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Achieving Net-Zero Electricity Sectors in G7 Members

The IEA has been supporting the UK government's COP26 Presidency, including co-hosting in March 2021 the IEA-COP26 Net Zero Summit with (at that time) COP26 President-Designate Alok Sharma. To inform policy makers, industry, investors and citizens in advance of COP26 , the IEA recently published its report, 'Achieving Net-Zero Electricity Sectors in G7 Members'. The report was prepared following the G7 Climate and Environment Ministers' Meeting in May 2021, where the UK Presidency of the G7 requested a report on a pathway to electricity sectors with net zero emissions in the G7 by 2035.

In 2020, G7 members – Canada, France, Germany, Italy, Japan, the United Kingdom, the United States plus the European Union – accounted for about 40% of the global economy, 30% of global energy demand and 25% of global energy related CO2 emissions, including 2.7 Gt from their electricity sectors. Use of coal, which once dominated their electricity mix, peaked years ago, together with total electricity sector CO_2 emissions. The primary causes of these reductions in recent years have been cheap natural gas in several markets and strong growth for renewables. In 2020, natural gas and renewables were their primary sources of electricity, each providing about 30% of the total, followed by nuclear and coal at close to 20% each.

With momentum building for countries and companies around the world to strengthen their energy and climate commitments, an increasing number have set targets to reach net zero emissions by mid-century or soon thereafter. The urgency of tackling greenhouse gas emissions was reaffirmed by the IPCC's report, 'AR6 Climate Change 2021: the Physical Science Basis' (see IEAGHG Blog of 20 August 2021), which asserted that the effects of climate change could come faster and be more intense than previously envisaged.

Building on its 'Net Zero by 2050 Roadmap', IEA's report provides a roadmap to achieving net zero emissions electricity in the G7, highlighting key milestones, emerging challenges and opportunities for innovation. It concludes that, considering country specific circumstances, the G7 could lead the way by shifting rapidly away from unabated coal towards low emissions sources while maintaining electricity security, thereby adding momentum to global efforts by economies around the world to reach net zero emissions by 2050.

CCUS plays a key role in meeting the G7's ambition for CO_2 emissions in its electricity sectors to be net zero by 2035. It helps meet the goal of net zero electricity, provides a low emissions source of seasonal flexibility to the electricity system, and contributes significantly to rising employment. In the NZE, when net zero for the electricity sector is reached in 2035, CCUS[1] provides 12% of the annual CO_2 reductions, with carbon removal technologies such as DAC and BECCS helping offset residual emissions.

[1] Retrofitting coal-fired power plants to reducing the emissions intensity of electricity generation involves fitting CCUS that could capture more than 95% of CO_2 emissions (for some technologies, capture rates could approach 100%) or to convert them to co-fire biomass or ammonia. Regarding higher capture rates, the report refers to IEAGHG (2019), Towards zero emissions CCS in power plants using higher capture rates and biomass.

Unabated coal-fired generation declines rapidly on the path to net zero emissions in the NZE, with no new unabated coal-fired plants approved from 2021. By 2030, total unabated coal-fired generation is reduced substantially, with just over 50 GW of capacity fitted with CCUS. By 2050, coal accounts for less than 1% of total generation, and all remaining coalfired capacity is fitted with CCUS.

While natural gas is the leading source of electricity generation in the G7 today, averaging around 30%, this is set to peak by 2023 in the NZE and decline rapidly thereafter. Fitting CCUS reduces the share of unabated gas from 31% in 2020 to less than 2% in 2035. In the 2020s, gas-fired power plants are equipped with CCUS or retrofitted to co-fire hydrogen, with gas CCUS generating nearly 400 TWh by 2035, enabling facilities to continue operating while cutting emissions.

Hydrogen also becomes important in the NZE; notably, a rapid shift to low-emissions options by 2030, with electrolysis accounting for more than half of hydrogen produced and fossil fuels with CCUS for the remainder.

Other key messages include:

- The G7 has an opportunity to lead the global energy markets towards net zero emissions by 2050.
- Decarbonising electricity is central to reaching net zero emissions, as it addresses the highest emitting sector today and enables the decarbonisation of other sectors.
- The electricity sector accounts for one-third of G7 energy-related emissions today, well below the peak share of nearly 40% in 2007: electricity sector emissions are on a decline with coal giving way to cleaner sources.
- Momentum is building as governments in the G7 are re-shaping the electricity policy landscape with net zero in their sights.
- Scaling up low-carbon technologies is the central pillar to achieve net zero, with wind and solar PV capacity additions scaling up from about 75 GW in 2020 to 230 GW by 2030.
- The expansion of low-carbon electricity goes hand-in-hand with phasing out unabated coal.
- Rapid electrification of end-uses is also needed to achieve net zero emissions by 2050, with energy efficiency moderating electricity demand growth.
- Net zero emissions from electricity in the G7 is part of the broader pathway set out in the IEA Net Zero by 2050: a Roadmap for the Global Energy Sector that establishes over 400 sector-specific and technology-specific milestones.
- Investments in electricity generation within the G7 triple in the coming decade in the IEA's Net-Zero Emissions Scenario (NZE), and then stabilise at about twice the current level in the 2030s and 2040s.
- The decarbonisation of electricity in the NZE creates many employment opportunities, including 2.6 million jobs in the G7 within the electricity sector in the next decade, although 0.3 million jobs are lost at fossil fuel power plants by 2030 plus reduced upstream jobs in fuel supply.

- The affordability of energy is crucial to ensuring a just and people-centred transition; in the long term in the NZE, households spend a lower share of their disposable income on energy in the G7.
- New challenges emerge as the share of electricity in total energy demand rises along with the share of wind and solar PV, leading to a tripling of hour-to-hour flexibility requirements in the G7 from 2020 to 2050.
- The challenges to electricity and wider energy security in the NZE require a whole systems approach.
- Innovation delivers about 30% of G7 electricity sector emissions reductions in the NZE to 2050 by bringing additional technologies to market.
- Innovation can be accelerated through international cooperation, building on existing initiatives, especially in the form of knowledge sharing and coordination of development and demonstration efforts.
- Digitalisation would also gain from international cooperation regarding best practices, unlocking benefits such as enhanced demand-side flexibility and approaches to cyber security.
- As advanced economies, the G7 must respond to global calls for major economies to go faster, as being a first mover will create spill-over benefits that support other countries' energy transitions.

COP26 President-Designate Alok Sharma said "*In this critical year of climate action ahead of COP26, I welcome this report, which sets out a roadmap for the G7 to meet the commitment, made earlier this year, to accelerate the transition from coal to clean power. The report also highlights the huge jobs and growth opportunities that this decade could bring, from scaling-up renewables and improving energy efficiency to driving digital solutions and deploying critical technologies.*"

Keith Burnard