

Berlin Seminar on Energy and Climate Policy

DSM from a power system perspective

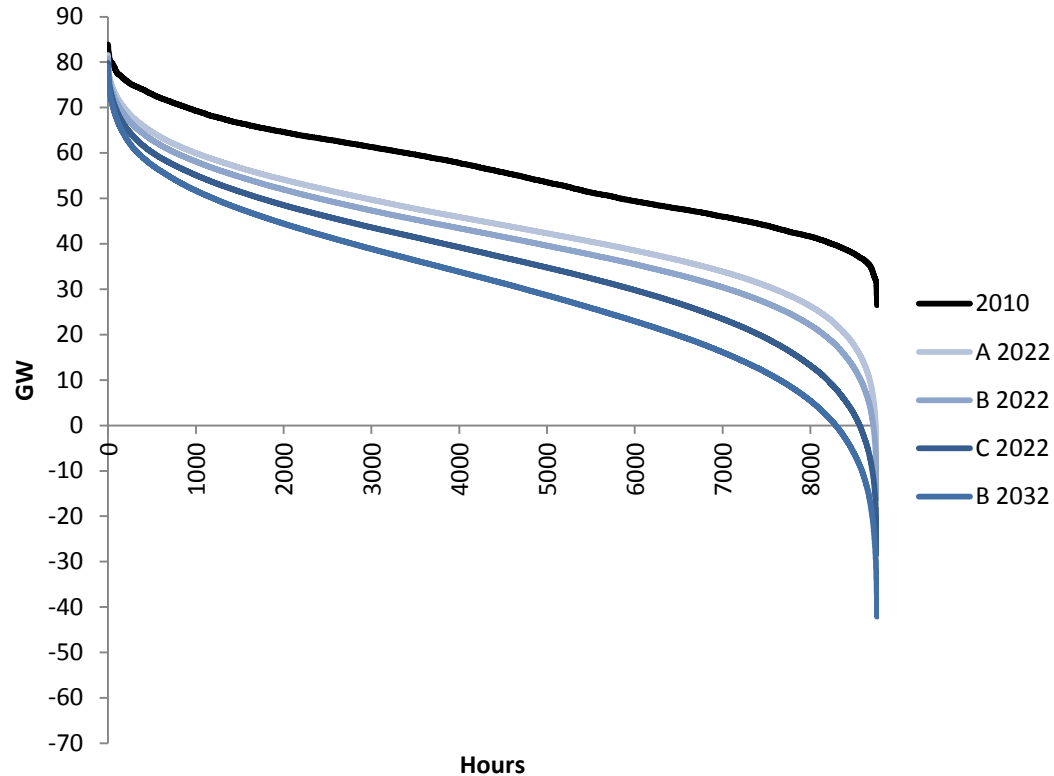
Wolf-Peter Schill

Berlin, 10 December 2014

Overview

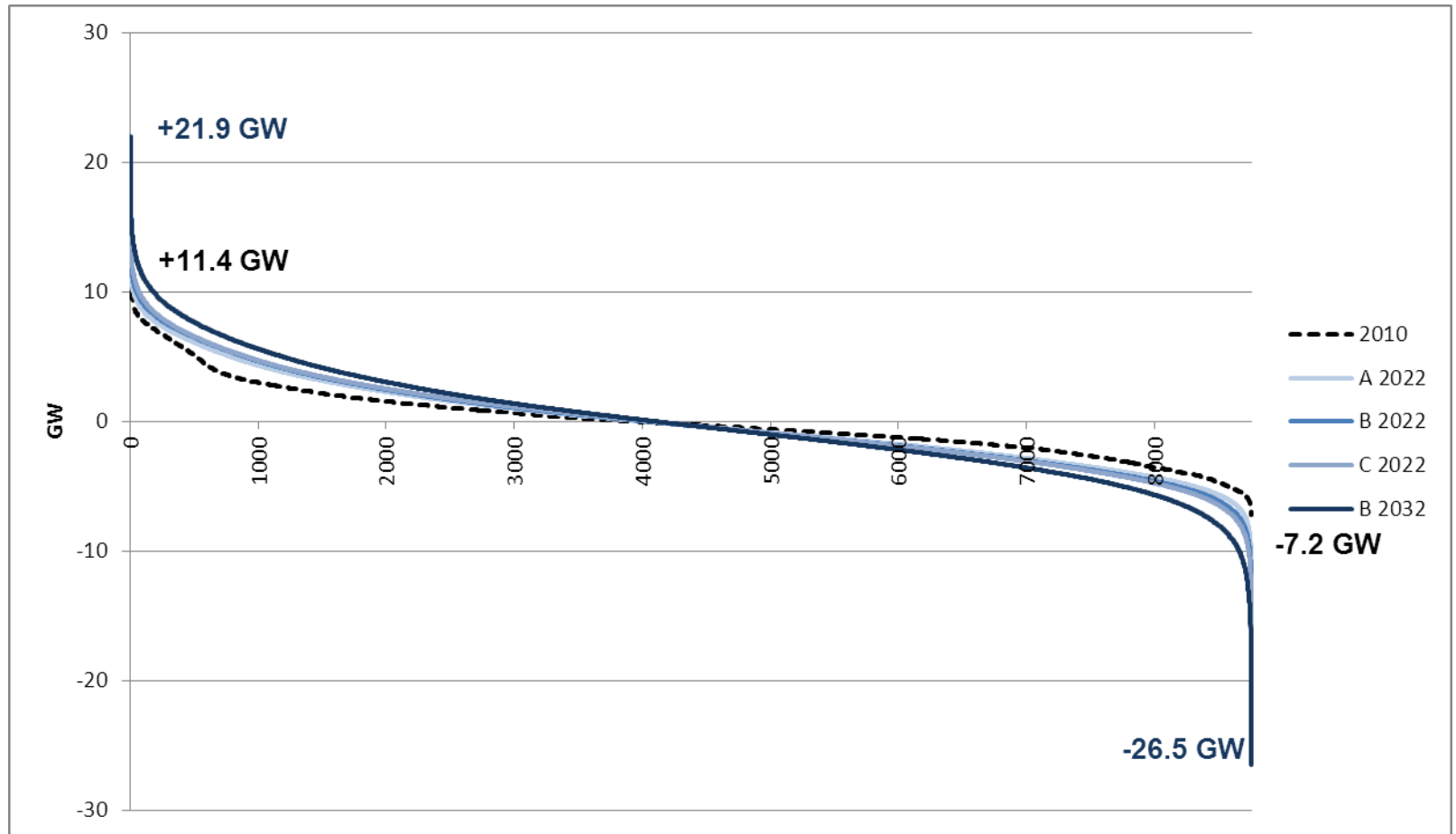
1. Increasing flexibility requirements
2. DSM and other flexibility options
3. Some insights from power system modelling
4. Conclusions

- *Energiewende*: Increasing shares of fluctuating renewables in Germany
- Special characteristics:
 - Fluctuating availabilities
 - Short-term forecast errors
 - Asynchronous network connections
 - Locations of RES potentials vs. geographic distribution of load and historic network configuration



Schill (2014), *Energy Policy*

→ Renewables substitute fuels, but not much capacity



Schill (2014), *Energy Policy*

→ Increasing short-term flexibility requirements

- Balancing of expected residual load:
 - Daily and seasonal balancing
 - Renewable surplus integration
 - Smoothing of load gradients } Arbitrage value
- Peak load supply → Capacity value
- Compensation of forecast errors → Reserve value
- Spatial balancing → Network value

→ Contributions of the demand side and other flexibility options

| Flexibility options | Examples |
|------------------------------------|---|
| Demand-side | <ul style="list-style-type: none"> • Load shifting • Load reduction |
| New flexible loads (Power-to-X) | <ul style="list-style-type: none"> • Power-to-Heat • Power-to-Gas • Power-to-Mobility <p>„Functional power storage“ (Power-to-Power)</p> |
| Supply-side | <ul style="list-style-type: none"> • Indirect water storage • Flexible biomass and CHP • Flexible RES feed-in • Flexible thermal plants |
| Power storage | <ul style="list-style-type: none"> • Mechanical, electrochemical, chemical • Short-term, daily, seasonal |
| Networks | <ul style="list-style-type: none"> • Network extension and optimization • Power electronics |

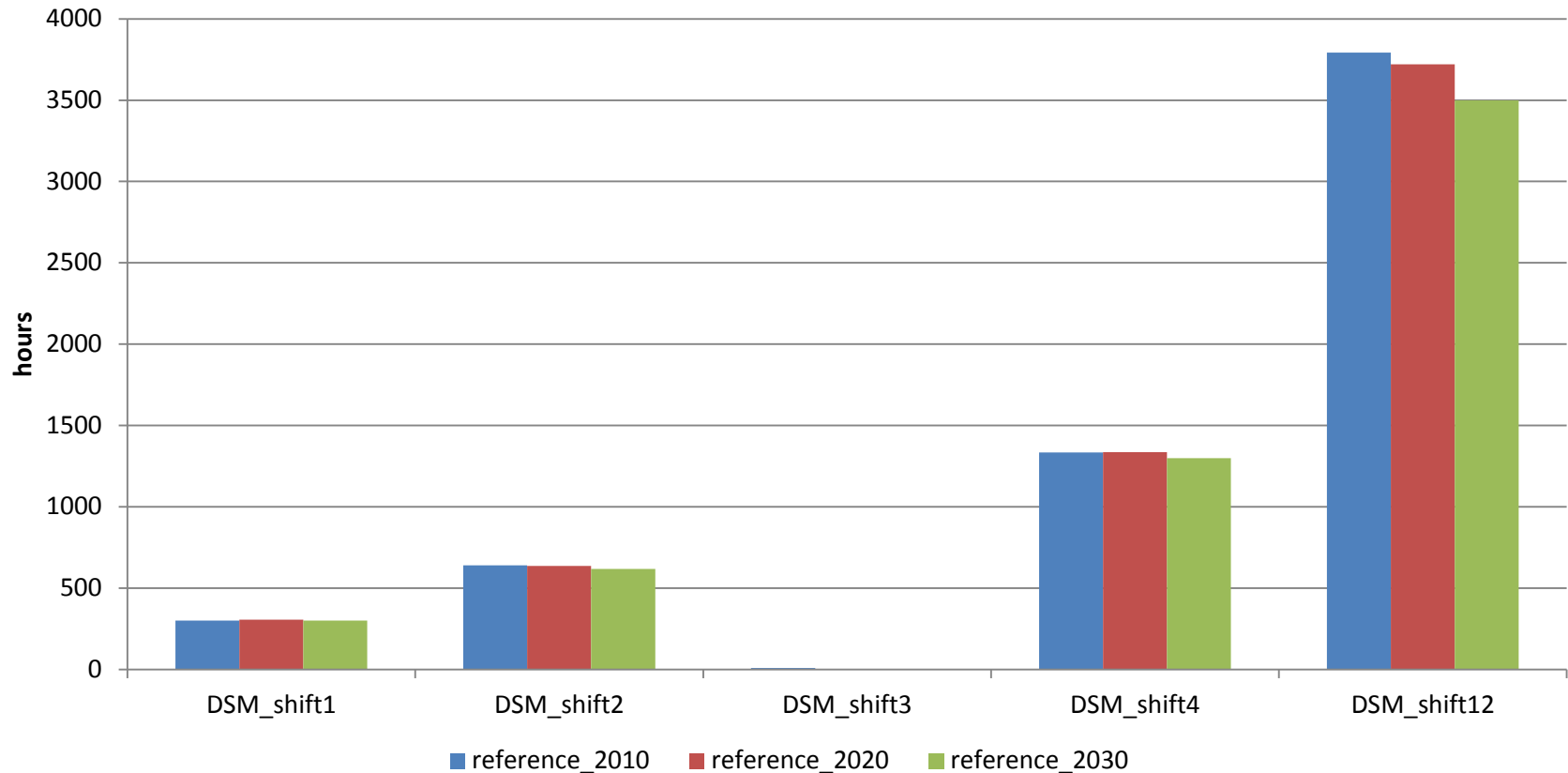
- Two stylized applications:
 - „NEP scenarios“: Existing generation capacities 2010, 2020, 2030
 - „Green field“: endogenous capacities, perspective 2050
 - Objective function: Cost minimization
 - NEP:
 - Dispatch of existing capacities
 - Only marginal DSM units (1 MW) with 1, 2, 3, 4, 12 hours
 - Green field: investment and dispatch of all capacities
 - Scope:
 - Germany only
 - Hourly resolution, full year
 - Wholesale only
- Focus on arbitrage value in hourly day ahead market and capacity value (green field)

- DSM parameters based on Frontier, Formaet (2014)

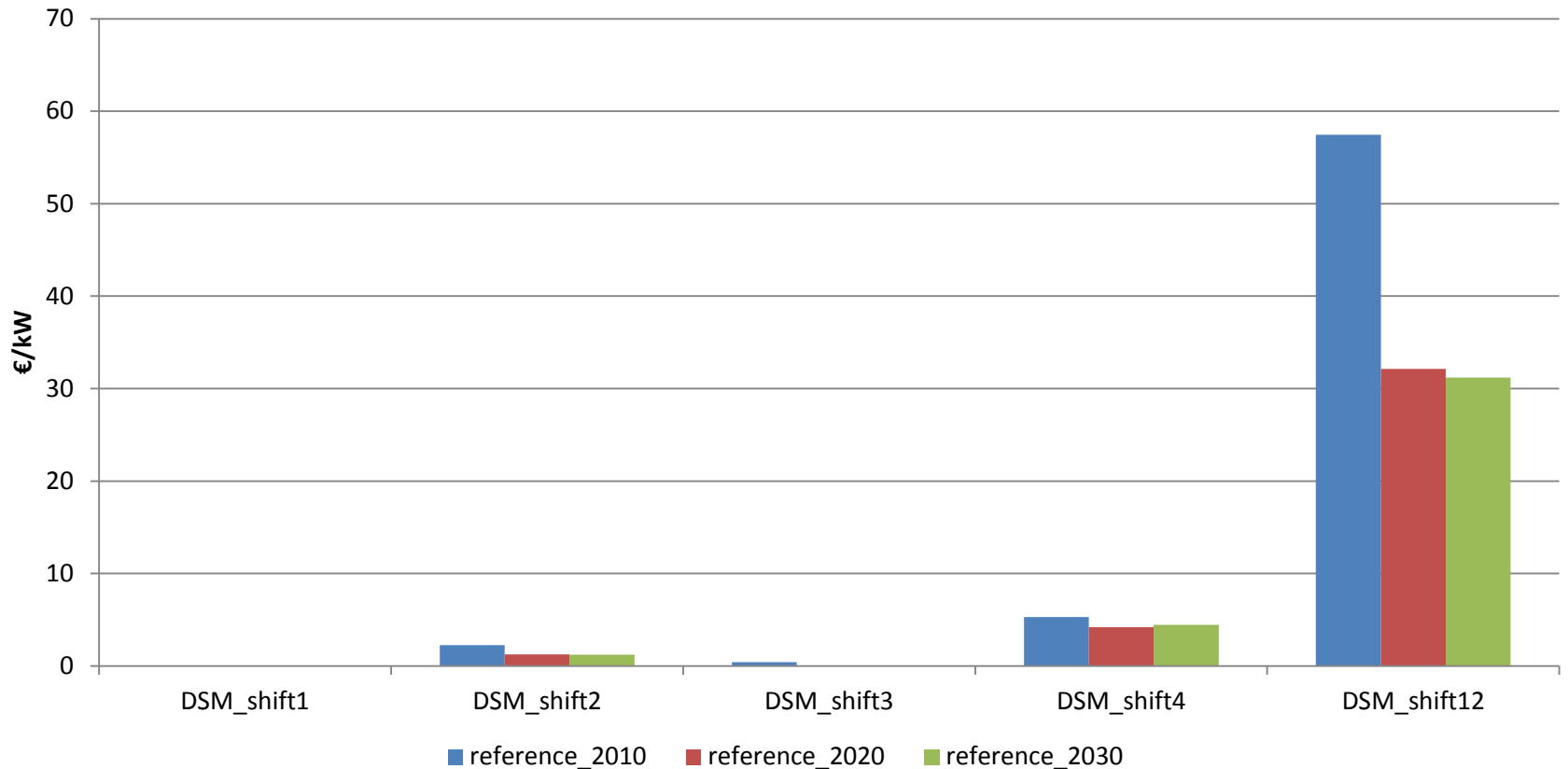
| | Duration (hours) | Variable costs (€/MWh) | Specific investments (€/kW) | | Max. installable (MW) | | |
|-------------|------------------|------------------------|-----------------------------|------|-----------------------|------|------------|
| | | | 2020 | 2030 | 2020 | 2030 | |
| DSM_curt1 | 4 | 500 | 10 | 10 | 1650 | 2700 | Industry |
| DSM_curt2 | 4 | 1500 | 10 | 10 | 132 | 1056 | |
| DSM_curt3 | 4 | 8000 | 10 | 10 | 450 | 3600 | |
| DSM_shift1 | 1 | 1 | 786 | 815 | 626 | 793 | HH + c/t/s |
| DSM_shift2 | 2 | 1 | 1817 | 1519 | 1966 | 2530 | |
| DSM_shift3 | 3 | 100 | 10 | 10 | 1385 | 1385 | Industry |
| DSM_shift4 | 4 | 1 | 842 | 835 | 737 | 1451 | HH + c/t/s |
| DSM_shift12 | 12 | 1 | 30 | 30 | 420 | 840 | |

→ Industry: low specific investments, high variable costs

→ Households and commerce/trade/services: opposite

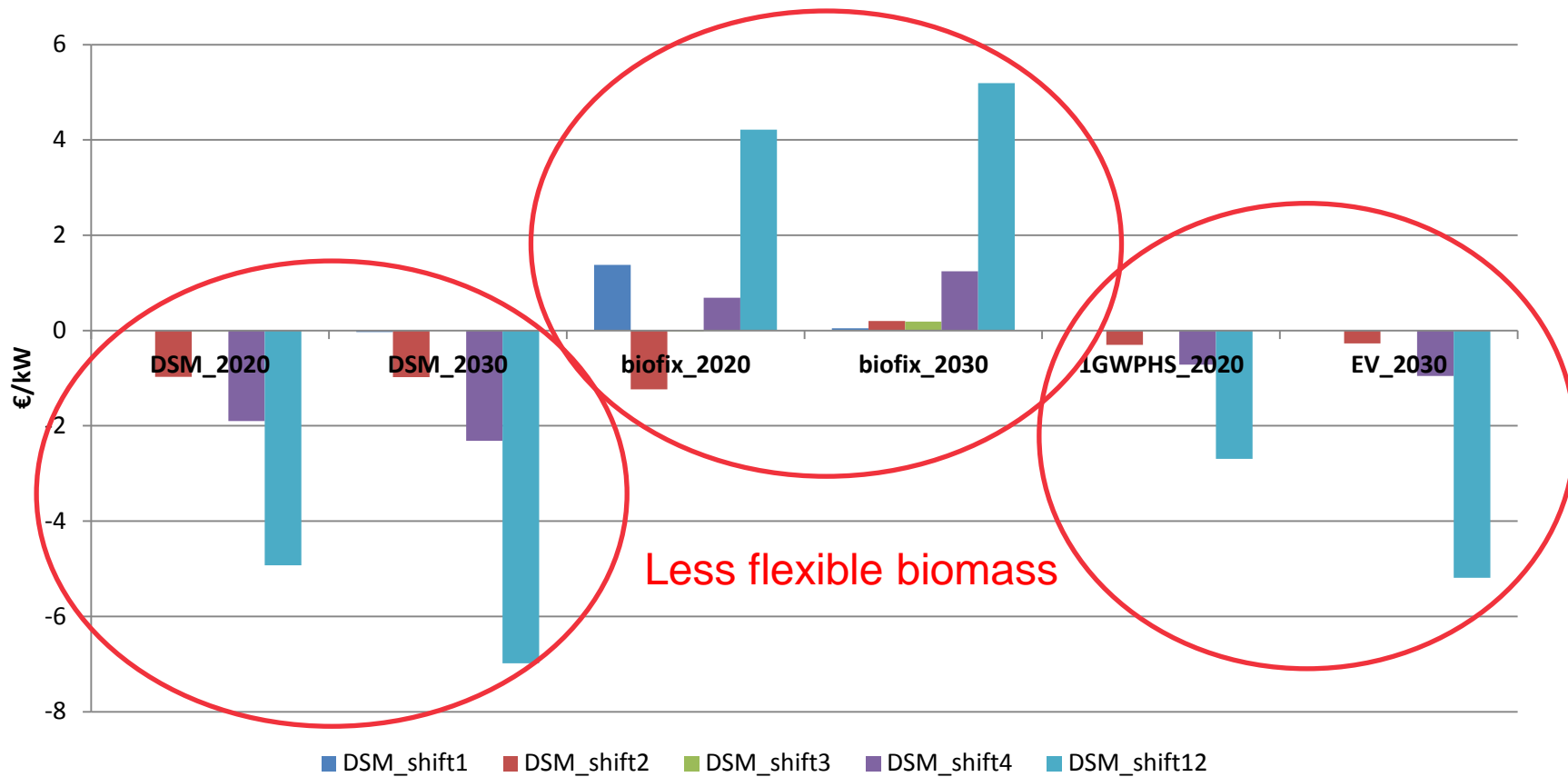


→ High full-load hours particularly for longer-term shifting



→ 12-hour-shifting substantially decreases system costs

Sensitivities for NEP scenarios: interaction with other flexibility options (shadow prices)

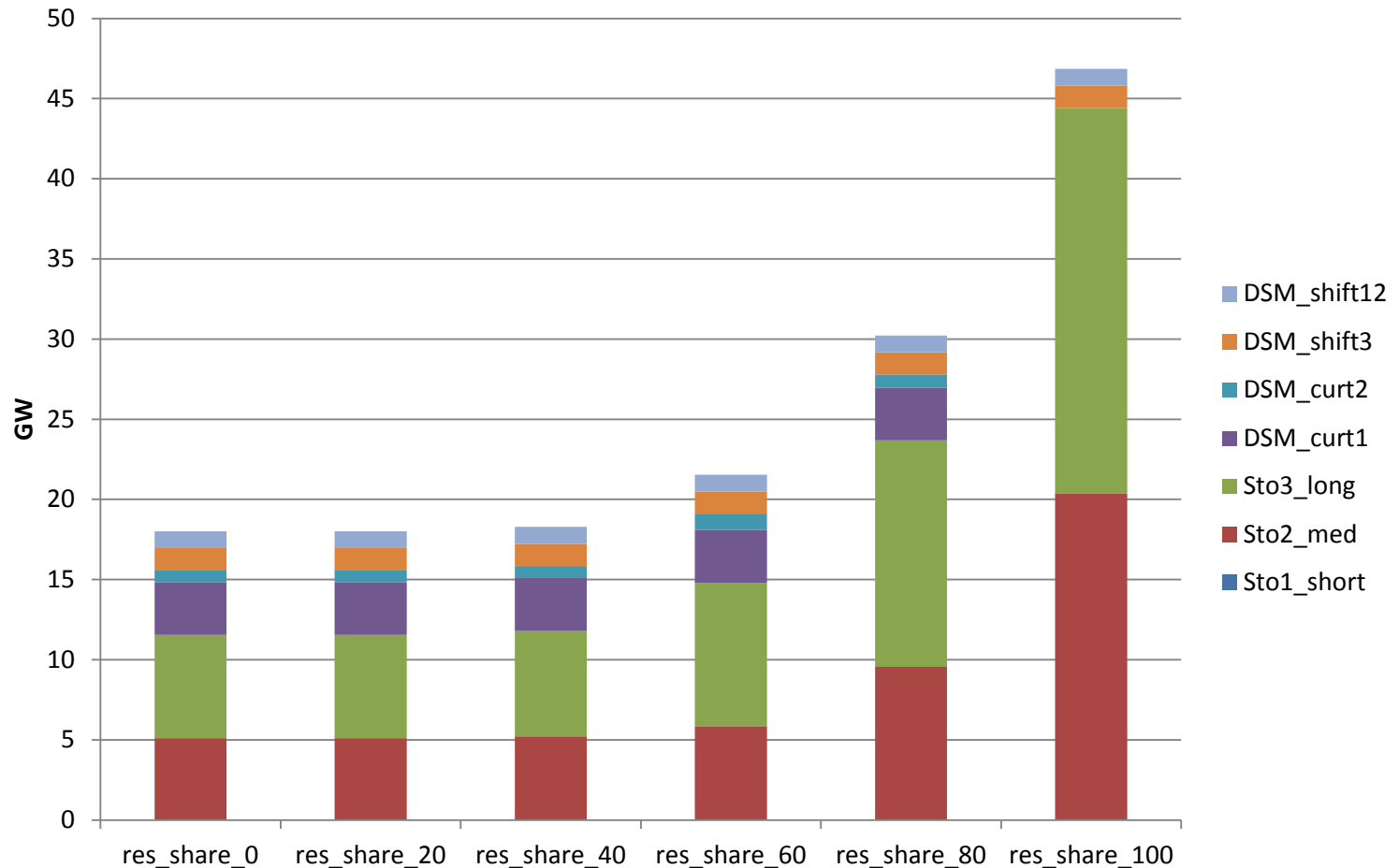


„Cannibalisation“

Less flexible biomass

Additional power
storage and electric
vehicles

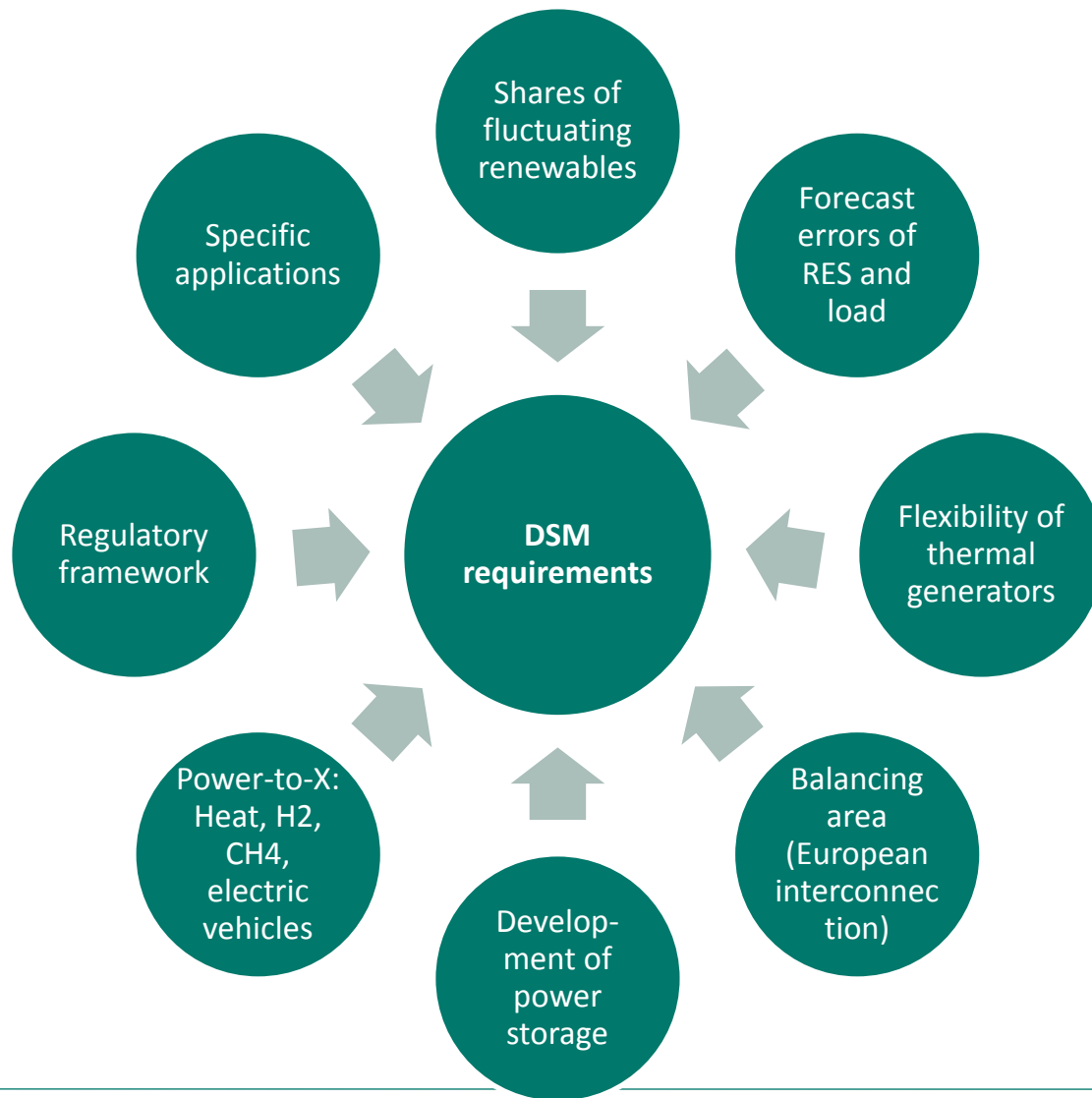
Green field (2050): Installed capacities of storage and DSM, depending on minimum RES share



→ Several DSM technologies at capacity restriction

→ Except for 100% renewable system (interaction storage)

- Renewable expansion: increasing flexibility requirements
- DSM and other options can provide flexibility in different fields of application
- Benefits compared to large-scale power storage: smaller project sizes, no acceptance problems, no losses?
- Modeler's view: vague potentials and costs parameters
- Interactions between DSM and other flexibility options
- Regulatory framework should ensure fair competition
- „When and what“? Highly dependent on context and field of application



Vielen Dank für Ihre Aufmerksamkeit.



**DIW Berlin — Deutsches Institut
für Wirtschaftsforschung e.V.**
Mohrenstraße 58, 10117 Berlin
www.diw.de

Redaktion
Dr. Wolf-Peter Schill | wschill@diw.de
