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# The flexibility challenge and renewable energy sources

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# Around 600 members from almost 60 countries

- Manufacturers with a leading share of the global wind power market
- Component suppliers
- Research institutes
- National wind and renewable associations
- Developers
- Electricity providers
- Finance and insurance companies
- Consultants
- Contractors

# EWEA's leading members

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SIEMENS

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Wind. It means the world to us.

## Leading Members

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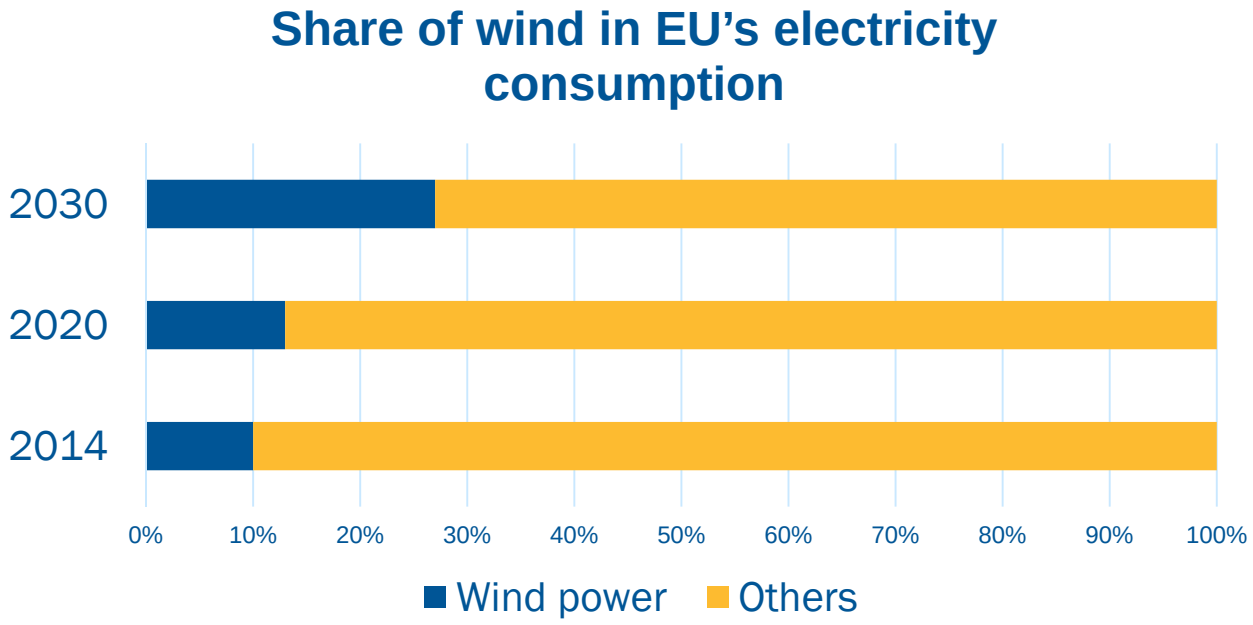
# Outline

- **An outlook** of wind power
- The need for flexibility
- Flexibility options
- Optimizing flexibility assets as no-regrets option
- Enabling the participation and optimization of existing flexibility assets
- A role for storage?

# Wind power today, and by 2030

- Wind meets 10.2% of the electricity demand in Europe
- 13% in 2020
- 27% in 2030

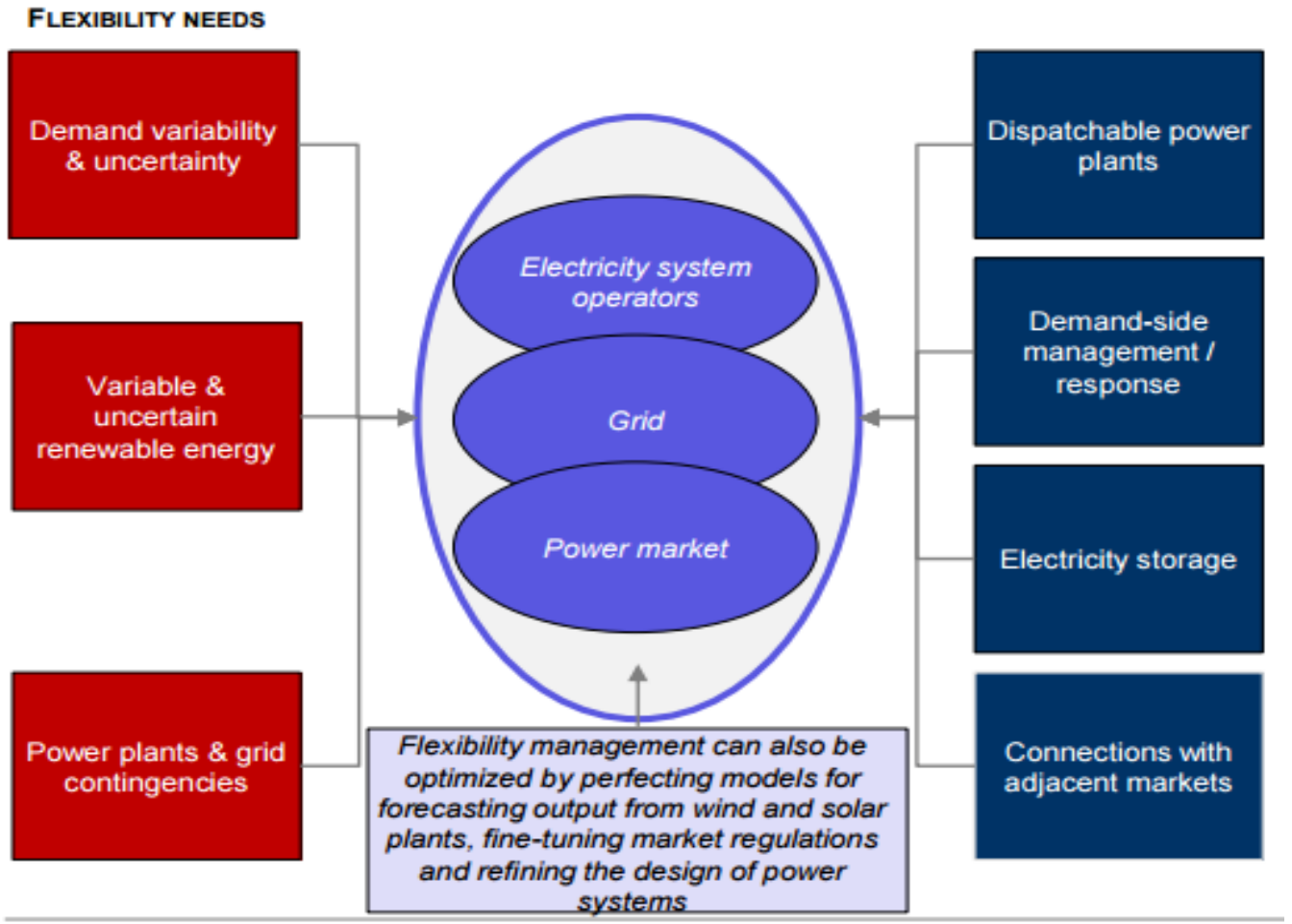


# The need for flexibility

Flexibility needs are often divided into three groups, depending on the timescale:

- **Stability** refers mainly to frequency and voltage control to comply with the grid's technical limits over a period of seconds;
- **Balancing** refers to load changes over minutes or days that must be balanced;
- **Adequacy** refers to capacity needed to meet peak demand even under the most extreme conditions in the long term (months to years).

# The need for flexibility. Flexibility options



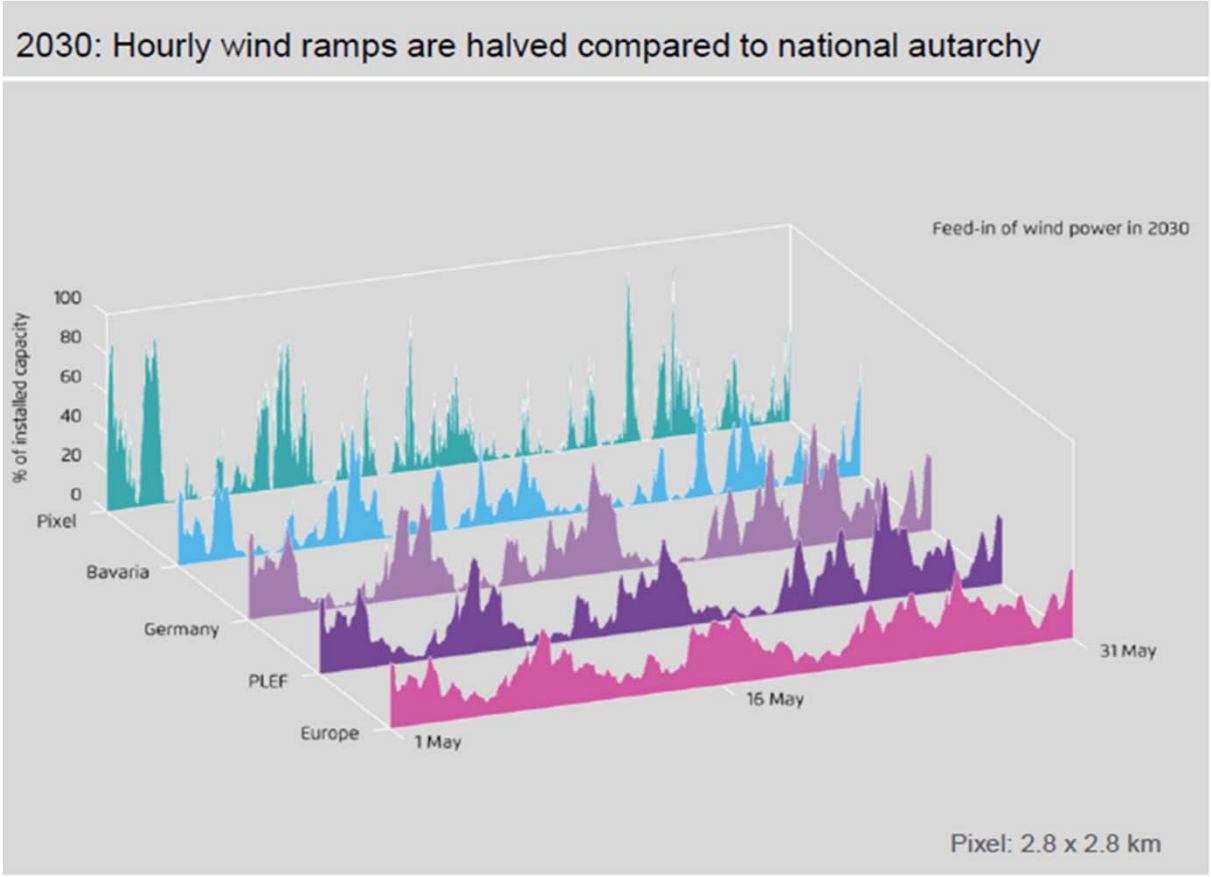

*Source: SBC Energy Institute analysis, based on IEA (2011a).*

# Optimizing flexibility assets as no-regrets option

- Increasing geographical extension of trading and balancing areas
- Establishing a trading and balancing market as close as possible to real time.
- Cross border trading and Balancing, making use of all available flexible assets
- Investing on a portfolio of different variable energy sources

# Optimizing flexibility assets as no-regrets option

Increasing geographical extension of trading and balancing areas (Example 1)



# Enabling the participation and optimization of existing flexibility assets

- Increase transmission and distribution capacity (=flexibility capacity) within and amongst balancing areas:
  - New/reinforced lines
  - Better available capacity measurement. Dynamic line rating has shown to enable up to 50% more transmission capacity*.
- Commercialization of ancillary services provision
- Improve market access to new players (aggregators, Demand-side response)

** Harnessing variable renewable, International Energy Agency 2011*

# Enabling the participation and optimization of existing flexibility assets

## Example

Storage can access time-shift market in all countries surveyed, but its ability to provide frequency reserve and T&D deferral is limited to certain countries

✔ Allowed ✖ Not allowed ✔ Regulation only governing pumped hydro

| | DE | FR | GB | IT | ES | GR[1] |
|---|---|---|---|---|---|---|
| **Can storage participate in the wholesale market?** | | | | | | |
| Time-shift | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| **Can storage participate in the frequency reserve market?** | | | | | | |
| Frequency reserve | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| **Can TSO/DSO own and operate storage?** | | | | | | |
| T&D | ✖ | ✖ | ✔[2] | ✔[3] | ✖ | ✖ |

1 Existing regulation is pertaining to hybrid stations only (renewables coupled with storage) in non-interconnected islands
2 Allowed for small storage assets
3 If proven as most cost effective solution

*Source: Commercialization of energy storage in Europe, Mckinsey & Company, Commissioned by the Fuel Cell and Hydrogen joint undertaking, March 2015*

# The need for flexibility. A role for Storage?

- **Stability**: Support of congested local grids. Can help to increase levels of variable renewables in grid. An ancillary services market should be further developed.

- **Balancing:** a level playing field should lead to the most cost-effective solution. The priority should be put on market operation and cross-border integration

- **Adequacy:** Current overcapacity and depressed prices. Not much room for storage. Very large shares of variable renewables * will require long-term, large-scale electricity storage (daily/seasonal)

** The share ranges from 35% to 100% in literature (SBC Energy Institute Analysis, 2014)*

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# Conclusions

Priority investment focus on increasing transmission and distribution capacity and utilization: to exploit existing flexibility

Reducing balancing cost by optimizing market operation and integration

In the long term, Very large shares of variable renewables will require long-term, large-scale electricity storage. There is need to continue research and demonstration

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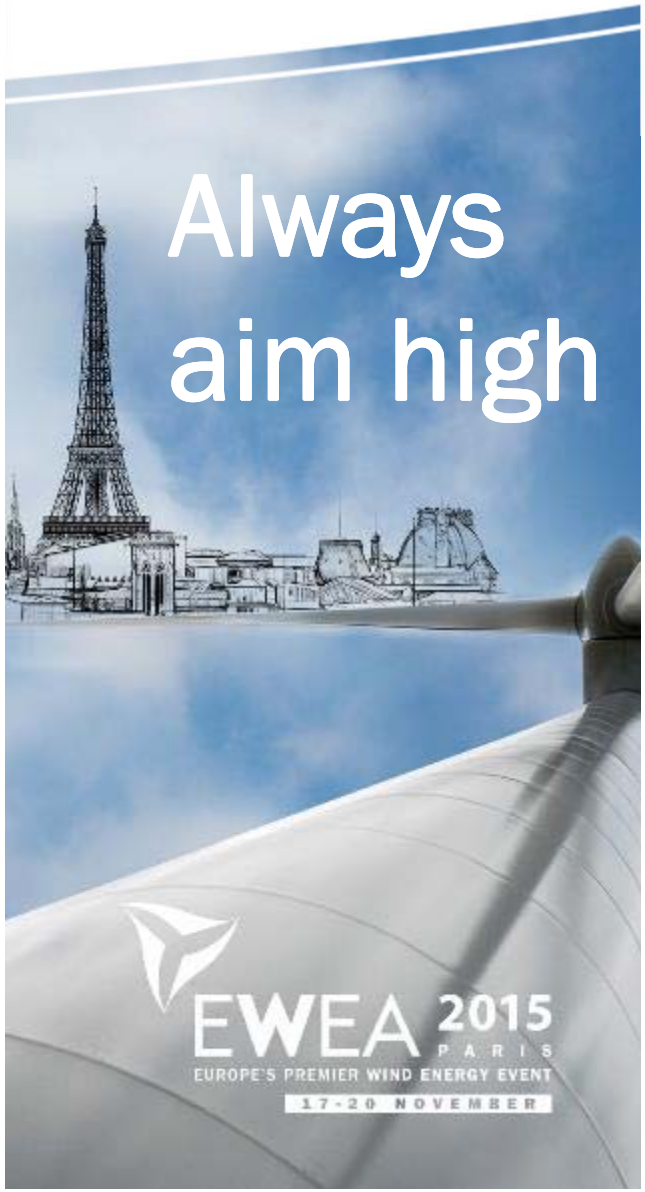


# EWEA 2015 Annual Event

17 - 20 November 2015, Paris

- Europe's premier wind energy conference and exhibition
- Uniting over 60 nationalities
- Just before COP 21

www.ewea.org/annual2015/

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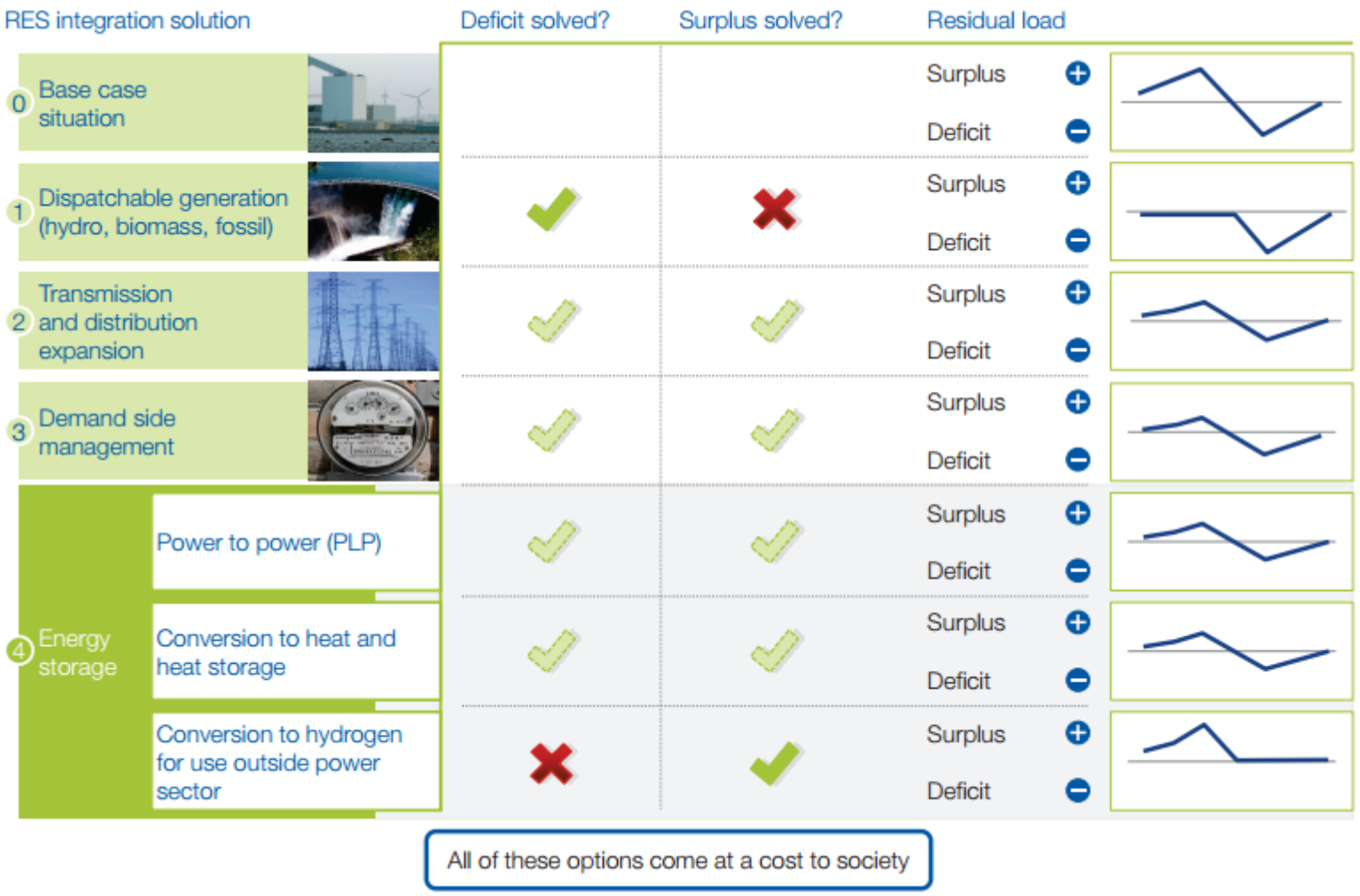
# BACKUP

# The need for flexibility. Flexibility options

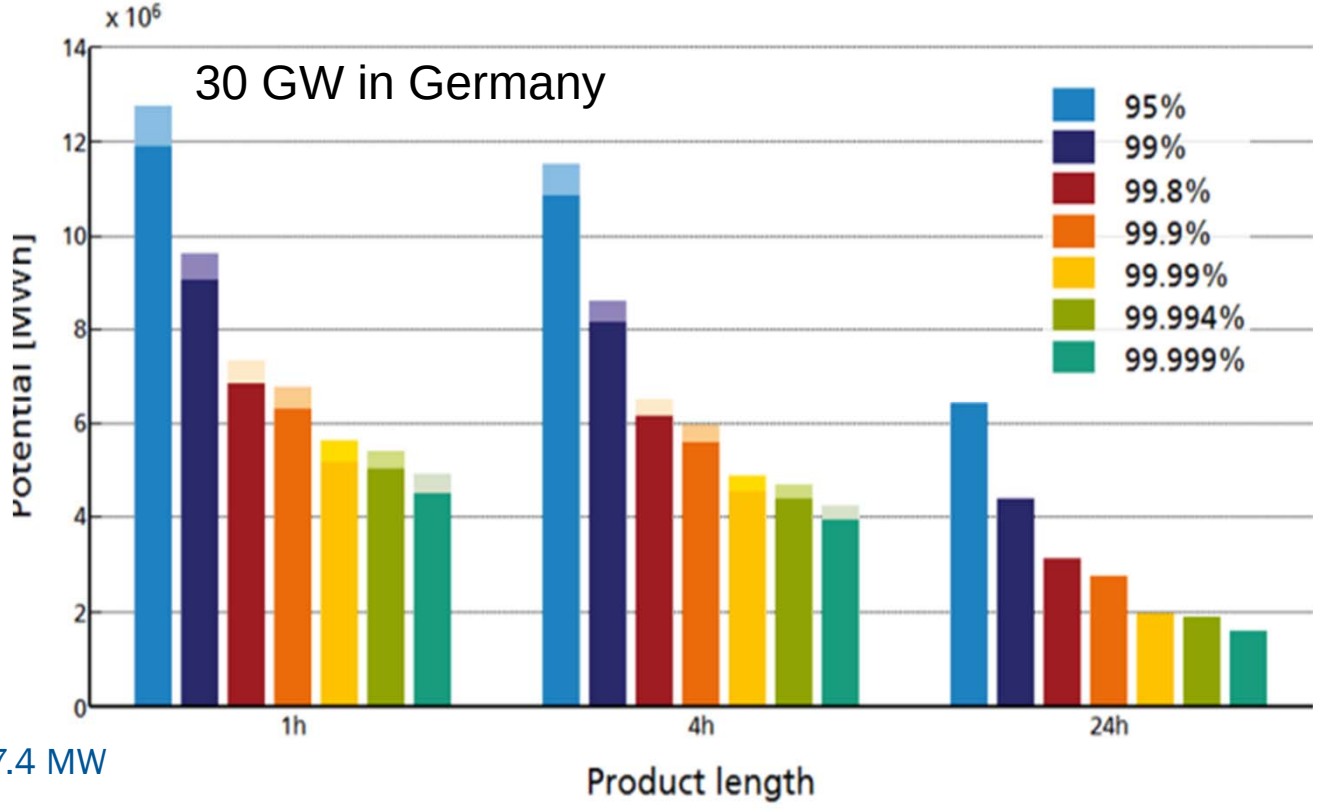



*Source: Commercialization of energy storage in Europe, Mckinsey & Company, Commissioned by the Fuel Cell and Hydrogen joint undertaking, March 2015*

# Optimizing flexibility assets as no-regrets option

## Establishing a trading and balancing market as close as possible to real time (Example 2)

### Confidence interval and product length effects


- 1 Wind Farm = 77.4 MW
- Cluster = 1 GW (WFs located in the same control area)

*Source:* Jansen, 2013. Wind turbine participation in control reserve markets. *Fraunhofer IWES*

# How do we achieve a high penetration of RES? Lessons learned up to now…

**Impediments:**

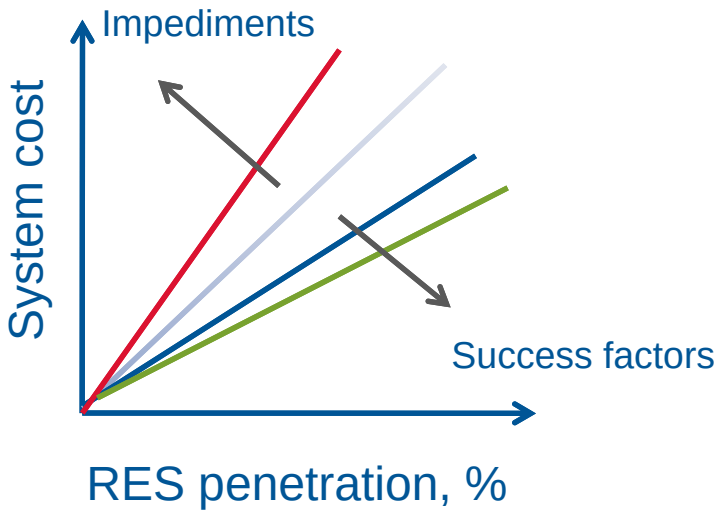
- Lack of transmission
- Lack of TSO cooperation
- Inflexibility due to market rules and contracts
- Unobservable RES – behind the fence

**Success factors:**

- Forecasting
- Thermal fleet:
  - More quick starts
  - Deeper turn down
  - Faster ramps
- More spatial diversity
- DSM
- Grid-friendly RES

**System cost:**

- Curtailments
- Higher fuel costs
- Higher emission costs
- Higher O&M costs




What's the « limit » is never quite the right question!

# 4 main electric peninsulas

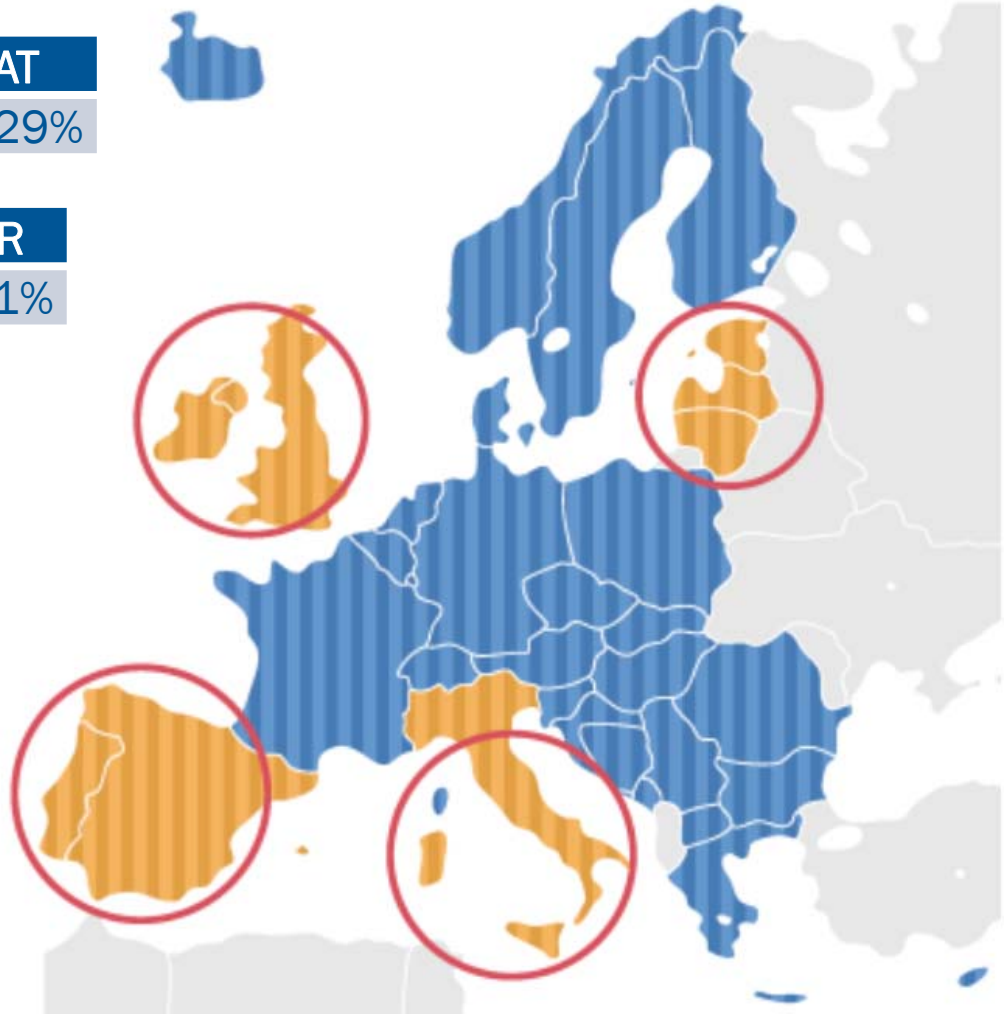
## Interconnection levels

| LU | HR | SI | SK | DK | FI | AT |
|---|---|---|---|---|---|---|
| 245% | 69% | 65% | 61% | 44% | 30% | 29% |

| HU | SE | CZ | NL | BE | BG | GR |
|---|---|---|---|---|---|---|
| 29% | 26% | 17% | 17% | 17% | 11% | 11% |

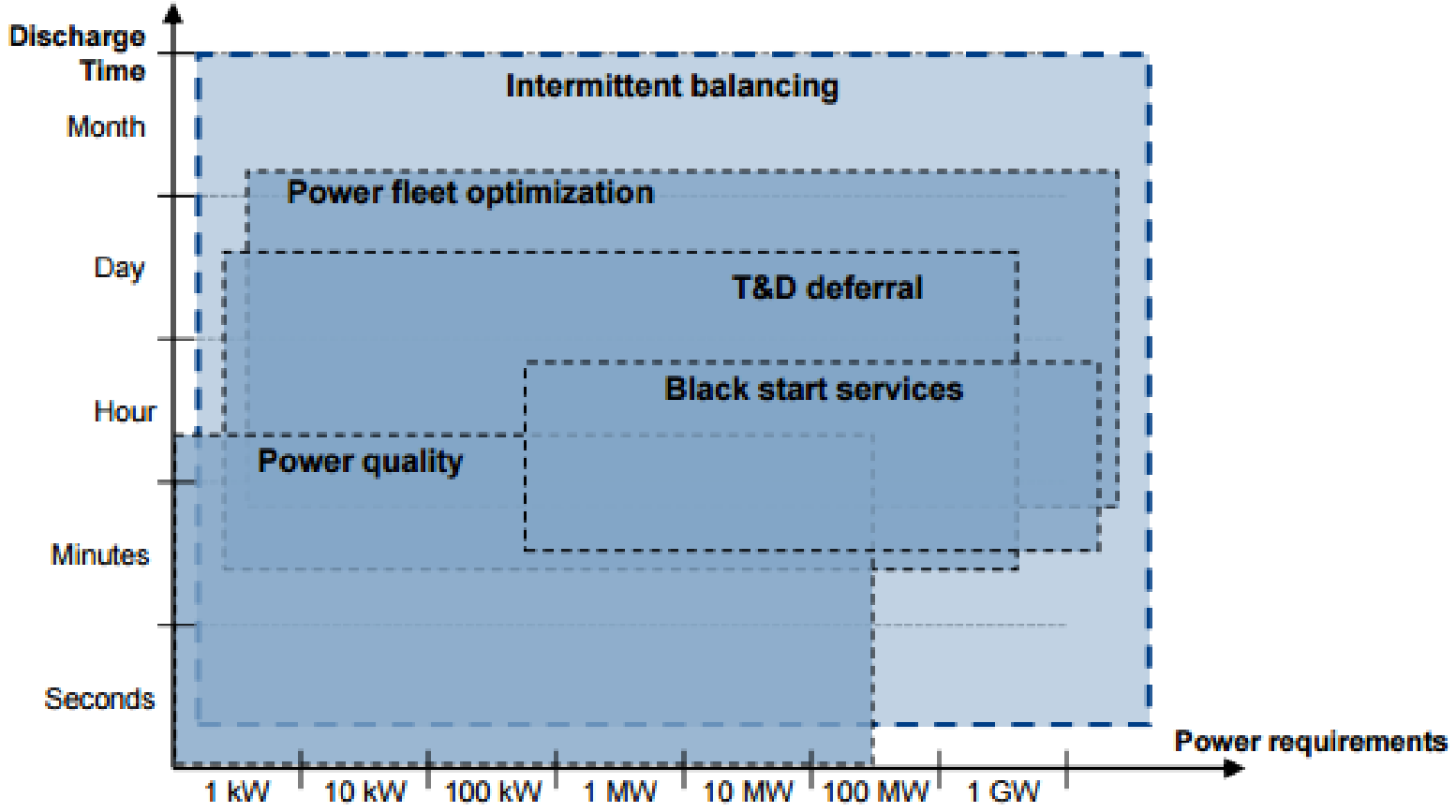
| FR | DE | IE | IT | RO | PT | UK |
|---|---|---|---|---|---|---|
| 10% | 10% | 9% | 7% | 7% | 7% | 6% |

| LT | LV | EE | ES | PL | CY | MT |
|---|---|---|---|---|---|---|
| 4% | 4% | 4% | 3% | 2% | 0% | 0% |



# A role for Storage?

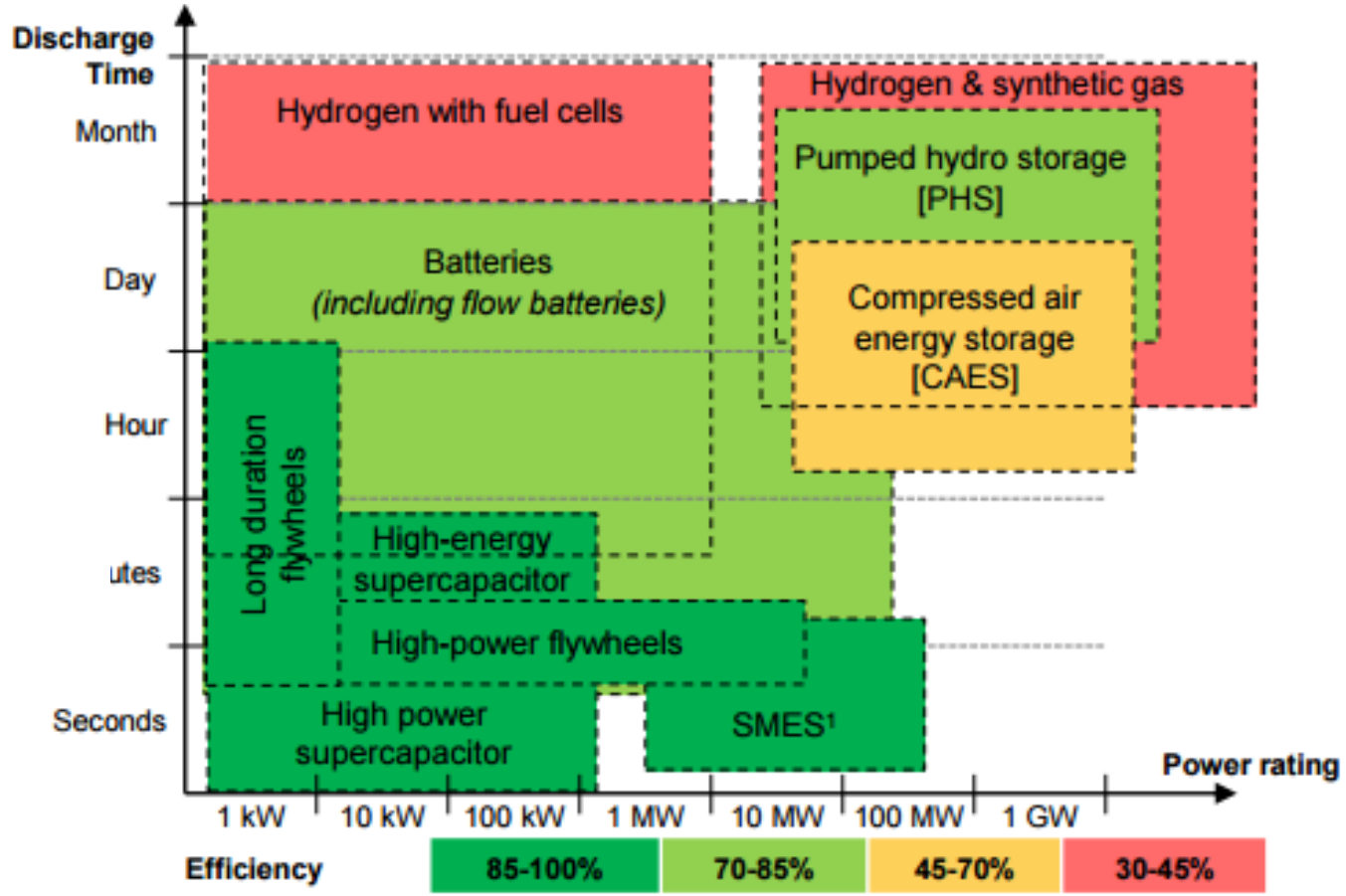
## Electricity storage application requirements




*Note:* *SMES: superconducting magnetic energy storage.*
*Source:* *SBC Energy Institute analysis, based on US DoE (2011) and Hydrogenics (2012).*

# A role for Storage?

## Electricity storage technology's features




*Note:* *SMES: superconducting magnetic energy storage.*
*Source:* *SBC Energy Institute analysis, based on US DoE (2011) and Hydrogenics (2012).*

## FLEXIBILITY RESOURCES

| | |
|---|---|
| Dispatchable power plants | Power plants are characterized by their installed capacity, but also by the speed at which they can change their output up & down (ramping rate), the time they need to start up or shut down, and finally by their minimum stable output. Hence, grid operators dispatch them to meet residual load variation. |
| Demand-side management / response | Instead of having generation follow the load, demand can also adjust generation to restrain peaking (*e.g. a* large industrial player can be asked to interrupt its operation in case of a high peak with no wind: demand response), or to shave the demand profile (*e.g.* time-of-use tariff to limit demand at night if there is a high share of solar PV and there is no sunlight: demand management). |
| Electricity storage | Electricity can be transformed and stored using technologies to extract electricity when residual load is decreasing (charging) and inject stored energy during a peak (discharging), thereby shaving the load profile on different time scales depending on considered power and energy capacities. |
| Connections with adjacent markets | The balancing of supply and demand over a larger area may reduce the impact of weather conditions, known as "smoothing impact", while mutualizing the ability to meet load variation (*e.g.* hydro-power plants in Norway to balance wind intermittency in Germany). Practically, this requires transmission lines between power systems (in both directions). |