

World Energy, Technology and climate policy Outlook 2030

KEY MESSAGES

Reference scenario

- The WETO study describes a Reference scenario that provides a description of the future world energy system, under a continuation of the on-going trends and structural changes in the world economy (a “business and technical change as usual” context). The scenario results should be seen as a **benchmark** for the assessment of alternatives, particularly with respect to resources, technologies and environmental policy. A sound understanding of the long-term issues is a key element in establishing future research and technological development priorities in the field of energy and environment. The Reference scenario does represent a baseline performance which can be bettered if appropriate policies are put in place.
- **World energy demand** is projected to increase at about 1.8%/year between 2000 and 2030. The impact of economic and population growth (respectively 3.1% and 1%/year on average), is moderated by a decrease in the energy intensity of 1.2%/year, due to the combined effects of structural changes in the economy, of technological progress and of energy price increases. Industrialised countries experience a slowdown in the growth of their energy demand to a level of e.g. 0.4%/year in the EU. Conversely, the energy demand of developing countries grows rapidly. In 2030, more than half of the world energy demand is expected to come from developing countries, compared to 40% today.
- The world energy system will continue to be dominated by fossil fuels with almost 90% of **total energy supply** in 2030. Oil will remain the main source of energy (34%) followed by coal (28%). Almost two-thirds of the increase in coal supply between 2000 and 2030 will come from Asia. Natural gas is projected to represent one quarter of world energy supply by 2030; power generation provides the bulk of the increase. In the **EU**, natural gas is expected to be the second largest energy source, behind oil but ahead of coal and lignite. Nuclear and renewable energies would altogether represent slightly less than 20% of EU energy supply.
- Given the continued dominance of fossil fuels, **world CO₂ emissions** are expected to increase more rapidly than the energy consumption (2.1%/year on average). In 2030, world CO₂ emissions are more than twice the level of 1990. In the EU, CO₂ emissions are projected to increase by 18% in 2030 compared to the 1990 level; in the USA the increase is around 50%. While the emissions

from developing countries represented 30% of the total in 1990, these countries are responsible for more than half the world CO₂ emissions in 2030.

- Sufficient **oil reserves** exist worldwide to satisfy the projected demand during the next three decades. However the decline in conventional oil reserves may constitute a preoccupying signal beyond 2030. It is only partly compensated by an increase in the reserves of non-conventional oil. The reserves of natural gas are abundant and expected to increase by around 10%. There is no constraint on coal reserves over this time horizon.
- **World oil production** is projected to increase by about 65% to reach some 120 million bl/day in 2030: as three quarters of this increase comes from OPEC countries, OPEC accounts for 60% of total oil supply in 2030 (compared to 40% in 2000).
- **Gas production** is projected to double between 2000 and 2030. However, regional disparities in gas reserves and production costs are expected to modify the regional gas supply pattern in 2030: about one third of the total production will originate from the CIS, while the remaining production will be almost equally allocated among other regions.
- **Coal production** is also expected to double between 2000 and 2030, with most of the growth taking place in Asia and in Africa, where more than half the coal would be extracted in 2030.
- The **oil and gas prices** trend corresponds to a significant increase from current levels: the oil price is projected to reach 35 €/bl in 2030 with gas prices at 28, 25 and 33 €/bl in 2030 on the European/African, American and Asian markets respectively. The regional gas price differentials are expected to diminish significantly, reflecting more comparable gas supply mixes. The coal price is expected to remain relatively stable at around 10 €/bl in 2030.
- The **final energy demand** will grow at a similar pace to the gross inland consumption. As all **sectors** are expected to experience similar growth, their share in final demand will remain roughly constant at world level: around 35 % for industry, 25 % for transport and 40 % for the residential and tertiary sectors. The energy demand by sector shows different patterns according to the regions: in developed countries, energy demand in the services sector is the fastest growing segment; in developing countries, all sectors experience sustained growth at 2 to 3 %/year.
- **Electricity** continues its penetration in all regions, accounting for almost a quarter of final energy demand; coal declines in industrialised countries; biomass is progressively phased out in developing countries. **Oil** remains the dominant fuel, with a share ranging from 40 to 50 % in 2030 according to the region.
- **Electricity production** increases steadily at an average rate of 3 %/year. More than half of the production in 2030 will be provided by technologies that

emerged in the nineties and afterwards like combined cycle gas turbines, advanced coal technologies and renewables.

- The share of **gas in power generation** increases steadily in the three major gas-producing regions (CIS, Middle East and Latin America) and the share of coal decreases in all regions, except in North America where it stabilises and in Asia where it increases significantly. The development of **nuclear** power does not keep pace with total electricity production: its market share comes down to 10 % in 2030. **Renewables** covers 4 % of the production (from 2 % in 2000), mainly because of a rapid progression in electricity production from wind.

Sensitivity to changes in hydrocarbons resources and technology developments

- With **lower hydrocarbons resources**, oil and gas prices are projected to be much higher than in the Reference at around 40 €/bl for oil in 2030. This induces a lower world energy demand (-3%), which particularly favours coal and non-fossil energies, and curtails demand for natural gas (-13%) and oil (-6%). As a result, world CO₂ emissions are 2% lower than in the Reference.
- Conversely, **increased gas resources** would lead to a drop in gas prices to 16, 20 and 28 €/bl in 2030 on the American, European and Asian markets respectively. Oil price decreases only slightly reflecting the limited potential for substitution between oil and gas. Although the world energy demand is slightly affected (+1.5%), the fuel mix is substantially modified in favour of natural gas (+21%, against -9% for coal, -3% for oil and -4% for primary electricity).
- **Accelerated technology developments for electricity generation** lead to significant changes in the structure of electricity production. Important though the power sector may be, it only accounts for about one third of world CO₂ emissions. Technologies only addressing this sector thus have a limited impact on total CO₂ emissions. The availability of advanced technology, however, can have considerable impact on the cost to meet emission reduction targets.

EU gas market in a world perspective

- The **EU gas market** is rapidly expanding and growth is expected to continue in the next two decades, driven by the "dash for gas" for power generation. Nevertheless, the EU contribution to world gas consumption is expected to decrease steadily.
- **World gas reserves** are abundant but concentrated in two world regions, the CIS and the Middle East, where gas production is projected to grow considerably during the next thirty years. In contrast, the European gas resources are limited and production is expected to decline steadily beyond 2010, resulting in an increasing dependence on external gas supplies.

- **Natural gas demand** is also projected to increase in the other world regions: some of them with limited or declining gas reserves will become net importers leading to important changes in the world gas trade patterns. For instance, the rapid growth of gas demand in Asia is expected to have some influence on the EU gas supply pattern in 2030: while Asia is projected to rely predominantly on gas supplies from the Middle East, the EU and Accession countries may import more than half their natural gas needs from the CIS.
- This outcome may translate into higher **supply risks** for the EU. These risks could however be limited through different actions as outlined in the EC Green Paper, like the multiplication of gas transport routes, the further integration of the European gas network, and a continuous dialogue with gas producing countries. Long-term contractual LNG supplies are projected to increase but more moderately and from more diverse sources in Africa and the Middle East.

Impacts of climate change policies

- By attaching a **carbon value** to fossil fuel use, CO₂ emissions in 2030 are 21 % lower than in the Reference at world level and 26 % lower in the EU and Accession Countries. At the world level and in most regions, this reduction is achieved by equal reductions in energy demand and in the carbon intensity of energy consumption.
- In the **carbon abatement case**, more than half of the world energy demand reduction is achieved in the industry sector. The **decrease in carbon intensity** comes mainly from the substitution of gas and biomass for coal and lignite and to a lesser extent oil; gas demand remains roughly stable as fuel switching in favour of gas takes place. In contrast, the consumption of biomass increases significantly and nuclear progresses considerably while large hydro and geothermal remain stable; finally, wind, solar and small hydro jump up by a factor of 20.