International Energy Agency

資料3

Electricity Network Tariffs

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The Future: Utility Scale Renewables?

World's largest PV Plant-Solar Star, California:
around 600 000 kW spread over 25 square kilometres

Or Off-Grid Solutions?

Off-Grid Solutions

Outline

- The changing role of networks
- Principles of network tariff design
- Locational signals
- Network tariff structure
- Regulation 2.0

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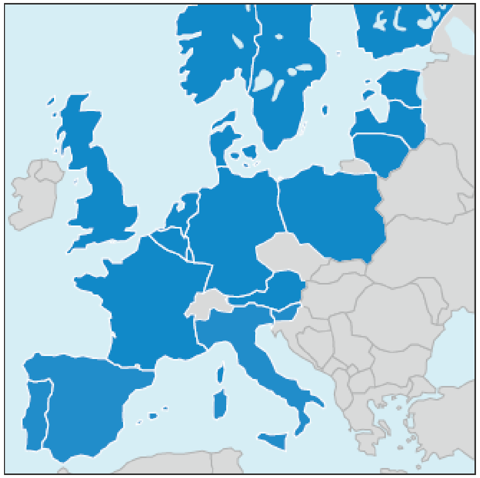
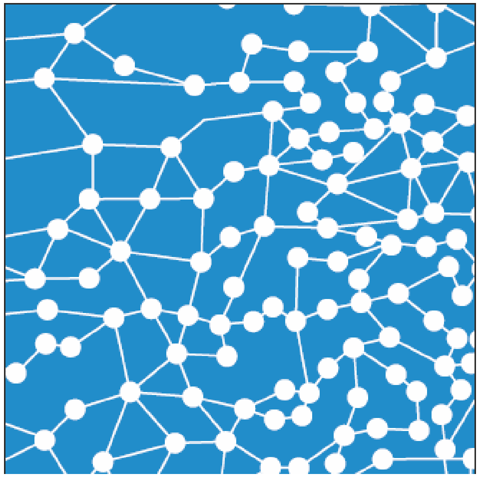
Efficient Co-ordination Between Generation and Network Needed at all Levels

Where to Invest?

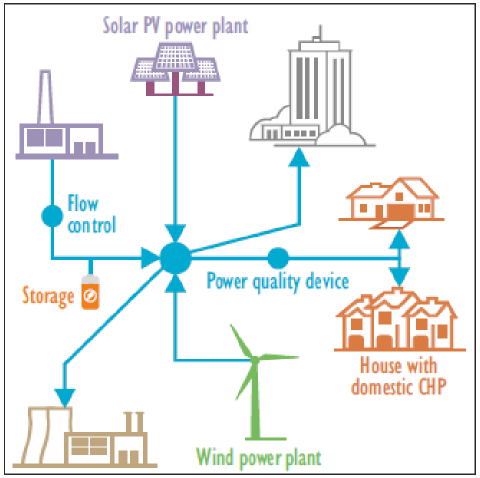
Continental Markets



Locational Markets



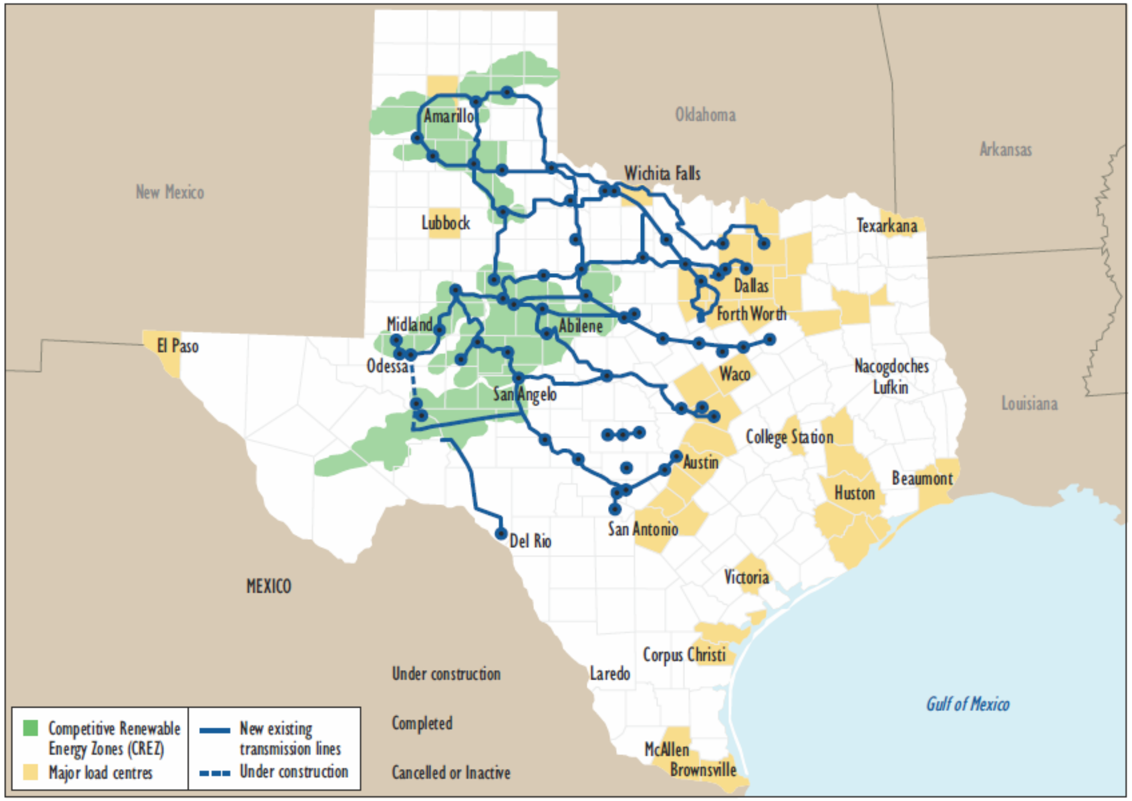
Local, Distributed Markets



Market designs with a high geographical 'resolution' can provide incentives for efficient and secure co-ordination of distributed power resources and across borders.

Network as the Backbone of Low-Carbon Electricity Markets

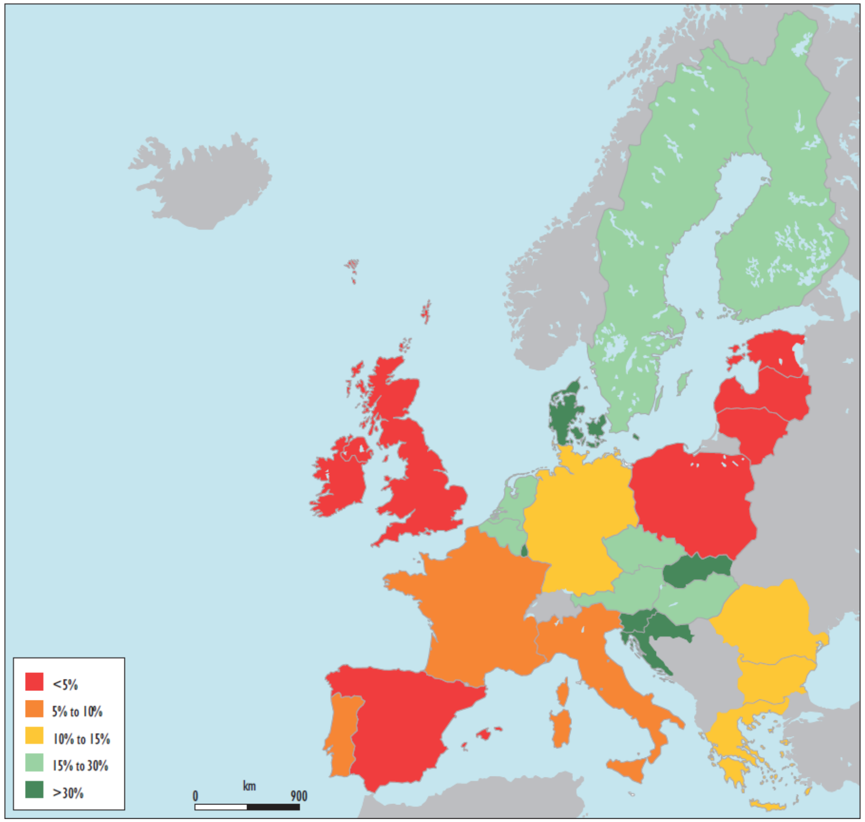
New Transmission Investments between Renewable Energy Zones and Load Centres in Texas



Renewables can be deployed in 2-3 years, much more rapidly than new transmission, which takes at least 7 years … and this can create congestions.

European Interconnections are Promoted by the EU to Reinforce the Internal Market

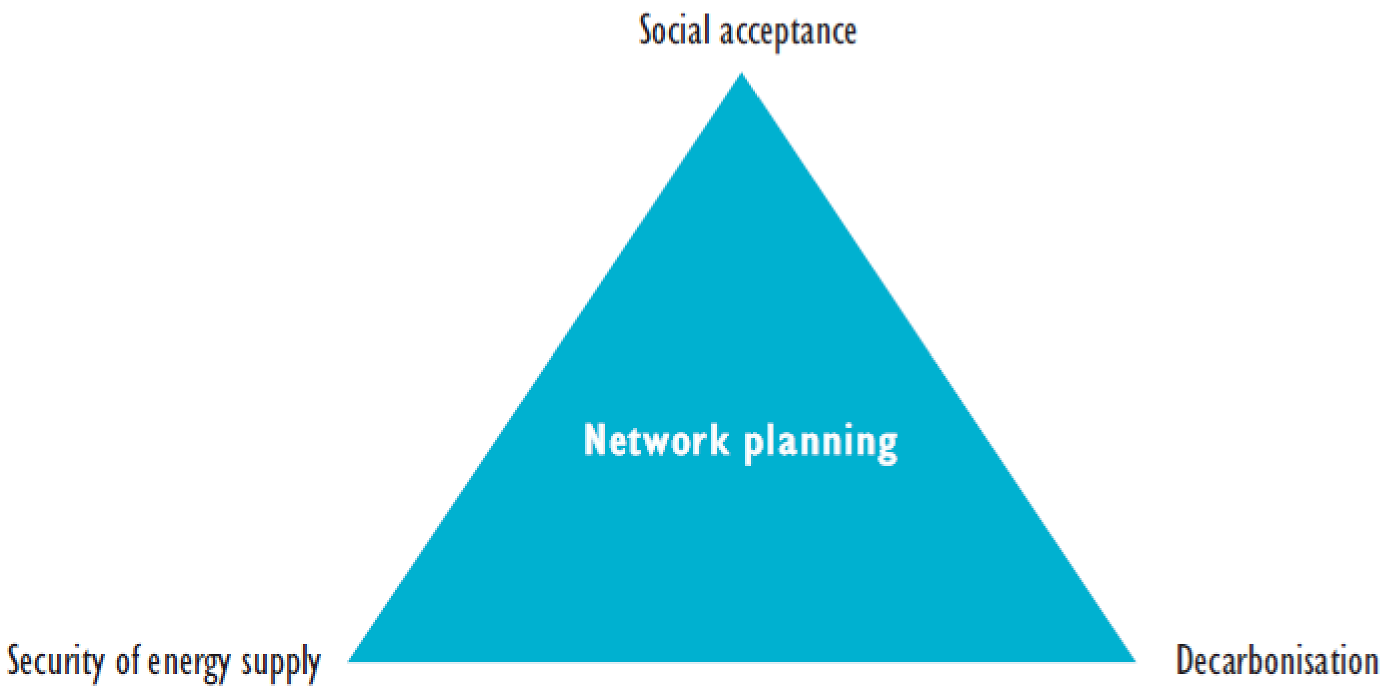
EU Interconnection Levels in 2020 After the Completion of Current Projects of Common Interest



Interconnectors between countries already represent 11% of installed generation capacity and Europe is currently introducing a target of 15% by 2030

Meeting Decarbonisation Targets Requires a Strong and Reliable Transmission Grid

Trilemma of Transmission and Distribution Planning



Cross-regional interconnectors are often a cost-efficient alternative to investing in other resources in order to balance a system with high shares of VRE

Changing role of networks

Reduced Energy Flows	But More Frequent Congestions

Reduced Energy Flows

- Declining demand
- Distributed generation reduces energy flows on the network
- Network investments remain key priority
- Efficient resource planning

But More Frequent Congestions

- Large renewable capacity needed
- Local acceptability problems delays transmission investments
- Non-transmission options (storage)
- Curtailment helps to integrate higher shares of renewables

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Network Tariffs: High Level Principles

The overall objective of network tariffs is to ensure fair access to, and to regulate, a natural monopoly

- **Access to the Network on Equal Terms**
  - **Cross-subsidies between different consumers (by voltage level)**
  - **Avoid price squeeze of competitors and foreclosure of the market**
- **Unbundling of Generation Activities and Network**
  - **Different type of unbundling (accounting, legal, ownership)**
  - **Key issue is the allocation of common and overhead costs**
- **Cost-Reflective Tariffs Send the Right Long-Term Signals**
  - **Congestion costs can be either mutualised or explicitly charged**
  - **Long-run costs calculation methodology**

⇒ Network charges are a significant part of final electricity bills and influence both the level and the structure of final electricity prices

Network Tariffs Level

- Capital expenditures
- Operating expenditures
- System services costs
- Congestion costs, if not reflected in energy market prices
- Network losses, included or not

Network Tariffs Differentiation and Structure

Key dimensions:

- **Connection Charge (deep versus shallow connection costs)**
- **Differentiation by Voltage Level**
- **Generation and Load (G/L) Tariffs**
- **Geographical Differentiation**
- **Capacity and Energy Components**
- **Time Differentiation**

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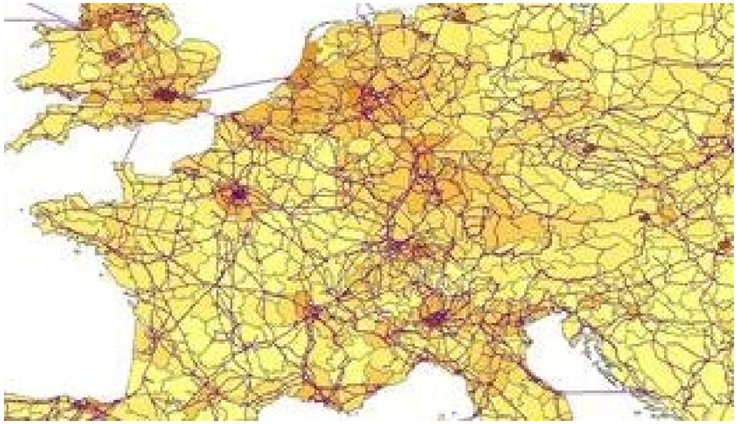
Locational signals: energy prices Vs network tariffs

Highly Meshed Networks



- Energy flows different from commercial flows
- New transmission benefits are spread over many countries
- Fragmented regulation

-> Zonal energy prices provide locational signals in Continental Europe

Radial Networks

- Dominant physical flow of electricity (North-South)
- Benefit of new transmission can be allocated
- One regulator

-> Geographical differentiation of the G-tariff provide locational signals in the UK

Using G-tariff to provide locational signals for generators

- Generators can be charged a significant fraction of costs
- 'Postage stamp'-like tariffs
  - Postage stamps can be differentiated by network company and / or zone
  - Energy or capacity charge?
- Compensation between TSOs for transit energy flows
- Cost-reflective tariffs can be based on long-run incremental costs (LRIC)

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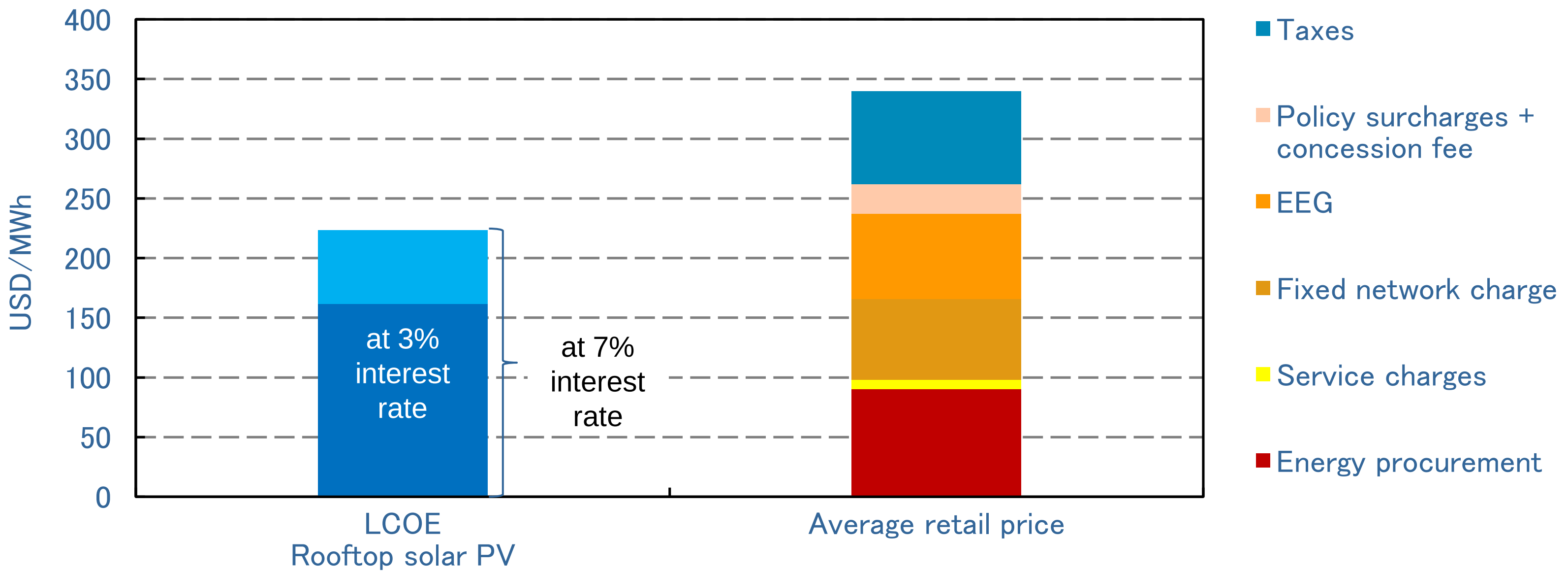
Capacity and Energy Components of Network Tariffs

- Existing network tariffs based mainly on energy
  - Consumers used to be inelastic to electricity prices
  - Different options (multipart-tariffs)
- Utility and network companies ask regulators to move away from electricity tariffs based on energy
- A capacity charge provides more stable revenues for network operators
  - Declining total electricity demand
  - Increasing of distributed resources
- A capacity charge is more cost-reflective
  - Investments driven by peak load

⇒ A clear trend of rebalancing from the energy to capacity charge is taking place in countries with rapid deployment of rooftop solar PV

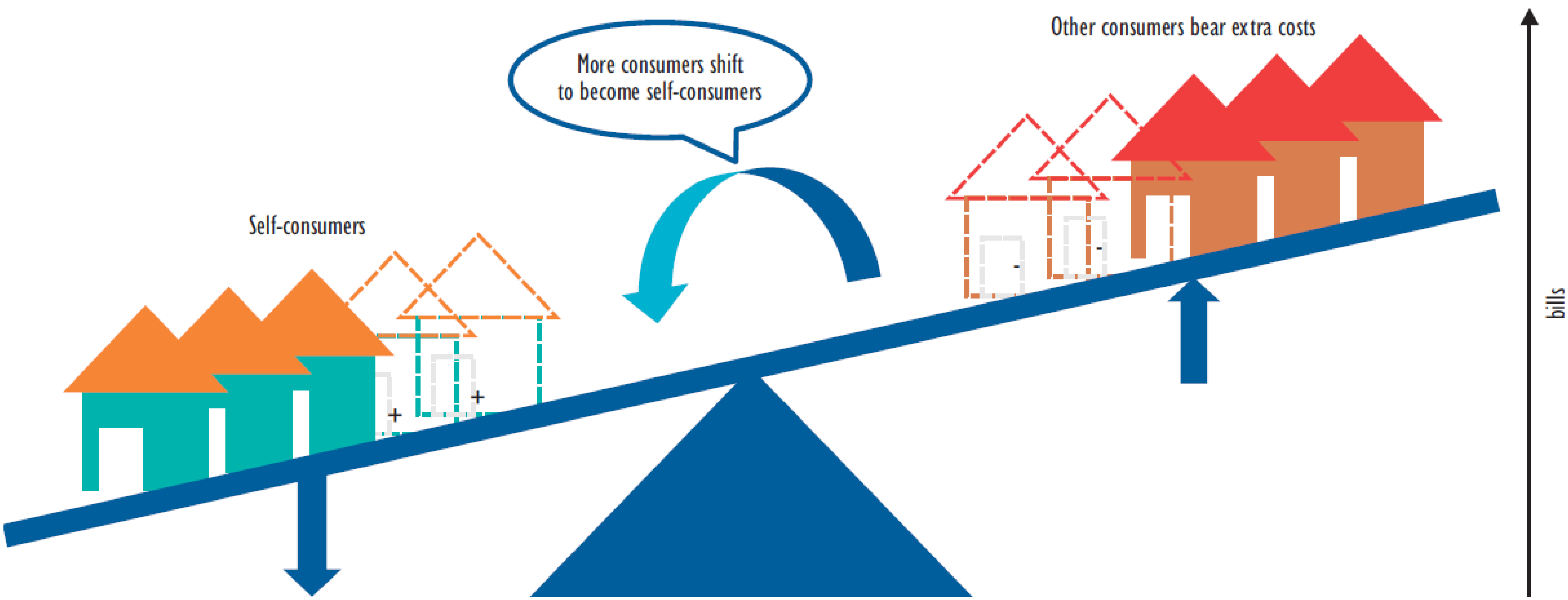
Distributed Resources Can Be Financed by Savings on Electricity Bills

Comparison of LCOE for PV and the Average Retail Price in Germany



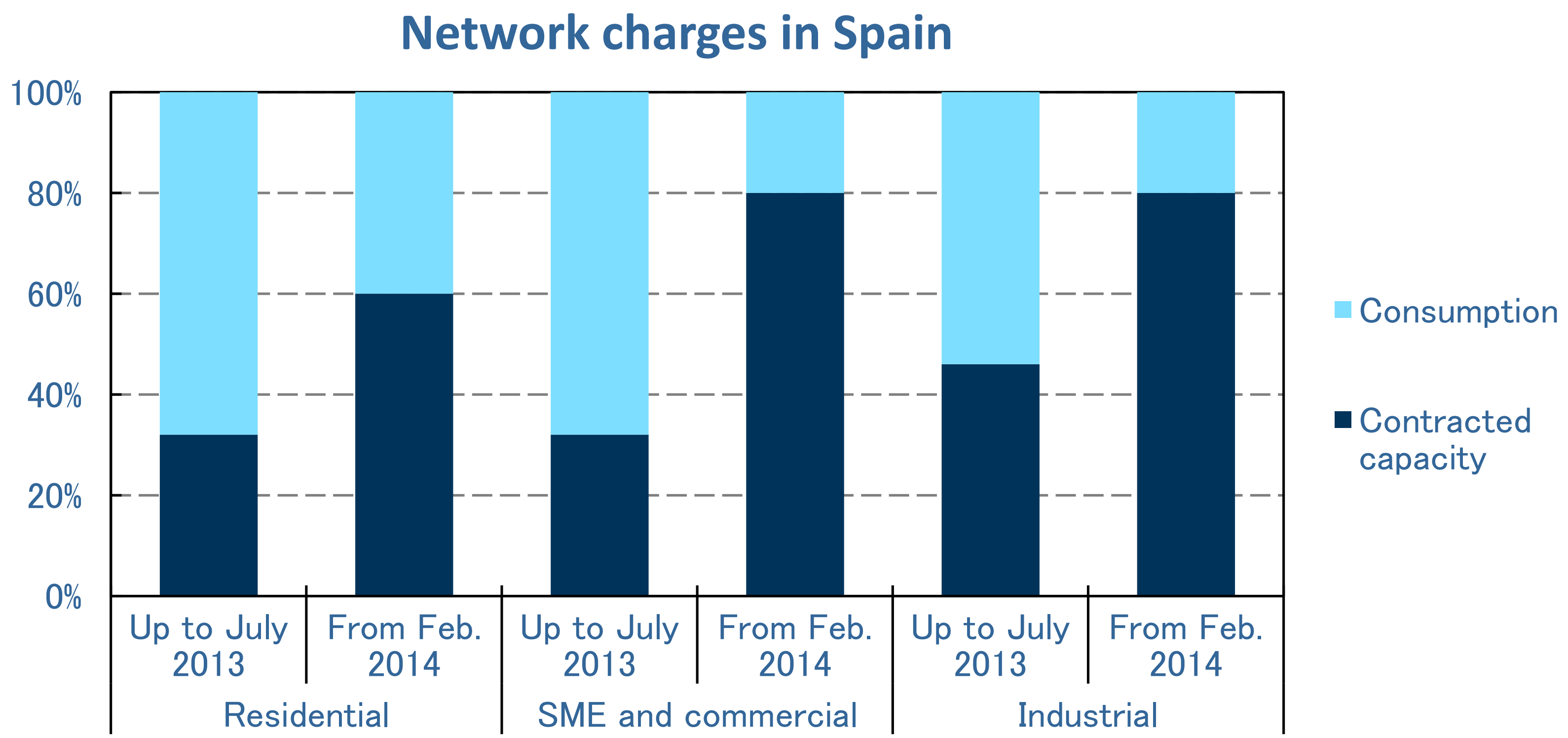
Behind the meter generation and storage can be installed rapidly while a retail-price reform may take some time to implement.

A Slippery Slope Towards Self-Consumption



Regulation of retail and network prices have to adjust to a reduced billing base and retail prices should give the right incentives to both network users and distributed energy resources.

Network Tariff Structure Can Be Improved to Better Reflect Costs



Rebalancing from a volumetric charging basis towards a capacity basis better reflects the cost structure of distribution networks.

Tariff Rebalancing to a kW Charge Raises Many Implementation Issues

- Cost-reflective tariffs are difficult to calculate
  - Many methodologies for the allocation of fixed and common costs
- Higher capacity charges increase smaller consumer bills
- Retroactive change affecting the economics of rooftop solar PV
  - In Nevada, the regulator decided the grandfather clause for tariffs for solar PV already installed
- High-capacity charge creates incentives for peak-load shaving and for installing storage behind the meter
- Tariff-rebalancing should not discourage the installation of behind-the-meter generation where it is efficient

Network Tariffs Can Be a Barrier for Demand Response and Storage

- **Demand Response**
  - Issue: demand response requires high price difference between the peak period and off-peak period
  - Ongoing discussions about the need for network tariff options specific for critical peak pricing (demand response), to the extent this reflects network costs
- **Electricity Storage**
  - Issue: Electricity storage plants are both loads and generators and have to pay the G and L components of the tariffs, which increases cost of storage
  - Storage companies (such as pumped hydro) ask exemption from all or part of network tariffs

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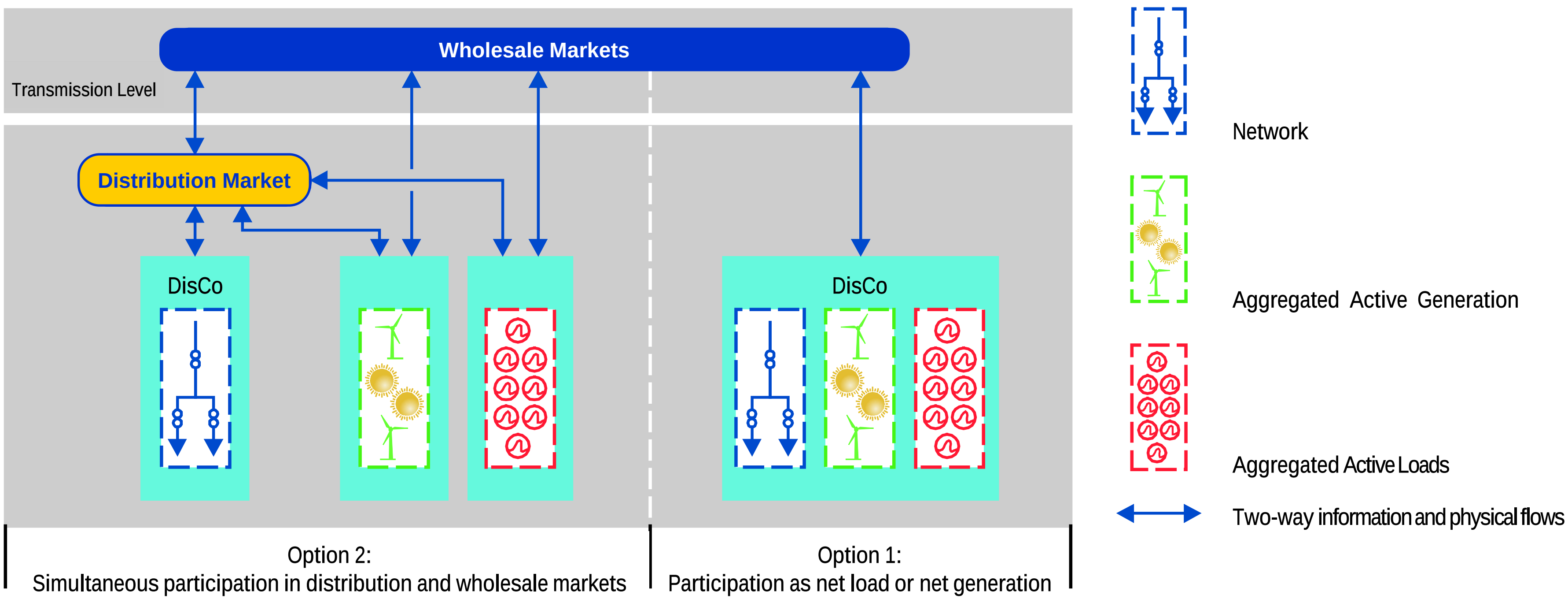
Ofgem's RIIO Regulation

Revenue	**Constraints set up-front to ensure:** Network companies are financeable; Transparency and predictability; Balance between costs faced by current and future consumers; Flexible for new outputs
=	
Incentives	**Deliver outputs efficiently over time with:** 8-year control; Up-front efficiency rate; Rewards/penalties
+	
Innovation	**Technical and commercial innovation** Core price control incentives; Exploring competitive tendering; Innovation stimulus package
+	
Outputs	**Outputs set out in clear contract**

Source: Ofgem

Output-oriented incentive scheme contributes to tap the potential of new distributed resources to optimise network investments and minimise overall costs

Distributed Market Platforms



A network regulation 2.0 is needed to establish a smart distribution network, enabling <u>market platform</u> where distributed energy resources can participate

Conclusions

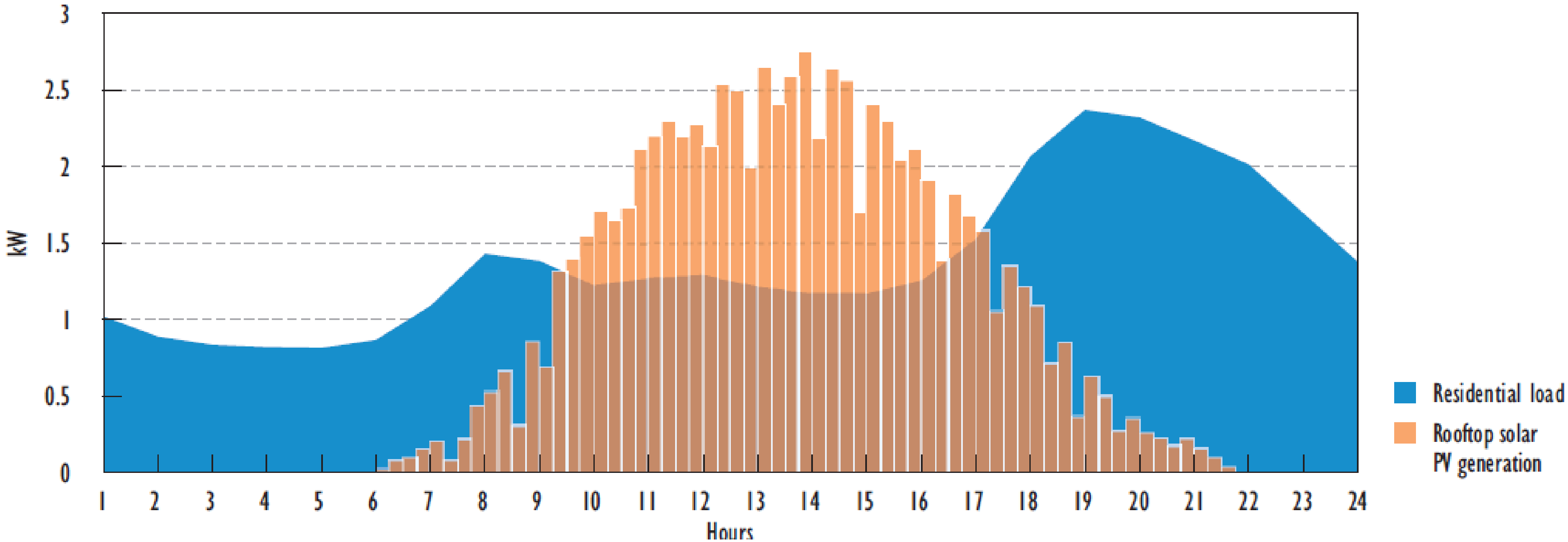
- Networks remain the backbone of power systems. They will not disappear, but their utilisation is changing.
- Network tariffs have to ensure undistorted competition.
- Cost-reflective tariffs send the right signals to the market and should not be distorted to promote specific technologies.
- Locational signals can come from energy prices or can be based on G-tariffs in radial power systems.
- Tariff rebalancing from energy to capacity but raises implementation issues.
- Integration of distributed resources calls for a modernisation of network regulation.

Thank you

http://www.iea.org/topics/electricity/publications/re-poweringmarkets/

Efficient Deployment of Behind-the-Meter Resources Requires Modernised Retail Tariffs

An Example of Hourly Profile of Household Load and Solar PV Generation



Real-time pricing reflects the variations in the cost of electricity generation, providing consumers the right incentive to install storage and generation