**ABSTRACT**

In the project FFF, TU Berlin, PIK, and DIW Berlin investigate previously under-researched aspects of decarbonizing the German electricity sector in the European context. Specifically, FFF aims to derive an assessment of policy instruments for both the German and the European levels. In doing so, we consider a phase-out of all fossil fuels, in particular natural gas.

We focus on three aspects of the future of fossil fuels by (1) identifying drivers and hurdles for implementing a European fossil fuel phase-out by 2050; (2) investigating how national phase-out pathways interact with European climate policies; and (3) analyzing interactions between a fossil fuel phase-out and power system flexibility requirements as well as the implications for sector coupling. Methodologically, the project builds on model-based analyses of the European power sector and case studies for Germany, the United Kingdom, Poland, and the Netherlands, which together account for more than half of coal and two thirds of gas demand in the EU.

The innovative approach combines advanced methodology (numerical modeling, economic theory, econometrics, and political economy) with “hands-on” questions of current political decision making, considering relevant stakeholders in the German and the European context. Our contribution is application- and policy-oriented; we focus on the concrete challenge of disestablishing industries that produce and consume fossil fuels. Our products – scientific publications, regular stakeholder engagement formats, policy papers, and concrete policy advice – will stimulate the scientific and public debate on how to phase-out fossil fuels while minimizing negative side-effects and societal costs.

**WP2: TECHNO-ECONOMIC ASSESSMENT OF A EUROPEAN FOSSIL FUEL PHASE-OUT**

*The Global Energy System Model (GEoEYS-MODS) – an application of the Open Source Energy Systems Model (OSeMOSYS)*

- **Methodological approach**
  - Long-term Investment Model for the Electricity sector in Europe (LIMIES-EU)
    - Geographical scope: Europe (23 model regions)
    - EU 28, China and India
    - Detailed representation of electricity system
    - 33 generation and storage technologies
    - EU ETS energy-intensive industry modelled through a marginal abatement cost curve
    - Policy focus: EU ETS and MSR

- **Impact of the coal phase-out at the EU-level**
  - Source: www.cleanenergywire.org (2019); own work

- **Further research**
  - How do policies at the national- and EU-level interact in the presence of strong sector coupling?
  - Will the MSR remove the waterbed effect?
  - What policies could help mitigating the waterbed effect?

**WP3: EUROPEAN POLICY INTERACTIONS**

- **The Long-term Investment Model for the Electricity sector in Europe (LIMIES-EU)**
  - Detailed analysis of German power sector in European context
  - Long-term investment and dispatch model
  - Representation of various options for flexibility and sector coupling
  - Electrical storage
  - Flexible demand
  - Sector coupling: heat, mobility, hydrogen

- **Impact of the market stability reserve?**
  - Source: Joint Working Group Energy Models

- **Further research**
  - How do policies at the national- and EU-level interact in the presence of strong sector coupling?
  - Will the MSR remove the waterbed effect?
  - What policies could help mitigating the waterbed effect?

**WP4: SECTOR COUPLING AND FLEXIBILITY REQUIREMENTS**

- **Open-source power sector model DIETER**
  - Detailed analysis of German power sector in European context
  - Long-term investment and dispatch model
  - Representation of various options for flexibility and sector coupling
  - Electrical storage
  - Flexible demand
  - Sector coupling: heat, mobility, hydrogen

- **We build on previous work on variable renewables and sector coupling**
  - Generic analysis of a power system with high shares of renewables (and some remaining fossil fuels)
  - Stylized power-to-x technology
  - If power-to-x is sufficiently flexible in time, it can substantially reduce required electrical storage capacities

- **Further research**
  - How does a cost-efficient power system look like when fossil fuels are phased out?
  - Focus on interactions of sector coupling technologies and storage: electric vehicles, power-to-gas
  - Socio-economic aspects: econometric analyses

**WP6: SYNTHESIS AND POLICY RECOMMENDATIONS**

Stakeholder discussions on possible pathways for (liquefied) natural gas and related actors