Net Metering

Definition, Design and Considerations for Implementation

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IET – International Energy Transition GmbH

Dr. David Jacobs

- Founder and director of IET
- 10+ years experience in renewable energy policies
- 50+ publications on energy and climate
- Lecturer on energy and climate issues at FU Berlin
- Focus on sustainable energy policy and market design
- Consulting and presentations in 35+ countries

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Introduction:

Framework conditions for prosumers

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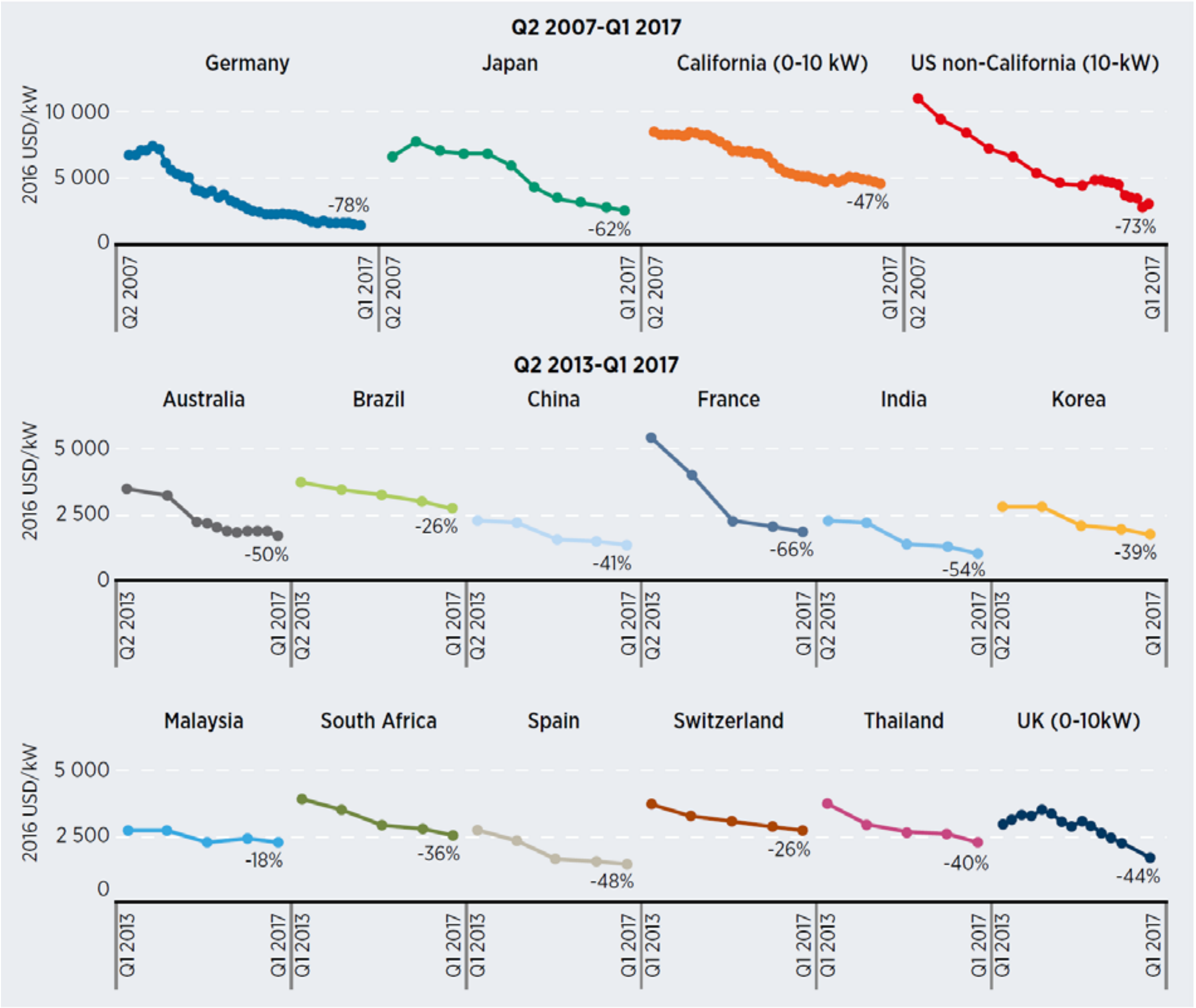
Sharp cost decline for residential PV in the past 10 years



Source: IRENA Renewable Cost Database.

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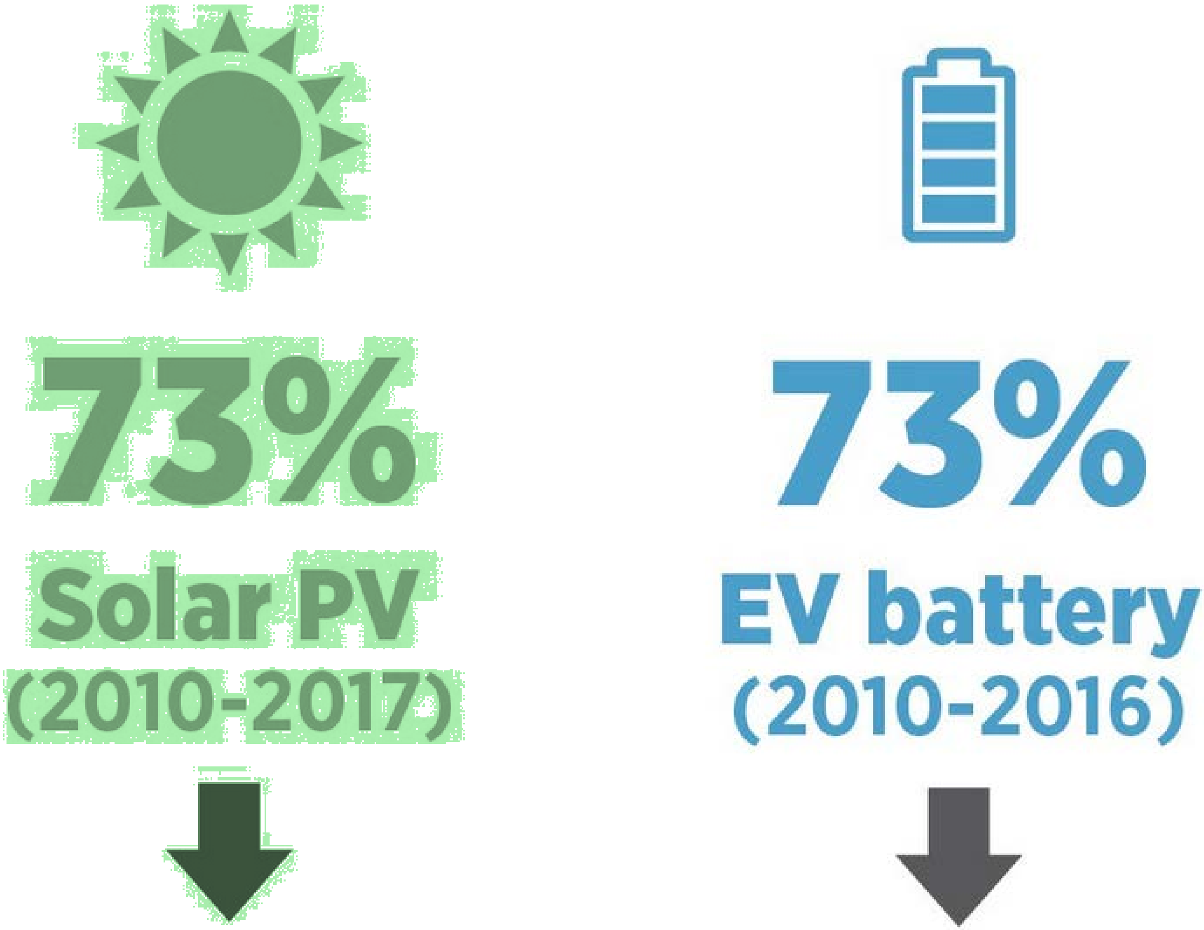
Rapidly falling prices for PV and batteries

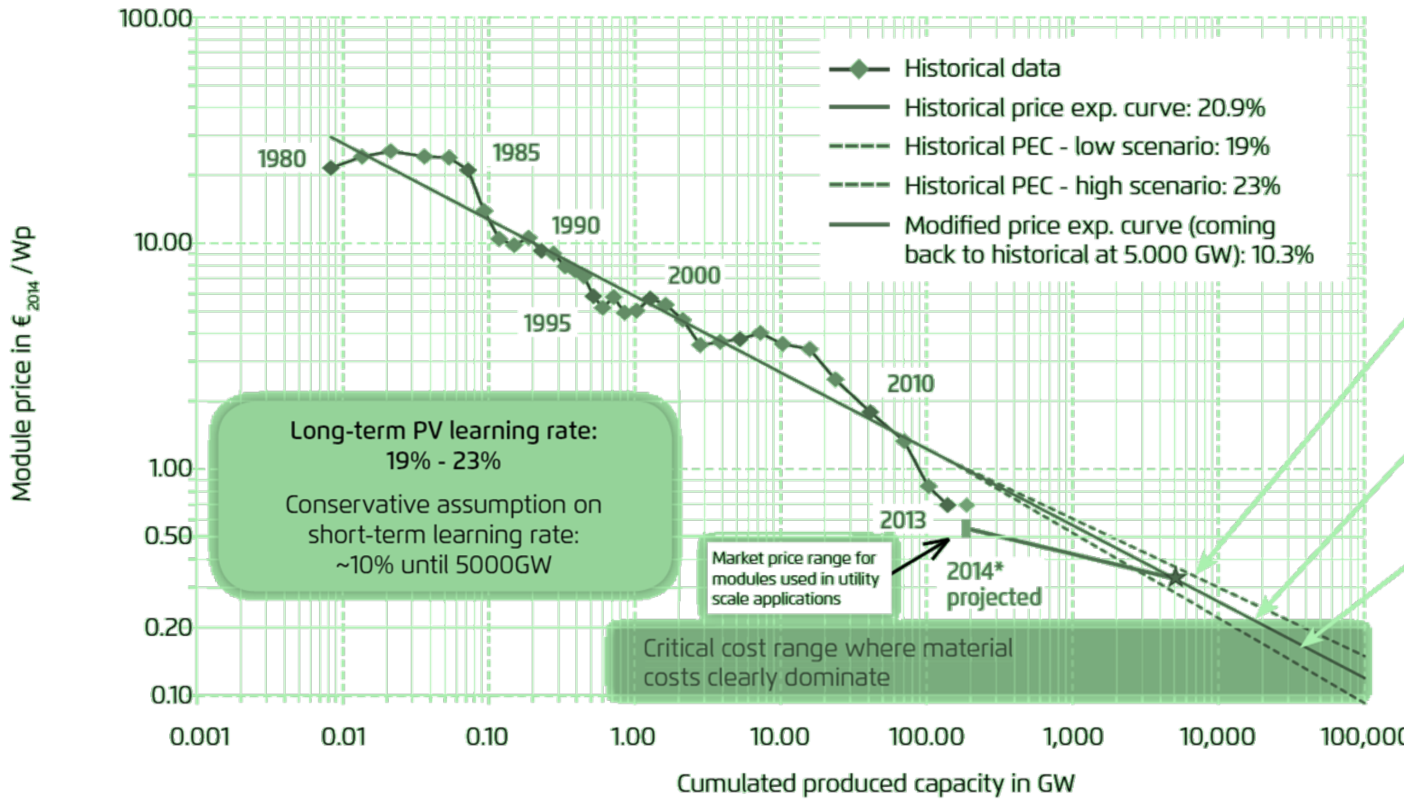


Source: IRENA 2017 (cost data)

Further cost decline of PV is expected

- Ranging from 1.4 -2,1 €cent/kWh in 2050

Future module prices in different scenarios based on the historical "learning rate" Figure E2



Source: Agora 2015

Frequently paired with increasing retail electricity prices

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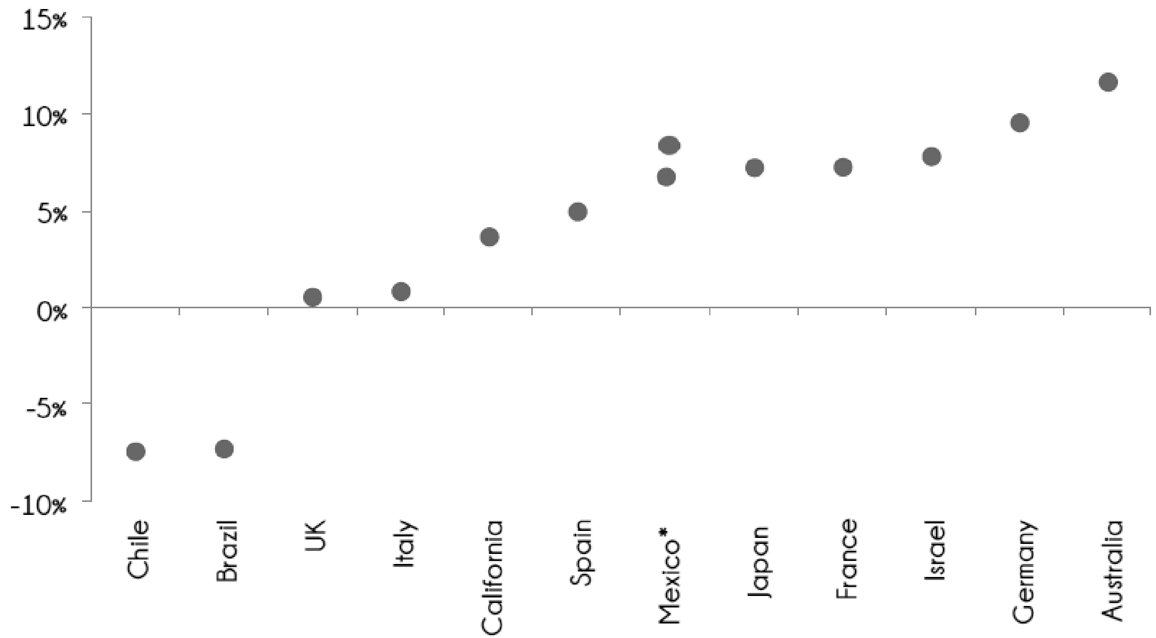
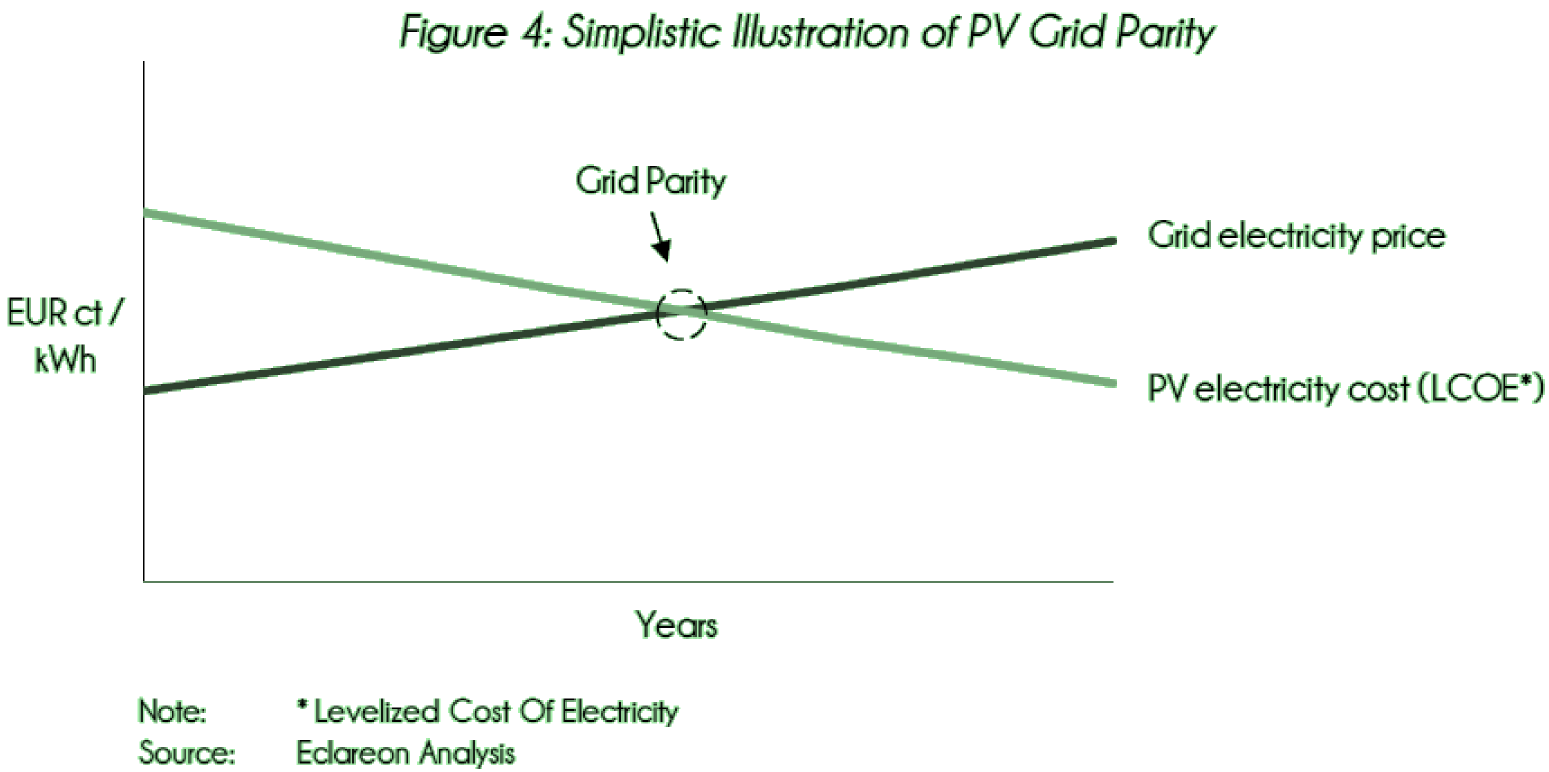
- Increasing wholesale and retail prices in many parts of the world

Figure 2: Evolution of retail electricity prices for residential consumers from 2009 to 2014



Source: Creara 2015

Grid parity (simplification)



Source: Eclareon 2013

Introduction:

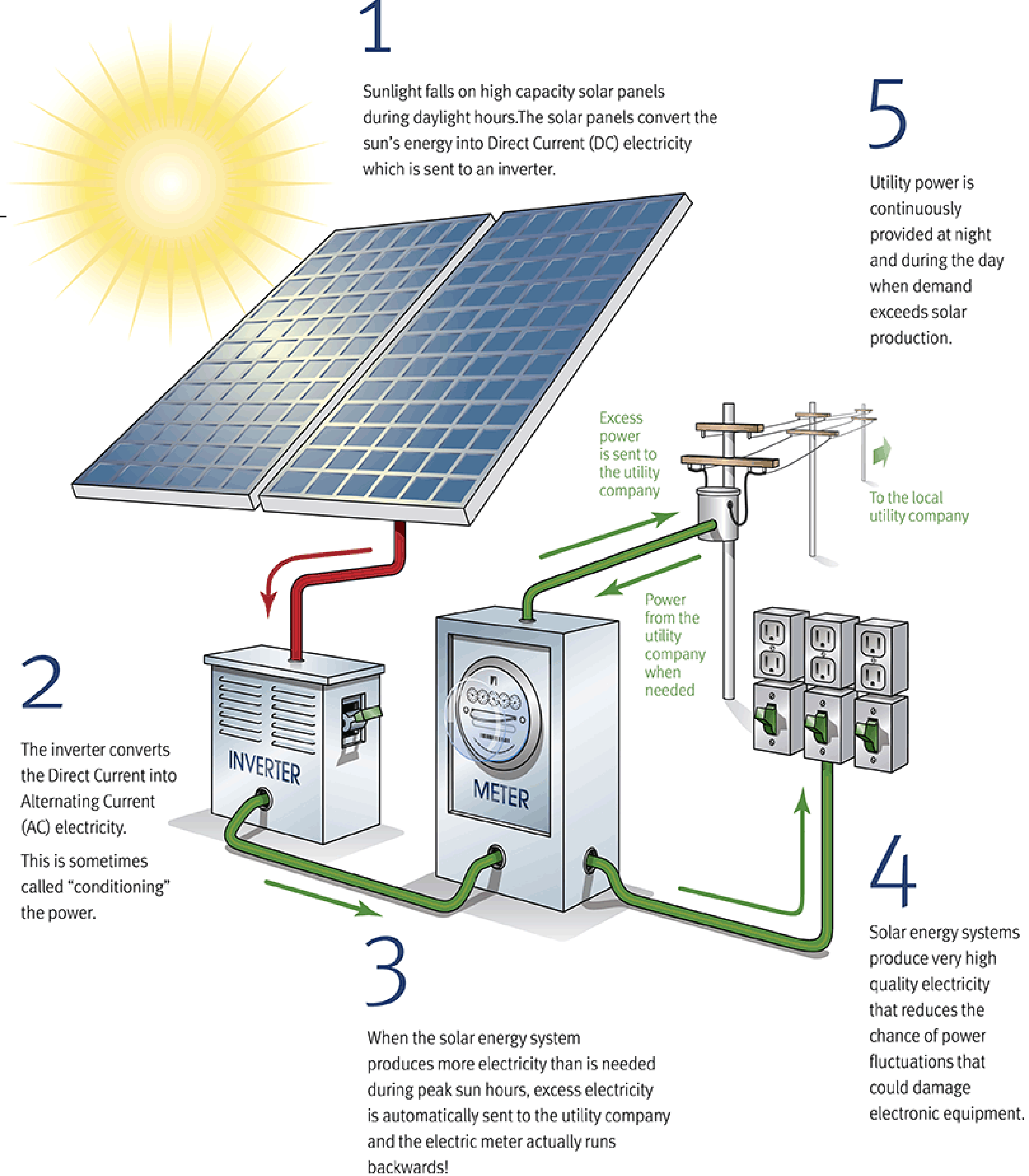
Net Metering Definition

Terminology: "Net Metering"

- Net ≠ "Internet": Refers to "Net" in contrast to "Gross"
- Net = Electricity consumption minus self-generated power
- Metering: Refers to the electricity meter

Net Metering

- "Classic" net metering does <u>not</u> result in a cash payment: **it simply *credits* customer-sited generation at a rate equivalent to the retail rate**
- Excess power is rolled over, typically up to 12 months



Source: SolarCraft.com

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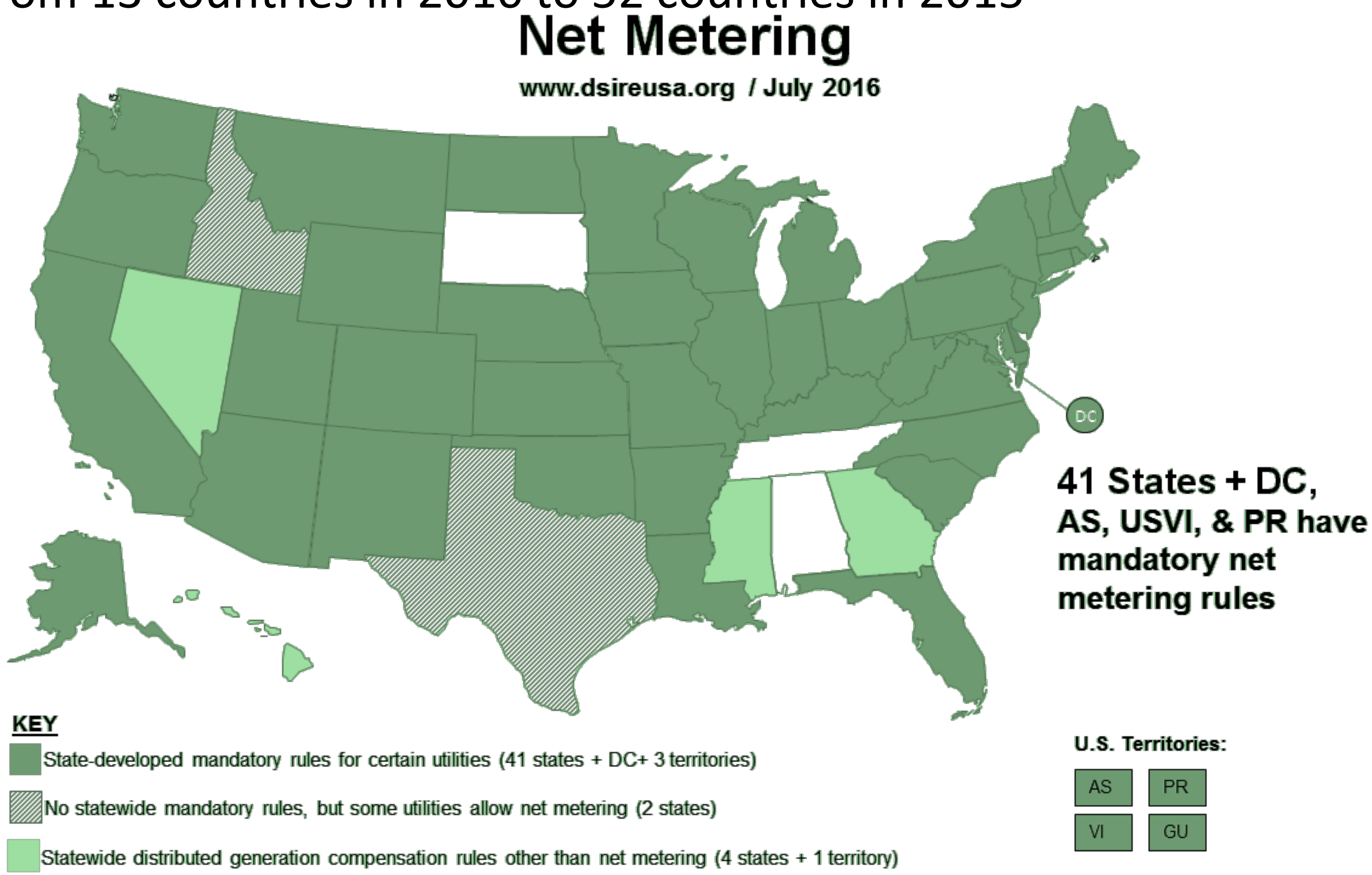
Introduction:

Net Metering World-Wide

Net Metering World-Wide

- Policy was first implemented in the US in early 1980s
- Up from 13 countries in 2010 to 52 countries in 2015



Source: http://www.dsireusa.org/resources/detailed-summary-maps/

Net metering programs worldwide

Europe	Americas	Americas	Asia	Middle East	Africa
Albania	Barbados	Argentina	Japan	Israel	Tunesien
Belgium (regional)	Chile	Canada	Korea	Jordan	Cap Verde
Czech Republic	Guatemala	Chile	Malaysia	Palestine	South Africa
Denmark	Canada (regional)	Costa Rica	Philippines	Lebanon	Egypt
Greece	Mexico	Grenada	Singapore	Syria	Lesotho
Italy	USA (43 States)	Jamaica	South Korea		
Malta	Peru	St. Lucia	Thailand		
Switzerland	Dominican Republic	Micronesia	India		
Portugal	Panama	Honduras,	Pakistan		
Spain	Uruguay	Guatemala	Sri Lanka		
Cyprus	Brazil		Vietnam		
Latvia					
Ukraine					

Source: REN21 2014, 2015

Net Metering Design:

Eligible Technologies

Design Options: Eligible technologies and sectors

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Features	Design Options
Eligible Renewable/ Other Technologies:	Photovoltaics (but also Solar Thermal Electric, Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Hydrokinetic, Anaerobic Digestion, Small Hydroelectric, Tidal Energy, Wave Energy, Ocean Thermal)
Applicable Sectors:	Residential (limitation to certain system size?) Commercial, Industrial, Schools, Local Government, State Government, Federal Government, Agricultural, Institutional

Source: Freeing the Grid 2014

Net Metering Design:

Project and Program Size Caps

Design Options: Program or system-size caps?

Features	Design Options
Program size caps	• Defined as a percentage of total peak demand (e.g. 5% of peak demand) • Defined as a capacity limit (e.g. 500 MW) • Unlimited
System size caps	• Limit on installed capacity per unit (e.g. 10 kW) • Limitation in relation to the average, annual electricity demand in a region/country (e.g. average electricity demand of 300 kWh/a; 1% of 300 kWh = maximum size of 3 kw) • Caps on the maximum allowable level of distribution level penetration on a per-circuit basis (e.g. 15% of decentralized generation). • No direct caps (indirectly via role-over provisions)

Net Metering Design:

Roll-over provisions

Design option: Wide range of roll-over provisions

Features	Design Options
Roll-over period	• monthly • yearly • daily • hourly • cash compensation, credit rollover, payout at avoided cost • Overall Pricing Methodology (retail rate, time-of-use, below retail rate, bill credit vs. cash payment, etc.)

- The electricity grid serves as a "storage unit"
- Electricity can be **banked** (surplus electricity is carried forward and used to offset consumption in the future)
- Depends on the billing system (frequency) and climate conditions

Net Metering Design:

The value of excess electricity (beyond the roll-over period)

"Classic" or "First Generation" Net Metering

- First introduced in the U.S. in the early 1980s
- Allowed individuals or businesses with customer-sited generation to connect to the grid and be **credited** for the excess power they fed into the system

Standard Formula:

Compensation rate = Retail rate

Retail electricity benchmark

- Rates differed for each customer class (Residential, Commercial, Industrial)
- Most developing countries: Net Metering will first be attractive for industrial and commercial consumers (since they pay the highest electricity prices)
- In jurisdictions with inclining block rates, the compensation rate for offsetting the first kWhs was higher than for subsequent kWhs: this meant that NM was most attractive for high-consumption households and businesses (also more able to self-finance the solar system)

The complexity of pricing methodologies: Important elements

Features	Design Options
Payment for excess electricity	• FIT levels • Retail electricity • Value of solar • Avoided costs • Wholesale electricity • No compensation

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Considerations for implementations:

Net Metering and Rate Design

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Rate design: Introduction

- Once net metering costumers increase in number, they begin to have impacts on rate design (cost sharing)
- Common concerns emerge over “cross-subsidization” and the (under-) recovery of fixed (i.e. non energy-related) system costs
- These issues are at the heart of the debate over the future of net metering

Fair cost distribution?

- Is net metering “fair” to residential customers that do not participate in the program? (“Death-spiral argument”)
- Pay a fair portion for the upkeep of the grid (net metering uses the grid as a storage unit)
- Fair cost distribution depends on electricity price structure (for the residential sector):
  - Volumetric charges (per kWh)
  - Fixed charges (per connection)
  - Maximum demand (kW)

Introduction

- So far, utilities and regulators have responded primarily in the following ways to the rise of net metered solar :
  - **Increased fixed charges** (either on all customers, or only on NM customers)
  - **Introduced demand charges**
  - **Establish minimum bills**
  - **Taxes** on self-consumed electricity
  - Other charges (e.g. standby charges)
  - Adjustments to **roll-over provisions** to restrict the ability to “bank” excess credits
- Do nothing
  - since the **existing rate design** allocates risks correctly
  - Since self-consumption/net metering has a very **limited effect**

Increasing shares of self-consumptions and (short-sighted) regulatory responses

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Arguments

- utility revenue loss
- Lack of fixed cost recovery
- Stability of the grid affected
- Uncertainty over utilities' long-term investment planning
- Impacts on existing Power Supply Agreements

(Short Sighted) Regulatory Response

- Tightening of the NM policy
- Introduction of caps, fixed charges, taxes, minimum bills, etc.

Increasing shares of self-consumptions and (short-sighted) regulatory responses

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Long-term visions missing!

Shock-reaction to short-term developments!

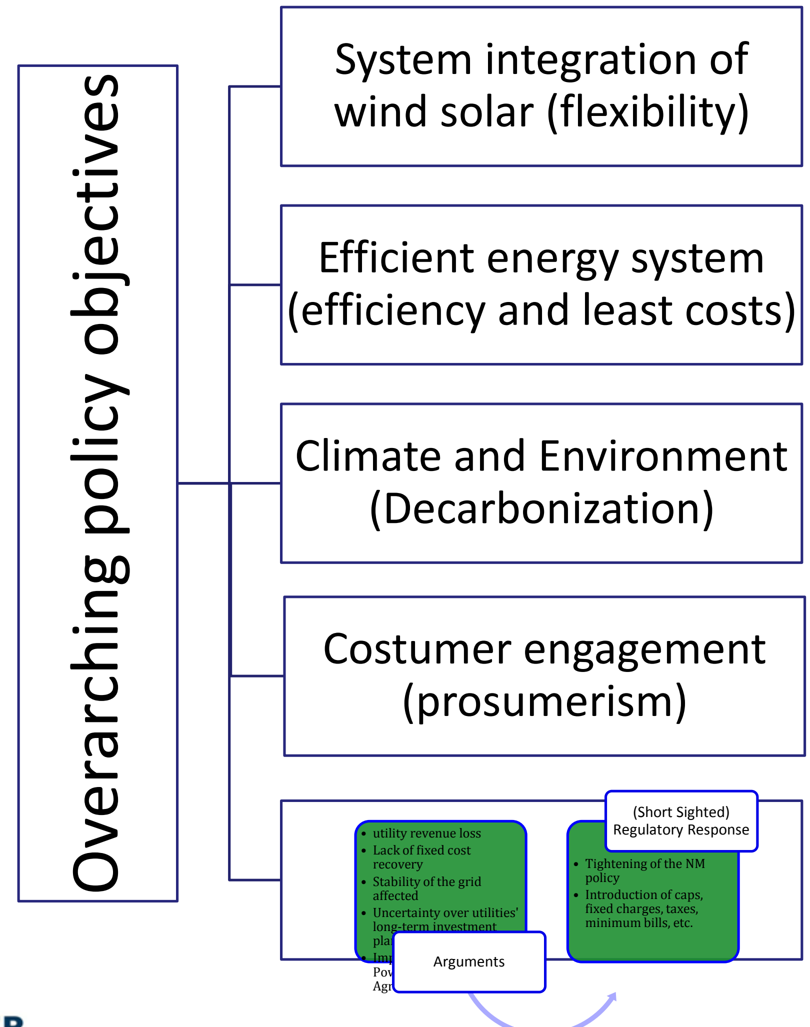
- utility revenue
- Lack of fixed co
- Stability of the
- Uncertainty ove term investmen
- Impacts on existing Power Supply Agreements

Arguments

t Sighted) ory Response

NM policy ps, fixed nimum bills, etc.

Increasing shares of self-consumptions and a long-term vision for the energy system



Opportunities and risks need to be clearly articulated and balanced – and stakeholder interests aligned

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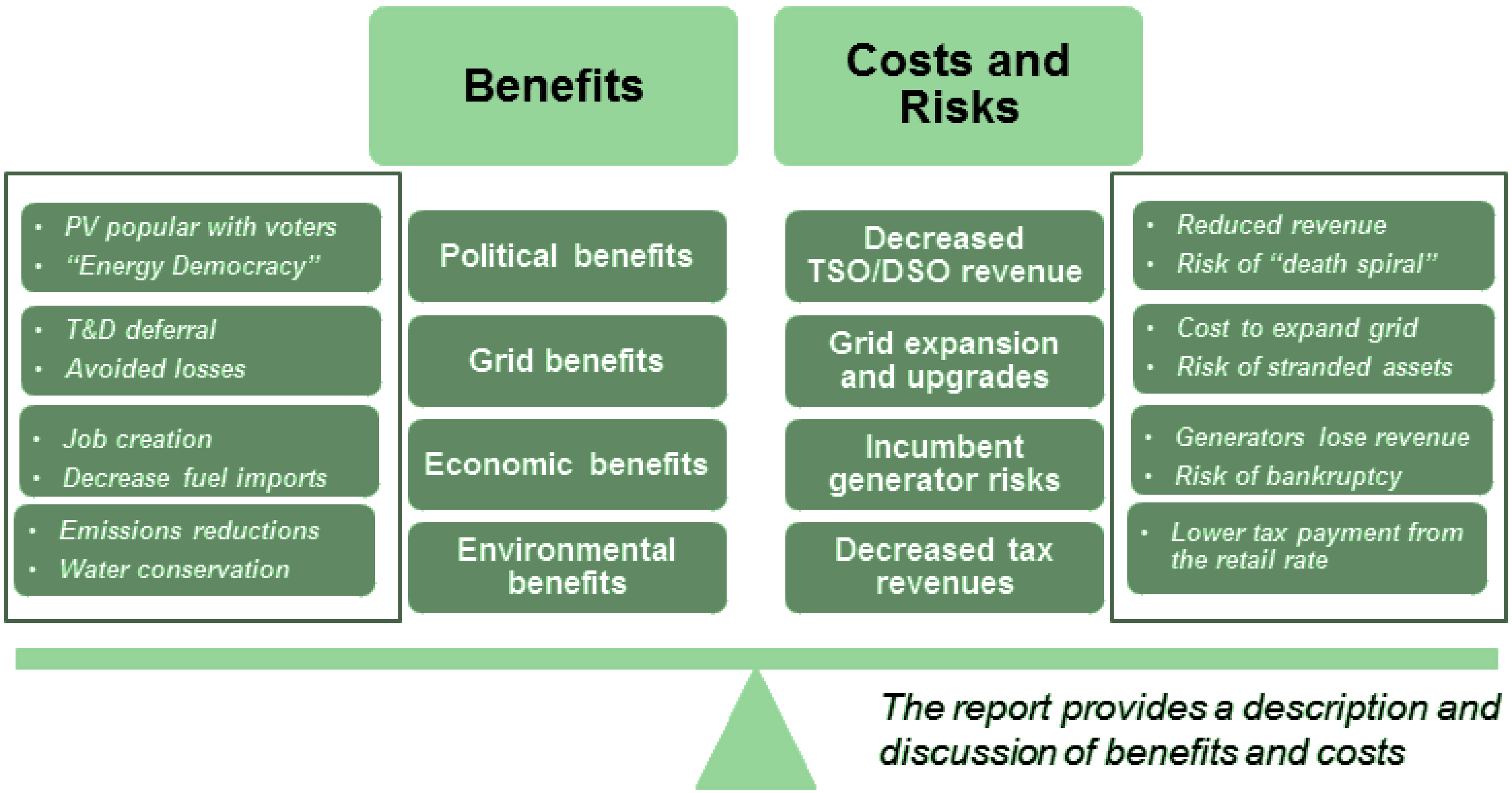


Source: IEA RETD 2014

Considerations for implementations:

Emerging Business Models

Third Party Ownership

Business Model	Description
Leasing / Third-party ownership model	The developer ("solar lessor") owns, installs, and operates a rooftop solar system on the site host's property. The site host ("solar lessee") pays for the solar systems through monthly instalments (fixed or escalating) and uses the solar electricity produced or sells it to receive FiT/NM credits. The lease term is 15-20 years in the U.S. and ranges from 3-10 years in Thailand (incentive structure highly affects interest and lease term).

The third-party-ownership model in the USA grew from 10–20% in 2009 to 65% in 2013 (GTM Research 2013; GTM Research, 2014).

Source: http://esi.nus.edu.sg/docs/default-source/default-document-library/solar-pv/3-solar-pv-business-models-and-key-policy-considerations_sopitsuda-tongsopit_esi-solar-conference_9-apr-15.pdf?sfvrsn=2

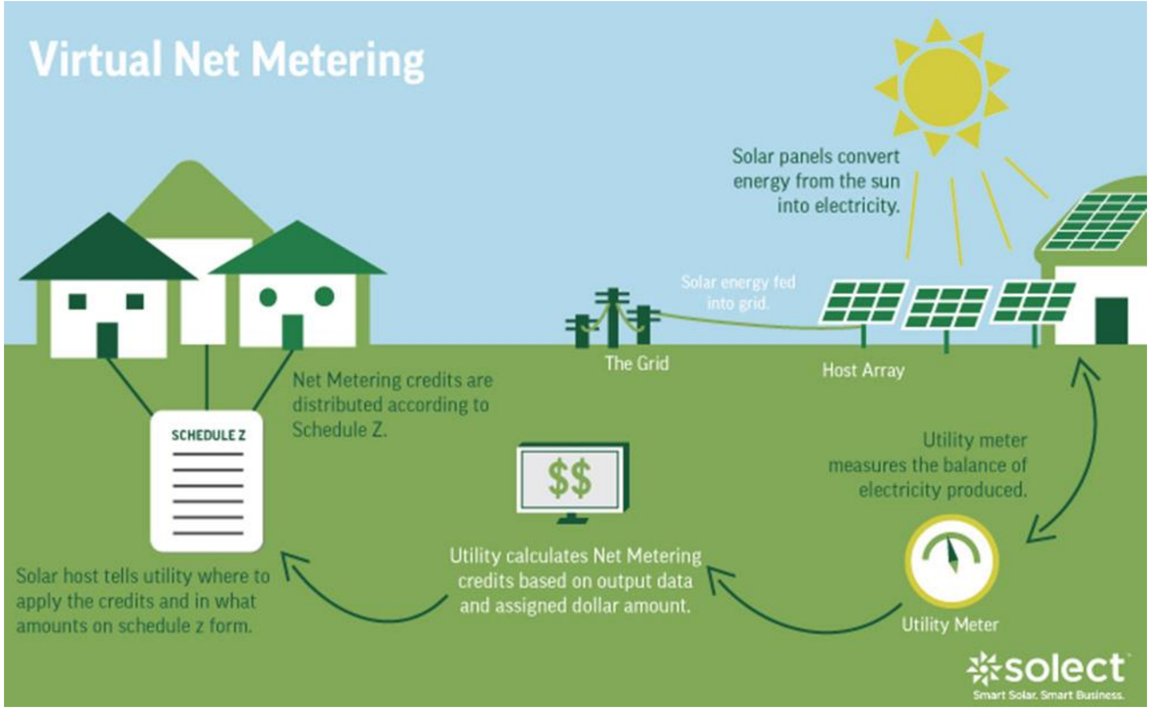
Third Party Solar PPA

Business Model	Description
Solar PPA	Similar to solar leasing model in that the developer owns, installs, and operates a rooftop solar system on the site host's property. The only difference is that customers pay for power (kWh) the solar systems produce (e.g. at a price 80–90% lower than the market retail price), as opposed to paying in monthly instalments to lease the equipment.

Source: http://esi.nus.edu.sg/docs/default-source/default-document-library/solar-pv/3-solar-pv-business-models-and-key-policy-considerations_sopitsuda-tongsopit_esi-solar-conference_9-apr-15.pdf?sfvrsn=2

Virtual Net Metering

- Virtual net metering (VNM) is a tariff arrangement that allows utility customers to share the electricity output from a single power project (enables a multi-meter property owner to allocate a solar system's energy credits to other tenants).



Source: https://cre.nerej.com/wp-content/uploads/2015/11/Solect-Net-Metering-Image.jpg

On-Bill Financing

- On-bill financing allows customers of a given utility to finance their own rooftop solar PV systems by making regular additional payments on their monthly electricity bill
- The utility effectively finances the system (lower cost of capital), and offers it to the home-owner for a fixed monthly cost
- Can assist in unlocking financing, particularly when bank loans are not available
- Also a way for utilities to retain "part of the action":
- On-bill financing of rooftop PV can even compete on cost with new generation investments in Integrated Resource Planning, similar to efficiency investments

Source: http://www.renewableenergyworld.com/articles/ucg-content/2016/08/29/a-kansas-electric-cooperative-offers-energy-savings-with-0-down--episode-32-of-local-energy-rules-po.html
See also: https://www.burlingtonelectric.com/energy-efficiency/other-resources/bill-financing

Combining Net Metering with Other Support Mechanisms

Combination with Other Support Mechanisms

- Depending on the attractiveness of self-consumption (delta between retail electricity prices and PV costs), additional rebates or investment incentives might be necessary

- Net Metering is usually applied for smaller-scale projects (e.g. up to 1 MW) where as other support mechanisms are used for larger scale projects (e.g. FITs or auctions)

Further reading

Select Publications

Couture, T., Jacobs, J., Rickerson, W., Healey, V., (2015). "The Next Generation of Renewable Electricity Policies: How Rapid Change is Breaking Down Conventional Policy Categories," Clean Energy Solutions Center, in collaboration with the National Renewable Energy Laboratory, Available at: http://www.nrel.gov/docs/fy15osti/63149.pdf

Jacobs, D., Couture, T.D., Zinaman, O., Cochran, J., (2016). "RE-TRANSITION: Transitioning to Policy Frameworks for Cost-Competitive Renewables," IEA-RETD, Paris. Available at: http://iea-retd.org/wp-content/uploads/2016/03/IEA-RETD_RE-TRANSITION.pdf

Rickerson, W., Koo, J., Crowe, J., Couture, T., (2016). "Tapping the Potential of Commercial Prosumers: Drivers and Policy Options," IEA-RETD, Paris. Available at: http://iea-retd.org/wp-content/uploads/2016/04/RE-COM-PROSUMERS-Report.pdf

Petrick, K., Couture, T. D., Rickerson, W., (2015). "Remote Prosumers: Preparing for Deployment: Roof-top Solar PV Prosumers in Remote Areas and Islands," (REMOTE-PROSUMERS), IEA-RETD, Available at: http://iea-retd.org/wp-content/uploads/2015/08/IEA-RETD-REMOTE-PROSUMERS-20150703v3.pdf

Rickerson, W., Couture, T., Barbose, G., Jacobs, D., Parkinson, G., Belden, A., Becker-Birck, C., Chessin, E., (2014). "RE-PROSUMERS", IEA-RETD: Paris, France. Available at: http://iea-retd.org/wp-content/uploads/2014/06/RE-PROSUMERS_IEA-RETD_2014.pdf

Thank you for your attention!

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Net Metering Design:

Combination with ToU?

Time-of-use tariffs (retail benchmark)

- Advantages:
  - Combined with load shifting, TOU pricing can benefit customers by empowering them to reduce their bills with technology-enabled, seamless control technologies that can avoid energy use during expensive peak hours.
  - When enough customers reduce their peak demand, or install DERs to provide peak energy to the grid, the utility's peak demand can either decrease or shift. This is significant because peak demand on a system level is one of the main factors that drive the need to build central generation assets, especially "surplus" generators built to meet peak spikes but which otherwise sit idle much of the time when demand doesn't call for them.

Sources: http://www.rmi.org/PDF_rate_design

Additional slides:

Fixed Charges, Demand Charges, Minimum Bills

Fixed charges: The way forward???

- Higher fixed charges are frequently put forward as a straightforward solution to the problem: the revenues from the fixed charges will allow the utility to cover the fixed system costs related to network infrastructure

- However, higher fixed charges also have some disadvantages:
  - Negatively impact the economics of “going solar”
  - Limit the incentives for energy efficiency
  - Unfairly penalize solar system owners (why not introduce a fixed charge for insulating your home, or efficient AC units?)
  - Place a higher burden on low-income households
  - Incentivize customers eventually to go off-grid (“grid defection”)

Demand Charges

- Demand-based rates are a special charge levied on electricity customers based on their peak electricity demand over a previous period of time (typically annual): calculated based on the interval with the highest kW usage within a billing period.

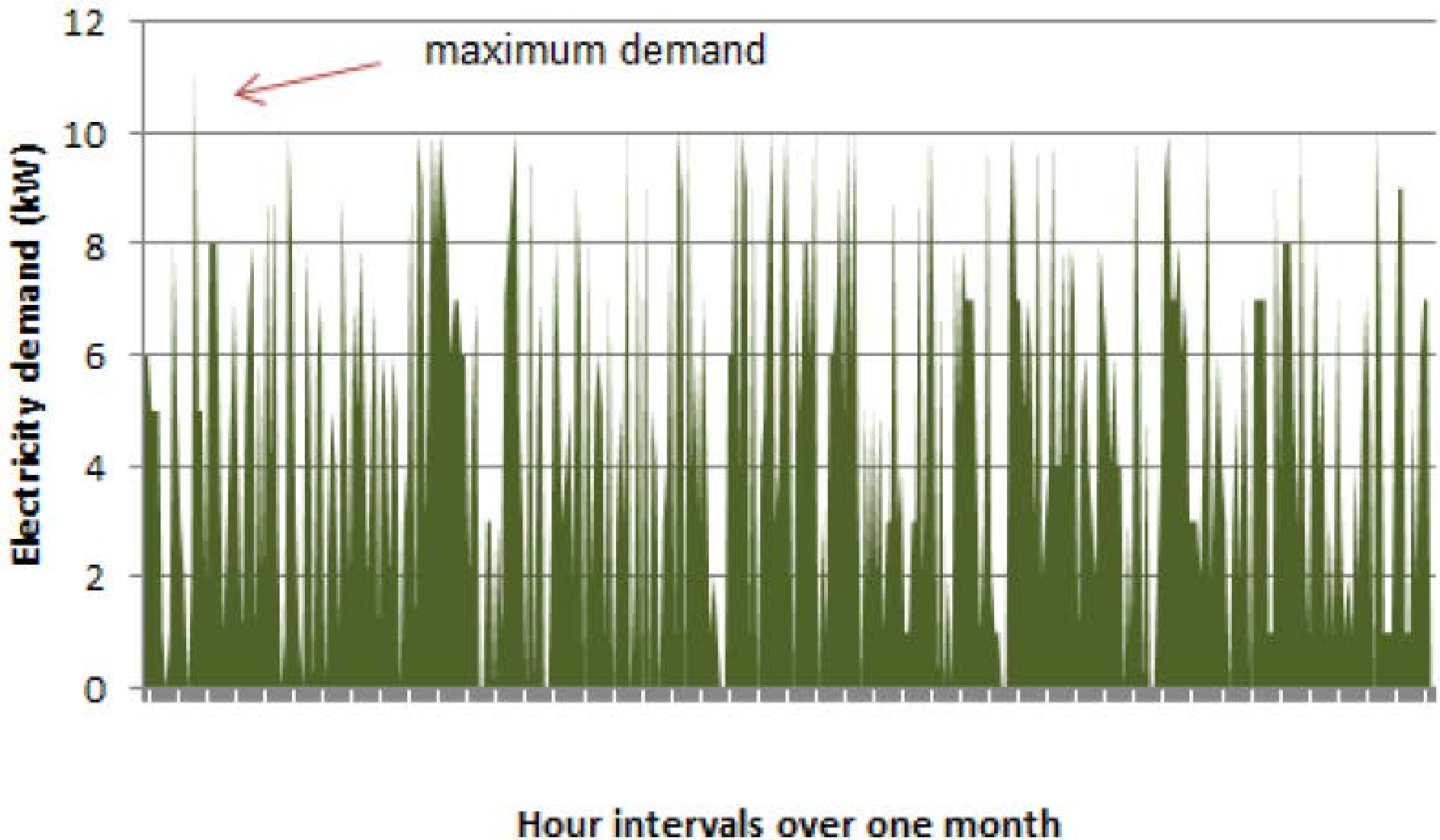
- Traditionally levied on large commercial and industrial customers: **increasingly discussed as a rate option for residential customers as well**

- Historically, residential customers have been less equipped to monitor real-time demand and respond to pricing signals, etc. than commercial and industrial customers

- This is likely to change as home energy management technologies, combined with improved metering infrastructure, become more sophisticated and widespread.

http://www.nrel.gov/docs/fy15osti/64850.pdf

Demand profile of a large residential power user in the U.S.



Minimum bills

- Minimum bills, and variations like it, are being introduced in some jurisdictions to prevent NM customers from fully eliminating their power bill
- Certain bill components can be “ring-fenced”, i.e. protected from being erased by NM credits, or via conservation
- Assure a minimum revenue stream per customer to the utility (to cover fixed costs):

- **Disadvantages:**
  - Hit low-income households hardest
  - Contradict policies for energy efficiency
  - Under retail competition, may drive some customers away from the first utility to introduce them: “first-mover disadvantage”

See: http://www.mass.gov/eea/docs/doer/renewables/task-5-report-final.pdf

Administrative fees: Overview

- Under net metering programs, a number of fees can be imposed on DG power producers:
  - Grid connection fees
  - Grid impact study fees
  - Permitting or processing fees
  - Meter costs/fees
  - Etc.