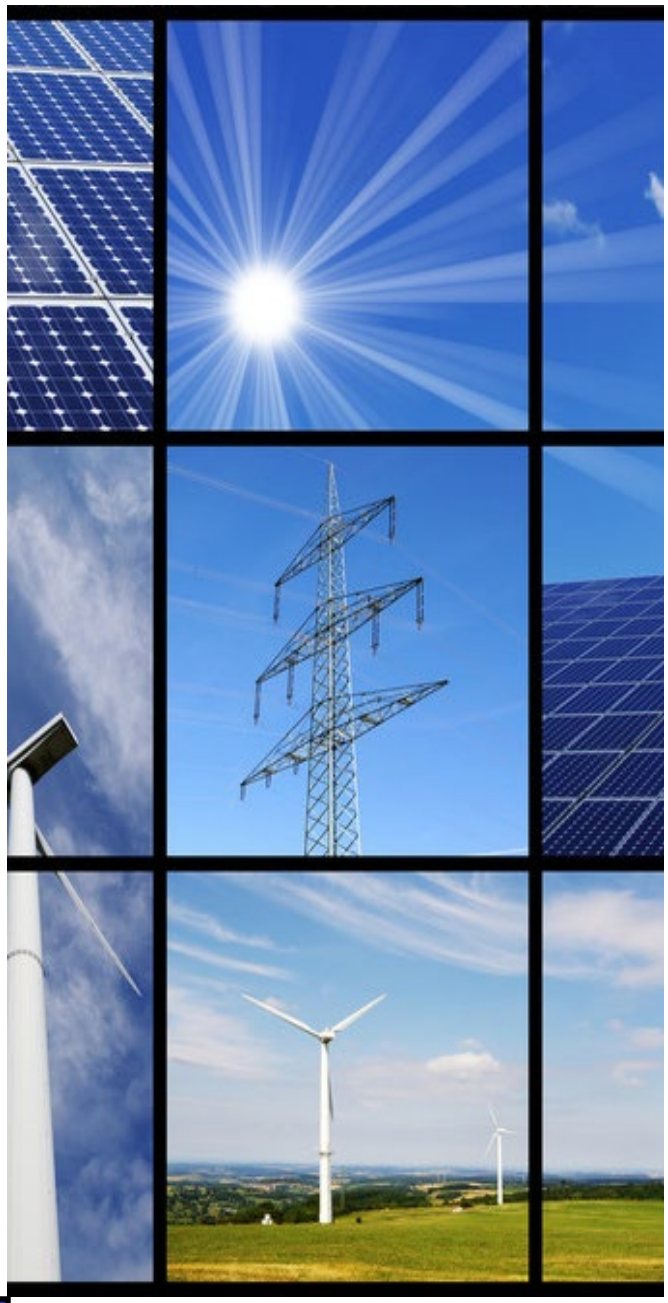
Asia-Pacific
Economic Cooperation

APEC ENERGY OVERVIEW 2021



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Foreword

The APEC Energy Overview (the Overview) is an annual publication that highlights the current energy situation in each of the 21 APEC economies. It has been the pioneer publication for APERC in showcasing the latest APEC energy data compiled by the Expert Group on Energy Data and Analysis (EGEDA) for 20 years.

This year, the Overview has been redesigned with a greater focus on conveying EGEDA data visually while also providing a summary of key energy policies and energy developments in tabular form.

The collective APEC energy goals remain:

1. An energy intensity improvement of 45% by 2035 (relative to 2005)
2. Doubling the renewable energy share in the APEC energy mix by 2030 (relative to 2010).

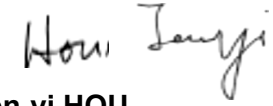
As of 2018, APEC energy intensity has improved by 22%, well on the way to meeting the goal of a 45% improvement by 2035. The share of renewable energy in APEC energy consumption has increased from 6.0% in 2010 to 8.7% in 2018. While there are no economy level targets for energy intensity or renewable energy share, economy level trends are discussed within each economy chapter to show how each economy is contributing to the aggregate goals.

The economy chapters also discuss policies, initiatives, and notable developments that are contributing to each economy's continued growth and development with respect to energy.

The basis of this report is the EGEDA data that each member economy submits on an annual basis. We thank you for your continued support in providing us this data. We also encourage APEC member economies and other stakeholders to make use of this publicly available resource to continue to develop, implement, refine, and analyse energy policy, alongside other energy related analysis.

President

Asia Pacific Energy Research Centre



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The ***APEC Energy Overview 2021*** could not have been accomplished without the contributions of many individuals and organisations in APEC. We would like to thank all those whose efforts made this publication possible.

We would also like to thank in particular those named below who contributed to the successful completion of this publication.

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Contents

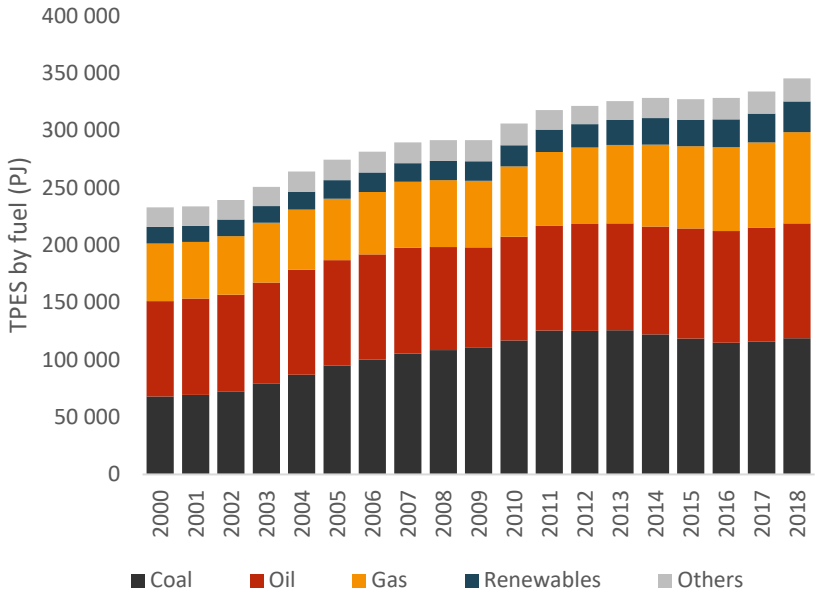
APEC ENERGY OVERVIEW 2021

Introduction

This year's APEC Energy Overview provides a detailed summary of energy supply and consumption statistics from 2000 to 2018, as well as an up-to-date discussion of energy policies and notable energy developments to 2021, for each APEC member economy.

There was a significant increase in energy supply in 2018, with growth in gas and renewables driving the APEC regional supply close to 350 exajoules (Figure 1). While gas and renewables recorded the largest growth, coal continues to account for the largest share of supply in the region at 34%.

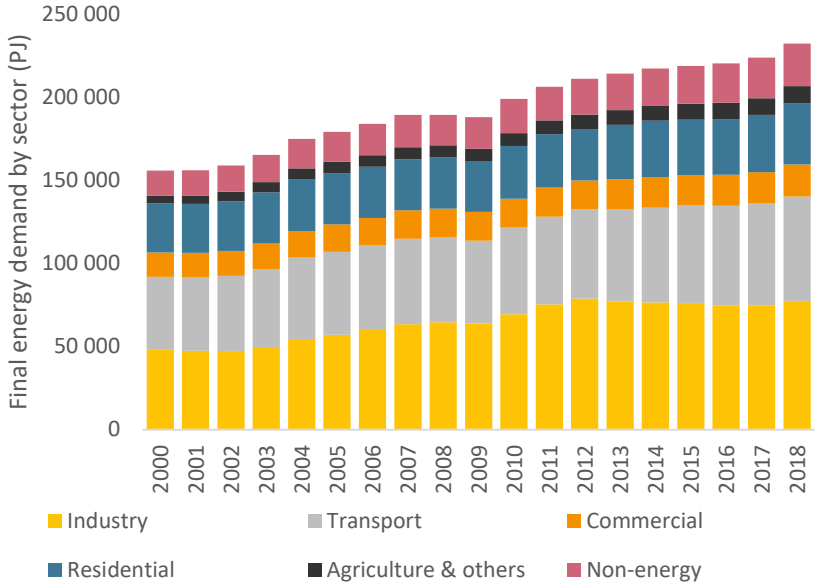
Figure 1: APEC Total Primary Energy Supply by Fuel



Source: EGEDA (2020)

In terms of consumption, the final energy sectors consumed over 230 exajoules in 2018 (Figure 2), with the 3.8% annual growth even larger than the growth in supply (3.4%). Industry continues to be the largest end-user of energy, while the residential sector posted the largest annual growth at 6.9% in 2018. For the 2000 to 2018 period, the sectoral breakdown has remained relatively stable, though industry's share has been slowly declining since 2012.

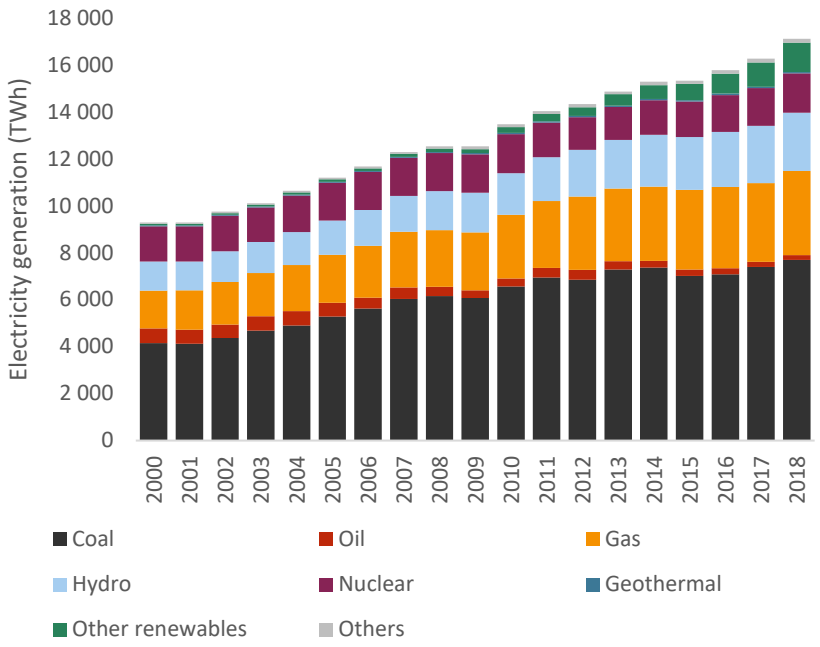
Figure 2: APEC End-Use Energy Consumption by Sector



Source: EGEDA (2020)

In the transformation sector, APEC electricity generation recorded very large annual growth of 5.2% in 2018 (Figure 3). Renewable electricity generation increased by 6.9%, though thermal generation technologies grew strongly as well, increasing by 4.8%.

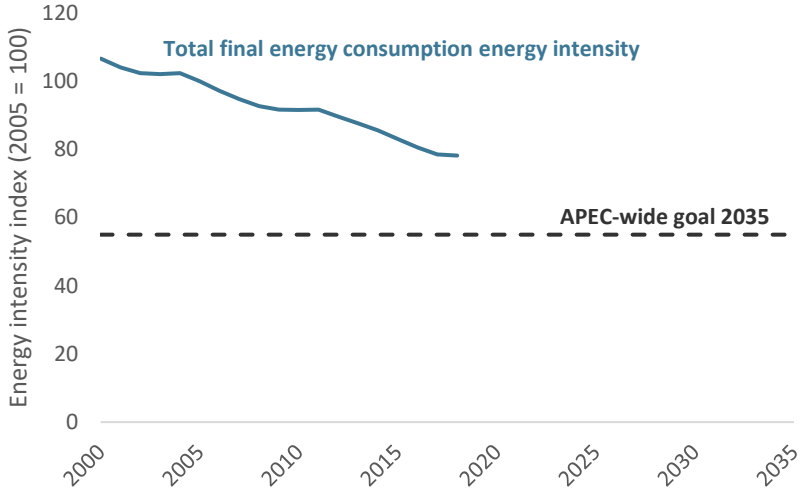
Figure 3: APEC Electricity Generation



Source: EGEDA (2020)

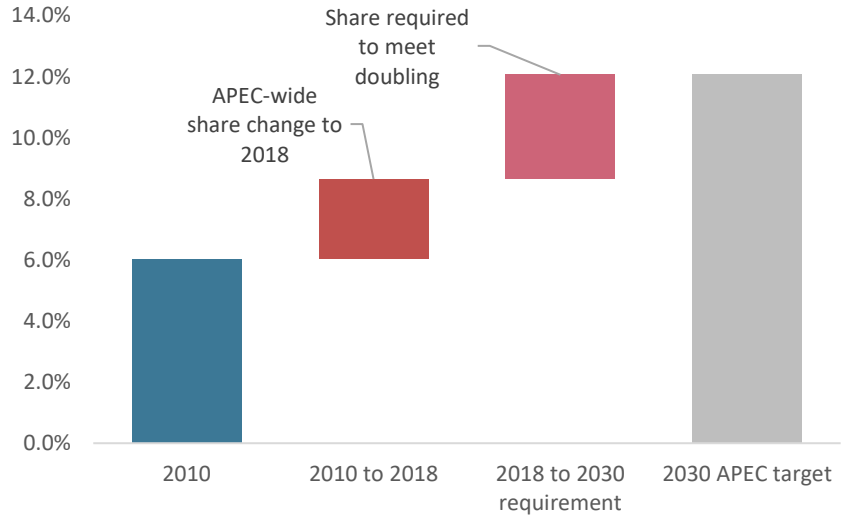
The APEC region has continued to make progress toward its 45% improvement in energy intensity goal by 2035 (relative to 2005). As of 2018, APEC-wide energy intensity has improved 22%, leaving an additional 23% improvement needed to meet the 2035 goal (Figure 4). Progress has also been made in doubling the share of modern renewables in the energy mix by 2030 (relative to 2010). The modern renewable share of final consumption has increased from 6.0% in 2010 to 8.7% in 2018 (Figure 5).

Figure 4: APEC Progress to the 2035 Energy Intensity Goal



Source: EGEDA (2020)

Figure 5: APEC Modern Renewable Share Target



Source: EGEDA (2020)

Table 1: Net-zero/Carbon neutral commitments by APEC economies, June 2021

Economy	Net-zero by	Share of APEC CO_2 emissions (2018) (%)	Share of APEC GDP (2018) (%)
Canada	2050	2.5	2.7
Chile	2050	0.4	0.7
China	2060	45.3	30.8
Hong Kong, China	2050	0.2	0.7
Japan	2050	5.1	7.7
Korea	2050	2.9	3.0
New Zealand	2050	0.1	0.3
Papua New Guinea	2050	1.0	1.3
Singapore	Second half of the century	0.2	0.8
Chinese Taipei	2050	1.3	1.9
United States	2050	24.4	29.5
Total		**83.3**	**79.3**

Source: APEC economies; World Bank (2020)

The second half of 2020 and first half of 2021 saw several large APEC economies make ambitious commitments to decarbonise. As of June 2021, eleven economies representing 83.3% of total APEC CO_2 emissions and 79.3% of total APEC GDP in 2018 had made formal commitments to reach net zero emissions in the coming decades (Table 1).

Australia

Introduction

Covering approximately 7.7 million square kilometres, Australia is the sixth-largest economy in the world in terms of land area. It lies in the southern hemisphere, between the Indian and Pacific Oceans, and is comprised of six states and two territories. Most of its population of 25 million is situated in the southeast corner of the continent, particularly in the cities of Sydney, Melbourne and Brisbane and the surrounding urban satellites.

In 2018, Australia's gross domestic product reached USD 1 239 billion (2017 USD purchasing power parity), which was a 2.9% increase from 2017 (World Bank, 2020).

Australia has abundant, high-quality energy resources that will last for many decades at the current rate of production. The Australian energy industry accounted for 7.2% (AUD 141 billion) of the economy in 2019–20 (ABS, 2020) and represented 29% of the value of Australia's exports (Industry, 2020). China's rapid economic development fuelled much of this export growth, with the proportion of Australian energy production destined for export markets increasing from 54% in 2000 to 68% in 2018 (EGEDA, 2020).

Australia is the world's largest metallurgical coal exporter and second-largest thermal coal exporter (Industry, 2020). It also became the largest exporter of liquefied natural gas (LNG) after nudging Qatar from the top spot in 2019.

Although Australia has large export capacity and tradeable volumes, the COVID-19 pandemic has led to a significant decline in its energy export earnings. Metallurgical coal exports fell to AUD 34 billion in 2019–20 from AUD 44 billion in the year before. Thermal coal earnings fell to AUD 20 billion in 2019–20 from AUD 26 billion the year before (Industry, 2020).

LNG export earnings remained relatively robust at AUD 48 billion in 2019–20, which is only slightly lower than the AUD 50 billion earned in 2018–19. However, the Australian Government is forecasting a sharp decline in revenue for 2020–21 due to weak, lingering demand and price-related impacts from COVID-19 (Industry, 2020).

Table 1: Australia's Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	7.7	Oil (billion barrels)	2.4
Population (million)	25	Gas (trillion cubic feet)	84
GDP (2017 USD billion PPP)	1 239	Coal (million tonnes)	149 079
GDP per capita (2017 USD PPP)	49 576	Uranium (kilotonnes U < USD 130/kgU)	1 184

Source: [a] World Bank (2020), [b] BP (2020) [c] OECD (2020)

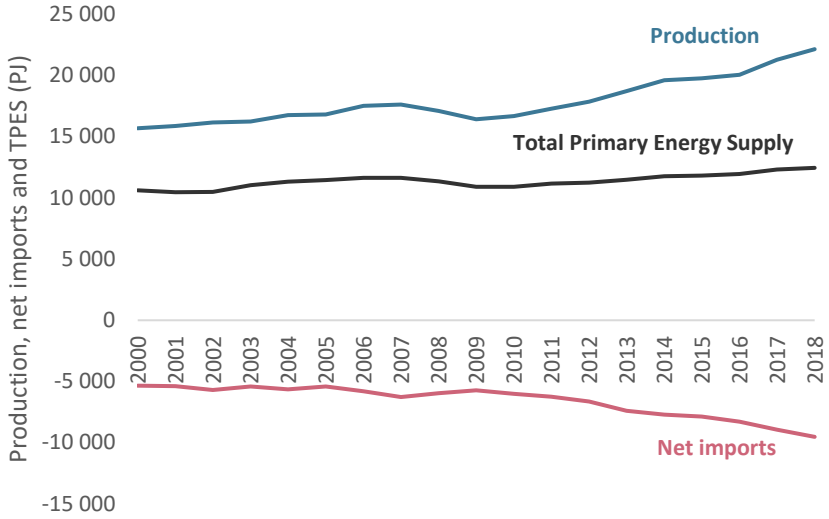
Note: Reserves are total proved reserves.

Energy Supply and Consumption

Total Primary Energy Supply

Australia's total primary energy supply (TPES) was 0.3% higher than in 2018, reaching 5 360 PJ (EGEDA, 2020). Energy production maintained strong, multi-decade growth, reaching 17 231 PJ in 2018. This was driven by external markets; net exports rose to 11 700 PJ in 2018 – a 3.8% annual increase (Figure 1). The significant increase in both production and net exports aligns with China's increasing appetite for bulk commodities and energy resources to support its continued economic growth.

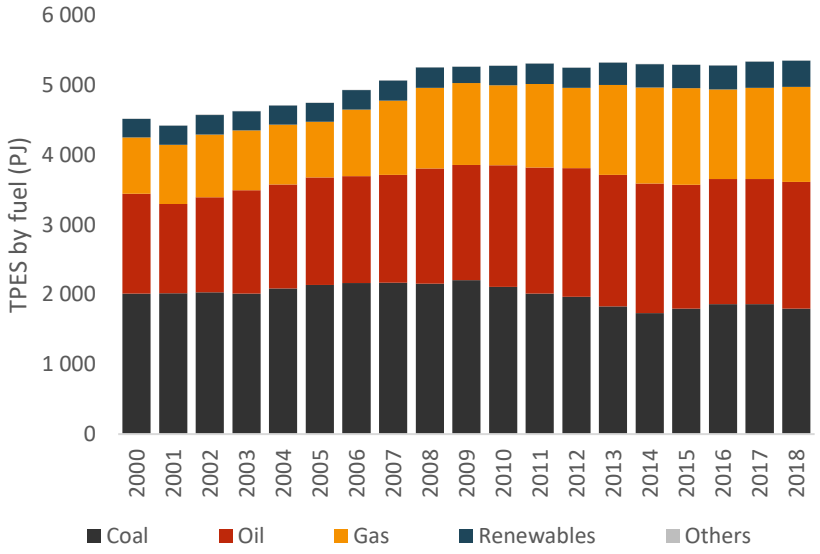
Figure 1: Australia's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

Australia's TPES fuel mix underwent a gradual transition from 2000 to 2018 (Figure 2). In this period, the share of coal declined from 45% to 34%, while that of natural gas increased from 18% to 25%. Oil's share remained stable in relative terms, increasing from 32% in 2000 to 34% in 2018. In the same period, renewables increased from 5.9% to 7.1% (EGEDA, 2020).

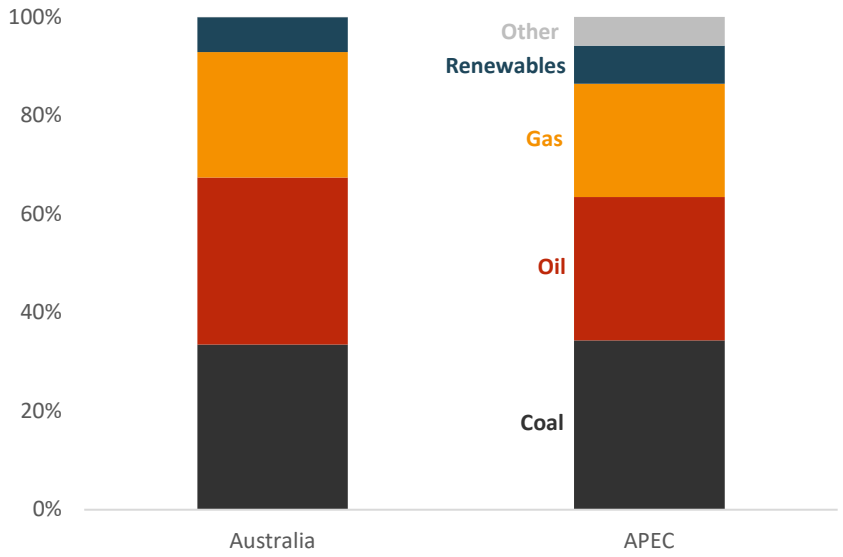
Figure 2: Australia's Total Primary Energy Supply by Fuel, 2000 to 2018



Source: EGEDA (2020)

Australia has a fuel mix that is similar to that of the entire APEC region (Figure 3). Coal and renewables have almost the same relative share, whereas oil and gas supply are proportionally larger. The others category includes nuclear energy and supply such as industrial waste and municipal solid waste, which are not prominent in Australia's total primary energy supply.

Figure 3: Total Primary Energy Supply and Relative Fuel Share – Australia and APEC, 2018



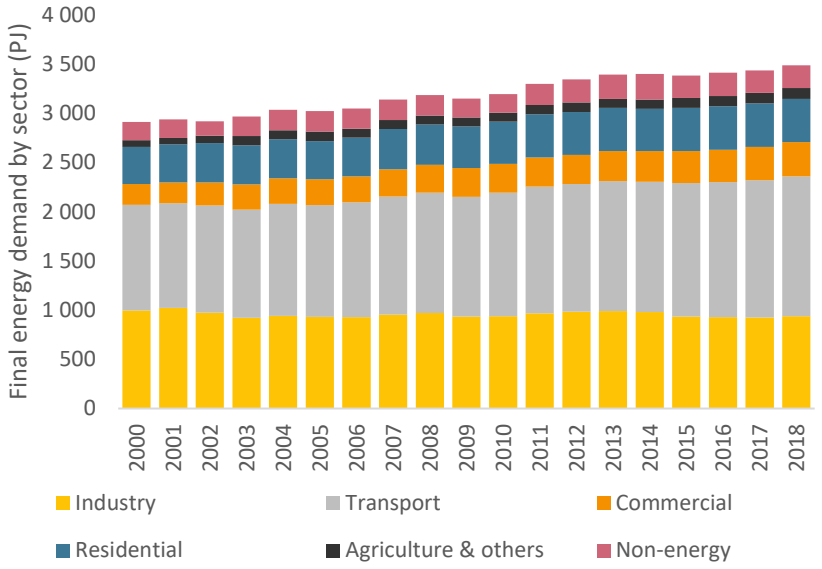
Source: EGEDA (2020)

Total Final Consumption

Total final consumption is a representation of end-use energy, including the non-energy consumption of energy products. Natural gas used as feedstock in chemical production is an example of non-energy use of natural gas. For Australia, transport is the dominant end-use sector, accounting for 41% of all end-use energy consumption (including non-energy) in 2018. The industry sector is the next largest, accounting for 27%.

The commercial sector, agriculture and others (which includes forestry and fishing; end users not classified elsewhere) have experienced the largest growth since 2000, increasing at an average annualised rate of 2.8% to 2018 (EGEDA, 2020). Figure 4 shows that, even with this growth, these sectors only account for a relatively small proportion of all end-use energy consumption. The residential sector has grown at a modest 0.8% since 2000, accounting for 13% of end-use energy consumption in 2018.

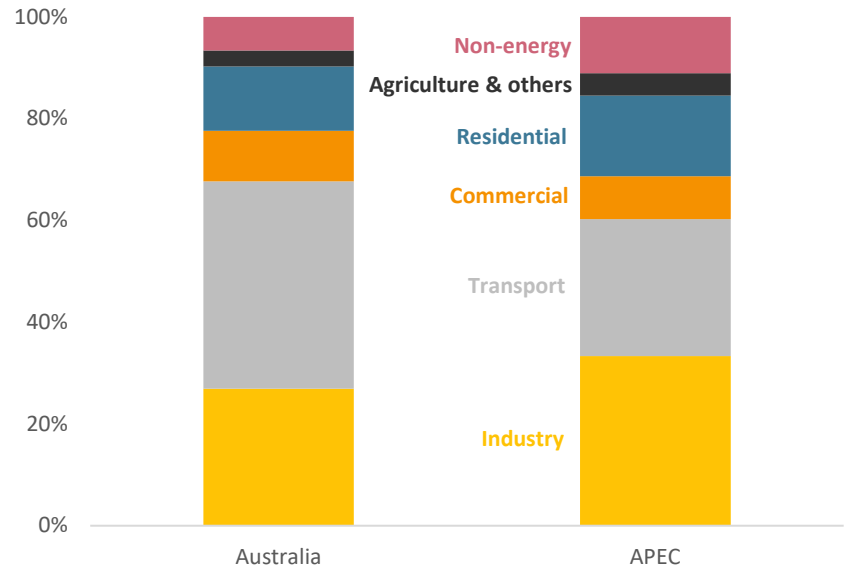
Figure 4: Australia's Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Compared to the APEC region, Australia's industry end-use sector uses less energy, whereas the transport sector uses more energy (Figure 5). This relatively large use of energy in the transport sector is partly driven by the size of the continent and the significant distances between population centres.

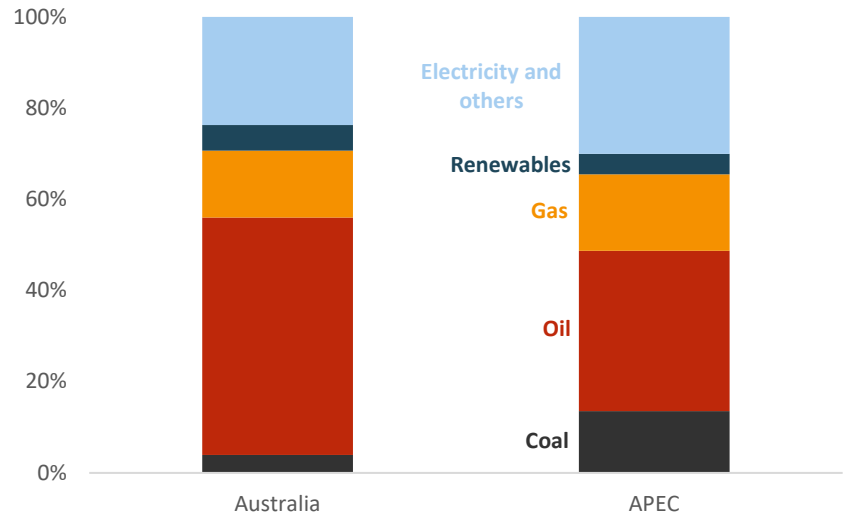
Figure 5: Relative Sectoral Final Energy Demand for Australia and APEC, 2018



Source: EGEDA (2020)

Australia's large transport sector remains reliant on oil-related products, meaning that the end use of oil is much larger in Australia than in the APEC region (Figure 6). In contrast, coal use in end-use demand sectors is relatively low. This is because energy-intensive industries such as steel-making and cement and chemical production are not as prominent in Australia as they are in many other APEC economies. Service-based industries constituted 64% of Australia's gross value added in 2019, whereas manufacturing only accounted for 6.1% (ABS, 2020).

Figure 6: Final Energy Demand Fuel Mix for Australia and APEC, 2018



Source: EGEDA (2020)

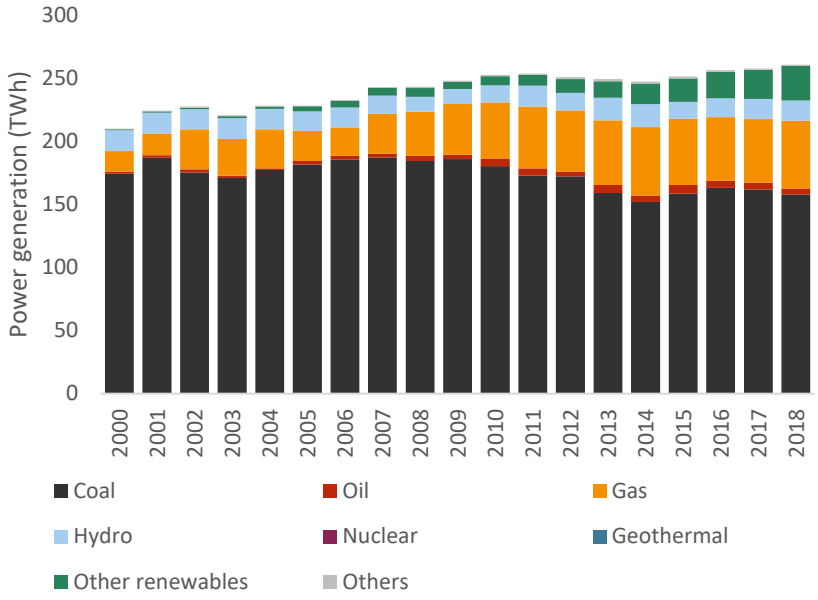
Transformation

The most prominent component of Australia's energy transformation sector is the power sector. Other transformation sectors such as coal transformation and oil refining have been in decline in recent decades. As of February 2021, two of Australia's four remaining oil refineries – Kwinana in Western Australia and Altona in Victoria – have announced plans to shutter their operations. This means that Australia will have to compensate for its reduced domestic oil-refining output by importing more refined products from Asia.

For the power sector, 60% of Australia's 261 terawatt hours (TWh) of electricity was generated by coal in 2018 (Figure 7). This is

significant but represents a decline from the 83% of 210 TWh generated in 2000 (EGEDA, 2020). For the same period, natural gas generation increased from 7.7% to 21%. Renewables generation increased to 17% in 2018 from 8.4% in 2000, with a 10.5% annual increase in the most recent year of data.

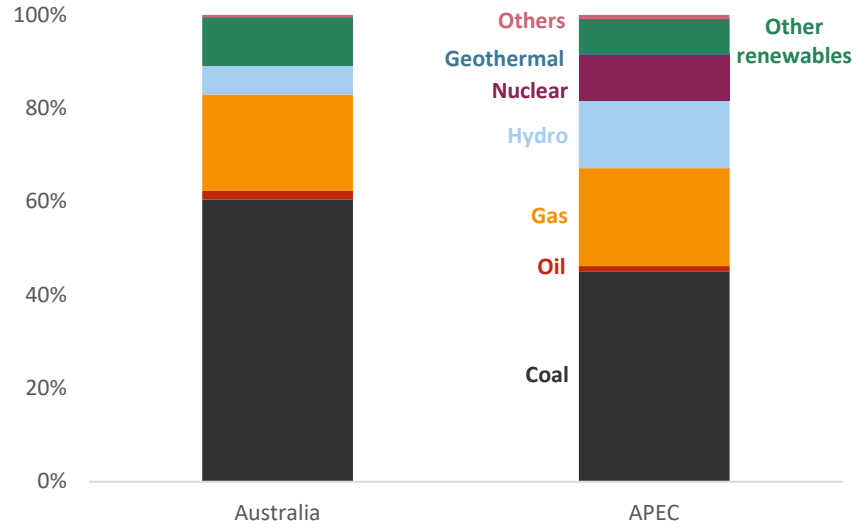
Figure 7: Australia's Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Coal's prominence in Australia's power sector is clear when viewed alongside the generation mix for APEC in 2018 (Figure 8). In contrast, hydro is proportionally lower in Australia's generation mix. Other renewables generation is larger, and rapid growth is expected to continue in this sector in Australia due to abundant renewable potential and continued decline in the cost of these technologies.

Figure 8: Electricity Generation by Fuel for Australia and APEC, 2018



Source: EGEDA (2020)

APEC Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective. These objectives are to improve energy intensity by 45% in 2035 as compared to 2005 and to double the share of modern renewables in the energy mix by 2030 as compared to 2010.

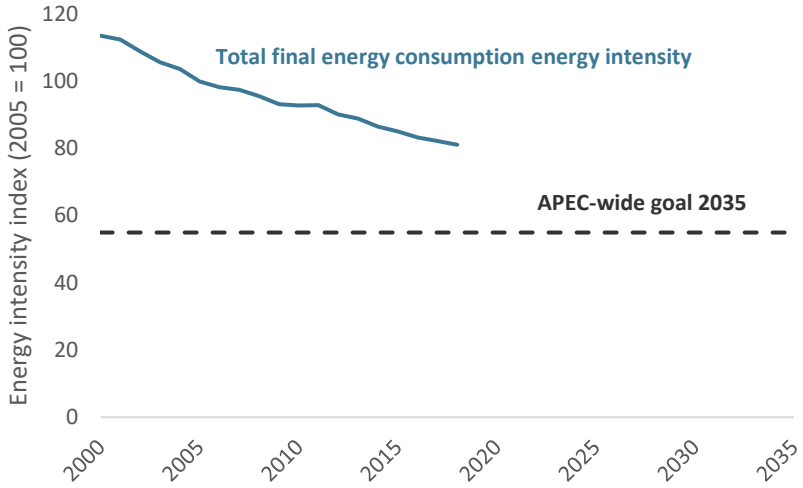
Energy Intensity Goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2018, Australia's total final energy consumption (not including non-energy) intensity improved by 19% relative to the 2005 level. This confirms Australia's commitment to the 2035 energy intensity goal, as shown in Figure 9.

Figure 9: Australia's Total Final Energy Consumption Intensity Index, 2000 to 2018 (2005 = 100)



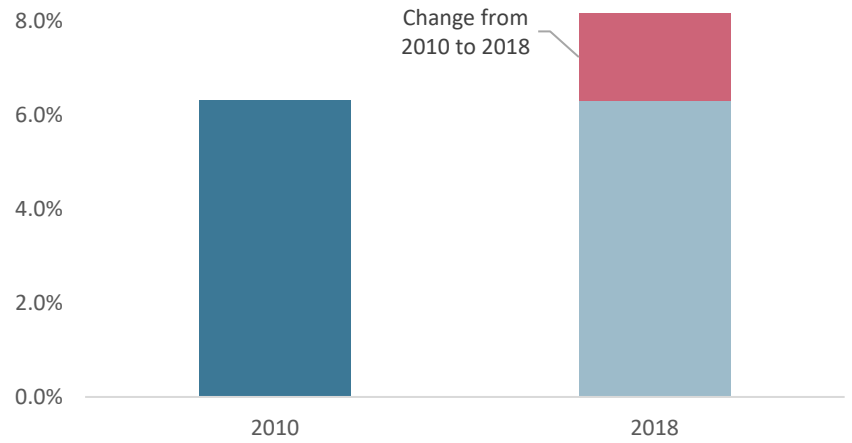
Source: EGEDA (2020)

Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption (it does not include non-energy consumption).

There is no economy-level goal for individual member economies, but improvements by individual economies will contribute to the doubling goal. Australia's share of modern renewables in final energy consumption in 2010 was 6.3%. In 2018, the proportional share was 8.2%, which represents a 29% increase in modern renewables (Figure 10). Meeting the APEC-wide doubling goal will require APEC's modern renewables share to reach 12.0% by 2030.

Figure 10: Australia's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)
Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass, and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also includes the share of electricity that is generated from renewable sources.

Energy policy

Energy Policy	Details	Reference
Emissions Reduction Fund (ERF)	Australian Carbon Credit Units (ACCUs) are earned for each tCO2e stored or avoided, and these can be sold to the government (reverse auction) or in the secondary market.	Clean Energy Regulator
Safeguard mechanism	The safeguard complements the ERF by placing a legislated obligation on Australia's largest greenhouse gas emitters to keep net emissions below their emissions limit (or baseline).	Clean Energy Regulator
Australia's National Hydrogen Strategy	Designed to establish Australia's hydrogen industry as a major global player by 2030.	Department of Industry, Science, Energy and Resources
Climate Solutions Fund	An investment of AUD 3.5 billion to deliver Australia's 2030 Paris climate commitments.	Clean Energy Regulator
Climate Active	Certification is awarded to Australian businesses that meet the requirements to achieve net zero carbon emissions.	Climate Active
The National Greenhouse and Energy Reporting scheme	A single economy-wide framework for reporting and disseminating company information about greenhouse gas emissions, energy production and energy consumption.	Clean Energy Regulator
Paris Agreement Nationally Determined Contribution	To reduce greenhouse gas emissions by 26 to 28% below 2005 levels by 2030.	Department of Industry, Science, Energy and Resources
Bilateral energy and emissions reduction agreements	The federal government is developing bilateral energy and emissions reduction agreements with state and territory governments to improve energy reliability and affordability and support the transition of energy markets to lower-emissions technologies.	Department of Industry, Science, Energy and Resources
Energy National Cabinet Reform Committee (ENCRC) and the Energy Ministers' Meeting (EMM)	Tasked with priorities to deliver the following: - Immediate measures to ensure reliability and security of the electricity grid - Redesign of the National Electricity Market - Package of reforms to unlock new gas supply, improve competition and better regulate pipelines	Department of Industry, Science, Energy and Resources
Liddell Taskforce	Will advise government whether sufficient dispatchable capacity is built to make up for the closure of the Liddell power plant in 2023.	Department of Industry, Science, Energy and Resources
National Energy Customer Framework	Regulates the connection, supply, and sale of energy (electricity and gas) to grid-connected residential and small-business energy customers	Department of Industry, Science, Energy and Resources

Energy efficiency and energy productivity	Offers support for the establishment of standards, programs, and innovative practices to improve energy efficiency and energy productivity. The National Energy Productivity Plan is a commitment to improve Australia's energy productivity by 40% between 2015 and 2030.	Department of Industry, Science, Energy and Resources
Australia's fuel security package	The government's long-term fuel security goal is to increase domestic storage and hold a sovereign refining capability that meets Australia's needs during an emergency.	Department of Industry, Science, Energy and Resources
Energy emergency management forums	Participation in gas, liquid fuel, and electricity emergency management forums to ensure effective communication and collaboration between governments and industry in energy supply emergencies	Department of Industry, Science, Energy and Resources
Energy infrastructure resilience	Trusted Information Sharing Network for Critical Infrastructure Resilience Energy Sector Group is a forum for sharing information on security issues and practical measures to improve the resilience of energy infrastructure to all hazards.	Department of Industry, Science, Energy and Resources
Energy security assessments	The Australian Government undertakes energy security assessments to better understand the risks to the adequacy, reliability, and affordability of energy in Australia.	Department of Industry, Science, Energy and Resources
Energy supply policy	The Australian Government is ensuring supply security, reliability, and affordability via clean energy and electricity market reforms, delivering priority transmission projects and pumped hydro, and supporting the Tasmanian energy taskforce.	Department of Industry, Science, Energy and Resources
Subsidies for residential (and commercial) storage and/or PV	Upfront subsidy for residential storage in South Australia until 2022; residential storage in Victoria until 2021; residential PV in Victoria until 2027	Solar rebates in Australia
Large-scale Renewable Energy Target	Annual targets for renewable electricity generation will be achieved through a market for large-scale generation certificates.	Clean Energy Regulator
Small-scale Renewable Energy Scheme	Incentivises small-scale renewable energy systems through legislated demand for small-scale technology certificates (STCs). The STCs act as a discount offered to small energy consumers to install RE systems such as solar water heaters and solar PV.	Clean Energy Regulator
Snowy 2.0	Sponsoring and commissioning of a 2GW pumped hydro facility in 2025 by the federal government.	Snowy Hydro
Retailer Reliability Obligation (RRO)	If there are forecast gaps between energy demand and supply, the Australian Energy Market Operator will compel energy retailers to contract additional generation.	Department of Industry, Science, Energy and Resources
Underwriting new generation investments (UNGI)	UNGI will provide financial support to increase generation capacity. The program is supporting 3 818 MW of new generation.	Department of Industry, Science, Energy and Resources
Grid Reliability Fund	Ensures that sufficient reliable generation capacity is available to meet periods of high demand in the National Electricity Market.	Department of Industry, Science, Energy and Resources

Fuel excise	Indexed to inflation and currently AUD 0.427 per litre for most liquid fuels.	Australian Tax Office
Australian Domestic Gas Security Mechanism	Temporary measure that can restrict LNG exports by those producers drawing more gas from the domestic market than they are replacing.	Department of Industry, Science, Energy and Resources
Petroleum Resource Rent Tax	A tax on the profits generated from the sale of marketable petroleum commodities.	Australian Tax Office
Taxes and royalties on minerals and petroleum	The Australian Government and state and territory governments own Australia's mineral and petroleum resources on behalf of the community. Companies that extract mineral and petroleum resources must pay taxes and royalties.	Department of Industry, Science, Energy and Resources
Commercial Buildings Disclosure	Requires sellers and lessors of large commercial spaces to provide energy efficiency information.	Department of Industry, Science, Energy and Resources

Notable Energy Developments

Energy Development	Details	Reference
LNG import terminals	Currently, there are five proposed import terminals for locations on the east coast of Australia at various stages of development. It is uncertain how many of these will be built.	Resources and Energy Quarterly
Refinery closures	Kwinana in Western Australia and Altona in Victoria have announced plans to cease operations. Remaining capacity will fall to 229 thousand barrels of oil per day (from 455 kbbl/day).	ABC

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Australian Government Department of Industry, Science, Energy and Resources – www.industry.gov.au

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Clean Energy Regulator – www.cleanenergyregulator.gov.au

COAG Energy Council – www.coagenergycouncil.gov.au

COAG Gas Market Reform Group – gmrg.coagenergycouncil.gov.au

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Brunei Darussalam

Introduction

Brunei Darussalam (BD) is a small nation on the northwest coast of the island of Borneo in Southeast Asia. Located approximately 442 kilometres (km) north of the equator, the economy covers a total area of 5 765 square kilometres (km^2) with a coastline length of 168 km along the South China Sea on the north. The Malaysian states of Sarawak and Sabah border the east and west sides of BD, respectively. The economy comprises four main districts: Belait, Tutong, Brunei-Muara and Temburong.

Demographically, the population in 2018 was 428 962 people (EGEDA, 2020). On average, BD Malays comprise 66% of the total population, followed by the Ethnic Chinese and other groups at 10% and 24%, respectively (MOFE, 2020). Most of the residents are from the Brunei-Muara district, which is home to the capital city Bandar Seri Begawan.

Table 1: Macroeconomic Data and Energy Reserves

Key Data[a]		Energy Reserves [b]	
Area (km^2)	5 765	Oil (billion barrels)	1.1
Population	428 962	Gas (billion cubic metres)	200
GDP (2017 USD billion PPP)	25.9	Coal (million tonnes)	-
GDP per capita (2017 USD PPP)	60 389	Uranium (kilotonnes U_3O_8)	-

Source: a – EGEDA (2020); b – BP (2020)

For over 85 years, since the commercial discovery of oil in the Seria and Belait districts in 1929 and Southwest Ampa gas field in 1963, Brunei Shell Petroleum (BSP) and Brunei LNG Sdn Bhd have been the backbone of BD's economy (BSP, 2021). The production and export of oil and gas accounted for about 57.1% of BD's total GDP and 91% of its total exports in 2018 (MOFE, 2020). In the same year, BD's GDP was valued at USD 25.9 billion (2017 USD purchasing power parity [PPP]), a 0.05% increase from 2017. The per capita GDP was USD 60 389, down by 1% from 2017 (EGEDA, 2020).

Evidently, BD is one of the economies that are heavily reliant on crude oil and LNG export revenues. 81% of the total government's revenues came from such sectors in 2018 (MOFE, 2020). This is risky as fluctuations in global oil prices have affected the economy in recent years. The 2014–2016 collapse in global oil prices rendered large fiscal deficits between 2015 and 2017 and forced fiscal spending cuts. Another cause of concern is the declining production due to ageing fields. Economic diversification has thus become the government's main goal, as mentioned in the Economic

Blueprint for BD. Non-oil and gas sectors are being targeted through the exploration of new economic activities to strengthen five key areas: downstream oil and gas, food, tourism, info-communications and technology (ICT), and services (MOFE, 2021).

In support of the above, BD has made significant investments to expand its downstream industries since 2010, specifically since the first operation of the Brunei Methanol Company (BMC) in Sungai Liang Industrial Park (SPARK)—the first of its kind. Hengyi Industries Sdn Bhd (Hengyi) is a joint venture between China's Zhejiang Hengyi Petrochemicals Co. Ltd and Damai Holdings Limited, a wholly owned subsidiary under BD's Strategic Development Capital Fund. Under this partnership, a USD 3.45 billion refinery and integrated petrochemical complex on a 260-hectare site at Pulau Muara Besar was constructed in the third quarter of 2017. Its operations successfully began in November 2019. The Brunei Fertilizer Industries (BFI) is another major downstream project that is expected to commence production not later than Q4 2021. Located in SPARK, the plant has a production capacity of 1 365 million metric tonnes of urea per year, making it one of the biggest fertilizer plants in Southeast Asia (BFI, 2021).

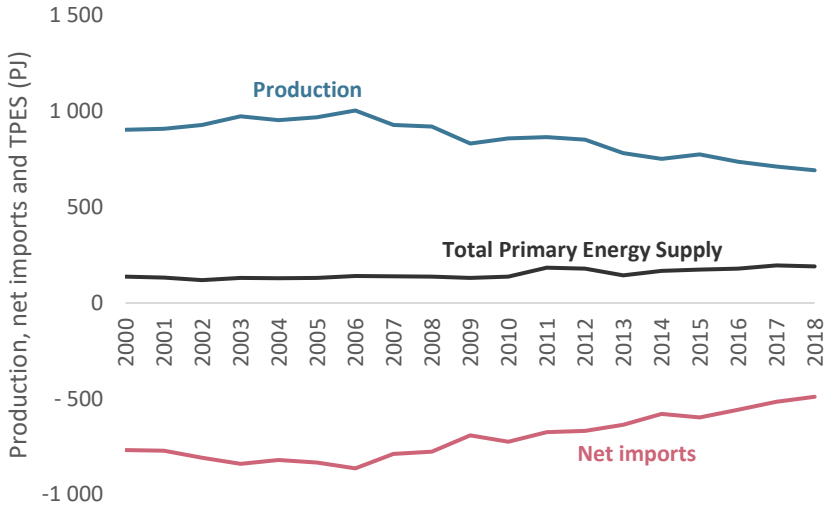
A consortium consisting of the Chiyoda Corporation, Mitsubishi Corporation, Mitsui & Co Ltd and Nippon Yusen Kabukishi Kaisha established the Advanced Hydrogen Energy Chain Association (AHEAD), which spearheaded the world's first global hydrogen chain between BD and Japan. A hydrogenation plant was built in SPARK to produce methyl-cyclohexane (MCHE) for export to Japan where it is converted to hydrogen. Novel low-carbon technologies, such as those based on hydrogen, help address the economy's energy security concerns while also supporting long-term environmental commitments (NEDO, 2017).

Energy Supply and Consumption

Total Primary Energy Supply

Figure 1 shows BD's total primary energy supply (TPES) from 2000 to 2018. BD's TPES declined 2% to 191PJ in 2018, which contrasts with the 1.9% per annum growth from 2000 to 2018. BD's energy production decreased at a rate of 1.5% per year through the same period, recording a 2018 level of 692 PJ. The net export position reflects BD's strong energy self-dependency.

Figure 1: Brunei Darussalam Total Primary Energy Supply, 2000 to 2018

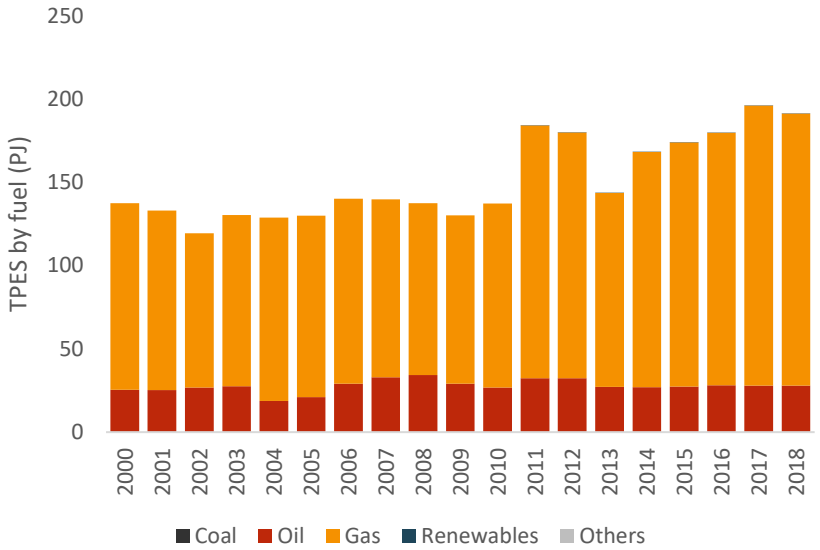


Source: EGEDA (2020)

Oil and gas dominated the economy's fuel supply from 2000 to 2018 at 19% and 81% average shares, respectively, as shown in Figure 2. From 2009 onwards, there was an increase in the share of gas,

which in turn decreased oil's share, as illustrated in the figure below. Renewables (solar) started entering the mix from 2011 to 2018, with a negligible average share of 0.002%.

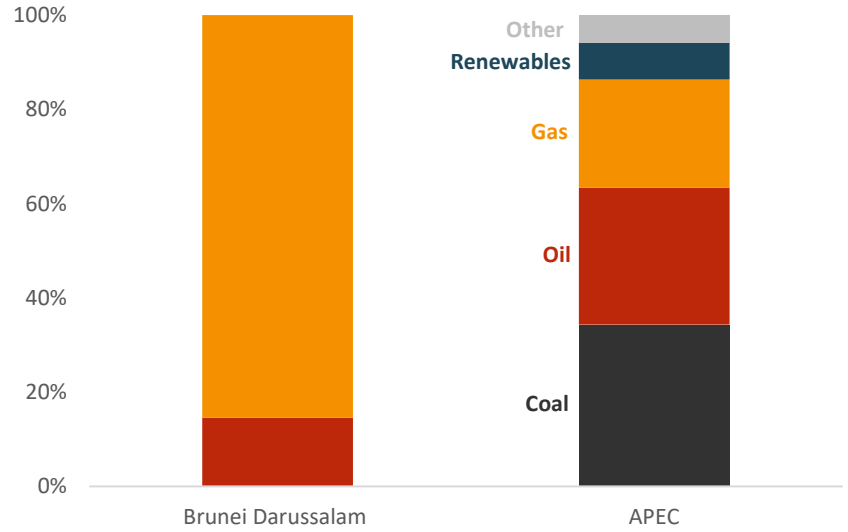
Figure 2: Brunei Darussalam Total Primary Energy Supply by Fuel Type, 2000 to 2018



Source: EGEDA (2020)

Due to oil and gas dominance, there is a considerable difference in the fuel proportionality between BD and the APEC region, as shown in Figure 3. BD's gas portion far exceeded that of the APEC region. Similarly, the APEC region has more oil and renewables than BD.

Figure 3: Total Primary Energy Supply Fuel Share, Brunei Darussalam and APEC, 2018



Source: EGEDA (2020)

Total Final Consumption

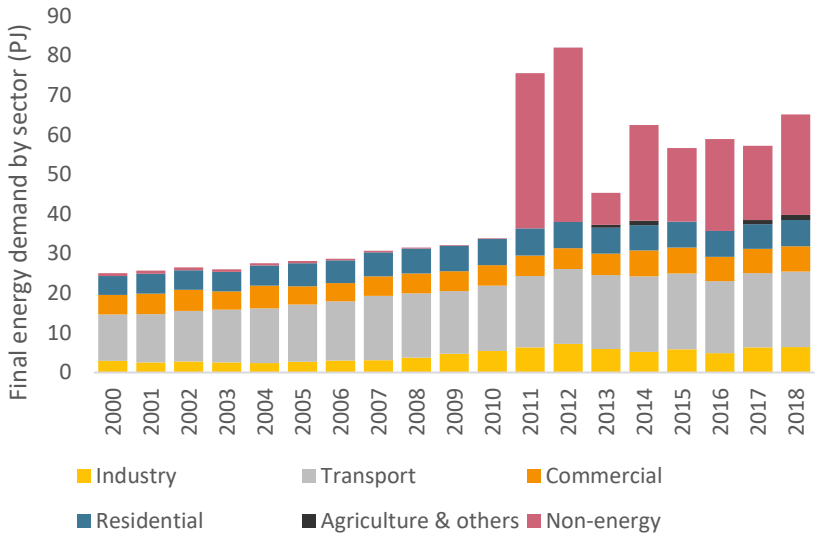
As shown in Figure 4, BD's total final energy consumption (not including non-energy) grew at a modest rate from 2000 to 2018. The story is altered when including non-energy use in the analysis.

Non-energy use became significant from 2011 onwards due to natural gas feedstock being used by the BMC, which has been commercially producing methanol since the second quarter of 2010 (BMC, 2020).

The sudden increase in non-energy consumption means that total final consumption (inclusive of non-energy) has a much larger

growth rate of 5.4% per annum for the 2000 to 2018 period. In 2018, total final consumption reached 65 PJ, an increase of 13.8% from its 2017 level. Non-energy use dominated the 2018 final consumption with a 39% share (22% annual growth), followed by transport, residential, commercial and industry at 29%, 10.1%, 9.9% and 9.8%, respectively. Agriculture and others only accounted for 1.9% of the total in 2018 (EGEDA, 2020).

Figure 4: Brunei Darussalam Final Energy Demand by Sector, 2000 to 2018

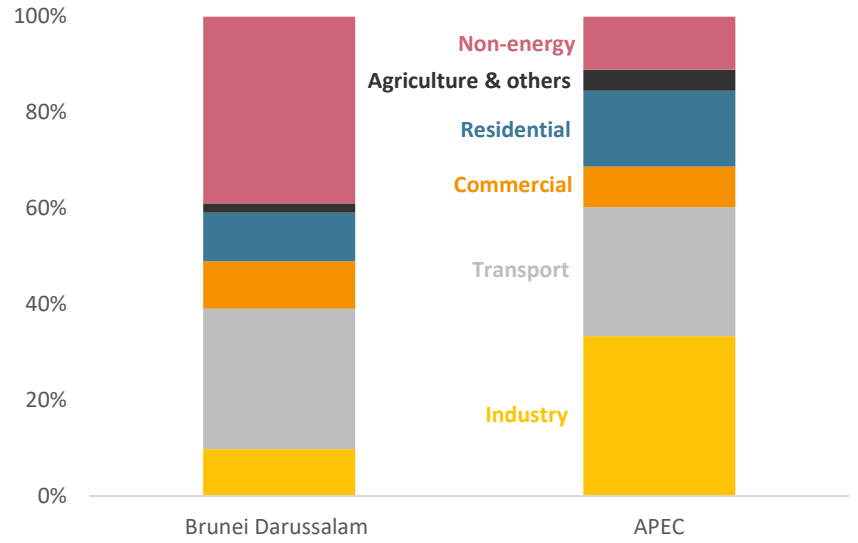


Source: EGEDA (2020)

Despite its tiny size, BD shows similarities in its transport, residential and commercial proportions relative to those of the APEC region. This is primarily due to BD's significant vehicle ownership and energy consumption per capita (Figure 5). Since BD's industry sector is still limited to oil and gas, the industry's demand for energy is still far below APEC's regional energy consumption.

Non-energy use in BD is higher than in the APEC region. This is due to the large relative size of the methanol production industry in BD, which consumes large amounts of natural gas as a feedstock.

Figure 5: Sectoral Share of Total Final Consumption, Brunei Darussalam and APEC, 2018



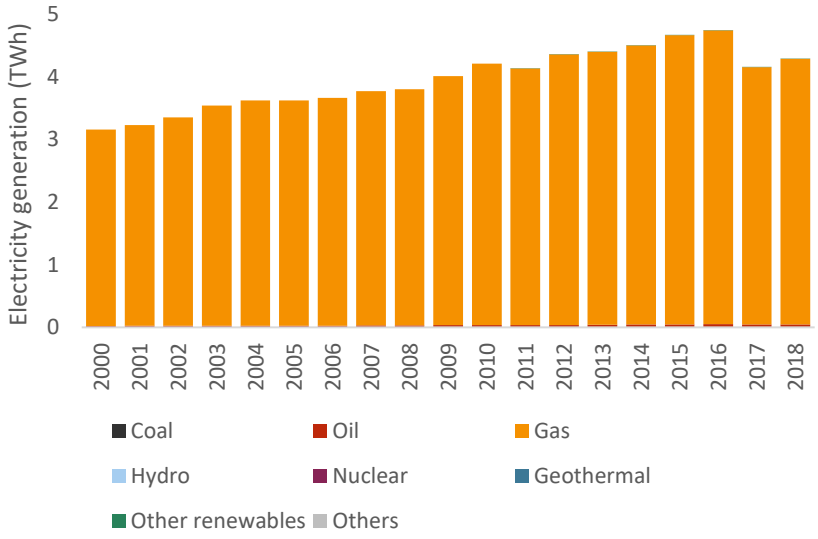
Source: EGEDA (2020)

Transformation

Brunei Darussalam's electricity generation is under the purview of two main utilities: (i) the Department of Electrical Services (DES) of the Ministry of Energy and (ii) Berakas Power Company Sdn Bhd (BPC). Practically, natural gas fuels all power generation, and oil (diesel) and other renewables' (solar) shares remain negligible as

shown in Figure 6. More than half (55%) of the power generated is via an open -cycle gas turbines located in DES-owned power stations (Gadong 1A and Gadong 2) and BPC's stations (Gadong 3, Berakas and Jerudong). DES also inherited a combined-cycle gas power plant in Bukit Panggal and a co-generation power plant in Lumut, from which the waste heat generated is supplied to Brunei LNG Sdn Bhd for their own use. BPC has also upgraded part of their Berakas gas turbine into an ORegen plant from which the waste heat from the gas turbines is used to generate power in an organic Rankine cycle (ORC) using turbo expander.

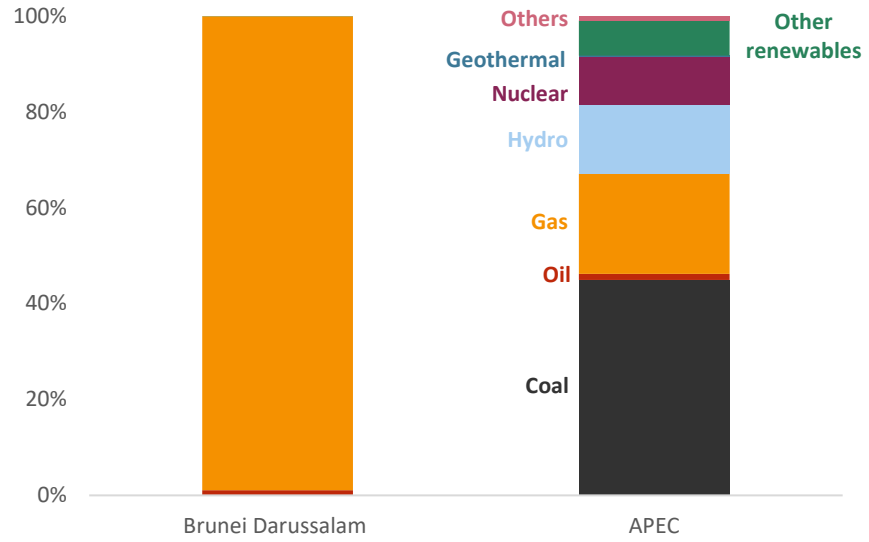
Figure 6: Brunei Darussalam Electricity Generation, by Fuel, 2000 to 2018



Source: EGEDA (2020)

Natural gas's monopoly in electricity generation in BD is clear in Figure 7. While the share of renewables in BD is almost non-existent, the economy is expected to pursue solar, which will drive renewable growth in the future.

Figure 7: Electricity Generation by Fuel for Brunei Darussalam and APEC, 2018



Source: EGEDA (2020)

APEC Goals

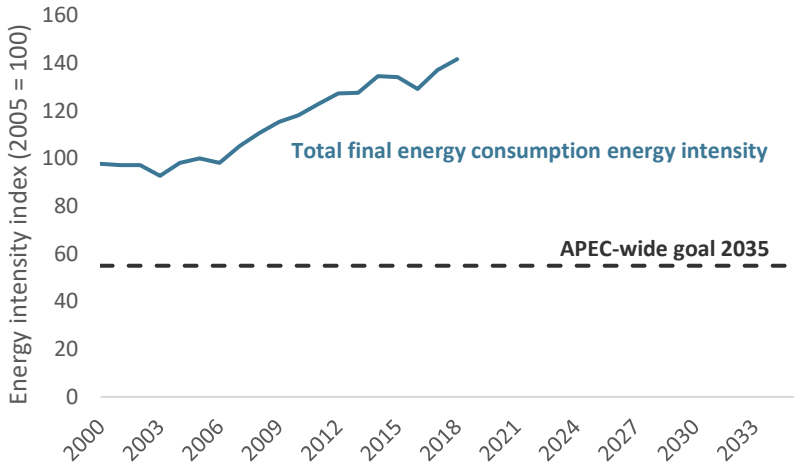
APEC member economies have set goals for energy intensity improvement as well as to increase the share of modern renewables in the energy mix.

Energy Intensity Analysis

APEC member economies have agreed to achieve a reduction of 45% in their energy intensities by 2035, relative to a 2005 baseline. APEC is on track to meet this intensity improvement. Although the goal is not being imposed on each of the APEC member economies, it is possible to track their individual progress relative to that overarching proportional improvement.

From Figure 8, BD's total final energy consumption (excluding non-energy) energy intensity has been showing an increasing trend since 2005, with the 2018 figure showing an increase of 5% from 2017.

Figure 8: Brunei Darussalam Total Final Energy Consumption Energy Intensity Index, 2000 to 2018 (2005 = 100)

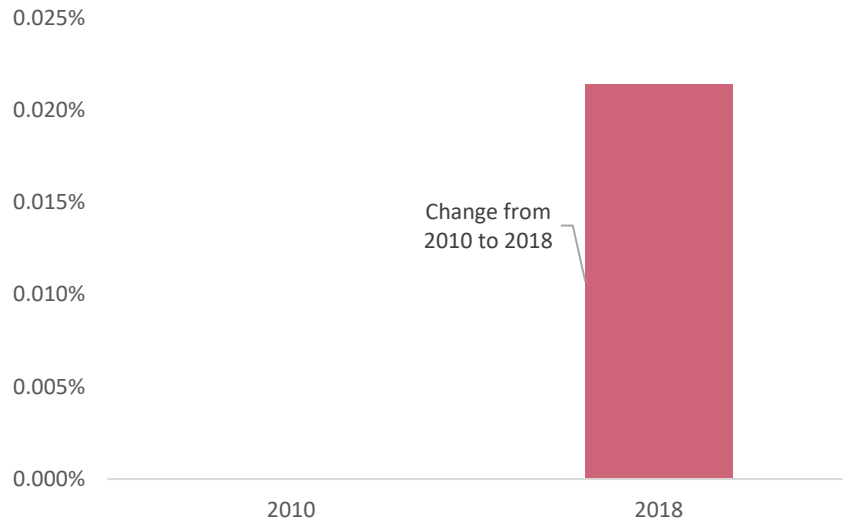


Source: EGEDA (2020)

Doubling of Renewables

BD's share of modern renewables is negligible given that its electricity supply is predominantly from natural gas. In 2011, the share of modern renewables was 0.0042% from when it first entered the economy's electricity mix. This increased to 0.02% in 2018. BD plans to intensify its renewables share by aiming to achieve at least 30% of its total installed electricity capacity by 2035, as stated in the Brunei National Climate Change Policy (BNCCP).

Figure 9: Brunei Darussalam Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)
Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass, and it is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

A major milestone was reached where BD launched its first National Climate Change Policy (BNCCP) in July 2020, paving the way for a low-carbon and climate-resilient nation. This eventually resulted in the update of BD's NDC, which was submitted in December 2020, with the goal of achieving a 20% emissions reduction by 2030, relative to business-as-usual (BAU) levels.

Energy Policy	Details	Reference
NDC Target	There will be a 20% reduction of GHG emission relative to BAU levels by 2030. This NDC target effectively supersedes the previous INDC.	UNFCCC (2020)
Brunei Darussalam National Climate Change Policy	The policy was established to pave for BD's low-carbon and climate-resilient pathways for a sustainable nation through the adoption of 10 key strategies related to industrial emissions, forest cover, electric vehicles, renewable energy, power management, carbon pricing, waste management, climate resilience & adaptation, carbon inventory, awareness & education.	BCCS (2020)
Electricity Order 2017	This involves the licensing of activities related to electricity generation, transmission, and distribution (GTD).	AENBD (2017)
Strategic Petroleum Reserve (SPR) - Directive 1	This directive serves to meet the objectives for ensuring BD's security, supply and production of crude oil, management of crude oil volatility and tensions for local producers, allowance of flexibility in volume to meet regional demand, and maintenance of sufficient crude oil volume for downstream activities.	ME (2020)
Production Adjustment - Directive 2	This directive is in support of OPEC and non-OPEC economies voluntarily adjusting the crude oil production downwards by 9.7 million barrels per day to establish a stable oil market.	ME (2020)

Notable Developments

Energy development	Details	Reference
Renewable Energy	BSP has inaugurated a 3.3 MW solar PV plant in April 2021, which will generate electricity for its headquarter office.	The Scoop (2021)

Renewable Energy	A 30MW solar PV plant is planned for development by the Ministry of Energy in Sungai Akar.	The Scoop (2020)
Renewable Energy	Berakas Power Company Sdn Bhd (BPC) has installed their first rooftop solar PV system with a total capacity of 135kW.	BPC (2020)
Electric Vehicles (EV)	The Electric Vehicle Pilot Project was launched in March 2021. The two-year project aims at exposing various aspects of electric vehicles, particularly on its usage, benefits and charging equipment, apart from studying and identifying the public's perception and acceptance on electric vehicles.	BruneiEV (2021)

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Useful Links

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Electricity Authority Brunei Darussalam – www.aenbd.gov.bn

Ministry of Energy – www.me.gov.bn

Ministry of Finance and Economy – www.mofe.gov.bn

Brunei Shell Petroleum Sdn Bhd – www.bsp.com.bn

Brunei Fertilizer Industries Sdn Bhd – www.bfi.com.bn

Brunei Methanol Company Sdn Bhd – www.brunei-methanol.com

Hengyi Industries Sdn Bhd – www.hengyi-industries.com

BruneiEV – www.bruneiev.gov.bn

Canada

Introduction

Canada has the second-largest land mass in both APEC and the world, after Russia. The Canadian–US border is the world's longest international border, and it extends from the Pacific Ocean in the west across the Atlantic Ocean to the east. There are 10 provinces and three territories in Canada, with a total population of 37 million in 2018 (EGEDA, 2020). In 2018, Canada's gross domestic product (GDP) grew by 2.0% to USD 1 813 billion (2017 USD purchasing power parity [PPP]), and GDP per capita grew by 0.6% to USD 48 924 (EGEDA, 2020).

The economy has extensive conventional and unconventional oil, natural gas and coal reserves as well as significant uranium deposits. It has the world's third-largest amount of proven oil reserves. At the end of 2019, the reserves were estimated at 170 billion barrels, of which oil sands constitute 97% (BP, 2020) (NRCan, 2020a). Canada has proven gas reserves of 72 trillion cubic feet (tcf), which is equal to 1.0% of the global reserves. Canada currently holds 6 582 million tonnes of proven resources of coal, and its 462 kilotonnes of uranium resources is the world's second-largest (NEA, 2020)[1]. Further, Canada's rivers discharge about 7% of global renewable water, which provides a large resource for hydroelectricity.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a, b]		Energy reserves [c, d]	
Area (million km^2)	10.0	Oil (billion barrels)	169.7
Population (million)	37	Gas (trillion cubic feet)	73
GDP (2017 USD billion PPP)	1 813	Coal (million tonnes)	6 582
GDP per capita (2017 USD PPP)	48 924	Uranium (kilotonnes U_3O_8)	462

Source: [a] World Bank (2020); [b] StatCan (2016); [c] BP (2020); [d] NEA (2020).

Energy Supply and Consumption

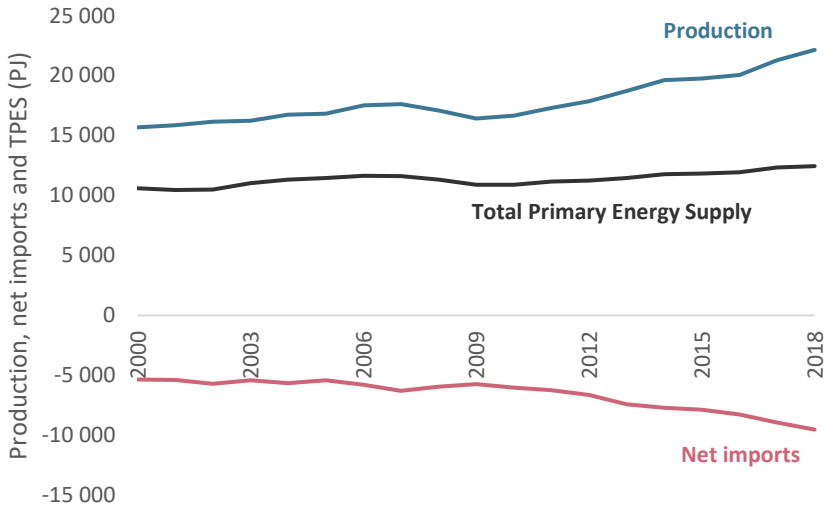
Total Primary Energy Supply

Canada is the fourth-largest energy producer in the APEC region, after China, the US and Russia, and the sixth largest in the world (NRCan, 2020a). Figure 1 illustrates that this production exceeds the domestic supply requirements. Therefore, much of Canadian production is for export markets. Canada is one of the world's top five exporters of crude oil, natural gas, uranium and electricity. The energy sector is an important contributor to Canada's GDP, directly

[1] Uranium resources measure reasonably assured resources at USD 130 per kilogram of uranium (kgU).

accounting for 7.2% of GDP in 2019 and indirectly (through purchases of goods and services from non-energy industries) for an additional 3.0%. In 2019, Canada exported CAD 134 billion worth of energy products and imported CAD 48 billion. The main export market for Canadian energy continues to be the US, which makes up 90% of its export value.

Figure 1: Canada Total Primary Energy Supply, 2000 to 2018

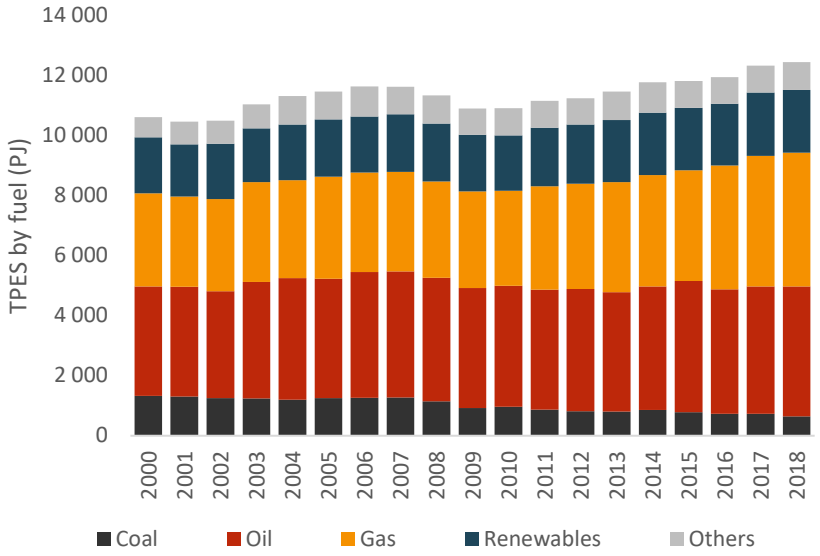


Source: EGEDA (2020)

Canada is a leading global producer of energy, as is evident from its global production ranks for gas (fourth), crude oil (fourth), hydro (second) and uranium (second) (NRCan, 2020a). Canada's domestic energy production increased by 4.1% to 22 160 petajoules (PJ) in 2018 (EGEDA, 2020). Fossil fuel dominated this production with a share of 86%. Oil, including natural gas liquids (NGLs), constituted the largest share (11 185 PJ, 50%), followed by gas (6 477 PJ, 29%) and coal (1 299 PJ, 5.9%). The share of nuclear energy production was 5.0% (1 099 PJ), leaving a share of approximately 9.4% for renewables (2 099 PJ).

Although Canada's crude oil source varies geographically, it predominantly comes from Western Canada. Almost two-thirds of the total production comes from the oil sands, while onshore methods, through both conventional and unconventional techniques, make up 32%; offshore methods make up the remaining 5.5%. Production hit 4.9 million barrels per day (MMb/d) in 2019 but fell to 4.5 MMb/d in 2020 due to the COVID-19 pandemic (CER, 2020a).

Figure 2: Canada Total Primary Energy Supply by Fuel, 2000 to 2018



Source: EGEDA (2020)

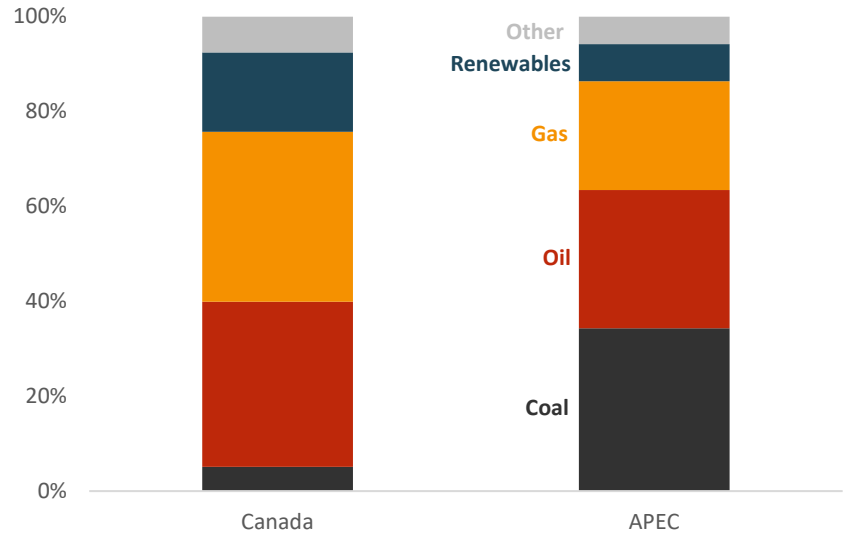
Almost 99% of natural gas production occurs in the Western Canadian Sedimentary Basin (WCSB) (CER, 2020a). While the

output from conventional resources is declining, advances in hydraulic fracturing have enabled the development of tight gas resources in the Montney Formation and the Alberta Deep Basin. Production from these basins is expected to dominate future production growth and allow for significant LNG exports over the coming decade.

Hydro is the most important source of renewable energy in Canada, supplying 61% of Canada's electricity in 2019 from an installed capacity of over 81 GW (CER, 2020a). Canada aims to leverage that hydro capacity and other emerging clean electricity sources to decarbonise its oil, natural gas and LNG operations through electrification, driving down own-use emissions to align with its net zero by 2050 objectives. Hydro is also the key fuel source for Canada's electricity exports, making up nearly three quarters of the generation in the six provinces that export electricity to the US. Canada is a net exporter of oil, gas, coal, uranium, and electricity, and the economy's energy exports go mainly to the US. From 2000 to 2018, energy exports grew at 3.3% annually and exports increased by 6.7% in 2018 to 9 530 PJ (excluding uranium exports) (EGEDA, 2020a).

Figures 2 and 3 illustrate how predominant fossil fuels continue to be in Canada's energy mix. However, Canada has significant renewable potential in addition to hydroelectricity. There are large and diverse biomass resources for energy production, owing to its large land mass and active forests. Moreover, Canada continues to tap into its variable renewable potential.

Figure 3: Total Primary Energy Supply Fuel Share, Canada and APEC, 2018



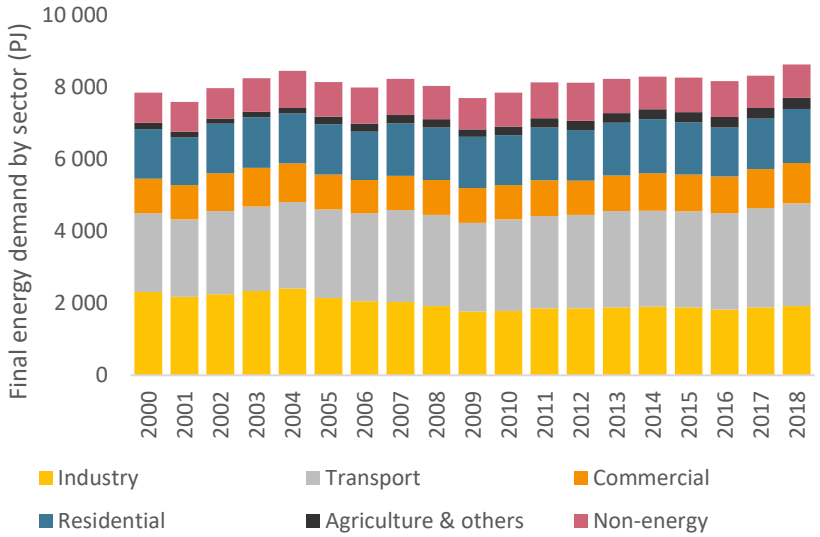
Source: EGEDA (2020)

Total Final Consumption

Canada's final energy consumption in 2018 increased by 3.7% to reach 8 627 PJ, making Canada the fifth-largest energy consumer in APEC, after China, the US, Russia, and Japan (EGEDA, 2020).

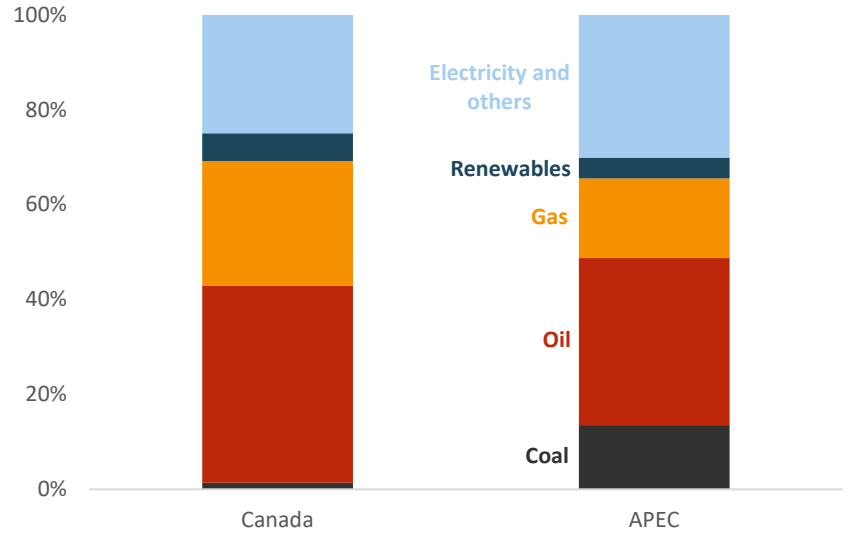
The transport sector accounted for the largest share of final energy consumption (2 855 PJ, 33%), followed by the industrial sector (1 919 PJ, 22%) (EGEDA, 2020). Non-energy use made up 11% (929 PJ), and buildings along with agriculture and non-specified others made up the remainder (2 925 PJ, 34%).

Figure 4: Canada final energy demand by sector, 2000 to 2018 (PJ)



Source: EGEDA (2020)

Figure 5: Final Energy Demand Fuel Share for Canada and APEC, 2018

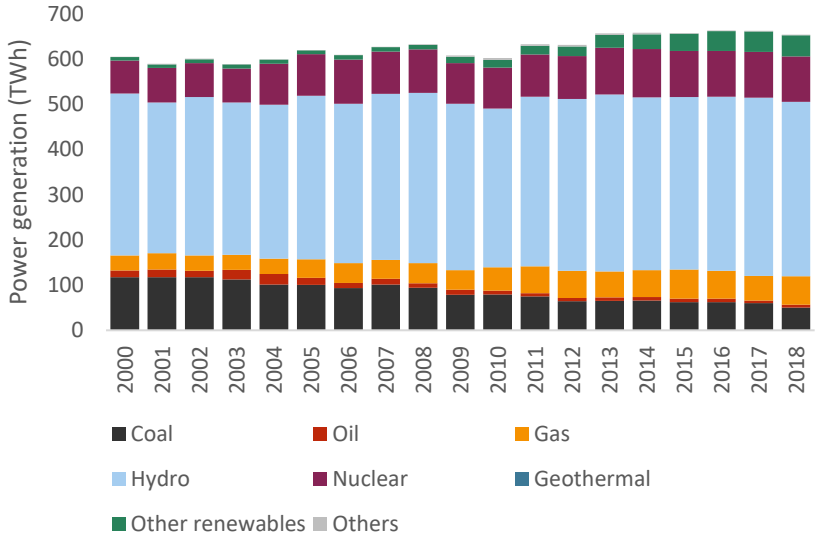


Source: EGEDA (2020)

Fossil fuels accounted for 69% of the final energy consumption[2] in 2018, comprising oil (3 193 PJ, 41%), gas (2 025 PJ, 26%) and coal (108 PJ, 1.4%). The remainder was formed by the share of renewables (451 PJ, 5.9%) and electricity and others (1 922 PJ, 25%), of which the share of renewable electricity and others was 1 256 PJ. Although coal makes up less of Canada's fuel mix than the APEC average, the economy does rely more on fossil fuels than other economies in the region.

[2] Note that the demands in the EGEDA energy balance differ than those in the Report on Energy Supply and Demand (RESD) energy balances due to differences in energy accounting frameworks (StatCan, 2021).

Figure 6: Canada Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Canada generated 654 terawatt-hours (TWh) of electricity in 2018, a decrease of 1.3% from the previous year. Renewables constituted the largest share of this generation (66%), with hydro as the major contributor (59%) and solar, wind, geothermal and tidal at 7.0% combined. The share of nuclear energy was 15%, which increased the combined share of non-emitting power generation to 81%. Fossil generation made up 18%, and natural gas generation (9.6%) surpassed coal (7.7%) for the first time. A combination of biomass (wood and spent pulping liquor) and other fossil fuels such as diesel, light fuel oil and heavy fuel oil accounted for 1.1%.

Canada has been increasing the share of renewables, including hydroelectricity, for electricity generation since 2000. Low natural gas prices, the rapidly decreasing cost of renewable energy, the introduction of emission pricing on electricity, and new regulations that limit the use of coal have all decreased the greenhouse gas (GHG) intensity of Canada's electricity sector. Canada's water resources enable significant parts of its economy to rely on clean electricity and provide clean electricity export options to several states in the US.

In 2016, the federal government announced its plan to phase-out coal-fired electricity generation in Canada by 2030. An acceleration of this phase-out started in 2018 – low natural gas prices and higher carbon prices increased the relative operating cost of coal-fired generation in Alberta, prompting utilities to co-fire natural gas at existing coal units. Since then, economics and investor pressure culminated in utilities announcing a complete coal phase-out in Alberta by 2023. The remaining coal-fired generation in Canada will be equipped with carbon capture and storage (CCS) or covered by an equivalency agreement to reduce power emissions.

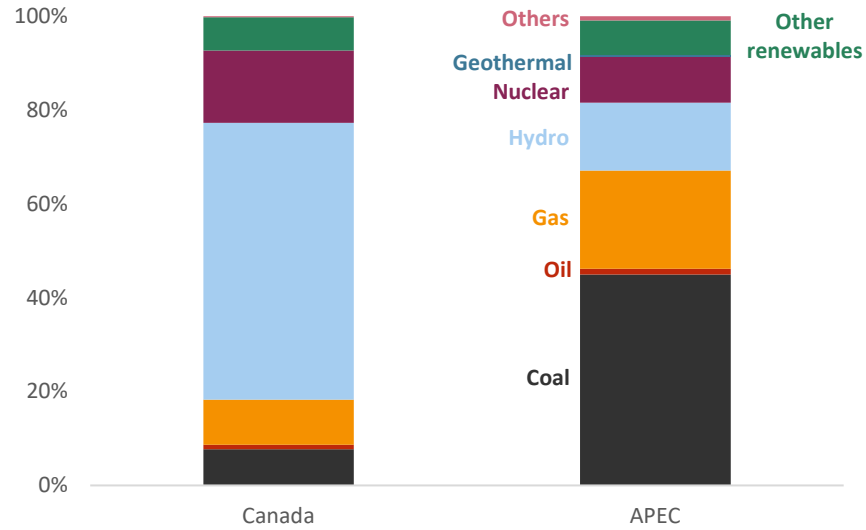
Canada also committed to phasing out inefficient fossil fuel subsidies that cause wasteful consumption by 2025, in line with its G7 and G20 partners.

Despite a series of renewable contract cancellations in Alberta and Ontario, declining costs are prompting renewable bids that are competitive with other sources of generation. Therefore, in the absence of guaranteed contracts, it is reasonable to expect expansions of wind and solar resources to continue throughout Canada.

Ontario intends to continue with the refurbishment of 10 nuclear reactors, albeit on an altered, more cost-effective schedule. These refurbishments will add approximately 25–30 years to the operational life of each unit.

The electricity networks of Canada and the US are highly integrated. In 2018, Canada exported 221 PJ of electricity to the US and imported 48 PJ (EGEDA, 2020). The bulk of Canada's electricity trade with the US occurs between Quebec, Ontario, Manitoba and British Columbia provinces and their neighbouring American states. Going forward, several new international power lines could increase electricity trade between the two economies (CER, 2020b).

Figure 7: Electricity Generation by Fuel Mix for Canada and APEC, 2018



Source: EGEDA (2021)

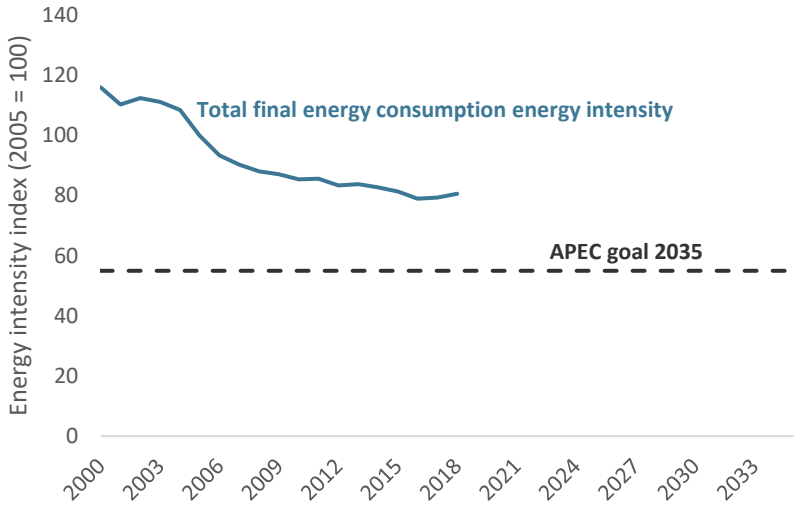
APEC Goals

APEC has two aspirational goals: The first is to reduce energy intensity by 45% between 2005 and 2035, and the second is to double the share of renewables in the fuel mix, including the electricity mix, as compared to 2010 levels. However, it is important to articulate that APEC does not specify any economy-specific targets. Thus, while Canada need not achieve such targets, improving energy intensity and renewable shares can help APEC achieve its aspirational goals.

Energy Intensity Analysis

Canada's energy efficiency policies, commitment to reducing GHG emissions and other targeted regulations have historically reduced energy intensity. Figure 8 illustrates this, showing a 19% reduction in energy intensity since 2005. Furthermore, total energy savings from energy efficiency were of 539 PJ in 2018 compared to a 2000 baseline.

Figure 8: Canada Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020), APERC (2021)

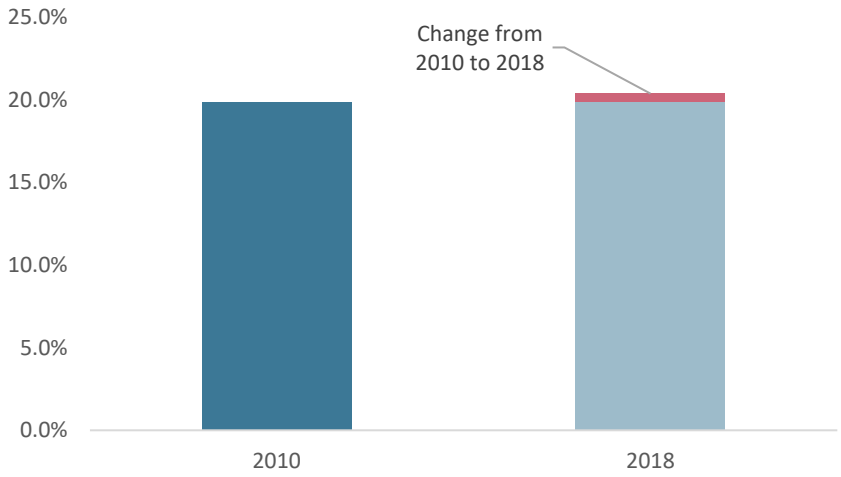
This reduction is slowing down; 2018 marks the second consecutive year of intensity increases. While it is difficult to determine the cause, one contributor is the rising role of trucks and SUVs in the vehicle mix, which is dampening fuel economy and reducing Canadian energy efficiency efforts in the transport sector (CER, 2019a; IEA, 2019). The implementation of economy-wide carbon prices and the adoption of energy-efficient technologies and climate policies (see below) could prompt a reversal of this recent trend.

Doubling of Renewables

Due to the prevalence of hydroelectricity in its electricity mix, Canada is starting from a much higher renewable base than the APEC region. While Canada's renewable share in 2010 was 20% (Figure 9), APEC's was 6%.

Canada is unlikely to double its share to 40%, but it can contribute to APEC achieving its aspirational goals. Several of Canada's climate policy announcements, including the Renewable Fuel Regulations, renewable power generation, and higher carbon prices, will continue to increase the share of renewables in the APEC fuel mix.

Figure 9: Canada's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020), APERC (2021)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policies

This table is not an exhaustive list of energy and cliamte policies in Canada or its provinces or Territories. However, it is a list of material policies that are expected to have a substantial impact on Canada's energy system going forward. For the complete list of key federal energy and climate measures, please refer to:

- The Pan-Canadian Framework on Clean Growth and Climate Change (ECCC, 2016): Canada's first-ever economy-wide climate plan that was developed with provinces and territories, and in consultation with Indigenous peoples. It is an important first step for Canada to achieve its Paris Agreement target. It is structured to cut pollution in a more practical and affordable way than any climate plan in Canadian history.
- A Healthy Environment and a Healthy Economy (ECCC, 2020d): Canada's strengthened climate plan comprised of over 60 new and strengthened federal measures and an initial CAD 15 billion in investments, to make life more affordable for Canadians, make communities more livable, and, at every turn, focus on creating jobs, growing the middle class, and supporting workers in a stronger and cleaner economy.
- Budget 2021 (Department of Finance, 2021): The Government of Canada proposes to provide an additional $17.6 billion towards a green recovery to create jobs, build a clean economy, and fight and protect against climate change.

Energy Policy	Details	Reference
Pan-Canadian approach to pricing carbon pollution	Carbon price on small emitters in Canada. Applies to residential, commercial and transport sectors.	Environment and Climate Change Canada
Green Municipal Fund	Invest $950 million to increase energy efficiency in residential, commercial, and multi-unit buildings.	Environment and Climate Change Canada
Greening Government Strategy	Introduced in 2017, the Greening Government Strategy sets a target to reduce greenhouse gas emissions from federal operations by 40% by 2030.	Environment and Climate Change Canada
Amendment 14 - Energy Efficiency Regulations - Air Conditioners	Regulations for small AC units (residential and small commercial). Room AC unit efficiency standard update - details in the link	IEA
Amendment 15 - Energy Efficiency Regulations - furnaces, boilers, fireplaces, HRV, tankless water heaters	Efficiency standards for residential and commercial electric furnaces, gas boilers, gas fireplaces, gas furnaces, HRV, oil boilers, tankless water heaters, oil water heaters.	Canada Gazette

Amendment 16 - Energy Efficiency Regulations - heat pumps, AC units, vending machines, freezers, etc.	Efficiency standards for residential and commercial AC and heat pumps, ceiling fans, portable AC units, chillers, coolers, vendors, vertical AC units, and other cooling devices	Canada Gazette
CMHC Green Home: Mortgage Financing of energy efficiency investments and retrofits	A partial refund of up to 25% of the premium for eligible home investments that improve energy efficiency.	Canadian Mortgage Housing Corporation Green Home
Energy Efficiency Regulations - Large AC units, Heat Pumps, condensing Units	Specifics regulations for commercial and industrial usage of large-scale cooling, condensing and space heating technologies.	Natural Resources Canada
NRCC National Energy Code of Canada for Buildings 2017	2017 NRRC Building Codes	National Research Council Canada
Output-based Pricing System (OBPS) for large emitters in industry and power sectors	Provide output-based allocations to large emitters to offset the effect of carbon leakage on carbon-intensive, trade exposed industries.	Justice Laws Canada
Federal Coal phase-out by 2030	Coal will be phased-out in Canada by 2030, with exceptions for coal power equipped with CCS units and Nova Scotia permitting its total electricity emissions decrease an equivalent to a phase-out.	Justice Laws Canada
Boiler standards for natural gas power units	Prohibits the operation of facilities exceed the standards: 420 tCO_2e/GWh for natural gas boilers; declining standard for coal-to-gas conversions; 550 tCO_2e/GWh if facility under 150 MW.	Environment and Climate Change Canada
Renewable Fuels Regulations	Refineries and importers to have an average of 5% renewable fuel content in gasoline and 2% in diesel fuel and heating distillate oil based on volume.	Environment and Climate Change Canada
Methane Reduction Initiative	Reduce upstream methane emissions by 40 - 45% below 2012 levels by 2025	Environment and Climate Change Canada
100 $MtCO_2eq$ oil sand emission cap	Total emissions by the oil sands, less some allowances, cannot exceed 100$MtCO_2eq$	Alberta Government
LDV, LDT emission Standards: 2017 - 2025	LDVs: 5% annual reduction in CO_2-e per mile for passenger cars from 2017 to 2025. LDTs: 3.5% per year 2017-2021, 5% 2022 to 2025.	Canada Gazette
Heavy duty vehicle regulations: 2021 - 2027	GHG reductions in Model Year (MY) 2027 versus MY 2017 resulting from the standards include: Tractor Trucks: 15%-27%; Vocational vehicles: 10% - 24%; HD trucks, vans: 16%; Commercial Trailers: 5% to 9%	Canada Gazette
EV and Alternative refueling infrastructure incentives	$182 million incentives for electric and alternative fuel infrastructure (refuelling, etc.)	Environment and Climate Change Canada

Short-term, capped ZEV subsidy	CAD 300 million between 2020-2023 on eligible ZEVs; CAD 5000 for long-range; CAD 2500 for short-range.	Transport Canada
Carbon Fuel Standard: liquid fuels	Reduce the lifecycle carbon intensity of liquid fuels by 13% below 2016 levels by 2030. Compliance can be achieved via refining efficiency increases, EV adoption and increases in biofuel content.	Environment and Climate Change Canada
Pricing Carbon Pollution Phase II: 2023-2030	Increase carbon pricing in Canada by 15 CAD per tonne annually from CAD 50 per tonne in 2023 to CAD 170 per tonne in 2030	Environment and Climate Change Canada
Reducing reliance on diesel power in remote communities	Investigate how bioheat, innovative technologies and renewable energy can reduce remote usage of diesel-fired power in Canada.	Natural Resources Canada
Light-duty sales targets for zero emission vehicles	Light-duty zero emission vehicle (ZEV) SALES targets: 10% by 2025; 30% by 2030; 100% by 2040	Environment and Climate Change Canada

Notable Energy Developments

The table below details the recent developments that will shape Canada's energy future. This includes sanctioned infrastructure projects, such as LNG Canada and the TMX crude oil export pipeline that will grant Canada increased access to energy markets, as well as cancelled projects such as the Keystone XL pipeline.

It also includes Canada's ambition to strengthen its climate change plan (ECCC, 2020a). Announced in late 2020, the plan includes a suite of policies: some build on existing policies, such as the adoption of a more stringent carbon price trajectory that hits CAD 170 per tCO_2e in 2030, some are for the implementation of previously announced policies (like the Clean Fuel Standard on liquid fuels), and some are new initiatives. An inherent goal of this plan is to achieve Canada's emission reduction goal of 30% below 2005 levels by 2030 and lay the groundwork for future policies to transform Canada's energy system into a net-zero economy by 2050. However, some of the components of this plan are in early developmental stages and are not included in the Energy Policy table.

Energy development	Details	Reference
Canada's Updated Climate Plan (A Healthy Environment and a Healthy Economy)	Suite of announced policies to achieve the Paris Agreement reduction targets, including a schedule for increasing the carbon price rate by 15 CAD annually until it reaches 170 CAD per tCO_2 in 2030.	Environment and Climate Change Canada
Net-zero GHG emissions by 2050 (Bill C-12)	An Act respecting transparency and accountability in Canada's efforts to achieve net-zero greenhouse gas emissions by the year 2050	Department of Justice
Hydrogen Strategy for Canada	Vision and Roadmap to 2050 could inform hydrogen modelling for Canada in APS.	Natural Resources Canada

Air Liquide Bécancour Electrolyser	The commissioning of the world's largest low-carbon proton exchange membrane (PEM) electrolyser increases production capacity by 50%.	Air Liquide
Smart Renewables and Electrification Pathways Program (SREPS)	SREPS provides nearly a billion (CAD) for smart renewable energy and grid modernisation projects over four years, incentivising the replacement of fossil-fuel generation with renewables that can provide essential grid services while supporting an equitable transition to an electrified economy.	Natural Resources Canada
The Canada Greener Homes Grant	This will help homeowners make their homes more energy-efficient. Participants are eligible for up to CAD 5 000 for eligible home retrofits and CAD 600 for EnerGuide evaluations to target retrofit planning. The program will also fund the recruitment and training of EnerGuide energy advisors.	Natural Resources Canada
SMR Action Plan	Action plan to commercialise SMR technology for the Canadian power sector by the end of the 2020s.	SMR Action Plan
Tilbury LNG project	0.053 Mtpa facility starts exporting to China late 2021	GIIGNL
LNG Canada	Assume that two 14 Mtpa facilities over the projection period, the first coming on H2 2025, the second H2 2031, raising capacity to 14 Mtpa in 2032	LNG Canada
Portland Xpress Project Phase 3	Online 2020; 24 MMcf/d	EIA
Westcoast expansion (to USA)	Online 2021: 95 MMcf/d; 2022: 190 MMcf/d	EIA
GTN XPress	Online November 2023; 250 MMcf/d	EIA
Empire North Expansion Project (from USA)	Online September 2020; 300 MMcf/d	EIA
Atlantic Bridge project Phase 2 (from USA)	Online 2021; 93 MMcf/d	EIA
Enbridge Line 3 export to USA	Online H2 2021; 382 kb/d	EIA
TMX (to pacific coast)	Online Q2 2023; 528 kb/d	CER
Various debottlenecking of US export pipelines	Online: 2020: 136 kb/d; 2021: 29 kb/d	CER
Westbrook Xpress Project Phase 2 (to USA)	Online 2021; 63 MMcf/d; progressing through permitting process	EIA
Iroquois Enhancement by Compression Project (to USA)	Online 2023; 125 MMcf/d; progressing through permitting progress	EIA
Keystone XL pipeline cancelled	Removed from analysis	US Federal Register

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Useful Links

Atomic Energy of Canada Ltd – www.aecl.ca

Canada Gazette – http://www.gazette.gc.ca/

Canada-Nova Scotia Offshore Petroleum Board – http://www.cnsopb.ns.ca/

Canadian Centre for Energy Information – https://energy-information.canada.ca/en

Canadian Energy Regulator – https://www.cer-rec.gc.ca/index-eng.html

Canadian Nuclear Laboratories – www.cnl.ca

Canadian Nuclear Safety Association – http://nuclearsafety.gc.ca

Canada Newfoundland and Labrador Offshore Petroleum Board – http://www.cnlopb.ca/

Environment and Climate Change Canada – www.ec.gc.ca

Natural Resources Canada – www.nrcan-rncan.gc.ca

Statistics Canada – www.statcan.ca

Transport Canada – www.tc.gc.ca

Chile

Introduction

Chile is one of the longest and narrowest economies on the planet, occupying a stretch of land in the southwest of Latin America. It extends from the Antarctic in the extreme south to the Atacama Desert in the north. Chile spans three continents, with its sovereign territory mainly on the South American continent, its westernmost border on Easter Island in Oceania, and its southernmost region in Antarctica. Peru is to the north, Bolivia and Argentina to the east, Antarctica to the south, and the Pacific Ocean to the west. Chile has a land area of 756 102 square kilometres (km2), with an average width of 175km and a coastline of 6 435 km.

Chile is the fifth-largest energy consumer of the Americas, but unlike most other large economies in the region, it is only a small fossil fuel producer. Despite the availability of vast solar and wind energy resources and the rapid shift towards cleaner energy over the past decade, Chile is dependent on energy imports. Recent exploratory drilling in the Magallanes Basin, a shale formation, may increase Chile's domestic oil supply. There are an estimated 2.4 billion barrels of shale oil in the Magallanes Basin (EIA, 2019).

Chile's conventional uranium resources are estimated at 1.45 kilotonnes (NEA, 2018). These resources are recoverable at a price of USD 260 per kilogram at a recovery factor of 75%. However, no new uranium resources have been identified since 2011 (IAEA, 2020).

Chile has 16 regions headed by president-appointed regional governors. In 2018, the population reached 18.7 million, with 40% residing in the Santiago metropolitan region (INE, 2018; UN, 2018).

Table 1: Macroeconomic Data and Energy Reserves, 2018

Key data [a]		Energy reserves [b, c]	
Area (km^2)	756 092	Oil (million barrels)	150
Population (million)	18.7	Natural Gas (billion cubic metres)	98
GDP (2017 USD billion PPP)	454.3	Coal (million tonnes)	171
GDP (2017 USD PPP per capita)	24 259	Uranium (kilotonnes U_3O_8)	1.45

Source: [a] World Bank (2019); [b] BP (2019); [c] NEA (2018).

Chile is one of the fastest-growing economies in South America, with an average annual growth rate of 2.7% between 2000 and 2018. In 2018, Chile's gross domestic product (GDP) reached USD 454.3 billion (constant 2017 USD PPP), an increase of 3.9% from 2017, and the GDP per capita grew by 2.5% to USD 24 259 billion (WorldBank, 2019).

In recent decades, Chile's economy has benefited from exports of copper, wood pulp, fish, and wine. Additionally, Chile has begun to capitalise on its domestic energy resources, namely the gusty coastal winds, intense desert sun, and plate tectonics for geothermal power generation.

China has substantially increased its investments in electricity, renewable energy, agribusiness, and mining in Chile. The most significant foreign investment in 2018 was from the China-based

Tianqi Lithium Corp, which acquired a 24% stake in the Chilean lithium mining company SQM for USD 4 billion.

In 2019, foreign direct investment (FDI) flows in Chile increased for the second consecutive year, with inflows reaching USD 11 billion (an increase of 63% from 2018), according to the World Investment Report 2020. These investments mostly flowed to utilities, mining and services, with a considerable contribution from China.

While the FDI inflows were a positive sign, 2019 was characterised by an increase in uncertainty following the announcement that the government would redraft the constitution. The overall stock of FDI fell 0.7%, to USD 267 billion (UNCTAD, 2020). The constitutional uncertainty was only exacerbated by the COVID-19 pandemic in 2020, with many mining companies announcing the suspension of activities and delays for expansion projects.

Energy Supply and Consumption

Chile's primary fuel mix has historically been dominated by oil, mostly consumed by the industry and transport sectors. Industry oil use rose in the past decade in response to the severe energy crisis that occurred when natural gas imports from Argentina suddenly dropped in 2004 (Chávez-Rodríguez et al., 2017).

Transport remains the largest oil consumer and has the second-highest overall energy consumption after the industry sector. Moreover, the number of private vehicles has increased with the rise in GDP and living standards.

Hydropower has long been an essential component of Chile’s electricity generation mix. When the Argentinian government curtailed the supply of gas in 2008, hydropower's importance increased significantly.

Chile's energy transformation over the past 20 years has involved power generators switching from natural gas to diesel, then to coal, and most recently to renewable energy.

At the beginning of 2010, only 3% of the power generation capacity used modern renewable energy resources: 183 MW in onshore wind farms alongside small amounts of solar PV, small hydro, and biomass and biogas plants.

As of 31 December 2020, 6 445 MW of modern renewable energy capacity has been installed in Chile, representing 25.9% of the total installed power capacity.

The breakdown of renewables is as follows: 39.2% for onshore wind farms, 55.6% for solar PV and 7.4% for biomass, with small hydro, geothermal and biogas plants constituting the rest (CNE, 2021). A 20% target for modern renewables by 2025, combined with declining capital costs and outstanding renewable resources, is transforming the market.

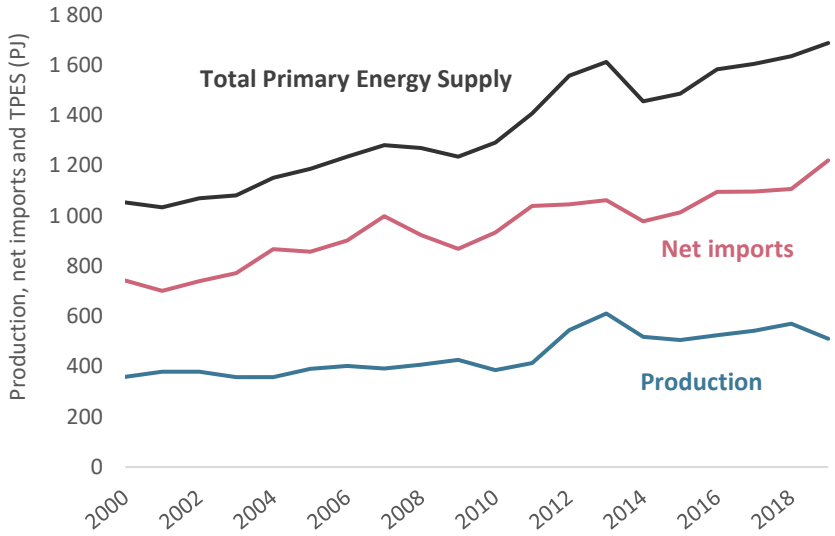
Total Primary Energy Supply

In 2019, Chile's total primary energy supply (TPES) was 1 688 PJ, seeing an increase of 3.2% compared to the 1 636 PJ supply in 2018.

Chile is dependent on imported fossil fuels (oil, gas and coal). Fossil fuel imports represented 74.3% of TPES in 2019, an increase of 9.8% from 2018 (IEA, 2020).

In 2018, the two largest source economies for Chile’s imported crude oils were Brazil (51.1%) and Ecuador (34.4%). Natural gas mainly came from Trinidad and Tobago (54.4%) and the US (29.4%), while coal mostly came from Colombia (59.5%), the US (28.1%) and Australia (9.1%) (CNE, 2019).

Figure 1: Chile's Total Primary Energy Supply, 2000 to 2019 (PJ)



Source: EGEDA (2020), APERC (2021)

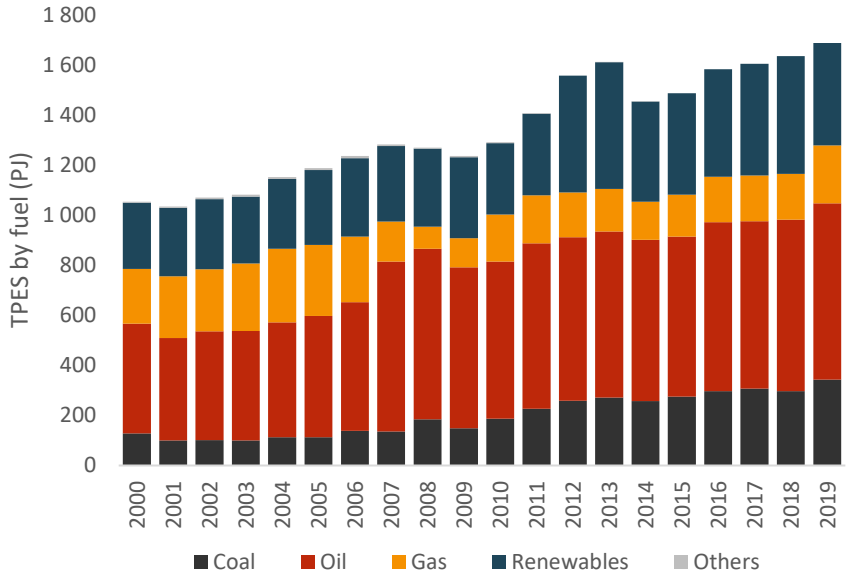
In terms of fuel type, oil contributed the largest share (41.7%), followed by coal (20.4%), biofuels (16.9%), natural gas (13.7%), hydro (4.5%) and modern renewables (2.9%). In 2019, Chile's net import of energy sources constituted 72.3% of TPES, growing by 3.0% annually from 2010 to reach 1 221 PJ in 2019 (EGEDA, 2021; IEA, 2020).

Coal's primary role is in the transformation sector, where it is used almost entirely in coal-fired power stations and coke ovens.

In 2019, the total renewable energy production in Chile was 410 PJ or 24.3% of TPES. However, production decreased by 12.9% from the previous year's level, with a significant reduction in solid biofuels and hydro (IEA, 2020). The primary forms of renewable energy production were biomass (69.5%) and hydro (18.3%).

Figures 2 and 3 illustrate how fossil fuels continue to be predominant in Chile's energy mix. However, Chile has significant renewable potential in addition to hydroelectricity.

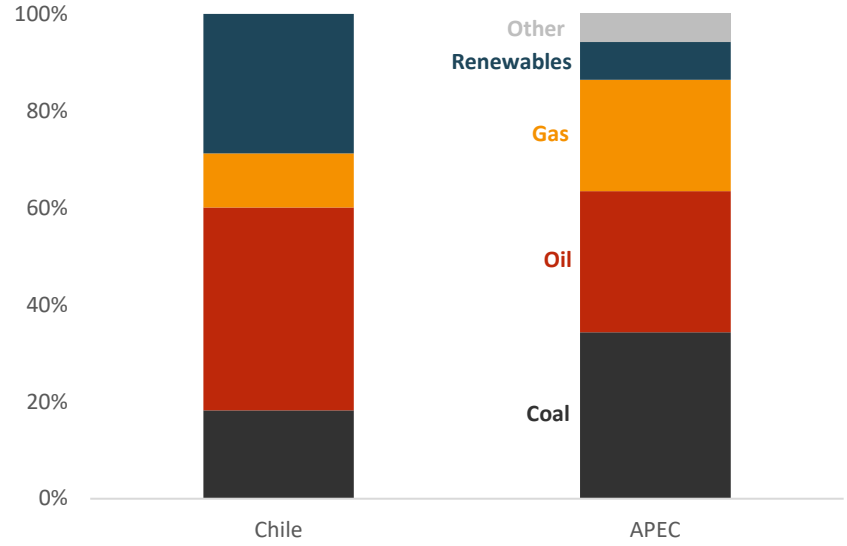
Figure 2: Chile's Total Primary Energy Supply by Fuel, 2000 to 2019 (PJ)



Source: EGEDA (2020), APERC (2021)

The Atacama Desert in the north boasts a direct normal irradiance of more than 9 kilowatt-hours (kWh) per square metre (m2) per day, the highest in the world. In its extreme south, together with Argentina, Chile has the best onshore wind resources globally.

Figure 3: Total Primary Energy Supply Proportional Share, Chile and APEC, 2018



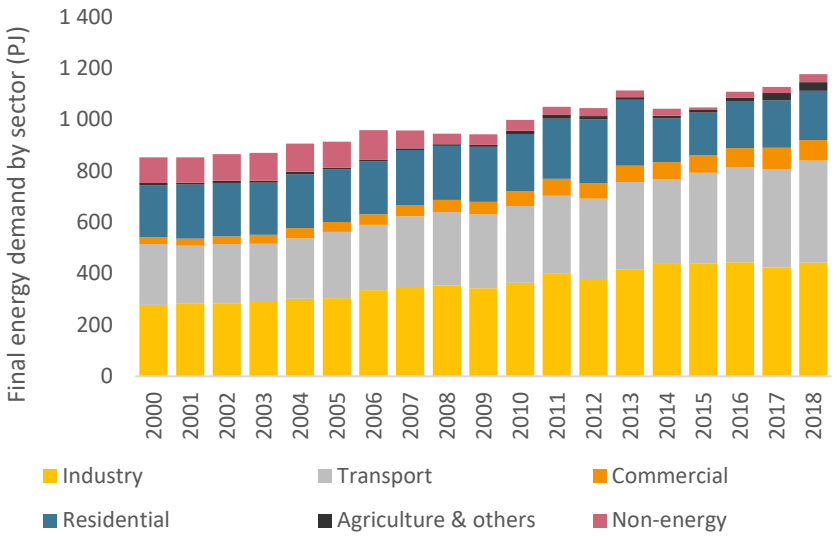
Source: EGEDA (2020)

Studies by the National Oil Company (ENAP), endorsed by the United States Geological Survey (USGS), estimated the non-conventional shale gas potential in Magallanes at 8.3 trillion cubic feet (tcf), which is twice the volume of gas that the ENAP has extracted from the Magallanes Basin over the last 70 years (4.2 tcf).

Total Final Consumption

In 2018, Chile's final energy consumption was 1 177 PJ, representing an annual increase of 4.5% (MEN, 2020). By sector, industry accounted for 37.7% of final consumption, followed by transport (33.7%), residential (16.4%), and commercial (6.8%).

Figure 4: Chile's Final Energy Demand by Sector, 2000 to 2018 (PJ)

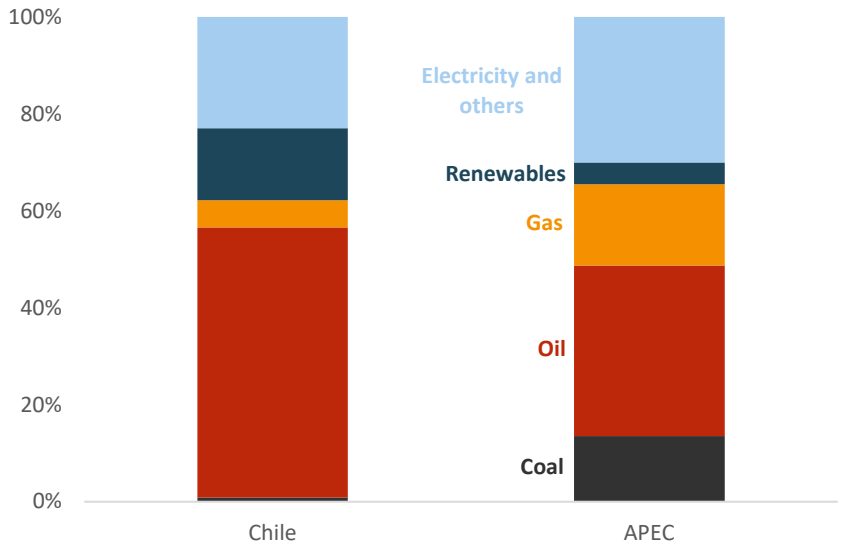


Source: EGEDA (2020)

Energy own consumption accounted for 2.8% of this final consumption in 2018. The remaining 2.7% was accounted for by non-energy use, agriculture and others. Strong annual growth in energy consumption was from aviation (6%) and domestic transport (3%).

The oil supply accounted for 55.7% of Chile's final energy consumption, primarily consumed by the transport and industrial sectors. Electricity and other sources (22.9%), natural gas (5.6%) and coal (0.8%) comprised the remainder. Oil consumption increased by 2.5% from 2017, and electricity and other use increased by 4.9% (EGEDA, 2021).

Figure 5: Final Energy Demand Proportional Fuel Share for Chile and APEC, 2018



Source: EGEDA (2020)

Fossil fuels accounted for 62.2% of final energy consumption in 2018, comprising oil (639 PJ, 55.7%), gas (65 PJ, 5.6%) and coal (10 PJ, 0.8%). The remainder consisted of renewables (170 PJ, 14.8%) and electricity and others (263 PJ, 22.9%), of which the share of renewable electricity and others was 122PJ.

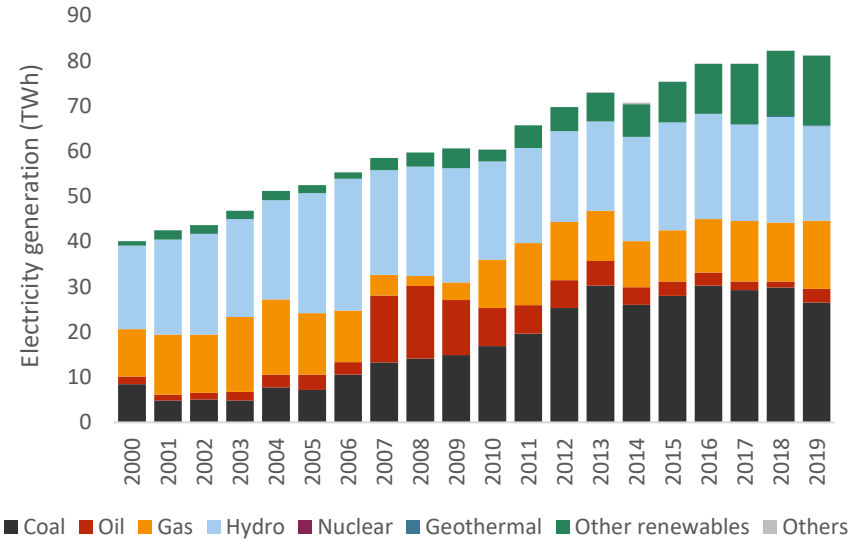
While coal makes up less of Chile's fuel mix than the APEC average, the economy does rely slightly more on fossil fuels than other economies in the region.

Electricity

Generation represents the production phase of the electricity supply chain. This segment is a competitive market in Chile, where generator companies offer energy at their marginal production cost. The system operator (CEN) must ensure balance in the market, aiming to meet the electric demands at minimum cost while preserving system security levels.

Electricity demand grew at an average annual rate of 4.0% between 2000 and 2019, reaching 81.2 TWh in 2019; 55% came from fossil fuel plants, 25.7% from hydro, 7.8% from solar PV and 5.9% from wind. Chile remains an electricity island, with only one intermittent cross-border connection with Argentina.

Figure 6: Chile Electricity Generation by Fuel, 2000 to 2019 (GWh)



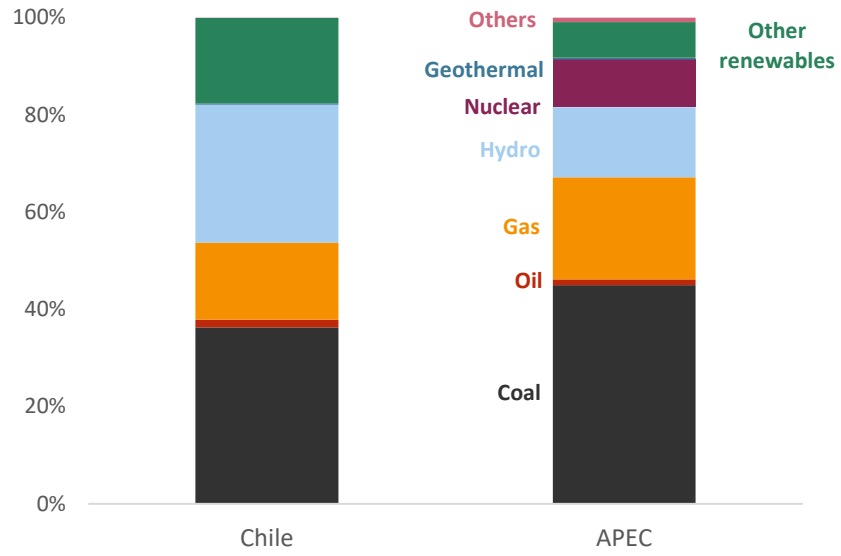
Source: EGEDA (2020), APERC (2021)

Over the past two decades, the energy mix for Chile's power generation has changed remarkably with the introduction of low-carbon technologies, mostly renewables. Between 2004 and 2007, Argentina, which was then the sole natural gas supplier to Chile,

faced an energy crisis and restricted its gas exports. Consequently, the natural gas supply in Chile decreased significantly in 2007, and its contribution to electricity generation dropped by 60% (IEA, 2018).

During this time, diesel units have been replaced with a combination of coal-fired and gas-fired generation. The commissioning of two liquefied natural gas regasification plants allowed gas-fired power plants to contribute to this replacement. Since 2010, the increased use of renewables has started to shape a new energy matrix.

Figure 7: Proportional Electricity Generation by Fuel for Chile and APEC, 2018



Source: EGEDA (2021)

Even with an evolving electricity generation mix, the share of coal is still large, at around 33% in 2019. Chile's reliance on coal is influenced by 10 consecutive drought years in the central-south region, which reduced hydropower supply from 44% in 2008 to 26% in 2019 (EGEDA, 2021; IEA, 2020).

Decarbonisation and Carbon Neutrality

The Chilean Government and the Ministry of Energy have relied on carbon policy instruments to decarbonise the power sector. One such initiative was establishing a working group to develop voluntary and binding agreements to retire coal generation facilities (Inodu 2019). Decommissioning all the coal-fired power plants by 2040 would result in a reduction of 7.5 $MtCO_2eq$ by 2050, with a positive abatement cost of USD 8 per tCO_2eq.

As of December 2018, the renewables share of electricity generation reached 45%. According to technical studies and projections made by generators, utilities, and the government, 30% of electricity could be solar powered by 2030, making it Chile's leading power source. In fact, almost 85% of electricity could be renewable by 2030.

In June 2019, the Chilean government announced its aim to reach carbon neutrality by 2050. Almost 3.63 GW of coal-fired power plants will shut down before 2025, which is equivalent to 65% of the total coal electricity capacity. The operation of coal power plants will completely cease by 2040 at the latest (MEN, 2021).

Chile is currently formulating a new Climate Change Framework Law. The main objectives are to achieve GHG neutrality by 2050, increase resilience against climate change effects, and comply with international climate change commitments. The current draft bill, which is open to public input, includes governance (rules, mechanisms and instruments), management strategies, financing measures and economic instruments.

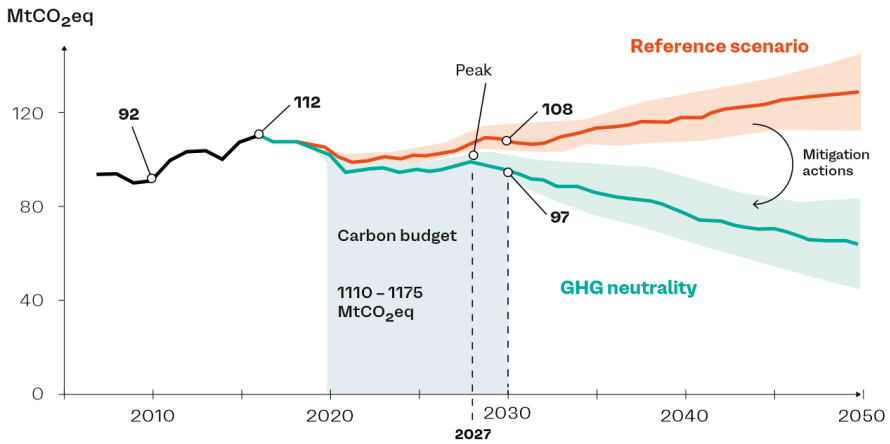
Carbon neutrality will require more than double the electrification rate; electric mobility and buildings with heat pumps will drive this

electrification increase (Chilean Association of Power Generators 2019).

Proposed and Updated Chilean NDC

Before the official submission, Chile released an NDC draft for public consultation (ME, 2019), which refers to economy-wide emissions excluding the Land Use, Land Use Change and Forestry sectors. The final update report was submitted to UNFCC on 9 April 2020.

Figure 8: Paths GHG Emissions in the Period 2005–2050



Source: *Chilean NDC mitigation proposal* (SC-COP25 & M&EWG, 2020)

It provides targets in terms of absolute emissions (95 $MtCO_2eq$ in 2030), including a carbon budget for 2020–2030 of 1 110 $MtCO_2eq$. However, the proposal predicts a peak in emissions by 2025. The new NDC proposal also includes a potential reduction of at least 25% in total black carbon emissions by 2030 with respect to the 2016 levels. This commitment will be implemented primarily through economy-wide policies focused on air quality.

In this new NDC draft update, Chile also acknowledges its 2030 target as a medium-term goal towards achieving its long-term goal of GHG neutrality by 2050.

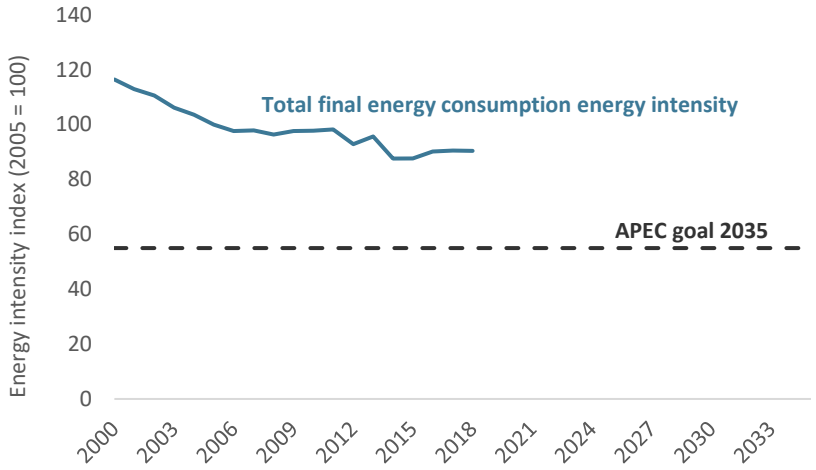
APEC Goals

APEC has two aspirational goals: The first is to reduce energy intensity by 45% between 2005 and 2035, and the second is to double the share of renewables in the fuel mix, including the electricity mix, compared to the 2010 levels. However, it is essential to articulate that APEC does not specify any economy-specific targets. Thus, while Chile need not achieve such targets, improving energy intensity and renewable shares would help APEC achieve its aspirational goals.

Energy Intensity Analysis

Chile's energy efficiency policies, commitment to reducing GHG emissions and other targeted regulations have historically reduced energy intensity.

Figure 9: Chile Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020), APERC (2021)

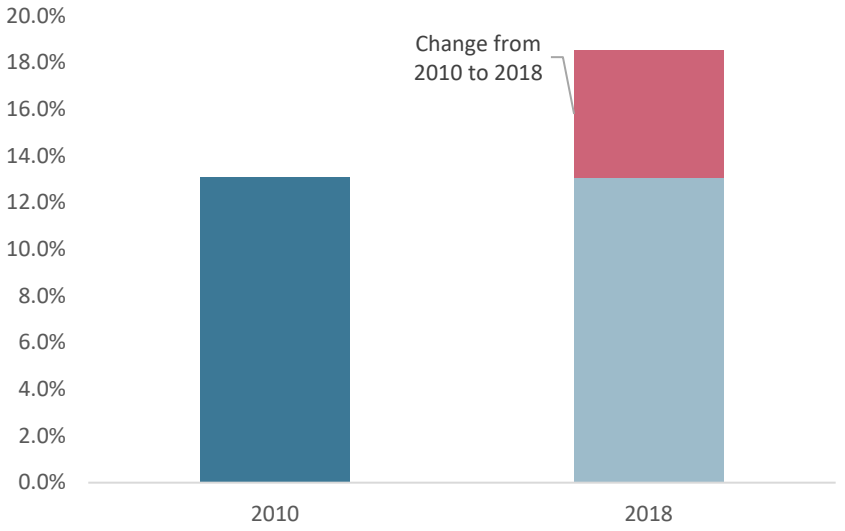
Figure 9 illustrates a 10% reduction in energy intensity since 2005. However, energy intensity improvements are slowing down; 2018 marks the third consecutive year of intensity increases.

Doubling of Renewables

Due to the prevalence of hydroelectricity in its electricity mix, Chile is starting from a higher renewable base than the APEC region. Chile's renewable share in 2010 was 13.1% (Figure 10), while APEC's was 6%.

Chile is on track to double its share to 26.2% and is likely to accomplish the goal by 2025, contributing to APEC's aspirational goal. In 2018, Chile's modern renewable energy share was 18.5%. Several of Chile's climate policy announcements, including the National Hydrogen Strategy, increases in renewable power generation, electromobility strategy and potential updates in the carbon prices will help increase the share of renewables in the APEC fuel mix.

Figure 10: Modern Renewable Energy Share Analysis



Source: EGEDA (2020), APERC (2021)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy Policy	Details	Reference
Carbon neutrality pledge	The Chilean government announced in June 2019 its aim to reach carbon neutrality by 2050.	Ministry of Environment
Coal-fired power plant shutdown	3.63 GW of coal-fired power plants will shut down before 2025, which is equivalent to 65% of the total coal electricity capacity. Operation of coal power plants will cease by 2040 at the latest.	Ministry of Energy
National Electromobility strategy	Outlines actions to be taken in the short- and medium-term to meet the government's goal of having 40% of the private vehicle and 100% of the public transport fleets powered by electricity in 2040. By the end of 2050, 58% of privately-owned vehicles will be powered by electricity.	Ministry of Energy
Energy Efficiency Bill	The law outlines a long-term energy efficiency plan, to be updated every five years. The new law promotes management of energy by large consumers and delivers information to home buyers regarding housing energy requirements.	Ministry of Energy
Hydrogen Strategy for Chile	The design and implementation of a development policy for hydrogen would allow the displacement of fossil fuels on a large scale in the Power Generation, Transport and Industries sectors.	Ministry of Energy

Notable Developments

Energy development	Details	Reference
NDC Update, Emission budget	A new absolute emission target: A maximum emission level in 2030 of 95 $MtCO_2$ (excluding LULUCF). A GHG emission budget of 1 110 $MtCO_2$ between 2020 and 2030, and GHG emissions peaking in 2025. The new target is 26% lower than the 2016 NDC agreement.	Ministry of Energy

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Useful links

Government Institutions

Chilean Commission of Energy (CNE) – www.cne.cl

Chilean Energy Sustainability Agency (ASE) – www.agenciaSE.org

National Electric Coordinator – www.coordinador.cl

Government of Chile – www.gobiernodechile.cl

Ministry of Economy, Development and Reconstruction – www.economia.cl

Ministry of Energy – www.energia.gob.cl

Ministry of the Environment – www.mma.gob.cl

Nuclear Energy Chilean Commission (CCHEN) – www.cchen.cl

National Energy Commission (CNE) – www.cne.cl

National Institute of Statistics (INE) – www.ine.cl

National Oil Company (ENAP) – www.enap.cl

Superintendence of Electricity and Fuel (SEC) – www.sec.cl

Energy Associations

Chilean Association of Power Generators – www.generadoras.cl

Chilean Association for Renewable Energies and Storage ACERA AG – www.acera.cl

Chilean Association of Power Utilities – www.electricas.cl

Chilean Association of Solar Energy – www.acesol.cl

Chilean Association for Small and Mid-hydro Power Plants (APEMEC) – www.apemec.cl

China

Introduction

China is in Northeast Asia and is bordered by the East China Sea, Yellow Sea, and South China Sea. Its population of 1.4 billion is approximately one-fifth of the world's population. China has a land area of approximately 9.6 million square kilometres (km^2) with diverse landscapes consisting of mountains, plateaus, plains, deserts, and river basins. Its total maritime area is 4.7 million km^2, and the length of its coastline is 32 400 km (NBS, 2020).

In 2018, China's gross domestic product (GDP) reached USD 21 229.7 billion (2017 USD purchasing power parity [PPP]), which was a 6.8% increase from 2017 (World Bank, 2020). The primary, secondary and tertiary industries accounted for 7.0%, 39.7% and 53.3%, respectively (NBS, 2020).

China is relatively rich in energy resources, particularly coal. According to the BP statistics published in 2020, China's proven coal reserves were over 141 billion tonnes, proven oil reserves were 26 billion barrels, and proven natural gas reserves were 8.4 trillion cubic metres (tcm) (BP, 2020). In addition, China has 400 gigawatts (GW) of economic hydropower potential, more than any other economy (NBS, 2020).

From 2000 to 2018, the compound annual growth rate (CAGR) of final energy consumption (excluding non-energy use of energy products) was 6.9%, and the CAGR of GDP was 9.2% (EGEDA, 2020; World Bank, 2020).

Table 1: China's Macroeconomic Data and Energy Reserves

Key Data [a]		Energy Reserves [b, c]	
Area (million km^2)	9.6	Oil (billion barrels)	26
Population (million)	1 393	Gas (trillion cubic metres)	8.4
GDP (2017 USD billion PPP)	21 229	Coal (million tonnes)	141 595
GDP per capita (2017 USD PPP)	15 243	Uranium (kilotonnes U < USD 130/kgU))	119[d]

Sources: [a] World Bank (2020); [b] NBS (2020); [c] BP (2020); [d] OECD (2020).

Energy Supply and Consumption

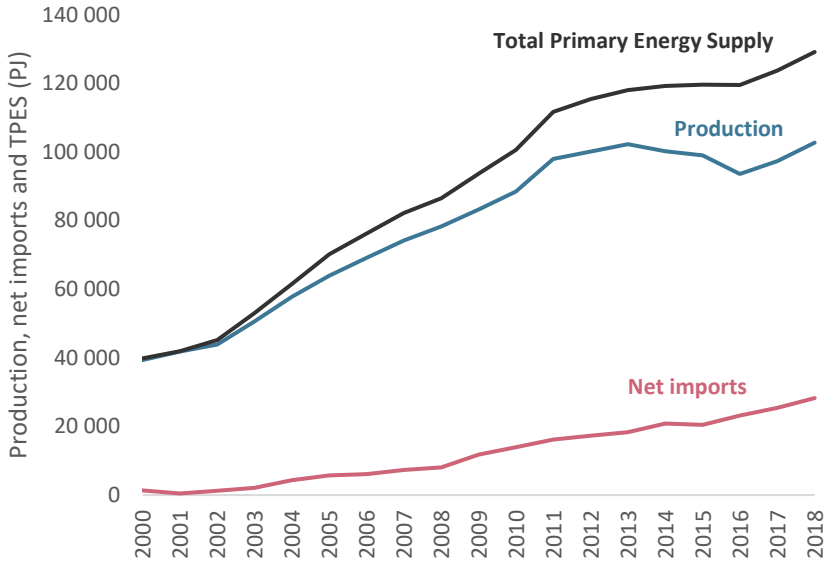
After a long period of development, China has become the world's largest energy producer and consumer, forming an energy supply system through the comprehensive development of coal, electricity, oil, natural gas, and renewable energy.

Total Primary Energy Supply

In 2018, total primary energy supply (TPES) increased by 4.4%, reaching 129 092 PJ. The supply of natural gas increased by 13.3% and that of renewable energy by 9.2%. Energy production increased by 5.6%: coal was the dominant source, accounting for 62%, followed by oil (20.3%), gas (8.0%), renewables (6.7%) and others (3.0%) (EGEDA, 2020). Coal production began to decline in 2014; it reached its lowest level in 2016 and resumed growth in 2017. The production in 2018 was roughly the same as in 2015.

Driven by internal demand, net imports rose to 28 271 PJ in 2018, an 11.1% annual increase (Figure 1).

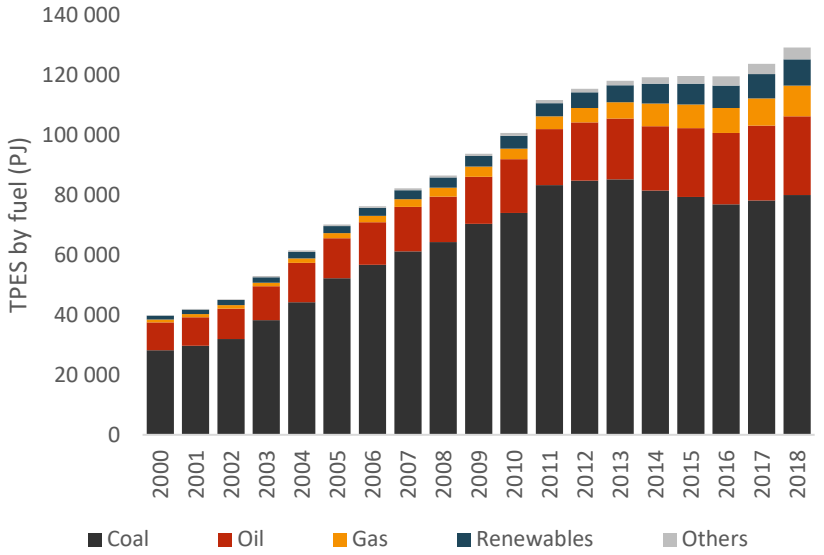
Figure 1: China's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

Since 2011, the different energy types that constitute TPES have shown different trends. Coal production continued to decline, decreasing by 12.6% in 2018. Imports of coal offset some of this decline which meant that coal's share of TPES declined by 1.2%, to 62% in 2018. The TPES shares of crude oil, gas and renewable energy increased by 3.6%, 4.1 % and 2.8%, respectively (Figure 2).

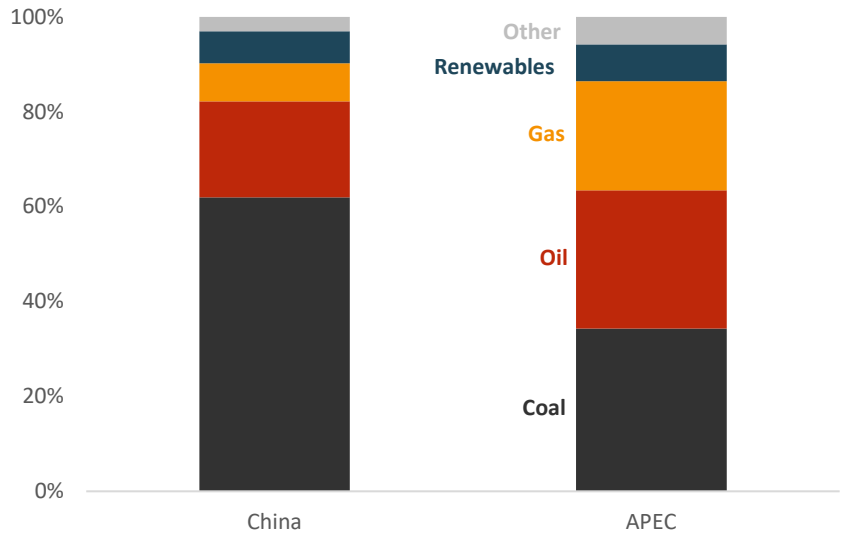
Figure 2: China's Total Primary Energy Supply by Fuel, 2000 to 2018



Source: EGEDA (2020)

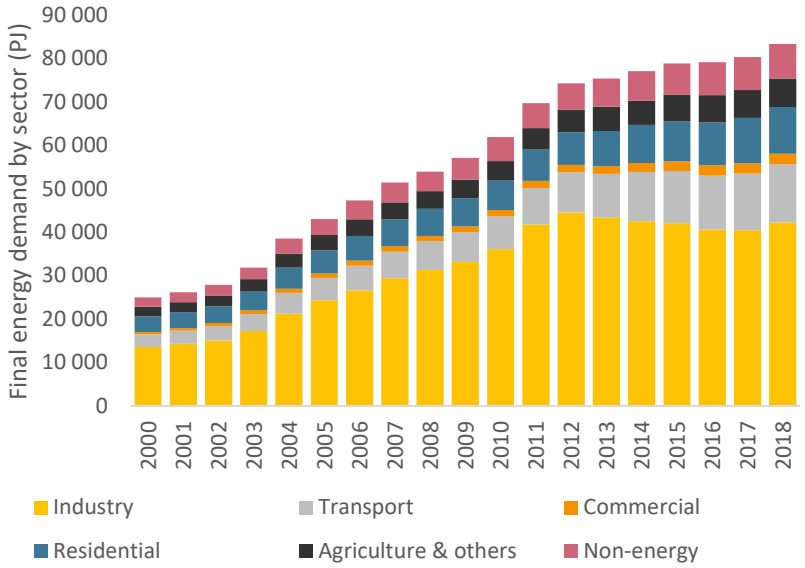
China's resource endowment combined with favourable economics mean that the proportion of coal in TPES is higher than that of APEC. Rapid development of renewable energy in China in recent years, shows that China's share of renewables is comparable to the APEC region in 2018 (Figure 3).

Figure 3: Relative Fuel Share of Total Primary Energy Supply, China and APEC, 2018



Source: EGEDA (2020)

Figure 4: China's Final Energy Demand by Sector, 2000 to 2018



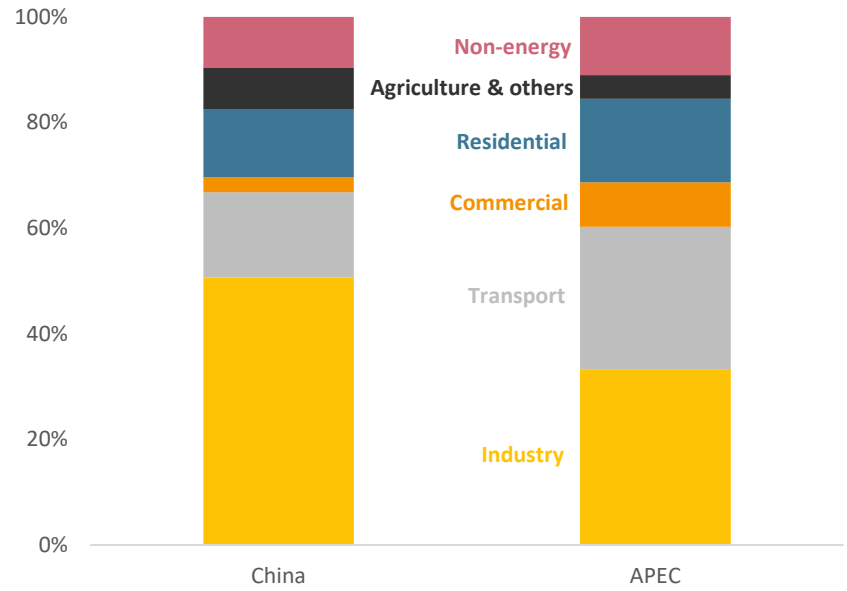
Source: EGEDA (2020)

Total Final Consumption

Total final consumption is a representation of end-use energy, including non-energy consumption. The proportion of industry is relatively large. It was above 50% in 2018, though this share represents a 9% decrease from 2011. The transport sector is the next largest, accounting for 16% of all end-use sectors (Figure 4).

Industrial energy consumption accounts for about a third of APEC's total final energy consumption, compared with 50.7% in China. Reducing the industrial share is the key to reducing the final energy consumption for China. This is shown in Figure 5.

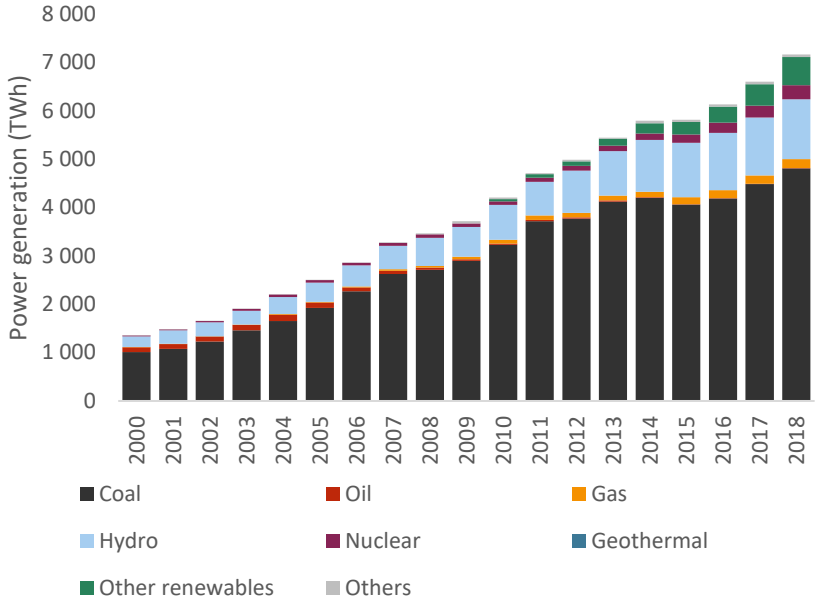
Figure 5: Relative Sectoral Final Energy demand for China and APEC, 2018



Source: EGEDA (2020)

Power generation has continued to grow since 2000. China's power sector is reliant on coal. Almost 67% of China's electricity was generated by coal in 2018, although this represents a significant decline from 75% in 2000 (EGEDA, 2020). From 2011, the proportion of non-fossil energy in electricity generation has increased (Figure 6).

Figure 6: China's Electricity Generation by Fuel, 2000 to 2018

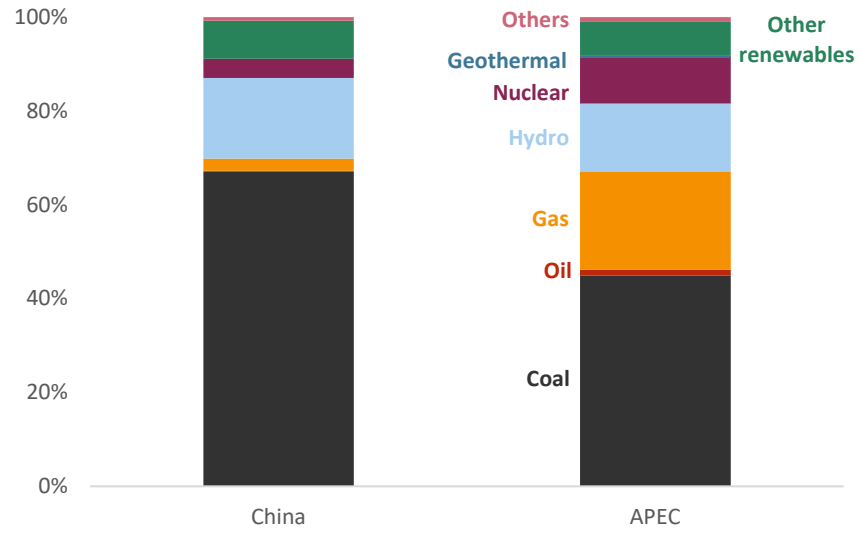


Source: EGEDA (2020)

Resource endowment combined with favorable economics has meant that the proportion of coal-fired power in China is higher than that of APEC, while that of gas generation is less than APEC (Figure 7).

In 2018, China's power generation reached 7 166 TWh. Thermal power and hydropower reached 5 004 TWh and 1 231 TWh, respectively, ranking each as first in the world. Nuclear power generation reached 294 TWh, ranking third.

Figure 7: Electricity Generation by Fuel for China and APEC, 2018



Source: EGEDA (2020)

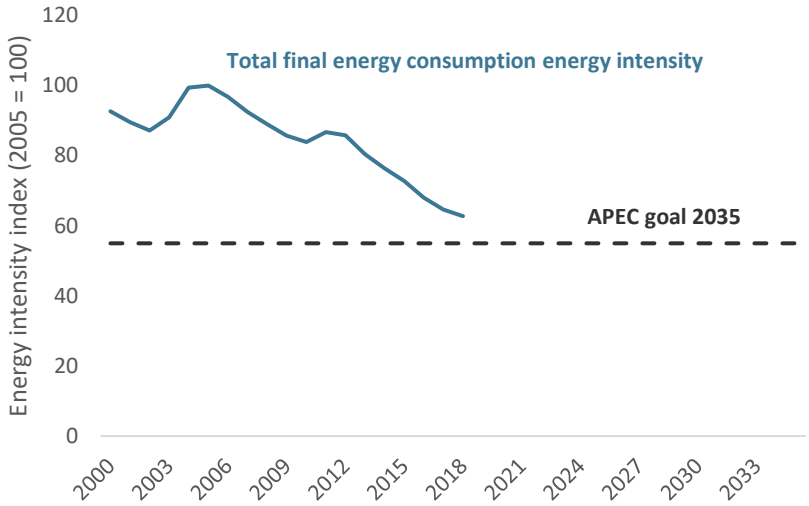
APEC Goals

APEC goals include reducing energy intensity 45% by 2035 (against the 2005 level) and doubling the share of renewable energy by 2030 with 2010 as the base year.

Energy Intensity Analysis

Energy intensity in the APEC region has been continuously improving. China is contributing to APEC's aspirational goal of a 45% energy intensity reduction by 2035 from the 2005 level. Since 2012, the growth rate of China's energy consumption has slowed significantly, and the "dual control" of energy intensity and total energy consumption has been included in China's 13th Five-Year Plan. In 2018, China's total final energy consumption (excluding non-energy sources) energy intensity improved by 37% relative to 2005 (Figure 8).

Figure 8: China's Total Final Energy Consumption Energy Intensity, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020)

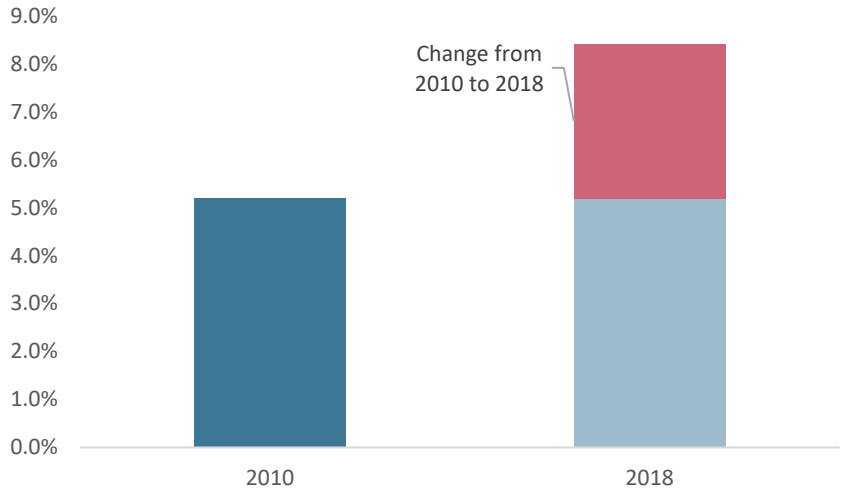
Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period of 2010–2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption.

There is no economy-level goal for individual member economies; however, it is possible to calculate the relative improvement of individual economies to get a better sense of whether the goal will be achieved.

Since the implementation of the Renewable Energy Law in 2006, China has entered a period of rapid development of renewable energy. The share of modern renewables to final energy consumption in 2010 was 5.2%. In 2018, this proportional share was 8.4%, which represents a 61%increase. China would need to increase its share of renewables by 2.0% for the 2018–2030 period to achieve a doubling of its renewables from 2010 to 2030 (Figure 9).

Figure 9: China's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy Policy	Details	Reference
The coal capacity structure optimization and upgrading	Gradually eliminate the annual output of 300 000 tons of less backward coal mines, orderly approval of new large coal mine projects	NEA
Tax and fee reduction	To encourage coal-bed methane exploitation, coal mining enterprises may be exempted from resource tax on coal-bed methane extracted for safe production.	State Taxation Administration (STA)
Fair and open supervision of oil and gas pipeline network facilities	Encouraging and supporting various types of capital to participate in the investment and construction of oil and gas pipeline network facilities that are included in the unified plan to improve guaranteed oil and gas supply capacity.	The State Council
The 2019 version of the Special Management Measures for Foreign Investment Access (Negative List)	Removing the restriction that foreign investment in oil and gas exploration and development must be in the form of joint ventures	The State Council
Support the reform and development of private enterprises	Clearly support them in entering the fields of oil and gas exploration and development, refining and marketing, building infrastructure construction in the fields of storage and transportation of crude oil, natural gas and refined oil products, and pipeline transportation.	The State Council
Accelerate the development of distribution to promote commercial consumption	Cancel the qualification for the wholesale distribution of refined oil products, and delegate to lower-level governments the examination and approval of the qualification for retail sales.	The State Council
Industrialisation of the development of biogas	Annual production of biogas will exceed 10 billion cubic meters by 2025 and 20 billion cubic meters by 2030.	National Development and Reform Commission (NDRC)
Wind power construction management	Changing the benchmark feed-in tariff for wind power to a guided tariff and the feed-in tariff for newly approved centralised onshore and offshore wind power projects to be allocated and determined through competition	NEA
Improve the feed-in tariff mechanism for photovoltaic (PV) power generation	Changing the benchmark feed-in tariff for centralised PV power stations to a guided tariff and reducing the intensity of subsidies for distributed PV projects	NDRC

Establish and improve the guarantee mechanism of renewable energy power consumption	Determine the proportion target of renewable energy power in electricity consumption in each provincial administrative region	NEA
Government work report for 2019	Promote the construction of facilities such as charging and hydrogenation	Report on the work of the government
The energy statistics report system	Hydrogen will be included in the 2020 energy statistics.	NBS
Non-water renewable energy generation	After 2021, the central finance will no longer subsidise new offshore wind and solar thermal projects.	Ministry of Finance (MOF)
Green production and consumption	Study and formulate standards, norms and supporting policies for the development of hydrogen energy, marine energy and other new sources of energy	NDRC
Management of power business licenses	Reduce the items subject to administrative examination and approval, simplify the scope and optimise procedures.	NEA
Reform the oil and gas system	Established an independent economy-wide pipeline network company to promote the formation of an “X+1+X” oil and gas market system	The State Council
Peak carbon emissions by 2030 and achieve carbon neutrality before 2060	No specific policy details yet	China news
Energy Law of the P.R.C. (Draft for Solicitation of Comments)	The to-be-announced Energy Law gives all energy policies a clear legal basis to ensure the direction of energy development and the stability of energy regimes.	Energy Law

Notable Developments

Energy development	Details	Reference
President Xi Jinping's speech at the Climate Ambition Summit in December 2020	By 2030, China's carbon dioxide emissions per unit of GDP will be cut by more than 65% from the 2005 level, and non-fossil energy will account for about 25% of primary energy consumption. The total installed capacity of wind and solar power will reach more than 1.2 billion kilowatts.	Xinhuanet
Formulating the 14th Five-Year Plan for energy development	Continue to increase the share of non-fossil energy and reduce the share of coal in total energy consumption, and strive to build a clean, low-carbon, safe and efficient energy system.	China's statement at the EWG60
The coal industry is concentrated in resource-rich areas	Shanxi, Inner Mongolia, Shaanxi and Xinjiang account for 76.8% of the total raw coal output.	News
In 2020, the newly installed wind power plus PV capacity totalled nearly 120 gigawatts	In December 2020, the newly installed wind power grid-connected capacity in a single month exceeded the total newly installed power grid-connected capacity in 2018 and 2019 combined.	NEA
Construction of major energy projects	The completion of Ali power network project in Tibet	Tibet news
Ultra-low emissions in the steel industry	Upgrading iron and steel enterprises to achieve ultra-low emissions in key regions, accounting for 80% of production capacity in 2025	Ministry of Ecology and Environment (MEE)
Coal consumption reduction	The goal was to increase the proportion of coal power consumption and reduce loose cool. The task of phasing out 20 million kilowatts of backward coal power units was completed ahead of schedule during the 13th FYP period.	Sina News
Nuclear power	The new capacity of nuclear power in 2018 was the highest in nearly a decade.	BJX News

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Useful links

The State Council, the People's Republic of China – http://www.gov.cn/

Ministry of Ecology and Environment (MEE) – https://www.mee.gov.cn/

Ministry of Industry and Information Technology (MIIT) – www.miit.gov.cn

Ministry of Housing and Urban-Rural Development – http://www.mohurd.gov.cn/

Ministry of Science and Technology – http://www.most.gov.cn/index.html

National Bureau of Statistics (NBS) – http://www.stats.gov.cn/

National Development and Reform Commission (NDRC) – https://www.ndrc.gov.cn/

National Energy Administration (NEA) – http://www.nea.gov.cn/

Ministry of Finance (MOF) – http://www.mof.gov.cn/

National Nuclear Safety Administration (NNSA) – nnsa.mee.gov.cn

Standardization Administration – http://www.sac.gov.cn/hdjl/

China Electricity Council (CEC) – https://cec.org.cn/

World Nuclear Association (WNA) – https://www.world-nuclear.org/

Hong Kong, China

Introduction

Hong Kong, China (HKC), is a special administrative region of the People's Republic of China. It is a world-class financial, trading and business centre with a population of 7.45 million people, and it is located at the southeastern tip of China. HKC derives its energy supplies almost entirely from external sources. Energy is either directly imported (as in the case of oil products and coal products) or produced through intermediate transformation processes that use imported fuel inputs (as in the case of electricity and gas).

Since early 2006, HKC also has very small-scale wind power generation. In addition, landfill gas has been utilised as fuel for gas production since 2007. Biodiesel has also been included in oil products since 2010.

In 2018, per capita gross domestic product (GDP) of HKC was USD 61 072 (2017 USD purchasing power parity [PPP]), which is the third highest among APEC economies. From 2010 to 2018, GDP increased by 26%, to USD 455 billion in 2018 (2017 USD PPP) (World Bank, 2020). The service sector is the dominant driving force of economic growth, constituting 93.1% of GDP in 2018 (HKTDC, 2020).

Table 1: Hong Kong, China: Macroeconomic Data and Energy Reserves

Key data		Energy reserves	
Area (km^2)	1 106	Oil (billion barrels)	–
Population (million)	7.45	Gas (petajoules)	–
GDP (2017 USD billion PPP)	455	Coal (million tonnes)	–
GDP per capita (2017 USD PPP)	61 072	Uranium (kilotonnes U)	–

Source: World Bank (2020)

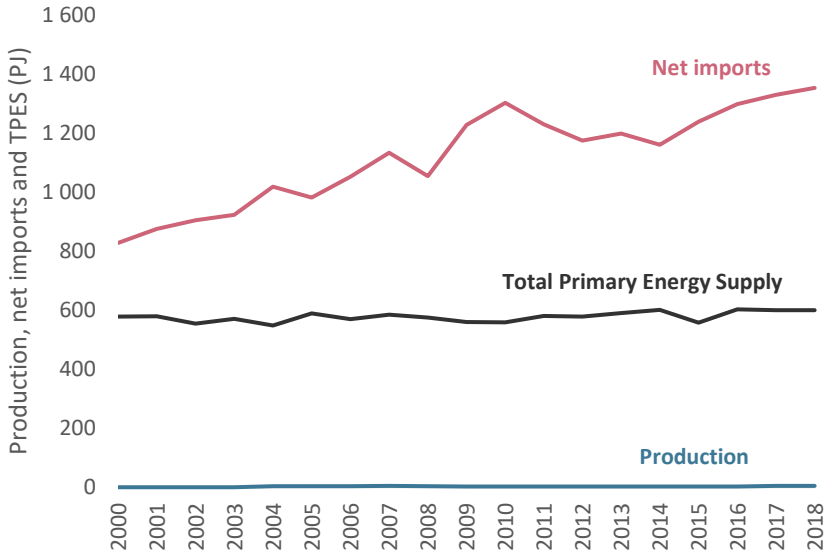
Energy supply and consumption

Total Primary Energy Supply

HKC has almost no locally produced energy, and the fuels required to meet all its primary energy needs are imported. A substantial share of imported energy is converted into secondary energy, such as electricity and gas, for final consumption (Figure 1).

The total primary energy supply (TPES) in HKC was 600 petajoules (PJ) in 2018, which was the same as the previous year. Coal maintained the highest share (45%) of TPES, followed by oil (26.5%), gas (20.5%), renewables (0.8%) and other sources (7.2%) (EGEDA, 2020).

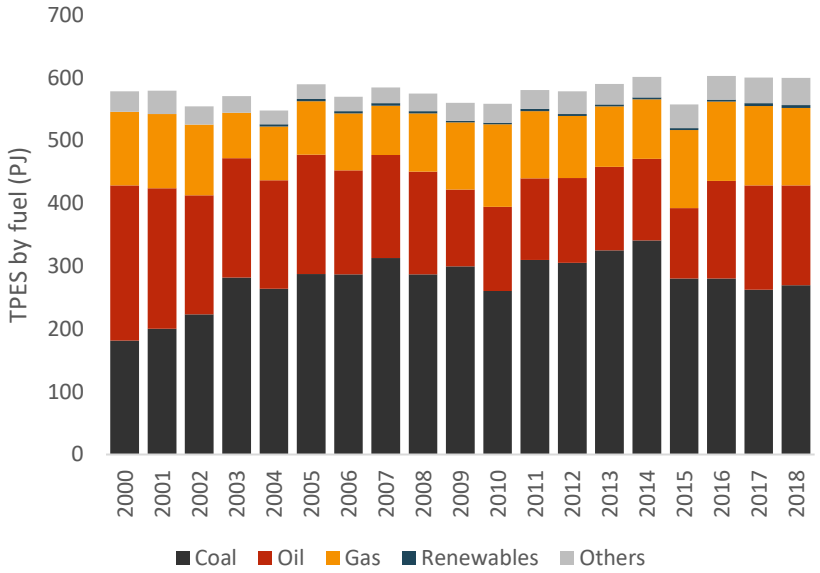
Figure 1: HKC Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

HKC's TPES fuel mix fluctuated by a small amount from 2000 to 2018 (Figure 2). Oil's share declined from 43% to 27% for this period. Meanwhile, the share of coal increased from 31% to 45%. Gas accounted for a modest increase from 20.2% to 20.5% (EGEDA, 2020).

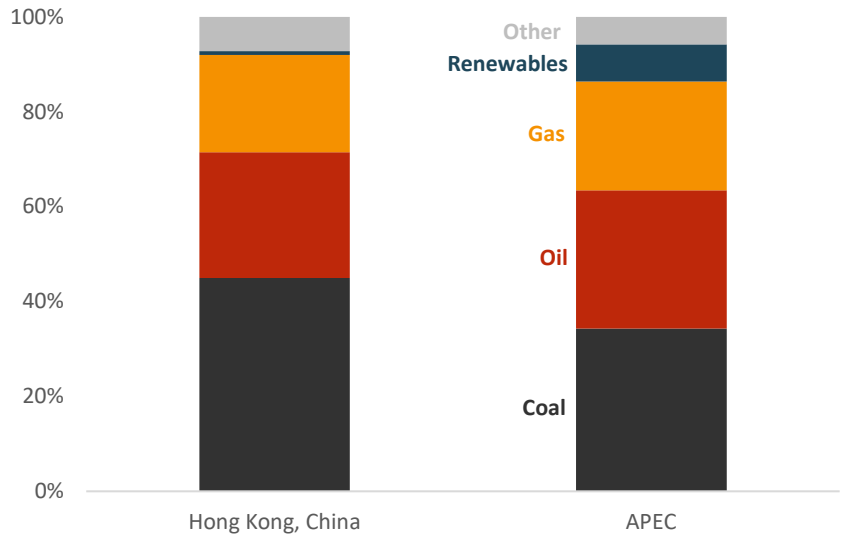
Figure 2: HKC Total Primary Energy Supply by Fuel, 2000 to 2018



Source: EGEDA (2020)

HKC exhibits a different fuel mix as compared to the entire APEC region (Figure 3). Other than coal, which is proportionally larger, the energy sources are smaller than APEC's share.

Figure 3: Relative Fuel Share of Total Primary Energy Supply, HKC and APEC, 2018



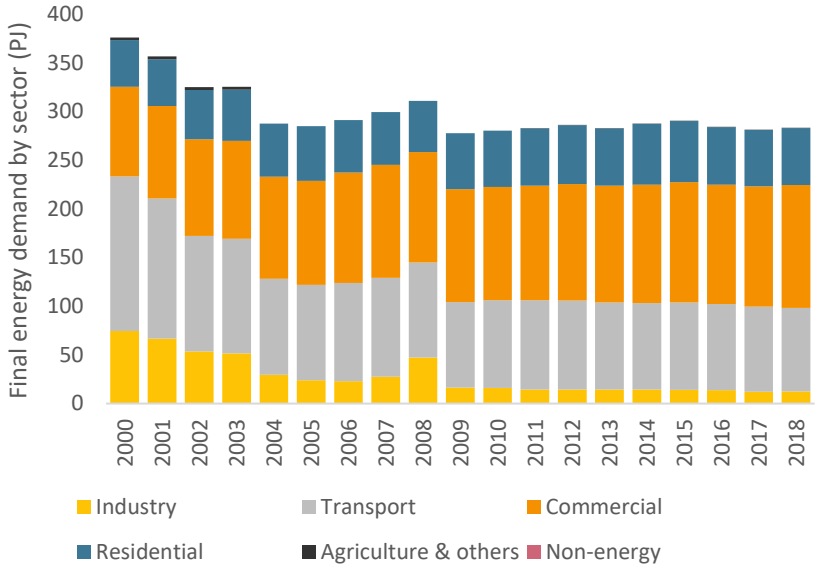
Source: EGEDA (2020)

Total Final Consumption

Total final consumption is a representation of end-use energy, including non-energy consumption. For HKC, the commercial and transport sectors are the main end-use sectors, accounting for 44.5% and 30.3%, respectively, of all end-use energy consumption (including non-energy) in 2018.

The commercial sector has experienced rapid energy growth since 2000, while the transport sector has slowly declined in energy use. In 2004, the former surpassed the latter for the first time and became the highest consumption sector. It has been rising gradually since then (Figure 4).

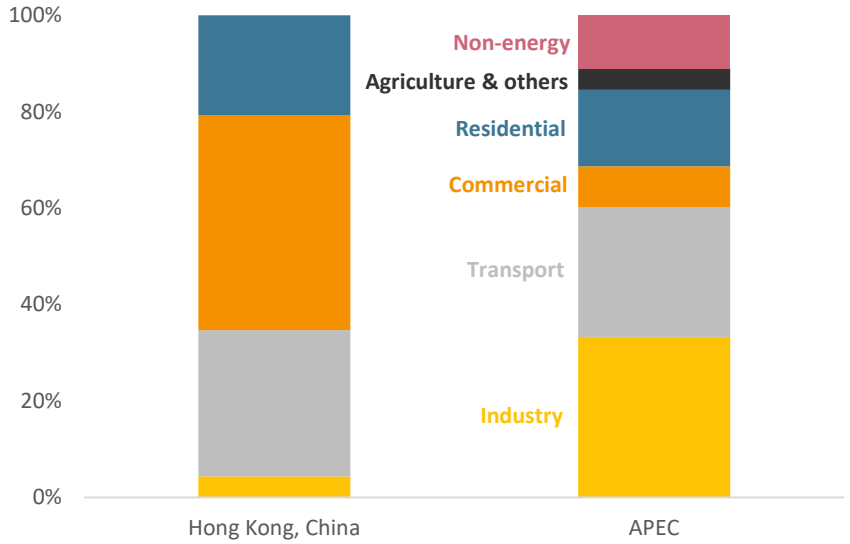
Figure 4: HKC Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Relative to APEC, HKC's industry and agriculture end-use sectors are much smaller energy users, whereas its commercial sector is highly developed and a much larger relative energy user (Figure 5).

Figure 5: Relative Sectoral Final Energy Demand for HKC and APEC, 2018

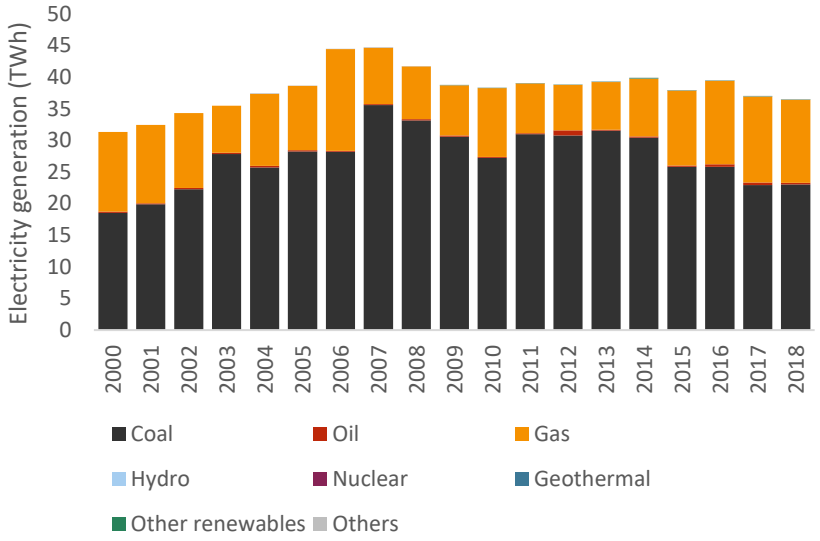


Source: EGEDA (2020)

Transformation

HKC's power sector is reliant on coal and gas. Between 2007 and 2018, the share of power generation by coal fell by 17%, while that of gas increased by 16%. Almost 63% of HKC's electricity was generated by coal and 36% by gas in 2018.

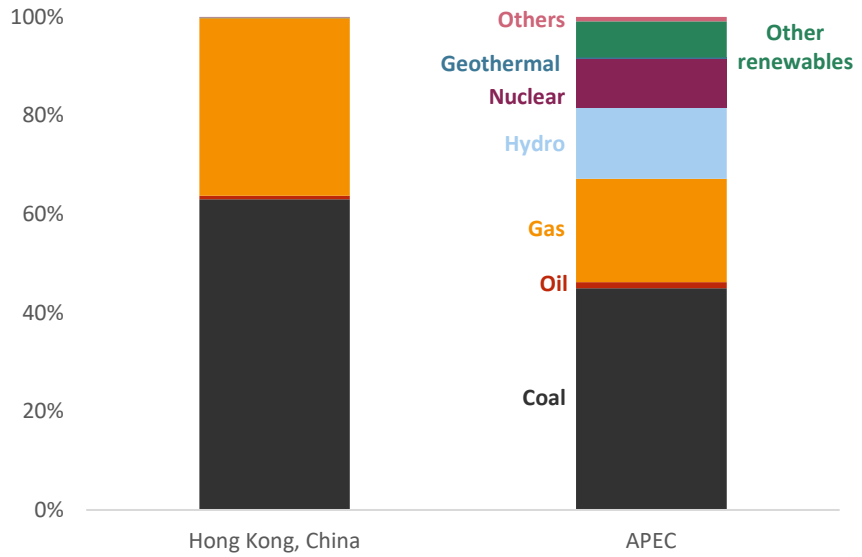
Figure 6: HKC Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

HKC imports fuel to meet all its energy demands. The majority of imported coal is converted into electricity for final consumption, and coal's prominence in the power sector is clear when viewed alongside the generation mix for APEC in 2018 (Figure 7).

Figure 7: Electricity Generation Shares by Fuel for HKC and APEC, 2018



Source: EGEDA (2020)

APEC Goals

The APEC member economies have agreed to meet two energy-related objectives. These are related to improving energy intensity and increasing the share of renewables in the energy mix.

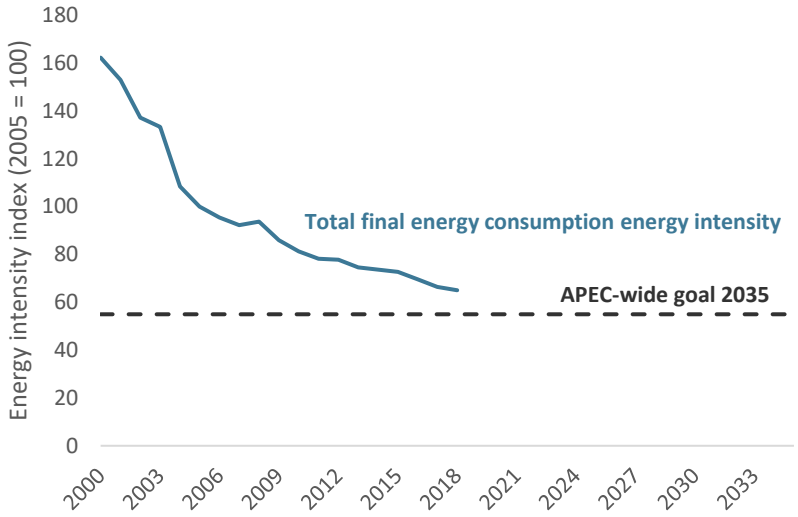
Energy intensity goal

In 2011, the APEC member economies agreed to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to meet this energy intensity improvement. The goal does not impose individual economy targets, but it's possible to track the progress of individual APEC economies relative to that overarching proportional improvement.

In 2018, HKC's total final energy consumption (excluding non-energy sources) intensity improved by 35% relative to 2005. To contribute in a proportional sense, HKC needs to improve its energy intensity by an additional 10% over the 17 years from 2018 to 2035 (Figure 8).

Figure 8: HKC's Total Final Energy Consumption and Energy Intensity Index, 2000 to 2018, (2005 = 100)



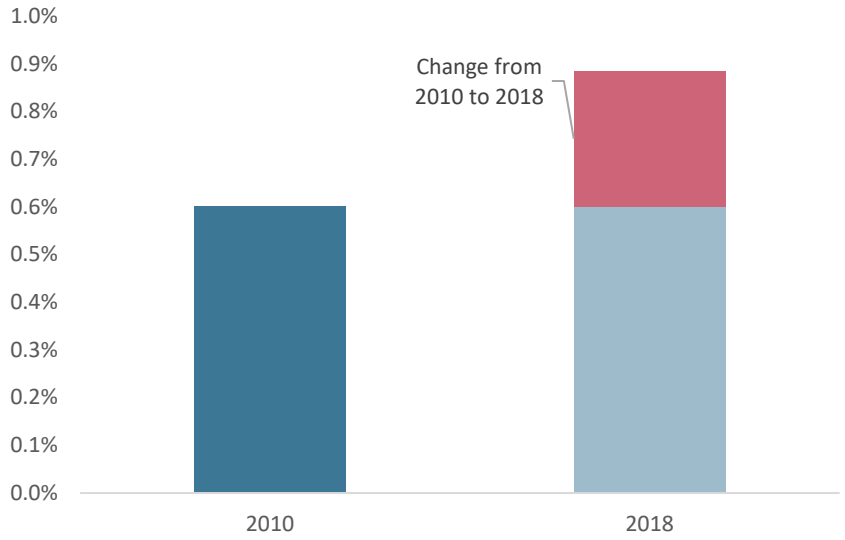
Source: EGEDA (2020)

Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period of 2010–2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption.

There is no economy-level goal for individual member economies; however, it is possible to calculate the relative improvement of individual economies to get a better sense of whether the broader APEC goal will be achieved. HKC's share of modern renewables to final energy consumption in 2010 was 0.60%. In 2018, this proportional share was 0.89%, which represents a 48% improvement. HKC would need to increase its share of renewables by an additional 0.31% from 2018 to 2030 to achieve a doubling of its renewables.

Figure 9: HKC Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

HKC's energy policy objectives are to ensure that the energy needs of the community are met safely, efficiently and affordably while minimising the environmental impact due to the production and use of energy (ENB, 2017a). The government also promotes the efficient use and conservation of energy. In combating climate change, reducing greenhouse gas (GHG) emissions and developing a low-carbon economy, HKC's emission reduction strategy emphasises the wider use of cleaner and low-carbon energies and fuels in power generation.

In keeping with the free market economic policy of Hong Kong, China, the government intervenes only when necessary to safeguard the interests of consumers, ensure public safety and protect the environment.

Energy Policy	Details	Reference
Green Tech Fund (GTF)	HKD 200 million for setting up the GTF to provide better and more focused funding support for environmental protection	GTF
Energy Efficiency Initiatives	Mandatory Energy Efficiency Labelling Scheme (MEELS), Building Energy Efficiency Ordinance (BEEO), District Cooling System (DCS), Retro-Commissioning	MEELS, RCx
Renewable Energy Initiatives	Feed-in Tariff and RE Certificate, Installing RE System in Various Government Schools and Welfare NGOs, Waste-to-energy Infrastructures	GOVHK
Striving for Carbon Neutrality	Energy Saving Plan 2015–2025+	Environment Bureau
Supporting Green Recovery	Electric Vehicles, Recycling Network, Green Employment	Policy Address 2020
Scheme of Control Agreements (SCAs)	Promotes the development of quality service of power companies, and improves energy efficiency and energy conservation	Environment Bureau
Solicit the public's view on the fuel structure	The government plans to increase natural gas generation to approximately 50% by 2020 and maintain the current interim measure of importing 80% of nuclear output from the Daya Bay Nuclear Power Station.	GOVHK
A memorandum of understanding (MOU) between NBS and HKC	PRC provides HKC with a stable supply of nuclear electricity and natural gas.	Agreement between NBS and HKC

The Buildings Energy Efficiency Ordinance	Conserve the energy used by buildings, including the Building Energy Code and Energy Audit Code	EMSD
Energy Efficiency Labelling	Covers 22 types of household and office appliances, including 13 types of electrical appliances	EMSD
Water-cooled air conditioning systems	The project is scheduled to be implemented in three phases: Phases I and II have been completed, and Phase III commenced in 2013 and is expected to be completed by the end of 2025.	EMSD
Reduce carbon emissions from transport	Extension of the public transport system, promoting of cleaner vehicles, running zero-emission buses, creation of the pilot Green Transport Fund, promotion of biodiesel as a motor vehicle fuel	Climate Change, GOVHK
Climate Action Plan 2030+ report	To reduce carbon intensity by 65% to 70% from the 2005 level by 2030, which is equivalent to a 26% to 36% absolute reduction and a reduction to 3.3–3.8 tonnes on a per capita basis.	Environment Bureau

Notable energy developments

Energy development	Details	Reference
Striving for carbon neutrality	Energy serving for all	EMSD
Energy Efficiency Initiatives(new)	Green energy target for government buildings and infrastructures, Green School 2.0, RCx training and registration scheme	Environment Bureau
Combating climate change	Strive to achieve carbon neutrality before 2050	Policy Address 2020
Supporting Green Recovery	Jockey club community sustainability fund-green recovery for community, 2020 HKC Green Finance Association Annual Forum financing a green industry recovery	Environmental Protection Blueprint
The Cleaner Production Partnership Program	The program helps HKC-owned factories in HKC and Guangdong adopt cleaner production technologies and practices, which was proposed in the 2019 Policy Address to be extended for five years up to March 2025.	Environment Protection Department (EPD)

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Useful links

The HKC Government – www.gov.hk/en

Electrical and Mechanical Services Department – www.emsd.gov.hk

Environment Bureau – www.enb.gov.hk

Environmental Protection Department – www.epd.gov.hk

Council for Sustainable Development – www.enb.gov.hk/en/susdev/council/index.html

Climate Ready – www.climateready.gov.hk

Low Carbon Living Calculator – www.carboncalculator.gov.hk

Indonesia

Introduction

Indonesia is the world's largest archipelagic state, located to the south-east of mainland South-East Asia, between the Pacific Ocean and the Indian Ocean. Indonesia's territory encompasses 16 056 large and small islands and large water bodies at the equator, covering a territorial area of 8.3 million square kilometres (km2), constituting Indonesia's exclusive economic zone. The economy's total land area (25% of its territory) is approximately 1.9 million km^2, and the population around 271 million in 2020 (Statistics Indonesia, 2021).

Indonesia had a gross domestic product (GDP) of USD 3 044 billion and GDP per capita of USD 11 372 in 2018 (2017 USD purchasing power parity [PPP]), recording an increase of 5.2% and 4%, respectively, compared to 2017 (World Bank, 2020). The ability to sustain economic growth is supported by the implementation of structural reforms, demographic bonuses, technological advances, and increased economic competitiveness.

Indonesia is the largest economy in South-East Asia and has undergone robust economic growth since overcoming the Asian and global financial crisis. It is projected to become a high-income economy by 2036 with the fifth largest GDP in 2045. To realise that vision, four pillars of development have been established, consisting of human development and mastery of science and technology, sustainable economic development, equitable development and strengthening economy-wide resilience and governance (NDPA, 2016).

The Indonesian Government has intensified infrastructure development, including energy infrastructure. Government spending on infrastructure projects has doubled from IDR 207 trillion in 2014 to IDR 415 trillion in 2019. Notable infrastructure developments are 3 843 km of highways, 1 298 km of toll roads, subways, and monorails, 18 ports, 58 km of bridges, and 61 hydro dams (MoPW, 2020a). Energy demand is expected to rise due to economic activities and improved infrastructure connectivity.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a, b]		Energy reserves [b, c]	
Area (million km^2)	1.9	Oil (billion barrels)	3.8
Population (2020 million)	270	Gas (TSCF)	77.3
GDP (2017 USD billion PPP)	3 044	Coal (million tonnes)	62.7
GDP per capita (2017 USD PPP)	11 372	Uranium (kilotonnes <USD 130/kgU)	5.3

Sources: [a] SI (2021), [b] EGEDA (2020), [b] MEMR (data of 2019c, Based on new parameter of Petroleum Resources Management System 2018), [c] OECD (2020)

Indonesia has substantial and diverse energy resources of oil, natural gas, coal, and renewables. In 2019, Indonesia's commercial fossil energy reserves consisted of 3.8 billion barrels of oil (excluding sub commercial reserves of 3.7 billion barrels), 77.3 billion barrels of natural gas (excluding sub commercial reserves of 58.3 billion barrels) and 37.6 billion tonnes of coal (MEMR, 2020a).

Indonesia is one of the largest thermal coal producers in the world. Coal production reached 616 million tonnes in 2019, with 74% of production exported (MEMR, 2020a). Indonesia exported 25.7 million barrels of crude oil, 92.0 billion barrels of oil equivalent of liquefied natural gas (LNG) and 45.3 billion barrels of oil equivalent of natural gas through pipelines (MEMR, 2020a).

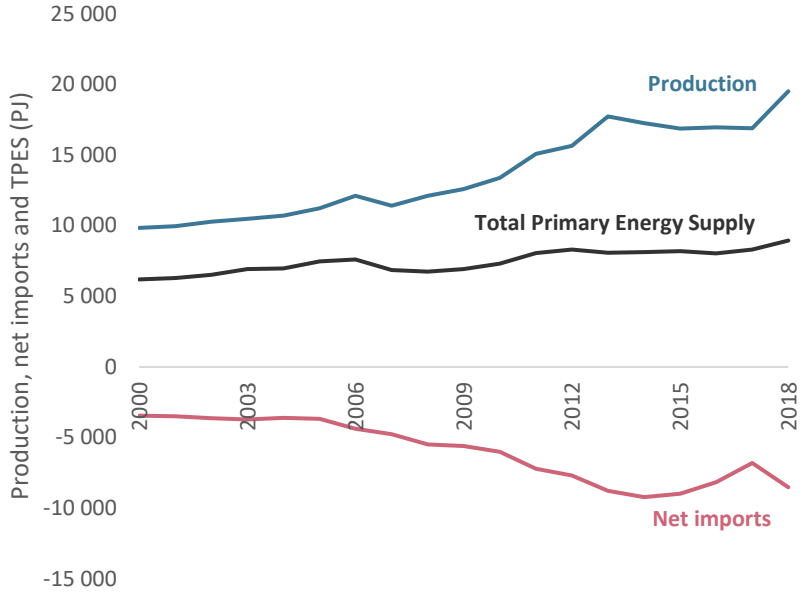
Renewable energy potential includes 28.5 gigawatts (GW) of geothermal, 94.3 GW of hydropower, 208 GW of solar, 33 GW of bioenergy, 61 GW of wind power and 17.9 GW of ocean energy (MEMR, 2020b).

Energy Supply and Consumption

Total Primary Energy Supply (TPES)

In 2018, Indonesia's TPES grew by 7.7% to reach 8 948 PJ (EGEDA, 2020). Energy production increased by 16% to reach 19 514 PJ, following a slow decline over the previous four years. A large proportion of this additional production was exported in 2018, though some of the growth was due to growth in domestic demand; net exports rose by 25% to 8 521 PJ (Figure 1). Indonesia is a net exporter of energy, exports crude oil, natural gas, LNG, petroleum products, LPG, Biodiesel and and coal.

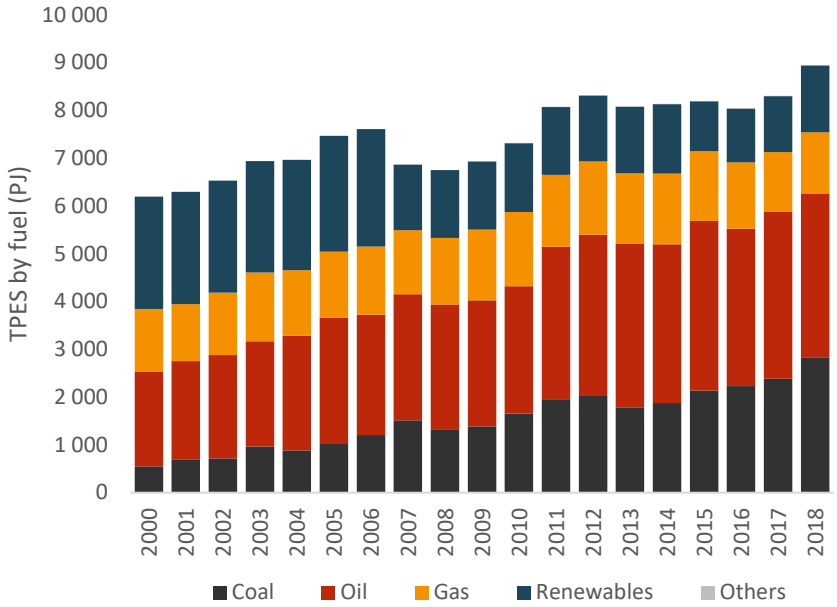
Figure 1: Indonesia's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

Fossils fuels remain prominent in Indonesia's TPES fuel mix (Figure 2). In 2018, oil declined by 1.6% from 2017 though continues to be the dominant component of Indonesia's energy mix. Coal's share has increased from 22.6% in 2010 to 32% in 2018 made possible due to Indonesia's abundant coal reserves. Coal experienced significant growth in 2018 of 18.6 %. Natural gas has remained relatively constant, declining from 1 319 PJ in 2000 to 1 279 PJ in 2018. Renewable energy increased by 20% in 2018 to 1 401 PJ (EGEDA, 2020).

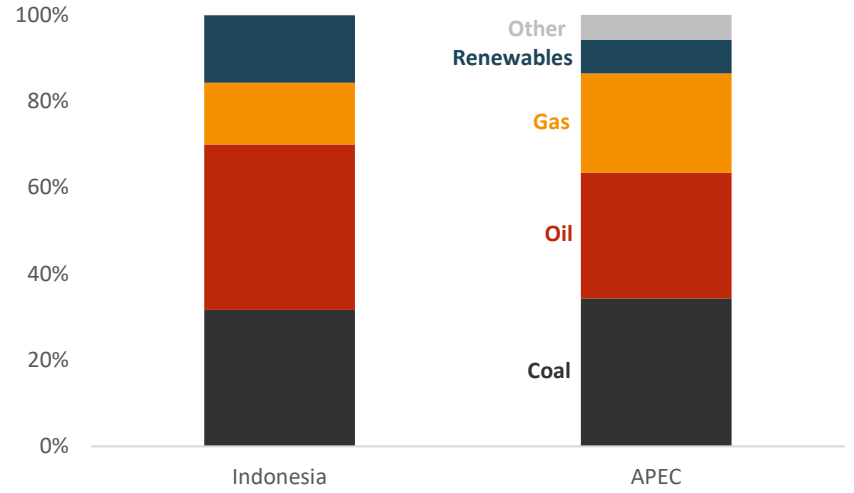
Figure 2: Indonesia's Total Primary Energy Supply by Fuel, 2000 to 2018



Source: EGEDA (2020)

Indonesia fuel mix is shown next to the APEC region in Figure 3. Fossil fuels are dominant: In 2018, fossil fuels constituted 84% of TPES in Indonesia and 86% of TPES in APEC. Coal's share is 32% in Indonesia, and 34% for APEC. Whereas the share of gas in Indonesia is smaller than for APEC, at 14% versus 23%. In contrast, oil is proportionally larger at 38% in Indonesia, as opposed to 29% in APEC. Renewable energy in Indonesia (16%) is double that of APEC (7.8%).

Figure 3: Total Primary Energy Supply Relative Fuel Share, Indonesia and APEC, 2018



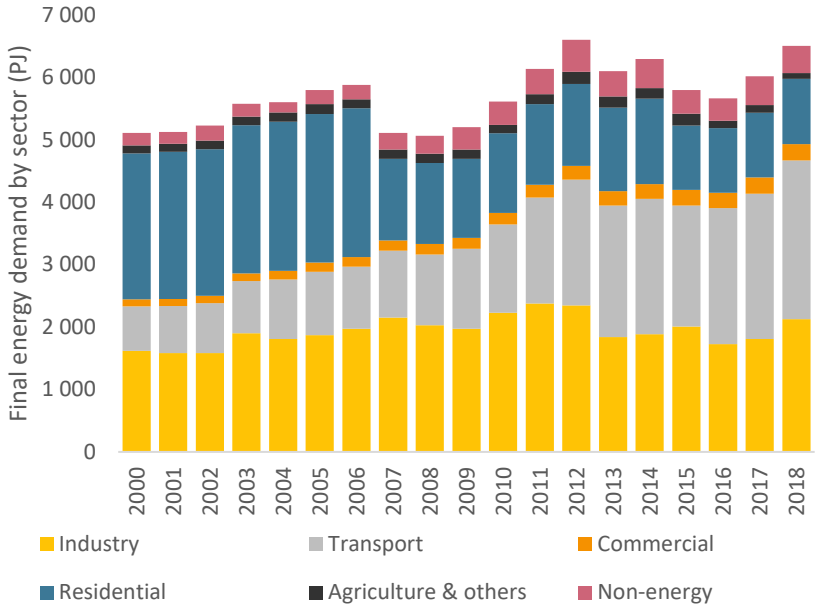
Source: EGEDA (2020)

Total Final Consumption

Final consumption is a representation of end-use energy, including non-energy consumption. Total final consumption was 6 508 PJ in 2018, representing an annual increase of 8.1%. Transport has become the dominant end-use sector, accounting for 39% of total final consumption in 2018, up from 25% in 2010. Residential's share declined from 23% in 2010 to 16% in 2018. The industrial sector remains prominent, accounting for 33% of all end-use sectors in 2018.

The commercial sector and agriculture, forestry and fishing and others consumed 791 PJ, which represent an annual decline of 6.2%. Figure 4 shows that these sectors only account for a small proportion of all end-users.

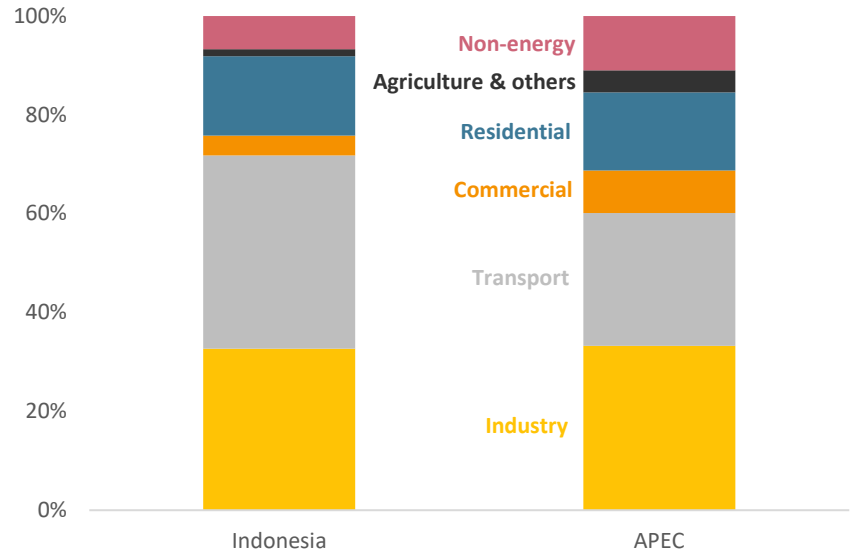
Figure 4: Indonesia Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Transport, industry and residential, account for the highest proportion of energy use in Indonesia. The industry share in 2018 was 33%, which is the same as for APEC. The transport sector in Indonesia is a more extensive relative energy end-user than APEC; 39% in Indonesia and 27% for APEC (Figure 5). Residential's 16% share was the same as for APEC. Indonesia's large transport sector is influenced by the archipelago nature of the economy and a trend of increasing connectivity.

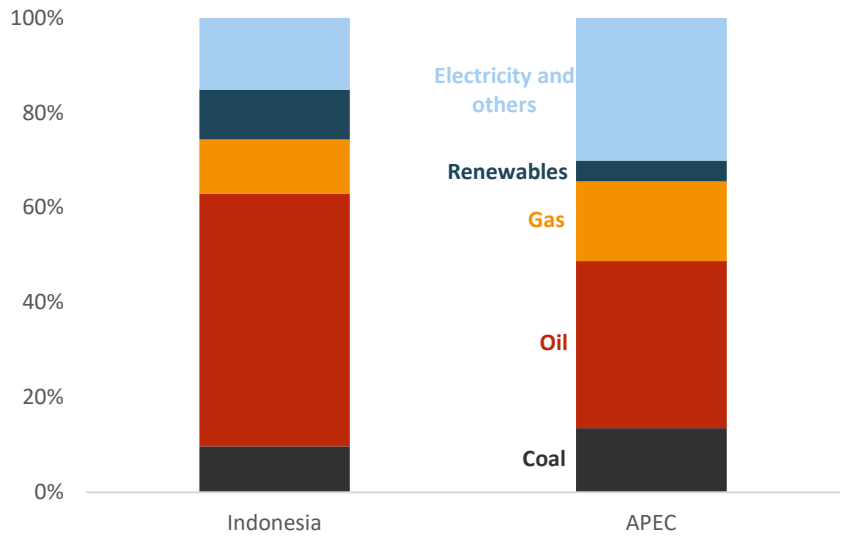
Figure 5: Relative Sectoral Final Energy Demand for Indonesia and APEC, 2018



Source: EGEDA (2020)

Fossil fuels accounted for 74% of final consumption in 2018, comprising oil (3 237 PJ, 53%), gas (692 PJ, 11%) and coal (589 PJ, 10%). Indonesia's large transport sector, and industry reliance on oil, means that the end-use of oil is relatively large in Indonesia, (66% in Figure 6). Coal use in final energy demand is relatively low (14%). The renewables share is higher (634 PJ, 10%) while electricity and others are lower (922 PJ, 15%).

Figure 6: Final Energy Demand Fuel Mix for Indonesia and APEC, 2018



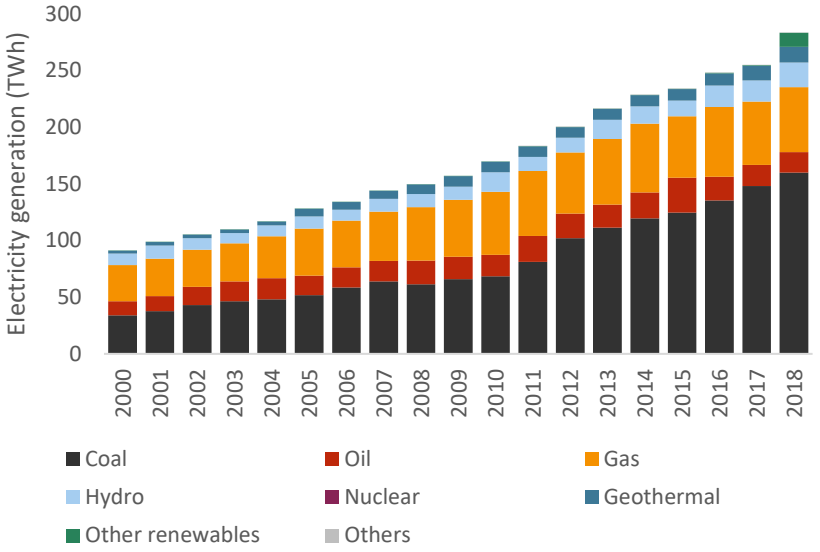
Source: EGEDA (2020)

Transformation

Indonesia had 64 955 megawatts (MW) of electricity generation capacity in 2018. This was held by the state-owned electricity company (PLN), independent power producers (IPPs) and private power utilities. In 2018, 284 terawatt-hours of electricity were generated, resulting in an increase of 11% compared to 2017, and a 6.5% growth annually since 2000.

Indonesia's power sector is reliant on coal; the economy is one of the largest thermal coal producers. Almost 56% of Indonesia's electricity was generated by coal in 2018, though coal's share actually declined 2% in 2018, despite an absolute increase (EGEDA, 2020). Natural gas generation decreased from 22% (2017) to 20% (2018). Hydro, geothermal, and other renewables accounted for 17% of electricity generation in 2018, up from 13% in 2017.

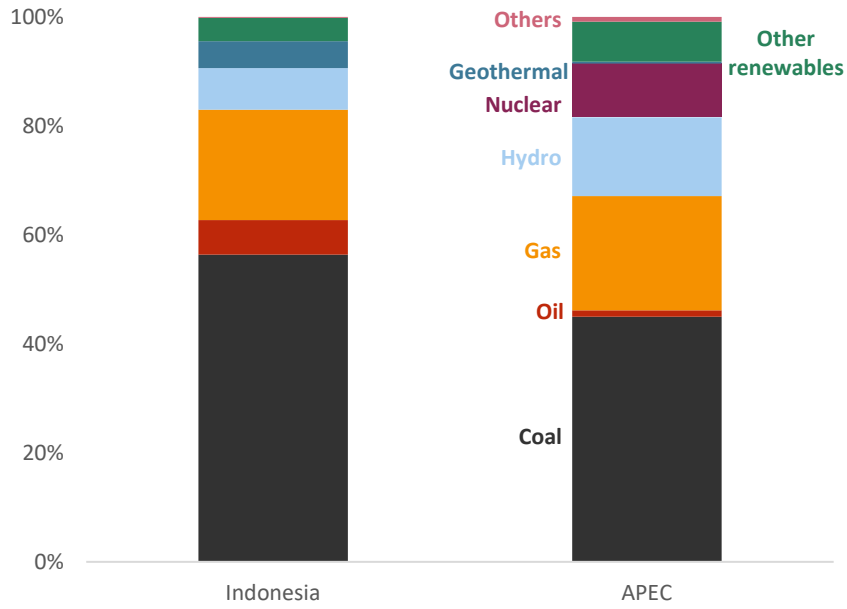
Figure 7: Indonesian Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Coal's dominance in Indonesia's power sector is evident when viewed alongside the generation mix for APEC in 2018 (Figure 8). Coal generation was 56% compared to 45% in APEC. Gas was almost the same (20% compared to 21% in APEC). Indonesia also has proportionally less hydro generation than APEC (7.6% compared to 14%). Geothermal generation is 4.9%, which is large compared to the negligible share for APEC. Other renewables generation is expected to grow due to the abundant renewable potential and increasingly cost competitive technologies.

Figure 8: Electricity Generation by Fuel for Indonesia and APEC, 2018



Source: EGEDA (2020)

APEC Goals

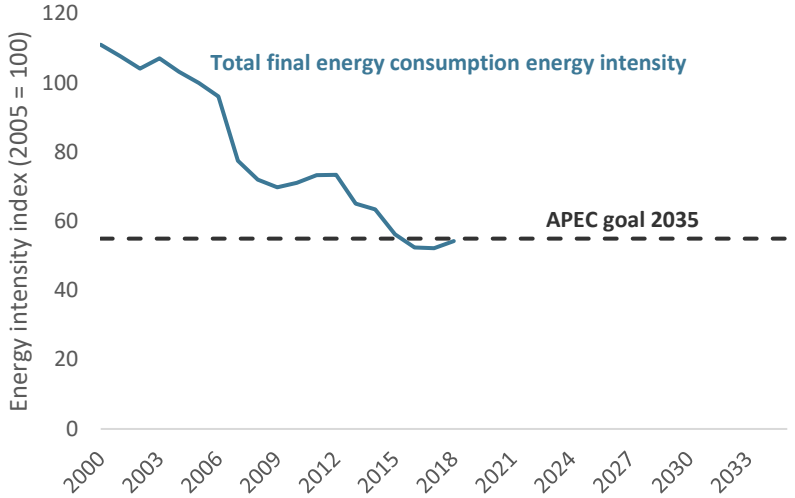
There are two energy-related objectives that APEC member economies have agreed to meet collectively – improving energy intensity and increasing the share of renewables in the energy mix.

Energy Intensity Analysis

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline. APEC is on track to meet this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track individual APEC economies' progress, relative to the overarching proportional improvement.

In 2018, Indonesia's total final energy consumption (not including non-energy) was 1.9 PJ per billion USD, an improvement of 46% relative to 2005. This has contributed to the overall commitment for the APEC region to improve energy intensity by 45% by 2035, as shown in Figure 9.

Figure 9: Indonesia's Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020)

Doubling of Renewables

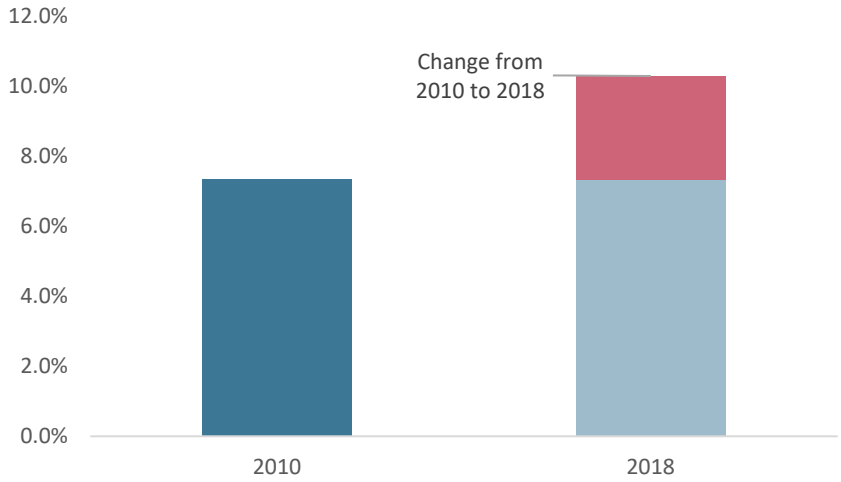
The second energy goal involves doubling modern renewables' share in the APEC energy mix for the period 2010–2030. Modern

renewables do not include traditional biomass, and the share is relative to final energy consumption (it does not include non-energy consumption).

There is no economy-level goal for individual member economies. However, it is possible to calculate the relative improvement of individual economies to understand how they can contribute to doubling the goal.

Indonesia's share of modern renewables to final energy consumption in 2010 was 7.4%. In 2018, that proportional share was 10.3%, representing a 40% increase (Figure 10).

Figure 10: Indonesia's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy sector policies support the Indonesia's development agenda, including realising Indonesia's vision for the energy sector's future. Supporting the achievement of the economy-wide energy policy goals involves the realisation of energy management to achieve energy resilience and energy security to support sustainable development.

Energy Policy	Details	Reference
General Plan of National Energy	Indonesia has planned renewable energy targets in the energy mix of 23% by 2025 and 31% by 2050.	Ministry of Energy and Mineral Resources
General Plan of National Electricity	Electricity generation targets are 23% renewables, 22% natural gas, 55% coal and 0.4% oil by 2025. For 2038, the targets are 28% renewables, 25% natural gas, 47% coal and 0.1% oil.	Ministry of Energy and Mineral Resources
Nationally Determined Contribution of Indonesia	A reduction target of 29% and conditional reduction targets up to 41% of the business-as-usual scenario by 2030, with the reduction of the energy sector targeted at 11%–14% and forestry by 17.2%–23%.	UNFCC
Indonesia's Gas Transition Policy	Indonesia's gas transition policy includes energy supply transformation from the oil-to-gas supplies.	Ministry of Energy and Mineral Resources
Coal-gasification Program	Indonesia is prioritising coal gasification as a critical energy security program. The first pilot program will be the delivery of the coal-to-dimethyl ether project in Sumatera. The constructed plant can produce 1.4 tons of DME annually from 2024.	Ministry of Energy and Mineral Resources
Mining Law	Indonesia's parliament recently passed a new revision on the Indonesian Mining Law on 12 May 2020. The revision allows greater business certainty for private investment in the coal and mining industries.	Ministry of Energy and Mineral Resources
Grand Strategy of Energy	The Indonesian Government is currently formulating a grand strategy for the energy sector to ensure sufficient energy supply that is good quality, affordable, environmentally friendly and reduces energy import.	Ministry of Energy and Mineral Resources
One Million Barrels of Oil Production	Program to increase domestic oil production through investments in new oil fields and enhanced-oil-recovery. Through this approach, oil production is expected to increase from 705 000 barrels per day (bpd) currently to 1 million bpd and gas production to 12 BSCFD by 2030.	Ministry of Energy and Mineral Resources
The Refinery Development Master Plan	The refinery development master plan improves Indonesian energy security by mandating the domestic processing of oil products. It is targeted to increase to 1.3 million bpd by 2025.	Pertamina
Green Refinery Project	The state-oil company produces 100% diesel from palm-oil by converting the existing Cilacap refinery, producing 6 000 bpd from 2021.	Pertamina

Energy Policy	Details	Reference
Oil and Gas Contract	The flexibility of oil and gas contracts (cost recovery, gross split and others)	Directorate General of Oil and Gas
Gas Pricing Policy for Industry	The gas price for the industrial sector has been lowered to close to USD 6/MMBTU for 2020–2024	Ministry of Energy and Mineral Resources
Gas Pricing Policy for Electricity Generation	The gas price for electricity generation has been lowered to close to USD 6/MMBTU for 2020–2024	Ministry of Energy and Mineral Resources
City Gas Expansion Program	Plans to increase the share of gas supply to buildings, mostly in residential areas. City gas network expansion will increase from 325 852 gas connections in 2018 to almost 8 million by 2030.	Ministry of Energy and Mineral Resources
The Moratorium of Coal-fired Power Plant Development	The Indonesian Government will stop developing new coal-fired power plants for the next 10 years in the Java Bali system. Electricity demand increase will be met through the development of gas power plants and renewable energy.	Ministry of Energy and Mineral Resources
Biodiesel Blending Rate Program	Mandatory biodiesel blending program that commenced with a 10% blend rate in 2016 to 20% rate in 2019 to 30% rate from 2020 onward.	Ministry of Energy and Mineral Resources
Coal Domestic Market Obligation 2020	Implementation of Coal Domestic Market Obligation rate at 25% of each coal mining company's production with a selling price of USD 70 per ton for power production in 2020	Ministry of Energy and Mineral Resources
Co-firing	Implementation of co-firing for coal-fired power plants using biomass in order to increase renewable energy utilisation	Ministry of Energy and Mineral Resources
Coal Tax	Coal mining products to be subject to Value Added Tax (VAT)	Directorate General of Mineral and Coal
Indonesian Environmental Estate Fund	Public service agency tasked with managing funds related to environmental protection and conservation, including forestry, energy and mineral resources, carbon trading, industry, transportation, farming and fishing.	Ministry of Finance
Renewable Energy Certificate	Indonesian state-owned electricity utility, PLN, has been issued RECs to support the Government's program to promote clean energy use.	PT PLN
Solar Rooftop Program	To encourage solar energy utilisation, the Ministry of Energy and Mineral Resources has issued regulations regarding Solar PV Rooftop Development and net metering.	Ministry of Energy and Mineral Resources

Energy Policy	Details	Reference
Refinement of Renewable Energy Electricity Purchasing Regulations	Minister of Energy and Mineral Resources Regulation No. 04 of 2020, changing of renewable procurement and contract.	Ministry of Energy and Mineral Resources
Special Economic Zone Development	The special economic zone (SEZ) includes industrial activities for steel and metal production, electronics, agricultural processing, manufacturing, tourism and commerce. As of 2019, 11 SEZs are currently operating, and 5 SEZs are under construction.	National Council for Special Economic Zone
EV Development Program	The target for light-duty EVs to reach 2 million units and electric motorcycles to reach 13 million units by 2030.	Ministry of Energy and Mineral Resources
Charging Station Regulation	Minister of Energy and Mineral Resources issued Regulation No. 13 of 2020, which regulates charging infrastructure business models, electricity tariff for EVs and charging stations, and technical and safety regulations.	Ministry of Energy and Mineral Resources
Electric Stove for Cooking	The Government continues to encourage the use of electric induction stoves in an effort to use clean energy and to reduce LPG Consumption. The conversion of one million LPG stoves to induction stoves can reduce gas subsidies by IDR 4.8 trillion within five years.	Ministry of Energy and Mineral Resources
Green Buildings	Mandatory green buildings in urban areas and specifically aimed to improve energy efficiency for commercial buildings in the cities.	ICED-USAID
Mandatory Energy Efficiency	Mandatory efficiency standards for home appliances (LED, lighting, air circulating and air conditioning)	Ministry of Energy and Mineral Resources
Energy Efficiency Improvement Program	The Indonesian Government put forward a target to improve energy efficiency by 17% of energy saving by 2025 and 39% by 2050 against business-as-usual energy consumption.	Ministry of Energy and Mineral Resources

Notable Developments

The table below details the projects that will be implemented to support the achievement of the development goals in the energy sector. The projects aim to improve infrastructure in the oil and gas sectors, electricity and renewable energy.

Energy development	Details	Reference
Abadi LNG Project	The Indonesian Government has approved the plan for the development of the Abadi LNG project. The project is currently under development and will start producing 9.5 mtpa of LNG and 35 000 barrels of condensate in 2027.	INPEX
Pertamina Enhanced Oil Recovery Program	Pertamina, the state-owned oil and gas company, undertook full-scale enhanced-oil-recovery, starting from 2020, to improve oil production from eight mature oil fields, increasing oil production 40%–60% from the 2019 rate of 922 000 bpd.	Pertamina
BP-Tangguh LNG Project Expansion	The BP Tangguh Train-3 LNG Project is expected to commence commercial operation in 2021, adding a capacity of 3.8 mtpa LNG production to a total capacity of 11.4 mtpa.	BP
Repsol Gas Development Plan in Indonesia	The discovery of 2TCF of natural gas in 2019 provided potential to increase gas production in Indonesia. The new gas field is located on the island of Sumatera and is expected to start production in 2023. The gas will be distributed via the 3 574 km trans Sumatera–Java gas pipeline.	REPSOL
The 35 GW Electricity Generation Program	To provide sufficient electricity supply for economic growth and increase the electrification ratio, the Government launched the 35 GW Electricity Program for Indonesia in May 2015. Commercial operation dates will vary between projects.	Ministry of Energy and Mineral Resources
Jawa 1 Power Plant FSRU	The FSRU LNG regasification terminal (2.4 Mtpa) will bring gas to the Jawa power plant starting from 2021.	Pertamina
Indonesia Deep Water Oil Project	The first Indonesia deep-water oil project is projected to start production in 2025, adding 1.1 billion cubic feet of natural gas per day to feed the Bontang LNG processing facility.	Ministry of Energy and Mineral Resources
Coal-to-Dimethyl Ether (DME) Conversion Program	The coal-to-DME conversion program is a strategy to reduce LPG imports relied on by the buildings sector. DME production is projected at 1.4 million tons in 2025, with a total investment value of around USD 2.1 billion	PT Bukit Asam

Energy development	Details	Reference
B-30	Indonesia implemented a B30 Mandatory program in January 2020. Through this program, it is projected that 9.6 million kilolitres of domestic biodiesel will be utilised by the end of the year.	Ministry of Energy and Mineral Resources
Municipal Waste-based Power Plants	Development of Municipal Waste-based power plants in 12 cities (234 MW)	Ministry of Energy and Mineral Resources
Smart Grid	In increasing the electric power system's reliability, Smart Grid is one solution to escalate efficiency and transmission flexibility to receive more Variable Renewable Energy (VRE). By 2025, 25 new Smart Grid systems will be developed.	Ministry of Energy and Mineral Resources
Cirata Floating Solar PV	The first and most significant Floating Solar PV in South-East Asia will be developed in Cirata, West Java. With a total capacity of 145MW and an investment of about USD 129 million, it will be online in 2022.	Ministry of Energy and Mineral Resources
Bio-energy Development	Implementation of a B30 mandatory program in January 2020. Developing green diesel and green gasoline through co-processing, in cooperation with Pertamina (Cilacacap refinery and Plaju refinery by 2022)	Ministry of Energy and Mineral Resources
Converting Diesel into Renewables Power Plant	Approximately 5 200 units of diesel power plants in 2 130 locations to be shifted gradually into renewables (first stage with a capacity of 225 MW).	PT PLN
Diesel Power Plant Gasification	Around 1.7 GW of PLN's power plants in 52 locations that previously ran on diesel fuel will be converted into natural gas. The savings from the conversion are projected to be more than Rp. 3 trillion per year, starting from 2020 up to 2022.	Ministry of Energy and Mineral Resources

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Useful Links

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Directorate General of Electricity – www.djk.esdm.go.id

Ministry of Energy and Mineral Resources (KESDM) – www.esdm.go.id

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PT Pertamina – www.pertamina.com

PT Pertamina Gas – www.pertagas.pertamina.com

PT PGN (Persero) – www.pgn.co.id

PT PLN (Persero) – www.pln.co.id

SKKMIGAS, Special Task Force for Upstream Oil and Gas – www.skkmigas-esdm.go.id

Statistics Indonesia (Badan Pusat Statistik, BPS) – www.bps.go.id

UNDP Indonesia – www.id.undp.org

World Bank – www.worldbank.org

Japan

Introduction

Japan, which is in East Asia, comprises several thousand islands, the largest being Honshu, Hokkaido, Kyushu and Shikoku. Most of its land area, approximately 377 976 square kilometres (km^2) (GIS, 2020), is mountainous and thickly forested. Japan is the third-largest economy in the world after fellow APEC economies, China and the United States. In 2018, its real GDP was approximately USD 5 197 billion (2017 USD purchasing power parity [PPP]). The population of 127 million people enjoyed a per capita income of USD 41 074. The GDP per capita grew 0.5% in 2018, relative to 2017.

Japan's energy resources are modest, which means that it imports nearly all of its fossil fuels to sustain economic activity. Proven energy reserves include approximately 44 million barrels of oil, 738 billion cubic feet (bcf) of natural gas and 350 million tonnes (Mt) of coal.

Table 1: Macroeconomic Data and Energy Reserves

Key data		Energy reserves	
Area (thousand km^2) [a]	378	Oil (million barrels) [c]	44
Population (million) [b]	127	Gas (billion cubic feet) [c]	738
GDP (2017 USD billion PPP) [b]	5 197	Coal (million tonnes) [d]	350
GDP per capita (2017 USD PPP) [b]	41 074	Uranium (kilotonnes U < USD 130/kgU) [e]	6.6

Sources: [a] GIS (2021); [b] World Bank (2020); [c] Conglin Xu and Laura Bell (2020); [d] BP (2020); [e] OECD (2020)

Energy supply and consumption

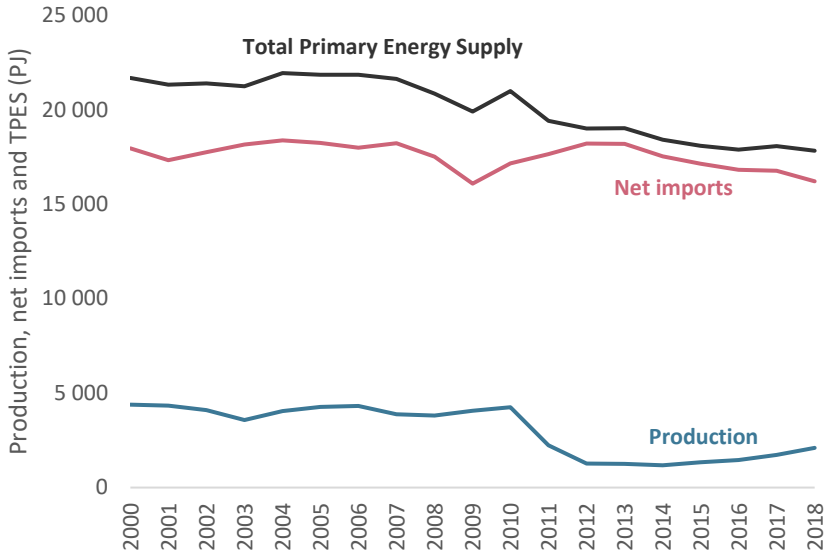
Total Primary Energy Supply

Japan's total primary energy supply was 17 836 PJ in 2018, which represents an annual decrease of 1.4% (Figure 1). Oil contributed the largest share (39%), followed by coal (27%) and natural gas (23%). Japan's energy supply is highly dependent on imports. In 2018, net imports of energy made up 91% of the total primary energy supply (EGEDA, 2020).

Japan was the fourth-largest oil consumer in the world and third among APEC economies in 2019, following the United States, China and India (BP, 2020). Almost all Japan's oil requirements are met through imports. Dependency on Middle Eastern oil declined in the early and mid-2010s due to oil imports from Russia via the expansion of the Eastern Siberia Pacific Ocean pipelines. More

recently, oil imports from Russia and other Asian regions have decreased, making Japan's dependency on the Middle East bounce back to 88% in fiscal year[3] (FY) 2018. Saudi Arabia, the United Arab Emirates and Qatar were the three largest suppliers of oil to Japan (METI, 2020a). In 2018, the primary oil supply was 6 960 PJ, a decrease of 5.5% from the previous year (Figure 2). In 2018, the primary coal supply was 4 791 PJ, which was a decrease of 1.7% from the previous year (EGEDA, 2020).

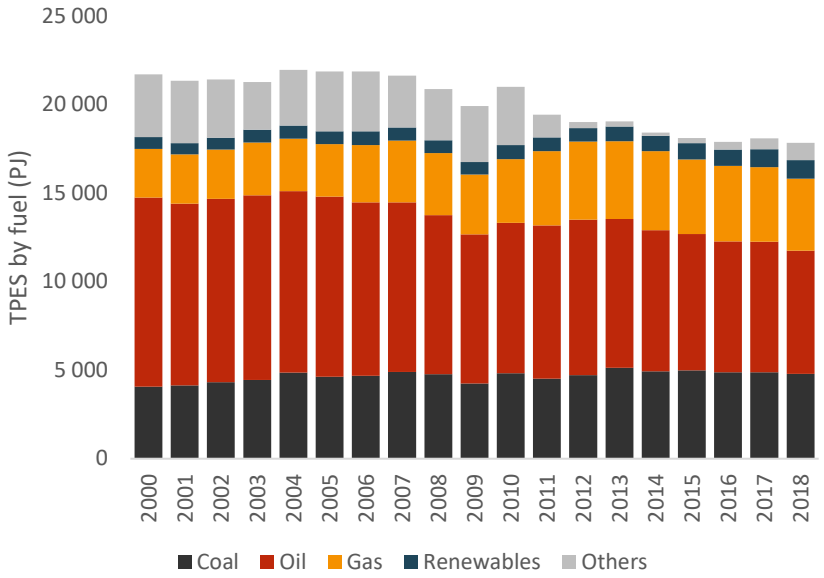
Figure 1: Japan's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

Almost all coal was imported, making Japan one of the world's largest coal importers. Power generation, steel production and the cement industries are the main users of coal. Japan's main steam (or thermal) coal suppliers are Australia (72% in FY2018), Indonesia (11%) and Russia (11%). The top suppliers for coking coal are Australia (46%), Indonesia (22%) and the United States (13%) (METI, 2020a).

Figure 2: Japan's Total Primary Energy Supply by Fuel, 2000 to 2018 (PJ)



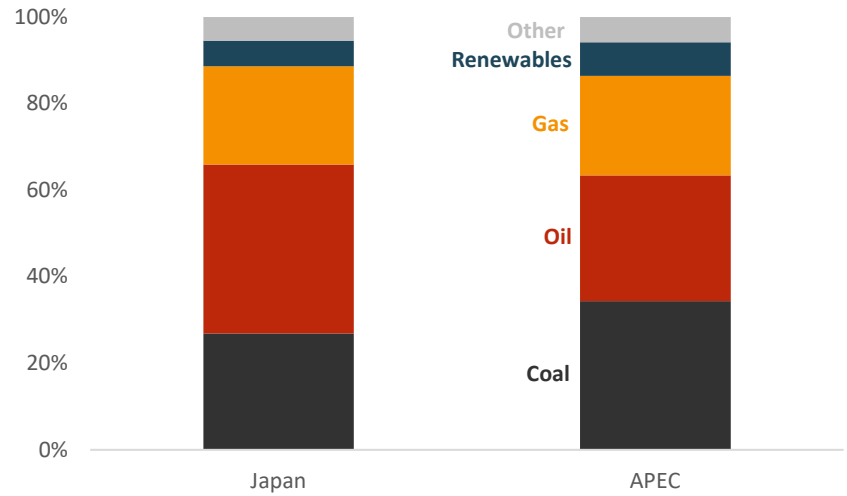
Source: EGEDA (2020)

Like coal, natural gas resources are scarce in Japan. Domestic production stands at 2.7 bcm and is mainly located in the Niigata, Chiba, and Hokkaido prefectures (METI, 2020a). In FY2018,

[3] The fiscal year starts in April in Japan.

imports in the form of liquefied natural gas (LNG) supplied almost the entirety of domestic demand. These imports were from Australia (37%); Malaysia (12%); Qatar (12%); and Russia (7.9%) (METI, 2020a). LNG imports to Japan accounted for 22% of the total global LNG trade in 2019 (BP, 2020). Electricity generation and reticulation as a city gas are the main use cases for natural gas in Japan (METI, 2020a). The primary natural gas supply was 4 060 PJ in 2018, a decrease of 3.9% from the previous year (EGEDA, 2020).

Figure 3: Relative Fuel Share of Total Primary Energy Supply, Japan and APEC, 2018

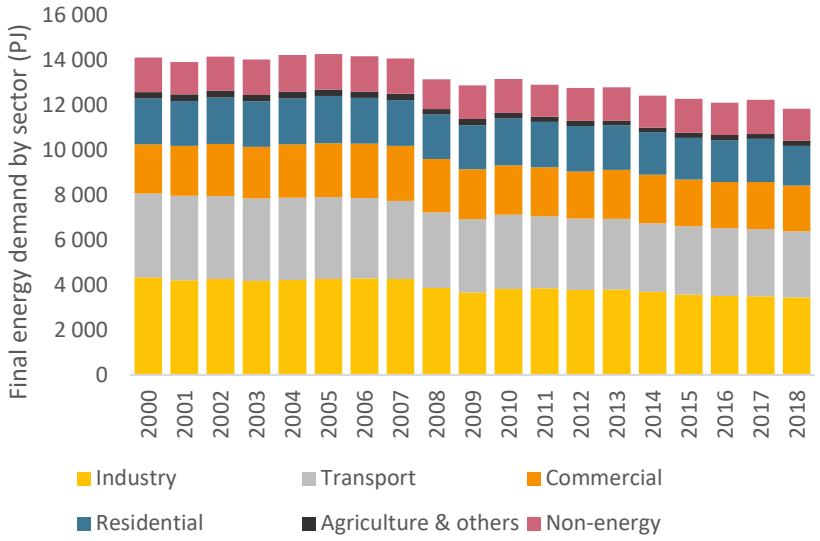


Source: EGEDA (2020)

Total Final Consumption

Final energy consumption (excluding non-energy) decreased by 2.8% to 10 420 PJ in 2018 (Figure 4). Oil constituted the largest share at 45%, electricity and others accounted for 34%, gas constituted 12% and coal 8.2%. Renewables grew 0.9% in 2018, though its share in final energy consumption was still low at 1.9%.

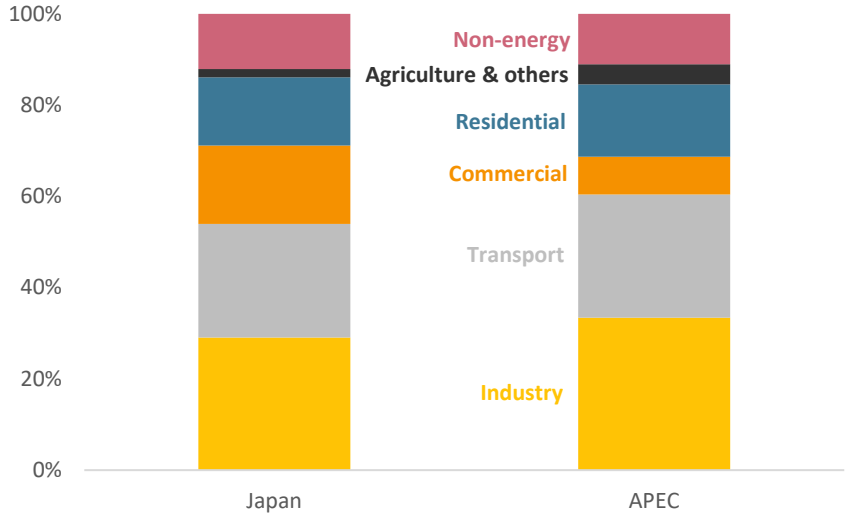
Figure 4: Japan's Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Non-energy uses amount to an additional 1 429 PJ of final energy consumption (with a decrease of 6.2% in 2018). Including non-energy makes the final consumption 11 849 PJ. The industry sector uses 29% of this final consumption, followed by the transport sector at 25% (Figure 5). The residential sector's final energy consumption decreased by 7.8% in 2018 to account for 15% of the final consumption. The commercial sector accounted for 17% of the final consumption (EGEDA, 2020).

Figure 5: Relative Sectoral Final Energy Demand for Japan and APEC, 2018



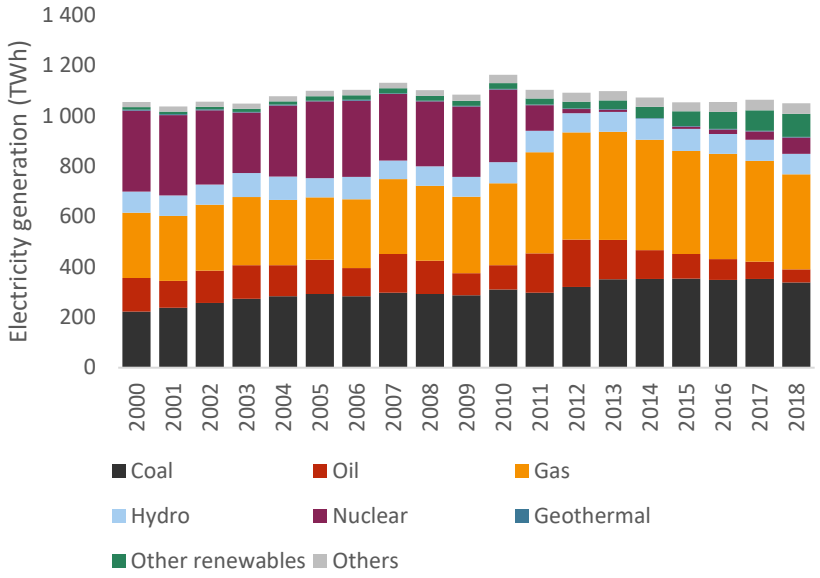
Source: EGEDA (2020)

Japan had 270 gigawatts (GW) of installed generating capacity by electricity utilities as of December 2020 (METI, 2020b) and generated 1 050 terawatt-hours (TWh) of electricity in 2018 (EGEDA, 2020). Fossil fuels – coal, gas, and oil – constituted 73% of the generated electricity (Figure 7). Renewables, including hydro, solar, wind, and geothermal, accounted for 17% of the generation. The remaining share was nuclear power, which almost doubled from 33 TWh in 2017 to 65 TWh in 2018 (EGEDA, 2020).

In 2018, the Ohi Unit 3, 4 and Genkai Unit 3, 4 nuclear power plants restarted operations (METI, 2020a). Many reactors have not been in operation since the Fukushima Daiichi nuclear power plant accident in 2011. As of May 2021, nine commercial reactors have begun operating again (METI, 2021a).

Since 1995, the Japanese electricity market has been partially liberalised to ensure fair competition and transparency. Independent power producers were introduced in 1995, and a system of power producers and suppliers (PPS) and partial retail competition (for purchases over 2 000 kW) was established in 2000. The scope of retail competition was expanded to include contracts larger than 500 kW in 2004 and larger than 50 kW in 2005 (METI, 2011). In 2016, the electricity market was fully liberalised.

Figure 6: Japan's Electricity Generation by Fuel, 2000 to 2018

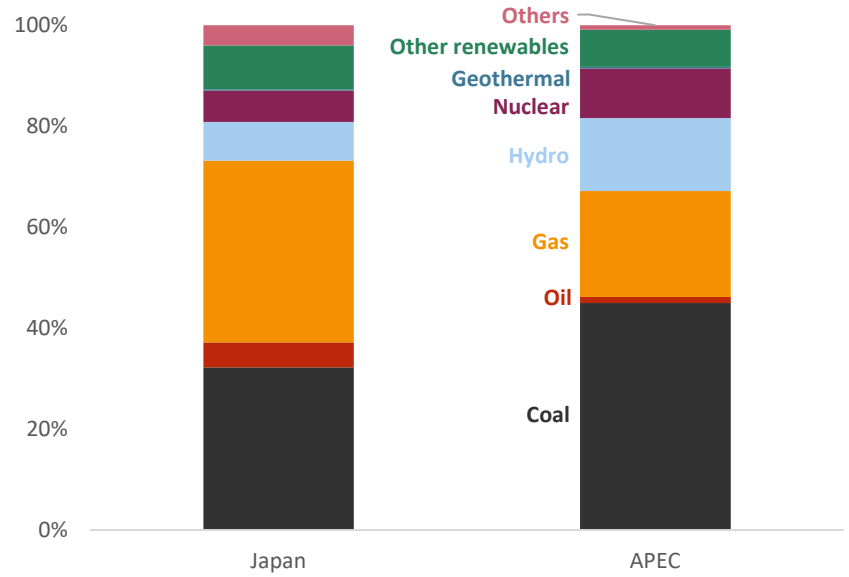


Source: EGEDA (2020)

As of January 2021, the sales share of PPS reached around 20% (METI, 2021b). After the earthquake and subsequent Fukushima Daiichi nuclear power accident, Japan's electricity sector faced

mounting pressure to deregulate even more to create a more competitive and transparent system. The Electricity Business Act was amended in 2013, 2014 and 2015 to reform the market accordingly. The amendment in 2015 included the legal unbundle of power transmission/distribution sector which began in 2020 to ensure neutrality. It also included the elimination of electricity rate regulation (METI, 2020c). However, regarding the elimination of electricity rate regulation, transitional measures are still in act to protect consumers (METI, 2021b).

Figure 7: Electricity Generation by Fuel for Japan and APEC, 2018



Source: EGEDA (2020)

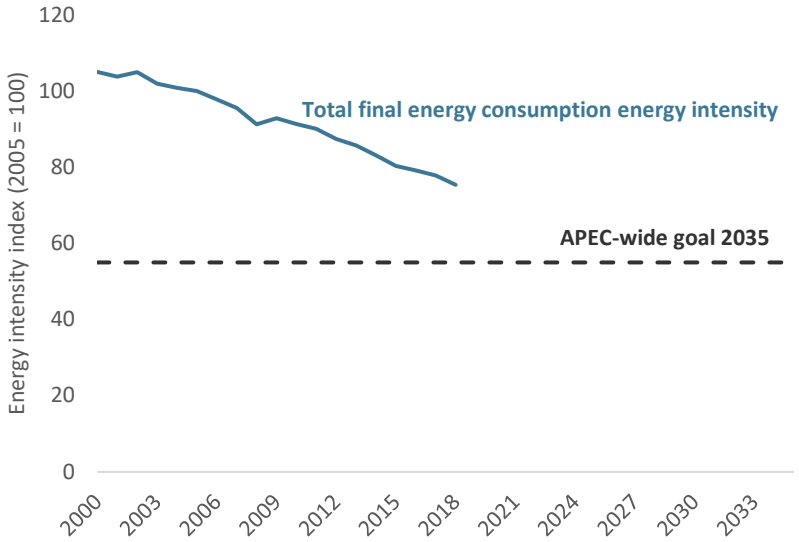
APEC goals

The APEC economies have agreed on achieving the following two goals: first, improving energy intensity (the total final energy consumption basis) by 45% by 2035 compared to 2005; second, doubling the share of renewables by 2030 compared to 2010.

Energy Intensity Analysis

Japan's energy intensity has gradually decreased in the last few decades. The total primary energy intensity continued this trend in 2018 and fell by 1.7%. The total final energy consumption (excluding non-energy) intensity also decreased by 3.1% in 2018 (EGEDA, 2020). The 1979 Energy Conservation Law, established after the oil crisis, is the basis of all energy conservation policies in Japan. It requires energy efficiency improvements for the industrial, building (commercial and residential) and transport sectors (METI, 2017). The economy achieved a 25% improvement in energy intensity from 2005 to 2018 (EGEDA, 2020) (Figure 8).

Figure 8: Japan's Total Final Energy Consumption Energy Intensity, 2000 to 2018, (2005 = 100)

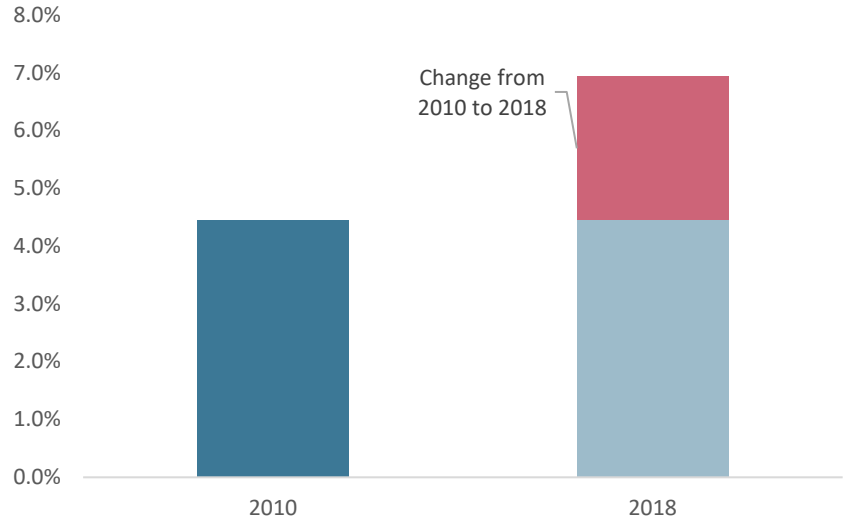


Source: EGEDA (2020)

Doubling of Renewables

In 2010, the share of modern renewables in the total final energy consumption was 4.4%. By 2018, it increased to 6.9%, which was 2.0% lower than the APEC requirement for doubling of renewables by 2030 (EGEDA, 2020) (Figure 9). The incremental growth of renewable electricity installations (following the introduction of the feed-in tariff (FIT) system in 2012) has contributed to larger shares in recent years (METI, 2020a).

Figure 9: Japan's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industries, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy policy

Energy Policy	Details	Reference
Submission of Japan's Nationally Determined Contribution (NDC)	The NDC includes a commitment to achieve a 26% reduction in GHG emissions by FY2030 compared to FY2013 (25.4% reduction compared to FY2005). In 2021, at the Leaders Summit on Climate, the Prime Minister declared a new target of 46% GHG emission reduction by FY2030 comparing to FY2013.	MOE (2020) MOFA (2021)
The Plan for Global Warming Countermeasures	Measures that businesses, citizens, the national government and local governments should implement to achieve the target of a 26% reduction in GHG emissions by FY2030.	METI (2016a)
RE100	RE100 is a global corporate leadership initiative to accelerate change towards zero-carbon grids. As of February 1, 2021, 50 Japanese companies have joined the initiative.	RE100 (2021)
KEIDANREN's initiative – publishing a voluntary action plan towards a low-carbon society	KEIDANREN's voluntary contributions to long-term global warming countermeasures on a global scale through efforts based on four pillars.	KEIDANREN (2020)
Revision of the TFCD Guidance	METI released the Task Force on Climate-related Financial Disclosures (TCFD) guidance in 2018. The guidance has since been revised by a private sector-led initiative.	METI (2020d)
Plan for Global Warming Countermeasures of the Ministry of Agriculture, Forestry and Fisheries	Various measures to reduce and absorb GHG and to adapt to climate change.	MAFF (2017)
Climate Change Adaptation Plan of the Ministry of Agriculture, Forestry and Fisheries	Leading production fields to disseminate adaptative techniques to evade and lessen influences of high temperature (caused by climate change) and introduce breeds with high-temperature tolerance.	MAFF (2015)
J-Credit Scheme	The government certifies CO_2 reduction or absorption volumes as credit. Credit creators can sell their credits, and buyers use purchased credits for various purposes such as CSR and carbon offset.	METI (2020e)

The Biomass Town Plan	Japanese local governments and private corporations have established biomass towns using agricultural residues, livestock waste, forestry residues, food waste and sewage sludge to convert to electricity, heat and ethanol etc.	MAFF (2013)
Act on the Rational Use of Energy	Securing the effective utilisation of fuel resources in accordance with economic and social conditions related to energy in and outside Japan by taking the necessary measures for the rationalisation of energy use.	MOJ (2018)
The 5th Strategic Energy Plan	The basic direction of Japan's energy policy, based on fundamental principles, namely, "safety", "energy security", "improvement of economic efficiency" and "environmental suitability".	METI (2018)
FIT Law and its revision	Creation of a new authorisation system, revised method of setting purchase prices, revision of businesses obliged to purchase renewable energy (and other regulations), and revision of the arrangement for reducing surcharges on electricity rates.	METI (2016b)
Electricity system reform	Expand Nationwide Coordination of Transmission Operators, achieve full liberalisation of electricity retail business and generation and secure neutrality of power transmission and distribution sectors.	METI (2021c)
Baseload Market	Ensure equal access to cheap power supplies for new power retail companies as part of reforms to foster competition in the market.	METI (2020f)
Establishing Resilient and Sustainable Electricity Supply Systems	Secure sustainable electricity supply systems by implementing measures including requiring electricity transmission/distribution businesses to formulate action plans on their collaboration in disaster responses, establishing a new scheme for supporting businesses in introducing renewable energy, and adding new functions to those provided by the Japan Oil, Gas and Metals National Corporation (JOGMEC).	METI (2020g)
Efforts towards 2030 by the Petroleum Association of Japan	For oil refineries, maintain and improve world-leading energy efficiency by introducing cutting-edge technologies and promoting partnerships with neighbouring refineries.	PAJ (2020)
JOGMEC's Financial Assistance to Japanese Companies	Multiple projects with equity capital and liability guarantees	JOGMEC (2017)

JBIC support	Export loans, overseas investment loans, import loans, united loans, equity participation and guarantees	JBIC (2021)
Japan-Russia Natural Gas Pipeline Project	Import pipeline from Russia into Japan	JPDO (2021)
Ishikari LNG tank expansion	Construction of a 230 000 kl LNG storage tank in 2020	HEPCO (2020)
Hitachi LNG tank expansion	Increase to 5.3 Mtpa capacity in FY2020	GIIGNL (2020)
The Ibaraki Line	Pipeline online in FY2020 to bring Hitachi LNG imports to city gas customers	TOKYO GAS Co., Ltd. (2017)
Carbon Recycling Promotion Office to be Established at ANRE	Aims to promote technological innovations involving the capture, storage and utilisation of CO_2.	METI (2019a)
local governments' initiatives about the net-zero carbon emissions by 2050	In Japan, as of May 2021, 387 local governments, including those of Tokyo, Kyoto, and Yokohama, have announced their commitment to net-zero carbon emissions by 2050.	MOE (2021)
Joint Statement on Japan–United States Strategic Energy Partnership	Both economies agreed to establish a free and competitive energy market, strengthen partnerships between private corporations and work on the integration of the energy market in this region.	METI (2020h)
Basic Plan for the Promotion of Biomass Utilisation	Promoting utilisation of biomass as energy or products to contribute to resolving the issues Japan faces, such as the revitalization of rural areas, the prevention of global warming, and the formulation of a recycling-oriented society.	MAFF (2016)

Compilation of the Revised Version of the Strategic Roadmap for Hydrogen and Fuel Cells	Released a revised version of the Strategic Roadmap for Hydrogen and Fuel Cells, including new goals and specific explanations of efforts to be made.	METI (2016c)
LNG Producer-Consumer Conference 2020	Since 2012, the LNG Producer-Consumer Conference has been held every year in Japan by METI as a platform for exchanging ideas and enhancing cooperation among producers, consumers and all the key stakeholders of the LNG Market.	METI (2020i)
Global Action Agenda announced at the second Hydrogen Energy Ministerial Meeting	Released a chair's summary with action guidelines regarding hydrogen and fuel cells that member economies should adopt.	METI (2019b)

Notable developments

Energy development	Details	Reference
Declaration of Carbon Neutrality by 2050	Aims to realise a carbon-neutral, decarbonised society by 2050	METI (2020j)
Tokyo "Beyond-Zero" Week	Features six international conferences organised and hosted by Japan in 2020	METI (2020k)
Environment Innovation Strategy	Formulated to create innovations in the fields of energy and environment, where Japan has a strength, to realize a feasible level of cost for adoption of such technologies in the society and to apply them globally.	Prime Minister of Japan and His Cabinet (2020)
Revision of Major Laws for Rebuilding Electricity Supply Systems	The Bill for the Act of Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems was passed by the Diet.	METI (2020l)

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Institute of Energy Economics, Japan

https://eneken.ieej.or.jp/

Ministry of Economy, Trade and Industry

https://www.meti.go.jp/english/index.html

Ministry of the Environment

http://www.env.go.jp/en/index.html

Republic of Korea

Introduction

The Republic of Korea (Korea) is in Northeast Asia, situated between China and Japan. It has an area of 100 284 square kilometres (km2) and a population of 51.6 million as of 2018. Korea's population density is very high, with an average of more than 526 people per km2. Approximately 20% of the population lives in Seoul, Korea's largest city and capital. The economy's geography consists of hills and mountains with wide coastal plains in the west and the south. The climate is relatively moderate, with four distinct seasons. Air conditioning is necessary during the tropical hot summers, and heating is required during the bitterly cold winters.

Over the past few decades, Korea has become one of Asia's fastest growing and most dynamic economies. Gross domestic product (GDP) reached USD 2 162 billion (2017 USD purchasing power parity [PPP]) in 2018. GDP per capita (2017 USD PPP) in 2018 was USD 41 894, approximately three times higher than in 1990.

Korea's major industries include semiconductors, shipbuilding, cars, petrochemicals, digital electronics, steel, and machinery parts and materials. Economic activity is driven by an export-oriented manufacturing sector. Manufacturing accounted for about 27% of GDP in 2018, but the share of the manufacturing industry is expected to decrease slightly in the future as the service industry grows faster.

Korea has few domestic energy resources. It has no oil resources except for a small amount of condensate, only 309 million tonnes of recoverable coal reserves and 256 petajoules (PJ) of natural gas. To sustain its high level of economic growth, Korea imports large quantities of energy products.

Table 1: Macroeconomic Data and Energy Reserves

Key Data [a, b]		Energy Reserves [c, d]	
Area (km^2)	100 284	Oil (million barrels)	–
Population (million)	52	Gas (petajoules)	256
GDP (2017 USD billion PPP)	2 162	Coal (million tonnes)	309
GDP (2017 USD PPP per capita)	41 894	Uranium	–

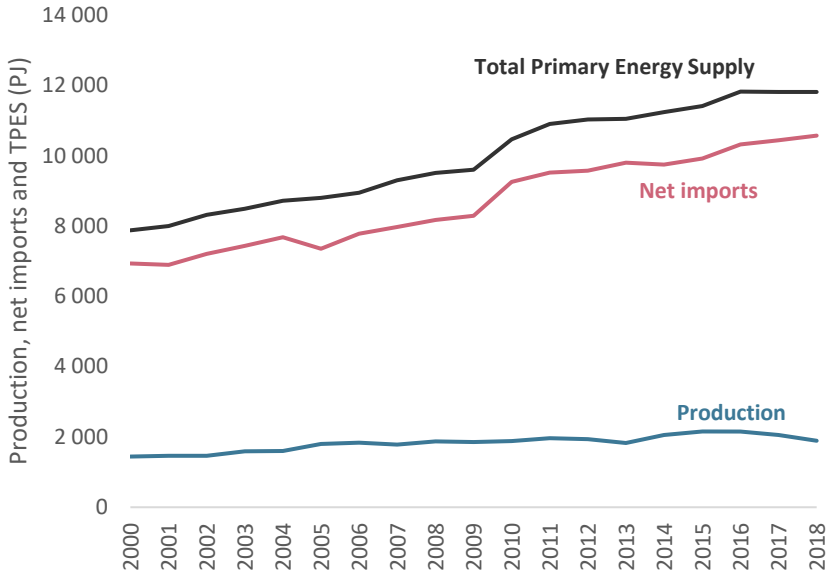
Source: [a] UN (2019); [b] EGEDA (2020); [c] EIA (2020); [d] KOSIS (2019)

Energy Supply and Consumption

Total Primary Energy Supply

Korea's total primary energy supply (TPES) more than tripled between 1990 and 2018, from 3 890 PJ to 11 818 PJ. From 1990 to 2000, energy supply increased at an average annual growth rate of 7.3%, exceeding the economic growth rate of 7.1% for the same period. After 2000, TPES increased by 50%, from 7 878 PJ to 11 818 PJ. In the recent three-year trend from 2016 to 2018, the increase was minimal as the rate of increase levelled off (Figure 1); Korea's TPES was almost unchanged in 2018 compared to 2016 (EGEDA, 2020).

Figure 1: Korea's Total Primary Energy Supply, 2000 to 2018 (PJ)

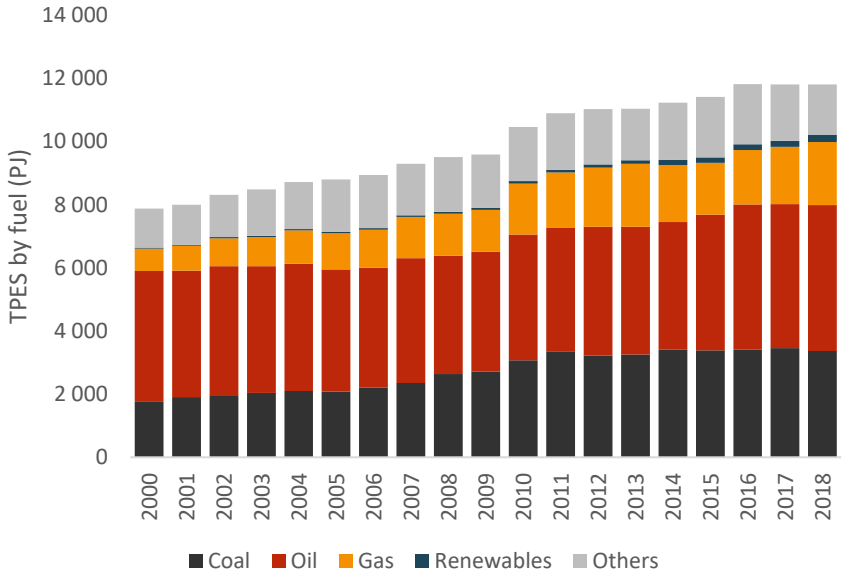


Source: EGEDA (2020)

Since Korea has limited domestic energy resources, a significant portion of Korea's TPES is imported. Korea imported approximately 89% of its TPES in 2018. In the same year, it was the world's fourth largest importer of crude oil, the fifth-largest importer of natural gas and the fourth-largest importer of coal (IEA, 2020).

Korea's TPES fuel mix has focused on a stable energy supply with expansion of renewable energy from 2000 to 2018, though it has not undergone a drastic change in terms of the fuel share (Figure 2). Coal's relative share increased from 22% to 29% for the period, while oil's share decreased from 53% to 39%. Natural gas expanded from 9% in 2000 to 17% in 2018. Renewables showed the fastest growth, having gradually increased by a small relative amount from 0.4% to 1.9% for the same period (EGEDA, 2020).

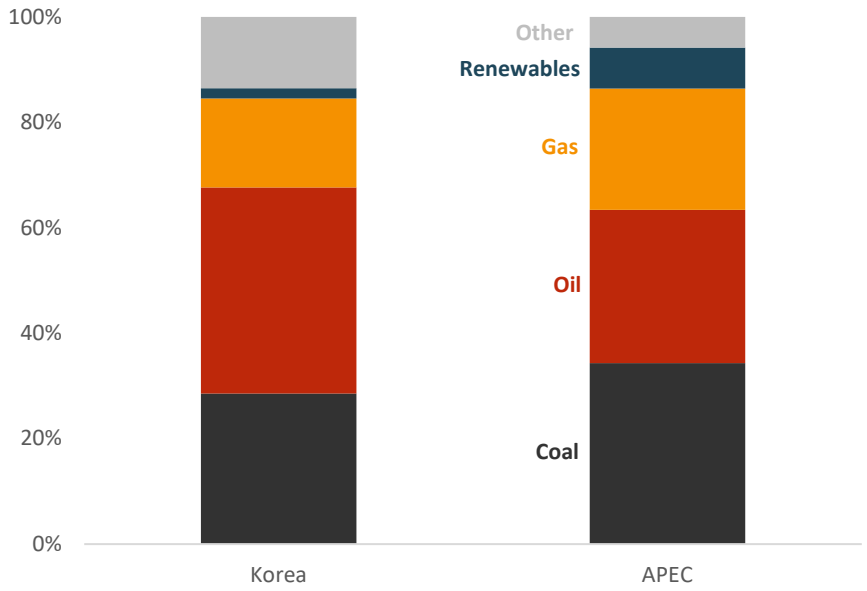
Figure 2: Korea's Total Primary Energy Supply by Fuel, 2000 to 2018 (PJ)



Source: EGEDA (2020)

As of 2018, Korea's TPES fuel mix had some differences in the share of energy sources compared to that of the entire APEC region (Figure 3). Oil supply was proportionally higher, whereas the other categories were relatively lower. Korea's oil share of TPES was 39%. Meanwhile, the portion of renewables in APEC was four times that of Korea. The share of renewable energy supply in APEC is 8%, whereas the share of renewables in Korea is 2%.

Figure 3: Total Primary Energy Supply Proportional Share, Korea and APEC, 2018

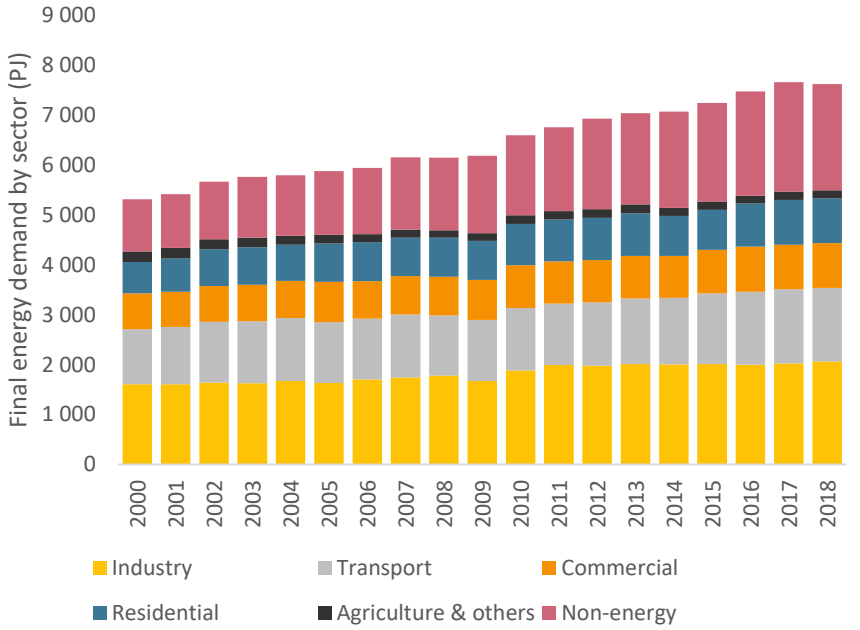


Source: EGEDA (2020)

Total Final Consumption

Total final consumption is a representation of end-use energy, including non-energy uses of energy products. Korea's total final consumption (including non-energy) in 2018 was 7 629 PJ, which was a 0.5% decrease from the previous year. The non-energy and industrial sectors, respectively, accounted for the largest shares at 28% and 27%, while the transport sector accounted for 19%. The remainder (26%) was associated with the other sectors (combined commercial, residential and agriculture sectors). In general, consumption in the agriculture sector has weakened since the late 1990s, and consumption in the industry, transport and commercial sectors has gradually increased.

Figure 4: Korea's Final Energy Demand by Sector, 2000 to 2018 (PJ)

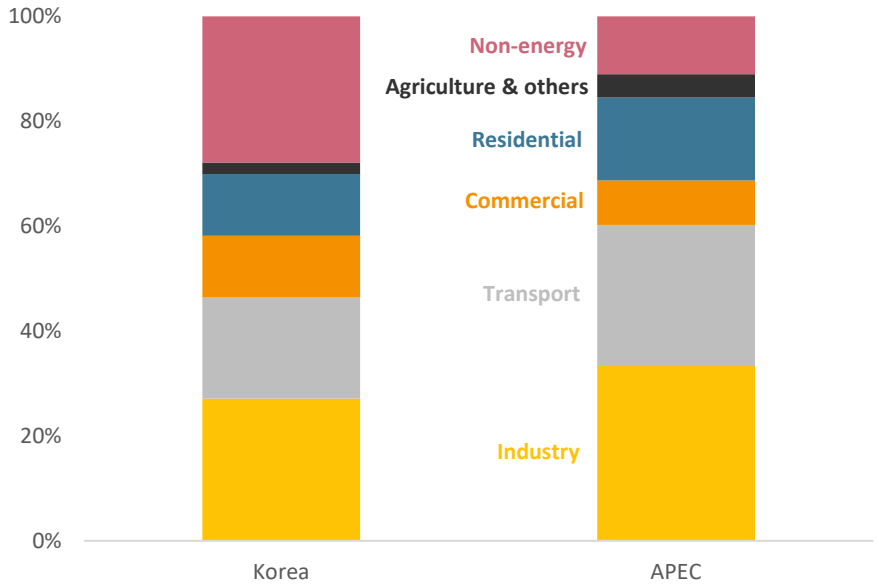


Source: EGEDA (2020)

Relative to APEC, Korea's industry and transport sectors constitute a lower portion of final consumption, whereas the non-energy sector accounts for comparatively more use (Figure 5). APEC's final consumption share in the industry and transport sectors was 33% and 27% respectively in 2018, whereas Korea's respective consumption accounted for 27% and 19% in the same year. Non-energy generally refers to energy products that are used as raw materials and not consumed as fuel or transformed. These are generally oil products

used in the chemical and petrochemical subsector to make plastics or lubricants.

Figure 5: Relative Sectoral Share of Final Consumption for Korea and APEC, 2018



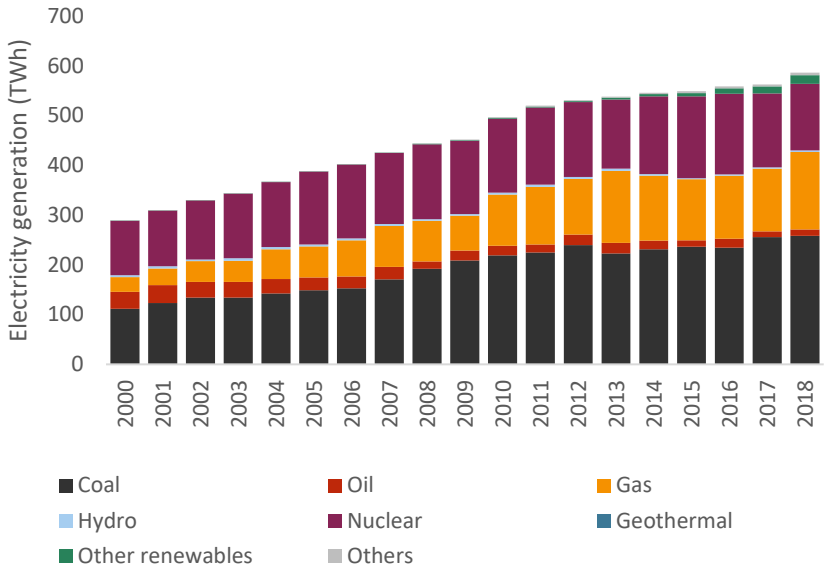
Source: EGEDA (2020)

Transformation

Energy use in Korea's transformation sectors has grown rapidly since 2000, driven by a steady expansion of refinery and electricity generation capacities. Korea's economic growth has led to a substantial increase in its electricity consumption over the past few decades. Between 2000 and 2018, total power generation increased two-fold, from 289 terawatt-hours (TWh) in 2000 to 586 TWh in 2018 (Figure 5). In 2011, a power outage gave rise to electricity supply restrictions in select areas. For these reasons, securing a stable supply of electricity has been one of Korea's top energy policy priorities.

Looking into each generation fuel, 44% of Korea's electricity was generated by coal in 2018, marking a 5% increase from 39% in 2000. Gas and renewables also expanded their shares in the generation mix between 2000 and 2018, whereas the portion of oil reduced for the same period. With the rise of carbon neutrality ambitions, the share of coal power generation is expected to considerably decrease in the future.

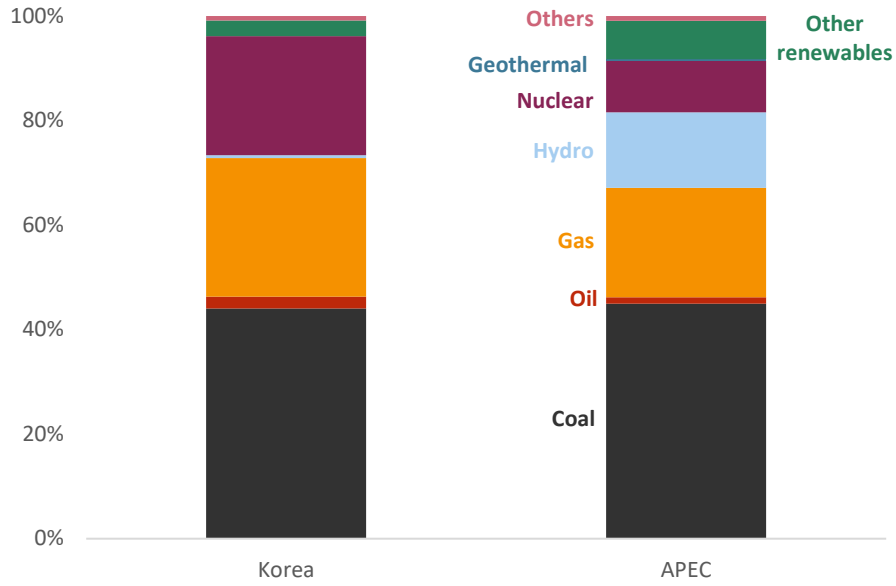
Figure 6: Korea's Electricity Generation by Fuel, 2000 to 2018 (TWh)



Source: EGEDA (2020)

In Korea's electricity generation mix, coal and oil had similar proportions when compared to the generation mix for APEC in 2018 (Figure 7). Meanwhile, other power generation fuels showed some difference in comparison between the two sides. The proportion of gas in Korea's power sector was relatively higher than that of APEC's. The Korean share of nuclear was 23%, more than double that of APEC's at 10%. In contrast to gas and nuclear, the share of renewables was higher for APEC than Korea. Particularly, the proportion of hydro, accounting for 1% in Korea and 14% in APEC.

Figure 7: Proportional Electricity Generation by Fuel for Korea and APEC, 2018



Source: EGEDA (2020)

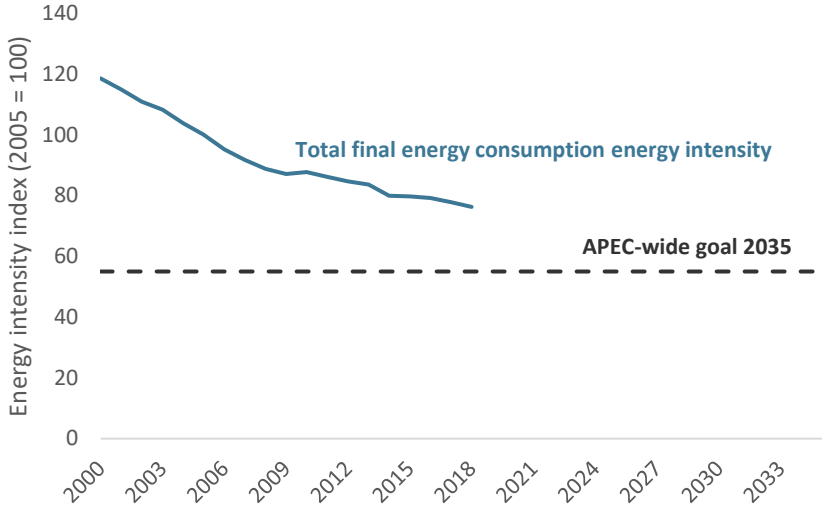
APEC Goals

APEC has two aspirational goals to achieve sustainable and resilient energy development within the Asia-Pacific region. These goals are to improve energy intensity by 45%, relative to 2005, by 2035 as well as double the share of renewanles in the overall energy mix by 2030, relative to 2010.

Energy Intensity Analysis

The APEC goal of improving energy intensity by 45% does not involve individual economy targets. However, member economy efforts are contributing to the overarching improvement for the APEC region (Figure 8).

Figure 8: Korea's Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



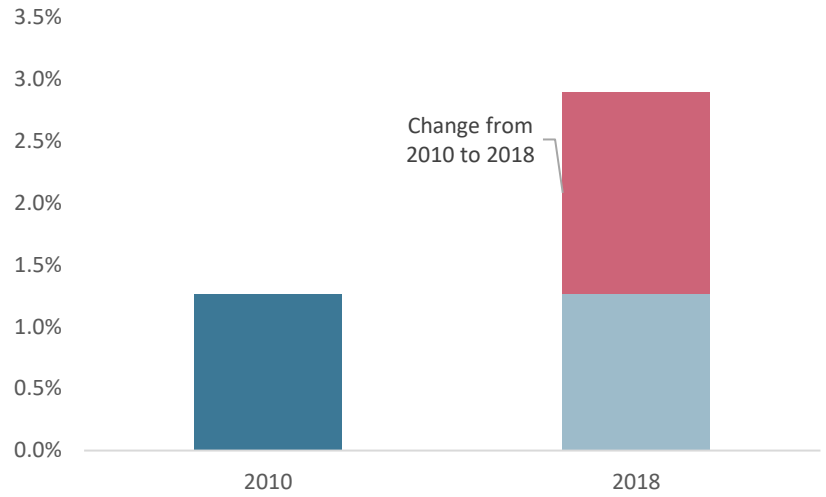
Source: EGEDA (2020)

Since 2005, Korea's total final energy consumption (not including non-energy) intensity has continued to improve. In 2018, this improvement was 24% relative to the 2005 baseline.

Doubling of Renewables

Doubling the renewable energy share is another important aim in the APEC region. This goal refers to the share of modern renewables, which doesn't include traditional biomass, doubling by 2030, relative to 2010. This goal is expected to gain momentum with NDCs in the Paris Agreement for achieving emissions reductions.

Figure 9: Korea's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Korea has continuously promoted policies to expand renewanle energy in response to climate change and for sustainable growth. In 2017, the Korean government released the 2030 Renewable Energy Initiative Implementation Plan. According to the plan, renewable's share of the energy mix will increase from its level of 7% in 2016 to 20% in 2030 through the provision of 49 GW in new generating capacity. In 2019, the government announced the 3rd National Energy Master Plan, and it is expected that the share of renewables in the power generation mix will increase to 30–35% by 2040.

Energy Policy

Energy Policy	Details	Reference
Framework Act on Low Carbon, Green Growth	This promotes the development of the economy by laying the foundation necessary for low carbon, green growth and by utilising green technology and green industries as new growth engines.	NATIONAL LAW INFORMATION CENTER
3rd Energy Master Plan	The plan was announced in June 2019 to provide a mid- to long-term (2019–2040) framework for coordinating energy policies throughout the economy, identifying several problem areas affecting Korea's energy system.	MOTIE (2019)
3020 Renewable Energy Initiative Implementation Plan	MOTIE released in December 2017 this plan in which RE's share of the energy mix would be increased from its 7% rate in 2016 to 20% in 2030 through the provision of 49 GW in new generating capacity.	MOTIE (2017)
Renewable Energy Competitive Incentive Program	This program was designed in April 2019 to prepare an industrial strategy for the domestic RE industry to make a new leap forward by taking the opportunity to change the energy paradigm.	MOTIE (2019)
2019 Long-term Energy Outlook	This outlook contains analysis of domestic and international energy demand and supply trends using KEEI's Energy Greenhouse-gas Modelling System and Korea's energy outlook until 2040.	KEEI (2019)
5th Basic Plan on New and Renewable Energy	MOTIE released a mid-to long-term plan with key strategies to accelerate the deployment of renewable energy between 2020 and 2034 with the detailed targets such as a target for increasing installed renewable energy to 106GW (or 31% of total power generation) by 2034.	MOTIE (2020)
9th Basic Plan on Electricity Demand and Supply	The plan for 2017–2031 was released in December 2020 to provide mid- to long-term power demand forecast and expansion of power facilities, reflecting on the increased demand for additional reductions in coal power generation due to the fine dust and greenhouse gases.	MOTIE (2020)
Hydrogen Economy Roadmap	The government announced this roadmap which aims to create an ecosystem for the hydrogen industry including energy production, storage, transportation, safety and harnessing its use such as mobility.	MOTIE (2019)
Resources Development Plan	MOTIE released in May 2020 this plan to increase the government's investment in private-sector companies' resource exploration projects and proposed a new policy goal covering resources security.	MOTIE (2020)

5th Comprehensive Plan for National Environment	ME announced this plan in December 2019 to provide directions for the environmental plans of each sector, including policies for overcoming climate and environmental crises and establishing a low-carbon safe society.	ME (2019)
3rd Five-Year Plan for Green Growth	The government established in May 2019 to realise the vision of a green inclusiveness which includes responsible greenhouse gas reduction and sustainable energy conversion.	OFFICE FOR GOVERNMENT POLICY COORDINATION (2019)
Energy efficiency innovation Strategy	This strategy aims to achieve the target demand (175.3 million TOE) in line with the 3rd Energy Master Plan by reducing 29.6 million TOE of final energy consumption in 2030 compared to the baseline demand (204.9 million TOE).	MOTIE (2019)
Enforcement Decree of the Electric Utility Act	This enforcement decree aims to diversify energy sources through the promotion of technology development, use and distribution of new and renewable energy and to convert energy systems into an environment-friendly structure through reducing greenhouse gas emissions.	NATIONAL LAW INFORMATION CENTER
Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy	This Act promotes the development of the economy by laying the foundation necessary for low carbon, green growth and by utilising green technology and green industries as new growth engines.	NATIONAL LAW INFORMATION CENTER
5th Basic Plan on Integrated Energy Supply	The plan was announced in February 2020 to provide a mid- to long-term (2019–2023) framework for planning to expand combined heat and power plant (CHP) by 2023, targeting a total of 4.84 million units, an increase of about 31% from 2018.	MOTIE (2020)
13th Plan for Long-term Natural Gas Demand and Supply	MOTIE released in April 2018 this plan to maintain a stable gas demand and supply and support the energy transition policy by including a long-term natural gas demand forecast from 2018 to 2031.	MOTIE (2018)

Notable Developments

Energy development	Details	Reference
Support for RE 100	MOTIE announced in January 2021 that it will allow domestic electricity consumers to purchase electricity from renewable sources as part of the RE100 initiative, a global campaign for transition to 100% RE.	MOTIE (2021)
2050 Carbon Neutral Strategy	This strategy suggests key elements and goals for Korea to achieve a Net-Zero society by 2050. The Korean government submitted the strategy to UNFCCC in December 2020.	UNFCCC (2020)
Korean New Deal Plan	As the COVID-19 pandemic has brought about changes with accelerating a move to a digital and eco-friendly economy, this plan was established in July 2020 to expand investment in a digital and green society.	MOEF (2020)
Act on the Promotion of Hydrogen Economy and the Safety Management of Hydrogen	This was enacted with the aim of contributing to promoting the implementation of the hydrogen economy, fostering the system of the hydrogen industry and establishing matters related to the safety management of hydrogen. It has been implemented since February 2021.	NATIONAL LAW INFORMATION CENTER

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UNFCCC (United Nations Framework Convention on Climate Change) (2020), *2050 Carbon Neutral Strategy of the Republic of Korea,* https://unfccc.int/documents/267683

Useful Links

Korea Electric Power Corporation – https://home.kepco.co.kr/kepco/main.do

Korea Energy Economics Institute – http://www.keei.re.kr/main.nsf/index.html

Korea Energy Agency – http://www.energy.or.kr/web/kem_home_new/new_main.asp

Korea Gas Corporation – https://www.kogas.or.kr:9450/portal/index.do

Korea National Oil Corporation – https://www.knoc.co.kr/

Ministry of Trade, Industry and Energy – http://english.motie.go.kr/www/main.do

Ministry of Strategy and Finance – https://english.moef.go.kr/

Ministry of Environment – http://eng.me.go.kr/eng/web/main.do

Statistics Korea – http://kostat.go.kr/portal/eng/index.action

Malaysia

Introduction

Malaysia covers an area of 330 535 square kilometres (km2) and lies entirely in the equatorial zone. It comprises 13 states and three federal territories (MEA, 2020). In 2018, Malaysia's population stood at 31.5 million, an increase of 1.7% from 2017 (EGEDA, 2020).

Malaysia's gross domestic product (GDP) reached USD 868.2 billion (2017 USD purchasing power parity [PPP]) in 2018, an increase of 4.9% from 2017. GDP per capita increased by 3.1% to USD 27 537 in 2018 (EGEDA, 2020). The largest contributors to Malaysia's GDP in 2018 were services (57.4%), manufacturing (22.6%), mining and quarrying (7.7%), agriculture (7.4%) and construction (4.9%). The main export products were manufactured goods (86.4%), mining (9.3%) and agriculture (9.3%) (MEA, 2020).

Malaysia's energy resources are modest compared to other APEC economies. East Malaysian states hold nearly two-thirds of Malaysia's energy reserves according to Malaysia's National Energy Balance (NEB). Peninsular Malaysia holds the remainder. The economy's oil reserves (including condensate) are 4.55 billion barrels, with 41.4% located in Sabah (EC, 2020a). There is an estimated 6.4 trillion cubic metres (tcm) or 79.5 trillion cubic feet (Tcf) of natural gas reserves with more than half located in the Sarawak Basin. Coal reserves are mostly located in Sarawak and Sabah and are estimated at 1.9 billion tonnes (EC, 2020a).

Malaysia harbours a wealth of resources capable of generating renewable energy. The Malaysian Government is working to transform the energy mix to one that comprises more renewables, not only to ensure the continuity of supply but also to address the pressing environmental concerns that emerge with a dependency on fossil fuels. Studies reveal that the current energy system can already accept solar photovoltaic (PV), and the Malaysian Government has a target of 31% renewables by 2025. Effective storage systems are necessary for increased penetration and to mitigate intermittency (EC, 2019a).

Malaysia is exploring small hydro technology, but hydro sites are long distances away from the demand centres. Financial solutions are required to connect these resources to the grid system. The potential of biomass and biogas is also promising, but again, remote locations present a similar challenge. Empty fruit bunches (essentially palm oil plantation waste) offer increased supply and great value (EC, 2019a).

Table 1: Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	0.3	Oil (billion barrels)	4.55
Population (million)	31.5	Gas (tcm)	6.4
GDP (2017 USD billion PPP)	868	Coal (million tonnes)	1 938
GDP per capita (2017 USD PPP)	27 537	Uranium (kilotonnes U_3O_8)	-

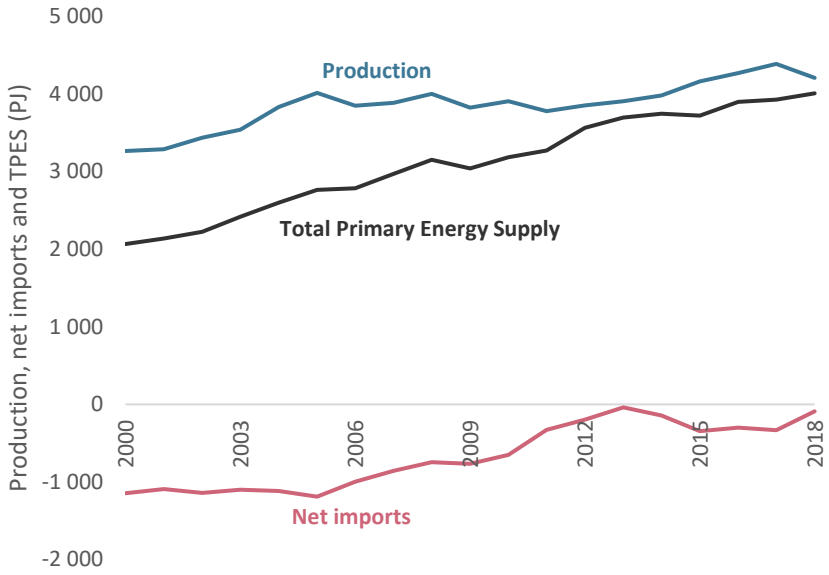
Source: World Bank (2020), GA (2020), OECD (2020)

Energy Supply and Consumption

Total Primary Energy Supply

The total primary energy supply (TPES) of Malaysia was 4.1% lower in 2018, reaching 4 007 PJ (EGEDA, 2020). Energy production decreased by 4.2% in 2018 to 4 205 PJ. Net exports reached 90 PJ in 2018, which continues a long-term trend of more imports, relative to exports (Figure 1).

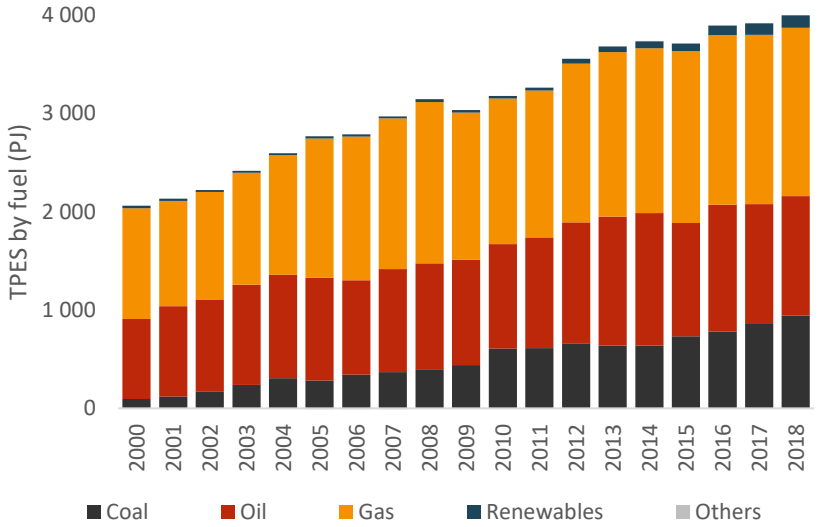
Figure 1: Malaysia TPES, 2000 to 2018



Source: EGEDA (2020)

Malaysia's oil supply was 30.4% of TPES in 2018 (1 218 TJ). The share of natural gas was 42.8% (1 717 TJ) and coal was 23.6% (946 PJ). Renewable energy increased by 3.3% in 2018, reaching 132 PJ. The rapid growth in the last decade was partly due to the feed-in tariff for renewable energy, which is part of the National Renewable Energy Policy and Action Plan (NREPAP) introduced by the government in 2009.

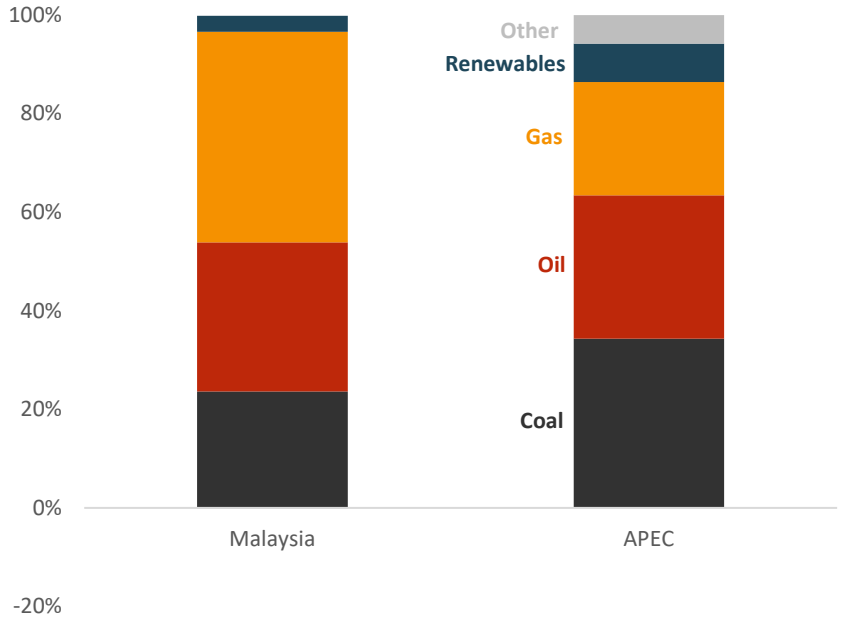
Figure 2: Malaysia TPES by Fuel, 2000 to 2018



Source: EGEDA (2020)

Malaysia's fuel mix is different to the APEC region as a whole, with a higher share of gas, and lower share of renewables and coal (Figure 3).

Figure 3: TPES – Relative Fuel Share, Malaysia and APEC, 2018

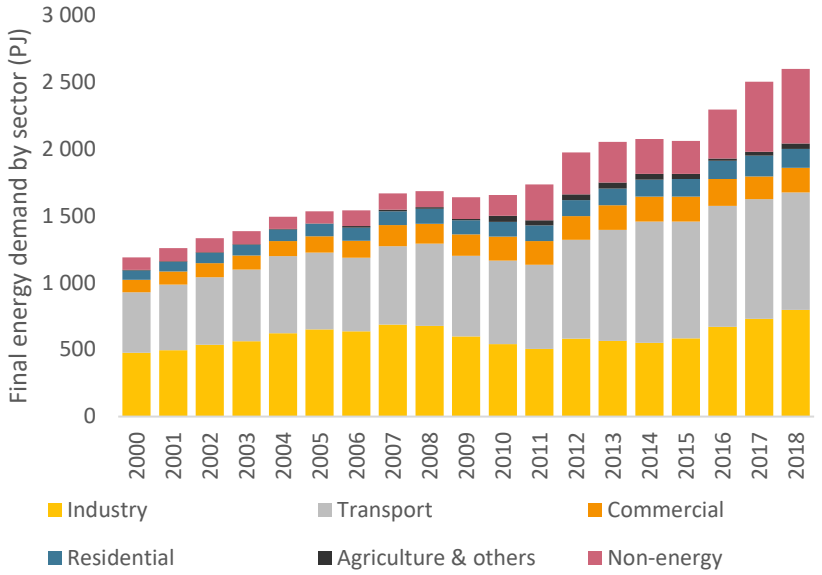


Source: EGEDA (2020)

Total Final Consumption

Total final consumption is a representation of end-use energy, including the non-energy consumption of energy products. Natural gas used as feedstock in chemical production is an example of non-energy use of natural gas. Total final consumption reached 2 601 PJ in 2018. The transport sector was the largest energy consumer, constituting 33.9% of the total final consumption (881 PJ). Industry followed with a 30.6% share (797 PJ), the non-energy sector with a 21.3% share (555 PJ), and other sectors (residential, commercial and agriculture sectors) had a combined share of 14.1% (368 PJ) (EGEDA, 2020).

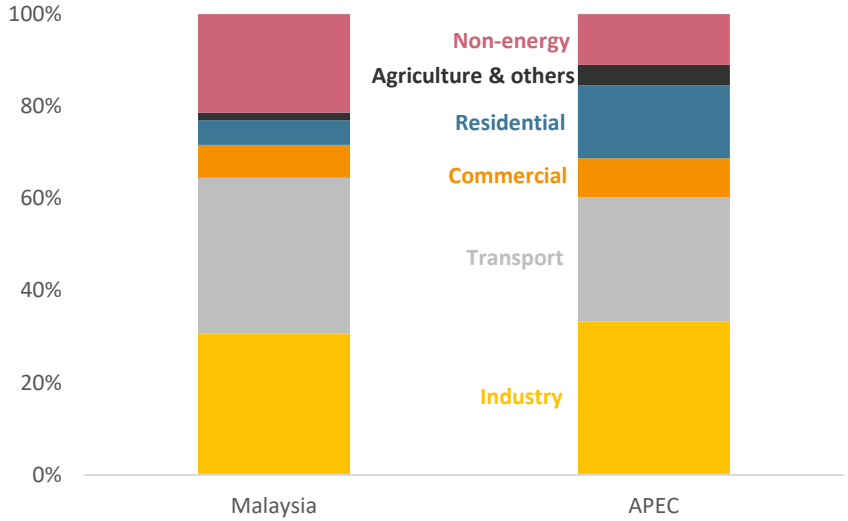
Figure 4: Malaysia's Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Similar to other APEC member economies, the transport and industrial end-use sectors consumed the largest portion of Malaysia's final energy use. Non-energy use was significantly larger in Malaysia when compared to the entire APEC region (Figure 5).

Figure 5: Proportional Final Energy Demand for Malaysia and APEC, 2018

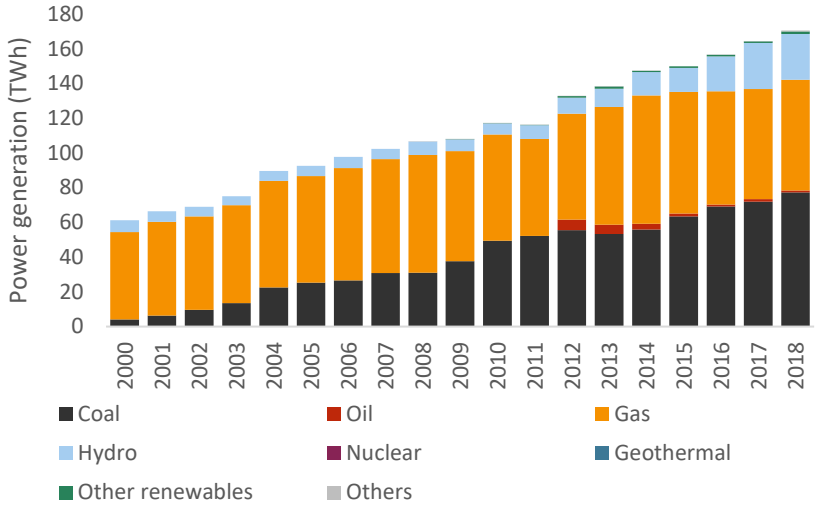


Source: EGEDA (2020)

Transformation

Coal and gas dominate Malaysia electricity generation. In 2018, the share of coal and gas reached 45.3%, and 37.5%, respectively. Hydropower generation fell in 2018 to account for 15.4% of electricity generation (Figure 6).

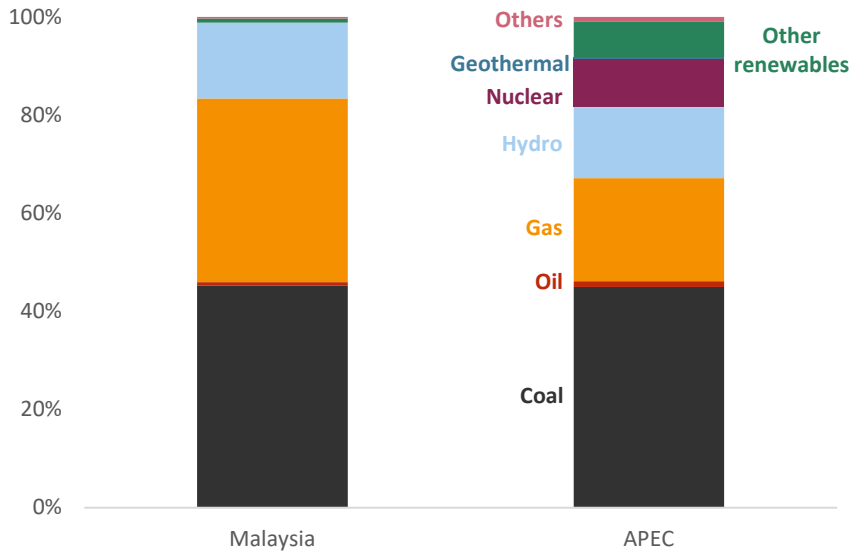
Figure 6: Malaysia Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

The share of coal and hydro in Malaysia's electricity generation mix was similar to the APEC region as a whole in 2018. Gas accounted for a much higher proportion of electricity generation in Malaysia when compared to APEC. There were minimal other sources of electricity generation in Malaysia in 2018.

Figure 7: Relative Electricity Generation by Fuel for Malaysia and APEC, 2018



Source: EGEDA (2020)

APEC Goals

The APEC member economies have agreed to meet two energy-related objectives. These are related to improving energy intensity and increasing the share of renewables in the energy mix.

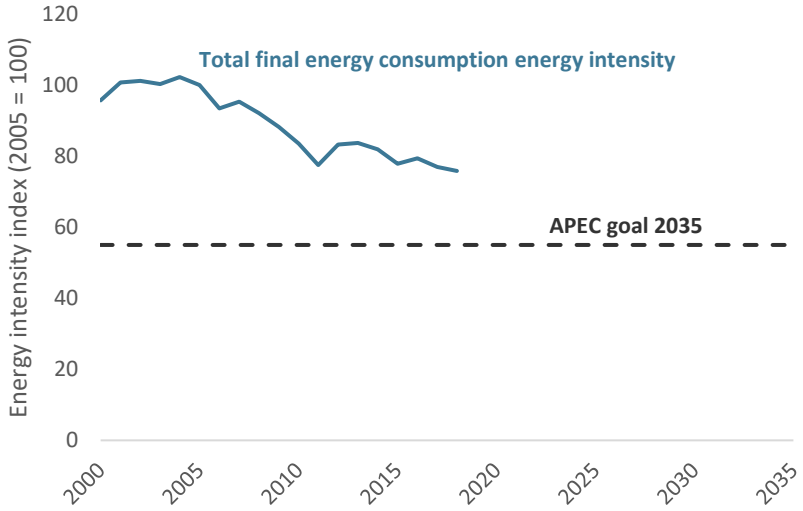
Energy Intensity Goal

In 2011, the APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

APEC is on track to meet this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Malaysia's total final energy consumption (not including non-energy) energy intensity has improved by 22%, relative to 2005. To contribute in a proportional sense, Malaysia will need to improve its energy intensity by an additional 22% over the next 17 years from 2018 to 2035 (Figure 8)

Figure 8: Total Final Energy Consumption Energy Intensity Index, 2000 to 2018 (2005 = 100)



Source: EGEDA (2020)

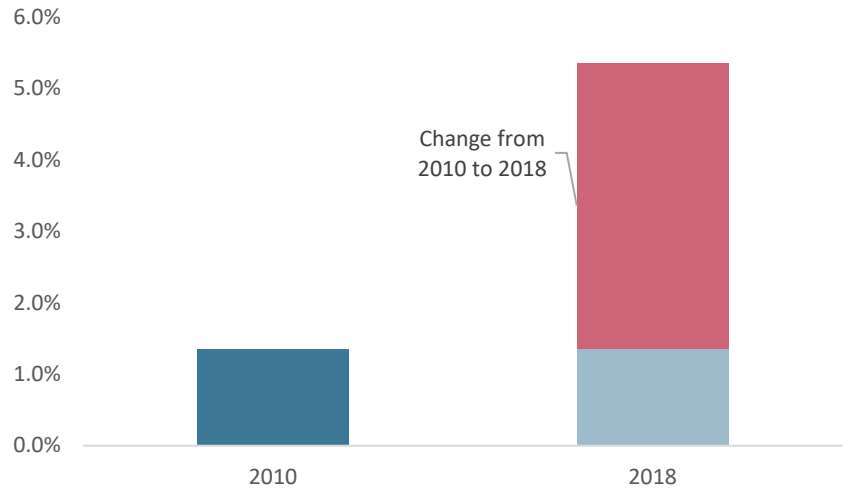
Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption.

Individual member economies do not have economy-level goals, but it is possible to calculate the relative improvement of individual economies to get a better sense of whether the APEC-wide goal will be achieved.

Since the introduction of the NREPAP in 2010, Malaysia's consumption of modern renewables has been increasing every year. Malaysia's share of modern renewables to final energy consumption in 2010 was 1.4%. In 2018, this proportion tripled to 5.4%. Malaysia has been overachieving in its efforts to contribute to the APEC-wide doubling goal (Figure 9).

Figure 9: Malaysia's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Malaysia recognises the importance of energy in achieving sustainable development. Energy policies have been developed following the evaluation of Malaysia's current and future energy needs. Malaysia's energy policies can be traced back to as early as the 1970s. The major energy policies implemented in the economy are as follows:

Energy Policy	Details	Reference
Petroleum Development Act 1974	It has vested in PETRONAS "the entire ownership in, and the exclusive rights, powers, liberties and privileges of exploring, exploiting, winning and obtaining petroleum whether onshore or offshore of Malaysia".	Petronas
National Biofuel Policy, 2006	Advocates the utilisation of environment-friendly and sustainable energy sources to reduce dependency on fossil fuels and help stabilise the palm oil (CPO) industry. Covers transportation, industries, technology and exports.	Ministry of Plantation Industries and Commodities
National Green Technology Policy (NGTP) 2010	The NGTP focuses on four pillars, namely energy, environment, economy and social. The NGTP has identified green technology as a key driver for accelerating the economy and promoting sustainable development.	Perbadanan Putrajaya
Malaysia 3rd National Communication & 2nd Biennial Update Report to UNFCCC	The Biofuel Initiative will help reduce diesel dependence and emissions by blending petroleum diesel with biofuels. Ambitious scenario: further upgrades biodiesel to B10 by 2020.	Ministry of Sains, Teknologi & Inovasi
The 12th Malaysia Plan 2021–2025 (12MP)	The 12MP encompasses three dimensions: economic empowerment, environmental sustainability and social re-engineering.	Economic Planning Unit, Prime Minister's Department
Green Technology Financing Scheme	Provides financial support for green technology in the energy, building, manufacturing, transport, waste management and water sectors.	Green Tech Malaysia
National Policy on Climate Change	Recommends the application of the low- or zero-emissions concept in the design and construction of new buildings and the retrofitting of efficient ventilation and cooling systems and lighting systems.	Ministry of Sains, Teknologi & Inovasi
Minimum Energy Performance Standard (MEPS)	MEPS regulations for five types of domestic electrical appliances have been in force since May 2013. Refrigerators, air-conditioners, televisions and domestic fans must meet the minimum two-star requirement to be available in the Malaysian market.	Suruhanjaya Tenaga

Third Industrial Master Plan (IMP3)	Manufacturing should grow at 5.6% annually and contribute 28.5% to the GDP in 2020; the total investments should be of RM 412.2 billion (RM 27.5 billion annually). Non-government services: to grow at 7.5% annually and contribute 59.7% to GDP in 2020, and total investments of RM 687.7 billion (RM 45.8 billion annually).	Ministry of International Trade and Industry
Efficient Management of Electrical Energy Regulations 2008	The energy consumption of large electric energy consumers (3 000 MWh or greater within six consecutive months) needs to be disclosed, and a registered electrical energy manager should conduct the audit.	Suruhanjaya Tenaga
Refinery And Petrochemical Integrated Development (RAPID)	The refinery has a capacity of 300 000 bpd, and the Steam Cracker will have a combined annual production capacity of more than 3mtpa of ethylene, propylene and C4–C6 olefins products.	Petronas
Malaysia Biofuel Industry Act 2007	Regulate the usage and production of biodiesel (including licensing, guidelines and standards)	Ministry of Plantation Industries and Commodities
National Renewable Energy Policy	Implementation of Enhanced Net Energy Metering (NEM) and solar leasing, the Large-Scale Solar Program 3 (LSS3) and Non-Solar RE Projects.	SEDA
Renewable Energy Act 2011	Establishment and implementation of a special tariff system to catalyse the generation of renewable energy.	SEDA
Initiative MESTECC 2020	Empowering the Malaysia Electricity Supply Industry (MESI) and ensuring the sustainability of the Sabah Electricity Supply Industry (SESI). By 2025, 20% renewable energy should be available. There should be 8% savings on energy efficiency (EE) by 2025.	Ministry of Sains, Teknologi & Inovasi
PETRONAS Carbon Commitments	Improve efficiency in cogeneration plants and invest in CCUS-related technologies. Minimise flaring wherever economically feasible and reduce methane emissions in operations	Petronas
Green Technology Master Plan (GTMP) 2017–2030	The GTMP creates a framework that facilitates the mainstreaming of green technology into the planned developments of Malaysia while encompassing the four pillars set in the NGTP, i.e., energy, environment, economy and social.	Ministry of Science, Technology and Innovation
National Biodiesel Program	The B5 program started in 2011 and was fully implemented in 2014. The B7 program was implemented in the transport sector in 2014. The B10 program was initiated in 2018 and was fully implemented in February 2019. The B7 program for the industrial sector was implemented in July 2019.	Ministry of Plantation Industries and Commodities

Malaysia Intended Nationally Determined Contributions to UNFCCC	Reducing the proportion of GHG emissions to GDP by 45% by 2030 relative to 2005. This consists of a 35% reduction on an unconditional basis and a further 10% that is conditional on the receipt of climate finance, technology transfer and capacity building from developed economies.	United Nations Climate Change
National Policy on the Environment	Encouraging energy conservation and the use of energy-efficient technology and processes through appropriate pricing mechanisms, the setting of efficiency standards, promoting technology transfer and providing consumer information. The use of cleaner fossil fuels and alternatives to fossil fuels shall be encouraged.	Department of Environment
Malaysia's Roadmap Towards Zero Single-Use Plastics	Aims to eliminate single-use plastics for a cleaner and healthier environment in Malaysia by 2030	Ministry of Science, Technology and Innovation
National Energy Efficiency Action Plan	Star energy rating of appliances and mandatory labelling and promotion of five-star appliances.	Ministry of Science, Technology and Innovation
Peninsular Malaysia Generation Development Plan 2019 (2020-2030)	For 2020–2030, the electricity demand is projected to grow by 1.8% p.a. By 2025, 3 758 MW of new RE capacities need to be developed in Peninsular Malaysia, starting 2020. This consists of 2 172 MW of solar and 1 586 MW of non-solar energy. The RE capacity is projected to increase from 9% to 23%.	Suruhanjaya Tenaga

Notable Energy Developments

Energy development	Details	Reference
Scarborough/Pluto LNG T2	5 Mtpa facility, aiming to be online in 2025	
Cash Maple Development LNG	2.5 Mtpa facility, aiming to be online in 2027	
Gorgon LNG T4	5.2 Mtpa facility, aiming to be online in 2027	
LNG import terminals	Several projects in development but only two 100 PJ projects are assumed to be online in 2023 and 2026.	
Rotang FLNG	Floating LNG export terminal came online in mid-2020 (0.75 Mtpa 2020); first full year of capacity to be in 2021 (1.5 Mtpa)	Petronas
ChargEV	Targets to have 400 ChargEV stations operational by the end of 2020	ChargEV
Solar PV	The 500 MW quota up to 2020 under the Net Energy Metering 2.0 (NEM2.0); expected operation date is 2021	SEDA
Solar PV	1 GW as part of Malaysia's Post-Covid Economic Stimulus and Recovery Measures; operation is expected by 2022	Renewables Congress
6 waste-to-energy plants (WTE)	Six WTE plants to be built nationwide by 2021. Sungai Udang landfill will be followed by the implementation of the same system at the landfills in Bukit Payung, Terengganu; Seelong, Johor; Samling, Selangor and Jabor, Pahang.	Malaysian Dutch Business Council
30% RE Target	• RE definition was reframed to include the base load RE, i.e., large hydro • RE target adjusted upward	IRENA
Competitive tariff and Economic Recovery (Solar Auctioning)	• In Dec 2019, 500 MW of solar quota was awarded through open bidding; the expected operation date is 2021 • In May 2020, 1 GW was offered as part of Malaysia's Post-Covid Economic Stimulus and Recovery Measures; the operation is expected to begin by 2022.	
Overarching Energy Policy (New Energy Policy)	• All-in-one macro-energy policy that addresses the complete value chain of energy supply and demand (power & non-power).	
Collaboration with IRENA (RE Outlook 2050)	• To determine the potential for future RE development • To update the existing RE Policy • To explore the available power supply and demand flexibility options	

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Useful links

Prime Minister's Office — www.pmo.gov.my

Ministry of Finance — www.mof.gov.my

Ministry of Energy and Natural Resources (KeTSA) — www.ketsa.gov.my

Ministry of Sains, Teknologi & Inovasi — www.mosti.gov.my

Ministry of Plantation Industries and Commodities — www.mpic.gov.my

Ministry of International Trade and Industry — www.miti.gov.my

Ministry of Environmental and Water — www.kasa.gov.my

Energy Commission — www.st.gov.my

Economic Planning Unit, Prime Minister's Department — www.epu.gov.my

Sustainable Energy Development Authority — www.seda.gov.my

Malaysia Green Technology Corporation — https://www.mgtc.gov.my/

Green Technology Financing Scheme — www.gtfs.my

MyHIJAU — www.myhijau.my

Malaysian Palm Oil Board — www.mpob.gov.my

PETRONAS — www.petronas.com

Tenaga Nasional Berhad — www.tnb.com.my

Sabah Electricity Sdn.Bhd. — www.sesb.com.my

Sarawak Energy Berhad — www.sarawakenergy.com.my

Single Buyer Department — www.singlebuyer.com.my

Grid System Operator — www.gso.org.my

Malaysia Energy Information Hub — https://meih.st.gov.my/

Mexico

Introduction

Mexico is a federal republic bordered by the United States of America to the north, Belize and Guatemala to the south, and the Atlantic and Pacific Oceans on the east and west. Mexico is in North America, though is also part of Latin America, for cultural and historical reasons.

Mexico is home to 126 million people and is the world's largest Spanish-speaking and the 11th most populated economy in the world. It is also the sixth most populated member in the Asia Pacific Economic Cooperation (APEC) region.

Mexico's gross domestic product (GDP) grew at a compound annual growth rate (CAGR) of 2.0% between 2000 and 2018 to USD 2 523 billion (2017 USD purchasing power parity [PPP]; EGEDA, 2020). However, GDP per capita growth was significantly lower in the same period, only increasing at a 0.7% CAGR (EGEDA, 2020). With 42% of the population living in poverty in 2018 and a Gini index coefficient of 45.4 in 2018, income inequality remains an urgent challenge in Mexico (CONEVAL, 2019).

Mexico is the 15th largest economy in the world and the sixth largest economy in APEC, economically comparable with Spain or Australia (World Bank, 2021). The service industry accounts for the largest share of GDP (60%) and manufacturing industry for 17%, with most exports being manufactured products (World Bank, 2020).

Economic reforms and free trade agreements introduced in the 1990s have resulted in macroeconomic stability, increased flows of foreign direct investment and the development of a robust manufacturing industry, profoundly integrated with the USA.

Energy, particularly crude oil, has historically been a significant component of the Mexican economy. Following an overall economic diversification and declining production, crude oil accounted for 5.3% of Mexico's total export value in 2019, compared with 37% in 1990 (World Bank, 2021). Despite this declining trend, Mexico still relied on crude oil rent for 10% of its government budget in 2019. However, this is low compared to the greater than 30% share for 2004-2014 (Banxico, 2021).

Mexico has a rich and diverse potential for renewable energy, conservatively estimated to be 2 593 gigawatts (GW) (SENER, 2021). While the potential is overwhelming for wind and solar energy, there are also prospects for hydropower, geothermal and bioenergy. Overall, Mexico's average daily solar PV potential is one of the highest in the world, exceeding 4.5 kilowatt hours per installed kilowatt of capacity (kWh/kWp). If Mexico dedicated around 0.1% of its territory to utility-scale PV power plants, it would be enough to cover its entire yearly electricity consumption (ESMAP, 2020).

Table 1: Mexico's Macroeconomic Data and Energy Reserves

Key data[a]		Energy reserves[b, c]	
Area (million km^2)	2.0	Oil (billion barrels)	5.8
Population (million)	126	Gas (trillion cubic metres)	0.2
GDP (2017 USD billion PPP)	2 523	Coal (million tonnes)	12 111
GDP per capita (2017 USD PPP)	19 992	Uranium (kilotons U <USD 130/kgU)	2.5

Source: [a]World Bank (2020), [b]BP (2020), [c]OECD (2020)

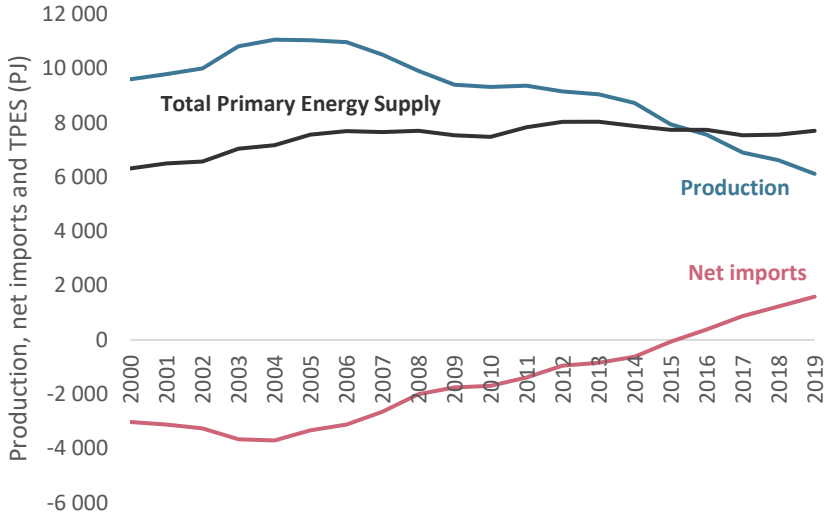
Energy Supply and Consumption

Total Primary Energy Supply

Mexico, a major oil and gas producer, has seen a decline in overall energy production since 2004, when crude oil production peaked. Figure 1 illustrates this decline and how, at the same time, Mexico's total primary energy supply (TPES) has modestly increased since 2010, boosting energy imports and turning the economy into a net importer. This shift has been driven by three main trends:

1) Decrease in crude oil production as major fields declined and discovery and development of new fields slowed
2) Simultaneous decline in natural gas production and a rapid increase in low-priced US piped gas imports
3) Lower refining outputs and a rapid growth in gasoline and diesel demand.

Figure 1: Mexico's Total Primary Energy Supply, 2000 to 2019



Source: EGEDA (2020)

In 2019, domestic production declined by 7.7% to 6 115 Petajoules (PJ), driven by a decrease in crude oil and natural gas production, while TPES increased 1.9% to 7 707 PJ. This increase in TPES, mostly oil products and natural gas, augmented the supply gap. Net energy imports (imports minus exports) rose by 30% to 1 592 PJ in 2019, resulting from a simultaneous increase in imported oil products and natural gas paired with declining domestic crude and natural gas production.

Mexico's TPES is still dominated by fossil fuels (89%), with oil accounting for 46% in 2019. The economy has historically been a major crude oil producer and exporter. However, crude production has seen a steady decline since it peaked at 3.4 million barrels a day (mb/d) in 2004, reaching a 40-year record-low in 2020 at 1.7 mb/d (CNH, 2021).

In 2013, a set of major legislative changes reorganised the energy sector in a bid to transition from state monopolistic structures to a market approach. Nevertheless, Pemex, Mexico's state-owned oil and gas company, remains dominant in crude production, with the share of other producers making up only 3.2% of the total in 2020 (CNH, 2021).

This fall in production was mainly due to the depletion of Pemex's largest asset, the Cantarell supergiant field, but was also a result of mismanagement and insufficient resources allocated to exploration activities. At its peak in 2004, Cantarell produced 2.1 mb/d, more than 60% of Mexico's then total crude oil production. By 2019, Cantarell produced less than 0.16 mb/d, representing only 9.3% of Mexico's production (CNH, 2021). Consequently, Mexico's crude exports have been declining, falling by 17% to 1.1 mb/d between 2010 and 2020 (SENER, 2021b).

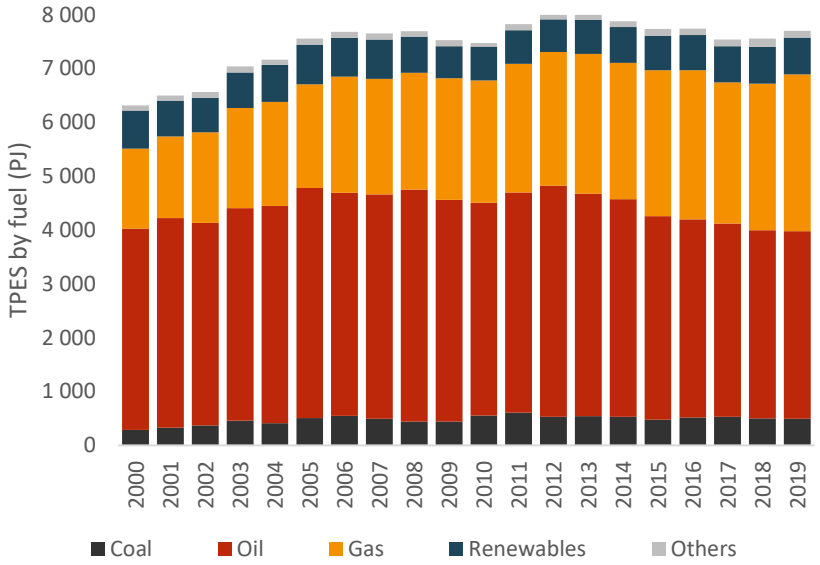
As for oil products, Mexico has a refining capacity of 1.6 mb/d in six refineries, all of which are owned by Pemex. Due to ageing infrastructure and lack of maintenance, the average refinery utilisation rate stood at 40% in 2019 (SENER, 2021c). Simultaneous increased demand for oil products has meant Mexico is now a major net importer of petroleum products. In 2019, imports accounted for 76% of gasoline consumption, 70% of diesel consumption and 63% of LPG consumption.

Since more than three-quarters of Mexico's natural gas production is associated with crude oil, domestic gas production has followed a similar downward trend to crude oil production. Natural gas production is also dominated by Pemex and is approaching a four-decade historical low in 2020 (CNH, 2019), having peaked in 2009 and consistently falling to 1 059 PJ in 2019.

At the same time, mostly driven by an oil-to-gas switch in the power sector, total gas demand has steadily increased at a 3.4% CAGR between to 2000 and 2018, making gas Mexico's fastest-growing fuel. With domestic production being unable to cover this rising demand, gas imports have more than quadrupled from 13 billion cubic metres (bcm) in 2009 to 59 bcm in 2019, registering a record high every year (CNH, 2021). In 2019, 90% of these imports were piped from the US, with the remainder being imported as LNG to one of Mexico's three regasification terminals (BP, 2020).

Coal has a relatively small share of Mexico's energy mix, compared to most APEC economies, representing 6.4% of total supply and falling by 1.2% to 496 PJ in 2019. While it produces some coal, Mexico is a net coal importer, mostly from Colombia and the US, with its use is predominantly in the power sector.

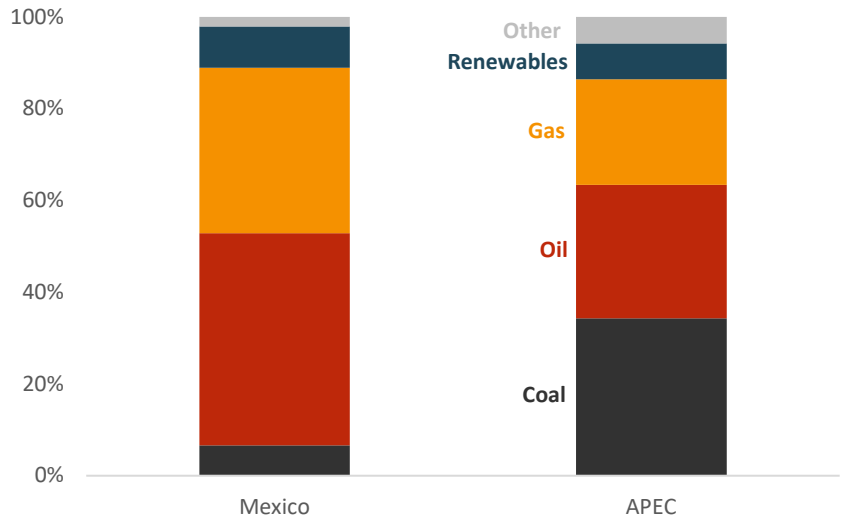
Figure 2: Mexico's Total Primary Energy Supply by Fuel, 2000 to 2019



Source: EGEDA (2020), IEA (2020).

Renewable energy has roughly grown at a 1% CAGR between 2010 and 2019, rising to 686 PJ and accounting for 9% of the total share in 2019. While bioenergy accounted for the largest share of renewables (5.0%), it is declining. In contrast, wind, solar and other renewables are rising rapidly and accounted for 2.7% of total supply in 2019. Hydropower, meanwhile, remained stable at 87 PJ, accounting for a 1.2% share. Another non-fossil fuel energy source in Mexico is nuclear, with a stable share amounting to 1.6% of the total in 2019.

Figure 3: Total Primary Energy Supply and Relative Fuel Share – Mexico and APEC, 2018



Source: EGEDA (2020)

Figures 2 and 3 illustrate how predominant fossil fuels continue to be in Mexico's energy mix. However, Mexico has a rather different fuel mix to that of the entire APEC region, as it is much more dependent on oil and gas. Mexico's oil share stood at 46% while the APEC's average was 29% in 2018.

This is explained, among other factors, by its high intensity demand for gasoline and diesel resulting from the predominance of road transportation, as well as a larger use of oil products for power generation and industrial processes. Mexico's rising gas share was almost double that of the APEC at 45% in 2018, mostly driven by the heavy reliance on this fuel in the power sector. The relative abundance of oil products and gas has been to the detriment of coal, which is almost six times lower in Mexico's mix compared to APEC. While Mexico's share of renewable is slightly larger than the APEC average, almost half of it is bioenergy. However, Mexico's wind and solar potential are above the APEC average; hence, if tapped into, this gap may increase in the future.

Total Final Consumption

Total final consumption is a representation of end-use energy, including the non-energy consumption of energy products. Natural gas used as feedstock in chemical production is an example of such non-energy use of natural gas.

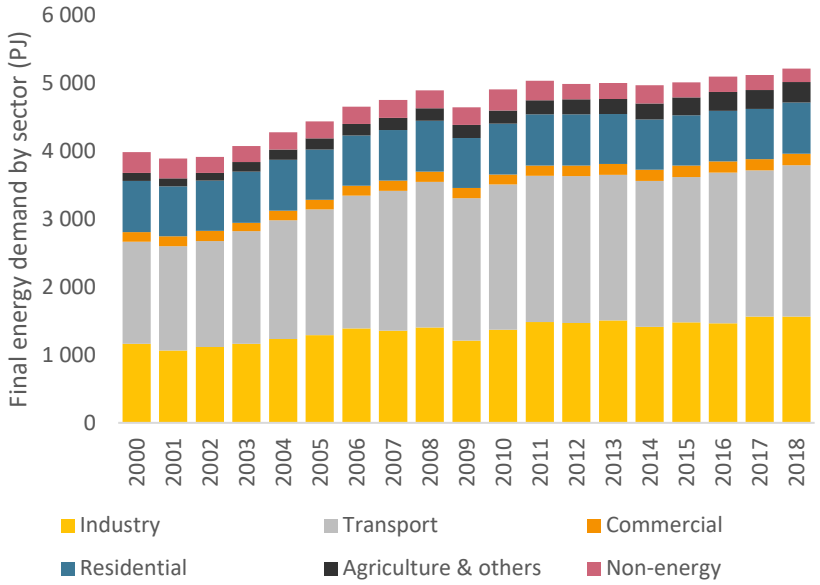
For Mexico, transport is the dominant end-use sector, accounting for 29% of all end-use energy consumption in 2018, most of which accounts for gasoline, diesel, and LPG to fuel road transport. The industrial sector is next, accounting for 21%. In 2018, energy consumption in the buildings sector accounted for 12.3% of the total with residential structures accounting for 10% and commercial buildings for 2.3%. In Figure 5, "Agriculture & others" refers to energy consumed by agricultural machinery and water pumping, but also livestock, fisheries, and forestry, among others, and it accounted for 4.0% in 2018. Finally, the non-energy sector corresponds mostly to the petrochemical industry, which is the only sector whose energy consumption declined in Mexico between 2000 and 2018.

Figure 4 shows that, in 2018, total final consumption in Mexico grew by 1.9%, reaching 5 217 PJ. This increase was mainly driven by a 3.6% growth in the transportation sector, followed by gains in the commercial, residential, agricultural, and other sectors. Moreover, growth in these sectors outpaced a 9.4% decline in the non-energy sector and a marginal decrease in the industrial sector.

Compared to APEC, Mexico's transport sector consumes substantially more energy. Aside from the economic and population

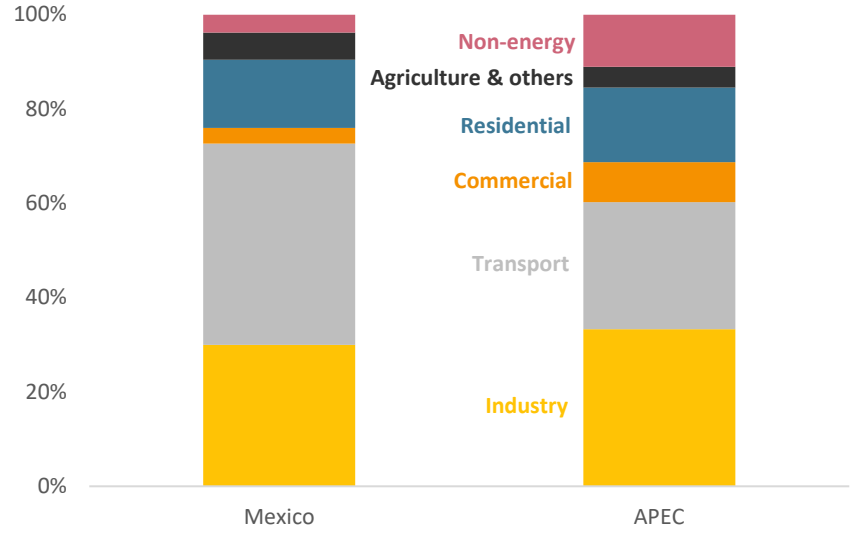
growth, this is due mainly to the predominance of the use of private vehicles as the preferred means of transportation, the limited options of less-energy intensive transportation modes such as trains, subways and public buses, and the preponderance of heavy-trucks for freight transportation. Mexico's industrial sector uses proportionally less energy than APEC, as Mexico's main industries such as manufacturing and construction are less energy intensive than steelmaking or cement, which are more prominent in other APEC economies. Additionally, the buildings sector energy demand, both for residential and commercial, is notably lower than APEC, as the need for space-cooling is lower and that for space-heating is minimal since extreme temperatures are seldom observed in most of Mexico.

Figure 4: Mexico's Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

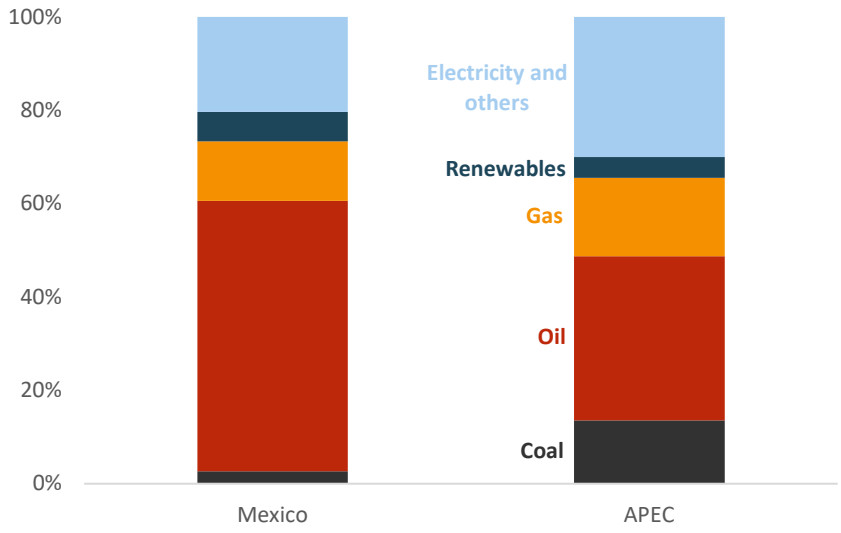
Figure 5: Relative Sectoral Final Energy Demand for Mexico and APEC, 2018



Source: EGEDA (2020)

By energy source, Mexico relies more on fossil fuels than the APEC region. Oil-based products increased their share to 58% of the total, mostly consumed in the transportation sector. Consequently, the end-use of oil is much larger in Mexico than in the APEC region (Figure 6). Electricity was the second-largest fuel (20%), including 3.3% of renewable-generated electricity. Natural gas accounted for 13% and coal for 2.7%. Direct final use of renewables accounted for 6.3% of the total. Most of this use, however, refers to the combustion of traditional biomass in the residential sector, a sign of poverty and limited access to modern sources of energy in Mexico's lowest-income households.

Figure 6: Final Energy Demand Fuel Mix for Mexico and APEC, 2018



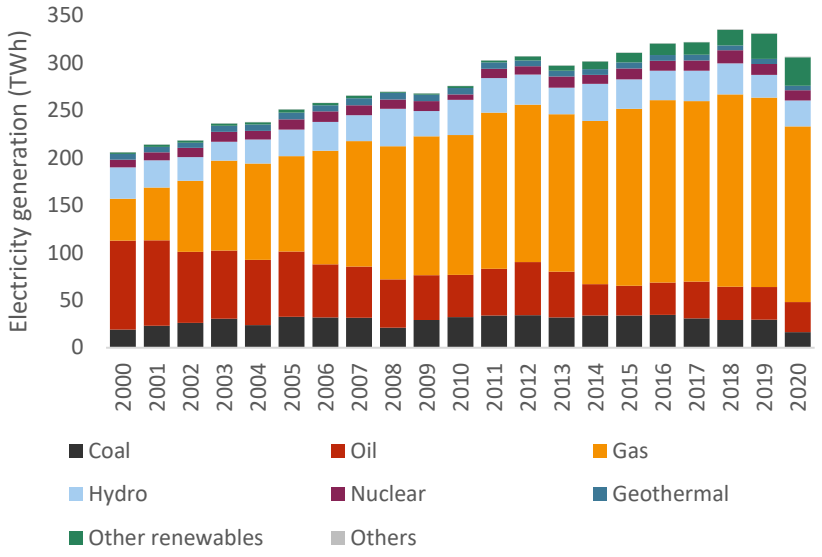
Source: EGEDA (2020)

Electricity

Electricity generation in Mexico has grown by an average of 2.7% annually since 2010, totalling 331 terawatt-hours in 2019. While renewable power generation grew by 6.2%, fossil fuels-based generation still accounted for 79% of the total. Although Mexico has a relatively diverse power generation technology portfolio, natural gas power was, by far, the dominant source of power generation, with 60% of the total in 2019.

This is the result of an oil-to-gas switch, led by CFE, the state-owned utility. As seen in Figure 7, gas accounted for 12% of total generation in 2000 and oil dominated with a 54% share. In 2020, oil-fuelled (mostly fuel oil but also diesel) plants had fallen to 10%, while gas fired generation increased to a 60% share. Coal generation dropped to 5.4%. Renewable energy accounted for 20% of total generation in 2020, with solar and wind accounting for a combined 10%, noted in Figure 7 as “other renewables”.

Figure 7: Mexico's Electricity Generation by Fuel, 2000 to 2020



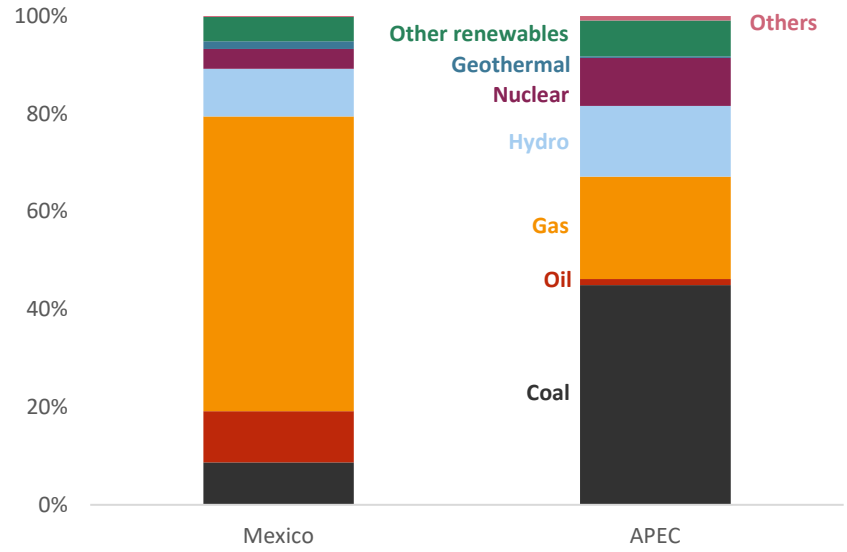
Source: EGEDA (2020), IEA (2021)

Solar and wind generation have increased their share very rapidly in the past five years. According to the most recent monthly-available data for March 2021, of the total energy generated, wind accounted for 7.8% and solar PV for 5.8%, raising the share of renewable power generation to 25% (CENACE, 2021). As of 2020, installed power capacity was 86 gigawatts (GW) (SENER, 2021d). Natural gas was the dominant fuel in power capacity, with 46% of the total share, followed by oil with 15%, hydropower with 15%, wind

with 8.1%, solar with 6.7%, coal with 6.4%, and the remaining 2.8% comprising nuclear and other renewables.

Mexico has 13 international interconnections, 11 of which are with the USA, one with Guatemala and one with Belize (SENER, 2021d). Mexico's electricity system is served via four separate grids. The main grid covers most of Mexico except for the Baja California Peninsula. Another system serves the north of that peninsula and two isolated systems serve the sparsely populated central and southern portions of the Baja California Peninsula.

Figure 8: Electricity Generation by Fuel for Mexico and APEC, 2018



Source: EGEDA (2020)

Natural gas' prominence in Mexico's power sector is clear when viewed in comparison with the generation mix for the APEC region in 2018 (Figure 8). In contrast, hydro and coal are proportionally lower in Mexico's generation mix, while oil is substantially higher. Other renewables' (particularly solar PV and wind) generation is still relatively lower in Mexico with respect to APEC, despite having abundant solar radiation and wind potential and seeing a continued decline in the cost of these technologies.

APEC Goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective. These are to improve energy intensity by 45% in 2035, as compared to 2005, and to double the share of modern renewables in the energy mix by 2030, as compared to 2010.

Energy Intensity Goal

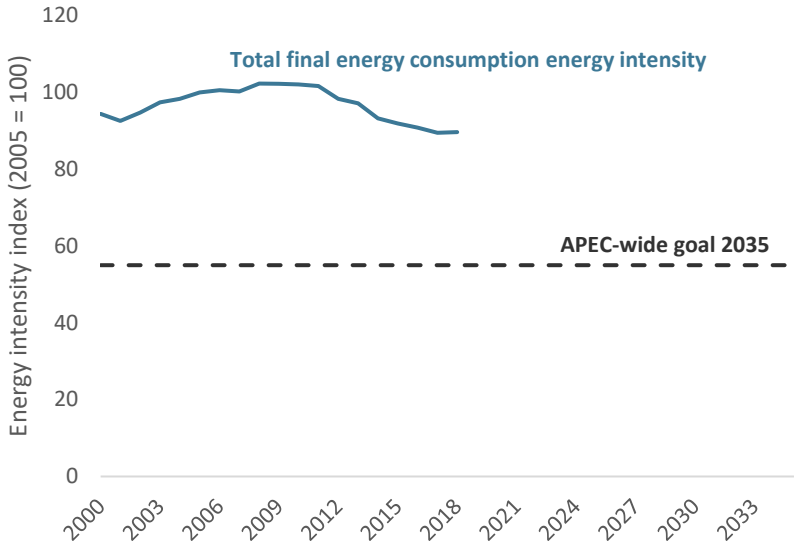
In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

The APEC region is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2018, Mexico's total final energy consumption (not including non-energy) improved by 12%, relative to the 2005 baseline. Since 1989, Mexico has implemented initiatives to improve its energy efficiency, which is reflected in its long-term declining energy intensity trends. Primary energy supply intensity improved by 1.8% from 2017 to 2018, while total final consumption intensity improved by a much smaller 0.3% in 2018. Total final consumption energy

intensity improvement was reduced due to inclusion of non-energy consumption such as by the petrochemistry and plastics industries.

Figure 9: Mexico's Total Final Energy Consumption Intensity Index, 2000 to 2018 (2005 = 100)



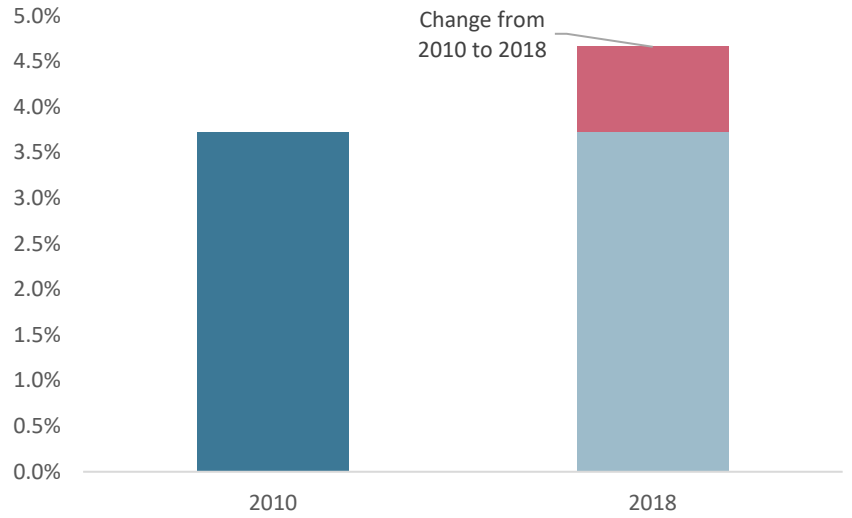
Source: EGEDA (2020)

Doubling of Renewables

The second energy goal involves doubling the share of renewables in the APEC energy mix for the period 2010–2030. Renewables comprise modern renewables, which do not include traditional biomass, and their share is relative to final energy consumption, which does not include non-energy consumption.

There is no economy-level goal for individual member economies, but improvements by individual economies contribute to the doubling goal. Mexico's share of modern renewables in final energy consumption in 2010 was 3.7%. In 2018, the proportional share was 4.7%, which represents a 25% increase in modern renewables compared to 2010 and a 5.2% increase compared to 2017 (Figure 10). While renewables for power generation, particularly solar PV and wind, have grown rapidly in the past five years, meeting Mexico's relative share of this APEC goal will require Mexico's modern renewables share to reach 7.5% by 2030. Without additional policy support, Mexico is unlikely to increase its current pace of progress.

Figure 10: Mexico's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)
Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass, and it is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy policy

Energy Policy	Details	Reference
National Development Plan 2019-2024	Outlines the main policy objectives and priorities of the current six-year (2018–2024) Presidential administration	Office of the President
Energy Sector Program 2020-2024 (PROSENER)	Planning instrument that sets the current administration's strategies and actions to achieve its six priority objectives: energy self-sufficiency, strengthening state-owned companies, organising research and development, attaining energy efficiency and sustainability, assuring universal energy access, and making the energy sector a lever of development.	Official Federal Gazette
Transition Strategy to Promote the Use of Cleaner Technologies and Fuels	The Transition Strategy constitutes the guiding instrument of the economy-wide policy in the medium and long term regarding clean energy obligations, sustainable use of energy and improvement in energy productivity.	Official Federal Gazette
Paris Agreement Nationally Determined Contribution 2020 Update	Mexico updated its NDC in 2020, but it did not improve upon the ambitions of its original NDC, which pledges to reduce greenhouse gas emissions by 22% by 2030 as compared to a baseline business-as-usual scenario with a 2013 baseline. No additional emissions reduction or decarbonisation plans have been published to date.	Ministry of Environment and Natural Resources (SEMARNAT)
National Electricity System's Development Program 2020-2034 (PRODESEN)	This program details the annual planning for the power sector with a 15-year horizon. It includes key elements for generation capacity additions and retirements, as well as plans for grids extensions and modernisations.	Ministry of Energy (SENER)
Oil and gas exploration and production five-year plan	It is a planning instrument that identifies the priority areas for oil and gas exploration and production, emphasising the potential on onshore and shallow-water resources. It excludes the development of any unconventional resources for the time being. The document also reaffirms the administration's moratorium on oil and gas auctions.	Ministry of Energy (SENER)
Five-year plan for the expansion of the integrated transportation and storage system of natural gas	This second five-year plan provides an overview of the natural gas transportation and storage infrastructure, as well as the consumption and supply observed in recent years. This planning document details a set of infrastructure projects to expand the storage and transportations networks.	Ministry of Energy (SENER)
National Program for the Sustainable Use of Energy 2020-2024 (PRONASE)	This instrument establishes the actions, projects and activities derived from the Transition Strategy that enable the accomplishment of the stated energy efficiency goals.	Official Federal Gazette
Energy Efficiency Roadmap	This roadmap on energy efficiency mentions energy efficiency goals, potential and sectoral scenarios as well as some sectoral barriers to tap into the full energy efficiency potential.	National Commission for the Efficient Use of Energy (CONUEE)

Energy Transition Law	The law, known as the LTE, provides a framework for clean energy, energy efficiency and greenhouse gas emissions reductions. The LTE establishes four planning instruments: a strategy with clean energy and energy efficiency goals; two special programs to implement such strategy; and a program focused on smart grids. It established clean energy goals for power generation as follows: 2018 – 25%; 2021 – 30%; 2024 – 35%.	Official Federal Gazette
Second Regulation of the Energy Transition Law	This secondary regulation or *reglamento* specified in greater detail the obligations that are stated in the LTE. Among other issues, it details the requirements for planning, methodologies and publishing of data, progress reports and other clean energy benchmarking data.	Official Federal Gazette
Roadmap for Building Energy Codes and Standards for Mexico	This document sets a pathway and policy framework for increasing energy efficiency in Mexico's building sector.	Ministry of Energy (SENER)
Minimum energy performance standards (MEPS) for 12 appliance groups	This set of standards regulate energy consumption of appliances that, due to their energy demand and massive use, offer substantial energy savings and cost-savings to end users.	National Commission for the Efficient Use of Energy (CONUEE)
National Program for Energy Management Systems (PronasgeN)	This program is aimed at supporting and bringing together Energy Management Systems (EnMS) activities, contributing to the EnMS market consolidation in Mexico. Case studies have demonstrated the value of implementing EnMS, with improvements in energy efficiency of at least 10% in industrial facilities.	Official Federal Gazette
Guidelines for the prevention and comprehensive control of methane emissions from the oil and gas sector	These guidelines apply to new and existing sources across the value chain. Under the regulation, facilities must develop a Program for Prevention and Integrated Control of Methane Emissions (PPCIEM). As a starting point, facilities must identify all sources of methane and calculate an emissions baseline (base year must be within the last five years).	Ministry of Environment and Natural Resources (SEMARNAT)
Pilot Emissions Trading System (ETS)	In 2020, this pilot ETS started operations as part of a two-phase process to gradually establish a fully-fledged ETS. The pilot ETS covers the power, oil and gas, and industrial sectors, which account for approximately 40% of Mexico's GHG emissions. Entities with annual emissions from direct sources greater than 100 $ktCO_2$ will be covered under the pilot.	National Commission for the Efficient Use of Energy (CONUEE)
Municipal Energy Efficiency Project (PRESEM)	PRESEM focuses on making energy efficiency investments in selected municipal sectors (pumping water systems, street lighting and public buildings).	Department of Industry, Science, Energy and Resources
Electricity subsidies to the residential and agriculture sectors	The Ministry of Finance (SHCP) provides subsidised electricity rates to most users in the residential and agriculture sector. The final rates vary depending on inflation rates, but it remains constant in real time. This rate was roughly 0.12 USD/kWh in 2020, which is about 46% of the total cost of the service.	Inter-American Development Bank (IADB)

Notable Energy Developments

Most of the notable energy developments in 2020–2021 are about key infrastructure projects or a series of regulatory and legal changes taken by the government to advance its policy priorities. These developments are contributing to Mexico achieving energy self-sufficiency and strengthening the role of state-owned companies, though they come with concerns for the environment, emissions and investment.

Energy Development	Details	Reference
Amendment to the Electricity Industry Law	After approval in both legislative chambers, this amendment proposed by the President was published in March 2021. The ultimate purpose of the law is to strengthen the state-owned utility CFE. Some of the changed provisions include granting a dispatch preference to CFE's power plants, removing the obligation from service suppliers to undertake actions to procure electricity and revoking self-supply permits.	Official Federal Gazette
Electricity Industry Law suspension by a court	The recently approved amended electricity law is in an ongoing judiciary process. It was granted a definitive suspension by a Mexican court, citing competition concerns and irreparable environmental damages. This decision has left the new amendment without effect until a Tribunal or the Supreme Court of Justice makes a decision.	Official Federal Gazette
Amendment to the Hydrocarbons law	This Presidential initiative was passed into law in May 2021. Among other provisions aimed at enhancing Pemex (the state-owned company), the law grants the Ministry of Energy and the regulator CRE power to suspend and revoke permits for oil and gas midstream activities, including international trade, should they consider security, energy security or the economy to be in "imminent danger".	Official Federal Gazette
Hydrocarbons law partial suspension	As with the Electricity law, this amendment has also been challenged in court. However, unlike the Electricity law, a court granted a partial suspension to certain provisions of the law. The process is ongoing and a Tribunal or the Supreme Court of Justice could overturn such a ruling.	Reuters
Revocation of asymmetrical regulation to Pemex	This law amendment takes away the faculty of the CRE, the energy regulator, to impose asymmetrical regulations to Pemex's oil, gas, fuels and petrochemicals activates. Asymmetrical regulation measures were initially aimed at limiting Pemex's former monopoly of storage and sales of these products.	Official Federal Gazette
Reliability Energy Policy	The Ministry of Energy published the “Policy on Reliability, Stability, Continuity and Quality in the National Electric System" in May 2020, which imposed stricter rules for new non-CFE generation permits and additional restrictions for wind and solar plants. After a series of injunctions, a federal judge instructed its general suspension. In March 2021, SENER cancelled the application of the policy ahead of the legislative vote for amending the Electricity Industry Law, which contains many of the same provisions.	Official Federal Gazette

Supreme Court's invalidation of the reliability Energy Policy	The abovementioned Reliability Energy Policy was the subject of a constitutional controversy promoted by the anti-trust commission, COFECE. Mexico's Supreme Court of Justice invalidated some of the key points of this policy, considering them unconstitutional.	Supreme Court of Justice
CENACE's Resolution to Guarantee the Efficiency, Quality, Reliability, Continuity and Stability of the National Electric Grid	In April 2020, CENACE, the grid operator indefinitely suspended pre-operational tests for new solar and wind projects and modified the rules for grid access. CENACE tried to justify such measures as part of a series of measures to assure stability on the grid amid the decreases in demand caused by the COVID-19 pandemic. Private generators began legal proceedings and the procedure was definitively suspended by a court in June 2020.	National Center for Energy Control of Mexico (CENACE)
Pemex purchase of the Deer Park refinery	Pemex, the state-owned oil company, agreed to a USD 596 million deal to buy Shell's majority interest in the joint venture 340 000 b/d refinery in Deer Park, Texas. Pending regulatory approval, Pemex would acquire full ownership of the refinery, increasing the share of gasoline and diesel coming from Pemex-controlled refineries.	Pemex
Construction of the Dos Bocas refinery	A key element of Mexico’s oil policy is boosting domestic refining. The construction of the emblematic Dos Bocas refinery is one of the landmark infrastructure projects of this administration. The 0.34 mb/d refinery will increase refining capacity by 25%, with a wholly government-funded investment of USD 8 billion, and it is expected to be operational by 2024.	Dos Bocas Refinery
Commissioning of the VAG gas pipeline	The Villa de Reyes-Aguascalientes-Guadalajara (VAG) pipeline started commercial operations in June 2020, connecting new demand markets in Mexico to US natural gas pipeline exports. This was the last segment of the 1 251 km-long Wahalajara system, a group of new pipelines that connects the Waha hub in Texas to Guadalajara and other population centres in west-central Mexico.	Argus Media
Construction of the Cuxtal gas pipeline	The Cuxtal I gas pipeline will connect Sistrangas, the economy-wide pipeline system, with the Mayakan pipeline, a 780-kilometer pipeline from a Pemex processing centre to the Yucatan Peninsula. This 16-kilometer pipeline will increase the supply by allowing imported gas volumes to flow to the peninsula, a region suffering from a shortage of natural gas.	Ministry of Energy (SENER)
ECA LNG Final Investment Decision	In November 2020, the American company Sempra reached a final investment decision (FDI) to develop a natural gas liquefaction facility called Energía Costa Azul (ECA) LNG Phase 1. ECA LNG, located in Mexico's north-western Pacific coast, will use feed-in gas production mostly from Texas to export LNG to Asian markets. It is the first project to export US shale gas from the Pacific coast and is expected to start operations in 2024.	ECA LNG
Construction of an LNG receiving terminal in Pichilingue Port	The American company New Fortress Energy is building a small-scale regasification facility of 0.8 MTPA with a 135 MW power plant and truck loading bays. The plant will also supply CFE's power plants and other users in La Paz, Baja California Sur, which is set to be operational in 2021.	New Fortress Energy

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Useful Links

Banco de México (Banxico)—www.banxico.org.mx

Centro Nacional de Control de Energía (CENACE)—www.cenace.gob.mx

Centro Nacional de Control del Gas Natural (CENAGAS)—www.cenagas.gob.mx

Comisión Federal de Electricidad (CFE)—www.cfe.gob.mx

Comisión Nacional para el Uso Eficiente de la Energía (CONUEE)—www.conuee.gob.mx

Comisión Nacional de Hidrocarburos (CNH)—www.cnh.gob.mx

Comisión Regulatoria de Energía (CRE)—www.cre.gob.mx

Comisión Nacional de Seguridad Nuclear y Salvaguardias (CNSS)—www.cnsns.gob.mx

Instituto Mexicano del Petróleo (IMP)—www.imp.mx

Instituto de Investigaciones Eléctricas (IIE)—www.iie.org.mx

Instituto Nacional de Investigaciones Nucleares—www.inin.gob.mx

Instituto Nacional de Estadística y Geografía (INEGI)—www.inegi.org.mx

Petróleos Mexicanos (PEMEX)—www.pemex.com

Presidencia de la República—www.gob.mx/presidencia

Rondas México—https://rondasmexico.gob.mx/

Secretaría de Energía (SENER)—www.gob.mx/sener

Secretaría de Hacienda y Crédito Público (SHCP)—www.gob.mx/hacienda

Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT)—https://www.gob.mx/semarnat

Sistema de Información Energética (SIE)—http://sie.energia.gob.mx

New Zealand

Introduction

New Zealand is an economy in the South Pacific comprising the North Island, South Island and numerous outer islands. New Zealand is similar in size to Japan, though it has a much smaller population of 4.84 million people (2018). The population enjoys a high standard of living with a per capita gross domestic product (GDP) of USD 42 635 (PPP, constant 2017 USD) in 2018.

Renewables make up a large share of supply and accounted for 83% of electricity generation in 2018. Hydro is the dominant renewable energy source, with support from geothermal and wind sources. New Zealand's wind resources are excellent, though they have yet to be significantly utilised due to limited demand and grid stability considerations (Roaring40s Wind Power ltd, 2020).

New Zealand is self-sufficient in all energy forms except for oil. Coal and natural gas are New Zealand's most abundant fossil energy resource. Almost all the coal produced are sub-bituminous and bituminous coal, though most of New Zealand's coal resources are in the form of low-value lignite. The relatively small oil reserves, 339 petajoules (PJ), are eclipsed by 2 100 PJ of natural gas and liquefied petroleum gas (LPG) (MBIE, 2020). Estimated coal reserves stood at 7.56 billion tonnes at the end of 2019 (BP, 2020)

Table 1: Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b, c]	
Area (thousand km^2)	268	Oil (PJ)	339
Population (million)	4.8	Gas (PJ)	2 043
GDP (2017 USD billion PPP)	206	Coal (million tonnes)	7 560
GDP per capita (2017 USD PPP)	42 635	Uranium	0

Notes: [a] World Bank (2020), [b] MBIE (2020), [c] Proven reserves plus probable reserves

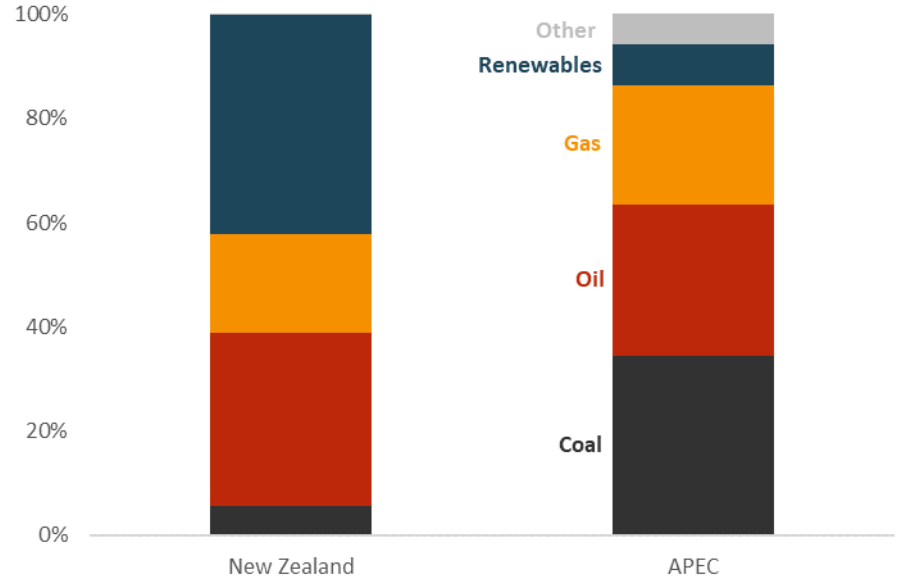
Energy Supply and Consumption

Total Primary Energy Supply

New Zealand's total primary energy supply (TPES) was 858 PJ in 2018. Renewable energy (geothermal, wind, solar and others) was a major contributor to TPES (42%), followed by oil (33%), gas (19%) and coal (5.8%) (EGEDA, 2020).

The share of geothermal energy in total final energy consumption was significantly smaller than the share of geothermal in TPES. This is because geothermal electricity generation has an assumed efficiency of 15% in New Zealand (MBIE, 2020).

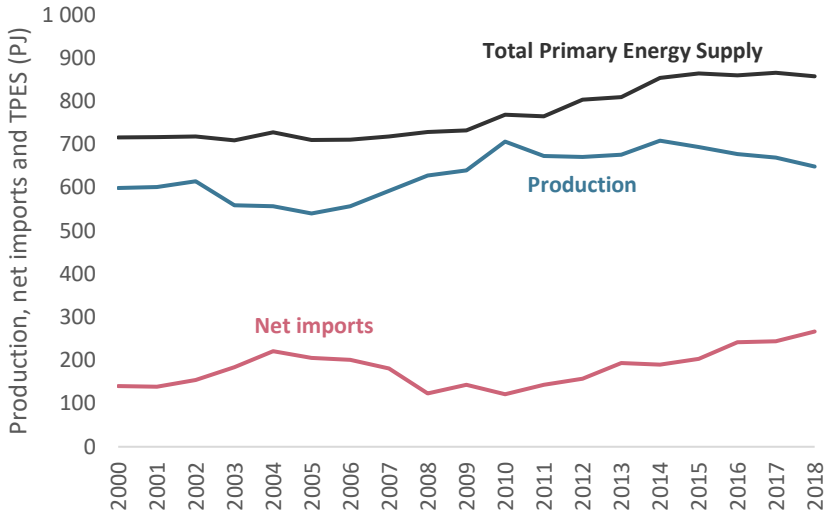
Figure 1: TPES – Relative Fuel Share, New Zealand and APEC, 2018



Source: EGEDA (2020)

New Zealand's energy self-sufficiency (production to primary energy supply) in 2018 was 76%. This continued a declining trend from the 2010 peak (92%), largely due to a decline in domestic oil production, combined with increasing demand for transport fuels. New Zealand's TPES has increased at an average annual rate of 1.0% since 2000 (EGEDA, 2020).

Figure 2: New Zealand's TPES, Production and Net Imports, 2000 to 2018



Source: EGEDA (2020)

Total Final Consumption

New Zealand's total final consumption fell by 1.8% in 2018 to 602 PJ when compared to 2017. Industrial energy demand and non-energy demand fell by 2.8% and 10.7%, respectively, due to disruptions in the gas supply in 2018, which was a key input for these sectors. The transport sector was the only sector to grow (2.2%). All other sectors saw an annual decrease in demand in 2018.

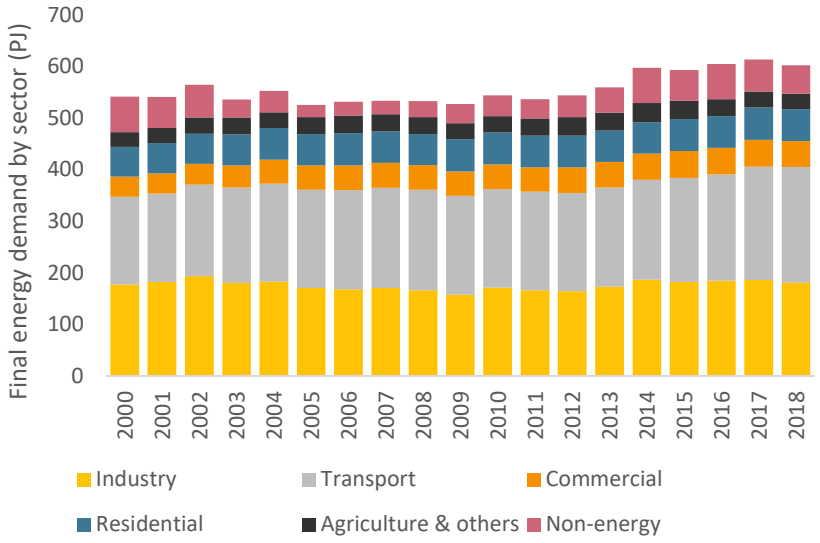
Transport and industry accounted for the largest share of final energy consumption at 37% and 30%, respectively. Oil was the largest component of final energy consumption at 268 PJ (49%),

followed by electricity and others at 140 PJ (26%), gas at 62 PJ (11%), and coal at 24 PJ (4.4%) (EGEDA, 2020).

New Zealand's industrial energy demand is dominated by a small number of large consumers: one aluminium smelting plant, one steel mill, one oil refinery, one methanol producer, two cement plants, several pulp and paper mills, and a large dairy company (with multiple facilities).

The increase in transport energy consumption (2.2% in 2018) has been a continuing trend since 2015. In the prior decade, transport energy demand was relatively flat.

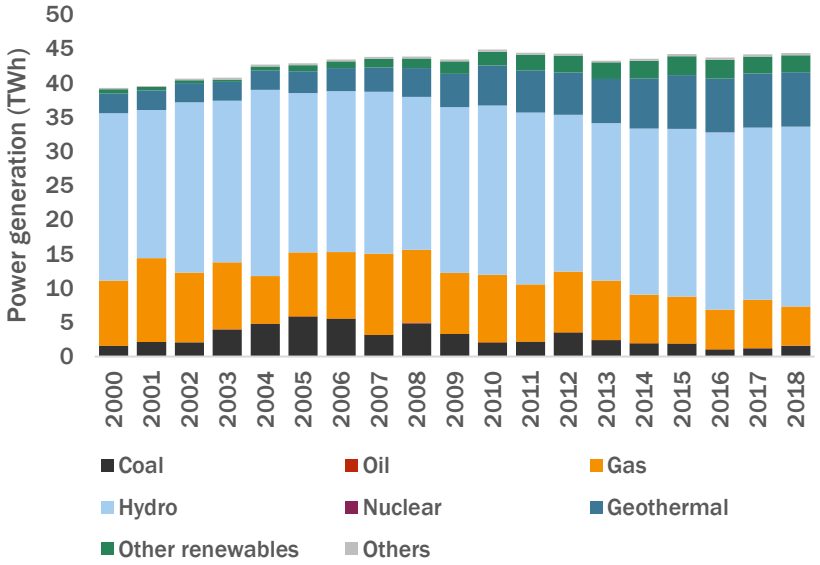
Figure 3: New Zealand's Total Final Energy Demand by Sector, 2000 to 2018 (PJ)



Source: EGEDA (2020)

In 2018, New Zealand generated 44 380 GWh of electricity, a 0.4% rise from the 2017 level. Hydro accounted for 59.2% of this generation, while other renewables accounted for 24.1% of the generation (EGEDA, 2020).

Figure 4: New Zealand's Electricity Generation by Fuel, 2000 to 2018 (TWh)



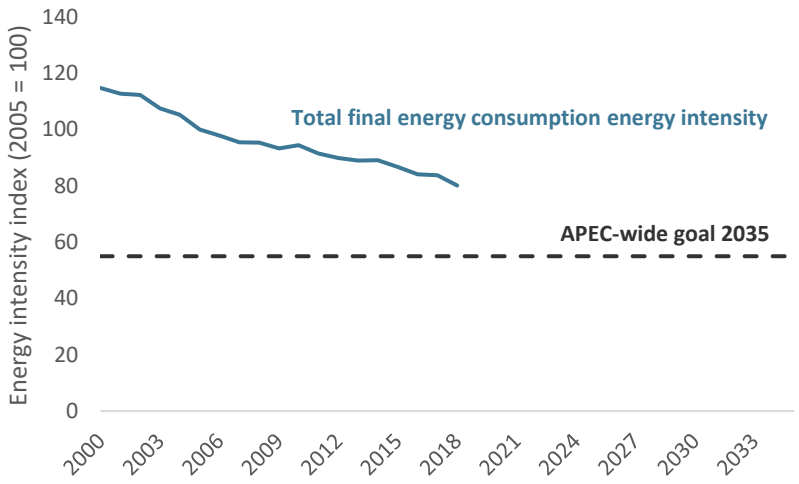
Source: EGEDA (2020)

APEC Goals

Energy Intensity Analysis

In 2018, New Zealand's energy intensity was 2.7 PJ per billion USD PPP of GDP, which represents a 4.4% year-on-year improvement. This is significantly higher than the average annual improvement of 1.8% since 2010.

Figure 5: New Zealand's Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)

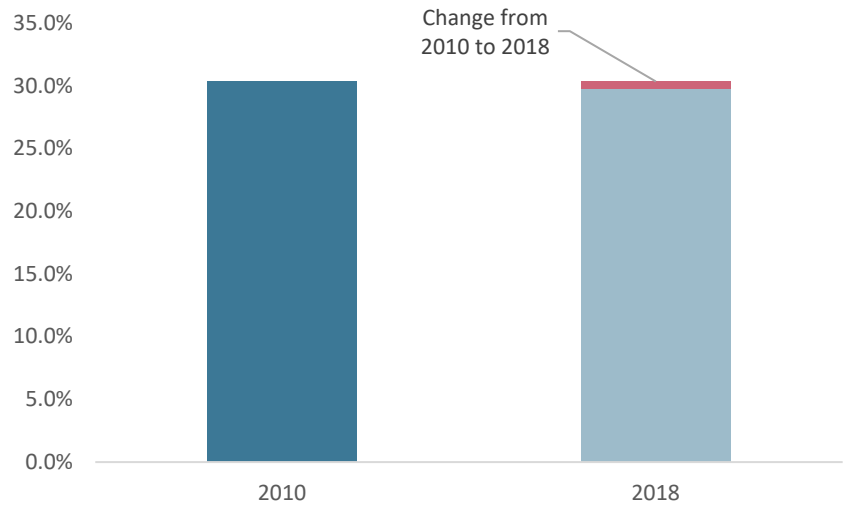


Source: EGEDA (2020)

Doubling of Renewables

New Zealand has the highest penetration of renewables in its energy mix out of all APEC economies. There has been a small reduction in New Zealand's renewables share since 2010 (the base year for the doubling goal). In 2018, New Zealand's renewable share was 29.8%, which is 0.6% lower than it was in 2010 (30.4%). Overall, APEC had a 6.0% share of renewables in 2018. While New Zealand can contribute to the APEC goal of overall renewable doubling by 2030, the current and former high penetration levels make significant growth challenging when compared to economies with much lower penetration rates for renewables.

Figure 6: New Zealand's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)
Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by the industry, hydro, geothermal, etc.) are considered to be modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

The May 2019 amendment to the Climate Change Response Act (Zero Carbon) set a legally binding goal of achieving a zero-carbon economy by 2050 (MFE, 2018). This policy will mean radical changes within New Zealand's energy sector and a drastic reduction in the intensity of emissions over the next 30 years. Further details of the specific policies aimed at supporting the low-carbon transition are provided in the table below.

Energy Policy	Details	Reference
Emissions trading scheme	This is currently limited to domestic credits only and excludes agriculture; the emissions limits are set on a five-year basis. The first period runs from 2021 to 2025 with a budget of 354 Mt CO_2-e. It contains price ceiling and price floor mechanisms to maintain market stability.	Ministry for the Environment
Renewable electricity	By 2025, 90% of the electricity will be generated from renewable sources.	Ministry for Business Innovation and Employment
Efficient and low-carbon transport	Electric vehicles will make up 2% of the vehicle fleet by the end of 2021.	Ministry for Business Innovation and Employment
Exemption for EVs and hybrids from road user charges	The exemption has been extended till 31 December 2021.	Ministry for Transport
Oil and gas exploration ban	The Crown Minerals Amendment Bill has ended all new offshore oil and gas explorations and limited onshore exploration to a small region.	The New Zealand Government
One Billion Trees	It aims to plant one billion trees by 2028.	Ministry for the Environment
New Zealand energy efficiency and conservation strategy 2017–2022	Its aims to decrease the intensity of industrial emissions by at least 1% per annum on average between 2017 and 2022 (Target 1).	Ministry for Business Innovation and Employment
NZ Battery Project	The project aims to investigate pumped hydro and other possible energy storage solutions for New Zealand's dry year electricity problem.	Ministry for Business Innovation and Employment

Decarbonising the industry	$69 million worth of capital grants co-investment has been made available to support projects. The fund is available to New Zealand-based private sector businesses that have committed to decarbonising their business and industrial processes and where government co-investment will help remove barriers to accelerating their decarbonisation goals.	Energy Efficiency and Conservation Authority
Funding for heaters and insulation	Warmer Kiwi Homes is a government program offering insulation and heater grants to low-income home-owners.	Energy Efficiency and Conservation Authority
Public sector decarbonisation	The Carbon Neutral government program will require public sector agencies to measure and publicly report their emissions and deliver offsets. The program is backed by the $200 million State Sector Decarbonisation Fund.	The Government of New Zealand
Government Investment in Decarbonising Industry (GIDI)	Government and business co-funding to accelerate the decarbonisation of industrial process heat.	Energy Efficiency and Conservation Authority

Notable Developments

Energy development	Details	Reference
New Zealand Aluminium Smelters	New Zealand Aluminium Smelters is supposed to remain in operation until at least 2025.	New Zealand aluminium smelters
Coal phase-out	Genesis has pledged to stop using coal to generate electricity, except in exceptional circumstances, by 2025 and fully retire it in 2030. This is the only coal plant in New Zealand (excluding cogeneration). It is also capable of using gas.	Genesis energy
Reducing refinery throughput	New Zealand refineries will reduce refinery throughput to 90 000 bbls/day.	NZ refineries
Climate Change Commission submitted draft advice to the government	The Climate Change Commission outlined recommendations for reducing emissions in Aotearoa New Zealand	Climate Change Commission

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MFE (Ministry for the Environment) (2018), Establishing the Climate Change Commission, https://www.mfe.govt.nz/climate-change/climate-change-and-government/establishing-climate-change-commission

Roaring40s Wind Power Ltd (2020), Wind Generation Stack Update, https://www.mbie.govt.nz/assets/wind-generation-stack-update.pdf

Useful links

Climate Change Information, Ministry for the Environment — www.climatechange.govt.nz

Electricity Authority — www.ea.govt.nz

Energy Efficiency and Conservation Authority (EECA) — www.eeca.govt.nz

Environmental Protection Authority — www.epa.govt.nz

Ministry of Business Innovation and Employment (MBIE) — www.mbie.govt.nz

Ministry for the Environment — www.mfe.govt.nz

New Zealand Government (contains news and speeches of government ministers) — www.beehive.govt.nz

New Zealand Parliament — www.parliament.govt.nz

New Zealand Petroleum & Minerals (formerly Crown Minerals) — www.nzpam.govt.nz

Transpower — www.transpower.co.nz

Papua New Guinea

Introduction

Papua New Guinea (PNG) is an island economy located in the Pacific Ocean. Roughly 600 islands stretch from just south of the equator to the Torres Strait, near Cape York Peninsula, Australia. PNG is the largest of the Pacific Island economies with a total land area of 462 840 square kilometres (km²). The largest PNG islands are New Britain, New Ireland and Bougainville. Port Moresby is the capital, located in south-eastern New Guinea on the Coral Sea.

PNG sits along the volcanically active 'Ring of Fire' and faces frequent earthquake and tsunami risks. Amidst the mountainous terrain, tropical rainforests, and scattered small islands, lie the economy's rich natural resources dominated by gold, copper, oil, gas, timber, and crops for agricultural export (coffee, cocoa, tea, palm oil and copra). Year-round, PNG has high temperatures and humidity combined with wet and dry seasons.

In 2018, PNG's real gross domestic product (GDP) was USD 37 billion (2017 USD purchasing power parity [PPP]), which represented a 0.8% decrease from 2017. Despite the fall, PNG posted strong economic growth between 2010 and 2018, with an annual average GDP growth rate of 4.8% (2017 USD PPP) (EGEDA, 2020).

Table 1: PNG's Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b]	
Area (km²)	462 840	Oil (billion barrels)	6
Population (million)	8.61	Gas (trillion m³)	84
GDP (2017 USD billion PPP)	36.5	Coal (million tonnes)	149 079
GDP per capita (2017 USD PPP)	4 236	Uranium (kilotonnes U < USD 130/kgU)	1 184

Source: [a] World Bank (2020), [b] BP (2020)

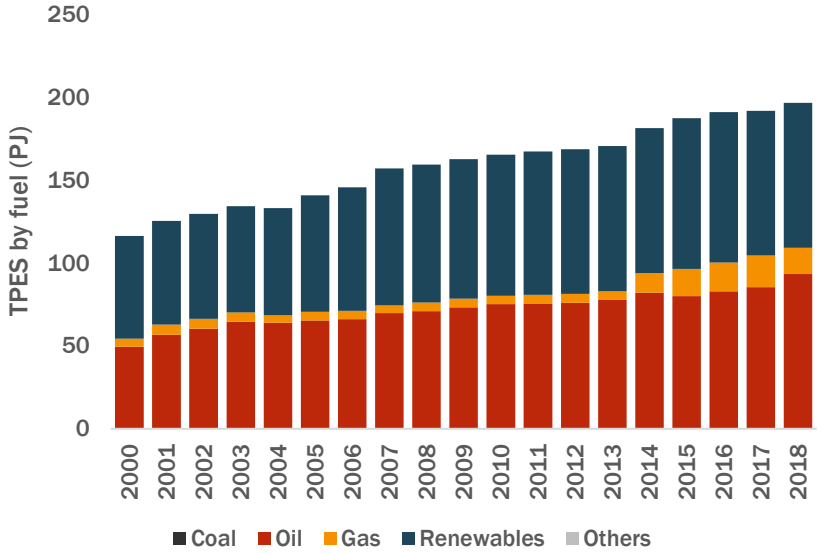
Energy supply and consumption

Total Primary Energy Supply

Total Primary Energy Supply (TPES) in 2018 was 196 PJ, which was 2.5% larger than the year before. This growth came from oil which grew 10.2%, offsetting the fall in gas which was down 17%. Other fuels showed no significant changes in consumption levels.

Oil now constitutes the largest share of TPES at 47.5% in 2018 (Figure 1). Renewables follow with 44.5%, and natural gas accounts for the remaining 8%.

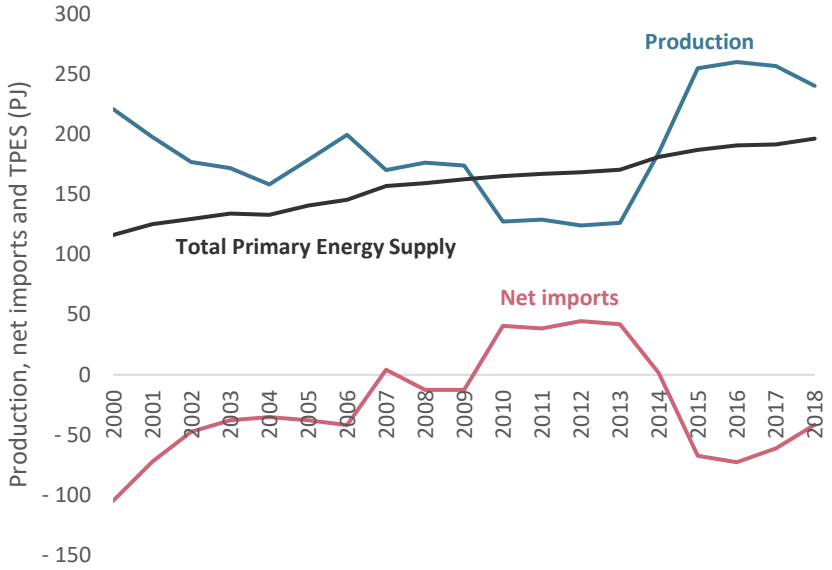
Figure 1: PNG's Total Primary Energy Supply Fuel Share (PJ) from 2000 to 2018



Source: EGEDA (2020)

TPES composition is significantly different from the APEC region. One of the main differences is that PNG does not have any coal-fired electricity generation or any significant domestic consumption of coal. While PNG has a rich gas resource, most of the production is exported, which means that the portion that is exported does not show in total primary energy supply (Figure 2). The net effect is that oil and renewables hold a much larger share of TPES relative to APEC.

Figure 2: PNG's Total Primary Energy Supply (PJ) from 2000 to 2018

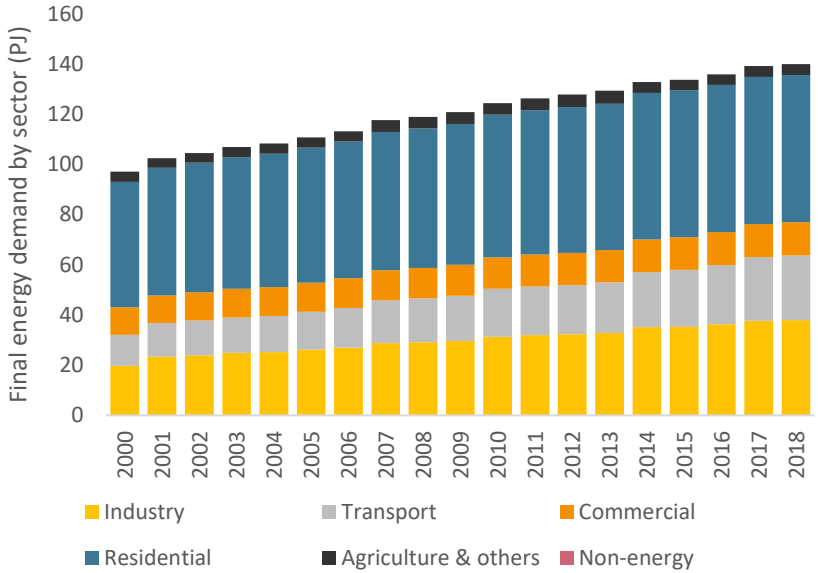


Source: EGEDA (2020)

Total Final Consumption

In 2018, the total final consumption was 140 PJ, which represented a 0.6% annual increase (Figure 3). The residential sector remained the largest energy user, accounting for 42% of final consumption. The industrial sector (27%) and the transport sector (18%) were the next two largest energy-consuming sectors.

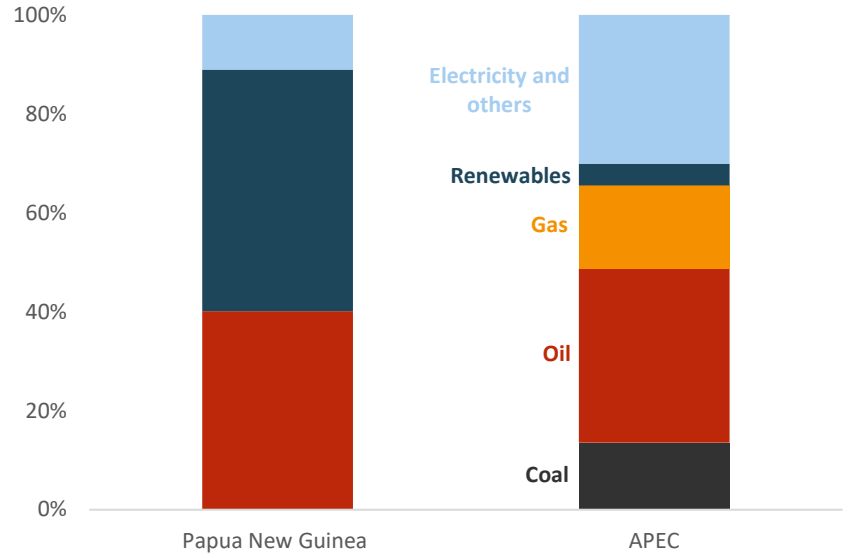
Figure 3: PNG's Total Final Consumption by Sector (PJ), 2000 to 2018



Source: EGEDA (2020)

Renewable energy contributed the largest share of final energy consumption (48%), as shown in Figure 4. Traditional biomass used in the residential sector for cooking, water heating and lighting accounted for half of the renewables share. Petroleum products accounted for 40% of final energy consumption, while electricity and other sources accounted for the remaining 11% (EGEDA, 2020).

Figure 4: Total Final Consumption by Fuel (PJ), PNG and APEC, 2018

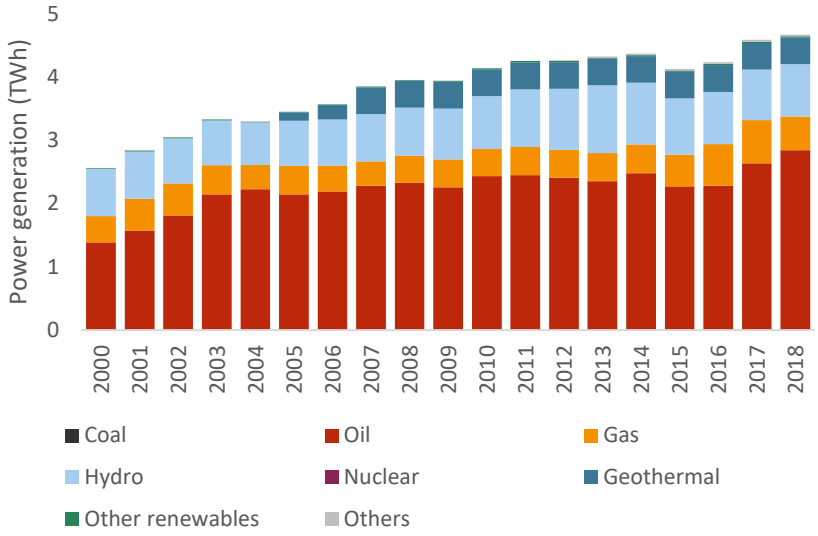


Source: EGEDA (2020)

Transformation

Electricity is mostly generated from thermal sources (72%), as shown in Figure 5. The largest of these thermal sources is oil, accounting for 61% of total electricity generation. Hydro is the largest source of renewable energy (17.8%), while geothermal and others contribute 10% of the electricity generation mix.

Figure 5: PNG's Electricity Generation by Fuel (TWh), 2000 to 2018



Source: EGEDA (2020)

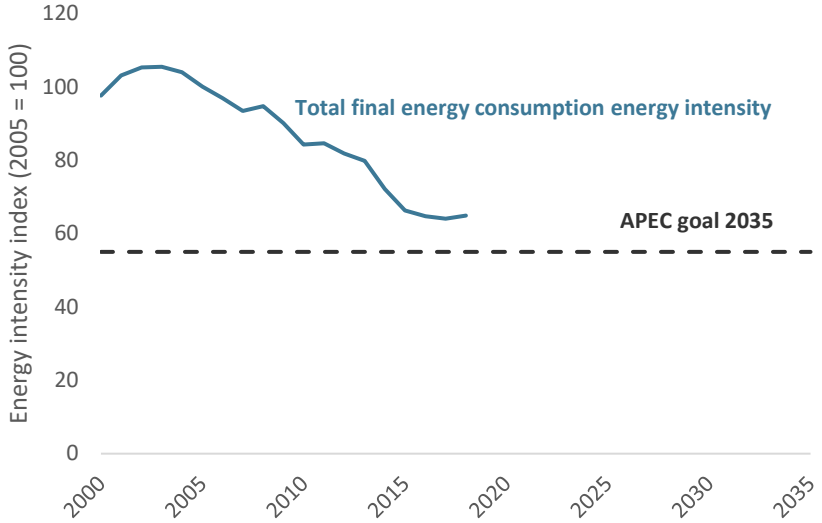
APEC Goals

Energy intensity analysis

Energy intensity was 3.5 PJ/USD PPP in 2018 and has remained relatively steady since 2015 (Figure 6). This follows a significant improvement over the prior decade. Economic growth and energy demand have moved closely together since PNG began exporting liquefied natural gas (LNG) in 2014. LNG exports partly explain the slowdown in improvement of energy intensity.

APEC member economies have agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. However, the APEC-wide target does not apply to individual economies.

Figure 6: PNG's Index of Total Fine Energy Consumption Energy intensity, 2000 to 2018 (2005 = 100)



Source: EGEDA (2020)

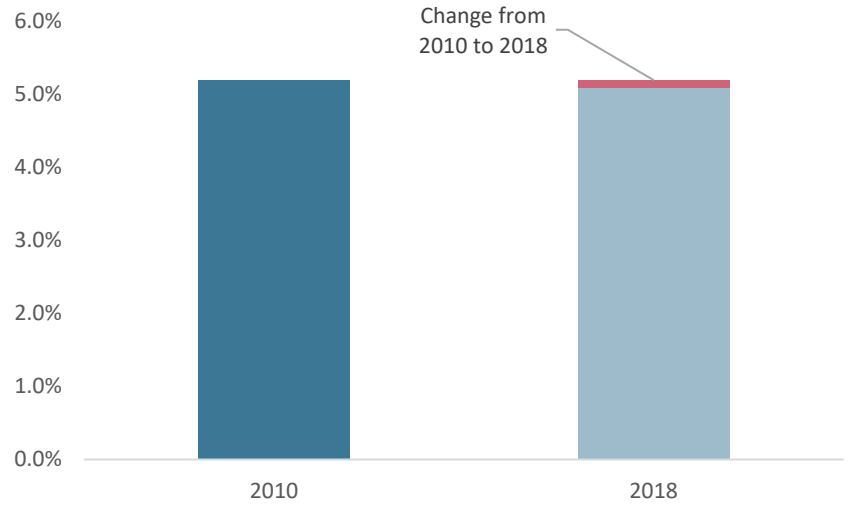
Doubling of renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption (it does not include non-energy consumption).

Given that the majority of PNG's renewable energy consumption is traditional biomass, this does not show in PNG's modern renewables share. The renewable sources included in PNG are mostly those consumed in the electricity sector. PNG's modern

renewable share (excluding traditional biomass) was 5.1% in 2018 (Figure 7). There has been no significant change since 2010.

Figure 7: PNG Modern Renewable Energy Analysis.



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass, and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also includes the share of electricity that is generated from renewable sources.

Energy policy

Energy policies in PNG have historically been focused on developing the rich natural resource sector. More recently there has been some shift in focus towards supporting a more rapid rollout of electrification, strengthening governance and institutional frameworks in the energy sector and meeting future challenges in the energy sector such as climate change.

Energy Policy	Details	Reference
100% renewable energy	An aspirational target to achieve in 100% renewable electricity sector by 2050.	Vison 2050
Economy-wide electrification	Electrification Rate of 70% by 2030 and 100% by 2050.	Vison 2050
Domestic resource utilisation	The Government will ensure 15% of gas reserves in new Oil and Gas projects should be made available for domestic gas utilisation	National Energy Policy 2017-2027
Renewable electricity generation	Increased share of renewable electricity generation from 4.4 in 2017 to 11.25 in 2020	Medium Term Development Plan
Energy Efficiency	Develop and enforce energy efficiency standards.	National Energy Policy 2017-2027
Governance	Build stronger institutions and governance frameworks for the energy sector.	National Energy Policy 2017-2027

Notable developments

Energy development	Details	Reference
USD 1.7 billion committed to electrification program	International funding from Australia, Japan, New Zealand, and the United States pledged to support achieving target of 70% of education by 2030.	Post Courier
Papua LNG Project	The project participants and the government have re-affirmed their commitment to this project at its expected to proceed. When complete it will add 6 Mpta of LNG production.	NASDAQ

References

EGEDA (Expert Group on Energy Data Analysis, APEC Energy Working Group) (2020), *APEC Energy Database*, www.egeda.ewg.apec.org/egeda/database_info/index.html

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Useful links

Papua New Guinea Mineral Resources Authority. *Government Links and Other Links* — www.mra.gov.pg/Help/UsefulLinks.aspx/

Papua New Guinea Chamber of Mines and Petroleum — http://pngchamberminpet.com.pg/

Peter O'Neill: Prime Minster of Papua New Guinea — http://www.pm.gov.pg/

Asia pacific energy https://asiapacificenergy.org

Peru

Introduction

Peru is a democratic constitutional republic with a multiparty system. With a land area covering 1.28 million square kilometres (km2), Peru is the 8th-largest economy by size in the APEC Region. Located in South America, Peru is bordered by the Pacific Ocean in the west, with Chile in the south, Ecuador and Colombia in the north, and Brazil and Bolivia in the east. Peru possesses a great range of climates as well as biodiversity. Peru has been traditionally divided into three geographical regions: the coastal region to the west, where most of the population lives, the mountain region (Andes Mountains), and the Amazonian region.

Peru has 25 administrative regions. In 2019, the population was 32.1 million, with 20.2% of inhabitants considered poor, and 2.9% under the extreme poverty line (INEI, 2019a). The major population centre of Peru is Lima, with 10.4 million people, which is nearly one-third of the total population; the urbanisation rate is 72% (INEI, 2019b).

In 2019, Peru's gross domestic product (GDP) was USD 418 billion (2017 USD purchasing power parity [PPP]), with GDP per capita increasing 0.5% from 2019 (WorldBank, 2020). Foreign reserves accounted for USD 68 billion, and the fiscal balance amounted to a deficit equal to 1.6% of the GDP (BCRP, 2019).

The industrial sector contributes 30% of Peru's GDP (WorldBank, 2020). Peru has a large and dynamic mining industry, mainly engaged in copper and gold extraction. Mining exports amounted to 9.1% of GDP and 60% of all exports value in 2010 (MINEM, 2020). In 2019, Peru was the second-largest producer of silver, copper, and zinc, the third largest-largest producer of lead, the fourth-largest producer of tin and molybdenum, and the eighth-largest supplier of gold (MINEM, 2020), which demonstrate the importance of this sector in this economy.

Table 1: Peru's Macroeconomic Data and Energy Reserves (2018)

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	1.3	Oil (million barrels)	344.5
Population (million)	32	Natural Gas (trillion cubic feet)	10.6
GDP (2018 USD billion PPP)	409	Coal (million tonnes)	5.5
GDP per capita (2018 USD PPP)	12 782	Uranium (kilotonnes U_3O_8)	14

Source: [a] WorldBank (2020),[b] MINEM (2020), [c] NEA (2020)

According to the Ministry of Energy and Mines (MINEM, 2020), Peru has substantial proven gas reserves estimated at 10.6 trillion cubic feet (Tcf). The most abundant gas reserves are located in Selva Sur (Ucayali, Madre de Dios), Costa, Zocalo and Talara, and the proven oil reserves are estimated at 344.5 million barrels (MMB). Peru's proven mineral coal reserves are around 5.5 million tonnes (Mt), with approximately 36.8% consisting of anthracite and the remainder formed by bituminous coal (MEM, 2020a). Most of the reserves are in the La Libertad, Ancash and Lima departments.

The Central Reserve Bank of Peru (BCRP) reported a flow of USD 8 892 million of foreign direct investment (FDI) in 2019, more than USD 2 404 million greater than in 2018. A FDI flow reduction is projected for 2020 due to the COVID-19 crisis, but with an expected recovery in the subsequent years (BCRP, 2020). The estimated amount of the mining project portfolio is USD 57 billion, making Peru an attractive hub for investments.

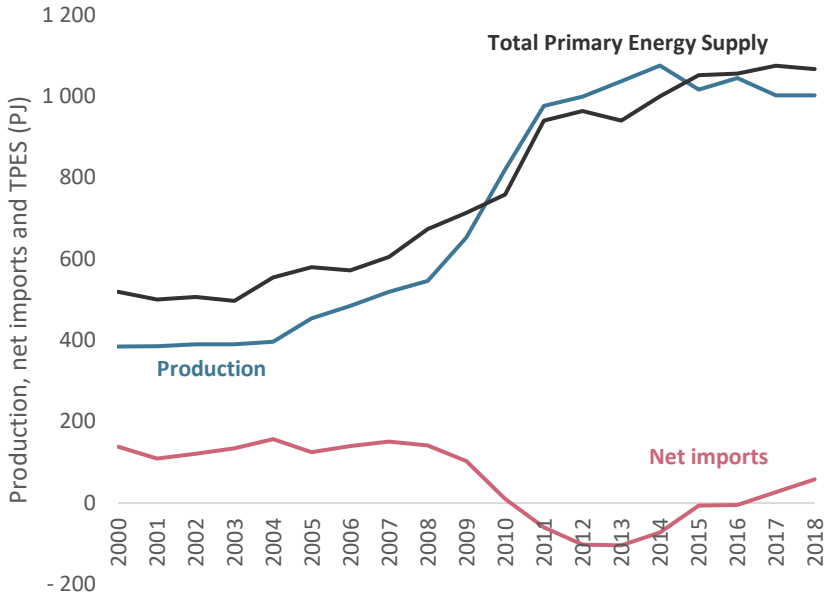
Peru was severely affected by the COVID-19 pandemic: the GDP decline for 2020 is estimated to be 11.6% due to the strict generalised quarantine that was implemented to control the spread of the virus. Economic growth of 10% is expected in 2021, assuming accelerated execution of public investment and improved global conditions with access to COVID-19 vaccines.

Energy Supply and Consumption

Total Primary Energy Supply

Peru's total primary energy supply (TPES) in 2018 was 1 067 petajoules (PJ), 1% lower than the 2017 level. This fall in TPES was mainly caused by the decrease in oil supply (–4%) (EGEDA, 2020). Energy production stayed at 2017 levels, 1003 PJ, and net imports reached 58 PJ, confirming Peru as a net energy importer.

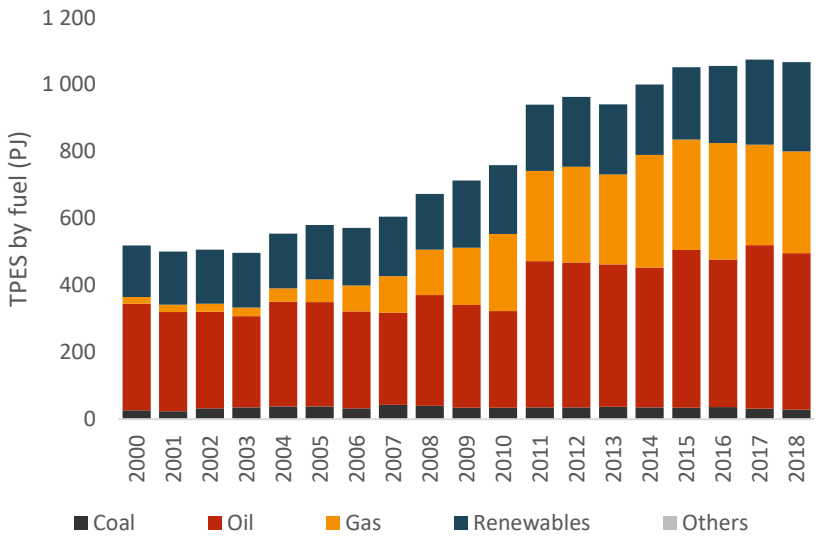
Figure 1: Peru's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

According to EGEDA (2020), in 2018, around 44% (468 PJ) of the TPES was from oil, 29% from natural gas (304 PJ), 3% from coal (28 PJ), and 25% (266 PJ) from renewable sources. Peru's TPES fuel mix from 2000 to 2018 (Figure 2) showed the impact of the Camisea Project that started natural gas production in 2004.

Figure 2: Peru's Total Primary Energy Supply by Fuel, 2000 to 2018



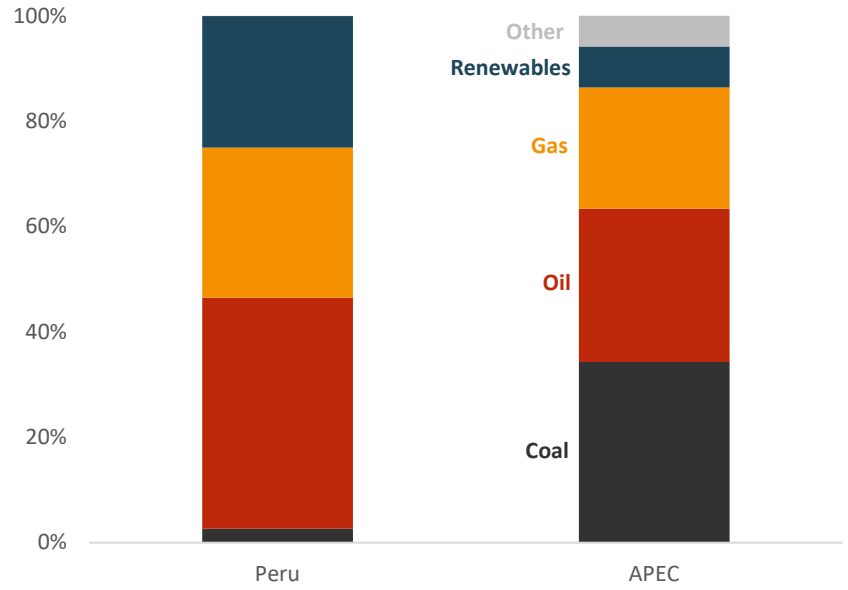
Source: EGEDA (2020)

When compared to the entire APEC region, Peru exhibits a different fuel mix (Figure 3), where the renewables share is larger due to hydro energy being utilised in the power sector and fuelwood, mostly, for cooking in the residential sector. Total renewable energy production in Peru in 2018 was 266 PJ, which represents 25% of Peru's TPES. Production increased by 4.6% from the previous year (255 PJ), with growth in hydro and modern biomass (EGEDA, 2020).

Additionally, oil share is also larger mainly due to the transport sector (EGEDA, 2020). Peru is a net oil importer because domestic production is insufficient to meet domestic demand. Domestic oil production supplies approximately 30% of crude oil consumed in local refineries. The modernisation project of the Talara refinery is a megaproject that is expected to conclude in 2022 and expand the Talara refinery capacity from 65 000 to 95 000 barrels per day (bpd), reducing the amount of sulphur in fuels and increasing the capability of processing heavy quality crude oil, among other benefits.

In 2018, Peru exported 5.2 bcm of LNG, which was equal to 31.2% of the total natural gas production (BP, 2019). Since 2012, more than 95% of Peru's total gas production comes from the Camisea field (MEM, 2020a).

Figure 3: Relative Fuel Share of Total Primary Energy Supply, Peru and APEC, 2018



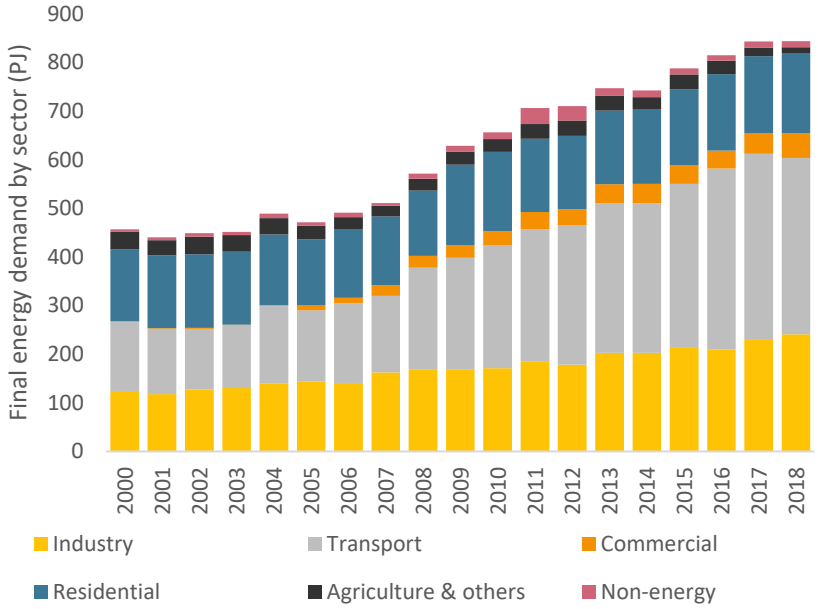
Source: EGEDA (2020)

Coal's primary role is in the industrial (81%) and electricity production (19%) sectors.

Total Final Consumption

Transport is the dominant end-use sector, accounting for 43% of all end-use energy consumption (including non-energy) in 2018. Industrial and residential are the next largest sectors, accounting for 29% and 20% of all end-use sectors, respectively.

Figure 4: Peru's Final Energy Demand by Sector, 2000 to 2018

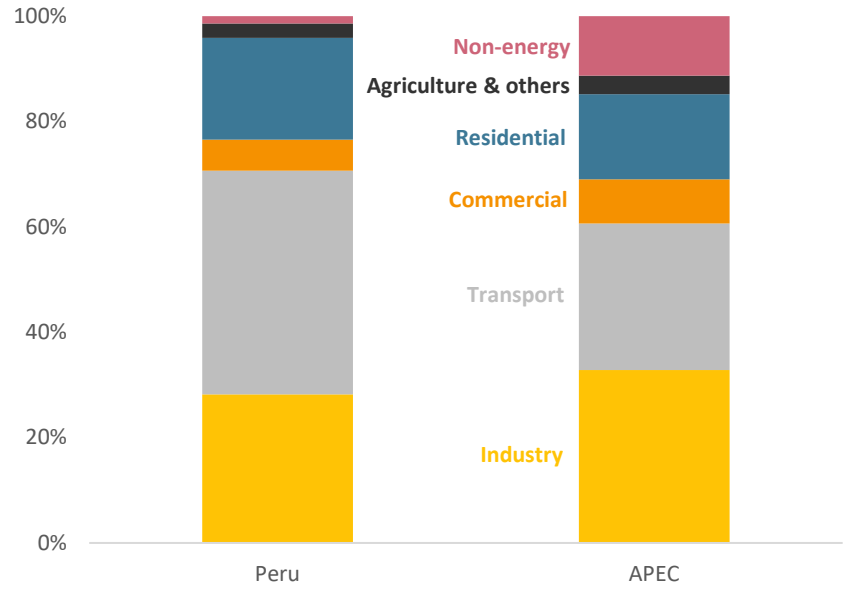


Source: EGEDA (2020)

The economic growth that Peru experienced during the last years, drove an activity increment in the industrial and transport sectors and an increase in energy efficiency in the residential sector, due to the displacement of traditional biomass stoves with more efficient fuels and technologies (Figure 4).

Peru's transport energy demand share is notoriously larger than APEC's (Figure 5), a situation that is incited by the complicated geography and insufficient transport infrastructure.

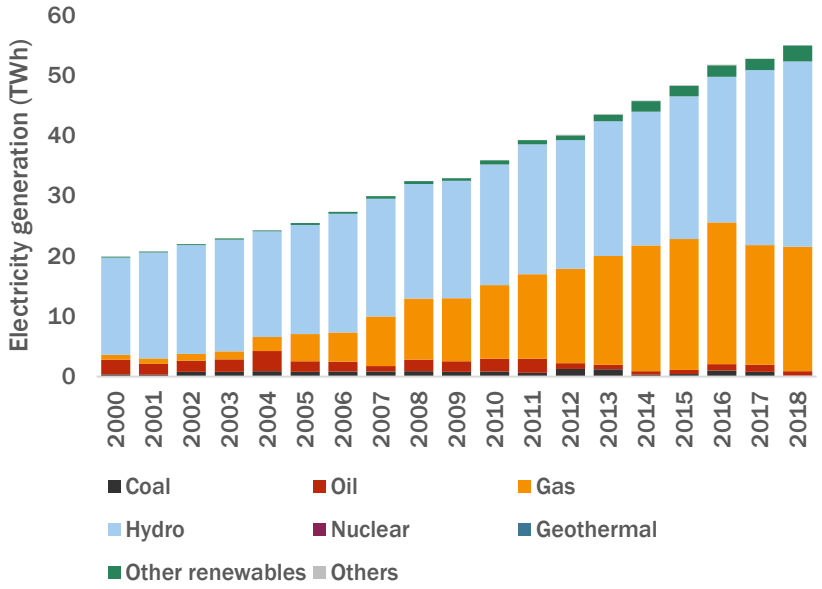
Figure 5: Relative Final Energy Demand by Sector, Peru and APEC, 2018



Source: EGEDA (2020)

In 2018, Peru's electricity generation totalled 55 003 gigawatt-hours (GWh), with 54,9% coming from renewable sources, 38% from natural gas, 1.4% from oil and 0.2% from coal (IEA, 2019a). Notable is the increase of power generated by natural gas starting in 2004 when Camisea became operational. In 2018, the power sector consumed around 55.8% of the natural gas available for domestic consumption.

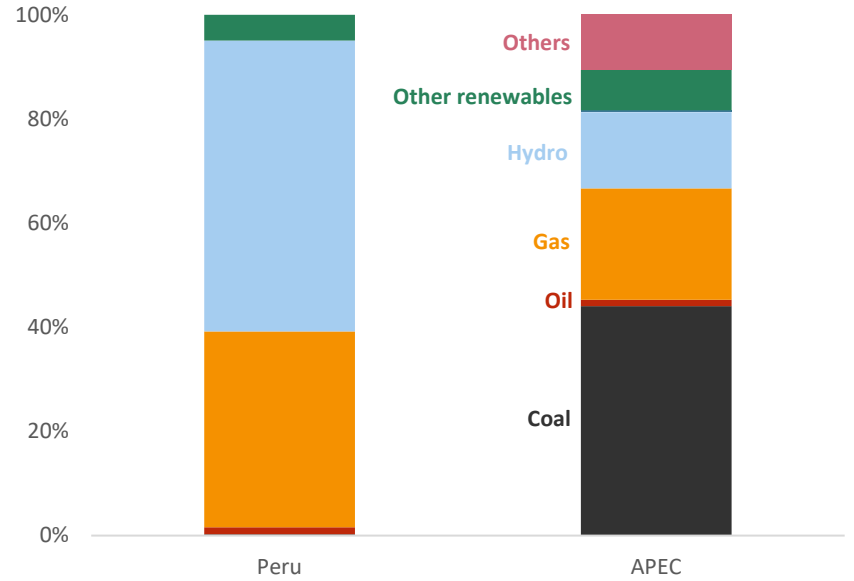
Figure 6: Peru's Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Coal has marginal participation in electricity generation. Peru generates greater renewable energy than APEC (60% in 2018), mainly due to hydro generation. Other renewables, including solar PV, Wind, and biomass , account for 4.8% of electricity generation.

Figure 7: Relative Electricity Generation by Fuel, Peru and APEC, 2018



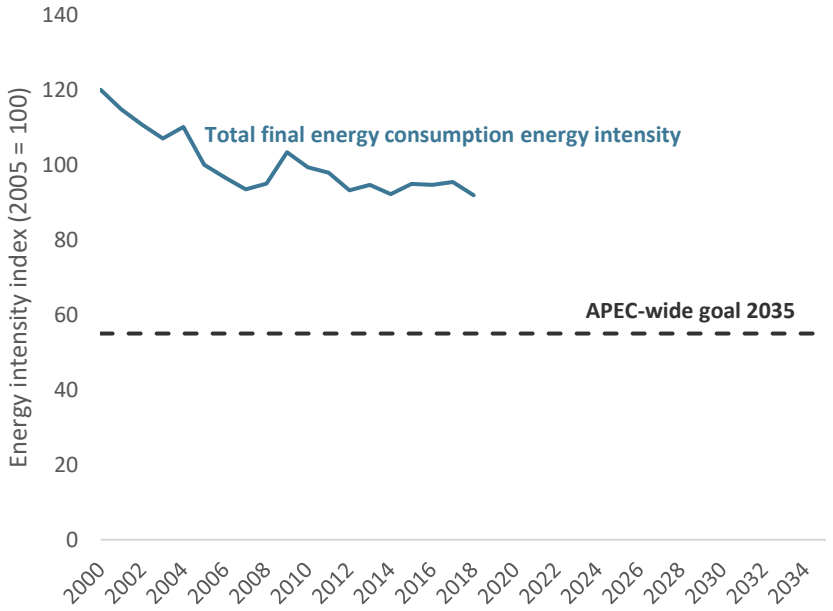
Source: EGEDA (2020)

APEC Goals

Energy Intensity Analysis

Peru's energy intensity, measured as total final energy consumption intensity (not including non-energy), has been declining since 2000 (Figure 8). In 2018, Peru reduced its energy intensity by 8% with respect to the 2005 level, which is far from the 45% reduction by 2035 agreed upon as an APEC-wide goal.

Figure 8: Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)

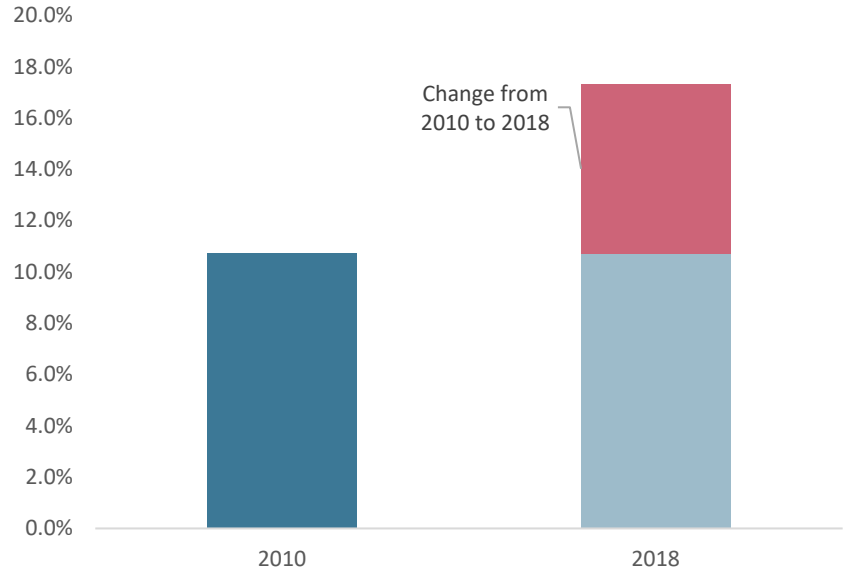


Source: EGEDA (2020)

Doubling of Renewables

On the other hand, there is a second energy goal which involves doubling the share of renewables in the APEC energy mix for the period 2010 to 2030. Modern renewables do not include traditional biomass and the share is relative to final energy consumption. Peru's contribution to that goal can be observed by the increase of the share of renewables from 10.7% in 2010 to 17.3% in 2018, being 4.1% short of reaching the doubling of renewables share.

Figure 9: Peru's Modern Renewable Energy Share, 2010 to 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy Policy	Details	Reference
Natural gas Massification	The project consists of the natural gas distribution through a pipeline network in the regions of Puno, Cusco, Ayacucho, Huancavelica, Apurímac, Ucayali and Junín.	Proinversion
Modernisation of Talara Refinery	The project involves the construction and extension of facilities aimed at increasing refining capacity from 65 000 bpd to 95 000 bpd by 2022, producing cleaner fuels, reducing imports of such products, and thereby improving Peru's trade balance.	Petroperu
Increase in Hydrocarbon Production	The plan is to increase oil production to 100 000 bpd, and natural gas production to 1 500 MM SCFD by 2023. Investment for 2019–2023: USD 3 935 million	Perupetro
20121 to 2030 Transmission Plan	The transmission plan, elaborated by COES and approved by the Ministry of Energy and Mines, defines a list of projects that reinforce the electric transmission grid. The estimated investment is USD 981 million.	Ministry of Energy and Mines
National Plan of Rural electrification	The objective of the Rural Electrification Project is to reduce greenhouse gas emissions by the use of Renewable Energy to provide electricity to rural areas. In 2018, rural electrification reached 86.7% and economy-wide electrification was 92%. The policy target is to reach 100% by 2022.	Ministry of Energy and Mines
Increase in Residential Natural Gas Coverage	Residential natural gas coverage reached 11% in 2019.	Ministry of Energy and Mines
Non-conventional Renewable Energy Target (NCRE)	Peruvian electricity generation has a significant amount of Renewable via hydropower (55%), but the NCRE is around 5%.	Ministry of Energy and Mines
The Southern Peruvian Gas Pipeline	This pipeline will increase the natural gas transportation capacity to 800mcf/d by 2026. Pre-investment studies have been concluded. Construction is expected to start in 2023. The areas to reach through the pipelines are as follows: Camisea – Lima (500km); Peru LNG (300km). Ica – Marcona (300km); Marcona – Mollendo loop (500km). Central Highlands – Trujillo (1,100 km); Trujillo – Piura (500 km); Piura – Tumbes (400km).	Ministry of Economy and Finance
Clean Fuel standards	Incorporation of more efficient vehicle fuels with natural gas, more efficient management of natural gas (CNG or LNG) fuel in passenger and cargo transportation fleets.	Ministry of Environment

Electric Vehicles Promotion	The expansion of electric transportation system. The government will look to replace traditional fleet vehicles with electric and hybrid counterparts across the public sector. This measure will help Peru to reach its goal of reducing CO_2 emissions by 30% at the end of 2030.	Ministry of Environment
Energy Efficiency Policies	Use of mass transportation corridors or subways in the main cities.	Ministry of Environment
Energy Efficiency Labelling Regulation	Regulation for household appliances, water heaters, lighting, electric motors and boilers. Also, outlining a minimum energy efficiency standard.	Ministry of Environment
National Determined Contributions	The Peruvian NDC envisages a reduction of emissions equivalent to 30% by 2030 with respect to the projected Business as Usual scenario which baseline is 2010.	Ministry of Environment

Notable Developments

Energy development	Details	Reference
2021 Annual Promotion Program	The Ministry of Energy and Mines approved projects to extend the coverage of natural gas residential services. Bonogas Residencial program will reach an additional 285 000 houses and Bonogas vehicular will reach 18 500 users in 2021.	Ministry of Energy and Mines
Shutdown Talara Refinery	The Talara Refinery modernisation required shutting down of the refinery since 2020. The new refinery is expected to be operating by the end of 2022	Ministry of Energy and Mines
Renewable Energy Projects	In 2020, four RE projects entered operation: the hydroelectric project Manta (20 MW), biomass project Callao (2.4 MW) and wind projects Huambo (18.4 MW) and Duna (18.4 MW).	Ministry of Energy and Mines

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Useful links

Central Reserve Bank of Peru — www.bcrp.gob.pe

Committee for Economic Operation of the Interconnected National System — www.coes.org.pe

Geological, Mining and Metallurgical Institute — www.gob.pe/ingemmet

Ministry of Economy and Finance — www.gob.pe/mef

Ministry of Energy and Mines — www.gob.pe/minem

Ministry of Environment — www.gob.pe/minam

Ministry of Production — www.gob.pe/produce

National Institute of Statistics — www.inei.gob.pe

Nuclear Energy Institute — www.ipen.gob.pe

Perupetro — www.perupetro.com.pe

Petroperu — www.petroperu.com.pe

Private Investment Promotion Agency — www.gob.pe/proinversion

Supervisory Organism of Investment in Energy and Mines — www.osinergmin.gob.pe

The Philippines

Introduction

The Philippines is an archipelago comprising 7 641 islands and covering a total land area of 343 448 square kilometres (km2). It is divided into three main island groups – Luzon, Visayas and Mindanao; Manila City in Luzon is the capital (gov.ph, 2021).

Seated along the 'Ring of Fire', the Philippines is one of the APEC economies with immense geothermal energy resources. Owing to this, the economy was the third-largest geothermal energy producer in the world in 2019, with 1 928 megawatts (MW) of installed geothermal power capacity. This placed the Philippines behind the US (2 555 MW) and Indonesia (2 131 MW) (IRENA, 2021).

The Philippines' GDP reached USD 908 billion (2017 USD purchasing power parity [PPP]) in 2018, a 6.3% increase from 2017 (World Bank, 2020). Business activities remained buoyant and contributed to the high growth rate (Borromeo et al., 2019). The population was 1.4% higher, reaching 107 million people in 2017. Although among the lowest in APEC, the GDP per capita increased 4.9% to USD 8 516 (2017 USD PPP) in 2018.

The government is committed to developing and utilising its own fossil fuel and renewable energy resources to ensure sufficient energy supply and to meet its growing requirements. The Philippines has 215 million barrels (MMb) of oil reserves (including condensate) and 2 360 million tonnes (Mt) of coal reserves that are potentially recoverable. The Philippines has been benefiting from its natural gas reserves (3 376 PJ) since its initial production in 2001 (DOE, 2017a) and, in anticipation of depletion, the economy has outlined plans to develop LNG facilities (DOE, 2020a).

Table 1: Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b]	
Area (thousand km^2)	343	Oil (billion barrels)	215
Population (million)	107	Gas (petajoules)	3 376
GDP (2017 USD billion PPP)	908	Coal (million tonnes)	2 360
GDP per capita (2017 USD PPP)	8 516	Uranium (kilotonnes U_3O_8)	-

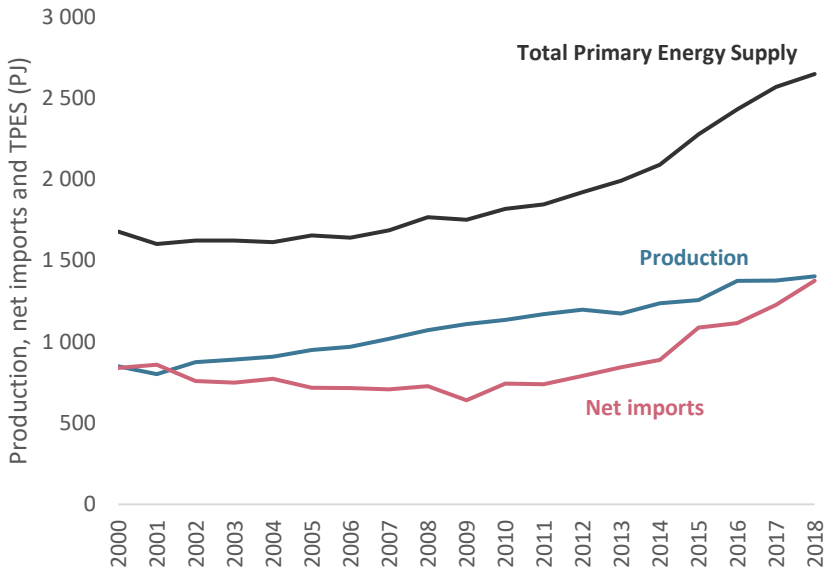
Source: [a] World Bank (2020), [b] DOE (2017a)

Energy Supply and Consumption

Total Primary Energy Supply

The Philippines' total primary energy supply (TPES) increased 3.1% to reach 2 648 PJ in 2018 (Figure 1). To augment the economy's domestic resources, energy imports increased 9.1% in 2018. Even with the increase in imports, domestic production still accounted for more than 50% (1 403 PJ) of TPES, consisting mostly of renewable energy sources (36%) (EGEDA, 2020).

Figure 1: The Philippines Total Primary Energy Supply, 2000 to 2018

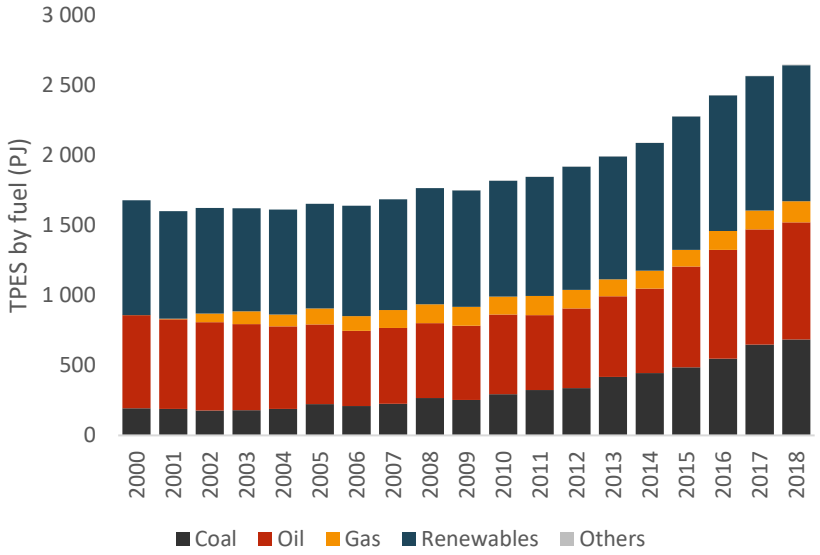


Source: EGEDA (2020)

Fossil fuels accounted for the lion's share of TPES (63%), with fuel sourced from oil dominating fossil fuels (50%) and imports (63%). Coal continued to play an important part in the economy's energy mix, especially for power generation, constituting 41% of total fossil fuels in 2018. Although natural gas contributed the smallest share among fossil fuels (9%) in 2018, it surged fastest, at 11.6% (Figure 2).

Among renewables, biomass had the largest share (532 PJ or 55%) of the total RE supply in 2018, while biofuels rose significantly: 13.4% from 2017 to 2018. Geothermal was also an important part of the economy's energy mix in 2018, accounting for the second-largest renewable energy supply (39%) and grew 1.6% to 375 PJ.

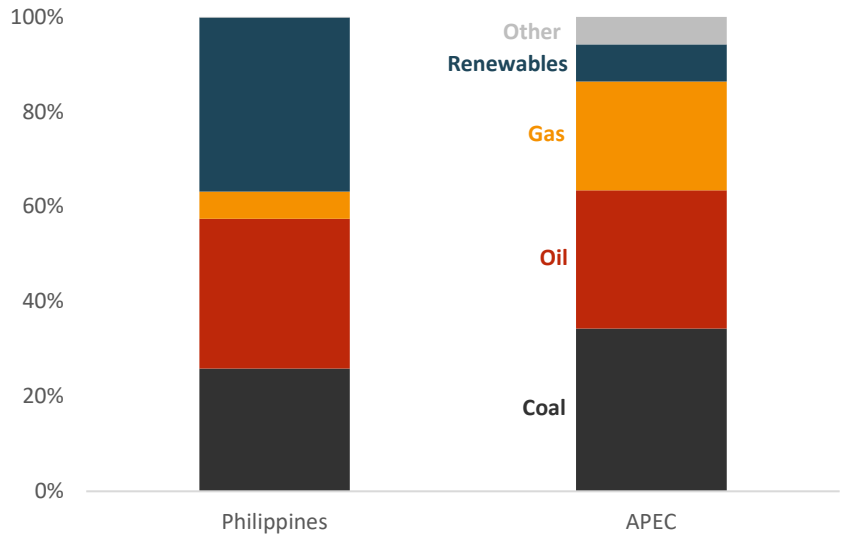
Figure 2: The Philippines Total Primary Energy Supply by Fuel 2000 to 2018



Source: EGEDA (2020)

In the Philippines, renewables had a much larger share of TPES than the entire APEC region, in 2018 (Figure 3). Oil's share was larger than for the entire APEC region, while coal's share was smaller.

Figure 3: Relative Fuel Share of Total Primary Energy Supply, the Philippines and APEC, 2018



Source: EGEDA (2020)

Total Final Consumption

Total final consumption in the Philippines, which includes non-energy consumption, posted a minimal 0.7% (1 496 PJ) increase in 2018. Although accounting only for 4%, the huge drop in non-energy use from 2017 to 2018 (11.8%) contributed to the dwindling growth of total final consumption. Excluding non-energy, total final energy consumption grew 1.3% to 1 436 PJ in 2018 (EGEDA, 2020).

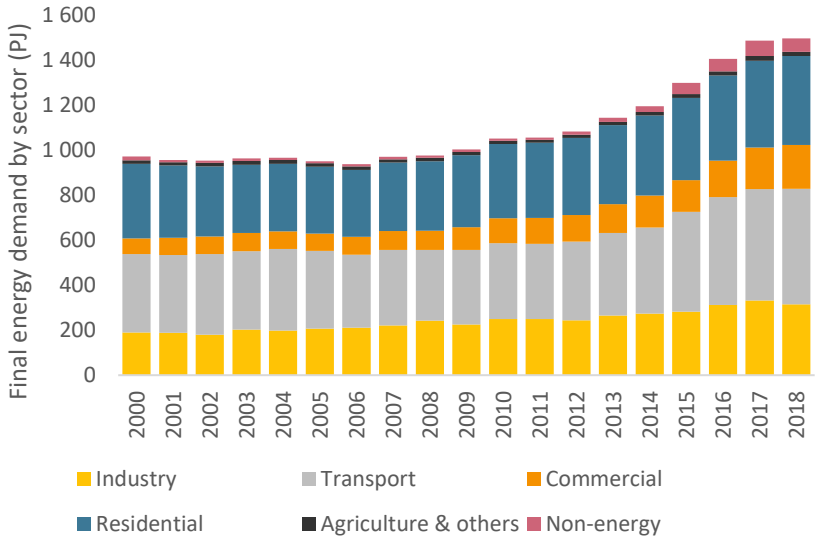
Transport was the largest energy consuming sector of the Philippines, accounting for 34% of total final consumption in 2018. The residential sector was the second largest, accounting for 26%.

The commercial sector accounted for 13% of the TFC, increasing by 6% to 195 PJ in 2018.

Agriculture, forestry and fishing, and other end-users not elsewhere classified declined by 14.8% in energy use in 2018, while the industry sector also fell by 5.1%.

In terms of fuel source, oil remained dominant, accounting for 51% of total final consumption (including non-energy); the transport sector was the major oil user. Growth in gas use was significant at 13.1% from 2017 to 2018, despite a meagre share of 0.2% to TFEC (excluding non-energy use).

Figure 4: The Philippines Final Energy Demand by Sector, 2000 to 2018

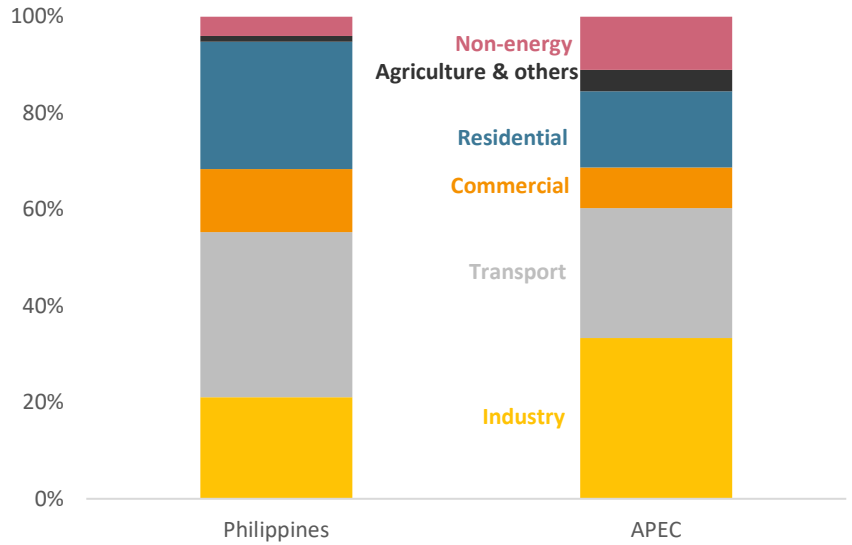


Source: EGEDA (2020)

Relative to APEC, the Philippines' transport and residential sectors were the largest energy users. This was reflective of the economy's

increasing income per capita that accorded consumers more power to purchase gadgets and technologies attributable to transport and residential use (DOE, 2020b) (Figure 5).

Figure 5: Proportional Final Energy Demand for the Philippines and APEC, 2018



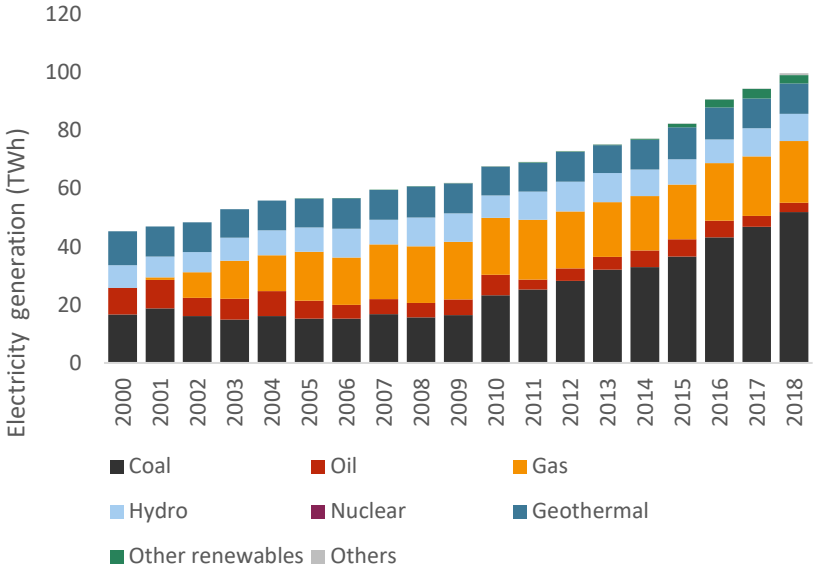
Source: EGEDA (2020)

Transformation

The Philippines' electricity generation reached almost 100 TWh in 2018. Fossil fuels contributed more than three-fourths of the economy's electricity generation mix. Coal accounted for the biggest share in the power generation mix increasing by 10.9% to 52 TWh in 2018 (or 52% of the mix). Gas came next (21%), and third was geothermal (10%) (EGEDA, 2020) (Figure 6).

Coal drove the increase in electricity generation while the renewables' contribution to power generation fell by percentage points to 23 TWh. The drop in RE's share from 2017 to 2018 was largely due to the decline in hydro (2.4%).

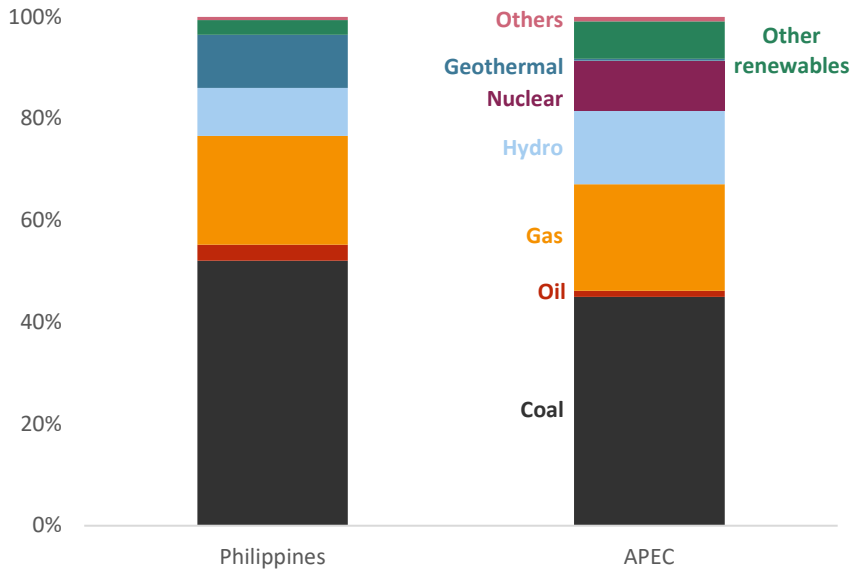
Figure 6: The Philippines Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

The dominance of coal in the Philippines' power generation mix is larger than for coal's share in the APEC region's electricity generation mix. For the Philippines, geothermal contribution to electricity generation is more prominent than for APEC as a whole. This is primarily because the Philippines was among the top three APEC economies with large geothermal resources (IRENA, 2021) (Figure 7).

Figure 7: Relative Electricity Generation by Fuel, the Philippines and APEC, 2018



Source: EGEDA (2020)

APEC Goals

There are two energy-related objectives that APEC member economies have agreed to meet. These pertain to improving energy intensity and increasing the share of renewables in the energy mix.

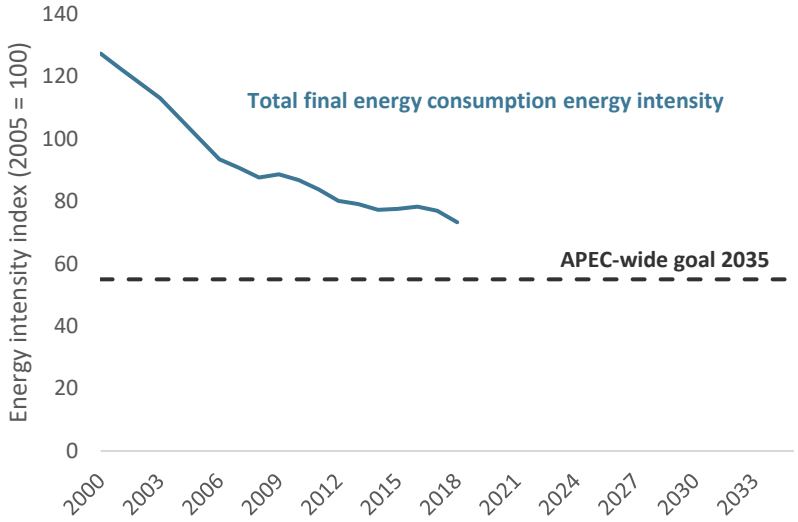
Energy Intensity Goal

In 2011, APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to the same 2005 baseline.

APEC is on track to meet this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2018, the Philippines' total final energy consumption (not including non-energy) energy intensity had improved by 27%, relative to 2005. To contribute proportionally, the Philippines will need to improve its energy intensity by an additional 18% between 2018 to 2035 (Figure 8).

Figure 8: The Philippines Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020)

Doubling of Renewables

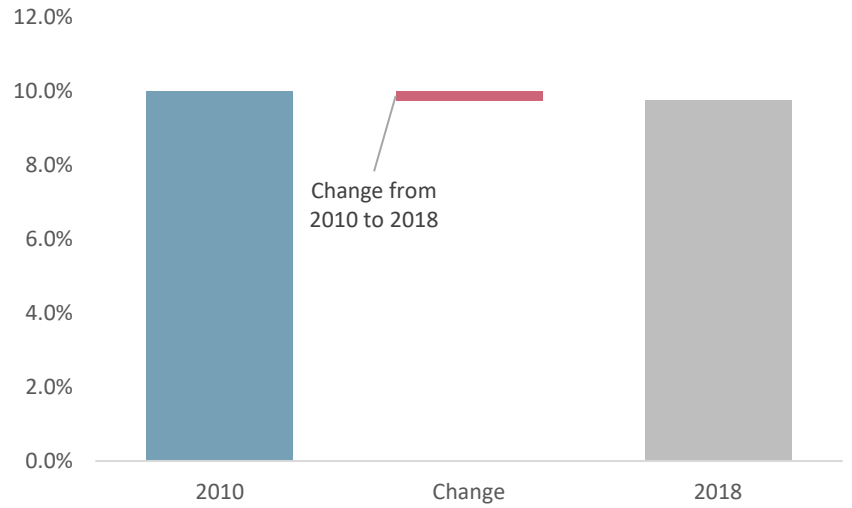
The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the 2010–2030 period.

Modern renewables do not include traditional biomass, and the share is relative to the final energy consumption.

There is no economy-level goal for individual member economies, but it is possible to calculate the relative improvement of individual economies to more effectively predict whether the goal can be achieved.

In line with this target, the Philippines also aims at increasing the share of renewable energy; the economy has intensified its renewable strategies (DOE, 2020b). However, in 2018, the modern renewable share of the economy was 9.7% of total final energy consumption, which was 0.3% lower than the 2010 share (10.0%) (Figure 9).

Figure 9: Philippines Modern Renewable Energy Share Analysis, 2010 to 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and not included in the definition of modern renewables. All other renewables (biomass used by industries, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

The energy sector is guided by the directives of the Filipino President's *AmBisyon Natin 2040*[4] (NEDA, 2017). To realise the vision, a sectoral roadmap has been crafted for each energy subsector containing long-term objectives, deliverables and targets consistent with the *Strategic Directions*[5] and the *Nine-Point Agenda (DOE, 2020b).*

Energy Policy	Details	Reference
NDC Targets	An economy-wide 75% reduction of GHG emission by 2030, relative to the business-as-usual scenario from 2000 to 2030[6]	UNFCC
Implementation of RA 9513 (RE Law)	The National Renewable Energy Program (NREP) outlines the policy framework stipulated in Republic Act 9513. The strategies set out in the Biofuels Act of 2006 form part of the implementation of the RE Law.	Department of Energy
Philippine Energy Plan (2018-2040)	The DOE's blueprint to secure the economy's energy future was created following regional consultations and IECs. The formulation of the PEP paved the way for the identification of sectoral energy roadmaps to achieve increased energy access and energy security.	Department of Energy
National Renewable Energy Program	A 20-year RE target capacity addition to triple the 2010 installed capacity from 5 439 MW to 15 304 MW by 2030	Department of Energy
National Energy Efficiency and Conservation Program	Increase awareness and attain measurable targets for the period 2011 to 2030, focusing on the following: - reducing the economy's final energy demand by 10% - energy savings of 69 100 ktoe - deferment of 6 780 MWe of the additional capacity - reduction of 178 980 kT of CO_2 emissions	Department of Energy
Energy Efficiency and Conservation Act of 2019 (RA 11285)	An act institutionalising energy efficiency and conservation, enhancing the efficient use of energy and granting incentives to energy efficiency and conservation projects	Department of Energy

[4] ***AmBisyon Natin 2040*** represents the collective long-term vision and aspirations of the Filipino people for themselves and the economy in the next 25 years. It describes the kind of life that people want to live, and how the economy will look like by 2040.
[5] Encompasses the government's call towards inclusive growth, high trust society and a globally competitive knowledge economy.
[6] Of the 75% reduction target, identified policies and measures (PAMS) account for 10.9% or 365.2 $MTCO_2e$ reduction from the BAU/Reference Scenario. Of this total, the energy sector is expected to contribute 45.9 MTCOe (12.6% share to total), which translates to a 1.4% reduction in the sector's GHG emission over the BAU. PAMS still to be identified will account for 64.1% avoidance, thereby completing the target of 75% GHG reduction.

RE Roadmap	To increase RE installed capacity to at least 20 000 MW by 2040. Around 16 949 MW of potential RE capacities are expected to be added within the planning horizon, 2017–2040	Department of Energy
FiT Installation Target (MW)	Policy mechanism under RE Law Run-off river hydro (250 MW) Biomass (250 MW) Wind (400 MW) Solar PV (500 MW) Ocean (10 MW)	Department of Energy
Biofuels Roadmap	Continue implementation of blending targets set in the Biofuels Act of 2006	Department of Energy
Power Development Plan (2017–2040)	A master plan which integrates all the development plans for the generation, transmission, distribution and supply sectors for the grid and off-grid areas. Also outlines the recent developments in the electricity market, the off-grid and missionary areas, household electrification and the institutional support mechanisms of the Philippines.	Department of Energy
Alternative Fuels and Energy Technologies Roadmap 2017–2040	Elements being prioritised are as follows: 1) Electric vehicles 2) Auto LPG 3) CNG 4) LNG 5) Hybrid-electric vehicles	Department of Energy
Upstream Oil and Gas Roadmap	Increase indigenous petroleum reserves to 57.12 MMB oil, 5.87 TCF gas and 56.81 MMB condensate. Produce 115.37 MMB oil, 4.04TCF gas, and 45.93 MMB condensate	Department of Energy
Downstream Oil Roadmap	An improved policy governing the downstream oil industry to ensure the continuous supply of high quality and an appropriate quantity of petroleum products in the market	Department of Energy
Biomass	Additional potential capacity: Grid connection: 312 MW Own-use: 13.77 MW	Department of Energy

Notable energy developments

At EWG 60, the Philippines announced its priority plans and programs in the coming years. This included the study on the use of hydrogen, which the government is actively pursuing. The DOE has signed two (2) Memorandum of Understanding (MOU) – on 27 January 2021 with Australia-based research and development company Star Scientific Ltd. to explore the potential of hydrogen as one of the economy's energy sources; and on 07 April 2021 with Tokyo-based company Hydrogen Technology Inc. (HTI) on 07 April 2021 to advance the study and research on hydrogen as a fuel for power generation(DOE, 2021). This is an addition to the continuing efforts of the DOE on nuclear power development with the passage of the Executive Order 116.

Meanwhile, as energy security is a critical driver of economic development, the DOE is pushing for its inclusion as a key priority area in the government's security plan as elucidated in the PEP. Other notable energy developments include the issuance of moratorium on greenfield coal projects and relaxing of foreign participation in geothermal projects.

Energy development	Details	Reference
Hydrogen	Priority research project of the Philippines. The DOE Secretary has instructed concerned units in the Department to conduct hydrogen fusion technologies and to include hydrogen in the energy mix as well as in the carbon neutralisation target.	DOE, 2021
Energy Security	Now an important inclusion in the Philippine Energy Plan which includes the mainstreaming of energy resiliency plans, programs and activities in the whole energy industry to ensure reliable and sufficient supply during crisis and disaster events	Department of Energy
Nuclear Energy	The passage of Executive Order 116 (s2020) in July 2020 constituted the Nuclear Energy Program Inter-Agency Committee (NEP-IAC) to address the infrastructure requirements nuclear energy development. The NEP-IAC has already submitted its recommendation to the Office of the President on adopting a position for a Nuclear Energy Program.	(gov.ph, 2020)
Declaration of a moratorium on endorsement of greenfield coal-fired power plants	The DOE has issued an advisory on the in line with improving the sustainability of the economy's electric power industry and in favour of more flexible capacities and technologies.	(DOE, 2020c)
Opening up the geothermal sector to greater foreign investments	Issued a Department Circular providing the guidelines for the 3rd Open and Competitive Selection Process, or OCSP3, in the awarding of Renewable Energy Service Contracts. OCSP3 allows for 100% foreign participation in large-scale geothermal exploration, development, and utilization projects.	(DOE, 2020d)

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Useful links

Asian Development Bank – www.adb.org

Climate Change Commission (CCC) – www.climate.gov.ph

Department of Energy, Republic of the Philippines (DOE) – www.doe.gov.ph

Department of Science and Technology (DOST) – www.dost.gov.ph/

Department of Trade and Industry (DTI) – www.dti.gov.ph/

Department of Transportation and Communication (DOTC)/Land Transportation Franchising and Regulatory Board (LTFRB) – www.dotc.gov.ph

GOV.PH – Home - GOV.PH (www.gov.ph)

National Power Corporation (NPC) – www.napocor.gov.ph/

National Transmission Corporation (TransCO) – www.transco.ph/

Philippine National Oil Company (PNOC) – www.pnoc.com.ph/

Wholesale Electricity Spot Market (WESM) – www.wesm.ph/

World Bank – https://www.worldbank.org/en/country/philippines

Russia

Introduction

Russia has the largest land area in the world, spanning over 17 million square kilometres. This economy is located in both Eastern Europe and Northern Asia. Russia shares land borders with 16 economies and has maritime boundaries with two more. Its territory is characterised by different geographic and weather conditions, including broad plains west of the Urals, coniferous forests in Siberia, tundra along the Arctic seaboard, and uplands and mountains in the southern regions. Russia has vast natural resources including major deposits of coal, natural gas, oil, and other minerals. Its population of 147 million people lives mostly in urban areas (74%); 68% of the population is in the European part of Russia, which accounts for 21% of the territory (World Bank, ROSSTAT, 2020).

In 2018, Russia's gross domestic product (GDP) reached USD 3 926 billion (2017 USD purchasing power parity [PPP]), a 2.5% increase from its 2017 GDP (World Bank, 2020).

Russia has the world's largest natural gas (19% of the world total), coal (15%), oil (6.2%) and uranium reserves (5.5%) (BP, 2020) (NEA, 2020).

Russia is the world's largest exporters of energy overall. In 2019, Russia was the world's largest exporter of natural gas and the second-largest exporter of crude oil, and it ranked third in coal exports (BP, 2020).

In 2020, due to a significant decrease in energy demand, natural gas pipeline exports decreased by 9% (year-to-year), oil exports by 11% and coal exports by 3%. At the same time, LNG exports increased by 4% (Federal Customs Service of Russia, 2020).

Most of Russia's energy exports go to Europe, as well as the Commonwealth of Independent States (CIS). Since 2008, Russia has been actively diversifying its export routes towards the Asia-Pacific region, aiming to deliver crude oil, petroleum products, natural gas and coal to China, Japan, Korea and Southeast Asia.

Russia has the world's largest, and among the oldest, district heating systems with centralised heat production and distribution networks in most major cities.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a, b]		Energy reserves [c, d, e]	
Area (million km^2)	17	Oil (billion barrels)	104.2
Population (million)	147	Gas (trillion cubic metres)	38
GDP (2017 USD billion PPP)	3 926	Coal (billion tonnes)	162
GDP per capita (2017 USD PPP)	26 378	Uranium (kilotonnes)	211

Source: [a] ROSSTAT (2020), [b] World Bank (2020), [c] EGEDA (2020), [d] BP (2020), [e] NEA (2020)

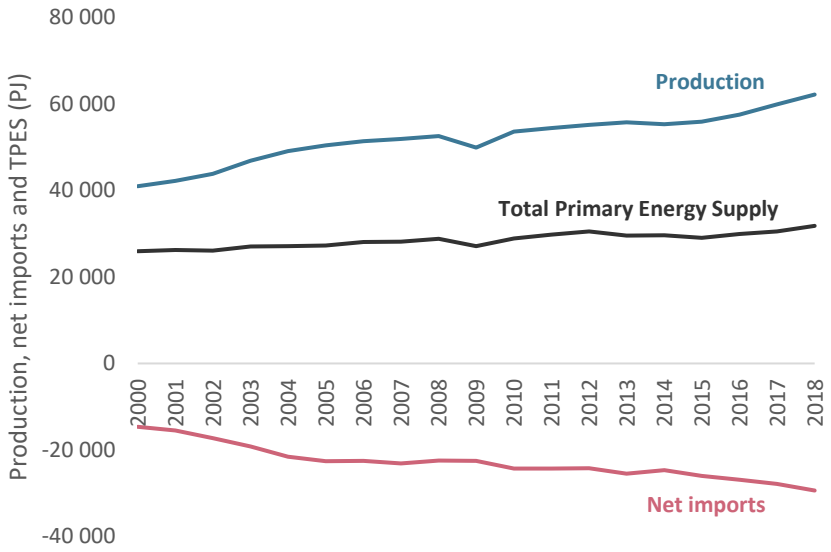
Energy supply and consumption

Total Primary Energy Supply

Russia is the third-largest energy producer in both the APEC and the world after China and the US. Russia's total primary energy supply (TPES) in 2018 was 31 792 PJ, 4.2% higher than in 2017 (EGEDA, 2020). The average annual growth rate of TPES from 2000 to 2018 was 1.1%.

Energy production has grown consistently since 2000 with a CAGR of 2.3%. In 2018, production was 62 138 PJ. The only year of decline for the period was in 2009, and was due to lower domestic consumption. Net exports grew at a much higher rate than production, with a CAGR of 3.9% from 2000 to 2018.

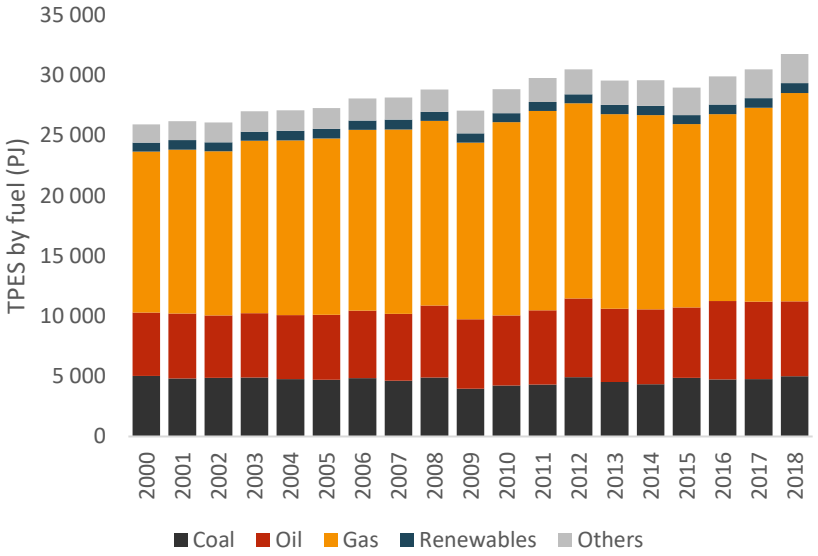
Figure 1: Russia's TPES, 2000 to 2018



Source: EGEDA, 2020

Russia's TPES fuel mix remained stable for 2000–2018; natural gas accounted for more than half with a slight decrease in the share of coal. In 2018, the TPES fuel mix comprised the following: natural gas (54%), crude oil and petroleum products (20%), coal (16%) and others, including nuclear and hydro (10%) (EGEDA, 2020). The TPES volumes of coal remained stable, oil increased by 18%, others, including nuclear and hydro, increased by 61% and renewables increased only by 7% during 2000–2018, while the volume of gas increased by 30%.

Figure 2: Russia's TPES by Fuel, 2000 to 2018

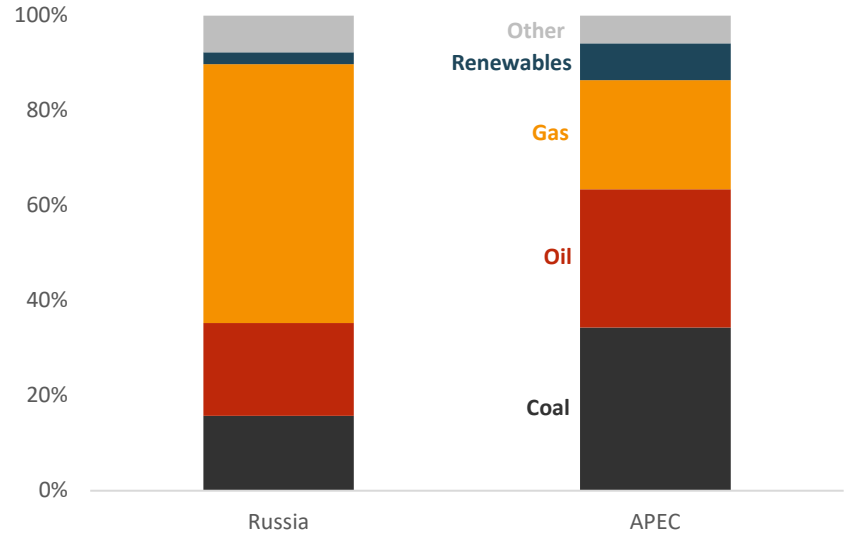


Source: EGEDA, 2020

Russia's TPES fuel mix is substantially different from that of the entire APEC. The share of natural gas in Russia is more than twice as high as in APEC, which is explained by its high reserves of natural gas. The territorial structure of gas consumption is uneven,

as the developed network of distribution pipelines is concentrated in the western part of the economy. In contrast, the shares of coal and renewables in Russia are less than half of that of APEC. The modest share of renewables in, for example, electricity generation is due to the uneven distribution of renewable energy sources, a large share of which is concentrated in remote areas, and is indicative of limited government support for new projects.

Figure 3: TPES – Proportional Share, Russia and APEC, 2018



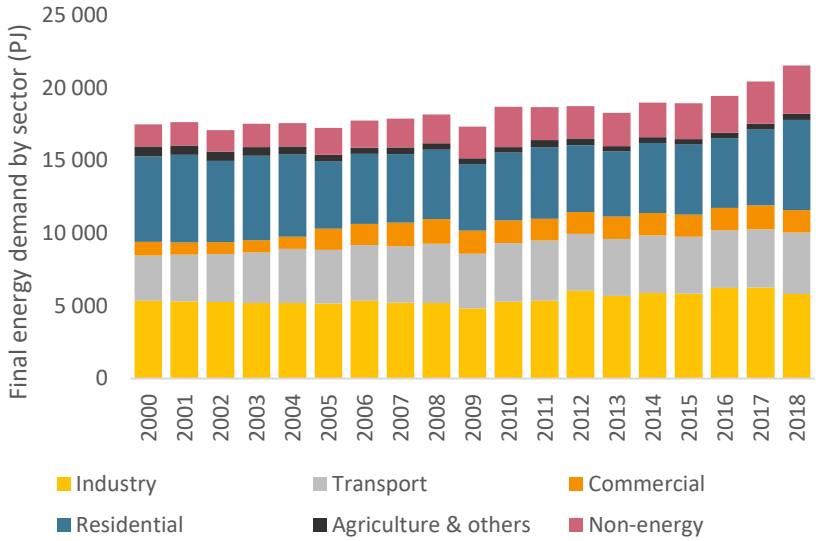
Source: EGEDA, 2020

Total Final Consumption

Russia's final energy consumption in 2018 was 21 539 PJ, 5.4% higher than in 2017 (EGEDA, 2020). This makes Russia the third-largest energy consumer in APEC after China and the US (EGEDA, 2020).

The residential sector accounted for the largest share of final energy consumption (6 207 PJ, 29%). One of the main reasons for this is the significant heat consumption for almost 8 months of the year. The second-largest consumer was the industrial sector (5 818 PJ, 27%), and the third was the transport sector (4 229 PJ, 20%). Non-energy use has more than doubled since 2000 and accounted for 15% in 2018. Agriculture and the commercial sector accounted for the remaining 9%.

Figure 4: Russia's Final Energy Demand by Sector, 2000 to 2018 (PJ)

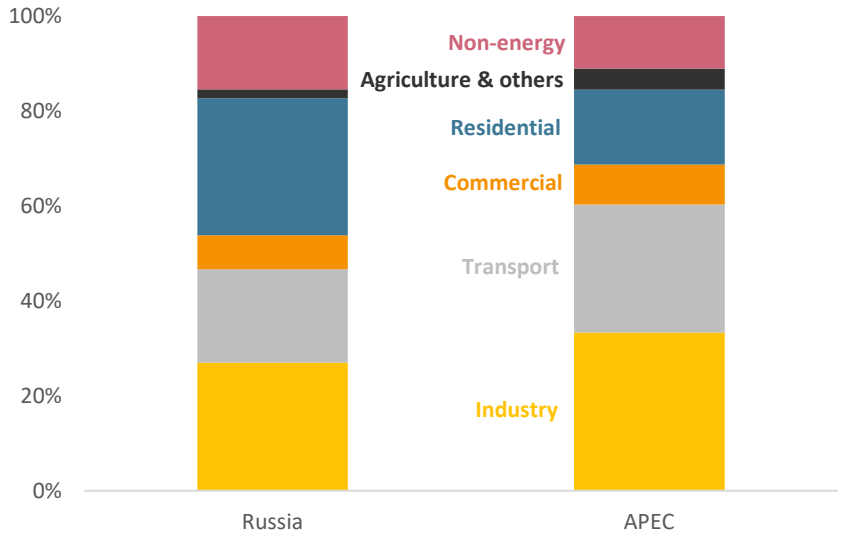


Source: EGEDA, 2020

Russia, like APEC, has the same major consumer sectors: industry, transport and residential. Their overall share is almost the same, accounting for three-quarters of total consumption. However, the structure is different. The share of the residential sector in

Russia is much higher than in APEC due to its significant heat consumption, while the share of industry and transport is lower. Non-energy use share is higher than in APEC due to its significant consumption as a feedstock in the chemical industry.

Figure 5: Proportional Final Energy Demand for Russia and the APEC, 2018



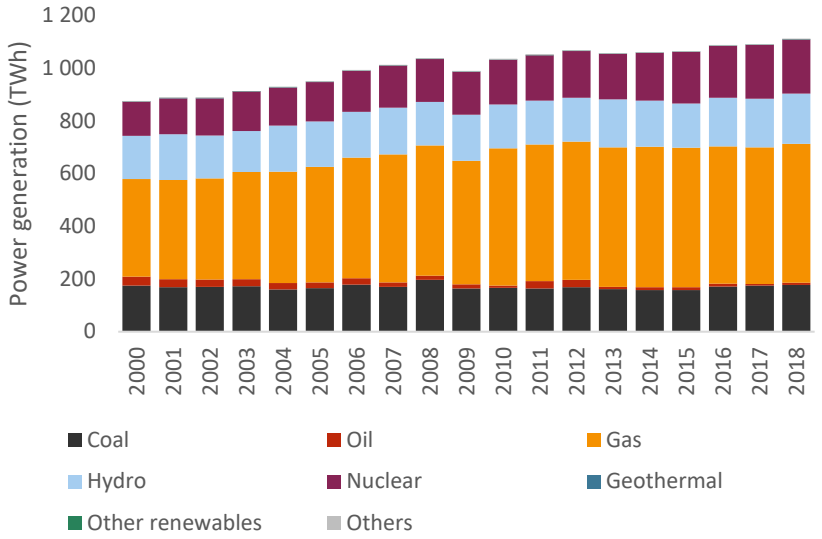
Source: EGEDA, 2020

Transformation

Electricity generation has grown consistently since 2000 (except in 2009) with a CAGR of 1.3%. Incremental electricity generation since 2000 has been fuelled almost exclusively with natural gas (66%) and nuclear power (31%). In addition, the oil-fuelled power generation declined by 11% during the same period. Renewable energy sources accounted for 12% of the increase in electricity generation with only 0.6% coming from wind and solar energy sources.

In 2018, Russia generated 1 113 TWh of electricity, an increase of 1.9% over the previous year. Fossil fuels accounted for the largest share of this generation (64%), of which natural gas contributed almost three-quarters. The remaining 36% of electricity generation came from hydropower and nuclear power in roughly equal shares.

Figure 6: Russia Electricity Generation by Fuel, 2000 to 2018



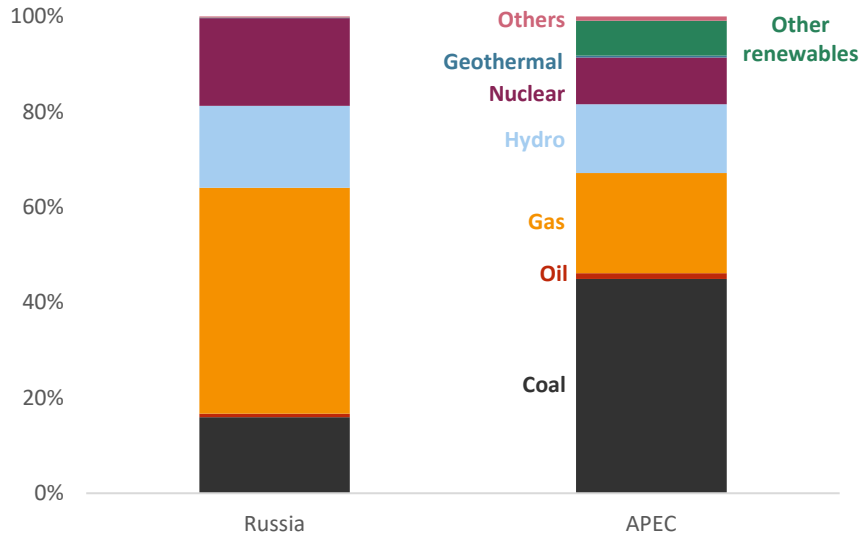
Source: EGEDA, 2020

The fuel mix for power generation in Russia and the APEC is quite similar in terms of the shares of fossil and non-fossil fuels: in Russia, fossil fuels comprise 64% of the fuel mix, and in the APEC, they account for 67%. However, the fossil fuels with the largest share in Russia and the APEC differ. Natural gas accounts for 47% in Russia while coal for 45% in the APEC.

The share of hydro is also different, amountingto 17% in Russia and 14% in APEC. Nuclear energy in Russia accounts for 18%, which is almost twice as much as APEC.

Russia lags far behind in solar and wind power generation in relations to the APEC-wide region. In APEC, the share of other renewables (mostly solar and wind) in 2018 exceeded 7%, while in Russia, it was lower than 1%.

Figure 7: Proportional Electricity Generation by Fuel, Russia and APEC, 2018



Source: EGEDA, 2020

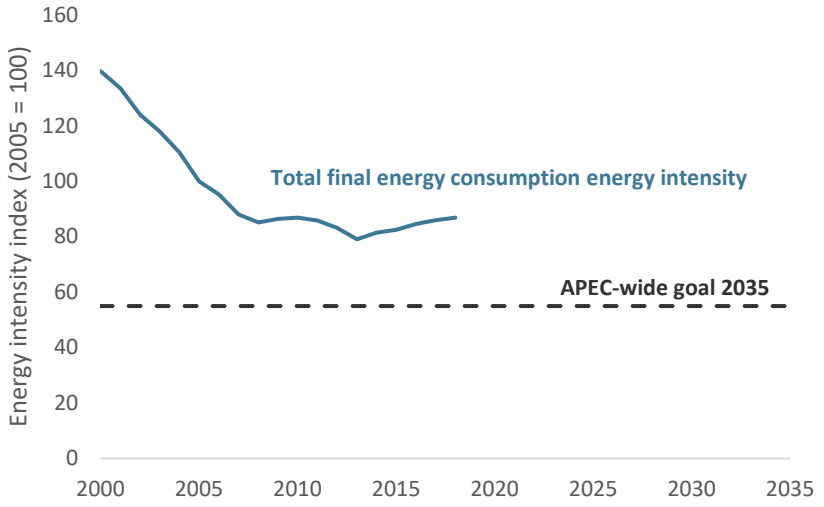
APEC goals

There are two energy-related objectives that APEC member economies have agreed to meet as a collective. These objectives are to improve energy intensity by 45% in 2035 as compared to 2005 and to double the share of modern renewables in the energy mix by 2030 as compared to 2010.

Energy Intensity Analysis

Russia is the most energy-intensive economy in the APEC region. In 2018, Russia's total final energy consumption (excluding non-energy) intensity improved by 13% compared to 2005. To contribute in proportional terms, Russia will need to reduce its energy intensity by another 32% over 17 years from 2018 to 2035.

Figure 8: Russia Total Final Energy Consumption Energy Intensity, 2000 to 2018, (2005 = 100)



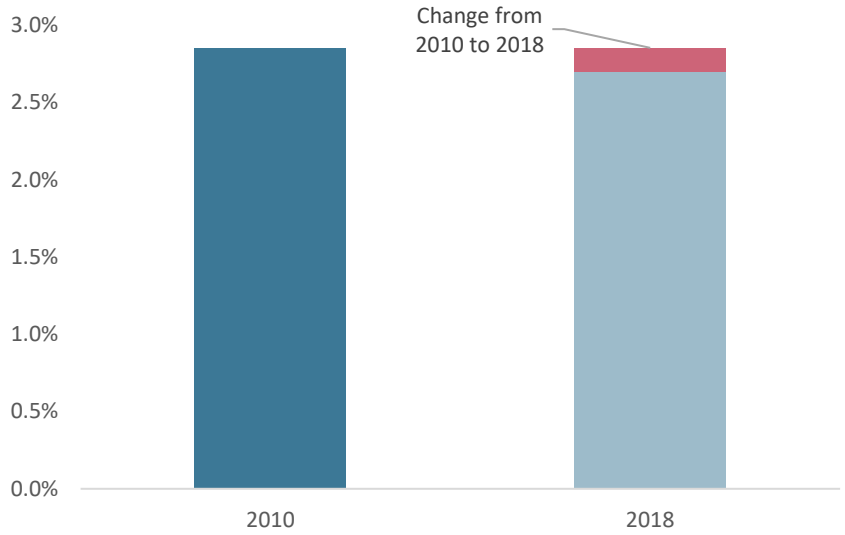
Source: EGEDA, 2020

Doubling of Renewables

There is no economy-level goal for individual member economies, but the improvements made by member economies will contribute to the doubling goal.

Russia's share of modern renewables to final energy consumption in 2010 was 2.9%. In 2018, this share decreased to 2.7%, as shown in Figure 9. This small decrease highlights the complexities of expanding the use of renewables in Russia.

Figure 9: Russia's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA, 2020

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy policy

Energy Policy	Details	Reference
Export of energy resources	Russia's Energy Strategy 2035, adopted in 2020, assumes an increase in energy exports by 9-15% by 2024 compared to 2018	Ministry of Energy
LNG production	Planned increase on liquefaction capacity to 46–65 mtpa by 2024 and 80–140 mtpa by 2035 (2.4–3.4 times growth to 2018 level); development of x (or x mtpa) small-scale LNG plants	Ministry of Energy
LNG exports	The Russian government intends to ease restrictions on exports of LNG and allow new companies to export on their own, unlike exports of pipeline gas, where Gazprom is a monopoly	Ministry of Energy
Gas processing	Russia's Energy Strategy 2035 assumes increasing the share of processed natural gas liquids (NGLs) to 30% by 2024 and to 35% by 2030	Ministry of Energy
Hydrogen exports	Start hydrogen production and exports up to 0.2mtpa by 2024 and 2 mtpa by 2035	Ministry of Energy
Oil production	Russia's Energy Strategy 2035 assumes that oil production by 2024 will remain at the current level of 11.6-11.7 million barrels per day, with a possible reduction to 10.2 by 2035	Ministry of Energy
Gas consumption in the transport sector	Russia's Energy Strategy 2035 assumes an increase of gas consumption in the transport sector to 2.7 bcm by 2024 and to 10–13 bcm by 2035	Ministry of Energy
Use of associated gas	Russia's Energy Strategy 2035 assumes an increase in the use of associated gas to 90% by 2024 and 95% by 2035	Ministry of Energy
Use of own energy in gas pipelines	Russia's Energy Strategy 2035 assumes reducing unit consumption of energy as own use in gas pipelines by 12% in 2024 and 17% in 2035 with respect to the 2018 level	Ministry of Energy
Thermal efficiency in the power sector	Russia's Energy Strategy 2035 assumes increasing of the thermal efficiency in the power sector to 43% by 2024 and 48% by 2035	Ministry of Energy
Share of regions with access to the economy-wide gas transportation system	Russia's Energy Strategy 2035 assumes an increase in the share of regions with access to the economy-wide gas transportation system to 75% by 2024 and 83% by 2035	Ministry of Energy
Russia’s Energy Security Doctrine	A foreign policy challenge to energy security to step up international efforts to implement climate policy and accelerate the transition to a green economy	Ministry of Energy
Greenhouse gases emission level	Russia's NDC proposes reducing GHG emissions to 70% by 2030 from the 1990 baseline. The NDC level of emissions was approved by presidential decree in November 2020	Presidential Decree

Notable developments

Energy Development	Details	Reference
Yamal LNG	The construction of the plant was carried out in three stages. The 3rd train was put into operation in 2019. Yamal LNG became the second large-scale and the largest LNG producer in Russia with a design capacity of 16.5 mtpa.	Novatek
Arctic LNG-2	The project includes the construction of three LNG trains, with a capacity of 6.6 mtpa of LNG each. The total LNG capacity of the three trains will be 19.8 mtpa. Arctic LNG is currently under construction. At the end of the first quarter 2021, the overall progress for Arctic LNG 2 is estimated at 39%, the first train is roughly 53% completed. It is expected to reach full capacity by 2025.	Novatek
Baltic LNG	The plant is going to become the largest gas processing plant in the economy and will process 45 bcm of natural gas and produce: 13 million tons of LNG, up to 3.8 million tons of ethane and up to 2.4 million tons of LPG. Construction began in May 2021.	Gazprom
Nord Stream 2	In December 2019, construction of the Nord Stream 2 subsea pipeline was suspended due to U.S. sanctions. Throughout the 2020, the possibility of completing the pipeline remained at the top of the news due to both the current situation in the natural gas market and political issues. Despite the restrictions, the first line of the gas pipeline has been built. It is expected that the pipeline will be fully completed by September 2021.	Gazprom
TurkStream	Gas supplies through the 31.5 bcm-per-year pipeline began in January 2020.	Gazprom
Power of Siberia	Gas supplies began on December 2, 2019. Design capacity of 38 billion cubic meters of natural gas exports to China will be reached by 2025.	Gazprom
Amursky Gas Processing Plant	Amursky GasPP will process 42 bcm of natural gas from Chayandinskoye and Kovyktinskoye fields and will produce 60 million cubic metres of helium, up to 2.5 million tons of ethane and up to 1.5 million tons of LPG by 2025. The first production train was put in operation in June 2021.	Gazprom
Vostok Oil	At the end of 2020, the state-owned company Rosneft announced the start of the Vostok Oil megaproject. According to the plans it is supposed to produce 30 million tons of oil by 2024 and deliver it by sea via the Northern Sea Route. This project is a challenge, because it involves significant infrastructure development in the region of new development in a very short time frame.	Rosneft
Azov Wind Project	The 90 MW Azov wind farm was commissioned in June 2021.	Enel

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Useful links

Ministry of Energy of the Russian Federation — http://minenergo.gov.ru/en

Ministry of Natural Resources and Environment of the Russian Federation — https://www.mnr.gov.ru/en/

Ministry of Economic Development of the Russian Federation — https://en.economy.gov.ru

Federal State Statistics Service of the Russian Federation — https://eng.gks.ru

Ministry of Industry and Trade of the Russian Federation — https://minpromtorg.gov.ru/en/

Federal Customs Service — https://eng.customs.gov.ru

Federal Tariff Service — http://www.fstrf.ru/eng

AtomEnergoProm — http://atomenergoprom.ru/en/

Rosseti, Public Joint Stock Company (PJSC ROSSETI) — http://www.rosseti.ru/eng/

Association NP Market Council — http://www.en.np-sr.ru/index.htm

Gazprom — http://www.gazprom.com/

Rosneft — https://www.rosneft.com/

RusHydro — http://www.eng.rushydro.ru/

Transneft — http://www.en.transneft.ru/

Analytical Centre for the Government — http://ac.gov.ru/en/

Central Dispatching Department of Energy Sector — http://www.cdu.ru/en/

Singapore

Introduction

Singapore is a city-state located in the south of the Malay Peninsula, between the Strait of Malacca and the South China Sea. This economy's land area is 724 square kilometres (km^2), with a population of 5.6 million in 2018.

Singapore is completely urbanised and highly industrialised but lacks domestic energy and mineral resources, and its small land size hinders renewable resource deployment. Even so, the economy is diverse and has enjoyed impressive economic success because of extensive financial activities, shipbuilding, petroleum, biotechnology, and due to Singapore being a regional hub for tourism. Singapore also has been expanding its role in international cargo and fuel shipping.

Singapore's gross domestic product (GDP) grew by 3.4% to USD 551 billion (2017 USD purchasing power parity [PPP]) in 2018, and GDP per capita grew by 3.0% to USD 97 745 (EGEDA, 2020). The services industry accounted for 65% of the GDP, the goods-producing industries (manufacturing and construction) accounted for 25%, and ownership of dwellings accounted for the remainder (DOS, 2020).

Table 1: Macroeconomic Data and Energy Reserves

Key data [a, b]		Energy reserves	
Area (km^2)	724	Oil (billion barrels)	–
Population (million)	5.6	Gas (trillion cubic feet)	–
GDP (2017 USD billion PPP)	551	Coal (million tonnes)	–
GDP per capita (2017 USD PPP)	97 745	Uranium (kilotonnes U_3O_8)	–

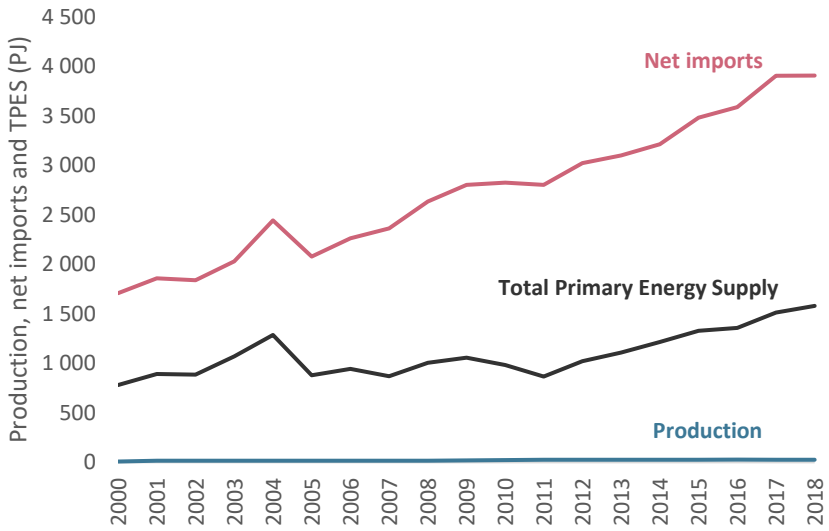
Source: [a, b] Department of Statistics Singapore (2020); EGEDA (2020)

Energy Supply and Consumption

Total Primary Energy Supply

Without indigenous natural resources, Singapore relies on fossil fuel imports to meet its domestic demand and feed oil refineries. The total energy imports were 7 473 petajoules (PJ) in 2018. Refined products exports mostly land in the Asia-Pacific Economic Cooperation (APEC). The total energy exports were 3 565 PJ in 2018 (EGEDA, 2020).

Figure 1: Singapore's Total Primary Energy Supply, 2000 to 2018 (PJ)

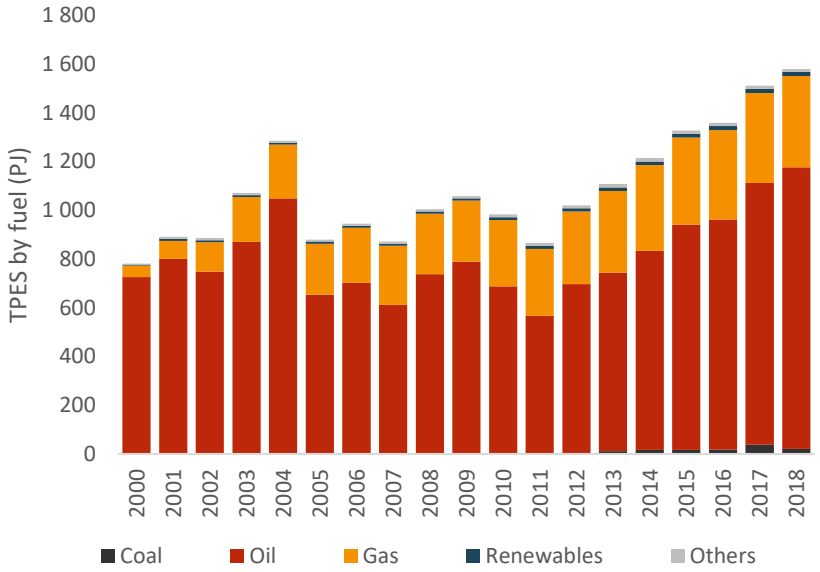


Source: EGEDA (2020)

Singapore also plays an important role in international shipping and aviation. In 2018, international marine bunkers received 2 009 PJ of its refined fuel and gas/diesel oil, and aviation bunkers received 365 PJ of aviation fuel.

Singapore's total primary energy supply (TPES) in 2018 was 1 581 PJ, 4.6% higher than in 2017. Figure 2 illustrates Singapore's reliance on fossil fuels in its energy mix. Its 2007 National Energy Report proposed strategies to balance the objectives of energy security, economic competitiveness, and environmental sustainability. The economy has since sought to strike this balance through multiple measures. Efforts to decrease reliance on oil imports have increased the role of natural gas in TPES over the last two decades, with gas primarily fuelling power generation.

Figure 2: Singapore's Total Primary Energy Supply by Fuel, 2000 to 2018

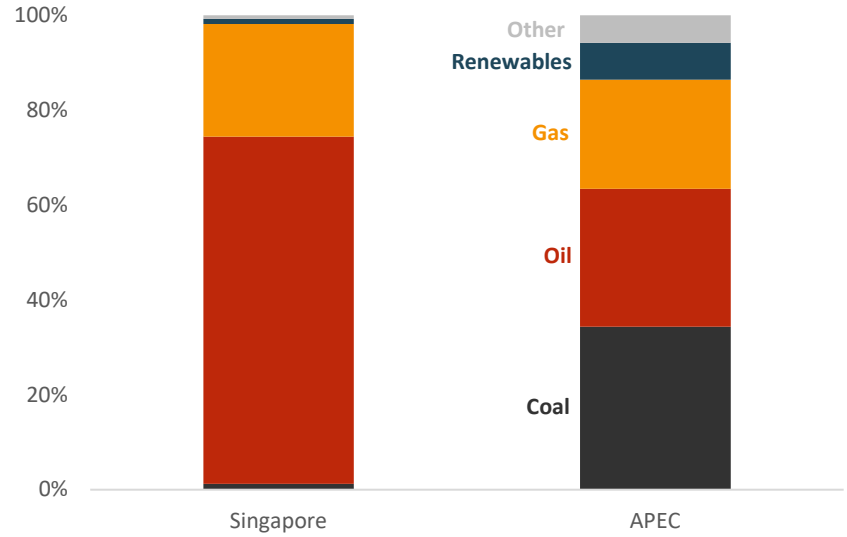


Source: EGEDA (2020)

To reduce its dependence on piped natural gas imports from Malaysia and Indonesia, Singapore began importing liquefied natural gas (LNG) in May 2013. Regasification and storage capabilities, along with auxiliary services, have increased the share of gas in the energy mix and enabled Singapore to diversify its gas supplies. Singapore has imported LNG from over 20 economies in the last five years, and LNG now makes up 35% of gas imports (UN Comtrade, 2020; EMA, 2020a).

With Indonesian gas pipeline imports set to decline in 2023, the role of LNG in Singapore's fuel mix will likely increase over the next decade (ESDM, 2019).

Figure 3: Total Primary Energy Supply Proportional Share, Singapore and APEC, 2018



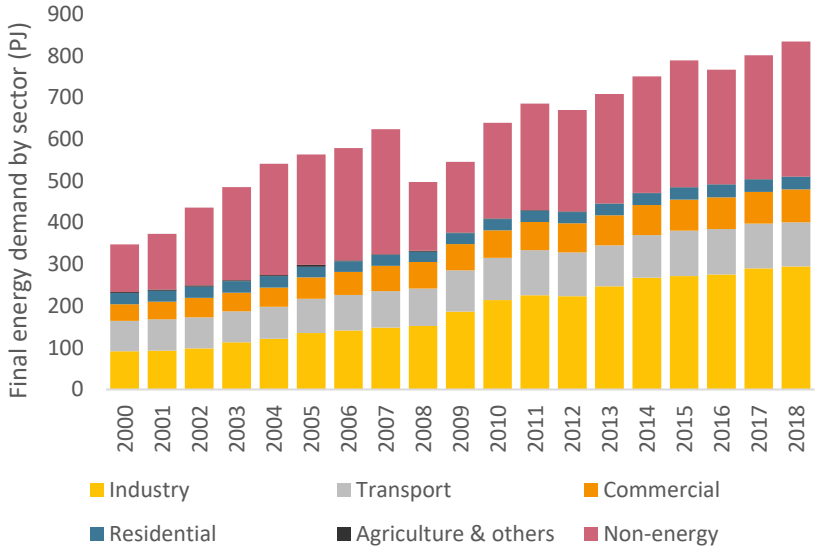
Source: EGEDA (2020)

In 2018, oil constituted the largest share of TPES at approximately 73% (1 156 PJ), followed by natural gas at 24% (375 PJ), coal at 1.3% (20 PJ) and renewables at 1.0% (16 PJ) (EGEDA, 2020). Figure 3 compares Singapore's TPES fuel shares to the entire APEC region. While fossil fuels play a more dominant role in Singapore, comprising 97% of the fuel mix, Singapore contains significantly lower coal in its mix. Another notable point is the low proportion of renewables; Singapore has limited options in terms of renewables because of its geological and geographical location. Hydro, wind, geothermal and tidal energies are not feasible, leaving solar PV systems and waste-to-energy (WtE) as Singapore's main renewable energy sources. The economy has also been producing biodiesel since 2010 to help diversify its liquid energy demand.

Total Final Consumption

Singapore's final energy consumption was 511 PJ in 2018, a 1.2% annual increase. Oil remained the most-consumed fuel (266 PJ), with a share of 52%, followed by electricity and others (36%, 182 PJ), natural gas (11%, 56 PJ) and coal (1.5%, 7.8 PJ). The largest sectoral energy user of total final consumption was non-energy uses (39%).

Figure 4: Singapore Final Energy Demand by Sector, 2000 to 2018



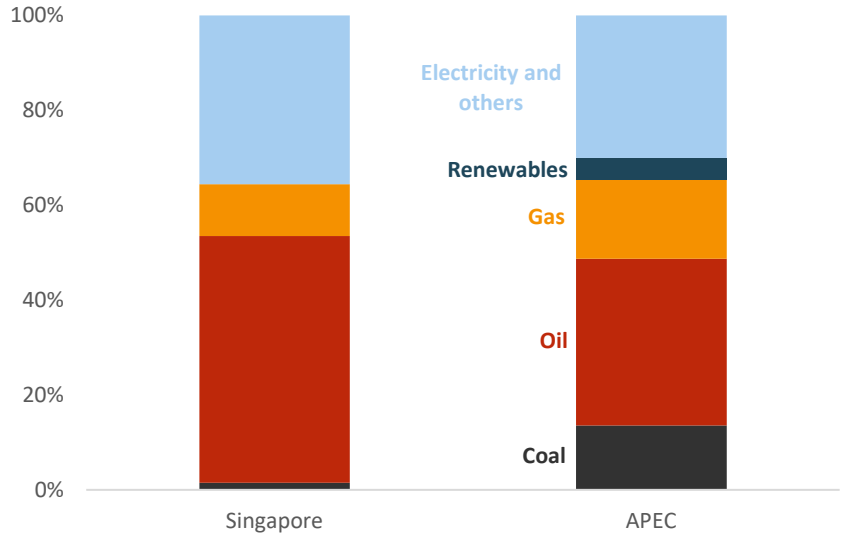
Source: EGEDA (2020)

The industrial sector accounted for 35% of total final consumption, while other sectors (including the buildings sectors) accounted for

over 13%, and the transport sector accounted for just shy of 13% (EGEDA, 2020).

In 2018, fossil fuels constituted 64% of Singapore's energy demand, and the remainder went towards electricity use. Figure 5 shows that, compared to APEC, Singapore derives its demand from a lower share of fossil fuels and renewables but a higher share of electricity.

Figure 5: Final Energy Demand Proportional Fuel Share, Singapore and APEC, 2018



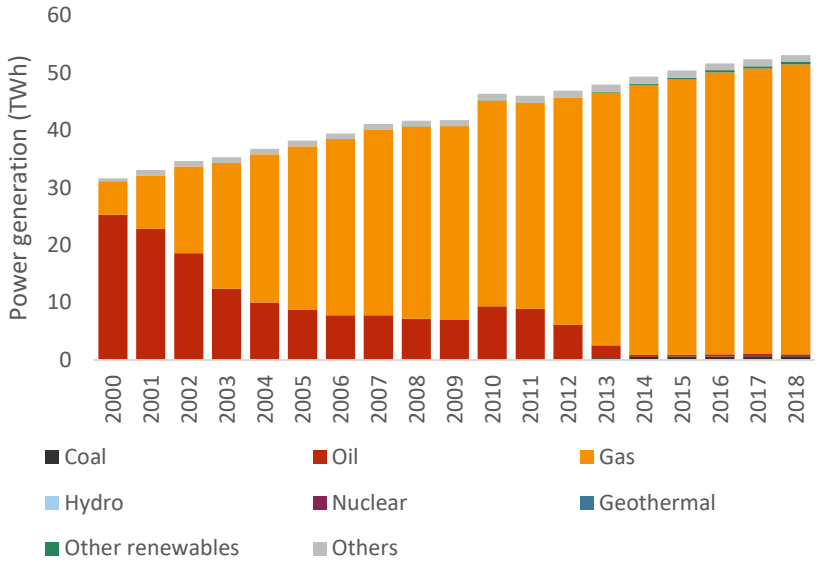
Source: EGEDA (2020)

Power Sector

Singapore's electricity generation increased 1.4% in 2018 to 53 144 gigawatt hours (GWh) (EGEDA, 2020). The peak demand for electricity stood at 7 370 megawatts (MW), a 2.5% annual increase (EMA, 2020a). Seven main power producers in Singapore contributed to the bulk of power generation (89%) in 2018.

Total licensed generation capacity reached 13 653 MW in 2018. In recent years, steam turbine plants have been displaced by the more efficient combined-cycle gas turbine (CCGT) power plants. Therefore, the share of CCGT in the overall generation capacity increased from 46% (4 534 MW) in 2005 to 77% (10 501 MW) in 2018. The share of steam turbine plants dropped from 48% (4 640 MW) in 2005 to 19% (2 555 MW) in 2018. Open-cycle gas turbine plants comprise 1.3% (180 MW) of the capacity, while WtE plants account for 1.9% (257 MW) and, finally, solar made up 1.2% (160 MW) of capacity in 2018 (EMA, 2020a).

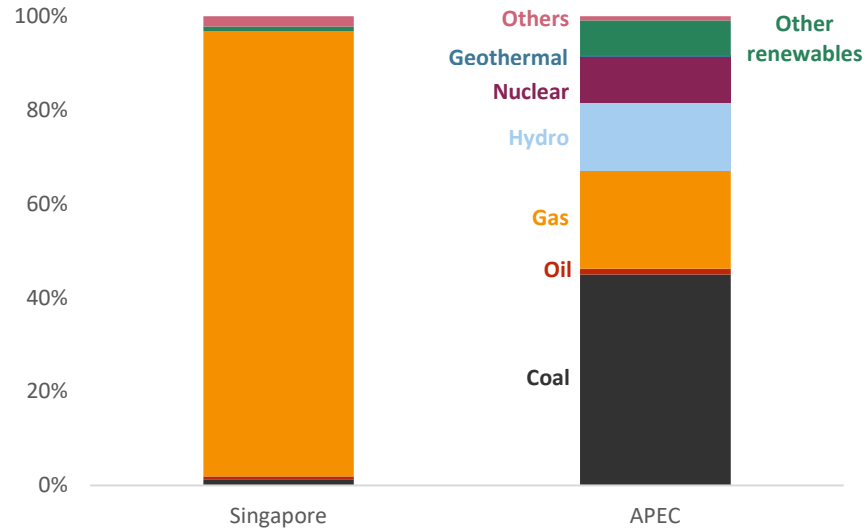
Figure 6: Singapore Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Figures 6 and 7 illustrate how technology, markets and policy collectively influenced Singapore's fuel mix over the past two decades. Oil-based generation fell from over 80% of the fuel mix in 2000 to 0.6% in 2018, while imports buoyed gas from under 20% to 95% over the same period. Coal and other fuels, including WtE and solar, constituted the remaining 4.1% of generation (EGEDA, 2020). Land scarcity made solar and WtE the only viable forms of renewable generation in Singapore.

Figure 7: Proportional Electricity Generation by Fuel for Singapore and APEC, 2018



Source: EGEDA (2021)

Total grid-connected solar PV installed capacity in Singapore increased by 36% to 208 megawatt-peak (MWp) in 2018. Singapore achieved its target of 350 MWp by 2020 in late 2019. Thus, in the last two years, Singapore achieved its 2020 target and set two more, aiming to install 1.5 gigawatt-peak (GWp) of solar capacity by 2025 and 2.0 GWp by 2030 (EMA, 2020b).

Singapore is striving to increase its deployment of rooftop PV via its SolarNova programme and the deployment of floating PV. The Housing Development Board (HDB) has successfully installed 280 MWp on 5 700 housing blocks and is aiming for 540 MWp by 2030 (HDB, 2019). A 60 MWp floating storage system in the Tengeh Reservoir should be deployed in 2021 (Mothership, 2021).

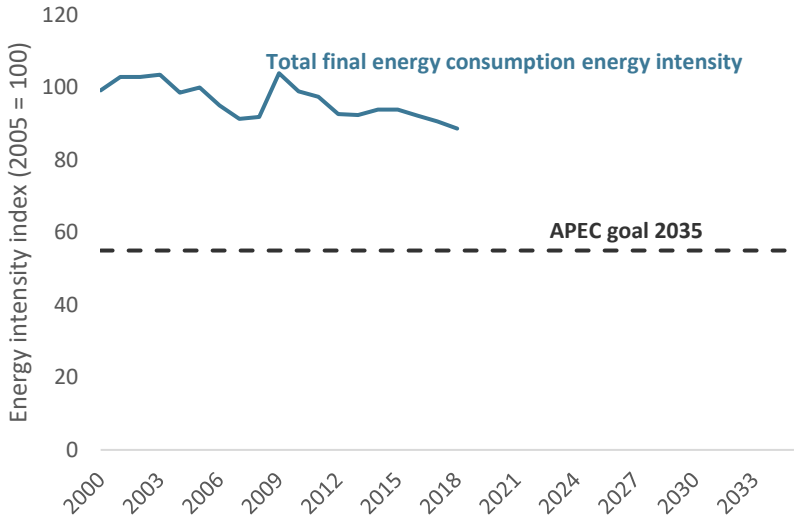
APEC Goals

APEC has two aspirational goals: reducing energy intensity by 45% from 2005 to 2035 and doubling the share of modern renewables in the fuel mix by 2030 (including the electricity mix), compared to the 2010 levels. However, it is important to articulate that APEC does not specify and institute economy-specific targets. Singapore need not achieve the targets; simply progressing towards them can help APEC achieve its goals.

Energy Intensity Analysis

In 2009, Singapore targeted a 35% reduction in energy intensity by 2035 and, in 2015, issued its first nationally determined contribution (NDC), pledging a 36% intensity reduction below 2005 levels by 2030 (NCCS, 2018a). Thereafter, energy intensity fell 11% since 2005 (Figure 8).

Figure 8: Singapore Total Final Energy Consumption Energy Intensity Index, 2000 to 2018 (2005 = 100)



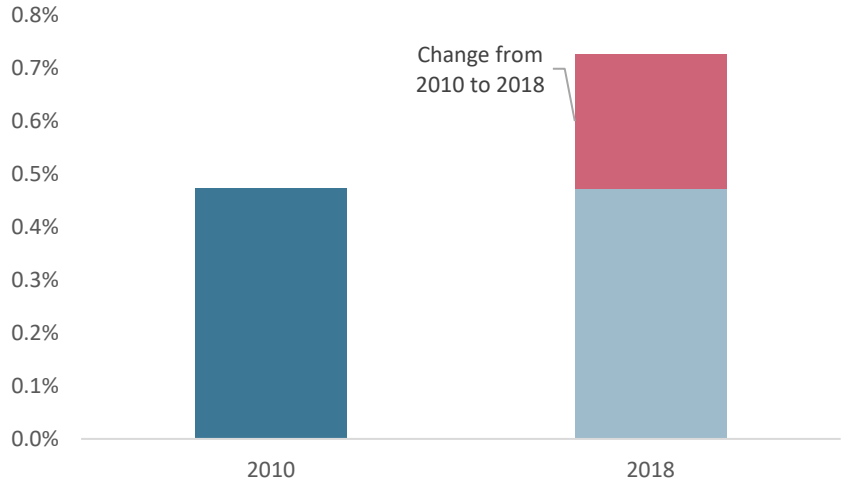
Source: EGEDA (2020), APERC (2021)

Singapore is committed to improving energy efficiency. The measures highlighted recently in an effort to meet this commitment include electrifying cooking and heating, reducing space cooling needs and space cooling efficiency, phasing out ICE vehicles, improving manufacturing efficiency with digitalisation, researching improvements in industrial and manufacturing efficiency through research grants, and improving logistics to optimise the movement of goods and people to minimise energy usage. Singapore is also exploring market strategies, such as having the right carbon price and collaborating with other economies to establish a global carbon market (EMA, 2020b). Together, these policies could accelerate energy intensity reductions and further help APEC achieve its aspirational targets.

Doubling of Renewables

Due to the prevalence of fossil fuels in its electricity mix, Singapore started from a very low modern renewable share of 0.47% in 2010 (Figure 9). Between 2010 and 2018, this share increased to 0.73%. However, achieving its solar capacity targets throughout this decade should enable Singapore to double its renewable fuel mix by 2030.

Figure 9: Singapore's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020), APERC (2021)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

It was an eventful year for Singapore on the policy front. In April 2020, the economy updated its NDC, pledging to peak emissions at an absolute level of 65 $MtCO_2e$ around 2030. Singapore also intends to halve its absolute emissions by 2050 with the goal of achieving net-zero emissions as soon as possible in the latter half of the century (UNFCCC, 2020). Furthermore, it announced an intention of phasing out ICE vehicles by 2040 (Reuters, 2020a).

Singapore typically announces major energy policies annually during the keynote address at Singapore International Energy Week (SIEW). At SIEW 2020, Minister Chan Chun Sing presented a vision for Singapore to become a "Bright Green Spark" for urban societies to emulate in the energy transition. Several of the policies and energy developments mentioned in this speech are presented in the tables below, as are other recent policies that will shape Singapore's energy system going forward. This list is not exhaustive but highlights recent announcements that could be more impactful to the energy system (EMA, 2020b).

Energy Policy	Details	Reference
UNFCCC NDC Pledge 2020	Targeting an upward limit and peak of 65 $MtCO_2e$ in 2030. Now including NF3 as a GHG.	National Climate Change Secretariate
Long-term Low-Emissions Development Strategy (LEDS)	Aspire to halve emissions from its peak to 33 $MtCO_2e$ by 2050, and achieve net zero emissions as soon as viable in the second half of the century.	United Nations Framework Convention on Climate Change
Singapore Carbon Tax	Carbon tax of SGD 5 per tonne starting in 2019 will cover refining, LNG, power, and industrial facilities that emit 25,000 tCO_2e/yr.	National Environment Agency
UNFCCC NDC Pledge 2015 (archived)	Reduce emissions intensity by 36% below 2005 levels by 2030.	United Nations Framework Convention on Climate Change
Singapore Economy-wide Solar Targets	Targets: 350 MWp by 2020 (achieved), 1.5 GWp by 2025, 2 GWp by 2030	Energy Market Authority
SolarNova Programme	Targeting 540 MWp of solar on HDB housing blocks by 2030.	Housing Development Board
Enhanced Vehicle Emissions Scheme	Incentive scheme that provides a rebate (up to SGD 25 000) or charge (up to SGD 25 000) to the MRSP of new vehicles based on their pollutant performance.	National Environment Agency
Commercial Vehicle Emissions Scheme	Incentive scheme that provides a rebate (up to SGD 30 000) or charge (up to SGD 10 000) to the MRSP new commercial vehicles based on their pollutant performance.	National Environment Agency

Early EV Adoption Incentive	45% rebate on Additional Registration Fee of EV sales (capped at SGD 20,000) from 2021 - 2023)	Land Transport Authority
Vehicle Quota System	By maintaining a growth rate of zero for vehicle registrations since 2018, the VQS effectively caps vehicle ownership in Singapore.	Land Transport Authority
ICE Vehicle Phase Out	Phase out ICE vehicles by 2040.	Reuters
Green Building Masterplans	Several initiatives aimed at increase energy efficiency and reduce energy demand in buildings.	Building Construction Authority
Mandatory Energy Labelling Scheme	Household appliances that are sold in Singapore must display an energy label, which helps consumers compare the energy efficiency of different appliances and make informed purchasing decisions.	National Environment Agency
Minimum Energy Performance Standards	Raises the average energy efficiency of household appliances, encouraging manufacturers to provide more energy-efficient appliances as technology improves.	National Environment Agency
Singapore Forward Capacity Market	Developing a competitive market-based auction to procure electricity capacity years in advance to help maintain reliability standards in the delivery period. First auction to be held in 2021.	Energy Market Authority

Notable Developments

The table below includes milestones, project announcements, pilot initiatives and prospective technological developments that could shape Singapore's energy future. This list is not exhaustive but highlights recent announcements that could be more impactful to the energy system.

Energy development	Details	Reference
Neste biorefinery expansion	Increase capacity 1.4 Mtpa to 4.5 Mtpa by 2023	Neste
Capacity reduction at Shell's Pulau Bokom Refinery	Half refinery capacity from 500 000 b/d to 250 000 b/d by 2023.	Reuters
Open Electricity Market enters second year	Providing retail competition for electricity services prompted almost half of households and businesses to opt for retailer choice over regulated rates.	Energy Market Authority
Indonesia halts gas exports to Singapore via Grissik-Singapore pipeline in 2023	Singapore gas pipeline import capacity from Indonesia to fall by 465 MMcf/d in 2023	Ministry of Energy and Mineral Resources, Indonesia

Electricity import trial	Two-year electricity import trial of 100 MW from Malaysia could begin by late 2021.	Energy Market Authority
Singapore's First Utility-Scale Energy Storage System	EMA and SP Group deployed a 2.4MW/2.4MWh ESS at a substation in 2020. The ESS will participate in the wholesale electricity to mitigate intermittency caused by solar, as well as reduce peak demand.	Energy Market Authority
Singapore's First floating Energy Storage System (ESS)	Keppel O&M working to deploy a 7.5 MW/7.5MWh lithium-ion battery ESS on its Floating Living Lab (FLL) by 2023.	Energy Market Authority
2020 Solar Target Achieved	350 MWp of solar capacity surpassed in early 2020	Energy Market Authority
Low emissions MOU signed with Australia	Collaborate on projects and initiatives to advance low-emissions solutions, such as CCUS, hydrogen and renewable trade, as well as measurement, reporting and verification mechanisms.	Singapore International Energy Week
Funding Research for Low-Carbon Energy Solutions	SGD 49 million to test-bed technologies such as hydrogen, CCUS, etc.	Energy Market Authority

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Useful Links

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Energy Efficiency Program Office – http://www.e2singapore.gov.sg/

Energy Market Authority – https://www.ema.gov.sg

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Land Transport Authority – https://www.lta.gov.sg

Ministry of National Development – https://www.mnd.gov.sg/

Ministry of the Environment and Water Resources – https://www.mewr.gov.sg

Ministry of Trade and Industry – https://www.mti.gov.sg

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Solar Energy Research Institute of Singapore (SERIS) – http://www.seris.nus.edu.sg/

Temasek Holdings – https://www.temasekholdings.com.sg

Chinese Taipei

Introduction

Chinese Taipei is an archipelago comprising Taiwan, Penghu, Kinmen and Matsu, located off the southeast coast of China and the southwest coast of Japan. With an area of 36 197 square kilometres (km^2) (MOI, 2020), Chinese Taipei has a variety of geological formations and unique landscapes. Although only 20% to 25% of the land is arable, its subtropical climate permits multi-cropping of rice and perennial growth of fruit and vegetables.

Chinese Taipei's GDP in 2018 reached USD 1 300 billion, 2017 USD purchasing power parity (PPP), a 6.3% increase from the 2017 level. GDP grew at a compound annual growth rate (CAGR) of 6% between 2000 and 2018. With a population of 24 million, Chinese Taipei had one of the highest GDP per capita in the APEC region, at USD 55 138 (2017 PPP), in 2018 (World Bank, 2020).

In 2018, Chinese Taipei's economic structure continued to be driven by the service sector, which accounted for 63% of the economy's GDP, followed by the industry sector (35%) and, finally, the agricultural sector (2%) (BOE, 2019).

The economy owns very small deposits of energy reserves. According to data from The World Factbook of CIA, as of 2018, Chinese Taipei holds only 2.38 million barrels of proven oil reserves (CIA, 2021). Coal reserves in the economy are scarce, and owing to the high cost of mining, there has been no coal production in the economy since 2000.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a, b]		Energy reserves [c]	
Area (thousand km^2)	36 197	Oil (billion barrels)	2.4
Population (million)	24	Gas (petajoules)	–
GDP (2017 USD billion PPP)	1 300	Coal (million tonnes)	–
GDP per capita (2017 USD PPP)	55 138	Uranium (kilotonnes U_3O_8)	–

Sources: [a] MOI (2020); [b] World Bank (2020); [c] CIA (2021).

Energy Supply and Consumption

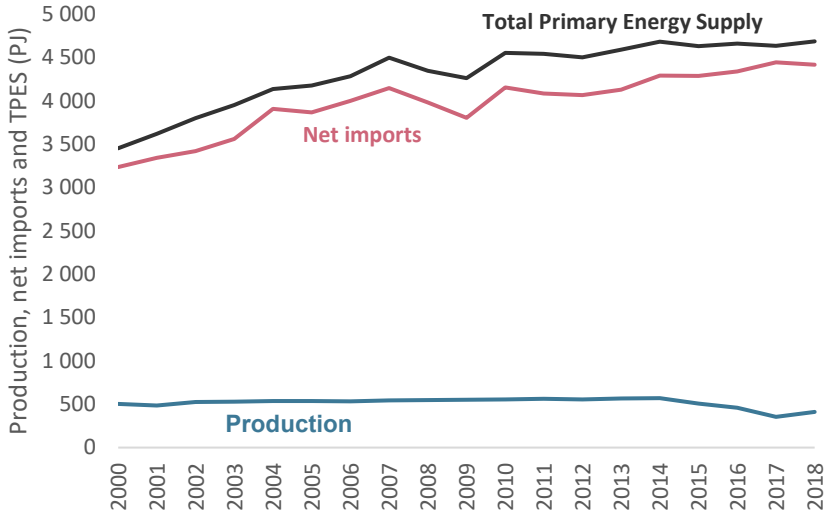
Total Primary Energy Supply

Chinese Taipei's total primary energy supply (TPES) reached 4 686 PJ in 2018, a 1.1% increase from the 2017 level (Figure 1).

Oil was the major fuel source, comprising 38% of TPES in 2018. It was followed by coal (36%) and gas (18%), and the remaining 9% was constituted by renewables (2%) and all other fuels (7%) (EGEDA, 2020) (Figure 2).

The economy depends on international trade and relies on imported energy to meet its energy demand. Its net imports accounted for more than 90% (4 416 PJ) of TPES in 2018 (EGEDA, 2020).

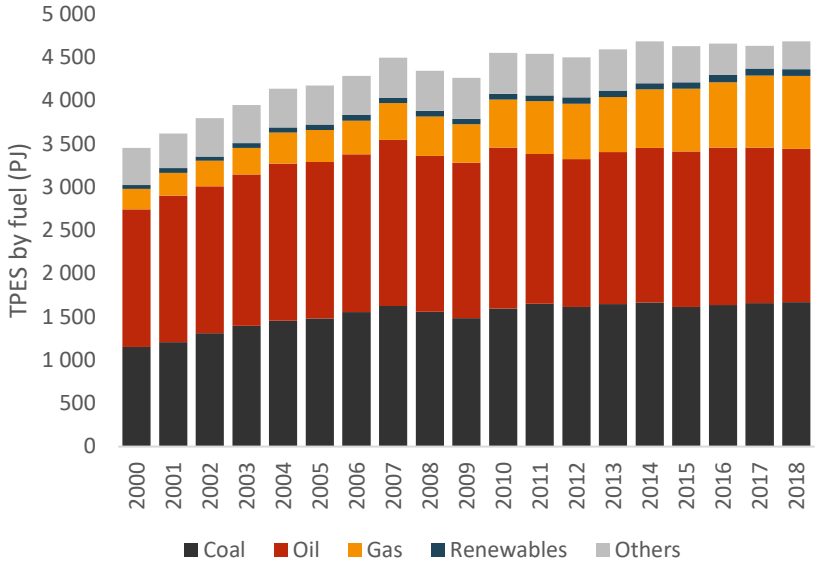
Figure 1: Chinese Taipei's TPES, 2000 to 2018 (PJ)



Source: EGEDA (2020)

Oil had the largest share of fuel imports in 2018 (52%). The Middle East was the largest source of imported oil for Chinese Taipei (80%), followed by the US (14%), and all other sources (6%) (BOE, 2019). Coal represented 32% of the fuel imports of the economy, although the 2018 level decreased by 1.1% compared with the 2017 level. Australia (50%), Indonesia (26%) and Russia (14%) were the three largest sources of coal imports for Chinese Taipei. Similarly, to augment the economy's gas requirement, especially for power generation, Chinese Taipei imports gas from Qatar (29%), Malaysia (17%) and Australia (15%), which were the top three suppliers of Chinese Taipei's LNG in 2018. Additionally, Chinese Taipei was among the top LNG importers in the world in 2018 (BP, 2020).

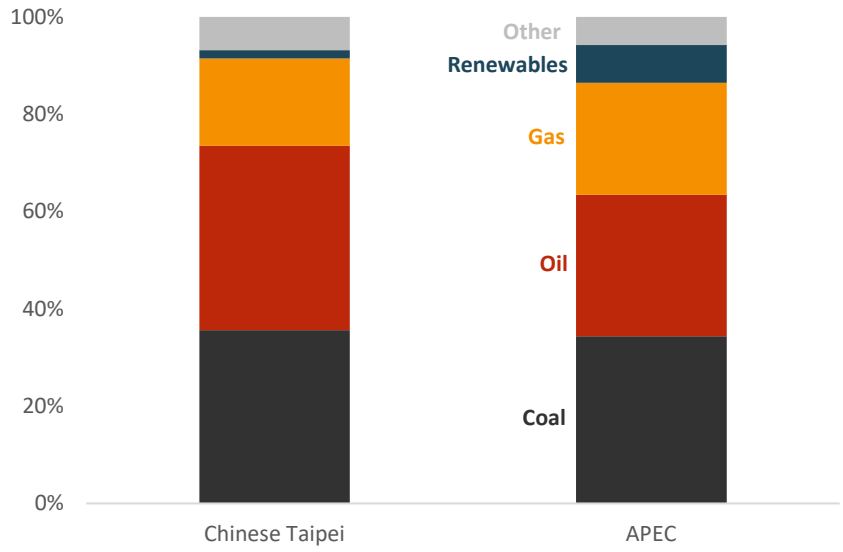
Figure 2: Chinese Taipei's TPES by Fuel 2000 to 2018 (PJ)



Source: EGEDA (2020)

Chinese Taipei has a similar pattern of energy supply mix as the APEC economies (Figure 3), though with a larger relative share of oil due to the economy's substantial exports of refined petroleum products. Meanwhile, the relative share of renewables was smaller than that of the APEC region, as the economy has very limited renewable energy sources.

Figure 3: TPES Relative Fuel Share, Chinese Taipei and APEC, 2018



Source: EGEDA (2020)

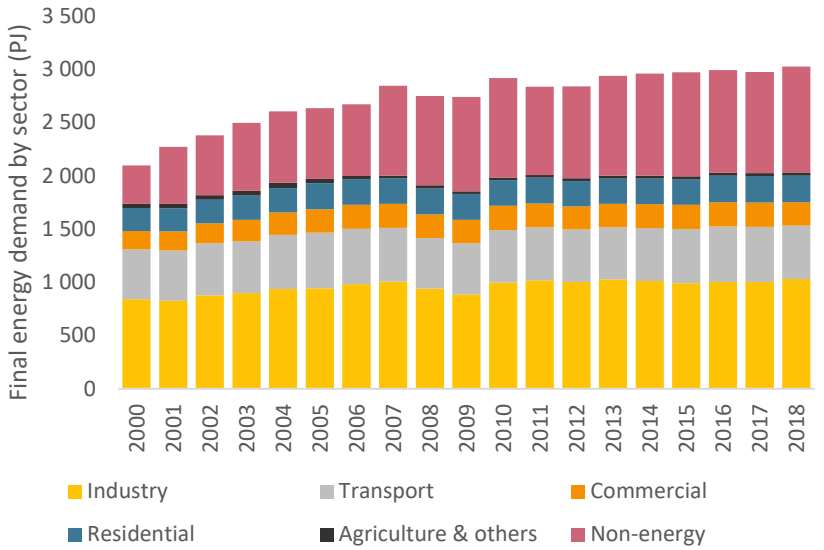
Total Final Consumption

Total final consumption (TFC) of Chinese Taipei, which includes non-energy consumption, increased by 1.7% to 3 489 PJ in 2018 (Figure 4).

The industrial sector was the largest energy-consuming sector in Chinese Taipei with a 34% share in TFC in 2018. It increased 2.9% to 1 032 PJ in 2018. Chemicals and petro-chemicals which was the biggest industry sub-sector, increased 7% from 2017 to 2018 offsetting the declines posted by six sub-sectors including the largest fall from mining and quarrying (-68.2%).

Non-energy consumption was the second largest component (33%; 994 PJ) of the economy's TFC in 2018 (EGEDA, 2020), growing at a CAGR of 5.8% between 2000 and 2018. Chinese Taipei is one of the major petroleum product refiners in APEC and exports refined products primarily to Korea, Indonesia, the Philippines, Pakistan, Singapore, the UAE, Papua New Guinea and Australia. This sector will likely continue to grow as the economy's largest refining company continues to explore additional export markets (CPC, 2020).

Figure 4: Chinese Taipei Final Energy Demand by Sector, 2000 to 2018 (PJ)



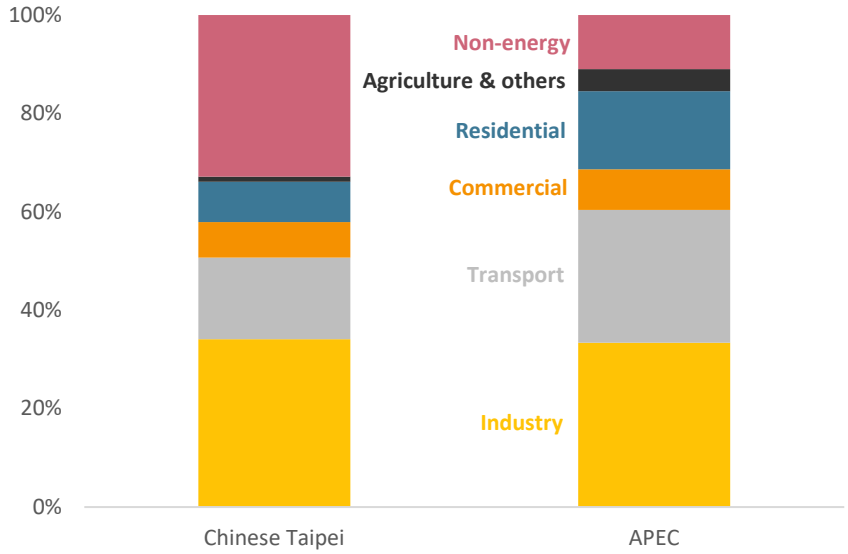
Source: EGEDA (2020)

The transport sector, which accounted for 17% of TFC in 2018, experienced an annual decline of 2.7%. The decrease was due to the large contraction in domestic navigation consumption (-71%).

The buildings sector (combined commercial and residential sectors) comprised 15% of TFC or 466 PJ in 2018. The residential sector was slightly large than the commerical sector, accouting for 53% of total buildings energy consumption. The residential and commercial sectors both posted annual declines of -0.4% and -4.6%, in 2018.

Agriculture and others sector only accounted for 1% of TFC, though it posted a positive annual growth of 14.4% in 2018 (EGEDA, 2020).

Figure 5: Proportional Final Energy Demand for Chinese Taipei and APEC, 2018



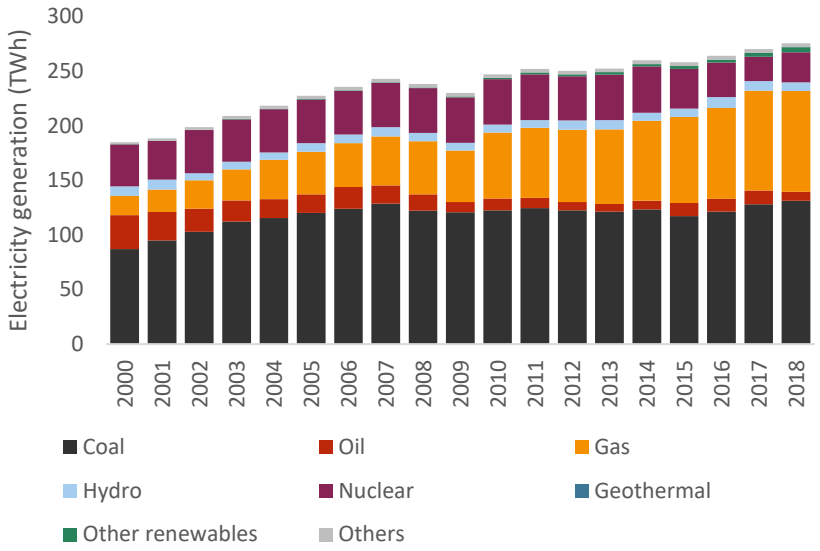
Source: EGEDA (2020)

Chinese Taipei's non-energy sector is proprotionally larger than that of the APEC region. This is a reflection of the extensive use of oil and oil products as feedstock for the economy's refining and petrochemical industry (Figure 5). In contrast, the transport sector is not as prominent in Chinese Taipei (EGEDA, 2020).

Transformation

Chinese Taipei's electricity generation reached 276 TWh, which represented a 2.0% annual increase in 2018 (EGEDA, 2020) (Figure 6). The economy's electricity generation mix was dominated by thermal energy, which constituted 84% of the mix in 2018. Among thermal energy sources, coal was the largest, comprising 56%, followed by gas (40%) and then oil (4%). Coal drove the expansion in thermal power generation with a growth of 2.6% to 131 TWh in 2018, whereas oil fell by 36% in 2018.

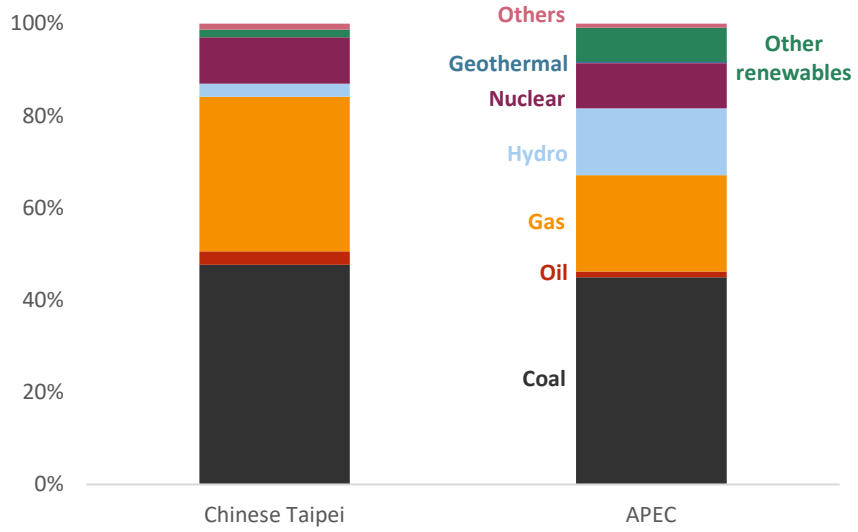
Figure 6: Chinese Taipei Electricity Generation by Fuel, 2000 to 2018 (TWh)



Source: EGEDA (2020)

The economy made efforts to shift from fossil fuels to low-carbon sources of electricity. Total renewables comprised 5.3% of the generation mix, increasing by 1.1% in 2018. Among renewables, biomass increased 28.8% to 4 586 GWh in 2018. Controversially, nuclear generation had an annual increase of 23% in 2018, which was 10% of the generation mix (EGEDA, 2020).

Figure 7: Proportional Electricity Generation Mix by Fuel for Chinese Taipei and the APEC, 2018



Source: EGEDA (2020)

Coal's prominence in the power generation mix for Chinese Taipei is similar to its prominence in the mix for APEC. The share of gas is relatively greater in Chinese Taipei compared with the APEC region. This is largely because the use of LNG for power generation has expanded in Chinese Taipei to meet its growing demand for electricity (EGEDA, 2020) (Figure 7).

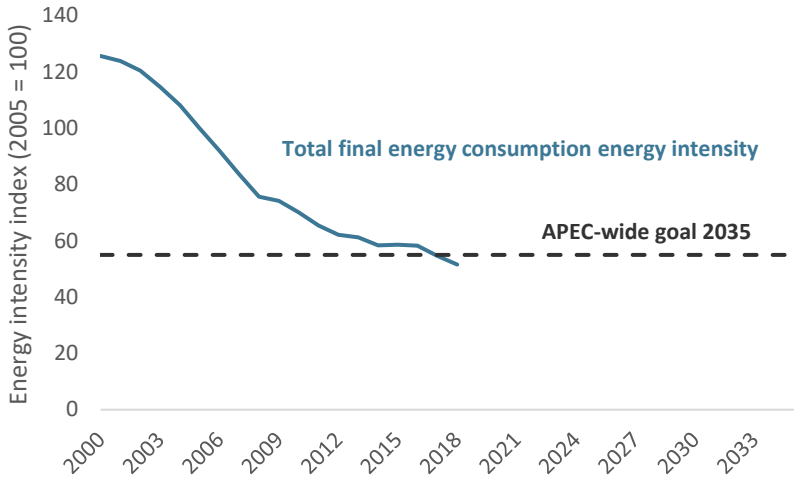
APEC Goals

APEC member economies have agreed to meet two energy-related objectives. These are related to improving energy intensity and increasing the share of renewables in the energy mix**.**

Energy Intensity Goal

In 2011, the APEC member economies agreed to revise their goal of reducing energy intensity, increasing the reduction required to 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

Figure 8: Total Final Energy Consumption Energy Intensity Index, 2000 to 2018, (2005 = 100)



Source: EGEDA (2020)

The APEC is on track to meet this goal of energy intensity improvement. The goal does not impose targets for individual

economies, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2018, the energy intensity of Chinese Taipei's total final energy consumption (excluding non-energy) had improved by 48%, relative to the 2005 level (EGEDA, 2020). The economy's energy intensity reduction has outpaced the APEC-wide commitment. Chinese Taipei will continue with its efforts towards energy efficiency (Figure 8).

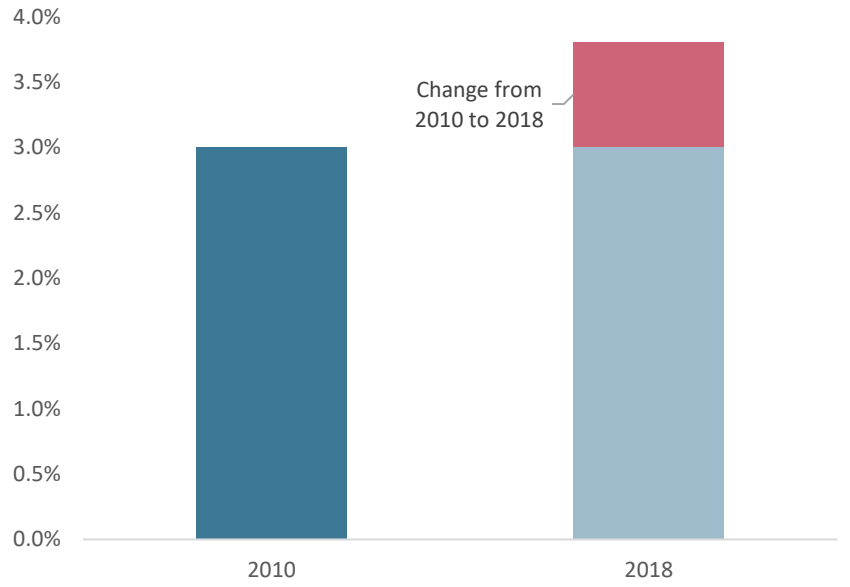
Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period 2010 to 2030. Modern renewables do not include traditional biomass, and the share is relative to final energy consumption.

Individual member economies have no economy-level goals, but it is possible to calculate the relative improvement of individual economies to better understand whether the goal will be achieved.

Chinese Taipei's share of modern renewables to final energy consumption was 3.0% in 2010. It increased to 3.8% in 2018, representing a 27% increase in modern renewables (EGEDA, 2020) (Figure 9). The APEC-wide doubling goal will require APEC's modern renewables share to reach 12.0% by 2030.

Figure 9: Chinese Taipei Renewable Energy Share Analysis, 2010 and 2018



Source: EGEDA (2020)

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by the industry, hydro, geothermal, etc.) are considered to be modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy Policy	Details	Reference
2015 Greenhouse Gas Reduction and Management Act	It aims to reduce annual GHG emissions by 2050 to less than half of the 2005 levels.	Laws and Regulations Database of the Republic of China
INDC	The economy-wide target to reduce greenhouse gas emissions (214 $MtCO_2eq$) by 50% from the business-as-usual level (428 $MtCO_2eq$) by 2030.	MOEA, EPA(a)
Energy Administration Act	The Act's purpose is rational and efficient use of energy. It includes the Guidelines on Energy Development to promote energy security, green economy, environmental sustainability and social equity consistent with the target of a nuclear-free economy by 2025.	Laws and Regulations Database of the Republic of China
Taipower Power Plants Plan by 2025	It aims to include additional capacities of gas and retire the oil, coal and nuclear plants by 2025 in the Power Plant Plan.	TaiPower
Renewable Energy Development Act	Sets 27,000 MW as the promotion objectives by 2025 for the electricity generated by renewable energy power generation facility	Laws and Regulations Database of the Republic of China
Energy Transition Policy by 2025	Measures to reduce the energy import rate, increase electricity supply adequacy rate, improve energy-saving efficiency, promote renewable energy development, promote green economy, reduce electricity emission coefficient, reduce air pollution from the power system, increase green vehicles, reduce dependence on nuclear energy and improve the public's knowledge on energy.	MOEA

Notable Energy Developments

Energy development	Details	Reference
Guidelines on Energy Development	The Energy Transition Whitepaper (2020) provides guidance on meeting the guidelines. Public consultations in three stages are part of the process, which includes the following: 1) preparatory meetings for collecting public opinions, 2) setting up of five working groups for collaborations and 3) face-to-face consultations with the public.	BOE EWG60 Report

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Useful links

Executive Yuan, ROC — https://english.ey.gov.tw/

Ministry of Economic Affairs, ROC — https://www.moea.gov.tw/MNS/english/home/English.aspx

Bureau of Energy, Ministry of Economic Affairs, ROC — www.moeaboe.gov.tw

Environmental Protection Administration, Executive Yuan, ROC — https://www.epa.gov.tw/ENG/

Chinese Petroleum Corporation — www.cpc.com.tw

Taiwan Power Company — www.taipower.com.tw

Thailand

Introduction

Thailand is known as 'the window to South-East Asia'. The economy is surrounded by Myanmar, the Lao People's Democratic Republic (Lao PDR), Cambodia to the north and east, and Malaysia to the south. Thailand has an area of 513 120 square kilometres (km^2) and had a population of 69 million in 2018. In 2018, its gross domestic product (GDP) reached USD 1 256 billion (2017 USD purchasing power parity [PPP]), a 4.2% increase from its GDP in 2017 (World Bank, 2020)

Thailand has limited domestic energy resources. At the end of 2018, Thailand had proven reserves of 293 million barrels of oil, 6 224 petajoules (PJ) of natural gas and 1 063 million tonnes (Mt) of coal. Based on the current rates of production, its domestic supply will soon become depleted – oil resources within four years and natural gas within five years (EPPO, 2020; BP 2019). Most coal-fired power plants in Thailand use low-quality, domestically produced lignite. Thailand is highly dependent on energy imports, particularly oil, with approximately 81% of its oil and 28% of its gas supply coming from imports (EPPO, 2020).

Most of Thailand's proven coal reserves are lignite coal, which has a low calorific value. For this reason, Thailand relies on coal imports to meet the energy demands of both the power and industrial sectors. In 2018, the coal supply was 809 PJ, an increase of 49% from the previous year's level. The natural gas supply in 2018 was 1 888 PJ, an 8.9% decrease from 2017. Natural gas is not only used for power generation in Thailand but also promoted in the transport sector as a replacement for conventional petroleum products, such as diesel and gasoline. Thailand has increased its reliance on imported natural gas in the form of piped gas from Myanmar and liquefied natural gas (LNG) from Qatar and Malaysia.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	513 120	Oil (million barrel)	293
Population (million)	69	Gas (PJ)	6 224
GDP (2017 USD billion PPP)	1 256	Coal (Mt)	1 063
GDP per capita (2017 USD PPP)	18 087		

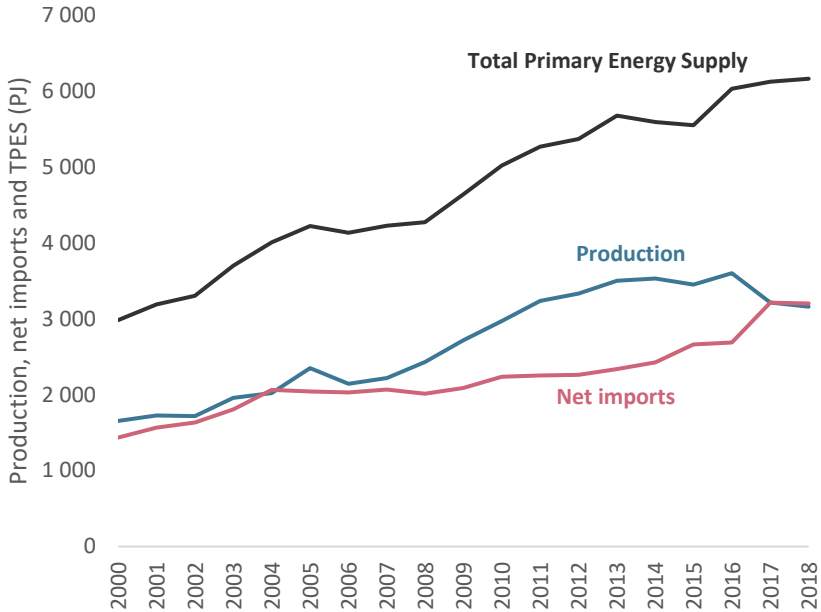
Source: EGEDA (2020), BP (2019), DMF (2019)

Energy supply and consumption

Total Primary Energy Supply

Thailand's total primary energy supply (TPES) in 2018 was 6 162 PJ, which was a 0.67% increase from the 2017 level. It has been on the rise at the rate of 3.7% annually for the past decade. Energy production decreased by 1.6%, reaching 3 160 PJ in 2018, while net imports rose significantly over the decade (4.7% annually) to reach 3 200 PJ in 2018 to compensate for the declining domestic production (Figure 1).

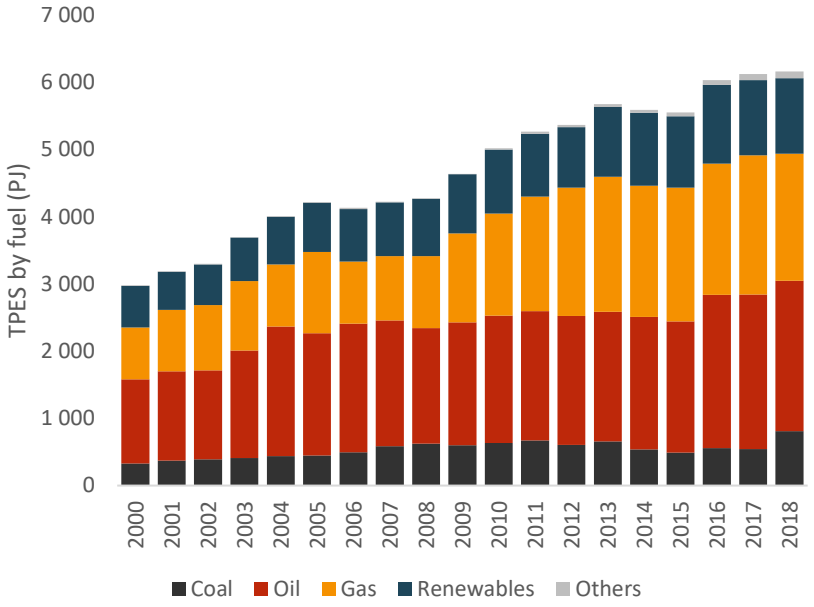
Figure 1: Thailand TPES, 2000 to 2018



Source: EGEDA (2020)

Thailand's TPES fuel mix has fluctuated by a small amount from 2000 to 2018 (Figure 2). The share of oil has declined from 42% to 36% for the period, while the share of natural gas has increased from 26% to 31%. Coal has accounted for a modest increase from 11% to 13% in 2018. Renewables and others have decreased from 21% to 20% for the same period (EGEDA 2020).

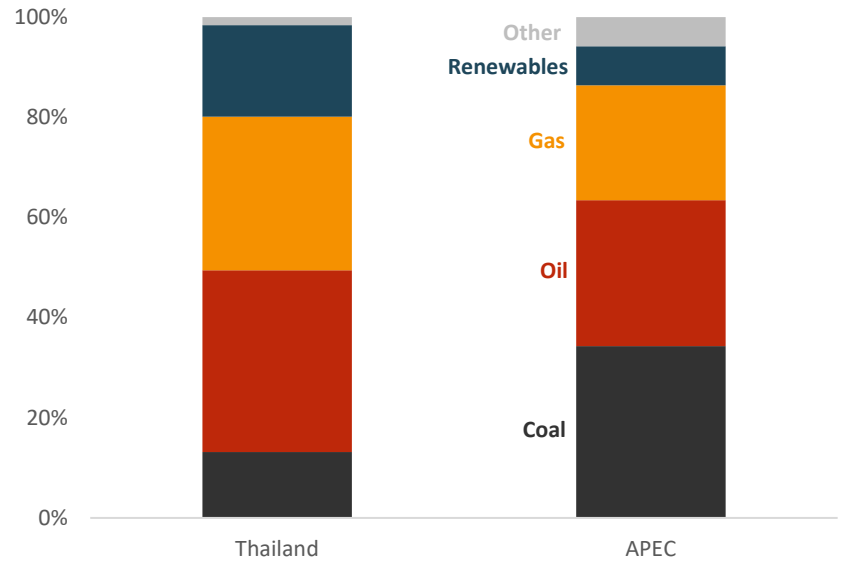
Figure 2: Thailand TPES by Fuel, 2000 to 2018



Source: EGEDA (2020)

Thailand exhibits a fuel mix different from that of the APEC region (Figure 3). The share of coal is smaller, whereas those of oil, gas, and renewables are proportionally larger. Coal supply growth is strongest among fossil fuels, suggesting that its share will be higher in the coming years.

Figure 3: TPES Relative Fuel Share, Thailand and APEC, 2018

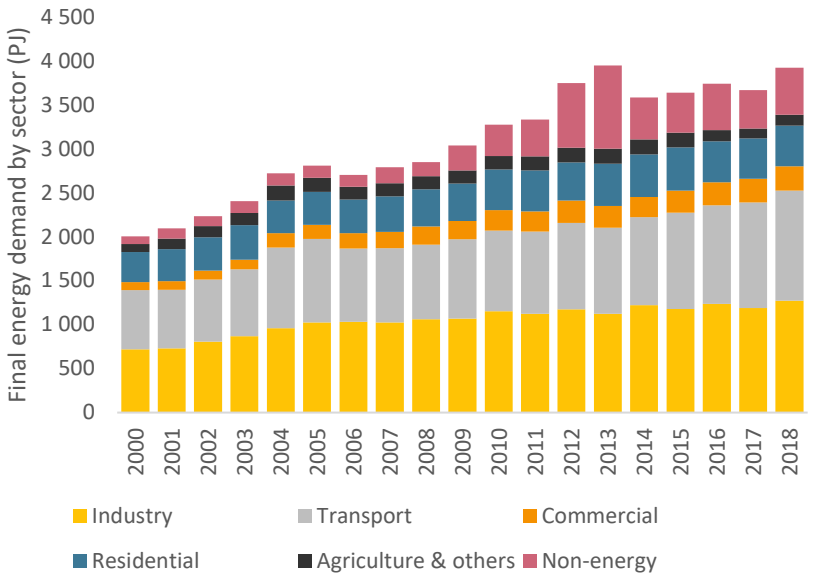


Source: EGEDA (2020)

Total Final Consumption

Thailand's total final consumption in 2018 was 3 924 PJ, an increase of 6.9% from 2017 (Figure 4). The industry and transport sectors were the two largest energy-consuming sectors, accounting for 1 272 PJ and 1 253 PJ; each accounted for 32% of the total final consumption. The buildings and non-energy sectors accounted for 19% and 14% of the total final consumption (741 PJ and 536 PJ), respectively. The non-energy sector is primarily composed of energy products that are used as feedstock (for example, in petrochemicals) instead of for energy purposes.

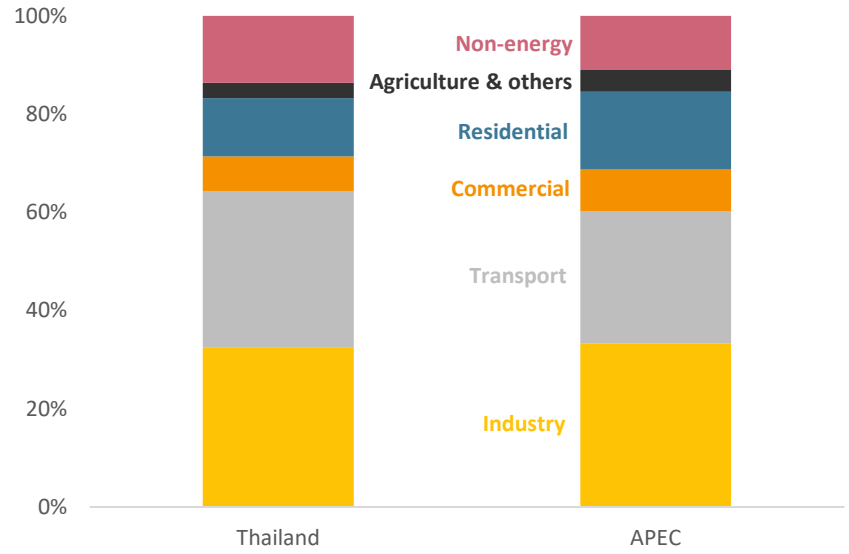
Figure 4: Thailand's Sectoral Final Energy Demand, 2000 to 2018



Source: EGEDA (2020)

Thailand's transport and non-energy sectors show higher proportional energy consumption, whereas the energy consumption of industries and buildings (residential and commercial) is lesser, compared to APEC as a whole (Figure 5). Industry and transport have been the key dominant sectors since 2000.

Figure 5: Sectoral Final Energy Demand, Thailand and APEC, 2018

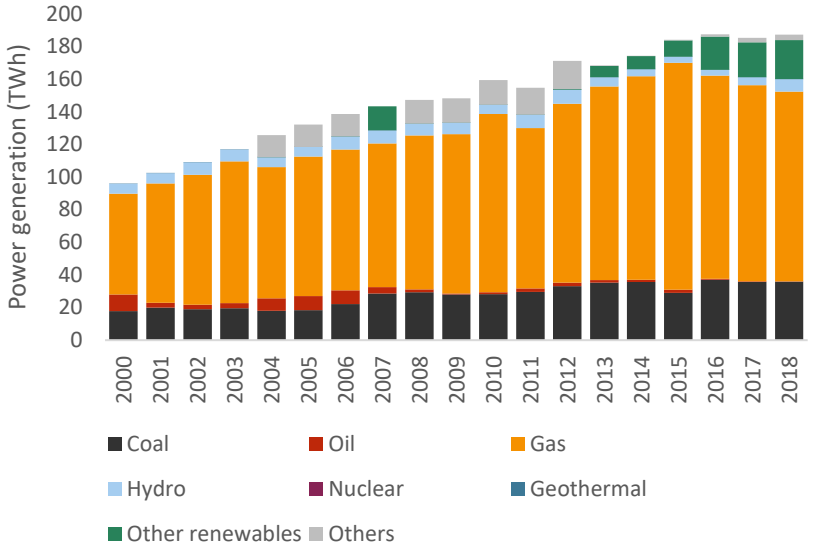


Source: EGEDA (2020)

Transformation

Thailand's power sector is reliant on natural gas. About 62% of Thailand's electricity was generated by gas in 2018, a decrease from 65% in 2000. Coal constantly maintained its share at 19% from 2000 to 2018, while that of renewables increased substantially from 6% in 2000 to 19% in 2018, with a 25% annual increase in the most recent year.

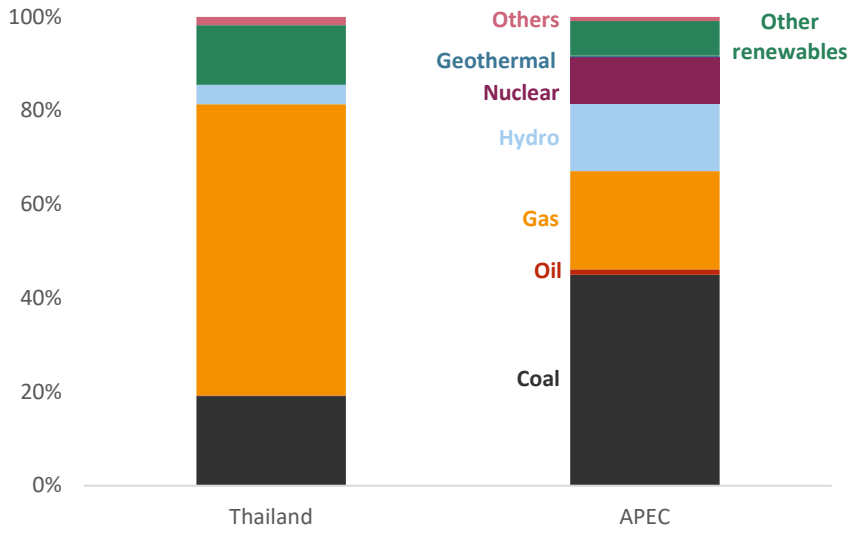
Figure 6: Thailand's Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

The prominence of natural gas and renewables in Thailand's power sector is clear when viewed next to the generation mix for APEC in 2018 (Figure 7). Thailand also has proportionally less coal and hydro generation than that of APEC. A continued strong growth in other renewables in Thailand is expected due to abundant renewable potential and technologies that are increasingly cost competitive.

Figure 7: Relative Electricity Generation Fuel Shares, Thailand and APEC, 2018



Source: EGEDA (2020)

APEC Goals

The APEC member economies have agreed to meet two energy-related objectives. These are related to improving energy intensity and increasing the share of renewables in the energy mix.

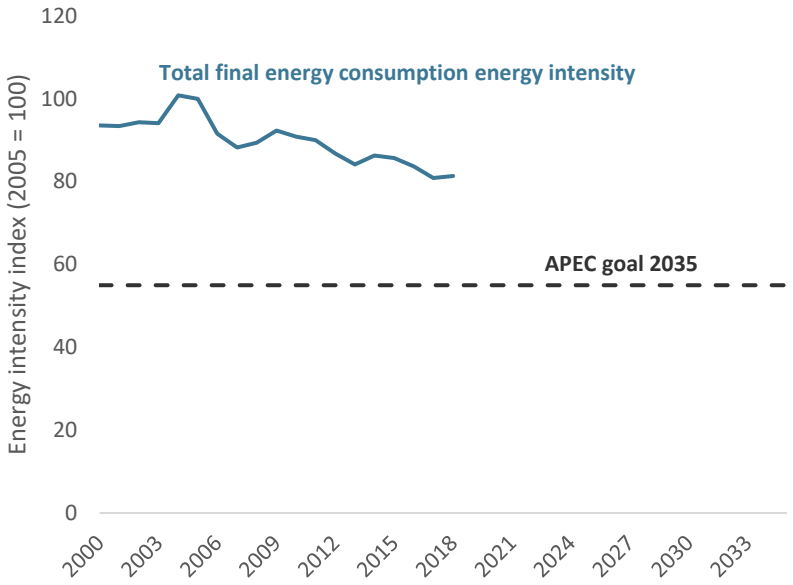
Energy Intensity Analysis

In 2011, the APEC member economies agreed to increase their ambition to reduce energy intensity by 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

The APEC region is on track to meet this energy intensity improvement. This goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

In 2018, Thailand's total final energy consumption (not including non-energy) energy intensity improved by 19% relative to the 2005 numbers. To contribute in a proportional sense, Thailand will need to improve its energy intensity by an additional 26% over the next 17 years from 2018 to 2035 (Figure 8).

Figure 8: Thailand's Total Final Energy Consumption Energy Intensity, 2000 to 2018 (2005 = 100)



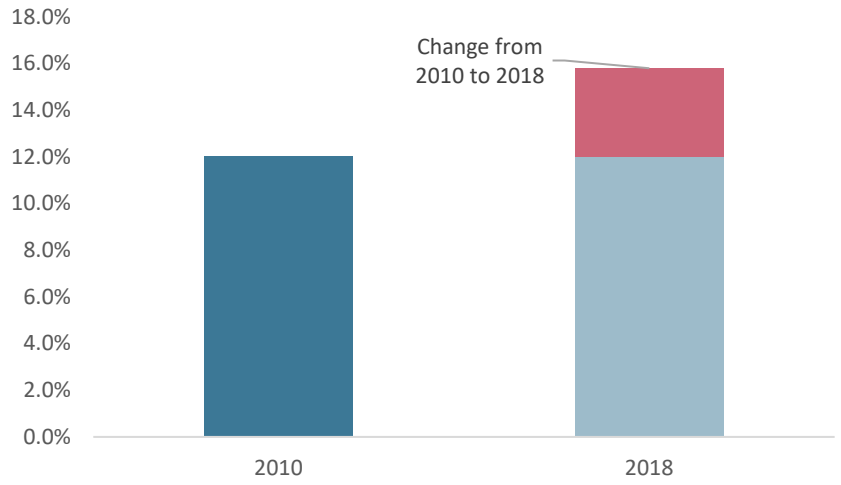
Source: EGEDA (2020)

Doubling of Renewables

The second energy goal involves doubling the share of renewables in the APEC energy mix for the period 2010 to 2030. Renewables comprise modern renewables, which do not include traditional biomass, and the share is relative to final energy consumption.

Individual member economies do not have economy-level goals, but it is possible to calculate the relative improvement in individual economies to get a better sense of whether this goal will be achieved. Thailand's share of modern renewables to final energy consumption in 2010 was 12.0%. In 2018, this proportional share was 15.8%. Thailand thus needs to increase its share of renewables by 8.2% for the period 2018 to 2030 to achieve a doubling (Figure 9).

Figure 9: Thailand's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policies

Energy Policy	Details	Reference
Climate Change Master Plan (CCMP)	The climate change master plan (2015–2050) is designed to help Thailand achieve sustainable low-carbon growth and climate change resilience by 2050.	https://climate.onep.go.th/wp-content/uploads/2019/07/CCMP_english.pdf
GHG Emission Reduction	The action plans for the decarbonisation of the energy sector aim to reduce greenhouse gas emissions by 20–25% by 2030.	http://ghgreduction.tgo.or.th/
Power Development Plan 2018 (PDP 2018 Revision 1)	The PDP 2018 has set a goal of achieving a power capacity of 77,211 MW, of which renewable energy projects are planned to account for 29,411 MW by 2037.	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp
Power Development Plan 2018 (PDP 2018 Revision 1)	The PDP 2018 has set the following goal for fuel mixes in 2037: natural gas = 53%, non-fossil fuels = 36% and coal = 11%.	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp
Energy Efficiency Plan 2018 (EEP 2018)	The energy intensity should be reduced by 30% by 2037 compared to 2010.	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-eep
Alternative Energy Development Plan 2018 (AEDP 2018)	Increase the proportion of renewable energy to 30% of the total energy consumption by 2037	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-aedp
Alternative Energy Development Plan 2018 (AEDP 2018)	The AEDP 2018 has set a goal of RE-based power capacity at 34.23% of the total installed capacity (5.75% of TFEC), RE-based heat at 41.61% of the total heat production (21.2% of TFEC) and biofuel at 9.99% of the total fuel consumption (3.22% of TFEC) by 2037.	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-aedp
Alternative Energy Development Plan 2018 (AEDP 2018)	Increase ethanol and biodiesel consumptions to 7.5 million litres/day and 8.0 million litres/day, respectively, by 2037	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-aedp
Drafted Oil Plan 2018	Increase oil reserves to 50 days by 2037	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-oilplan

Drafted Oil Plan 2018	Increase E-20 to 90% of the gasoline consumption by 2027	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-oilplan
Drafted Oil Plan 2018	Increase Euro-V diesel production to match the total diesel demand by 2023	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-oilplan
Gas Plan 2018	Increase gas consumption in the industry sector by 5% annually by 2037 (versus 2018)	http://www.eppo.go.th/images/Information_service/public_relations/PDF/Gasplan2018.pdf
Gas Plan 2018	Increase gas production to a minimum rate of 1,500 mmscfd	http://www.eppo.go.th/images/Information_service/public_relations/PDF/Gasplan2018.pdf
Gas Plan 2018	Increase the utilisation of LNG terminal to be at a minimum of 60%	http://www.eppo.go.th/images/Information_service/public_relations/PDF/Gasplan2018.pdf
Imports from Myanmar	Follow the Gas Plan 2015, assuming declining imports from Myanmar that reach zero by 2031	http://www.eppo.go.th/images/Information_service/public_relations/PDF/Gasplan2018.pdf
Thailand's Energy 4.0	The initiatives include the SMART grid, energy storage, 1.2 million EVs, 690 charging stations, and technology for heat production from renewables.	https://iecc.energy.go.th/wp-content/uploads/2019/03/00_Energy-4.pdf

Notable Developments

Energy development	Details	Reference
2nd PTT LNG import terminal (T-2)	A new facility with 7.5 Mtpa (expandable to 15 Mtpa) capacity, aiming for completion in 2022	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp
3rd PTT LNG import terminal (T-3)	A new facility with 10.8 Mtpa (expandable to 16 Mtpa) capacity, aiming for completion in 2027	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp
1st EGAT FSRU project (F-1)	A new facility of 5 Mtpa capacity, aiming for completion in 2023	http://www.eppo.go.th/index.php/en/policy-and-plan/en-tieb/tieb-pdp
Eastern Economic Corridor (EEC)	Development of the infrastructure in eastern Thailand to encourage investment, uplift innovation, and advanced technology in Thailand.	https://www.eeco.or.th/en
Map Ta Phut Phase III	The project is an extension to the Map Ta Phut Industrial Port and will help reduce the congestion at the port and develop logistical facilities to support the EEC.	https://www.eeco.or.th/en/news/eec-signed-the-first-mega-project-the-construction-of-map-ta-phut-port-phase-3
Hydro-Floating Solar Hybrid	The EGAT project will install 16 floating solar farms with a combined capacity of 2.7 gigawatts by 2037.	https://www.egat.co.th/en/news-announcement/news-release/egat-kicks-off-the-world-s-largest-hydro-floating-solar-hybrid-project
Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP)	The multilateral cross-border power trade aims to improve people's quality of life and the electrification and economic growth of the region.	https://policy.asiapacificenergy.org/node/2574

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United States

Introduction

The United States (US) is the world's second-largest economy, with a gross domestic product (GDP) of USD 20 trillion (2017 USD purchasing power parity [PPP]) in 2018 (World Bank, 2020). The US spans 9.9 million square kilometres (km^2) (Census, 2010) and had a population of 327 million in 2018. Since 2000, the economy's population has grown at 0.8% per year.

The US enjoyed economic expansion from 1990 to 2000, recording an annual growth of 3.4% in real terms, which then slowed to 1.9% from 2000 to 2018. In 2018, GDP increased by 2.9% from 2017. The per capita GDP in 2018 was USD 61 391.

Table 1: Macroeconomic Data and Energy Reserves

Key data [a]		Energy reserves [b, c]	
Area (million km^2)	9.9	Oil (billion barrels)	69
Population (million)	327	Gas (petajoules)	464 400
GDP (2017 USD billion PPP)	20 055	Coal (million tonnes)	249
GDP per capita (2017 USD PPP)	61 391	Uranium (kilotonnes U_3O_8)	47

Source: World Bank (2020), BP (2020), OECD (2020)

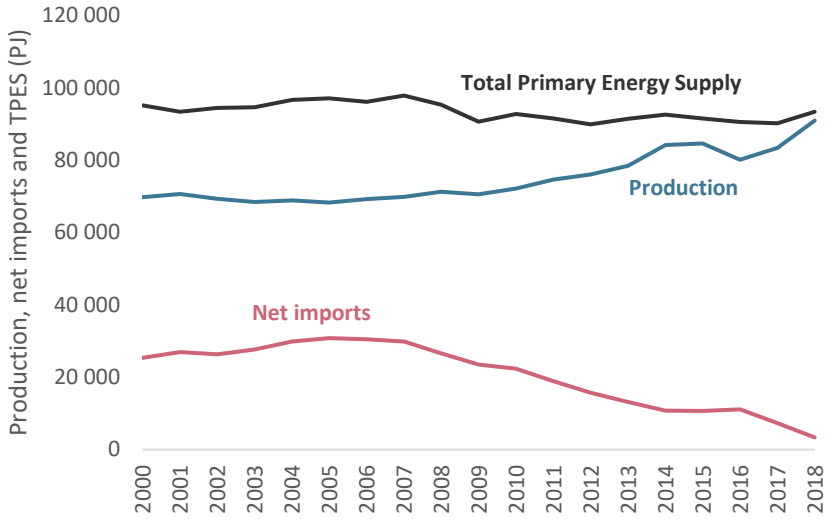
The US is the second-largest producer and consumer of energy in APEC. In 2018, the US had 69 billion barrels of proven oil reserves, 464 400 PJ of natural gas reserves and 249 billion tonnes of coal reserves (BP, 2020).

Energy Supply and Consumption

Total Primary Energy Supply

The total primary energy supply (TPES) in the US in 2018 was 93 398 PJ, including production and net imports. This represented a 3.5% increase compared with the 2017 level. Energy production was over 97% of the TPES in 2018, reflecting the substantial production of oil, natural gas, and coal.

Figure 1: US TPES (PJ)

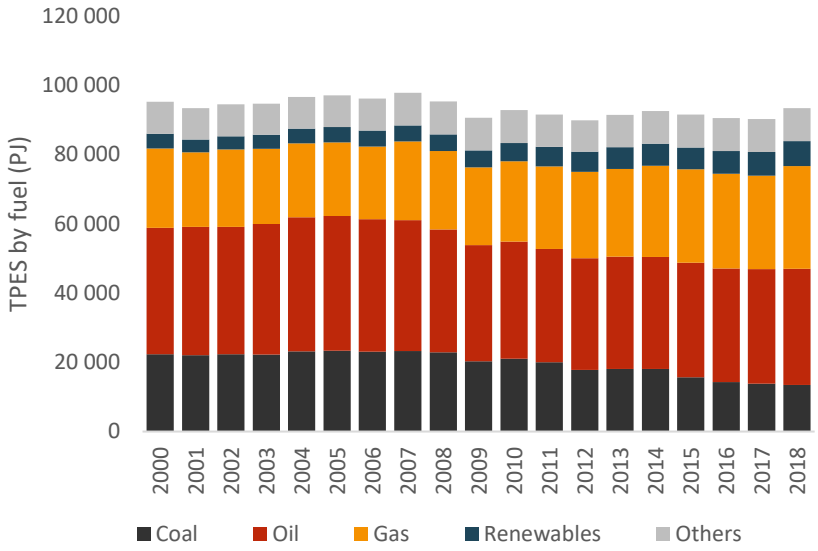


Source: EGEDA (2020)

While TPES has been flat or gradually decreasing, the contributions of production and net imports have been diverging since around 2008. Only 3.6% of the economy's primary energy requirements in 2018 came from net imports. The share of net energy imports has declined from a peak of 32% in 2006 (EGEDA, 2020).

Energy production has largely substituted net imports due to tight oil and gas production. Production plateaued in 2015 due to, in part, a sharp drop in global oil benchmark prices. Growth resumed at a rate of over 13% between the low in 2016 and 2018.

Figure 2: US TPES by Fuel, 2000 to 2018 (PJ)



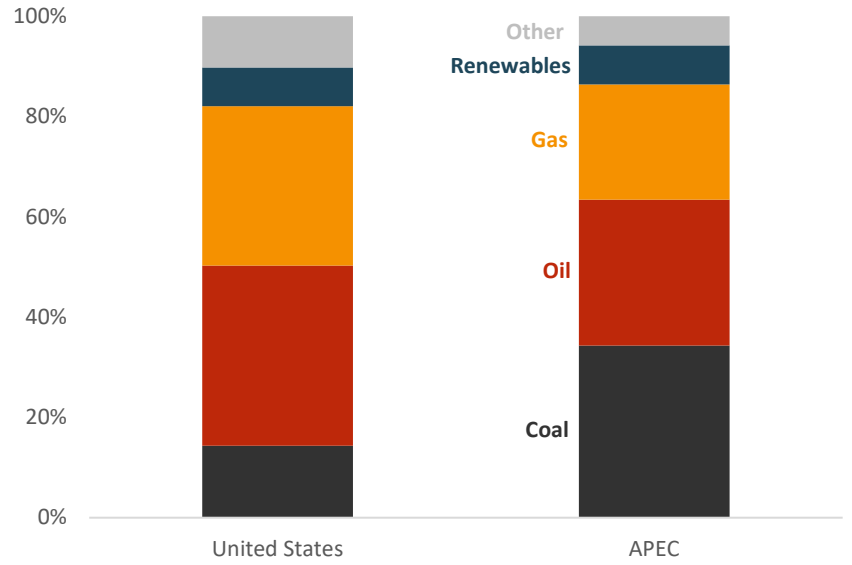
Source: EGEDA (2020)

By fuel type, 36% of the supply came from crude oil and petroleum products, 32% from natural gas, 14% from coal and the rest from other sources such as nuclear energy, hydropower, wind, solar, biomass, and geothermal energy.

Coal TPES peaked in 2005 at 23 377 PJ and has declined year-over-year through 2018. The oil TPES of 2018 is almost 14% lower than the peak in 2005. Meanwhile, gas TPES increased 41% in 2018 from a low of 21 024 PJ in 2006.

These dynamics are reflected in the composition of TPES of the US compared to the aggregate APEC TPES. The US is much less reliant on coal and more reliant on oil and natural gas.

Figure 3: TPES – Relative Fuel Share, the US and APEC, 2018

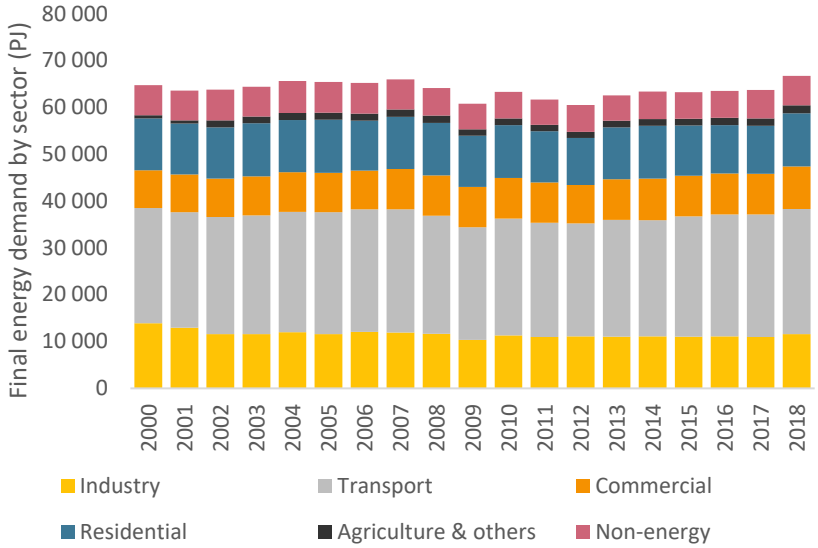


Source: EGEDA (2020)

Total Final Consumption

On the demand side, the total final consumption (TFC), including non-energy, by end-use sectors was 66 743 PJ in 2018. The TFC of the US reached a low of 60 791 PJ in 2009 after the economic recession, which was below the average of 63 829 PJ for the period from 2000 through 2018.

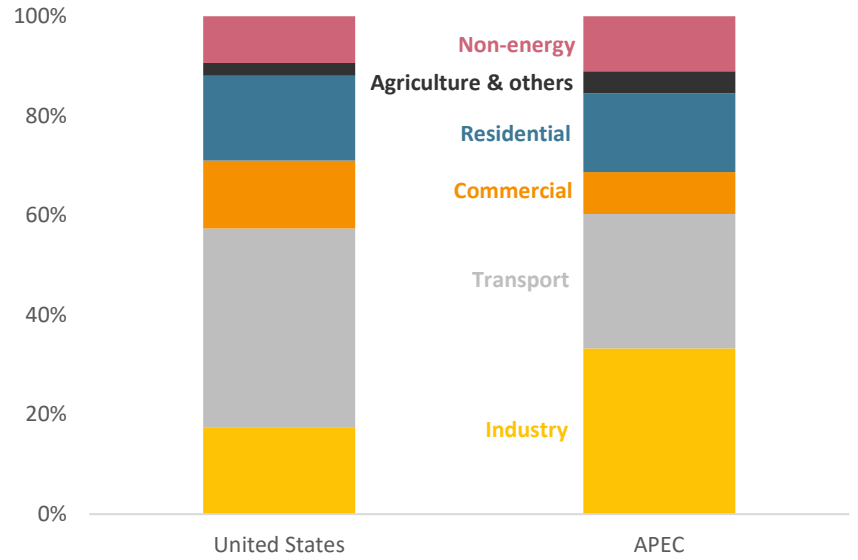
Figure 4: US Final Energy Demand by Sector, 2000 to 2018 (PJ)



Source: EGEDA (2020)

The transport sector is the largest consumer of energy in the US. In 2018, the share of transport TFC was 40%, followed by residential and industry (17% each), commercial (14%), non-energy (9%) and agriculture (3%). There has been no marked shift in the sectoral TFC patterns since 2000.

Figure 5: Proportional Final Energy Demand for the US and APEC, 2018



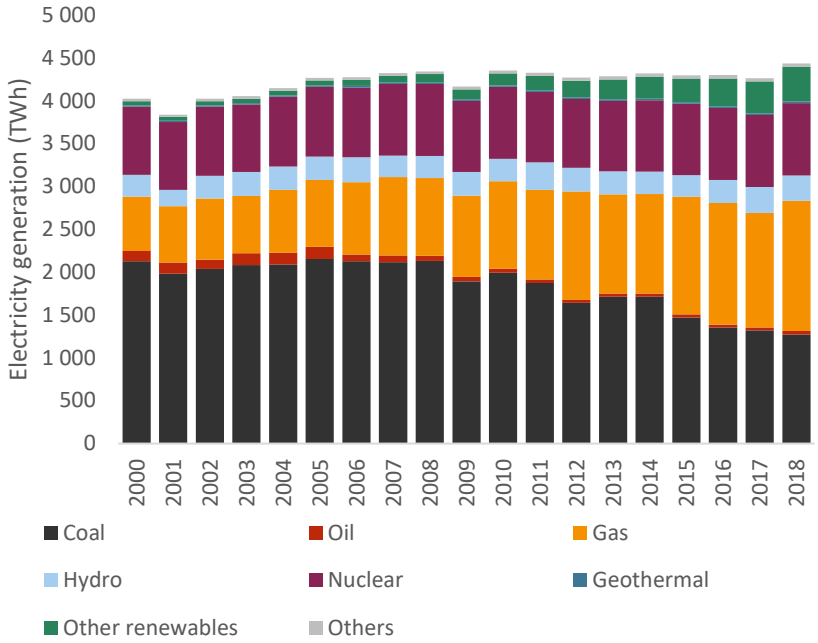
Source: EGEDA (2020)

The share of the transport sector's TFC in the US is roughly 48% greater than the aggregate APEC TFC. However, the share of the industrial sector's TFC in the US is nearly half that of APEC.

Transformation

The US generated 4 434 TWh of electricity in 2018. This was slightly higher than the average of 4 228 TWh since 2000. Over 50% of the electricity was generated from coal between 2000 and 2006, but this share has declined since then to 29% in 2018. Electricity generation from natural gas increased from a low of 16% in 2000 to a high of 34% in 2018. These trends reflect the dynamics in TPES discussed previously.

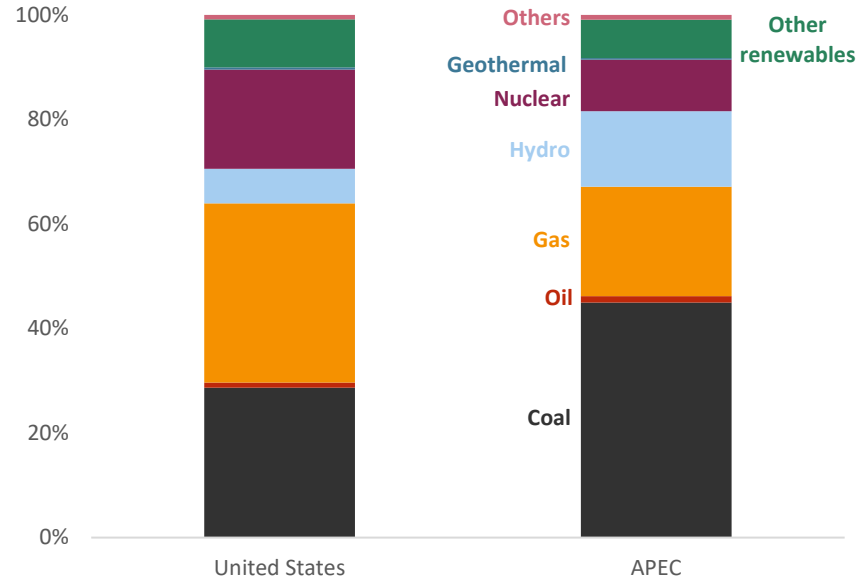
Figure 6: US Electricity Generation by Fuel, 2000 to 2018 (TWh)



Source: EGEDA (2020)

The shares of nuclear, hydro and oil have remained mostly constant since 2000, totaling around 27%.

Figure 7: Proportional Power Generation by Fuel for the US and APEC, 2018



Source: EGEDA (2020)

In general, natural gas and nuclear energy have larger shares of electricity production in the US compared to the APEC region. The share of gas in electricity generation is nearly double for the US compared to APEC (54% compared to 31%). Nuclear consumption, which is estimated using the thermal efficiency of nuclear power plants, is double APEC's share of nuclear.

On the other hand, coal and hydro have smaller shares in electricity generation relative to APEC. Coal consumption for electricity generation in APEC is around 49% higher than in the US. The share of electricity generated from hydro in the US is less than half of the share in APEC.

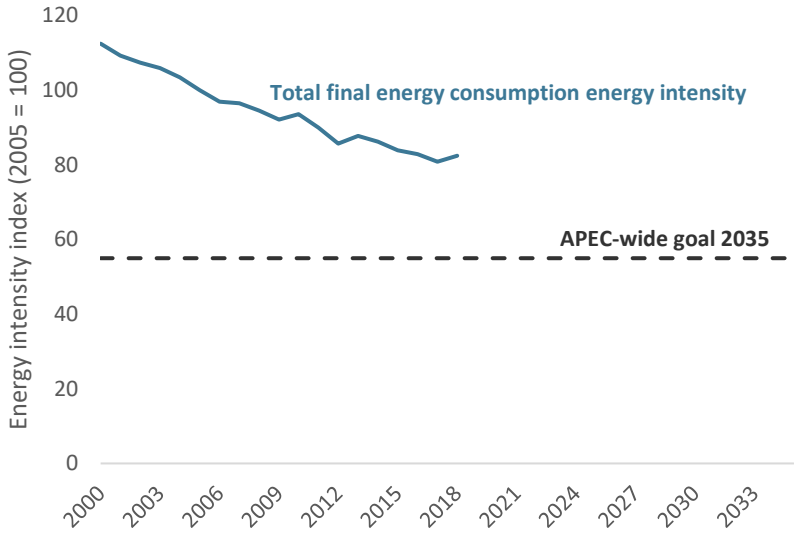
APEC Goals

APEC member economies have agreed to meet two energy-related objectives. These are to improve energy intensity and increase the share of renewables in the energy mix.

Energy Intensity Goal

In 2011, APEC member economies agreed to revise their goal of reducing energy intensity, increasing the reduction required to 45% in 2035, relative to a 2005 baseline. The original goal was a 25% improvement by 2030, relative to a 2005 baseline.

Figure 8: Total Final Energy Consumption Energy Intensity Index, 2000 to 2018 (2005 = 100)



Source: EGEDA (2020)

APEC is on track to meet this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to that overarching proportional improvement.

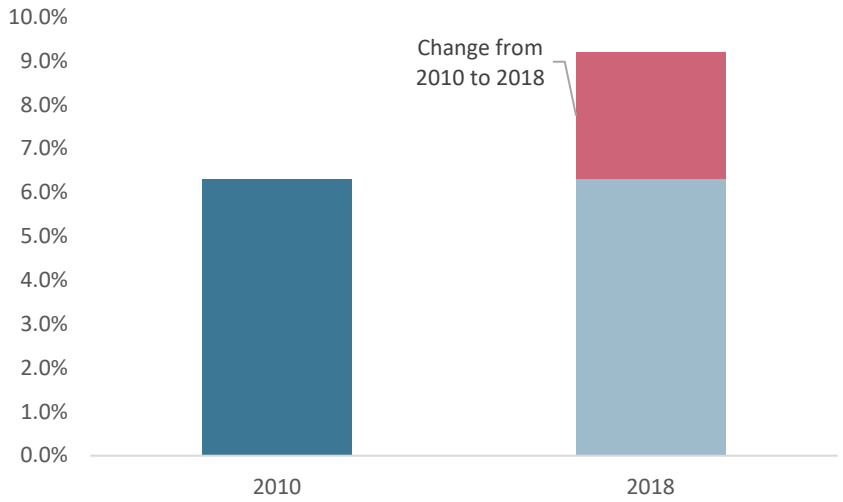
In 2018, the energy intensity of the total final energy consumption (excluding non-energy) of the US improved by 18% relative to 2005. To contribute in a proportional sense, the US will need to improve its energy intensity by an additional 27 percentage points over the 17 years from 2018 to 2035 (Figure 8).

Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period from 2010 to 2030. Modern renewables do not include traditional biomass, and the share is relative to the final energy consumption.

Individual member economies do not have economy-level goals, but it is possible to calculate the relative improvement of individual economies to get a better sense of how and whether the goal will be achieved. In the US, the share of modern renewables to final energy consumption in 2010 was 6.3% and 9.2% in 2018. Thus, the US would need to increase its share of renewables by 3.4 percentage points for the period from 2018 to 2030 to achieve a doubling (12.6% share for modern renewables) (Figure 9).

Figure 9: US Modern Renewable Energy Share Analysis, 2010 and 2018



Source: EGEDA (2020)

Note: The biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by the industry, hydro, geothermal, etc.) are considered to be modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

Energy Policy

Energy Policy	Details	Reference
Nationally Determined Contribution (NDC)	The US updated its NDC to target "setting an economy-wide target of reducing its net greenhouse gas (GHC) emissions by 50–52 percent below 2005 levels in 2030."	UNFCC
Legislative mandates on biofuels	In 2007, Congress mandated annual biofuel volumes, including 136 billion litres (36 billion gallons) of biofuel by 2022. The statutory targets have never been met. EPA issues annual RFS rulemakings to establish volume requirements based on expected market conditions. The last final EPA rulemaking was issued 12/19/2019 and set targets for 2020 cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel, and 2021 biomass-based diesel.	US EIA
E15 Ethanol	Nearly all the gasoline in the US contains 10% ethanol. In 2019, at the president's initiative, the EPA issued a final rule allowing gasoline with 15% ethanol (E15) to be sold year round. However, very few retail fuelling stations offer E15 (last estimated at less than 2% of stations).	US EIA
IRS USD 1 tax credit for biodiesel producers	On average, diesel fuel contains nearly 5% biodiesel and renewable diesel. In the years when the tax credit was in effect, during the time of production (i.e., not applied retroactively), such as in 2013 and 2016, domestic production and imports of biodiesel increased significantly relative to the preceding years.. Tax credit is in effect through 12/31/2022.	US EIA
CCS tax credits (IRS 45Q)	Any new or existing cement, ammonia, fertilizer, steel or methanol plant that commences construction before 2024 and captures more than 100 000 tonnes of CO_2 for EOR or geologic storage or 25 000 tonnes for other uses per year is eligible for tax credit for up to 12 years.	US Congress
EPA Cross-State Air Pollution Rule (CSAPR)	This targets So_2 and No_x. Under the CSAPR, in the summertime, the power plants in 22 states in the Eastern US must limit the emission of sulphur dioxide and nitrogen oxides. The implementation of the regulations began in 2015 with further modifications starting in 2017.	US EPA
EPA Mercury and Air Toxics Standard (MATS) on air emissions	This covers Hg, As, Cr, Ni, HCl and HF. The MATS regulates acid gases and mercury from coal-fired plants of 25 MW or greater. Under the MATS, mercury emissions must be 88% below their uncontrolled levels. For example, the mercury standard for existing units not burning low-rank virgin coal is 1.2E0 lb/TBtu. (1.3E–2 lb/GWh).	US EPA
IRS Sections 45 and 48 investment and production tax credits for wind	IRS Sec. 45 and 48 production or investment tax credits for taxpayers using wind to produce electricity or for placing wind energy property into service are being gradually phased down for onshore wind generators but are held at full value for offshore wind electricity generation.	Wind Tax Credits - NLR

Solar Tax Credits Extended	The stimulus bill enacted in January 2021 extended investment tax credits for solar generation. The ITC is phased down from 26% to 10% based on beginning of construction date from 2021 to 2023.	Solar Tax Credits Extended - IDEA
NRC 89 nuclear reactor license extensions approved	These are 20-year extensions, enabling reactors to operate for 60 years. Three more units have informed the agency of their intention to seek extensions between 2022 and 2024.	US NRC
Ten-state northeast and mid-Atlantic Regional Greenhouse Gas Initiative (RGGI)	It focuses on reducing the CO_2 emissions of the fossil fuel power plants of over 25 megawatts by 60% by 2020 compared with the 2005 levels. Using a cap-and-trade system, the states sell emission allowances through auctions and spend the proceeds on energy efficiency, renewable energy and other consumer benefit programs. RGGI plans an additional 30% regional cap reduction between 2020 and 2030.	RGGI
New England Governors/Eastern Canadian Premiers Climate Change Action Plan	Regional 2030 GHG reduction goal. The six New England state Governors and five Eastern Canadian Premiers resolved in 2015 to reduce the region's GHG emissions to 35–45% below the 1990 levels by 2030 and reaffirmed that goal in 2019.	Coalition of Northeastern Governors
California GHG cap and trade, 60% RPS by 2030, carbon neutrality by 2045	California's cap-and-trade program applies to both utilities and non-utilities and runs through 2030.	California Air Resources Board
Renewables Portfolio Standards (RPS)	State-based RPS programs.	Lawrence Berkeley National Laboratory
Building and Appliance Energy Efficiency	The Department of Energy has adopted policies and implemented programs to encourage building and appliance energy efficiency	DOE Energy Efficiency Programs
State Energy Efficiency Policies	Several states also have adopted incentives to meet energy efficiency standards.	Energy Efficiency Standards
IRS Section 30D tax credit of $2 500 – 7 500 for up to 200 000 EVs per manufacturer	An ITC of USD 2 500 to 7 500 is available for plug-in electric vehicles depending on the size of the vehicle and its battery capacity. Tax credit is available till 200 000 qualified vehicles have been sold in the US by each manufacturer.	US IRS
EPA emission standards for heavy trucks through 2027	In 2016, the EPA released new emission standards for semi-trucks, large pickup trucks and vans, and all types of buses and work vehicles for 2018–2027.	GOVINFO
Federal CAFE standards	Fuel standards for the model year 2026 are 17.0km per litre (40.4 miles per gallon). However, the estimated real-world mpg is 33.2 (14.1km/litre).	regulations.gov
State clean vehicle policies	Numerous states have adopted numerous clean vehicle policies, including zero emission vehicle (ZEV) mandates.	State Clean Vehicle Policies

Notable Developments

Energy development	Details	Reference
Keystone XL pipeline	The permit for the TransCanada Keystone pipeline was revoked through an Executive Order	The White House
Paris Agreement	The US re-joined the Paris Agreement	The White House
Review of new oil and gas leasing on federal land	A temporary moratorium on oil and gas leases on federal land	The White House
Whole-of-government approach to climate change	Various activities related to climate change policies under the auspices of the Federal Government as per an Executive Order.	The White House

Useful links

US Department of Energy — https://www.energy.gov/

US Energy Information Administration — https://www.eia.gov/

US Environmental Protection Agency — https://www.epa.gov/

The White House Presidential Actions — https://www.whitehouse.gov/briefing-room/presidential-actions/

Viet Nam

Introduction

Viet Nam is an economy located in Southeast Asia, with China to the North, Laos and Cambodia to the west, and the East Sea and Pacific Ocean to the east and south, respectively. The geography consists of hills and densely forested mountains in the northwest and a land area of 331 236 square kilometres (GSO, 2020). As it is in a tropical monsoon zone and profoundly affected by the East Sea, Viet Nam has warm weather throughout most of the territory, abundant solar radiation, high humidity, and generous seasonal rainfall. Viet Nam has been a member of the Asia-Pacific Economic Cooperation (APEC) since 1998.

Viet Nam has been one of the fastest-growing economies in Asia for decades, with a gross domestic product (GDP) growth rate above 6% per annum (DEA, 2019). In 2018, the population was 95.5 million (World Bank, 2020), with an urbanisation rate of 35% (GSO, 2020). In 2018, GDP reached USD 725 billion (2017 USD purchasing power parity), marking a 7.1% increase from 2017 (World Bank, 2020).

Natural resources are diverse, including coal, oil, natural gas, and renewables, which is an advantage for Viet Nam (Table 1). The proven fossil energy reserves were 4.4 billion barrels of oil, 21 600 petajoules (PJ) of gas, and 3 360 million tonnes (Mt) of coal in 2019 (BP, 2020). The Organisation for Economic Cooperation and Development (OECD) estimated the identified recoverable resources of uranium at approximately 3 900 tonnes, and an additional 5 200 tonnes were identified as in situ resources (NEA-IAEA, 2020). In addition, Viet Nam has high renewable energy potential, including hydro, solar, wind, biomass, and waste. The renewable energy share in the total primary energy supply (TPES) was 21.6% in 2018 (EGEDA, 2020) and will double by 2050 (PMVN, 2015; Politburo, 2020).

The economic structure has gradually shifted away from agriculture in recent decades. The industry and service sectors expanded from 62% in the early 1990s to 75% in 2020 (GSO, 2020).

Viet Nam ranked 70th in the world for its business environment. Its access to electricity is the most progressive sub-indicator (27th globally) (World Bank, 2019). Electrification in rural areas and remote islands is 99%. The government has promoted a “green growth” strategy since 2012 for Viet Nam’s ongoing industrialisation and modernisation (PMVN, 2012).

Table 1: Viet Nam’s Macroeconomic Data and Energy Reserves

Key Data [a, b]		Energy Reserves [c, d]	
Area (km^2)	331 236	Oil (billion barrels)	4.4
Population (million)	95.5	Gas (petajoules)	21 600
GDP (2017 USD billion PPP)	725	Coal (million tonnes)	3 360
GDP per capita (2017 USD PPP)	7 586	Uranium (tonnes U < USD 260/kgU)	3 900

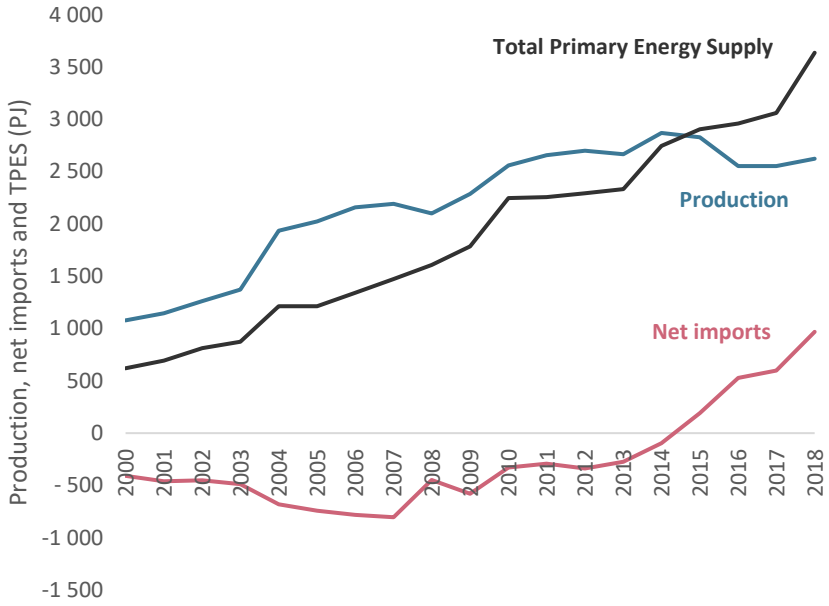
Source: [a] GSO (2020), [b] World Bank (2020), [c] BP (2020), [d] NEA-IAEA (2020)

Energy Supply and Consumption

Total Primary Energy Supply

Viet Nam's TPES was 18.8% higher than the previous year in 2018, reaching 3 636 PJ (EGEDA, 2020). Energy production increased slightly by 2.8% from the 2017 level, reaching 2 624 PJ in 2018 (Figure 1). It was the first time an ascending trend was seen after reaching a peak in 2014. Due to the increased domestic energy demand for economic development, Viet Nam has been a net energy importer since 2015. Energy imports have grown dramatically in recent years.

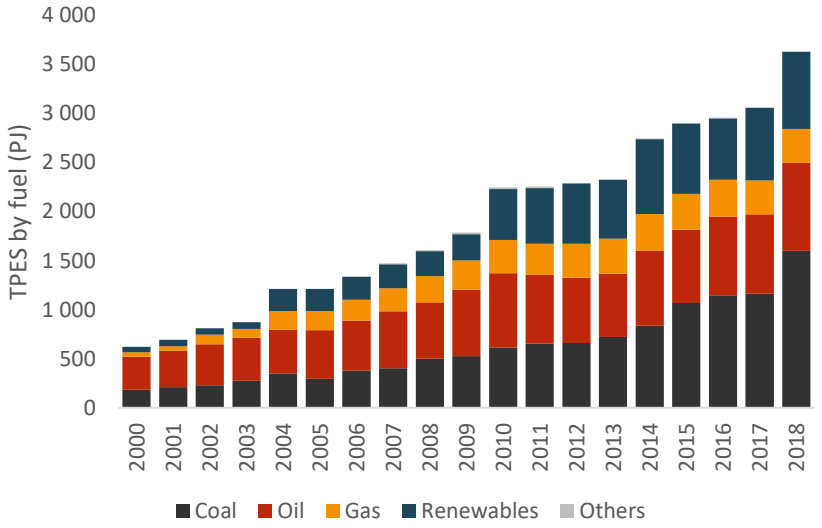
Figure 1: Viet Nam's Total Primary Energy Supply, 2000 to 2018



Source: EGEDA (2020)

Viet Nam's TPES fuel mix increased substantially from 2000 to 2018 (Figure 2). Coal's share increased from 29.5% to 44%, and oil's share decreased from 54.5% to 24.7% over the same period. Additionally, the share of gas increased from 7.6% in 2000 to 9.6% in 2018, while renewables rose considerably from 8.4% to 21.6% (EGEDA, 2020).

Figure 2: Viet Nam's Total Primary Energy Supply by Fuel, 2000 to 2018

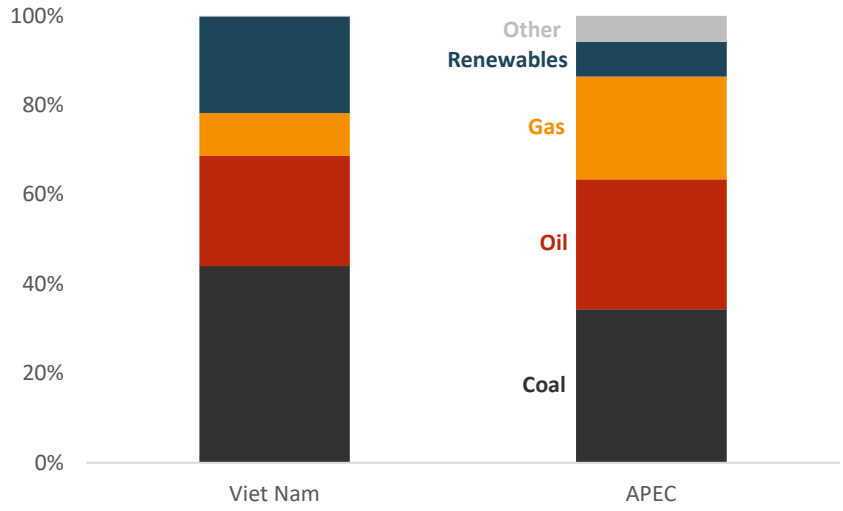


Source: EGEDA (2020)

Although policy on renewable energy development has been deployed since 2015 (PMVN, 2015), coal still plays a significant role in the transformation sector and is used almost entirely in coal-fired power plants.

Figure 3 shows significant differences in TPES fuel mix for Viet Nam and the entire APEC region in 2018. Coal has dominated Viet Nam's TPES, accounting for 44% – larger than coal's share in the APEC region. Oil's share in Viet Nam's TPES is slightly lower than that of the APEC region.

Figure 3: Total Primary Energy Supply by Fuel Share, Viet Nam and APEC, 2018



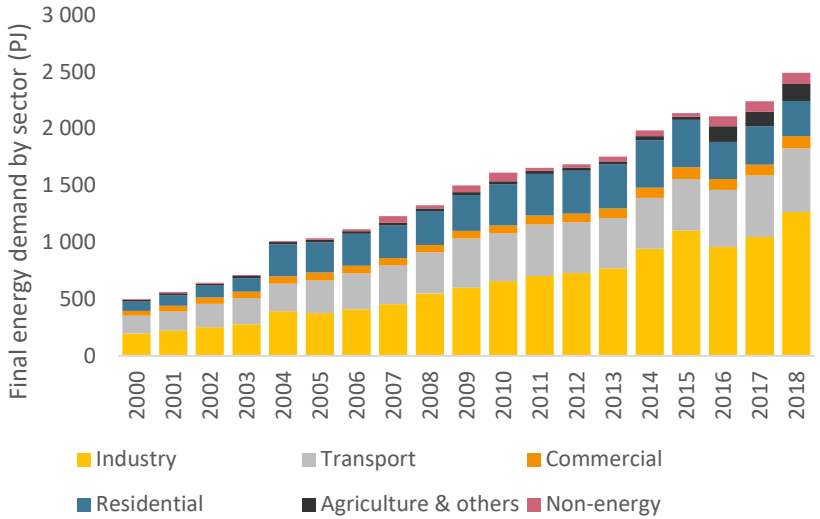
Source: EGEDA (2020)

In 2018, Viet Nam's renewable energy share reached 785 PJ, accounting for 21.6% of TPES, which is much higher than the share of the entire APEC region. It is the highest number seen over the last 30 years. Although gas's share was only 9.6%, much lower than APEC gas share, the proportion of gas will increase substantially in the coming years due to the operation of many gas-fired power plants (O Mon 3, O Mon 4, Dung Quat 1, Dung Quat 2, Nhon Trach 3, Nhon Trach 4 Mien Trung 1, Mien Trung 2, Bac Lieu) (MOIT, 2019).

Total Final Consumption

Figure 4 shows that Viet Nam's final energy demand rose noticeably during the 2000–2018 period. This increase resulted from GDP and population growth and urbanisation. Final energy demand in 2018 was 2 494 PJ, an increase of 11.3% compared to the previous year. Industry was the dominant end-use sector, accounting for 51% of all end-use energy consumption (including non-energy) in 2018. The transport sector was the next largest with a proportion of 23%. The commercial sector, agriculture and others, and non-energy sectors had similar shares as the previous year, while the residential sector fell by 8.4% compared to 2017.

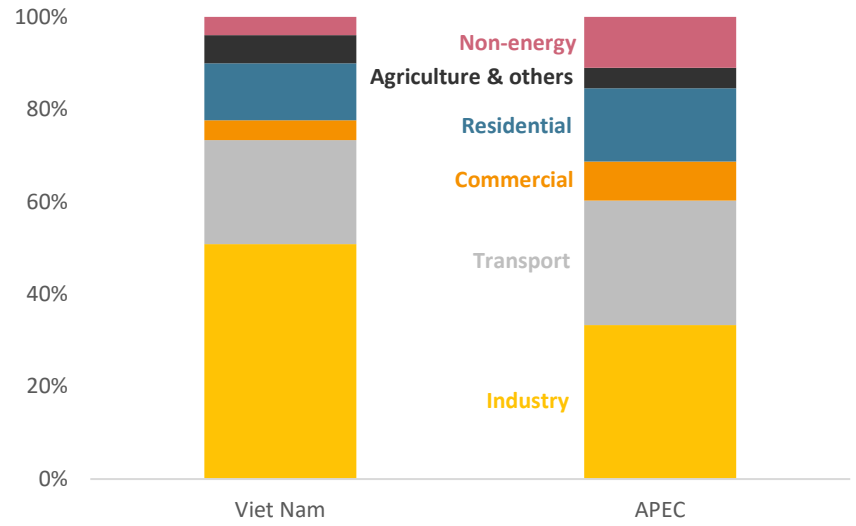
Figure 4: Viet Nam's Final Energy Demand by Sector, 2000 to 2018



Source: EGEDA (2020)

Compared to the entire APEC region, Viet Nam's industry end-use sector accounts for more energy use, whereas the transport sector is relatively smaller (Figure 5). Viet Nam's relatively large use of energy in the industry sector is driven by government policies for industrialisation and modernisation by 2030 (Politburo, 2018).

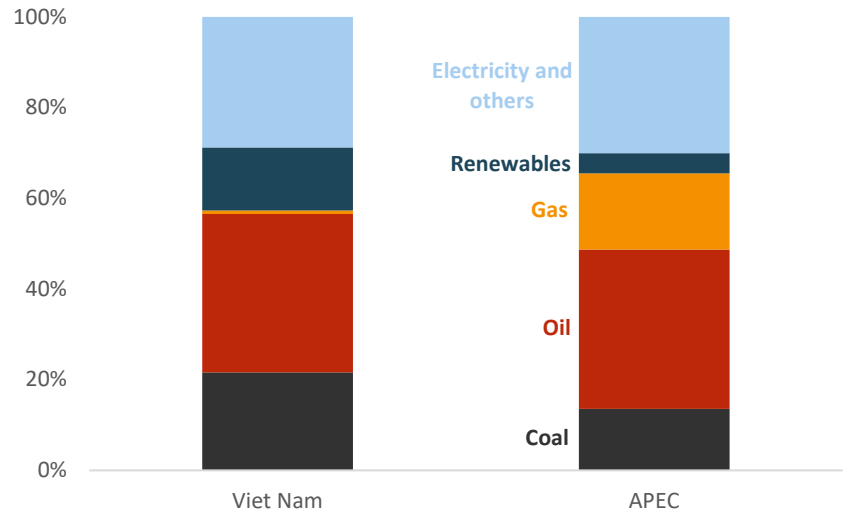
Figure 5: Relative Sectoral Final Energy Demand for Viet Nam and APEC, 2018



Source: EGEDA (2020)

In terms of fuel, both Viet Nam and APEC have similar shares of oil and electricity in final energy demand; however, Viet Nam consumes more coal and renewables relative to APEC (Figure 6). The share of gas in end-use demand is lower in Viet Nam than in APEC.

Figure 6: Final Energy Demand Fuel Mix for Viet Nam and APEC, 2018



Source: EGEDA (2020)

Transformation

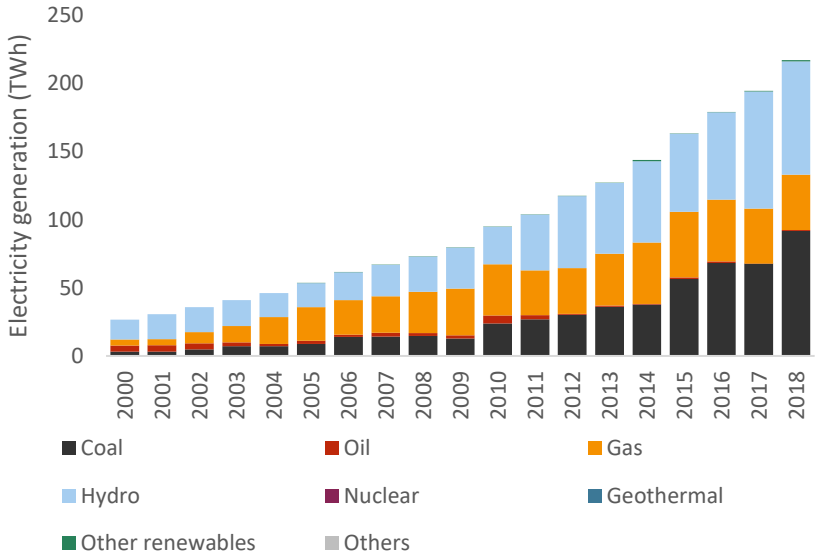
Viet Nam Electricity (EVN) is a state-owned company that has significant control over power transmission and distribution, contributing to 58% of power generation (EVN, 2019a).

Total power generation grew by 11.5% compared to the previous year, reaching 217 TWh in 2018 (Figure 7). Thermal energy accounted for 61.3% of the total generation; hydro accounted for 38.3%, and biomass and others constituted less than 0.5% (EGEDA, 2020).

Viet Nam's power sector is increasingly reliant on coal. About 42% of the electricity generation share was attributable to coal in 2018, a dramatic annual increase of 35.4% (EGEDA, 2020). The increase

resulted from the newly constructed coal-fired power plants (Vinh Tan 1 and Vinh Tan 4) that have been in operation since 2018 with a total capacity of 2.4 GW (MOIT, 2019).

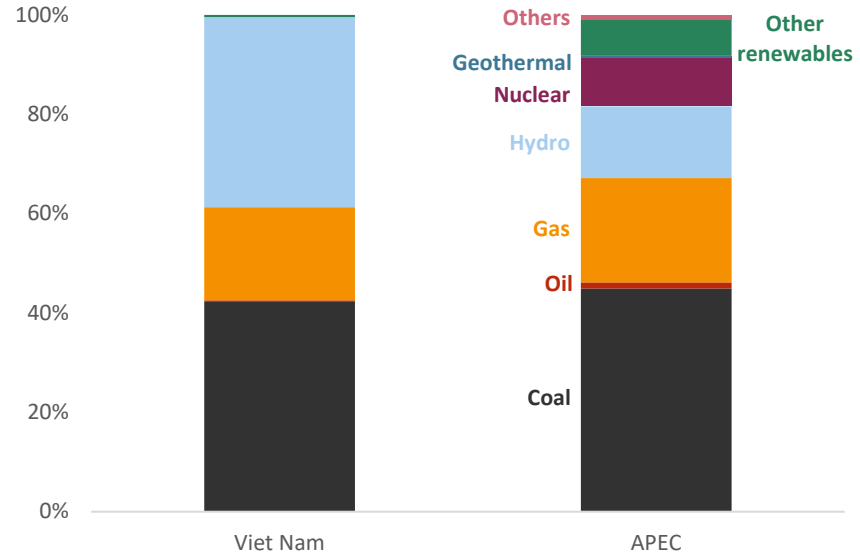
Figure 7: Viet Nam's Electricity Generation by Fuel, 2000 to 2018



Source: EGEDA (2020)

Viet Nam's electricity generation from coal in 2018 was comparable to that same share for the entire APEC region (Figure 8). The share of gas in electricity generation for Viet Nam was comparatively lower than for APEC. Hydro was the second-largest share in Viet Nam's electricity generation mix in 2018, at a share only slightly smaller than for coal. In contrast, hydro in APEC constituted a much smaller share, though still held third position in the total generation mix. Other renewables generation of Viet Nam only accounted for a very small proportion compared to the APEC region.

Figure 8: Electricity Generation by Fuel for Viet Nam and APEC, 2018



APEC Goals

The APEC has two energy-related goals that all member economies have agreed to meet as a collective: The first is to reduce energy intensity by 45% in 2035 compared to the 2005 level, and the second is to double the share of modern renewables in the energy mix by 2030 as compared to the 2010 level.

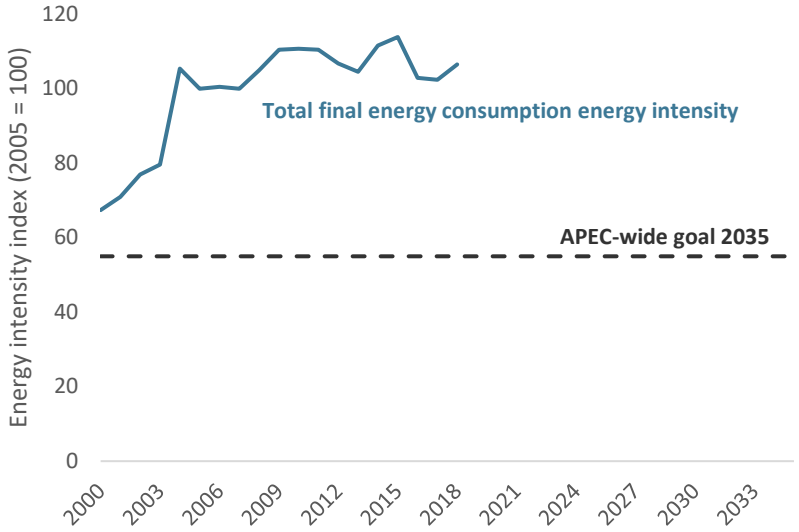
Energy Intensity Analysis

APEC is on track to achieve this energy intensity improvement. The goal does not impose individual economy targets, but it is possible to track the progress of individual APEC economies relative to the overarching proportional improvement.

Although Viet Nam has had an approved Viet Nam Energy Efficiency Programme since 2006 (PMVN, 2006) and the Law on Economical and Efficient Use of Energy since 2010 (NAVN, 2010), its energy intensity is still high compared to other economies.

Viet Nam's total energy consumption (not including non-energy) energy intensity improved 0.5% for the 2010–2018 period. However, it increased again by 4.1% in 2018 compared to the previous year (Figure 9). Viet Nam has approved the Program on Economic and Efficient Use of Energy for the period 2019–2030, with a target of saving 8–10% of the economy-wide energy consumption and ensuring electric loss is below 6% (PMVN, 2019). This program will partly contribute to the APEC's aspirational target of reducing energy intensity.

Figure 9: Viet Nam's Total Final Energy Consumption Intensity Index, 2000 to 2018 (2005 = 100)

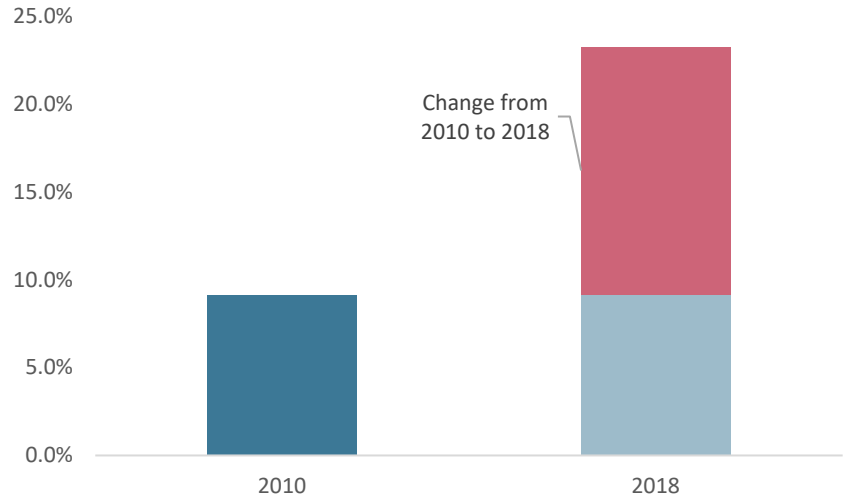


Source: EGEDA (2020)

Doubling of Renewables

The second energy goal involves doubling the share of modern renewables in the APEC energy mix for the period of 2010–2030. Modern renewables do not include traditional biomass, and the share is relative to the final energy consumption (not including non-energy consumption).

Figure 10: Viet Nam's Modern Renewable Energy Share, 2010 and 2018



Source: EGEDA (2020)

Note: Biomass used in the residential and commercial sectors is assumed to be traditional biomass and is not included in the definition of modern renewables. All other renewables (biomass used by industry, hydro, geothermal, etc.) are considered modern renewables. Modern renewables also include the share of electricity that is generated from renewable sources.

There is no economy-level goal for individual member economies, but improvements by individual economies contribute to the doubling goal. Viet Nam is starting from a higher renewable base than the APEC region; its renewable share in 2010 was 9.2% (Figure 10), while APEC's was 6%. In 2018, the proportional share reached 23.3%, which is more than a doubling already.

According to the Development Strategy of Renewable Energy of Viet Nam by 2030 with a Vision to 2050, modern renewables share will reach 32.3% by 2030 and 44% by 2050 (PMVN, 2015). This will contribute to APEC meeting its goal of doubling the share of renewables by 2030.

Energy Policy

Energy Policy	Details	Reference
Politburo's Resolution No. 55 on Viet Nam's National Energy Development Strategy to 2030, with a vision to 2045	The resolution provides for the prioritisation of fast and sustainable energy development while fostering favourable conditions for all economic sectors, particularly the private sector, to participate in energy development.	Communist Party of Viet Nam
Updated Nationally Determined Contribution (2020 version)	Viet Nam will reduce GHG emissions by 9% compared to BAU by 2030 with domestic resources. However, this 9% contribution could be increased to 27% if international support is received through bilateral and multilateral cooperation.	United Nations Framework Convention on Climate Change
Law on Economical and Efficient Use of Energy	This law provides economical and efficient use of energy; policies and measures to promote economical and efficient use of energy; and the rights, obligations and responsibilities of organisations, households, and individuals in economical and efficient use of energy	Viet Nam Government Portal
Petroleum Law	This law prescribes activities of petroleum prospection, exploration, and exploitation within the territory, exclusive economic zone and continental shelf of the Socialist Republic of Viet Nam.	Viet Nam Government Portal
Electricity Law	This law prescribes the electricity development planning and investment, electricity saving, electricity markets, rights and obligations of organisations and individuals conducting electricity activities and using electricity, protection of electric equipment and facilities, electricity works and electric safety.	Viet Nam Government Portal
Law on Environmental Protection	This law provides statutory provisions on environmental protection activities, measures and resources used for the purpose of environmental protection, rights, powers, duties, and obligations of regulatory bodies, agencies, organisations, households, and individuals who are tasked with the environmental protection task.	Ministry of Natural Resources Environment
Viet Nam's National Energy Development Strategy to 2030, with a Vision to 2050	This strategy addresses the Viet Nam government's energy development views, objectives, policies, and measures to achieve the 2050 vision.	Centre Database on Legal Normative Documents

Development Strategy of Renewable Energy	The share of produced electricity from RE (including both small and large hydro) in the total electricity production should reach about 38% by 2020, 32% in 2030 and about 43% in 2050.	Viet Nam Government Portal
National Strategy for Climate Change	To bring into play economy-wide capacity and simultaneously carry out measures of climate change adaptation and GHG emission reduction to assure safety for people and properties for sustainable development goals.	Viet Nam Government Portal
National Program on Economical and Efficient Use of Energy for the Period 2019–2030	To promote the economical and efficient use of energy by means of state management duties and solutions, technical assistance, scientific and technological research, product development, market transformation, human resource training and development.	Viet Nam Government Portal
National Strategy for Environmental Protection to 2020, vision to 2030	This involves controlling and limiting of environmental pollution levels, depression of natural resources and biological diversity, continuing to improve the environment and enhancing of capacity to cope with climate change toward sustainable development.	Viet Nam Government Portal
Development Plan of the Gas Industry of Viet Nam by 2025 with a Vision to 2035	This includes development of the gas industry sector with all stages which are organised in a complete and uniform manner, including extraction, gathering, transport, processing, storage, distribution of gases and import and/or export of gas products across the economy, and to ensure that gas production produced from the blocks/gas fields of the Viet Nam Oil and Gas Group (PVN) and oil and gas contractors operating in Viet Nam is fully gathered.	Viet Nam Government Portal
National Strategy on Green Growth	This includes green growth towards a low-carbon economy, natural capital enrichment as a decisive tendency in sustainable economic development, and reduction in emissions and increase in the possibility to absorb greenhouse gases as mandatory and important targets in socio-economic development	Viet Nam Government Portal
Viet Nam Power Development Plan for the Period 2011–2020 with a Vision to 2030	This involves the following: Supplying electric power at a reasonable price for the nation's growth in terms of economy and society, utilising varied resources of primary energy for effective production of electricity, development and use of renewable energies for electricity generation to avoid reliance on import coal, and contributing to energy security, mitigating climate changes, and protecting the environment.	Viet Nam Government Portal
Master Plan for Viet Nam's Coal Industry Development to 2020 and Vision towards 2030	The plan is to develop Viet Nam's coal industry into a competitive industry by applying technological advances to coal exploration, mining and preparation, processing and trading and to ensure the sufficiency of coal resources to meet the domestic consumption demand, especially for the thermal power industry.	Viet Nam Government Portal

Supporting Mechanism for Development of Power Generation Projects Using Solid Waste in Viet Nam	This regulates the supporting mechanism for the development of power generation projects using solid waste in Viet Nam.	Viet Nam Government Portal
Support Mechanism for Development of Biomass Power Projects in Viet Nam	The policy provides the support mechanism for the development of projects generating power using biomass energy in Viet Nam.	Viet Nam Government Portal
Viet Nam's Industrial Development Strategy through 2025, a Vision toward 2035	This provides the overall objectives and specific targets to develop the industrial sector, including state-owned, private, and foreign-invested sectors. Focuses on agricultural and rural industrialisation and modernisation.	Viet Nam Government Portal

Notable Developments

Energy development	Details	Reference
Thi Vai LNG Terminal	New 1 Mtpa capacity in the first phase of Thi Vai LNG import terminal will be completed in 2022.	Petro Times
Hai Linh LNG Terminal	New 1 Mtpa capacity in the first phase of Hai Linh LNG import terminal will be compete in 2022.	S&P Global Platts
Renewable Energy in Generation Mix	RE share (excluding hydropower) will increase up to 30% by 2030 and 44% by 2045.	Electricity and Renewable Energy Authority
Song Hau 1 Coal-fired Plant	New 1200 MW generation capacity will be online in 2021.	Investment News

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Useful links

Government of Viet Nam – http://chinhphu.vn/portal/page/portal/chinhphu/trangchu

Ministry of Industry and Trade – http://www.moit.gov.vn/

National Energy Efficiency Programme (VNEEP) – http://vneec.gov.vn/

Electricity Regulatory Authority of Viet Nam (ERAV) – http://www.erav.vn/

National Load Dispatch Centre (NLDC) – https://www.nldc.evn.vn/

Viet Nam Electricity (EVN) – http://www.evn.com.vn

Energy Savings – https://tietkiemnangluong.evn.com.vn/

Viet Nam Energy – http://nangluongvietnam.vnViet Nam Oil and Gas Group – http://www.pvn.com.vn

Viet Nam National Petroleum Group (Petrolimex) – https://petrolimex.com.vn/

Viet Nam National Coal and Mineral Industries Holding Corporation Ltd (Vinacomin) – http://www.vinacomin.vn/

Viet Nam Economic Times – https://vneconomy.vn/

Viet Nam News Agency – https://vietnamnews.vn/

General Statistics Office – https://www.gso.gov.vn/

Commonly Used Abbreviations and Terms

Abbreviation	Term
2017 USD PPP	2017 USD purchasing power parity
APEC	Asia Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
ASEAN	Association of South-east Asian Nations
B/D	barrels per day
Bcf	billion cubic feet
bcm	billion cubic metres
Btu	British thermal units
GW	gigawatt
GWh	gigawatt-hour
kL	kilolitre
km	kilometre
km/L	kilometres per litre
ktoe	kilotonne of oil equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
Mbbl/D	thousand barrels per day
ML	million litres (megalitre)
Mloe	Million litres of oil equivalent
MMbbl	million barrels
MMbbl/D	million barrels per day
MMBFOE	million barrels of fuel oil equivalent
MMBtu	million British thermal units
MMcf/D	million cubic feet per day
MMscf/D	million standard cubic feet per day
mpg	miles per gallon
Mt	million tonnes
Mtce	million tonnes of coal equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
PJ	petajoules
Tbbl/D	trillion barrels per day
tce	tonnes of coal equivalent
Tcf	trillion cubic feet
toe	tonnes of oil equivalent
tU	tonnes of uranium metal
TWh	terawatt-hours
W	watt
Wh	watt-hours

Currency Codes

Code	Currency	Economy
AUD	Australian dollar	Australia
BND	Brunei dollar	Brunei Darussalam
CAD	Canadian dollar	Canada
CLP	Chilean peso	Chile
CNY	yuan renminbi	China
HKD	Hong Kong dollar	Hong Kong, China
IDR	rupiah	Indonesia
JPY	yen	Japan
KRW	won	Korea
MYR	Malaysian ringgit	Malaysia
MXN	Mexican peso	Mexico
NZD	New Zealand dollar	New Zealand
PGK	kina	Papua New Guinea
PEN	nuevo sol	Peru
PHP	Philippine peso	Philippines
RUB	Russian ruble	Russia
SGD	Singapore dollar	Singapore
TWD	New Taiwan dollar	Chinese Taipei
THB	baht	Thailand
USD	US dollar	United States
VND	dong	Viet Nam