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Institutional Working Group

Support to the evaluation of a net metering system in Palestine

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Corso di Porta Vittoria 27, 20122 Milan, Italy - Tel + 39 02 655 65 529 - Fax +39 02 655 65 562
info@medreg-regulators.org – www.medreg-regulators.org

INFORMATION PAGE

Abstract

This document, elaborated under the guidance of the MEDREG RES WG, has the scope to support the Palestinian regulator PERC in evaluating the possibility to establish a net metering system in the country, based on the legal documents already issued on this topic. First, the report describes the role of net metering in the electricity grids through the presentation of several international experiences. Then, the legal and technical situation of Palestine in relation to net metering application is analyzed in detail, providing highlights on the technical and economic impact that net metering could have on the Palestinian grid. Finally, recommendations on the regulatory, economic procedural, technical and capacity development steps to be taken in order to implement net metering in Palestine are provided.

About MEDREG

MEDREG is the Association of Mediterranean Energy Regulators, bringing together 25 regulators from 21 countries, spanning the European Union, the Balkans and North Africa.
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Through constant cooperation and information exchange among members, MEDREG aims at fostering consumers' rights, energy efficiency, infrastructure investment and development, based on secure, safe, cost-effective and environmentally sustainable energy systems.
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If you have any queries relating to this paper please contact:
MEDREG Secretariat
Telephone: +39 02 65565 524
E-mail: vlenzi@medreg-regulators.org

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Related Documents

MEDREG documents

- MEDREG RES WG (2014) “Study to evaluate net metering systems in Mediterranean countries”, http://www.medreg-regulators.org/Portals/_default/Skede/Allegati/Skeda4506-59-2015.1.9/7b_Med14-18GA-7b%20RES.pdf?IDUNI=wtszovwhwypxp0mrmlvfgg234132.

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Main drafters: Mr. Nidal Tayeh (Consultant), Ms. Veronica Lenzi (MEDREG Secretariat), Dr. Honi Kabalo (PUA, Israel), Eng. Ahmed Sallam (EgyptERA, Egypt)

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1. Introduction to net metering

Net metering is an enabling policy designed to foster private investment in renewable energy. The concept of net metering is mostly applied in the promotion of decentralized solar electricity. Net metering is a regulatory scheme under which the excess electricity injected into the grid can be used at a later time to offset consumption during times when the onsite renewable generation is either absent or insufficient. In other words, net metering is an electricity policy which allows consumers to partially or completely offset their electricity use through the employment of self-produced electricity with electricity from renewable energy sources (RES-E) systems[1].

Indeed, net metering permits consumers who generate some or all of their own electricity to use that electricity anytime, instead of using it when it is generated. This is particularly important with renewable energy sources like wind and solar, which are non-dispatchable (when not coupled to storage). Monthly net metering allows consumers to use solar power generated during the day at night, or wind from a windy day later in the month. Annual net metering rolls over a net kilowatt credit to the following month, for example, allowing solar power that was generated in July to be used in December, or wind power from March in August.

Net metering schemes originated in the United States, where small wind turbines and solar panels were connected to the electrical grid, and consumers wanted to be able to use the electricity generated at a different time or date from when it was generated. The state of Minnesota is commonly cited as passing the first net metering law, in 1983, and allowed anyone generating less than 40 kW to either roll over any kilowatt credit to the next month or be paid for the excess. In 2000, this law was amended to compensation at the average retail utility energy rate[2]. This is the simplest and most general interpretation of net metering and, in addition, allows small producers to sell electricity at the retail rate.

Net metering policies can vary significantly by country and by state or province: if net metering is available, if and how long banked credits can be retained, and how much the credits are worth (retail/wholesale) are subject to the law of the country. Most net metering laws involve monthly roll over of kWh credits, a small monthly connection fee, monthly payment of deficits (i.e., normal electric bill), and annual settlement of any residual credit. Unlike a feed-in tariff (FIT), which requires two meters, net metering uses a single, bi-directional meter and can measure current flowing in two directions. Net metering can be implemented solely as an accounting procedure, and requires no special metering, or even any prior arrangement or notification.

Under this framework, consumers use the grid as a backup system for their excess power production. Generally, net metering approaches have limited the system size to which it is applicable, with limits ranging from 20 kW to 2 MW or expressed in proportion to prosumer's power capacity use[3]. The applicable billing period can extend from one hour to longer periods of time (e.g., one billing period) or one year, renewable. Net metering requires the use of a meter that is able to spin and measure energy flows in both directions. When a consumer

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[1] Net Metering Website - 1. How net metering works: Understanding the basics of policy, regulation and standards". www.doe.gov.ph.

[2] https://web.archive.org/web/20121019232315/http://www.dsireusa.org/solar/incentives/incentive.cfm-?Incentive_Code=MN01R&re=1&ee=1.

[3] https://www.emissions-euets.com/internal-electricity-market-glossary/1342-net metering.

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draws power from the grid (i.e., he is using more energy than he is producing), the meter spins forward. On the contrary, when a consumer injects power in the grid (i.e., he is using less energy than he is producing), the meter spins backward. At the end of a given month, the consumer is billed only for the net electricity used.

The use of net metering can take place only for systems connected to the grid. The clear advantage of this technology, besides offsetting a home's energy consumption with an RES-E system, is that excess energy sent to the utility managing the grid can be sold back at retail price. If more energy is produced than consumed, producers receive benefit for this positive balance such as, for example, renewable energy credits (RECs), which are deposited in the consumer's account toward the next billing cycle. If a surplus remains at the end of the year, then, depending on the policy of the utility, the consumer may: (a) receive a payment for the total REC collected at retail cost rate; (b) the total REC collected may be kept and used later as compensation for a possible future negative balance of the consumer towards the utility; (c) the collected RECs are given back to the utility[4].

Under the net billing scheme, the invoice issued by the supplier is based on the value of withdrawn energy, which is reduced by the value of injected energy. In this case, any remaining surplus of injected energy during the billing period is credited in monetary units to the next billing period. The excess energy is valued at a level below the retail electricity price.

Net metering schemes have proved to be effective in jump-starting distributed generation markets and are progressively being introduced in a number of states. In addition to the European Union (EU), net metering forms the basis of support for solar PV across most US and Australian states.

However, net metering may be considered controversial, as it affects different interests on the grid. It can be argued that distributed generation systems, like rooftop solar, present unique challenges to the future of electric utilities. Utilities in the United States have led a largely unsuccessful campaign to eliminate net metering[5].

From the consumer perspective, net energy metering is attractive and easy to apply and understand, as it relies on the use of one single meter. On the one hand, it can be stated that while distributed solar and other energy efficiency measures do pose a challenge to electric utilities' existing business model, the benefits of distributed generation outweigh the costs, and the benefits are shared by all ratepayers. Grid benefits of private distributed solar investment include reduced need for centralizing power plants and reduced strain on the utility grid. They also point out that, as a cornerstone policy enabling the growth of rooftop solar, net metering creates a host of societal benefits for all ratepayers that are generally not accounted for by the utility analysis, including public health benefits, employment and downstream economic effects, market price impacts, grid security benefits, and water savings.

On the other hand, owners of generation systems do not pay the full cost of service to use the grid, thus shifting their share of the cost onto prosumers without distributed generation systems. Most owners of rooftop solar or other types of distributed generation systems still rely on the grid to receive electricity from utilities at night or when their systems cannot generate sufficient power.

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[4] Andreas & Kourtis, George & Hadjipaschalis, Ioannis (2013) "A review of net metering mechanism for electricity renewable energy sources", Journal homepage: www. IJEE. IEEFoundation. org. 4. 975-1002.
[5] https://www.greentechmedia.com/articles/read/the-utility-industry-can-survive-the-energy-transition-it-s-leading-it#gs.uKUjttQ.

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From a system perspective, however, net metering raises concerns when large deployment levels are reached. This is because remuneration for the excess production from onsite renewable energy systems is made at a retail price that in most cases exceeds the value of that generation to the electricity system. Under this model, consumers with self-generation are using the grid to artificially store electricity produced at one point of time to consume it at another point of time without reflecting the value of electricity which may vary substantially between the time periods. An alternative approach is provided by the Italian 'net billing' scheme which calculates the value of the excess electricity fed into the grid (at wholesale price)[6]. Such value can be used as a credit for subsequent period or is paid to the consumer.

Net metering is seen as an appropriate mechanism to promote self-consumption in the phase-in periods, when solar photovoltaic (PV) installations have achieved grid parity. However, the recent rapid decline of technology costs, together with concerns about grid cost recovery and likely overcompensation, have initiated a wide debate about reform of the self-consumption schemes. According to some critics, net metering can cause problems, as it implies that the system is used as storage capacity for free. In addition, the European Commission gives preference to the self-consumption schemes with a standard supply arrangement over the net metering schemes, while the latter are deemed to be appropriate for phase-in periods.

[6] European Commission Staff Working Document (2015) “Best practices on Renewable Energy Self-consumption”, https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_autre_document_travail_service_part1_v6.pdf.

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2. Overview of net metering international practices

2.1. The Mediterranean

2.1.1. Tunisia

Within the framework of prevailing regulations authorizing electricity generation to cover one's energy needs, the Tunisian government has implemented an incentive system, PROSOL ELEC[7]. This programme aims at promoting the development of photovoltaic installations connected to the low-voltage grid for the purpose of self-generation, mainly in the residential sector. The low-voltage grid corresponds to 230/400V at 50 Hz frequency. The size of photovoltaic systems allowed to be installed by prosumers is determined by their annual electricity consumption, in order to minimize as much as possible the introduction of surplus energy in the grid. In case of surplus generation, a bi-directional meter calculates the amount of kWh injected and notes the electricity volume which may be used on the grid, based on the principle of net metering. The STEG electricity billing system is unique for all residential prosumers: meter readings are done every 4 months and bills are issued every 2 months. One bill is estimated while the next one is based on meter readings. Each bill assesses generated kWh and consumed kWh. The residue of generated kWh that were not consumed is carried over to the following bill.
From an economic point of view, the PROSOL ELEC programme is particularly interesting for residential prosumers connected to the low-voltage grid and with an electricity consumption of more than 200 kWh per month. Indeed, electricity tariffs for low-income households being the most subsidized, the total saved on the electricity bill thanks to consumption of photovoltaic energy generated by a residential prosumer consuming less than 200 kWh will be lower than that of the aforementioned prosumers. Another particularity of the PROSOL ELEC programme resides in the possibility for the PV electricity producer to reduce the amount of private capital in the initial investment of the PV installation. Indeed, the financing of photovoltaic installations is comprised of three different contributions:

- The purchaser's own contribution;
- The State's subsidy;
- An Attijari bank loan – the Attijari bank is the only Tunisian bank to have signed an agreement with the STEG for the development of a bank credit mechanism in the form of a subsidized loan at 5.94% p.a. rate over a period of 7 years, intended for 1 or 2 kWp photovoltaic installations.

The initial financial contribution largely comes from the installer, who directly receives the National Energy Management Commission (FNME) subsidy, as well as the Attijari bank loan, in order to acquire and complete the installation in the name of the PV owner. Once the installation is operational, the PV owner reimburses the entirety of the loan through his electricity bill over a period of 7 years. Monthly payments for the loan reimbursement are set in the loan application form submitted to Attijari bank and depend on the installation's capacity (1 or 2 kWp). This financing process is intended to balance electricity savings and loan reimbursements for the prosumer. The repayment of the loan to Attijari bank by the STEG also involves financial equalization between the STEG and Attijari bank.

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[7] http://www.steg.com.tn/fr/prosol_elec/presentation.html.

Tunisia also launched a special programme, called the "Solar Buildings" programme[8], which is aimed at promoting the development of photovoltaic installations connected to the low-voltage grid for the purpose of self-generation. Unlike the PROSOL ELEC programme, it is intended for residential as well as service and industrial prosumers. The low-voltage grid corresponds to 230/400 V at 50 Hz frequency. The output of the photovoltaic system that may be installed by the prosumer may not exceed the capacity subscribed to by the prosumer at the STEG. Electricity generated by the photovoltaic installation is entirely fed into the STEG grid and recorded via the electricity meter. The consumer then consumes the STEG grid electricity on the principle of net metering. Each modified bill summarizes generated kWh and consumed kWh. The remainder of the generated but not consumed kWh is carried over to the following bill.

The "Solar Buildings" programme provides for the grant of a subsidy from the FNME. As for the PROSOL ELEC programme, this subsidy amounts to 30% of the investment costs and is limited to 15,000 TND per project. Following the decline in photovoltaic panels prices in the international market, the subsidy limit has been revised in June 2012. Since 1 January 2013, this subsidy is therefore limited to 1,800 TND for 1 kWp installations and 1,450 TND per kWp for 2+ kWp installations.[9] Unlike with the PROSOL ELEC programme, installations completed under the Solar Buildings programme do not have access to the subsidized loans offered by Attijari bank and guaranteed by the STEG.

Eligibility criteria for the "Solar Buildings" programme are as follows:

- Owning the premises to equip and being currently subscribed to a valid low-voltage STEG contract under one's name
- The installed capacity is at most equal to that subscribed to the STEG by the producer. Moreover, the photovoltaic installation may access several tax benefits.

First, the equipment and products used for energy management that do not have equivalents manufactured in Tunisia benefit from the lowest minimum customs duty of 15%. Furthermore, energy-saving equipment and products benefit from VAT exemption.

As for the PROSOL ELEC program, the installer receives the FNME subsidy directly in order to acquire and complete the installation in the name of the producer. The installer also receives an up-front payment from the prosumer to complete the installation. Project stages within the "Solar Buildings" programme are therefore the same as for installations completed under the PROSOL ELEC programme, except for the stages related to the Attijari bank loans.

The net metering provided for under the PROSOL ELEC programme is a further variant of the auto consumption system which involves a financial incentive provided at the point of acquisition of a photovoltaic facility and a credit for each kWh produced over and above the producer's electricity requirement and fed back into the network.

Historically, in Tunisia, this scheme is based on the PROSOL programme and the first solar water heating systems installed by a public company called Seret Energie Nouvelle in 1985. The programme started in 1995 with a modest level of production, then developed strongly thanks to GEF (Global Environment Fund) funding. When this source of finance came to an end, the possibility of a complete reworking of the system was examined and, in 2004, the PROSOL programme was launched with the help of the Italian government and the United

[8] http://www.nama-facility.org/projects/scaling-up-renewable-energy-and-energy-efficiency-in-the-building-sector/.

Nations Environment Programme (UNEP). It combines a tax incentive mechanism, an investment subsidy and a credit via STEG. The residential sector has seen very rapid growth in the installation of photovoltaic systems. Tunisia currently has 490,000m² of photovoltaic panels in 160,000 installations giving an implementation rate of 6% in the residential sector.
This programme also involves a number of other measures associated with the development of solar water heating in the industrial and tertiary sectors:

- PROSOL Industry, under which any industrial business using solar water heating receives a subsidy of 30% of the investment costs up to TND 150 per m² of solar panels installed.
- PROSOL Tertiary, under which hot water consumers in the tertiary sector (hotels, private health clinics, student residences, hammams, and covered swimming pools, etc.) can attract a grant of 50% of the cost of technical and economic feasibility, sizing , support, and monitoring studies up to TND 5,000 from Italian funds provided via the UNEP, a grant of 30% of investment costs up to TND 150/m² from FNME resources, an additional grant of 10% up to a total of TND 50/m², a grant towards maintenance costs for the first four years after the end of the equipment warranty and an interest rate reduction of 2 points on loans made by commercial banks to hotel owners.

The programme was set up to encourage the construction of 1000 solar buildings with a total photovoltaic capacity of 1500 kWp.
According to the information available on STEG's website, these financial incentives consist of:

- an FNME grant of 30% of the investment costs up to a maximum of TND 3000/kW;
- an additional grant of 10% of investment costs made by the Italian Ministry of the Environment through the Mediterranean Renewable Energy Centre;
- a contribution in kind from STEG in the form of a free uninterruptible power supply;
- a 5-year interest-free loan repaid via the STEG bill thanks to the interest rate reduction granted by the Italian Ministry of the Environment.

All residential prosumers who meet the following condition are eligible for the project. They must:

- be planning to install a photovoltaic capacity of 1 or 2 kWp;
- be the owner of the property on which the solar panels are to be placed and hold a current STEG low voltage account in their name;
- have a minimum annual electricity consumption of 2000 kWh for 1 kW installations and of 4000 kWh for 2 kW installations.

Once the eligibility has been established, STEG and the producer sign an "Agreement for the Purchase by STEG of "Surplus" Electricity produced from Solar Photovoltaic Energy by Low Voltage Residential Consumers".
The surplus purchase tariff is calculated as follows for each billing period. An assessment of both production and consumption is made on site with one of the two results set out below:

- where consumption is greater than the electricity produced and fed into the network, the consumer pays for any additional kWh consumed;
- where consumption is less, any credit due for kWh fed into the network is carried forward to the next billing period.

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It should be noted that the surplus electricity supplied to STEG under the agreement may not be pledged or assigned to a third party under any circumstances. Under the terms of the agreement, only the producer itself may benefit from the energy balance which appears on its bill. Finally, the agreement is renewed tacitly for further periods of one year, unless notice of cancellation is served by one or the other party by registered letter with acknowledgment of receipt at least one month before the end of the current year. In reality, this right of cancellation amounts to a unilateral right of termination and represents an obstacle to the long-term reliability of the programme. This is a systemic failing of the purchase agreement in that it creates a lack of certainty for investors.

2.1.2. Spain[10]

In Spain, the support scheme for the so-called ‘Special System’ (Renewables –bar large hydro–, Combined Heat and Power –CHP– and Waste) has been one of the main reasons for the fast deployment of these technologies. In parallel to the increase in installed capacity, the number of generation plants in Spain has grown very significantly in the last few years.

2.1.2.1. Recent net metering/ renewable metering regulation in Spain: Royal Decree 1699/2011 of 18 November

The main purpose of this royal decree is to set administrative and technical conditions for the network connection of small renewable and CHP generation plants. Facilities included in the scope are renewables up to 100 kW and CHP up to 1000 kW of installed capacity.
Some of the key objectives of this royal decree are:

- To simplify requirements and to cut the red tape for small facilities.
- To set a technical, general framework for the metering of ‘self-consumption’.

2.1.2.2. New Spanish Power Act: Law 24/2013 of 26 December

This law sets out provisions about specific cases of ‘self-consumption’ of electricity; in accordance with article 9, “for the purposes hereof, self-consumption means the consumption of electricity originating from generation facilities connected inside a consumer’s grid or through a direct line [a type of private use, proprietary line, as opposed to common lines, open to third party access regime] of electricity associated with a consumer”.
There are different net metering configurations envisaged by the law, and one of them is “supply with self-consumption”, that is a consumer with a generation facility for their consumption connected to their own grid. In this instance, the production device would be deemed part of a consumer facility — and not as a producer on their own. The Spanish law doesn’t provide for a mixed prosumer role; either one or the other role is attributed. Consumers under ‘self-consumption modalities’ must be inscribed on a specific administrative register, set up for this purpose at the Ministry of Industry, Energy and Tourism. Consumers under self-consumption are required to pay the same grid access tariffs and charges associated to the system costs as the rest of the consumers. The government may nevertheless establish/effect/introduce reductions in those tariffs and charges, if self-consumption reduces overall system’s costs (e.g., reducing network losses or improving generation adequacy).

[10] MEDREG RES WG (2014) “Study to evaluate net metering systems in Mediterranean countries”, http://www.medreg-regulators.org/Portals/_default/Skede/Allegati/Skeda4506-59-2015.1.9/7b_Med14-18GA-7b%-20RES.pdf?IDUNI=wtszovwhwypxp0mrmlvfgg234132.

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2.1.2.3. Draft Royal Decree regulating self-consumption

In July 2013, the Spanish Ministry of Industry, Energy and Tourism sent a draft Royal Decree on the administrative, technical and economic conditions for the connection to the grid of facilities with self- consumption to the National Regulatory Authority (now CNMC) for its due report.

The draft proposes that production devices connected to consumers under self-consumption are limited to a maximum of 100 kW, and production capacity installed cannot be above consumption capacity contracted as a consumer (point of supply). The metering system for these consumers should be capable of registering independently all energy consumed and all energy generated. Therefore, no deferred net balancing is foreseen; net metering would be allowed only instantaneously. The draft also sets down some economics aspects. For instance, these consumers wouldn't be eligible for last resort supply (regulated end-user price), since they're deemed as more sophisticated than average consumers, capable of some degree of active demand management.

2.1.2.4. Other related legislations

The Royal Decree 647/2011, of 9 May, regulating activity for charging point managers (companies allowed to buy and resell electric energy exclusively for electric vehicle charging; specific low access tariffs are foreseen for night / off-peak recharging).

The Royal Decree 216/2014, of 28 March, setting final prices for electricity consumers according to real metering in hourly basis.

The Third Energy Package requires Member States to ensure implementation of intelligent metering systems for the long-term benefit of consumers. This implementation is regulated in Spain by the Royal Decree 1634/2006 of 29 December and Ministerial Order ITC/3860/2007, which set a full, mass roll-out of electricity smart meters for all (some 28 million) points of supply, and is expected to be completed by end 2018; partial intermediate deadlines are also established, and compulsory advancement reports are foreseen.

2.2. The Americas

2.2.1. Mexico

Since 7 June 2007, Mexico activated a model of contract to connect small-scale photovoltaic solar systems to the general power grid. Under this model, any small household producer of electricity from RES could connect to and exchange electricity with the grid of the Comisión Federal de Electricidad (CFE), the state-owned electric utility of Mexico.

In 2010, the scheme of net metering further evolved, on the one hand, providing eligibility to new technologies generating electricity from RES (such as micro windfarms and biomass) and cogeneration and, on the other hand, opening up to middle-sized producers.[11] In 2012, following several petitions on the part of the users, a complementary model of interconnection contract was approved to include collective sources of RES or cogeneration in the net metering scheme.[12] Therefore, this complementary model is specifically designed for the installations using small scale RES or cogeneration and the multifamily or commercial buildings.

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[11] https://www.lexology.com/library/detail.aspx?g=a209a583-86c1-4531-ab28-ddf95d441d9b.

[12] Carl Linvill and Donna Brutkos (2015) "Designing Distributed Generation in Mexico", https://www.nrel.gov/docs/fy17osti/66026.pdf.

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According to the Mexican net metering system, all types of renewable energy and cogeneration sources can connect to the CFE grid. The definition of what is considered to be a renewable source of energy is provided by the Law for the Use of Renewable Energy and the Financing of the Energy Transition (article III, paragraph 2)[13], which specifies that RES includes windfarms, solar, hydropower, geothermal, and some of the bioenergy plants. The substantial majority of the installations currently connected through net metering use the solar photovoltaic technology.
According to the existing legislation, there are three different categories of installations that can connect to the grid, depending on their installed capacity.

- Small installations**:** They can be divided in two sub-categories which depend on the final use of the generated electricity.
- If the installation using RES or cogeneration is for residential use, it will have a maximum installed capacity of 10KW.
- If the installation using RES or cogeneration is for general use (small firms or shops), it can have a maximum installed capacity of 30KW.

In both cases, the installations connect to the grid with voltage inferior to 1kV.

- Medium-scale installations: This type of installation includes those with a minimum capacity of 500KWp that connect to the electricity grid of CEF with a voltage higher than 1kV and lower than 69kV. This is the type of model adequate for the firms that want to produce their own electricity.
- Community generation installations: These are collective installations using RES or cogeneration that are connected to the electricity grids with a voltage below 1kV. This is the type of contract adequate for single-family houses or a set of small businesses where the users can neither physically host their generation equipment for space reasons nor have a specific connection point to the grid. In order to connect to the grid, they have to make use of the common spaces and benefit from the common interconnection point of the building to the grid. This contract model is conceived so that several inhabitants of the building can participate, in equal or differentiated forms, in the RES installations, using the installation together.

  This contract can be considered as an adaptation of the contract model for the small-scale system, as it also distinguishes between the residential and commercial use of the installations.

  Adding together the various participants to these community installations, it is likely that the total power consumed by the system goes beyond the 10 Kw or the 30 kW allowed for the single unit participating, reaching the levels of the medium-scale installations. The difference between the community generation installation and the medium-scale one is the tension of the connection, which is to be inferior to/below/less than 1kV against the range between 1kV and 69kV of the medium-scale) and the functioning of the accounting unit of the energy used.

A household or firm producing electricity through RES can sell it to the grid of CFE in case it does not fully use it for its internal needs as well as withdraw energy from the grid when the

[13] https://www.iea.org/policiesandmeasures/pams/mexico/name-24706-en.php.

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production of energy is not sufficient. All the energy injected/taken from the grid is registered through a double meter. Each month the energy balance is calculated. One of the following two situations may occur:

- The RES energy producer injects more energy in the grid than the amount he consumes: In this case, the producer will earn a positive balance, equal to the difference between KWh injected and withdrawn, which he can recover from the grid in 12 months. After this deadline has passed, the producer can no longer claim a compensation (neither in monetary nor in energy terms).
- The RES energy producer withdraws more energy from the grid than the amount he produces: The CFE will discount the energy produced from the energy consumed and apply the relevant tariff.

2.2.2. United States

In the USA, all public electric utilities are required by legislation to make available upon request net metering service to their prosumers. Overall, 47 states apply the net metering mechanism for the promotion of RES-E technologies, with the exception of Alabama, Mississippi, South Dakota, and Tennessee. Most of the state's place a capacity limit for the eligible RES-E technologies for net metering, except for the prosumers of investor-owned utilities (IOUs) and the electric cooperatives of the state of Arizona, the state of New Jersey, Ohio, and for the prosumers of Ashland Electric in the state of Oregon. Also, 28 states employ aggregate capacity limit for their net metering mechanism which is expressed as a percentage of the state utility's peak demand.[14]

In 30 states, any prosumer's net excess generation (NEG) is credited to the prosumer's next electricity bill for a 12-month billing cycle at the retail rate, whereas in 5 states it is credited at the state's utility's avoided cost rate. Also, in 4 states, the NEG is credited at various other rates, such as (a) the TOU rate, (b) a rate predetermined by the utility, and (c) as a percentage of either the retail or the avoided cost rate. Furthermore, in 8 states the NEG is credited to the prosumer's next electricity bill via a combination of the retail rate and the avoided cost rate or, between the retail rate and any one of the other various rates as mentioned above.[15] The actual type of NEG credit is decided by a number of set criteria, such as the type of RES-E technology, the RES-E capacity limit, the type of prosumer and the type of utility.

Regarding any excess credit at the end of the 12-month billing cycle, in 11 states this is granted to the utilities, whereas in 8 states it carries over indefinitely to the prosumer's next electricity bill.[16] In 6 states the excess credit is reconciled annually at the avoided cost rate and in 5 states at any one of the various other rates mentioned above. One state grants any excess credit back to the utility every month and two states offer the option to their prosumers to credit any excess credits at the end of the annualized period at any rate or granted to the utilities. Finally, 8 states offer the option to their prosumers to credit any excess credits at the end of the annualized period either indefinitely to their next electricity bill or to receive payment at any rate. The net metering mechanism in the state of California and Connecticut, the states with the most extensive experience in net metering, is described in more detail below.

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[14] http://freeingthegrid.org/.
[15] https://www.energy.gov/sites/prod/files/2014/05/f15/fupwg_may2014_net_metering.pdf.
[16] http://freeingthegrid.org/.

2.2.2.1. California

California's net metering applies to all utilities with one exception. Publicly-owned electric utilities with more than 750,000 prosumers which also provide water are exempt from offering net metering. Net metering is applied to wind energy systems, solar-electric systems, hybrid (wind/solar) systems, biogas-electric facilities up to 1MW, fuel cells up to 45MW within the service territory of a utility with a peak demand of at least 10,000MW, or up to 22.5MW within the service territory of a utility with a peak demand of 10,000MW or less.[17]

The maximum total capacity of all net-metered fuel cells in all service territories is limited to 500MW.[18] The aggregate limit of net metering systems in a utility's service territory is set at 5% of the utility's aggregate prosumer peak demand. NEG is carried forward to a prosumer's next bill at retail price. Prosumers have two options for the NEG remaining after a 12-month period. They can roll over any remaining NEG from month-to-month indefinitely, or they can receive financial compensation from their utility for the remaining NEG.

The California Public Utilities Commission (CPUC) set the compensation rate at the 12-month average spot market price for the hours of 7 am to 5 pm for the year in which the surplus power was generated. The rate making authorities of municipal utilities must develop their own compensation methods for the remaining NEG through a public proceeding. The RECs associated with the electricity produced and used on-site remain with the prosumer-generator. If, however, the prosumer chooses to receive financial compensation for the NEG remaining after a 12-month period, the utility will be granted the RECs associated with just that surplus they purchase. The local government is allowed, if certain conditions are met, to distribute bill credits from an RES-E system across more than one meter. To be eligible for this billing arrangement, all electrical accounts involved must receive electricity under a TOU tariff, and all accounts must be owned by the same entity. California also allows virtual net metering for certain utility prosumers. Virtual net metering concerns all multi-tenant properties and all distributed generation technologies. It allows the bill credits associated with the electricity produced by the system to be distributed across all the tenants' electricity bills.

2.2.2.2. Connecticut

In Connecticut, the IOUs are required to provide net metering to prosumers that generate electricity using RES-E systems, such as solar, wind, landfill gas, fuel cells, sustainable biomass, ocean-thermal power, wave or tidal power, low-emission advanced renewable energy conversion technologies, and hydropower facilities up to 2MW capacity.[19] There is no stated limit on the aggregate capacity of net metered systems in a utility's service territory. Any prosumer’s NEG during a monthly billing period is carried over to the following month as a kWh credit. At the end of an annualized period, the utility pays the prosumer for any remaining NEG at the utility's avoided cost rate. Recently, Connecticut established virtual net metering for municipal prosumers only.

A virtual net metering facility may serve the electricity needs of the municipal host prosumer and additional beneficial accounts as long as the beneficial accounts and the host account are within the same electric distribution company's service territory. Up to five beneficial accounts may be assigned. If a municipal host prosumer produces more electricity that it consumes, the

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17 http://www.cpuc.ca.gov/General.aspx?id=3800.
18 http://www.cpuc.ca.gov/General.aspx?id=3800.
19 https://www.energy.gov/sites/prod/files/2014/05/f15/fupwg_may2014_net_metering.pdf.

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excess electricity will be credited to the beneficial accounts for the next billing period at the retail rate. Excess credits rollover monthly for one year. The electric distribution company is to compensate the municipal host prosumer for excess virtual net metering credits, if any, remaining at the end of the calendar year at the retail generation rate.

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3. Focusing on the functioning of the net metering schemes of Israel and Egypt

3.1. Net Metering Scheme – The Israeli Experience

3.1.1. General information – The Israeli RES Scheme

The Israeli RES market legal framework was established in 2009 in a government decision (4450) that declared a national target (10%) of RES generation for Israel by 2020. Since then, the target was ratified in three more government decisions (2011, 2014, 2016), as well as Israel's commitments for GHG emissions in the Paris convention in 2015.
The planned scheme to reach the 2020 target changed through the years. In 2010-2011, it was estimated that the target would be obtained by 1.7 GW of Solar, 0.8 GW of Onshore Wind, and 0.2 GW of Biogas and Biomass – but in 2014, and finally in 2016, due to the slow pace of implementation of non-solar technologies, the Israeli Minister of Energy shifted the efforts to solar PV – and the existing updated target for solar is now 3.6-3.7 GW by 2020.
The Public Utilities Authority - Electricity (PUA) was entrusted with the implementation of these decisions. The main economic mechanism originally used to encourage individuals and companies installing RES was the Feed-in-Tariff (FiT), accompanied by a series of quotas for installations. The legislation and planning related to four different sizes of installations: residential (up to 15 KWp); commercial (up to 50 KWp), Medium-Utility Scale (up to 10 MWp) and Large-Utility Scale (above 10 MWp).
In accordance with those government decisions the PUA has published, since 2008, several regulatory decisions which include feed-in tariffs, auctions, and net metering quotas, in the following scale:

Approved Israeli Solar Energy Scheme 2018				
System size	Incentive System Type	Technology	Total Cap	Comment
x<15KW	FiT	PV	**310** MW	All Installed
15KW<x<50KW	FiT			
50KW<x<10 MW	FiT	PV	**300** MW	All Installed
10 MW<x	FiT	PV	**200** MW	All Installed
10 MW<x	FiT	CSP Shifted to PV	180 MW	Will be installed by the end of 2018
50KW<x	Land Tender	PV	120 MW	16 MW Installed, 60 MW more will be installed by 2020
10 MW<x	Ashalim - Auction	PV + CSP	31**5** MW (Including Ashalim)	35 MW of PV installed, 240 MW of CSP will be installed by the end of 2018, 40 MW of PV is yet to be published for auction

X < 5 MW	Net Metering	PV	**400**MW	180 Installed, 70 MW under installation, quota will be completed by 2020
50KW<x<10 MW	PV Auctions	PV	1,000	400 auctioned by 2017
10 MW<x	PV Auctions			
X > 100 KW	PV large rooftop Auctions	PV	200 MW (minimal cup)	To be implemented in 2018-2019
X<100 KW	PV small rooftop FiT	PV	300 MW	To be implemented in 2018
Additional quota to be allocated		PV	410 MW	To be implemented in 2018-2019
Total			**Total Cap:** **3,735 MW** **Of which:** **- ~1,000 MW currently installed** **- 3,652 MW will be installed by 2020**	

Table 1. Approved Israeli Solar Energy Scheme 2018

As demonstrated in the table – the Net Metering regulation (published in 2012) is set in a capacity cap of 400 MW, as a part of the total 3.7 GW Israeli RES scheme – aimed at reaching the national target in 2020.

3.1.2. The Net Metering regulation framework

In December 2012, the PUA Board of Directors approved a new Net Metering regulation for RES systems which started implementation in 2013, with an established cap of 400 MW.
According to the decision, self-consumers owning an RES system will be able to save their electricity at retail tariff through self-consumption, in the following terms20:

- - For self-consumption, consumers are saving at the alternative TOU/Fixed retail tariff but are charged with Balancing costs (15 NIS / MWh) and Adequacy costs (up to 60 NIS / MWh) for every KWh consumed.
- - For the energy exported to the grid, consumers are rewarded by "Credit" calculated by the TOU/Fixed tariff minus Balancing and Adequacy costs as well as Grid Use tariff (e.g. 27 NIS/MWh for low-voltage consumers).

Credit will be reduced from the consumer's electricity bill at the end of the month (production surplus will be offset with consumption surplus). It will be possible to accumulate and transfer surplus credit from one bill to another, up to a maximum period of 2 years.
The regulation includes the possibility of selling credit surplus to the grid. In this case, however,

20 See: IEA WEO 2011 methodology page 191, https://www.iea.org/publications/freepublications/publication/WEO2011_WEB.pdf

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since the consumer is turned in practice to a generator, the value of credit will be determined by the level of retail generation tariff. This option is intended to reduce risks and increase bankability of the RES systems by ensuring the possibility to use and refund electricity generated in the RES system even in case of a permanent decline in consumption (e.g., factory closed, household consumption declined over the years, and so on).
Below is a recap of the cases in which net metering is used in Israel.

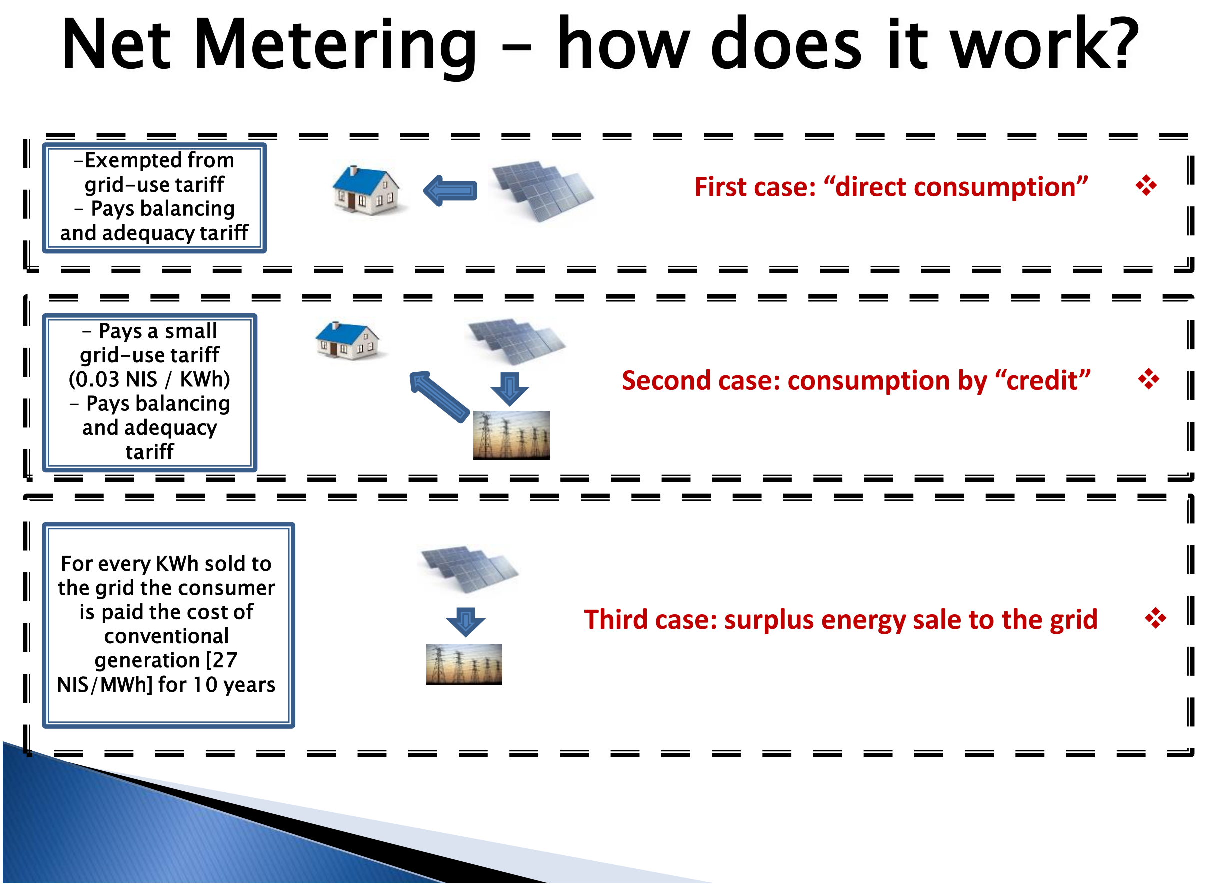

Table 2. Recap of net metering system in Israel

3.1.3. Six years of Net Metering in Israel – lessons learned

The net metering regulation was published in 12/2012 and its implementation began in 2013. Here is a summary of the installed capacities since its beginning**:**

	1.1.2014	1.1.2015	1.1.2016	1.1.2017	1.1.2018	21.3.2018
Capacity (MW)	0.0	26.9	59.5	91.7	146.0	~170
Additional Capacity - MW (Annual)	0	26.9	32.6	32.2	54.3	24 MW in less than ? months
Number of Systems						2,105
Average System Size						85 KW

Table 3.Summary of the evolution of installed net meters in Israel

As demonstrated in the table, after a first year of nearly no installations, the NM market stabilized at ~30 MW a year during 2014-2016, rising to over 50 MW in 2017, and is currently

at a record-high pace, with over 100 MW expected in 2018.
Despite the fact that the installed capacity (170 MW) is still far from the cap, the "rush" of applications in 2018 makes it feasible that the cap would actually be realized/finalized soon:

Application status	Total MW
Installed Capacity	170 MW
Approved applications	80 MW
Applications in process	~100 MW
Total applications (Installed + Approved + in process)	**~350 MW**
Total Cap	400 MW

Table 4. Summary of net metering applications status in Israel

Here are some insights and lessons learned in the six years of NM implementation in Israel:

- **Avoid "cannibalism" by competing incentive systems** – an aspect which slowed the development of NM was the fact that in 2013-2014 there were still FiT incentives for PV rooftops up to 50 KW size. That created a situation where the market was still over-occupied by these mechanisms, considered more bankable and familiar, and the natural transition towards NM was distorted.
- **De-regulation of the surrounding regulatory framework area is critical for success** The NM regulation created a chain reaction of deregulation in all bureaucratic aspects of small and medium RES rooftop installations. The most important landmark in this process was the exemption of rooftop PV installations from a construction permit requirement up to 700 KW system size and the exemption from Improvement Levies, which are mandatory for all construction works in Israel. These exemptions – and others (see below) – created a simple, fast, and certain business atmosphere for rooftop PV companies, and are the main catalyst for the 2018 "boom" of rooftop applications (over 100 MW in 3 months).

De-Regulation of Rooftop PV in Israel		
	Requirement	Status
Electricity Authority	Generation License	Canceled – replaced by application process for connection
Tax Authority	Income Tax for PV Rooftops	Exemption for income < 24,000 NIS a year
Tax Authority	Annual VAT report	Exemption for income < 70,000 NIS a year
Construction regulations	Requirement of a construction permit	Exemption of PV < 700 KW from a construction permit
Construction regulations	Requirement of an Improvement Levy for PV rooftops	Exemption of PV < 7000 Meter Square from a construction permit

Table 5. Summary of the changes in regulation for PV on rooftops

- **Prefer simplicity over perfect accuracy in scheme** design – though it is clearly more economically accurate to run an NM scheme when credit is calculated and accumulated by the consumer through TOU or even real-time tariffs rather than the fixed retail tariff common to most consumers, it makes the regulation more complicated for ordinary consumers. The outcome may be: slower implementation of the scheme. The same outcome might occur when there are too many different "charges" calculated in a way that is not clear or transparent enough. Conclusion: "keep it as simple as possible".

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- **"Safety Net", especially for larger systems, is essential to increase bankability and reduce risks –** In the beginning (early 2013), the NM scheme was not clear enough regarding the possibility to use credit surplus for any purpose except self-consumption. That created a risk for consumers and financial organizations in case of consumer "default". In that case, what would the consumer do with his credit surplus? And what assurances does the financing organization have for a return of its debt? These lessons led to a review of the scheme and an addition of specific permission to the consumer to sell credit surplus to the grid at generation tariff.

3.2. Net metering scheme in Egypt

3.2.1. Introduction

Egypt has adopted a very ambitious target to dramatically increase the integration of renewable energy resources in its energy mix to reach 40% of the total electricity production by 2035. The Egyptian government and the Egyptian Electricity Regulator (EgyptERA) have been working very closely to set the framework for the schemes through which this target can be achieved. Five main schemes have been adopted simultaneously with very different regulatory frameworks to fit different investors and customers and categories. The five schemes are:

- BOO based power plants
- State-owned power plants
- Independent Power Producers (IPP) based power plants on commercial basis
- Feed-in tariff based power plants
- Net metering based PV power plants

This section will provide insights into the application of the net metering scheme in Egypt.

3.2.2. Legislative and regulatory framework

Unlike the other four schemes mentioned above, net metering schemes have not been mentioned in the renewable energy law that has been issued in 2015. The net metering scheme has been designed, adopted, and issued by EgyptERA. The net metering scheme as it is today has been passed through three different phases:

3.2.2.1. Phase I

Regulatory framework

In Jan 2013, EgyptERA initiated the net metering scheme under which the PV technology can be exclusively used to serve electrical power to the consumer who owns the system. On a monthly settlement basis the network operator will check the bidirectional meter to decide if the prosumer, in this case, is a net importer or net exporter of electricity. Whenever a PV system generates more power than is consumed by the prosumer, the owner of the system can export this surplus to the grid. The settlement is made on a monthly basis and, in the case of a surplus, the surplus is considered as a credit in the customer’s account and can be used in the following months. By the end of the year if there is still a surplus in the prosumer’s account, it will neither be credited for later usage nor be paid by the network operator which means it will considered as a free of charge energy exported to the grid.

Phase I records

The scheme has almost failed to achieve any sensible records since on the one hand the utility tariff was highly subsided which makes the electricity tariffs very low and on the other hand the prices of the PV technology was so high to the extent that it was almost impossible for this kind of investment to break even. Moreover, the government had already declared its intention to initiate the FiT scheme for both PV and wind technology, so it was better to wait for it.

3.2.2.2. Phase II

Regulatory framework

The devaluation of the Egyptian pound in Nov 2016 has had a significant negative impact on FiT that applies to small scale and top roof PV projects since the FiT for this scale has been issued in Egyptian Pounds. Therefore, the FiT rate is kept as fixed after the devaluation, while the prices of the PV technology has almost doubled and, as a result, the applied rates are no more attractive. Again, EgyptERA has significantly interfered to keep fostering the PV projects in Egypt by substituting the FiT scheme by a new, redesigned net metering scheme in such a way as to make it attractive for investment in this field, considering the following key factors:

- The FiT scheme for PV technology was very close to the expiry date in OCT 2017.
- The FiT scheme has already opened the market. Therefore, investors in Egypt are already running their projects under the FiT scheme and are simply eager to keep investing in such a booming market.
- According to the tariff subsidy reform that was first implemented by the government in 2014 to fully phase out the electricity tariff subsidies over a period of 5 to 7 years, the utility tariffs have dramatically inflated and will continue to do so till the subsidy is fully phased out.
- The price of the PV technology has incredibly declined over the last 4 years to the extent that PV technology can compete with conventional technologies in terms of levelised energy cost.
- Pursuant to the renewable energy law that has been issued in 2014, all producers who produce electricity from projects that are below 500 KW will be exempted from obtaining a generation license.

Referring to all the above driving and promising factors, EgyptERA, in Feb 2017, issued the regulatory framework for the redesigned net metering scheme. The main outlines of the redesigned scheme are:

- Only PV systems that are equal or below 500 KWp are eligible to benefit from the new net metering scheme.
- Only consumers who are directly connected to distribution networks are eligible to benefit from this scheme.
- The settlement is made on a monthly basis and in the case of a surplus, the surplus is considered as a credit in the customer’s account and can be used in the following months.
- By the end of the year if there is still a surplus in the prosumer’s account the distribution company **will buy** it at a price equivalent to the avoided cost of producing this amount of energy from state-owned generating fleet. This cost is calculated and approved annually by the regulator and for the year 2017/2018, is 0.714 Egyptian pounds (around US$0.040).

3.2.2.3. Phase III

Regulatory framework

Due to the pressure created by the larger consumers (consumers who are connected to medium and high voltage networks) to participate in the new net metering scheme, the regulator in August 2017 approved some amendments to the new net metering scheme which are:

- All PV projects that are equal or below 20 MWp are eligible to benefit from the new net metering scheme.
- All consumers, whether directly connected to distribution or transmission networks, are eligible to benefit from this scheme.
- Whenever the capacity of the installed PV projects exceeds 500 KWp, the owner has to apply for obtaining a generation license from EgyptERA.

Phase II and phase III records

Since the new net metering scheme has been first issued by EgyptERA in Feb 2017, new PV capacities are being added to the system every day. According to the last report in Mar 2018, the total installed PV capacity in Egypt through net metering schemes has exceeded 6.5 MWp. Moreover, there is an investor who has already applied for generation license for a 10 MWp net metering based PV project.

3.2.3. Metering Systems

According to the availability of meters in the network operator's stock, there are two different metering schemes that can be applied to the net metering scheme. The first metering system consists of one bidirectional meter, while the second one consists of 2 unidirectional meters. The connection layout of each system is shown in Fig 1 and Fig 2 below.

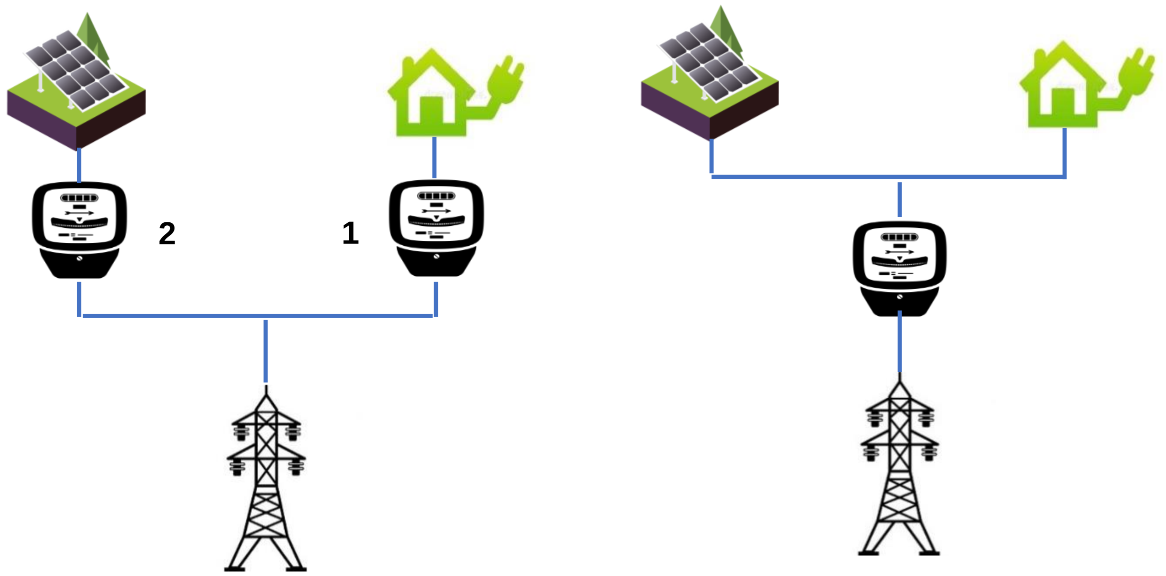

Figure 1. Metering system using 2 unidirectional meters vs metering system using 1 bidirectional meter.

According to the availability of the meter, each net metering based project shall be connected to the metering system using one of the above alternatives. Referring to the two unidirectional meters- based system, in order to make the monthly settlement, the readings of the two meters have to be recorded simultaneously. The net consumption will be calculated using equation 1. If the net consumption is positive this means that the prosumer is a net importer in this month and in case of a negative value the prosumer is considered as a net exporter in this month. Referring to the bidirectional meter, the net consumption is recorded

1

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automatically by the meter.

$$\textbf{Net Consumption} = \textbf{Meter 1 reading} - \textbf{Meter 2 reading} \longrightarrow$$

Figure 2. Formula to calculate net consumption

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4. The status of net metering in Palestine

4.1. Net metering law and policy in Palestine

The Net metering policy in Palestine is based on several legal documents:

- The President's decision bylaw number 13 of the year 2009 on the general law of electricity and its amendments;
- The President's decision bylaw number 14 of the year 2015 on the law of Renewable energy and Energy Efficiency;
- The Council of Minister's decision number 03/77/17 of the year 2015 on adding an article to the council's decision on approval of the electricity tariff; and
- The Council of Minister's decision number 04/77/17 of the year 2015 on the guidelines for renewable energy projects that are connected to the power grid via the Net metering system.

After deep consultations with different stakeholders including: the Palestinian Electricity Regulations Council (PERC), Distribution companies and investors, the Chairman of the Palestinian Energy and Natural Resources (PENRA)[21] recommended to the Palestinian cabinet the regulations and guidelines with regard to the implementation of the net metering policy in Palestine.
These instructions can be categorised as follows:

4.1.1. General terms

A. All dues and debt amounts of the new net metering prosumers (that are wishing to install a Net metering system) to the distribution companies should be paid to the Distributor or agreed with the Distributor to be scheduled.
B. The Net – Metering new prosumer should have a permanent subscription to the distributor.
C. The commitment to install equipment that is in line with the Palestinian Standards
D. The Commitment to comply with the distributor's technical specifications with regard to the project and connection point.

4.1.2. Technical terms

A. The articles of these guidelines are valid for self-consumption projects whose capacity will

[21]PENRA was created according to the law no 12 of the year 1995 (also based on law no 13/2009) and authorized to be the sole national authority responsible for managing the Palestinian energy sector, including, but not limited to, policy formulation, development, restructuring, and coordination. The Palestinian Energy and Natural Resources Authority has the following objectives: Ensure that the electricity supply is delivered to citizens through developing and rehabilitating internal electricity networks and main electricity lines; completing the Rural Electricity Project to provide electricity to all citizens; rehabilitating the Gaza electricity generation station; nationalization of the high voltage transmission sector by creating the Palestine Electricity Transmission Ltd (PETL); privatization of the distribution sector by creating several distribution companies in the Gaza Strip and the West Bank; reducing the cost of electricity consumption through setting plans for interconnectivity with Arab regional electricity and gas networks and for procuring petroleum; continuing work towards effective exploitation of the Gaza gas field off the Gaza coastline and using natural gas to generate electricity; developing alternative energy sources, including renewable energy; improving the financial performance of the electricity sector by applying the Electricity Law, incorporating distribution companies, reducing net lending, and curbing illegal consumption

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not exceed 1000 KW.

B. With no contradiction with these guidelines, the annual electricity production from the project should not exceed 100% of the average annual electricity consumption of the prosumer.
C. If the prosumer subscription period is less than one year, which doesn't allow a clear knowledge of the real annual consumption, the annual electricity production from the project should not exceed 50% of the average annual electricity consumption estimated by the distributor. The prosumer will be able to increase his project capacity after one year according to item B of this article.
D. With no contradiction with items (A) and (B) of this article, the project capacity should not exceed the building production capacity that is estimated by the distributor or the capacity of the transformer if it is private.
E. The project capacity will be estimated based on a special formula.
F. The distributor must study the technical status of the network with regard to the renewable energy project capacities that are connected to it, and it is for him to decide about the possibility of connecting more projects to the network from a technical perspective.

4.1.3. Meters

A. The prosumer's current meter should be replaced with a bidirectional meter to measure the electricity consumption and the exported electricity to the distributor network. The prosumer will pay for the replacement. In this framework, PENRA cooperated with the World Bank to begin an ambitious project which aimed at improving the operational performance of Palestinian Electricity Distribution Companies (DISCOs) through the implementation of a Revenue Protection Program (RPP). The RPP will install smart meters to a segment of commercial and industrial consumers, which represent the largest electricity consumption and sales of the selected DISCOs. Thus, the RPP is expected to improve billing and collection from this "high-value" segment of customers. The RPP will also include Advance Metering Infrastructure (AMI), comprising communication devices, software, i.e. Meter Data Management System (MDMS), and a Metering Control Center (MCC). The functionalities of the AMI and MCC include revenue protection (detection of theft and frauds), automatic meter reading, remote disconnection/reconnection, and load control and outage detection. The available budget for the RPP is US$ 3.4 million.
B. A pilot smart meters' project has been financed and managed by the Jerusalem District Electricity Company (JDECO) with the result of installing 91,144 smart meters (45% of total JDECO's meters) at the end of 2018, thus, encouraging other DISCOs to follow the practice in order to increase their revenues and improve the quality of service. The project plans to install additional 13,200 smart meters and related Advanced Metering Infrastructure (e.g. MDM, MCC) in five years in the selected DISCOs.
C. If the meter mentioned in item (A) is not available for any reason, another meter should be added to measure the exported electricity to the distributor network; in this case, the prosumer will have two meters and will have to pay for the extra meter. In case the prosumer has a pre-paid meter, the distributor should replace it with a normal post-paid meter to be able to make the financial calculations. Prosumer will have to pay for the extra meter.

4.1.4. Calculation and Tariff

A. The distributor issues a monthly report showing the amount of electricity exported from the project to the distribution network and the power consumed from the distributor.

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B. If the amount of electricity consumed is more than the amount of electricity exported, the prosumer pays for the monthly net amount of electricity.
C. If the amount of electricity consumed is less than the amount of electricity exported, the distributor will rotate the electricity surplus to the following month's account, minus 25% of the amount of electricity exported to the network based on Council of Minister’s decision number 04/77/17 of the year 2015
D. A financial settlement is made at the end of the project's production year (1 April - 31 March) so that the energy balance exported to the prosumer is rotated within only one year of production.

4.1.5. Different locations of the project and place of consumption

A. With no contradiction to the terms of instructions, any prosumer within the Distributor's area of operation shall be entitled to set up a project for the production of renewable energy (max capacity of 1000 KWp) and connect it to the distributor's network.The place of consumption of electricity produced from this project could be in a different location than the place of production provided that both places are in the same distributor's area of operation. In this case and based on Council of Minister’s decision number 04/77/17 of the year 2015, the distributor will deduct 10% of the produced electricity as transmission fees.
B. The beneficiaries of Item (A) have to comply with all other rules and instructions that regulate renewable energy projects that are connected to the electricity network with a Net – Metering system.

4.1.6. Procedures

A. Submission of the application

- Those who wish to participate must apply to the distributor using a special form, in which there will be information about the prosumer and his project including: prosumer’s current electricity subscription, financial status vis-à-vis the distributor, information about his project capacity and the place to install it and some other information and supporting documents.
- The new prosumer will pay an application fee of 70 NIS (20 USD).
- The new prosumer should provide the distributor with a preliminary study of his project including project designs and details of the point of connection after the initial approval.

B. Study of the Application

- The Distributor will study the application within 30 days from the date of submission.
- The impact of connecting the project to the distribution network and the extent to which the project meets the technical conditions should be studied.
- If there are comments on the project, the prosumer will be notified within ten days of the completion of the study.

C. Connection Agreement

- After the prosumer has modified the application based on the distributor's remarks, or if the application is in accordance with the distributor's conditions, he may sign the connection agreement according to a specific model agreement.

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- The prosumer shall commence the implementation of the Project and shall complete it within six months from the date of signing the Agreement. If the prosumer does not comply with this period, the Agreement shall be deemed null and void.
- The Distributor shall have the right to extend the implementation period at the request of the prosumer and for an additional period of three months only.

4.1.7. Inspection, Connection and Operation

A. The prosumer shall request to connect the project after filling out a request for inspection and connection from the distributor according to a model prepared for this purpose.
B. The distributor shall check the compatibility of the project with conditions applied within 20 days for a non-refundable inspection fee of NIS 50 and NIS 150 for a single-phase[22] or a 3-phase meter[23], respectively.
C. In case the project does not comply with the technical conditions, the prosumer shall amend his project in accordance with the distributor's remarks within one month only, and submit a new inspection and connection request according to item (2).
D. If the project complies with the technical conditions of the distributor, the distributor must connect the project to the distribution network and operate it for a non-refundable connection fee of NIS 50 and NIS 150 for a 1-phase or a 3-phase meter, respectively.

4.1.8. Distribution and prosumer relationship

A. Connection costs: The prosumer shall bear all costs to connect the project to the approved point of connection from the Distributor.
B. Limitation of liability: The Subscriber shall be directly responsible for the operation and maintenance of the Project and up to the Connection Point. Therefore, the Distributor shall not be liable for any damages caused by any fault, error, change or misuse of the Project.
C. Disconnection of the Project: The distributor may temporarily suspend the renewable energy Project/system based on the following conditions without any financial obligations;

- In the case of programmed interruption of the distribution system and after notice to the user.
- In case of unplanned interruptions or emergency conditions on the distribution system.

D. The distributor may carry out periodic inspection of the project to monitor its compliance with the technical conditions. If the project does not comply with these standards, the prosumer shall adjust the project conditions according to the comments submitted by the distributor.
E. In case the prosumer does not comply with the technical notes, the distributor may

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[22]Single Phase power is a two wire Alternating Current (AC) power circuit. Most people use it every day because it's the most common household power circuit and powers their lights, TV, etc. Typically, there's one power wire and one neutral wire and power flows between the power wire (through the load) and the neutral wire. In the US, 120V is the standard single-phase voltage with one 120V power wire and one neutral wire. In some countries, 230V is the standard single-phase voltage with one 230V power wire and one neutral wire.
[23]Three Phase power is a three wire Alternating Current (AC) power circuit. Most commercial buildings use a 3 Phase 4 Wire 208Y/120V power arrangement because of its power density and flexibility. Compared to single phase, a 3-phase power arrangement provides 1.732 (the square root of 3) times more power with the same current and provides (7) power circuits.

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disconnect the project from the distribution network without any financial obligations. If the prosumer modifies the project based on the comments made by the distributor, the distributor will re-connect the project according to the item D-4 above.

F. In case the prosumer wishes to suspend the project connected to the network temporarily, he/she shall notify the distributor five days before the day of commencement of the suspension period.

G. In case the prosumer wishes to suspend the project connected to the network permanently, he/she shall notify the distributor five days before the day of commencement of the suspension period and clarify the reasons for this suspension within the notice.

4.2. Objectives of net metering in Palestine

Net metering policy in Palestine has no specific quantitative targets. However, it supports, in general, the achievement of the 2020 and 2030 targets. However, this report's findings show that almost 41% of the renewable energy production in 2020 will be through Net metering projects.

As part of the assessment of the policy rationale for and objectives of a net metering programme in Palestine, a brief analysis of the potential Net metering contribution to meeting national renewable energy targets and examples from other countries of ways in which it could have economic development benefits is provided.

4.2.1. Net metering contribution to renewable energy targets

Palestinian national Energy strategy aims at 10% of renewable energy in the total energy mix by the year 2020, which can be met by the implementation of an ambitious suite of policy measures of which net metering could be an integral component. And since the main renewable energy source in the national energy strategy for renewables will be the solar energy, net metering could make an important contribution.

Unfortunately, the Palestinian Energy Strategy didn't set a specific target for each renewable energy source or technology which is limiting the ability to analyze the effect of Net metering within the general renewable energy policy quantitatively.

According to the Palestinian Electricity Regulations Council (PERC), the total renewable energy projects' installed capacity was 4,308 KWp, 6,015 KWp, and 11,843 KWp for the years 2015, 2016, and 2017, respectively.

While the total Net metering installed capacity was 5,483 KWp as of the end of 2017 with a total production of 6,715,199 KWh, It should be noted that these statistics are provided for 5 Electricity distribution companies out of 6[24] as follows;

- Jerusalem District Electricity Company "JEDCO".
- Northern Electricity Distribution Company "NEDCO".
- Hebron Electric Power Company "HEPCO"
- Southern Electricity Company "SELCO", and
- Tubas District Electricity Company "TEDCO"

Description	Unit	2015	2016	2017
Renewable Installed Capacity	KWp	4,308	6,015	11,843

[24] Gaza Electricity Distribution Company (GEDCO) is not included

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Renewable production	KWh	5,792,000	7,104,000	13,648,733
Net Metering Installed Capacity	KWp	0	2,919	5,483
Net Metering Production	KWh	0	3,164,435	6,715,199

Table 6. Renewable Energy and Net – Metering capacities for the period (2015-2017)[25].

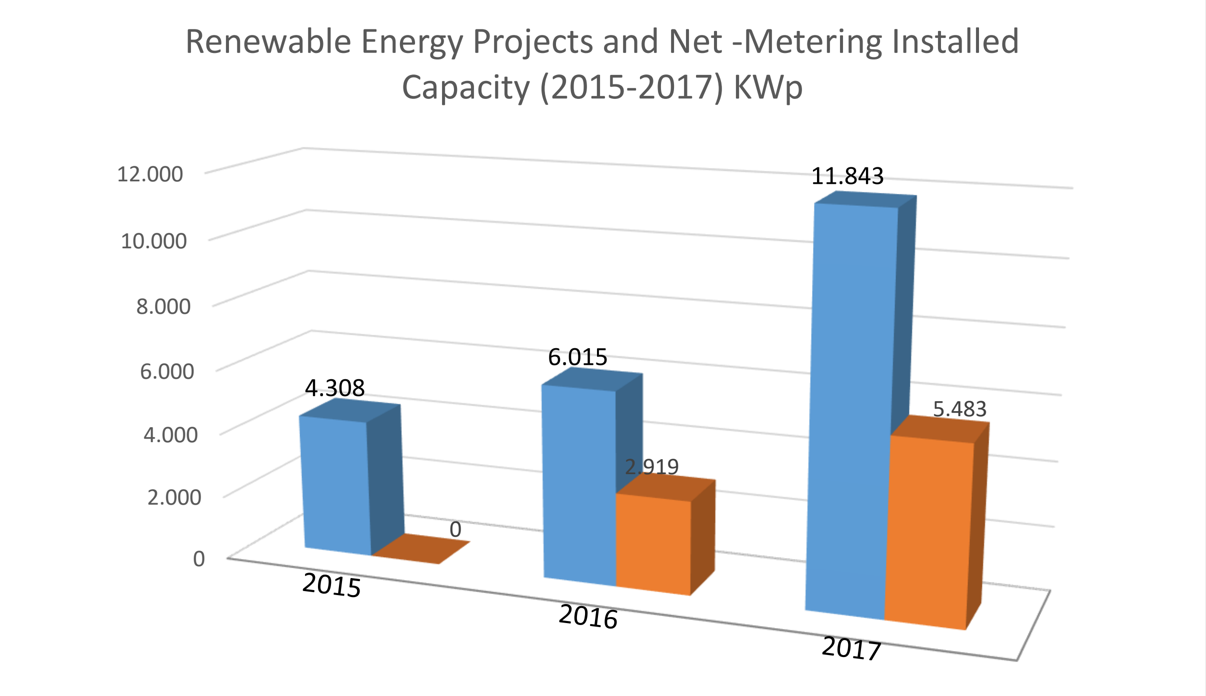

Figure 3. Renewable Energy and Net – Metering capacities for the period (2015-2017)

4.2.2. Net metering contribution to economic development, technology innovation, local industry and job creation

Of the several countries analyzed, many consider economic development and related aspects such as job creation as a prime motivation for the implementation of net metering. While information on the actual contribution is scarce and listed achievements may not be solely attributable to net metering per se, the following findings give some examples of economic benefits:[26]

In Tunisia, with 739 prosumers and approximately 1.3 MWp of solar PV under net metering as of February 2012, the programme had facilitated the emergence of 30 new solar PV installation companies. The success is partially due to investment subsidies provided by the government. Furthermore, the market potential with an initial target of 15 MWp led to the establishment of the first unit of a solar PV module manufacturing facility with an annual capacity of 25 MWp.

In the United States, more than 3,500 MW of decentralized capacity, mostly under net metering across more than 300,000 prosumers as of December 2012, gives an indication the level of demand from distributed solar PV generation that helps support almost 120,000 “solar worker” jobs in the country with a November 2012 12-month employment growth rate of 13.2% against

[25] According to PERC key indicators statistics received on 2nd April 2018.
[26]Unless otherwise referenced, the findings are taken from the country overviews, where references for each are available.

2.3% for the American economy as a whole.[27] Of these jobs, 26,000 are in California, where it is noted that the success in generating employment is due to the diversity of the positions available in the industry: design, manufacturing, sales and marketing, installation and maintenance. As biomass and biogas were only more recently (2011) included as eligible project types in California, further economic benefits are expected to accrue in the farming sector where agricultural residues can be used to generate power for own consumption and grid export under net metering.[28] The job count does not include indirect employment such as financial service providers and government positions to oversee and support the sector. While there are other drivers behind the industry and job growth (such as funding incentives), it is arguable that net metering mechanisms are playing an important role.

Other benefits in California, in particular, include the availability of peak-coincident solar energy and enhanced resilience to unexpected supply interruptions, both of which have positive economic impacts. On the other hand, including distributed solar PV under net metering has played a role in the application denial of at least one proposed 100 MW natural gas power plant, which may have had negative financial repercussions for the company involved.

An additional example that looks beyond the case studies we analyzed concerns Sri Lanka, where, due to potential national and regional demands from net metering and other programs, the Lanka Electricity Company, the smaller of the two utility companies in the country, has established a domestic high-tech energy meter manufacturing facility with an annual production capacity of 500,000 units. The factory can make both electromechanical and electronic meters of single or three-phase and can produce polyphase meters, smart meters, pre-paid meters, automatic or remote meter reader-enabled meters and Broadband Power Line (BPL) meters. This has also helped the utility to diversify its business interests and revenue streams.

There are undoubtedly further examples. The small selection provided here nevertheless shows why some countries took national economic considerations into account when adopting net metering.

4.3. The potential market for net metering in Palestine

4.3.1. Electricity maximum load and Palestinian renewable energy target projection

As was explained in items 4.2 and 4.3.1, there are no specific targets for net metering in Palestine; so, it was also very difficult to get information on the daily electricity dispatch since Israeli Electricity company is still controlling the network, and there is no long history for PV information. This being the situation, we will make some assumptions with regard to the market estimation:

- The overall load measured for five distribution companies and provided by PERC will be considered as the whole electricity market.

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[27] The Solar Foundation website. National Solar Jobs Census, November 2012, http://thesolarfoundation.org/research/national-solar-jobs-census-2012- accessed 25 August 2013.

[28] Weissman, Steven and Nathaniel Johnson, February 2012, *The State wide Benefits of Net metering in California & the Consequences of Changes to the Program*, University of California, Centre for Law, Energy and the Environment, net metering

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- Power factor is 0.92 for low voltage according to PERC.
- The increase in electricity demand is estimated by PERC at 8% annually which makes the highest total demand in 2020 is expected at 994 MVA (914.5 MW).
- The average load in the year 2020 will be around 764 MVA (703 MW)
- If Palestine is targeting 10% renewables in 2020, this will be around 70.5 MW based on the average load and around 91.5 MW based on the highest expected load.

Network and loads		load forecast 2017 (base)	load forecast for 2018	load forecast for 2019	load forecast for 2020
Max Load	January	726	784	847	914
	February	622	672	725	783
	March	554	598	646	698
	April	499	539	582	628
	May	464	501	541	584
	June	466	503	543	586
	July	600	648	700	756
	August	564	609	658	710
	September	572	618	667	721
	October	451	487	526	568
	November	570	616	665	719
	December	610	659	711	768

Table 7. Electricity load forecast for five distribution companies till 2020 in MW[29]

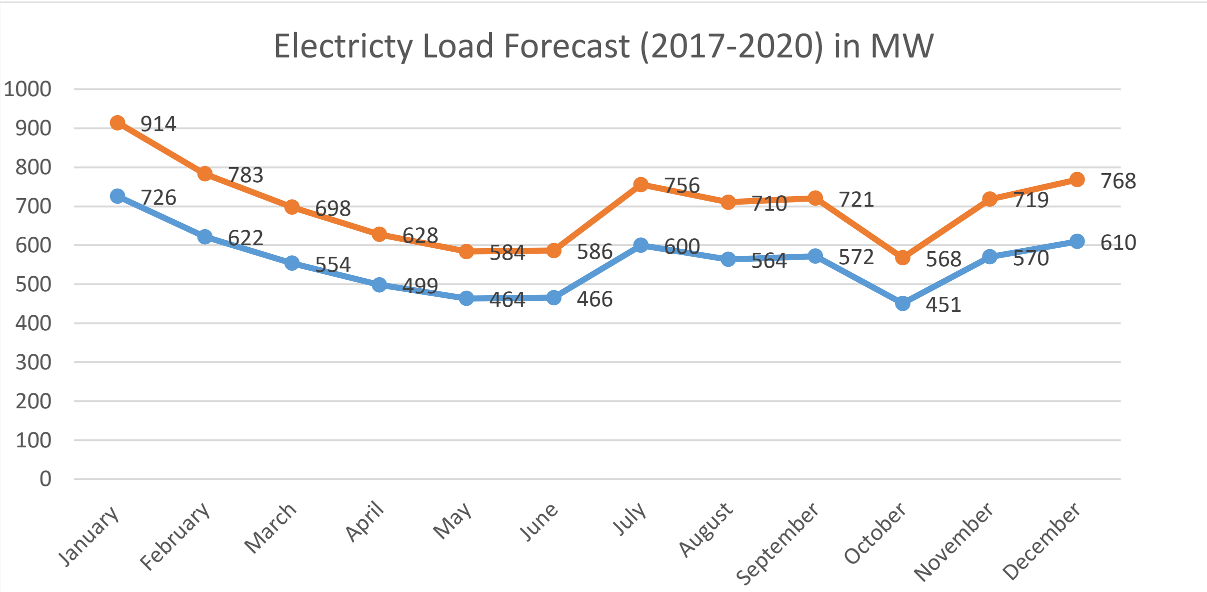

Figure 4. Electricity load forecast till 2020 in MW.

4.3.2. Estimation of renewable energy production and net metering

[29] Calculated based on 2017 actual statistics received from the Palestinian Electricity regulations council on 4th March 2018.

market size

In this section, we will be looking at the actual renewable energy installations in Palestine and projecting the size of the market for years to come until 2020 with a clear focus on Net metering according to PERC statistics for the years from 2015 to 2017 and for the monitored five distribution companies. Based on these statistics, we will make an estimated projection for the RE in the following years until 2020 to estimate the size of Net metering by 2020.
The table below shows this projection which was done based on the information received from PERC and the following assumptions:

- Renewable energy installed capacity is projected by taking an average annual increase of 112 %[30].
- Renewable Energy Production is projected by taking an average annual increase of 104%[31].
- Net – Metering capacity is projected by taking an average annual increase of 94 %[32].
- Net – Metering production is projected by taking an average annual increase of 106 %[33].

Projection results show that the RE market size in Palestine will be around 113 MW in 2020 and, according to the load figures shown in the previous section, the RE capacity will reach almost 12.4 % (2.4% above the target) of the highest projected load and around 16 % from the average annual load in 2020 (6% above the target).
On the Net – Metering side, and as shown by the projection, Net metering installed capacity will reach around 49MWp in 2020 which represents 51.8 %, 47.3% and 43.3% of the RE projected capacity in 2018, 2019, and 2020, respectively. But on the production side, Net metering will represent around 40.5%, 40.6%, and 41%, of the projected RE production in years 2018, 2019, and 2020, respectively.

Years	2015	2016	2017	2018	2019	2020
Renewable Installed Capacity (KWP)	4,308	6,015	11,843	25,127	53,313	113,116
Renewable production (KWH)	5,792	7,104	13,648,733	27,969,864	57,317,652	117,459,034
Net Metering Installed Capacity (KWP)	NA	2,919	5,483	13,021	25,247	48,954
Net Metering Production (KWH)	NA	3,164,435	6,715,199	11,294,980	23,267,659	47,931,377

Table 8. Renewable energy Production and Net metering Market Size Projection[34].

30 The annual increase percentage for projection is calculated as the average of installed capacity increase between 2015 and 2017 according to PERC Statistics.
31 The annual increase percentage for projection is calculated as the average of RE production increase between 2015 and 2017 according to PERC Statistics.
32 The annual increase percentage for projection is calculated as the average of Net metering installed capacity increase between 2016 and 2017 according to PERC Statistics.
33 The annual increase percentage for projection is calculated as the average of Net metering production increase between 2016 and 2017 according to PERC Statistics.
34 Calculated based on 2015, 2016, 2017 actual statistics received from the Palestinian Electricity regulations council on 4th March and 2nd April 2018.

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5. The technical impact of net metering on Palestinian power grid

This section investigates the high-level technical impact that net metering might have on the stability of the Palestinian grid, with the objective of identifying any constraints on the endorsement and uptake of net metering. We consider the size of the net metering market potential (at current levels and in the future) and its impact on grid operations, both from a regional and aggregate perspective. We also consider the time of supply and prosumer consumption.

In considering the impact of net metering uptake in Palestine, we assume 49 MW installed capacity of net metering systems in 2020 as shown in the table 8.

Since daily dispatch statistics are not available, it will be difficult to assess the impact of the Net metering on the peak and off-peak times during the daytime. Also, statistics received don't show the monthly net metering production, but the annual production and capacity. The projection related to the load impact will be based on the main assumption that Net metering monthly production will be measured according to the annual percentage of net metering production to the total load in the years 2017, 2018, 2019 and 2020 as shown in the figure (3) below.

The net metering installed capacity will represent 1.66%, 2.98%, and 5.36% from the average annual load of 2018, 2019, and 2020, respectively.

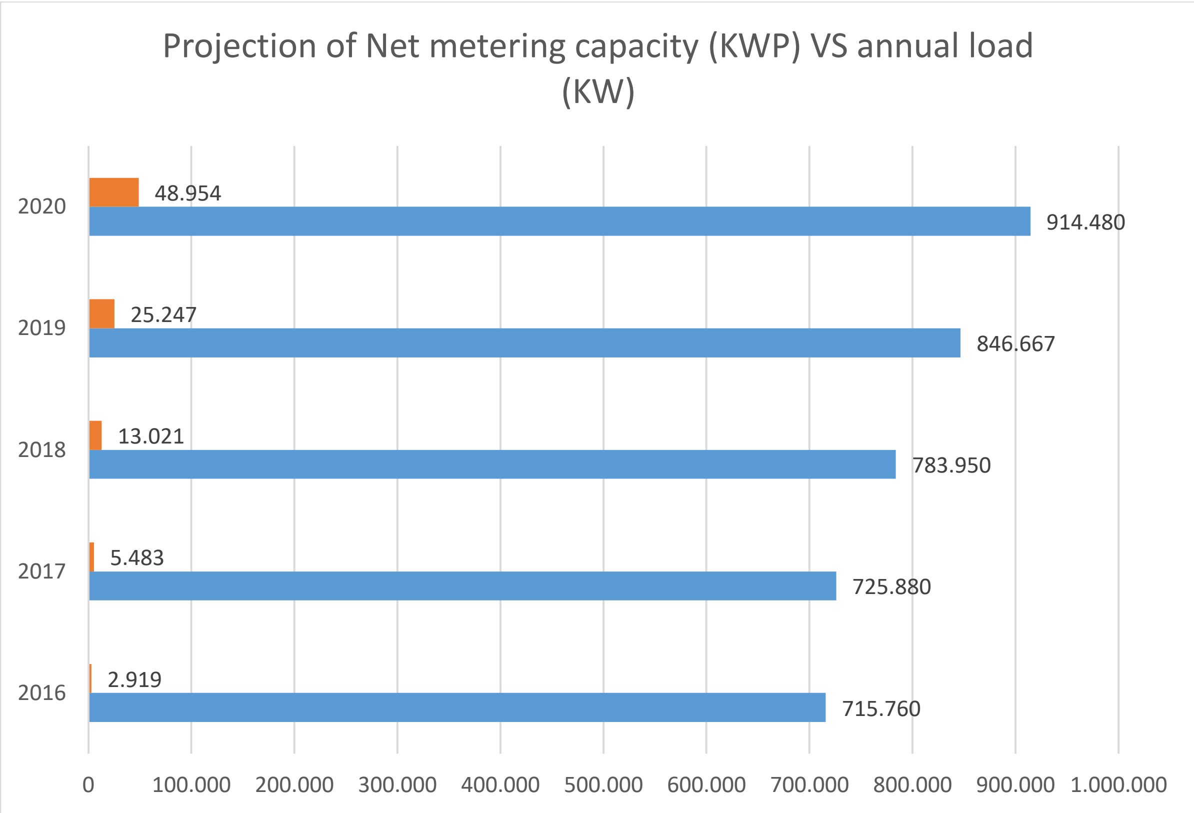

Figure 5. Projection of Net – Metering Capacity (KWp) VS Annual Load (KW).

Taking into consideration the results of previous projections and analysis, the projected RE production of 117 MW and net metering projected production of almost 48 MW by 2020 will:

- Displace/Replace purchased power from the Israeli Electricity company “IEC”; and

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- Reduce the annual load of 2018, 2019, and 2020 by 1.66%, 2.98%, and 5.36% respectively; and
- Contribute a maximum of 41 % of the RE production load by 2020.

We can also observe that net metering will not make a significant contribution to power generation during peak demand hours based on the current load profile and generation mix.

Year	Max Load (MVA)	Max load (KW)	Net metering (KWp)	%
2016	778	715,760	2,919	0.41%
2017	789	725,880	5,483	0.76%
2018	852.12	783,950	13,021	1.66%
2019	920.29	846,667	25,247	2.98%
2020	993.91	914,480	49,000	5.36%

Table 9. Net metering capacity and load displacement projection.

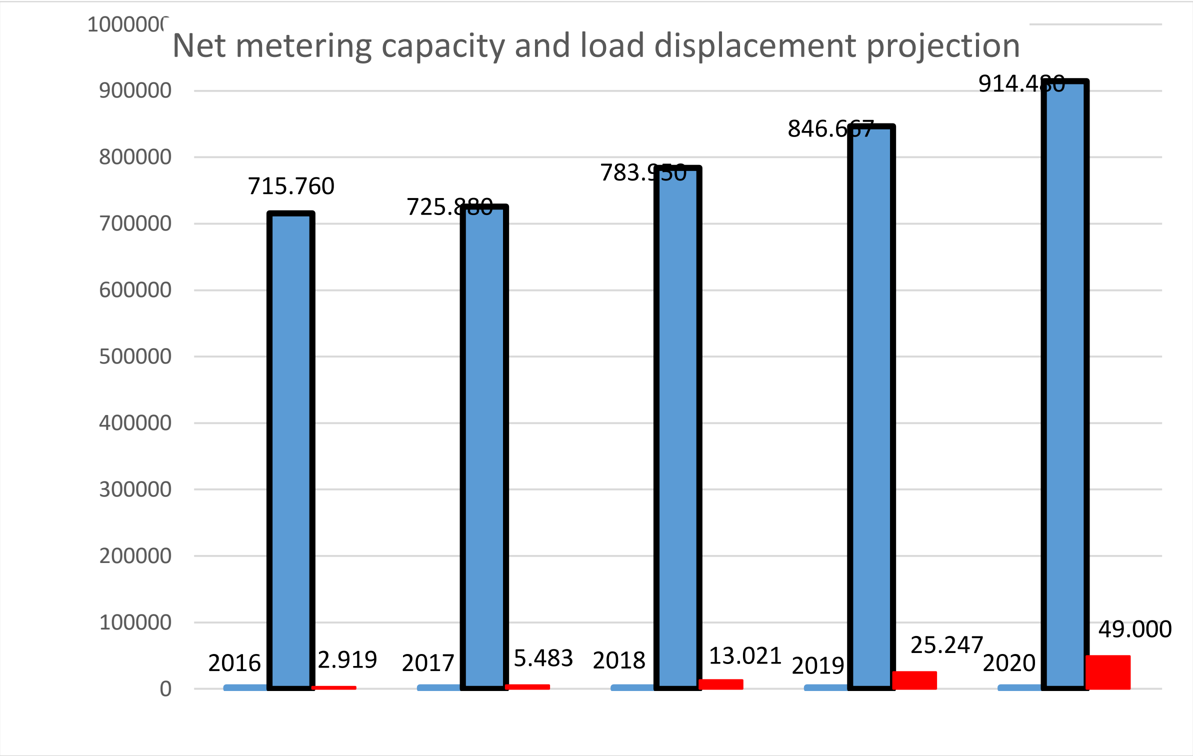

Figure 6. Net metering capacity and load displacement projection.

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6. The economic impact of net metering on Palestinian power sector

In this section, we identify and quantify the possible positive and negative economic impacts of introducing net metering on Palestine Power.
Also, net metering will also have wider impact on Palestine society. These include:

- **Economic development:** through technology innovation, local industry, and job creation.
- **Environmental benefits:** net metering would displace thermal generation from diesel or heavier fuels. This would have positive environmental benefits as emissions of CO2, NOx, SOx and PM are reduced.[35]

6.1. Calculating the costs and benefits

We evaluate the impact of net metering on the utility from a rate impact perspective based on the methodology proposed by the Solar America Board for Codes and Standards (SABCS 2012)[36]. This approach includes some aspects of the "Utility Cost Test" as described in Utility and Prosumer Economic Impacts of Net Metering for Distributed Renewables (NERA 2013) but differs from alternatives such as the Total Resource Cost test[37]. A generalized approach to rate impacts was selected for this assessment due to the inclusion of a selected range of considerations in determining costs and benefits with some emphasis on the utility perspective and its focus on the experience in the US, which has the most studies on the impacts of net metering.
The costs of net metering are often argued to be the utility's lost revenue and any associated administrative costs. Every kilowatt-hour (kWh) generated by a net metering prosumer means one less kWh sold by the utility at retail rates. The retail rate in question depends on the type of prosumer. Residential and small commercial prosumers (DC and SC) have a bundled rate that covers both their utility's fixed and variable costs, while large commercial and industrial prosumers have an "energy" charge based on kWh for variable costs, and a "demand" charge based on the prosumer's peak usage, measured in kVA, for fixed costs.
On the benefits side of the rate impact calculation, the three studies reviewed in SABCS 2012 indicate that net metering allows utilities to save fuel expenses, avoid some line losses, and release at least some capacity benefit.
The analysis and results of such studies are utility-specific, but the methodology should not be. If benefits exceed costs, then regulators may want to consider lifting restrictions on net metering and crediting net metering prosumers for the net benefits they provide. If costs exceed benefits, then other ratepayers are subsidizing net metering prosumers, and regulators must decide whether externalities such as reduced pollution, job creation, and resource diversity justify the subsidy.
For the specific case of Palestine, the benefits and costs of net metering shown in Table 5

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[35] Assuming diesel consumption of 500L/MWh, 100 MWp of solar PV would have the potential of displacing almost 90,000 cubic meters of diesel per year. Avoided CO2 emissions would amount to approximately 230,000 ton CO2/year. Given the prolonged downward trend in prices for Certified Emission Reductions, CO2 emission reductions are not expected to have a significant contribution to NEM benefits in monetary terms.
[36] Keyes, Jason B. and Joseph F. Weidman (January 2012). A Generalized Approach to Assessing the Rate Impacts of Net Energy Metering. Solar America Board for Codes and Standards Report.
[37] Heidell, Jim and Mike King (June 2013). Utility and Prosumer Economic Impacts of Net Metering for Distributed Renewables. NERA Economic Consulting paper.

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have been identified, and many of them are quantified in the following sub-sections.

Benefits to the Utility	Costs to the Utility
Avoided energy purchases	NEM Bill Credits
Avoided T&D losses	Programme administration
Avoided capacity purchases	Connection/approval costs (meter, technical inspection, etc.)
Avoided T&D Investments and O&M	Power planning/system reconfiguration
Avoided RES Generation Purchases	
Reliability benefits	

Table 10. List of benefits and costs of Net metering to Palestine Power Sector.

6.2. Benefits Calculations

6.2.1. Avoided energy purchases

This section analyses what source of energy is being displaced by RE energy production and in particular Net metering and its associated cost.

While in countries that generate electricity, the Power purchase costs are divided into basic costs which are aimed at paying fixed and variable costs of the power generators excluding fuel costs, and fuel costs. In Palestine, most of the electricity is imported from Israel, and there is no real electricity generation. So, the following two main points should be noted:

- Assuming that transmission and distribution fixed costs cannot be offset/displaced by net metering, only purchased electricity cost has been considered relevant;
- In calculating the Avoided Energy Purchases, a flat rate of 0.3792 NIS per KWH was used; this flat rate is provided by PERC.

This will lead us to modify the model as follows:

Power cost = purchase cost from IEC + variable cost of the transmission and distribution

With this model, the purchased electricity from Israeli Electricity Corporation IEC will be displaced partially with RE production, net metering included.

Table 11 below shows the annual avoided energy purchases by RE production and Net metering, in 2016 and 2017, Palestine avoided electricity costs of 1,199,954 and 2,546,403 NIS respectively. In 2020, Palestine will avoid buying electricity that will cost 18,175,578 New Israeli Shekels equal to 5,086,326.45 US Dollars.

Year	Purchased Electricity in KWH	RE Production (KWH)	%	Avoided Electricity Purchased NIS	Net metering Production (KWH)	%	Avoided Electricity Purchased NIS
2015	3,350,676,304	5,792,000	0.17	2,196,326	0	0	0
2016	3,526,891,928	7,104,000	0.20	2,693,837	3,164,435	0.09%	1,199,954
2017	3,732,181,032	13,648,733	0.37	5,175,600	6,715,199	0.18%	2,546,403
2018	3,918,790,084	27,969,864	0.71	10,606,172	11,294,980	0.29%	4,283,056
2019	4,114,729,588	57,317,652	1.39	21,734,854	23,267,659	0.57%	8,823,096
2020	4,320,466,067	117,459,034	2.72	44,540,466	47,931,377	1.11%	18,175,578

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Table 11. Annual Avoided Electricity purchase projection[38].

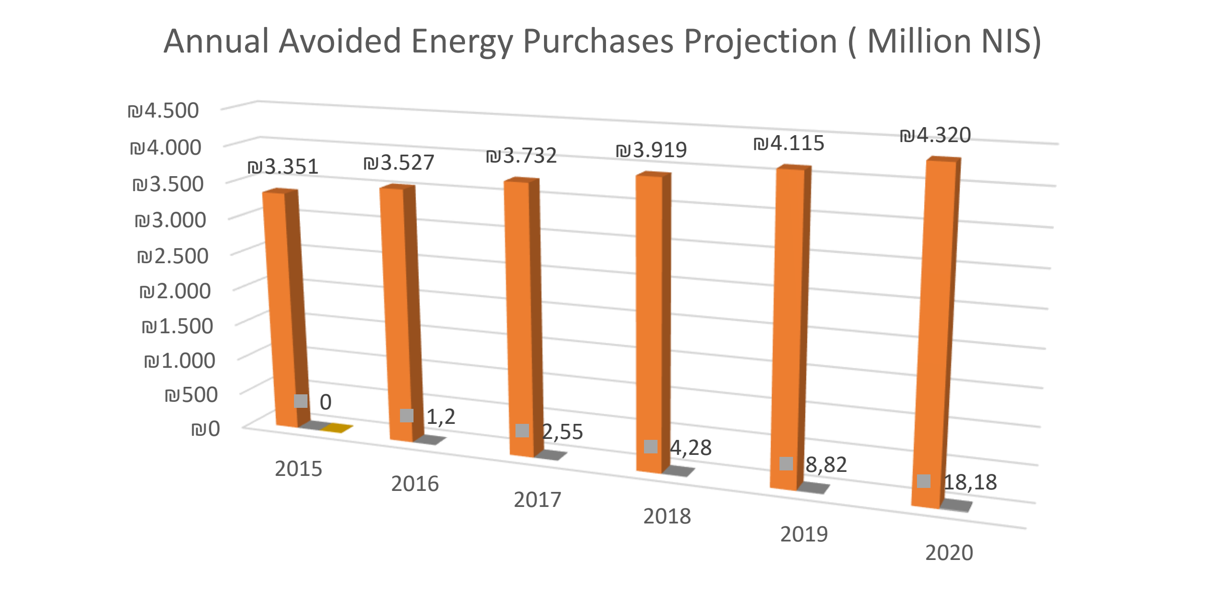

Figure 7. Annual Avoided Electricity purchase projection (Million NIS).

6.2.2. Avoided transmission and distribution losses

No matter which type of generation is offset, line loss savings are an important benefit of net metering. According to the Palestinian Electricity Regulation Council (PERC), system losses accounted for 22 % to 23% of total energy supplied. The high T&D losses are the result of the electricity distribution network problems.

Table 12 below shows the expected total losses for the years 2018, 2019, and 2020 based on the information received from PERC on losses for 2015, 2016, and 2017.

The total losses in Palestine are divided into: Black losses of around 50 % and Technical loses of around 50%[39],

Year	Total losses (NIS)	Annual Black losses (NIS)	%	Annual Technical Losses (NIS)	%
2015	349,000,000	174,500,000	50%	174,500,000	50%
2016	331,000,000	165,500,000	50%	165,500,000	50%
2017	370,000,000	185,000,000	50%	185,000,000	50%
2018	331,000,000	165,500,000	50%	165,500,000	50%
2019	331,000,000	165,500,000	50%	165,500,000	50%
2020	331,000,000	165,500,000	50%	165,500,000	50%

Table 12. Projected total transmission and distribution losses including VAT.

In contrast, net - metering generation occurs at the prosumer's site, with almost no line loss. Excess generation from a net metering facility can be expected to be consumed by neighboring consumers with negligible line losses (there are very modest losses associated with excess generation stepping up to utility line voltage then back down when used nearby on the same

[38] All costs calculated numbers are VAT excluded.
[39] According to PERC on 10th April 2018.

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circuit).
An average of 22% T&D losses has been used for the years 2018, 2019, and 2020 to estimate and value avoided T&D losses.This does not consider fixed and unavoidable T&D losses (such as transformer losses) that may not be addressed by distributed generation. However, Net metering system "lost" production due to grid downtime will not be considered in the analysis.
The estimated avoided transmission and distribution losses for the years 2015, 2016, and 2017 were calculated according to PERC key indicators report for the power sector in Palestine; these losses were at 349, 331, and 370 million NIS for the mentioned years, respectively. And they are projected for the years 2018, 2019 and 2020 at 22% annually or 331 million NIS per year.
To take better account of fixed and unavoidable T&D losses while also recognizing the impact of lost net metering production due to grid downtime estimated at 4 – 6.5% based on the net metering international experiance, an average of 5.25% will be considered for Net -Metering Technical losses.
The estimated technical losses that could be avoided by Net metering are shown in the table 13 below;

Year	Net Metering Production KWH	Net - Metering Production in NIS	Net metering Possible Technical Losses (5.25%)	Total Avoided Technical Losses NIS	% of Technical losses	% of Total losses
2015	0	0	0	0		
2016	3,164,435	1,403,946	73,707	80,727	0.05%	0.02%
2017	6,715,199	2,979,292	156,413	171,309	0.09%	0.05%
2018	11,294,980	5,011,176	263,087	288,143	0.17%	0.09%
2019	23,267,659	10,323,023	541,959	593,574	0.36%	0.18%
2020	47,931,377	21,265,426	1,116,435	1,222,762	0.74%	0.37%

Table 13. Projected total avoided transmission and distribution losses[40].

[40] All costs calculated numbers are VAT included, VAT was considered at 17% as the losses were calculated considering the VAT on the electricity purchases from Israeli Electricity corporation.

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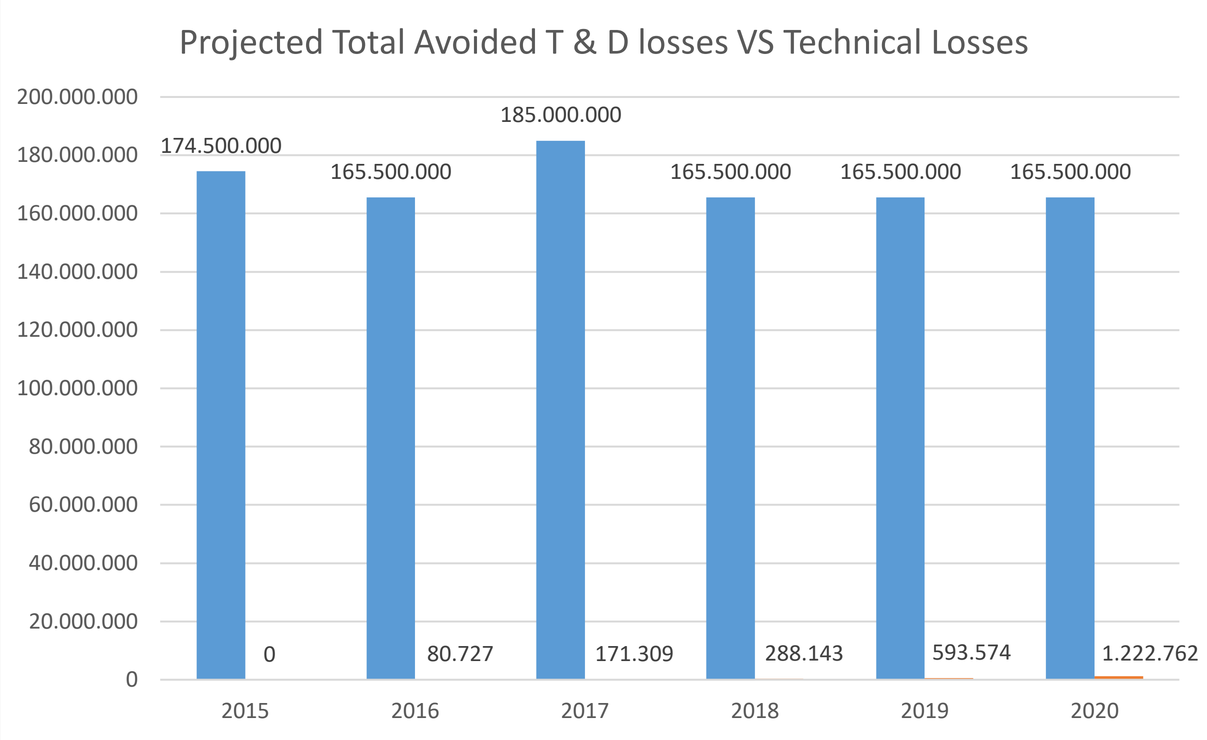

Figure 8. Projected total avoided transmission and distribution losses.

6.2.3. Avoided capacity purchases

As already mentioned in this report, there is no detailed information about peak and off-peak time and electricity dispatch for the whole Palestinian power system to give any indication. But for orientation purposes, the below mentioned Israeli and United States cases provide an overview of the avoided capacity purchases.

Figure (7) shows the peak and off-peak times for 20% of the prosumers of Jerusalem Electricity distribution company where:

- The peak demand occurs typically in the late afternoon/evening (16:00 – 22:00) in winter (December-February) with a total of 6 hours per day, 540 hours in the whole season.
- The Peak demand occurs almost all day (06:00-20:00) in the transition season (March-November), 14 hours per day and 2982 hours in the whole period;
- The Peak demand occurs 7 hours during the daytime in summer (July-August) which accumulating 434 hours.

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Winter season (Dec, Jan, Feb)		Hours of the Day																							
	From	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	To	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Weekday	Off Peak						Mid Peak		Off Peak								On Peak						Off Peak	
	Fri, and holiday eve*	Off Peak																Mid Peak				Off Peak			
	Sabbath and holiday*	Off Peak																	On Peak		Mid Peak		Off Peak		
Transition season (March, Apr, May, Jun, Sept, Oct, Nov)		Hours of the Day																							
	From	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	To	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Weekday	Off Peak						On Peak														Mid Peak		Off Peak	
	Fri, and holiday eve*	Off Peak						Mid Peak														Off Peak			
	Sabbath and holiday*	Off Peak																	Mid Peak				Off Peak		
Summer season (Jul, August)		Hours of the Day																							
	From	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	To	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Weekday	Off Peak							Mid Peak			On Peak							Mid Peak				Off Peak		
	Fri, and holiday eve*	Off Peak																							
	Sabbath and holiday*	Off Peak																							

Figure 9. Peak and off-peak Electricity Demand by Jerusalem Electricity Distribution company.

Net metering studies for different utilities in the USA were reviewed, and they all differed in their treatment of capacity benefits. A study by the Interstate Renewable Energy Council in the USA (IREC 2012) states that capacity benefits can be considered real and incremental, with aggregate distributed solar generation far more stable and predictable than the obviously intermittent nature of individual solar facilities. However, without historical data for renewable energy in the Palestinian grid, the estimation of capacity benefits would be contentious. At this stage, capacity benefits are not quantified, and it is proposed to consider these at a later stage after grid-connected renewable Energy projects reach a greater scale in Palestine.

6.2.4. Avoided transmission and distribution “T&D” investments and operations and maintenance “O&M”

T&D investment deferrals stem from decreased prosumer load at the feeder, substation, and transmission levels, and can include deferrals of investment and postponing of investment in T&D upgrades. Same as for avoided capacity purchases, with peak demand occurring mostly in the evening, the benefits of Net metering in avoiding T&D investments can be considered negligible at this point.

6.2.5. Avoided Renewable Energy Sources “RES” generation purchases

Net metering is viewed as a means by which countries can achieve renewable energy targets. When these targets are mandated by law, the value of avoided RES generation purchases can be quantified. In Palestine, the renewable energy production quota or commitment is 10% from the energy mix by 2020, but there are no quantitative targets for each RE technology, including net metering.

6.2.6. Reliability benefits

The ability of decentralised generation to provide ancillary services and VAR support has been widely acknowledged for inverter-based systems. However, the output voltage is typically pre-set rather than being reactive to utility grid voltage, so the ability to provide support is not used at present.
However, this ability is very likely to be tapped, at least for larger solar facilities and could add significant value. Previous studies for utilities in the USA (IREC 2012) have set VAR support and backup power values at zero but properly directed that those values should be estimated. At this stage, and without substantial grid-connected solar PV history in the Palestinian system, this benefit is not quantified and will be left for future analysis.

6.3. Calculation of costs

6.3.1. Use of net metering bill credits during peak times

When net metering prosumers produce energy more than their consumption and this excess is exported to the grid, the utility credits energy for these prosumers. This credit is consumed during hours when energy production from the net metering prosumer is below the energy demand. Energy credits will normally be consumed during the peak demand hours (when the cost of energy is highest) or during the night and early morning hours (when demand is low, and energy is less costly).
In Palestine, with the single buyer perspective (transmission company), most of the electricity is purchased from Israel with a flat rate tariff of 0.3792 NIS per KWH, and this rate will not change by time of use (except Jerusalem Electricity Distribution Company). The same is true for consumers who will pay a flat rate for each consumed KWH (except for 20% of Jerusalem Electricity Distribution Company).
When all companies start using time-of-use (ToU) tariffs for prosumers, and we will have the statistics of daily dispatch, we will then be able to calculate accurately how much companies are losing by selling less electricity in peak times where the prices are the highest among all times of the day. Also, ToU tariff structure would allow a transparent valuation of the energy exported to the grid by net metering prosumers versus the energy consumed at a different time of the day, in addition to the daily dispatch statistics.
However, we can try to make some indications taking into consideration the time of use tariffs that Jerusalem Electricity Distribution Company “JEDCO” is using, as they are buying and selling electricity for 20% of their prosumers using ToU. The results of this projection are shown in table 14.
Numbers show that in summer, JEDCO purchased 1 KWH for 0.9331 NIS which is considered to be the most expensive of the year, while peak time in summer is almost 58% of the consumption period.
In spring and fall, JEDCO purchases each KWH for 0.4034 NIS for almost 75% of the time which constitutes the peak time during seven months’ time.
And in winter, JEDCO is buying each KWH for 0.8548 NIS for 24 % of its consumption.
The projection shows that if Palestine uses ToU tariffs, the Net metering producer's behavior will consume the credit electricity during the peak time, mostly in summer, spring, and fall seasons when solar radiation will also be good.

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Season	Time of Use	Price per KWH	Total consumption hours	%
Summer (July & August)	Off - Peak	0.2762	620	42%
	Mid-Peak	0.4086	434	29%
	Peak	0.9331	434	29%
Total			1488	100%
Spring, Fall (March to November excluding summer)	Off - Peak	0.2701	836	16%
	Mid-Peak	0.3296	426	8%
	Peak	0.4034	3850	75%
Total			5112	100%
Winter (November to February)	Off - Peak	0.3036	1484	67%
	Mid-Peak	0.5111	184	8%
	Peak	0.8548	540	24%
Total			2208	100%

Table 14. Indicators for the use of net metering bill credits during peak times[41].

6.3.2. Programme administration costs

The other aspect of net metering costs is the utility's administrative expense. Most utilities use proprietary billing software that is costly to adapt for net metering. Therefore, in the short term, many utilities use manual billing for net metering prosumers to avoid incurring a large cost for a relatively small group of prosumers. However, over the medium to long term, changes to a utility's billing software to support evolving energy use patterns—e.g., differentiated time-of-use tariffs—will occur in the ordinary course of business. Logically, updating billing software to handle net metering programme participants can occur as part of this longer-term evolution.

At this stage, the programme administration costs have been estimated based on costs reported by utilities in the USA, where net metering has achieved scale. The IREC 2012 study indicated that reported costs reported by utilities varied significantly (between 3 and 18 USD/prosumer per month). As a first estimation, the programme administration costs have been estimated at the average of reported costs in the USA of 9 USD/prosumer/month. Costs in Palestine will most likely differ from those in the USA, as most companies are administrating the net metering scheme manually which are lowering the cost to a minimum.

According to PERC, distribution companies are still using manual billing for Net metering to avoid additional costs of the software.

6.3.3. Connection/approval costs

The cost of connection and approval of net metering systems (both for assessment/ administrative costs and hardware costs incurred by the utility) can be absorbed by the net metering prosumer as a one-time fee at the time of connection to the grid. In this way, this initial cost will not have an impact on electricity rates.

[41] Information about prices and ToU were provided by PERC.

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6.3.4. Power planning/system reconfiguration costs

If significant uptake of net metering is expected, it will need to be considered in future power sector planning whether net-metered prosumers are to be considered as generators or as negative loads. As power sector planning and system studies are already performed on a periodic basis and need to consider a range of variables, the additional burden of net metering is not expected to be significant and such costs are excluded in this assessment.

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7. The impact of net metering on government revenue

In this section, we analyze the impact on the collection of the VAT and other statutory levies.

7.1. Value-added tax (VAT)

Net metering with electricity "banking" implies that monetary transactions between consumers and the utility are minimized. The electricity that is not billed to prosumers may lead to a reduction in VAT collection from the government, especially in the case of residential prosumers. However, it may be possible to balance these losses against the VAT collected from the sales of solar or other renewable energy equipment intended for net metering.
The Value, Added Tax policy, implemented in Palestine doesn't exclude renewable energy equipment from the VAT. The implications of this policy for the net metering analysis are:

- Solar PV equipment: a VAT tax rate of 16% is applicable for all Renewable energy materials, equipment, and accessories.
- Electricity sales: a VAT tax rate of 16% is applicable for all electricity sales by authorised utilities in Palestine.

Since 16% VAT rate applies to both solar PV equipment and the electricity from Palestine power sector, the government as mentioned before could balance its VAT reduction from the use of net metering.
To analyze this impact and since information about the VAT collected by the government on the capital cost of equipment is not available to PERC, we have to consider some assumptions as follows:

- Electricity consumed directly would offset VAT charges as well, but since self-generation requires no net metering policy, the only relevant electricity transactions are those above direct consumption of electricity.
- Only one-third of the electricity produced is exported to the grid. The other two-thirds is consumed directly.

As shown in the table 15 below, and taking into consideration the above assumptions, the VAT that will be offset by Net metering prosumers will be calculated on 33% of the Net metering production as projected in the table (3) of this report. The governmental VAT reduction will be 228,430, 470,565, and 969,364 NIS for the years 2018, 2019 and 2020, respectively.

Year	Net metering Production (KWH)	Net metering Production (NIS)	Consumed by Prosumer (NIS)	%	Exported to the NW	%	VAT Reduction (NIS)
2015	0	0	0	0	0	0	0
2016	3,164,435	1,199,954	799,969	67%	399,985	33%	63,998
2017	6,715,199	2,546,403	1,697,602	67%	848,801	33%	135,808
2018	11,294,980	4,283,056	2,855,371	67%	1,427,685	33%	228,430
2019	23,267,659	8,823,096	5,882,064	67%	2,941,032	33%	470,565
2020	47,931,377	18,175,578	12,117,052	67%	6,058,526	33%	969,364

Table 15. Projection of Value Added Tax offset by Net metering

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7.2. Other statutory levies

In Palestine, distributors are not collecting any governmental statuary levies other than the VAT (16%).

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8. Conclusion and policy recommendations

8.1. Policy recommendations

- As there is no specific target for the net metering policy in Palestine, we recommend identifying a quantitative and clear target for net metering policy in Palestine for the following period of at least two years (until 2020). The target should also include a net metering capacity cap, as most countries with successful net metering programs started with a cap. Regular coordination between PERC, PEC, and PENRA is highly recommended on this issue.
- Currently, renewable energy project materials are exempted from customs duties; we recommend maintaining the current situation for at least two years until the net metering market is established and characterized.
- The policy should encourage owners of suitable existing off-grid systems to connect their systems to the grid under net metering, once the grid reaches their area and a net metering policy is in place.
- Make all renewable energy sources eligible for the programme, not only the PV which is the predominant technology deployed and discussed in the report.
- We recommend structuring the net metering programme in Palestine into 2 phases of implementation, phase (1) from 2016-2020 as a pilot phase and phase (2) from 2021 -2025. Observations and results of the pilot phase will be used to modify the policy in the second phase.

8.2. Regulatory recommendations

- Only allow banking, not payment for net exports, at least for the first phase (2016-2020) which will keep the programme administratively simple to implement, easy for prosumers to understand, and delineates net metering from feed-in tariffs (FiTs) which are paid for renewable energy generation. Currently, banking is allowed for a maximum period of one year.
- Consider simplified or automatic approval procedures for proposed net metering facilities that meet certain requirements; for instance, systems of 10 kW or less, or systems that don't inject more than 15% of shared feeder line capacity.
- The current guideline is focusing on projects at 1MW or less only; it is recommended to amend these regulations to allow all prosumer classes to install net metering systems.
- Allow all renewable energy sources to be tapped through net metering, not only the solar related ones.

8.3. Economic recommendations

- Consider an annual (net metering) fee depending on the size of the PV system to increase the utility's profit.
- Continue to allow monthly carry-over of excess electricity but prevent annual payments of the utility to the prosumer.
- Set fair fees that are proportional to project's size.

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8.4. Procedural recommendations

- In order to ensure quality and safety of PV systems connected to the grid under net metering, a qualified and competent entity should be in charge of approving and inspecting all installed systems through a standardised, transparent, and efficient procedure.
- Ensure that policies are transparent, uniform, detailed, and public and that the regulation sets out the required minimum policies without over-regulating the market.
- Applications should be processed quickly; decisions should occur within a few days, not 30 days as the current regulations state.
- Categorize applications by the degree of complexity, adopt plug-and-play rules for residential-scale systems and expedite procedures for larger systems.
- Ideal procedure to commission a PV plant on net metering could be:

A. Up to a certain rated power, no permission or LV grid affirmation from the distribution company is required;
B. Either the distribution company or a technician with a certificate from the distribution company may exclusively commission the plant;
C. The investor/prosumer has to prepare a properly documented commissioning protocol provided by PERC; and
D. The Distribution Company will consider this consumer as net metering prosumer once the PERC commissioning protocol is given.

8.5. Technical recommendations

- We recommend adding a section to the Palestinian Grid Code for inverter-based generators, or generators connected to the LV grid. This would clarify the requirements for potential Independent Power Producers.
- We recommend using modern converters that comply with the Palestinian Grid Code and can perform active filtering by injecting compensating current harmonics, reactive power control, voltage level control, phase symmetry control, reduce losses at the transmission and the distribution grid, support the grid during disturbances (Fault-Ride-Through Capability), and balance non-symmetric loads.
- In the short term, for low PV capacities, PV can be directly used through net metering without any adverse impact on the power system. On a mid-term basis, settings for frequency bands and over frequency behaviour should be adapted to the general network settings.
- Prohibit requirements for extraneous devices, such as redundant disconnect switches, and do not require additional insurance.
- Take into account the continuous updating of Technical standards and requirements for PV and net metering systems, especially the European technical standards.
- To guarantee economic returns for prosumers' power generation as projected for the utility and minimal grid stability hazards, it is of utmost importance to prescribe high-quality installation and service standards for the grid-connected PV systems.
- The quality control of the installed systems should be ensured through a procedure as described above, under the supervision of PERC.

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8.6. Capacity development recommendations

- It is recommended that key personnel responsible for distribution networks should be trained to be aware of a grid supporting potential of the new inverters and to use it for the benefit in their specific grid situation.
- Developing PV market requires a strong available capacity for services. Therefore, capacity building of technicians on design and installation of grid-connected PV systems is strongly recommended.

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Annex 1 – List of abbreviations

Term	Definition
BOO	Build, Own, Operate
CFE	Comisión Federal de Electricidad – Mexico
CHP	Renewables – bar large hydro –, Combined Heat and Power
CNMC	Spanish National Regulatory Authority
EgyptERA	Egyptian Electricity Regulator
Fit	Feed-in Tariff
FNME	Tunisian National Energy Management Commission
GEF	Global Environment Fund
HEPCO	Hebron Electric Power Company
Hz	Hertz
IEC	The Israeli Electricity Corporation
IOU	Investor-owned utilities
IPP	Independent Power Producer
JDECO	Jerusalem District Electricity Company
KW	Kilowatt
kWh	Kilowatt- hour
KWp	Kilowatt Peak
LV	Low Voltage
MW	Megawatt
MWh	Megawatt hour
MWp	Megawatt Peak
NEDCO	Northern Electricity Distribution Company
NEG	Net Excess Generation
NIS	New Israeli Shekels
O&M	Operations and Maintenance
PEC	Palestinian Energy and Environment Research Centre
PENRA	The Palestinian Energy and Natural Resources Authority
PERC	The Palestinian Electricity Regulations Council
PROSOL ELEC	Tunisian Programme for PV / Part from Renewable Energy Framework
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Credits
RES	Renewable Energy Sources
SABCS	Solar America Board for Codes and Standards
SELCO	Southern Electricity Company
STEG	La Société tunisienne de l'électricité et du gaz /Tunisian Company of Electricity and Gas
T&D	Transmission and Distribution
TEDCO	Tubas District Electricity company
TND	Tunisian Dinar
TOU	Time of Use
UNEP	The United Nations Environment Programme

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Term	Definition
V	Volt
VAR	Volt-Ampere Reactive
VAT	Value Added Tax

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