DIW BERLIN

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

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

Overview of other FFF project results generated at DIW Berlin

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Future of
Fossil Fuels

DIW Berlin activities in the FFF project

- Three strands of DIW Berlin activities in FFF project
  1) Conceptual analyses of flexibility and sector coupling
  2) Numerical analyses using DIETER
  3) Empirical analyses of socioeconomic implications of energy infrastructure

1 Conceptual analyses of flexibility and sector coupling under a fossil fuel phase-out

- Three papers
  1) Role of electricity storage and sector coupling with increasing VRE shares

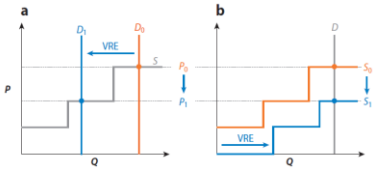
     → Published in *Joule* https://doi.org/10.1016/j.joule.2020.07.022
  2) Review paper: Economics of VRE and electricity storage

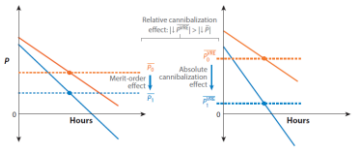
     → Preprint https://arxiv.org/abs/2012.15371, forthcoming in *Annual Review of Resource Economics* https://doi.org/10.1146/annurev-resource-101620-081246
  3) Extension to production theory: Elasticity of substitution of VRE and conventional energy inputs in production functions

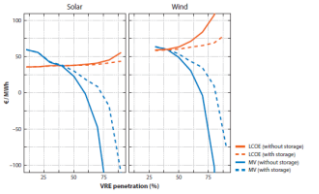
     → DIW Working Paper http://hdl.handle.net/10419/222934, *under review*

1.2 The economics of variable renewables and electricity storage (López Prol, Schill)

- Research question
  - Review of economics of VRE and electricity storage
- Method
  - Literature review
  - Stylized illustrations, partly made with DIETER
- Main results
  - Discussion of merit order and cannibalization effects
  - Electricity storage can mitigate these effects
- Conclusions
  - Storage and VRE are complementary:
    higher penetration of one increases value of the other
  - Further research on sector coupling required:
    effects on VRE integration and market values

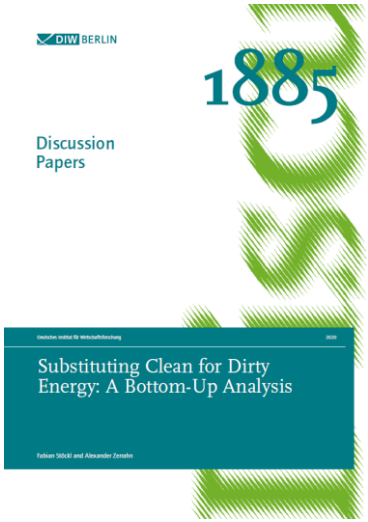






1.3 Substituting clean for dirty energy: a bottom-up analysis (Stöckl, Zerrahn)

- Research question
  - Substitution between VRE and conventional energy inputs changes with increasing VRE shares
  - Can this be adequately represented by aggregate production functions (CES, VES) in macro models?
- Method
  - Fit production isoquants to data derived with DIETER
- Main results
  - Yes, CES or VES can well represent this substitution
  - Common CES function works particularly well
  - Substitution easier with a mix of different VRE and storage techs
- Conclusions
  - Proof of concept for macroeconomic modeling
  - Different tech availabilities / costs can be parameterized in EoS



2 Numerical analyses using DIETER

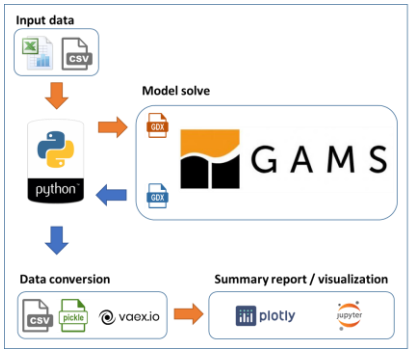
- Three papers
  1) Software development paper: DIETERpy

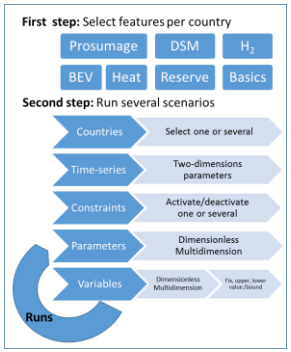
     → Published in *SoftwareX* https://doi.org/10.1016/j.softx.2021.100784
  2) Methodological paper: Unintended Storage Cycling

     → Preprint https://arxiv.org/abs/2107.13380, *under review*
  3) Paper focusing on power-to-mobility: Power sector effects of battery-electric vehicles in scenarios with fossil fuel phase-out

     → Work in progress, preprint should be available soon

2.1 DIETERpy: a Python framework for The Dispatch and Investment Evaluation Tool with Endogenous Renewables (Gaete et al.)





- Motivation
  - Maintain GAMS model core,
  - but use Python functionalities
- Method
  - Embed existing model in Python environment
- Main results
  - New features for pre- and post-processing
  - Easier scenario runs
  - Source code provided (Python package)
- Conclusions
  - Approach may also be useful for other energy models

3 minute video introducing DIETERpy (includes some singing): https://youtu.be/n7L0i5Dc5fM

3 Empirical analyses of socioeconomic implications of energy infrastructure

- Two econometric papers
  1) Paper on externalities of transmission infrastructure

     → Work in progress
  2) Paper on externalities of biogas plants

     → SOEPpaper http://hdl.handle.net/10419/229848, *under review*

3.1 External costs of electricity transmission infrastructure: evidence from well-being data (Roth et al.)

- Research question
  - Effect of electricity transmission infrastructure on life satisfaction of people living nearby
- Method
  - Spatial diff-in-diff design allows for causal conclusions
  - Use of general life satisfaction indicator reported in SOEP
- Intermediate results
  - So far, limited negative (correlational) effect on life satisfaction
  - Causal analysis work in progress
- Next steps
  - More robustness checks & analysis of channels

3.2 Quantifying the Externalities of Renewable Energy Plants Using Well-being Data: The Case of Biogas (Krekel et al.)

- Research question
  - Effect of biogas plants on life satisfaction of people living nearby
- Method
  - Spatial diff-in-diff design allows for causal conclusions
  - Use of general life satisfaction indicator reported in SOEP
  - Also considering wind direction and intensity
- Main results
  - Limited evidence for negative externalities
  - Moderate effects, and only for 2000m treatment radius
- Conclusions
  - Minimum setback distances, potential monetary compensation?

Figure 4: Depending on the distance to the nearest installation, a household is allocated to the treatment group, the control group, or does not enter the analysis.

Vielen Dank für Ihre Aufmerksamkeit.

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