Urban Pathways

FACTSHEET on
Net energy metering
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In brief

Net energy metering (NEM) policy, also called 'net metering', provides a transaction arrangement between owners of distributed (energy) generation (DG) systems such as solar photovoltaic, geothermal electric, biomass etc. and the utility from which they consume energy and to which they supply energy (NREL, n.d.). Key technical component of an NEM policy is a net energy meter that calculates the net energy consumption by the DG owner from the utility grid against the energy supplied by the DG systems to the utility grid. The DG owner is compensated if the net value is negative, i.e., energy supplied to the grid is more than the energy consumed. The owner has to compensate the utility if the net value is positive, i.e., the energy supplied to the grid is less than the energy consumed. The value and mode of compensation, DG system type and capacity, billing cycle and other fine prints depend on the NEM policy. NEM is especially useful for the diffusion of DG systems, e.g., in emerging economies, where there is a limited possibility to store generated energy for later use (e.g., a battery less grid integrated solar photovoltaic system). It offers an inexpensive, an easy to integrate and an easy to understand billing concept for owners of DG systems.

Examples/measures

Key factors in framing a NEM policy are the prevailing or target DG technology, state of energy generation, grid readiness, financial implications to the utility provides as well as for the existing utility scale generators etc. Key elements of a net metering policy and few examples are described below (NCSI, n.d.; NREL, n.d.):

DG owner (or NEM consumer): Describes the eligibility criteria of consumers who wish to participate in the NEM programme. This usually depends on the profile/sector of DG owner, e.g., residential, commercial, institutional, public or private; whether the systems are on-site self owned, operated or involves third party etc.

DG type: Describes the technologies that are eligible for the NEM policy, e.g., solar photovoltaic, wind energy systems, geothermal electricity, biomass systems, micro CHCP systems etc. (DSIRE, n.d.-a).

DG capacity: Describes the capacity of the DG system, usually depending on the DG owner, DG type, and other policy caveats. The capacity can be capped at a percentage of the total connected load of the DG owner (DSIRE, n.d.-b), or an absolute limits on the minimum and maximum capacity of the system (BERC, 2015).

Compensation: Describes the way in which the DG owner is compensated for the supply of excess energy generated to the grid. This rate of compensation can either exceed the retail value of energy or be lower compared to the retail energy price as determined in the policy. In some cases a cost neutral compensation is offered.

Billing cycle: Describes the periodic credit settlement mechanism of the compensation agreed between the DG owner and the utility. This could be monthly, bi-monthly, quarterly, half-yearly or annually as described in the net metering policy or agreed in the terms of the contract.

Programme size cap: Describes a cap on total DG capacity of the NEM programme. Capacity is usually capped at a percentage, e.g., percentage of peak demand, or percentage of capacity of the distribution transformer, or it can be capped in absolute terms, e.g., cap in MW (NREL, n.d.). Further the cap can be defined at a specific geographic level, e.g., per utility area, per State etc (BERC, 2015). The cap is also defined per fixed duration, e.g., one year, 5 years, etc. and can be reviewed periodically. The cap is determined by factors such as the interaction between NEM and other policies, financial and technical im-

plications on utility provides and the existing grid infrastructure (BERC, 2015).

Aggregate and virtual net metering: Aggregate net metering allows DG owners with multiple net meters installed in a specific site or a contiguous property to aggregate net energy generation or energy consumption based on the cumulative value of the individual net energy meters. Virtual net metering provides similar facility to DG owners with off-site generation systems, e.g., credits earned though participation in shared renewable energy projects.

Renewable Energy Certificates (RECs): Describes the conditions under which the net metering policy allows DG owners issuance of RECs for the energy generated by their DG output. These are especially beneficial in the case of net metering policy that offer no compensation for excess energy supplied to the grid (cost neutral compensation) (Cox, Walters, Esterly, & Booth, 2015).

Results

NEM policy is a crucial aspect in the diffusion of distributed renewable energy systems such as solar photovoltaic systems which provides various environmental and societal benefits such as avoided greenhouse gas emissions, recued public health threats, and also aid in job creation and economic development, besides economic benefits such as avoided costs on generation and supply (Hallock & Sargent, 2015). Further, NEM offers a reliable and guaranteed mechanism that supports:

- DG owners by ensuring return on investment
- Financial institutions to provide capital investment in renewable DG systems
- Utility providers to enter into reliable contracts with DG owners and to upgrade the demand side infrastructure
- State to easily demonstrate the benefits of uptake of renewable energy systems and meet their Nationally Determined Contributions (NDCs) in reducing CO2 emissions

Technical and financial considerations
Technical

NEM policy requires the DG owners to install an net meter. This is usually provided by the utility either against a one-time payment or redeemed via utility bills as equated monthly instalments. Depending on the net metering policy, two types of meters are used: time-of-use meters and non-time-of-use meters. Non-time-of-use meters are simple net meters, which run in both directions and only measure the net positive or negative. On the other hand, time-of-use meters also measure electricity consumed from the gird at various times. Net energy meters can easily replace the existing meters. DG systems should be integrated to the grid for drawing and supplying energy. However, utilities have to ensure grid readiness for the deployment of DG systems. This is usually taken care of by the capping the NEM programme size.

Financial

The costs for deploying NEM programme are often miniscule compared to the financial implications that need to be considered after the programme has been rolled out. One key challenge to framing an NEM policy is to ensure that owners of DG systems do not shift a net cost to non generating consumers of the grid, that they do not cause loss of revenue and growth of utility; and DG owners are not exempted from the costs of grid maintenance (Hewett, 2017; Muro & Saha, 2016). California public utility commission has introduced a small compulsory non-by-passable charge for the energy consumed from the gird to address this distortion. However, some studies show that net metering polices help in fostering the deployment of DG systems, without transferring the costs to non-participating utility customers, although, with a few caveats on the modelling methods used (Price, Pickrell, Kahn-Lang, Ming, & Chait, 2014; Stanton et al., 2014). The difference in the value perception arises due to the relatively lower values attributed to the 'avoided costs by DG systems' by studies commissioned by private utilities compared to those commissioned by non-utility groups and public utilities. In addition, non-monetary environmental and non-energy costs are also usually ignored in the studies commissioned by the former (Hallock & Sargent, 2015).

Detailed cost benefit studies have to be carried out by the policy makers in consultation with the utilities and DG owners to identify specific sensitivities that needed to be taken care of while deciding the compensation mechanism. The effectiveness of NEM when compared to Feed in Tariff (FiT) increases on the amount of reduction in electricity consumption as well as the with the percentage of households with DG systems (Yamamoto, 2012). However, this also depends on overall policy framework and ecosystem and broad objectives of the state. For example, the prevailing electricity price, capital costs of the PV systems, other incentives and subsidies, lost revenue adjustment mechanisms for the utilities etc. (Ramírez, Honrubia-Escribano, Gómez-Lázaro, & Pham, 2017; Trabish, 2014). In emerging economies where there is a large demand supply gap, power blackouts, relatively high cost of electricity, NEM presents a greater opportunity in the deployment of DG systems as they provide higher rates of avoided costs.

Policy/legislation

NEM policy supports the increase of diffusion of DG systems, especially ideal for solar rooftop photovoltaic systems in residential building sector as well as for small to medium scale commercial buildings. NEM should be mentioned as supporting policy measure in policy frameworks on climate mitigation strategies, renewable energy development (especially, micro and mini-scale solar, wind, biomass, CHCP systems etc.), and green buildings and energy efficient buildings.

Institutions

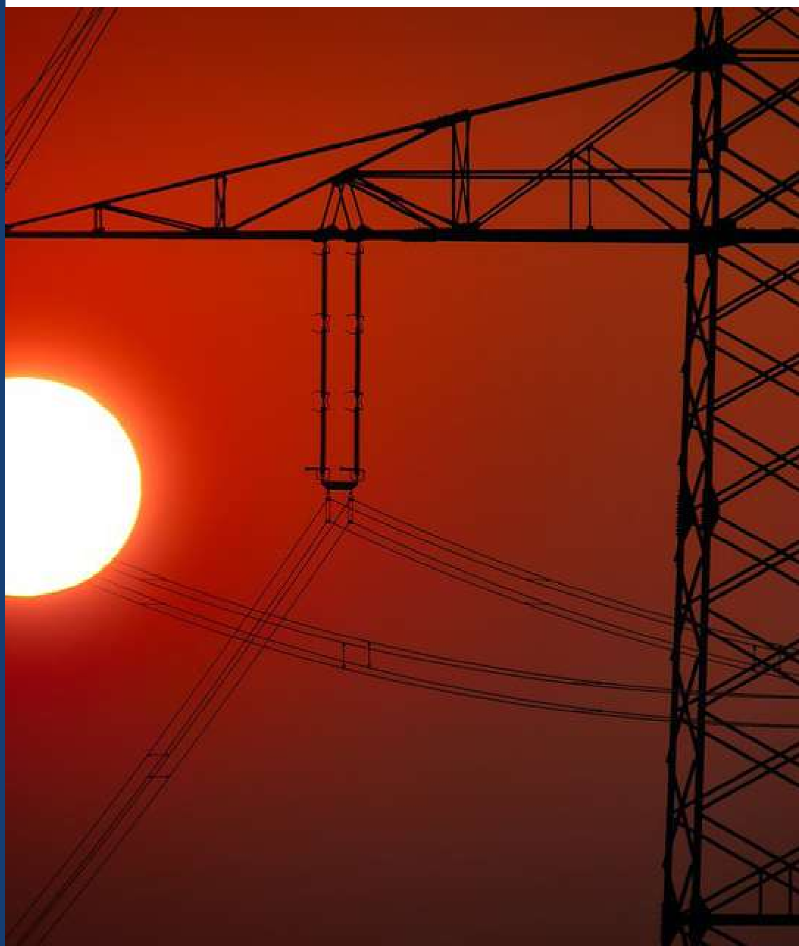
The authority to issue and amend NEM policies usually vests with state institutions such as Electricity Regulatory Commissions (MNRE, n.d.), Public Services/Utility commissions (DSIRE, n.d.-a) by way of regulation or legislation. Public or private utilities or distribution companies provide net meters to the DG owners after inspecting the DG systems for its compliance and safe operation as defined in the NEM policy. Utility providers offer net meters by after receiving a one-time payment or as recurring instalments in the utility bills thus eliminating any significant financial costs on the DG owner or the utility.

NEM policy is a crucial link in a policy framework that combines regulatory, financial incentives, outreach mechanisms to foster an ecosystem for the promotion of micro and mini scale renewable energy generation systems. Primary stakeholders include electricity regulatory bodies/utility commissions, DG owners, public or private utilities.

Transferability

NEM is a mature policy whose specific elements make it highly modular. Net metering is offered in a number of states in the USA (NCSI, n.d.), in a number of countries in the European Union (EC, 2015), Thailand (IEA, 2016), in a number of states in India (MNRE, n.d.), and is under consideration for implementation in a number of African countries like Kenya (Brückner, 2015), South Africa, with a pilot tariff programme already in implementation in Cape Town municipality (Montmasson, Kritzinger, Scholtz, & Gulati, 2017), Windhoek municipality in Namibia (Bungane, 2017) etc.

The cost benefits, expected results, technical and financial considerations, policy framework of drafting and implementing a net metering policy is supported with scientific literature, and other academic and non-academic reports. Replicating cities can use this well-crafted logical sequence of steps while informing themselves of key issues at each module. This helps in framing a consolidated net metering policy within the scope of a larger policy framework. Net metering policy is usually drafted at central/national level, which could then be easily adapted and adopted by various states/municipalities/utilities.



Case study: Net Energy Metering in California

Context

The state of California is pioneer in the USA in enacting and implementing polices and measures aimed at lowering CO2 emissions. It is a leader in terms of solar energy with over five times the amount of solar energy capacity as Arizona, the next highest state in 2014 (Ladisch & Hagood, 2017). Initially passed in 1996, the NEM policy in California has undergone several revisions with the latest and significant revision adopted on January 28, 2016 popularly referred to as NEM 2.0 (CPUC, 2018; Ladisch & Hagood, 2017). Extending the NEM programme over long term has served as one of the key drivers of California Solar Initiative program (CSI) as it ensures DG owners a fair value for the net energy supplied to the grid (Hallock & Kinman, 2015). Various cities in California have adopted the California Public Utility Commission's NEM policy into their renewable energy programmes. Along with their own framework of regulatory and incentive programmes at municipal level, cities such as San Diego, Los Angeles pioneered in the generation capacity of solar photovoltaic (Davis, Madsen, & Kinman, 2012).

In action

California NEM policy allows DG owners who install small solar, wind, biogas, and fuel cell generation (using renewable sources) facilities to serve onsite electricity needs either in part or full to participate in the programme. In addition to NEM, participants of the programme can also avail of any other rebate, incentive or credit provided by the state, municipality or electric utility etc. DG owners pay a one-time interconnection fee depending on the size of the system and the utility provider. In addition, they also pay a small charge (called non-bypassable charges) on each kilowatt-hour of electricity they consumed from the grid. This helps to align NEM customer costs more closely with non-NEM customer costs by using time-of-use (TOU) meters. The capacity of the DG system is usually capped at 1 MW with special allowances to certain sectors such as government or universities etc. Net surplus compensation is provided at the end of a 12-month billing period. The rate of compensation is based on a 12-month rolling average of the market rate for energy. Aggregate and virtual net metering options are also available under this programme (CPUC, 2018).

Results

Summarises the results achieved by the action. As far as possible, achievements should be quantified and the benefits obtained should be highlighted clearly.
Over the years NEM programme in California has seen modifications in the DG system type and capacity which has been very instrumental in the exponential growth of participation in the programme (Ladisch & Hagood, 2017). Although, net metering cannot be rated in isolation, it has been a very critical instrument in the success of California's flagship initiative called the Million Solar Roofs. Under this programme the total PV generation capacity has increased 12 fold from 156 MW (prior to the initiative) in 2006 to 1,891 MW (under the initiative alone) in 2014. In addition to the increased capacity, the programme also aided in bringing down the installed cost of the solar PV systems by about 45% in residential systems and by about 50% in non-residential systems (Hallock & Kinman, 2015).

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