

THE ROLE OF FOSSIL ENERGY DURING THE ENERGY TRANSITION IN APEC

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Overview

The 21 economies that comprise the Asia Pacific Economic Cooperation (APEC) forum are home to almost three billion people, produce 60% of global GDP, and account for the majority of total final energy consumption. The role of fossil energy in the APEC economies as these economies implement the energy transition will have important impacts on the demand and supply of these fuels over the coming decades. This paper utilizes the energy projections contained in the 8th Edition of the APEC Energy Demand and Supply Outlook to provide quantitative estimates of the potential role that fossil fuels can play in fueling the APEC region as it embraces carbon neutrality from now to 2050.

Methods

The 8th Outlook modelling involves decomposing the APEC energy system into multiple subcomponents spanning demand sectors (such as industry, transport, and buildings), transformation (power, heat, and refining), and supply (production and trade). Demand sector modelling relies on estimates of output, energy efficiency, fuel switching rates, activity rates, technology diffusion, and multiple other variables. Calibration occurs via knowledge-based iteration, particularly with economy-level experts. When demand is finalised, the power, heat, refining and supply, sector models deliver the required energy based on assumptions about fuel cost trajectories, and policy/market intervention. In the case of the power sector, a least-cost model is deployed. However, cost-based decisions are assumptions that are overridden if there is political backing for certain technologies or fuels that enhance their relative economic viability. There is a frequent iteration of results, with extensive review and input from economy and energy experts to arrive at final energy demand, transformation, and supply results.

The model was used to project energy demand and supply under two scenarios. The Reference (REF) scenario is a pathway where existing trends in technology development and deployment and policy frameworks continue. The Carbon Neutrality (CN) scenario illustrates a more aspirational pathway where energy efficiency, fuel switching, and technology advances substantially reduce CO₂ emissions from fossil fuel combustion by 2050. Technology maturity and commercial availability are key assumptions in the CN. Hydrogen supply chains – blue and green – are assumed to be available at scale starting in 2030 to serve end-use applications in the buildings, industry, and transport sectors. While technically possible, hydrogen consumption by the power sector is not considered.

Results

APEC continues to rely heavily on fossil fuels to fuel its economic activity throughout the CN scenario, but their role is significantly diminished. Use rises initially following the COVID-19 recovery, but electrification, along with higher material and energy efficiencies, in the end-uses sectors and deployment of renewables causes a steady decline in fossil fuel use starting in 2023. Overall fossil fuel supply requirements are down by half, while the fossil fuel share of supply falls from 86% today to close to 55% in 2050.

Coal use falls three-quarters as APEC members deploy more renewables and coal-to-gas switching in their pursuit of carbon neutrality. Coal's share of the supply mix falls from a third today to a tenth in 2050, down from a fifth in the REF. Use in power falls almost 90%, and by 2045, industry is the dominant sector using coal, for cement and steel production. Further reductions in coal use will require adopting lower-emitting end-uses for heavy industry.

Coal use falls at least three-quarters in all regions, except in south-east Asia, which grows a quarter, as the cement and steel that comes with significant economic growth generates demand by industry, and some economies elect to continue burning coal, some of it with CCS, to extend the life of existing assets by using the cheap, plentiful, but high-emitting resource. China and south-east Asia together make up 90% of APEC's coal use in 2050.

Oil use falls by half, mainly due to the adoption of EVs in road transport, but also efficiency improvements in both the industry and buildings sectors, and lower activity requirements from own-use energy stemming from declines in fossil fuel production. Non-energy use of oil remains resilient in the CN. Oil use falls about a half in most regions,

except Russia, where it falls a third, and south-east Asia, where it falls a quarter. Further reductions in oil use will require the adoption of lower-emitting end-uses for heavy industry and non-energy use.

Gas supply requirements grow 14% in the CN, as coal-to-gas conversions and the deployment of CCS on gas-fired units in the power sector and significant growth in steam methane reformation for hydrogen production more-than-offsets declines in other sectors. Supply peaks in 2041, falling over a fifth relative to the REF by 2050, as electrification in buildings reduces usage by a half, lower fossil fuel production reduces own-use demand by half, and fuel-switching and efficiency in industry reduces demand by a third. Gas supply falls in all regions except China, Russia and south-east Asia. Use in China more than doubles, as the economy grows into the largest gas user in the 2040s. The role of natural gas in a carbon-neutral global economy is contingent on the successful mitigation of methane leakages in the natural gas supply chain. Failing to contain these emissions would prompt global consumers away from natural gas in a carbon-neutral pathway.

While APEC continues to play a significant role in supplying world fossil fuels in the CN, facing lower domestic supply requirements and a declining global market, production is halved in the CN and trade falls over three-fifths. Coal production falls three-quarters, with trade falling two-thirds. APEC oil production in the CN never reaches its pre-pandemic peak, falling by half in the CN, and oil trade falls similar levels, with both imports and exports falling about a half. Gas production grows initially, peaking in 2032, and while trade grows over a third, it falls a quarter below REF levels by 2050.

Conclusions

The CN provides a touchstone for the level of fossil fuel energy required for APEC to pivot towards carbon neutrality by 2050 but still maintain a prospering economy. This scenario is one of many possible paths for APEC members to achieve this goal.

While there is a steady transition away from fossil fuels, fossil fuels still account for half of APEC energy supply by 2050. The modelled pace of change for the CN means that emissions are only slightly lower by 2030, are down two-thirds by 2050, and are not consistent with international climate commitments such as the Paris Accord or the net-zero goals of several APEC members. While the decoupling of fossil fuel use from GDP accelerates in this scenario, achieving these targets may require more transformation change than this pathway illustrates. Emissions from fossil fuel sources remain by 2050, and achieving carbon neutrality will require removals, offsets or further abatement via sequestration of these remaining emissions. Furthermore, the reality of a CN world is that all economies would need to adapt to faster rates of climate change, but less so than in the Reference scenario. Such changes would have implications for socio-economic outcomes and projections.

Natural gas plays a key role as a transition fuel in the CN scenario. However, APEC needs to prove that it can mitigate methane emissions throughout the supply chain. Commitments by some members to join the Global Methane Pledge and separate ambitions to reduce further methane venting and fugitives are welcome initiatives.

Coal consumption in APEC is still significant even in the CN scenario, especially in the power and industry sectors. It will continue to play a crucial role even during the transitional period in coal-reliant APEC economies.

Oil also continues to play a substantial in the transitional period, especially in transport, non-energy, industry and buildings sectors. While APERC assumes constant macroeconomic fundamentals in both Outlook scenarios, the declining revenues from a declining oil market could impact the economies of large-scale producer-exporters such as Brunei, Russia, Canada and the US. APEC members should investigate the economic implications of these trends for each producer-exporter.

The results presented here will require further reductions in fossil fuel use to achieve the NDCs in the Paris Agreement. This projection highlights the risk of stranding recent investment in fossil fuel infrastructure as a world embraces carbon neutrality.

References

Asia Pacific Energy Research Centre, APEC Energy Demand and Supply Outlook 8th Edition [scheduled to be published in June 2022]