Innovation in Network Industries – Challenges for Energy Regulation

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Brief history of the current times

Why regulate?

- Regulation creates and implements a framework or **'rules of the game'** that ensures a level playing field to all involved stakeholders.
- The energy regulators are currently facing three key challenges that arise from the D-syndrome or the 3-Ds, namely, **decarbonisation, digitalisation** and **decentralisation.**
- In this dynamic era of rapid innovation, regulation that does not reflect this change, will lead to negative externalities

Disruptor who?

- The 3Ds cannot be looked at as silos. Interaction between the 3Ds is altering functions of different stakeholders in the value chain.
- Decentralisation has changed the traditional one directional centralised flow of electricity to a bi-directional one.
- Greater interaction between different sectors is redefining rules of the game.
- Digital technologies are bring new challenges to the energy sector from technologies such as block chain and internet of things.

What are the areas of innovation challenges?

- Evolving network operators
- Batteries
- Sector coupling
- E-mobility

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Evolving network operators

What are the key challenges?

Business model innovation

- Risk to DSO business model due to grid defections.
- Regulated retail prices versus full competition.
- Regulation should be adapted to enable a reasonable sharing of risks and rewards between infrastructure owners and users.

Digital innovation

- Grey area concerning legal definitions for emerging technologies and arbitration mechanisms in case of disputes.
- Key is to find a balance between protecting consumer privacy and providing cybersecurity while ensuring adequate incentive for new technologies.

Politics

- The future of the network operator would depend on policy decision at different levels of the political establishment.

Current developments
Regulating Innovative Business Models

Great Britain - OFGEM

- RIIO (Revenue = Incentive + Innovation + Output).
- The Offshore Transmission Owner (OFTO) model for developing offshore networks.

California – No wire regulation

- Utility must identify portfolio of distributed resources Counter investments in distribution level.
- Regulator will decide best fit between wire and no-wire based on set criteria.

Mauritius

- ‘Home Solar Project’, targets vulnerable customers by providing them with electrification using the BOO (Build Own Operate) model.
- Central Electricity Board (CEB) installs and manages rooftop solar systems while charging the consumer a fixed price.

Current developments
Digital Innovation

Cybersecurity

- The European Network for Cyber Security (ENCS) was formed in 2012.
- Not for profit organization formed to support in facing the current and future cybersecurity challenges.
- Some of the major gas and electricity network operators are members.

Blockchain

- Tennet became the first transmission system operator in the EU to implement blockchain technologies for power grid stabilisation.
- The pilot project for integrating ‘decentralised home energy storage’ for providing services to the grid services.

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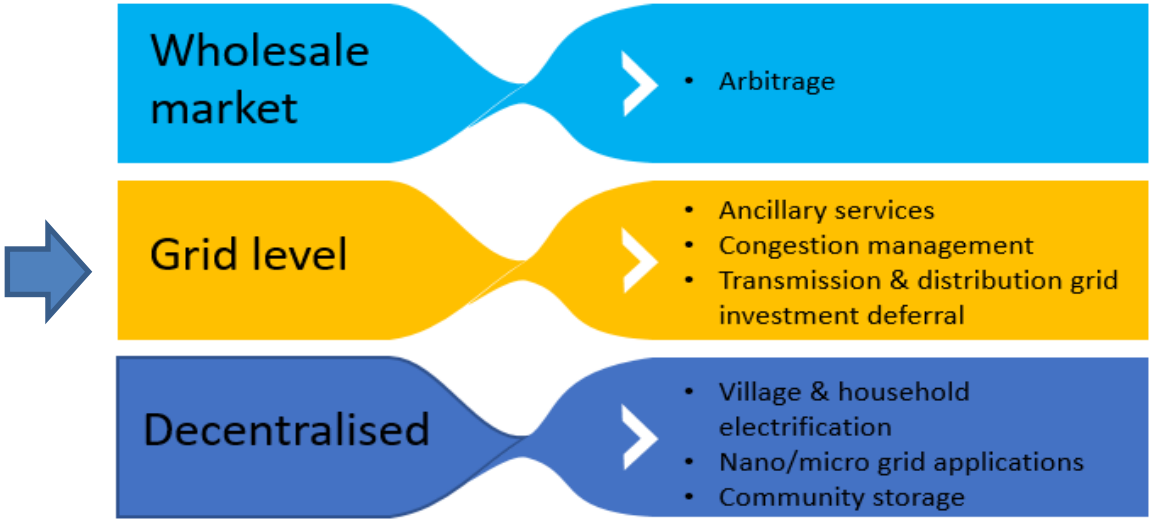
Integrating batteries

Batteries are functionally versatile

- While “copper wires” transmit electricity over geographical distances, storage transmits electricity across time.
- The potential application of batteries is varied and can participate in different segments of the electricity value chain.
- This functional versatility of batteries also makes it difficult to define them in the current regulatory framework.

A power system based on renewable energy needs the flexibility to balance demand and supply.

The use of batteries for balancing services has the potential to improve operational and economic efficiency and thus lower the cost for consumers.



What are the key challenges?

Ownership

Should system operators be allowed to own batteries?

- Pro: Investment in batteries by the system operators can be considered for grid investments deferral and to mitigate (if any) market power issues when the system is stressed.
- Con: It may distort the market as the system operator may prefer to use its own battery resources for system balancing rather than other flexible resources.

Market Integration

Are the market structures adapted to enable flexible technologies?

- The current view appears to be that market structures are not yet adapted and would need to be modified to encourage flexible technologies such as batteries.
- European Parliament resolution of 13 Sep. 2016 on Towards a New Energy Market Design too calls upon the European Commission to adopt a market design structure that rewards flexible and fast reacting resources.
- In 2011, the US federal energy regulatory commission (FERC O-755) ordered the overhaul of the frequency regulation market as it saw the current system as (negatively) discriminatory towards flexible and fast responding assets.

Current developments
System operator ownership of batteries

Project Owner	Location	Year	R&D	Emergency	Temporary
UK Power Network	Leighton Buzzard	2013	✓		
Terna – Energy Intensive	Southern Italy	2011		✓	✓
Terna –Power Intensive	Sicily and Sardinia	2013	✓		
Electric Transmission Texas	Presidio, Texas	2010		✓	✓

Current developments
Market-based integration

Special Markets – GB (National Grid)

- Enhanced Frequency Response (EFR) to support fast responding assets was created
- During the first auction in 2016, ~ 200MW of batteries cleared the auction.

Market Modification – US (Pennsylvania-New Jersey-Maryland (PJM))

- As a consequence of the US Federal Energy Regulatory Commission (FERC) order 755, frequency response markets were restructured.
- In PJM, additional power provided by fast resources in a given time frame is taken into consideration while calculating payments. (Further updated in recent times).

Technology Specific Procurement – US (California)

- The load-serving entities are required to organize a local capacity requirement auctions which can be considered as a type of local level capacity mechanism to ensure reliability.
- In 2014, while approving South California Edison's local area requirements, the California Public Service Commission specified the share of different technologies that should be contracted, of which storage was one technology.
- South California-Edison contracted 100MW of batteries in combination with a CCGT power plant.

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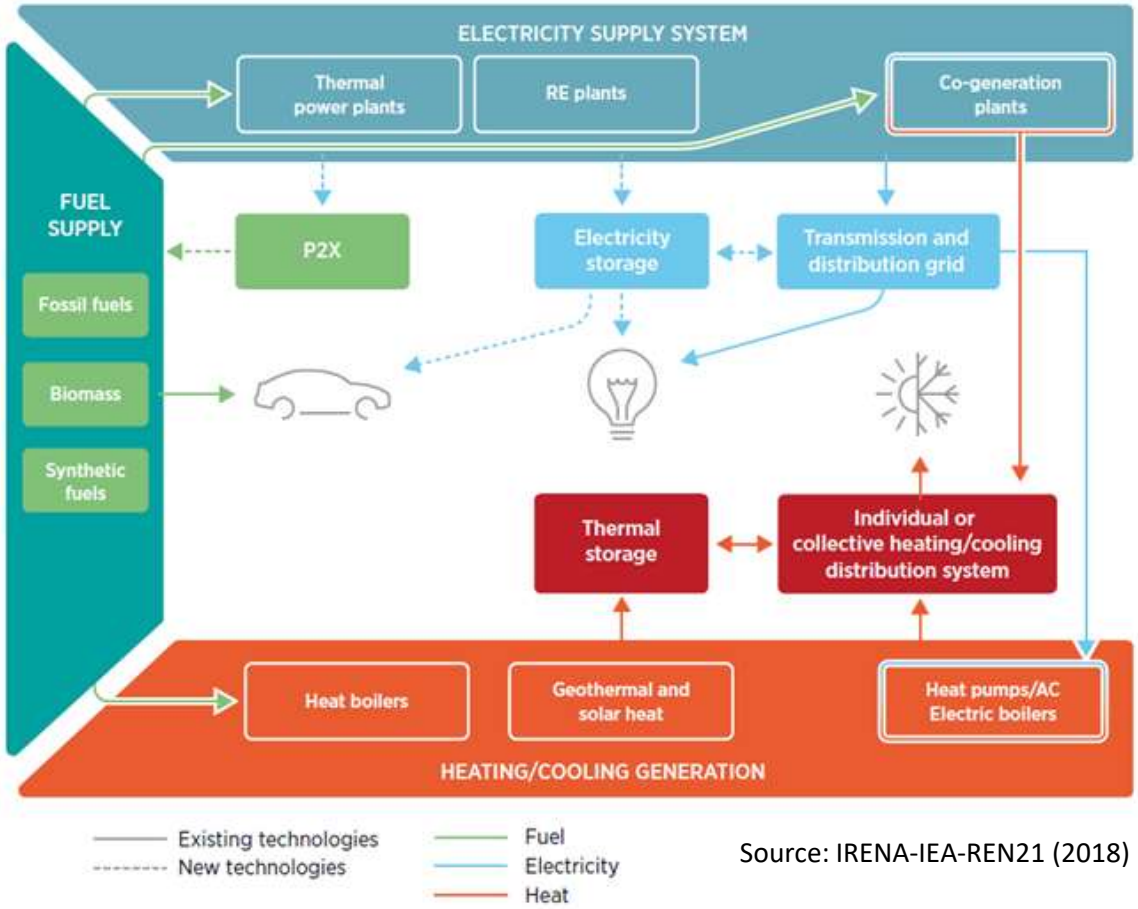
Sector coupling

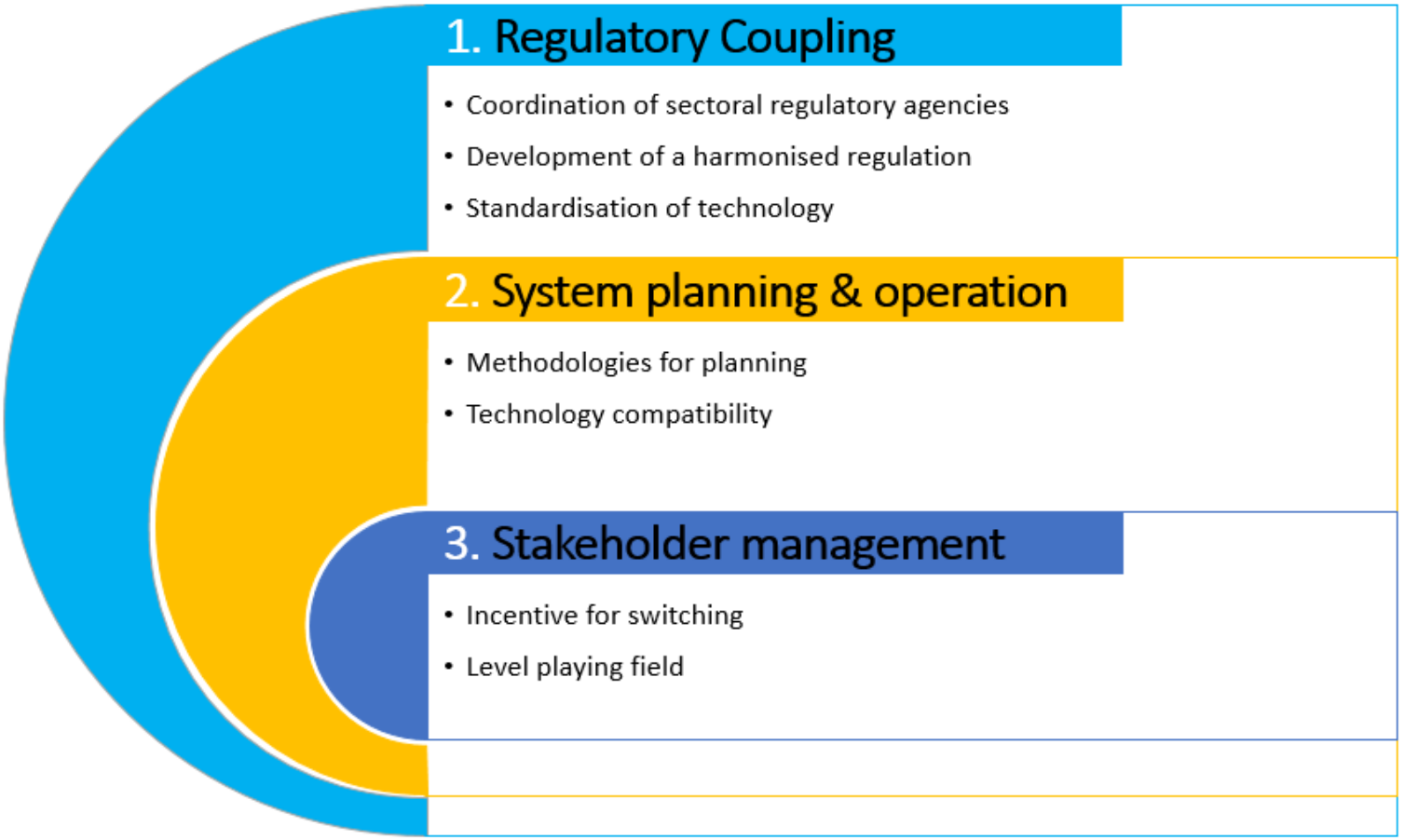
What is sector coupling?

"the energy engineering and energy economy of the connection of electricity, heat, mobility and industrial processes, as well as their infrastructures, with the aim of decarbonisation, while simultaneously increasing the flexibility of energy use in the sectors of industry and commercial/trade, households and transport under the premises of profitability, sustainability and security of supply". – BDEW (2017)



Source: IRENA-IEA-REN21 (2018)

What are the key challenges?



Current developments

Energy & Steel Sector

- Pilot conducted in Linz, Austria by H2Future, a H2020 project.
- Step 1: Test polymer electrolyte membrane to produce hydrogen for use in the steel industry.
- Step 2: Assess scalability of this this technology.
- When the system is scaled up, regulatory modifications (if any) would need to be considered.

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E-Mobility

What are the key challenges?

1. Charging infrastructure

- Risk to network stability
- Market design for charging infrastructure
- Standardisation of charging infrastructure

2. Vehicle to X services

- Consumer behavior unpredictability
- Vehicle to grid market design

Current developments
EV Charging Infrastructure

Japan

- Next Generation Vehicle Charging Infrastructure Deployment Promotion Project with ~$1 billion budget.
- Developed mainly under a public-private partnership model.
- Price structures such as time of use tariffs, per minute plans, hook-up fees, free charging and monthly memberships are utilized.

United States

- Funding is at federal, state and local agency level.
- Federal funding via EV Project and the U.S. Department of Transportation's Transportation Investment Generating Economic Recovery program.
- As of 2016, 36,000 charging stations are in existence.

France

- French government provided funding for 12,000 charging points in 3000 cities.
- EDF is building a DC fast charging network nationwide.
- French government estimates that 7 million publicly accessible charge points will be installed by 2030.

Italy

- In Italy, five pilots were run between 2011 and 2015 to build and operate EV charging stations to assess three different business models: 1) DSO and multiple retailers 2) charging service provider (CSP) for a region 3) Multiple charging service providers for a region.

Current developments

EVs as an electricity market participant

PJM ISO (US)

- Pilot for using EVs for grid services since 2007.
- As of 2014, the pilot project was able to earn roughly $110 per vehicle per month.
- Collaboration with University of Delaware.

United Kingdom

- V2G trials conducted by ENEL & Nissan (May 2016).
- 100 V2G units at various locations for Nissan LEAF and e-NV200 electric van.
- Similar project is also underway in Denmark.

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"I know that history is going to be dominated by an improbable event, I just don't know what that event will be"

— Nassim Nicholas Taleb,

The Black Swan: The Impact of the Highly Improbable

Thank you!

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