

### **Electricity grid flexibility and market design**

Webinar

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## **Speakers' introduction**



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### **Our services** – Combining fields of expertise from research, data science to modelling

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# A wide portfolio of services & products



• Databases

- Market reports
- Long-term forecasts
- Market watch

- Tailor-made research platform
- Tailor-made forecasting models



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- Market studies & diagnostics
- Strategic analysis
- Due Diligences
- Tailor-made forecasts
- Regulatory studies
- Feasibility studies



TRAINING

- Energy statistics
- Modelling
- Energy Efficiency
- Climate change





## Agenda

- Introduction to Flexibility
- Electricity markets global overview
- Zoom on German and Californian Flexibility markets
  - Market design description
  - Local ecosystem
  - Flexibility mechanism
  - Future developments

Have a look at our recent article:

#### "Capturing business opportunities in emerging power system flexibility services"

7 Apr 2022 Available in Enerdata's website



## **Introduction: What is flexibility?**





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#### Power system flexibility?

It is an umbrella term that can be seen as a subset of the even broader term "smart grid".

We identified at least a dozen different definitions. While it has become a popular term in Europe, mainly due to the policy mandates for demand-side flexibility, it is increasingly gaining traction in other regions.

A simple, yet restrictive definition would be **"The ability to provide upward and downward power adjustments to the electricity grid."** 

But **"flexibility" covers a wide portfolio of practices and technologies, both mature and nascent**. Its ultimate goal is to optimize the overall system costs while increasing grid asset usage and efficiency, its resilience, and (but not only) the ability to integrate variable renewable energy sources (e.g., solar and wind).

# **Flexibility assets evolution**

- > Flexibility assets are evolving with the rise of new types of power generation and consumption assets
- > Flexibility is now interacting with other type of energy networks (e.g. gas, heat...)



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## **Electricity value chain evolution**

From a **traditional « legacy » energy-centric electricity delivery value chain**.



To a **flexibility-centric value chain** with new flexibility resources, new stakeholders & evolving markets.



#### Zoom on country specific value chain



Figure 1: Germany value chain



Economic interest for flexibility (price and incentive-based)
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# **Energy market designs**

Flexibility is highly dependent on regulation & market design. There is therefore a high diversity of market designs across geographies: from fully regulated to fully deregulated (See below IEA graph).

#### Market design, regulation - Key themes related to flexibility:

- Value chain unbundling: number and role of stakeholders from generation to delivery
- Wholesale & retail market structures
- Utility regulation: revenue model, incentives for innovation, planning & operation practices
- Retail rate structure
- Grid (network) codes: obligations for grid-connected resources to provide system support
- Grid (inter)connection rules, cost allocation
- Role of aggregators



Source: IEA RETD, 2015 update

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Lots of regulatory changes are underway, allowing greater use of flex, expanding the value of DR/DSF.

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### **Energy markets definition: US vs EU**

 $\rangle$ The US and EU energy markets are references for the rest of the world. The understanding of their mechanisms allows for apprehending most issues related to energy markets.

	European Union 🌔	United States
Market Design	<b>Self-dispatch in most countries:</b> Portfolio balancing obligations for market participants via BRP*	<b>Central dispatch (pool):</b> Direct market participation (LSE/generator/aggregator) Dispatch is managed by the ISO/RTO
Price formation	Single price or Zonal prices	Nodal Locational Marginal Prices
Wholesale Markets	Forward (OTC, wholesale PX) Day-Ahead Intra-day Balancing (=Real-time)	Forward (OTC, wholesale ISO/RTO) Day-Ahead Real-time
Wholesale structure	Market operator (Power Exchange) + Transmission system operator (TSO)	Independent system operator (ISO) or Regional Transmission Operator (RTO) **
Players Regulation	Full unbundling, harmonized construct between member states	Partial deregulation, various constructs



Enerdata - 8/11/2022 - Electricity grid BRP: Balance Responsible Parties / OTC: Over the Counter / ISO: Independent System Operator/ LSE: Load Service Entity flexibility and market design Webinar \*\*: ISO and RTO are both in charge of power system operation and organized power markets. They do not own the assets.

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### Focus on two examples: Germany (DE) and California (CA)

### Both front runners in the transition to power systems with high renewable penetration – Both needing more flexibility

- > Both CA and DE already **cover approx. 50% of their load with renewables.** They are able to run with very high instantaneous VRE penetration.
- > Aggressive policy mandates
  - Germany now wants to cover 80% of its electricity production by renewables by 2030.
  - California with its Renewable Portfolio Standard set a goal of being net zero by 2045 (Source: Energy.ca.cov).

Similarities		Differences		
Already suffering from a <b>high level of renewable</b>			Germany	California
Very <b>high electricity costs</b> for ratepayers	VS	Interconnection	<b>Strong</b> integration with other EU countries	Weak interconnection with other states in Western U.S.
High penetration of <b>home storage</b>		Power system decarbonation	Wind & solar mix + Power to gas for long-duration	Mix predominantly solar + batteries and
Resource adequacy (capacity) issues, closing		strategies	storage	gas peakers
nuclear and gradually retiring other traditional power plants			<b>Slow</b> uptake of smart meters (Does not include	Higher, lot of DR
Gas power plants needed during the transition		Demand Response (DR/DSF)	small residential customers so far) and some DR programs	out of smart meters for all customer classes across the entire state
Grid congestion issues				
erdata		Resilience	Not a key driver	<b>High</b> with lots of microgrids

# Market places for electricity in Germany





Market not allowing to value a flexibility asset

Market allowing to value a flexibility asset

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# Market places for electricity in California



## Local ecosystems



*N.B:* Utilities have at least here a production and retail activity

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# **Flexibility resources/mechanism**

Today, they are **mainly national programs** (only few of them are accessible to DR/DSF).



Flexibility mechanism in Germany (Non-exhaustive)\*



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 $\rangle$ 

\*: Frequency control mechanisms (FCR, aFFR and mFRR) and wholesale DSF from large industrial have not been added to this graph

Today, they are **mainly utility programs**. (10 to 20 programs available per utility)



#### Main DR programs in California\*\*

Type of DR products	DR products		
Frequency regulation	-		
	Demand Response Auction Mechanism (DRAM)		
	Base Interruptible Program (emergency) BIP		
	Demand bidding (energy) DBP		
Capacity/reliability and time of use programs	Reliability Demand Response Resource RDRR		
P. 00	Proxy Demand Resource (economic) PDR		
	New Emergency Load Reduction Program ELRP pilot		
	Capacity bidding CBP		
Other products	Flexalert behavioural demand response program		

**Total DR portfolio: approx. 2 GW** (4% of peak load) for a market size **in the range of a billion dollar**. (Estimated from FERC's <u>Demand Response report</u>)

\*\*: Other non-DR flexibility programs exist but are not displayed here

## Possible development of flexibility market in Germany

Redesign of support mechanisms To ensure that sufficient peak load capacity will be build up after the way out of coal.

> **Evolution of tariff structure** From fixed tariff to real-time pricing

New bidding zone

south.

Creation of 2 separated zonal prices to reduce congestion problems between north and

#### **Redispatch 3.0**

Develop the use of flexibility in particular at LV level and demand response to reduce feed in management use.

Participation to cross border balancing mechanism

PICASSO TERRE, MARRI

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## **Possible development of flexibility options in California**

**Implement DER access to wholesale market, FERC 2222** clarify structural market participation (aggregator role...)

**Redefinition of the mission and business models** of distribution utilities (« DSO », Distribution System Operator model) **Extension of Western Energy Imbalance Market (EIM**) to a wider set of energy & capacity products

New tariff structure

NEM 3.0: new Net Energy Metering tariff structure

**Refine resource adequacy** (**RA**) **options**, including a potential capacity market, long duration energy storage...

Set the Stage To Enable « Widespread Demand Flexibility »



# What can Enerdata offer?

### **Off-the-shelf products (e.g. Flexibility assets)**

#### Power Plant Tracker

- Detailed, up-to-date information about power generation assets
- 127 countries coverage, 85% of the world's power capacity,
- Assessment of renewables penetration
- Includes H2 electrolysis and fuel cell capacities
- Benchmark power-mix evolution
- CAPEX and Renewables LCOE Module

#### • European Battery market report (coming soon)

- Battery technologies benchmark
- European market qualification and quantification (including space for grid services)
- Focus on second-life and Vehicle-to-Grid applications
- Focus on 3 key countries (UK, Spain and Germany)

#### Micro-grid database (on demand)

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- Power plant tracker focus on hybrid micro-grid projects globally.
- Analyse of current and future trends of the microgrid market.

### **Custom analysis**

We can provide on demand, our experience and expertise on multiple flexibility-linked topics:

- Specific Country reports
  - Policy, regulation (market design, self-consumption, DSF policy, electricity markets...)
  - Existing assets (Generic flex resources panorama)
  - Local ecosystems (players along the value chain)
  - Flex. Monetisation (*Revenue streams, existing markets, market participants,...*)
- **Training** on flexibility for your teams
  - Fundamentals of flexibility
  - Definitions, detail of market design's specificities
  - Detail of specific countries
- Market study for a specific product/offer (e.g. demand response, battery technology, battery business model...)
- Portfolio of flexibility **technology providers** (e.g. EMS)

#### *Examples of past references*

- Analysis of the **French flexibility market** for a software provider
- Market study for a short-term PV forecasting solution. Study of short-term market optimisation and in-depth analysis of European electricity markets.
- Market study on **decentralised grid flexibility software** solutions in Europe.

### HELPING YOU SHAPE THE ENERGY TRANSITION

#### **About Enerdata:**

Enerdata

Enerdata is an independent research company established in 1991, specializing in the analysis and forecasting of energy and climate issues, at world and country level.

Leveraging our globally recognised databases, intelligence systems and models, we assist our clients in designing their policies, strategies and business plans.

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CONTACT

### Thank you for your attention!

https://www.enerdata.net/