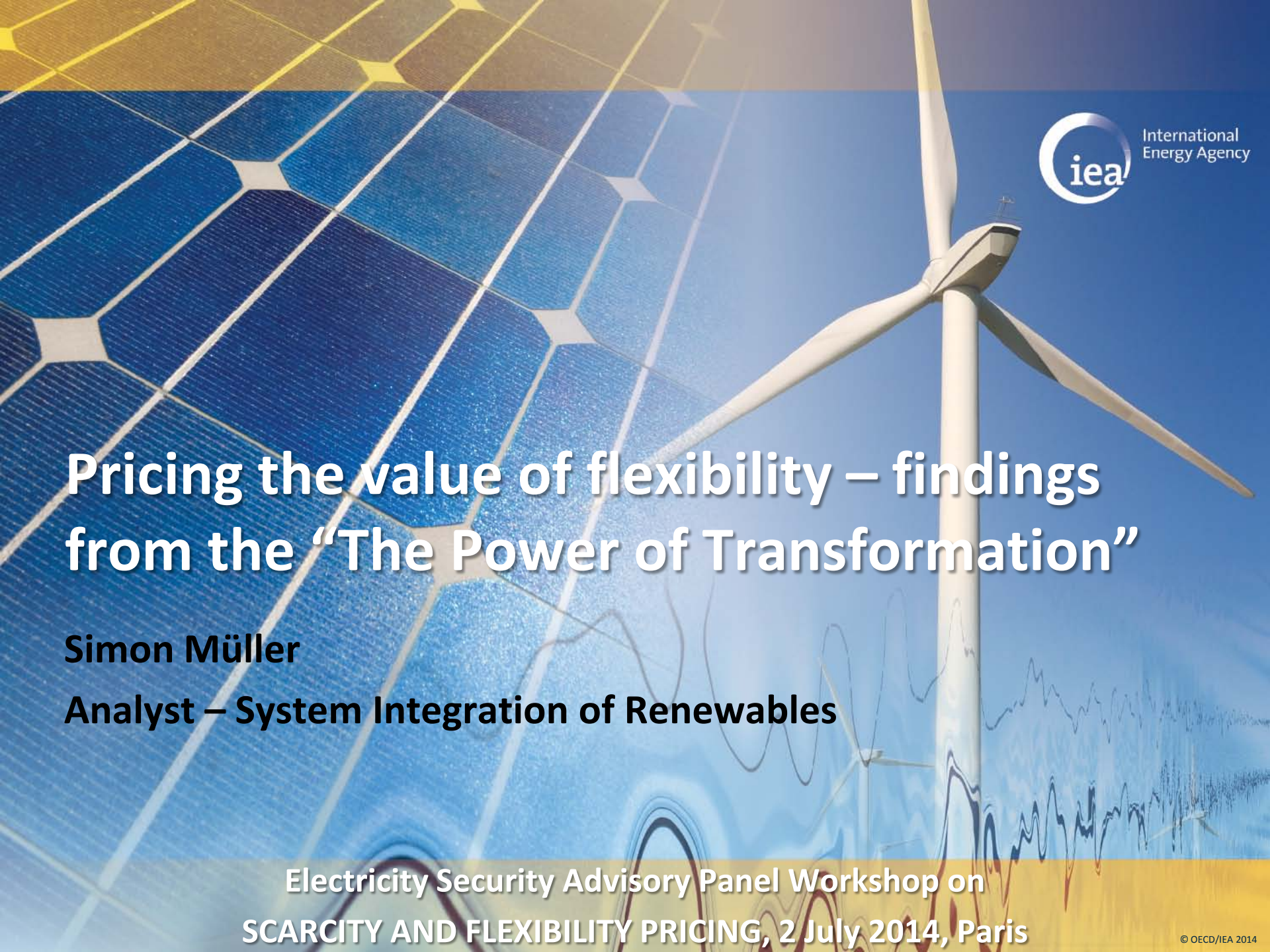


Pricing the value of flexibility – findings from the "The Power of Transformation"

Simon Müller

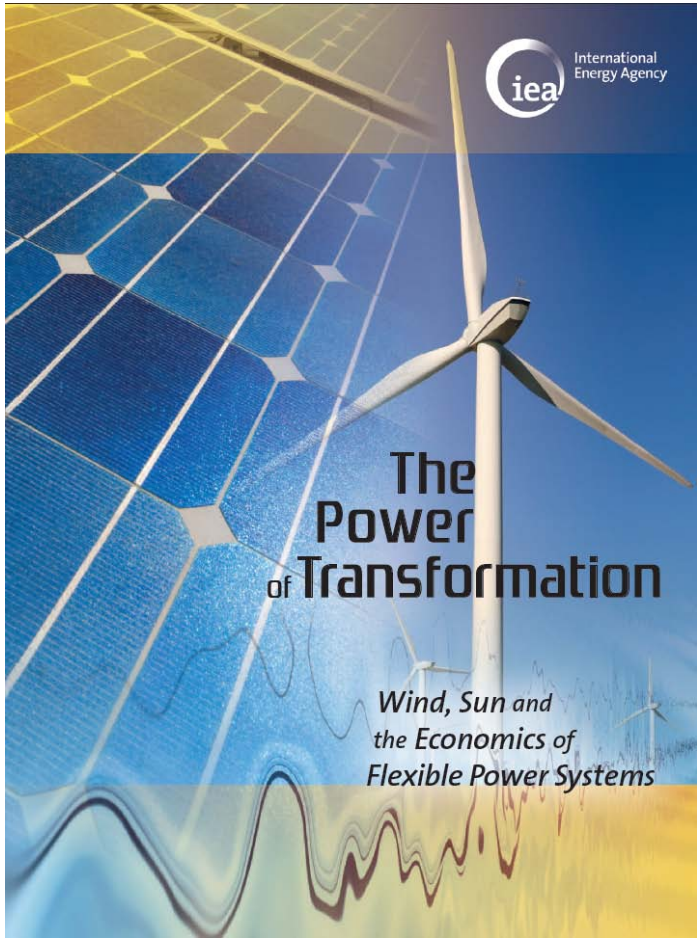
Analyst – System Integration of Renewables

Electricity Security Advisory Panel Workshop on

SCARCITY AND FLEXIBILITY PRICING, 2 July 2014, Paris

The Grid Integration of Variable Renewables Project - GIVAR

- Third project phase at a glance
  - 7 case studies covering 15 countries, >50 in-depth interviews
  - Technical flexibility assessment with revised IEA FAST tool
  - Detailed economic modelling at hourly resolution



What shapes the integration challenge?

Properties of variable renewable energy (VRE)

Flexibility of other power system components

yrs

sec

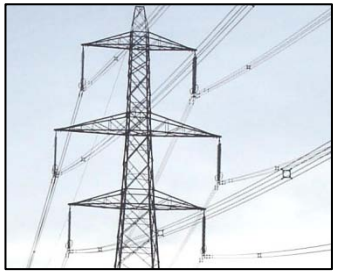
- **Variable**
- **Uncertain**
- **Non-synchronous**

100s km

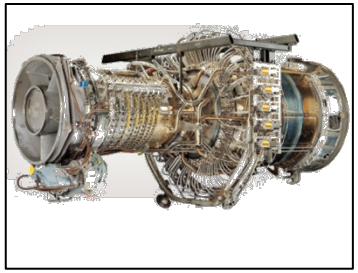
1 km

- **Location constrained**
- **Modularity**
- **Low short-run cost**

Grids



Generation



Storage

Demand Side

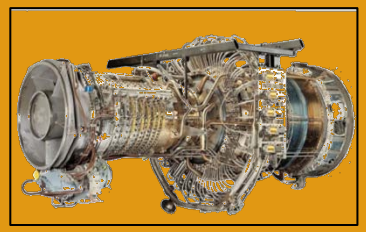
Three pillars of system transformation

Technology spread

Geographic spread

Design of power plants

System friendly VRE



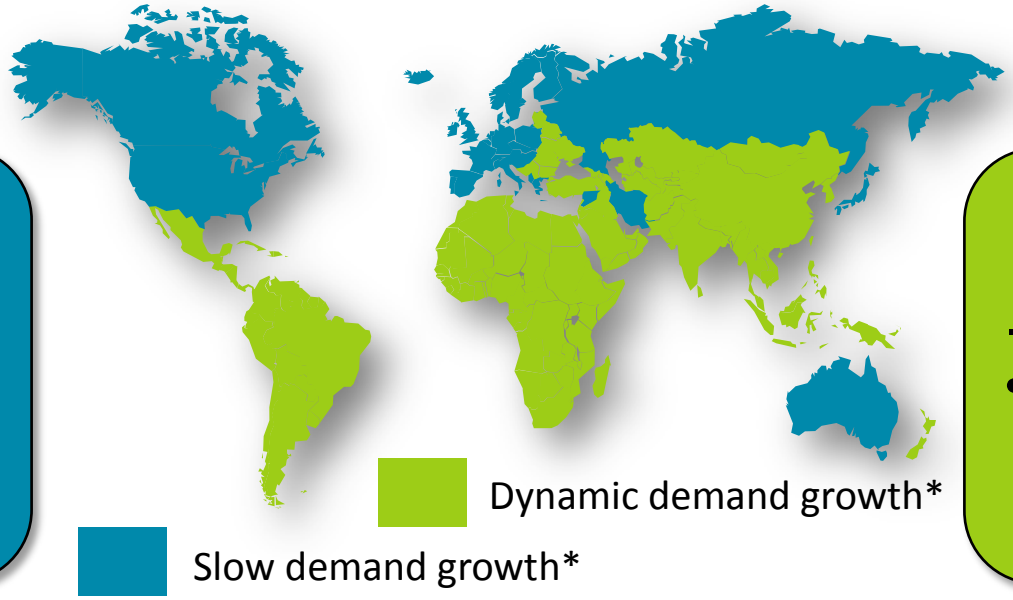
Investments

Operations

Transformation depends on context

Stable Power Systems

- Little general investment need short term



Dynamic Power Systems

- Large general investment need short term

➔ **Maximise the contribution from existing flexible assets**

➔ **Decommission or mothball inflexible polluting surplus capacity to foster system transformation**

➔ **Implement holistic, long-term transformation from onset**

➔ **Use proper long-term planning instruments to capture VRE's contribution at system level**

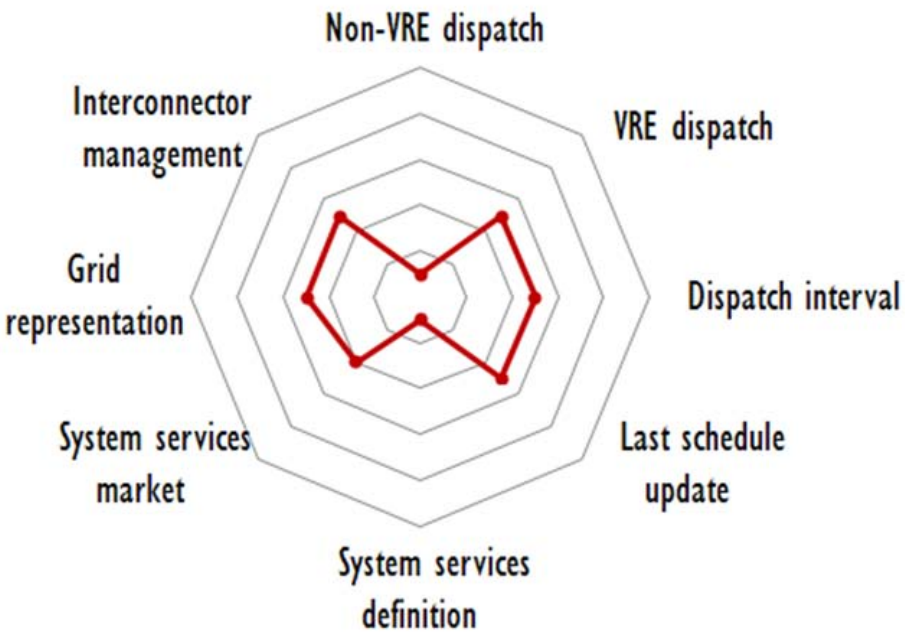
* Compound annual average growth rate 2012-20 , slow <2%, dynamic ≥2%; region average used where country data unavailable

Efficient prices at high shares of VRE

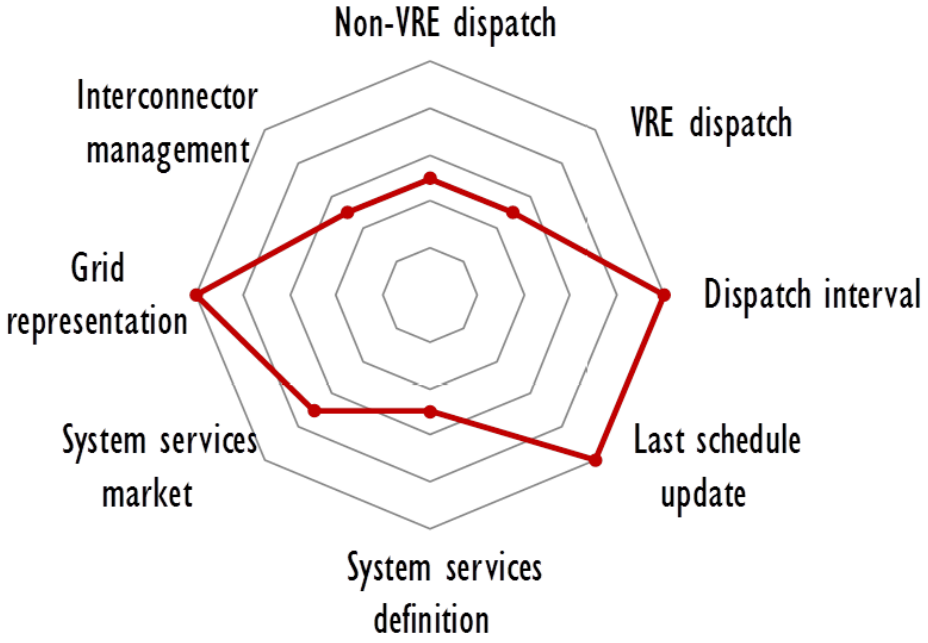
- **Variability**
  - high temporal resolution of price signals, *i.e.* prices are valid only for short time periods
  - allowing large differences in prices, *i.e.* negative and very high prices
- **Uncertainty**
  - short-term price signals, *i.e.* prices formed close to real-time and based on current system status
  - operating reserves and balancing, *i.e.* how to deal with forecast errors
- **Location constraints and modularity**
  - high spatial resolution of price signals, *i.e.* prices differ from place to place
- **Non-synchronous technology**
  - (additional) system service markets, *i.e.* substitutes for classical inertial response in certain systems

How do today's markets fare?

Example: DEU + FRA



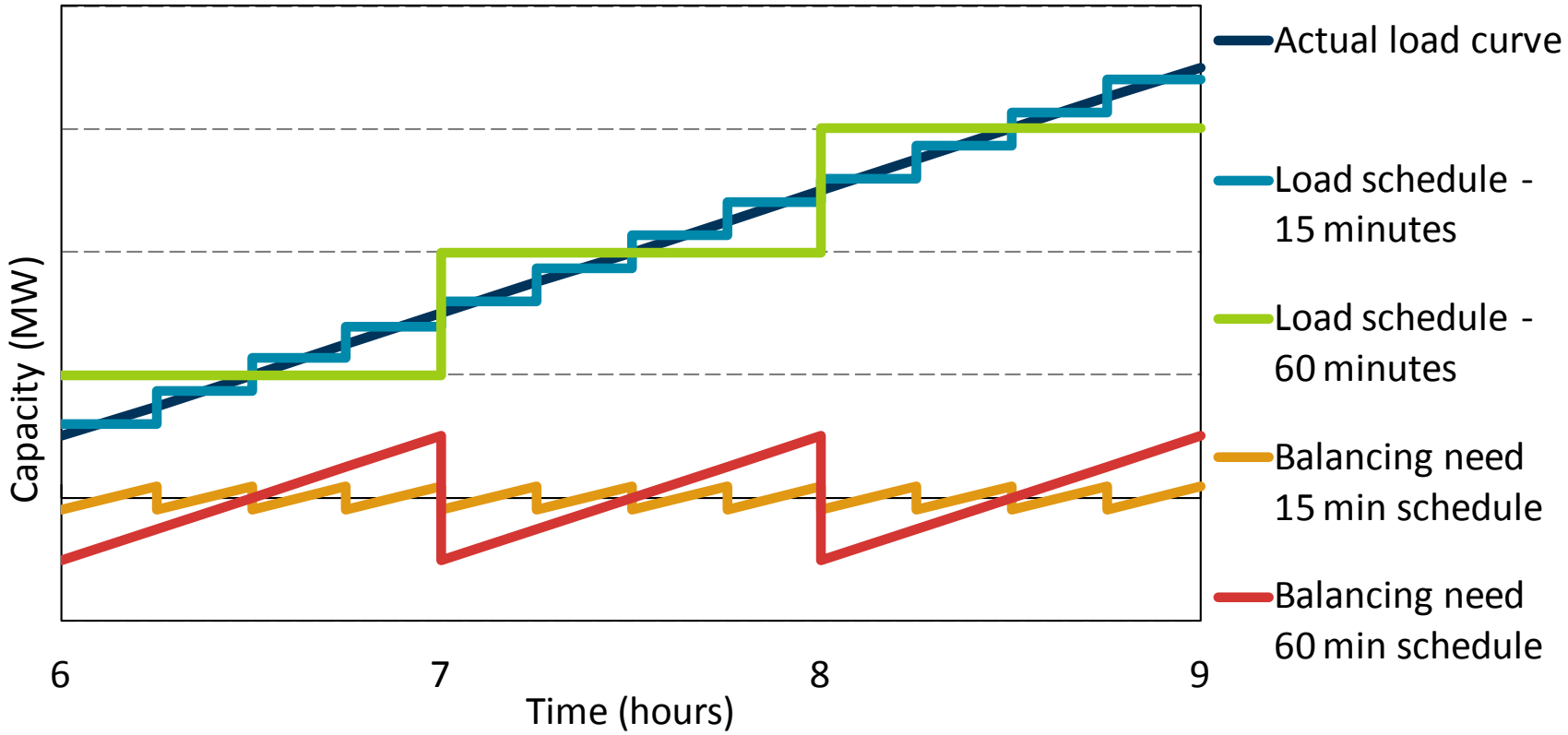
Example: ERCOT



- **Large room for improvement in design of system services markets**

Generation and transmission schedules

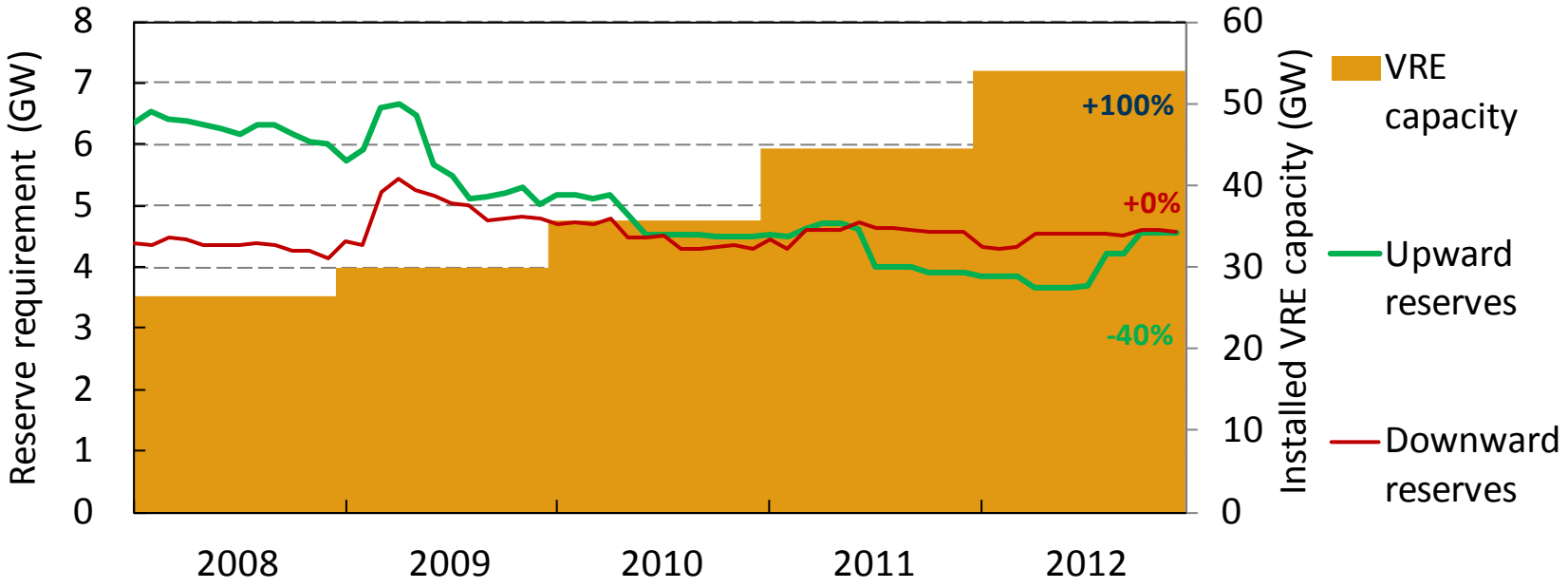
Impact of scheduling interval on reserve requirements, illustration



- Short scheduling intervals (5min best practice)
- Adjust schedules up to real time (5min best practice)

Co-operation with neighbours

Required frequency restoration reserves in Germany



- Germany has four balancing areas (historic reasons)
- Reserve sharing mechanism across four areas
- Reduced requirements despite rapid increase of VRE

Do we price flexibility at its value?

- We already have markets for flexibility:
  - In particular: balancing markets
- Three main problems:
  - Product definition often not robust at high shares of VRE
  - Services sometimes not remunerated or markets under-developed
  - Trading ill-aligned with trading on wholesale market

→ Value of flexibility is not appropriately priced

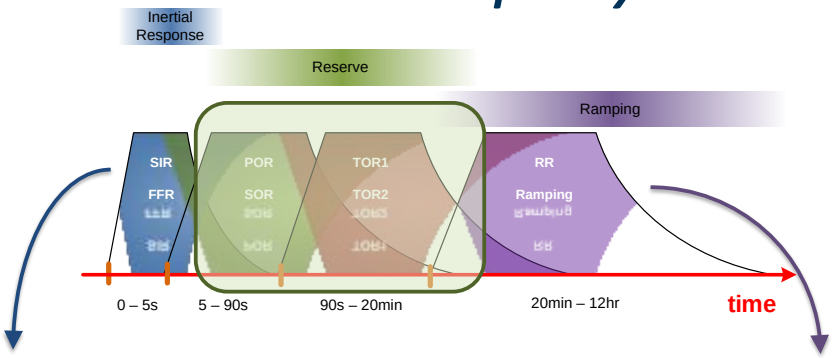
→ Wholesale market prices do not reflect value during scarcity (including flexibility)

System service definitions

Prepared for a variable future?

- **Are your operating reserve and system service definitions VRE ready?**
  - **Example Ireland DS3 programme**

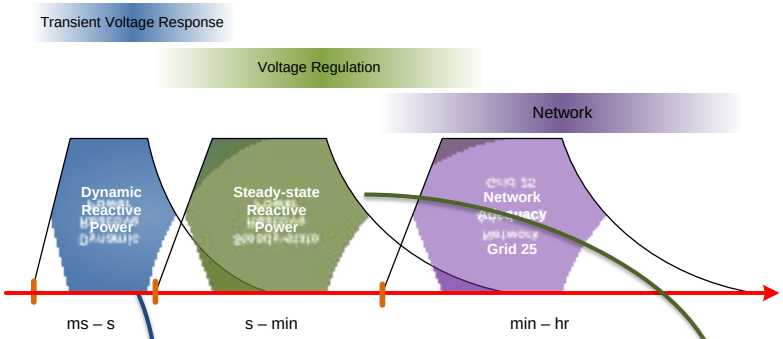
Frequency Services



- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery

- Ramping Margin

Voltage Services

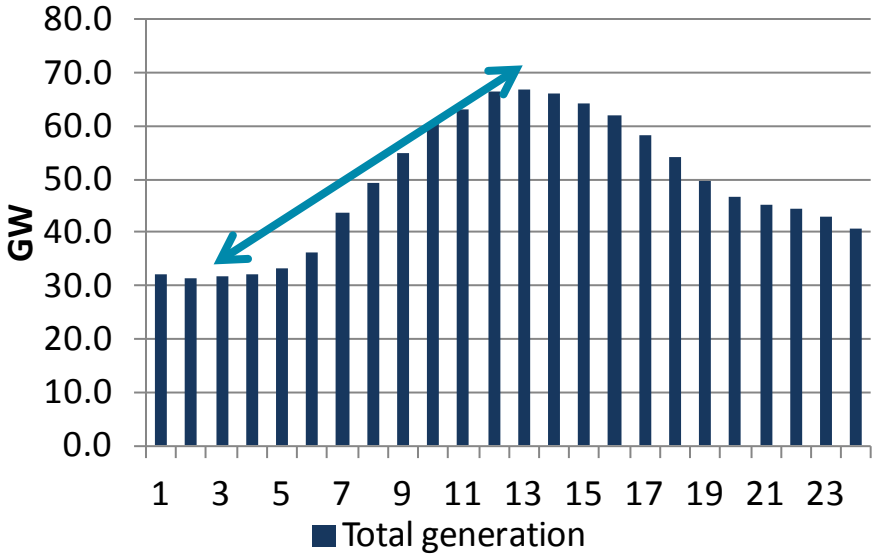


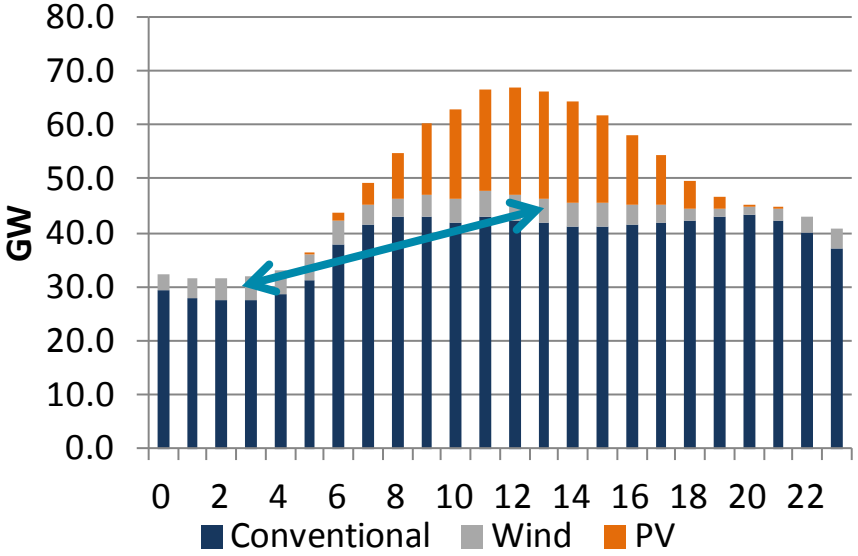
- Dynamic Reactive Power

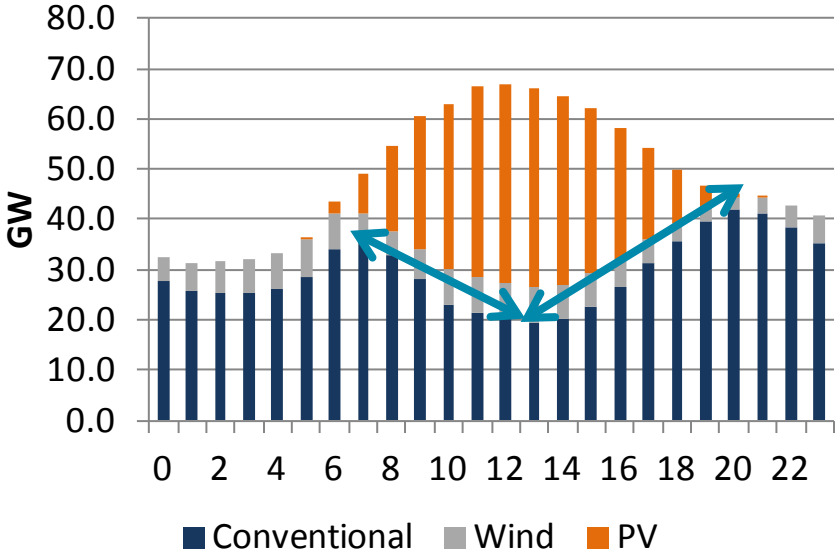
- Steady-state Reactive Power

Source: EirGrid

But does flexibility have a value today?







- **Medium-term: PV *reduces* value of pumped storage**
- **Long-term: Mutual *increase* of market value**

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