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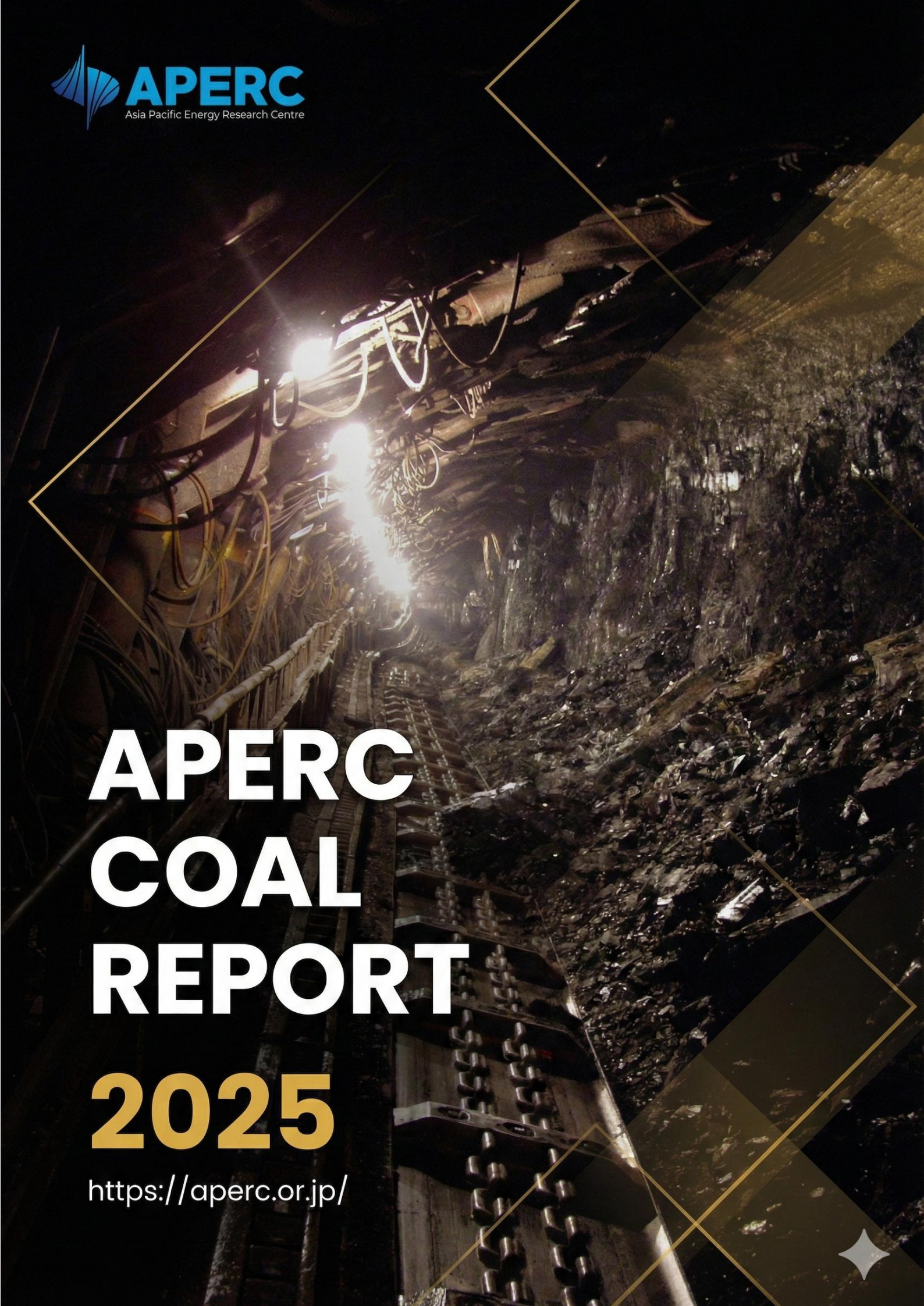

APERC COAL REPORT 2025

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Foreword

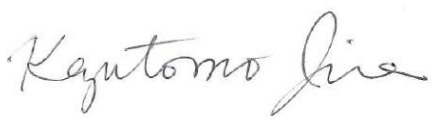
In 2024, APEC-wide coal consumption reached over 125 exajoules (EJ), surpassing its previous peak in 2014. At the same time, APEC coal production reached an all-time record high of approximately 145.5 EJ, representing a 0.6% increase relative to the previous year.

Coal consumption patterns across APEC economies vary in 2024. While the US saw a 3.5% decrease and Russia a 1.8% decline, emerging economies experienced growth, with Viet Nam increasing by 9.6% and Indonesia by 9.3%. China, the largest coal consumer in the region, recorded an all-time high coal consumption in 2024. These trends highlight a focus on affordable and reliable energy sources in developing economies, where coal-fired power plants remain a vital role in meeting baseload power needs. As a result, China, Indonesia, and Viet Nam are likely to continue operating existing coal power plants while also pursuing decarbonization efforts to reach net-zero goals.

Decarbonization of coal-fired power generation has become a priority across APEC economies, particularly through technologies deemed game changers for the sector. Notable milestones include China's Pingshan Phase II power plant, which achieved a world-record net efficiency of 49.4%. Additionally, Japan successfully demonstrated 20% ammonia co-firing at the Hekinan coal-fired power plant, confirming reductions in CO_2, NOx, and SOx emissions. Progress in Carbon Capture, Utilization, and Storage (CCUS) is also accelerating, with 17 coal-related CCUS projects now in various development stages across the region, totalling a capacity of 43 Mtpa.

The *APERC Coal Report 2025* provides updated insights into coal policies, consumption, production, trade, pricing, decarbonization technologies, and coal-related greenhouse gas emissions across APEC economies. This report is a part of the APERC Fossil Fuel Reports Series, published annually to support discussions within the APEC Expert Group on Clean Fossil Energy (EGCFE) and the broader APEC Energy Working Group (EWG).

On this occasion, I would like to extend my sincere gratitude to the author and contributors for their dedication to producing this report. I also appreciate the support of APEC member economies for providing updated data through the APEC Expert Group on Energy Data and Analysis (EGEDA) and supplying valuable comments.



Dr Kazutomo IRIE
Chairman and President
Asia Pacific Energy Research Centre

Acknowledgments

We would like to thank the APEC Expert Group on Energy Data and Analysis for supplying data. We also thank the administrative staff of APERC for their joint supportive role.

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Abbreviations and Acronyms

Abbreviations

EJ	Exajoules
GW	Gigawatt
Gt	Gigatonne
Mt	Million tonnes
Mtpa	Million tonnes per annum
PJ	Petajoules
TWh	Terawatt hour
USD	US Dollar

Acronyms

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CMM	Coal Mine Methane
CO_2	Carbon Dioxide
COP26	The 26th United Nations Climate Change Conference
EOR	Enhanced-Oil-Recovery
IEA	International Energy Agency
IGCC	Integrated Coal Gasification Combined Cycle
IGFC	Integrated Coal Gasification Fuel Cell Combined Cycle
REF	Reference Scenario
TGT	Target Scenario
USC	Ultra-supercritical

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Executive Summary

Divergent Policy Pathways and Net-Zero Targets: While 19 APEC economies have formally committed to net-zero or carbon neutrality by the middle of this century, coal phase-out strategies remain divided. One group, including Canada, New Zealand, and the Philippines, has committed to phasing out unabated coal under agreements like the COP26 Statement. Conversely, emerging economies prioritizing energy security, such as China, Indonesia, and Viet Nam, continue to maintain and expand coal fleets for reliable baseload power while investigating decarbonization pathways.

Decarbonization Technology and Efficiency Milestones: Economies are deploying specific technologies to mitigate emissions from existing coal assets.

- Japan successfully demonstrated 20% ammonia co-firing at the Hekinan thermal power station, validating a 20% reduction in CO_2, NOx, and SOx emissions. Viet Nam aims to implement 20% ammonia co-firing after 2030, targeting 100% ammonia firing in the existing coal power plants by 2045.
- China's Pingshan coal-fired power plant (Phase II) achieved a world-record net efficiency of 49.37%, surpassing the 33% average of conventional subcritical plants.
- As of December 2025, the APEC region has 17 coal-related CCUS projects with a total capacity of 43 Mtpa, though only seven are currently operational.

Consumption Trends Driven by Weather and Industrial Demand: APEC coal consumption rose marginally by 1.3% in 2024, reaching over 125 EJ.

- Viet Nam recorded the highest growth rate at 9.6%, driven by summer heatwaves increasing cooling demand and low hydropower output. Indonesia's consumption rose by 9.3%, largely attributed to energy demand from the expanding nickel processing industry.
- In contrast, United States consumption fell by 3.5%, continuing a two-decade downward trend, while Russia and Japan saw declines of 1.8% and 0.1%, respectively.

Record Production and Export Dynamics: APEC coal production hit an all-time high of approximately 145.5 EJ in 2024, a 0.6% increase year-on-year.

- China, representing 65% of the total, increased production by 1.2% to 94.5 EJ. Indonesia achieved significant growth of 7.9%, while the United States' coal production fell by approximately 10%.
- Australian thermal coal exports rose by 6 Mt in 2024 following the removal of China's unofficial import ban. Indonesia increased thermal coal exports by 36 Mt in 2024 due to robust demand from China and India.
- Following record peaks of USD 450 per tonne in 2022, Newcastle thermal coal spot prices stabilized between USD 100 and USD 150 per tonne throughout 2024.

Greenhouse Gas Emissions: In 2024, APEC economies emitted 11.9 Gt of CO_2 from coal combustion, representing 75.4% of global coal-related emissions. Furthermore, coal mining activities within APEC released 28.2 Mt of methane, accounting for approximately 70% of global coal mine methane (CMM) emissions, with China responsible for 66% of this regional total.

Chapter 1: APEC coal policies and decarbonisation technologies

Recent coal policy developments

In the APEC region, 19 economies have made commitments to achieve net-zero or carbon neutrality targets within this century. Most of these economies aim to meet their targets by 2050, while China, Indonesia, and Russia have set their goal for 2060. Thailand plans to reach net-zero emissions by 2065 (Net Zero Tracker).

Several APEC economies have reduced or eliminated their proposed coal projects after signing "the Global Coal to Clean Power Transition Statement" at COP26 or joining the "No New Coal Power Compact". At COP26, nine APEC economies signed the Global Coal to Clean Power Transition Statement, wherein they committed to rapidly scale up technologies and policies in this decade to achieve a transition away from unabated coal power generation in the 2030s or the 2040s, depending on each economy's situation. These economies include Brunei Darussalam, Canada, Chile, Indonesia, Korea, New Zealand, the Philippines, Singapore, and Viet Nam.

APEC economies are on different paths to achieving their net-zero targets, influenced by their economic strength, energy mix, and availability of domestic energy resources. Advanced technologies, renewable energy, nuclear energy, and the circular carbon economy play a significant role in many APEC economies. However, some APEC economies prioritize the need for affordable and reliable energy supply sources. In the power sector, coal-fired power plants remain the primary choice for several developing and emerging APEC economies due to their reliable baseload characteristics.

In most APEC economies, switching from coal to cleaner or renewable energy is in progress. Fourteen economies have been improving thermal efficiency in coal-fired power plants to reduce coal consumption. While Australia, Canada, China, Indonesia, Japan and the United States are advancing CCS/CCUS technology in the coal-based plants, five additional economies (Korea, Malaysia, Chinese Taipei, Thailand, and Viet Nam) have plans to deploy CCS/CCUS projects in the coming years, considering coal-based plants. Twelve economies are deploying or considering the deployment of clean coal technologies.

Table 1.1: Current and planned measures to support decarbonising in coal combustion users

Economies	Fuel switching	Thermal efficiency improvement	CCS/CCUS	Clean coal technologies[1]
Australia	●	●	●	●
Brunei Darussalam	●			
Canada	●	●	●	●
Chile	●			
China	●	●	●	●
Hong Kong, China	●			
Indonesia	●	●	●	●
Japan	●	●	●	●
Korea	●	●	●	●

[1] Clean coal technologies include co-firing biomass/ammonia with coal, coal-to-gas, coal-to-liquid with carbon capture and storage, hydrogen/ammonia production from coal with carbon capture and storage.

Malaysia	●	●	●	●
Mexico	●	●		
New Zealand	●			
Papua New Guinea				
Peru	●			
Philippines	●	●		
Russia	●	●		●
Singapore	●			
Chinese Taipei	●	●	●	●
Thailand	●	●	●	●
USA	●	●	●	●
Viet Nam	●	●	●	●

Source: compiled by the authors based on Boom and Bust Coal (2022), Global Energy Monitor, EGEDA, E3G (2022), and IEA (2023b).

Note: 'Hong Kong, China', Singapore, Peru, Brunei Darussalam, and New Zealand have small-scale coal consuming facilities, while Papua New Guinea is not using coal in its energy system.

Table 1.2: Notable developments of coal policies in APEC economies

Economy	Notable developments
Australia	Australia could export coal to China since China lifted all restrictions on Australian coal imports on March 13, 2023 In the 2024 Integrated System Plan, about 90% of the current 21 gigawatts (GW) of coal capacity would retire by 2034-35, and all before 2040.
Brunei Darussalam	Coal has been imported since 2019 to generate electricity and heat for Hengyi Industries' refinery and petrochemical complex in Pulau Muara Besar. Coal imports are expected to increase due to an increase in the size of the facility.
Canada	Canada has committed nationally to eliminate conventional coal in electricity generation by 2030 as part of its climate targets. This policy supports net-zero goals and reducing emissions from the electricity sector. Canada is a member of the Powering Past Coal Alliance, a global coalition aimed at accelerating the transition away from coal power internationally.
Chile	The AES Andes shut down its two-unit Norgener Power Plant in Tocopilla, in the northern region of Antofagasta, with a total capacity of 276 MW. On 16 April 2024, it was disconnected from the national electricity system[2]. In 2025, Chile's President announced a bill to accelerate coal plant closures and bring forward the coal exit target from 2040 to around 2035 or earlier, contingent on increased renewable generation and investment.

[2] AES Andes, formerly AES Gener S.A., is a producer and distributor of electricity based in Santiago, Chile. It is a subsidiary of American Company AES Corporation which operates in South America's Andes region.

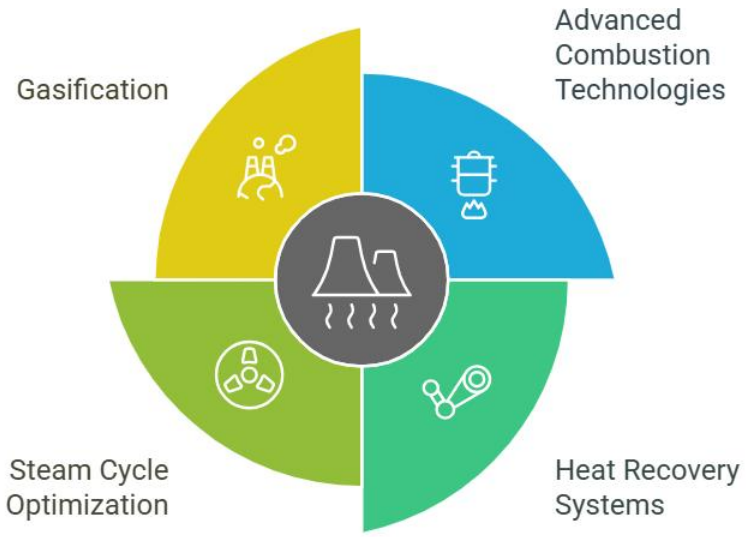
China	On March 13, 2023, China lifted all restrictions on Australian coal imports, allowing all domestic companies to import coal from Australia. This ended the trade restrictions that had been in place since late 2020. China began building 94.5 GW of new coal-power capacity and resumed 3.3GW of suspended projects in 2024. It is the highest level of new coal-power construction in the past 10 years.
Hong Kong, China	The economy plans to stop investing in coal-fired capacity additions now and to phase out coal by 2050.
Indonesia	Indonesia plans to implement co-firing for coal-fired power plants using biomass and producing dimethyl ether fuel from coal. Indonesia still implements the domestic market obligation policy for coal. In March 2025, Indonesia enacted Law No. 2/2025 amending the foundational mining law (Law No. 4/2009). This places greater emphasis on prioritising domestic use of ores and coal rather than export alone.
Japan	In late 2025, Japan's largest power generator JERA secured government subsidies to import low-carbon ammonia from the U.S. for co-firing with coal at facilities like Hekinan thermal station, starting around 2029. This is part of Japan's plan to cut emissions from existing coal plants while keeping them running longer for energy security and emissions reduction.
Korea	South Korea officially joined the Powering Past Coal Alliance at the COP30 climate summit in Brazil (Nov 2025), committing to phase out the majority of coal-fired power by 2040 and to stop building any new unabated coal plants. The government pledged to close 40 of the 61 existing coal power plants by 2040 and determine specific closure dates for the remaining units by 2026, based on economic and environmental feasibility.
Malaysia	On June 25, 2024, Malaysia's Deputy Prime Minister Fadillah Yusof revealed the country's timeline for phasing out coal-fired power plants to achieve its net-zero commitment by 2050. By 2035, Malaysia aims to reduce its coal power plants by half and retire all of them by 2044. The Malaysian government has affirmed it will no longer build new coal-fired power plants going forward, pushing for cleaner energy sources instead.
Mexico	Mexico has been a member of the Power Past Coal Alliance (PCCA) since 2017, which implies a phase-out from unabated coal by 2030. However, there is no specific federal strategy to attain the goal as of 2023.
New Zealand	The government intends to ban new low—and medium-temperature coal boilers and phase out those already in use by 2037.
Papua New Guinea	There is no production or consumption of coal in Papua New Guinea.
Peru	The 135 MW Ilo coal-fired power plant was already retired in 2022. Coal is mainly consumed in the cement industry and plays a minor role in the power sector.

The Philippines	The Philippines Department of Energy has issued a moratorium (October 2020) on the endorsement of greenfield coal-fired power projects. In June 2024, the Climate Investment Funds endorsed a new investment plan presented by the Government of the Philippines, allocating $500 million to facilitate the early retirement or repurposing of the Mindanao plant and other privately owned coal-fired power plants. In total, the economy plans to accelerate the retirement of up to 900 MW of existing coal generation capacity by 2027.
Russia	Russia's official power sector strategies for 2025–2030 and 2031–2042 (approved in 2024) do not include a phase-out of coal from electricity generation. Instead, coal generation is expected to remain a significant part of the mix. Russia has not adopted any COP26 coal exit commitments and plans coal use to persist.
Singapore	The Development Bank of Singapore has become the first Singaporean bank to commit to a phase-out of coal exposure by 2039.
Chinese Taipei	Taichung Power Plant plans to replace coal with gas, reducing coal usage by 3 million tons annually starting in 2032 and completing coal phase-out by the end of 2034 at the latest. Some coal units will be decommissioned or converted into emergency backup status through 2034, with usage limited and periodically reassessed.
Thailand	Thailand does not plan to issue new permits for coal-fired power plants. Under its new Power Development Plan, Thailand aims to further reduce the use of coal-fired power to 12% by 2037.
USA	The White House issued an executive order officially declaring that coal is essential to U.S. national and economic security and directing federal agencies to support coal production, reduce regulatory barriers, and encourage coal-fired electricity generation. This policy effectively positions coal as a strategic energy resource. The White House will open 13.1m acres (5.3m hectares) of public land to coal mining while providing $625m for coal-fired power plants.
Viet Nam	Vietnam's Prime Minister Pham Minh Chinh signed Decision No. 266/QĐ-TTg in early 2025, approving the implementation plan for the Global Coal-to-Clean Power Transition Statement. This is the central coal policy directing how the country will reduce emissions from coal and transition to cleaner energy. The target through 2050 is to decommission or convert coal plants and deploy co-firing and carbon capture in coal-fired power plants.

Decarbonisation technologies[3]

Thermal efficiency improvement

Figure 1.1: Methods for improving thermal efficiency in coal-fired power plants



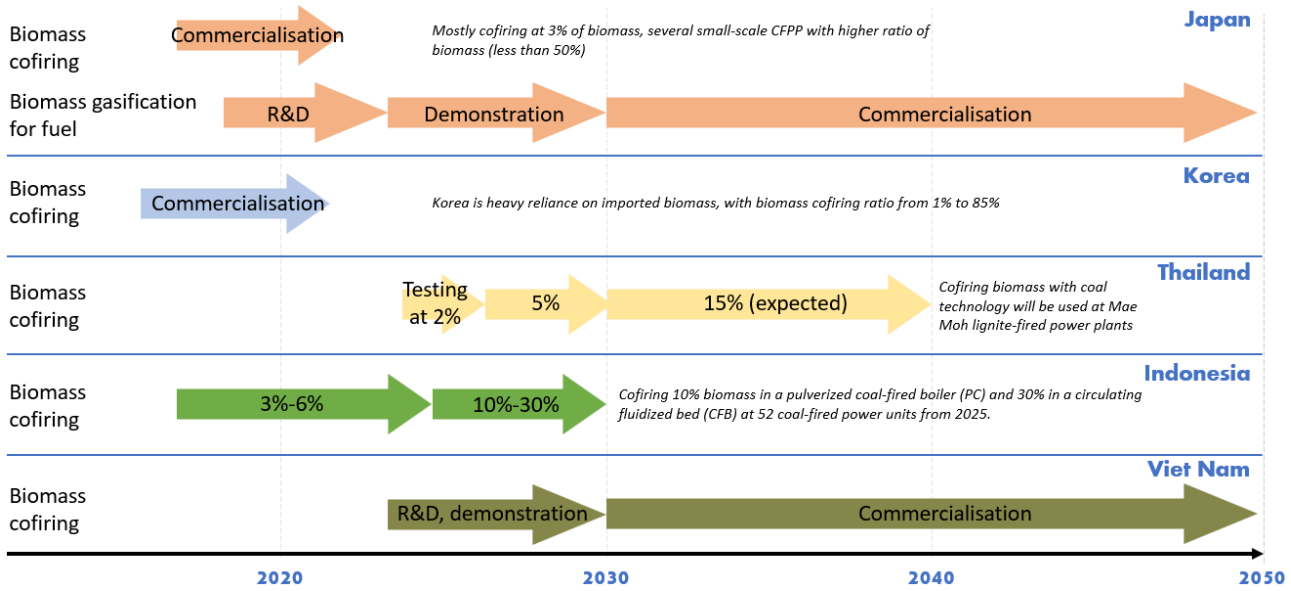
Key points

- Advanced Combustion Technologies: Advanced combustion technologies like supercritical and ultra-supercritical boilers greatly enhance efficiency. Operating at higher temperatures and pressures, USC plants can achieve efficiencies over 45%, compared to about 33% for conventional subcritical plants.
- Heat Recovery Systems: Heat recovery steam generators capture waste heat from the flue gas and use it to generate additional steam, which can then be used to drive turbines and generate more electricity. This can improve overall plant efficiency and reduce fuel consumption.
- Steam Cycle Optimization: Optimizing the steam cycle by increasing temperatures and pressures can enhance power plant efficiency. This includes upgrading turbines, improving condenser performance, and using advanced materials. Refurbishing older steam turbines also aids in boosting efficiency.
- Gasification: Gasification transforms coal into synthesis gas for burning in combined cycle turbines, enhancing efficiency and reducing emissions. Future IGCC systems aim for efficiencies of nearly 45%, with a goal of 60%.
- China's Pingshan Phase II power plant has been recognized as the world's most efficient coal-fired power plant. The 1.35 GW USC unit achieved a net efficiency of 49.37%. This efficiency was confirmed by an independent assessment led by Siemens and Steinmueller (Power, 2023).

[3] In this session, we provide only updated information compared to last year's coal report. Detailed technological explanations can be found in the APERC Coal Report 2023 on our APERC website.

Co-firing biomass and coal

Figure 1.2: Development status in co-firing biomass and coal at selected APEC economies



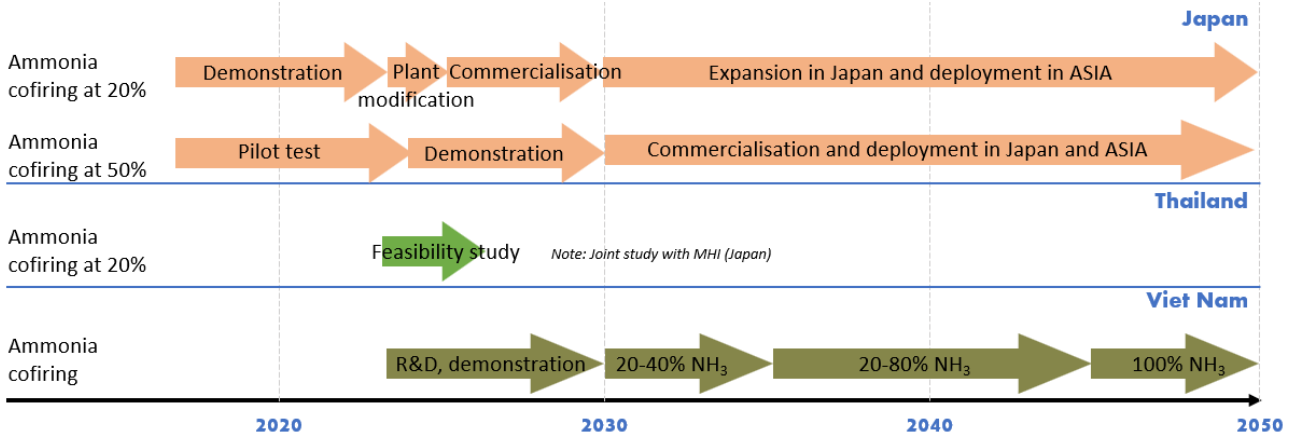
Sources: compiled by authors based on ERIA (2023), IEA (2023b), Mongabay (2022), PDP8 (2023), Argus (2024).

Key points

- Japan has commercialized biomass co-firing in coal-fired power plants with a biomass ratio of less than 10%, except for some projects with special designs that allow a higher biomass ratio. While Japan has not abandoned biomass-coal co-firing, enthusiasm has cooled after the incident at Taketoyo thermal power plant in January 2024. The focus has shifted from "expanding capacity" to "ensuring safety". The energy sector's "future tech" attention is increasingly pivoting toward ammonia co-firing as the preferred method for decarbonizing the remaining coal fleet.
- In Korea, the co-firing ratio ranges from 1% to 85% on an energy basis, with biomass supply heavily reliant on imports. The most critical update is the implementation of major reforms to the Renewable Energy Certificate (REC) system, effective January 2025. The government has effectively signaled the end of the "co-firing boom (REGlobal, 2025).
- Thailand started testing 2% biomass co-firing at Mae Moh lignite-fired power plant, and the co-firing ratio is expected to increase to 5% and 15% in the coming years (Argus, 2024).
- In Indonesia, 48 coal-fired power units had conducted biomass co-firing by the end of 2024, with 3% of biomass in a pulverized coal-fired boiler and 6% of biomass on an energy basis in a circulating fluidized bed. The PLN, an Indonesian government-owned corporation, plans to conduct biomass co-firing at 52 coal-fired power units in Indonesia from 2025, with a co-firing rate between 10% and 30%.
- Viet Nam issued a Power Development Plan (PDP8) in May 2023 and revised it in April 2025, which includes the consideration of biomass co-firing technology in existing coal-fired power plants after 2030. Owners of coal-fired power are currently drafting a detailed roadmap for implementing biomass co-firing. Recently, Erex Company announced plans to conduct co-firing tests at the Na Duong coal-fired power plant, beginning with 5% biomass and gradually increasing to 20% on an energy basis.

Co-firing ammonia and coal

Figure 1.3: Development status in co-firing ammonia and coal at selected APEC economies



Sources: compiled by authors based on METI (2020), ERIA (2023), IEA (2023b), Mongabay (2022), PDP8 (2023), MHI (2023), IHI (2025).

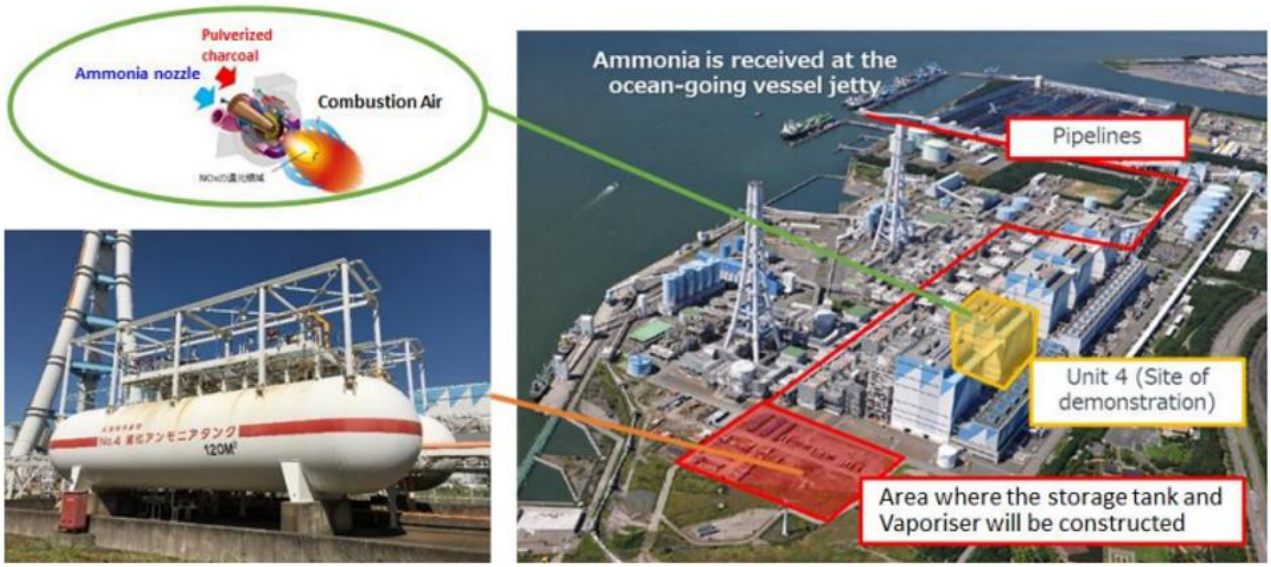
Key points

- In Japan, a demonstration test of co-firing ammonia in the existing coal-fired power plant was successfully conducted at the Hekinan coal-fired power plant with 20% of ammonia on an energy basis. The Japanese engineering groups intend to commercialise 20% ammonia co-firing technology in the Asian region by 2030. Parallelly, Japan starts the demonstration step for 50% of ammonia cofiring in a coal-fired power plant to support Japan as well as coal-power dependent economies in their carbon neutrality target.
- In Thailand, the cooperation between the Thai's power company and Mitsubishi Heavy Industries (MHI) has been made in a feasibility study of ammonia co-firing at a coal-fired thermal power plant operated by BLCP Power Limited[4]. JERA[5] will examine the procurement and transportation of ammonia fuel, whereas JERA and Mitsubishi Corporation will investigate the port facilities and ammonia receiving and storage facilities (MHI, 2023).
- Viet Nam plans to deploy ammonia co-firing in the existing coal-fired power plants after 2030, starting from 20% of ammonia on an energy basis, targeting 100% of ammonia firing by 2045. To prepare for the ammonia supply, Viet Nam started constructing a 200 MW electrolysis plant last year in Tra Vinh province, which will produce 150 000 – 180 000 tonnes of ammonia and 30 000 tonnes of green hydrogen per year.

[4] BLCP Power Ltd. is an independent power producer in Thailand and a joint-venture (50:50) between Banpu Power Public Company Limited and Electricity Generating Public Company Limited.

[5] JERA is a 50-50 joint venture between TEPCO Fuel & Power, a wholly owned subsidiary of Tokyo Electric Power Company, and Chubu Electric Power, founded in April 2015

Figure 1.4: Demonstration of ammonia co-firing in the existing Hekinan coal-fired power plant, Japan



Source: JERA (2022).

Key points

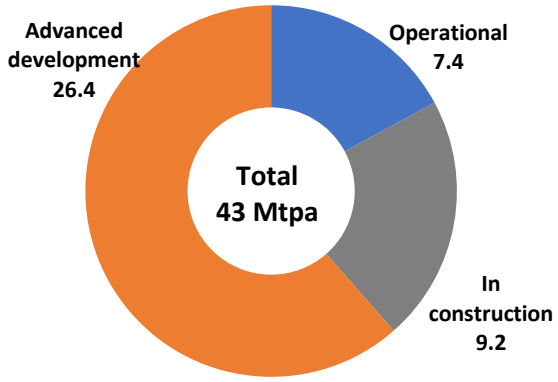
- On April 10, 2024, the co-firing demonstration test of 20% of fuel ammonia and coal at Unit 4 of the Hekinan Thermal Power Station was successful. It is confirmed that CO_2 emissions at the unit fell around 20%, nitrogen oxide (NOx) emissions were equal to or less than when mono-firing coal before ammonia substitution, and sulfur oxide (SOx) emissions were down about 20%. Emissions of the potential greenhouse gas nitrous oxide (N_2O) were undetectable. IHI[6] and JERA[7] also confirmed that operability was equivalent to that before the conversion to fuel ammonia (IHI, 2024).
- IHI will apply the knowledge gained through the demonstration test to establish a combustion technology that increases the ammonia ratio to more than 50% at thermal power plants and develop burners for 100% ammonia combustion. IHI will leverage its advanced clean fuel substitution technologies to help reduce carbon dioxide emissions and tailor solutions for communities and customers to drive the achievement of carbon neutrality by 2050 (IHI, 2025).
- With 20% of ammonia co-firing, 600 000 tonnes of ammonia will be required annually to fuel this plant. Therefore, the establishment of the ammonia supply chain is significantly important.
- Under its "JERA Zero CO_2 Emissions 2050" objective, JERA has been working to reduce CO_2 emissions from its domestic and overseas businesses to zero by 2050, promoting the adoption of greener fuels and pursuing thermal power that does not emit CO_2 during power generation. JERA continues to contribute to the decarbonisation of the energy industry through its proactive efforts to develop decarbonisation technology while ensuring economic rationality.

[6] IHI stands for IHI Corporation, a Japanese engineering corporation headquartered in Tokyo.

[7] JERA is an electric utility company in Japan.

Carbon Capture, Utilization, and Storage

Figure 1.5: Capacity of CCS facilities equipped at coal-related plants in APEC[8]



No	Facility title	Economies
1	Boundary Dam Carbon Capture and Storage	Canada
2	Petra Nova Carbon Capture	US
3	Great Plains Synfuels Plant and Weyburn-Midale	US
4	Sinopec Qilu-Shengli	China
5	Yangchang Yulin CO2-EOR	China
6	China National Energy Taizhou	China
7	China National Energy Guohua Jinjie 1	China
8	China National Energy Ningxia	China
9	Huaneng Longdong Energy Base	China
10	Yulin intergrated coal-to-liquid	China
11	Baotou Steel	China
12	Xinjiang Jinlong Shenwu	China
13	Minkota Power Project Tundra	US
14	Sinopec Shengli Power Plant	China
15	Gerald Gentleman Station	US
16	Prairie State Generating Station	US
17	Four Corners Power Plant Integrated CCS	US

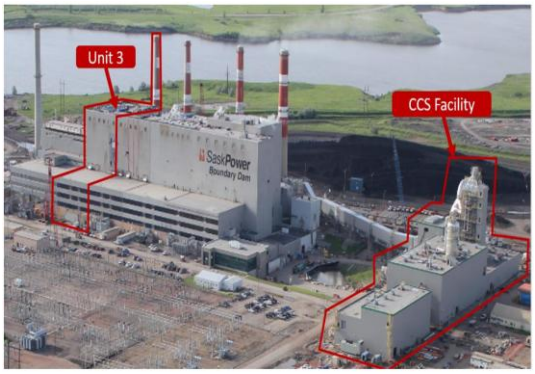
Source: compiled by the authors based on Global CCS Institute (2025).

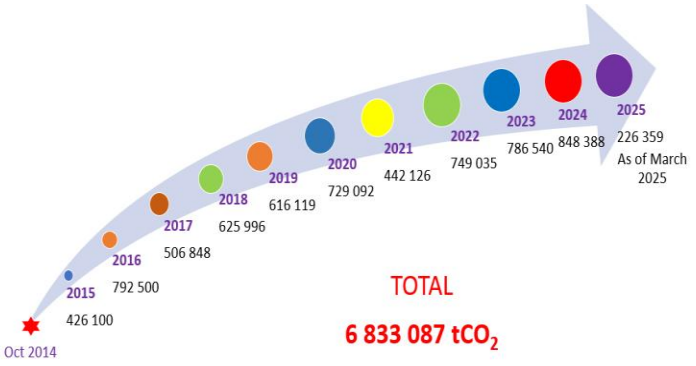
Key points

- As of December 2025, there are 17 coal-related CCUS projects in different development stages in the APEC region, with a total capacity of 43 Mtpa. Of these, seven projects are operational with a capacity of 7.4 Mtpa (one in Canada, two in the United States, and four in China).
- There are currently five coal-related CCUS projects under construction with a total capacity of 9.2 Mtpa, coming online in the coming years. All the above projects are located in China. Additionally, five coal-related CCUS projects are in advanced development with a total capacity of 26.4 Mtpa.
- Among six coal-related CCUS operational facilities, three are associated with coal-fired power plants, and the other three projects include coal-to-syngas, coal-to-hydrogen, and coal-to-chemical plants.
- In the coal power sector, the Boundary Dam and the Petra Nova are the only two coal-fired power plants in the world with retrofitted CCUS facilities with a total capacity of 2.4 Mtpa.
- The Boundary Dam CCUS facility in Saskatchewan (Canada) is currently operational. Captured CO_2 from this facility is used for EOR, which involves injecting CO_2 into oil reservoirs to recover incremental oil from producing wells.
- The Petra Nova is another coal-fired CCUS facility used for EOR in Texas, United States, that was suspended in May 2020 due to operational problems and unfavourable economics. However, this facility was restarted in September 2023.

[8] Coal-related plants include coal-fired power, coal-to-syngas, coal-to-hydrogen, coal-to-liquid, and iron & steel plants.

Figure 1.6: CCUS-equipped coal-fired power plant - The Boundary Dam, Canada





Source: compiled by the authors based on SaskPower, International CCS Knowledge Centre.

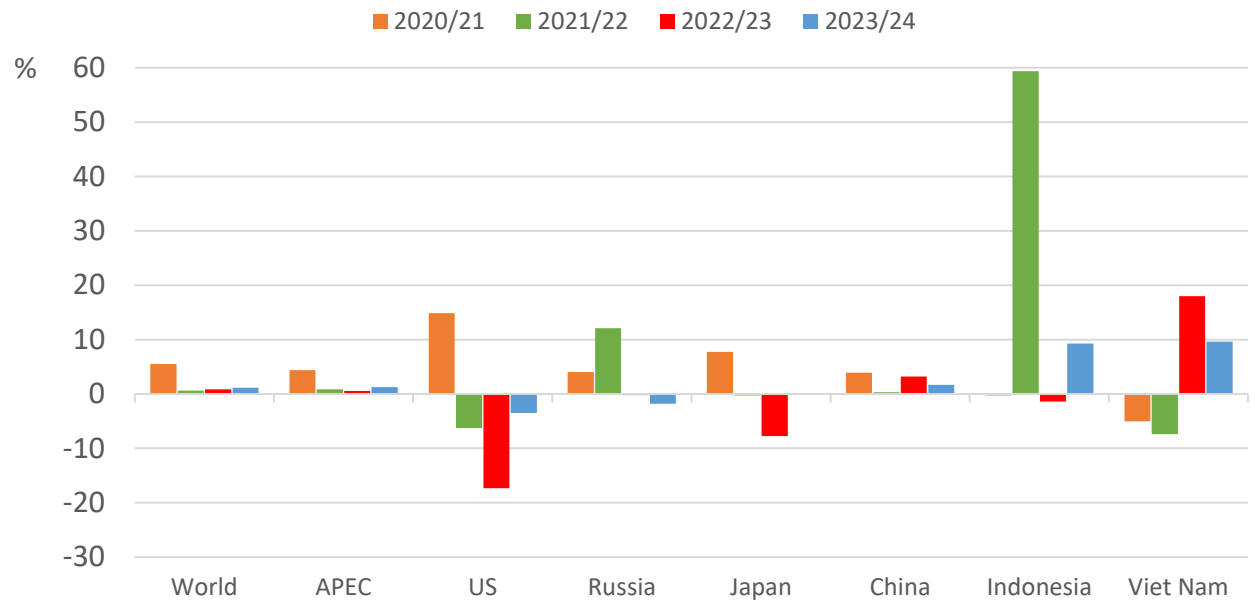
Key points

- The Boundary Dam is an 824 MW coal-fired power plant located in Saskatchewan, Canada. Generation Unit 3, which opened in 2014, is the world's first commercial-scale CCUS at a coal-fired power plant.
- Unit 3 was originally scheduled for closure in 2013 after 45 years of service. A retrofit was undertaken to transform the unit into a reliable long-term producer of 110MW of clean baseload electricity and simultaneously supply CO_2 to an EOR project in the province. Unit 3 is expected to have an increased life expectancy of 30 years and has the potential to capture one million tonnes of CO_2 a year (Sask Power).
- The Unit 3 retrofit included the replacement of the existing steam turbine generator with a new one that could be integrated with the CO_2 and SO_2 capture mechanism. The captured CO_2 is compressed and transported through a 66 km-long pipeline to an EOR project near Weyburn, which is part of an agreement signed with Cenovus Energy to purchase the full volume of one million tonnes of CO_2 a year.
- Unused CO_2 is transported to an injection well and storage site belonging to an Aquistore research project that is managed by the Petroleum Technology Research Centre. The SO_2 provides feedstock to a 50-tonne per-day sulphuric acid plant, which will be built next to Unit 3. A flue gas desulphurisation (FGD) system was put in place to allow the installation of carbon capture equipment, which reduces CO_2 emissions by approximately 90%.
- The total captured CO_2 has reached 6.8 Mt by the end of March 2025 since it began operating in 2014.
- Emerging economies will continue to consume more energy. Therefore, governments need to maintain the value of existing generation assets from diverse fuel sources, especially low-cost fuels such as coal. The Boundary Dam unit 3 project paves the way for continuing to rely on coal while simultaneously striving to lower greenhouse gas (GHG) emissions. Coal with CCUS can help coal become a sustainable, reliable, and clean energy source.
- Today, the Boundary Dam Unit 3 remains a significant part of Sask Power's generating fleet, producing enough low-carbon emission electricity for 110,000 Saskatchewan households.
- CCUS is applicable beyond the power sector and can be applied to hard-to-abate sectors such as iron and steel and cement.

Chapter 2: Coal consumption

World and APEC coal consumption

Figure 2.1: Coal consumption growth rate for the world and selected APEC economies

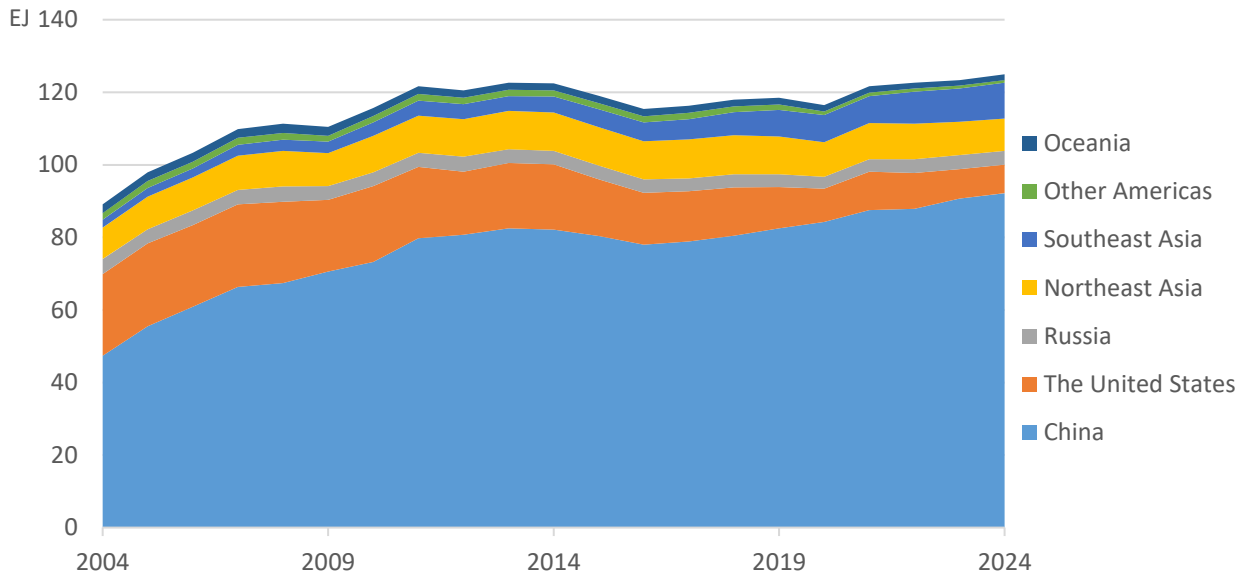


Source: compiled by the authors based on Energy Institute (2025).

Key points

- Global coal consumption increased only marginally by 1.17% in 2024. The main driver for this increase is the need for energy security, economic growth in emerging economies, and the role of coal in meeting soaring electricity demand.
- APEC coal consumption also showed a slight change, a 1.28% increase in 2024 relative to the 2023 level. The change in coal consumption is often driven by the five largest coal consumption economies (China, the United States, Japan, Russia, and Indonesia), which account for almost 90% of APEC coal consumption.
- The United States' coal consumption dropped 3.5% compared to the previous year, continuing the declining trend in coal consumption observed during the last two decades, except in the year 2021.
- Coal consumption in China, the world's largest coal consumer by far, grew by approximately 1.66% in 2024 but was much smaller than last year.
- Coal consumption in Indonesia increased again by 9.29% in 2024 relative to the previous year. Coal consumption in Russia and Japan in 2024 declined by 1.76% and 0.12%, respectively, relative to the previous year. The drop in coal consumption in Japan is due to the increased use of renewable energy and the restart of nuclear power plants.
- Viet Nam coal consumption grew by 9.6% in 2024, the highest growth among APEC economies, mainly due to heatwaves in summer driving up cooling demand. Additionally, low hydropower electricity caused by low water levels further pushed coal consumption for coal-fired power generation.

Figure 2.2: APEC coal consumption by region

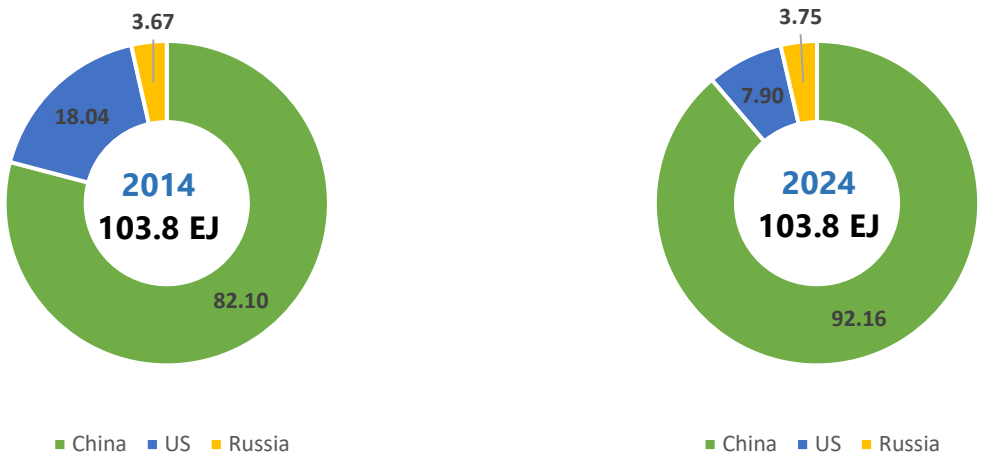


Source: compiled by the authors based on Energy Institute (2025).

Key points

- APEC-wide coal consumption rose 1.4-fold over two decades, reaching over 125 EJ in 2024, surpassing its previous peak in 2014.
- China, the largest coal consumer in the APEC and the world, continued to increase its coal consumption over the decades. China's coal consumption reached an all-time record high in 2024, accounting for approximately 74% of the total coal consumption in the APEC region.
- Coal consumption in the United States has declined gradually since 2007. In 2024, the United States consumed around 6.3% of the total APEC-wide coal consumption.
- Northeast Asia, including Japan, Korea, Chinese Taipei, and Hong Kong (China), accounted for 7.2% of the total APEC coal consumption in 2024, mainly consumed by Japan and Korea.
- The Southeast Asia economies accounted for 7.9% of APEC coal consumption in 2024. Indonesia consumed the most, followed by Viet Nam.
- Oceania, including Australia and New Zealand, accounted for 1.3% of the APEC-wide coal consumption in 2024. Australia consumes over 95% of coal consumption in the Oceania region.
- Other Americas, namely, Canada, Chile, Mexico, and Peru, consumed less than 1% of APEC coal consumption.
- Russia consumed 3% of total APEC coal consumption in 2024, which has plateaued over the last two decades.

Figure 2.3: Coal consumption in China, US, and Russia, 2014-2024

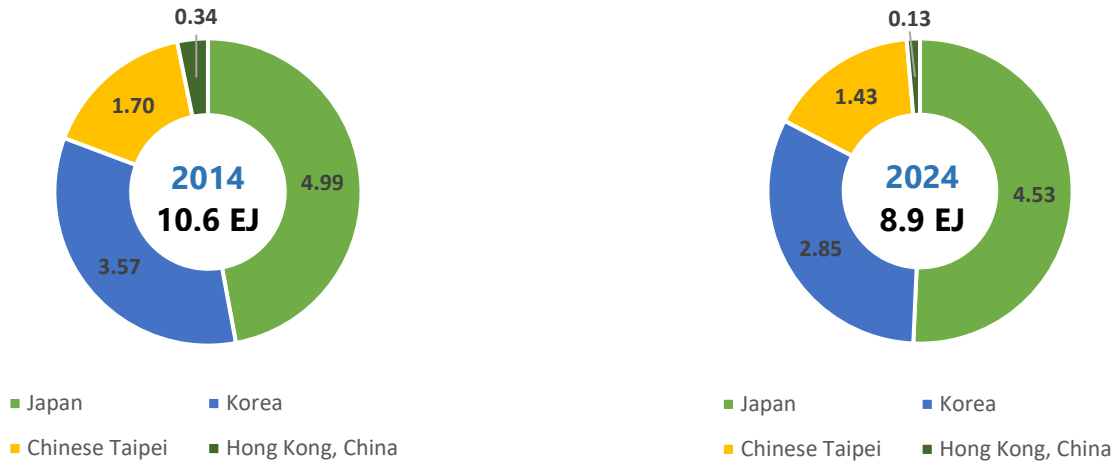


Source: compiled by the authors based on Energy Institute (2025).

Key points

- China's coal consumption rose 12.3% over the last decade, from 82.1 EJ in 2014 to 92.16 EJ in 2024. Approximately 64% of coal was used for power generation, and around 24% was used for energy-intensive industries such as steelmaking, aluminium smelting, cement manufacturing, and fertiliser production. The power sector in China is still highly dependent on coal. In recent years, coal-fired power generation accounts for approximately two-thirds of total electricity generation in China.
- In contrast, the United States' coal consumption fell by 56.2% over the 2014-2024 period, from 18.04 EJ in 2014 to approximately 7.9 EJ in 2024. Coal consumption has fallen substantially since 2007 due to shale gas prices that are lower than coal's and the widespread deployment of renewable energy, despite a temporary surge in 2021. Coal consumption in the United States is expected to continue declining due to coal-to-gas switching in the power sector.
- Russia's coal consumption slightly rose by 2.3% over the 2014-2024 period. Even though coal phase-out is not a priority for Russia, the global low-carbon trend is affecting the Russian coal sector. Coal consumption is expected to gradually decline in the coming decades due to the competition with natural gas (Korppoo, A. et al., 2021).

Figure 2.4: Coal consumption in Northeast Asia, 2014-2024

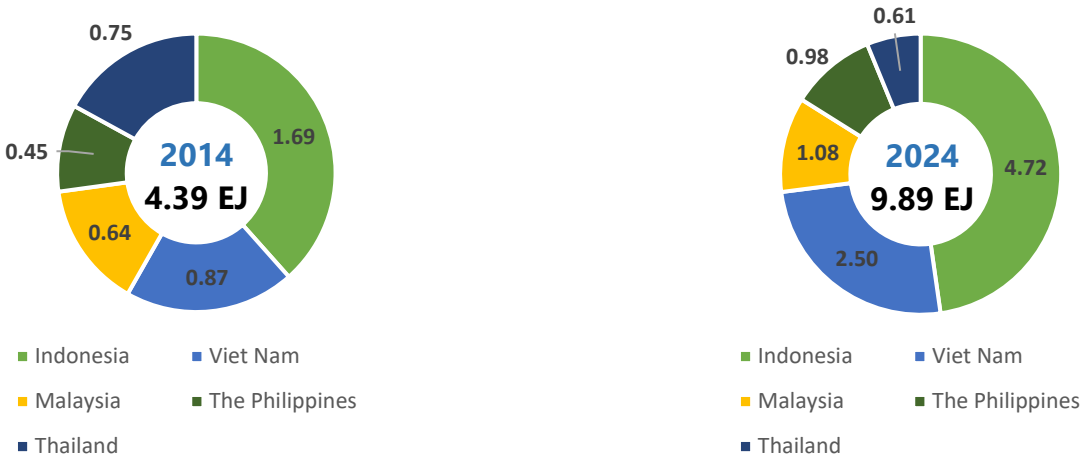


Source: compiled by the authors based on Energy Institute (2025).

Key points

- Coal consumption in the Northeast Asia economies declined from 10.6 EJ to 8.9 EJ over the 2014-2024. The recent decline in coal consumption is due to environmental issues and net-zero commitments by economies in this region.
- Japan was the largest coal consumer in Northeast Asia, with 4.53 EJ in 2024. Although Japan plans to reduce reliance on coal power generation, with plans to phase out inefficient coal power plants by 2030, Japan did not sign the Global Coal to Clean Power Transition Statement at COP26 to phase out all coal-fired power plants by the 2030s or 2040s. Coal power technologies are still a significant business for major Japanese power plant makers and power utilities. As a long-time supporter of this industry, the Government has not yet moved away from coal (Japan Beyond Coal). However, Japan agreed with a declaration from the G7 Italia 2024 meeting to achieve a fully or predominantly decarbonized power sector by 2035 and to phase out existing unabated coal power generation in the energy system during the first half of 2030s, or in a timeline consistent with keeping a limit of 1.5 ºC temperature rise within reach, in line with countries's net-zero pathways (G7 Italia, 2024).
- Korea's coal consumption declined by 20% from 3.57 EJ in 20134 to 2.85 EJ in 2024, contributing to carbon emissions reduction to realize the carbon neutrality target by 2050. Improved energy efficiency, increased share of renewable energy, and the emergence of a hydrogen industry are expected to offset the reduction in coal consumption.
- Chinese Taipei's coal consumption declined by 16.1% over the last decade due to the Government's efforts to reduce reliance on coal-fired generation.

Figure 2.5: Coal consumption in Southeast Asia, 2014-2024

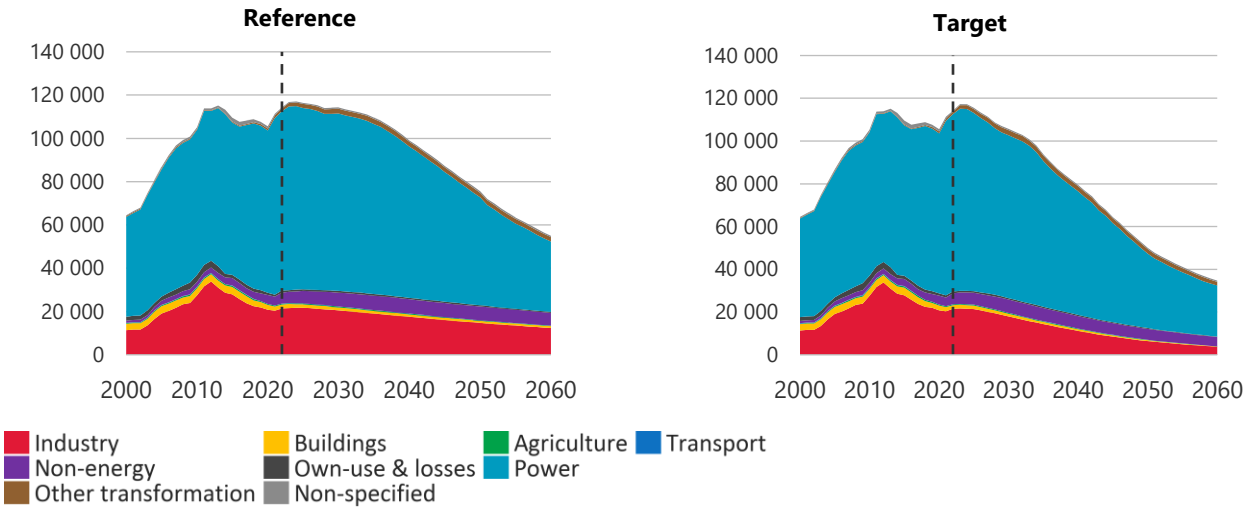


Source: compiled by the authors based on Energy Institute (2025).

Key points

- Due to high energy demand caused by rapid economic growth, coal consumption in Southeast Asia over doubled from 2014 to 2024, from 4.39 EJ in 2014 to 9.89 EJ in 2024. Coal is mainly used in the power sector, as most Southeast Asian economies rely on coal-fired power generation.
- Indonesia was the largest coal consumer among Southeast Asia economies, with 4.72 EJ in 2024, a 2.8-fold increase relative to 2014. Coal is used mainly in the power sector, accounting for around 70% of the total coal consumption in recent years. Coal-fired power generation for nickel smelters has significantly increased by approximately 8 times over the last ten years (IESR, 2024).
- Viet Nam was the second-largest coal-consuming economy in the region in 2024. Coal consumption increased approximately 2.9-fold from 0.87 EJ to 2.5 EJ to meet high coal demand for coal-fired power generation and industry over the 2014-2024 period. Approximately 70% of coal is consumed in coal-fired power plants, and the remainder is for heavy industries and other sectors. Electricity production from coal-fired power plants has increased approximately sixfold over the last decade.
- Coal consumption in Malaysia rose by 1.68 times over the last decade due to a significant increase in coal-fired power capacity. Coal dominates the power sector, which makes up 92% of Malaysia's coal consumption. However, coal also provides heat for industrial processes, particularly cement, iron, and steel.
- Coal consumption in the Philippines rose approximately 2.1 times over the 2014-2024 period, mainly used for power and industrial sectors. Although coal is the single biggest source of carbon emissions, coal continues to be supported by both the Government and businesses in the Philippines as it is the cheapest fuel option.
- Thailand's coal consumption has reduced by approximately 18% over the last decade, the only economy in Southeast Asia that has reduced coal consumption. Unlike other ASEAN economies, Thailand uses just above 50% of total coal consumption for the power sector, while the remainder is used for industrial processes.

Figure 2.6: APEC coal consumption: history and outlook, PJ



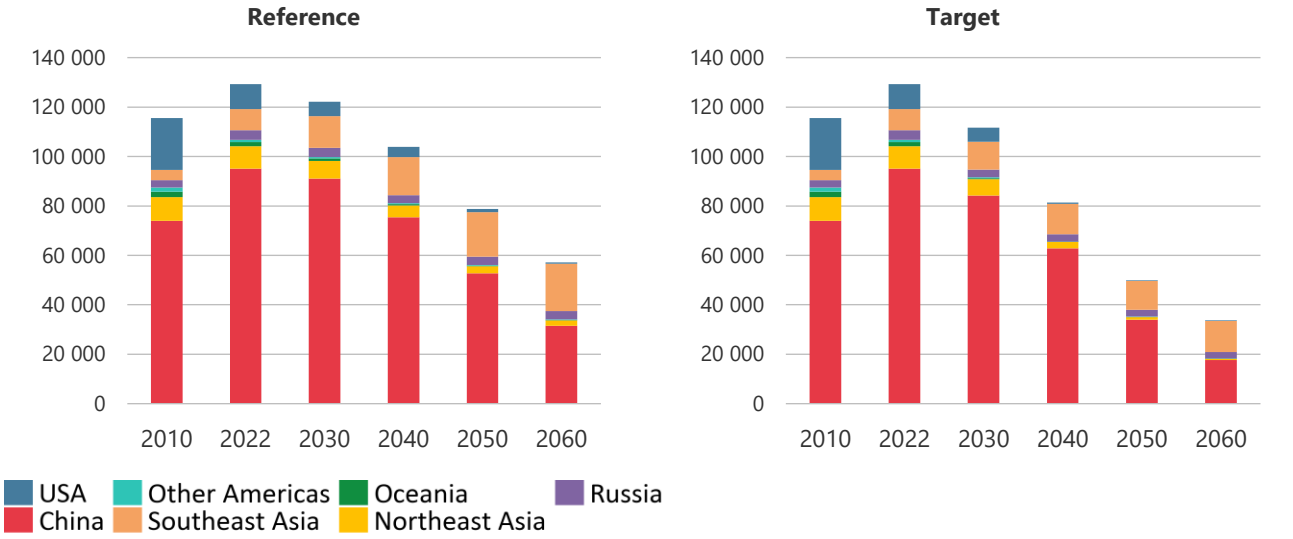
Source: APEC Outlook 9th (2025).

Key points

- Historically, coal consumption across APEC economies experienced dramatic growth from 2000 through the early 2010s, nearly doubling during this period before leveling off in subsequent years. The power sector dominates this consumption, utilising approximately 72% of APEC's coal consumption in 2022, primarily for electricity generation.
- In REF, APEC coal consumption is projected to decline by half between 2022 and 2060. The power sector will drive most of this reduction, with widespread coal power retirement policies expected to cut coal use for power generation by 60% through 2060. Industrial demand shows more resilience, with projections indicating a 42% decline by 2060 relative to 2022. This persistence partly arises from the significant role of metallurgical coal in the iron and steelmaking processes, where substitution by other fuels remains challenging.
- In TGT, APEC coal consumption is projected to drop by nearly 70% by 2060 compared to 2022, with coal use in the industry and power sectors experiencing more dramatic reductions than in REF. Coal consumption in the power and industry sectors declined by 71% and 82% over the 2022-2060 period, respectively.
- This substantial decline results from accelerated fuel switching initiatives and increasingly stringent coal phase-down and phase-out policies across the APEC region. Electrification initiatives and alternative fuel adoption drive industry transformation, while emerging technologies such as electric arc furnaces and hydrogen-based processes begin displacing traditional metallurgical coal in steelmaking toward the end of the projection period.

Coal consumption by subregion

Figure 2.7: APEC coal consumption by subregion: history and outlook, PJ



Source: APEC Outlook 9th (2025).

Key points

- Coal consumption is expected to decrease in almost all APEC subregions from 2022 to 2060, except Southeast Asia. China's coal supply declines by 81.4%, Northeast Asia by 94%, Oceania by 99.4%, Russia by 33.4%, the USA by 97.7%, and other Americas by 90.7%.
- Southeast Asia's coal consumption is expected to grow by 120% in REF and 50% in TGT between 2022 and 2060, with power generation accounting for three-quarters of additional coal use. This growth trajectory is driven by several interconnected factors that distinguish Southeast Asia from other APEC subregions.
- First, the Southeast Asia subregion has experienced rapid growth in both economic and energy demand. Energy demand is growing at twice the global average rate, driven by rapid economic development. The subregion stands out as one of the few areas where GDP and emissions continue to rise in tandem, signalling that Southeast Asia's economic development remains highly carbon-intensive. Coal-fired power plants currently generate over 40% of the region's electricity, making it a critical component of the region's energy security strategy.
- Second, affordability and energy security are top priorities in this subregion. The ongoing dependence on coal is due to its affordability and widespread availability amid worldwide energy price fluctuations. Energy security remains a top priority, especially after the recent global energy crisis highlighted the subregion's vulnerability to fuel price shocks. Southeast Asia's commitment to coal reflects a combination of economic pragmatism and the imperative to maintain affordable, reliable energy supplies for growing populations and economies.
- Third, most coal-fired power plants in Southeast Asia were built after 2000, creating a young fleet that commits the subregion to significant emissions through 2060. In the REF scenario, around 57 GW of coal-

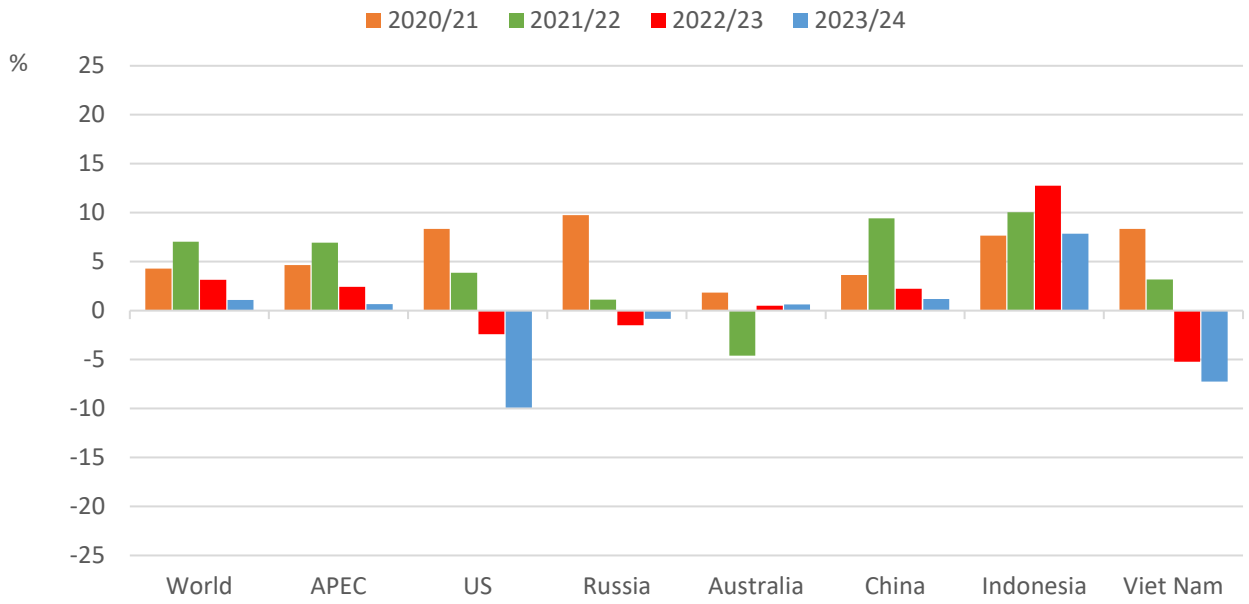
fired power plants will be added between 2022 and 2060 from 103 GW in 2022, representing one of the most significant challenges to rapid decarbonisation efforts across the subregion.

- Finally, the demand for coal in the industrial sector is increasing in Southeast Asia, where coal accounts for 30% of industrial energy needs. This trend is exemplified by a rise in nickel production in Indonesia, reflecting the subregion's manufacturing-driven economic growth. Industrial applications account for a significant portion of coal consumption, with new captive coal plants being planned by industrial facilities. These developments persist despite existing regulations, potentially undermining economies' climate commitments.
- Overall, these factors underscore both the importance of coal in Southeast Asia and the complexities of reducing reliance on this fuel type. Transitioning this subregion away from coal will require a multifaceted approach that balances energy security, affordability, and climate commitments.

Chapter 3: Coal production

World and APEC coal production

Figure 3.1: Coal production growth rate for the world and selected APEC economies

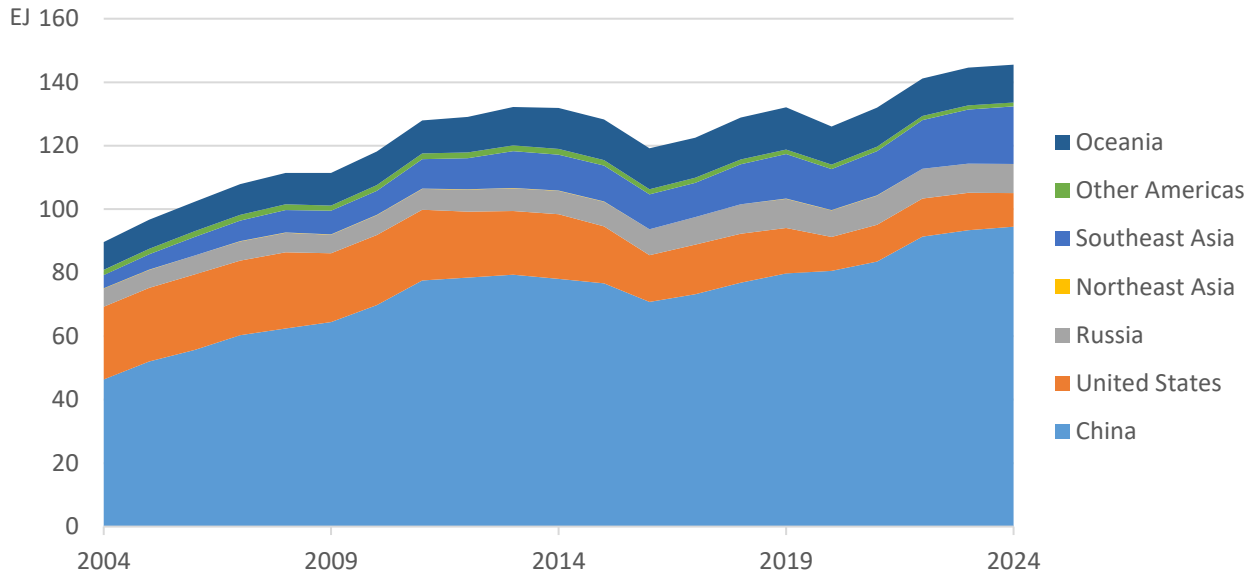


Source: compiled by the authors based on Energy Institute (2025).

Key points

- Global coal production rose 1.1% in 2024 to meet the continued high coal demand, with even lower growth than in recent years. Coal production reached a record-high level in 2024. In the APEC region, coal production only rose 0.67% in 2024 compared to the previous year, though the rising trend was not uniform across all economies.
- China, the world's largest coal producer, increased coal production by 1.2% in 2024 compared to the previous year in response to the high demand for coal, particularly for power generation. After the coal crisis in 2021, China increased its coal production at existing coal mines and reopened the closed coal mines in the Inner Mongolia and Shanxi areas to meet the rising domestic coal demand.
- Indonesia's coal production rose 7.9% in 2024, the highest growth among APEC economies. The increased coal production was both for export and domestic use.
- Coal production in Australia rose slightly by 0.6% in 2024 compared with 2023, a slight recovery from the coal exports ban and weather issues in the last several years.
- The United States, Viet Nam, and Russia showed a drop in coal production in 2024. The United States' coal production fell by 9.91%, followed by Viet Nam (-7.3%) and Russia (-0.8%).

Figure 3.2: APEC coal production by region

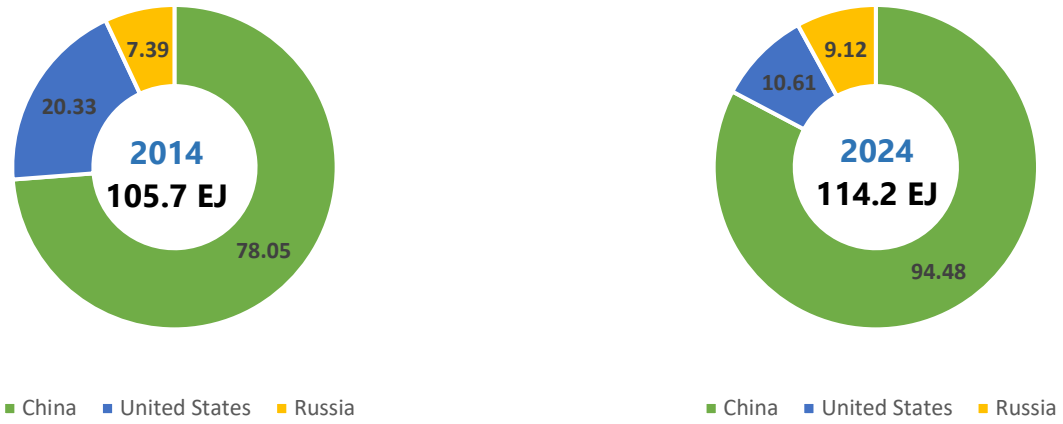


Source: compiled by the authors based on Energy Institute (2025).

Key points

- APEC coal production reached an all-time record high of approximately 146 EJ in 2024, a 0.6% increase relative to the previous year.
- China, the largest coal producer in the APEC and the world, produced 94.5 EJ, accounting for approximately 65% of APEC coal production in 2024. Many coal mines have been closed in the last five years due to mining safety and land-use rights for mining issues. To offset the shortfall in coal production from closed mines, the Chinese Government boosted output from existing large mines.
- Southeast Asia produced 18.1 EJ in 2024, accounting for 13% of the total APEC coal production. Indonesia has dominated coal production in the region for decades, followed by Viet Nam and Thailand.
- Oceania produced approximately 12 EJ, accounting for 8.2% of APEC coal production in 2024, while other Americas accounted for less than 1%.
- The United States and Russia were the third and fifth-largest coal producers in 2024, accounting for 7.3% and 6.3% of APEC coal production, respectively.

Figure 3.3: Coal production in China, US, and Russia, 2014-2024

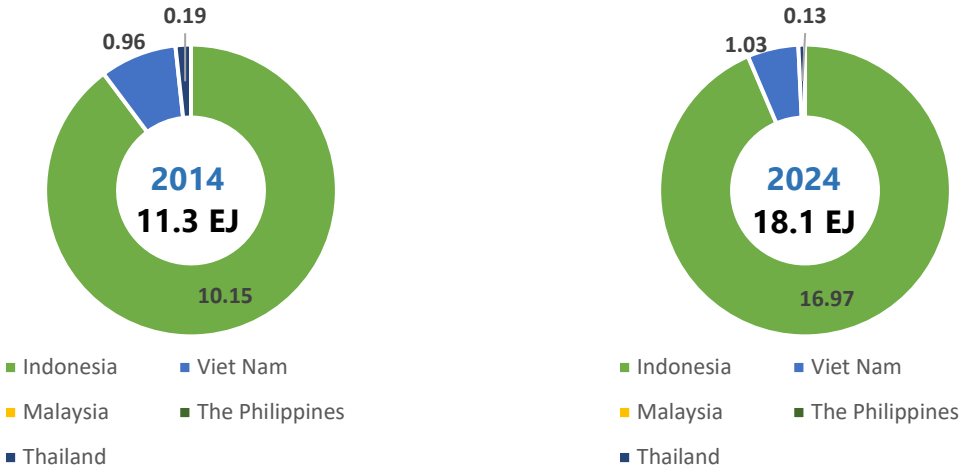


Source: compiled by the authors based on Energy Institute (2025).

Key points

- Coal production in China grew substantially over the last decade, with an increase of 21%. Although high domestic coal production was achieved in 2024, China is still the largest thermal and metallurgical coal importer.
- In 2024, China's coal production reached a new record-high level of 94.5 EJ due to high coal demand for both coal-fired power and industrial plants. The coal crisis in the second half of 2021 caused electricity blackouts in four provinces (Liaoning, Hei Longjiang, Jilin and Guangdong), disrupting the daily lives of 10 million people. In response, the authorities asked coal enterprises to rapidly increase coal production at existing coal mines while reopening closed coal mines in the Inner Mongolia and Shanxi areas.
- Russia achieved substantial growth in coal production over the last decade (+23%), with production increasing from 7.39 EJ in 2014 to 9.12 EJ in 2024. As the third-largest coal-exporting economy in APEC, over half of its coal production has been used for exports in recent years.
- In contrast, coal production in the United States fell by approximately 48% in the 2014-2024 period, responding to declining coal demand except in 2021 and 2022.

Figure 3.4: Coal production in Southeast Asia, 2014-2024.



Source: compiled by the authors based on Energy Institute (2025).

Key points

- Southeast Asia showed the fastest growth in coal production among subregions in APEC, rising from 11.3 EJ to 18.1 EJ over the 2014-2024 period. This growth was driven by Indonesia, an economy possessing abundant coal reserves and favorable geological conditions for coal mining. Over 90% of coal mines are mined by the opencast mining method, which makes coal prices competitive with those of other economies.
- Indonesia, the largest coal producer and exporter in Southeast Asia, increased its coal production by 67%, from 10.5 EJ in 2014 to approximately 17 EJ in 2024. Most of Indonesia's coal production is low-quality coal (sub-bituminous coal), which is mainly used for electricity generation. Therefore, Indonesia still imports higher coal types such as bituminous, anthracite, and metallurgical coal to use for industrial processes.
- Viet Nam increased its coal production slightly over the last decade from 0.96 EJ in 2014 to 1.03 EJ in 2024, mainly mined in the northern provinces and Quang Ninh anthracite coal basin. However, the complex geological conditions and deep coal seams hinder the significant growth of coal production in these coal fields. The Red River Delta coal basin is a newly discovered sub-bituminous coal resource in Viet Nam, but it has not been mined due to technical and economic obstacles.
- Thailand's coal production fell by 32%, from 0.19 EJ in 2014 to 0.13 EJ in 2024. Currently, the Mae Moh coal mine is the only operational mining facility in Thailand, producing lignite, with the lowest calorific content as compared to other types of coal. According to Thailand's long-term low-emission development strategy, the economy aims to phase out coal in the power sector by 2050 as part of its goal to achieve carbon neutrality by 2050 and net-zero emissions by 2065.

Figure 3.5: Coal production in Oceania, 2014-2024

Source: compiled by the authors based on Energy Institute (2025).

Key points

- In the Oceania region, coal is primarily produced by Australia. Over the last decade, coal production declined slightly from 12.9 EJ in 2014 to 11.9 EJ in 2024. Only a small portion has been used domestically; the remainder was exported. Australian coal production has declined over the past decade mainly due to a global shift away from coal to cleaner fuels. This change is driven by environmental concerns, which have decreased the demand for Australian coal exports. Additionally, policy changes and community opposition to new coal mine developments also contributed to this decline.

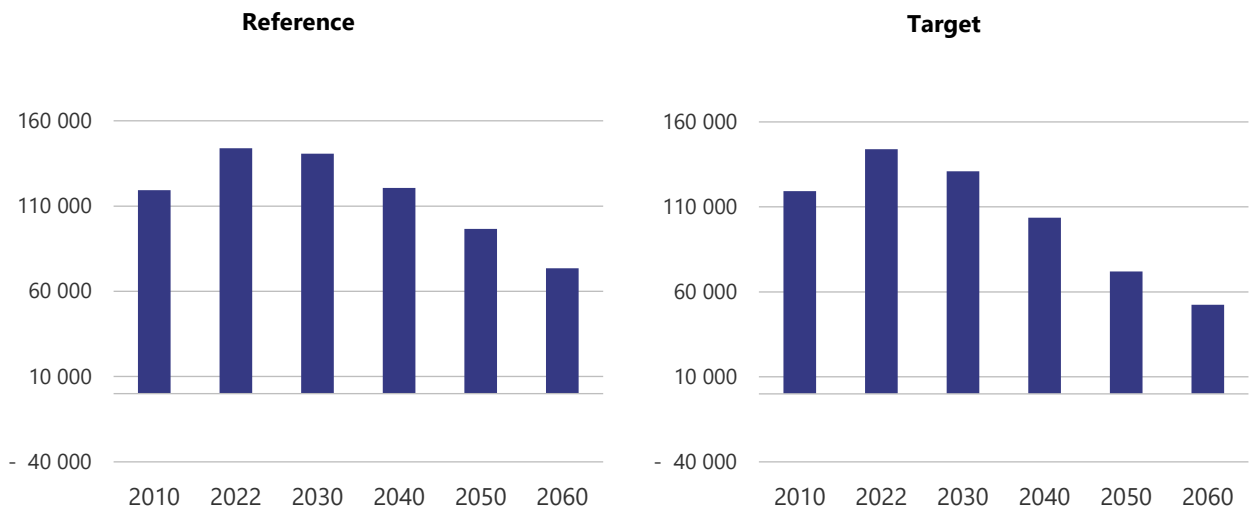
- Australia's coal production declined slightly from approximately 13 EJ to 12 EJ over the last decade. Most of its coal production is used for exports due to strong ongoing coal demand from Asia. Supplier reliability, proximity to key markets, and good infrastructure availability put Australia in a strong position to take advantage of growing demand from customers in Japan, China, India, Chinese Taipei, and Korea, as well as newer buyers in Viet Nam, Malaysia, the Philippines, and Thailand.

- The majority of Australia's black coal basins are in New South Wales and Queensland, while the main brown coal basins are in Victoria[9].

- Open-cut coal mines are the most visible sign of coal mining in Australia. In New South Wales open-cut mines now make up 80% of coal production, increasing from 75% just a few years ago. It's a similar situation in Queensland, with the top 10 producing mines being open-cut. Data released by Global Energy Monitor indicates that Australia is out of step with the rest of the world, which is closer to a 50/50 balance between open-cut and underground mining.

[9] Black coal refers to several coal types, including bituminous, sub-bituminous, and anthracite, used as a fuel for electricity generation, in iron and steel making, and in cement, alumina, and paper manufacturing. Brown coal, commonly referred to as lignite, is a soft, brown sedimentary rock. It is classified as low-rank coal and has low heat content. It is often used for power generation.

Figure 3.6: APEC coal production: history and outlook, PJ



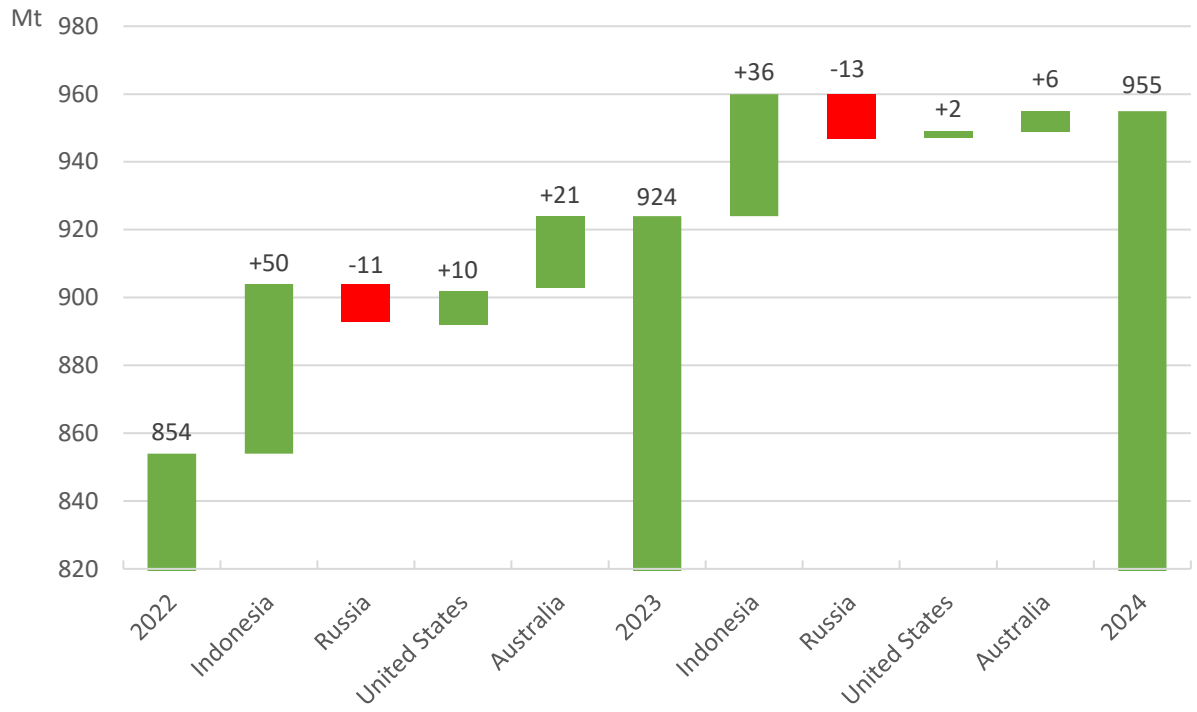
Source: APEC Outlook 9th (2025).

Key points

- In REF, APEC coal production has historically mirrored consumption patterns from 2010 through 2022, and this correlation is anticipated to persist as output decreases from 143,900 PJ in 2022 to 73,500 PJ by 2060.
- The APEC region includes several of the world's largest coal-producing economies, such as China, Indonesia, Australia, the United States, and Russia. Despite reduced domestic output, APEC is expected to maintain its position as a dominant coal supplier to the world, with coal exports projected to be approximately 24,000 PJ by 2060.
- In TGT, coal production is expected to decline more quickly, with a 15% reduction compared to REF. This reduction is due to the weakness of coal demand both within APEC economies and globally.
- In China, coal production is expected to decline by 82% by 2060. The major driver for this reduction is a sharp drop in coal consumption in the power sector, where coal is transitioning from a dominant fuel to a supporting power source. All newly installed and retrofitted coal power units are mandated to enhance their peak-shaving and load-following capabilities, reflecting this evolving role.
- Australia's coal production is projected to decline by 53% by 2060, mainly from the power sector. The reduction in coal-fired generation brought on by voluntary closures by coal operators drives coal's major decline. Coal consumption in the power sector is expected to be largely phased out by 2040.
- However, Indonesia's coal production is expected to increase by 19% by 2060. Different from most economies in APEC, Indonesia's coal consumption is expected to increase quadrupling in REF and tripling in TGT (APEC Outlook 9th, 2025), primarily due to increased coal-fired power plant capacity to meet rising electricity demand. Growing industry demand is expected to require more coal due to resource availability, practicality, and affordability. Renewable energy generation deployment has faced challenges related to renewable energy integration and insufficient energy transition funding, leading to coal-fired power generation still playing a significant role in the coming decades.

Chapter 4: Coal trade and prices

Figure 4.1: Change in thermal coal exports from major APEC coal exporters

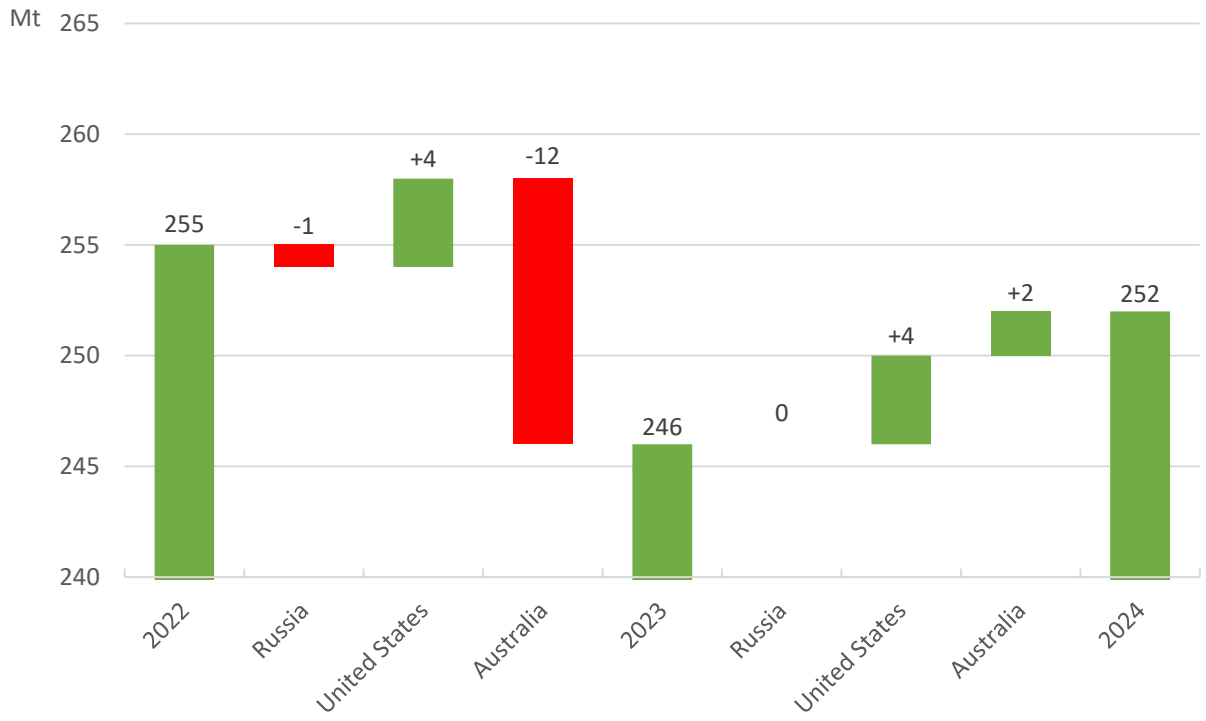


Source: compiled by the authors based on IEA (2023a) and IEA (2024a).

Key points

- In 2023, Indonesia's thermal coal exports increased by 50 Mt, the highest growth in thermal coal exports among APEC economies. The growth in coal exports is due to increased global demand for coal, particularly from major importers, pricing, and geographical advantage. In 2024, Indonesia continued to increase thermal coal exports by 36 Mt compared to 2023, driven by high coal demand for power generation in China, India, and some Southeast Asian economies.
- Australia's thermal coal exports increased by 21 Mt in 2023 and 6 Mt in 2024 as a result of the end of the unofficial ban of the Chinese government on coal imports from Australia in early 2023.
- The United States's thermal coal exports increased by 10 Mt in 2023 and 2 Mt in 2024, while Russia's coal exports dropped by 11 Mt and 13 Mt in 2023 and 2024, respectively.

Figure 4.2: Change in metallurgical coal exports from major APEC coal exporters



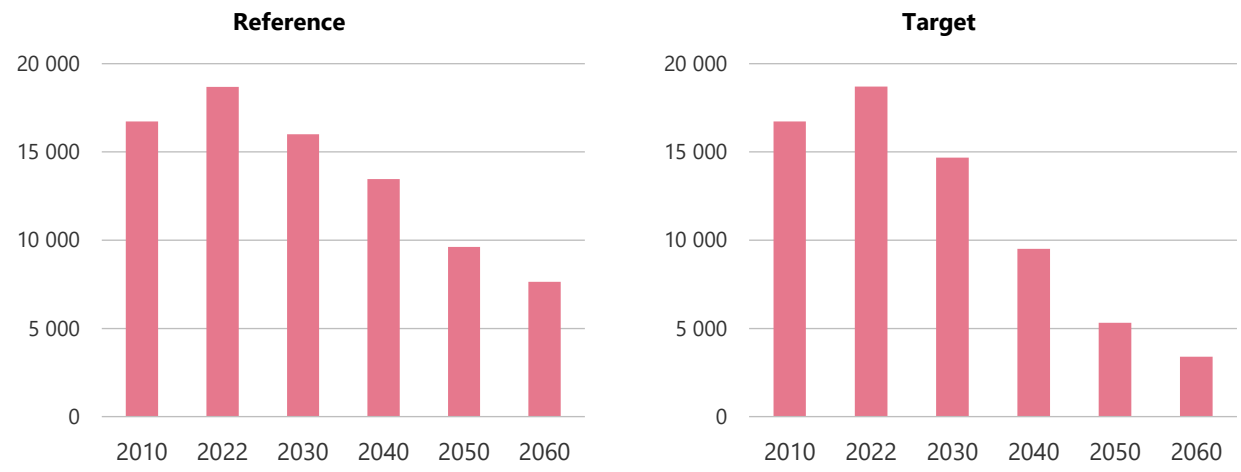
Source: compiled by the authors based on IEA (2023a) and IEA (2024a).

Key points

- After the Russian-Ukraine conflict started in February 2022, Western countries refused to buy Russian coal, causing its metallurgical coal exports to fall by 1 Mt in 2023. Although Russia has shifted the metallurgical coal trading flow to China, India, and other Southeast Asia countries, the increase did not fully offset the loss of markets in Europe, Japan, and Korea.
- Metallurgical coal exports from Australia fell by 12 Mt in 2023. There were several reasons, including unprecedentedly high coal prices, weather-related disruptions to coal supply, and a decline in global steel production.
- In 2024, while metallurgical coal export growth has been seen in the United States and Australia, Russia's metallurgical coal export remained unchanged.
- According to the IEA Coal 2024 report, Australia's metallurgical coal export slightly increased from 151 Mt in 2023 to 153 Mt in 2024. However, export value has declined from 2023 to 2024, largely due to falling global metallurgical coal prices.
- Metallurgical coal remains a meaningful share of Russia's total coal exports and continues to be directed primarily toward Asian steel-making importers. However, metallurgical coal export faces market and logistical challenges due to geopolitical issues.

APEC coal trade projections

Figure 4.3: APEC coal imports: history and outlook, PJ

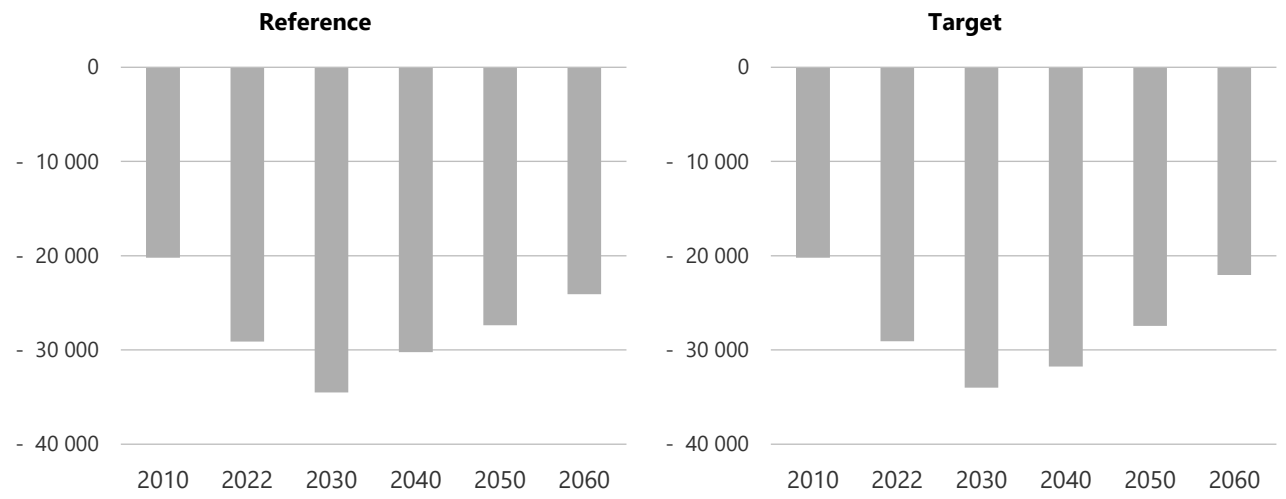


Source: APEC Outlook 9th (2025).

Key points

- Coal imports experienced substantial growth before 2022. However, coal imports are projected to decline dramatically through 2022-2060, landing at 7,647 PJ in REF and 3,400 PJ in TGT scenario by 2060 from 18,965 PJ in 2022. Major APEC coal importers in 2022 include China, Japan, Korea, Chinese Taipei, and Malaysia, accounting for 80% of total APEC coal imports. In the projection period, all coal importers reduce their coal imports due to low coal demand in power generation and industries in the TGT scenario.
- China is expected to reduce coal imports by 87% by 2060, mainly because of its commitment to carbon neutrality, which requires a steep decline in coal use. The rapid expansion of renewable energy, nuclear power, and energy storage will likely replace coal in electricity generation. At the same time, higher domestic coal production and energy efficiency gains reduce reliance on imports. Together, these factors drive a structural shift away from imported coal as China transitions to a low-carbon energy system.
- Japan's long-term climate strategy is focused on achieving carbon neutrality by 2050, which requires a dramatic reduction in the use of fossil fuels, especially coal, in its energy mix. By 2060, coal imports are expected to decline by 92% due to a decrease in the share of coal in electricity generation and a reduction in reliance on imported coal. The government also plans to phase out inefficient coal plants, improve energy efficiency, and adopt cleaner fuel technologies such as ammonia co-firing to reduce emissions from remaining coal use.
- Korea has committed to achieving carbon neutrality by mid-century, which entails a significant shift away from coal toward low-carbon energy sources like nuclear power and renewables. The government is planning to phase out most coal-fired power plants (with many scheduled to close by 2040) and reduce coal's share of electricity generation, cutting the need for imported coal. This transition is supported by expanding nuclear capacity and renewable energy targets, along with policies to lower greenhouse gas emissions and improve energy security (JOGMEC, 2025). In our projection, coal imports are expected to decline by 95% by 2060 compared to the 2022 level in the target case.

Figure 4.4: APEC coal exports: history and outlook, PJ



Source: APEC Outlook 9th (2025).

Key points

- The APEC region includes several of the world's largest coal-producing economies, such as China, Indonesia, Australia, the United States, and Russia. Despite reduced domestic output, APEC is expected to maintain its position as a dominant coal supplier to the world, with coal exports projected to be approximately 24,000 PJ in the REF and 22,000 in the TGT scenario by 2060.
- Under the TGT scenario, coal exports from Australia are projected to decline significantly, falling by 44.6% from 9,678 PJ in 2022 to 5,367 PJ in 2060. This decline is primarily driven by a sharp reduction in coal demand from major coal-importing economies, as they accelerate their energy transitions and implement long-term decarbonization policies. Key importers are expected to substantially reduce coal use in power generation and industry, replacing it with renewable energy, nuclear power, and other low-carbon alternatives. As a result, Australia's coal export volumes decrease steadily over time, reflecting both weakened international demand and structural changes in the global energy system.
- Indonesia, the largest thermal coal exporter in APEC, is also projected to experience a substantial decline in coal exports, decreasing by 40% from 9,351 PJ in 2022 to 5,615 PJ in 2060. This reduction reflects weakening demand from key importing economies and Indonesia's own domestic energy transition policies and efforts to prioritize energy security and value-added use of coal.

Coal prices

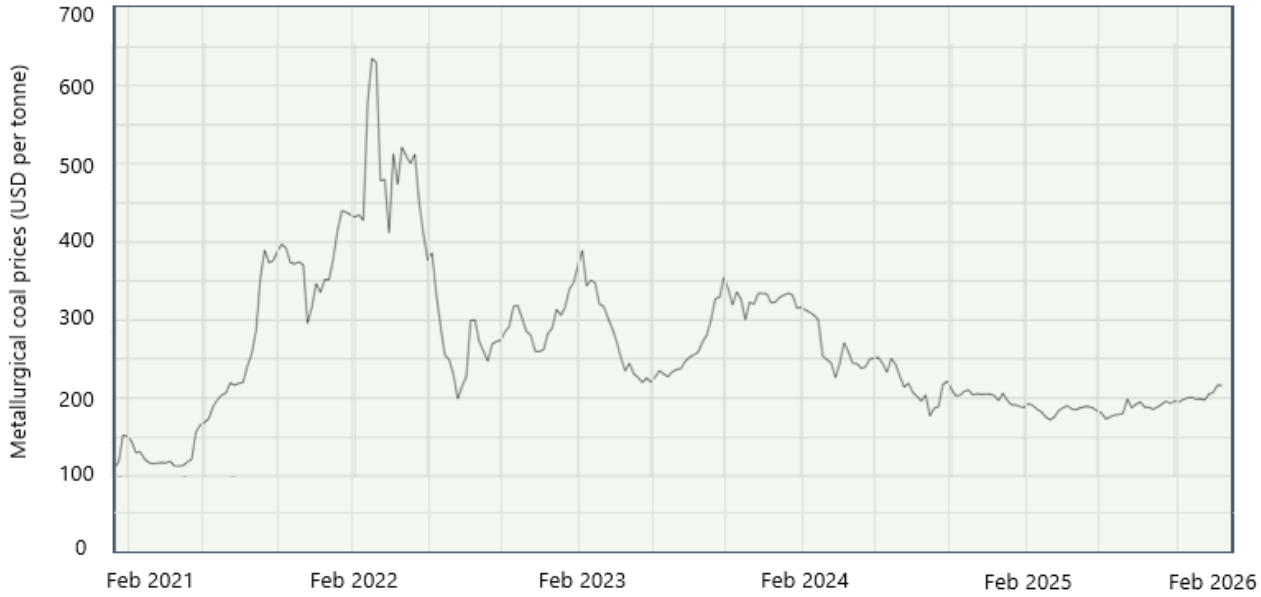
Figure 4.5: Newcastle benchmark thermal coal spot prices

Source: compiled by the authors based on Trading Economics.

Key points

- In 2022, the impacts of sanctions against Russia due to the Russian-Ukraine war drove thermal coal prices to record high of USD 420 per tonne on 9 March 2022. With the measures to stabilise the global energy markets from developed countries, thermal coal spot prices softened briefly in April. However, Newcastle benchmark thermal coal spot prices surged again to the next record high of about USD 425 per tonne in May due to coal transportation disruption in Australia.
- In September 2022, an all-time record high of thermal coal spot prices occurred, reaching approximately USD 450 per tonne, nine times higher than the prices in September 2020. Strong thermal coal demand from APEC Northeast Asia economies such as Japan, Korea and Chinese Taipei caused the price surge. In addition, extreme weather in Australia in 2022 hindered the coal transportation route from coal mines to seaborne port, causing a decline in coal export volume.
- In 2023, thermal coal spot prices dropped dramatically from USD 400 per tonne in early 2023 to around USD 130 per tonne in July. In some of the last months of the year, thermal coal spot prices fluctuated at around USD 150 per tonne. Lower demand from major consumers like Europe due to mild winters, increased gas supply, high coal stockpiles, and a shift towards renewable energy sources led to an oversupply in the market and, subsequently lower prices.
- In 2024, thermal coal spot prices were relatively steady compared with the previous year, varying between USD 100 per tonne and USD 150 per tonne.
- In 2025, thermal coal spot prices decline further, staying around USD 100–120 per tonne. This reflects a structural decrease in coal demand (due to energy transition, renewables, and efficiency improvements), sufficient global supply, and a lower geopolitical risk premium compared to 2022.

Figure 4.6: Australian premium hard coking[10] coal spot price



Source: compiled by the authors based on Barchart.

Key points

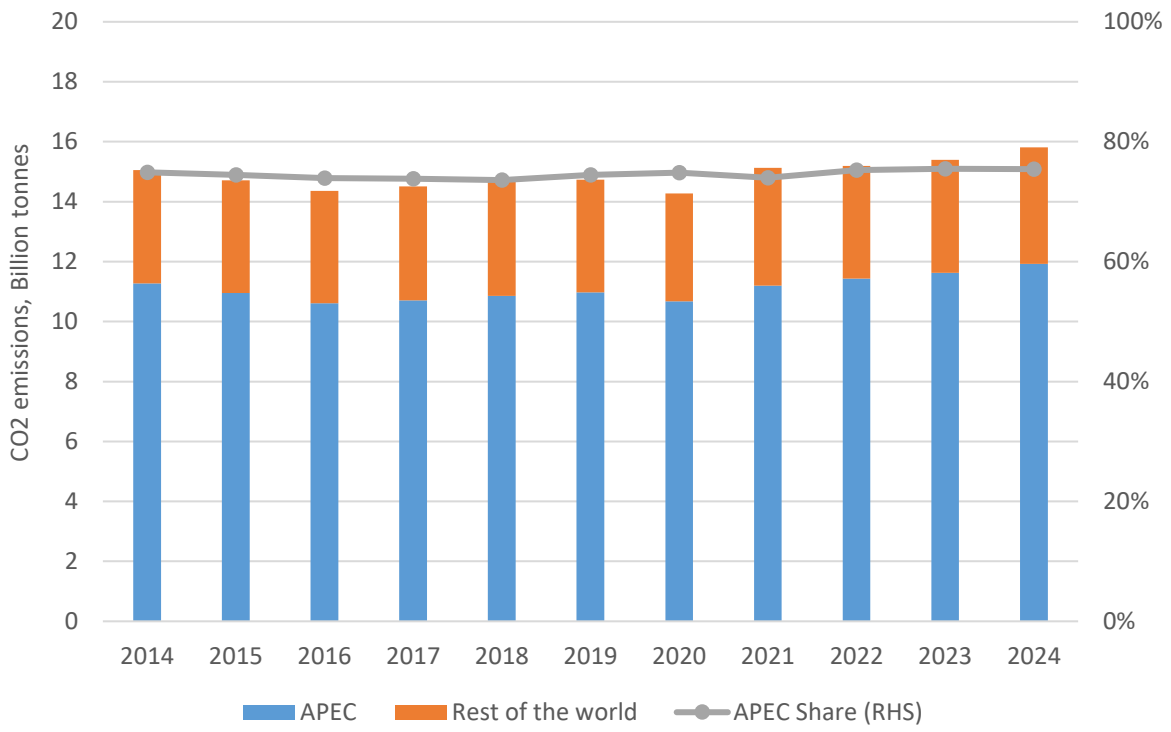
- The Australian coking coal spot prices started to rise in mid-2021 and continued to climb in 2022, even before the Russian-Ukraine war. With the impact of the war and volatile energy prices, coking coal prices surged to an unprecedented level of about USD 630 per tonne on March 2022. Coking coal prices then eased somewhat and remained at around USD 500 per tonne until the end of May.
- In June 2022, coking coal prices dropped again due to the weak demand from China's steelmaking industry. As a result, the Australian coking coal spot prices declined to USD 200 per tonne in August 2022. In the last quarter of 2022, coking coal spot prices rebounded to around USD 300 per tonne to a small extent, partly due to a met-to-thermal coal switch and high demand at the end of the year[11].
- In 2023, coking coal prices fell in net terms during the first quarter and eased further in June as Australian supply picked up, global steelmaking showed signs of softening, and strong post-COVID Chinese demand failed to emerge. The limited supply of Australian high-quality raw coking coal explains the price increase for coking coal in the third quarter. Coking coal prices dropped dramatically from USD 330 per tonne in early 2024 to around USD 200 per tonne in December 2024.
- Coking coal prices decline in the first half of 2024 and stabilize around USD 200 per tonne for the rest of 2024 and throughout 2025, leading to a significant reduction in volatility. This price trend is supported by a more balanced global coking coal market, slower growth in steel demand, and early effects of steel decarbonization efforts (such as electric arc furnaces and hydrogen pilots), although blast furnaces still remain dominant.

[10] "Coking coal" and "metallurgical coal" can be used as interchangeable terms.
[11] A "met-to-thermal coal switch" refers to the practice of a coal mining company or trader switching from producing or selling metallurgical coal (met coal), primarily used in steelmaking, to producing or selling thermal coal, which is used for electricity generation, due to market factors like higher demand or price for thermal coal compared to met coal

Chapter 5: Greenhouse gas emissions from the coal value chain

Carbon dioxide emissions

Figure 5.1: Coal-related CO_2 emissions in APEC and the rest of the world, 2014-2024

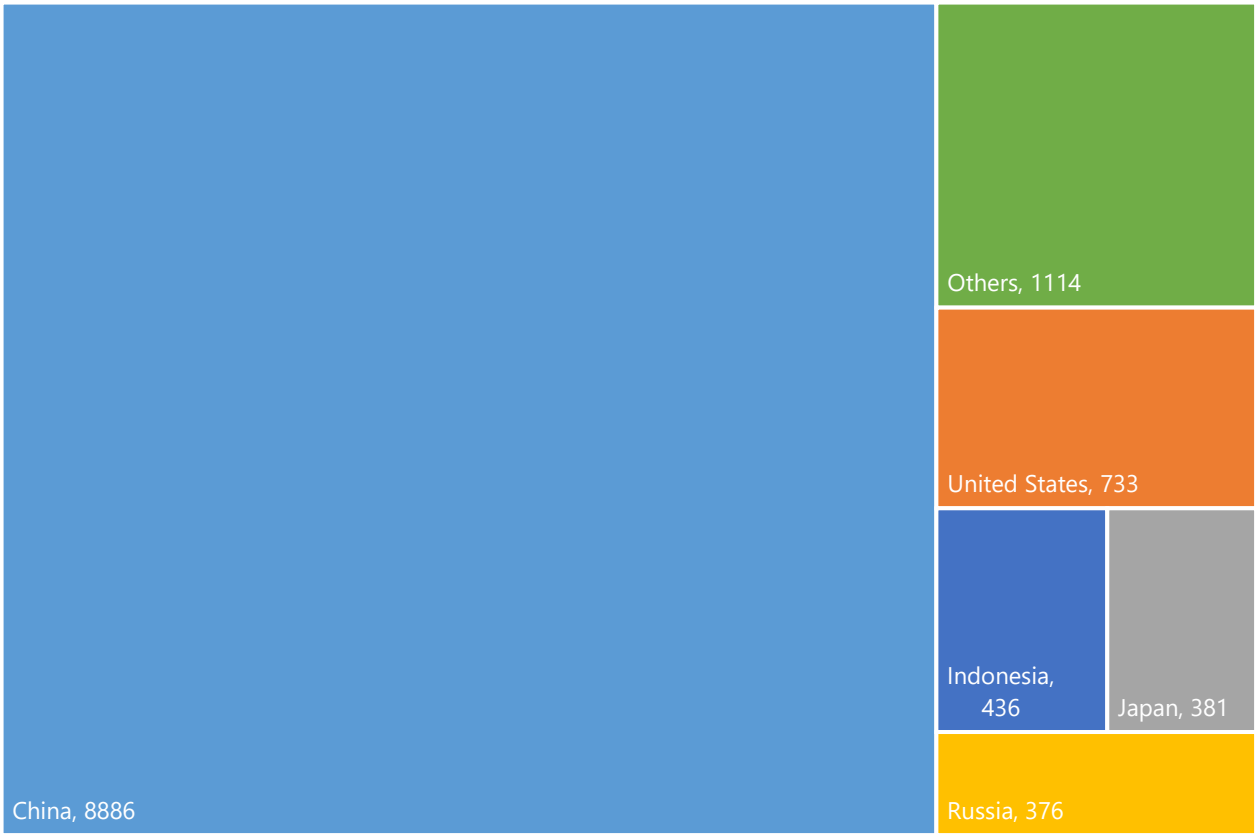


Sources: compiled by the authors based on Our World in Data.

Key points

- When coal is burned, the carbon in the coal combines with oxygen to form CO_2. One molecule of CO_2 is 3.67 times heavier than a molecule of carbon due to the additional weight of the two oxygen atoms. Basically, coal is not 100% of carbon. Therefore, burning a tonne of coal emits 2.07 tonnes of CO_2.
- CO_2 emissions from coal combustion processes in the APEC region accounted for around three-quarters of the global coal-related CO_2 emissions over the last decade because four APEC economies (China, the United States, Japan, and Russia) were often in the top five largest coal consumers worldwide for many years.
- APEC coal-related CO_2 emissions totalled 11.3 Gt in 2014, declined in 2015 through 2018 and increased again to 11.9 Gt in 2024 after a substantial drop in 2020. CO_2 emissions from coal were roughly proportional to the coal consumption profiles in each region.

Figure 5.2: CO_2 emissions from coal combustion in APEC economies in 2024, Mt



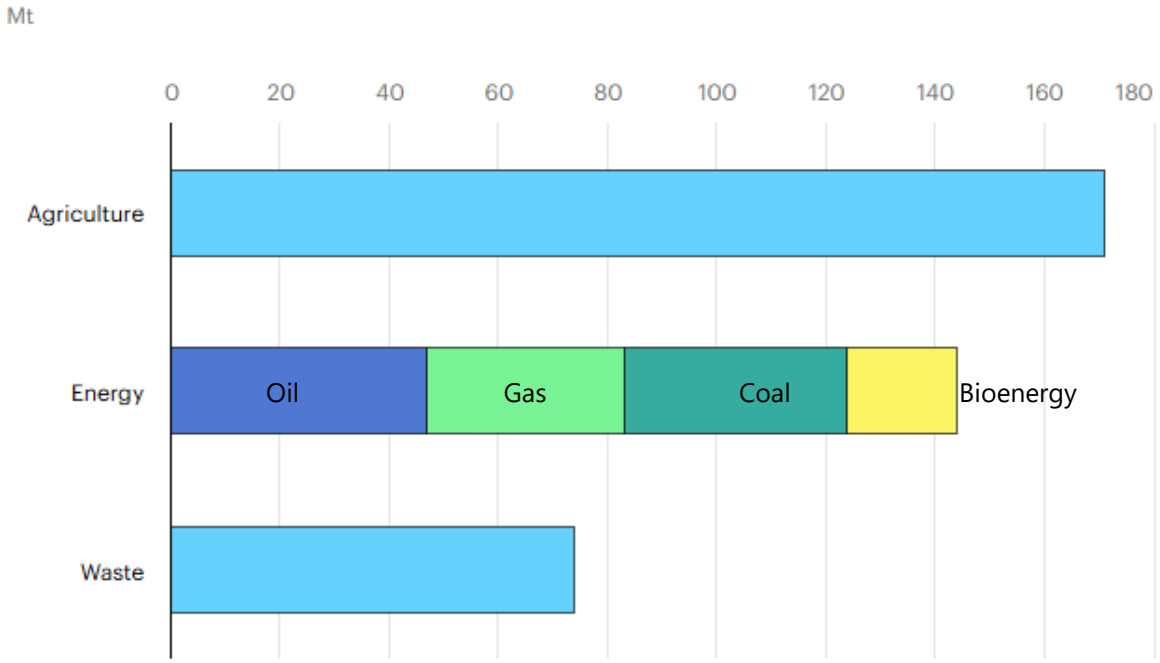
Sources: compiled by the authors based on Our World in Data.

Key points

- In 2024, APEC economies emitted 11.9 Gt of CO_2 from coal combustion processes, accounting for 75.4% of the global coal-related CO_2 emissions.
- Among APEC economies, China is the largest emitter, releasing 8 886 Mt, followed by the United States (733 Mt), and Indonesia (436 Mt).
- Russia and Japan emitted 381 Mt and 376 Mt in 2024, respectively.

Methane emissions

Figure 5.3: Global methane emissions and sources of emissions, 2024



Source: IEA (2025).

Key points

- Two key characteristics determine the impact of different greenhouse gases on the climate: the length of time they remain in the atmosphere and their ability to absorb heat. Methane has a much shorter atmospheric lifetime than CO_2 but absorbs much more heat while it exists in the atmosphere.
- Estimates of methane emissions are subject to a high degree of uncertainty, but according to IEA Global Methane Tracker 2025, the global methane emissions from different sources are 331 Mt in 2023. This includes emissions from agriculture, energy, and waste (IEA, 2024).
- The largest anthropogenic source is agriculture, which is responsible for around 43% of emissions, followed by the energy and waste sectors.
- IEA estimates that the energy sectors emitted 145 Mt of methane in 2024, including approximately 20 million tons of methane emissions came from bioenergy, primarily due to the traditional use of biomass. Emissions have remained roughly at this level since 2019, when they peaked at a record high.
- In 2024, methane emissions from coal mines are one-third of total emissions from fossil fuels. Accordingly, coal mine methane emissions were 40 Mt, compared to 45 Mt from oil and 35 Mt from natural gas production. Methane emissions from coal production vary depending on mine characteristics. For underground mines, ventilation systems are usually the leading source of emissions. For surface mines, drainage systems, outcrops and workings are the main sources of methane emissions. Post-mining activities such as processing, storage and transport of coal are also sources of emissions, as any methane still trapped in the matrix of the coal can continue to seep out.

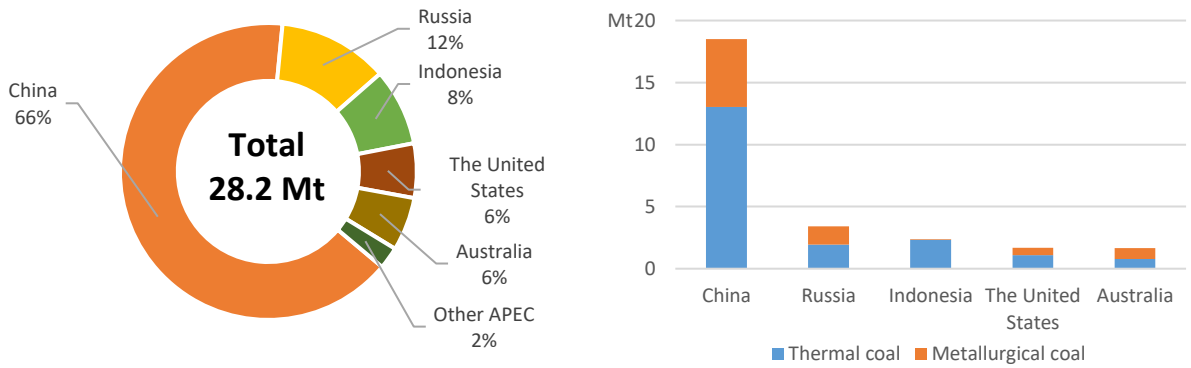
Figure 5.4: Sources of coal mine methane emissions

Source: Authors

Key points

- Coal seams naturally contain methane, which can be released during or after mining operations and is referred to as coal mine methane (CMM).
- Sources of CMM emissions include underground coal mines, open-pit coal mines, coal preparation plants and abandoned mines.
- In the open-pit coal mines, methane is released as coal seams are broken up and coal is extracted for processing.
- In underground mines, methane is mainly released into the atmosphere via mine ventilation system, with methane concentration often less than 2%. In gassy coal mines, methane is drained from target coal seams prior to mining operations because the gas is highly explosive and poses a significant safety risk. CMM emissions tend to be higher from underground mines than from surface mines, as deeper coal seams tend to contain more methane than shallower coal seams.
- Coal mine methane continues to be released for decades after mining stops, as the gas gradually permeates from the underground formations and escapes through disused mine shafts to the surface.
- A total of 41.8 Mt of CMM was released into the atmosphere in 2022, representing an estimated 10% of total methane emissions from human activity. Thermal coal and lignite accounted for around 75% of CMM emissions, and coking coal for the remaining 25%. Underground mines were responsible for around 70% of emissions, and surface mines were responsible for the remainder. Emissions from abandoned coal mines are not included in these estimates but could represent a significant source of emissions.

Figure 5.5: Coal mine methane emissions in the selected APEC economies, 2024



Source: compiled by the authors based on IEA (2025).

Key points

- In 2024, APEC coal-producing economies released 28.2 Mt of methane during their coal mining activities, accounting for approximately 70% of the global CMM emissions (IEA, 2025).
- The five largest CMM emitters accounted for almost all of the total APEC CMM emissions. China was the largest emitter, corresponding to the large amounts of coal it produces, accounting for 66% of total APEC CMM emissions. Around three-quarters of Chinese CMM emissions came from thermal coal mining activities, while the remainder of CMM emissions came from metallurgical coal mining.
- Russia's share accounted for 12% of the total APEC CMM emissions. Approximately 60% of CMM emissions came from thermal coal mines, and the rest of CMM emissions came from metallurgical coal mining activities.
- Indonesia was responsible for 8% of the total APEC CMM emissions. Thermal coal production dominated the mining industry in Indonesia. Therefore, most of the CMM emissions came from thermal coal mining activities.
- The United States and Australia both accounted for 6%. The share of CMM emissions from thermal and metallurgical coal mines was roughly equal in the Australian coal mining industry, while CMM emissions from thermal coal mining activities in the United States were slightly higher than those from metallurgical coal mines.
- Most CMM in China and Indonesia were emitted from thermal coal mines, while half of CMM emissions in Russia, the United States, and Australia were released from metallurgical coal mines in 2024.

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