Electricity markets: trends and future perspectives

Joana Resende, Thereza Aquino

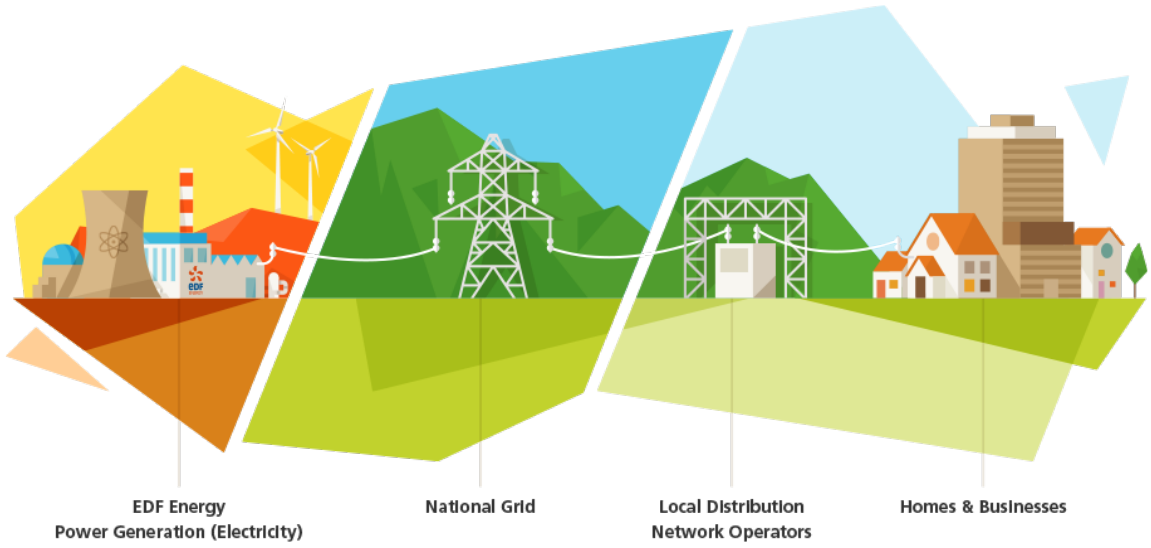
U.PORTO
FEP FACULDADE DE ECONOMIA UNIVERSIDADE DO PORTO
cef.up
Centro de Economia e Finanças da UP
Center for Economics and Finance at UP
GESEL
Grupo de Estudos do Setor Elétrico
UFRJ
20 anos
ISEG
LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Outline of the Presentation

1. Introduction
2. Recent trends and business model innovation
3. Electricity Markets
4. Regulatory Challenges
5. Conclusions

Introduction

Going from a unidirectional value chain....



Source: EDF

Introduction

... to a smart grid system based on Distributed Energy Resources

SUSTAINABILITY

DECENTRALIZATION

DIGITIZATION

BUSINESS MODEL INNOVATION

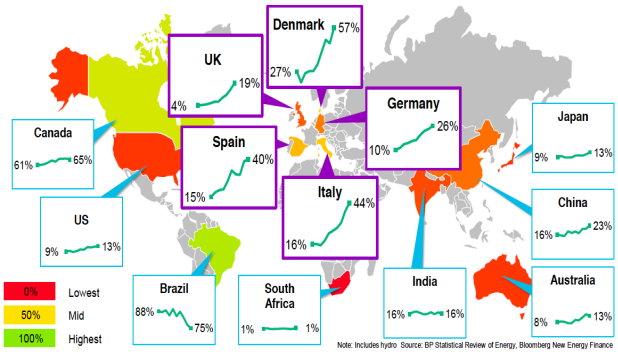
Recent trends and Business Model Innovation

Recent trends

New Electricity Paradigm

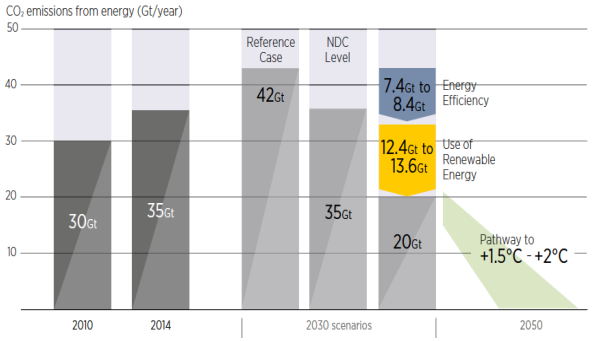
- **More Sustainable (RES)**
- **More efficient (e.g. DSM)**
- Decentralized
- Storage
- Electric Mobility
- Digital
- New business players

RES proportion of power generation (10 years to 2014)



Source: Bloomberg New Energy Finance

Expected pathways to reduction in CO2 emissions from energy



Source: IRENA (2017)

Recent trends and Business Model Innovation

Recent trends

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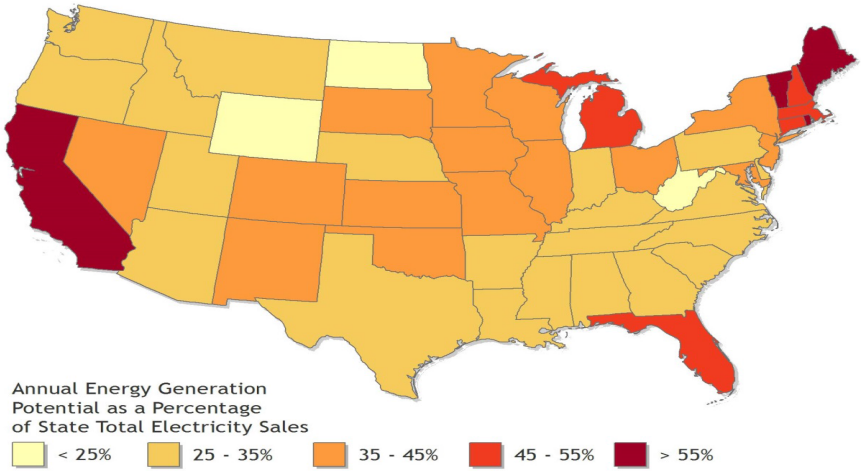
Potential rooftop PV annual generation from all buildings (% of state total 2013 electricity sales)



Source: NREL (2016)

Reduction in LCOE + Easier Grid Parity

Recent trends and Business Model Innovation

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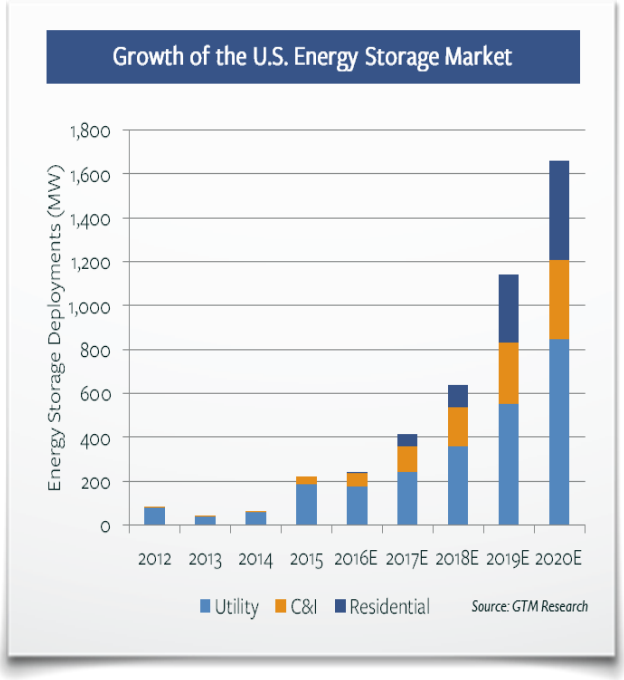
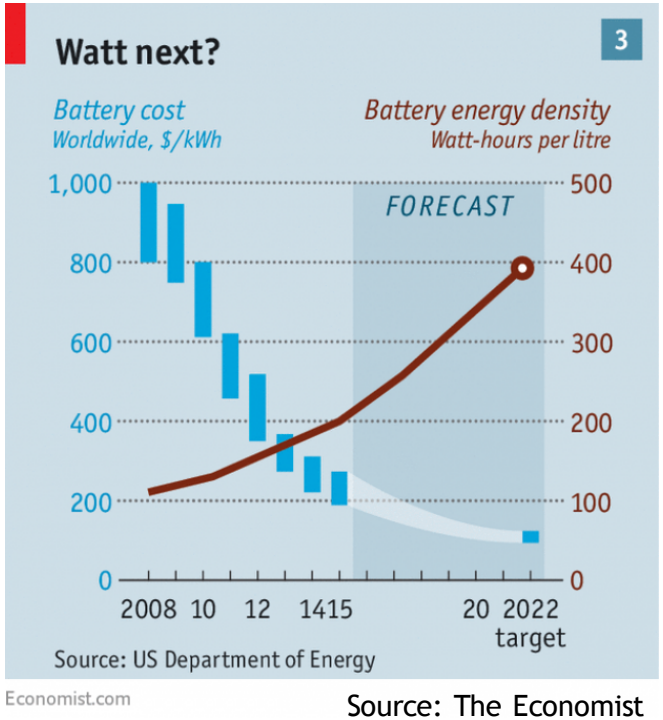


Source: GTM Research



Source: The Economist

Recent trends and Business Model Innovation

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- **Digital**
- New business players

- Digital Grid Management+ Smart Meeters = Unprecedented sets of *Real Time* Data
- Shift in the operative management paradigm:
  - Easier/ Faster detection of system flaws & faster corrections (Self-repairing systems)
  - Reduction in technical losses
  - Huge investments are needed to build the smart grid
  - Need for more coordination between TSO & DSO)
  - Shift in the key resources (human capital, data management, cybersecurity)

Recent trends and Business Model Innovation

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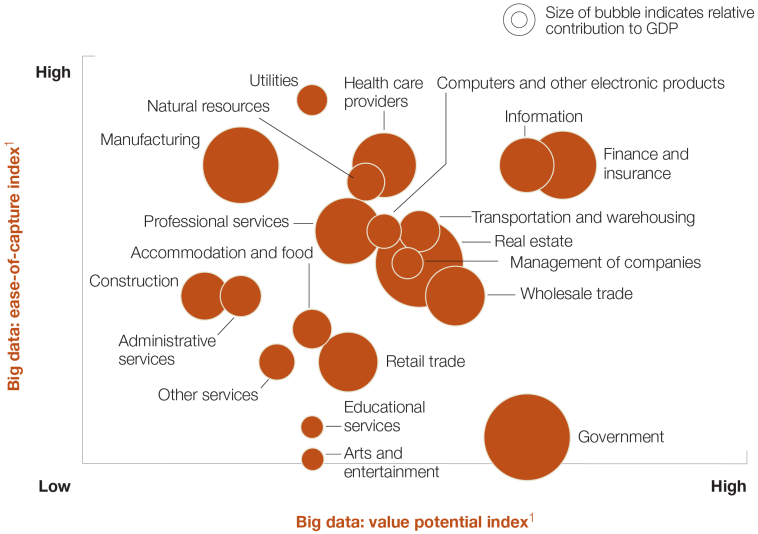
Big data: ease of capture and potential value



[1]For detailed explication of metrics, see appendix in McKinsey Global Institute full report *Big data: The next frontier for innovation, competition, and productivity*, available free of charge online at mckinsey.com/mgi.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

Source: McKinsey

- New business lines
  - System reliability services
  - Energy efficiency services
  - Big Data & Internet of Things – New business Models

Recent trends and Business Model Innovation

Recent trends

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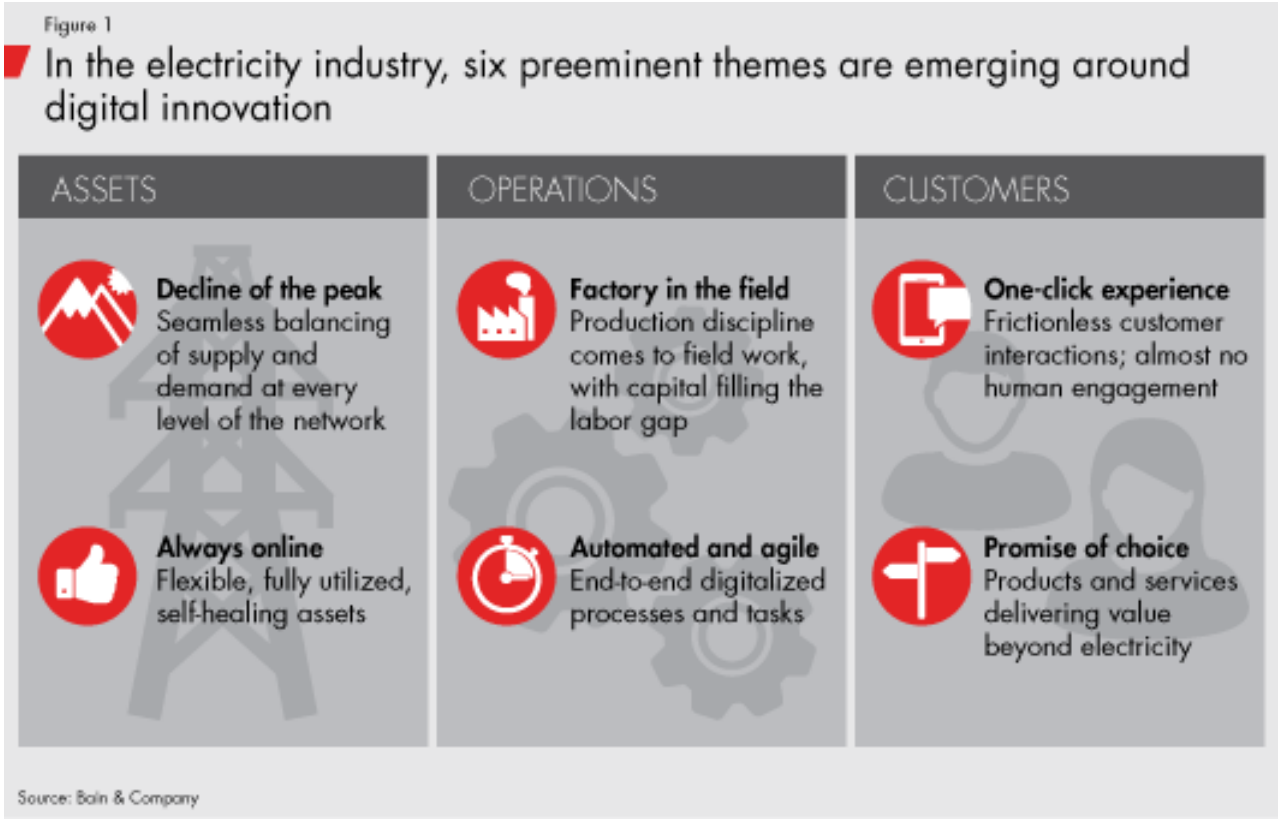

Source: Bain & Company

Recent trends and Business Model Innovation

Recent trends

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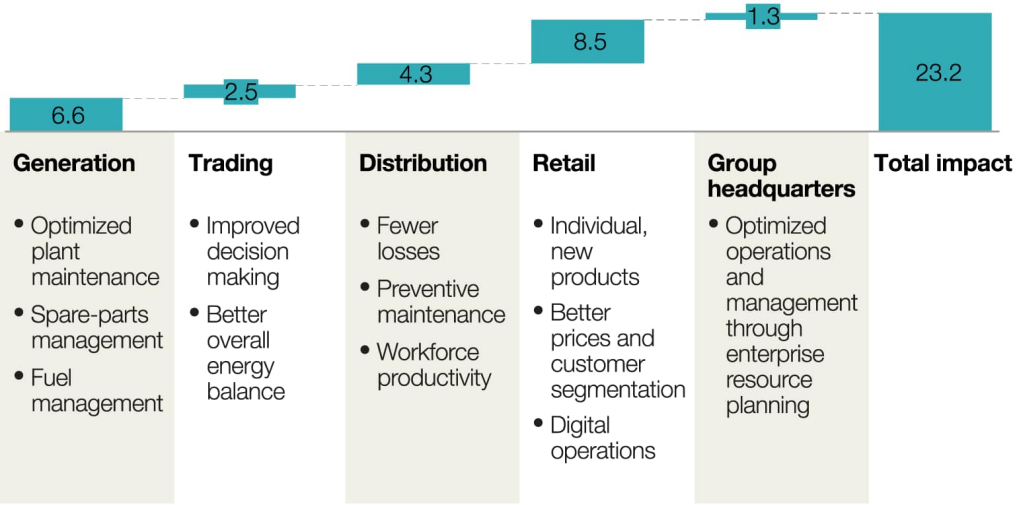
- **Digital**
- New business players

Digitization has demonstrable impact on utility earnings.

Improvement areas, case study, EBIT,[1] %



[1]Earnings before interest and taxes.

McKinsey&Company

Source: McKinsey

- Utilities' profit from digital potential
  - Smart meters and the smart grid,
  - Digital productivity tools for employees,
  - Automation of back-office processes.

Recent trends and Business Model Innovation

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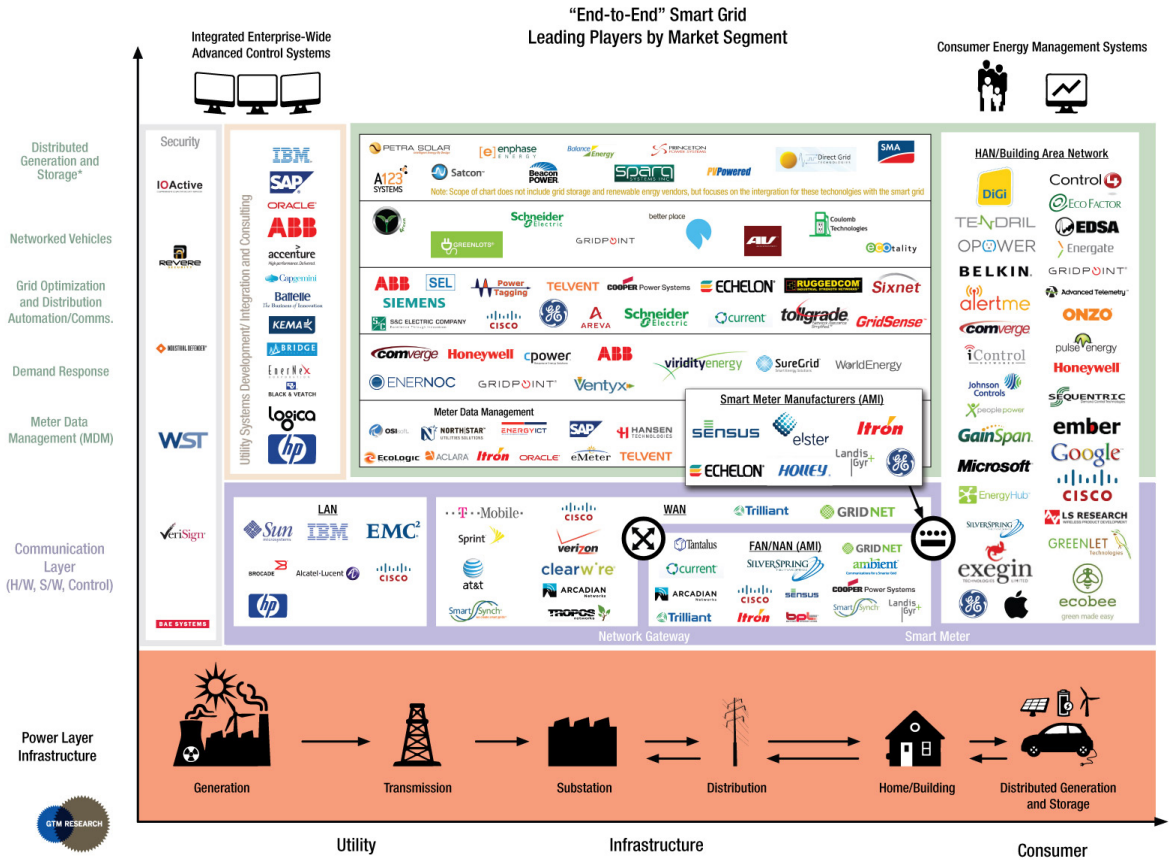
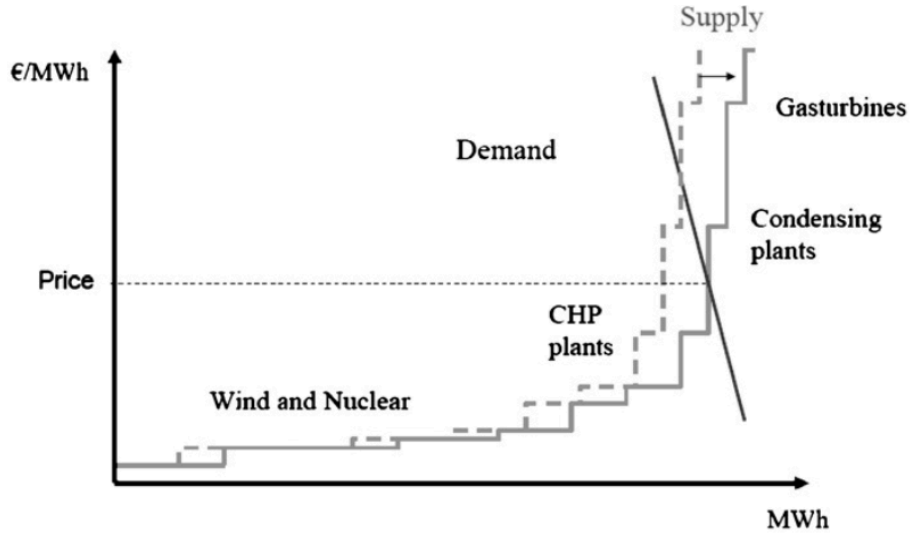
- **New business players**



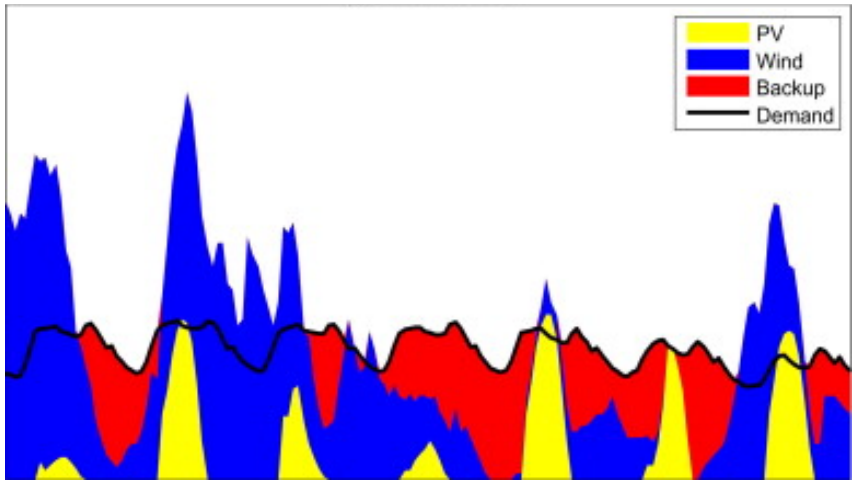
Source: GreenTechMedia

Electricity markets
Current Challenges (The European case)

- Increasing weight of RES => Investment and supply security



Price-effect of an increase of the electricity generation using wind.
Source: Vine and Juliani (2014).

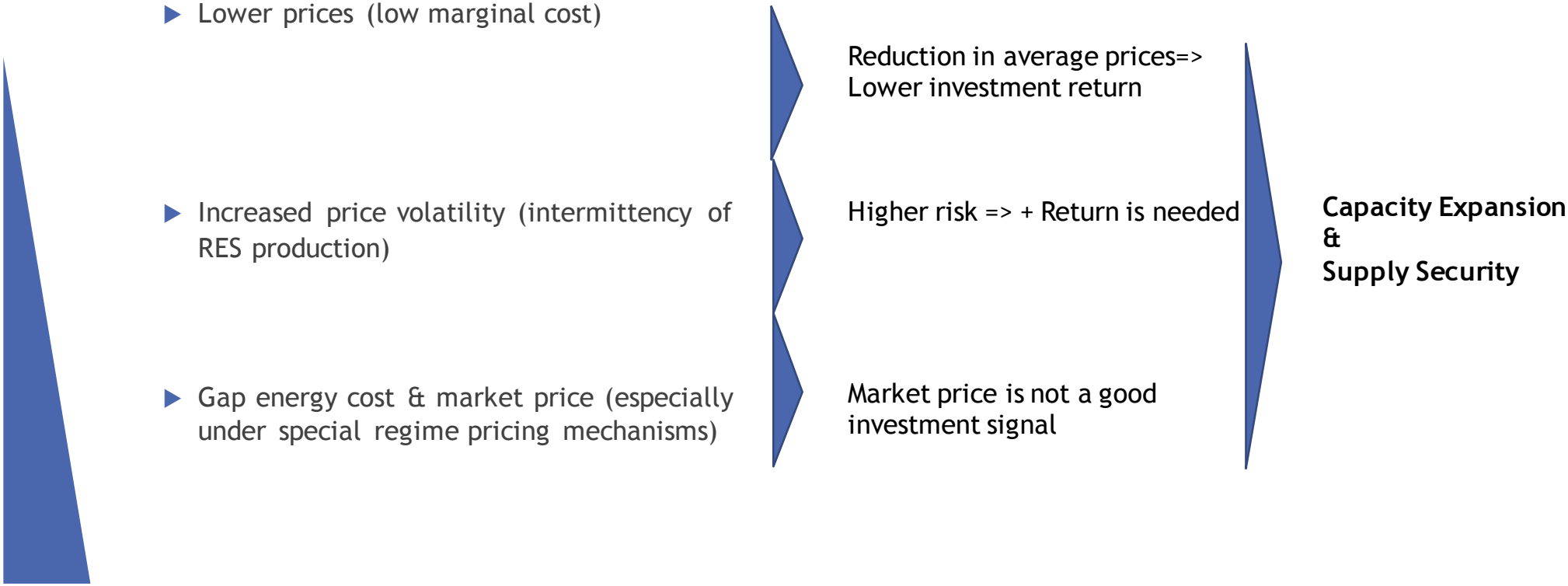


Electricity generation and demand during a typical winter week in Italy.
Source: Steinke *et al.* (2013).

Electricity markets
Current Challenges (The European case)

The entrance of RES in the market

- Lower prices (low marginal cost)
- Increased price volatility (intermittency of RES production)
- Gap energy cost & market price (especially under special regime pricing mechanisms)

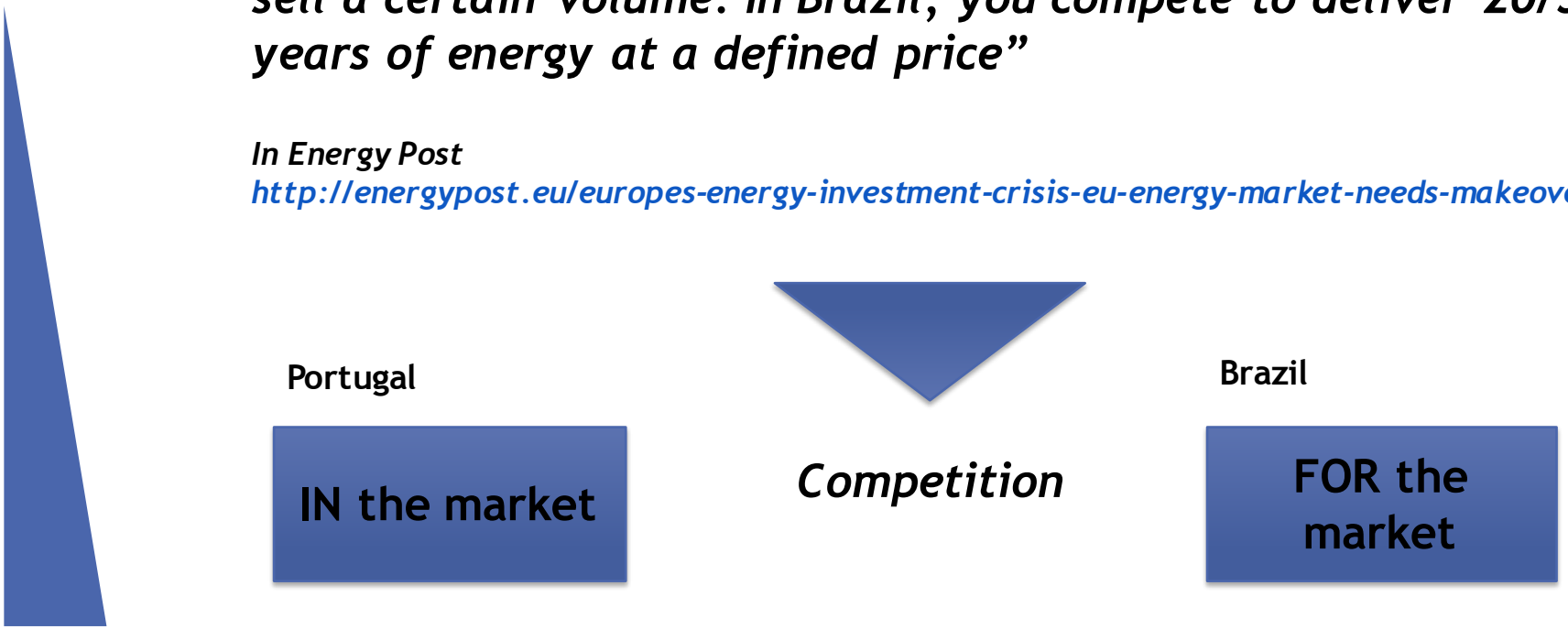


Electricity markets
Current Challenges (The European case)

- Some of these questions could be solved by adapting the market design

"In Europe, you compete every minute, 15 minutes or hour to sell a certain volume. In Brazil, you compete to deliver 20/30 years of energy at a defined price"

In Energy Post
http://energypost.eu/europes-energy-investment-crisis-eu-energy-market-needs-makeover/



Electricity markets
Current Challenges (The European case)

- Capacity markets? Auctioning mechanisms? Regulatory pricing mechanisms to guarantee power availability and investment?

Capacity remuneration mechanisms/ Capacity markets

Trade-off :

- Investment incentives vs
- Market distortions
  - Changes investment priorities
  - Environmental externalities;
  - Competition distortions (national and international)

Electricity markets
Future challenges

- Existing problems will be considerably exacerbated by new trends in the electricity sector :
  - Strong Intermittency challenges (Decentralized and Intermittent sources, e.g. PV)
  - Many more players (very heterogeneous and much smaller - PROSUMER)
  - Demand Side Management & Storage (Positive effects on grid congestion)
- Digitization & Big Data
  - Information management gains
  - Sophisticated pricing schemes (more cost-effective with efficiency gains)
  - Price regulation under real time pricing?

- **Towards a service-based paradigm**
- **The Utilities' Circulation Death Sprial**

Recent trends and Business Model Innovation

Business Model Innovation

- Business Model Innovation (New value proposition) => Towards a service-based paradigm

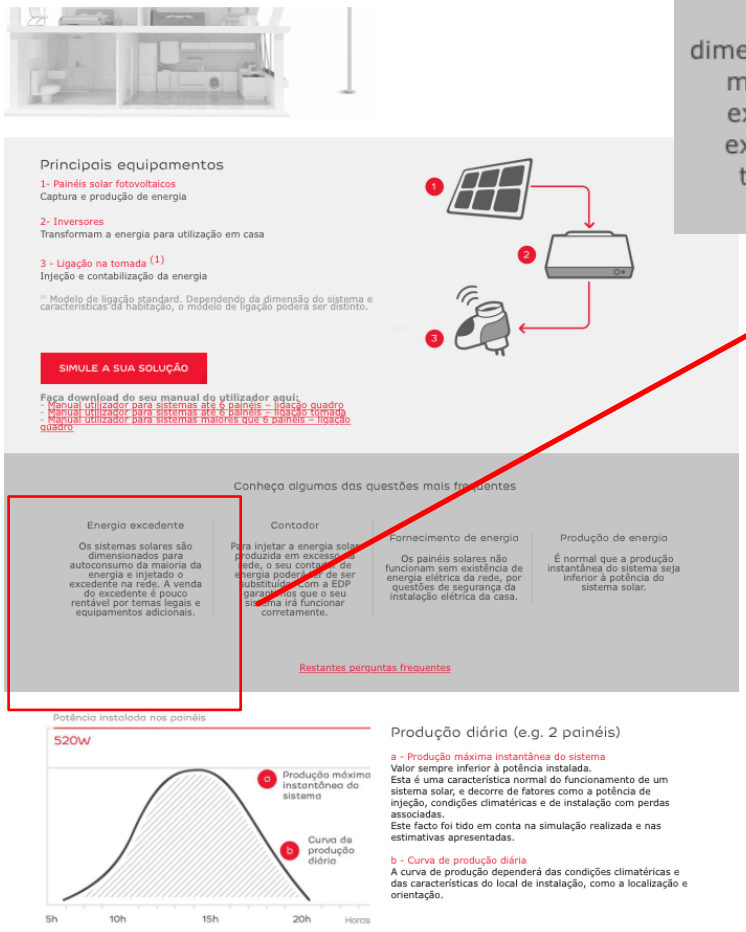
Demand Response and EMS (I)	**Storage (II)**	**PV Solar (III)**
EMS Providers	End-user optimization	Technology manufacturing
Utility-based capacity and Reserve DR	End-user and system co-optimization	Solar-plus-storage ("virtual power plant)" end-user optimization
Market-based Capacity and Reserve DR	Network services	Solar-plus-storage ("virtual power plant)" end-user and system co-optimization
	Pure-play software and technology developers	Utility scale PV financiers and integrators
		Distributed PV financiers and integrators

Source: Own elaboration based on Burger and Luke (2016, 2017)

- Innovative **funding solutions:** customer-centric BM, third-party, solar community
- The strong change in the **product's characteristics** and the **market structure** (both on the **supply** & the **demand** side) calls for MARKET DESIGN INNOVATION

Recent trends and Business Model Innovation

Business Model Innovation



Produção diária (e.g. 2 painéis)

a - Produção máxima instantânea do sistema
Valor sempre inferior à potência instalada.
Esta é uma característica normal do funcionamento de um sistema solar, e decorre de fatores como a potência de injeção, condições climatéricas e de instalação com perdas associadas.
Este facto foi tido em conta na simulação realizada e nas estimativas apresentadas.

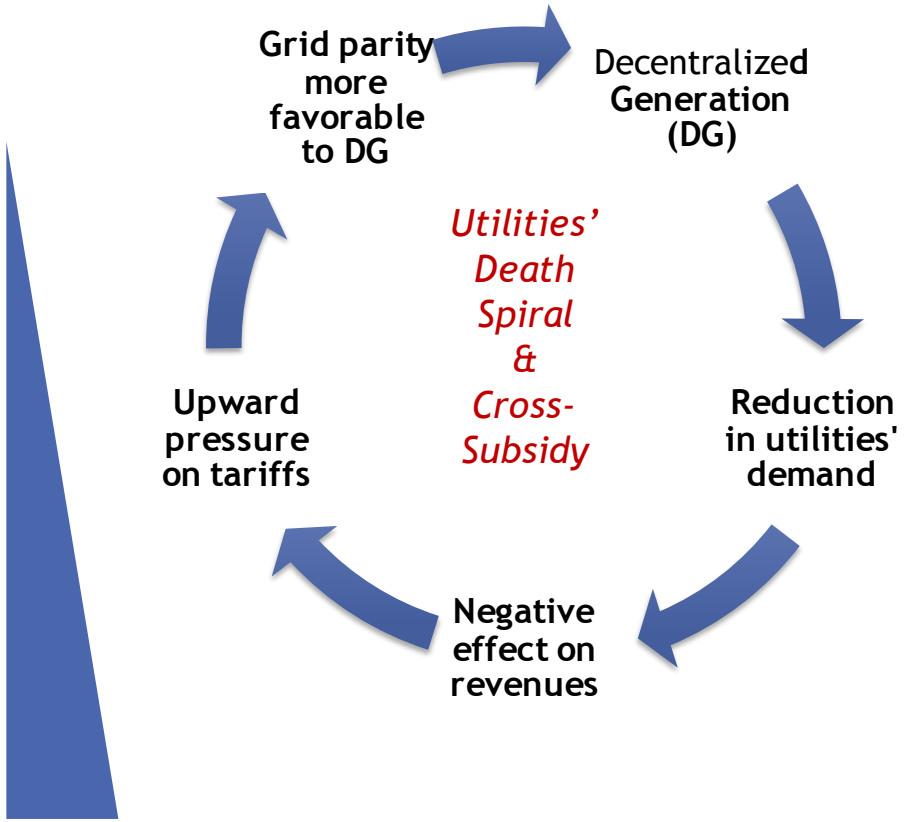
b - Curva de produção diária
A curva de produção dependerá das condições climatéricas e das características do local de instalação, como a localização e orientação.

Energia excedente

Os sistemas solares são dimensionados para autoconsumo da maioria da energia e injetado o excedente na rede. A venda do excedente é pouco rentável por temas legais e equipamentos adicionais.

Regulatory challenges
Utilities' Death Spiral

- **Distributed Generation may threaten the utilities' conventional business model – "Death spiral"**

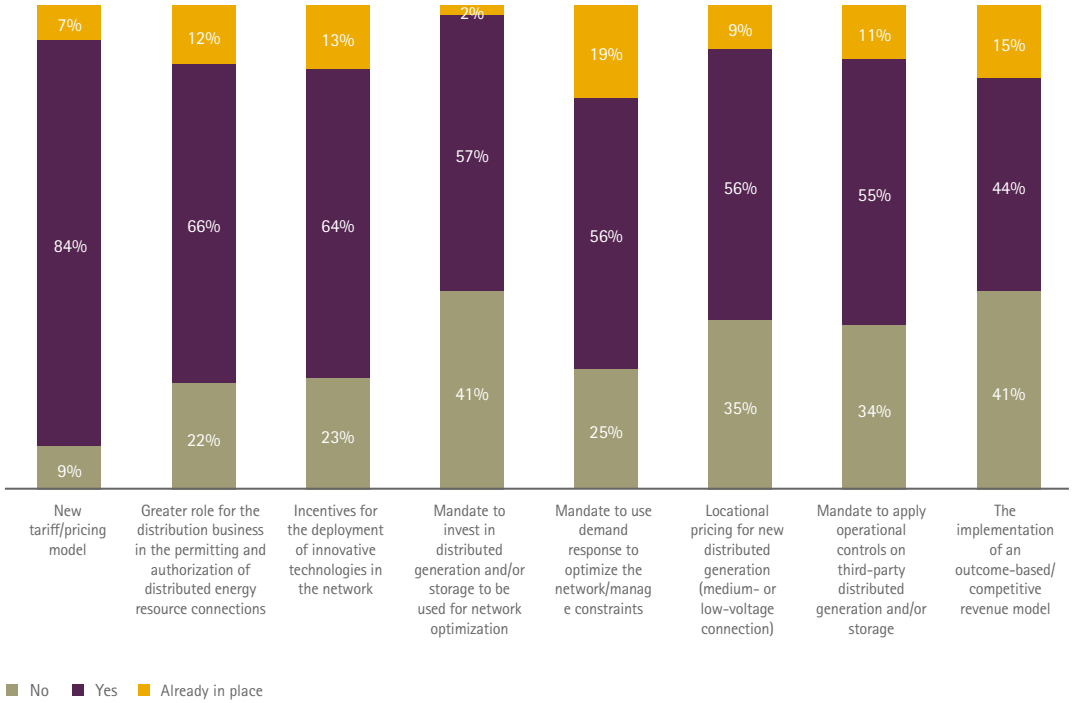


YET...

- Utilities' activity is increasingly challenging:
  - Huge investment needs
  - Integration of DG production in the grid
  - Uncertain decentralized production & intermittent RES
  - Coordination among many heterogeneous agents
  - Grids' reliability & resilience
  - Facilitate coordination among many new heterogeneous problems

Regulatory challenges
Balancing Solar PV incentives & Utilities financial viability

Necessary regulatory challenges in the next 10 years according to utilities' managers:



Base: All respondents.
Source: Accenture's *Digitally Enabled Grid* research program, 2016 executive survey.

Utilities' major concern in the short-run - Tariff & pricing tools

1. ***Re-designing conventional tools***
2. ***Market Design Innovation***

Source: Accenture (2016)

Regulatory challenges
Redesigning conventional tools: tariff structure

1. Tariff structure

   - Towards non-linear **pricing schemes**:

     - Change the current (mostly) volumetric system

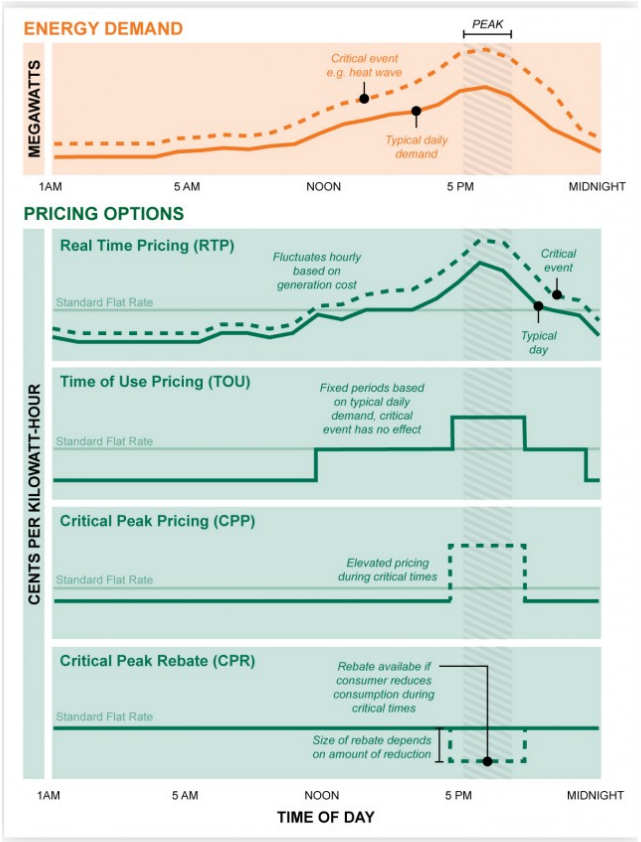
     - **Cost-reflective system** (that accounts for the different costs imposed on the network by different profiles of users)… the case of telecoms?

Regulatory challenges

Redesigning conventional tools: tariff structure

1. Tariff structure
   - **Dynamic tariffs (ERSE's pilot project)**
     - Critical peak pricing
     - Critical peak rebate
     - Real time pricing…

- Cost-effectiveness
- Complexity of the tariff design process
- Sophisticated metering/ communication systems
- Sophisticated and Tech-savvy consumers
- Social impact

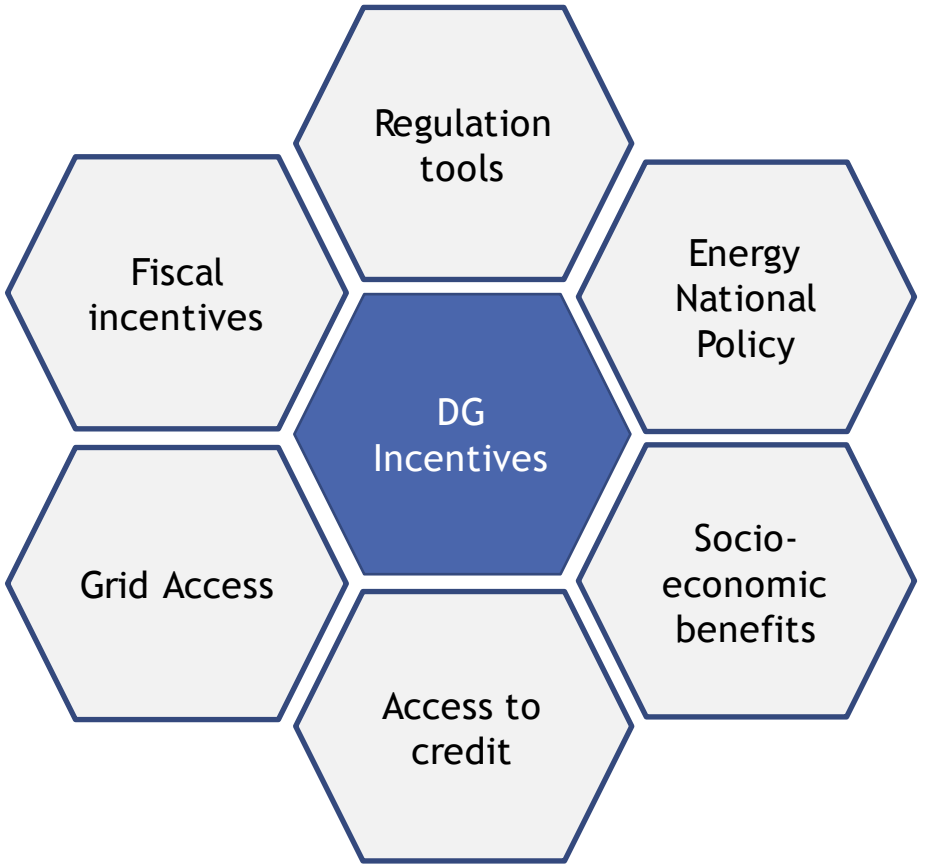


Source: Environmental Defense Fund (blog)

Regulatory challenges

Redesigning conventional tools: new market design

2. Design appropriate incentives for DG investments



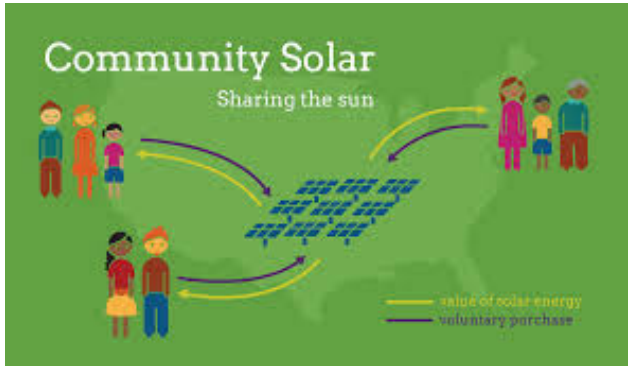
Source: Own elaboration based on IRENA (2017), *Overview of the types of renewable energy policies and measures adopted*

Regulatory challenges

Redesigning conventional tools: new market design

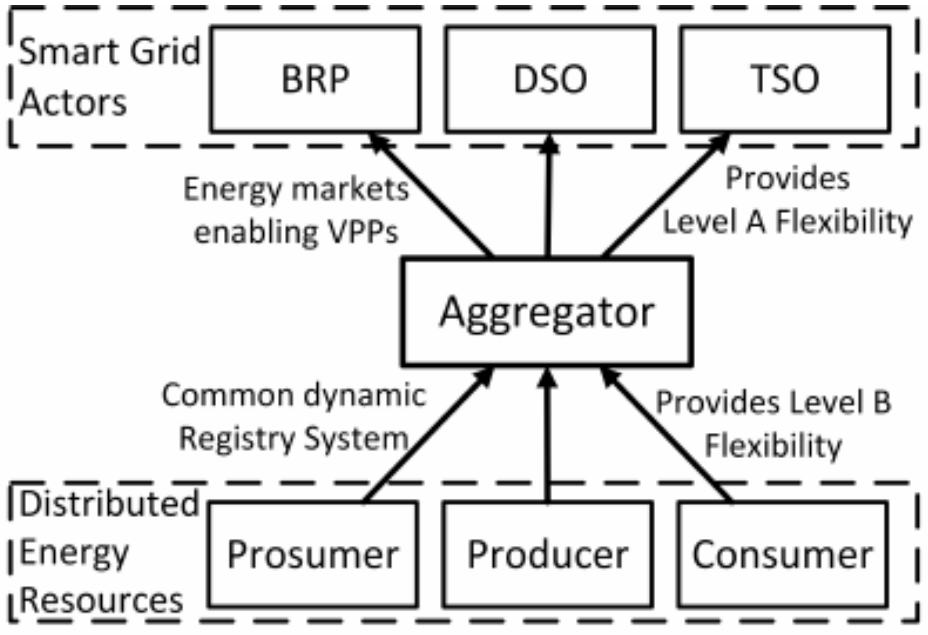
2. Create appropriate (market) mechanisms to remunerate DG

- **Feed-in tariffs?**
- **Net Metering?**
- **Net Billing?**
- **Wholesale market price?**



Regulatory challenges

Redesigning conventional tools: new market design



Source: Dethlefs, Preisler, Renz (2015)

Conclusion

- Electricity markets are already suffering deep challenges
  - The most visible face is the entry of RES (lower expected prices+higher volalility)
  - Discussions on New Market Design => Capacity investment & Supply Security

- New electricity paradigm: more sustainable, more decentralized, digital, storage, demand-side response, electric mobility, …
  - Key changes in product(s) characteristics => Towards a service-based paradigm (third-party models, prosumers, community solar, energy management systems, batteries, EV,…
  - Deep change in the market structure (Demand & Supply)
    - Demand side management
    - From the Vertically Integrated Utility to a market with many heterogeneous players (often rather small – e.g. prosumer, energy efficiency consulting & other economic giants intersecting other activity areas – ICT, Internet Giants, Automotive Sector, Electronics….
  - **Regulation and an appropriate Market Design** is key to address current challenges and promote a smooth transition to the new electricity paradigm.

THANK YOU!!!

OBRIGADA!!!!

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