Wind + Storage: Co-located projects and market opportunities

Daniel Fraile

Rationale

Context

- Increasing number of Wind + storage projects coming online
- Rapid increase of utility-scale storage markets
- Ongoing EU discussion on the legislative framework (strong focus on flexibility)

Objective

- Increase understanding of the regulatory frameworks and define clear policy positions
- Provide a clear picture on the available (storage) technologies and the large range of applications
- Provide intelligence to members (database of projects)

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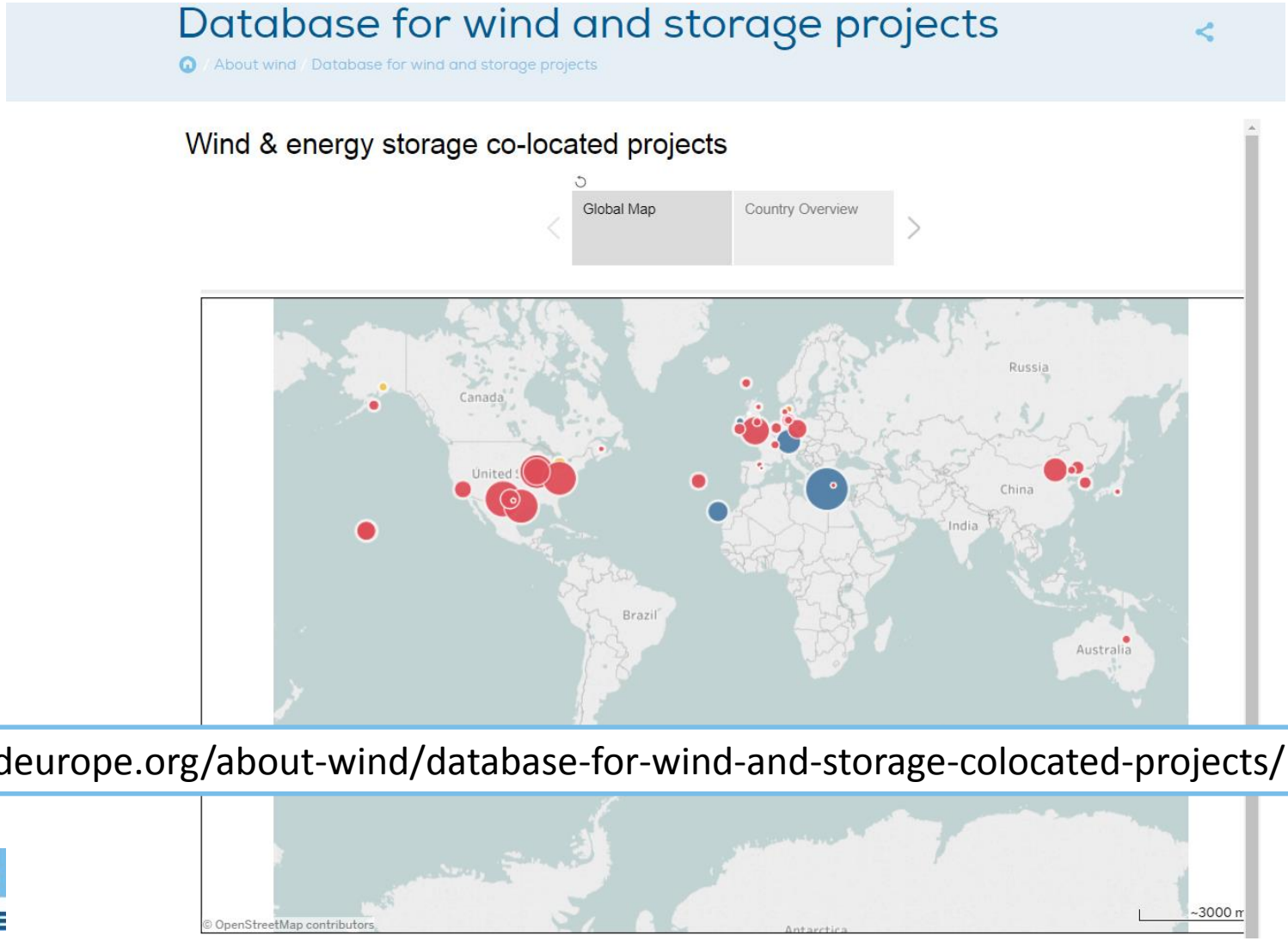
WindEurope online platform for *wind+storage* co-located projects



https://windeurope.org/about-wind/database-for-wind-and-storage-colocated-projects/

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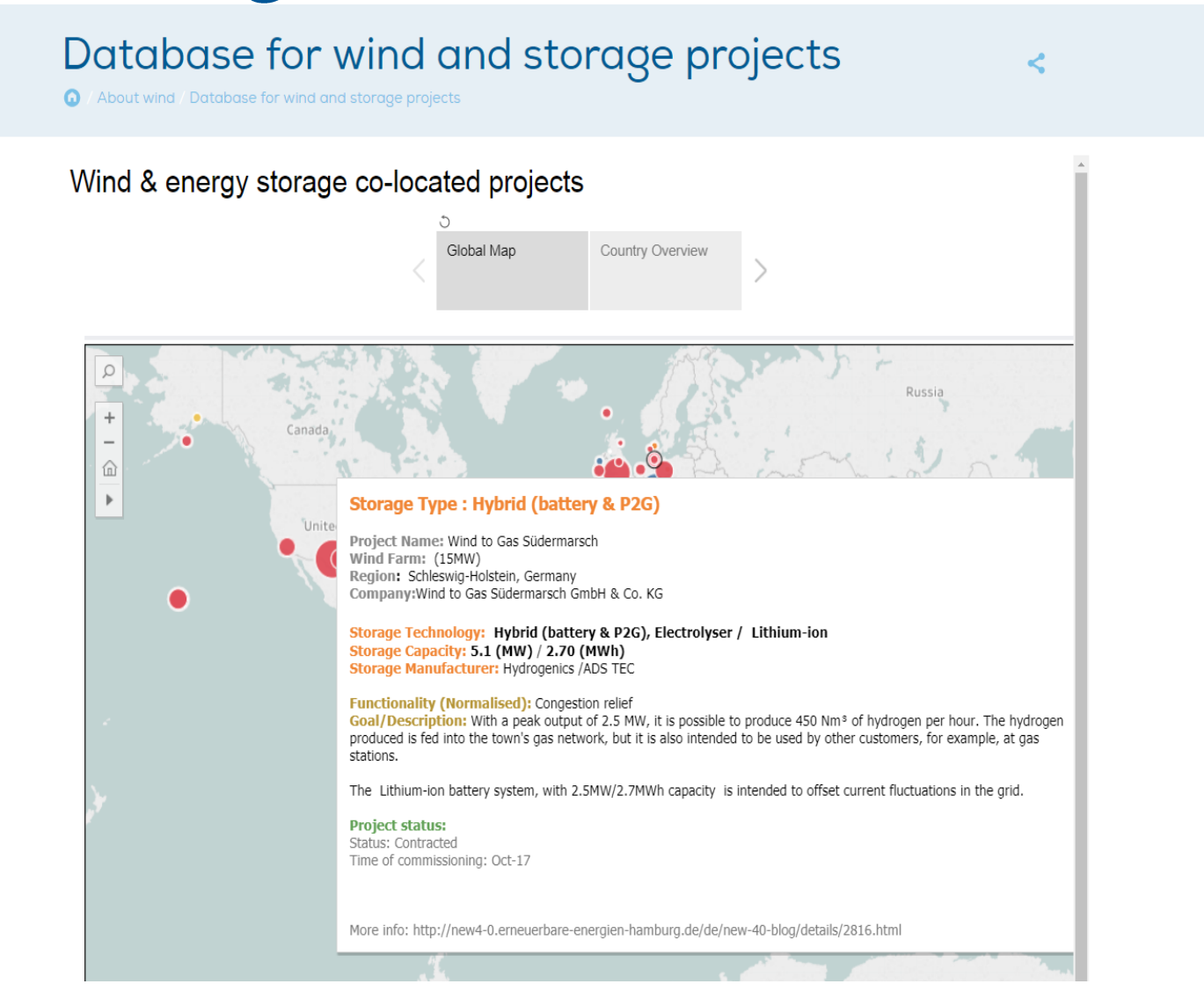
WindEurope online platform for *wind+storage* co-located projects



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167 GW Storage capacity globally (operational)

388 MW Co-located Wind + Storage capacity globally (operational & planned)

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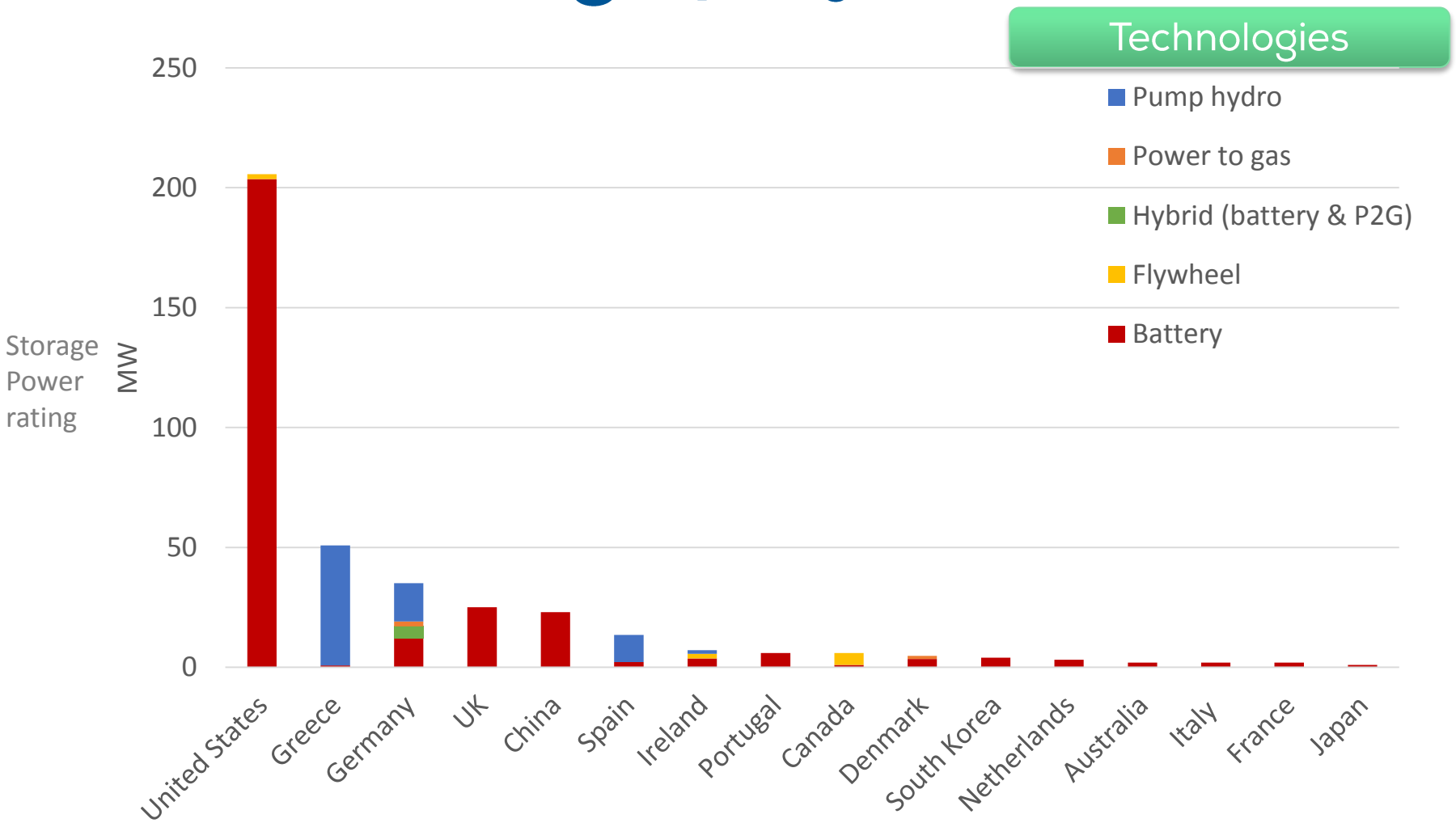
Source: Total figure: DOE Energy storage database, co-located: WindEurope

Wind+Storage projects overview



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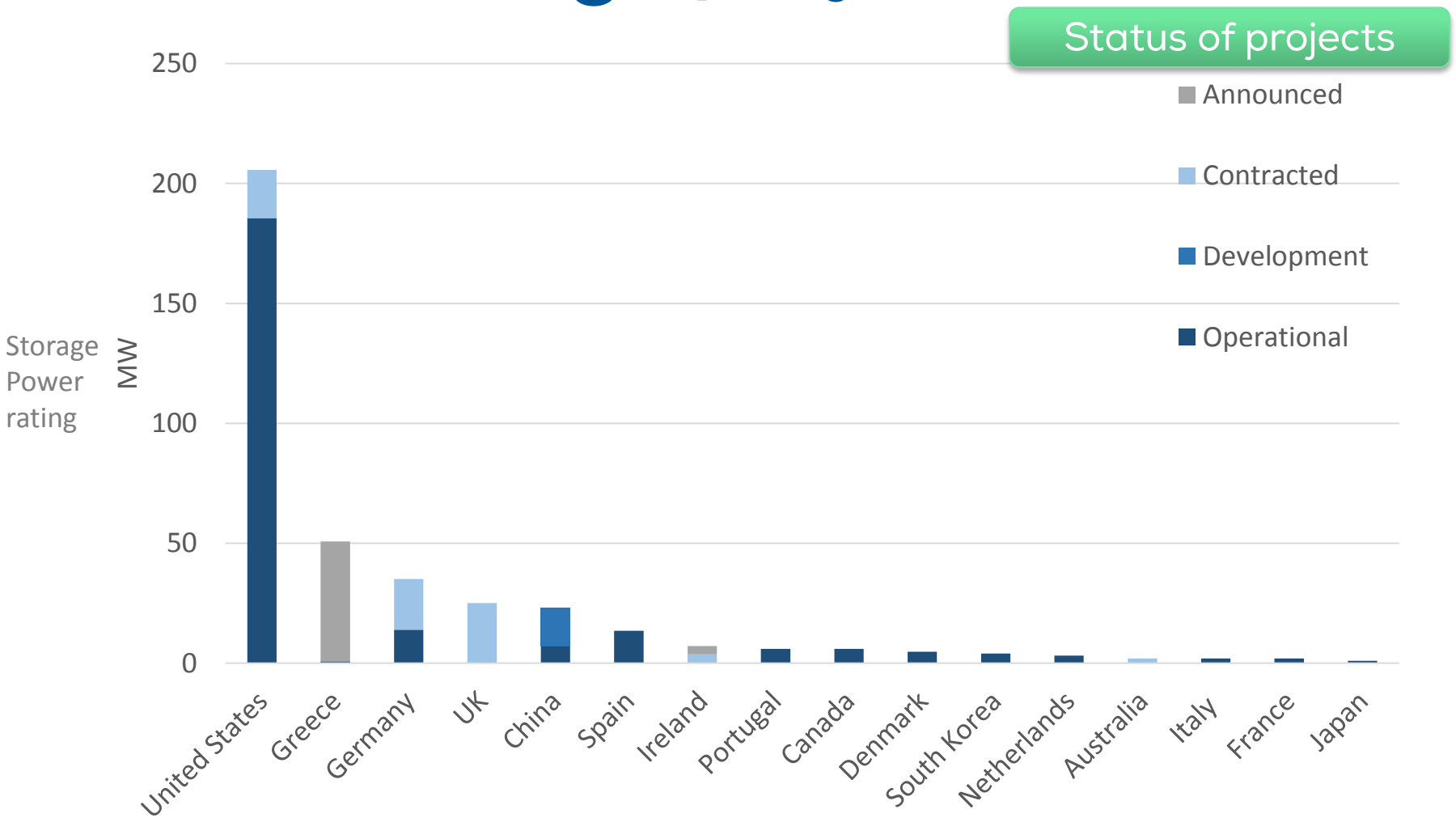
Source: WindEurope, updated 17 November 2017

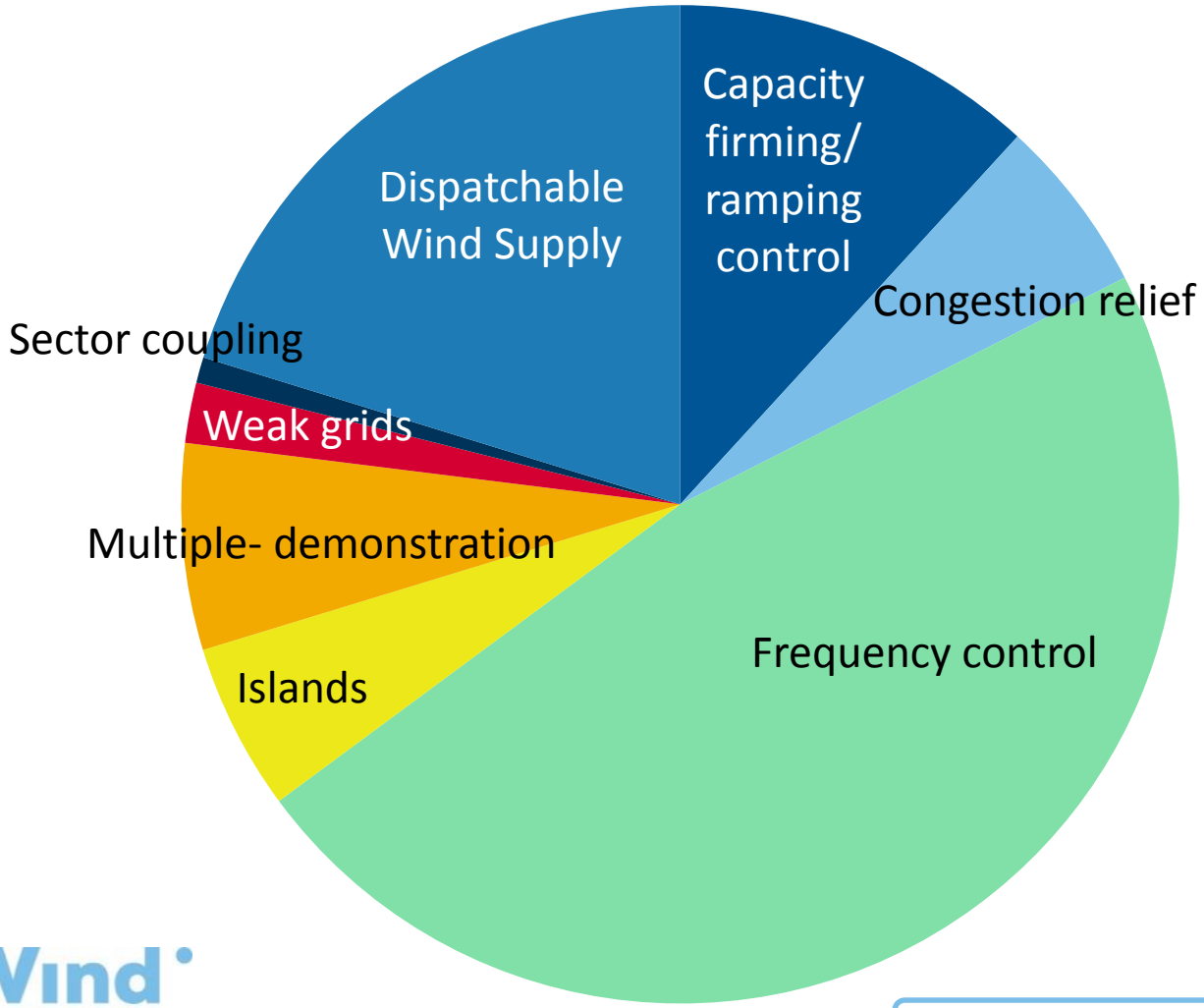
Wind+Storage projects overview



Source: WindEurope, updated 17 November 2017

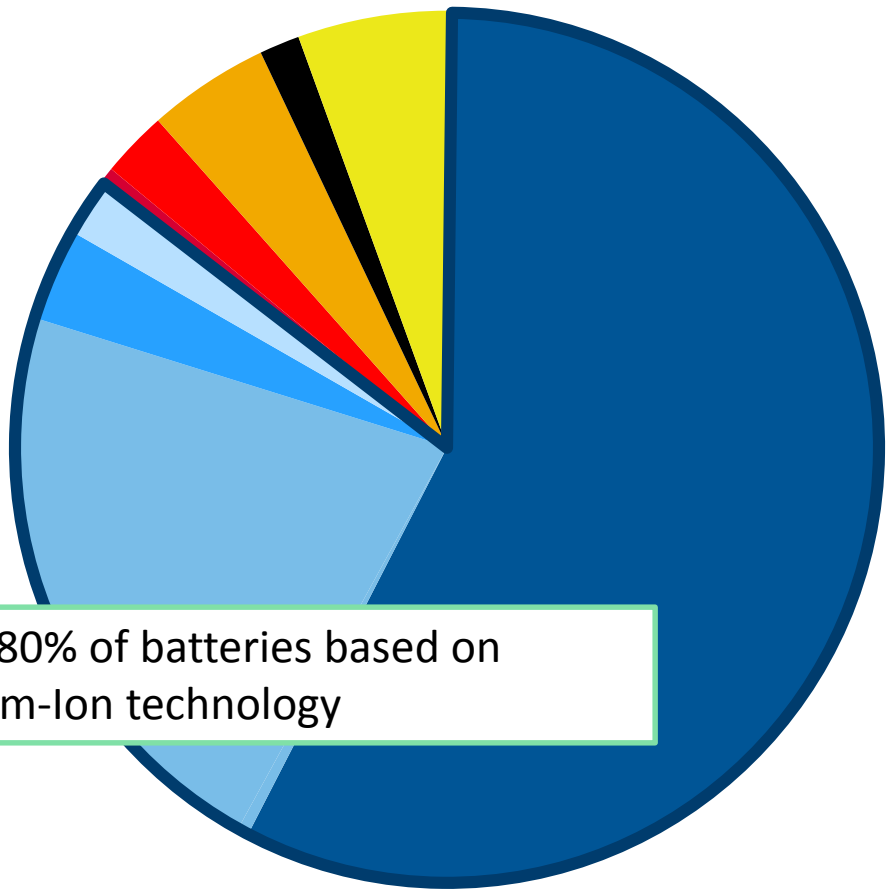
Wind+Storage projects overview

Main Functionality



Source: WindEurope, updated 19 October 2017

Wind+Storage projects overview



Over 80% of batteries based on Lithium-Ion technology

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Source: WindEurope, updated 19 October 2017

Assessment of storage services in co-located plants vs stand-alone storage

Category of service	Services of electricity storage	Potential Value of Co-location	Type of Market
Energy Time Shift	Energy arbitrage	Low	DA, ID
	Self-consumption	Low	DA, ID
Ancillary services	**Frequency reserves**	High	FCR, aFRR, Fast frequency response, synthetic inertia
	Voltage control	High	Reactive power
	Black-start	Medium	Ancillary services
Grid adequacy	**Network Upgrade deferral**	Medium	TSO/DSO investment
	Congestion management	Low	Redispatching mechanism
	Curtailment Reduction/ congestion	High	Balancing/redispatch
	Ramping control/ smoothing	High	New product?
	Capacity firming/ Imbalance reduction	High	Balancing, Frequency reserves
System adequacy	**Generation adequacy**	Medium	Capacity market
	Seasonal storage	Low	DA, ID, Capacity market

Hybrid wind-battery projects (examples)

Frequency control

Feldheim project

ENERCON, Germany

Wind farm size (MW)	Battery size (power-MW)	Battery size (energy-MWh)
81	10	

Frequency control

Barasoain experimental project

Acciona energia, Spain

Wind farm size (MW)	Number Turbines	Battery size (power-MW)	Battery size (energy-MWh)
15	5	1	0.39

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Hybrid wind-battery projects (examples)

La Muela

Gamesa, Spain

Wind farm size (MW)	Number Turbines	Battery size (power-MW)	Battery size (energy- MWh)
1.2			0.5

Gigha community wind project

Redt, UK

Wind farm size (MW)	Number Turbines	Battery size (power-MW)	Battery size (energy-MWh)
1	4		1.68

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Islands

Open-loop Pumped Hydro Storage

El Hierro Hydro-Wind Plant

Endesa, REE, El Hierro, Spain

Wind Farm(MW)	Storage power rating (MW)	Storage capacity (MWh)	Main function
11.5	6 (pump) 11(generation)		Capacity firming/ energy shifting

Description: Operations started in 2015, aiming to provide 100% wind power to the inhabitants of the island. So far, the system still relies on diesel generators either for stability issues or to endure for very long period (10+ days) of no wind resources. Ongoing analysis is providing further evidence of the potential as well as of the challenges of 100% RES systems.

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Weak grids/ Islands

Battery: Lithium-Ion

Husahagi wind farm

ENERCON, Faroe Island

Wind farm (MW)	Storage power rating (MW)	Storage capacity (MWh)	Main function
12	2.3	0.7	Capacity firming/ Ramping control

Description: The goal of the system, which entered into operation by the end of 2015, is to enhance grid stability by smoothing ramp rates and providing ancillary grid services such as frequency control.

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Weak grids

Flywheel Energy Storage System

Kodiak Powerstore

ABB, Alaska, United States

Wind farm (MW)	Storage power rating (MW)	Storage capacity (MWh)	Main function
9	2		Frequency control + Voltage control

Description: The ABB PowerStore units will provide voltage and frequency support for a new crane to be installed at Kodiak Island's port facility. They can also extend the life of the battery systems by up to 6 years, and provide renewables integration by helping to manage the intermittencies from a 9 MW wind farm on the island

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Policy recommendations

1. Stand-alone energy storage systems should be treated as any other technology that offer services to the electricity system
2. Members States should remove the double charging (network charges) from energy storage. Phase out of G-charges.
3. Governments should adopt the definition for energy storage assets proposed by the EC under the recast electricity directive
4. TSOs should allow energy storage operators to provide multiple services to the grid (service staking).
5. Finally, new capabilities required in Network Codes should be market-based and not mandatory.

6. Wind energy asset owners should not need to reapply for support schemes when adding energy storage to an existing wind farm

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Thanks for your attention

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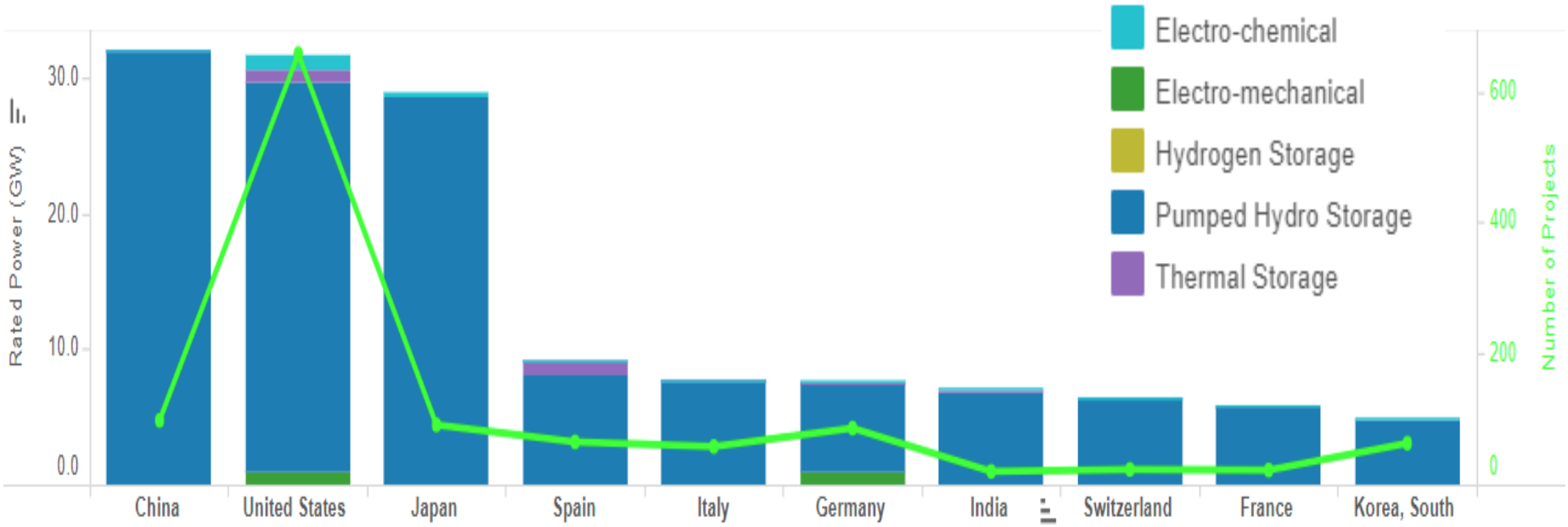
Global Electricy storage capacity

Top 10 countries



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Source: DOE Energy Storage database, updated June 2016