

# **[PRESENTATION ON SHELL'S NEW LENS SCENARIOS AND THE WORLD ENERGY MODEL]**

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## **Overview**

Shell has been developing scenarios to explore the future and deepen its strategic thinking for 40 years. The scenarios draw on wide-ranging expertise from inside and outside the company and over time, have gained a global following among governments, academia and business.

Shell's New Lens Scenarios provide an in-depth analysis of how economic, social and political forces might play out over the 21st century, as well as their consequences for the global energy system and environment.

They set out multiple, contrasting views, and create plausible stories around them.

Our scenarios are part of an ongoing process used in Shell that challenges our executives' perspectives on the future business environment. They help the company see opportunities and risks more clearly, and use those insights to make informed business decisions.

From the outset in building the new scenarios, the Shell Scenarios team appreciated the need for a tool that could help them model the energy aspects of the alternative futures that it came up with. Understanding the pathways to these futures was critical. Any model had to be able to cover the whole world, encompassing all plausible energy sources over a time horizon of 50 years.

Shell's World Energy Model (WEM) is a comprehensive model of the world's supply and demand for energy at a global level, integrating economic evidence on aggregate demand for energy, the choices influencing the energy mix and a bottom up research on the availability, access and speed of development of different resources and technologies.

## **Methods**

Shell scenarios differ from other annual outlooks or forecasts in that they are not mechanistic predictions: they explore multiple, contrasting views of the future and create plausible, quantified stories around them.

Shell scenarios go beyond traditional energy outlooks – they cover a broad set of drivers and trends in economics, geopolitics, social change, and environmental stresses on water and climate. They are based on plausible assumptions and quantification, and include the impact of different patterns of individual and collective choices.

Shell scenarios consider developments further into the future than most energy outlooks (up to 2100 in the case of the New Lens Scenarios), recognising the long timescales of energy infrastructure and the consequences of today's choices.

The WEM combines important physical and engineering considerations with political and social trends and a sound economic approach to balance supply and demand. As such, it is a partial equilibrium model focused on the energy system.

The WEM comprises three principal components: the Energy Ladder, Energy Choice and Energy Supply modules. Feedback from the supply module ensures a balancing of supply and demand.

The Energy Ladder represents the way aggregate energy demand responds to changes in prices and incomes (GDP). The Energy Choice is a two-stage process to determine the energy mix. The first stage assigns the final forms of energy (electricity, gasoline) to different end-use sectors. The second takes the demand for these energy carriers and seeks to meet these by drawing on the energy sources.

The third module is a representation of the supply potential for each of the energy sources (e.g. oil, nuclear, wind energy). It is a combination of build-rate constraints, physical supply potential, cost-of-supply curves for renewables and scenario-dependent supply outlooks.

## Results

The New Lens Scenarios set out two distinct directions the world might take in the decades ahead.

Mountains imagines a world of more moderate economic development in which policy plays an important role in shaping the world's energy system and environmental pathway. This scenario sees governments retain the authority to introduce firm and far-reaching policy measures. These help to develop, for example more compact cities and transform the global transport network. New policies unlock plentiful natural gas resources and accelerate carbon capture and storage technology, supporting a cleaner energy system.

Mountains describes a world where sluggish economic growth reduces the pace of energy demand growth. Gas becomes the "backbone" of a cleaner global energy system; natural gas emerges as a backup for renewable energy and global natural gas consumption increases by more than three-quarters by 2035. Oil is displaced from the global transport mix.

Oceans envisions a more prosperous, volatile world with an energy landscape shaped mostly by market forces and civil society, with government policy playing a less prominent role. Energy demand surges, due to strong economic growth. Influence is more widely distributed and governments take longer to agree major decisions. Market forces rather than policies shape the energy system: oil and coal remain part of the energy mix but renewable energy also grows: by the 2070s solar becomes the world's largest energy source.

Oceans describes a world where high energy prices, rather than policies, shape the evolution of the global energy system for several decades. Gas grows but plays a less prominent role than in "Mountains". High oil prices serve to prolong the oil era. Demand for coal remains high in the power sector until at least mid-century. Solar PV enjoys striking success among renewable energy sources.

Neither the Mountains nor the Oceans scenario is intended to be preferable to the other.

## Conclusions

According to our Shell Scenarios, in the next 50 years global energy demand could be 60% higher than its level in the year 2015, as wealth levels rise in the emerging economies and the global population expands to 9 billion.

Fossil fuels will continue to supply the majority of energy demand for decades, but renewable sources will also grow rapidly. In both the Mountains and Oceans scenarios, the pace at which renewable energy sources grow is determined by what societies can afford to spend on them and the political will to invest in new forms of energy technology.

A cleaner energy system is one that has cleaner fossil fuels at its core. Replacing coal-fired power with natural gas, the cleanest-burning fossil fuel, can make the biggest contribution to reducing CO<sub>2</sub> emissions over the next 25 years. The more abundant the world's available resources of low-cost gas, the quicker the world can move to displace coal.

Carbon capture and storage (CCS) technology will be critical to tackling the world's greenhouse gas emissions, even if renewable energy grows quickly.

Lastly, strong, co-ordinated and proactive national and international policies are essential to meeting the world's rising energy needs, and safeguarding the environment for future generations.