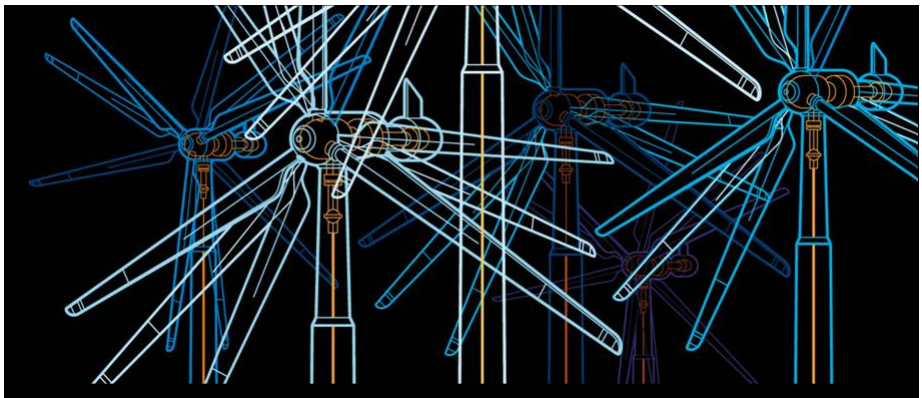

Stephen Clifford; Smart Grids

Influence of smart technology on storage strategies

Power and productivity for a better world™ ABB

What is a smart grid?

A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

Source: European Technology Platform Smart Grids

A Smart Grid is self-healing, enables active participation of consumers, operate resiliently against attack and natural disasters, accommodate all generation and storage options, enable introduction of new products, services and markets, optimize asset utilization and operate efficiently, provide power quality for the digital economy.

Source: US Department of Energy

The future electrical system (or “smart grid”) must offer:

Capacity	Upgrade/install capacity economically Provide new infrastructure for PHEV
Reliability	Stabilize the system and avoid outages Provide high quality power at any time
Efficiency	Improve efficiency of power generation Reduce losses in transport and consumption
Sustainability	Connect renewable energy to the grid Manage intermittent generation

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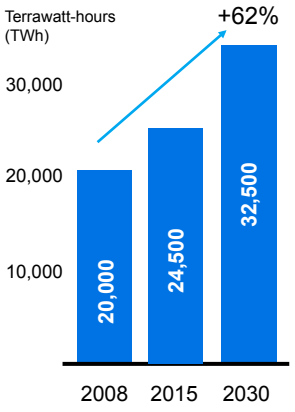
Driving forces towards a smart grid?
Increasing demand for electricity

Forecast rise in global electricity generation by 2030
Source: IEA, World Energy Outlook 2010



Smart technologies are those:

- Meeting rising demand for electricity
- Increasing energy efficiency and reducing CO_2 emissions
- Improving productivity to raise competitiveness of businesses and utilities

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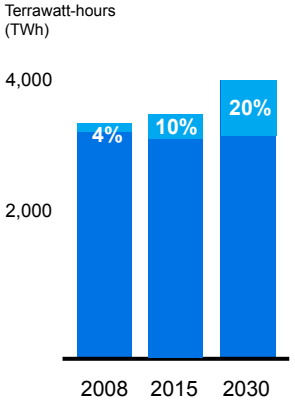
Driving forces towards a smart grid?
Society's desire for renewable energy

Forecast change in electricity generation type by 2030 in the EU
Source: IEA, World Energy Outlook 2010



- EU target: 20% of energy from renewables by 2020
- Potential for Europe is shown in the EU's Strategic Energy Technology plan ("SET Plan")

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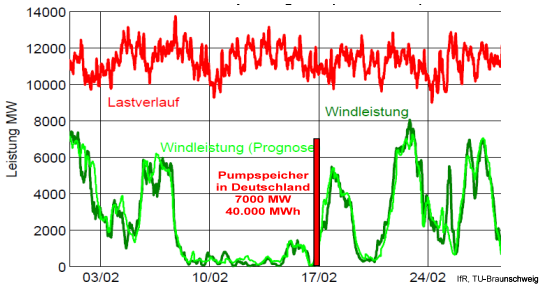
What if the grid does not become smart?
Stability & sustainability needs will not be met

Situation in the transmission network of Vattenfall Europe in February 2008

Source: IfR, TU Braunschweig

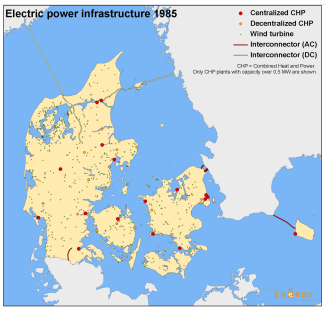
- The existing storage capacity is insufficient to balance out fluctuations lasting days, let alone seasonal fluctuations
- Without large amounts of storage capacity wind energy cannot replace conventional thermal power stations

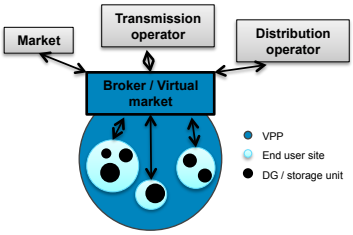


How can smart technology help?

How can smart technology help?
Control

- The Danish case: 43% of distributed generation installed capacity
- Virtual Power Plant ("VPP") concept
- Aggregation of distributed generation and storage units into a **single entity** with a dispatchable output





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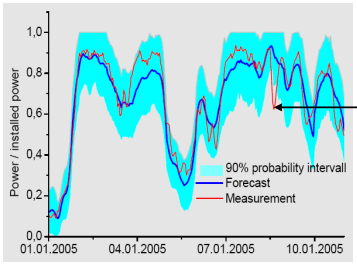
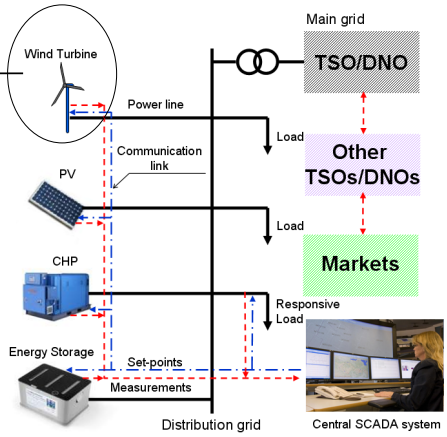
How can smart technology help?
Sensing and prediction



Source: Former Fraunhofer: ISET

- Prediction error of power output:
  - How can the error be reduced?
  - What is the impact on the system?
  - How can the impact be minimized?



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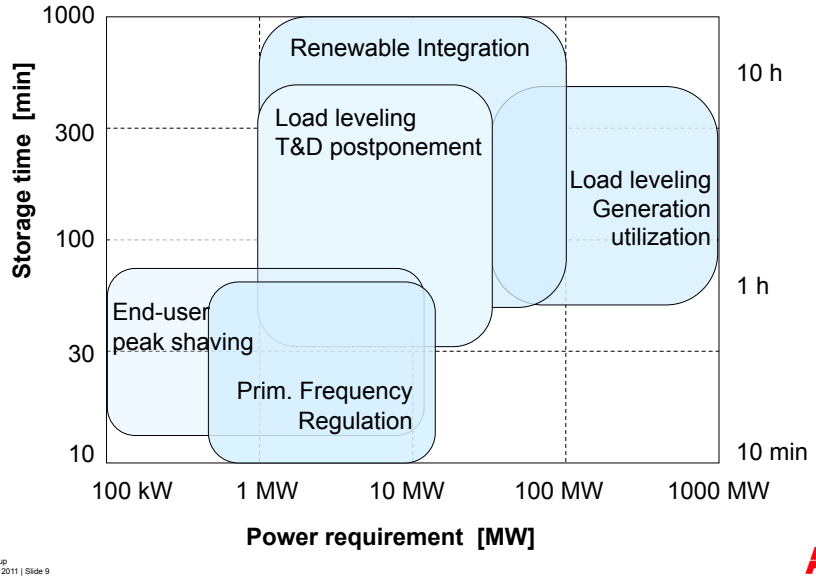
How can smart technology help?
Elasticity and balancing – "energy storage"



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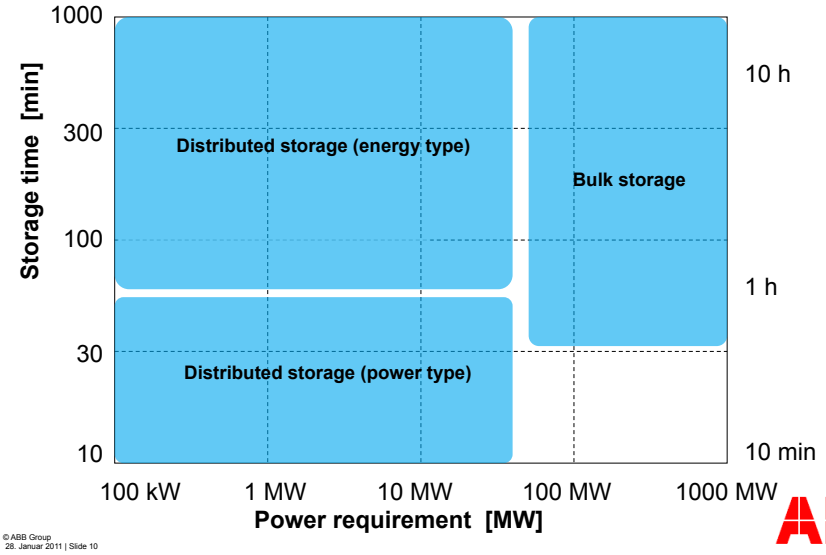
Energy Storage Systems (ESS)
Technology needs



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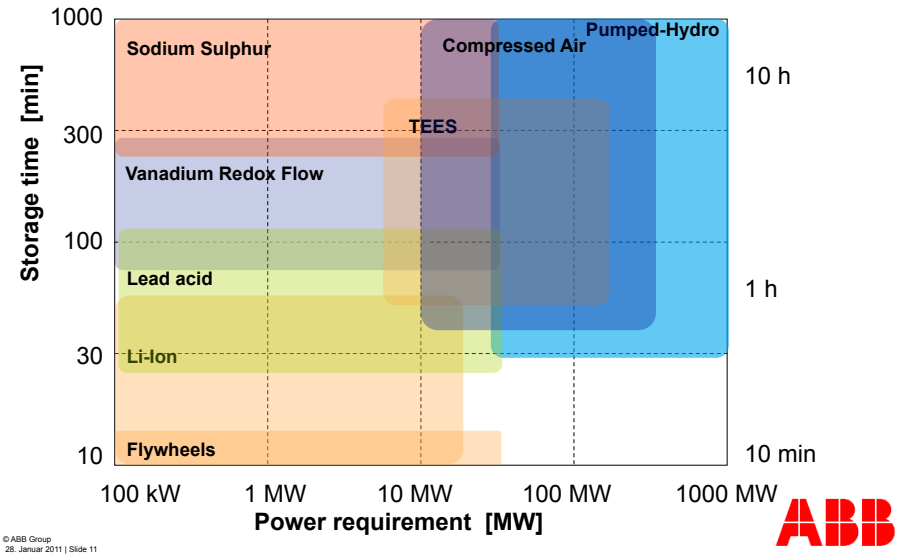
Energy Storage Systems (ESS)
Technology options



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Storage strategy?

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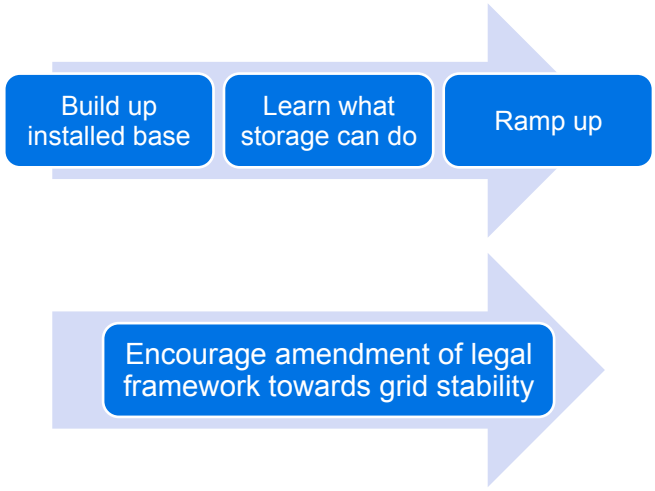
Proposal for a storage strategy



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