Energy for a Shared Development Agenda: The three scenarios

Our assessment considers three scenarios from 2009 through 2050. Here we summarize key assumptions and findings. A collection of high-resolution graphics from the report is available on the SEI website.

Baseline scenario (BAS)

This scenario examines global "business as usual" trends for population, greenhouse gas (GHG) emissions, macroeconomic indicators, energy consumption and production, and resource use. It assumes that current economic and energy policies will broadly continue, without major efforts to tackle climate change.

Global energy demand rises from 365 exajoules (EJ) in 2010 to 775 EJ by 2050. Global CO_2 emissions rise to 64% above 1990 levels by 2020 and to 152% above 1990 levels by 2050, for a 98% likelihood that global average temperatures will increase by more than 2°C.

The dramatic growth in emissions results from rapid population and economic growth, particularly in developing countries. Even so, emissions intensities (tonnes of CO_2 per USD) show significant improvements as energy efficiency converges towards the lower values generally seen in industrialized nations.

Coal, oil and gas continue to dominate primary energy use, rising slightly from 81% of the total in 2010 to 83% in 2050. The pattern of primary energy use shifts dramatically: while in 1990, more than 66% of primary energy use was in the developed world, by 2050, 65% occurs in the developing world. However, due to continued disparities in wealth, developing nations' per capita emissions remain far below those of richer regions.

Electricity generation almost triples, from 19,000 TWh in 2010 to 57,000 TWh in 2050, dominated by natural gas and coal. Hydropower more than doubles, while nuclear power declines slightly; wind and solar generation grow to 13% of global generation by 2050. Carbon capture and storage (CCS) is not significantly deployed.

Basic energy access scenario (BEA)

This scenario starts with the same basic macroeconomic and demographic assumptions as BAS, but explores the implications of providing basic energy access for all by 2050 – defined as energy for household lighting, heating and cooking – without addressing poverty in more fundamental ways, so average incomes in the poorest countries don't change.

At the same time, energy systems are constrained by limiting limits global GHG emissions to 1,300 Gt CO_2 between 2000 and 2050 (406 Gt of which has already been emitted), for a 60% chance of keeping global warming under 2°C.[1] Reflecting the current status of climate negotiations, major mitigation efforts are not assumed to begin until at least 2015, with the poorest regions beginning significant efforts only after 2020.

In this scenario, energy demand dramatically decreases due to concerted efforts to improve energy efficiency and sharply reduce the energy intensity of economies. Primary energy use continues to rise until 2020, peaking at 575 EJ but declining to 441 EJ by 2050. Global CO_2 emissions increase by 38% in 2020 relative to 1990, but by 2050 decrease by 92% compared with 1990 levels.

Because of the slower growth and more stringent reductions in energy intensity in the global North, primary energy use there peaks at 257 EJ in 2010 and drops to 99 EJ in 2050. In the South, it stays essentially flat after 2020 at about 330 EJ, as energy intensity reductions are roughly balanced by rapid economic growth.

The energy mix in this scenario is completely different from the baseline mix. Conventional fossil fuels are phased out before 2050, while electricity generation from wind, solar and other renewable sources increases by a factor of 8.8 to meet the increased demand. Generation from nuclear power grows by a factor of 2.8, while CCS-based generation from coal and natural gas is deployed extensively, providing almost 20% of electricity by 2050. Biomass use almost doubles, from 49 EJ in 2010 to 93 EJ in 2050.

[1] The carbon budget follows Meinshausen, M. et al. (2009) 'Greenhouse-gas emission targets for limiting global warming to 2°C'. *Nature*, 458. 1158–63. http://dx.doi.org/10.1038/nature08017. The authors note that while scenarios usually aim for a 67% likelihood of keeping warming to 2°C, their analysis shows achieving that level of emission reductions "is now almost impossible" (see p.18).

Shared development agenda scenario (SDA)

This scenario builds on the BEA scenario, but explores the implications for energy systems of providing energy to support more extensive development in the poorest regions. Specifically, it assumes that all nations attain per capita incomes of at least $10,000 (in 2005 purchasing power parity terms) by 2050, while growth in wealthiest regions is reduced, leading to a more balanced income distribution.

In this scenario, energy demand rises sharply across much of Africa, and to a lesser extent, in South Asia. Yet global energy demand is only 33.5 EJ (11%) higher in 2050 than under BEA, partly due to sharper reductions in U.S. and Canadian energy use, but with no major changes elsewhere. Carbon emissions increase minimally.

The sharp energy demand increases in Africa and Asia reflect rapid income growth and accompanying rises in demand for household energy. Demand also increases for energy for productive uses, such as industry. To meet the targets of the scenario, energy intensities have to decline fast, at 2.8% per year reaching only 32% of the 2010 value by 2050. In part these reductions can be achieved through massive energy efficiency investments, but they are also likely to require some lifestyle changes, especially in wealthier countries.

It is important to note that the energy transitions in this scenario look very different across regions, depending on their energy mix, available resources, economic structures, and income trends. The figures below illustrate some of these differences; for more details and additional graphics, see Chapter 2 of the report.

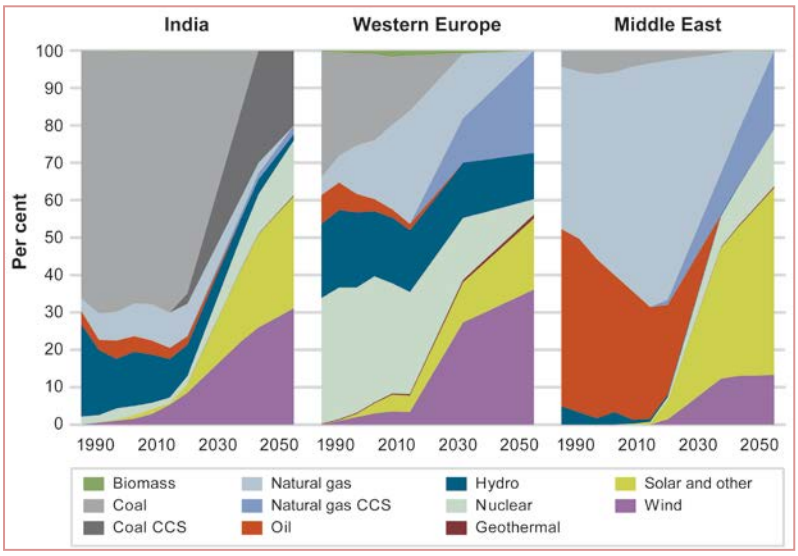

Figure 2.22: The evolution of electricity generation in percentage terms, by fuel, in the SDA scenario in India, Western Europe and the Middle East
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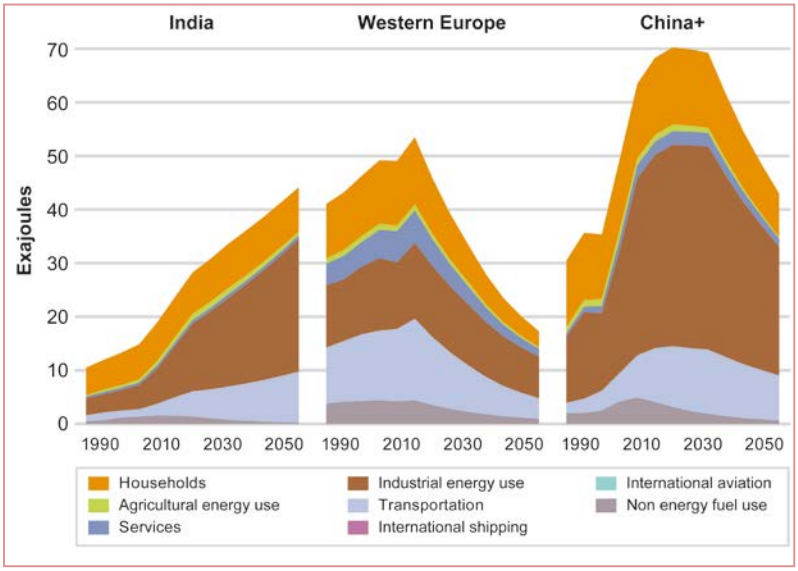

Figure 2.23: The evolution of energy demand by sector in exajoules (EJ) in three regions: India, Western Europe and China+ under the SDA scenario
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Note: The energy scenario analysis that underlies this report was produced with SEI's LEAP (Long-range Energy Alternatives Planning) software system, used by governments, academics, NGOs, companies and energy utilities in more than 190 countries for energy and climate change mitigation planning.