



Self-Consumption and Net Balancing: Issues and solutions

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Why "net metering"?



 With "net metering", the electricity self-generated is subtracted from the consumer's gross demand, so that the consumer is only charged for the "net" demand he actually takes from the grid.

Consumer with self-generation

Self supply demand

Self generation

Self generation

Consumer without self-generation

Gross demand

With "net metering", two consumers taking the same amount of electricity (kWh) from the grid pay the same for that electricity. (Whether they impose the same costs is a different question...)

"Net metering" savings for consumers are given by the per-kWh tariff charges



Charges paid through the energy charge by consumers without DG

Savings perceived by the consumer

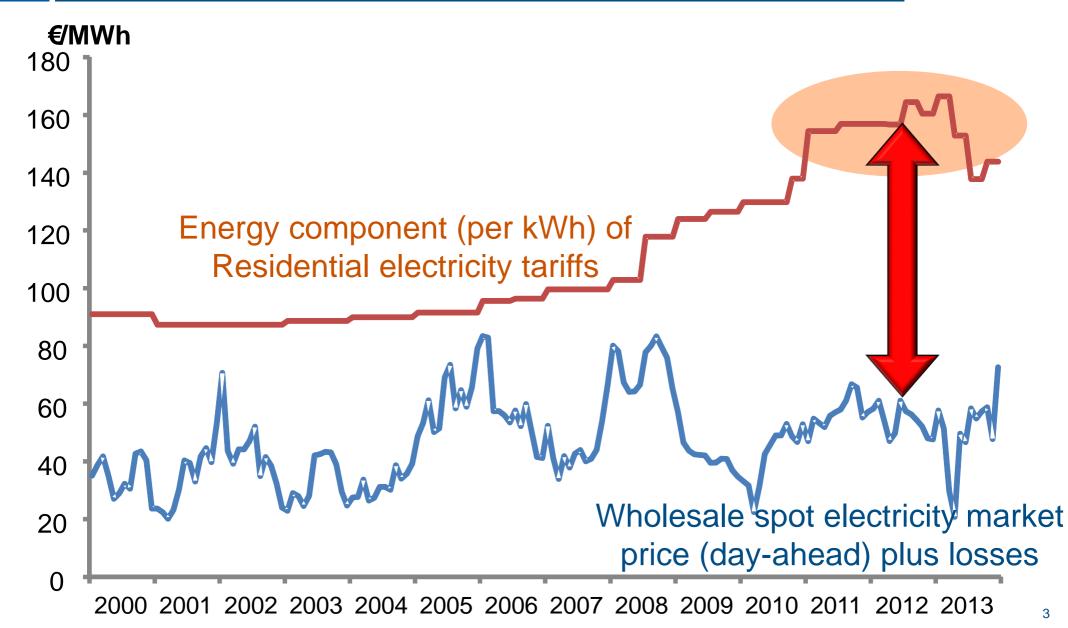
Per-kWh levelised cost incurred by consumers with DG

Energy charge (per kWh) in the consumer tariff

Levelised cost (per kWh) of distributed generation

"Net metering" savings for consumers: The case of Spain





"Net metering" savings for consumers are given by the per-kWh tariff charges



Charges paid through the energy charge by consumers without DG Savings perceived by the consumer

Government policies

Network costs

Generation Capacity

Ancillary Services

Losses

Cost of wholesale generation

Per-kWh levelised cost incurred by consumers with DG

Levelised cost (per kWh) of distributed generation

Which of these costs are really saved by the system?

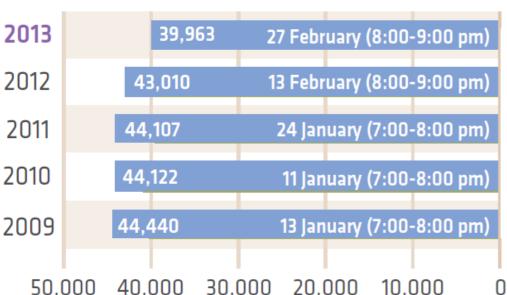
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Does solar PV reduce the need for capacity in Spain?

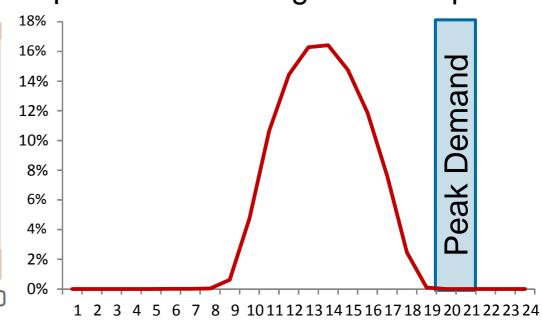


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Spain's winter PV generation profile



In Spain, solar PV generation does NOT reduce the need for distribution, transmission or generation capacity.

Source: REE

"Net metering" leads to waste of resources and cost transfers



Charges paid through the energy charge by consumers without DG

Savings perceived by the consumer

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Cost of wholesale generation

Per-kWh levelised cost incurred by consumers with DG

Levelised cost (per kWh) of distributed generation

Costs really avoided by the system

Losses

Spot wholesale electricity market price Costs incurred inefficiently (waste of resources)

Costs transferred to other consumers

"Net metering" leads to waste of resourc Government ost trasfers



Government policies

Network costs

Generation
Capacity

Ancillary Services

Levelised cost (per kWh) of distributed generation

Costs transferred to other consumers

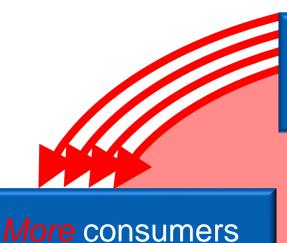
Costs incurred inefficiently (waste of resources)

Losses

Spot wholesale electricity market price Costs really avoided by the system

"Net metering" is not a sustainable policy





choose self-supply

Self-supply becomes more attractive

Regulatory "ticking

Tariffs to remaining consumers go up



Tariff receipts fall by more than cost

bomb¹

Cheap generation is replaced with more expensive generation



How can the regulator prevent this from blowing up in his hands?



- One possibility is simply not to allow "net metering", so that:
 - consumers with DG continue to pay for their total electricity demand at the normal consumer tariff, but
 - they receive a payment for their total generation equal to the spot electricity market price plus losses
- However, if "net metering" is allowed:
 - the costs that the consumer avoids in his electricity supply invoice must be equal to
 - the costs that the system avoids when the consumer self-supplies.

1. Apply a "backup" tariff on selfgeneration



Energy charge (per kWh) in the consumer tariff

Government policies

Network costs

Generation
Capacity
Ancillary

Losses

Services

Cost of wholesale generation

Backup tariff (per kWh) on self-generation

- Under this option, consumers <u>pay</u> a backup tariff on the energy they self-generate
 - The result is the same as with "no net metering"
 - Consumers who self-generate require distribution, transmission and generation capacity to continue to be available in case their equipment fails
- Decisions to self-generate will be efficient
 - BUT: risk of fraud (e.g. non-declaration of installations) creates need for policing and means that this solution is unlikely to be sustainable

2. Recover all the non-avoidable costs through the capacity (per kW) charge



Energy charge (per kWh) in the consumer tariff

Government policies

Network costs

Generation Capacity

Ancillary Services

Losses

Cost of wholesale generation

Move to the capacity (per kW) charge

- Consumers who self-generate only cease to pay the costs that the system really avoids
- Consumers' decisions to self-generate will be efficient
 - -BUT: allocating the costs of government policies to the capacity charge leads consumers to inefficiently reduce their capacity demand (e.g. installing batteries)

3. Move the costs of government policies to a per-customer charge



Government policies

Network costs

Generation
Capacity
Ancillary
Services

Move to the per-customer charge

Move to the capacity (per kW) charge

- Consumers' decisions to self-generate and their capacity demand will be efficient
 - –BUT: if the per-customer charge is substantial, consumers would have incentives to:
 - aggregate loads (to pay the per-customer charge only once)
 - disconnect from the grid (e.g. using batteries, or micro CHP)

4. Take the costs of government policies out of the electricity tariff



Government policies

Network costs

Generation
Capacity
Ancillary
Services

Financed

outside the
electricity tariff

Move to the capacity (per kW) component

- Consumers' decisions to self-generate, their capacity demand, and their decision as to whether to be connected to the system will all be efficient
- Cost recovery through the government budget (taxes on income, consumption, etc.) is the least distortionary

Summary of options



	Option	Advantages	Disadvantages
No net metering		 Efficient installation of DG 	 Risk of fraud, need for policing
ng	Backup tariff on self-generation	• Efficient installation of DG	•Risk of fraud, need for policing
net metering	Non-avoidable costs in capacity charge	• Efficient installation of DG	 Inefficient capacity decisions and battery installation
<u></u>	Extracosts in customer charge	Efficient installation of DGEfficient capacity decisions	Aggregation of consumersConsumers connect to "wrong" voltage level
If there	Extracosts recovered out of tariff	Efficient installation of DGEfficient capacity decisionsEfficient extracosts funding	

Is distributed generation efficient? Should it be subsidised?



- The cost of distributed generation is expected to fall, while wholesale electricity prices are expected to increase.
 - However, this does not mean that distributed generation will be efficient.

Technology	Advantages	Disadvantages
Distributed generation	 Reduction in energy losses 	Loss of economies of scaleNeed to adapt distribution grid
Distributed solar PV	Use of costless space (roof tops)	Installation cost, lower efficiencyDistribution grid investments
Distributed micro CHP	• Higher efficiency (sometimes)	Gas network investmentsGHG emissions concerns
Isolated DG system	Grid costs are avoided	Suboptimal despatch/load factorBatteries and limited supply (if PV)

Summary and conclusions



- On the surface, "net metering" seems to be "fair". While DG was expensive and rarely adopted, this misperception was not a problem.
 - However, the fact that non-avoidable costs are recovered though the energy (per kWh) charge makes DG appear to efficient, even when it is not.
 - Electricity tariffs are often used to finance government policies, because electricity demand was "price inelastic" and the costs could be "hidden".
- In reality, "net metering" is a "ticking bomb" leading to resources being wasted, lower social welfare, and cost transfers across consumers.
- Spain has moved in the right direction, by (a) shifting some costs from the energy (per kWh) to the capacity (per kW) charge, and (b) adopting a backup tariff. However, this solution is unlikely to be sustainable.
- The only efficient and sustainable option is:
 - to put all capacity costs in the capacity (per kW) charge and
 - to take any significant "political costs" out of the electricity tariff.





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