Joint Research Centre (JRC)

International Strategies on Energy Storage

An outlook of European Union's strategy

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Agenda

1. EU activities on storage development

- SET-Plan framework
- SETIS activities
- Challenges for EU policy design

2. Challenges for market evaluation of storage

- The design of business models
- System drivers: a case by case storyline
- Market drivers: some perspectives

3. Ending remarks

1. EU activities on storage development

1. EU framework for storage development

EU Challenges:

- Energy security & geopolitics
- Progress in reducing climate change
- Economic recovery
- Investing for transforming the energy system

EU Proposal:

- **Europe 2020 Strategy**

EU Actions:

- Deliver 20-20-20 targets
- Complete the Internal Energy Market
- Implement **EU's Technology Policy = SET-Plan**
  - Strategic Energy Technology Plan – Low Carbon energy technology assessment

  - In the framework of the **SET-Plan**,
    Energy Storage has been identified as a critical technology for the transition to Low Carbon European energy system.

SETIS PROVIDING INFORMATION FOR DECISION-MAKING

European Community Steering Group (SET-Group)

Objectives

- Steer implementation of EU ETP
- Reinforce coherence between national, European and international efforts
- Identify resources available
- Foster European joint actions
- Optimize energy RDD&D efforts

Funds

MS, Private/Public Sector, EII, EERA, International Cooperation, EU (R&D phase).

Implementation

- Information System SETIS
- European Industrial Initiatives
- European Energy Research Alliance
- Trans-European Energy Networks
- International Cooperation

- Technology Map (…+ **storage**)
- EII **storage**-related: CSP, SG, SC, FC-H2
- EERA Smart Grids. 4.1 **Storage**

Place on the political agenda ~ recommendations to investigate energy storage:

Council Conclusions (February, 2008)

"Further Industrial Initiatives may be necessary, and therefore the Council encourages the Commission to continue to examine areas with great potential such as marine energy, ***energy storage*** *and energy efficiency for this purpose…"*

EP Conclusion (June, 2008)

"Asks the Commission to investigate the possibility of extending EIIs to other sectors…… ***better energy storage...."***

RES Directive (2009)

"the RES Directive stipulates that MStates should develop transmission and distribution grid infrastructure, intelligent networks, ***storage facilities*** *and the electricity system generally, so as to accommodate the development of electricity production from RES energy sources, which includes interconnection between MS and between MS and third countries."*

Consensus:

storage will **complement** and not substitute DSM, grid extension, RES forecasting techniques. The later measures are prioritized by the Stakeholders.

SETIS PROVIDING INFORMATION FOR DECISION-MAKING

SETIS activities on electricity storage (1/2)

SET-Plan – examines the storage support to:

- intermittent renewable energy development
- electricity grid capability to integrate variable RES
- electrified road transport development
- green building implementation.

Expert Consultation:

- Setting-up Workshop on electricity storage (2008)
- Setting-up European task–force on electricity storage (2009)
- Supporting European workshop on storage (2009)
- Involvement in EERA "Smart Grids/ Task Storage Technologies" (2010)
- Supporting European Association for Storage of Energy, EASE (2010)

SETIS activities on electricity storage (2/2)

Technology Assessment:

- Studies on the economics and deployment of storage in Europe

- Study on scenarios of electricity storage up to 2030 in Europe
- Valuation framework for large scale electricity storage in a case with wind curtailment
- Market evaluation of hybrid wind-storage power systems ~ balancing responsibilities

- Technology Map - 2 chapters in the Technology Map 2009:
  – Electricity storage in the power sector
  – Electrification of road transport

Key messages:

- Storage will play a key role in supporting intermittent RES.
- The magnitude and timing of storage investment and contribution are system specific, difficult and multi-faceted.

2. Challenges for market evaluation of storage

Different Storage applications, Different Business models

- **Why** storage

  Identify specific cases, as storage is not a power generator.
  Examples Program: Max real-time consumption, Max wind power use, ...

- **Where** to store

  Depends on physical / system constraints. Near load or generation?
  Program: Min transmission loss.

- **When** to store

  Timing (on-off peak; congestion; curtailment). Time: Seconds/ minutes/ days/ seasons
  Program: Max Income Permutation (€/MW, €/MWh, €/life-cycles, €/round trip Eff).

- **How** much to store

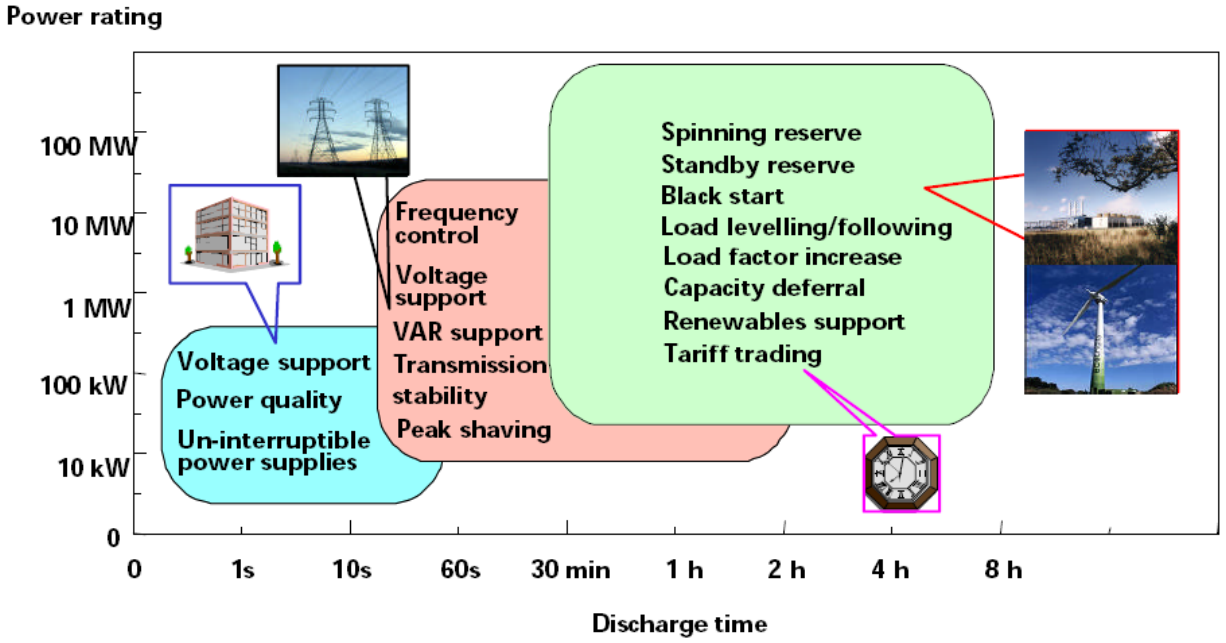
  Sizing of storage to the real needs.
  Program: Max Income, u.c. (System+Storage) needs

- **What** technology to choose

  Function of why, where, when, how long...

General overview of RES support with storage

Power rating and discharge time of storage applications for different network services



Source: ESA 2000, Energy storage: a solution in network operation

Key message:

to answer with a technology to as many problems as possible, in order to **cumulate potential benefits**. In practice is difficult, as different markets and payment schemes exist for different problems.

Storage drivers/ barriers

The factors that **improve** the opportunities for storage:

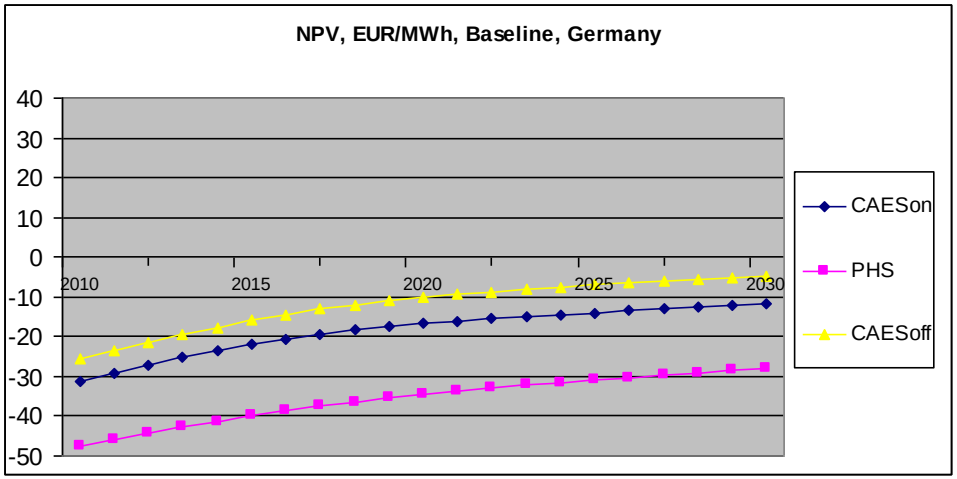
- **Geological potential:** near load *vs* generation sited
- **Energy mix:**
  - High price spread, frequent price fluctuations.
  - Must-run technologies, in particular nuclear and CHP.
  - Non-dispatchable RES increase market volatility ~ uncertainties in supply, price fluctuations
- **Regulation: hybrid systems design (Ex: FR DOM-TOM, PV)**

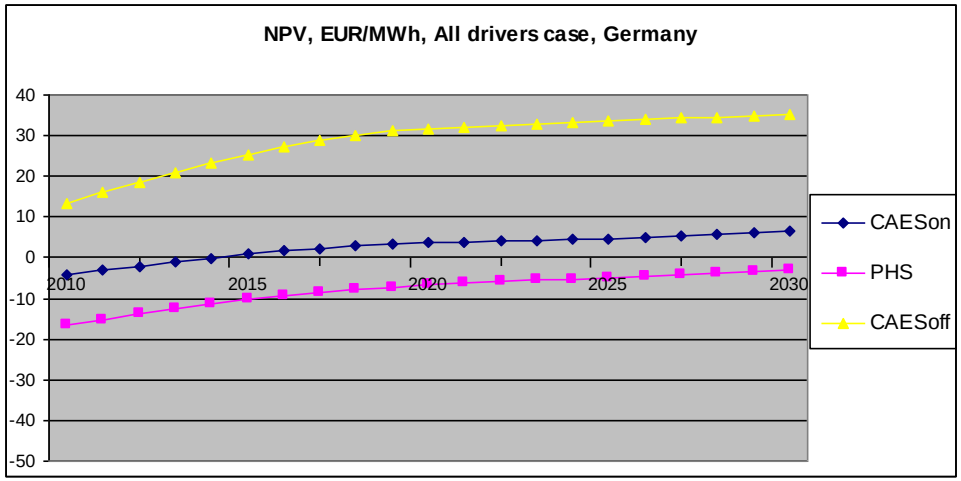
The factors that **reduce** the opportunities for storage are:

- **Geological potential:**
  - Reduced PHS additional sites in Europe. Still, underground/ subsurface reservoirs, near cost sea water,...
- **Energy mix:**
  - Availability of import/export capacities from other grids.
- **Regulation: withdrawal authorization (Ex: Livorno, IT)**
  subsidies, conflicts of interests (Ex: Graciosa, GR).

An example of Market Evaluation of storage at local level

Simulations show that storage can provide benefits to the power system through wholesale price arbitrage, the provision of reserves and avoided wind curtailment and grid bottleneck.





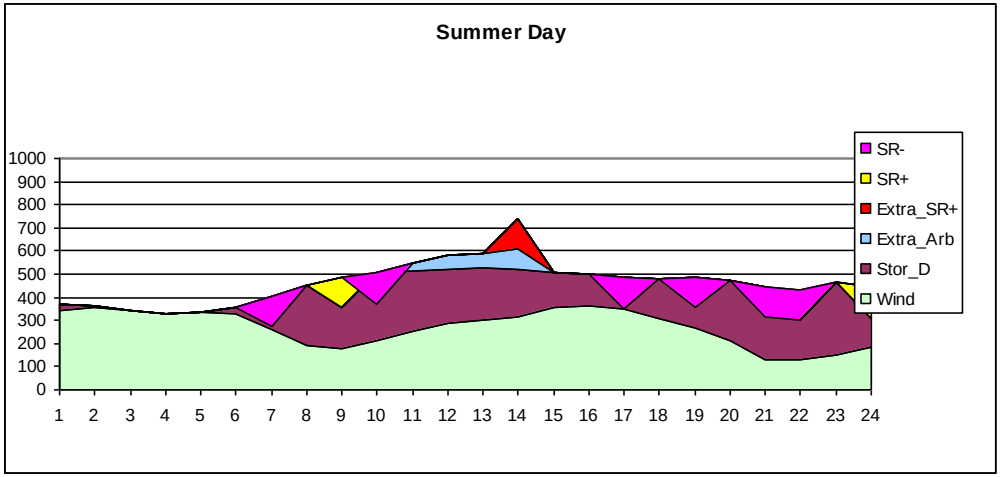
Reference case:

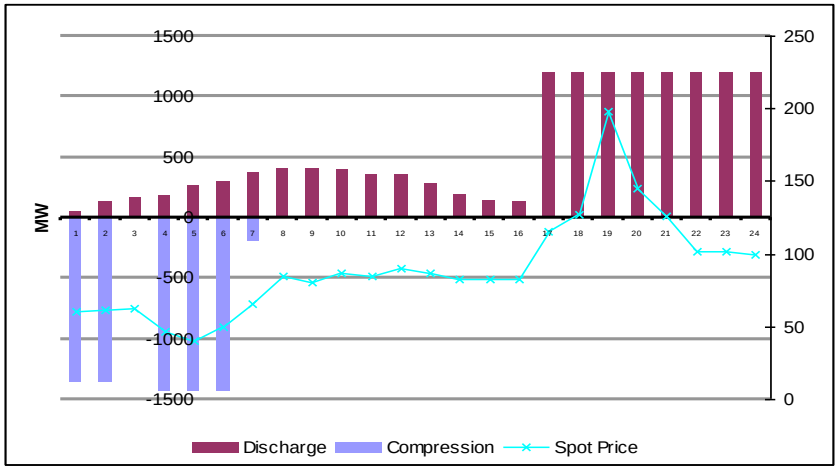
Unless storage is sufficiently rewarded, it is unlikely to be economically viable.

Sensitivity test to market drivers:

Market rules and regulations need to be adapted to allow storage operators to capture the full benefits of storage.

Valuation framework for large scale electricity storage in a case with wind curtailment,
Rodica Loisel, Arnaud Mercier, Christoph Gatzen, Nick Elms, Hrvoje Petric,
Energy Policy 38(11): 7323-7337, 2010, doi:10.1016/j.enpol.2010.08.007.





Wind and storage are considered in a hybrid system: **cost-benefits sharing**. The storage facility supports the balancing needs of the system and makes additional profits on the other segments of the market, like price arbitrage and ancillary services provision.

The storage facility is optimally charged with wind-based electricity and grid-supplied power. The storage is here **discharged continuously**, even during base-load periods due to insufficient wind power. A higher rate of discharge power during peak times is due to higher spot prices.

Market evaluation of hybrid wind-storage power systems in case of balancing responsibilities,
Rodica Loisel, Arnaud Mercier, Christoph Gatzen, Nick Elms. *Submitted to RSER 2010.*

Market drivers. Debate on perspectives

Issue: Short-run marginal cost pricing (SRMC)

SRMC pricing - high competition with flexibility provided by conventional generators, grid extension, wind curtailment.
Does not fully internalize the value of security of supply and energy independency.

Real-time pricing + intraday markets would be beneficial to storage, but is a complex issue (ec-soc-pol concerns).

Perspectives: Market - Liberalization and restructuring towards a green power system

Prices – uncertainties / forecast error + variability / fluctuations = beneficial to storage

Uncertainties: infrastructure; price spread; technical costs integration; innovative solutions development.

Issue: Ancillary services markets development

Current design - Often lack of transparency of AS markets and regulated tariffs.

Redesign of flexibility. Drivers: market liberalization; large-scale RES.

- Towards a **market** of flexibility?
- Intermittency balancing **responsibility**?

Issue: Feed-in tariffs / Infrastructural planning support

Storage = support to RES for **avoided wind curtailment**.

- **Possible Sharing of FIT? Hybrid wind-storage systems?**

Storage = support / substitute to grid upgrades/ **avoided grid congestion**.

- **Possible consideration in transmission planning and financing?**

Public policy role in supporting storage RDD&D

Why

Storage requires - long term (R phase) and high risk investment (demo stage).
Objective: estimate the optimal level of innovation from the perspective of society;
provide support if **market failure** leads to lack of R&D.

Where

How

➢ Supply side

Providing additional expenditure in R&D and stimulating innovation.
R&D funds, research grants, public-private partnerships, cost-sharing schemes, loan guarantees, capital grants, support for achieving policy goals.

➢ Demand side

Sending market signals to researchers and investors.
Tools: Feed-in tariffs, ancillary services markets designs, procurement obligations.

➢ Supra-national level

Coordinating R&D across Europe: Joint Actions (SET-Plan)

- the challenge is not only national, it concerns the stability of the European transmission system, the technology mix and the European energy dependency.
  - Storage markets are likely to be global. Research into power storage in one country may create benefits in another country (lower costs, better performance).

Conclusion

- Storage – identified as critical technology
- Storage is a key thematic for SETIS
- EU is active in the field of storage
- Storage faces challenges but also development opportunities
  - Need to fill the gap between strategic planning and technical / economic potential
  - Need to identify the services that can be provided by storage at individual level, and their fair remuneration.

More information at

http://setis.ec.europa.eu/

http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm

Thank you!

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