CLEAN ENERGY SOLUTIONS CENTER
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INTERNATIONAL SOLAR ALLIANCE

International Solar Alliance Expert Training Course: Session 6, Part 1

Solar PV Policy: Net Metering

In partnership with the Clean Energy Solutions Center

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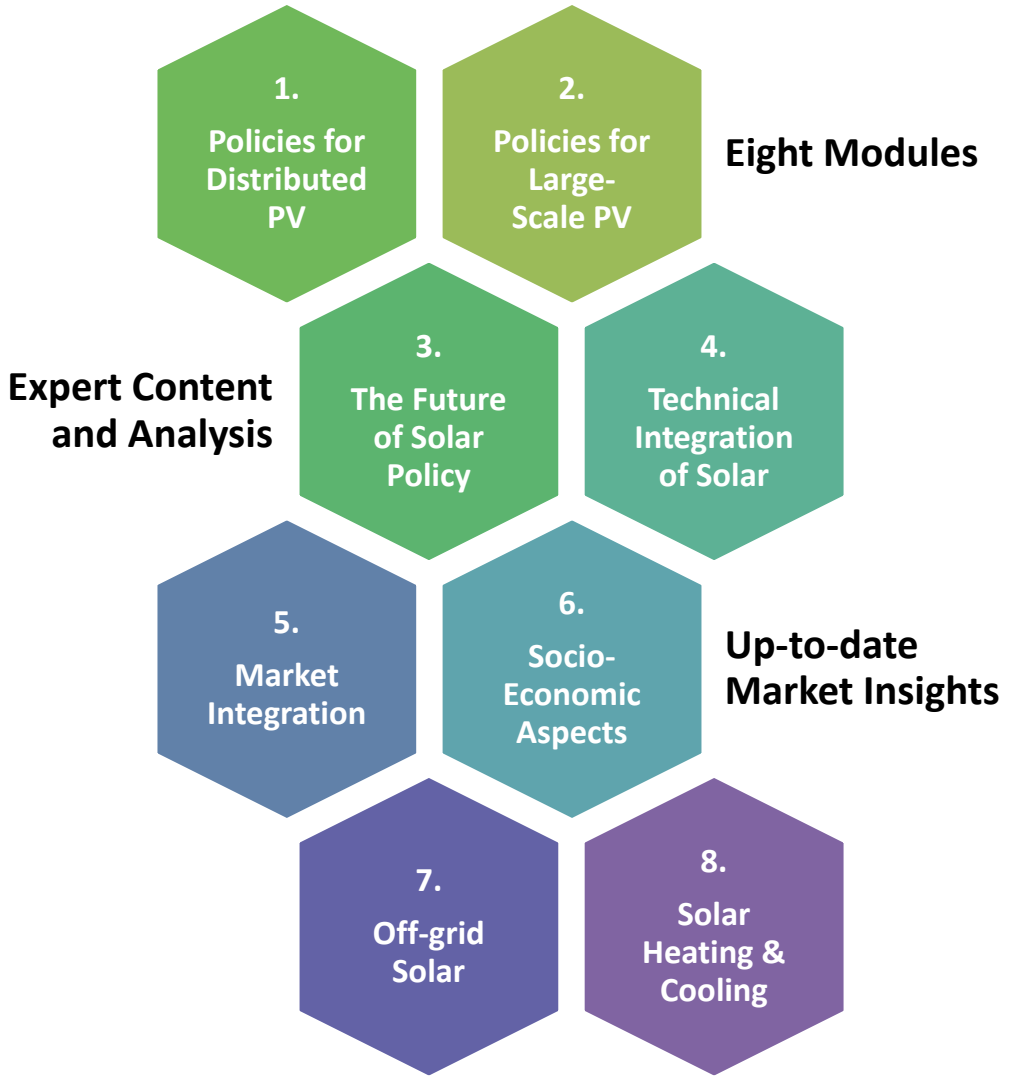
Supporters of this Expert Training Series

Overview of Training Course Modules

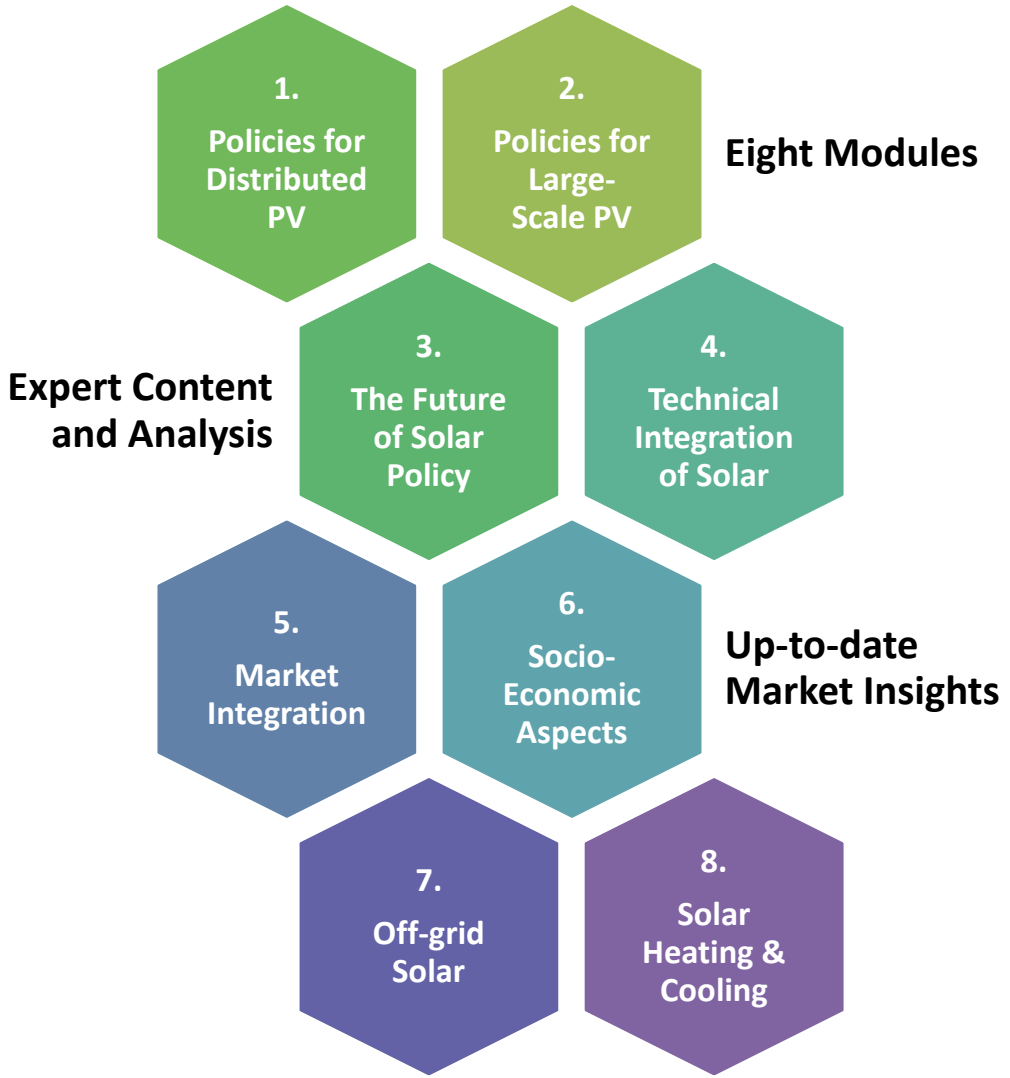
This Training is part of Module 1, and focuses on the issue of Net Metering



Two-Part Training

Part 1: Focuses on Net Metering

Part 2: Focuses on Net Billing



Overview of the Presentation

1. Introduction: Learning Objective
2. Historical Context
3. Main body of presentation
4. Concluding Remarks
5. Further Reading
6. Knowledge Check: Multiple-Choice Questions

1. Introduction: Learning Objective

Learning Objectives

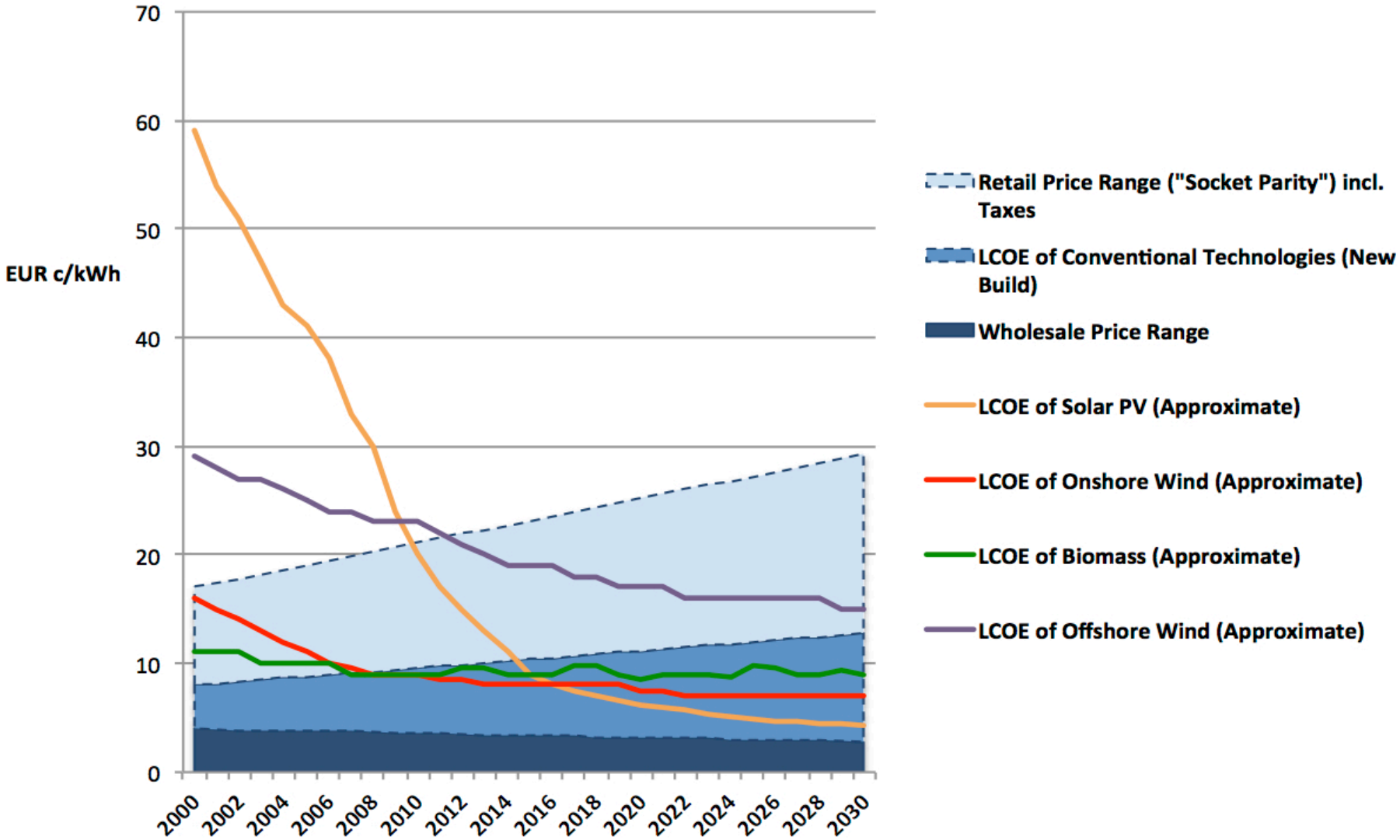
- Understand the rise of Net Metering
- Understand how Net Metering policies are designed, as well as how they have evolved over time
- Understand how Net Metering has been adapted in different jurisdictions around the world
- Understand how the rise of “prosumers” changing the electricity sector

2. Historical Context

Historical Context

- In most parts of the world until the 1970s, utilities had a monopoly on power generation: exceptions were often made for large industrial customers (e.g. steel, auto, paper mills, etc)
- Onsite power generation used to be too expensive for most customers (economies of scale): only made sense for certain large industrial customers
- The rise of low-cost solar has fundamentally changed this
- Net Metering policies first emerged in the U.S. in the 1980s to enable electricity customers to connect to the grid and export their surplus generation

Three Key Cost-Competitiveness Benchmarks



Historical Context

- Net Metering (self-consumption) did not make economic sense in most cases in the 1980s and 1990s
- Where the policy was first introduced in the U.S. state of Minnesota in 1983, it experienced little uptake
- This has started to change as solar and other renewable energy costs have declined
- Net Metering and other policies governing distributed generation are now becoming more critical, and a focus of more utility and customer interest

3. Net Metering Policies

Net Metering

- Allows individuals or businesses with customer-sited generation to connect to the grid and be **credited** for the excess power they fed into the system

- The meter rolls backward when onsite generation exceeds onsite consumption: the bill is based on the ”**net**” electricity consumed from the utility

- Bill “credits” are typically granted in kWh: customers can ”bank” their excess kWh and use them to offset their future consumption

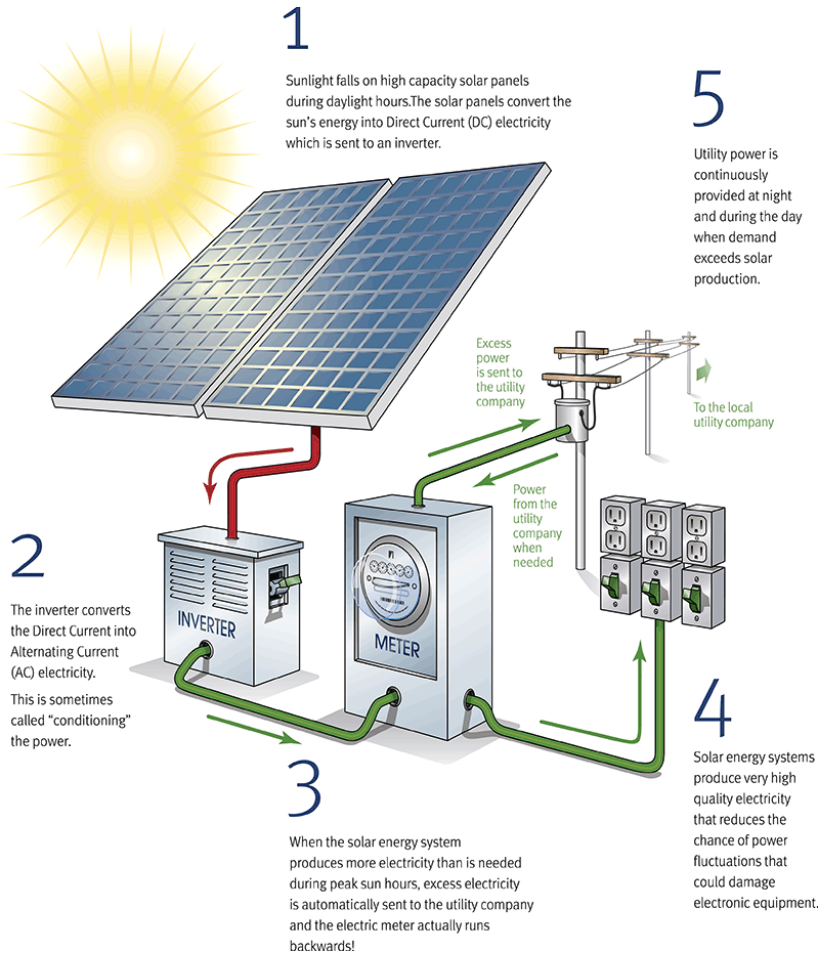
Net Metering

Formula:

Compensation rate = Retail rate

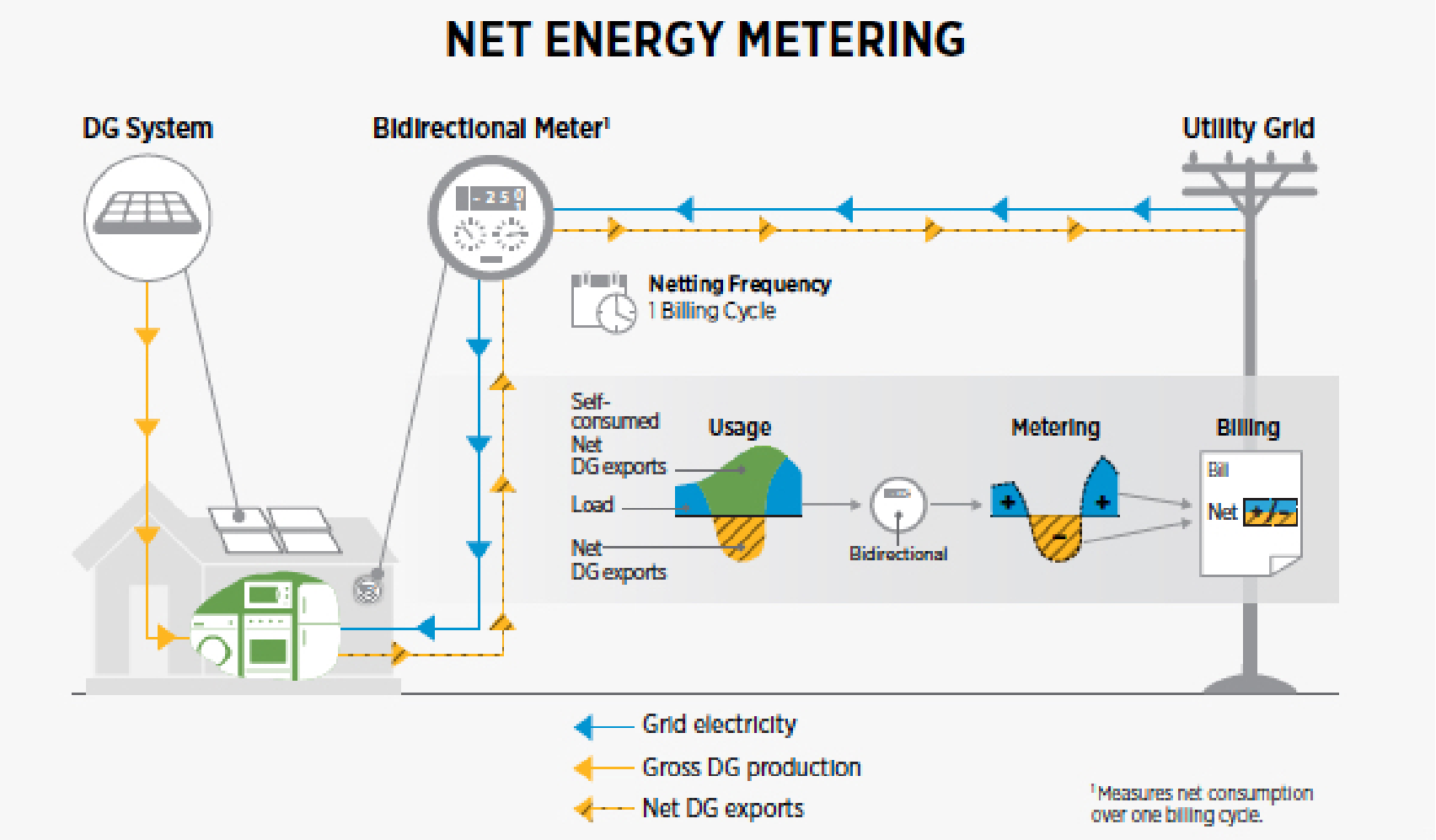
"Traditional" net metering does not result in a cash payment: **it simply *credits* customer-sited generation at a rate equivalent to the retail rate**

Incentive → savings on power bill



- Source: SolarCraft.com

Net Metering



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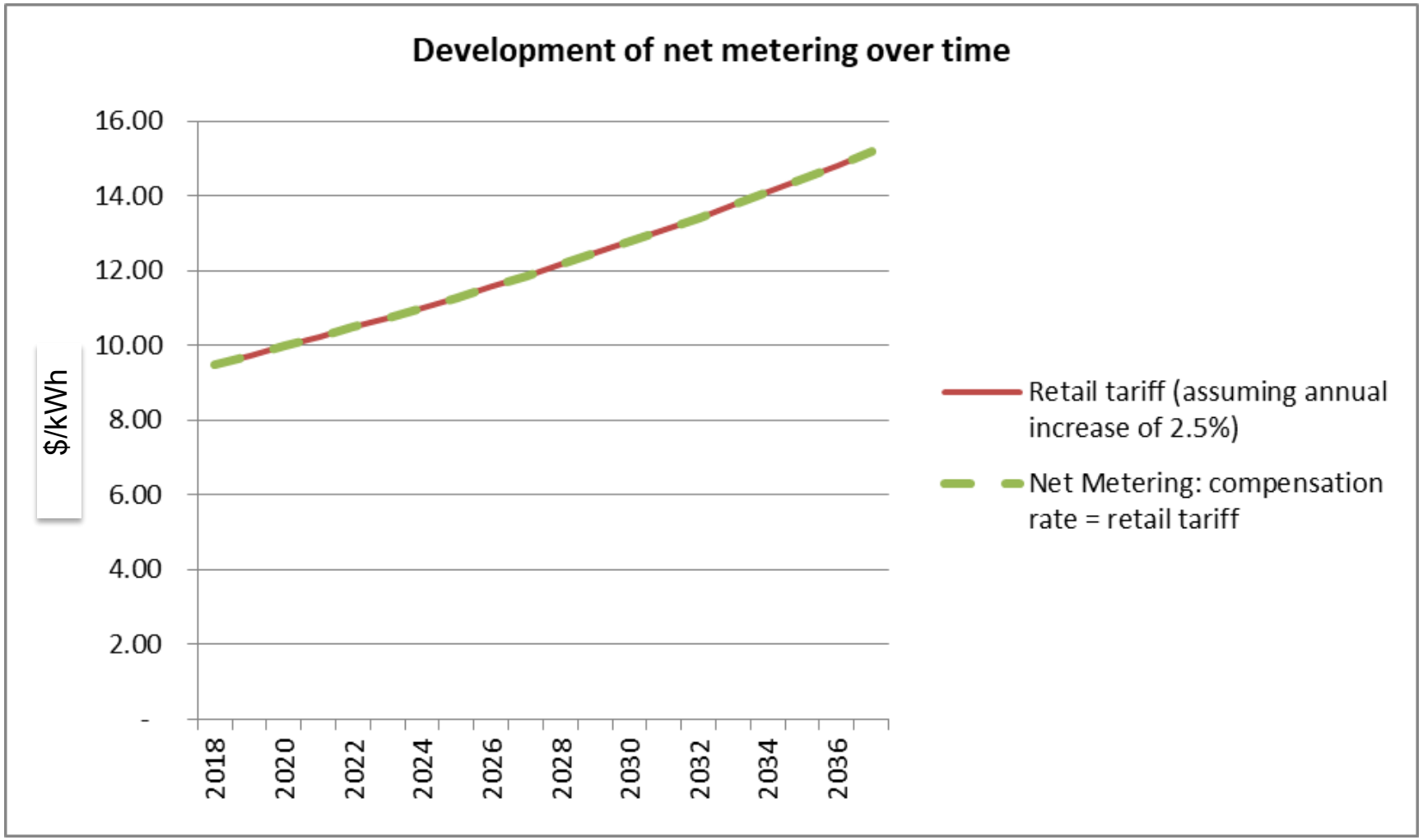
The *value* of customer-sited generation increases over time as retail prices rise



Net Metering

- **Over 60 countries around the world have adopted some form of Net Metering**
- In some regions, residential solar surpasses 200% of maximum daytime load (e.g. **Hawaii**)
- **Germany** has an estimated 1.65 million individual solar systems
- In **Queensland, Australia** over 30% of households have a solar PV system

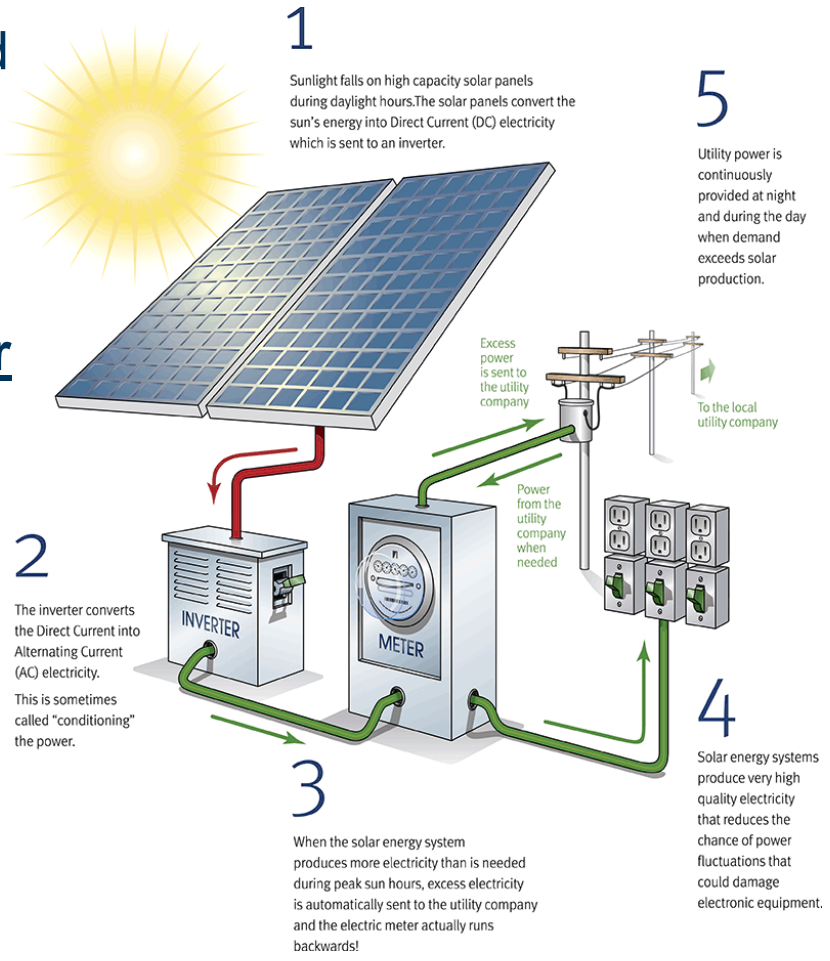
- **Such a large uptake of distributed generation signals a fundamental shift in the power industry**

Net Metering Design

– Net Metering is most commonly used for rooftop **solar PV** projects (<1MW)

– Can also be used for larger-scale projects (e.g. 1-10MW) as well as **other technologies**

– Typically connected at the **distribution level**, though some projects occasionally connect at the transmission level (e.g. for larger industrial customers)



Source: SolarCraft.com

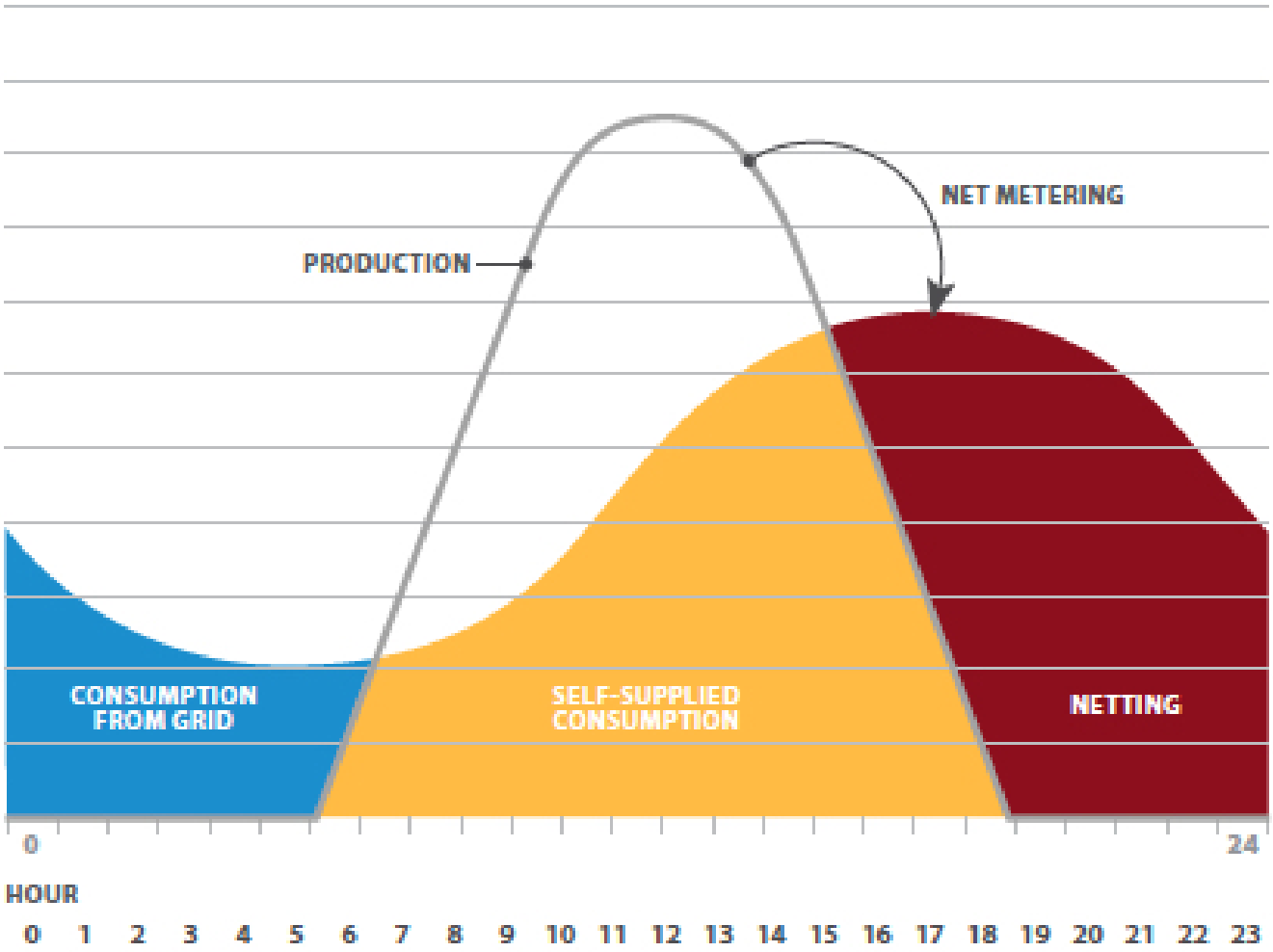
Net Metering Design

- Most Net Metering policies enable the customer to “bank” their excess generation up to 12-months: excess credits in one month (or billing cycle) can then be used to offset credits in subsequent months

- After the 12-month ”settlement period” (for instance), the excess credits are then forfeited (some policies like Net Billing allow the net excess credits to be compensated, while NET-FITs allow for *remuneration*: see Session 6, Part 2 on Net Billing and Session 7 on NET-FITs)

- The primary goal is often to **encourage “right-sizing”**

Net Metering Design



https://gridworks.org/wp-content/uploads/2018/01/Gridworks_SustainingSolar_Online.pdf

Net Metering Design

- The **roll-over period** refers to the time period over which net excess generation credits are calculated: typically connected to the billing cycle (i.e. one month)
- Different roll-over periods have a fundamental impact on the attractiveness of investing in a DG project

Feature	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.)

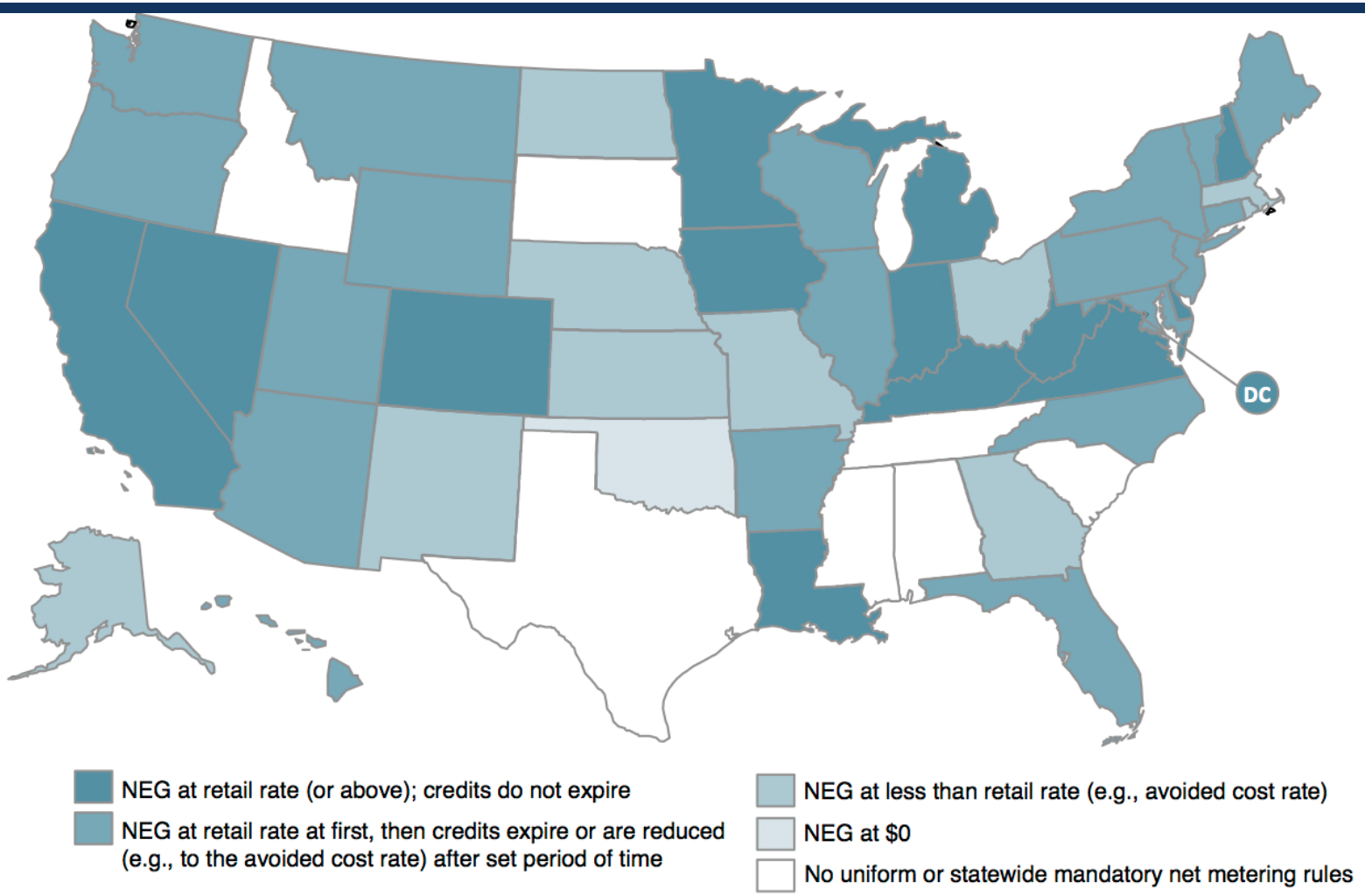
Net Metering Design

- The **settlement period** refers to the time at which the net excess generation credits are “trued-up”, and ”settled” from a financial standpoint
- The settlement period is typically 12 months
- Main options for dealing with net excess generation after 12-month period:
  a) Excess generation is forfeited (Net Metering)
  b) Excess generation *credited* at some rate (e.g. wholesale rate): i.e. receives a further bill credit (Net Billing)
  c) Excess generation *remunerated* at some rate (e.g. avoided costs): i.e. receives a cash payment (NET-FIT)

Net Metering Design

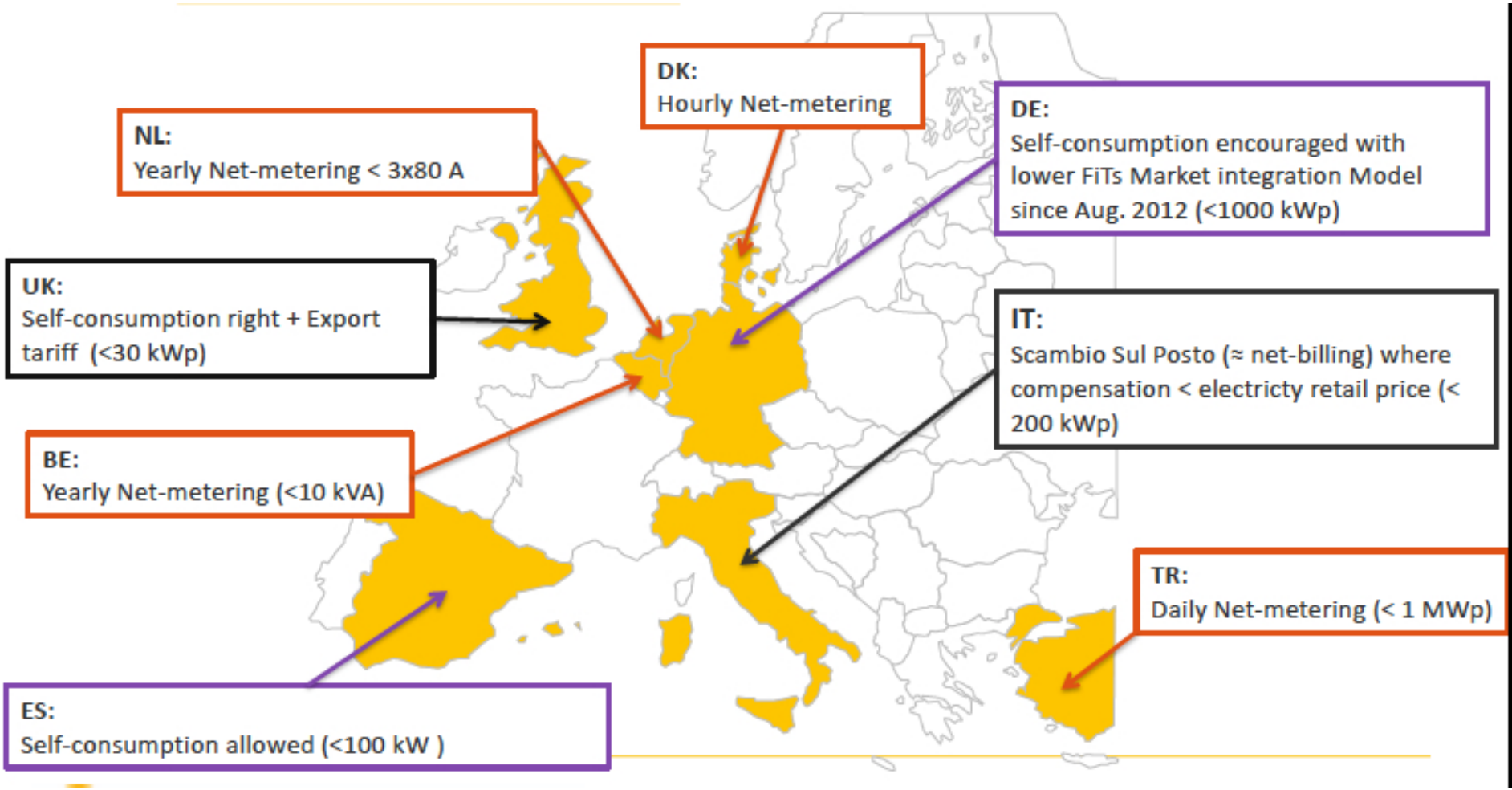
Key Design Features		
Compensation Mechanism	Eligibility	Permitting Fees
Time of Use (TOU) Option	Roll-over Provisions	Grid Impact Study fees
Project Size Caps	Settlement Period	Metering approach + who pays
Program Size Caps	Fixed Charges ($/kW)	Application Processing
Contract Duration	Demand Charges	Grid interconnection Rules
Treatment of RECs	Minimum Bills/Ring-fencing	Permitting Fees

Net Metering in the U.S.



Source: DSIRE 2015, http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/03/Net-Metering-Policies-Treatment-of-Net-Excess-Generation.pptx

Net Metering in the EU



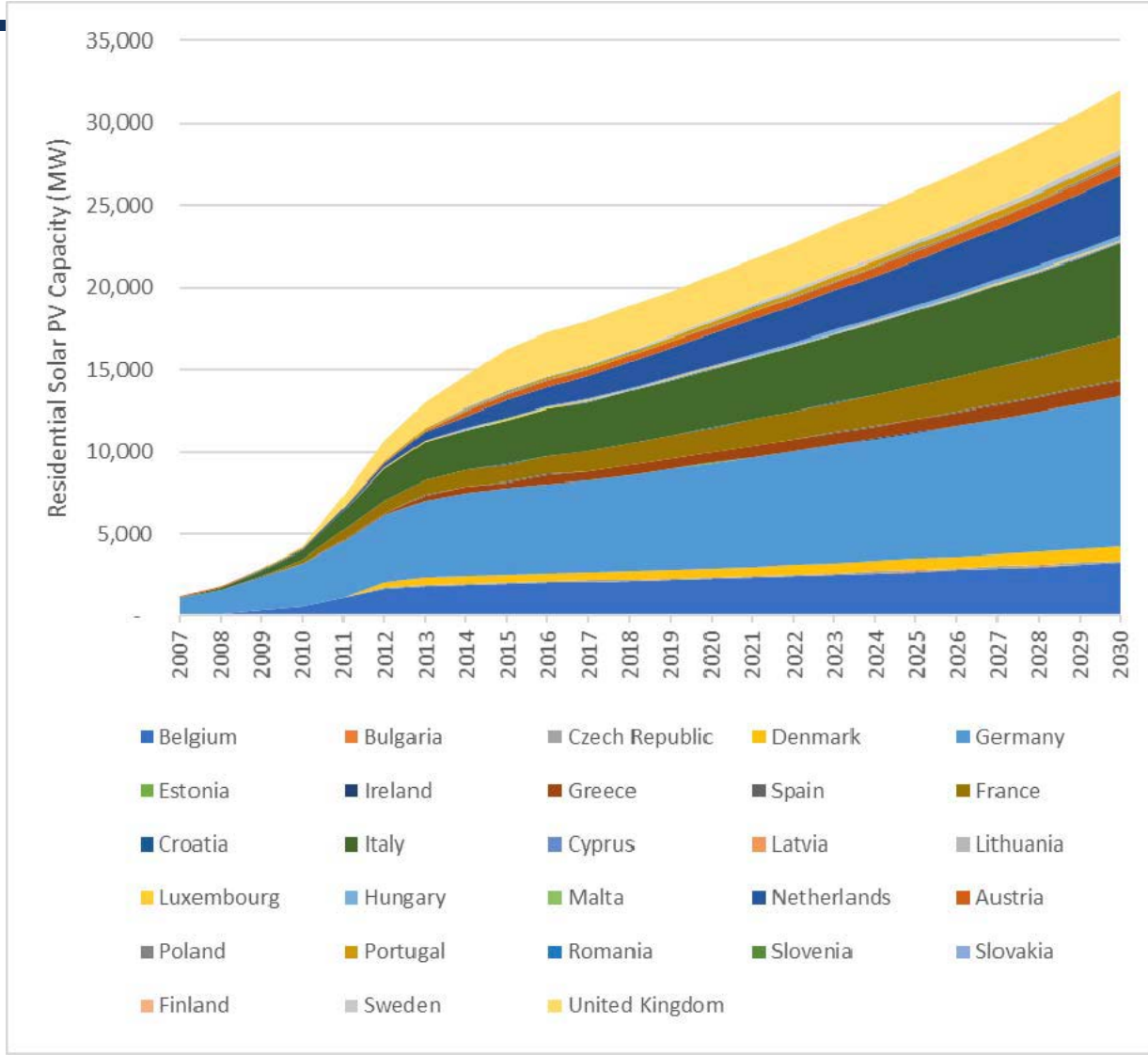
Source: EPIA 2015

Net Metering Around the World

Europe	North America	LAC	Asia	Middle East	Africa
Albania	Canada (regional)	Argentina	Japan	Israel	Tunisia
Belgium (regional)	Mexico	Canada	Korea	Jordan	Cap Verde
Czech Republic	USA (44 States)	Chile	Malaysia	Palestine	South Africa
Denmark		Costa Rica	Philippines	Lebanon	Egypt
Greece		Grenada	Singapore	Syria	Lesotho
Italy		Jamaica	South Korea		
Malta		St. Lucia	Thailand		
Switzerland		Micronesia	India		
Portugal		Honduras,	Pakistan		
Spain		Guatemala	Sri Lanka		
Cyprus					
Latvia					
Ukraine					

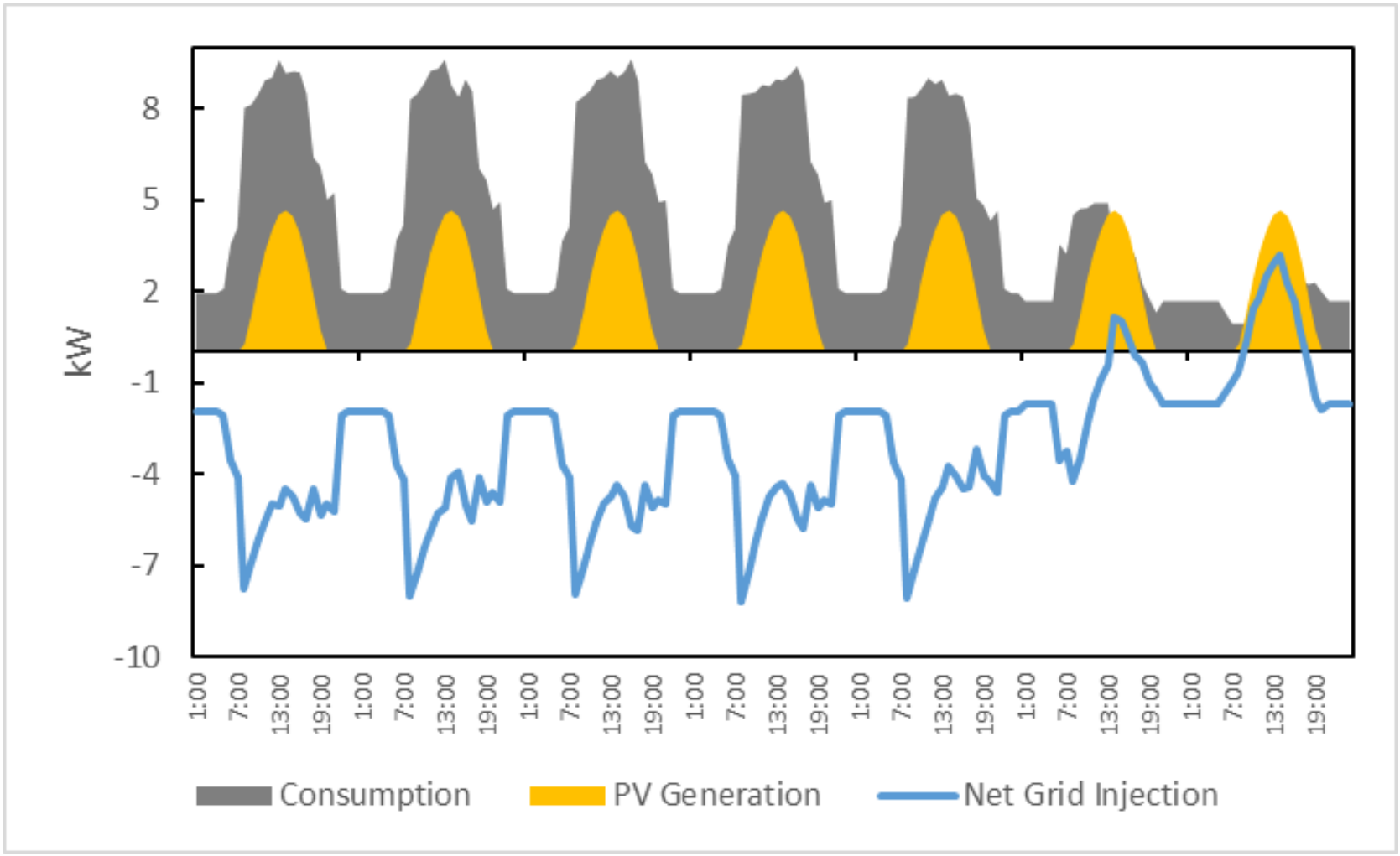
Uptake of Residential Solar PV in the EU

Residential Solar PV is becoming a major source of new power generation



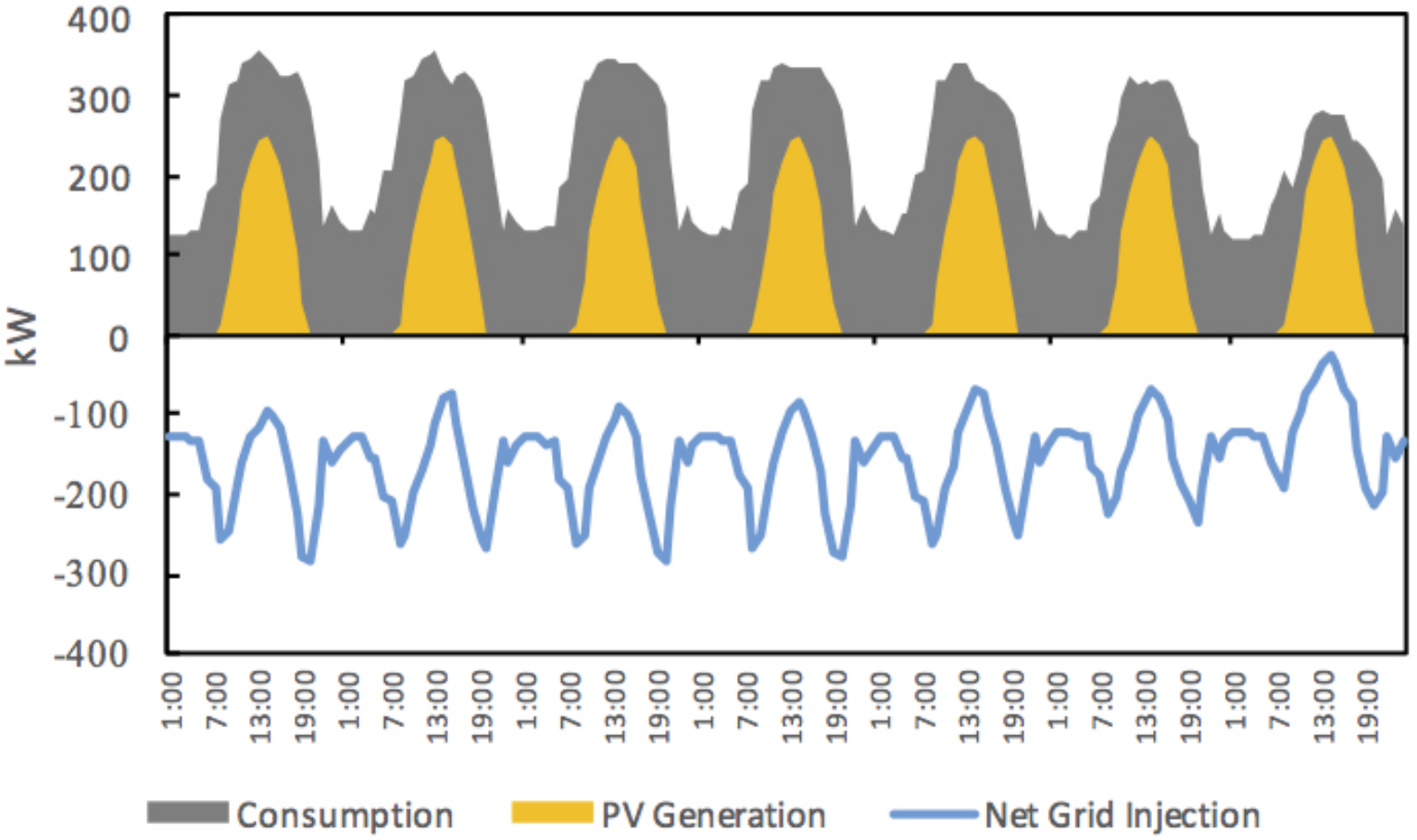
https://ec.europa.eu/commission/sites/beta-political/files/study-residential-prosumers-energy-union_en.pdf

Office Building Load Curve: 7.5kW Solar PV Array



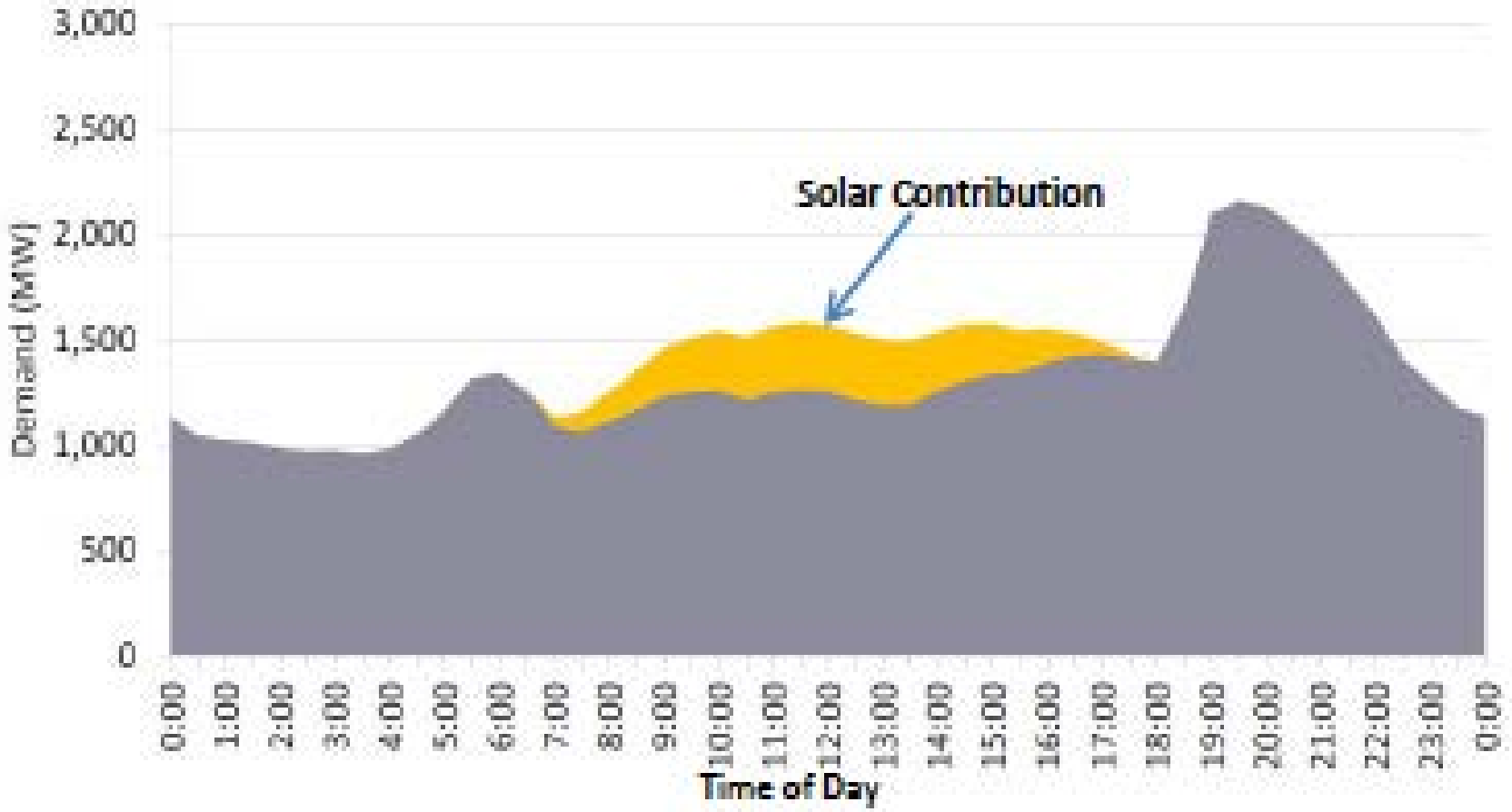
Source; E3 Analytics 2018

Supermarket Load Curve: 300kW Solar PV Array



Source; E3 Analytics 2018

System-wide Perspective



Source; E3 Analytics 2018

Net Metering: Advantages

- Allows customers to develop onsite generation, connect to the grid, and export their Net Excess Generation
- Provides a simple compensation formula (@ retail rate)
- Easy to understand, typically easy to participate
- Decreasing PV costs are making Net Metering increasingly attractive: customers can use the grid as a battery, export the surplus, avoiding the need to invest in storage
- Can be easily combined with new business models (e.g. leasing, virtual net metering, community solar, etc.)

Net Metering: Challenges

- Typically limited to small and medium project sizes (<2MW): **artificially limits project size**
- **Compensation rate is arbitrary** (the retail rate has no relationship to the cost of customer-sited RE generation)
- Compensation rate may **discriminate against certain customer classes**
- **Favors larger electricity consumers**, including wealthier households

Net Metering: Challenges

- **Higher ”value” awarded to certain customers** than others (e.g. ‘x’ for residential vs. ‘y’ for commercial)

- **The “value” of Net Excess Generation and banked credits goes up over time** as electricity retail prices increase: however, **the “value” of solar to the grid may in fact decline as the share of solar grows**…

- In island regions with high retail tariffs (e.g. Hawaii, Caribbean, Pacific islands), **compensation at the full retail rate may result in over-compensation**

Net Metering: Challenges

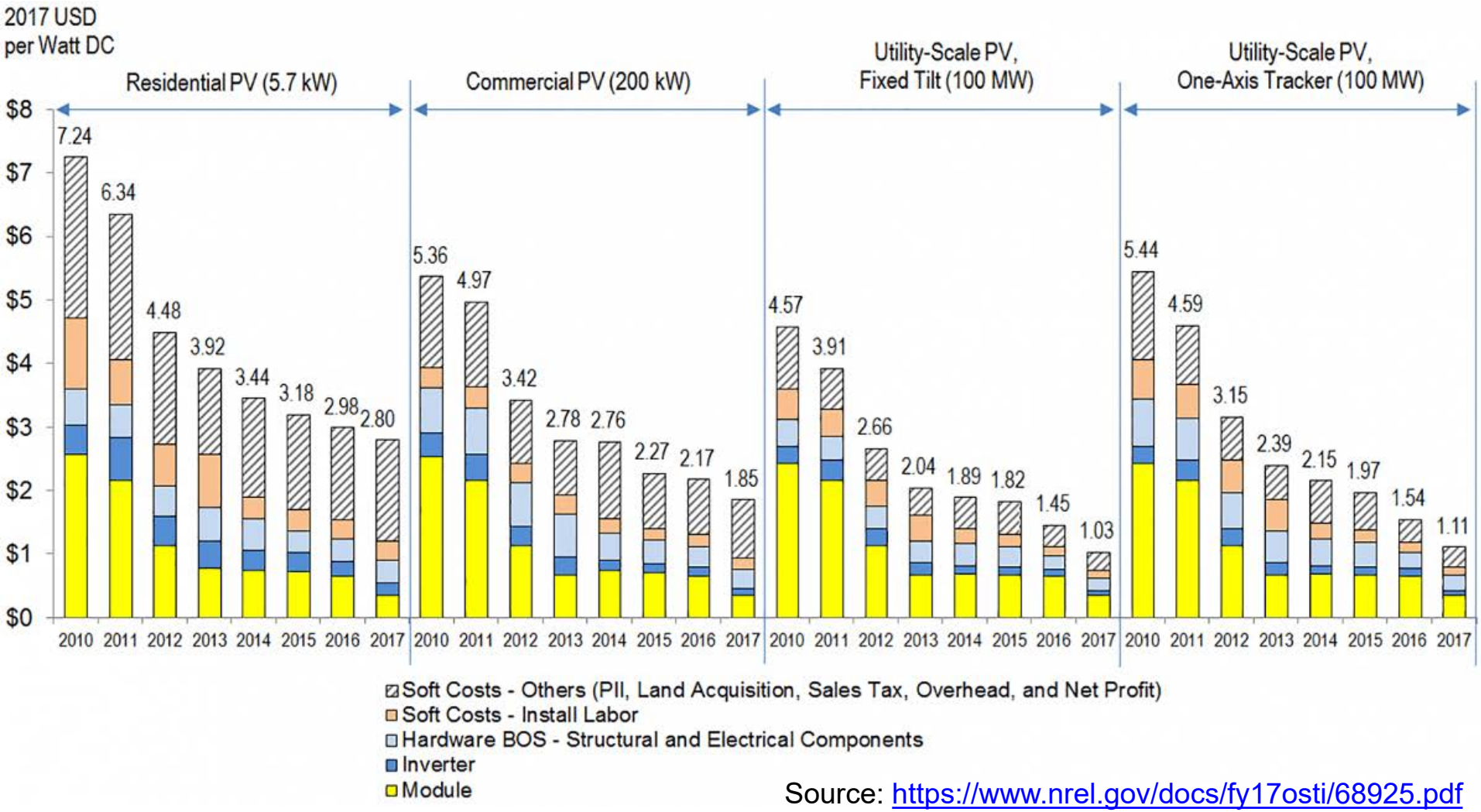
- Can negatively affect **utility cost recovery**
- May lead to **cross-subsidies** between customers with solar and those without solar
- **Tax treatment**, as well as treatment of **fixed bill charges** remains contentious
- Net Metering does not allow for a cash payment : only bill credits. This makes Net Metering **less bankable**
- **Power system subsidies keep retail rates artificially low,** which makes customer generation less attractive

Net Metering: Key Decision Points

1. Does the same rate apply both to self-consumption and exported generation?
2. Which technologies are eligible?
3. Which customer types are eligible?
4. What are the project size categories?
5. Is there a cap on the total allowable capacity?
6. What is the length of the NM agreement?
7. Do existing projects qualify?
8. Are there any additional charges or fees?
9. Are any bill components “ring-fenced” (i.e. non-erasable through self-consumption)?

3. The Future of Net Metering

Solar PV Costs Continue Their Downward March



Source: https://www.nrel.gov/docs/fy17osti/68925.pdf

Solar Already Below Retail Rates in Many Jurisdictions

Country	Current Retail Rate (EUR/kWh)	Approximate levelized cost of customer-sited PV (EUR/kWh)	PV LCOE as a Percentage of Retail Rate
Germany	**0.30/kWh**	0.10/kWh	**~33%**
Hawaii	**0.33/kWh**	0.9/kWh	**~30%**
Australia	**0.20/kWh**	0.65/kWh	**~33%**
New York (U.S.)	**0.18/kWh**	0.10/kWh	**~55%**
Cape Verde	**0.27/kWh**	0.13/kWh	**~50%**

Source; E3 Analytics 2018

Net Metering Policies Are Evolving

In response to the growing cost-competitiveness of customer-sited generation, Net Metering policies have evolved into a wide range of alternatives and hybrids in recent years:

- **Net Billing (Session 6, Part 2)**
- **NET-FITs (Session 7)**
- **Buy-all, Sell-all policies (aka FITs)**
- **Etc.**

1st, 2nd, and 3rd Generation Net Metering

Net Metering	Net Billing	NET-FIT

1st Generation

- Net excess generation compensated at the retail rate
- No cash payment for net excess generation
- DPV understood primarily (if not exclusively) as demand reduction

2nd Generation

- Net excess generation begins to be compensated at a rate below retail
- Some jurisdictions begin to tighten the screws (e.g. limit roll-over, size caps, etc.)
- DPV still understood primarily as **demand reduction**

3rd Generation

- Net excess generation continues to be compensated at a rate **below** retail
- Some jurisdictions begin to introduce the option of **cash payments** for net excess generation
- DPV begins to be recognized as a potential new (major) source of power supply

Several Different Trends Emerging

- Trend toward **compensation being set below the retail rate** (i.e. Net Billing)
- Movement toward offering a **cash settlement** of Net Excess Generation (instead of simply bill credits)
- **Time-based rates** (TOU rates) becoming more common
- Some jurisdictions exploring **location-specific rates**
- **Ring-fencing** is becoming more common: i.e. making certain bill components “non-bypassable” or “non-erasable” via self-consumption to protect against utility revenue erosion
- Differentiation of the policy design for different project **size categories**
- Use of **Blockchain** and **peer-to-peer power sharing**, as well as **solar leasing** and **community solar**

Why traditional Net Metering is becoming less appropriate in certain contexts

- Arguably *overcompensates* distributed PV owners
- Tends to be most attractive for customers in the highest tariff classes: NM therefore erodes revenue from the most profitable customers first
- The Net Metering rate (i.e. the retail rate) is arbitrary, differs by customer class, and has no relation to the cost of solar, or to the value of solar to the grid
- Raises electricity customer cross-subsidization issues

4. Concluding Remarks

The Genie is out of the bottle

- Solar PV is getting increasingly the least-cost source of new power supply
- The cost of solar is now below the retail price that customers pay in a wide number of markets (Hawaii, California, Massachusetts, South Africa, Germany, Philippines, etc.)
- **Governing the growth of such "prosumers"** while striking the right balance between prosumers and other customers **is poised to become one of the key challenges in the years ahead**

Photo Credits: Disney

5. Further Reading

Further Reading

- 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
- Zinaman et al. (2018). Distributed Generation Compensation Mechanisms (2018): https://www.nrel.gov/docs/fy18osti/68469.pdf
- https://gridworks.org/wp-content/uploads/2018/01/Gridworks_SustainingSolar_Online.pdf

Further Reading

- 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

- Rickerson, W., Couture, T., Barbose, G., Jacobs, D., Parkinson, G., Belden, A., Becker-Birck, C., Chessin, E., (2014). “A Study on the Effects of a Large Uptake of Non-Incentivised Residential PV (RE-PROSUMERS)”, IEA-RETD: Paris, France. Available at: http://iea-retd.org/wp-content/uploads/2014/06/RE-PROSUMERS_IEA-RETD_2014.pdf

- EU Study on Prosumers in the EU: https://ec.europa.eu/commission/sites/beta-political/files/study-residential-prosumers-energy-union_en.pdf

Thank you for your time!

6. Knowledge Checkpoint: Multiple Choice Questions