licensed solar PV had been installed due largely to the lengthy and complex licensing

procedures. A draft regulation was introduced by MENR in January 2018 to incentivize RSPV below 10 kW capacity and is expected to be approved in the coming months. While the FiT can be a good driver for RSPV in Turkey, as in other countries, MENR has indicated its plans to phase it out by 2020.

The study also reviewed international RSPV programs globally in order to identify lessons to assist Turkey with its market development plans. Table 1 summarizes the most salient features of the RSPV policies and programs from the People's Republic of China, Germany, India, Japan and the United States. The last column provides some implications of these experiences for Turkey.

## **RSPV Market Potential in Turkey**

### *Market Survey*

A questionnaire was implemented in order to:

1. Assess the perceived gaps in current policies and procedures for RSPV systems;
2. Identify the barriers and challenges faced by various stakeholders in installing RSPV systems;
3. Determine possible support measures to encourage RSPV adoption; and
4. Assess potential growth in the RSPV market.

A telephone survey was issued to a sample of 243 stakeholders. Survey respondents were selected to provide a representation of the country and to cover all key stakeholders— engineering, procurement and construction firms (EPCs), financial institutions, distribution companies (Discoms) and consumers in the four sectors noted earlier. Questionnaires were customized for each stakeholder category and covered building characteristics, use of roofs, motivation for RSPV adoption, barriers in RSPV deployment, preferred business models, financing and incentive needs and other aspects. Some main findings from the survey included:

- 92% of consumers indicated that their roof was not being used
- 64% of the consumer rooftops are of the pitch type (P-type), 24% are flat and 12% are a mix of flat and P-type construction
- 58% of consumers indicated that environmental concerns were the main motivation for adopting RSPV systems; 51% responded that a reduction in their electricity bills was a main driver.
- For 36% of respondents, a lack of awareness on related policies and regulations was the greatest barrier to RSPV implementation; 34% indicated it was a lack of knowledge on how to arrange financing.
- In terms of incentives, 65% of the respondents indicated a preference for the FiT scheme, while the remaining respondents preferred net-metering (NM). 46% of respondents indicated a preference for upfront or buy-down incentives; 26% preferred low-cost financing.
- About 50% of the EPCs believe that RSPV development in the commercial sector is the most promising; 83% believe a lack of skilled labor is a critical barrier to RSPVs.
- FIs expressed difficulties in providing finance to EPC companies, because most of them are early-stage firms with weak balance sheets. A mismatch between the current FiT (which only lasts 10 years) and most RSPV systems (with 25-year lifespans) was also concern.

Table 1: Lessons on RSPV development from international experience

Parameter	USA	Germany	India	China	Japan	Lessons for Turkey
<b>Permitting and Licensing Requirements</b>	<ul style="list-style-type: none"> <li>On-line permitting practice</li> <li>Single-window clearance</li> </ul>	<ul style="list-style-type: none"> <li>Streamlined permitting process</li> <li>No permit fee for small residential PV systems</li> </ul>	<ul style="list-style-type: none"> <li>Single-window clearance</li> <li>Technical standards are pre-defined</li> </ul>	No data available	<ul style="list-style-type: none"> <li>Online application system</li> <li>Requires both a pre- and final inspection</li> </ul>	<ul style="list-style-type: none"> <li>Licensing and permitting procedure should be simple, online and time bound</li> </ul>
<b>FiT vs. Net-Metering</b>	<ul style="list-style-type: none"> <li>Net-metering</li> </ul>	<ul style="list-style-type: none"> <li>Market-based net-metering</li> </ul>	<ul style="list-style-type: none"> <li>Net-metering is mostly used</li> </ul>	<ul style="list-style-type: none"> <li>Net-metering (self-consumption) and FiT co-exist</li> </ul>	<ul style="list-style-type: none"> <li>A FiT policy has been implemented</li> </ul>	<ul style="list-style-type: none"> <li>Move towards net-metering</li> </ul>
<b>Self-Consumption</b>	<ul style="list-style-type: none"> <li>Net-metering and self-consumption are popular in the United States</li> </ul>	<ul style="list-style-type: none"> <li>Self-consumption is legally permitted under the Renewable Energy Act (amended in 2014)</li> </ul>	<ul style="list-style-type: none"> <li>25 of the 29 states have prepared policies on net-metering and self-consumption</li> </ul>	<ul style="list-style-type: none"> <li>Self-consumption is allowed</li> </ul>	<ul style="list-style-type: none"> <li>FiT is the main option</li> </ul>	<ul style="list-style-type: none"> <li>Self-consumption must be encouraged</li> </ul>
<b>Other Key Incentives</b>	<ul style="list-style-type: none"> <li>Green building incentive, soft loans, guaranteed loan, property tax exemption, capital subsidy, tax credits, up-front rebates on RSPV system cost</li> </ul>	<ul style="list-style-type: none"> <li>Guaranteed grid inter-connection for all RSPV plants and low-interest loans</li> </ul>	<ul style="list-style-type: none"> <li>Accelerated depreciation, capital subsidy, training and capacity development programs</li> </ul>	<ul style="list-style-type: none"> <li>National Renewable Energy Fund with tax benefits, renewable purchase obligation (RPO) for utilities, capital subsidies as high as 30 – 50% for distributed generation</li> </ul>	<ul style="list-style-type: none"> <li>Residential incentive of \$0.20/W for systems priced below \$4.10/W. A lower subsidy of \$0.15/W for systems priced between \$4.10/W and \$5.00/W. RPO, tax incentives of 30% against standard purchase prices or 7% tax deduction (for small &amp; medium enterprises)</li> </ul>	<ul style="list-style-type: none"> <li>Initial push to consumers for whom RSPV is less financially attractive</li> <li>Variable incentive scheme based on solar resource availability</li> <li>Develop capacity building and outreach programs.</li> </ul>

<p><b>Energy Storage for Rooftop Solar</b></p>	<ul style="list-style-type: none"> <li>• AB 2514: Directing utilities to set an energy storage target</li> <li>• Self-Generation Incentive Program (Law AB 327): To identify optimal locations for distributed resources</li> <li>• Electric Tariff Rule 21: Interconnection and smart inverters, permitting, inspection and safety</li> </ul>	<ul style="list-style-type: none"> <li>• KfW 275 incentive: 30% investment grant on equipment purchased with low-interest loans</li> </ul>	<ul style="list-style-type: none"> <li>• Pilot projects to demonstrate energy storage in supporting a national-level action plan</li> <li>• Capital subsidy for PV systems with energy storage</li> </ul>	<ul style="list-style-type: none"> <li>• Innovation in the Energy Storage Technology Revolution: New Action Plan (2016-2030): R&amp;D grants for energy storage</li> <li>• Outline for the Strategy of Driving National Innovation</li> <li>• R&amp;D grants for storage with SPV</li> </ul>	<ul style="list-style-type: none"> <li>• Storage Battery Strategy: integrated strategic policies for storage batteries</li> <li>• Technical requirements by METI include a guideline for grid interconnection to secure electricity quality</li> <li>• Electricity Business Act: A requirement for the approval of large electricity storage systems of more than 80,000 kWh</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate battery storage option with RSPV. In Turkey, the peak energy demand falls between 5 to 10 PM and the peak tariff is 90% more than the day tariff. Such tariff difference is likely to offer a business case for battery storage with RSPV</li> </ul>
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### *Estimation of Market Potential for RSPV*

A three-step approach was used to estimate the RSPV market potential in Turkey:

1. Determination of usable roof area using building data and geographic information system (GIS) imagery mapping.
2. Calculation of the technical potential combining roof area with solar resource data.
3. Estimation of the market potential taking into account current market conditions.

**Determination of Usable Roof Area:** Seven of Turkey's 81 provinces were selected to cover the country's varying features, such as solar radiation, availability of sun, roof type, building density, and consumer categories. A random data set of 909 polygons across these provinces was developed for residential, commercial and public buildings and building stock data from 1992 to 2016 was used for the analysis. All 909 polygons were mapped on Google Earth to develop the solar polygon, largely based on roof type (Figure 1).

*Figure 1: Main and solar polygons*



The ratio of the main polygon area and solar polygon area was determined for all 909 polygons. To determine the representative multiplication factor for each building type (e.g., public, commercial), a weighted average was used. These multiplication factors were applied to building data to determine the usable roof area. Based on this methodology, the total usable area for RSPV installations in Turkey was estimated at 1.1 billion square meters (m<sup>2</sup>).

**Technical Potential of RSPV:** The total usable area was further adjusted to account for: (i) shading from other parts of the roof or from neighboring buildings and trees; (ii) the use of roof space for other applications, such as ventilation, heating/air conditioning, dormers or chimneys; and (iii) installation and racking of the PV panels. To account for these factors, an access factor was estimated based on comparable studies in other countries. Based on all these considerations, the technical potential of RSPV in Turkey was estimated at about 46.8 GW, as shown in Table 2. It should be noted that the technical potential assumes all technically viable RSPV systems are installed, regardless of physical or economic viability and, thus, it is not an achievable figure.

Table 2: Estimation of RSPV technical potential

Building Type	# of Buildings (in thousand)	Base Area (million m <sup>2</sup> )	Weighted Average Usable Area	Usable Area (million m <sup>2</sup> )	RSPV Technical Potential (GW)
Residential	8,230	1,269	47%	596	23.2
Commercial and Industrial	950	875	57%	499	21.5
Public	69	93	45%	42	2.1
<b>Total</b>	9,248	2,237	-	1,137	46.8

**Market Potential of RSPV:** The market potential is the technical potential that is economically viable and achievable. To estimate the RSPV market potential, four key elements were considered:

1. Grid capacity
2. Growth in RSPV sales
3. Income levels
4. Creditworthiness

The grid capacity available for RSPV was estimated by considering the total energy demand and assumed a 25% grid absorption capacity for intermittent RE (i.e., wind and solar)<sup>1</sup>. This analysis also took into account solar and wind capacities already contracted and in operation, and assumed that RSPV systems could provide about 30% of the total RE grid capacity. Based on these factors, the grid capacity for RSPV was estimated at approximately 6.5 GW over the next 10 years.

For the market potential, the analysis also considered the current installed RSPV capacity and compared growth rates from other countries, as well as impacts of the affordability of RSPV systems and creditworthiness of the main customer classes, as shown in Table 3. Thus, the market potential for RSPV in Turkey was estimated at 3.9 GW. The annual RSPV penetration was estimated using an S-curve trajectory as shown in Figure 2.

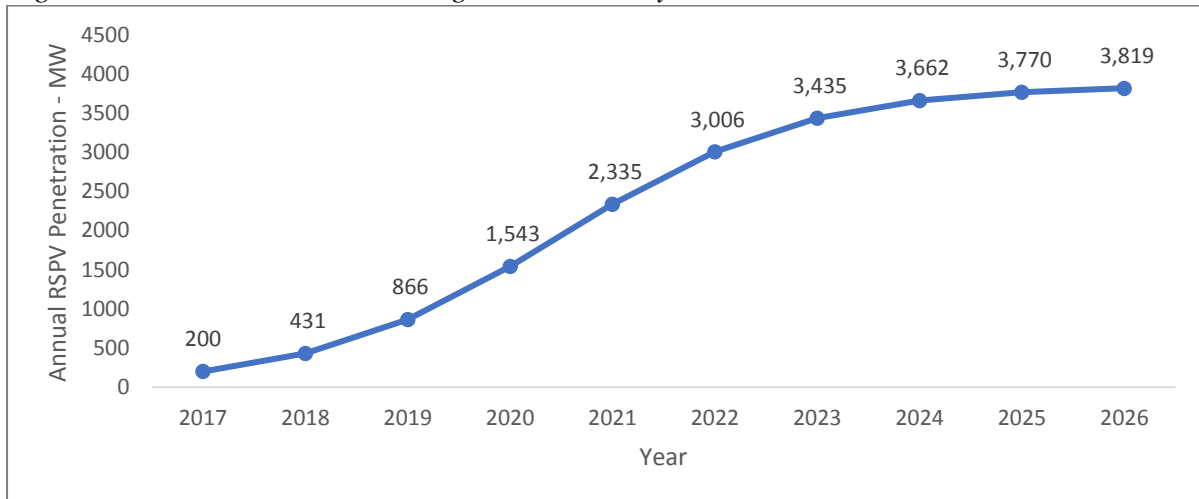
Table 3: Estimated grid capacity for RSPV in Turkey

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
<i>Residential: Total</i>	<u>3,283</u>			<u>683</u>
Commercial	1,488	1	1	1,488
Industrial	1,523	1	1	1,523
<i>Commercial &amp; Industrial: Total</i>	<u>3,011</u>			<u>3,011</u>
Public	291	0.7	0.8	163
<b><i>Total (MW)</i></b>	<b><u>6,585</u></b>			<b><u>3,858</u></b>

<sup>1</sup> The 25% grid renewable energy absorption capacity is based on a study by AF Mercados, Turkey.



Figure 2: Estimated annual RSPV growth in Turkey



These figures compare well with DGRE's own analyses, which have determined the market potential of RSPV over next 10 years to be: (a) 1.8 GW - Basic Scenario, (b) 4.0 GW - Medium-advanced Scenario, and (c) 7.5 GW - Advanced Scenario.

### Pre-Feasibility Assessment of RSPV

Field visits to 18 buildings were conducted to collect data for prefeasibility assessments. These buildings were selected as representative buildings in the residential, commercial, industrial and public sectors. Key considerations in conducting these assessments included:

1. Solar PV system size, including roof structural stability
2. Solar generation potential
3. Accessibility and grid interconnection
4. Financing requirements
5. Financial and economic assessments

Based on a detailed modelling exercise carried out for India, a RSPV system with a capacity of 80% of the building connected load was shown to cause losses (for RSPV electricity not self-consumed) of around 1%. Thus, in the interest of maximizing self-consumption, it is recommended that the RSPV system size not exceed 80% of the building's connected load. For the 18 surveyed buildings in Turkey, four financial indicators were estimated: electricity (or the levelized cost of electricity, LCOE), internal rate of return (both economic – EIRR and financial – FIRR), net present value (NPV), and payback period. The analysis also looked at economic indicators based on both net-metering<sup>2</sup> and 10-year FiT schemes<sup>3</sup>.

An Excel-based model was developed based on a standard cash flow methodology to determine these financial and economic parameters. All financial and economic parameters – such as interest rate, debt equity ratio, and operation and maintenance costs – were taken based on Turkey's current market conditions. The results for the residential, industrial, commercial and public sectors are shown in Table 4.

<sup>2</sup> Net metering is a billing mechanism that credits RSPV system owners on their utility bills for the excess electricity they sell to the grid.

<sup>3</sup> Feed-in tariffs are premium rates paid to RE developers for the electricity they sell to the grid.

Table 4: Results of economic and financial analyses for all consumer classes

Building	RSPV Capacity	EIRR (%)	FIRR (%)		NPV (US\$)	Payback Period (Years)	LCOE (\$/kWh)
	(kW)		Net-metering	FiT-10 y			
Residential							
AE1	15	21	16	15	14,355	7.9	0.15
AE2	15	22	16	15	14,355	7.9	0.15
Batikent	56	40	29	28	81,527	6.5	0.12
Nezih	30	25	19	18	29,279	7.4	0.14
Doga	6.5	14	8	8	1,058	9.8	0.20
Industrial							
Aydinlar	48	17	5	24	-5,114	9.4	0.13
Turanlar	60	12	2	11	-16,192	10.1	0.15
Temsa	100	12	2	11	-26,284	10.1	0.15
Commercial							
IBC	4	1	Low	Low	-5,547	13.2	0.26
Muyar	32	24	5	9	-2,967	8.8	0.16
Batikent	600	High	42	High	394,664	6.3	0.11
Ulusoy	72	29	8	13	2,081	8.3	0.15
Ikizler	280	High	23	High	118,803	6.9	0.12
Public							
DGRE	192	58	14	26	44,779	7.6	0.13
Guzel	160	58	14	29	37,002	7.6	0.13
EEE	160	High	22	High	73,785	7.0	0.12
MOH	40	70	14	29	10,225	7.6	0.13
Menderes	75	70	14	32	20,817	7.6	0.13

In the residential sector, the projected financial rates of return (FIRR) for RSPV investments are generally high, largely due to the higher grid-based electricity tariff. The results indicate that the sample projects using a net-metering (or self-consumption) scheme are all financially attractive to these consumers.

In the industrial sector, the FIRR is relatively low for all industrial buildings, mostly due to the lower industrial tariff. In these cases, a 10-year FiT scheme offers a better return on RSPV investments for these customers. The financial and economic results for the public and commercial sectors show that the size of the RSPV system and availability of solar resources cause differences in the rates of return.

Sensitivity analyses were also conducted based on three parameters: (i) adjustments in the solar resources of the site; (ii) changes in the capital costs; and (iii) the use of alternative

business models<sup>4</sup>. The findings showed that for the residential sector, a 1 kWh/m<sup>2</sup>/day reduction in solar resources results in a corresponding reduction in the FIRR by about 6%. For industrial consumers, the FIRR changed by around 10%. The public and commercial sectors incurred an even larger reduction of roughly 19%. The FIRR for public and commercial consumers was more sensitive to capital costs than for residential and industrial consumers. In terms of business models, the RESCO model offered higher returns due to their lower costs from economies-of-scale. The difference between the FIRR in the RESCO and self-ownership business models increases as the system size increases.

## Barriers to RSPV Development in Turkey

As part of the assessment, several barriers to achieving the RSPV market potential were identified. They include:

### *Legal, Regulatory and Procedural*

- Complex and lengthy licensing/permitting procedures, complex decision-making for MABs, lack of obligations and guidance for Discoms to connect RSPV systems.
- Restrictions for residential consumers to sell electricity to the grid.
- Lack of RE purchase obligations (RPOs) for Discoms and large industries.
- Lengthy and complex processes for obtaining surveillance certificates<sup>5</sup> to import solar panels.
- Lack of awareness of the technical aspects, costs and benefits of RSPV systems.

### *Financial and Tariff*

- Short FiT terms (10 years as compared to the typical 25-year lifespan of a RSPV system), which creates uncertainty regarding the future revenues and thus profitability of investments.
- Limited collateral availability for small consumers.
- Perceived risks for banks to lend to EPC companies, since most are relatively new and have neither sufficient track records nor strong balance sheets.

### *Technical*

- Lack of skilled technicians, which is a main concern for EPC companies.
- Low availability of quality RSPV system suppliers and installers.
- Non-availability of standards for products, workmanship, grid connection and installation.

## Recommendations

Based on the analyses, the following recommendations are proposed to develop the RSPV market in Turkey:

- ✓ **Set Annual Targets for RSPV:** MENR should establish and disseminate a target of '3.9 GW of RSPV by 2026.' The target should include annual milestones and sub-targets for each market segment. The targets for all three consumer categories should be

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<sup>4</sup> For all the base case analyses, the self-ownership business model was used, where the building owner owns the system and sells any excess electricity to the grid. The sensitivity analysis considered a Renewable Energy Service Company (RESCO) model, where a service company finances and owns the systems, generally leases the roof space from the building owner, and sells the electricity generated to the building owner and/or grid.

<sup>5</sup> The surveillance certificate is a certificate for a waiver of duties on imports of materials for RSPV installations.

monitored regularly, i.e., on a quarterly basis. If a particular segment's milestone is not achieved, a detailed analysis should be conducted to determine why, and corrective measures developed and implemented.

- ✓ **Establish a Dedicated, Low-Interest Credit Line through Commercial Banks for RSPV Systems:** MENR should work with local financial institutions to develop dedicated loan products for RSPV systems in each market segment, and with the government and international financial institutions to offer longer-term, low-interest financing, at least for the initial 500 MW or so. Such a measure would help stimulate the market and encourage early adopters. This would be consistent with the experience in other countries as well as market survey results, where 25% of the respondents indicated a preference for low-cost finance as an incentive for RSPV investments. Given that many EPC firms are new or start-up companies with weak balance sheets, some credit enhancement, risk sharing, or payment security mechanisms may also be needed to help them access financing, particularly under the RESCO model.
- ✓ **Transition to Net Metering:** Since Turkey will phase out its RE FiT scheme by 2020, MENR should further develop and institutionalize a net-metering scheme for RSPV systems for all consumer classes as soon as possible. A net-metering scheme will also impose a reduced financial burden on electricity consumers as compared with the current FiT. Net metering can also be used for MABs—a grid-connected RSPV system can allow the benefits (i.e., the RPSV power sold to the grid) to be credited among the residents based on their past average consumption and deducted from their monthly electricity bill, as is common in the United States.
- ✓ **Offer Additional Incentives to the Industrial Sector:** MENR should consider the development and implementation of additional incentive schemes for the industrial sector, given their low rates of return. The industrial sector represents about 40% of the total market potential and its high electricity consumption and better access to financing can make RSPV system deployment for these consumers easier. However, the financial analyses showed that the profitability on industrial RSPV systems is low under the net metering scheme, with FIRRs of 2 to 5%. MENR should develop a program specifically targeting the industrial sector with additional incentives, which may include tax rebates for using electricity generated from RSPV, upfront cash incentives, tax exemptions for imported components, a higher tariff for supplying excess electricity to the grid, simplified procedures, easy access to information, special connection protocols, etc.
- ✓ **Remove the Surveillance Certificate:** The requirement for a surveillance certificate (certificate for imported PV systems issued by the Turkish Ministry for Economy) should be waived for RSPV systems. Under the current regulation, the price can be more than 70% higher than the border price, representing a major barrier.<sup>6</sup> It is more efficient to simply remove the import tax on solar PV modules than to provide additional incentive schemes to promote their use. If this is not politically feasible, the application process for such certificates should be simplified to make it easier for all consumers to obtain one.

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<sup>6</sup> For example, a 300 W PV module with a border price of US\$0.4/W costs about US\$120. Given that the surface area is around 1.6 m<sup>2</sup>, the surveillance tax would be about US\$86.40 (US\$300\*1.6\*18% = US\$86.4).

- ✓ **Create a Single Window/Online Approval for RSPV Systems<sup>7</sup>:** MENR should work with EMRA, TEDAS and others to simplify the permitting and licensing process. Having an online single-window and time bound, integrated permitting and licensing platform, would substantially reduce the transaction costs for new RSPV installations, perhaps up to 150 kW, as is now takes roughly 17 months to complete the approval process for both large and small systems. A “single-window” permitting and licensing platform, preferably managed by one centralized organization such as the Discom, can be developed to ensure a quick and safe permitting process. Under such a system, upon receipt of the installation certificate from an EPC, the Discom would visit the site, ensure the installation complies with the defined protocols and specifications, and connect the system with the grid within a specified time.
- ✓ **Develop and Implement Capacity Building Programs:** Training and capacity building programs should be developed by MENR and delivered at all levels: for policy makers and officials, regulators, prospective/target consumers, banks, Discoms, EPCs and equipment manufacturers/suppliers. In addition, training should be provided to create a large pool of skilled technicians that EPC firms and other relevant players can draw upon.
- ✓ **Conduct Outreach Programs:** MENR should create stakeholder awareness of government programs and policies, business models, technical aspects, etc. through targeted outreach programs. The outreach channels should be appropriately developed for each stakeholder group.
- ✓ **Develop Technical Standards:** Technical standards should be developed for RSPV products, workmanship, grid connections and installations. Such standards would help lower project development costs while helping to ensure consistent technical quality, safety, reduce perceived technical risks, and facilitate the approvals and further streamlining of construction and environmental permits. These would include standards for: (a) solar panels and modules; (b) solar invertors; (c) installations; (d) grid interconnection; and (e) testing of structural stability of roofs for RSPV installations.

## Stakeholder Workshop

A stakeholder workshop was held on December 14, 2017 in Ankara. About 80 people attended the event including representatives from MENR, Treasury, EMRA, TEDAS, Discoms, the solar associations, EPC firms, banks, the World Bank, KfW and international experts from Germany, India and the United States. Some notable take-aways included:

- There was general consensus that the market potential for RSPV in Turkey is substantial. While the government generally found the 3.9 GW estimate to be realistic, the solar industry felt it was on the low side.
- All participants recognized the tremendous decline in solar costs globally, from about US\$4/W to US\$0.70-80/W today. Large scale solar auctions have seen even lower prices, with prices around 2 US¢ in Saudi Arabia and Mexico, 4 US¢ in Germany

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<sup>7</sup> All permits, licenses and approvals such as construction, grid connection, safety, environment, etc. should be provided by making a single application on one platform.

and less than 7 US¢ for the most recent auction in Turkey. As such, the study was considered to be timely.

- Most stakeholders agreed that a significant amount of the solar PV potential in Turkey could come from RSPV systems. Benefits would include reduced transmission and distribution system losses, lower prices to consumers, reduced energy imports, environmental benefits and economic development and job creation.
- Complex licensing and permitting procedures was highlighted as a major constraint today. While most participants agreed on the need to streamline them, concerns were raised that waiving certain steps could create safety and other risk. Others were not sure how various agencies would be allowed to give up their responsibilities for approvals or delegate them to other entities. It was agreed this would need more discussion and would have to be implemented carefully. MENR and EMRA indicated some steps are already being discussed to shorten the timing for RSPV connections.
- The private sector noted the need for easier access to affordable financing and other incentives to help stimulate the RSPV market.
- With the phaseout of FiTs, there was general agreement on the need to further develop net metering schemes in Turkey for RSPVs, especially for MABs.
- There was strong overall support for this initiative, appreciation for an open consultation with stakeholders, and strong interest about the timing of next steps.