

# Electricity markets: trends and future perspectives

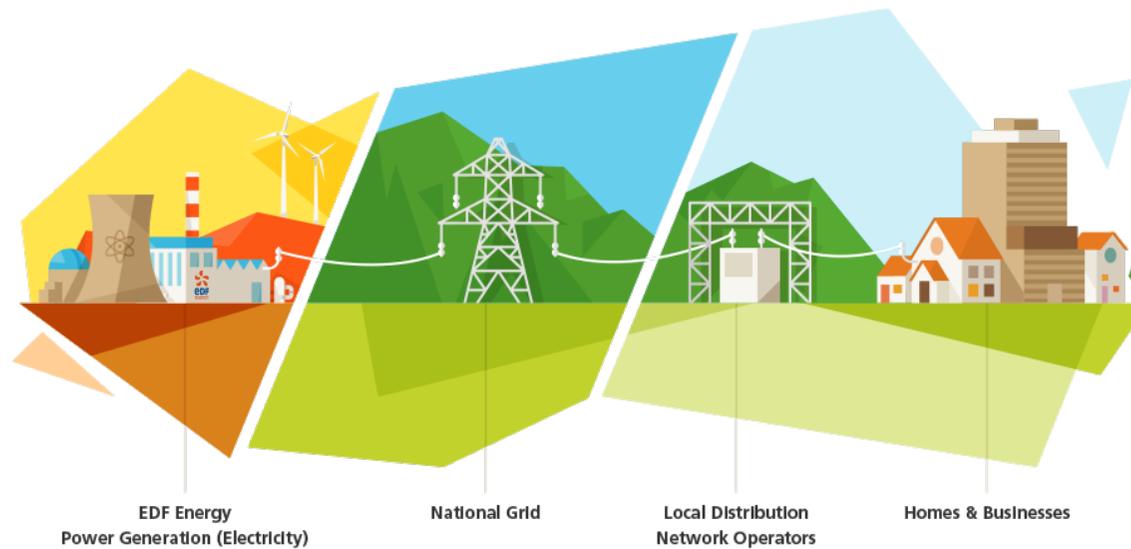
Joana Resende, Thereza Aquino

## 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

**DECENTRALIZATION**

**DIGITIZATION**



**SUSTAINABILITY**



**BUSINESS MODEL INNOVATION**

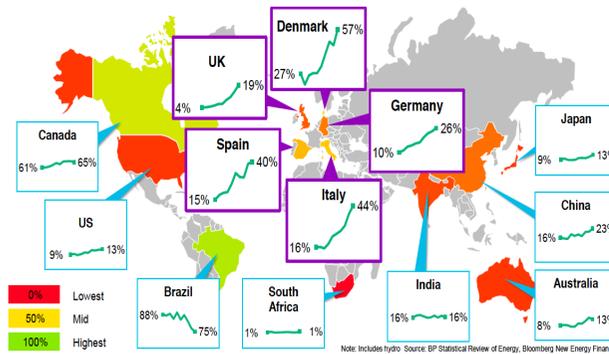
# Recent trends and Business Model Innovation

## Recent trends

### New Electricity Paradigm

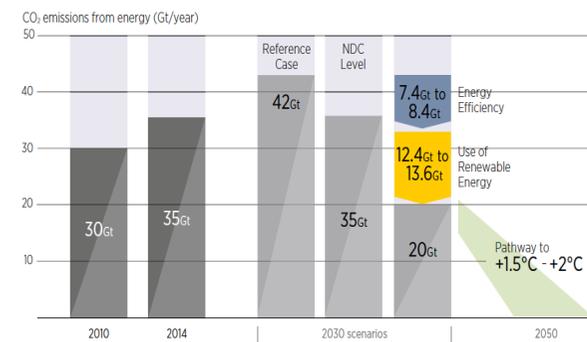
- More Sustainable (RES)
- More efficient (e.g. DSM)
- Decentralized
- Storage
- Electric Mobility
- Digital
- New business players

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

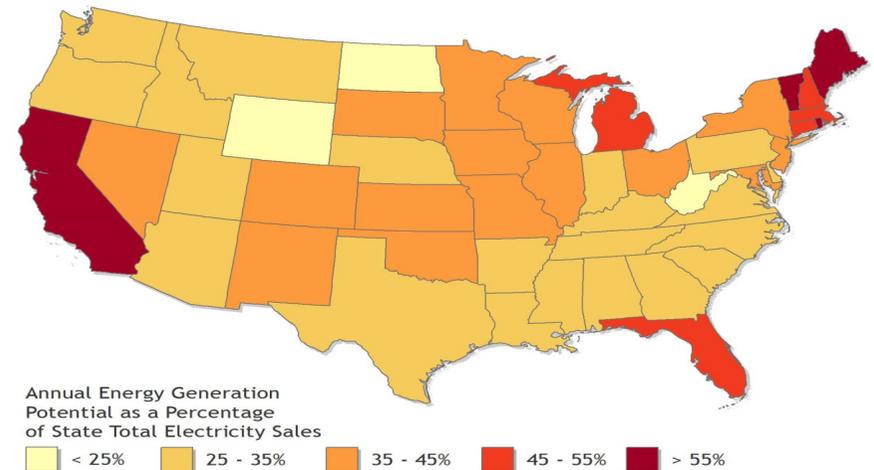
## Recent trends

### New Electricity Paradigm

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



Source: NREL (2016)

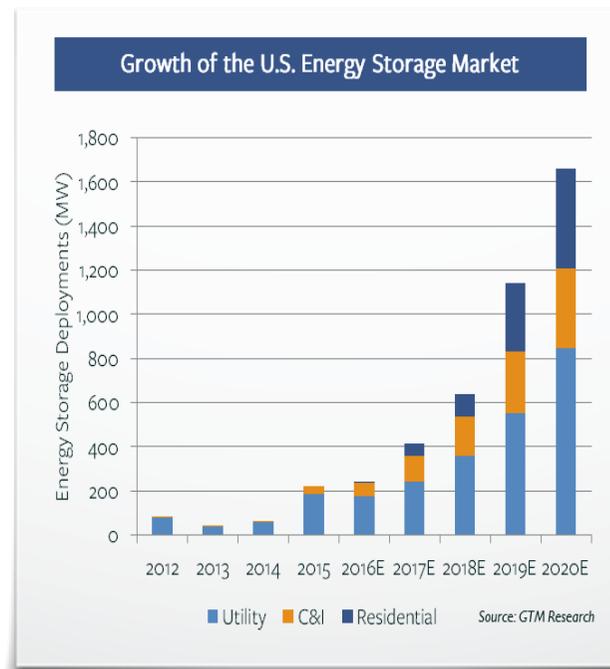
Reduction in LCOE + Easier Grid Parity

# Recent trends and Business Model Innovation

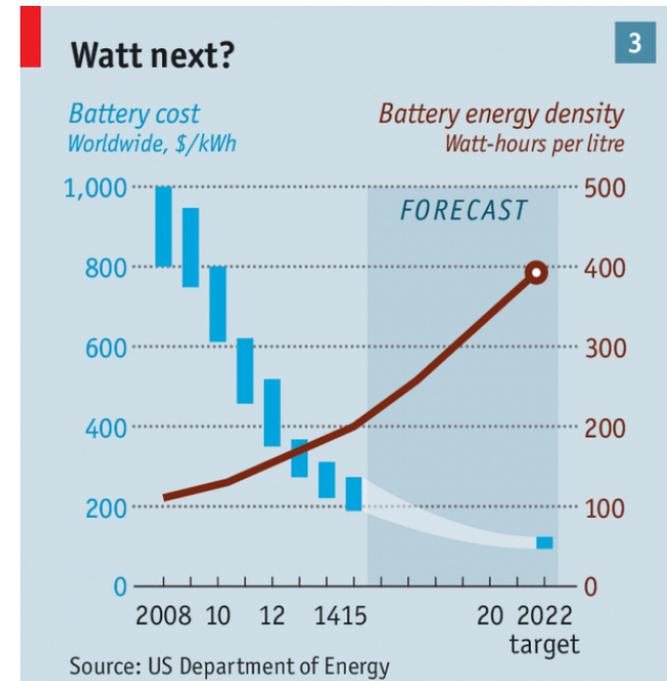
## Recent trends

### New Electricity Paradigm

- More Sustainable (RES)
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Source: GTM Research



Economist.com

Source: The Economist

# Recent trends and Business Model Innovation

## Recent trends

### New Electricity Paradigm

- More Sustainable (RES)
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- Decentralized
- Storage
- Electric Mobility
- **Digital**
- New business players



- ▶ Digital Grid Management+ Smart Meters = 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)

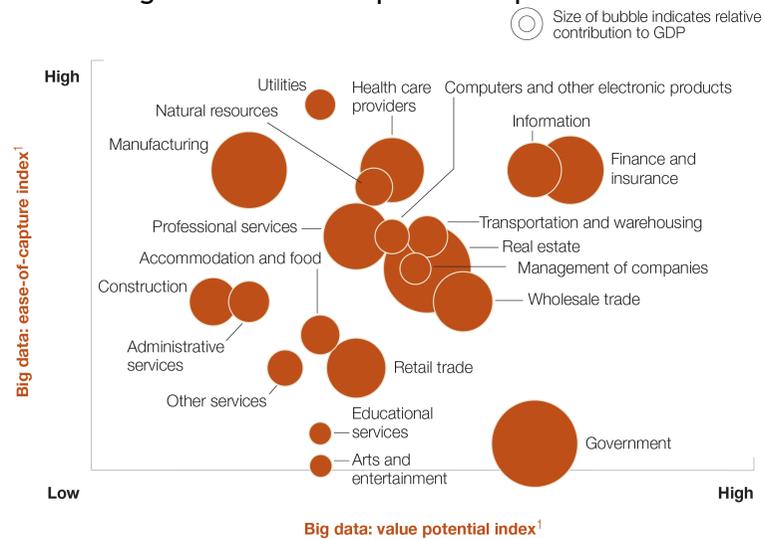
# Recent trends and Business Model Innovation

## Recent trends

### New Electricity Paradigm

- More Sustainable (RES)
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### Big data: ease of capture and potential value



<sup>1</sup>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](http://mckinsey.com/mgi).

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

Source: McKinsey

### ▶ New business lines

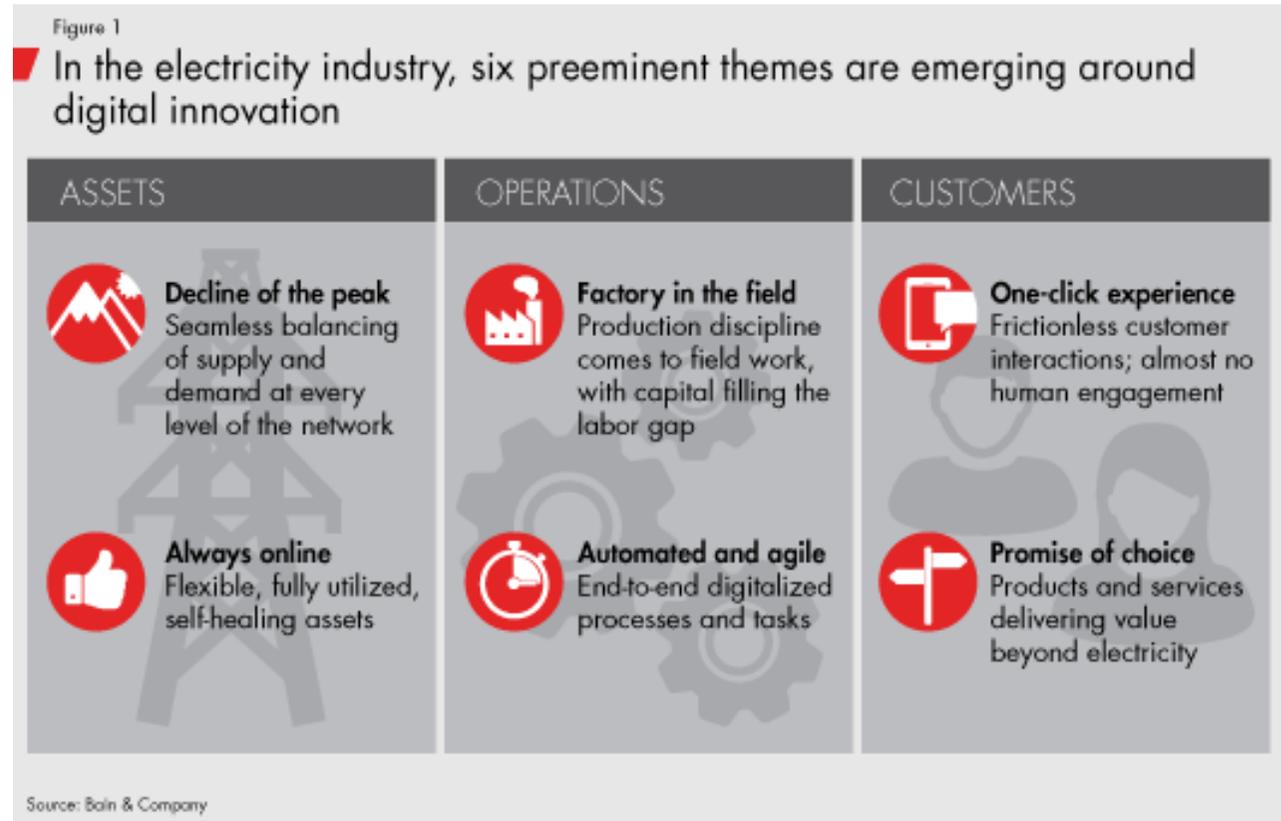
- ▶ System reliability services
- ▶ Energy efficiency services
- ▶ Big Data & Internet of Things - New business Models

# Recent trends and Business Model Innovation

## Recent trends

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Source: Bain & Company

# Recent trends and Business Model Innovation

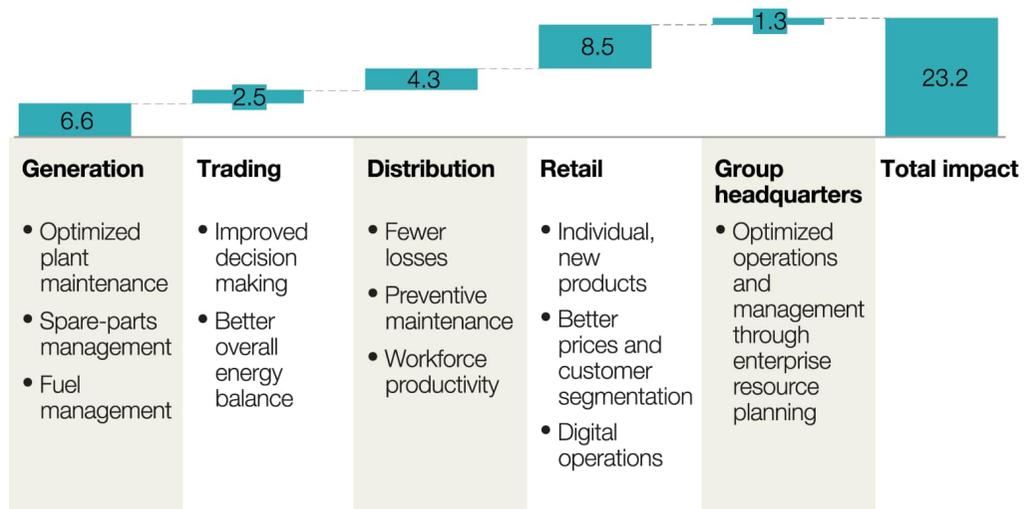
## Recent trends

### New Electricity Paradigm

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Digitization has demonstrable impact on utility earnings.

Improvement areas, case study, EBIT,<sup>1</sup> %



<sup>1</sup>Earnings before interest and taxes.

McKinsey&Company

Source: McKinsey

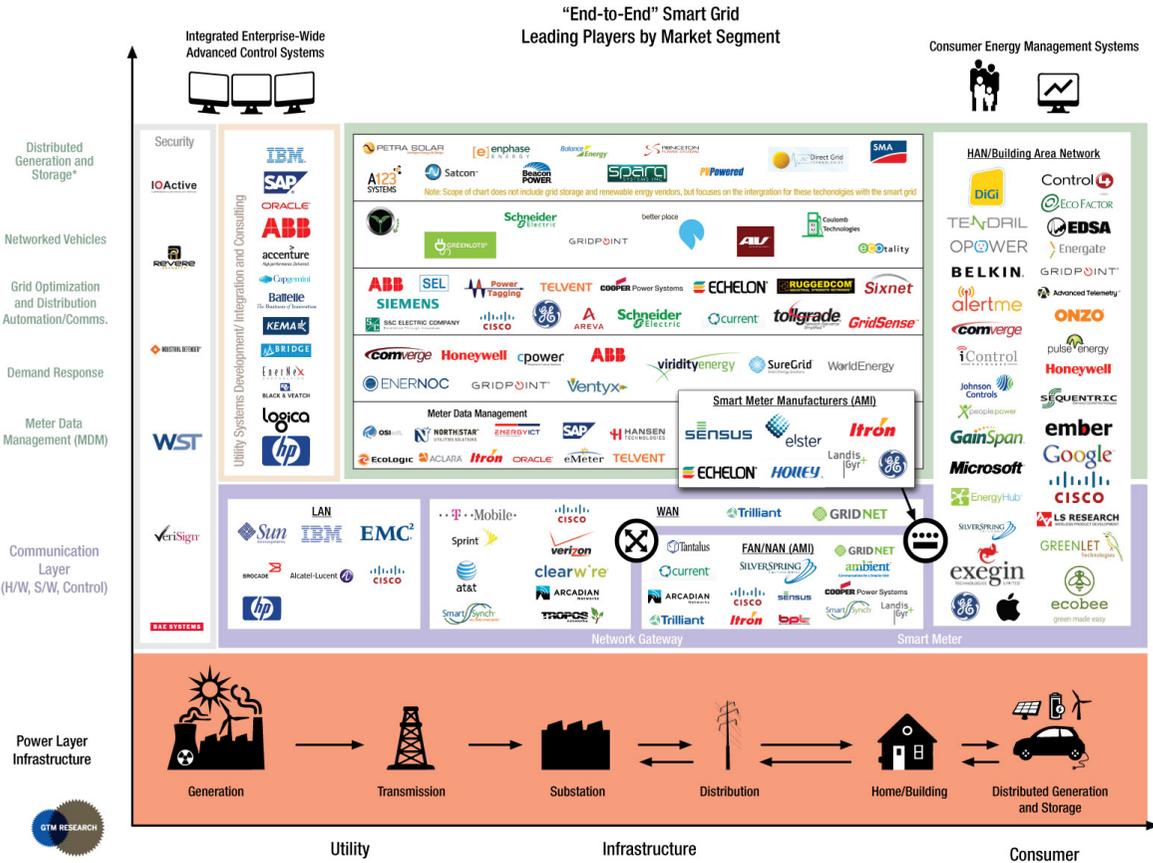
- ▶ Utilities' profit from digital potential
  - ▶ Smart meters and the smart grid,
  - ▶ Digital productivity tools for employees,
  - ▶ Automation of back-office processes.

# Recent trends and Business Model Innovation

## Recent trends

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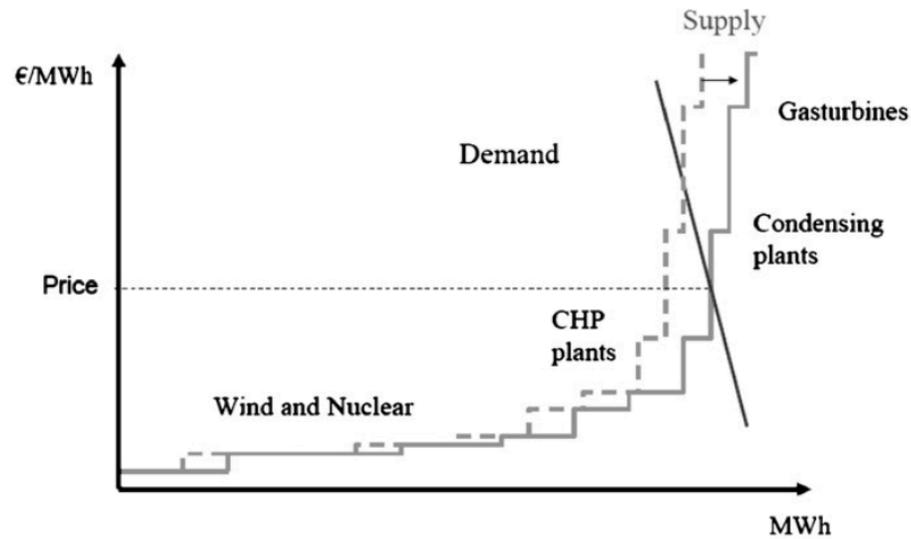


Source: GreenTechMedia

# Electricity markets

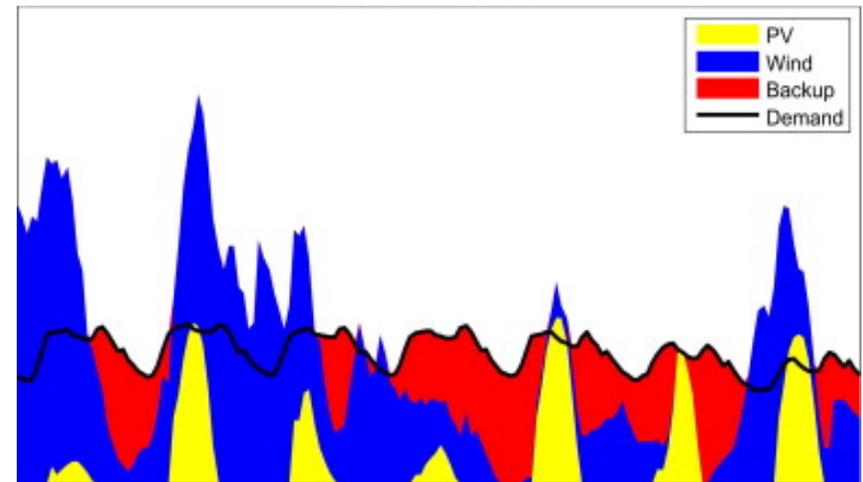
## Current Challenges (The European case)

- ▶ 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)

Reduction in average prices=>  
Lower investment return

Higher risk => + Return is needed

Market price is not a good  
investment signal

**Capacity Expansion  
&  
Supply Security**

## 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/>

Portugal

**IN the market**



***Competition***

Brazil

**FOR the market**

## 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 Spiral

# Recent trends and Business Model Innovation

## Business Model Innovation

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

<b>Demand Response and EMS (I)</b> EMS Providers	<b>Storage (II)</b> End-user optimization	<b>PV Solar (III)</b> 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

**50% desconto**

**Funciona**  
Segurança e assistência em sua casa, com a qualidade EDP. 50% de desconto nos primeiros 3 meses, durante 3 meses, 7,90€/mês **3,95€**

**ADERIR**

**Fatura segura**  
Garante o pagamento da sua fatura nos momentos difíceis.

1,40€ /mês

**ADERIR**

**Esquentador**  
A nossa gama de esquentadores tem a classe energética mais alta do mercado e ainda lhe garante o máximo de conforto e de segurança. 28,50€ /mês

**SIMULAR POUPANÇA**

**Termoacumulador**  
A nova geração de termoacumuladores elétricos que faz a aprendizagem dos seus hábitos e permite-lhe otimizá-los para poupar energia. 70%

**SIMULAR POUPANÇA**

**Bombas de Calor**  
A solução mais eficiente do mercado para aquecimento de água, que aproveita o calor do ar para aquecer a água do seu aquecedor até 65%

**SIMULAR POUPANÇA**

**Ar Condicionado**  
Opte pela solução mais eficiente para aquecer e arrefecer a sua casa e comece já a poupar no consumo de eletricidade até 40% /mês

**SAIBA MAIS**

**em 12 mensalidade**

**Certificação Energética**  
A certificação energética classifica o desempenho energético da sua casa e recomenda um conjunto de melhorias.

**CONTACTE-NOS**

**em 12 mensalidade**

**Auditoria Energética**  
Conheça melhor os consumos de sua casa e fique a saber como pode reduzir a sua fatura energética.

**CONTACTE-NOS**

**Energia solar**  
Poupe de dia com a energia solar e à noite com 10% de desconto na eletricidade.

a partir de 20€ /mês

**SABER MAIS**

**edp re:dy**  
edp re:dy, um sistema que lhe permite conectar e controlar a sua casa numa única aplicação, onde e quando quiser.

**SABER MAIS**

**15.000 kms eletricidade grátis**

**Mobilidade elétrica**  
Recarregue todas as suas baterias. Descubra as vantagens da mobilidade elétrica.

**SABER MAIS**

**edp re:dy base**  
O kit edp re:dy para iniciar a sua smarthome

mensalidade grátis 6 meses  
3,90€

**ADIRA IÁ**

**edp re:dy solar**  
O kit edp re:dy para quem produz a sua energia solar

mensalidade grátis 6 meses

**edp re:dy a/c**  
O kit edp re:dy para o controlo do seu ar condicionado

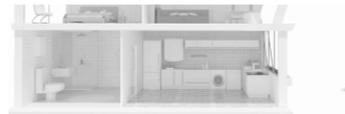
mensalidade grátis 6 meses

**edp re:dy carro elétrico**  
O kit edp re:dy indicado para quem quer controlar o seu carro elétrico

mensalidade grátis 6 meses

**edp re:dy aquecimento**  
O kit edp re:dy para o controlo do seu aquecimento

mensalidade grátis 6 meses



### Principais equipamentos

- 1 - Painéis solar fotovoltaicos**  
Captura e produção de energia
- 2 - Inversores**  
Transformam a energia para utilização em casa
- 3 - Ligação na tomada (1)**  
Injeção e contabilização da energia

(1) Modelo de ligação standard. Dependendo da dimensão do sistema e características da habitação, o modelo de ligação poderá ser distinto.

**SIMULE A SUA SOLUÇÃO**

Faça download do seu manual do utilizador aqui:  
[Manual utilizador para sistemas até 6 painéis - ligação quadro](#)  
[Manual utilizador para sistemas maiores que 6 painéis - ligação quadro](#)

### Conheça algumas das questões mais frequentes

<p><b>Energia excedente</b> 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.</p>	<p><b>Contador</b> Para injetar a energia solar produzida em excesso na rede, o seu contador de energia poderá ter de ser substituído com a EDP garantindo que o seu sistema irá funcionar corretamente.</p>	<p><b>Fornecimento de energia</b> Os painéis solares não funcionam sem existência de energia elétrica da rede, por questões de segurança da instalação elétrica da casa.</p>	<p><b>Produção de energia</b> É normal que a produção instantânea do sistema seja inferior à potência do sistema solar.</p>
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**Restantes perguntas frequentes**

**Energia excedente**

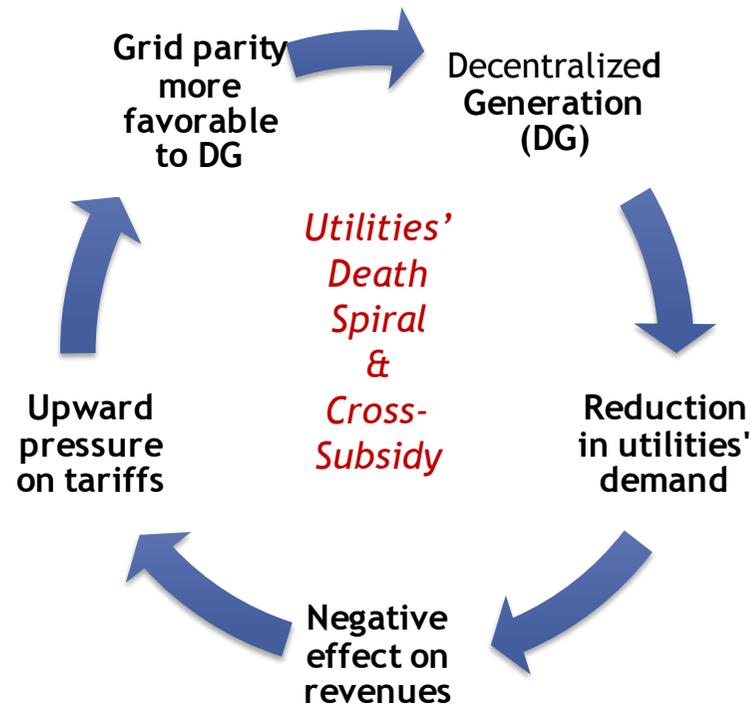
Os sistemas solares são dimensionados para autoconsumo da maioria da energia e injetado o excedente na rede. A venda do excedente é pouco rentável por temas legais e equipamentos adicionais.



# Regulatory challenges

## Utilities' Death Spiral

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



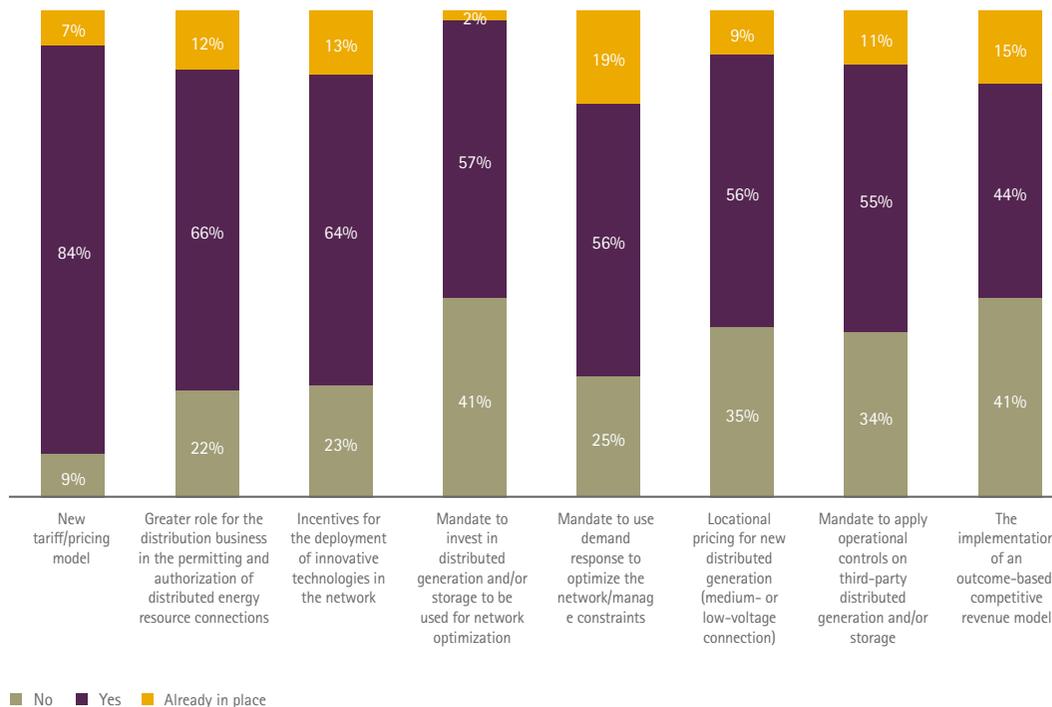
YET...

- ▶ 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

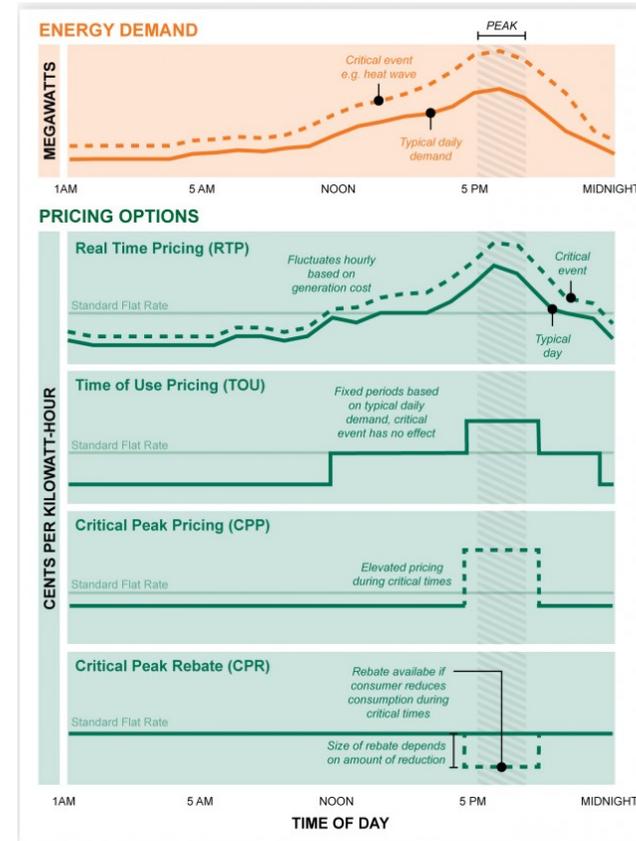
### 1. Tariff structure

- ▶ 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

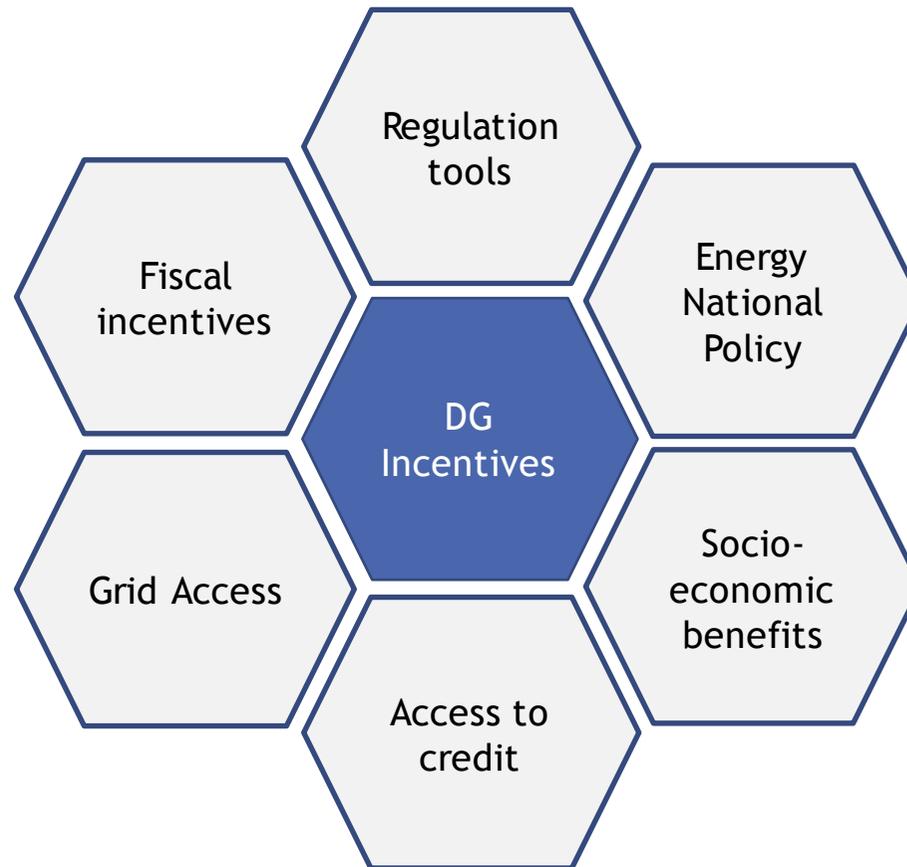


Source: Environmental Defense Fund (blog)

## Regulatory challenges

Redesigning conventional tools: new market design

2. Design appropriate incentives for DG investments



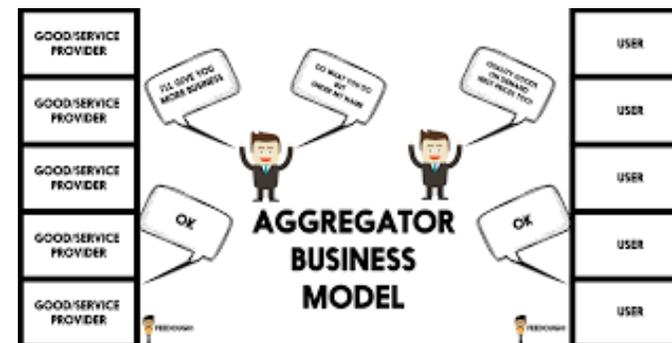
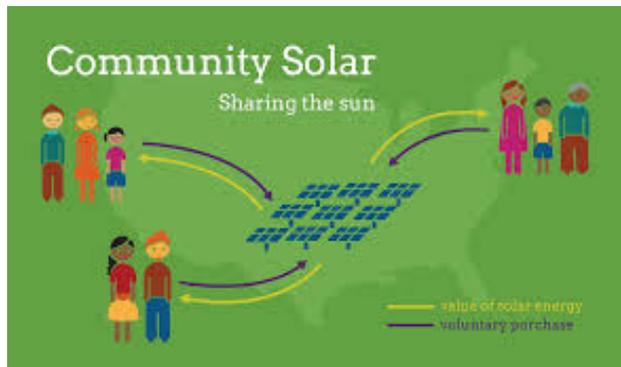
Source: Own elaboration based on IRENA (2017), *Overview of the types of renewable energy policies and measures adopted*

# Regulatory challenges

Redesigning conventional tools: new market design

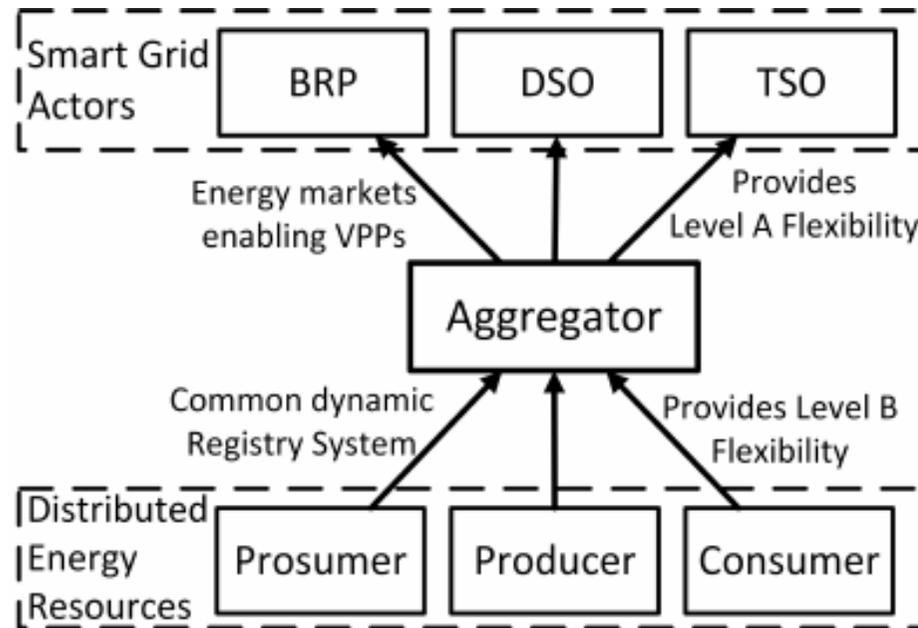
- 2. Create appropriate (market) mechanisms to remunerate DG

- ▶ 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 volatility)
  - ▶ 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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