June 08, 2015 , Clearingstelle EEG, Berlin

Business Cases für Speicher und regulatorische Hemmnisse

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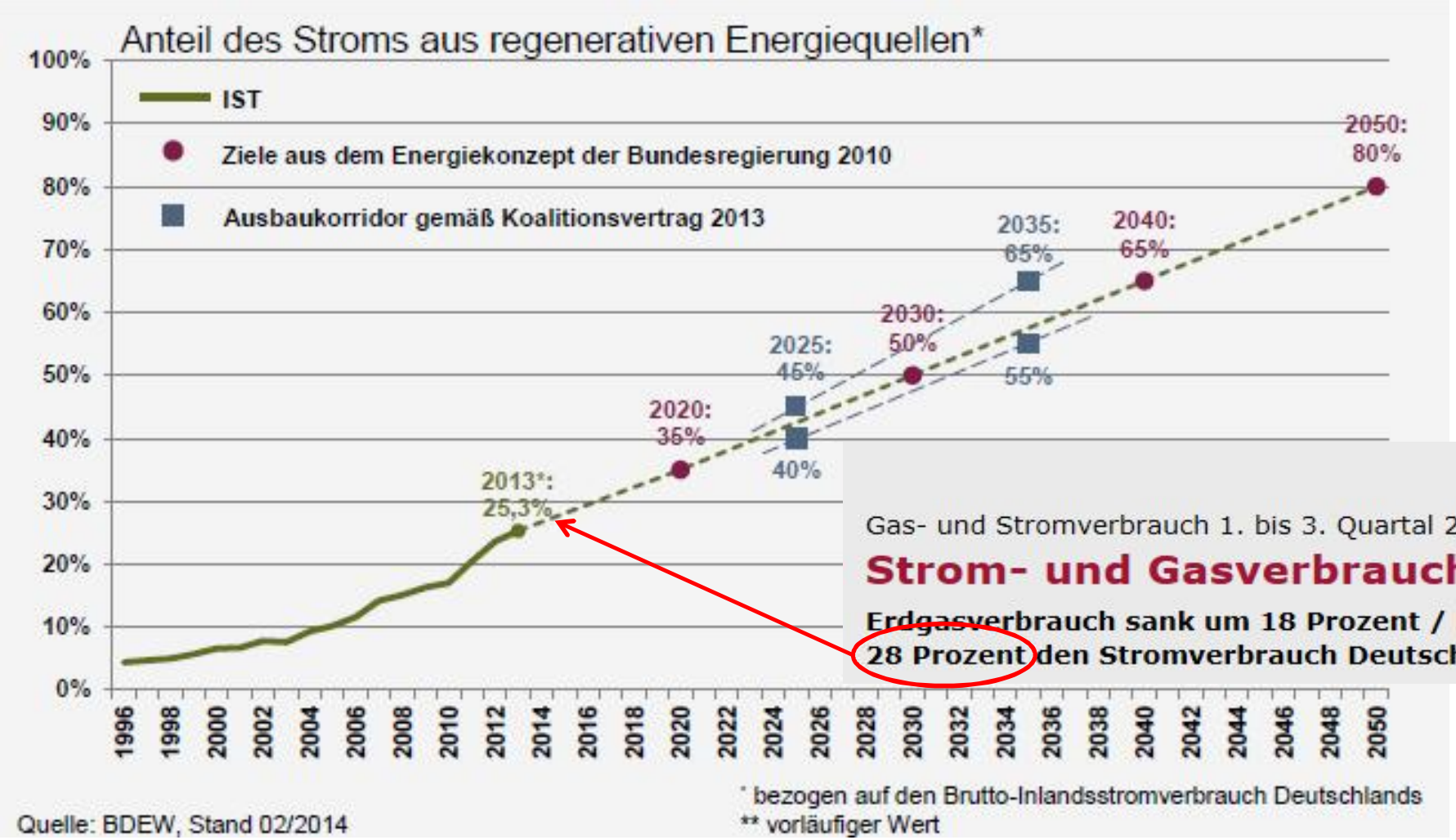
Siemens AG, Erlangen

Contribution of renewables to electricity supply in Germany



23. Oktober 2014, Berlin

Gas- und Stromverbrauch 1. bis 3. Quartal 2014:

Strom- und Gasverbrauch rückläufig

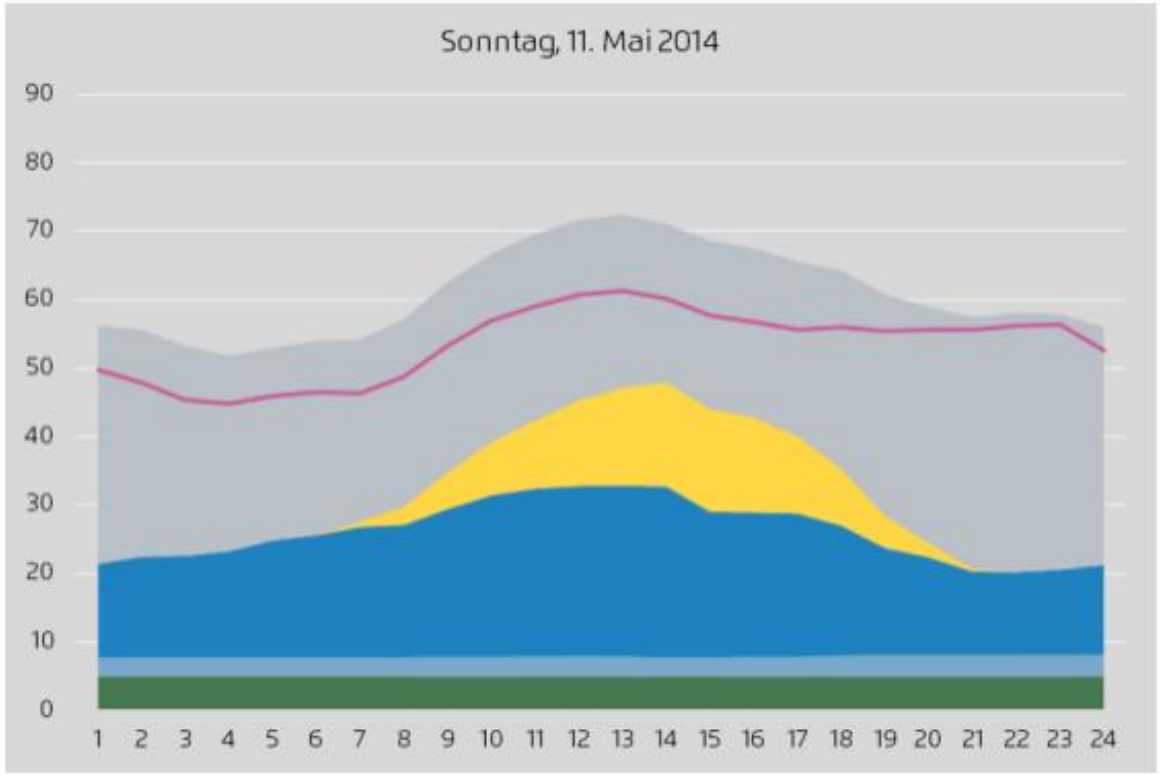
Erdgasverbrauch sank um 18 Prozent / Erneuerbare Energien decken zu 28 Prozent den Stromverbrauch Deutschlands

Source: https://www.bdew.de/internet.nsf/id/20141023-pi-strom-und-gasverbrauch-ruecklaeufig-de

Ambitious German RE targets require highly flexible back-up systems

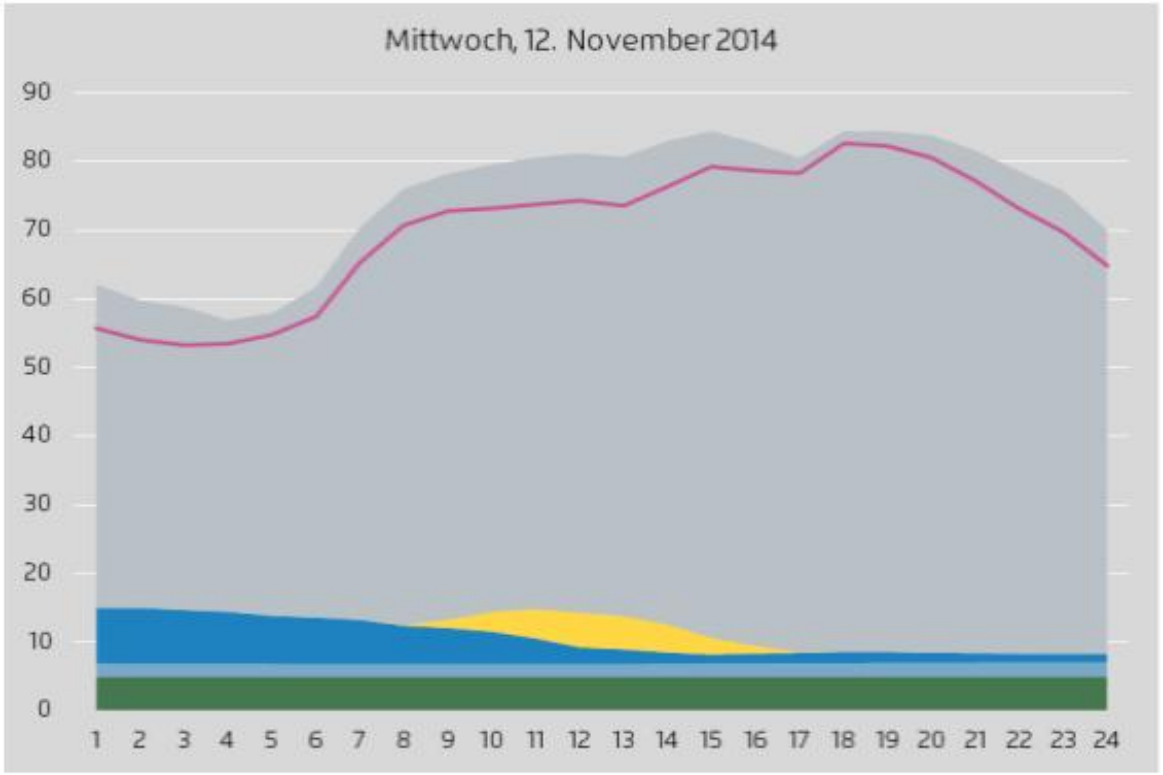
80% German electricity load coverage from Renewabes

(Net Power Generation and load, red line, in GW)



10% German electricity load coverage from Renewabes

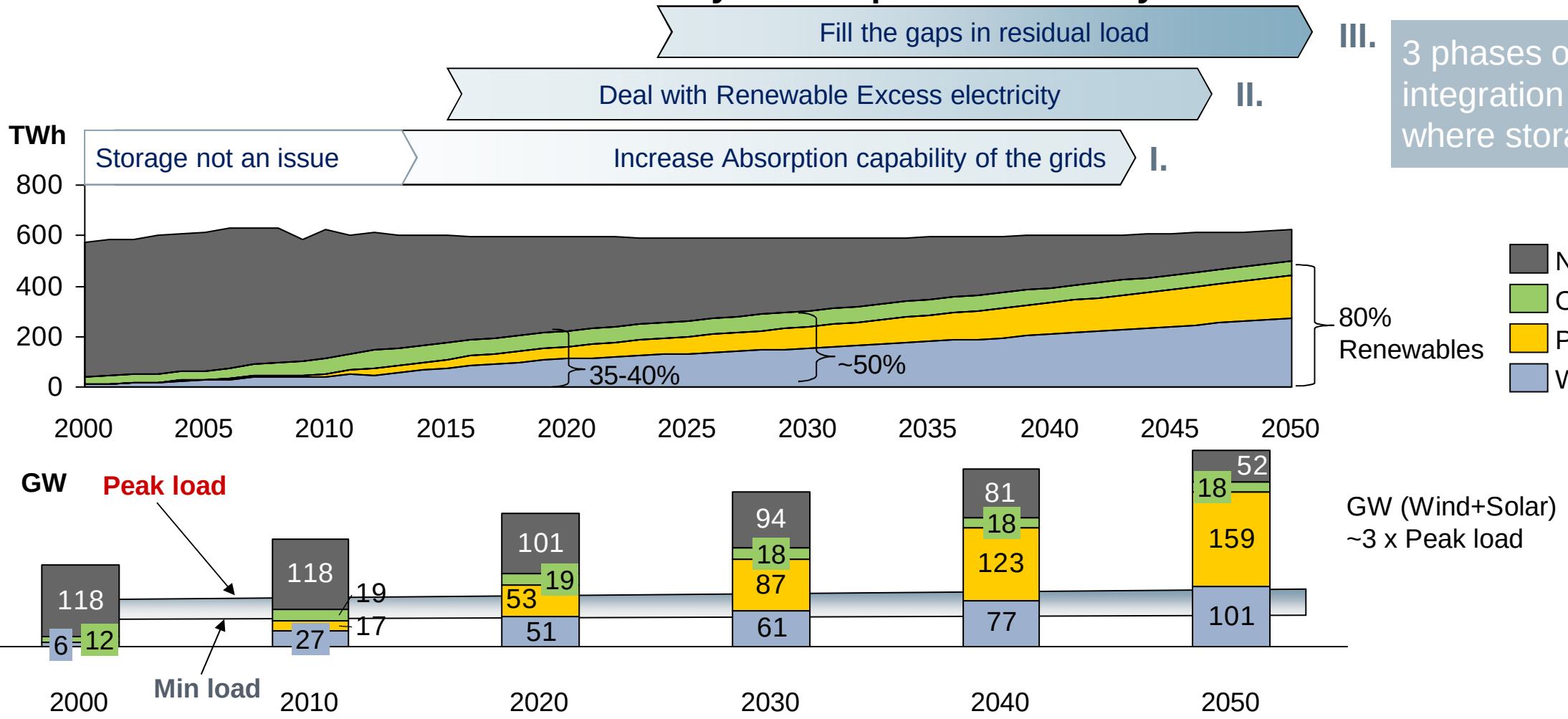
(Net Power Generation and load, red line, in GW)



Quelle: Agora Energiewende, 07.01.2015

Role of energy storage for German Energiewende

Contribution of Renewables to electricity consumption of Germany

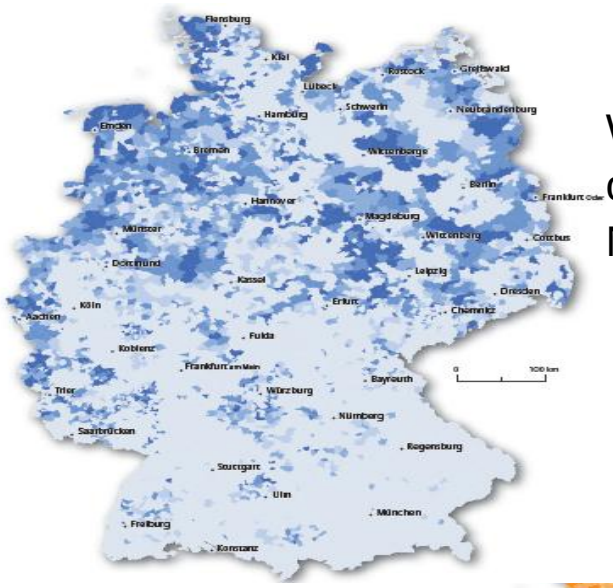


3 phases of RE integration challenges where storage can help

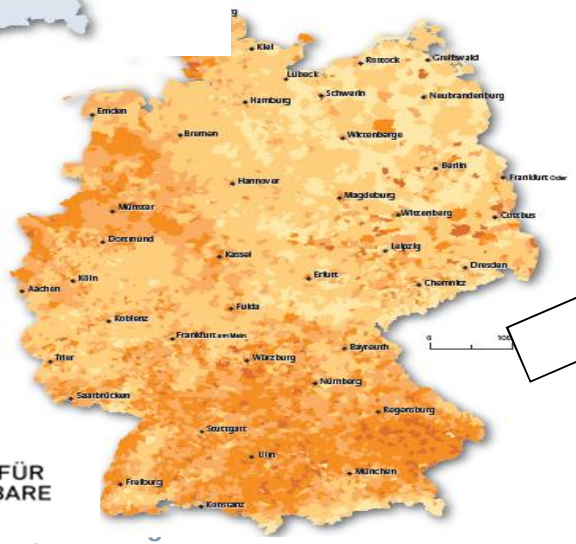
GW (Wind+Solar)
~3 x Peak load

Source: Siemens AG

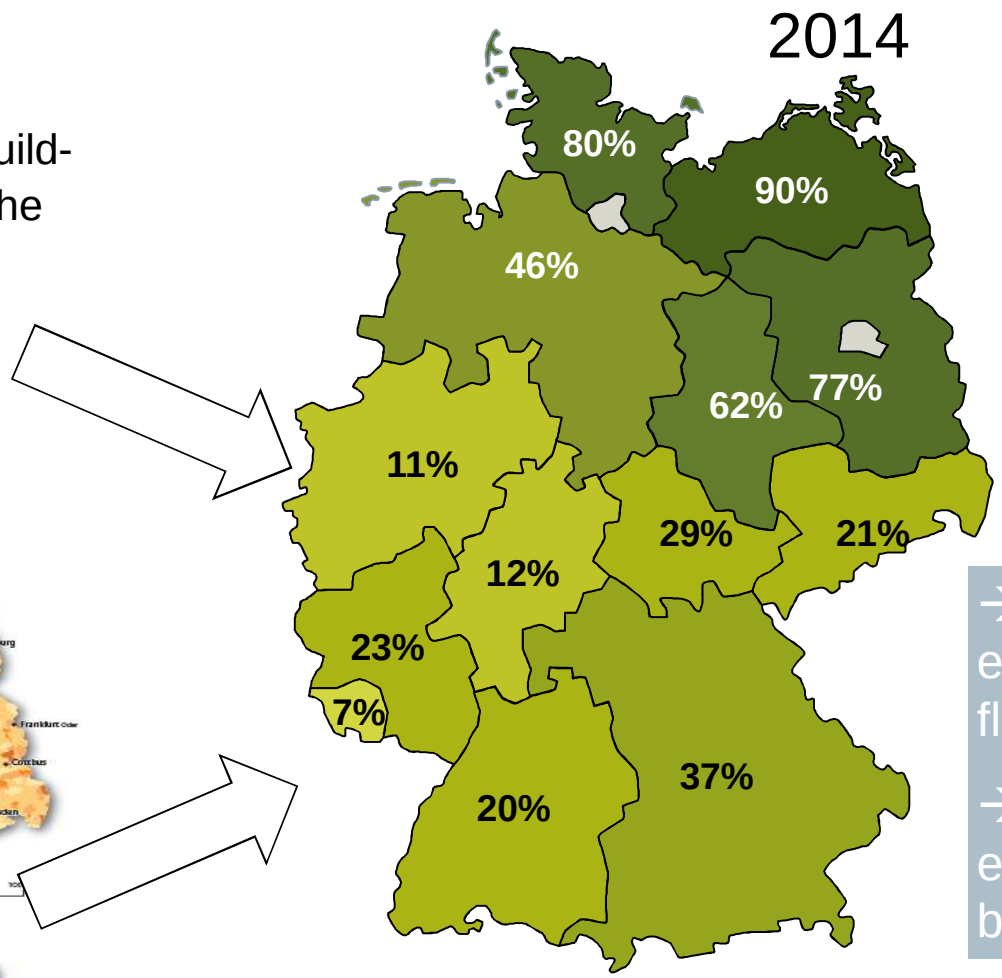
Uneven build out of renewables create integration challenges on a regional level



Wind power build-out mainly in the North



Solar power build-out mainly in the South



→ Ambitious renewable energy plans need additional flexibilities

→ Even with planned grid extensions Germany will not become a „copperplate“

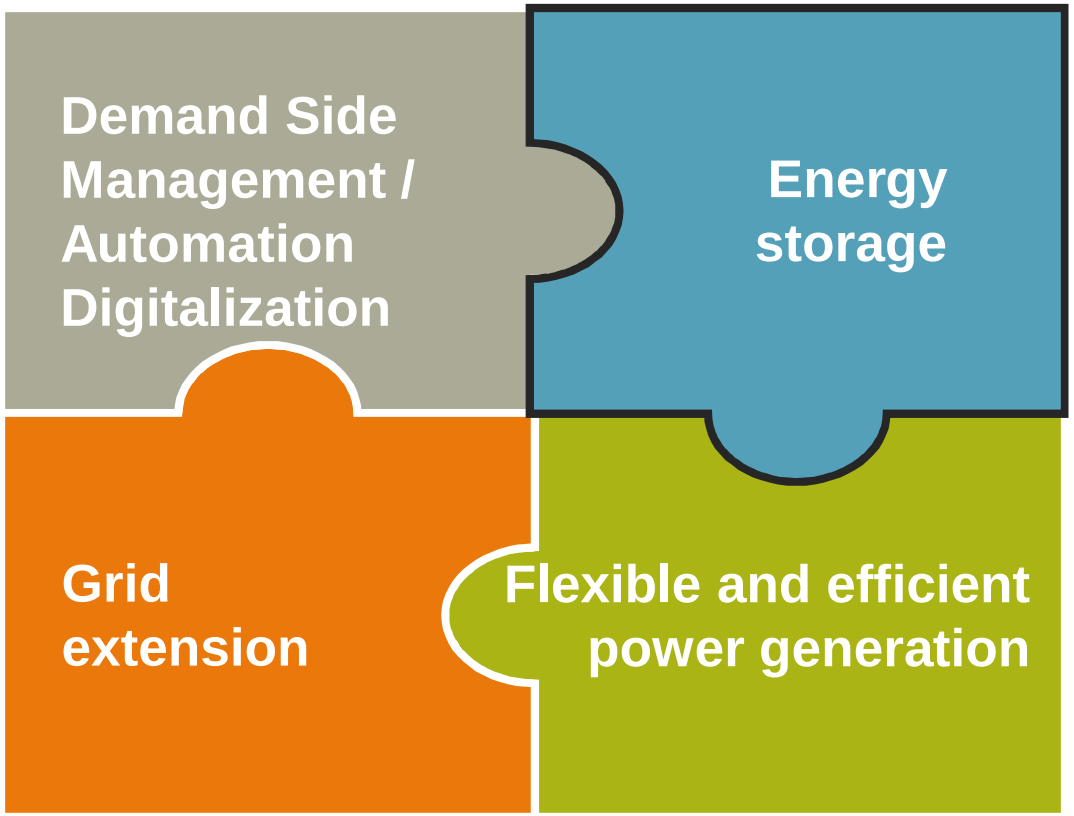
Share of Renewable generation (energy yield) In regions *

* Source: AGEE-Stat, LAK, extrapolated

AGENTUR FÜR ERNEUERBARE ENERGIEN

Energy storage is one of 4 major flexibility options to cope with increased volatile renewable build out

e.g. Flexibilise Demand with Smart tariffs



e.g. Grid stability and system efficiency; time shift of „excess electricity“

Cross-regional electricity transfer and integration of distributed generation

e.g. cost-efficient use of conventional power supply and backup capacity

Bottom up analysis of storage market - Storage used for very different purposes

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Application

D Energy reserve

C Time shift

B Firming

A Power system stability

Segmentation (use-cases)

Days Weeks

Hours

Minutes

Seconds

1 kW

100 kW

1 MW

10 MW

100 MW

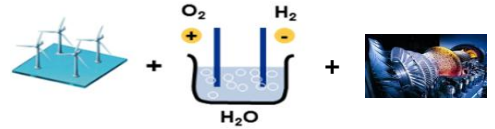
1000 MW

Power

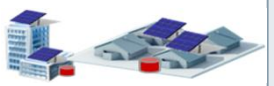
1 Electricity reserve

Electricity reserve

- Cover low wind or sun periods



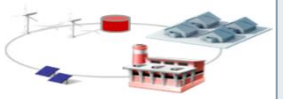
4 Con-/ Prosumer



- Residential/ commercial self supply
- Industrial peak shaving

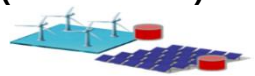
2 Generation buffer

2a Decentra-lized fleet



- On-Grid + grid expansion deferral
- Remote areas / off-grid

2b Volatile plants (PV / Wind On)

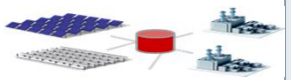


- Avoid curtailment
- Integration and grid services

2c Conventional power plants

- Increase flexibility/ load optimization

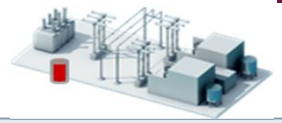
2d Central fleet



- Energy arbitrage (Time Shift)
- Provide balancing energy

3 Grid stability

3a Distribution grid



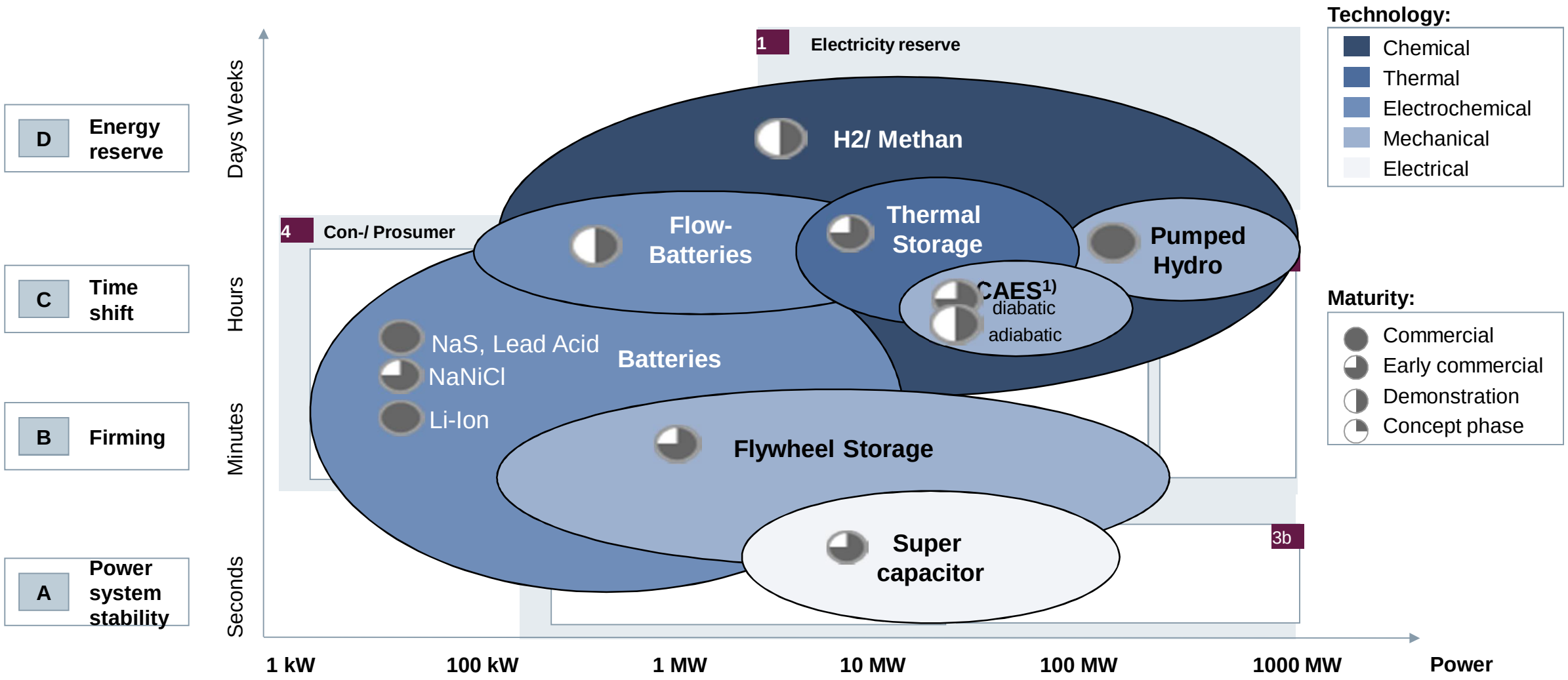
- Ensure power system stability

3b Transmission grid

- Ensure power system stability

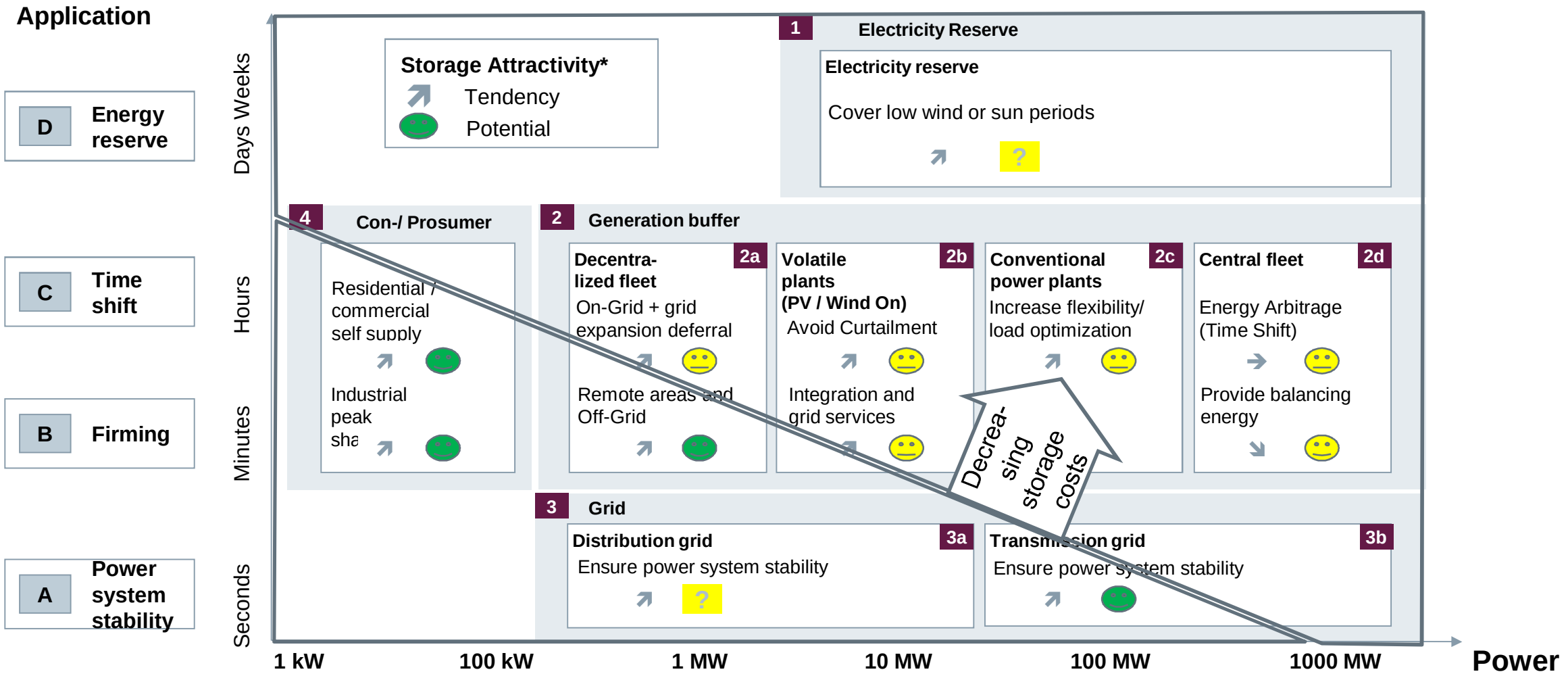
Source: Siemens AG

Different technologies available for various use-cases – not all developed to full maturity



1) Compressed Air Energy Storage
Source: Siemens

Electricity Storage attractive today in use-cases with high power prices or grid quality issues



Combination of various revenue streams are needed to make storage a viable business case – regulation may not hamper multiple use cases

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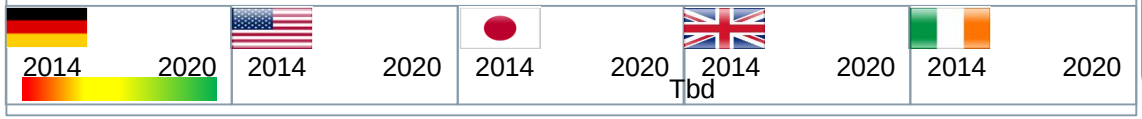
Volatile Power Plants – Onshore Wind

Description and expected geographic focus

- Onshore wind-plants
- Main motivation:
  - + Offer ancillary services (primary operating reserve)
  - + Increase wind yield (e.g. ramp rate control)
  - + Avoid/Reduce forecasting error and increase yield in direct marketing
  - + Reduce curtailment losses



Typical installation (used for illustrative business case)

- Storage is co-located with 10 MW wind-park, 3000 full load hours.
- Storage: Li-Ion Battery System
  - Power: 2 MW
  - Capacity: 1 MWh

Main drivers of business case: assumptions

Technical / Commercial

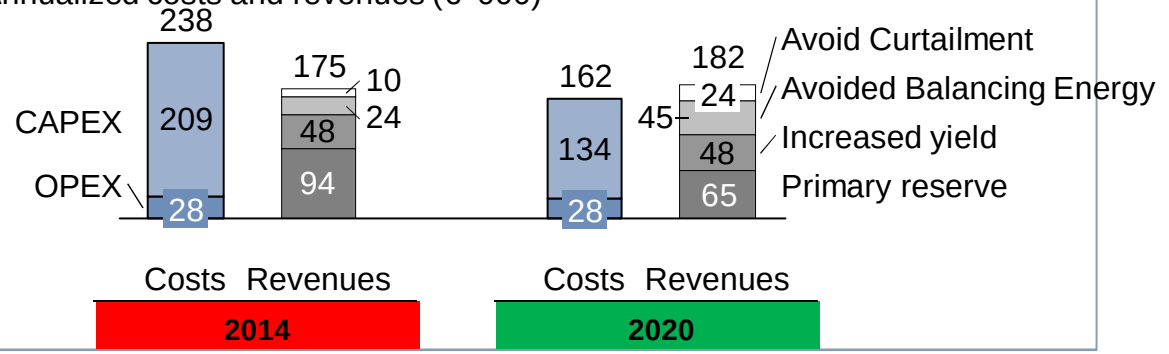
- CAPEX 2014 | 2020: 2,3' |1,4' € (1100 | 720€/kW)
- Efficiency (AC-AC): 87,3 %
- Cycles: 2/day
- System lifetime: 20 years
- WACC: 7%

Market value

- Primary reserve 2014 | 2020: 3,000 | 2,500 €/MW/week
  - Bids accepted: 60% | 50%
- 2% increased yield of wind turbines due to storage
- Avoided balancing energy of 2€ | 3€/MWh (direct market.)
- Curtailment losses 2% | 5%, 20% not compensated

Illustrative business case

Annualized costs and revenues (€ '000)



Negative business case | Close business case | Positive business case

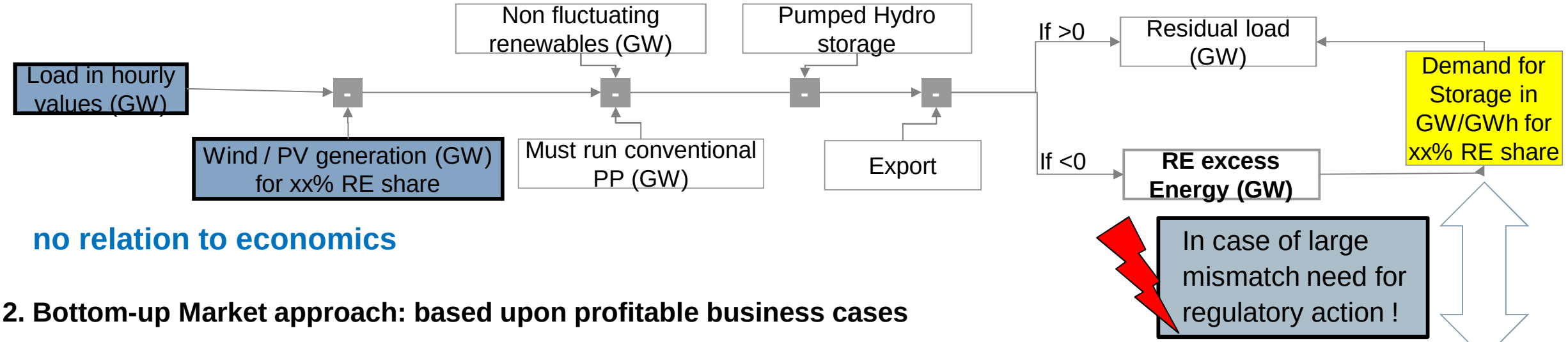
Source: Siemens AG, regelleistung.net

Key regulatory topics in relation to storage

Regulatory topic	Impact on storage business case
• Definition of Storage → Is it generator or consumer	• Impact on grid fees to be paid by storage
• Who is allowed to own / operate storage systems?	• Could DSOs/TSOs make use of benefit in combination with other market based benefits?
• Is storage acknowledged as an asset of the grid ?	• Could be substitute to traditional grid enforcement if guaranteed ROI is give in regulated market
• Storage Subsidies / Surcharges for self consumed electricity • Participation of behind the meter storage systems in energy markets	• Effects business case for behind the meter storage • Allows combination of use cases
• Qualification conditions for balancing markets • Are system services (e.g. speed and accuracy of system reaction) valued by market design?	• In a system consisting up to 100% of inverter connected generation system dynamics change, there is currently no market mechanism in D
• Smoothing / Balancing Requirements for PV and Wind farms and Grid codes	• Encourages RE operators to contribute to power system stability

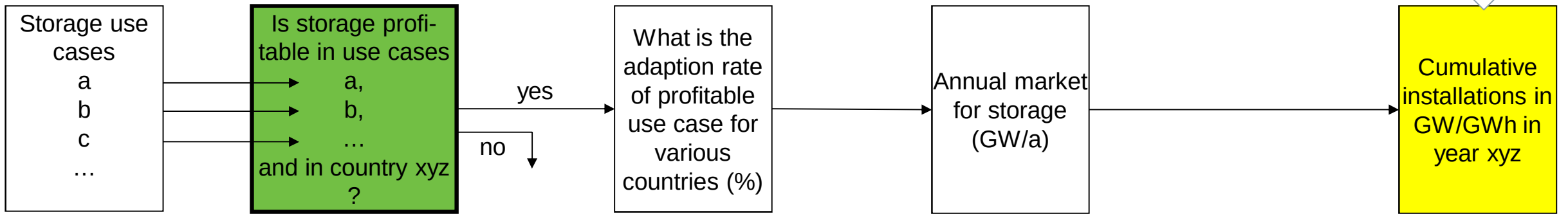
By comparing Top down storage demand with Bottom Up Business case analysis need for regulatory action can be derived

1. Top-Down Demand side approach: based upon mismatch between volatile supply and demand



no relation to economics

2. Bottom-up Market approach: based upon profitable business cases



no relation to share of renewables

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Vielen Dank!