

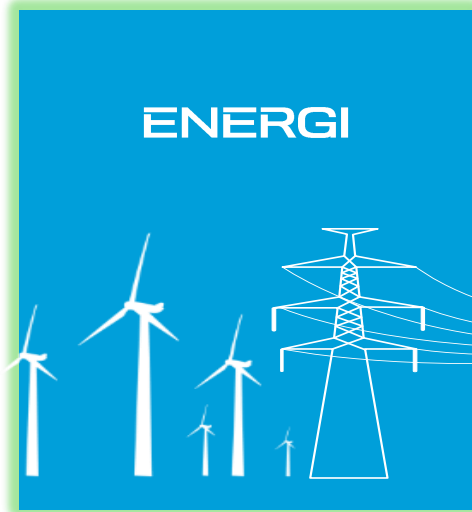


Barriers for integration of energy storage in the current regulatory and market framework

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18 April 2017

DNV GL Energy Advisory Nordics & Baltics



2200 employees world wide,
100 Nordics & Baltics



Market analysis & design
Integration of renewables,
storage and balancing market
Economic analysis and concept
evaluation studies
Regulatory economics and
policy impacts
Innovation and strategies
Due Diligence

The eStorage project

Our goal is to **deploy variable speed PSPs across the EU** and to **enhance grid management systems to improve renewable energy management.**

Project scope

- Upgrade existing unit to variable speed (EDF, GE)
- Develop smart dispatch and balancing market clearing (GE)
- Asses the value of variable speed PSP (DNV GL, ICL)
 - Market modelling
 - Business case modelling
 - **Regulatory and market review (ICL)**
- Identify potential for upgrade and new PSP (DNV GL, GE)
 - PSP fleet database
 - GIS model of suitable potential locations

4-year project
13.3M€ budget
FP7 funded



Imperial College
London



Regulatory and market review: Obstacles for the integration of storage in regulatory and market framework

Elements reviewed



- PSP definition



- Transmission fees



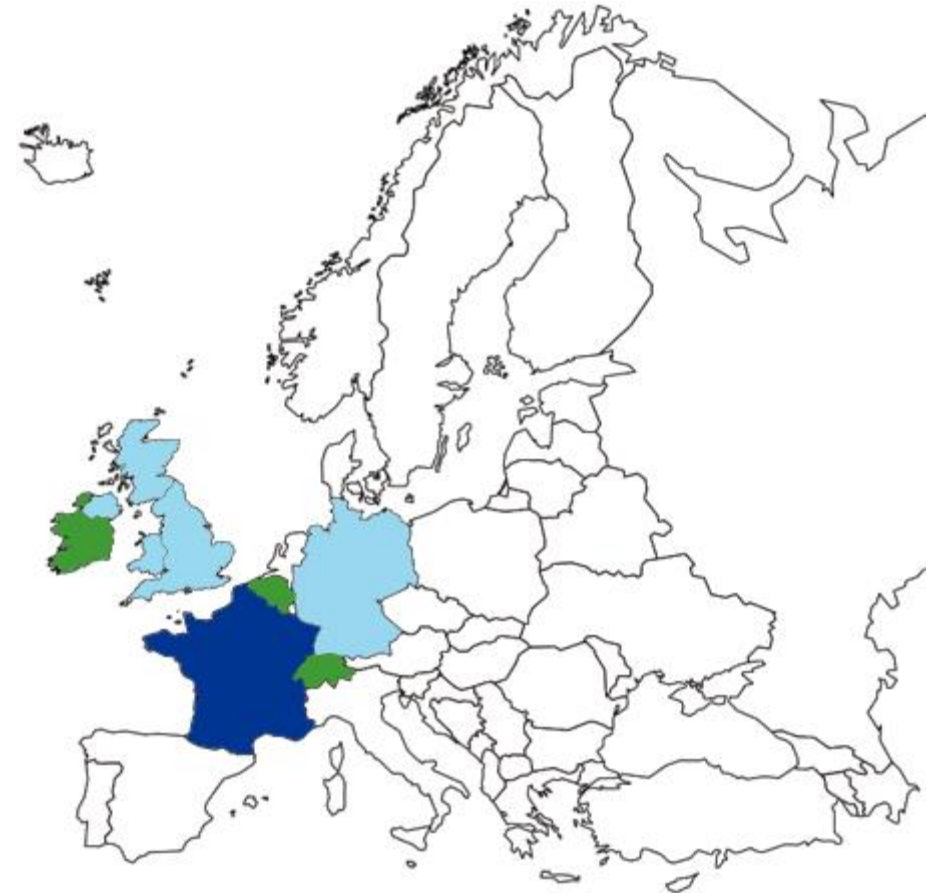
- Balance responsibility and pricing



- AS market products



- Capacity markets



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Regulatory treatment – status of PSP asset class

Generation, consumption, both, none?

- Unclarity in regulation
- Double grid fees
- Allowed ownership

Summary of results

- Most treat as generators
- Regulatory status often unclear
 - both defined as generator and consumer
 - or as none of them
- Access to markets no problem, practical consequences limited?

Per country results



BE: ownership under discussion, Elia wants to own PSP for regulating flows in the grid and balancing.

GE: PSP is a consumer, ongoing discussion on changing this.



Regulatory treatment – transmission fees

Fees remunerate value of PSP?

- Payment of double transmission fees
- Spatial and/or time variation of transmission fees
- If classified as consumer: grid use?

Summary of results

- No locational or time variation – missed opportunity to realize grid relief value?

Per country results



IR, BE: tariffs both for offtake and injection.

FR: consumption based.



Balancing responsibility and imbalance pricing

Balancing responsibility and pricing scheme

- Balancing responsibility per plant or per portfolio
- Single or dual imbalance pricing scheme
- Pricing on marginal or weighted average prices

Summary of results

- In general, move to single pricing schemes

Per country results

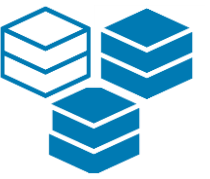


GB, IR: balancing per unit

FR, CH: dual price

GE, FR: weighted avg prices

GB: other design changes leading to price spikes when the system is short



AS and balancing products

Criteria

- Product definition
- Transparency of procurement
- Reflection of future system needs

Summary of results

- In most countries, no future-proofing of balancing products implemented yet.
- Move towards shorter term balancing procurement contracts.

Per country results



- UK: 22 balancing services, including rapid frequency product. Discussion on inertia as a product. Future proof.
- FR: procurement from utilities based on pro rate share of generation capacity, with option for bilateral contracts.



Criteria

- PSP eligible for participation
- If so, full swing capacity or generation capacity
- Product definition friendly for PSP

Summary of results

- Mechanisms under development, open discussions

Per country results









- UK: capacity payment with indefinite obligation to deliver.
- GE, BE: only interesting for decommissioning units.
- FR: bilateral capacity market design

Summary so far

- Large local differences
- Several barriers:
 - Regulatory definition unclear
 - Double transmission charges, no locational or time component in transmission charges (“energy storage is not consumption”)
 - Balancing market design impacts PSP
 - Balancing market products diverse
 - Capacity market discussions ongoing
- Harmonization would be beneficial!
- Larger problem maybe is low daily price spread, volume and price uncertainty on AS markets, and competition of alternative sources of flexibility?



	Yellow	Yellow	Green	Green	Yellow
	Yellow	Red	Yellow	Green	Yellow
	Yellow	Yellow	Red	Yellow	Red
	Yellow	Yellow	Red	Yellow	Yellow
	Red	Red	Red	Red	Green
	Red	Red	Yellow	Yellow	Red

Regulatory developments move in the right direction

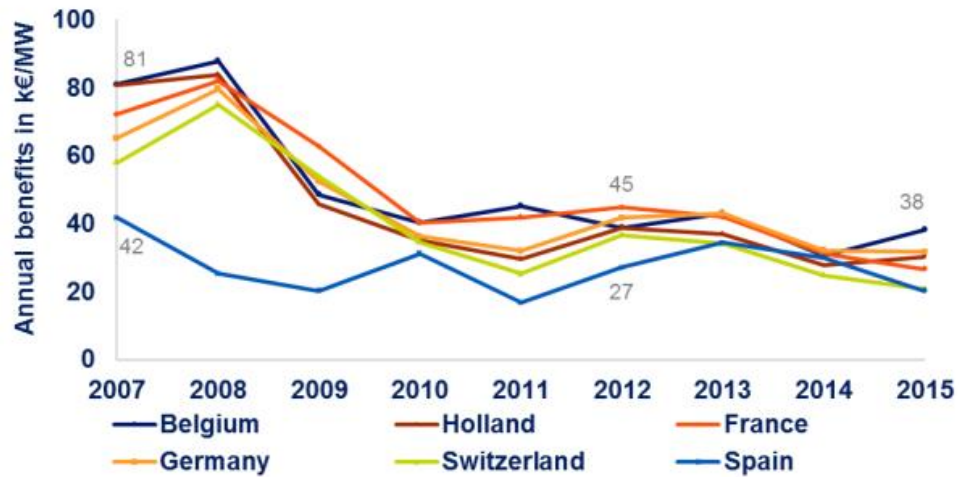
- Winter package (EU) proposal for recast of common rules for the internal market in electricity:
 - **Defined storage:** 'energy storage' means, in the electricity system, deferring an amount of the electricity that was generated to the moment of use, either as final energy or converted into another energy carrier (Art 2.47).
 - **Clarified ownership:** TSOs shall not own, develop, manage or operate storage facilities, unless other parties are not interested, and it is needed for efficient reliable and secure operation of the transmission system, and not used to sell electricity to the market (art. 54).
- Ongoing harmonization work around network codes



<http://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition>

Price developments move in the opposite direction

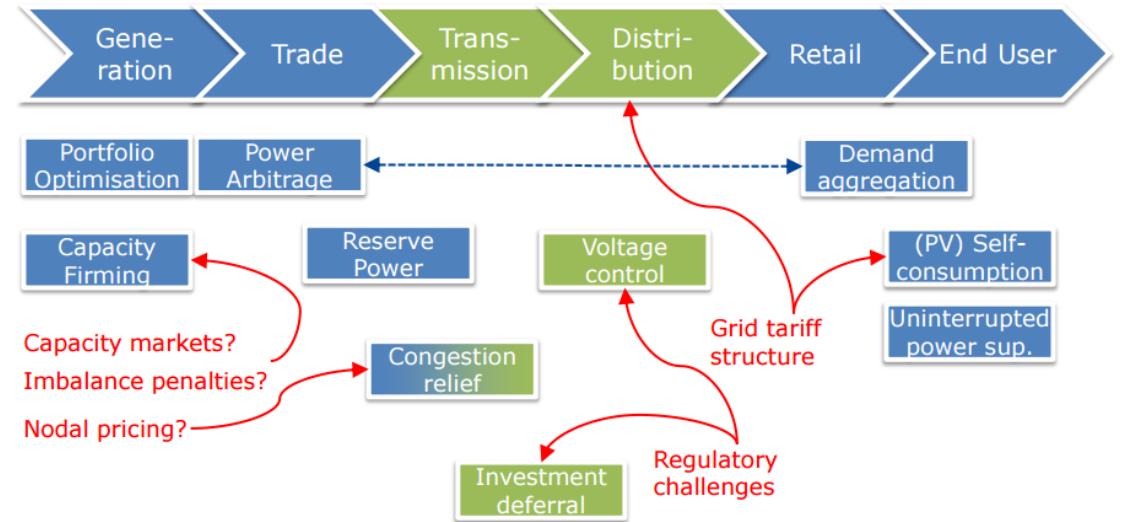
Yearly benefits on DA markets of 6h storage



Need for revenue stacking to make PSP work

The value of storage can depend on the regulatory environment

Electricity value chain



EDF within e-Storage project

Andreas Zucker, EC DG JRC – presentation on Estorage workshop 2016

Uncertainty regarding need, competitiveness and value of PSP

Recent system studies cast doubts on need for large scale storage in mid term

Study	Time horizon	Key findings
Agora Energiewende	Germany 2030-50	<ul style="list-style-type: none">• Other flexibility options less expensive if RES-E capacity between 40%-60% (2030 horizon)• Storage can add system value for 90% RES-E system (2050 horizon)
Etude PEPS	France 2030	<ul style="list-style-type: none">• No significant increase of storage need by 2030 (+1 – 1.5 GW) if PV below 30 GW• Largest value driver is "capacity value" i.e. avoided investments in gas turbines
ADEME 100% RES-E	France 2050	<ul style="list-style-type: none">• 36 GW needed for a 100% RES- system, thereof 17 GW of seasonal storage (e.g. power 2 gas)• Only 15 GW needed for 80% RES-E system, thereof no seasonal storage

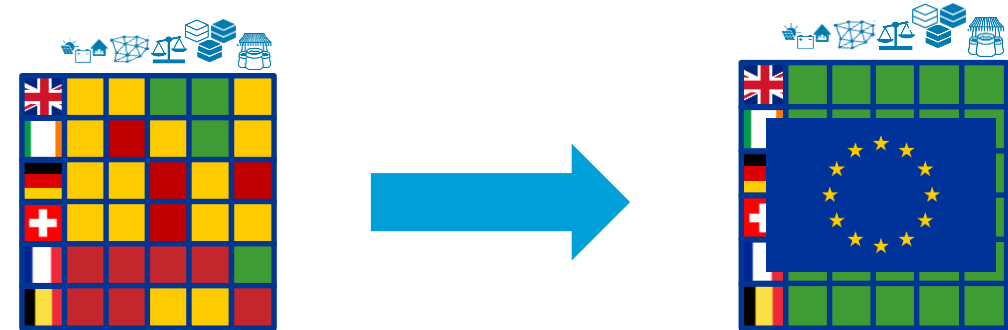
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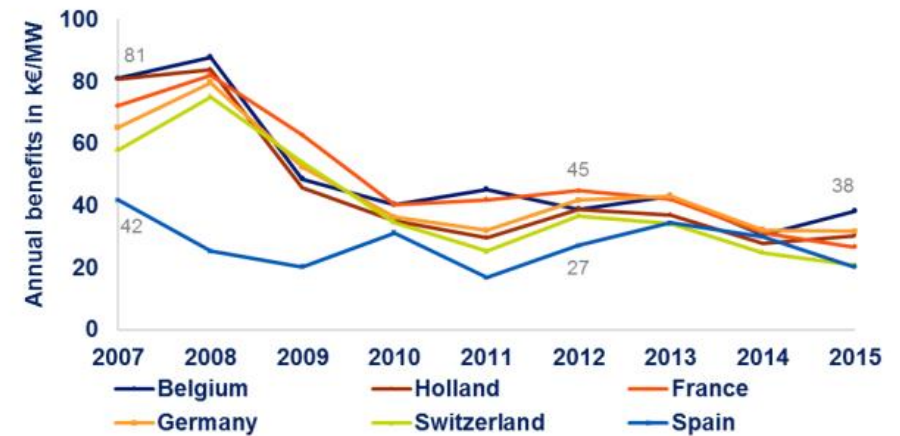
Andreas Zucker, EC DG JRC – presentation on Estorage workshop 2016

Conclusions

- Regulatory barriers decrease under winter package and network code harmonization



- Larger problem is profitability due to:
 - Low daily/spot market price spread
 - Volume and price uncertainty on AS markets
 - Competition of alternative sources of flexibility



Other work within the project performed by DNV GL

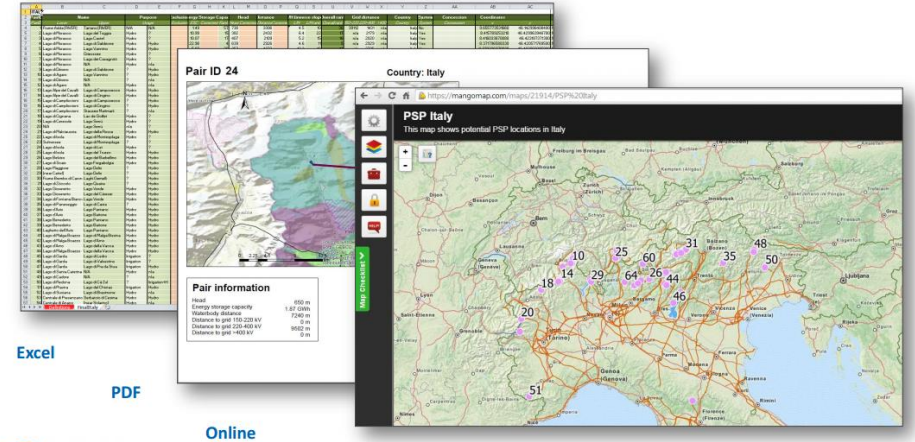
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 - **GIS model of suitable potential locations (DNV GL)**

T4.1.2 Inventory of suitable locations



Main achievements: presentation formats for ESP



Excel

PDF

Online

Results VS PSP conversion

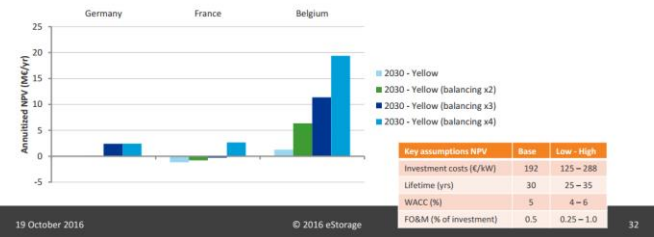


Value of storage for participation in competitive electricity markets

VS PSP conversion

Comparing the VS PSP annuitized NPV to the regular fixed-speed PSP NPV, we determined the impact of the PSP to VS PSP conversion on the annuitized NPV (i.e. difference in PSP and VS PSP annuitized NPV)

Current balancing markets: no significant opportunities. Impact of increasing balancing market price spread differs per country, due to different balancing market characteristics.



Takk for meg!

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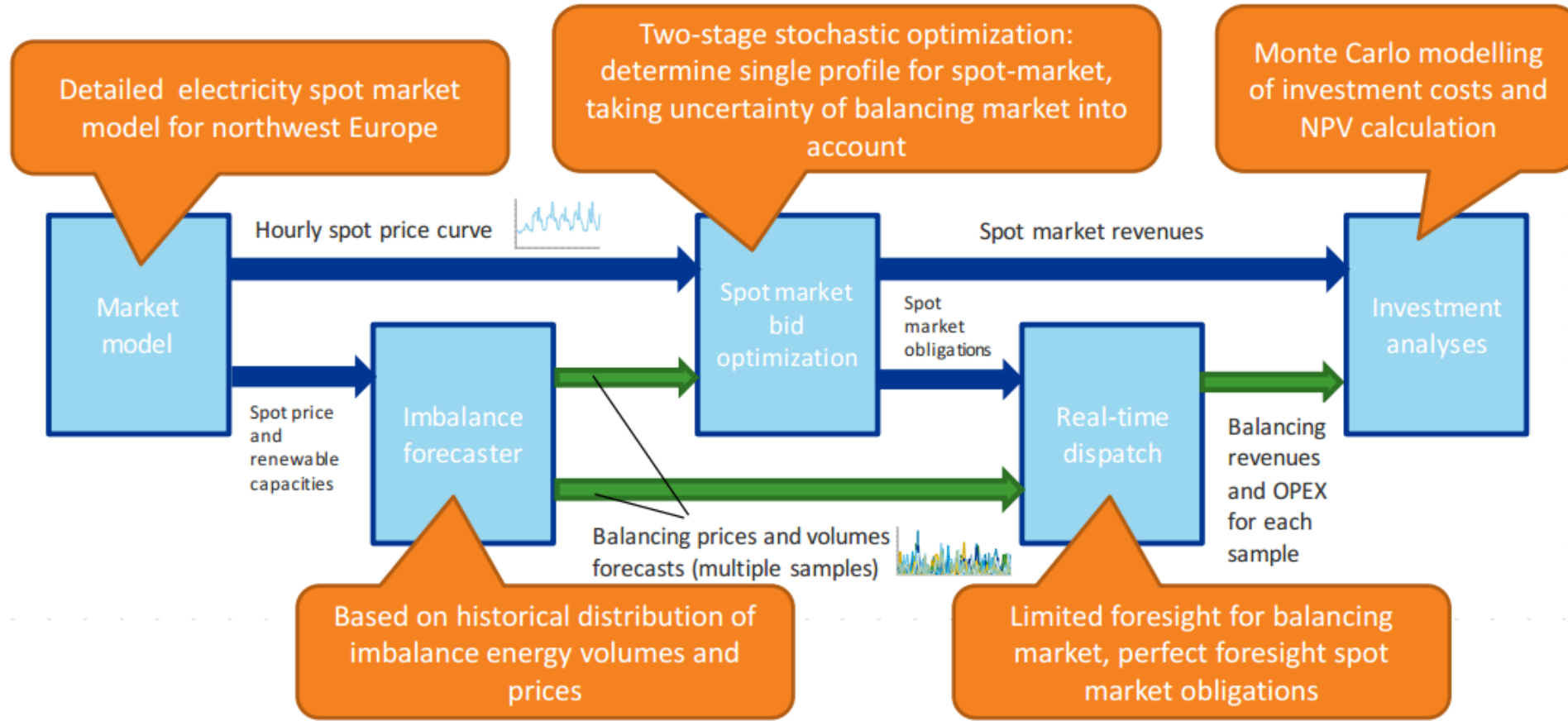
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SAFER, SMARTER, GREENER

Value of storage on spot and balancing market

Value of storage for participation in competitive electricity markets

Structure of approach and individual modules



Value of storage on spot and balancing market

Results VS PSP conversion

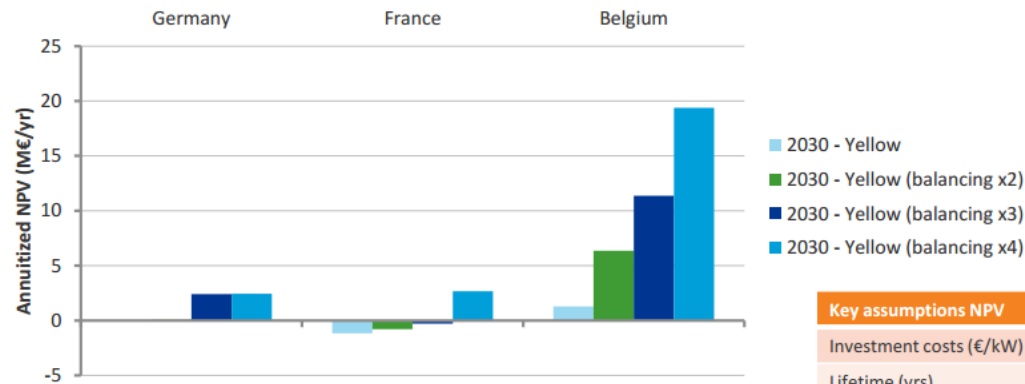


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Key assumptions NPV	Base	Low - High
Investment costs (€/kW)	192	125 – 288
Lifetime (yrs)	30	25 – 35
WACC (%)	5	4 – 6
FO&M (% of investment)	0.5	0.25 – 1.0

19 October 2016

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Conclusion



Value of storage for participation in competitive electricity markets

New build

- The operational profits of a new-build VS-PSP are in the range of 13 to 18 M€/year in base case.
- In base case scenarios there is no profitable business case.
- The balancing price distributions strongly impact the operational profit distribution (e.g. balancing price spread of x4 improves the annuitized profits of more than 50M€)

Conversion

- VS PSP has higher operational profits due to increasing flexibility in pumping mode.
- In base case scenarios there is already a profitable business case.
- Higher balancing prices (to x4) lead to annuitized profits of more than 20M€ (at 49M€ conversion cost).

Country specifics

- The most attractive business case for conversion is to be found in Belgium.
- France and Belgium show comparable business cases for new build.
- German shows large width in operational profit distribution due to large spread in balancing prices.

Open issues

- Future balancing prices key in flexibility revenues but are also very uncertain
- Additional revenues from stacking services (FCR, intraday and congestion management,...), ownership model and portfolio benefits