A new age in electrification

Low-carbon electricity is at the core of a sustainable energy system

Low-carbon electricity is a prerequisite to reducing fossil fuel use and to mitigating CO_2 emissions not only in power generation but across all the end-use sectors (industry, transport and buildings). The power generation sector is responsible for roughly 40% of CO_2 emissions, but it is a relatively centralised sector. Decarbonising the world's power sector impacts the entire energy system and is crucial for achieving deep emissions cuts in a relatively short time, until 2050, as required in the ETP 2012 2°C Scenario (2DS), which if achieved gives the world an 80% chance of keeping average global temperature rise below 2°C compared to pre industrial levels.

- In the 2DS, the power sector must cut global CO_2 by almost 80% in 2050 from today's level of 12 $GtCO_2$ per year. Deployment of low-carbon technologies can cut average emissions per kilowatt-hour of the electricity mix by nearly 90%, from around 500g/kWh in 2009 to 60g/kWh in 2050.
- Zero- or low-carbon technologies supply 90% of the global electricity demand in 2050: renewable technologies reach a share of 57% in the world's electricity mix (a sixfold increase from today in absolute terms), nuclear power provides around 20%, and power plants equipped with carbon capture and storage (CCS) contribute 14%.
- The total investments in transmission and distribution (T&D) networks until 2050 in 2DS and 4DS only differ by 2% to 12%, depending on the region. The additional investments to integrate renewable generation in the 2DS roughly outweigh the larger infrastructure requirements in the 4DS due to overall lower energy efficiency. The additional investments to integrate variable renewables do not make up more than 10% of total investments in T&D in the 2DS.
- The flexibility of the electricity system operation must increase, requiring the development of smart grids, stronger grid interconnections, electricity storage and demand-side response measures. Smart grids are cost-effective and deliver a 2:1 to 4:1 return on investment depending on the region.
- Today's technology choices define future challenges. Around 1 000 GW of existing coal capacity (or capacity under construction) may still be operating in 2050, producing annual CO_2 emissions of 4 Gt. This exceeds by far the global CO_2 emissions of 2.5 Gt in the power sector in the 2DS. Co-firing with biomass and retrofitting with CCS can reduce the carbon intensity of this locked-in capacity, but the 2DS requires early retirement of around 850 GW of coal-fired energy capacity.
- The average cost of generating electricity will rise by 40% to 50% in all ETP 2012 scenarios between today and 2050. But the cost differences between scenarios will be modest, with an average increase of 10% at the global level in the 2DS in 2050 compared to the 4DS. Reduced demand, lower technology costs and lower fossil fuel prices are the three most important parameters that keep electricity costs from rising at a much faster rate in the 2DS.
- In the 2DS, natural gas acts as a transitional fuel towards a low-carbon power system, displacing coal, but carbon emissions from natural gas are not low enough to meet the levels required in the 2DS for the long term. Carbon intensity of the global electricity mix becomes lower than the specific carbon emissions from combined cycle gas turbine (CCGT) plants, the most efficiency gas power plants, by 2025 at the latest.

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