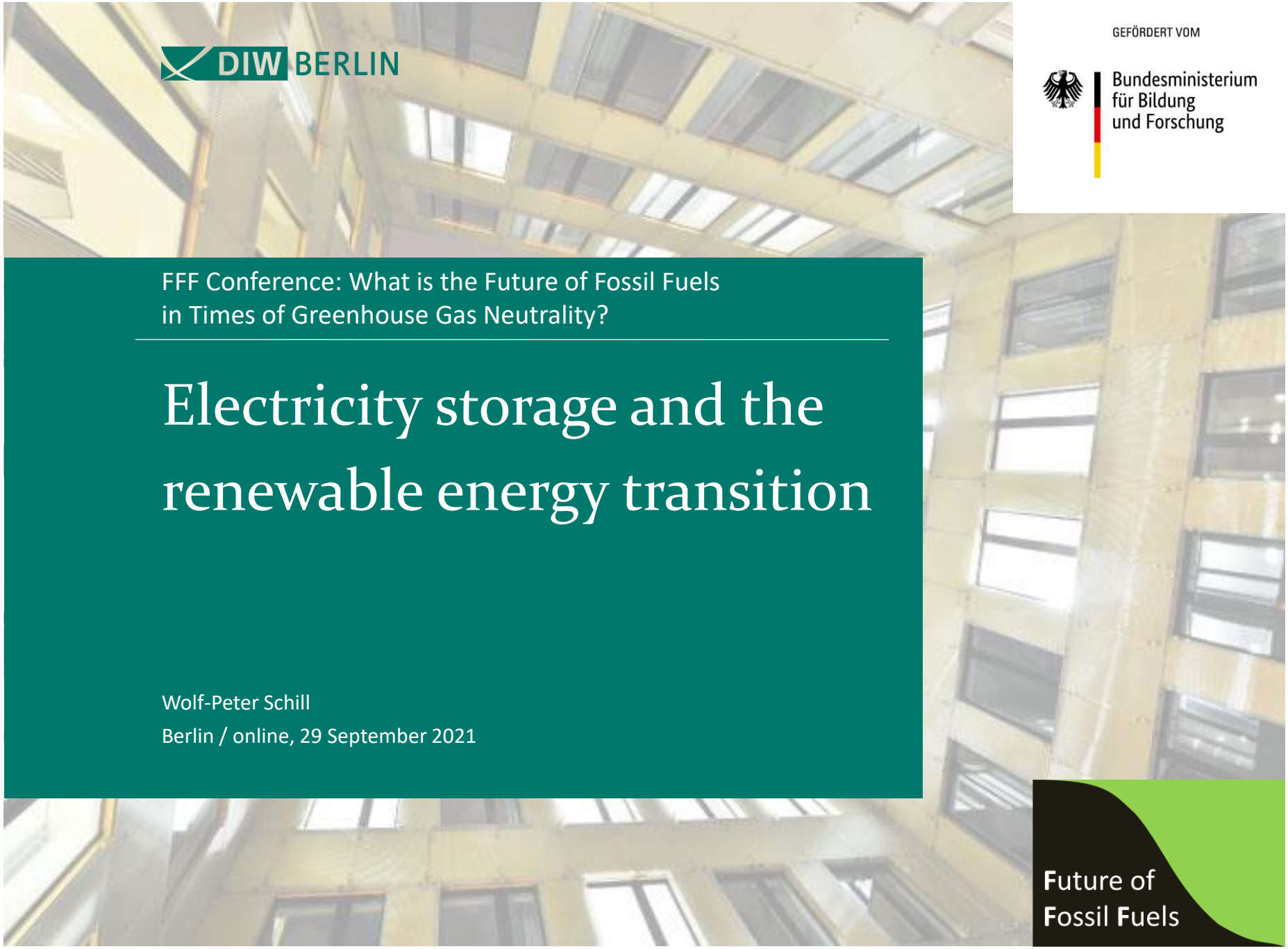

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FFF Conference: What is the Future of Fossil Fuels
in Times of Greenhouse Gas Neutrality?

Electricity storage and the renewable energy transition

Wolf-Peter Schill

Berlin / online, 29 September 2021

Future of
Fossil Fuels

1 Introduction

Commentary published in *Joule*

- Brief summary of three strands of storage research literature
- Illustration how storage use changes with increasing renewables and sector coupling, i.e. with a fossil phase-out


Joule

CellPress

Commentary

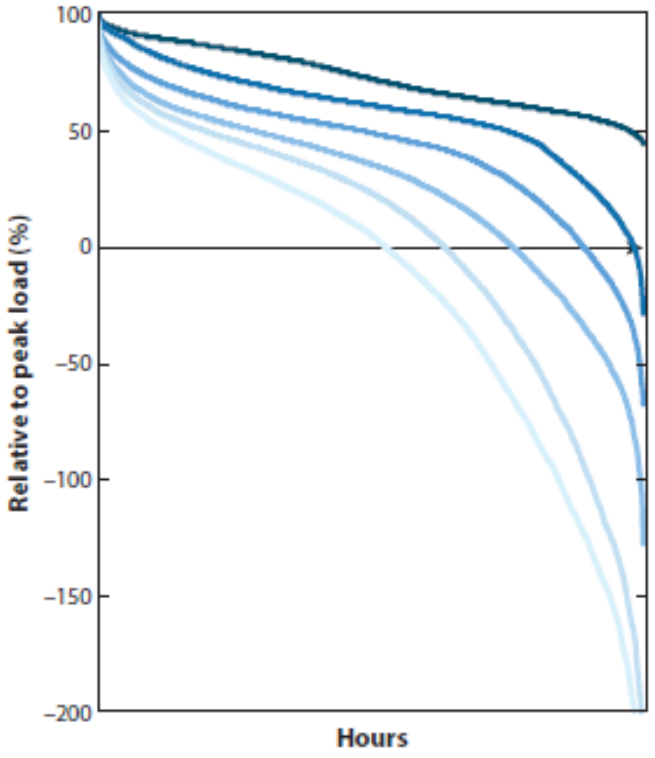
Electricity Storage and the Renewable Energy Transition

Wolf-Peter Schill[1,*]

https://doi.org/10.1016/j.joule.2020.07.022

Residual load duration curves (RLDC)

- RL: electric load – potential renewable generation
- RLDC: Hourly RL values, sorted in decreasing order
- Generated with stylized version of DIETER, calibrated to Germany
- Zenodo: https://doi.org/10.5281/zenodo.3935702



1 Electricity storage: technologies, applications, and competitors

Various technologies

- Always: „Power-to-Power“
- Differences in roundtrip efficiency and costs related to energy and power
  → different typical E/P ratios

Many different applications

- Focus here: bulk electricity storage (energy arbitrage)
- Other applications: ancillary services, transmission or distribution grid relief, …

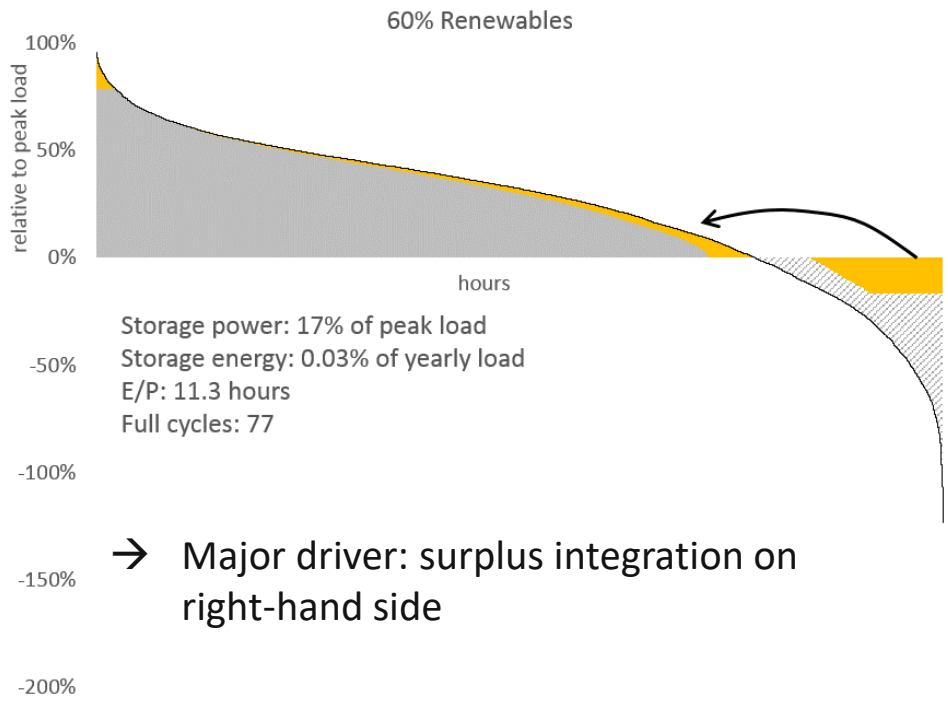
Competing flexibility options

- Power-to-Power: e.g. demand-side management of existing load
- X-to-Power: Flexible operation of dispatchable plants
- Power-to-X: New and flexible loads related to sector coupling, e.g. Power-to-Heat
- Geographical balancing

2 Electricity storage in power sectors without sector coupling

Common findings in the literature

- Optimal storage deployment remain moderate until ~80% RES
- Increases substantially towards 100% renewable, also storage duration
- Depends on other sources of power sector flexibility



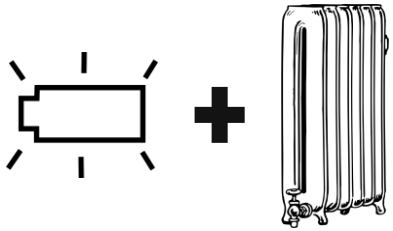
→ Major driver: surplus integration on right-hand side

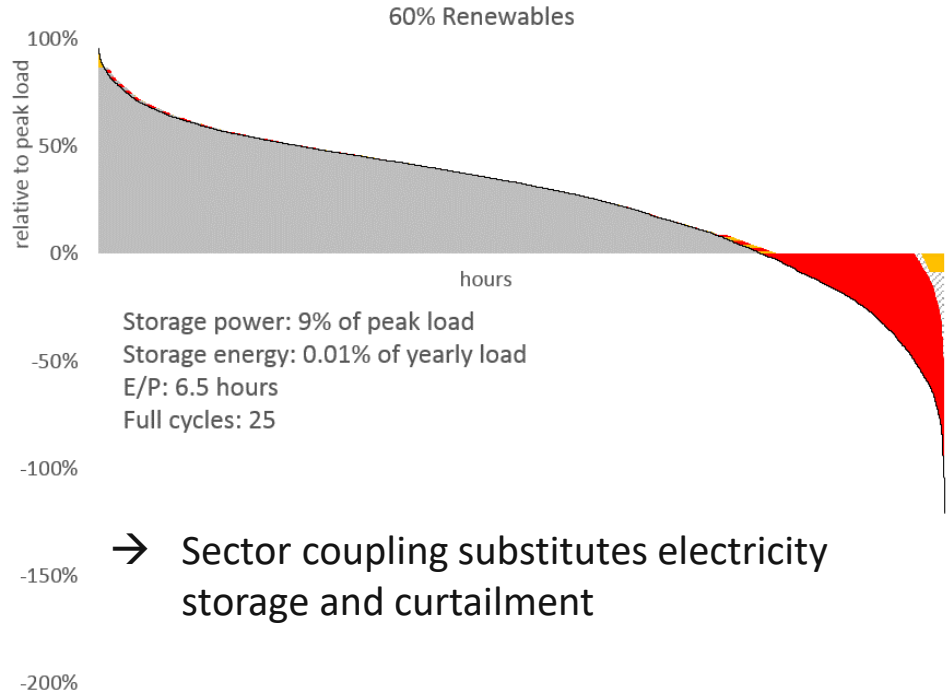
→ Driver for storage deployment shifts to left-hand side (residual load coverage)

2 Enter: sector coupling (and other types of energy storage)

Intuition on Power-to-X

- New loads can increase the demand-side flexibility of the system
- E.g. Power-to-heat, electric vehicle batteries, green hydrogen
- This can mitigate storage needs for lower RES shares

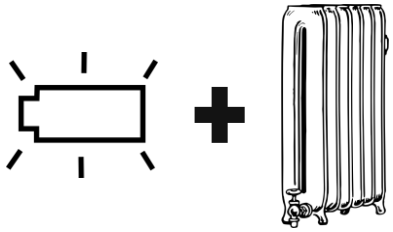




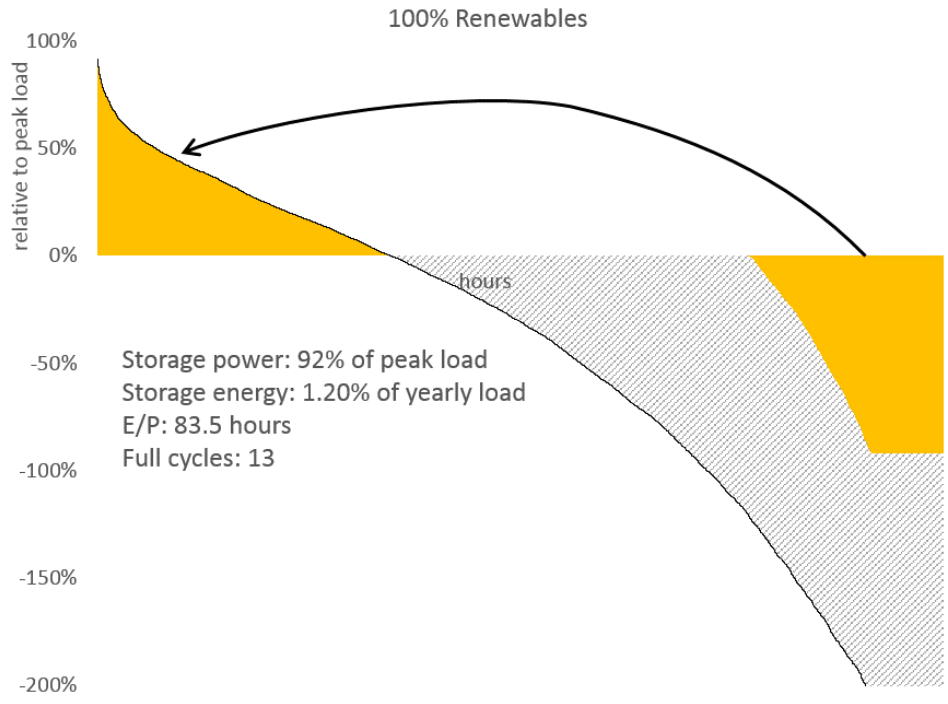
→ Sector coupling substitutes electricity storage and curtailment

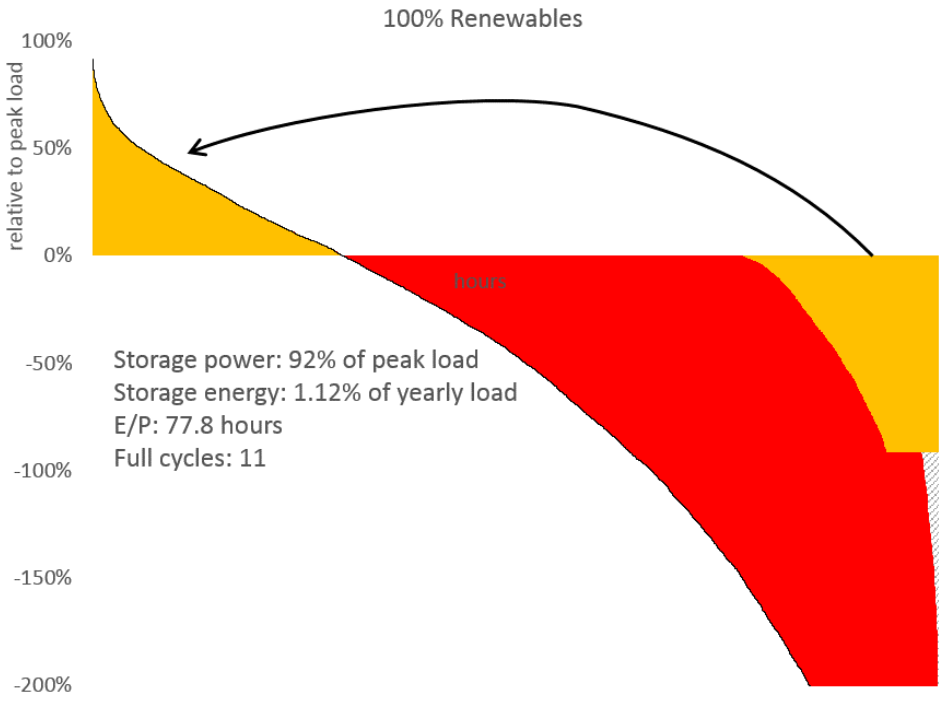
2 100% renewables and massive, flexible sector coupling

100% renewables



- Storage needs strongly increase vs. 90%
- Even massive sector coupling hardly changes optimal storage deployment
  → Again, left-hand side of RLDC
- If sector coupling is less flexible, additional electricity storage may be required…





Sector coupling | Renewable curtailment | Electricity storage | Dispatchable generation | Residual load

3 Conclusions

Policy conclusions

- Electricity storage concerns currently no reason to slow down renewable deployment
- Long-duration storage becomes key for high VRE shares
  - Focus for R&D
  - Incentives for market uptake to scale up, foster learning, and develop supply chains
- Enable sector coupling to become temporally flexible
  - Sufficient investment in heat and hydrogen storage
  - Non-distortive charges and tariffs

Conclusions for energy system research

- Research on „power sector only“ is over
- Put flexibility aspects of sector coupling in the focus
- Special case: Battery-electric vehicles → sector coupling with reconversion

Thank you for listening

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Backup: less flexible storage

Inflexible sector coupling increases electricity storage needs