

Electricity markets: trends and future perspectives

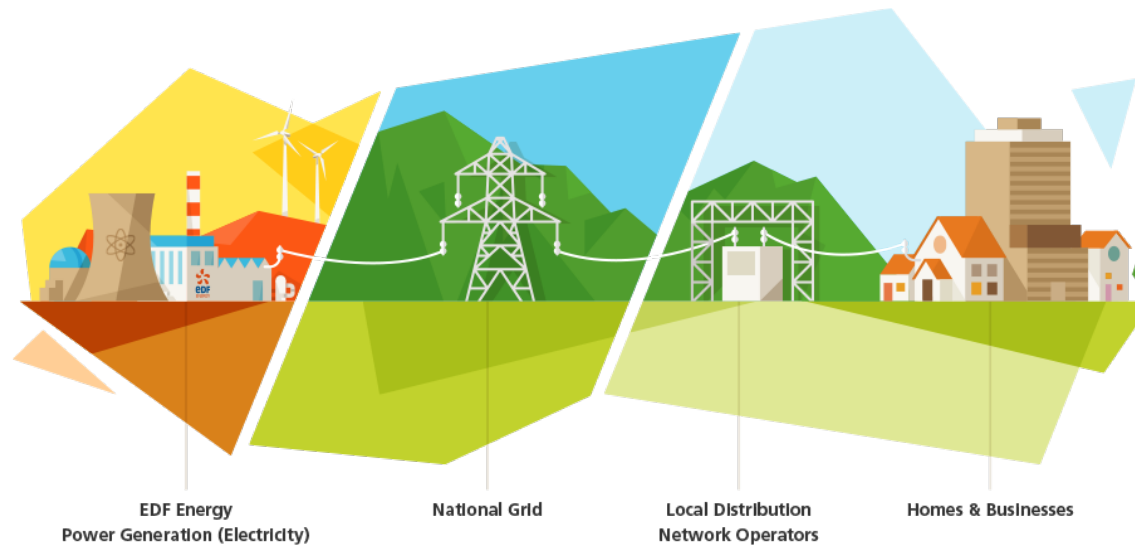
Joana Resende, Thereza Aquino

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

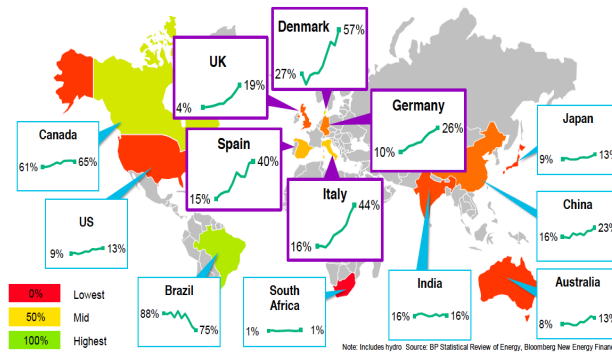
Recent trends and Business Model Innovation

Recent trends

New Electricity Paradigm

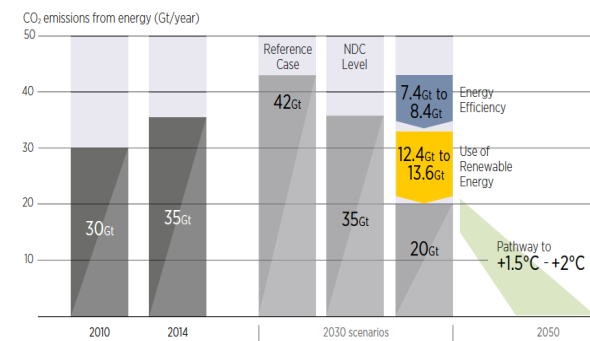
- More Sustainable (RES)
- More efficient (e.g. DSM)
- Decentralized
- Storage
- Electric Mobility
- Digital
- New business players

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

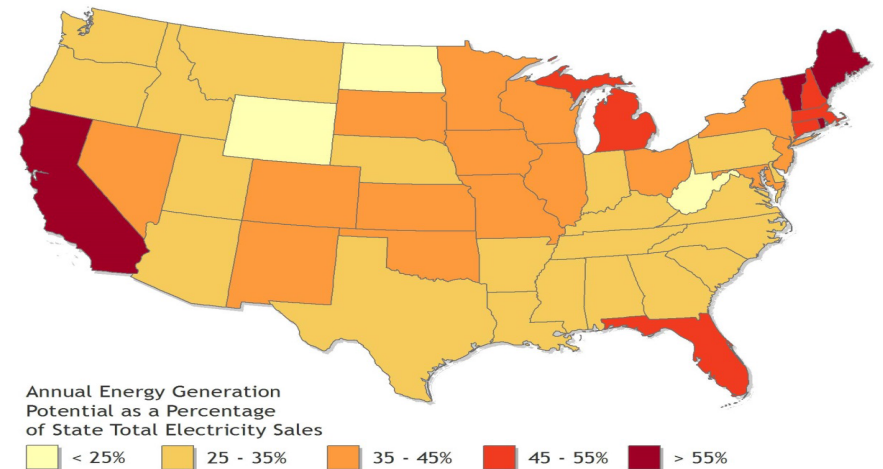
Recent trends

New Electricity Paradigm

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



Source: NREL (2016)

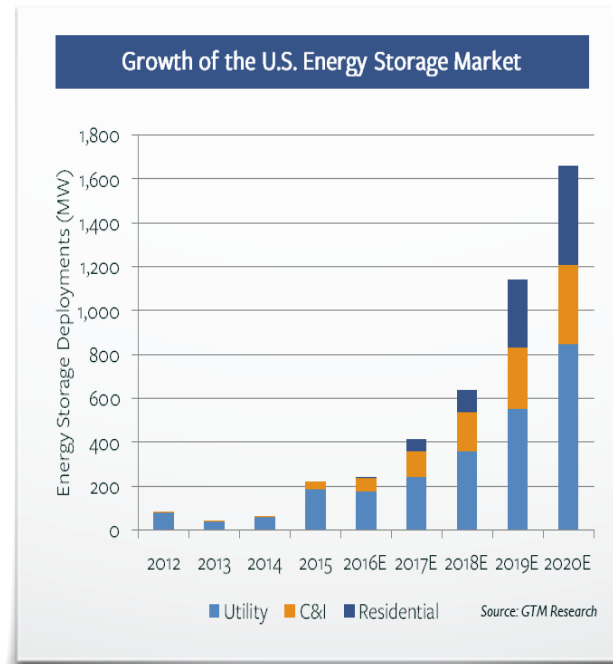
Reduction in LCOE + Easier Grid Parity

Recent trends and Business Model Innovation

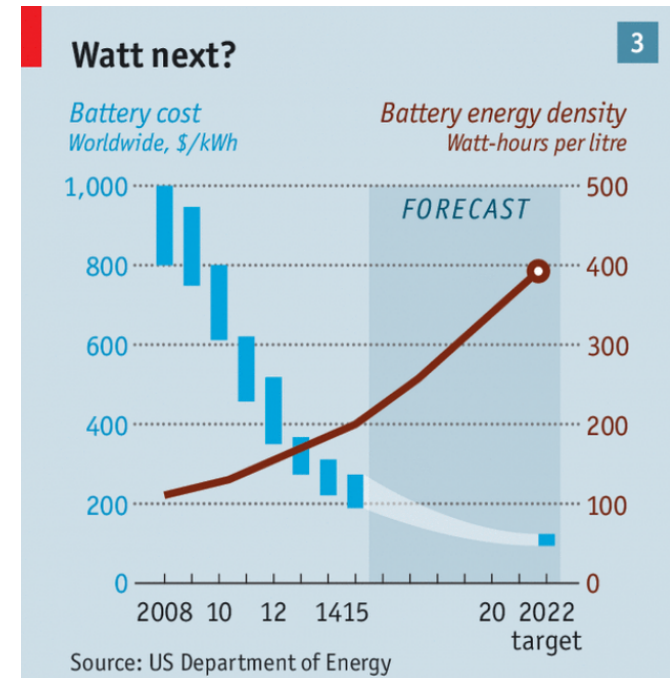
Recent trends

New Electricity Paradigm

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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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- 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)

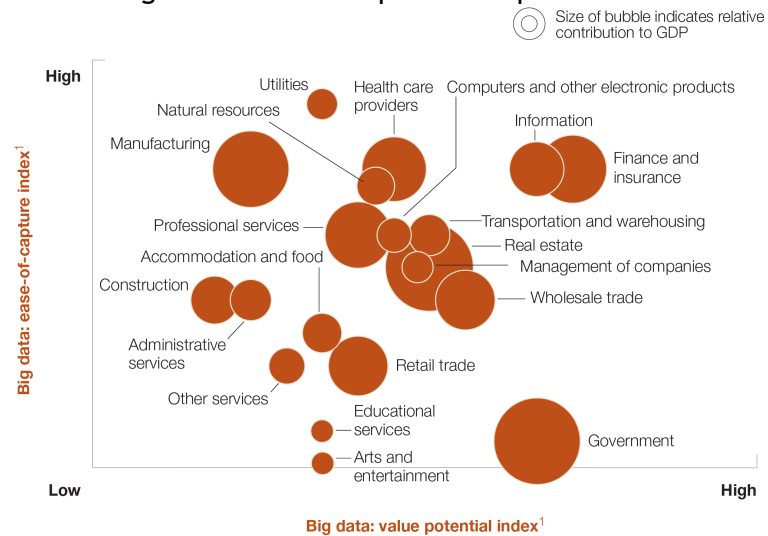
Recent trends and Business Model Innovation

Recent trends

New Electricity Paradigm

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- Digital
- New business players

Big data: ease of capture and potential value



¹For 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

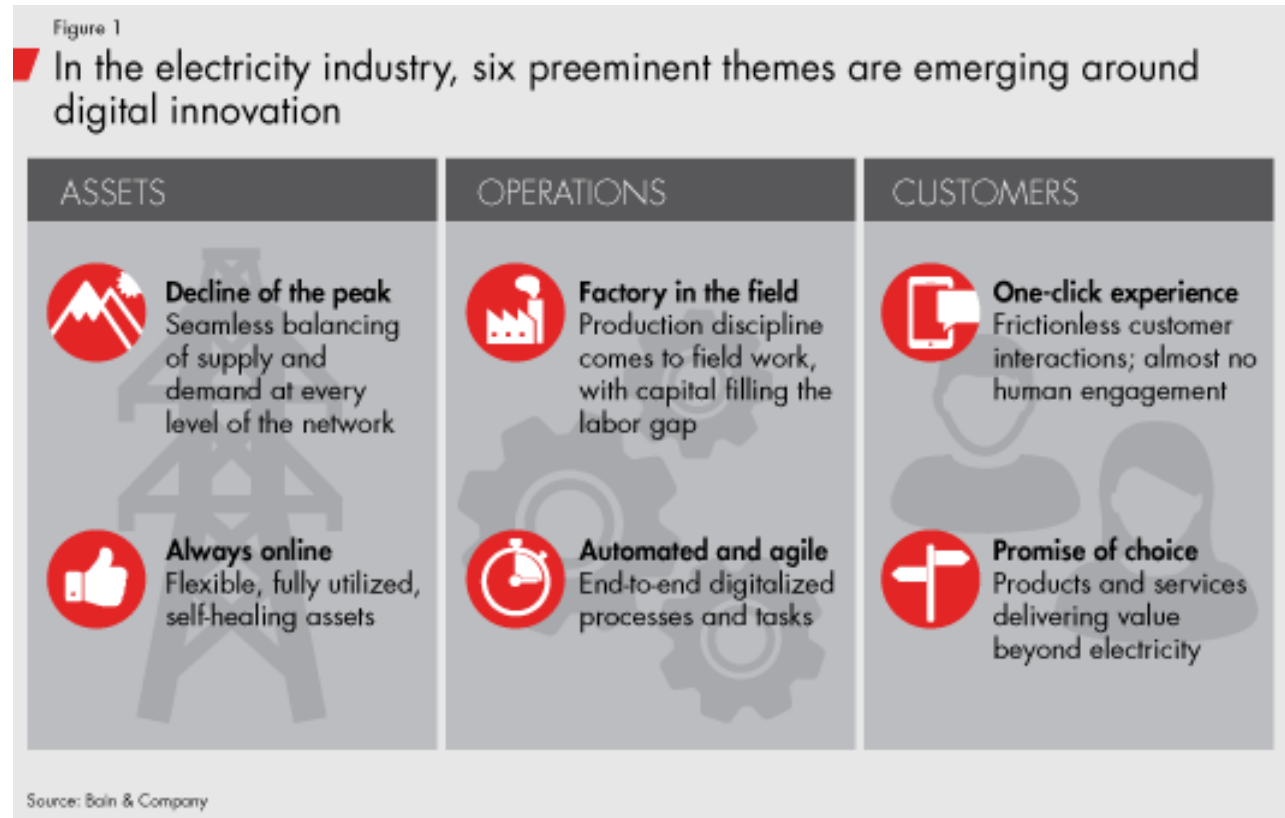
- ▶ System reliability services
- ▶ Energy efficiency services
- ▶ Big Data & Internet of Things - New business Models

Recent trends and Business Model Innovation

Recent trends

New Electricity Paradigm

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Source: Bain & Company

Recent trends and Business Model Innovation

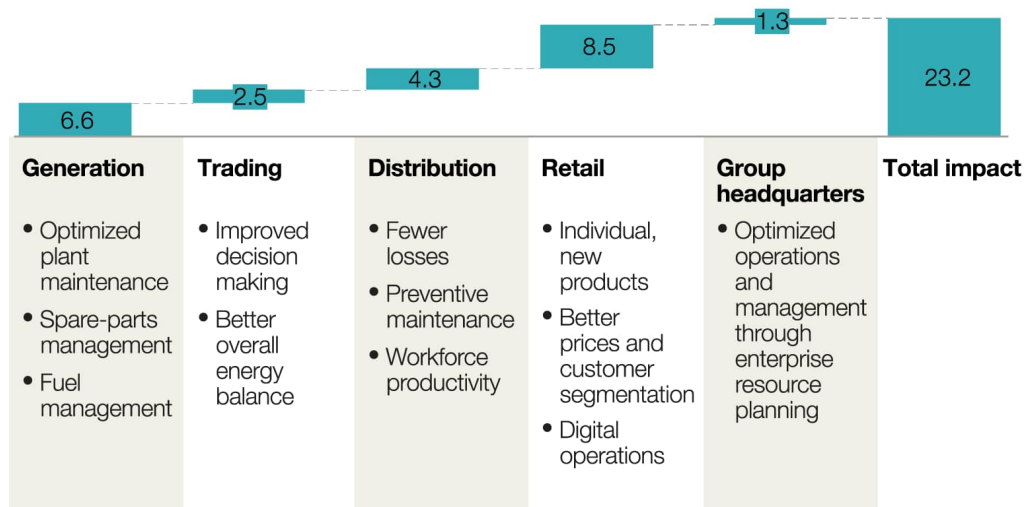
Recent trends

New Electricity Paradigm

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Digitization has demonstrable impact on utility earnings.

Improvement areas, case study, EBIT,¹ %



¹Earnings before interest and taxes.

McKinsey&Company

Source: McKinsey

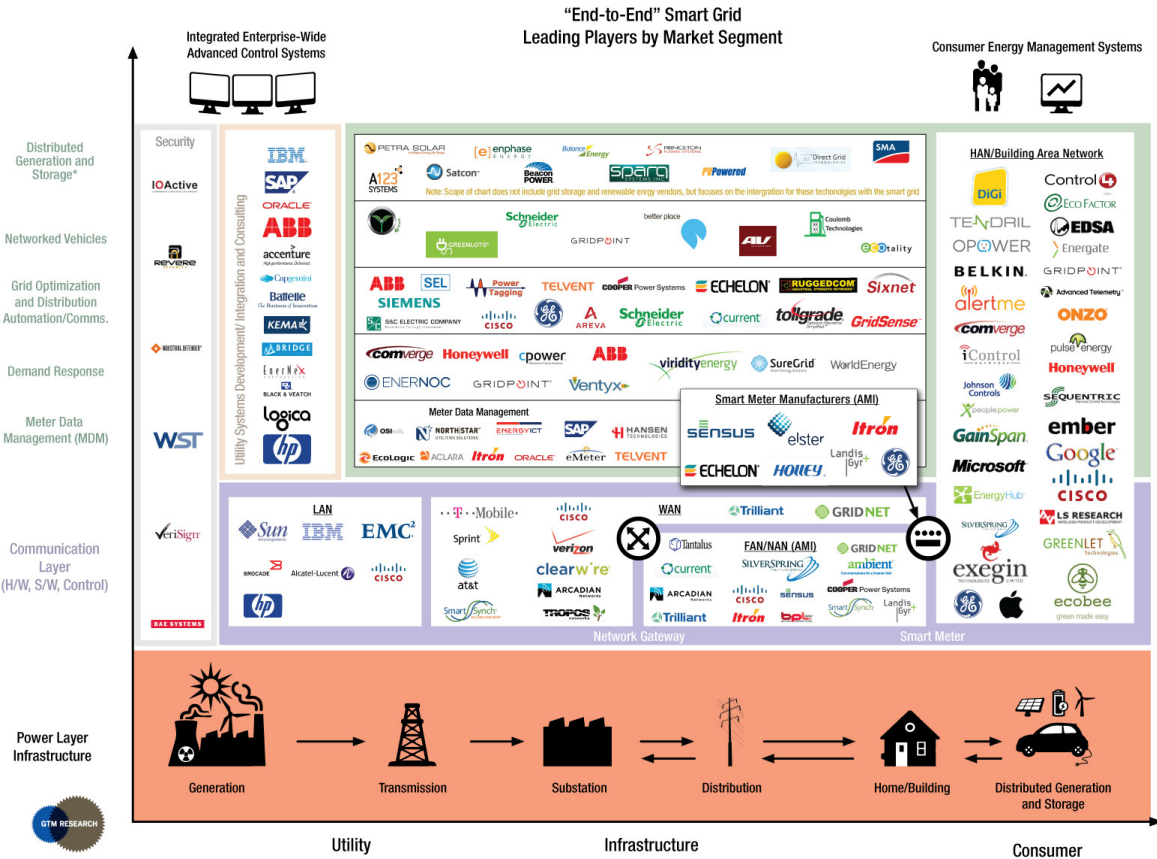
- ▶ Utilities' profit from digital potential
 - ▶ Smart meters and the smart grid,
 - ▶ Digital productivity tools for employees,
 - ▶ Automation of back-office processes.

Recent trends and Business Model Innovation

Recent trends

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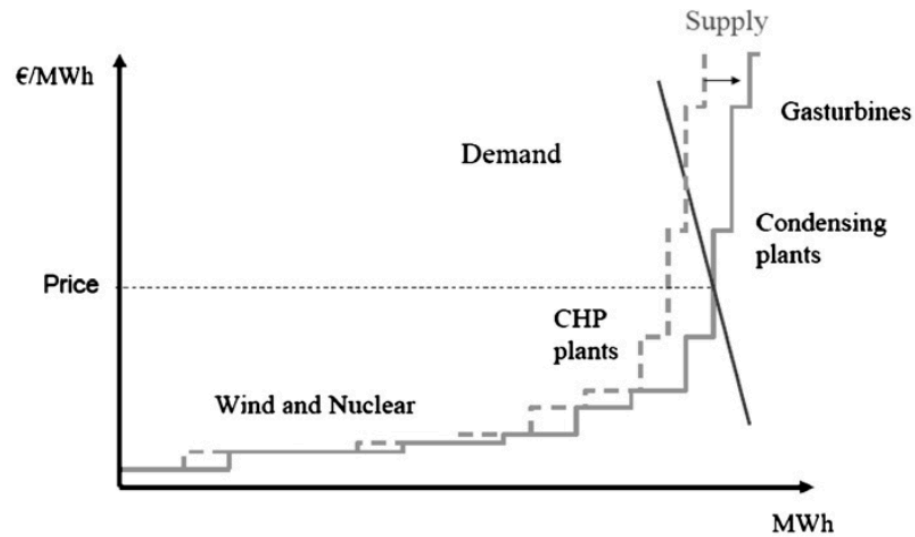


Source: GreenTechMedia

Electricity markets

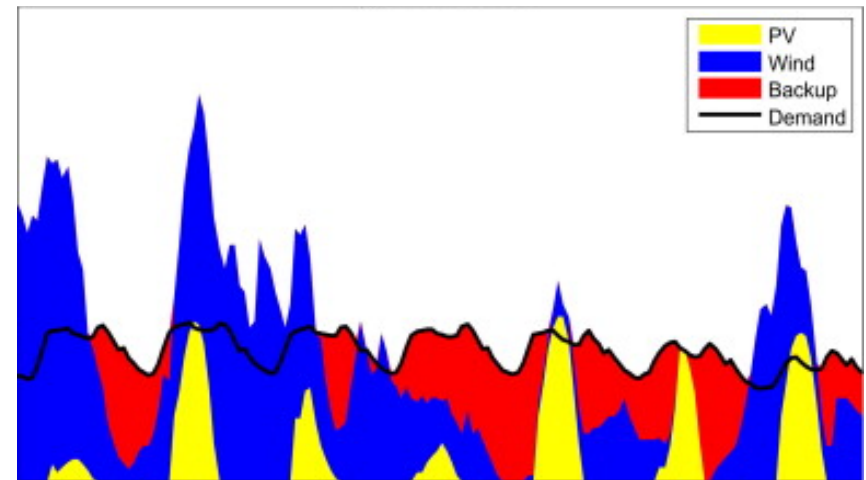
Current Challenges (The European case)

- ▶ 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

| Demand Response and EMS (I) EMS Providers | Storage (II) End-user optimization | PV Solar (III) 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 até 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 de 40% /mês

SAIBA MAIS

Certificação Energética

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

CONTACTE-NOS

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

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

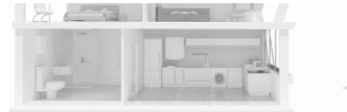
O kit edp re:dy indicado para quem tem um carro elétrico

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

1º 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](#)

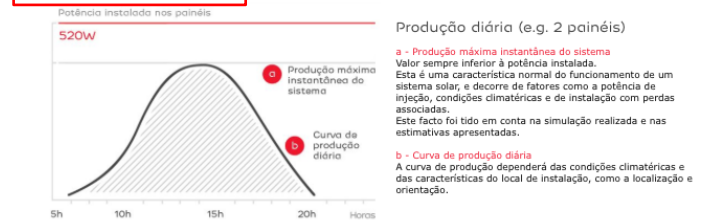
Conheça algumas das questões mais frequentes

| | | | |
|---|---|---|--|
| <p>Energia excedente</p> <p>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>Contador</p> <p>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>Fornecimento de energia</p> <p>Os painéis solares não funcionam sem existência de energia elétrica da rede, por questões de segurança da instalação elétrica da casa.</p> | <p>Produção de energia</p> <p>É normal que a produção instantânea do sistema seja inferior à potência do sistema solar.</p> |
|---|---|---|--|

Restantes perguntas frequentes

Energia excedente

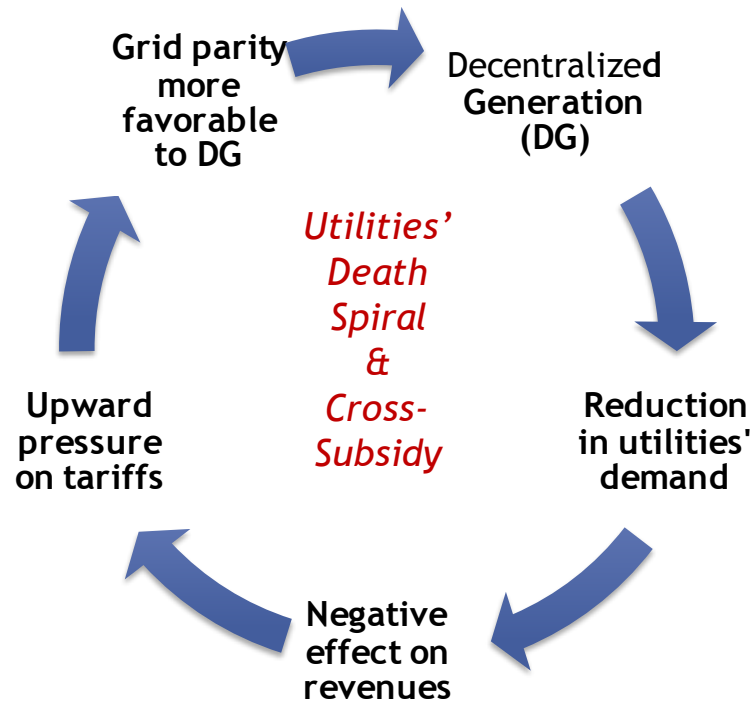
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Regulatory challenges

Utilities' Death Spiral

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



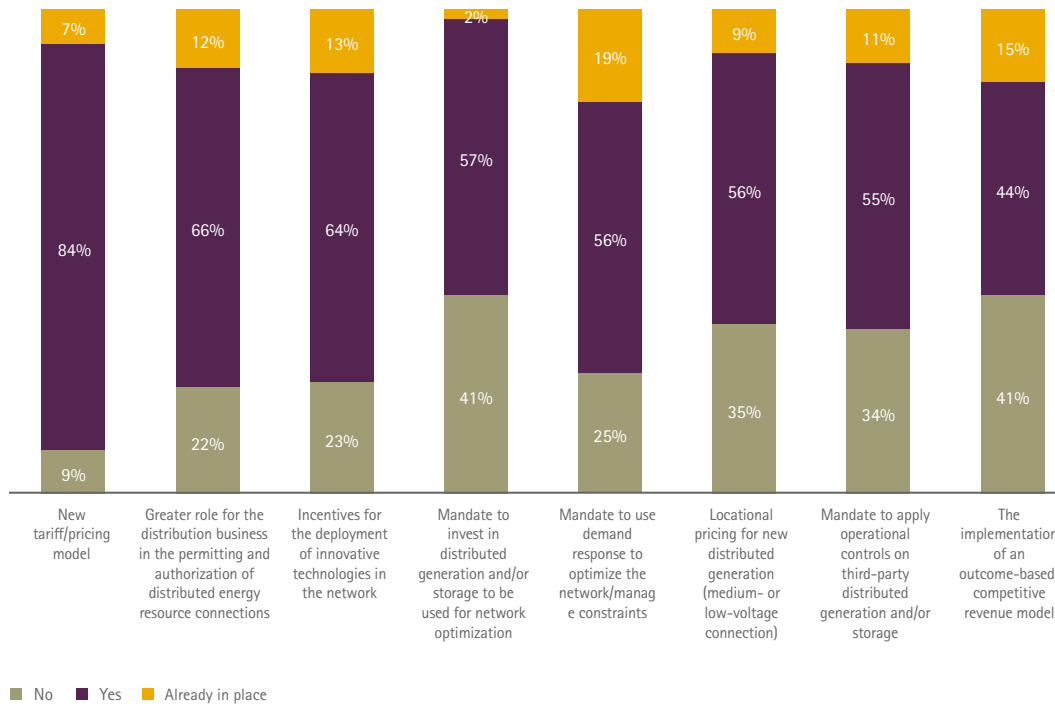
YET...

- ▶ 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

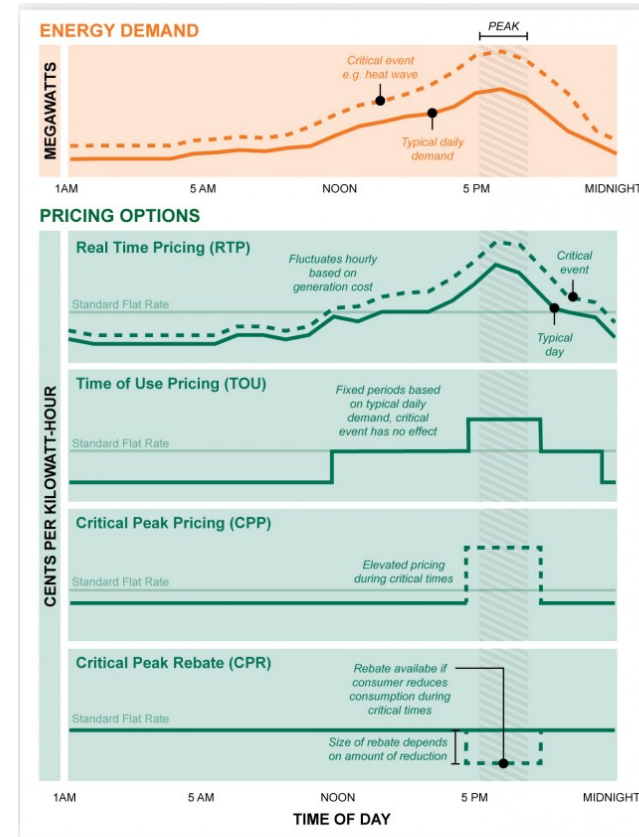
1. Tariff structure

- ▶ 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

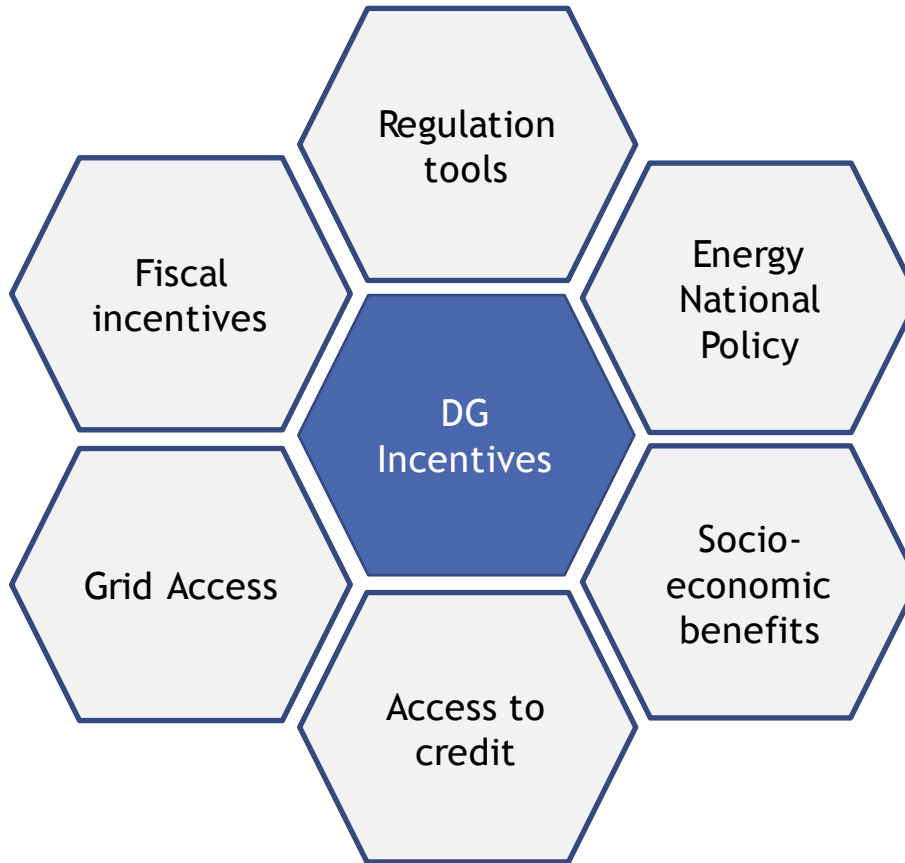


Source: Environmental Defense Fund (blog)

Regulatory challenges

Redesigning conventional tools: new market design

- 2. Design appropriate incentives for DG investments



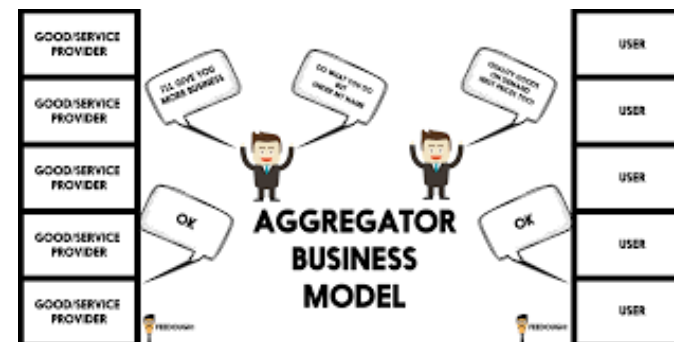
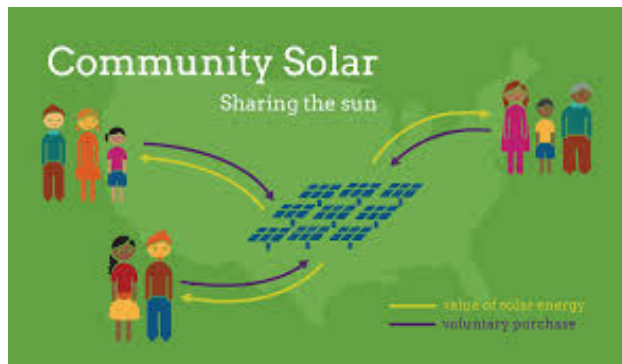
Source: Own elaboration based on IRENA (2017), *Overview of the types of renewable energy policies and measures adopted*

Regulatory challenges

Redesigning conventional tools: new market design

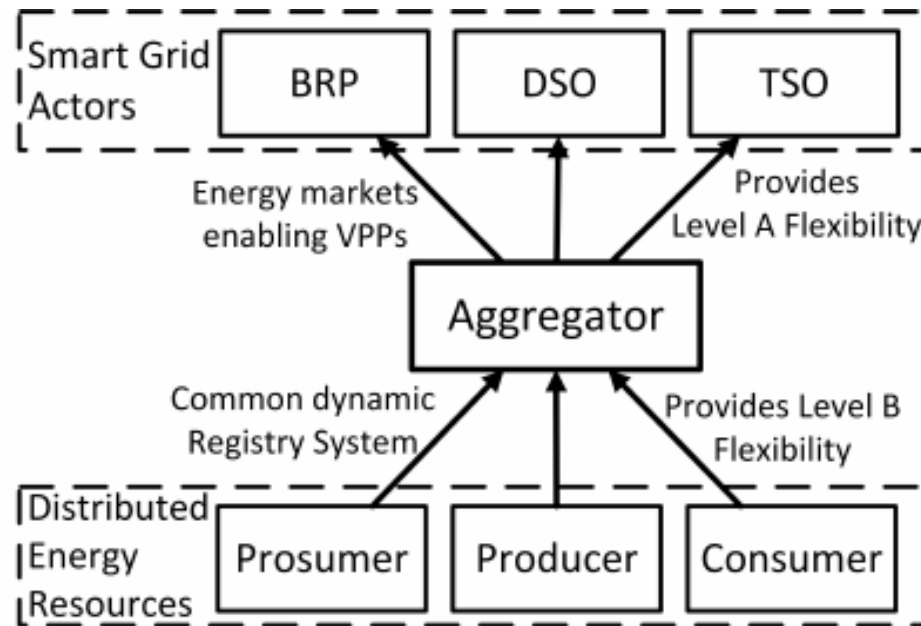
- 2. Create appropriate (market) mechanisms to remunerate DG

- ▶ 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!!!!

jresende@fep.up.pt

