

Energy outlooks compared: Global and regional insights

Dawud Ansari, Franziska Holz, Hashem al-Kuhlani

Executive Summary

Scenarios are a widely used tool to assess the conditions and effects of alternative future developments in the energy sector. Scenarios can be defined as consistent and coherent descriptions of alternative futures that help explore the range of plausible futures rather than aiming at finding the most probable among them.

For this study, we consider prominent energy scenarios with different characteristics and methods. First, we consider the World Energy Outlook (WEO), which is published by the International Energy Agency (IEA) – an intergovernmental, public body established in the framework of the OECD – and arguably the most prominent energy outlook. We also consider the energy outlooks published by the World Energy Council (WEC), a global energy body with UN accreditation; the international oil companies Royal Dutch Shell, BP, Equinor, and ExxonMobil; as well as the research institution MIT; and the scientist-led civil society organisation Energy Watch Group (in cooperation with LUT University). Moreover, we add our own recent energy outlook to the comparison: four scenarios that are the result of research at the Resource and Environmental Market division at the German Institute for Economic Research DIW Berlin (DIW-REM).

Most organisations develop several scenarios in the same outlook with the desire to englobe a large range of potential futures. As the uncertainty and, hence, the spread between scenarios, increases over time, the entire range of potential futures is often referred to as the “scenario cone”. The outermost limits of this cone are scenarios that are objectively impossible, followed by futures that are possible but not necessarily plausible. Plausible scenarios, in turn, occupy the cone’s core. Scenarios that extrapolate current trends most closely are usually called ‘probable’ scenarios, whereas (un-)preferable scenarios can be found at the core’s boundaries. We typically refer to them as “best” (“worst”) cases.

We also distinguish whether scenarios are exploratory (i.e. what will happen in a specific setting?) or normative (i.e. what should happen?). Both are entirely different ways to approach scenarios: Exploratory scenarios start in the present and analyse how the future evolves given certain conditions and assumptions. Normative scenarios (“target scenarios”) are futures that are constructed deliberately to reach a certain final state, for example an emissions target. In the energy world, for instance, an exploratory scenario could analyse which energy mix will unfold towards 2050 if a certain policy is adopted, while a normative scenario could assume (“target”) a carbon-free energy sector by 2050 and analyse a pathway from today to that 2050 world.

Many of the outlooks discussed in this article contain “best cases” and “worst cases”, for which the line between explorative and normative is blurry. Their deliberate aim is to illustrate (un-)preferable futures. Yet, they are explorative in nature as long as they were generated based on (present) drivers (as opposed to pre-defining a final target).

All scrutinized outlooks deal with the entire energy system on the supply and the demand side, including the ones by the major oil companies. They are, hence, more comprehensive than sectoral scenario analyses. We include outlooks that are recognised strongly by both an academic and a non-academic audience. Moreover, we have chosen outlooks from different kinds of actors that create scenarios (a government agency, private energy companies, research institutions, and civil society). Limiting the scope of the survey to nine outlooks allows us to present detailed remarks with regards to the individual outlooks. At the same time, we want to present the existing variety of potential trajectories and do not limit our analysis to 2°C scenarios.

We collect meta information on the scenarios and energy system indicators (primary energy demand and fuel shares on the global and the regional level) which provide compact overviews. We make several observations that may inspire future research.

First, the various outlooks exhibit different degrees of an elaborate qualitative side with the inclusion of storylines and the analysis of drivers. There is no clear pattern as to whether outlooks with a strong qualitative foundation would entail fundamentally different trajectories than outlooks without. We have found, however, that some of the outlooks with a stronger qualitative side show more mid-term fluctuations, i.e. their numerical trajectories tend to be non-monotonous, potentially as a result of the qualitative input. Moreover, missing a qualitative elaboration makes it harder to assess a scenario's social, technological and political feasibility.

Second, to varying degrees, world-wide outlooks seem to neglect the regional dimension. This manifests in varying degrees of regional coverage where some outlooks provide virtually no regional numbers or developments, but also in the quality of the numerical indicators. Many regional trajectories towards 2050 are can be categorized better by outlooks (i.e. by the publishing organisation) than by content (e.g. best cases vs. worst cases).

Third, regarding the success of climate change mitigation, a variety of options seems to be plausible. Some scenarios rely on a very strong role of renewables, others on a substantial role of negative emission technologies with fossil fuel use, yet others on assuming decreasing energy demand. This means that neither the share of renewables nor future energy demand are good indicators to assess whether a scenario is effective in climate change mitigation. While some scenarios with high shares of renewables fail to curb emissions, other scenarios with lower renewable shares eventually succeed in it. Similarly, while some climate-friendly scenarios consider a stagnation of primary energy demand, others exhibit growth rates of primary energy demand even above those of other futures without successful climate change mitigation. Moreover, our survey backs the observations that current paths are incompatible with the Paris Agreement's 2°C target.

Fourth, our observations have raised concerns about a lack of transparency in data and methods but also about differences in accounting across the outlook spectrum.

We conclude that – while there is no consensus between outlooks on how to attain low-emission futures towards 2050 – the actual inclusion of a qualitative analysis of drivers and storylines helps ensure the political, social and technological feasibility of scenarios.