Fossil Fuels, Global Energy, and International Policy:
Qualitative and Quantitative Scenario Forecasting Towards 2055

by

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Extended Abstract

The future of global energy and fossil fuel markets is subject to numerous uncertainties, which is why researchers make use of different techniques to predict possible pathways. While qualitative forecasting can include a wide range of factors, it fails to estimate system-wide consequences and reliable numbers. Quantitative forecasting, on the other hand, delivers consistent and precise numerical results, but it is inherently bound by the model's underlying assumptions.

This study aims to bridge between both worlds and give independent insight into four distinct, novel scenarios of future developments. Our scenarios (base case 'Business-as-usual', worst case 'Survival of the Fittest', best case 'Green Horizon', and surprise scenario 'ClimateTech') were established as storylines using multiple scenario generation, including an expert-led scenario workshop. Then, key variables of each storyline (e.g. emission targets, transport possibilities, reference demand trajectories) were extracted and fed into Mutimod, a DIW-maintained multi-fuel, multi-sector numerical partial equilibrium model with endogenous investments and fuel substitution. The model, originally a MCP, was reformulated into a convex NLP, i.e. a minimisation of the scalar potential of the stationarity conditions.

In contrast to previous work, our conceptual approach focuses on changes in the global order, the behavioural perception of climate objectives, and resulting technological pathways. The scenarios provide an understanding how emerging trends of today may be 'weak signals' of forthcoming threats and opportunities. They do not attempt to predict the state of the global energy system by the year 2055 but rather give bounds to the range of plausible alternative futures by defining certain trajectories, downside risks, new trends, and 'unknown unknowns' that could significantly affect markets and policy in the years to come.

Sets of indicators for each scenario help identify different easy-to-observe situations that provide a signal that the future develops into the direction of either of the scenarios. Model results quantify key variables along the trajectories of each scenario, particularly energy supply and demand, power fuel mix, investments, and CO2 emissions. Also, results quantify asset stranding between the scenarios and reveal time-inconsistent investments with potentially-devastating economic consequences in certain regions.

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The scenarios make clear that is necessary to look beyond the economics of energy markets for a comprehensive understanding of climate policy. In turn, several factors can be influential – and can therefore be tackled by policy-makers. The prospects and likelihoods for an energy transition are distributed unequally, and a successful global energy transition is strongly tied to international relations and the global state of security as well as the integration of energy transition with wider economic objectives.