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A Study on the Impact of Financing Restrictions on New Coal-Fired Power Plants in the Asian Region

Edited by

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Foreword

Recent years have seen lively discussions, mainly in Europe, on restricting fossil fuel-related assistance to developing countries against a backdrop of growing climate change concerns. In response to calls for environmental, social, and governance investment, private companies are also increasingly holding back and withdrawing from coal-fired power projects.

This study evaluates the impact of investment and financing restrictions on new coal-fired power plants in seven Asian countries. It quantitatively shows the economic impact and shares the results with stakeholders in each country.

The seven East Asia Summit (EAS) countries in this study – India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam – rely on coal to a different but significant extent in their power mix. Without coal power, these seven countries would risk power supply stability, see a huge increase in gas demand that the world liquefied natural gas (LNG) system could not absorb, and find their CO2 emissions still rising.

Coal divestment is not the only way to control CO2 emissions. Clean fuels and other low-carbon technologies and decarbonisation measures such as energy efficiency, renewables, carbon capture, utilisation, and storage (CCUS), ammonia, and hydrogen should be strongly promoted, and financing high-efficiency ultra-supercritical (USC) coal power plants and clean coal technologies like integrated coal gasification combined cycle (IGCC) should still continue.

I hope this report will encourage ASEAN Member States to pursue a rational balance of economic efficiency, energy access, energy security, and protecting the environment in their respective energy policies.

Hidetoshi Nishimura

President

Economic Research Institute for ASEAN and East Asia

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Abbreviations and Acronyms

ADB	Asian Development Bank
CCUS	carbon capture, utilisation, and storage
CFPP	coal-fired power plant/project
EAS	East Asia Summit
GHG	greenhouse gas
HNC	Halving New Coal-Fired Power Plant Scenario
IDA	International Development Association
IEA	International Energy Agency
LNG	liquefied natural gas
NNC	No New Coal-Fired Power Plant Scenario
OECD	Organisation for Economic Co-operation and Development
REF	Reference Scenario
SDG	Sustainable Development Goal
UK	United Kingdom
UN	United Nations
US	United States
USC	ultra-supercritical

Executive Summary

Financial restrictions on coal-fired power projects (CFPPs), or coal divestment, have become a global trend to address climate change. Coal divestment was initiated first by international organisations and state-owned financial institutions and now spread around commercial banks. While Organisation for Economic Co-operation and Development (OECD) financiers have been subject to the OECD guideline restricting financing less-efficient CFPPs, such restriction does not apply to non-OECD financiers.

The seven East Asia Summit (EAS) countries in this study – India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam – rely on coal to a different but significant extent in their power mix. Local opposition has often been evident in many countries, and coal divestment already affects the CFPPs, especially in Viet Nam.

The robust growth of the economy and population will generally drive electricity demand in the seven countries towards 2050. The share of coal in the seven countries' power mix will decrease gradually to 50% in 2050 without strict restrictions on coal-fired power but will drop to 11% without new CFPPs. These impacts will be particularly significant in India, Indonesia, the Philippines, and Viet Nam.

Without coal power, the seven countries would see CO_2 emission still rise and face energy security problems and huge gas demand increase that the world liquefied natural gas (LNG) system could not absorb. Therefore, the seven countries must balance economic efficiency, energy access, energy security, and the environment in their respective energy policies. Relatively developed countries like Malaysia and Thailand are on the track of lesser dependency on coal. However, India, Indonesia, Myanmar, the Philippines, and Viet Nam still need low-cost electricity like coal-fired power generation to support economic growth. Financing efficient ultra-supercritical (USC) coal power plants and clean coal technologies like integrated coal gasification combined cycle (IGCC) should, therefore, continue. Still, less-efficient plants should be excluded from coal financing. While OECD countries have difficulty financing coal power projects, international financial institutions like the Asian Development Bank (ADB) now have a greater role in funding efficient and clean coal power projects.

The International Energy Agency (IEA) considers energy efficiency, electrification, CCUS (carbon capture, utilisation, and storage), bioenergy, and hydrogen as major measures to address climate change. Coal divestment, therefore, is not the only way to control CO_2 emissions. As for CCUS and hydrogen, Japan is developing blue ammonia and ammonia-coal blending power generation, which could offer effective measures to balance lower CO_2 emission and utilise existing CFPPs in the seven countries in this study.

Introduction

There is substantial pressure on coal-fired power generation worldwide, mainly because of the large amount of greenhouse gas (GHG) emissions from burning coal at power plants. One example of such pressure is the so-called coal divestment to restrict financing on coal-fired power plants (CFPPs). In the meantime, power demand in Asia is increasing rapidly. Thus, addressing climate change and meeting power demand is a great challenge.

In this study, we worked on the impact of coal divestment and the implications for the seven East Asia Summit (EAS) countries, namely, India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam.

This report comprises five chapters.

Chapter 1 covers the coal divestment trend by United Nations (UN) agencies, individual governments, and financial institutions. Chapter 2 illustrates coal in the power mix and coal-fired power development in the seven countries. Chapter 3 sets up several scenarios concerning the absence of new CFPPs and alternative fuels and analyses how the power mix would change in the seven countries. Chapter 4 examines the impact of coal divestment on energy security, CO_2 emission, and natural gas, particularly on the liquefied natural gas (LNG) market. Chapter 5 summarises the discussion and presents policy recommendations.

Chapter 1

Coal Divestment

Coal-fired power generation provides reliable and affordable electricity and shares 62% in the power mix of India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam. With many new CFPPs under construction and planning, coal is likely to remain the primary fuel for power generation in those countries. However, since climate change is a pressing issue to address, it is increasingly common that building CFPPs face strong opposition. While traditionally such opposition tended to come from local communities and environmentalists, it is increasingly common that financial institutions restrict themselves from financing such power plants to suppress coal consumption and address climate change. This chapter illustrates where such financial restriction, or coal divestment, came from and looks at how international organisations, governments, and financial institutions implement it.

1. Initiatives by International Organisations

1.1. The United Nations

The recent coal divestment stems from concerns over climate change. While a wide range of other countermeasures such as energy efficiency, emission trading, renewables, hydrogen, CCUS (carbon capture, utilisation, and storage) are implemented and studied, how coal use should be cut down has been one of the main focuses. Perhaps one notable move, albeit conceptual, was the Sustainable Development Goals (SDGs) adopted by the United Nations (UN) in September 2015.[1] These goals cover climate change and a wide range of development areas such as human rights, technology, and peace. Nevertheless, at least two of them – renewable energy (SDG 7) and climate action (SDG 13) – are directly related to climate change issues. Although the SDG document does not mention coal at all, it provided a conceptual basis for coal divestment.

[1] United Nations, https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

Figure 1.1: 17 SDG Areas by the United Nations

SDG = Sustainable Development Goal.
Source: United Nations, https://sdgs.un.org/goals.

What followed the SDGs was the Paris Agreement (UN, 2015) in December 2015. Two key messages were (i) the need to hold 'the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels' (Article 2[1a]); and (ii) 'achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century' (Article 4[1]). Again, coal is not mentioned in the Agreement; the latter message became a basis for the carbon-neutral, or net-zero, target by 2050.

1.2. Organisation for Economic Co-operation and Development

While the UN played a major role in coal divestment by providing the conceptual basis, the coal divestment idea emerged from other spheres. The Sector Understanding on Export Credits for Coal-Fired Electricity Generation Projects formulated by the OECD in November 2015 sets the guideline for financing CFPPs by financial institutions in OECD countries. More concretely, the Understanding divides nine CFPPs according to plant size and thermal efficiency, and restricts financing of less-efficient supercritical and subcritical plants. Some exemption is applied to International Development Association (IDA)-eligible countries,[2] which include Cambodia, the Lao PDR, and Myanmar. Ultra-supercritical (USC) is eligible, but the maximum repayment term is 12 years. However, this Understanding does not apply to non-OECD lenders, so financing, for instance, by ASEAN countries, China, and India is not restricted.

[2] Countries with a gross national income per capita below a certain threshold (US$1,185 in fiscal year 2021).

Table 1.1: Repayment Terms for Coal-Fired Power Plants, by OECD Lender

Plant Unit Size	Unit>500MW	Unit ≥300 to 500 MW	Unit < 300 MW
Ultra-supercritical (i.e. with a steam pressure >240 bar and ≥593°C steam temperature), OR Emissions <750 g CO_2/kWh	12 years	12 years	12 years
Supercritical (i.e. with a steam pressure >221 bar and >550°C steam temperature), OR Emissions between 750 and 850 g CO_2/kWh	Ineligible	10 years, and only in IDA-eligible countries	10 years, and only in IDA-eligible countries
Subcritical (i.e. with a steam pressure <221 bar), OR Emissions >850 g CO_2/kWh	Ineligible	Ineligible	10 years, and only in IDA-eligible countries

IDA = International Development Association.
Note: IDA-eligible countries are counties with gross national income per capita below a certain threshold ($1,185 in the fiscal year 2021).
Source: OECD (2015).

2. Initiatives by Governments

The Paris Agreement, ratified by 189 countries or regions, has been in force since 2016. These countries submitted their Intended National Determined Contribution, which sets each party's target to address climate change. Since one of the Agreement's principles was the bottom-up approach, the parties freely set different targets. The OECD countries tended to set reduction targets of total GHG emissions; other countries adopted different methods. As far as the seven EAS countries of this study are concerned, India and Malaysia pledged to reduce emission intensity. Indonesia, Malaysia, the Philippines, and Viet Nam set unconditional and conditional targets, depending on international support availability. Thailand envisaged a reduction from the assumed future emission amount, and Myanmar did not set a numerical target.

Table 1.2: INDCs by the Seven EAS Countries

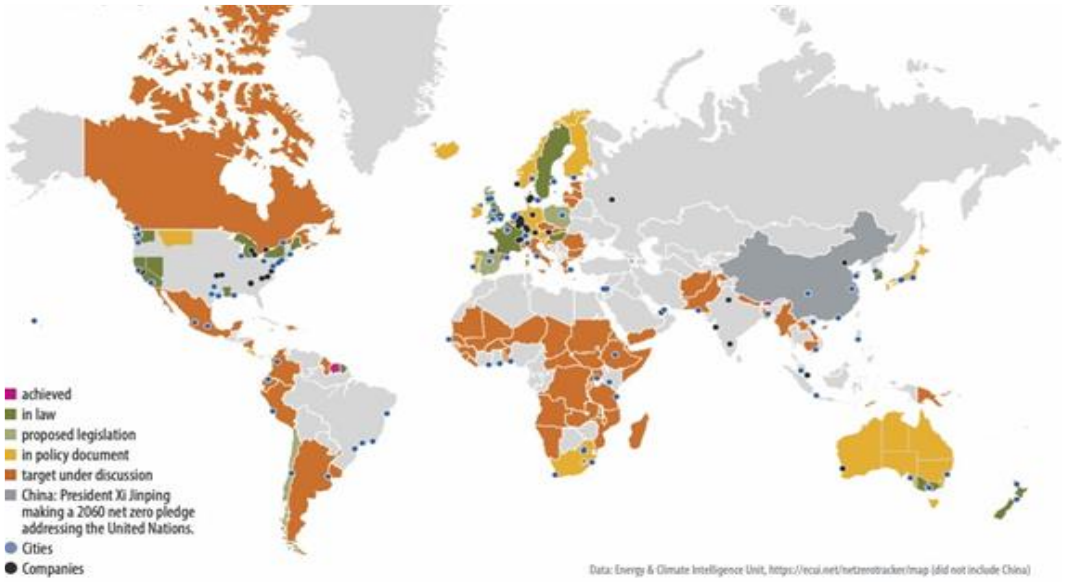
	Base Year	Target Year	Target
India	2005	2030	30%–35% reduction of emissions intensity of its GDP
Indonesia	2010	2020 & 2030	Unconditional: -26% by 2020 and -29% by 2030 Conditional: -41% by 2030 with international support
Malaysia	2005	2030	Unconditional: -45% of emission intensity & -35% of total emission Conditional: -45% of total emission with international support
Myanmar	-	2030	Policies and measures in multiple sectors, to be implemented
Philippines	-	2030	Conditional: -70% of total emission with international support
Thailand	2005	2030	-20% from business-as-usual level (possible to increase by 25% in 2030)
Viet Nam	2010	2030	Unconditional: -8% of total emission Conditional: -25% with international support

INDC = Intended Nationally Determined Contribution.
Source: UNFCCC INDC Portal, https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx.

Although the above seven countries largely retain their targets, many countries rushed to set a carbon-neutral, or net-zero, target especially since 2019, referred to as the 'net zero race'. Sweden initiated this trend in 2017, followed by the United Kingdom (UK) and the European Union in 2019, and others including China, Japan, and the Republic of Korea (hereafter Korea) in 2020. As of December 2020, more than 123 countries and one region have committed to becoming carbon neutral (Agence France-Press, 2020). The seven countries in this study have not pledged a net-zero target, although Cambodia, the Lao PDR, and Myanmar are reportedly considering such a target.[3]

[3] Energy & Climate Intelligence Unit, https://eciu.net/netzerotracker.

Figure 1.2: Net-Zero Pledging Countries



Source: Energy & Climate Intelligence Unit. https://eciu.net/netzerotracker/map.

Coal-fired power generation alone shares 30% of the total CO_2 emission worldwide in 2018 (IEA, 2019a), the largest emission sector. Thus, it is understandable that environmentalists and increasingly governments and financial institutions focus on reducing coal use for power generation. For instance, France, the UK, and Germany have decided to abandon CFPPs in 2022, 2025, and 2038. Some countries, including Japan and Korea, aim at reducing coal-fired power generation by closing inefficient plants or introducing tighter environmental restrictions. The United States (US) is a different story, but a similar consequence. Even under the Trump administration that supported fossil fuel use, including coal-fired power, coal use significantly declined because coal became less competitive than natural gas and renewables. Since the 'greener' Biden administration is now in power, the US is unlikely to go back to the coal-friendly policy.

Governments, especially in Europe and some states in the US, now divest coal-related projects through state-owned financial institutions. For instance, the California Public Employees' Retirement System (CalPERS), in 2015, decided to sell stocks of thermal coal companies by 2017 (CalPERS, 2017). In 2016, the Government Pension Fund of Norway excluded mining companies and power producers whose income from thermal coal is at least 30% or had at least 30% of their operations on thermal coal from their investment portfolio (Norges Bank, 2016). In addition to OECD's Understanding on Export Credits for Coal-Fired Electricity Generation Projects in 2015, governments, especially in Europe, started to restrict financing on coal and other fossil fuel businesses. In 2019, the European Investment Bank announced it would stop financing fossil-fuel energy projects, including coal mining and CFPPs, from the end of 2021 (European Investment Bank, 2019). In 2019, the European Bank for Reconstruction and Development decided to end financing thermal coal mining and coal-fired power generation (IEA, 2020a). In September 2020, the Swedish government decided that to stop state-backed loans and export credit guarantees for

exports to extract and explore fossil fuels after 2022 (EKN, 2020). In October 2020, the French government announced that it would stop providing state export guarantees to projects involving shale oil and oil sand, followed by all oil types from 2025 and gas from 2035 (*Reuters*, 2020a). In December 2020, the UK government announced an end to its direct support, including export finance, for the fossil-fuel energy sector overseas (Prime Minister's Office, 2020).

In July 2020, the Japanese government also tightened conditions for CFPP export. The government supports the export of CFPPs only if the importing country has no alternatives. The country requests Japan to export highly efficient plants, and the latest USC or more efficient plants will be exported.[4] With this decision, the government intends to promote the export of low-carbon infrastructure, providing these are USC and renewables, hydrogen, and any options that will reduce CO_2 emission in importing countries.[5]

Policies in the seven countries in this study have primarily supported coal and coal-fired power generation. India, Indonesia, Malaysia, and the Philippines have numerical targets to increase domestic coal production. Most of the countries intend to retain the significant role of coal-fired power generation in their power mix. However, there are a few cases where some of these countries plan to decrease coal use in recent years. Thailand, for instance, envisages that the capacity of coal-fired power generation will decrease from 4,637 MW in 2018 to 3,910 MW in 2037.[6] Viet Nam also plans to limit coal-fired power generation by not allowing new projects (Argus, 2020). Indonesia now intends to replace old CFPPs with renewables (*Reuters*, 2020b). Several CFPPs, especially in Viet Nam, face severe opposition from environmentalists, influencing future coal policy in the seven countries.

3. Initiatives by Financial Institutions

While some governments disincentivise or do not allow CFPPs to be built, an increasing number of financial institutions restrict or withdraw from financing CFPPs to address climate change. Coal divestment was initiated by international organisations, followed by the public sector, and then spread around the private sector. Today various bodies implement divestment, such as international financial institutions like the World Bank, regional financial institutions like the European Investment Bank, commercial banks like the Deutsche Bank, pension funds, investment management corporations, insurance companies, and government financial agencies.

The World Bank initiated coal divestment when it announced it will 'only in rare circumstances' provide financial support for new greenfield coal power generation projects, such as "meeting basic energy needs in countries with no feasible alternatives"' (World Bank, 2013). The World Bank later in 2017 decided not to finance upstream oil and gas after 2019 (World Bank, 2017). International financial institutions based in Asia started

[4] インフラシステム輸出戦略 (Infrastructure System Export Strategy), 9 July 2020, https://www.kantei.go.jp/jp/singi/keikyou/dai47/siryou3.pdf.
[5] Ibid.
[6] Government of Vietnam, Power Development Plan 2018.

to move away from coal financing. ADB, for instance, has financed only high-efficiency coal-fired plants since 2009. Although its Independent Evaluation unit recommended divesting CFPPs in August 2020 (ADB, 2020), ADB has not announced a formal exit from coal financing. The Asian Infrastructure Investment Bank announced it would not finance any CFPP in September 2020 (AIIB, 2020).

Major financiers for CFPPs in the seven countries are development banks and export credit agencies from China and Japan. As commercial actors announce new restrictions, coal power finance relies on fewer sources, especially development banks and export credit agencies from China and Japan (AIIB, 2020). However, the solely state-owned Japan Bank for International Cooperation acknowledged the difficulty in financing coal and revealed it has no coal financing projects as of March 2021.[7]

While public financial institutions tightened, especially in Europe, coal divestment became common in commercial banks following the World Bank since the mid-2010s. Since 2013, more than 100 global financial institutions have made increasingly tight divestment and/or exclusion policies around thermal coal (Buckley, 2019). Commercial banks in OECD countries had already been subject to the above-mentioned OECD guideline in 2015. Japan's three biggest commercial banks announced to begin withdrawing from financing new CFPPs in 2020.

4. Securing Finances for CFPPs in the Seven EAS Countries

Coal divestment, especially amongst OECD financiers, intends to address climate change. One obvious problem is that non-OECD financiers are not subject to OECD's sector understanding. Non-OECD lenders are, therefore, not restricted to finance less-efficient plants. If less-efficient plants are built, CO_2 emissions will increase against the spirit of coal divestment. According to the IEA, the largest debt providers in coal financing are development banks and export credit agencies in China and Japan (IEA, 2020a). With Japan's policy change, coal financing will come more from China and other non-OECD countries. Amongst the seven countries in this study, difficulty securing coal financing is already a problem for Viet Nam. The Viet Nam government considers reinforcing the financial support by launching a new grant and diversifying financing sources presumably away from OECD lenders. Wherever the financing may come from, the financier should set its standard equivalent to OECD's sector understanding in terms of efficiency to prevent less-efficient plants from being built. Simultaneously, all financiers should promote low-carbon technologies in coal power, such as integrated coal gasification combined cycle (IGCC) and CCUS attached to CFPPs. While OECD countries have difficulty financing CFPPs, international financial institutions like ADB now have a more significant role in financing efficient and clean coal power projects.

[7] NHK (2021), 3 March, https://www3.nhk.or.jp/nhkworld/en/news/20210303_16/ (accessed March 2021).

Chapter 2

Coal in the Seven EAS Countries

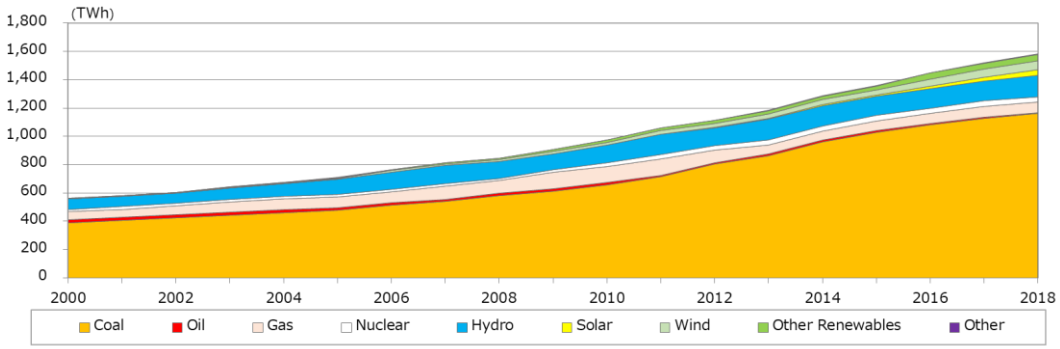
While coal divestment is gaining momentum, especially in Europe, many EAS countries rely on coal-fired generation to meet rapidly growing power demand. This chapter looks at coal in the power mix and coal-fired power development in the seven EAS countries: India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam.

1. India

1.1. Coal in the power mix

India's power generation has almost tripled since 2000 with an annual growth of 5.9% and reached 1,583 TWh in 2018. With abundant domestic coal, coal has been the largest source of power generation in India. Coal-fired power generation has tripled since 2000 with an annual growth of 6.3%.

Figure 2.1: Power Mix in India



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	390	477	657	716	803	862	962	1,030	1,080	1,128	1,161	73.3	6.3	3.0
Oil	22	18	18	10	10	13	14	11	9	8	8	0.5	-5.5	0.4
Gas	56	75	113	114	87	64	62	68	72	76	74	4.6	1.5	1.3
Nuclear	17	17	26	32	33	34	36	37	38	38	38	2.4	4.6	2.2
Hydro	74	108	125	142	126	148	143	136	138	142	151	9.5	4.0	2.0
Solar	0.002	0.003	0.126	1	2	4	6	10	19	26	40	2.5	73.3	19864.1
Wind	2	6	20	25	30	33	36	35	48	55	64	4.1	22.4	38.2
Other Renewables	1	5	15	17	20	23	25	26	43	43	45	2.8	21.8	34.9
Other	1	1	2	2	2	2	3	3	3	3	3	0.2	9.2	4.9
Total	562	708	975	1,060	1,115	1,184	1,287	1,358	1,449	1,519	1,583	100.0	5.9	2.8

CAGR = compound annual growth rate.

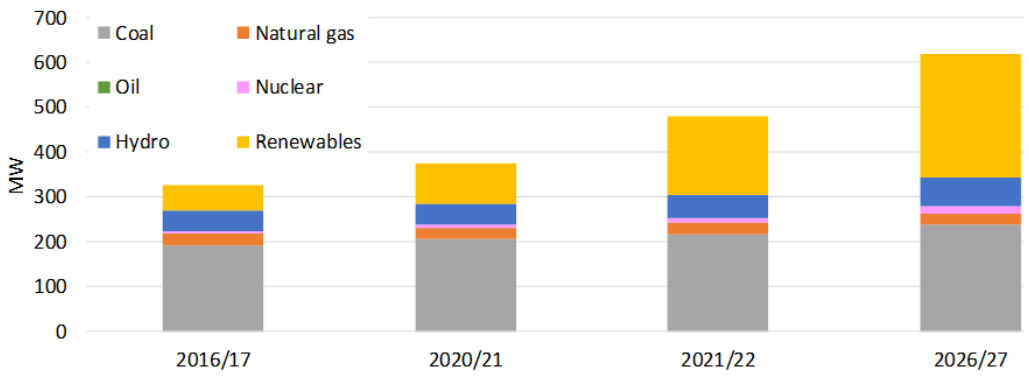
Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

1.2. Coal-fired power development

As of fiscal year (FY) 2020/21, India's installed power generation capacity was 479,418 MW, consisting of coal with 217,302 MW[8] (55% of the total capacity); renewables[9] 90,399 MW (24%); hydro 45,699 MW (12%); gas 24,957 MW (7%); and nuclear 6,780 MW (2%) (Ministry of Power, 2020).

The Central Electricity Authority released the 'National Electricity Plan' in January 2018. This plan projects the country's electricity demand to grow by 6.6% annually from FY2016/17 to FY2026/27, and nearly double during the period. It also projects that power generation capacity will increase by 89% from FY2016/17 and reach 619,066 MW in FY2026/27. Under this plan, coal will increase generation capacity by 24% during the same period, which is a more moderate pace than renewables (+380%), nuclear (+149%), and hydro (+42%).

Figure 2.2: Power Generation Capacity in India



	2016/17 (A)		2020/21		2021/22		2026/27 (B)		CAGR (A-B)
	MW	%	MW	%	MW	%	MW	%	
Coal	192,163	59%	205,855	55%	217,302	45%	238,150	38%	2.2%
Natural gas	26,167	8%	24,957	7%	25,735	5%	25,735	4%	-0.2%
Oil	-	-	510	0%	-	-	-	-	-
Nuclear	6,780	2%	6,780	2%	10,080	2%	16,880	3%	9.6%
Hydro	44,478	14%	45,699	12%	51,301	11%	63,301	10%	3.6%
Renewables	57,244	18%	90,399	24%	175,000	37%	275,000	44%	17.0%
Total	326,832	100%	374,199	100%	479,418	100%	619,066	100%	6.6%

CAGR = compound annual growth rate.

Notes: Renewables include small hydro projects, biomass gasifier, biomass power, urban and industrial waste power, and solar and wind energy. The installed capacity of renewables in FY2020/21 as of 30 November 2020.

Source: IEEJ, based on Central Electricity Authority, 'National Electricity Plan', January 2018; and Ministry of Power (2020).

[8] It includes lignite-fired power plants.

[9] Renewables include small hydro projects, biomass gasifier, biomass power, urban and industrial waste power, and solar and wind energy.

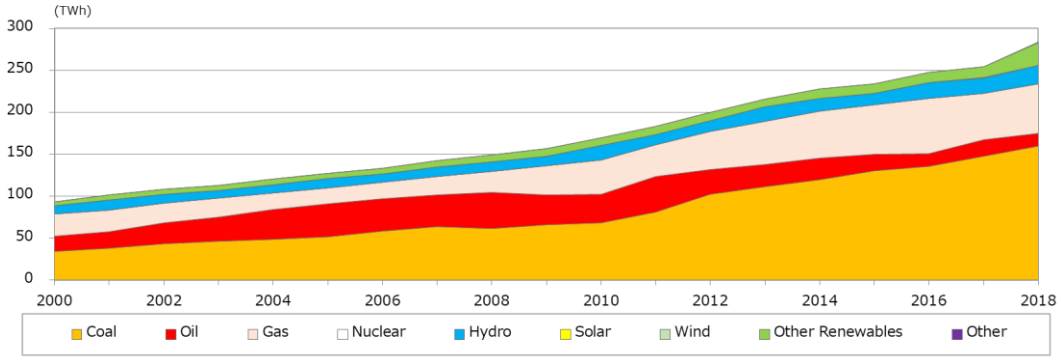
There have not been outstanding opposition campaigns against CFPPs so far in India. As far as the latest developments are concerned, the National Thermal Power Corporation Ltd (NTPC), India's largest energy conglomerate, commissioned the country's first USC-based units (660 MW x 2) of Khargone Super Thermal Power Station in Madhya Pradesh state (NTPC, 2020) in 2019 and 2020.

2. Indonesia

2.1 Coal in the power mix

Indonesia's power generation has tripled since 2000 with an annual growth of 6.4% and reached nearly 284 TWh in 2018. Coal has been the largest power source, followed by natural gas. Coal-fired power generation has increased nearly fivefold since 2000 with an annual growth of 9%.

Figure 2.3: Power Mix in Indonesia



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	34,002	51,793	68,445	81,090	102,166	111,252	119,532	130,508	135,358	147,875	160,021	56.4	9.0	4.7
Oil	18,342	39,299	34,150	42,178	29,919	26,752	26,152	19,650	15,704	19,413	14,879	5.2	-1.2	0.8
Gas	26,090	19,086	40,247	38,137	45,453	51,490	56,025	58,894	65,699	55,320	59,421	20.9	4.7	2.3
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	10,016	10,725	17,456	12,419	12,799	16,923	15,162	13,741	18,677	18,632	21,636	7.6	4.4	2.2
Solar	0	0	1	1	3	5	7	5	21	29	91	0.0	n.a.	n.a.
Wind	0	0	4	5	5	0	0	4	6	6	190	0.1	n.a.	n.a.
Other Renewables	4,875	6,626	9,452	9,572	9,670	9,578	10,980	11,172	12,452	13,299	27,221	9.6	10.0	5.6
Other	0	0	0	15	15	20	18	10	3	295	311	0.1	n.a.	n.a.
Total	93,325	127,529	169,755	183,417	200,030	216,020	227,876	233,984	247,920	254,869	283,771	100.0	6.4	3.0

CAGR = compound annual growth rate.

Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

2.2. Coal-fired power development

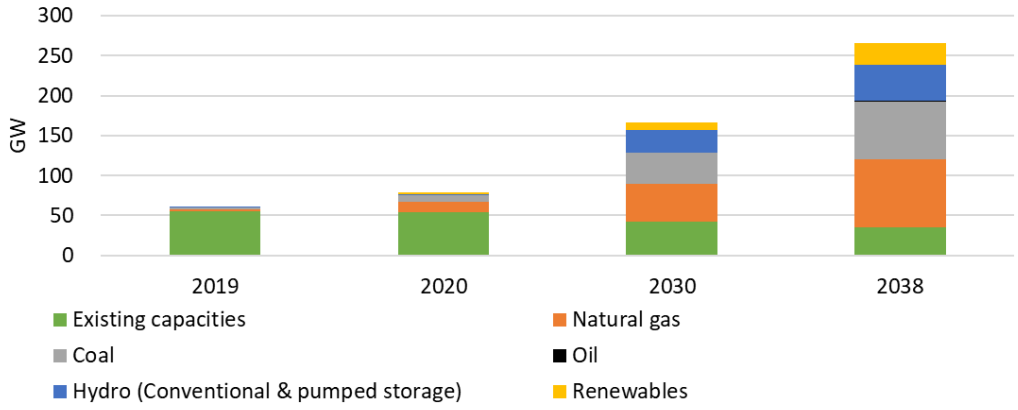
As of 2018, Indonesia's installed power generation capacity was 56,510 MW, consisting of coal 26,411 MW (47% of the total capacity); gas 16,424 MW[10] (29%); oil 6,658 MW (12%); hydro 4,939 MW (9%); and renewables 2,078 MW (4%).[11]

The Ministry of Energy and Mineral Resources released *'Rencana Umum Ketenagalistrikan Nasional* (RUKN) 2019–2038' (National Electricity General Plan) in August 2019. This plan projects the country's electricity demand to increase at an annual growth of 7.9% and reach 1,361 TWh in 2038, a more-than-fourfold increase from 2019. The Indonesian government has tried to fully utilise natural resources, including coal, to develop additional power generation capacities to meet the country's growing electricity demand despite opposition campaigns of local and international environmental groups against CFPPs. At the workshop for this study, the Indonesian government confirmed its intention to continue using coal for power generation, although it plans to expand renewables significantly.

RUKN 2019–2038 projects additional generation capacities coming online between 2019 and 2038, amounting to 267 GW. Following natural gas, coal will be the second-largest in terms of additional capacities during the same period.[12] The recent two coal power projects are both in Java. PT Shenhua Guohua Pembangkitan Jawa Bali[13] commissioned the country's first two USC-based units (1 GW each) in 2019–2020 at Java 7 coal-fired power station in Banten Province, the easternmost of Java. PT. Bhumi Jati Power[14] is building nos. 5 and 6 USC-based units (1 GW each[15] 2021) adjacent to the existing four units at the Tanjung Jati (Java 4) coal-fired power station in Central Java.[16]

[10] It includes gas turbines, gas cogeneration, and gas and oil dual fuel power plants.
[11] PT. PLN (Persero), Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2019–2038, 20 February 2019.
[12] Kementerian Energi Dan Sumber Daya Mineral, RUKN 2019–2038, 1 August 2019.
[13] It is an independent power producer (IPP) owned by PT Pembangkitan Jawa Bali (a subsidiary of PLN , the national electric power company) and China Shenhua Energy Co., http://www.xinhuanet.com/english/asiapacific/2019-12/13/c_138629371.htm.
[14] It is an IPP owned by PT. United Tractors, Sumitomo Corporation, and The Kansai Electric Co.
[15] Commercial operation date.
[16] https://www.bhumi-jati.co.id/project-profile/background-and-introduction.html.

Figure 2.4: Power Generation Capacity in Indonesia



	2019		2020		2030		2038	
	GW	%	GW	%	GW	%	GW	%
Existing capacities	55	90%	54	68%	42	25%	35	13%
Additionall capacities								
Natural gas	3	5%	13	16%	47	28%	85	32%
Coal	2	3%	8	10%	40	24%	73	27%
Oil	0.1	0%	0.1	0%	0.1	0%	0.1	0%
Hydro (Conventional & Pumped storage)	1	2%	2	3%	28	17%	46	17%
Renewables	0	0%	2	3%	9	5%	27	10%
Total	62	100%	79	100%	166	100%	267	100%

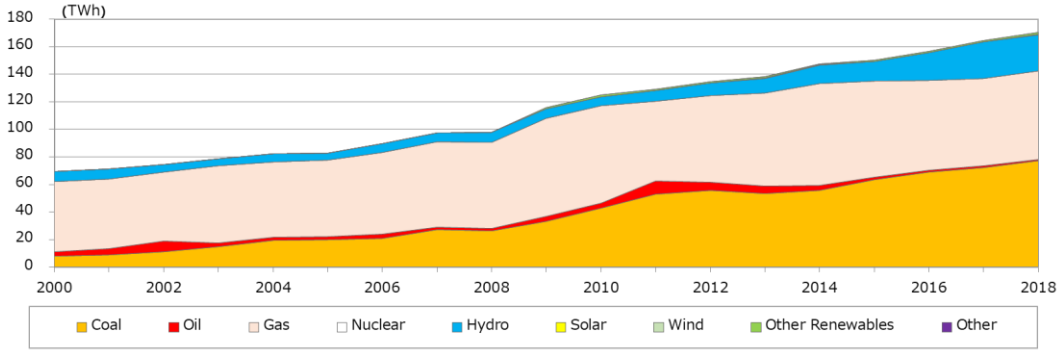
Source: IEEJ, based on Kementerian Energi Dan Sumber Daya Mineral, '*Rencana Umum Ketenagalistrikan Nasional 2019–2038*' (RUKN 2019–2038), 1 August 2019.

3. Malaysia

3.1. Coal in the power mix

Malaysia's power generation has increased by 2.5 times since 2000, with an average annual growth rate of 5.1% and reaching 170 TWh in 2018. Coal-fired power generation increased tenfold from 2000, with an average yearly growth rate of 13.7%, overtaking natural gas in 2016.

Figure 2.5: Power Mix in Malaysia



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	7,691	19,991	42,839	52,983	55,788	53,372	55,827	63,474	69,153	71,959	77,286	45.3	13.7	10.0
Oil	3,600	2,203	3,670	9,450	6,014	5,339	3,490	1,739	1,184	1,527	1,048	0.6	-6.6	0.3
Gas	50,998	55,287	70,795	58,158	62,649	67,761	73,836	69,962	65,234	63,273	63,886	37.5	1.3	1.3
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	6,966	5,191	6,472	7,623	9,056	10,586	13,388	13,924	20,019	26,575	26,325	15.4	7.7	3.8
Solar	0	1	0	0	47	141	227	273	310	330	573	0.3	n.a.	n.a.
Wind	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Other Renewables	0	0	1,006	1,065	819	1,140	701	751	760	839	1,352	0.8	n.a.	n.a.
Other	0	0	4	4	8	9	0	0	0	0	0	0.0	n.a.	n.a.
Total	69,255	82,673	124,786	129,283	134,381	138,348	147,469	150,123	156,660	164,502	170,469	100.0	5.1	2.5

CAGR = compound annual growth rate.
Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

3.2. Coal-fired power development

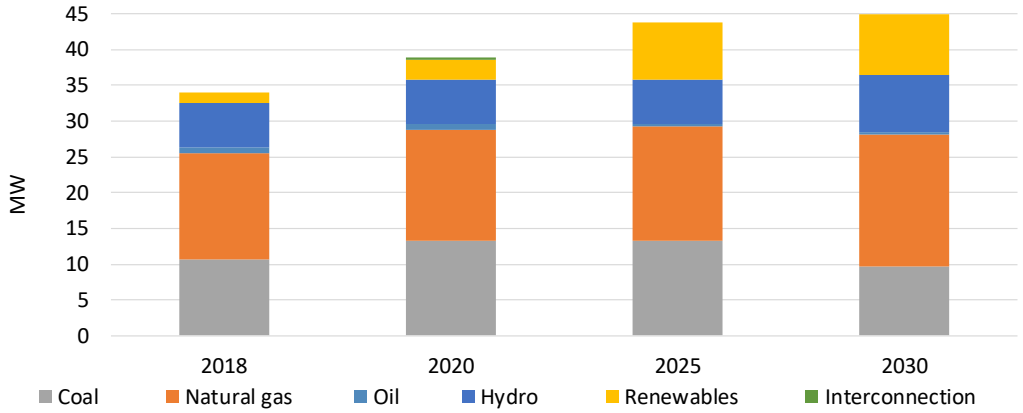
As of December 2018, Malaysia's installed power generation capacity was 33,991 MW, consisting of gas 14,853 MW (44% of the total capacity); coal 10,660 MW (31%); hydro 6,168 MW (18%); renewables 1,497 MW (4%); and oil 812 MW (2%) (Energy Commission, 2020a).

The Malaysian government is preparing the Twelfth Malaysia Plan (12MP), a national development plan for 2021–2025 until 2030. Under 12MP, the government targets an average yearly growth rate of 4.7% to achieve a GDP of RM3.4 trillion within 2021–2030 (Ministry of Economic Affairs, 2019). However, the projection of electricity demand in 12MP is not yet available.

Jimah East (1 GW x 2) in the Malay Peninsula and Balingan (312 MW x 2) in Sarawak, which commenced commercial operations in 2019, are the newest CFPPs in Malaysia. They may be the last ones as no specific CFPPs are currently scheduled. The largest power generator, Tenaga Nasional Berhad (TNB), has pledged not to invest in a greenfield coal plant in its investor presentation in December 2020 (TNB, 2020). The ageing CFPPs in Kapar (1,486 MW owned by Kapar Energy Ventures Sdn Bhd) and Manjung (2,070 MW owned by TNB Janamanjung Sdn Bhd) are scheduled to retire in 2029 and 2030, respectively (Energy Commission, 2020b).

The Malaysians have a strong interest in environmental issues, such as the growing use of renewables and recycling. However, opposition campaigns against CFPPs have not been outstanding in the Malay Peninsula as the newly installed coal-fired plants are highly efficient and have a cleaner operation.

Figure 2.6: Power Generation Capacity in Malaysia



	2018 (A)		2020		2025		2030 (A)		CAGR (A-B)	Change (B/A)
	MW	%	MW	%	MW	%	MW	%		
Coal	10,660	31%	13,284	34%	13,284	30%	9,728	22%	-0.8%	-8.7%
Natural gas	14,853	44%	15,514	40%	15,986	36%	18,430	41%	1.8%	24.1%
Oil	812	2%	825	2%	333	1%	333	1%	-7.2%	-59.0%
Hydro	6,168	18%	6,198	16%	6,198	14%	7,975	18%	2.2%	29.3%
Renewables	1,497	4%	2,749	7%	8,074	18%	8,527	19%	15.6%	469.5%
Interconnection	0	0%	386	1%	0	0%	0	0%	n.a.	n.a.
Total	33,991	100%	38,956	100%	43,876	100%	44,994	100%	2.4%	32.4%

CAGR = compound annual growth rate.

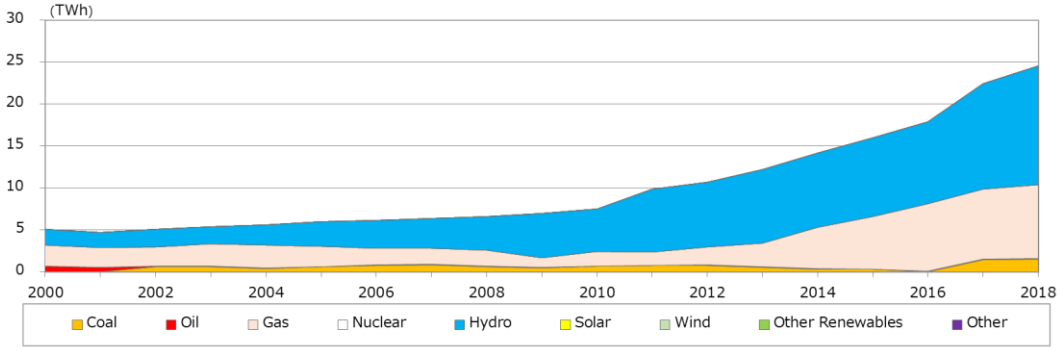
Source: IEEJ, based on Energy Commission (2020a, 2020b), SESB (2019), Sarawak Energy website, https://www.sarawakenergy.com.

4. Myanmar

4.1. Coal in the power mix

Myanmar's power generation was 25 TWh in 2018, nearly a fivefold increase from 2000. Hydro and natural gas are the primary sources of power generation in the country. Hydropower had the most significant share (56%) in total generation, followed by natural gas (34%), together totalling 90% of the mix. Figure 2.7 shows the power mix of Myanmar since 2000.

Figure 2.7: Power Mix in Myanmar



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	0	589	671	724	771	569	286	285	10	1,415	1,543	6.3	n.a.	n.a.
Oil	691	34	33	38	51	61	65	55	61	69	77	0.3	-11.5	0.1
Gas	2,535	2,396	1,734	1,588	2,144	2,794	4,977	6,231	8,052	8,345	8,798	35.8	7.2	3.5
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	1,892	2,997	5,105	7,518	7,766	8,823	8,829	9,399	9,744	12,584	14,126	57.5	11.8	7.5
Solar	0	0	0	0	0	0	0	0	11	9	10	0.0	n.a.	n.a.
Wind	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Other Renewables	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Other	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Total	5,118	6,016	7,543	9,868	10,732	12,247	14,157	15,970	17,878	22,422	24,554	100.0	9.1	4.8

CAGR = compound annual growth rate.
Source: IEEJ, based on IEA World Energy Statistics and Balances 2020, July 2020.

Coal-fired power generation was 1,543 GWh in 2018, accounting for only 6.3%. Currently, only one CFPP operates in the country: Tigyit (120 MW) in southern Shan State, which commenced commercial operations in 2005. Tigyit is a mine-mouth power plant located near the Tigyit coal mine. There has been local opposition against the mining activities and power plant operations due to local health concerns and social impacts, leading to the Tigyit power plant's experiencing operational disruptions in 2014.[17] In 2016, a commercial agreement with a Chinese engineering company was reached to upgrade and operate the existing Tigyit plant.

4.2. Coal-fired power development

As of 2019, Myanmar's installed power generation capacity was 5,632 MW, consisting of hydro 3,255 MW (58%); gas 2,217 MW (39%); coal 120 MW (2%); diesel 92 MW; and renewables 40 MW.[18]

[17] Environmental Justice Atlas, https://ejatlas.org/conflict/tigyit-coal-power-plant-shan-state-myanmar (accessed December 2020).

[18] U Han Zaw, Current Status of Myanmar's Electricity Sector, Ministry of Electricity and Energy, The Republic of the Union of Myanmar, Bangkok, March 2019

The government approved the National Energy Policy in 2014, which includes the Energy Sector Development Plan. According to the Plan, new power plants to be constructed by FY2030/31 will be based on the following energy mix: hydro 38% (8,896 MW); natural gas 20% (4,758 MW); coal 33% (7,940 MW); and renewables 9% (2,000 MW).[19]

As indicated in the Plan, coal was expected to play a more significant role in Myanmar's power mix to meet the nation's growing energy demand, as hydro and gas resources had their limits to expand further. In this background were several CFPP development projects with an aggregate installed capacity of 3,325 MW upon the Plan's endorsement.[20] However, due to widespread public opposition, including residents and environmental groups, coal-fired power development projects have been stalled (EuroCham Myanmar, 2018). Local policymakers and residents have continuously challenged the operation of the existing Tigyit plant. However, the central government sees the merit in having the power plant supply electricity to the region.[21]

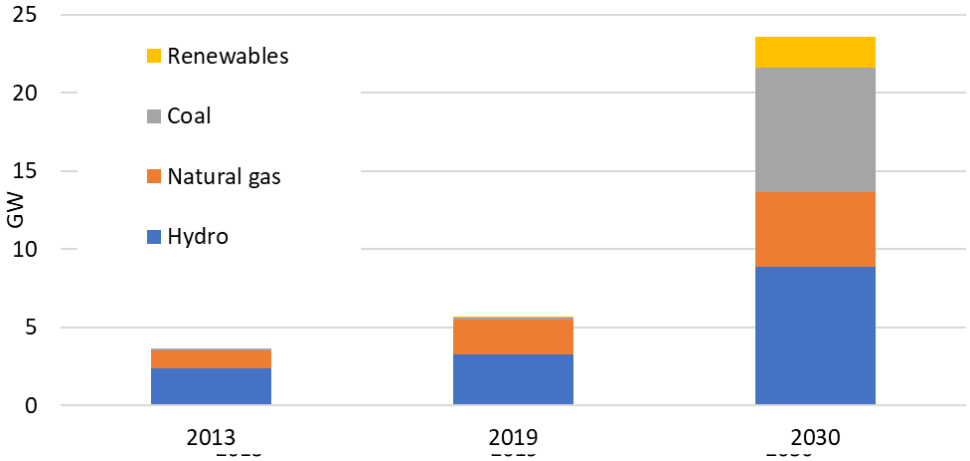
An ERIA study forecasted electricity demand to grow at a yearly average of 7%, a fivefold increase from 2016 to 78 TWh in 2040 (ERIA, 2020a). Against the backdrop of widespread opposition against coal-fired power generation projects, the Myanmar government is expected to review the Power Development Plan. However, due to the coup in February 2021, most policies, including the Power Development Plan, seem to stall.

[19] National Energy Policy, National Energy Management Committee, The Republic of the Union of Myanmar, 2014

[20] Ibid.

[21] https://www.iea-coal.org/myanmar-government-rejects-motion-to-shutter-polluting-chinese-owned-coal-plant/

Figure 2.8: Power Generation Capacity in Myanmar



	2013 (A)		2019		2030 (B)		CAGR (A-B)	Change (B/A)
	MW	%	MW	%	MW	%		
Hydro	2,361	65%	3,255	58%	8,896	38%	8.1%	277%
Natural gas	1,152	32%	2,217	39%	4,758	20%	8.7%	313%
Coal	120	3%	120	2%	7,940	34%	28.0%	6517%
Renewables			40	1%	2,000	8%	n.a	n.a
Total	3,633	100%	5,632	100%	23,594	100%	11.6%	549%

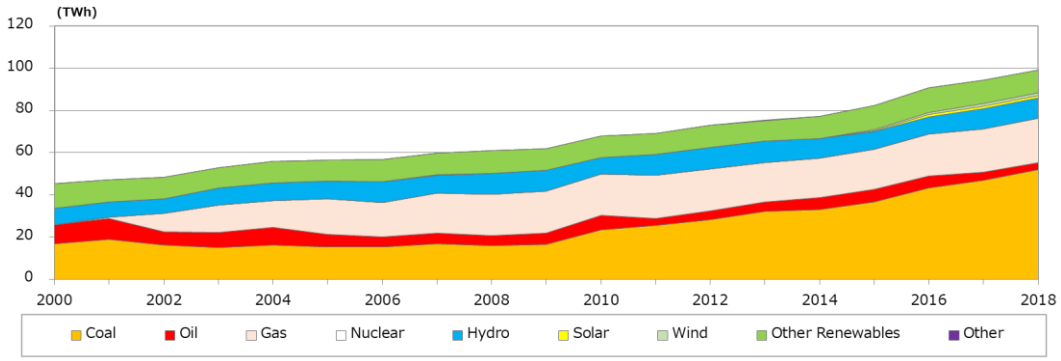
Note: Excludes diesel engine generators.
Source: IEEJ, based on National Energy Management Committee (2014) and ERIA (2020b).

5. Philippines

5.1. Coal in the power mix

Philippine power generation has more than doubled since 2000, with an annual growth of 4.5%, and reached 99 TWh in 2018. Coal has been the largest power source since 2000, followed by gas. Coal-fired power generation has more than tripled since 2000, with an annual growth of 6.5%.

Figure 2.9: Power Mix in the Philippines



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	16,663	15,257	23,301	25,342	28,265	32,081	33,054	36,686	43,303	46,847	51,932	52.4	6.5	3.1
Oil	9,185	6,141	7,101	3,398	4,254	4,491	5,708	5,886	5,661	3,787	3,173	3.2	-5.7	0.3
Gas	17	16,861	19,518	20,591	19,642	18,791	18,690	18,878	19,854	20,547	21,334	21.5	48.6	1254.9
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	7,799	8,387	7,803	9,698	10,252	10,019	9,137	8,665	8,111	9,611	9,384	9.5	1.0	1.2
Solar	0	2	1	1	1	1	17	139	1,097	1,201	1,249	1.3	n.a.	n.a.
Wind	0	17	62	88	75	66	152	748	975	1,094	1,153	1.2	n.a.	n.a.
Other Renewables	11,626	9,902	9,949	10,036	10,414	9,787	10,471	11,392	11,787	11,273	10,957	11.0	-0.3	0.9
Other	0	0	7	22	18	30	33	19	9	10	11	0.0	n.a.	n.a.
Total	45,290	56,567	67,742	69,176	72,921	75,266	77,262	82,413	90,797	94,370	99,192	100.0	4.5	2.2

Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

5.2. Coal-fired power development

As of 2019, the country's installed power generation capacity was 25,531 MW, comprising coal 10,417 MW (41% of the total capacity); oil 4,262 MW (17%); hydro 3,760 MW (15%); renewables 3,639 MW (14%); and natural gas 3,453 MW (14%) (DOE, 2020).

The Department of Energy (DOE) projects the country's electricity demand to grow by about 5% annually and will reach 49,287 MW by 2040. To meet this demand growth, 43,765 MW additional capacities must come online (DOE, 2017). As 'DOE stands with its technology-neutral position, … 'all types of technologies are welcome as long as they are efficient, reliable, and able to provide the least-cost option and flexibility in the system'.[22]

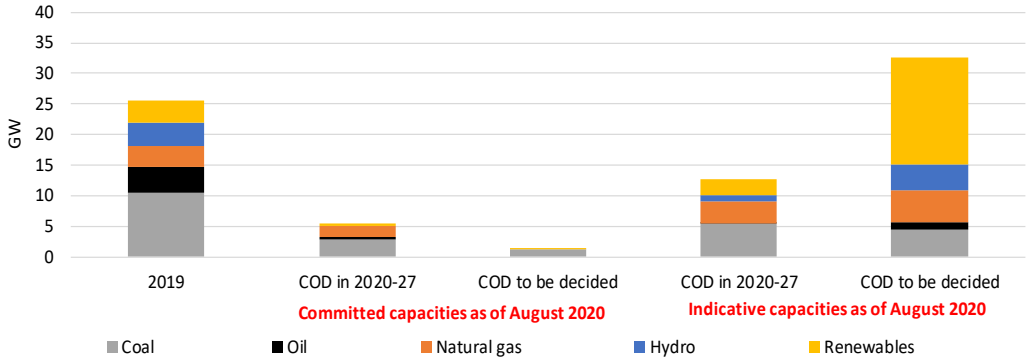
As of August 2020, 6,733 MW committed capacities are expected to come online and provide additional capacities to the system. Committed capacities come from power generation projects, which already secured financing. Amongst the committed capacities, 5,530 MW are to start commercial operations by 2027, 50% of which are CFPPs. These committed CFPPs include the GNPower Dinginin's supercritical units (600 MW x 2) scheduled to be commissioned in 2021 and the Atimonan One Energy's No. 1 unit (600 MW) scheduled to be commissioned in 2024 in Luzon, the largest and most populous island of the Philippines. On the other hand, the remaining 1,203 MW committed capacities have no target commissioning dates yet; all these are CFPPs. These projects are

[22] The Department of Energy website, https://www.doe.gov.ph (accessed January 2021).

still acquiring various permits, approvals, and licences, and may or may not have a definite timeline for commercial operations.[23]

Although local and international environmental groups oppose new CFPPs in the Philippines, the campaigns have failed to attract considerable support in the country in great need of additional electric power supply. However, amongst major local conglomerates actively involved in power generation, the Ayala Corporation firstly revealed its plan in April 2020 to divest from CFPPs by 2030 (Jiao and Murtaugh, 2020).

Figure 2.10: Power Generation Capacity in the Philippines



	2019		Committed capacities as of August 2020				Indicative capacities as of August 2020				2040	
	MW	%	COD in 2020-27		COD to be decided		COD in 2020-27		COD to be decided		MW	%
			MW	%	MW	%	MW	%	MW	%		
Coal	10,417	41%	2,791	50%	1,200	100%	5,400	43%	4,403	13%	–	–
Oil	4,262	17%	426	8%	0	0%	36	0%	1,325	4%	–	–
Natural gas	3,453	14%	1,750	32%	0	0%	3,600	28%	5,158	16%	–	–
Hydro	3,760	15%	0	0%	0	0%	979	8%	4,287	13%	–	–
Renewables	3,639	14%	564	10%	3	0%	2,685	21%	17,496	54%	–	–
Total	25,531	100%	5,530	100%	1,203	100%	12,700	100%	32,670	100%	43,765	100%
			6,733				45,370					

COD = commercial operation date.
Source: IEEJ, based on DOE (2020a, 2020b, 2017).

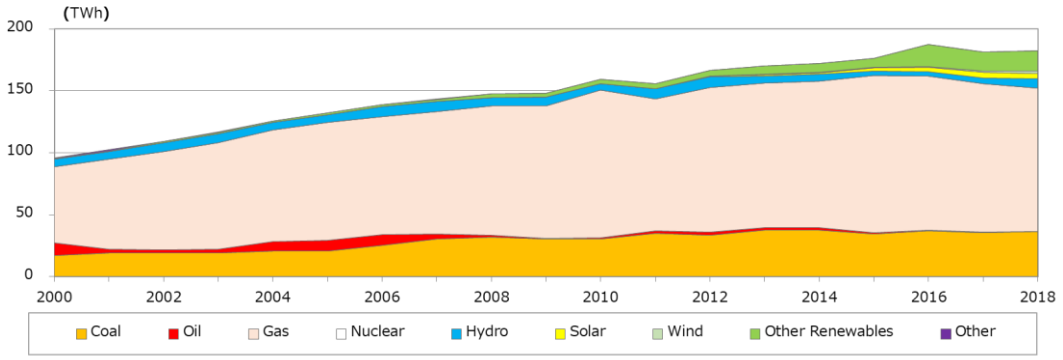
[23] The Department of Energy, Private Section Initiated Power Projects (Luzon) Committed as of 31 August 2020, Private Section Initiated Power Projects (Luzon) Indicative as of 31 August 2020, Private Section Initiated Power Projects (Visayas) Committed as of 31 August 2020, Private Section Initiated Power Projects (Visayas) Indicative as of 31 August 2020, Private Section Initiated Power Projects (Mindanao) Committed as of 31 August 2020, Private Section Initiated Power Projects (Mindanao) Indicative as of 31 August 2020, Power Development Plan 2017–2040.

6. Thailand

6.1. Coal in the power mix

Thailand's power generation has almost doubled since 2000 with an annual growth of 3.6% and reached 182 TWh in 2018. Natural gas has been the largest source of power generation since 2000, followed by coal, including domestic lignite. Coal-fired power generation has more than doubled since 2000, with an annual growth of 4.3%.

Figure 2.11: Power Mix in Thailand



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	17,083	20,482	30,047	34,809	33,363	37,627	37,579	34,582	36,920	35,605	36,408	20.0	4.3	2.1
Oil	10,028	8,724	1,177	2,062	2,427	1,677	1,721	1,014	570	305	178	0.1	-20.1	0.0
Gas	61,639	95,621	119,349	106,566	117,058	117,006	118,560	126,986	124,760	120,015	115,640	63.4	3.6	1.9
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	6,026	5,798	5,537	8,163	8,754	5,748	5,540	3,752	3,527	4,694	7,565	4.1	1.3	1.3
Solar	0	0	20	95	493	1,080	1,385	2,378	3,377	4,543	4,537	2.5	n.a.	n.a.
Wind	0	0	0	5	141	305	305	329	345	1,109	1,641	0.9	n.a.	n.a.
Other Renewables	511	1,532	3,392	4,291	4,406	6,705	7,169	7,447	18,055	15,443	16,328	9.0	21.2	32.0
Other	690	40	0	0	0	0	0	0	0	0	0	0.0	-100.0	0.0
Total	95,977	132,197	159,522	155,991	166,642	170,148	172,259	176,488	187,554	181,714	182,298	100.0	3.6	1.9

Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

6.2. Coal-fired power development

As of 2018, the Kingdom's installed power generation capacity was 48,004 MW, comprising natural gas 28,718 MW; renewables 6,473 MW; coal including domestic lignite 4,637 MW; conventional hydro 3,918 MW; oil 380 MW; and imports from neighbouring countries 3,878 MW (National Energy Policy Council, 2019). The national power generation company, Electricity Generating Authority of Thailand (EGAT), operates the Mae Moh lignite-fired power plants[24] in the north of the kingdom. Independent and small power producers operate CFPPs based on imported coal around Bangkok, the capital city.

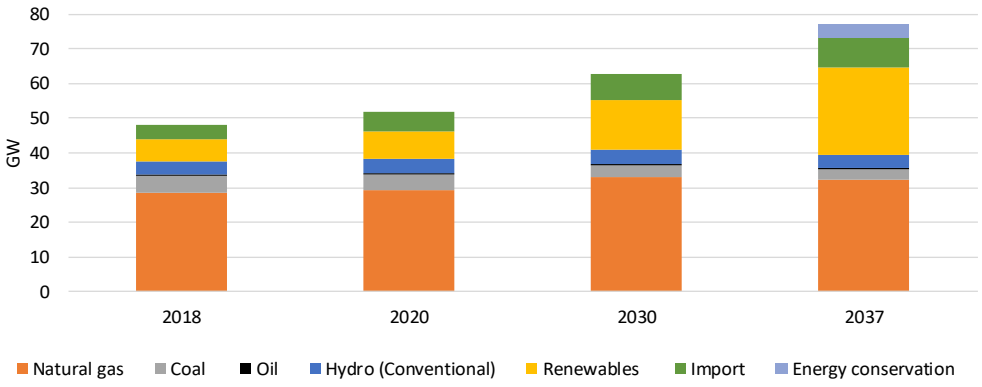
Major environmental disruptions, including health problems for the surrounding population, occurred due to sulphur dioxide emissions from the Mae Moh power plants from its commissioning in the 1960s, which created a strong anti-coal public opinion in

[24] At Mae Moh power plant, six old subcritical units (300 MW each) and a new ultra-supercritical (USC) unit (655 MW) are in operation. The newest one began commercial operations in 2019 to replace four old subcritical units (150 MW each).

the kingdom.[25] EGAT planned new CFPPs in the far south of Thailand,[26] but residents and environmental groups have strongly opposed for years, and the government eventually put them on ice.

The government approved the Thailand Power Development Plan 2018–2037 (PDP2018) in April 2019 and updated it in October 2020 as PDP2018 rev.1.[27] According to Thailand's Board of Investment, PDP2018 rev.1 aims to increase the installed power generation capacity by 61% from 2018 to 77,211 MW by 2037. PDP8 rev.1 projected that coal-fired power generation capacity would decrease by 27% from 2018 to 3,370 MW by 2037, while gas and other renewables would increase by 12% and 288%, respectively.[28] New CFPPs scheduled in PDP8 rev.1 are (i) EGAT's USC unit (600 MW) replacing two old subcritical units (300 MW each) at Mae Moh power plants, (ii) a 1 GW unit built in the eastern region, and (iii) another 1 GW unit built in the southern region.[29]

Figure 2.12: Power Generation Capacity in Thailand



	2018		2020		2030		2037		CAGR (A-B)	Change (B/A)
	MW	%	MW	%	MW	%	MW	%		
Natural gas	28,718	60%	29,331	56%	33,224	53%	32,112	42%	0.6%	12%
Coal	4,637	10%	4,637	9%	3,377	5%	3,370	4%	-1.7%	-27%
Oil	380	1%	380	1%	380	1%	65	0%	-8.9%	-83%
Hydro (Conventional)	3,918	8%	3,918	8%	3,918	6%	3,918	5%	0.0%	0%
Renewables	6,473	13%	7,957	15%	14,461	23%	25,086	32%	7.4%	288%
Import	3,878	8%	5,721	11%	7,509	12%	8,661	11%	4.3%	123%
Energy conservation	0	0%	0	0%	0	0%	4,000	5%	n.a.	n.a.
Total	48,004	100%	51,943	100%	62,868	100%	77,211	100%	2.5%	61%

CAGR = compound annual growth rate.

Source: IEEJ, based on National Energy Policy Council (2019).

[25] The problems have been settled once flue gas desulphurisation devices were retrofitted to the power plants and financial compensation was paid by EGAT for damages.

[26] Krabi project (800 MW x 1) and Thepa project (1 GW x 2) PDP2015 (Ministry of Energy, 2015)

[27] As of January 2021, available only in Thai.

[28] Thailand Board of Investment, accessed January 2021.

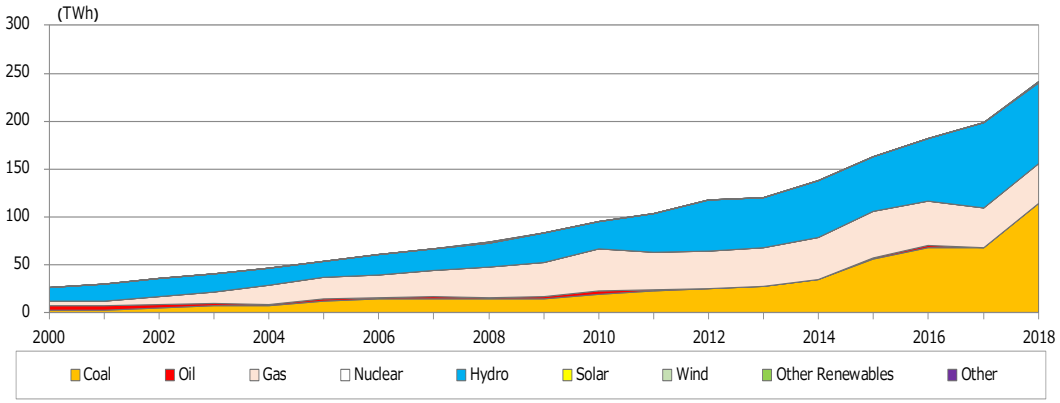
[29] The PDP rev.1 does not specify who will build the two 1 GW units in 2033–2034.

7. Viet Nam

7.1. Coal in the power mix

Viet Nam's power generation has grown ninefold since 2000 with an annual growth of 13% and exceeded 240 TWh in 2018. Coal-fired power generation has grown sharply by more than 36 times since 2000. As coal overtook gas and then hydro in 2015 and 2016, respectively, it has been the most significant power source since then.

Figure 2.13: Power Mix in Viet Nam



	2000 (A)	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018 (B)	Share (2018)	CAGR ('00-'18)	B/A
	GWh											%	%	
Coal	3,135	12,175	19,690	22,429	24,855	27,192	34,602	56,469	68,211	67,558	114,182	47.4	22.1	36.4
Oil	4,519	2,167	3,410	1,749	372	424	515	1,293	1,910	700	258	0.1	-14.7	0.1
Gas	4,356	22,319	44,148	38,827	39,426	40,862	43,263	48,147	46,055	41,020	41,729	17.3	13.4	9.6
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Hydro	14,551	16,945	27,550	40,924	52,795	51,955	59,841	57,174	65,722	88,982	84,125	34.9	10.2	5.8
Solar	0	0	0	0	0	0	0	0	0	0	23	0.0	n.a.	n.a.
Wind	0	0	50	87	87	87	87	124	218	323	497	0.2	n.a.	n.a.
Other Renewables	0	50	55	55	56	57	58	70	68	76	126	0.1	n.a.	n.a.
Other	0	0	0	0	0	0	0	0	0	0	0	0.0	n.a.	n.a.
Total	26,561	53,656	94,903	104,071	117,591	120,577	138,366	163,277	182,184	198,659	240,940	100.0	13.0	9.1

CAGR = compound annual growth rate.

Source: IEEJ, based on IEA's 'World Energy Statistics and Balances 2020', July 2020.

7.2. Coal-fired power development

As of 2018, Viet Nam's installed power generation capacity was 48,573 MW, consisting of coal 18,516 MW (38% of the total capacity); hydro 17,031 MW (35%); gas 8,978 MW (18%); and renewables 3,476 MW (7%).[30]

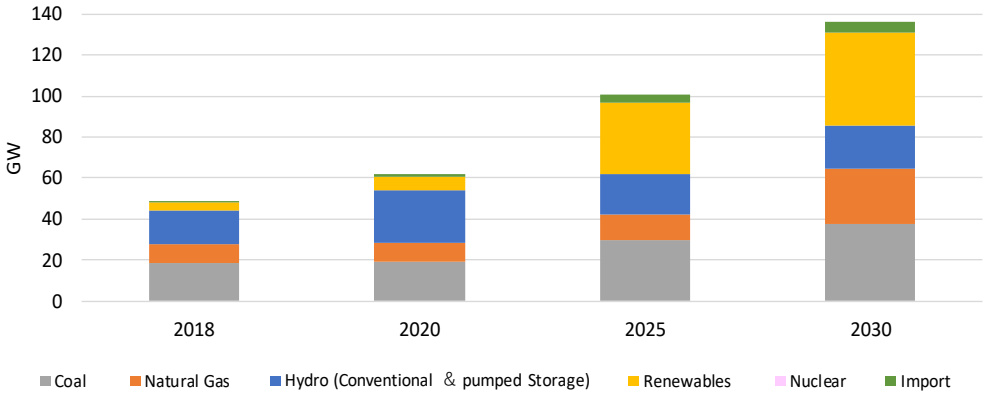
The Prime Minister approved the Revised National Power Development Master Plan for 2011–2020 with the Vision to 2030 (RPDP7) in March 2016.[31] Compared to PDP7 of 2011, one noticeable change in the RPDP7 was a stronger emphasis on renewable energy development.[32] However, coal is still projected to remain the largest power source in 2030 while renewables (hydro and other renewables) will more than double the capacity during the same period.

Viet Nam has strong opposition against CFPPs because of air pollution and their negative impacts on climate change. Local and international environmental groups have vigorously campaigned against specific CFPPs such as Van Phong 1[33] (660 MW x 2) and Vung Ang 2[34] (600 MW x 2).[35] Viet Nam's Ministry of Industry and Trade regards difficulty securing financing as a serious problem for coal power projects.

Viet Nam requires foreign investment to develop additional power generation capacities as its domestic financial institutions are not mature enough to support its power development plan.[36] It partly explains why a few CFPPs have been delayed by years and coal-divestment trends, especially from OECD countries.[37]

[30] In addition to domestic power plants, Viet Nam utilises generation capacities in the neighbouring countries to import electricity (EVN, 2019).
[31] Prime Minister's Decision on the Approval of the Revised National Power Development Master Plan for the 2011–2020 Period with the Vision to 2030, 18 March 2016.
[32] Deutsche Gasellshaft fur Internationale Zusammenarbeit (GIZ) GmbH; Vietnam Power Development Plan for the period 2011 2020 - Highlights of the PDP 7 revised.
[33] It is planned by Sumitomo Corporation.
[34] It is planned by One Energy Asia, which is owned by CLP Holdings and Mitsubishi Corporation.
[35] Friends of the Earth Japan, 19 March 2019, https://www.foejapan.org/en/aid/jbic02/vp/190319.html, 29 December 2020, https://www.foejapan.org/en/aid/jbic02/va/201229.html
[36] Direct communication with the Vietnamese government.
[37] Viet Nam is not a IDA-eligible country. Therefore, OECD lenders are required to restrict financing on both supercritical and subcritical plants.

Figure 2.14: Power Generation Capacity in Viet Nam



	2018 (A)		2020		2025		2030 (B)		CAGR (A-B)	Change (B/A)
	MW	%	MW	%	MW	%	MW	%		
Coal	18,516	38%	19,200	30%	29,478	29%	37,398	27%	6.0%	102%
Natural Gas	8,978	18%	9,536	15%	12,546	12%	27,462	20%	9.8%	206%
Hydro (Conventional & pumped Storage)	17,031	35%	25,600	40%	19,686	19%	20,976	15%	1.8%	23%
Renewables	3,476	7%	6,336	10%	35,292	35%	44,850	33%	23.8%	1190%
Nuclear	0	0%	0	0%	0	0%	0	0%	n.a.	n.a.
Import	572	1%	1,536	2%	3,468	3%	5,658	4%	21.0%	889%
Total	48,573	100%	64,000	100%	102,000	100%	138,000	100%	9.1%	184%

CAGR = compound annual growth rate.

Source: IEEJ, based on EVN (2019) and the 'Prime Minister Decision on the Approval of the Revised National Power Development Master Plan for the 2011–2020 Period with the Vision to 2030', 18 March 2016.

According to the Power Sources Development Program, the government significantly revised the renewables' share in the power mix from the previous target of 21% to 32.5% in 2030. On the other hand, coal's share is expected to shrink from the previous 43% to 27.1% in 2030. This downward revision reflects the above-mentioned opposition against coal-fired power generation and delays of new coal power projects.

Chapter 3

Power Outlook in the Seven EAS Countries

This chapter analyses the impact of divestment on coal-fired power generation in India, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam. After the assumptions and model structure in section 3.1, section 3.2 explains the outlook for electricity-generated, coal-fired power generation capacity, and the power mix of the seven countries.

1. Assumptions and Model Structure

1.1. Scenarios

The model sets three scenarios with different degrees of restrictions on financing new CFPP construction and replacement starting 2021. This restriction is assumed to be applied to the seven EAS countries and the entire world.

Reference Scenario ('REF')

We developed the Reference Scenario or REF as an energy outlook according to past trends and the energy and environment policies in place so far. The REF assumes that policies expected through traditional and conventional ways of thinking are incorporated. In contrast, no aggressive energy conservation or low-carbon policies deviating from past trends will be adopted. The REF also assumes no global restrictions on financing new CFPP construction and replacement; nevertheless, the role of coal-fired power generation in some regions will decline even in the REF. The power mix in the REF is developed based on several conditions, such as the past trend of the mix, energy policies, the development policy of CFPPs, and power demand outlook.[38]

No New Coal-Fired Power Plant Scenario ('NNC')

The No New Coal-Fired Power Plant Scenario or NNC assumes that the restriction on the financing of new CFPP construction and replacement will result in no new or replaced CFPPs coming online worldwide starting 2021. In this scenario, existing CFPPs that have been operating for 40 years will be phased out, while no coal-fired power generation capacity will be added starting 2021, leading to a gradual reduction of total coal-fired power generation capacities. Note that we do not assume the early decommissioning of CFPPs operating for less than 40 years.

[38] However, we did not directly incorporate the energy plans of each government into the model as the REF, especially when those plans significantly deviate from reality.

Halving New Coal-Fired Power Plant Scenario ('HNC')

The Halving New Coal-Fired Power Plant Scenario or HNC is an intermediate scenario between the REF and the NNC, assuming that only half of the new or replaced coal-fired power generation capacities in the REF will be built worldwide in 2021 onwards.

In the NNC and the HNC, alternative power sources must compensate for the electricity that CFPPs would have furnished after 2021. In this study, we prepared two cases under both the NNC and the HNC. In the first case, natural gas–fired power generation will substitute for all lost electricity that new or replaced CFPPs would have supplied. In the second case, solar photovoltaic (PV) and wind power generation will do the same.[39]

Table 3.1 summarises key assumptions that branch the REF, HNC, and NNC.

Table 3.1: Key Assumptions of REF, HNC, and NNC

Scenario	**Reference Scenario (REF)**	**Halving New Coal-Fired Power Plant Scenario (HNC)**		**No New Coal-Fired Power Plant Scenario (NNC)**	
New or renewed coal-fired power plants after 2021	No restriction	Half in the REF		None	
Substitution for the above-restricted coal-fired power plants	Not applicable	Natural gas-fired	Solar PV/ wind	Natural gas-fired	Solar PV/ wind

Source: The Institute of Energy Economics, Japan (2021).

Other assumptions, which apply to all scenarios and cases, are as follows.

CO_2 capture and storage

This study assumes that thermal power plants constructed or replaced starting 2021 will not be equipped with carbon capture and storage facilities.

Population

The assumptions on population refer to the UN's World Population Prospects 2019 (UN, 2019).

[39] We did not presume a nuclear power substitution case because (i) nuclear power projects often face severe challenges on the aspects of technology transfer, regulations, and non-proliferation, which are difficult to overcome in a short period, and (ii) coal phase-out discussions rarely suppose the substitution by nuclear.

Macroeconomy

We assumed the economic growth rates (Table 3.2) refer to outlooks by international organisations, such as the International Monetary Fund and ADB, and governments' economic development plans.

Table 3.2: Average Annual Growth Rate in Real GDP (2018–2050), %

World	2.6	Myanmar	5.3
India	5.6	Philippines	4.4
Indonesia	4.5	Thailand	3.1
Malaysia	3.7	Viet Nam	5.3

Source: The Institute of Energy Economics, Japan (2021).

International energy prices

Oil prices are assumed to creep up over the medium to long term with increased demand and higher production cost, though experiencing high volatility over the short term. The real oil price (in 2019 dollars) for the REF is assumed to increase to US$97/bbl in 2030 and US$128/bbl in 2050. Oil prices for the HNC and the NNC are assumed to remain at the REF level.

While natural gas prices in the US will remain lower than in other regions, Japan's real LNG import price is assumed to deviate from the REF oil prices gradually. However, since coal divestment will likely increase gas demand, the HNC and the NNC assume much higher gas prices (in 2019 dollars) at $14.2/Mbtu for the HNC and $18.2/Mbtu for the NNC.

As production has been adjusted to weak demand and demand has been recovering due to a halt in economic deterioration in China, the world's largest coal consumer, coal prices will turn up in the future. While demand for coal for power generation is expected to increase in other Asian countries, stricter environmental regulations are likely to make it challenging to expand coal production capacity. As the supply–demand balance tightens gradually, coal prices for the REF will moderately rise over the medium to long term to reach $128/t in 2050 in 2019 dollars. However, with coal divestment decreasing coal demand, the real price is expected to be significantly lower at $87/t for the HNC and $77/t for the NNC in 2050.

Table 3.3: International Energy Prices

REF			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236
Natural Gas								
Japan	$/Mbtu	9.9	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	112	122	128	140	186	236

HNC			Natural gas-fired substitution						Solar PV/Wind substitution					
			2019 Real Prices			Nominal Prices			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236	97	117	128	120	178	236
Natural Gas														
Japan	$/Mbtu	9.9	12.5	13.6	14.2	15.5	20.7	26.2	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	11.2	12.4	13.9	13.9	18.8	25.6	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	6.6	7.8	9.7	8.3	11.9	17.9	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	98	95	87	122	144	160	98	95	87	122	144	160

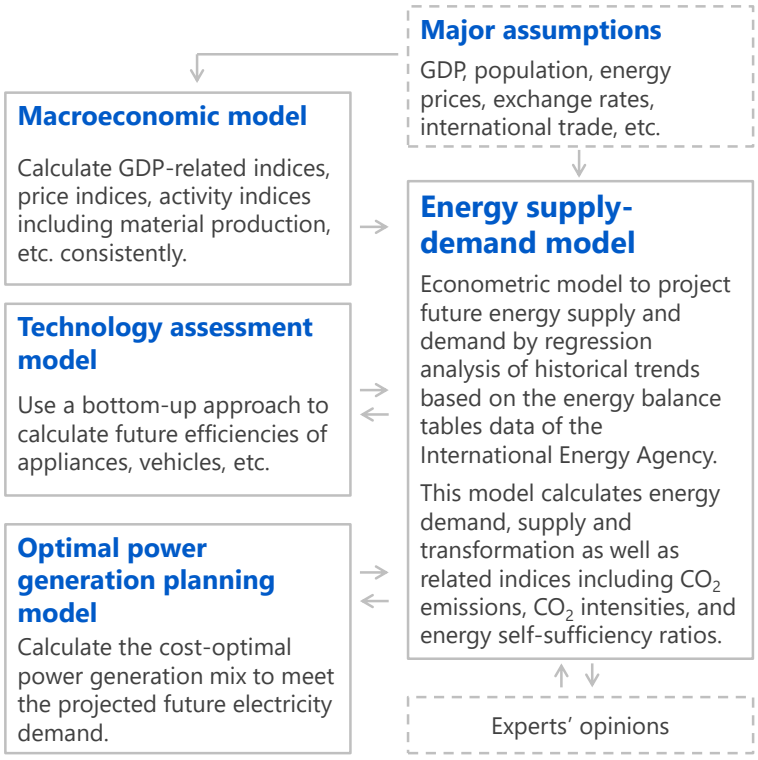
NNC			Natural gas-fired substitution						Solar PV/Wind substitution					
			2019 Real Prices			Nominal Prices			2019 Real Prices			Nominal Prices		
		2019	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
Oil	$/bbl	64	97	117	128	120	178	236	97	117	128	120	178	236
Natural Gas														
Japan	$/Mbtu	9.9	15.3	17.4	18.2	19.0	26.3	33.7	9.7	9.9	10.1	12.0	15.0	18.6
Europe (UK)	$/Mbtu	4.8	14.1	16.3	18.6	17.5	24.6	34.3	8.3	8.6	9.2	10.3	13.0	17.0
United States	$/Mbtu	2.5	9.4	11.4	14.4	11.7	17.3	26.6	3.8	4.3	5.0	4.8	6.5	9.2
Steam Coal	$/t	109	83	81	77	103	122	141	83	81	77	103	122	141

Source: The Institute of Energy Economics, Japan (2021).

1.2. Model structure

We used a quantitative analysis model to develop an energy outlook and assess energy supply and demand in the world through 2050 (Figure 3.1). Based on IEA's energy balance tables, the model covers various economic indicators and population, vehicle ownership, basic materials production, and other energy-related data collected for modelling. We divided the world into 42 regions and international bunkers (Figure 3.2) and built a detailed supply and demand analysis model for each.

Figure 3.1: Modelling Framework



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.2: Geographical Coverage

Source: www.craftmap.box-i.net.

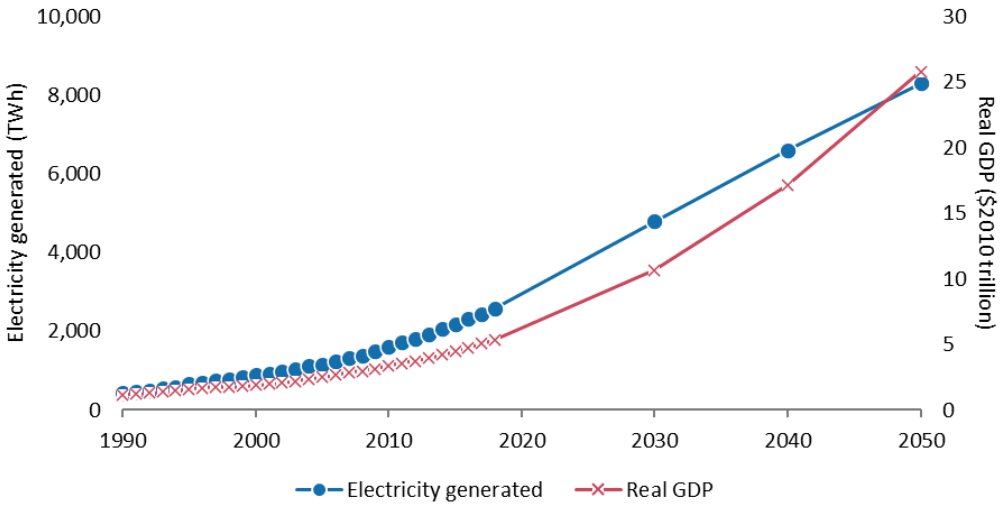
2. Reference and Divestment Scenarios

We quantitatively analysed global energy supply and demand using the assumptions and models described in section 3.1. In the REF case, the seven EAS countries' total power generation in 2050 will reach 8,308 TWh, 3.2 times greater than in 2018. Also, the cumulative coal-fired power generation throughout the projection period in the NNC will be 53% less than in the REF. Section 3.2 shows the collective and individual outlook of electricity generated, CFPP capacities, and the seven EAS countries' power mix.

2.1. Total of the seven EAS countries

Although there are differences between the countries, the robust growth of the economy and population will generally drive electricity demand in the seven EAS countries towards 2050. In response to this rapid demand growth, total electricity generation in the region will increase from 2,584 TWh in 2018 to 8,308 TWh in 2050 (Figure 3.3).

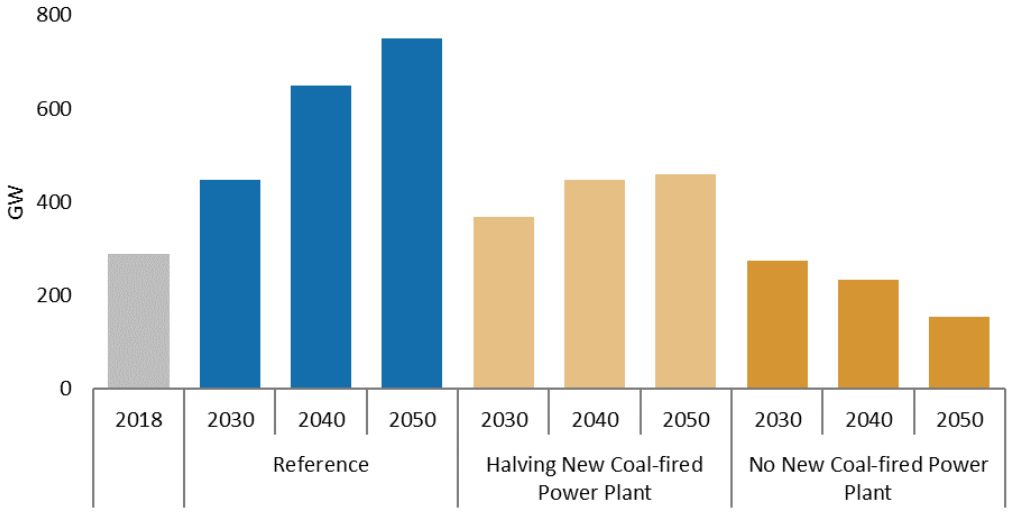
Figure 3.3: Electricity Generated and Real GDP in the Seven EAS Countries (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

In the REF, coal-fired power generation capacities in the seven countries will increase from 289 GW in 2018 to 749 GW in 2050. As a result, coal-fired power generation will continue to be the region's primary power source (Figure 3.4). In contrast, the capacities in the NNC will continue to decline after 2021, reaching 155 GW in 2050. In the HNC, the capacities will plateau after a modest increase until the late 2040s, and reach 459 GW in 2050.

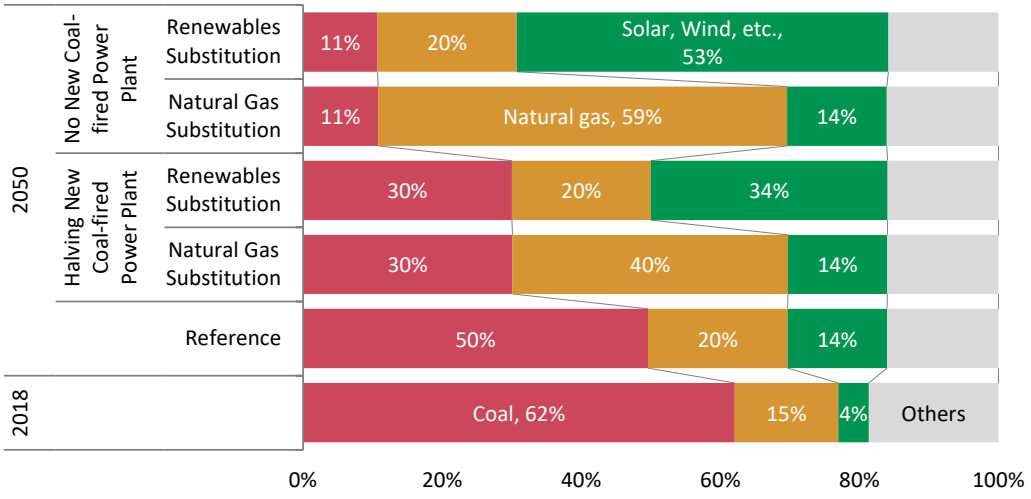
Figure 3.4: Coal-Fired Power Generation Capacity in the Seven EAS Countries (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

Consequently, coal share in the seven countries' power mix, which was 62% in 2018, will be 50%, 30%, and 11% in the REF, HNC, and NNC, respectively (Figure 3.5).

Figure 3.5: Power Mix in the Seven EAS Countries (2018, 2050)



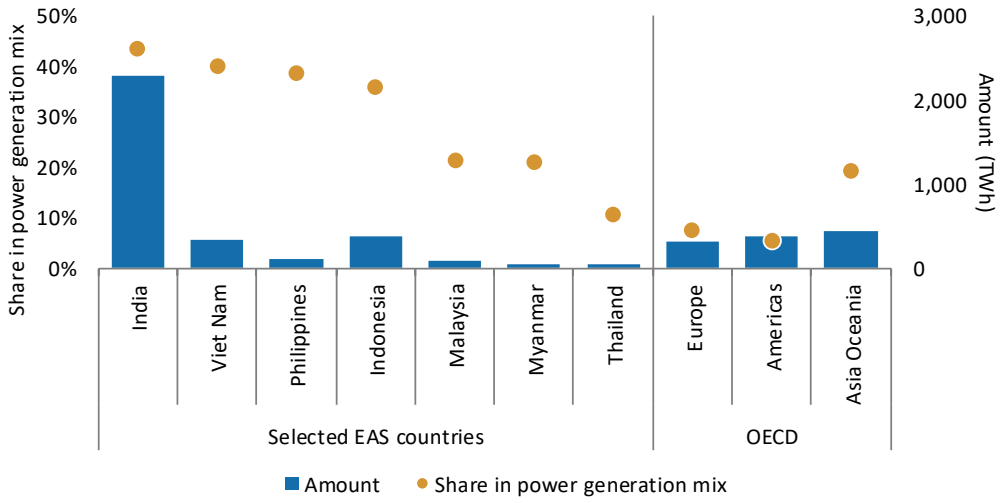
Source: The Institute of Energy Economics, Japan (2021).

The cumulative coal-fired power generations from 2018 to 2050 in the region will be 96 PWh in the REF, 45 PWh in the NNC (53% less than the REF), and 71 PWh in the HNC (27% less than the REF). Therefore, some alternative power sources must compensate for the differences of 51 PWh or 26 PWh in the cumulative power generation between the REF

and the other two scenarios. The difference of 51 PWh between the REF and the NNC is so huge that it is equivalent to the sum of cumulative power generation in Japan and Korea in the same period.

Besides, in 2050, the seven countries will require 3,265 TWh of substitute power, approximately three times as needed in the total OECD (Figure 3.6). Figure 3.6 also shows that most of the share of coal-fired power generation in each country will be higher than that of each OECD region. Given the above, if these EAS countries' governments enforce the restriction, the region will face significant challenges than in the OECD. We are to see such challenges in more detail in Chapter 4.

Figure 3.6: Electricity Generated by New and Replaced Coal-Fired Power Plants in the Seven EAS Countries (2050, REF)

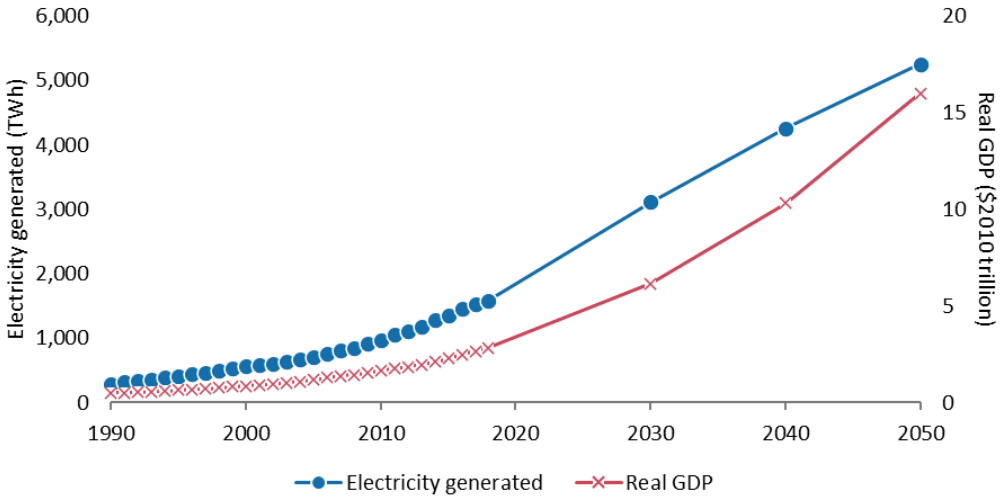


EAS = East Asia Summit, OECD = Organisation for Economic Co-operation and Development.
Note: OECD Americas consists of Canada, Mexico, and the US.
Source: The Institute of Energy Economics, Japan (2021).

2.2. India

The model presumes that India's population and economy will drastically grow throughout the projection period. As a result, its population and real GDP in 2050 will rank first and third in the world, respectively. However, GDP per capita in 2050 will be less than US$10,000, and there is much room for further economic development. Based on this growth, this country's electricity will surge from 1,583 TWh in 2018 to 5,255 TWh in 2050, corresponding to the increased demand (Figure 3.7). In 2050, India will have the third-largest volume of electricity generation in the world, following China and the US. The final consumption of electricity per person in 2050 will be 2.7 MWh, which is equivalent to the current level in Thailand and is far from saturated.

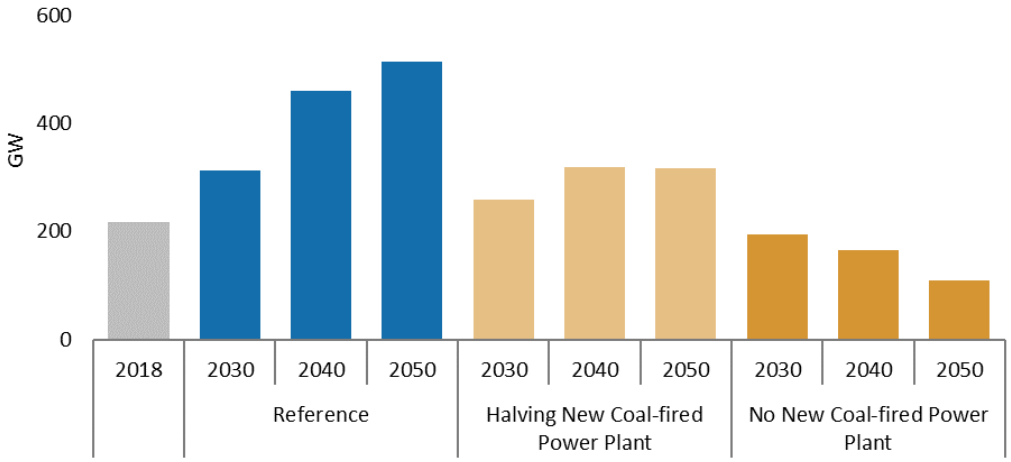
Figure 3.7: Electricity Generated and Real GDP in India (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.8 shows coal-fired power generation capacities in India by scenario.

Figure 3.8: Coal-Fired Power Generation Capacity in India (2018–2050)

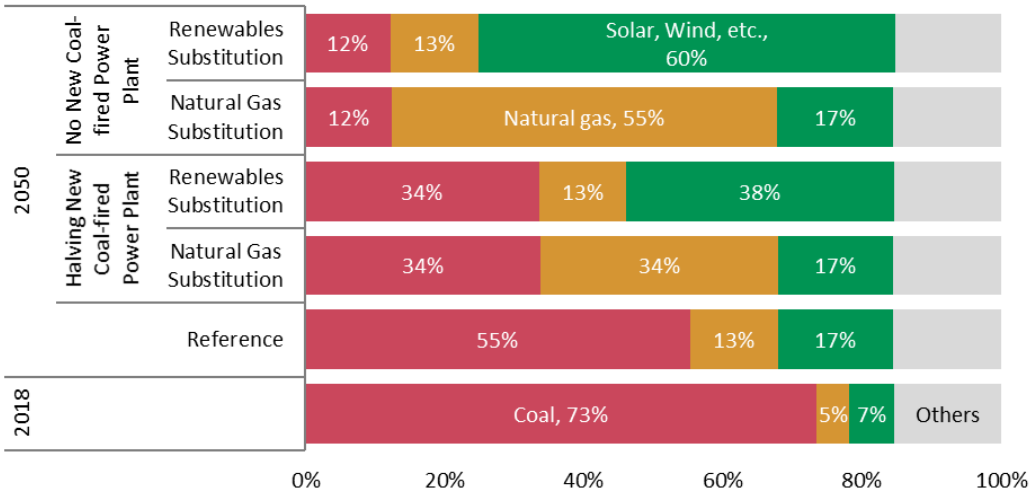


Source: The Institute of Energy Economics, Japan (2021).

The capacities in the REF will reach 515 GW in 2050, 2.4 times as 218 GW in 2018. By contrast, in the NNC, no new or renewed plants and the gradual phase-out of ageing plants will lead coal-fired power generation capacities to decline to 108 GW in 2050. The capacities in the HNC will increase at a modest pace until the mid-2040s, then level off and remain at 318 GW in 2050.

Figure 3.9 shows how coal share in the power mix, 73% in 2018, will branch by scenario. The NNC and the HNC will see shares of 12% and 34% in 2050, respectively, significantly lower than 55% in the REF backed by steady growth in the capacity.

Figure 3.9: Power Mix in India (2018, 2050)

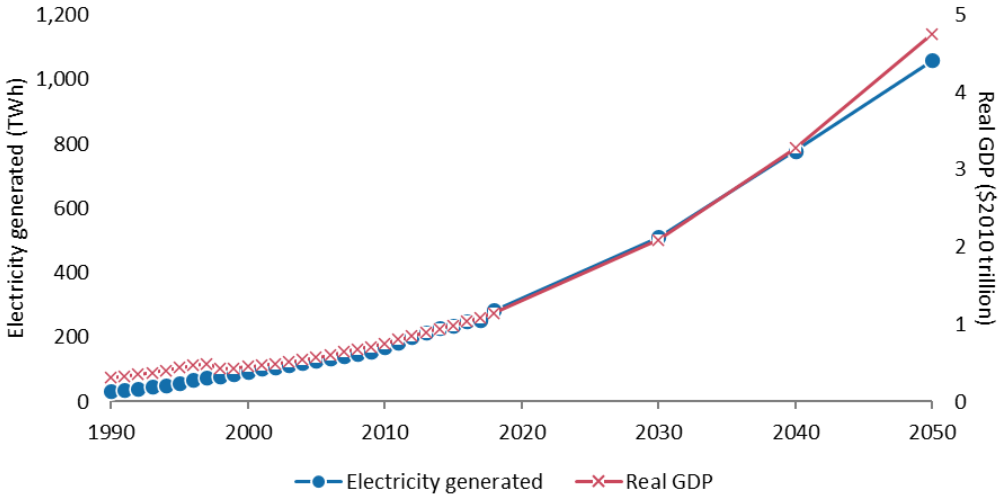


Source: The Institute of Energy Economics, Japan (2021).

2.3. Indonesia

In Indonesia, population and economic growth will drive electricity demand and supply throughout the projection period. The total power generation in 2050 will hit 1,059 TWh, 3.7 times as in 2018 (Figure 3.10). In 2050, however, the final electricity consumption per capita will remain at 2.9 MWh, only 70% of the global average for that year. Hence, this country's power demand could go up further if a power-intensive lifestyle prevails as the economic level rises.

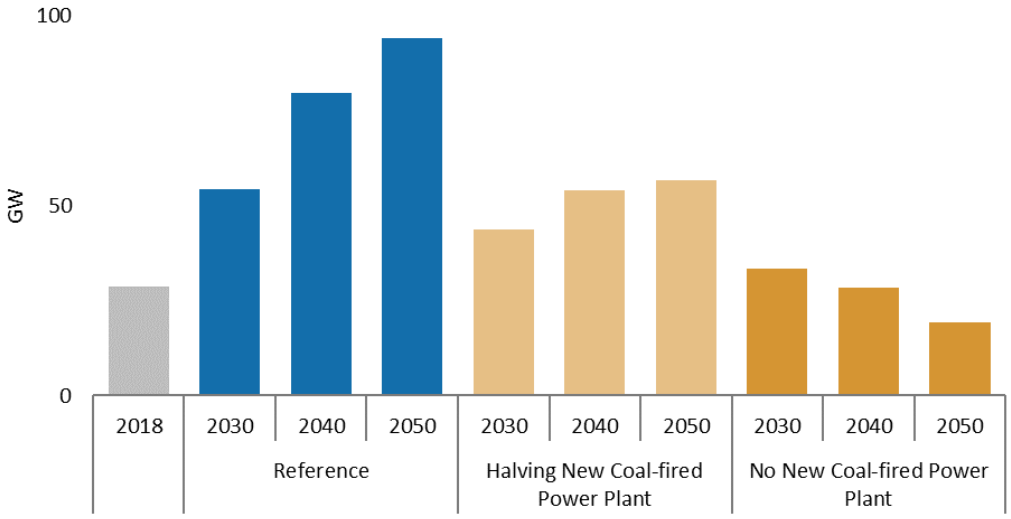
Figure 3.10: Electricity Generated and Real GDP in Indonesia (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.11 presents coal-fired power generation capacities by scenario.

Figure 3.11: Coal-Fired Power Generation Capacity in Indonesia (2018–2050)



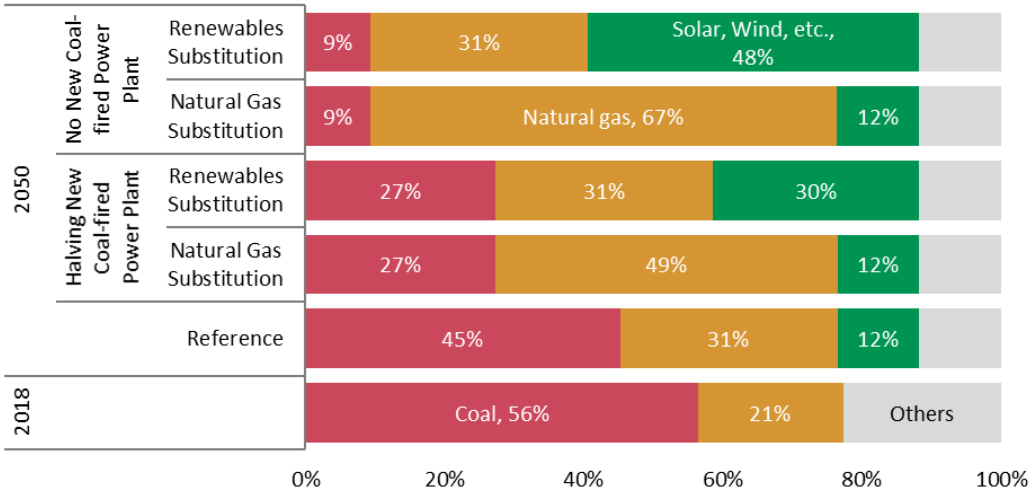
Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that although Indonesia plans to utilise CFPPs for the following years, the country is trying to reduce dependency on them and introduce low-emission technologies such as critical integrated gasification combined cycle (IGCC) and CCS. Dependence on coal-fired power generation will decrease in the REF as well. However,

as power demand increases, the capacities in the REF will robustly surge to 94 GW in 2050, more than three times than in 2018 (29 GW). On the other hand, the capacities in the NNC will drop to 19 GW by 2050, reflecting the retirement of ageing plants. In the HNC, the capacities will remain at 57 GW in 2050, after almost flattening in the mid-2040s.

Figure 3.12 shows that coal's share in the power mix of the NNC will plummet from 56% in 2018 to 9%. This shrinking is compared to 45% in the REF, provided that the capacity in 2050 in the NNC will only be 30% less than in 2018. In the HNC, the share will drop to 27%.

Figure 3.12: Power Mix in Indonesia (2018, 2050)

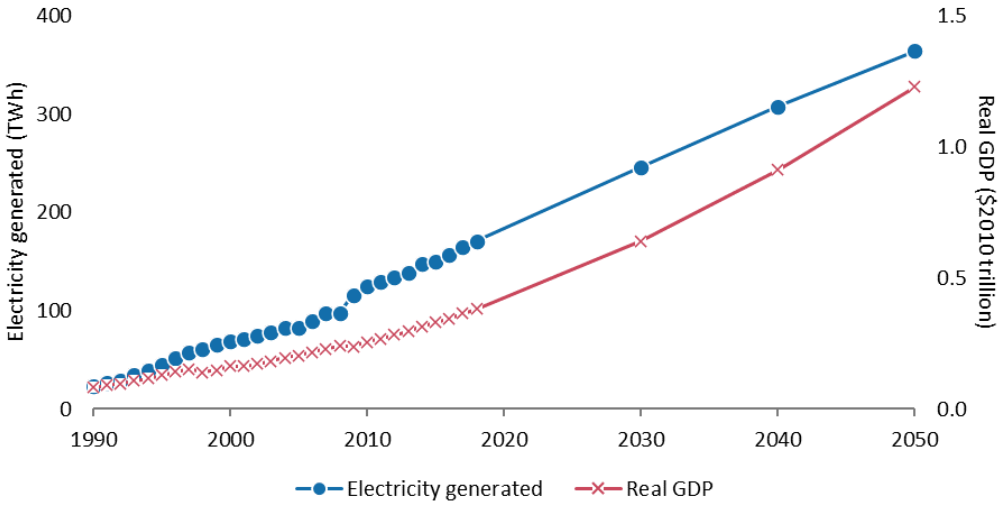


Source: The Institute of Energy Economics, Japan (2021).

2.4. Malaysia

Malaysia has the highest GDP per capita amongst the seven countries. The average annual GDP growth of this country is the second-slowest after Thailand. However, in 2050, the GDP per capita of about US$30,000 will be three times the average of the seven countries. Power demand will increase at a modest pace than in other countries. Nevertheless, the power generation in 2050 will be at 364 TWh, 2.1 times as in 2018 (Figure 3.13). The final consumption of electricity per capita will exceed 8 MWh, comparable to the average of current OECD countries.

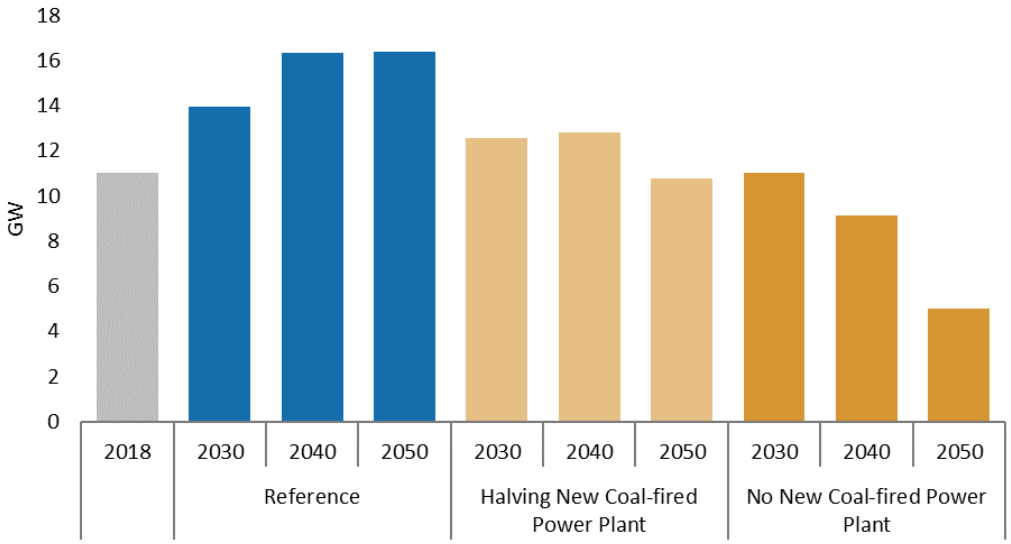
Figure 3.13: Electricity Generated and Real GDP in Malaysia (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.14 shows Malaysia's coal-fired power generation capacity by scenario.

Figure 3.14: Coal-Fired Power Generation Capacity in Malaysia (2018–2050)



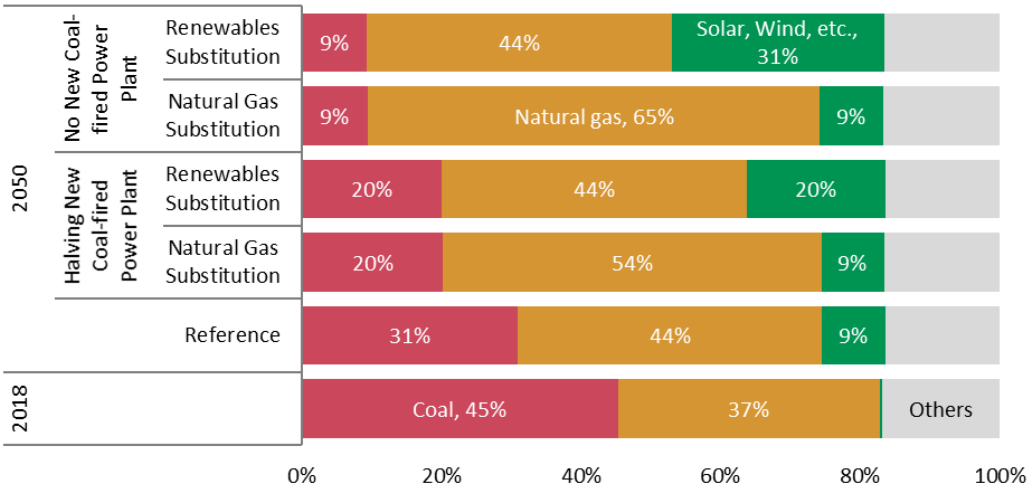
Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that Tenaga Nasional Berhad, the largest power generator, pledged not to invest any more in greenfield CFPPs. Therefore, the increase in coal-fired power generation capacity in the REF will be restrained. The REF capacities will plateau in the mid-2040s and reach 16 GW in 2050, 1.5 times as in 2018 (11 GW). In contrast, the capacities in the NNC will drop to 5 GW in 2050. In the HNC, the capacities

will slightly increase until the mid-2030s. After that, they will decrease to 11 GW in 2050, almost the same as in 2018.

As a result, coal share in the power mix will vary from the current level of 45% (Figure 3.15). In the REF, renewables' expansion will erode the share of coal power to 31% by 2050, lower than in 2018. On the other hand, coal share in the NNC and the HNC in 2050 will decline to 9% and 20%, respectively.

Figure 3.15: Power Mix in Malaysia (2018, 2050)

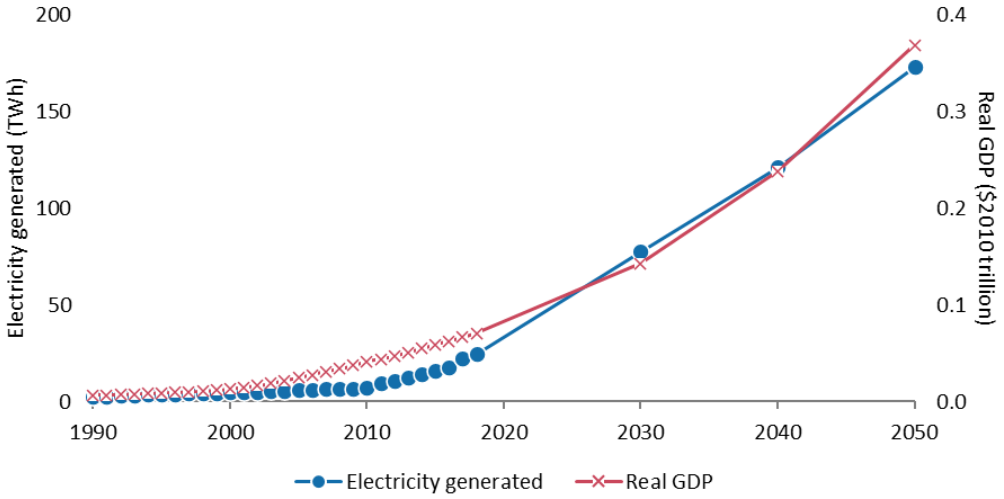


Source: The Institute of Energy Economics, Japan (2021).

2.5. Myanmar

Out of the seven countries, Myanmar is the least developed, but its GDP per capita in 2050 will approach US$6,000. In a few years, it will reach the current level of Thailand. In Myanmar, electricity demand will increase rapidly as its population and economy grow. In 2050, the country will generate seven times more electricity than in 2018, 173 TWh (Figure 3.16). This growth rate is the fastest amongst the seven EAS countries. The final consumption of electricity per capita in 2050 will be 1.8 MWh, which is lower than the current level in Viet Nam. Electricity demand is expected to continue to expand rapidly after the projection period.

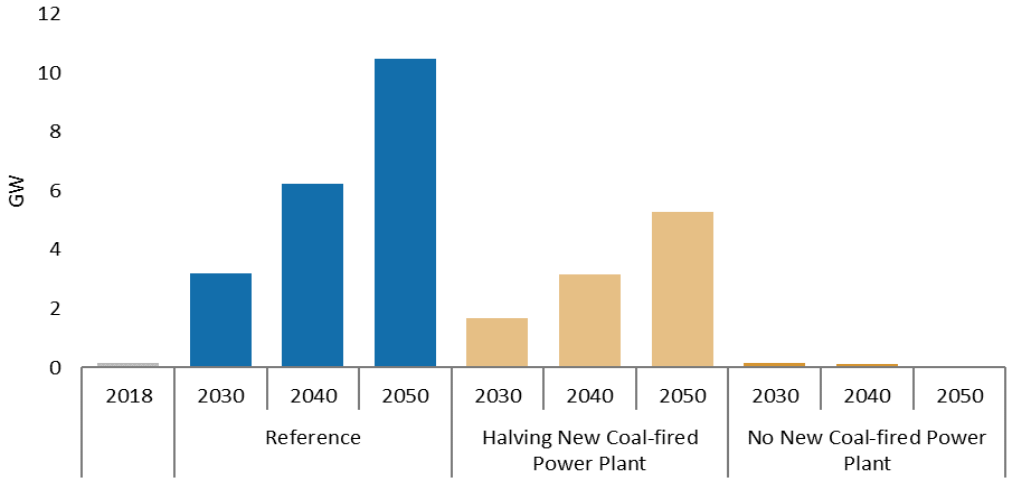
Figure 3.16: Electricity Generated and Real GDP in Myanmar (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.17 shows the coal-fired power generation capacities in Myanmar by scenario.

Figure 3.17: Coal-Fired Power Generation Capacity in Myanmar (2018–2050)

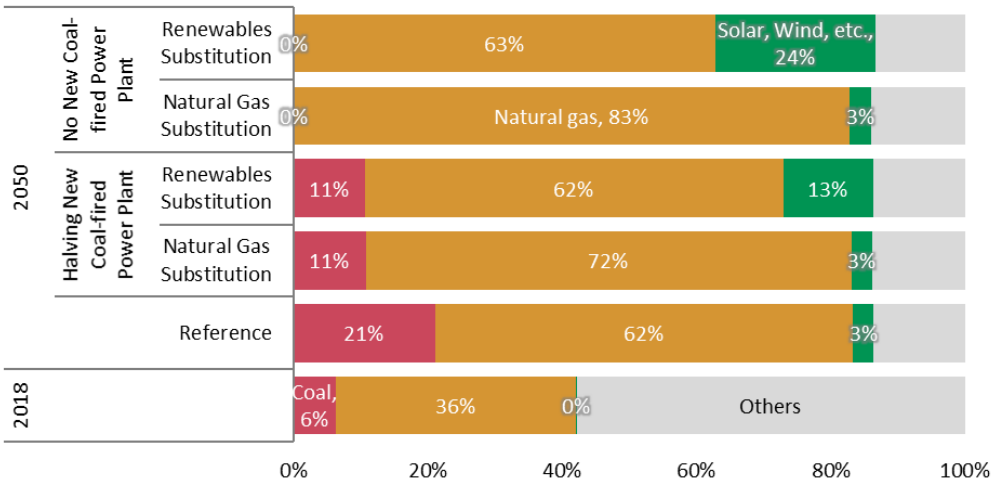


Source: The Institute of Energy Economics, Japan (2021).

The REF will see a steady increase in coal-fired power generation capacity, reaching 10 GW in 2050. As opposed to the REF, the NNC capacity will remain at almost 0 GW in 2050. In the HNC, the capacity will slowly increase than in the REF, resulting in 5 GW in 2050.

As a result of the above, the coal share in the power mix will change (Figure 3.18). In the REF and the HNC, the share in 2050 will rise to 21% and 11% from 6% in 2018, respectively. In the NNC, on the other hand, the share as of 2050 will be almost 0%.

Figure 3.18: Power Mix in Myanmar (2018, 2050)

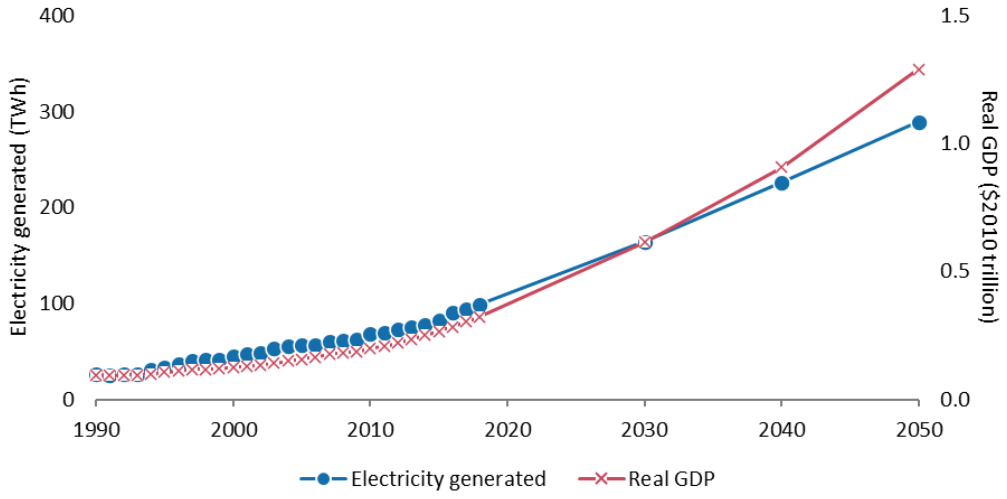


Source: The Institute of Energy Economics, Japan (2021).

2.6. Philippines

The Philippines has the fastest population growth rate amongst the seven EAS countries. This growth will robustly support its power demand increase throughout the projection period along with economic growth. The electricity generated in 2050 will hit 289 TWh, 2.9 times as in 2018 (Figure 3.19).

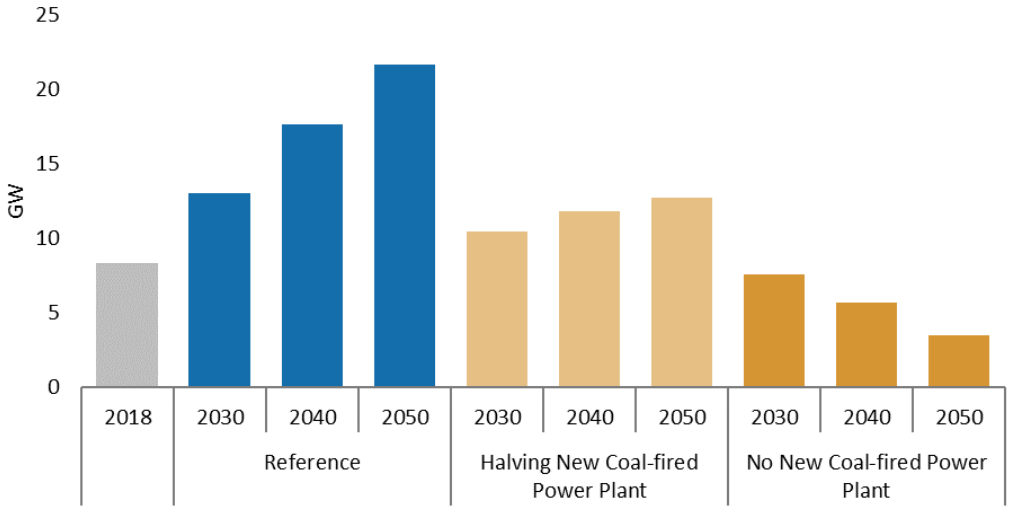
Figure 3.19: Electricity Generated and Real GDP in the Philippines (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.20 shows the coal-fired power generation capacities in the Philippines by scenario.

Figure 3.20: Coal-Fired Power Generation Capacity in the Philippines (2018–2050)

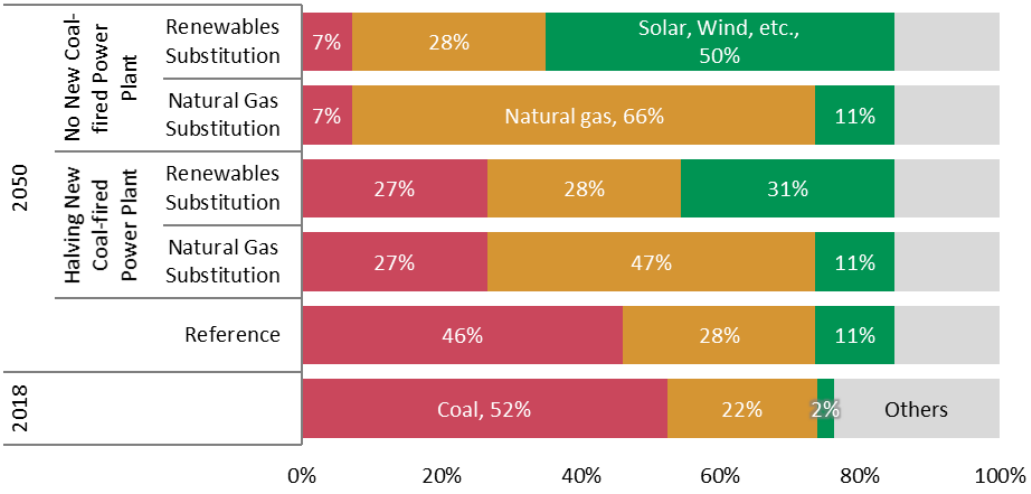


Source: The Institute of Energy Economics, Japan (2021).

The coal-fired power generation capacities in the REF will steadily increase, reaching 22 GW by 2050. In contrast, the NNC capacities will gradually decrease with ageing plants' retirement, reaching 3 GW in 2050. In the HNC, the capacities will increase but slower than the REF and hit 13 GW in 2050.

Figure 3.21 shows how coal share in the power mix will diverge from 52% in 2018. In the REF, the share in 2050 will slightly drop to 46% due to the expansion of natural gas and renewables. The coal share in the NNC and the HNC in 2050 will drastically decrease to 7% and 27%, respectively.

Figure 3.21: Power Mix in the Philippines (2018, 2050)

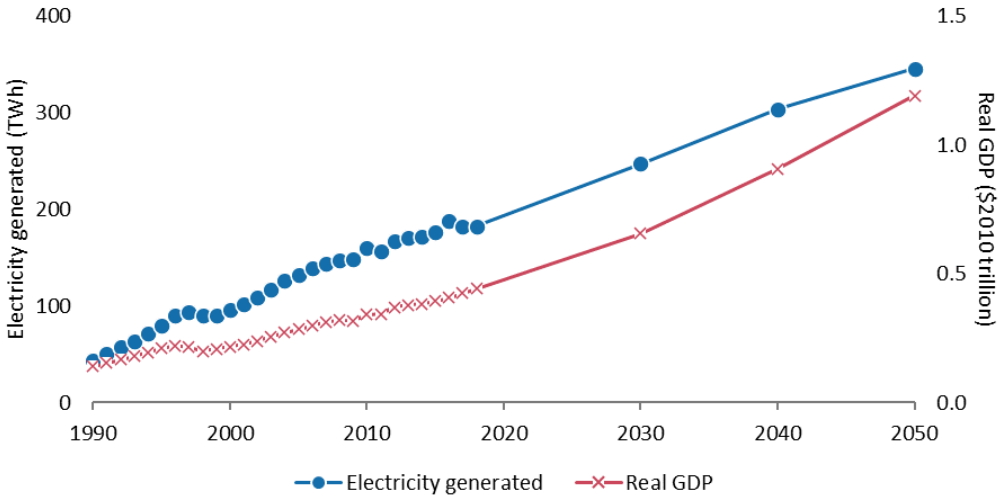


Source: The Institute of Energy Economics, Japan (2021).

2.7. Thailand

Thailand is the only country amongst the seven whose population is expected to peak off by 2050. However, its economic growth will drive power demand. The projected power generation of 345 TWh in 2050 is 1.9 times greater than in 2018 (Figure 3.22).

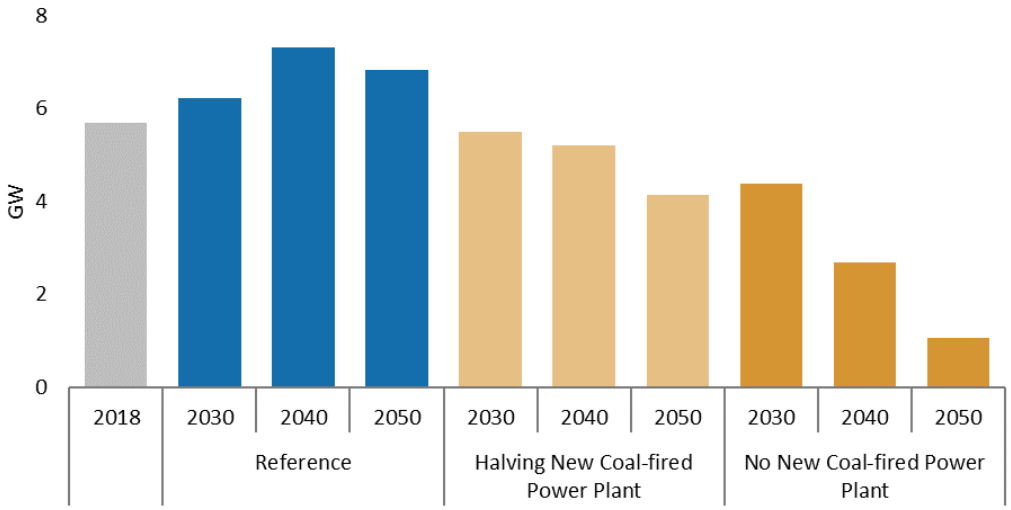
Figure 3.22: Electricity Generated and Real GDP in Thailand (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that although existing coal and lignite plants will remain in the power mix at least until 2037, the power development plan does not include new CFPPs. On the other hand, there is information on new CFPPs of 1 GW each in the eastern region and the southern region (see section 2.6.2 on coal-fired power development). The REF of this study incorporates them and assumes that coal-fired power generation capacities in this country will tend to continue to increase until the 2030s. After that, however, the capacities will gradually decrease because of the active penetration of renewables, mainly solar PV. Figure 3.23 shows coal-fired power generation capacity in Thailand by scenario.

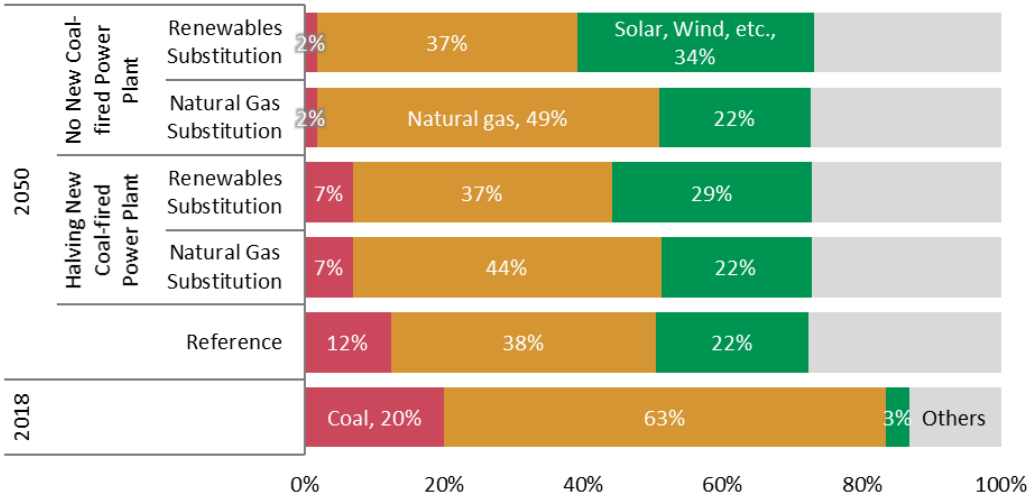
Figure 3.23: Coal-Fired Power Generation Capacity in Thailand (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

The coal share in the power mix, which was 20% in 2018, will also change (Figure 3.24). In the REF, the share will decrease to 12% due to the expansion of renewables. The share in the NNC and the HNC will see further drops to 2% and 7%, respectively.

Figure 3.24: Power Mix in Thailand (2018, 2050)

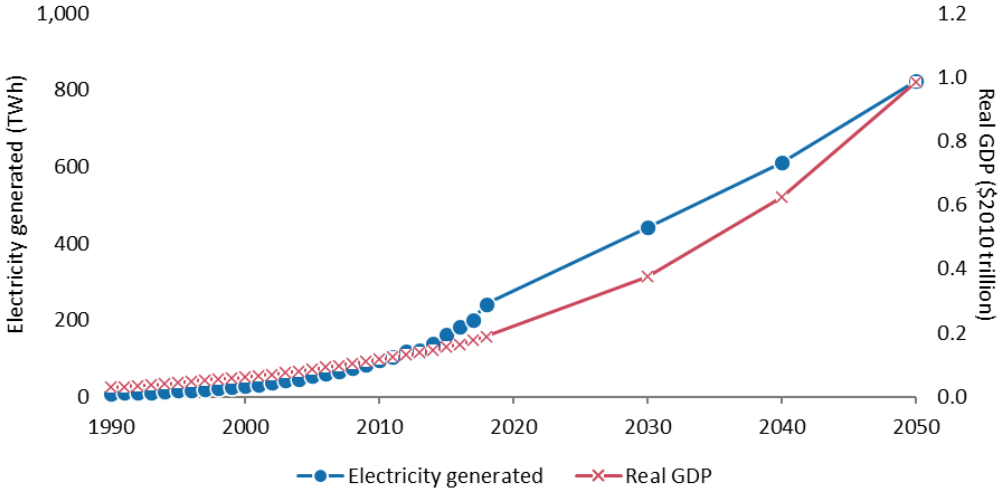


Source: The Institute of Energy Economics, Japan (2021).

2.8. Viet Nam

The power supply in Viet Nam will increase as population and economic growth robustly surge power demand (Figure 3.25). The electricity output of 823 TWh in 2050 will be 3.4 times greater than that in 2018.

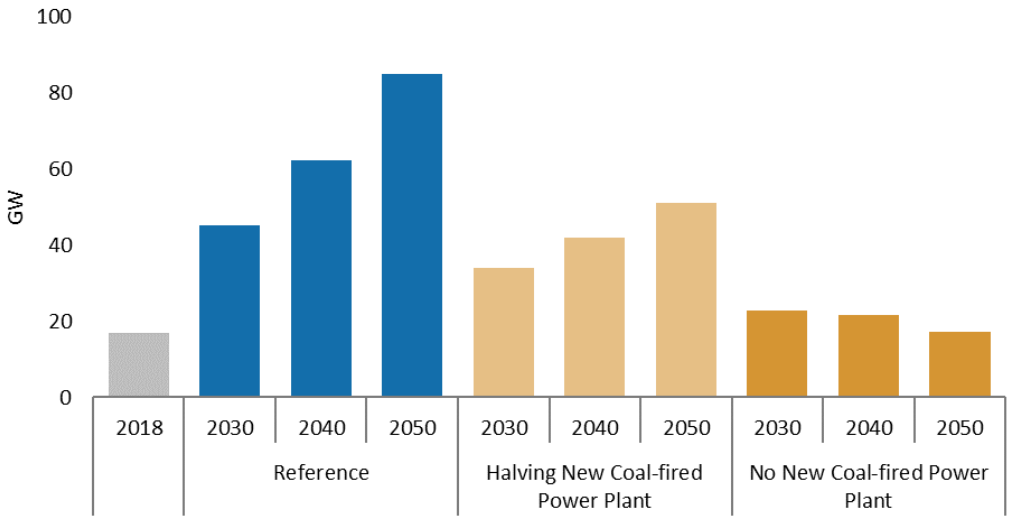
Figure 3.25: Electricity Generated and Real GDP in Viet Nam (1990–2050, REF)



Source: The Institute of Energy Economics, Japan (2021).

Figure 3.26 shows the transition of coal-fired power generation capacity in Viet Nam. The capacities in the REF will reach 85 GW in 2050, five times as in 2018. The capacity in the NNC will slightly increase. After that, it will decrease to 17 GW, which is the same level as of today. In the HNC, the capacity will grow slowly and remain at 51 GW in 2050.

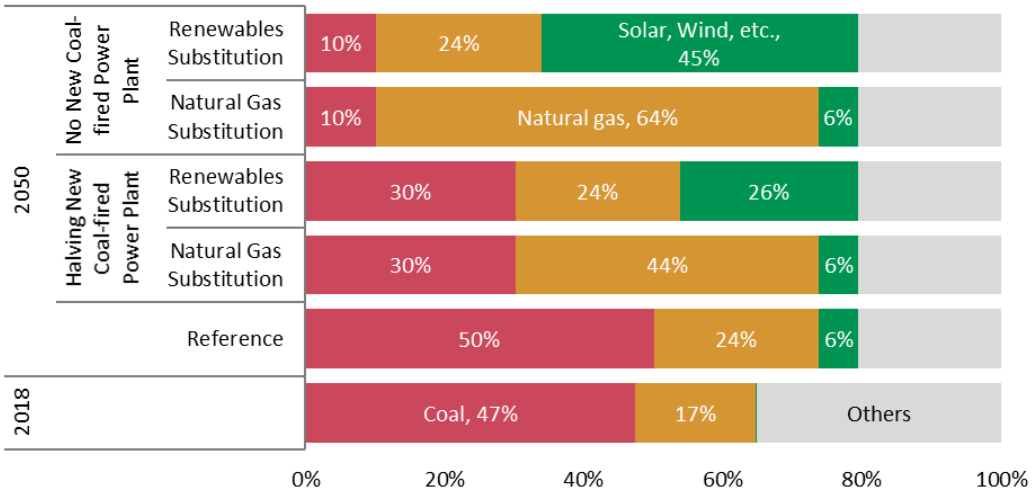
Figure 3.26: Coal-Fired Power Generation Capacity in Viet Nam (2018–2050)



Source: The Institute of Energy Economics, Japan (2021).

At the workshop, it was mentioned that finance for new thermal power plants is a big problem. Coal share in the power mix will change (Figure 3.27). In the REF, the share will rise to 50% from 47% in 2018. On the other hand, the shares in the NNC and the HNC will drop to 10% and 30%, respectively.

Figure 3.27: Power Mix in Viet Nam (2018, 2050)



Source: The Institute of Energy Economics, Japan (2021).

Chapter 4

Impact of Coal Divestment

Assuming the restriction on CFPP construction and renewal is introduced worldwide, we will examine its impacts on the seven countries in this chapter. There are two key implications. The first is that even in the NNC, the future CO_2 emission will increase in these countries. Hence, other measures to achieve the climate change target should be adopted. The second is that this restriction will cause severe energy security challenges in both natural gas–fired substitution and renewables (solar PV and wind power) substitution.

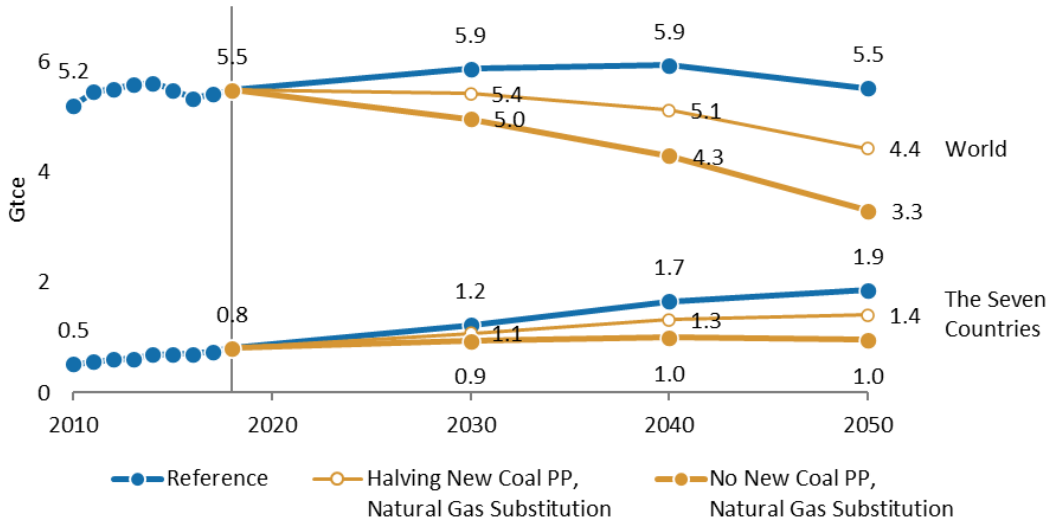
1. CO_2 Emission Reduction

In the NNC and the HNC, coal-fired power generation is capped and replaced by natural gas or solar PV and wind power generation. Therefore, CO_2 emissions in both scenarios are lower than the REF. Nevertheless, in both cases, CO_2 emissions will steadily increase throughout the projection period due to the sheer increase in power demand.

In the NNC or the HNC, coal consumption for power generation is suppressed compared to the REF since coal-fired power generation is relatively suppressed. Due to this effect, for the NNC, where coal-fired power generation is the most reduced amongst all scenarios, the total primary consumption of coal in the seven EAS countries in 2050 will be about 1.0 Gtce, which is nearly half of the REF in the same year (about 1.9 Gtce). With the NNC, increases in coal's primary consumption from 2018 to 2050 can be suppressed to approximately 0.2 Gtce (Figure 4.1).

The trend that coal's primary consumption is suppressed from the REF in the NNC and the HNC is also true globally. In the NNC, the world's primary consumption of coal will be reduced to 3.3 Gtce, equivalent to the level at the beginning of this century. The global primary consumption of coal declines more rapidly than the seven EAS countries because consumption outside Asia has been declining.

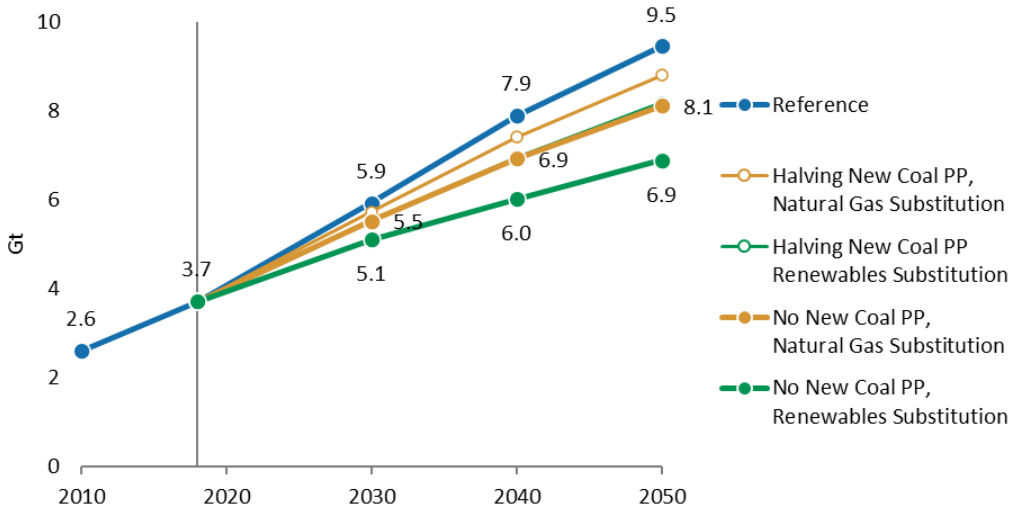
Figure 4.1: Primary Consumption of Coal in the Seven EAS Countries and the World



Source: The Institute of Energy Economics, Japan (2021).

Natural gas has a lower carbon emission factor than coal. Solar PV and wind are CO_2-free power sources. Therefore, replacing coal-fired power generation with natural gas–fired power generation or solar PV and wind power generation contributes to reducing CO_2 emissions. The reduction in coal's primary consumption results in lower CO_2 emissions than the REF for both the NNC and the HNC (Figure 4.2). In the NNC, with renewables substitution, where CO_2 emission reduction effect will be the greatest, CO_2 emissions in 2030 will be reduced by 0.8 Gt (-14%) and in 2050 by 2.6 Gt (-27%) compared with the REF. In natural gas–fired power generation, the CO_2 emission reduction effect of the NNC (natural gas substitution) is about half that of the NNC (renewables substitution). As described above, although the effect varies from case to case, the introduction of this restriction considerably affects CO_2 emission reduction compared to when no restriction is introduced.

Figure 4.2: CO_2 Emission in the Seven EAS Countries, by Scenario



PP = power plant.
Source: The Institute of Energy Economics, Japan (2021).

On the other hand, Figure 4.2 also indicates that in all cases, CO_2 emissions will increase steadily towards 2050. Even in the NNC (renewable substitution), where CO_2 emissions from the power generation sector are reduced most, CO_2 emissions in 2050 will be 1.9 times higher than in 2018 (3.7 Gt), reaching 6.9 Gt. This is because fossil fuel consumption in non-power sectors such as industry, buildings, and transportation increases against the backdrop of significant economic growth in the seven EAS countries.

Therefore, based on the results of the analysis described above, we can say that the restriction on financing for the construction and renewal of CFPPs has a considerable CO_2 emission reduction effect compared to the case where no limitation is introduced. Still, the reduction effect through this restriction is not enough to solely reduce GHG emissions.

2. Energy Security

Countries and regions must procure the energy required for their stable development. Regarding energy security, it is not enough to focus only on procurable energy amount. For example, the IEA defines energy security as the uninterrupted availability of energy sources at an affordable price (IEA, 2019b). In other words, for energy security, governments and utilities must promptly procure sufficient energy amounts at a reasonable price without interruption.

Each country or region has different geographical and socio-economic conditions for energy, such as economic standards, demand volume, indigenous production, and distance from producing countries. It means that even if a restriction on energy use introduced as a measure against climate change is globally uniform, its impacts on energy

security can vary from country to country. Therefore, the acceptability of such undifferentiated restrictions could also differ by country.

This study examined the impacts of coal divestment on the construction and renewal of CFPPs on energy security in the seven EAS countries. The result implies that the adoption of alternative power sources, both natural gas–fired and renewable energy (solar PV and wind), will cause energy security challenges for the region. The following sections describe such challenges in each case in detail.

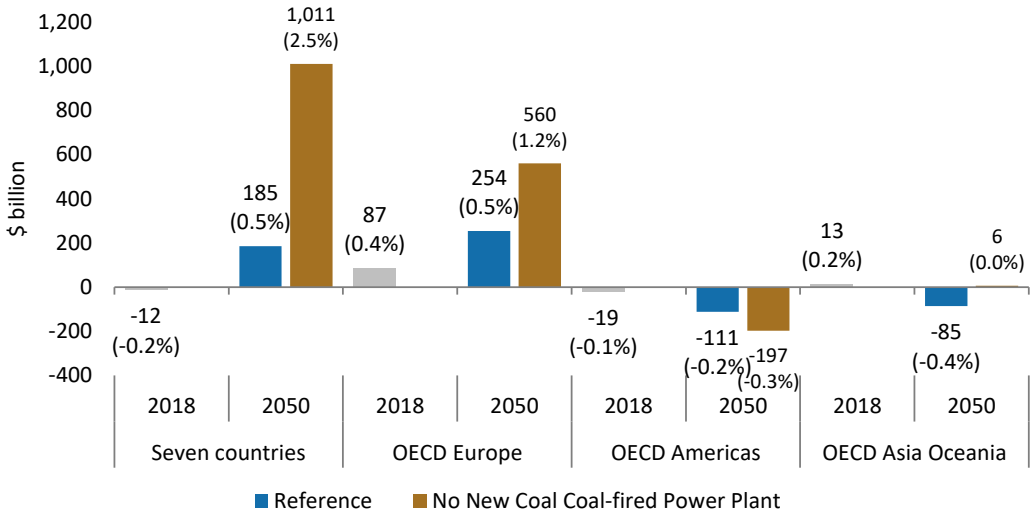
2.1. Natural gas substitution cases

Comparing the natural gas substitution cases of the NNC and the HNC with the REF, there are two issues regarding the seven EAS countries' energy security. The first is that the net import spending on natural gas will increase significantly, putting pressure on the regional economy. The second is that ensuring a stable supply of the requisite natural gas becomes much more difficult. The details of each issue are below.

(i) Substantial increases in total net import spending on natural gas and coal will weigh on the regional economy.

In the NNC, the seven EAS countries' net import spending on natural gas and coal in 2050 totalled US$1,011 billion, 5.5 times larger than that of US$185 billion in the REF (Figure 4.3). The spending in 2050 accounts for 0.5% of the REF's regional nominal GDP, while it accounts for 2.5% in the NNC. It means that net import spending in the NNC will further squeeze the seven EAS countries' economy compared to the REF.

Figure 4.3: Net Import Spending on Natural Gas and Coal



Notes: OECD Americas comprises Canada, Mexico, and the US. Percentages represent the ratios of the net import spending to the nominal GDP of the region.
Source: The Institute of Energy Economics, Japan (2021).

The total net import spending in the NNC increased because the net import volume of natural gas, which has a higher price per unit calorific value than coal, increases from the REF. The coal demand will decrease in the NNC by reduced CFPP capacities. Comparing the net imports of coal in 2050 under the two scenarios, the NNC is about 585 Mtoe lower than the REF. Net import spending of coal in the NNC will be -US$83 billion (negative) with the nominal unit price of $141/t, well below US$40 billion of the REF. On the other hand, in the NNC, the natural gas demand for power generation will soar from the REF. Comparing the net imports of natural gas in 2050 under the two scenarios, the NNC is 496 Mtoe higher than the REF. As seen in Table 3.3, the natural gas unit price in the NNC could skyrocket relative to the REF due to the drastic expansion of the natural gas supply chain. As described in issue (ii) below, it will be necessary to rapidly develop the supply chain to cover enormous natural gas demand in the NNC. Natural gas prices must surge to make such an expanded supply chain economically viable. In total, the increase in natural gas import has much more impact on the net import spending than the decrease in net coal import.

In the NNC, the natural gas prices will globally surge compared to the REF. Nevertheless, its impacts on the net import spending varies from region to region (Figure 4.3). In OECD Americas, high natural gas prices in the NNC will help its net surplus improve. Although OECD Asia Oceania will turn to a net importing region in the NNC, its net import spending will be limited as Australia remains in the LNG export position. In contrast, net import spending in the seven EAS countries and OECD Europe will notably deteriorate in the NNC.

However, the increase in net import spending of OECD Europe in the NNC is much less than the seven EAS countries. One reason for this is the additional natural gas demand in OECD Europe will be well below that of the seven EAS countries as coal-fired power generation capacities are much less. OECD Europe's net import will be 364 Mtoe in 2050 in the NNC, just 51% of the seven EAS countries. The other reason is the import cost difference since Asian import prices are expected to remain higher than Europe's.

(ii) Difficulty of a stable supply of necessary natural gas volume increases

In general, to supply reserved natural gas to consumption areas, supply chains such as exploration, development, production, transportation, and storage should be developed corresponding to the scale and timing of supply and demand. Therefore, in the NNC or the HNC, where the natural gas demand surges for power generation, the supply chain must be expanded accordingly. For such expansion, it is essential to provide many development resources like materials, equipment, experts, and investment funds at each stage of the chain. However, as the demand gets large, it becomes more difficult to secure these resources.

First, it is necessary to explore and develop more gas fields worldwide to produce much more natural gas. In addition to conventional gas resources, producers must actively work on shale and other technically and economically challenging developments, such as in polar regions and deep water. This process will require many development resources like geological data, materials, and equipment for drilling activities and the construction of

facilities, specialists from energy, service, and engineering companies, as well as sufficient funds to cover all these operations.

Secondly, it is necessary to ramp up transport capacities to ship the produced natural gas to consuming areas. With coal divestment in place, the LNG demand in the seven countries will increase from 31 MT in 2018 to 300–400 MT in 2040 and 400–600 MT in 2050. Considering the world total LNG demand in 2018 is 314 MT and IEA forecasts the demand to be 847 MT in 2040, it is difficult to assume that the seven countries and the global LNG industry can accommodate the sheer amount of additional LNG demand.

2.2. Renewables substitution cases

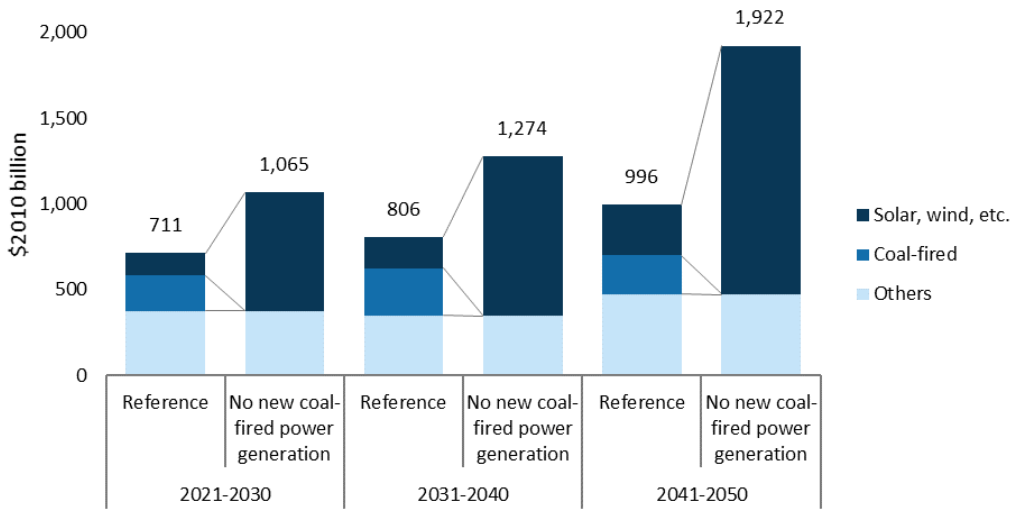
In the renewables substitution cases in the NNC and the HNC, two issues on energy security of the seven EAS countries will arise. The first is higher power costs, and the second is the difficulty of a stable power supply.

(i) Increase in the power cost

Higher electricity costs burden the overall economy and industrial competitiveness via higher electricity prices. Also, higher costs could give rise to a gap in energy accessibility amongst customers, depending on their economic situation. Chapter 3 illustrated that in the case of renewable energy substitutes, the electricity cost would go up in the seven countries for two reasons.

The first reason is the enormous amount of capital investment for new solar PV and wind power generation. In the NNC, the seven countries will see reduced coal-fired power generation capacity in 2050 by 594 GW relative to the REF, requiring the augmentation by renewables to meet electricity demand. Figure 4.4 shows rough estimates of total power generation plant costs (not including transmission and distribution facilities costs) for the REF and the NNC.

Figure 4.4: Capital Expenditures for Power Generation in the Seven EAS Countries



Source: The Institute of Energy Economics, Japan (2021).

The cumulative capital expenditures through 2021 to 2050 in the NNC will increase by about US$1.7 trillion relative to the REF. This increase will put upward pressure on electricity costs in the region.

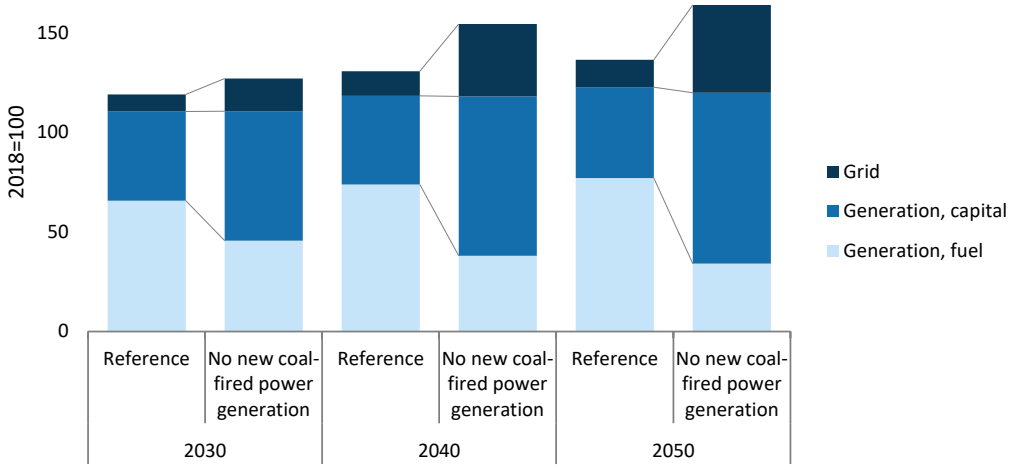
The power transmission and distribution facilities for connecting the new power generators with existing systems should be expanded because each solar PV and wind facility locations are to be geographically dispersed compared with conventional large-scale power plants. Although estimation in Figure 4.4 does not include them, this expansion also requires vast facility costs.

Besides, a large part of total cash out for construction occurs during the construction period, in short, before the income from electricity sales comes in. In terms of the feasibility of the NNC, it is necessary to consider whether utilities can finance such considerable amounts with acceptable conditions.

The second reason is that the operating costs of power grids and other software increase. Concurrent with the construction of facilities, utilities must drastically reform the system operation methodologies because solar PV and wind power generation is intermittent. This reformation and new methods will raise operating costs compared to the REF.

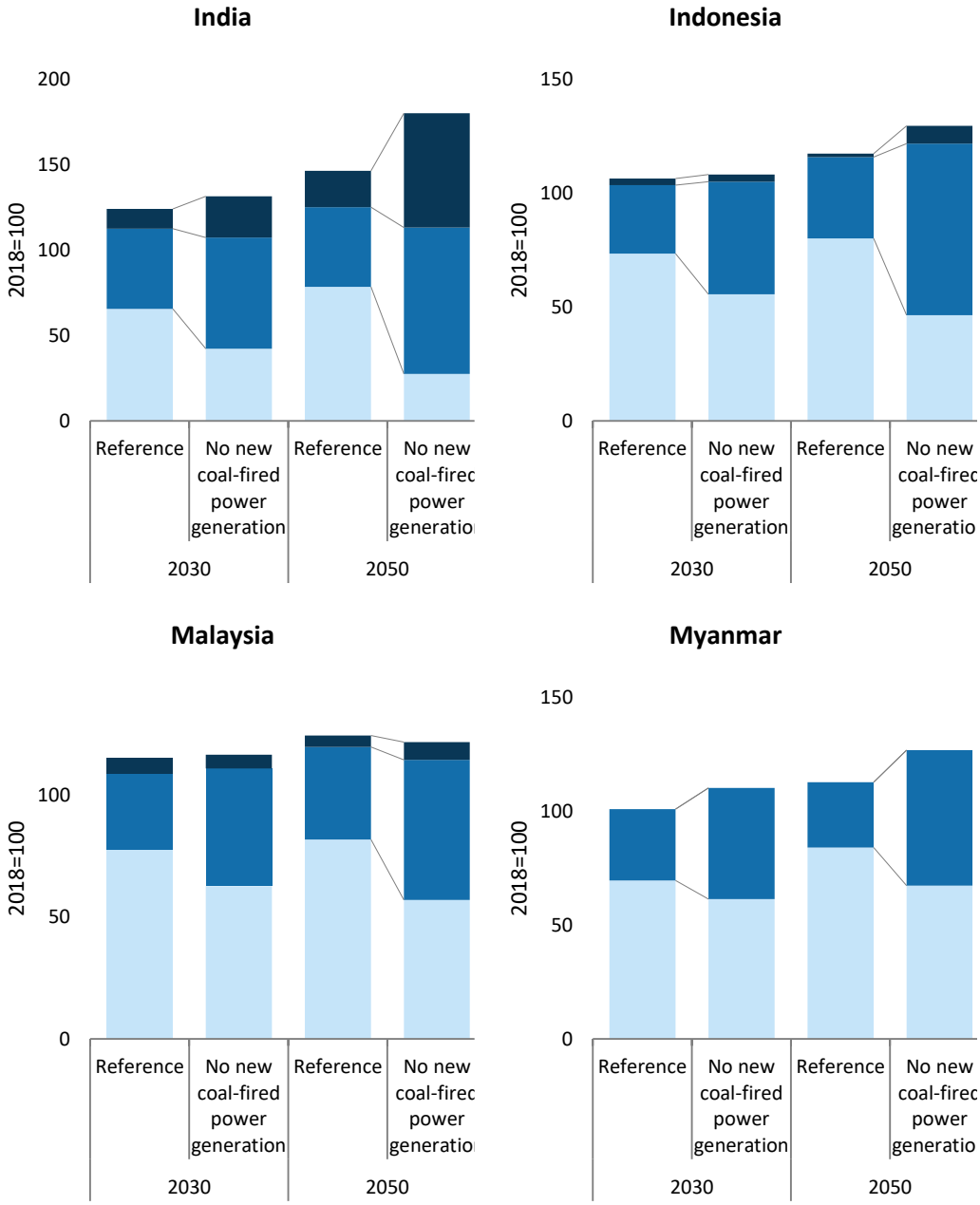
Figures 4.5 and 4.6 show the estimated electricity costs of the seven EAS countries in the REF and the NNC. The difference between the two scenarios widens in later years; finally, the electricity costs in 2050 in the NNC become 20% higher than the REF.

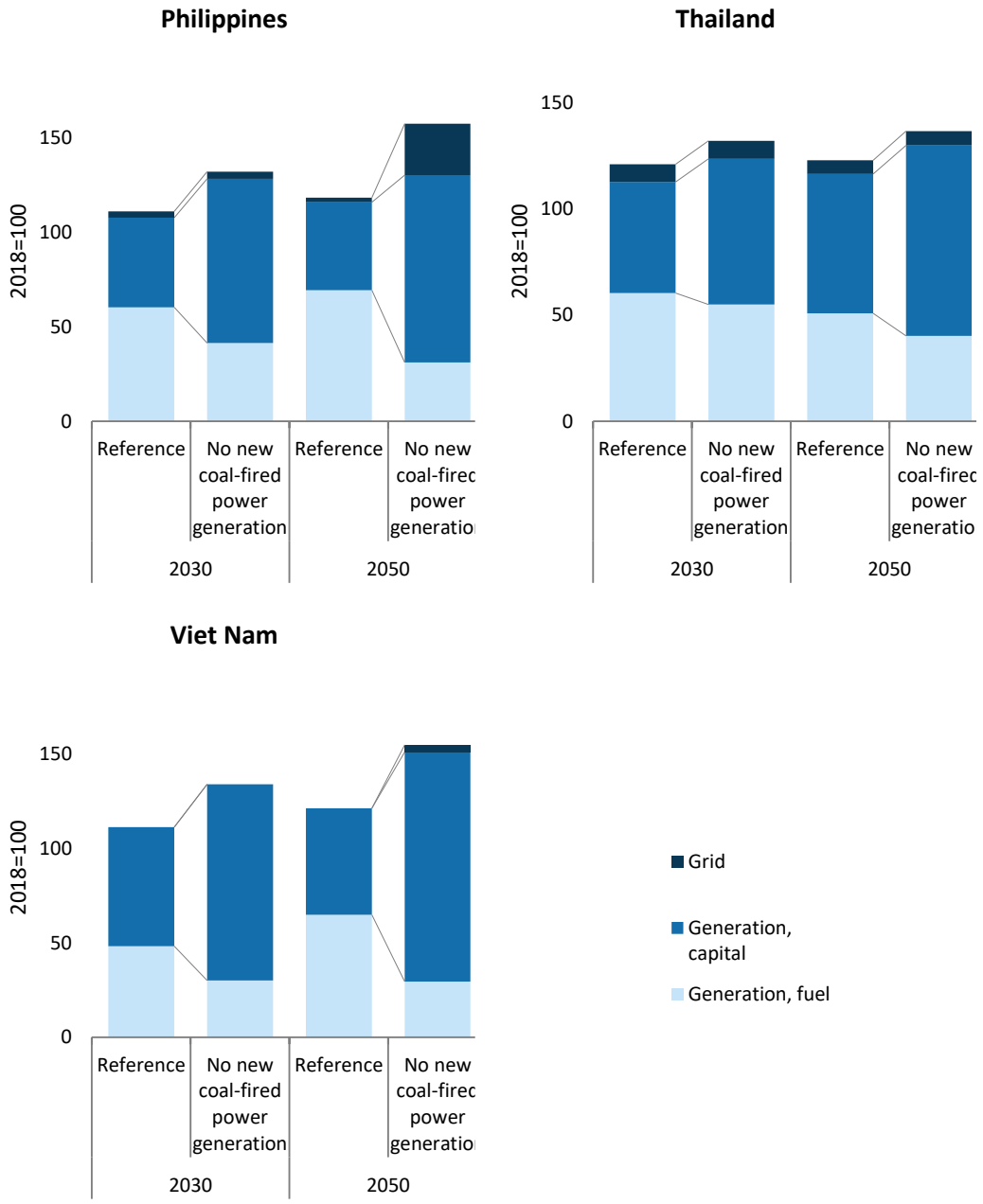
Figure 4.5: Indicative Electricity Costs in the Seven EAS Countries (Combined)



Note: Electricity prices are also affected by other costs, such as labour costs, taxes, subsidies, price regulation, power companies' profit, etc.
Source: The Institute of Energy Economics, Japan (2021)

Figure 4.6: Indicative Electricity Costs in the Seven EAS Countries





Note: Electricity prices are also affected by other costs, such as labour costs, taxes, subsidies, price regulation, power companies' profit, etc.
Source: The Institute of Energy Economics, Japan (2021).

Capital and operating costs of renewables can also vary from the region based on technical and commercial situations. For example, in OECD Europe, continuous innovations in renewables technologies have contributed to lower capital and operating costs. Moreover, the developed wholesale trading system in the region helps renewable energy to replace thermal power generation. Furthermore, the well-interconnected power grids play a role in alleviating costs to deal with supply intermittency caused by renewables. On the other hand, in the seven EAS countries, technology innovations, market developments, and grid

connectivity are relatively less developed than those in OECD Europe. These differences will lead to significant differences in expenses to introduce a vast amount of renewables amongst regions, even under similar restrictions.

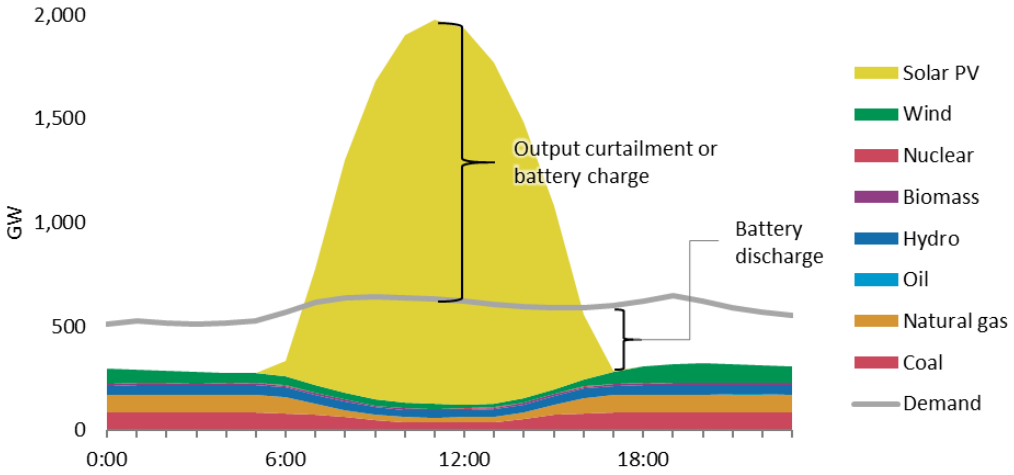
(ii) Stable supply of electric power becomes difficult.

Electricity supply and demand must always balance in a grid to avoid a blackout. Hence, utilities continuously control the power supply in networks to deal with fluctuating demand. However, unlike thermal power generators, it is almost impossible to artificially manage the inflow from solar PV and wind generation without large-scale battery technologies as sunlight and wind conditions are beyond control.

Solar PV and wind power generation capacities in 2050 in the NNC will hit 3,244 GW, 48 times the level in 2018. This dramatic capacity increase could urge utilities to close some of their thermal power plants. Thermal power generation balances supply and demand by covering the intermittency of renewables. Therefore, the expansion of solar PV and wind power could hinder the stable power supply.

Figure 4.6 shows an indicative example of electricity supply and demand in a day in January 2050 in India, which assumes the largest renewable capacities amongst the seven EAS countries in the NNC.

Figure 4.7: Indian Electricity Supply and Demand (January 2050, Indicative)



Source: The Institute of Energy Economics, Japan (2021).

In Figure 4.7, the power supply overshoots the demand during the daytime due to solar PV, while there is a shortage after sunset. This figure implies that it is essential to develop large-scale batteries and output control technologies to balance supply and demand adequately before introducing a vast amount of renewables.

3. Natural Gas Market

Natural gas would be one of the main alternatives to coal in power generation in the economies discussed in this study. Demand for natural gas in Asian countries is expected to grow faster than the total energy in the region in the REF. In parallel with the expansion of renewables, the share of natural gas in the seven countries' energy mix is expected to expand from 12% in 2018 to 16% in 2050.

In the alternative scenarios (the NNC and the HNC), more specifically in the natural gas substitution cases, natural gas demand in the seven countries and the rest of the world is forecasted to be unrealistically higher than the REF. This will lead to undesirable impacts on the healthy growth of the natural gas market in the region.

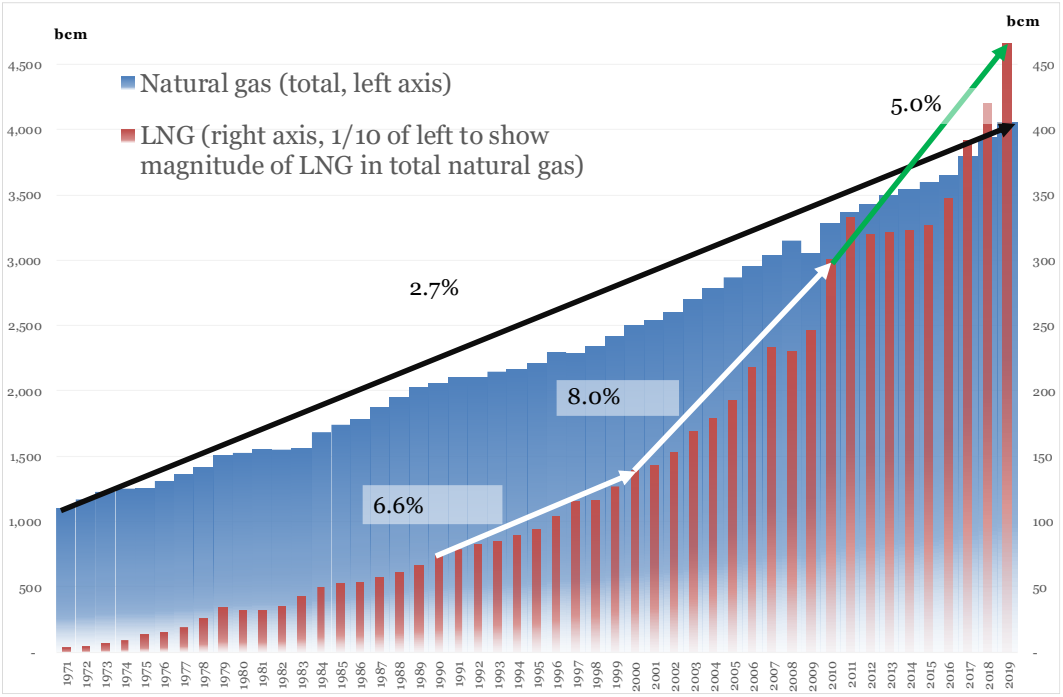
With modest domestic production growth in ASEAN and India, the region's import dependency could rise significantly from the current level of around 30% to nearly 50% by 2050 in the REF and even a higher dependency in the NNC and the HNC. Therefore, ASEAN and India need a stable investment in the infrastructure of natural gas and LNG-receiving terminals and pipelines, gas-fired power generation facilities, and securing natural gas and LNG supply sources from within and outside the region.

Globally, new LNG liquefaction plants with significant capacity have started operation in recent years. The world is expected to see a further considerable expansion of LNG production in the next decade. However, considering that the sheer increase of natural demand would have to be met by imported LNG, the LNG market would be severely constrained in natural gas substitution cases of the NNC and the HNC.

3.1. LNG development in the seven countries

Global natural gas demand grew at 3% per year from 2009 to 2019 to 4 trillion cubic metres. The Asia-Pacific region was the largest contributor to this, annually increasing 5.3%. Most other regions saw growth, with North America and the Middle East contributing about one-third to the increase. The LNG market continued expanding in 2019, with the absolute volume growth in 2019 second only to 2010.

Figure 4.8: Historical Natural Gas and LNG Market Development in the World



Note: The bars for LNG use 1/10 scale of total natural gas, meaning that when natural gas and LNG bars have the same length, LNG represents 10% of the total natural gas.
Source: Compiled by the author based on data of IEA and Cedigaz.

Natural gas and LNG in the seven countries vary in their development stages. India, Indonesia, Malaysia, Singapore, and Thailand are in the advanced stages of development of integrating LNG into their energy needs. Myanmar, the Philippines, and Viet Nam use LNG in its initial stage or is under consideration. While ASEAN is forecasted to continue to be a net natural gas exporter until 2030, the region's LNG imports are expected to grow.

As one of the fastest-growing economies globally, India is a relatively newcomer in the LNG market, starting imports in 2004. The country's primary LNG buyers have been the entities set up by national companies or the national companies themselves. But with government policies supporting a shift to a natural gas–based economy, private companies have set up additional LNG receiving infrastructure in recent years.

ASEAN is also expected to be a key market for small-scale LNG projects. In archipelagic countries, such as Indonesia and the Philippines, many islands have been using oil products to generate power; thus, replacing old and inefficient oil-fired power plants with more efficient natural gas systems is desired. The largest barrier to extending small-scale LNG to smaller islands is cost. Therefore, sufficient demand should be aggregated and generated, and logistic operation is optimised. The companies that have already developed LNG-receiving infrastructure in the region can provide physical hubs to redistribute LNG in smaller parcels; some have already expressed a willingness to do so. Some have already initiated LNG-bunkering operations in the region, too.

3.2. International market

(i) Recent market trend

Looking at ASEAN and India's situation, it is essential to note the region's significance in the global LNG market and LNG's importance in the regional natural gas supply. As ASEAN and India include three exporting, six active, and two prospective importing countries of LNG, and major markets and production centres are not necessarily interconnected with pipelines, LNG is the focus in discussions over the prospect of natural gas in the region.

The four markets in Northeast Asia, historically important LNG markets from Southeast Asia, represent 55% of global LNG imports. LNG represents about 55% of the region's natural gas supply. The two regions are still firmly interconnected through LNG trade, once as the supplier and consumer and now as market development partners.

The world's LNG market grew substantially over the past decade as more countries see LNG to diversify energy sources; switch from coal to gas in power generation; and industrial, residential, and commercial sectors to reduce GHG emissions. The LNG trade grew by 13% between 2018 and 2019 to 355 million tonnes, mainly driven by production growth in Australia, Russia, and the US.

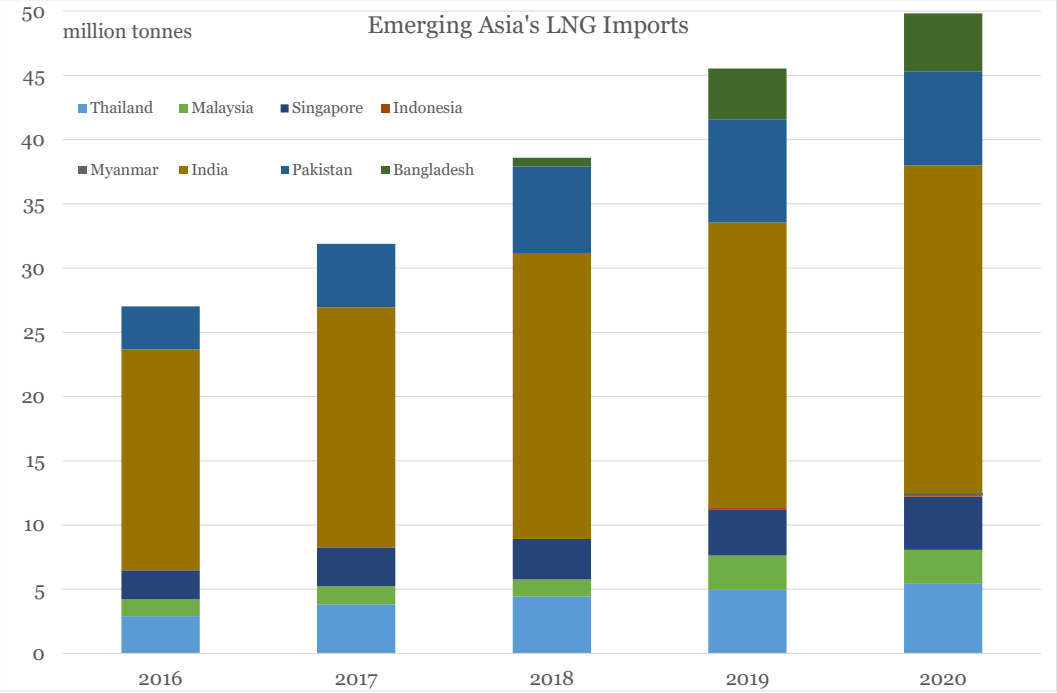
In addition to supply expansion, the rapid increase of LNG demand in Asia also contributed to the market's robust trade.

The booming supply and demand for LNG, especially better volume flexibility required by new LNG importers, brought the industry into a new phase of flexibility. New trading patterns such as spot trading, short-term contracts, arbitrage, equity lifting, and portfolio trading are spreading widely in the global LNG trade scenes. Furthermore, the LNG from the US has added another layer of flexibility and liquidity into the market as its supply is free from destination restrictions.

Japan has been the largest importer of LNG in the world for more than 3 decades. China is the third-largest consumer of natural gas (including imports of LNG and pipeline gas, as well as its rapidly growing domestic gas production) globally, following the US and Russia, after taking over Japan as the largest consumer of natural gas in the region as recently as in 2011. Northeast Asia's four big importers represented 55% of the global LNG imports in 2019.

The global demand shock in 2020 also significantly affected natural gas demand in the seven countries, but in different ways by country. While India imported 26 million tonnes of LNG in 2020, 15% more than in 2019, its gas consumption as a whole is estimated to decline by 2%. The ASEAN countries imported 9% more LNG in 2020 than a year earlier. Ample supply and relatively palatable prices are expected to stimulate demand there.

Figure 4.9: LNG Imports in ASEAN and South Asia

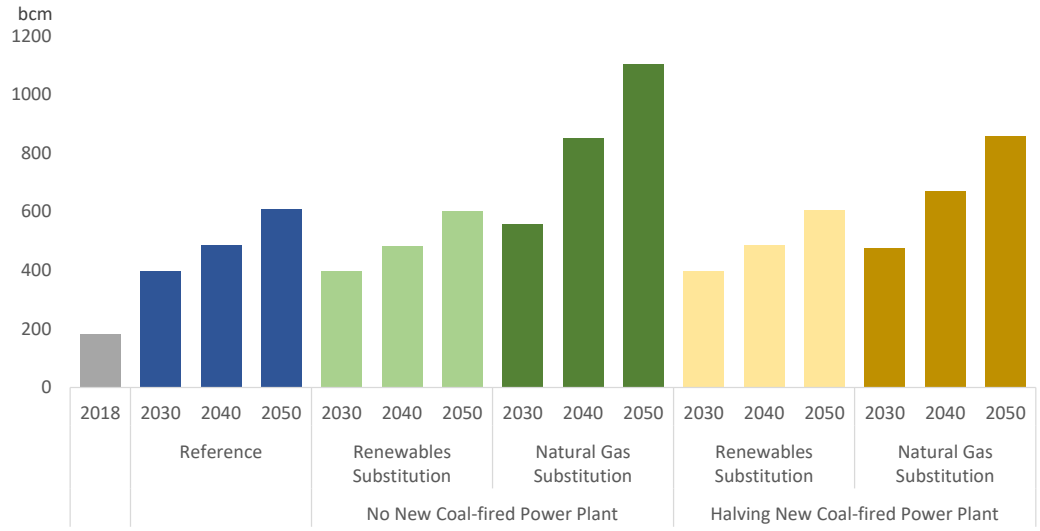


Source: Based on data from Cedigaz LNG Service.

(ii) Coal divestment and additional LNG needs

Based on the analysis in Chapter 3, coal divestment would substantially increase natural gas demand. In the REF, demand in the seven countries will grow by 4% per year to reach 707 bcm in 2050, which is already robust. Meanwhile, the growth rate of natural gas substitution case of Halving New Coal-fired Power Plant (NGHNC) and No New Coal-fired Power Plant (NGNNC) would be 5%–6% per year, and the demand would reach as much as 997 bcm (NGHNC) and 1,284 bcm (NGNNC) in 2050.

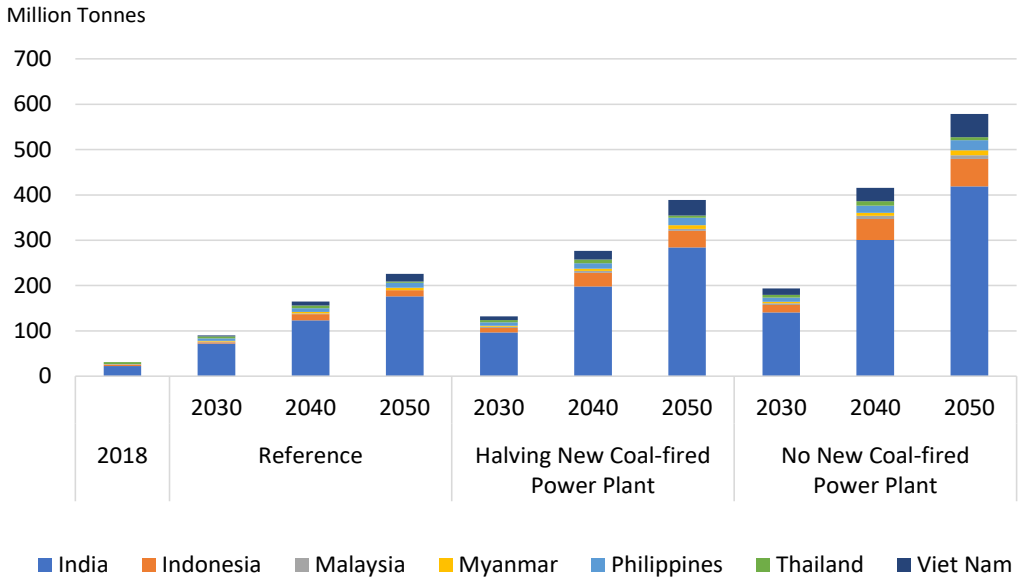
Figure 4.10: Natural Gas Demand Outlook, by Scenario



Source: The Institute of Energy Economics, Japan (2021).

Natural gas production in ASEAN and India is expected to grow only 1% per year towards 2050. Considering the limited potential of pipeline gas imports, imported LNG should meet most gas demand increases. Therefore, additional demand for imported LNG would be huge. The seven countries imported 31 MT of LNG in 2018, 10% of the world total. In the REF, LNG demand in the seven countries will grow by 6% per year, much faster than the natural gas demand, to reach 240 MT in 2050, expanding the market share to 30% of the world total. The growth rate of the natural gas substitution case of NGHNC and NGNNC would be 8%–10% per year, and the demand would reach as much as 389 MT (NGHNC) and 579 MT (NGNNC) in 2050. World LNG demand in the REF, which considers feed gas production availability and liquefaction plant additions, is about 800 MT in 2050. Thus, 389–579 MT demand size of the seven countries in 2050 seems almost unrealistic. Substituting natural gas for coal for power generation in the seven countries would cause severe stress on the LNG supply system, resulting in supply shortages and higher LNG prices.

Figure 4.11: Demand for Imported LNG in the Seven Countries, by Natural Gas Substitution Scenario



Source: The Institute of Energy Economics, Japan (2021).

Chapter 5

Policy Recommendations

Climate change is an important global issue. Therefore, it will undoubtedly be necessary for countries and regions worldwide to make a significant effort to mitigate and resolve it. Criticism against coal-fired power generation has become particularly radical. Coal-fired power generation faces tighter regulations, and coal divestment is increasingly common to restrict coal financing. This study's workshop reveals that coal divestment is already delaying coal power projects in Viet Nam, while Malaysia and Thailand do not have any new coal power projects.

However, this study shows that coal divestment is not a 'silver bullet' for reducing GHG emission and that the negative impacts on the seven EAS countries are by no means small. Without coal in the power mix, CO_2 emissions from the seven EAS countries will slow down. However, even in the NNC, CO_2 emissions in 2050 are higher than in 2018. Therefore, removing coal from the power mix alone cannot decrease CO_2 emissions. It is necessary to adopt other measures, such as energy efficiency, CCUS, and other decarbonisation technologies, to address climate change.

Removing coal from the power mix affects the seven EAS countries' energy security. In the NNC (natural gas substitution), the total net import spending on natural gas and coal in 2050 is about 5.5 times as much as in the REF, and the total net imports account for 2.5% of nominal GDP. Hence, this side effect will squeeze the seven EAS countries' economies. Like natural gas, most LNG imports in the seven EAS countries will skyrocket. The capacity constraints of import infrastructure and liquefaction will make it very difficult for the countries to replace the lost coal-fired power with natural gas–fired power.

On the other hand, in the NNC (renewables substitution), the required investment increases by US$1.7 trillion (2021–2050) from the REF. This would cause an upward pressure on electricity costs and damage the countries' economy. Also, power supply stability may be reduced as it is difficult to control the electricity output from solar PV and wind artificially.

There is no perfect measure for climate change. Whatever actions are taken will negatively impact the sustainable development of the economy and society. However, the negative impacts on the seven EAS countries, particularly those at relatively low economic development levels and those without alternative energy, are by no means small and should not be easily overlooked.

For example, the net imports of natural gas and coal combined in 2050 in the NNC (natural gas substitution) will account for 2.5% of nominal GDP that year. This number is much higher than Japan's record of 1.9% in 2013, after the sudden jump of LNG imports because of the Fukushima nuclear accident and the lost nuclear capacity. This fact helps us imagine how the 2.5% rate in the NNC will burden the seven EAS countries' economies.

Cumulative power generation investments from 2021 to 2030 in the NNC (renewables substitution) increase by approximately US$350 billion over the REF. According to International Monetary Fund data, the cumulative total fiscal measures for the COVID-19 pandemic by the seven EAS countries' governments until 11 September 2020 amounted to $332.6 billion. It is necessary to carefully assess whether this region can additionally spend the amount of such emergency contributions to eliminate coal-fired power generation.

Relatively developed countries like Malaysia and Thailand are on the track of lesser dependency on coal. But India, Indonesia, Myanmar, the Philippines, and Viet Nam still need low-cost electricity like coal-fired power generation to support economic growth. Thus, even if the restriction on financing for the new construction and replacement of CFPPs is introduced, power producers may construct or renew CFPPs with other financing sources. In this case, to minimise construction costs, producers may construct inefficient CFPPs with high CO_2 emissions. As a result, CO_2 emissions might increase more than the REF. Financing efficient USC coal-power plants and clean coal technologies like the integrated coal gasification combined cycle (IGCC) should continue. However, less efficient plants should be excluded from coal financing. While OECD countries have difficulty financing coal power projects, international financial institutions like ADB now have a greater role to continue financing efficient and clean coal power projects.

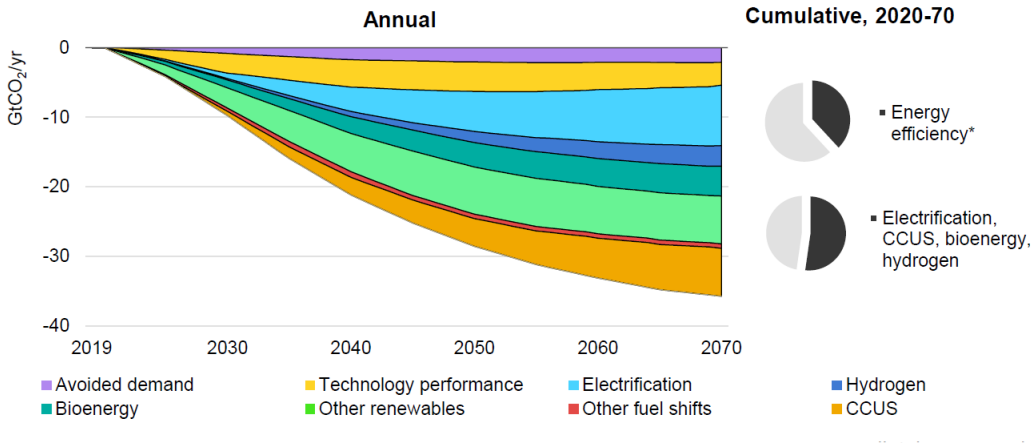
Addressing climate change is just one of the components for achieving sustainable development. The United Nations defines 'sustainable development' as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (UNESCO, 2015). They also point out that 'For sustainable development to be achieved, it is crucial to harmonise three core elements: economic growth, social inclusion, and environmental protection. These elements are interconnected, and all are critical for the well-being of individuals and societies' (UN, 2020).

Putting it in the context of energy policy, when the seven countries, especially India, Indonesia, Myanmar, the Philippines, and Viet Nam, address climate change, they should comprehensively assess the impact of coal divestment and prioritise it vis-à-vis other measures. Energy policy needs to balance various elements in any country. Balancing elements like economic efficiency, energy access, energy security, and environment is no easy task but should be pursued in a sound energy policy. The analysis in Chapter 3 clarifies that removing coal-fired power for the sake of the environmental element of energy will strain other elements (economic efficiency, energy access, and energy security) to a great deal.

Therefore, the sensible decarbonisation pathway for an individual country in this study is worth questioning. IEA analyses a scenario for CO_2 emission reduction measures globally and regards energy efficiency, electrification, CCUS, bioenergy, and hydrogen as major measures (IEA, 2020b). Electrification would involve renewables and/or fossil fuel generation with CCUS, and coal-fired power generation without CCUS would be largely diminished. This scenario envisages the world total, and proportions of each measure

could significantly vary country by country. Nevertheless, coal divestment is not the only way to control CO_2 emissions.

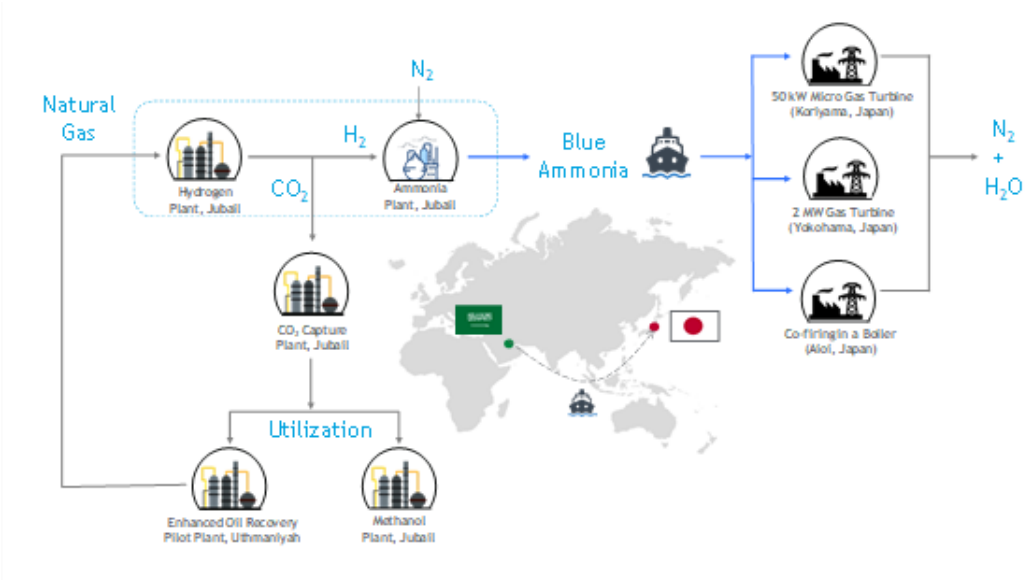
Figure 5.1: Global Energy Sector CO_2 Emission Reductions, by Measure in the SDG Relative to the Stated Policies Scenario, 2019–2070



CCUS = carbon capture, utilisation, and storage; SDG = Sustainable Development Goal.
Source: IEA (2020b).

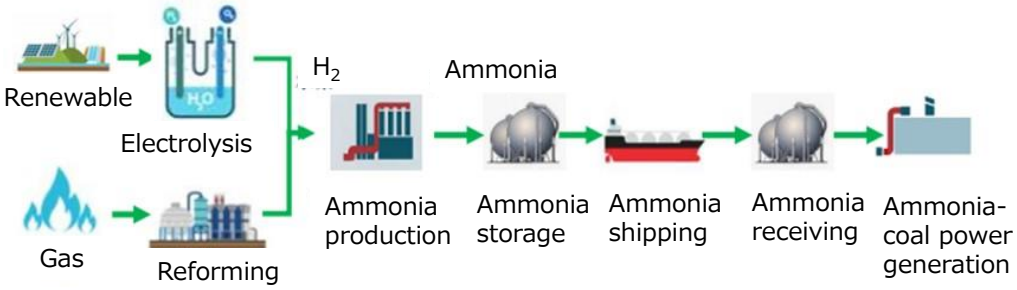
As for CCUS and hydrogen, utilising ammonia for power generation and other carbon-recycling methods has gained attention, especially since 2020. Japan and Saudi Arabia have been working on the so-called 'blue ammonia' produced mainly from natural gas with CO_2 used for material use or enhanced oil recovery. Saudi Aramco made the first test shipment of blue ammonia to Japan in 2020. A consortium of Japanese companies is working on ammonia–coal co-firing power at the existing CFPPs in Japan. The government targets utilising 3 million tonnes of ammonia in 2030 and 30 million tonnes in 2050, mainly for power generation. The government also envisages developing global ammonia supply chain of 100 million tonnes, mainly for power generation and bunker fuel. Japan's effort to develop an ammonia supply chain is certainly in the initial stage. Still, it could provide one of the effective measures to balance lower CO_2 emissions and utilise existing CFPPs in the seven countries in this study.

Figure 5.2: Ammonia Supply Chain Demonstration between Saudi Arabia and Japan



Source: IEEJ (2020).

Figure 5.3: Concept of Ammonia–Coal Blending Power Generation



Source: JERA (2020).

Climate change must be addressed globally, but the principle of common but differentiated responsibilities suggests that all countries are responsible for environmental issues destruction yet not equally responsible. Should this principle hold, OECD countries and now China that share about 80% of the global cumulative CO_2 emissions must take greater responsibility to address climate change. That greater responsibility includes achieving carbon neutrality in their own countries and contributing to developing countries through technical and financial assistance to establish a sound balance of economic efficiency, energy access, energy security, and the environment in their energy policies.

References

Agence France-Presse (2020), 'Countries Pledge "Net-Zero" Emissions by a Certain Year, What's the Big Fuss about it?', 10 December 2020, https://www.firstpost.com/tech/science/what-is-the-big-fuss-about-countries-pledging-to-go-net-zero-by-a-certain-year-9097141.html (accessed January 2021).

Argus (2020), 'Vietnam Prepares to Rein in Coal-Power Growth', 6 August, https://www.argusmedia.com/en/news/2129998-vietnam-prepares-to-rein-in-coalpower-growth (accessed January 2021).

Asian Development Bank (ADB) (2020), 'Independent Evaluation Recommends ADB Formally Withdraw from Financing New Coal-Fired Energy Projects', News release, 31 August, https://www.adb.org/news/independent-evaluation-recommends-adb-formally-withdraw-financing-new-coal-fired-energy (accessed January 2021).

Asian Infrastructure Investment Bank (AIIB) (2020), 'AIIB and Amundi Launch Climate Change Investment Framework to Drive Asia's Green Recovery and Transition', 9 September, https://www.aiib.org/en/news-vents/news/2020/AIIB-and-Amundi-Launch-Climate-Change-Investment-Framework-to-Drive-Asia-Green-Recovery-and-Transition.html (accessed January 2021).

Buckley, T. (2019), 'Over 100 Global Financial Institutions Are Exiting Coal with More to Come', 27 February, Cleveland, OH: Institute for Energy Economics and Financial Analysis, http://ieefa.org/wp-content/uploads/2019/02/IEEFA-Report_100-and-counting_Coal-Exit_Feb-2019.pdf (accessed January 2021).

California Public Employees' Retirement System (CalPERS) (2017), Public Divestiture of Thermal Coal Companies Act: Report to the California Legislature and Governor', 4 July, California: CalPERS, https://www.calpers.ca.gov/docs/forms-publications/public-divestiture-coal-companies-act-2017.pdf (accessed January 2021).

Cedigaz (2020), Natural Gas in the World, Rueil Malmaison: Cedigaz.

Department of Energy (DOE) (2020a), '2019 Power Statistics', www.doe.gov.ph/energy-statistics/2019-power-statistics?ckattempt=1 (accessed January 2021).

Department of Energy (DOE) (2020b), 'Power Sector – Initiated Power Projects as of 31 August 2020', https://www.doe.gov.ph/private-sector-initiated-power-projects?ckattempt=1 (accessed January 2021).

Department of Energy (DOE) (2017), 'Power Development Plan 2017–2040', https://www.doe.gov.ph/sites/default/ files/pdf/electric_power/pdp_2017-2040.pdf (accessed January 2021).

Economic Research Institute for ASEAN and East Asia (ERIA) (2020a), 'Myanmar Energy Outlook 2040', *ERIA Research Project* FY2019 No. 01, Jakarta: ERIA.

Economic Research Institute for ASEAN and East Asia (ERIA) (2020b), 'Energy Supply Security Study for Myanmar', *ERIA Research Project* 2020 No. 11, Jakarta: ERIA.

EKN (2020), 'EKN Submits Report to the Swedish Government: An Export Finance System that Contributes to Climate Transition', Press release, 4 September,

https://www.ekn.se/en/about-ekn/newsroom/archive/2020/press-releases/ekn-submits-report-to-the-swedish-government/#:~:text=The%20Swedish%20Government%20has%20decided,fuels%20will%20cease%20after%202022 (accessed January 2021).

Energy Commission (2020a), 'National Energy Balance 2018', June.

Energy Commission (2020b), Report on Peninsular Malaysia Generation Development Plan 2019 (2020–2030), February.

European Chamber of Commerce Myanmar (EuroCham Myanmar) (2018), *Energy Guide 2019*.

International Energy Agency (IEA) (2020a), *World Energy Investment 2020*. Paris: IEA.

International Energy Agency (2020b), 'Energy Technology Perspectives', September, Paris: IEA, https://www.iea.org/reports /energy-technology-perspectives-2020 (accessed January 2021).

International Energy Agency (IEA) (2019a), 'Global Energy & CO2 Status Report 2019', Paris: IEA, https://www.iea.org/reports/global-energy-co2-status-report-2019/emissions (accessed January 2021).

International Energy Agency (IEA) (2019b), 'Energy security', https://www.iea.org/areas-of-work/ensuring-energy-security (accessed September 2020).

International Monetary Fund (2020), 'Fiscal Monitor: Policies for the Recovery', https://www.imf.org/en/Publications/FM/Issues/2020/09/30/october-2020-fiscal-monitor (accessed November 2020).

JERA (2020), 'Feasibility Study under NEDO Program on Ammonia Co-firing in Thermal Power Generation Facility', https://www.jera.co.jp/system/files/private/%E3%80%90Attachment%E3%80%91Overview%20of%20Feasibility%20Study.pdf (accessed January 2021)

Jiao, C. and C. Murtaugh (2020), 'Philippines' Oldest Conglomerate to Get out of Coal by 2030', *Bloomberg Green,* 20 April, https://www.bloomberg.com/news/articles/2020-04-20/philippines-oldest-conglomerate-to-divest-from-coal-by-2030 (Report on Peninsular Malaysia Generation Development Plan 2019).

Ministry of Economic Affairs (2019), Shared Prosperity Vision 2030 Summary.

Ministry of Energy (2015), Thailand Power Development Plan 2015–2036 (PDP2015), 30 June, Bangkok: Energy Policy and Planning Office, Ministry of Energy, http://www.egat.co.th/en/images/about-egat/PDP2015_Eng.pdf (accessed January 2021).

Ministry of Power (2020), 'Power Sector at a Glance: ALL INDIA', 14 March, https://powermin.nic.in/en/content/power-sector-glance-all-india (accessed January 2021).

National Energy Management Committee (2014), National Energy Policy, National Energy Management Committee, The Republic of the Union of Myanmar.

National Energy Policy Council (2019), Thailand Power Development Plan 2018–2037, Bangkok: National Energy Policy Council.

National Thermal Power Corporation Ltd. (NTPC) (2020), '44th Integrated Annual Report 2019–20', https://www.ntpc.co.in/sites/default/files/downloads/44-final-NTPC-AR-30082020.pdf (accessed January 2021).

Norges Bank (2016), 14 April, 'Exclusion of Coal Companies from the Fund', 14 April, https://www.nbim.no/en/the-fund/news-list/2016/exclusion-of-coal-companies-from-the-fund/ (accessed January 2021).

Organisation for Economic Co-operation and Development (OECD) (2015), 'Sector Understanding on Export Credits for Coal-Fired Electricity Generation Projects', Paris: OECD, https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/PG(2015)9/FINAL&docLanguage=En (accessed January 2021).

Prime's Minister's Office (2020), 'PM Announces the UK will End Support for Fossil Fuel Sector Overseas', Press release, 12 December, https://www.gov.uk/government/news/pm-announces-the-uk-will-end-support-for-fossil-fuel-sector-overseas (accessed January 2021).

Reuters (2020a), 'France to Rein in Export Guarantees for Oil and Gas Industry', 12 October, https://www.reuters.com/article/us-france-economy-export-financing-idUKKBN26X1VI (accessed January 2021).

Reuters (2020b), 'Indonesia Plans to Replace Old Coal Power Plants with Renewable Plans: Minister', 30 January, https://www.reuters.com/article/us-indonesia-power-coal-idUSKBN1ZT17N (accessed January 2021).

Sabah Electricity Sdn Bhd (SESB) (2019), Sabah Electricity Supply Industry Outlook 2019, Putrajaya, Malaysia.

Tenaga Nasional Berhad (TNB) (2020), 'Investor Presentation 3Q FY 2020', https://www.tnb.com.my/assets/conference_materials/Investor_Presentation_-_3QFY20.pdf (accessed January 2021).

The Institute of Energy Economics, Japan (2020), 'World's First Blue Ammonia Shipment Opens New Route to a Sustainable Future', https://eneken.ieej.or.jp/data/9135.pdf (accessed January 2021).

United Nations (2020), 'The Sustainable Development Agenda', https://www.un.org/sustainabledevelopment/development-agenda/ (accessed September 2020).

United Nations (2019), *World Population Prospects 2019*. https://population.un.org/wpp/ (accessed July 2020).

United Nations (UN) (2015), 'Paris Agreement', https://unfccc.int/sites/default/files/english_paris_agreement.pdf (accessed in January 2021).

United Nations (UNESCO) (2015), 'Sustainable Development', https://en.unesco.org/themes/education-sustainable-development/what-is-esd/sd (accessed in September 2020).

United Nations Framework Convention on Climate Change (2021), 'INDCs as Communicated by Parties',

https://www4.unfccc.int/sites/submissions/INDC/Submission%20Pages/submissions.aspx (accessed January 2021).

Vietnam Electricity (EVN) (2019), *Annual Report 2018.* : EVN.

World Bank (2017), 'World Bank Group Announcements at One Planet Summit', 12 December, https://www.worldbank.org/en/news/press-release/2017/12/12/world-bank-group-announcements-at-one-planet-summit (accessed in January 2021).

World Bank (2013), 'World Bank Group Sets Directions for Energy Sector Investments', Feature story, 16 July, https://www.worldbank.org/en/news/feature/2013/07/16/world-bank-group-direction-for-energy-sector (accessed January 2021).

Appendix

Outlook Tables

Table A.1: Energy Supply and Demand of Total of the Seven EAS Countries (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,205.70**	**1,547.16**	**2,443.74**	**3,129.11**	**3,750.87**	**100**	**100**	**100**	**100**	**100**	**3.2**	**3.9**	**2.5**	**1.8**	**2.8**
Coal	364.52	563.45	857.98	1,159.17	1,305.03	30.2	36.4	35.1	37.0	34.8	5.6	3.6	3.1	1.2	2.7
Oil	332.98	446.25	687.71	914.14	1,193.04	27.6	28.8	28.1	29.2	31.8	3.7	3.7	2.9	2.7	3.1
Natural gas	169.84	181.33	398.15	486.81	608.12	14.1	11.7	16.3	15.6	16.2	0.8	6.8	2.0	2.3	3.9
Nuclear	6.84	9.85	43.04	63.36	86.68	0.6	0.6	1.8	2.0	2.3	4.7	13.1	3.9	3.2	7.0
Hydro	16.75	27.02	39.46	48.58	57.04	1.4	1.7	1.6	1.6	1.5	6.2	3.2	2.1	1.6	2.4
Geothermal	24.63	33.08	75.12	95.75	117.47	2.0	2.1	3.1	3.1	3.1	3.8	7.1	2.5	2.1	4.0
Others	290.13	286.17	342.29	361.30	383.50	24.1	18.5	14.0	11.5	10.2	-0.2	1.5	0.5	0.6	0.9
Biomass	286.77	273.60	299.97	291.45	271.66	23.8	17.7	12.3	9.3	7.2	-0.6	0.8	-0.3	-0.7	0.0
Solar, Wind, Ocean	2.01	10.81	39.52	66.57	108.07	0.2	0.7	1.6	2.1	2.9	23.4	11.4	5.4	5.0	7.5
Biofuels	1.07	6.57	8.61	12.71	17.71	0.1	0.4	0.4	0.4	0.5	25.5	2.3	4.0	3.4	3.1
Electricity	1.35	1.76	2.76	3.26	3.76	0.1	0.1	0.1	0.1	0.1	3.4	3.8	1.7	1.4	2.4

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**836.15**	**1,039.59**	**1,607.81**	**2,049.56**	**2,500.67**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Industry	267.22	349.93	610.25	771.63	876.63	32.0	33.7	38.0	37.6	35.1	3.4	4.7	2.4	1.3	2.9
Transportation	148.97	233.11	356.25	506.62	729.69	17.8	22.4	22.2	24.7	29.2	5.8	3.6	3.6	3.7	3.6
Others	351.38	356.20	472.92	554.70	629.77	42.0	34.3	29.4	27.1	25.2	0.2	2.4	1.6	1.3	1.8
Non-energy	68.59	100.34	168.39	216.61	264.59	8.2	9.7	10.5	10.6	10.6	4.9	4.4	2.5	2.0	3.1
Total	**836.15**	**1,039.59**	**1,607.81**	**2,049.56**	**2,500.67**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Coal	127.35	146.91	243.32	301.56	338.83	15.2	14.1	15.1	14.7	13.5	1.8	4.3	2.2	1.2	2.6
Oil	290.24	412.11	638.90	851.36	1,115.58	34.7	39.6	39.7	41.5	44.6	4.5	3.7	2.9	2.7	3.2
Natural gas	46.51	76.77	163.32	220.52	268.07	5.6	7.4	10.2	10.8	10.7	6.5	6.5	3.0	2.0	4.0
Electricity	109.74	179.62	339.01	478.03	616.86	13.1	17.3	21.1	23.3	24.7	6.4	5.4	3.5	2.6	3.9
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	262.32	224.17	223.26	198.09	161.33	31.4	21.6	13.9	9.7	6.5	-1.9	0.0	-1.2	-2.0	-1.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,599.05**	**2,584.44**	**4,801.86**	**6,604.48**	**8,308.14**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.3**	**3.2**	**2.3**	**3.7**
Coal	842.95	1,604.77	2,459.22	3,571.51	4,122.07	52.7	62.1	51.2	54.1	49.6	8.4	3.6	3.8	1.4	3.0
Oil	67.21	27.46	37.49	39.98	32.59	4.2	1.1	0.8	0.6	0.4	-10.6	2.6	0.6	-2.0	0.5
Natural gas	409.08	384.43	1,070.39	1,220.20	1,668.57	25.6	14.9	22.3	18.5	20.1	-0.8	8.9	1.3	3.2	4.7
Nuclear	26.27	37.81	165.17	243.19	332.66	1.6	1.5	3.4	3.7	4.0	4.7	13.1	3.9	3.2	7.0
Hydro	194.85	314.29	458.88	564.95	663.34	12.2	12.2	9.6	8.6	8.0	6.2	3.2	2.1	1.6	2.4
Geothermal	19.29	24.46	53.68	66.97	80.74	1.2	0.9	1.1	1.0	1.0	3.0	6.8	2.2	1.9	3.8
Others	39.41	191.22	557.02	897.69	1,408.17	2.5	7.4	11.6	13.6	16.9	21.8	9.3	4.9	4.6	6.4

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**330.28**	**481.35**	**776.56**	**1,016.30**	**1,161.39**	**100**	**100**	**100**	**100**	**100**	**4.8**	**4.1**	**2.7**	**1.3**	**2.8**
Coal	225.75	392.87	570.65	792.03	875.89	68.4	81.6	73.5	77.9	75.4	7.2	3.2	3.3	1.0	2.5
Oil	19.37	12.18	11.23	11.35	8.73	5.9	2.5	1.4	1.1	0.8	-5.6	-0.7	0.1	-2.6	-1.0
Natural gas	85.15	76.30	194.68	212.92	276.77	25.8	15.9	25.1	21.0	23.8	-1.4	8.1	0.9	2.7	4.1

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.3**	**36.0**	**39.5**	**40.9**	**43.1**		**0.6**	**0.8**	**0.3**	**0.5**	**0.6**
Coal	32.1	35.1	37.1	38.8	40.5		1.1	0.4	0.5	0.4	0.4
Oil	29.8	19.4	28.7	30.3	32.1		-5.2	3.3	0.5	0.6	1.6
Natural gas	41.3	43.3	47.3	49.3	51.8		0.6	0.7	0.4	0.5	0.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**2,596.9**	**3,714.3**	**5,934.9**	**7,888.8**	**9,468.7**	**100**	**100**	**100**	**100**	**100**	**4.6**	**4.0**	**2.9**	**1.8**	**3.0**
Coal	1,440.6	2,225.9	3,392.3	4,583.5	5,162.1	55.5	59.9	57.2	58.1	54.5	5.6	3.6	3.1	1.2	2.7
Oil	834.9	1,145.9	1,782.3	2,391.1	3,160.6	32.2	30.8	30.0	30.3	33.4	4.0	3.7	3.0	2.8	3.2
Natural Gas	320.8	340.7	758.6	912.5	1,144.3	12.4	9.2	12.8	11.6	12.1	0.8	6.9	1.9	2.3	3.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	3,378	5,383	10,662	17,171	25,805	6.0	5.9	4.9	4.2	5.0
Population (millions of people)	1,804.1	1,977.1	2,195.8	2,324.0	2,393.3	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.87	2.72	4.86	7.39	10.78	4.8	4.9	4.3	3.9	4.4
Primary energy consumption per capita (toe/person)	0.67	0.78	1.11	1.35	1.57	2.0	3.0	1.9	1.5	2.2
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	357	287	229	182	145	-2.7	-1.9	-2.3	-2.2	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	248	193	151	119	97	-3.1	-2.0	-2.3	-2.1	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	769	690	557	459	367	-1.3	-1.8	-1.9	-2.2	-2.0
CO_2 emissions per unit of primary energy consumption (t/toe)	2.15	2.40	2.43	2.52	2.52	1.4	0.1	0.4	0.0	0.2

Table A.2: Energy Supply and Demand of India (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**700.76**	**919.44**	**1,525.04**	**1,991.93**	**2,410.38**	**100**	**100**	**100**	**100**	**100**	**3.5**	**4.3**	**2.7**	**1.9**	**3.1**
Coal	279.03	414.21	637.23	877.20	983.39	39.8	45.1	41.8	44.0	40.8	5.1	3.7	3.2	1.1	2.7
Oil	162.07	235.25	400.41	567.02	787.01	23.1	25.6	26.3	28.5	32.7	4.8	4.5	3.5	3.3	3.8
Natural gas	54.40	52.41	179.88	214.85	282.18	7.8	5.7	11.8	10.8	11.7	-0.5	10.8	1.8	2.8	5.4
Nuclear	6.84	9.85	43.04	53.66	68.24	1.0	1.1	2.8	2.7	2.8	4.7	13.1	2.2	2.4	6.2
Hydro	10.74	13.00	21.00	27.69	34.51	1.5	1.4	1.4	1.4	1.4	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	187.67	194.72	243.49	251.50	255.04	26.8	21.2	16.0	12.6	10.6	0.5	1.9	0.3	0.1	0.8
Biomass	185.20	185.10	209.49	197.03	174.63	26.4	20.1	13.7	9.9	7.2	0.0	1.0	-0.6	-1.2	-0.2
Solar, Wind, Ocean	1.99	9.95	34.30	54.77	80.71	0.3	1.1	2.2	2.7	3.3	22.3	10.9	4.8	4.0	6.8
Biofuels	0.05	0.88	1.38	2.69	4.31	0.0	0.1	0.1	0.1	0.2	41.8	3.8	6.9	4.8	5.1
Electricity	0.48	-0.33	-0.33	-0.33	-0.33	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**478.45**	**606.58**	**998.56**	**1,300.54**	**1,614.51**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Industry	151.62	206.09	390.51	499.42	559.01	31.7	34.0	39.1	38.4	34.6	3.9	5.5	2.5	1.1	3.2
Transportation	64.80	103.77	183.02	291.47	468.22	13.5	17.1	18.3	22.4	29.0	6.1	4.8	4.8	4.9	4.8
Others	227.92	245.92	336.40	389.69	436.38	47.6	40.5	33.7	30.0	27.0	1.0	2.6	1.5	1.1	1.8
Non-energy	34.12	50.81	88.63	119.95	150.90	7.1	8.4	8.9	9.2	9.3	5.1	4.7	3.1	2.3	3.5
Total	**478.45**	**606.58**	**998.56**	**1,300.54**	**1,614.51**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Coal	87.19	106.61	186.34	233.64	262.84	18.2	17.6	18.7	18.0	16.3	2.5	4.8	2.3	1.2	2.9
Oil	138.11	207.70	363.22	518.54	724.75	28.9	34.2	36.4	39.9	44.9	5.2	4.8	3.6	3.4	4.0
Natural gas	18.64	32.42	79.09	114.90	144.18	3.9	5.3	7.9	8.8	8.9	7.2	7.7	3.8	2.3	4.8
Electricity	61.94	103.29	208.98	296.69	380.19	12.9	17.0	20.9	22.8	23.5	6.6	6.0	3.6	2.5	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	172.56	156.56	160.93	136.77	102.54	36.1	25.8	16.1	10.5	6.4	-1.2	0.2	-1.6	-2.8	-1.3

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**974.80**	**1,583.22**	**3,114.06**	**4,258.18**	**5,255.29**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.8**	**3.2**	**2.1**	**3.8**
Coal	657.96	1,163.40	1,738.58	2,576.12	2,905.75	67.5	73.5	55.8	60.5	55.3	7.4	3.4	4.0	1.2	2.9
Oil	17.67	7.85	10.08	8.94	5.10	1.8	0.5	0.3	0.2	0.1	-9.6	2.1	-1.2	-5.4	-1.3
Natural gas	113.29	73.62	503.60	442.86	664.51	11.6	4.6	16.2	10.4	12.6	-5.2	17.4	-1.3	4.1	7.1
Nuclear	26.27	37.81	165.17	205.94	261.88	2.7	2.4	5.3	4.8	5.0	4.7	13.1	2.2	2.4	6.2
Hydro	124.92	151.13	244.24	322.04	401.40	12.8	9.5	7.8	7.6	7.6	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	34.70	149.40	452.39	702.28	1,016.65	3.6	9.4	14.5	16.5	19.3	20.0	9.7	4.5	3.8	6.2

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**209.39**	**304.61**	**502.93**	**660.48**	**744.10**	**100**	**100**	**100**	**100**	**100**	**4.8**	**4.3**	**2.8**	**1.2**	**2.8**
Coal	177.27	284.97	407.96	579.09	631.39	84.7	93.6	81.1	87.7	84.9	6.1	3.0	3.6	0.9	2.5
Oil	7.25	4.18	4.74	4.16	2.39	3.5	1.4	0.9	0.6	0.3	-6.7	1.1	-1.3	-5.4	-1.7
Natural gas	24.87	15.46	90.23	77.23	110.33	11.9	5.1	17.9	11.7	14.8	-5.8	15.8	-1.5	3.6	6.3

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**32.4**	**35.1**	**38.5**	**39.4**	**41.3**						**1.0**	**0.8**	**0.2**	**0.5**	**0.5**
Coal	31.9	35.1	36.6	38.3	39.6						1.2	0.4	0.4	0.3	0.4
Oil	21.0	16.2	18.3	18.5	18.4						-3.2	1.0	0.1	0.0	0.4
Natural gas	39.2	40.9	48.0	49.3	51.8						0.6	1.3	0.3	0.5	0.7

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,585.0**	**2,324.2**	**3,903.3**	**5,354.0**	**6,519.0**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.4**	**3.2**	**2.0**	**3.3**
Coal	1,083.7	1,628.4	2,505.9	3,450.0	3,867.8	68.4	70.1	64.2	64.4	59.3	5.2	3.7	3.2	1.1	2.7
Oil	425.9	611.1	1,054.9	1,511.0	2,131.1	26.9	26.3	27.0	28.2	32.7	4.6	4.7	3.7	3.5	4.0
Natural Gas	74.7	83.5	341.3	391.8	518.9	4.7	3.6	8.7	7.3	8.0	1.4	12.5	1.4	2.8	5.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	1,670	2,831	6,146	10,304	15,988	6.8	6.7	5.3	4.5	5.6
Population (millions of people)	1,234.3	1,352.6	1,503.6	1,592.7	1,639.2	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.35	2.09	4.09	6.47	9.75	5.6	5.7	4.7	4.2	4.9
Primary energy consumption per capita (toe/person)	0.57	0.68	1.01	1.25	1.47	2.3	3.4	2.1	1.6	2.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	420	325	248	193	151	-3.2	-2.2	-2.5	-2.5	-2.4
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	287	214	162	126	101	-3.6	-2.3	-2.5	-2.2	-2.3
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	949	821	635	520	408	-1.8	-2.1	-2.0	-2.4	-2.2
CO_2 emissions per unit of primary energy consumption (t/toe)	2.26	2.53	2.56	2.69	2.70	1.4	0.1	0.5	0.1	0.2

Table A.3: Energy Supply and Demand of Indonesia (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**201.69**	**231.14**	**345.04**	**446.13**	**539.34**	**100**	**100**	**100**	**100**	**100**	**1.7**	**3.4**	**2.6**	**1.9**	**2.7**
Coal	31.84	55.23	88.08	120.18	136.73	15.8	23.9	25.5	26.9	25.4	7.1	4.0	3.2	1.3	2.9
Oil	67.39	77.31	104.50	128.68	150.56	33.4	33.4	30.3	28.8	27.9	1.7	2.5	2.1	1.6	2.1
Natural gas	38.82	38.93	71.51	97.41	125.41	19.2	16.8	20.7	21.8	23.3	0.0	5.2	3.1	2.6	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	1.50	1.86	2.19	2.65	3.11	0.7	0.8	0.6	0.6	0.6	2.7	1.4	1.9	1.6	1.6
Geothermal	16.09	24.11	57.94	76.35	96.10	8.0	10.4	16.8	17.1	17.8	5.2	7.6	2.8	2.3	4.4
Others	46.04	33.69	20.81	20.85	27.43	22.8	14.6	6.0	4.7	5.1	-3.8	-3.9	0.0	2.8	-0.6
Biomass	46.04	33.54	20.38	18.13	16.63	22.8	14.5	5.9	4.1	3.1	-3.9	-4.1	-1.2	-0.9	-2.2
Solar, WIDN, Ocean	0.00	0.02	0.30	2.59	10.68	0.0	0.0	0.1	0.6	2.0	65.4	23.3	24.1	15.2	21.0
Biofuels	0.17	2.83	3.12	4.02	4.98	0.1	1.2	0.9	0.9	0.9	41.7	0.8	2.5	2.2	1.8
Electricity	0.00	0.13	0.13	0.13	0.13	0.0	0.1	0.0	0.0	0.0	129.0	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**145.98**	**156.06**	**213.89**	**270.12**	**324.78**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Industry	49.08	50.16	74.46	93.43	109.32	33.6	32.1	34.8	34.6	33.7	0.3	3.3	2.3	1.6	2.5
Transportation	30.14	54.38	75.78	96.46	118.64	20.6	34.8	35.4	35.7	36.5	7.7	2.8	2.4	2.1	2.5
Others	56.55	43.03	48.41	60.66	72.96	38.7	27.6	22.6	22.5	22.5	-3.4	1.0	2.3	1.9	1.7
Non-energy	10.20	8.49	15.24	19.57	23.86	7.0	5.4	7.1	7.2	7.3	-2.3	5.0	2.5	2.0	3.3
Total	**145.98**	**156.06**	**213.89**	**270.12**	**324.78**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Coal	17.18	14.72	21.71	27.32	31.78	11.8	9.4	10.2	10.1	9.8	-1.9	3.3	2.3	1.5	2.4
Oil	55.01	75.67	101.93	124.04	145.30	37.7	48.5	47.7	45.9	44.7	4.1	2.5	2.0	1.6	2.1
Natural gas	15.86	16.68	32.78	43.38	52.45	10.9	10.7	15.3	16.1	16.2	0.6	5.8	2.8	1.9	3.6
Electricity	12.67	22.02	39.42	59.93	81.67	8.7	14.1	18.4	22.2	25.1	7.2	5.0	4.3	3.1	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	45.26	26.97	18.05	15.44	13.58	31.0	17.3	8.4	5.7	4.2	-6.3	-3.3	-1.6	-1.3	-2.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**169.76**	**283.77**	**511.24**	**778.01**	**1,058.88**	**100**	**100**	**100**	**100**	**100**	**6.6**	**5.0**	**4.3**	**3.1**	**4.2**
Coal	68.45	160.02	275.82	405.43	478.95	40.3	56.4	54.0	52.1	45.2	11.2	4.6	3.9	1.7	3.5
Oil	34.15	14.88	22.92	27.71	26.34	20.1	5.2	4.5	3.6	2.5	-9.9	3.7	1.9	-0.5	1.8
Natural gas	40.25	59.42	146.43	234.87	331.49	23.7	20.9	28.6	30.2	31.3	5.0	7.8	4.8	3.5	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	17.46	21.64	25.46	30.84	36.22	10.3	7.6	5.0	4.0	3.4	2.7	1.4	1.9	1.6	1.6
Geothermal	9.36	14.02	33.70	44.41	55.89	5.5	4.9	6.6	5.7	5.3	5.2	7.6	2.8	2.3	4.4
Others	0.10	13.79	6.91	34.74	129.98	0.1	4.9	1.4	4.5	12.3	85.1	-5.6	17.5	14.1	7.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**35.21**	**60.59**	**100.32**	**141.82**	**168.02**	**100**	**100**	**100**	**100**	**100**	**7.0**	**4.3**	**3.5**	**1.7**	**3.2**
Coal	18.08	40.51	66.35	92.84	104.93	51.4	66.9	66.1	65.5	62.5	10.6	4.2	3.4	1.2	3.0
Oil	8.47	6.75	5.48	6.43	6.08	24.1	11.1	5.5	4.5	3.6	-2.8	-1.7	1.6	-0.6	-0.3
Natural gas	8.65	13.32	28.48	42.54	57.00	24.6	22.0	28.4	30.0	33.9	5.5	6.5	4.1	3.0	4.6

Thermal Efficiency

	%					AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.9**	**33.3**	**38.2**	**40.5**	**42.8**	**-0.6**	**1.2**	**0.6**	**0.6**	**0.8**
Coal	32.5	34.0	35.7	37.5	39.2	0.5	0.4	0.5	0.4	0.5
Oil	34.6	18.9	36.0	37.0	37.2	-7.3	5.5	0.3	0.1	2.1
Natural gas	40.0	38.4	44.2	47.5	50.0	-0.5	1.2	0.7	0.5	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**396.0**	**539.5**	**809.8**	**1,058.5**	**1,243.2**	**100**	**100**	**100**	**100**	**100**	**3.9**	**3.4**	**2.7**	**1.6**	**2.6**
Coal	141.8	222.0	354.1	483.1	549.6	35.8	41.2	43.7	45.6	44.2	5.8	4.0	3.2	1.3	2.9
Oil	174.7	234.6	309.5	376.4	437.3	44.1	43.5	38.2	35.6	35.2	3.8	2.3	2.0	1.5	2.0
Natural Gas	79.5	82.3	145.7	198.5	255.8	20.1	15.3	18.0	18.8	20.6	0.4	4.9	3.1	2.6	3.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	755	1,147	2,089	3,278	4,753	5.4	5.1	4.6	3.8	4.5
Population (millions of people)	241.8	267.7	299.4	318.9	331.4	1.3	0.9	0.6	0.4	0.7
GDP per capita (thousands of 2010 USD/person)	3.12	4.28	6.98	10.28	14.34	4.0	4.1	3.9	3.4	3.8
Primary energy consumption per capita (toe/person)	0.83	0.86	1.15	1.40	1.63	0.4	2.4	2.0	1.5	2.0
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	267	202	165	136	113	-3.5	-1.6	-1.9	-1.8	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	193	136	102	82	68	-4.3	-2.3	-2.1	-1.9	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	524	470	388	323	262	-1.4	-1.6	-1.8	-2.1	-1.8
CO_2 emissions per unit of primary energy consumption (t/toe)	1.96	2.33	2.35	2.37	2.30	2.2	0.0	0.1	-0.3	0.0

Table A.4: Energy Supply and Demand of Malaysia (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**72.49**	**93.43**	**130.77**	**148.03**	**156.93**	**100**	**100**	**100**	**100**	**100**	**3.2**	**2.8**	**1.2**	**0.6**	**1.6**
Coal	14.60	22.61	26.57	29.37	27.51	20.1	24.2	20.3	19.8	17.5	5.6	1.4	1.0	-0.7	0.6
Oil	25.33	28.98	35.10	35.28	34.28	34.9	31.0	26.8	23.8	21.8	1.7	1.6	0.1	-0.3	0.5
Natural gas	31.20	38.78	64.39	74.16	83.05	43.0	41.5	49.2	50.1	52.9	2.8	4.3	1.4	1.1	2.4
Nuclear	0.00	0.00	0.00	3.66	3.65	0.0	0.0	0.0	2.5	2.3	-	-	-	0.0	-
Hydro	0.56	2.26	3.00	3.32	3.43	0.8	2.4	2.3	2.2	2.2	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.80	0.79	1.71	2.24	5.00	1.1	0.9	1.3	1.5	3.2	-0.1	6.6	2.8	8.3	5.9
Biomass	0.82	0.87	1.65	2.00	2.30	1.1	0.9	1.3	1.4	1.5	0.8	5.5	1.9	1.4	3.1
Solar, WMYS, Ocean	0.00	0.05	0.19	0.37	2.83	0.0	0.1	0.1	0.3	1.8	-	11.7	7.2	22.5	13.5
Biofuels	0.00	0.44	0.39	0.38	0.36	0.0	0.5	0.3	0.3	0.2	77.7	-1.0	-0.2	-0.4	-0.6
Electricity	-0.01	-0.13	-0.13	-0.13	-0.13	0.0	-0.1	-0.1	-0.1	-0.1	33.1	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**41.74**	**62.53**	**87.90**	**99.29**	**108.02**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Industry	14.92	19.51	25.38	29.15	31.74	35.8	31.2	28.9	29.4	29.4	3.4	2.2	1.4	0.9	1.5
Transportation	14.93	20.96	22.15	21.83	20.75	35.8	33.5	25.2	22.0	19.2	4.3	0.5	-0.1	-0.5	0.0
Others	8.19	8.80	12.25	14.58	16.53	19.6	14.1	13.9	14.7	15.3	0.9	2.8	1.8	1.3	2.0
Non-energy	3.70	13.26	28.12	33.74	39.00	8.9	21.2	32.0	34.0	36.1	17.3	6.5	1.8	1.5	3.4
Total	**41.74**	**62.53**	**87.90**	**99.29**	**108.02**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Coal	1.83	1.81	1.99	2.07	2.08	4.4	2.9	2.3	2.1	1.9	-0.1	0.8	0.4	0.0	0.4
Oil	23.96	28.28	32.13	32.37	31.49	57.4	45.2	36.6	32.6	29.2	2.1	1.1	0.1	-0.3	0.3
Natural gas	6.25	18.85	34.22	40.49	45.63	15.0	30.1	38.9	40.8	42.2	14.8	5.1	1.7	1.2	2.8
Electricity	9.53	13.15	19.01	23.74	28.12	22.8	21.0	21.6	23.9	26.0	4.1	3.1	2.2	1.7	2.4
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.17	0.44	0.55	0.63	0.70	0.4	0.7	0.6	0.6	0.6	12.3	2.0	1.2	1.1	1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.79**	**170.47**	**246.26**	**307.45**	**363.91**	**100**	**100**	**100**	**100**	**100**	**4.0**	**3.1**	**2.2**	**1.7**	**2.4**
Coal	42.84	77.29	95.80	112.13	112.46	34.3	45.3	38.9	36.5	30.9	7.7	1.8	1.6	0.0	1.2
Oil	3.67	1.05	0.83	0.30	0.00	2.9	0.6	0.3	0.1	0.0	-14.5	-2.0	-9.6	-100.0	-100.0
Natural gas	70.80	63.89	109.18	133.58	158.94	56.7	37.5	44.3	43.4	43.7	-1.3	4.6	2.0	1.8	2.9
Nuclear	0.00	0.00	0.00	14.05	14.02	0.0	0.0	0.0	4.6	3.9	-	-	-	0.0	-
Hydro	6.47	26.32	34.92	38.57	39.94	5.2	15.4	14.2	12.5	11.0	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	1.01	1.93	5.54	8.82	38.56	0.8	1.1	2.2	2.9	10.6	8.4	9.2	4.8	15.9	9.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.72**	**33.67**	**45.17**	**50.98**	**52.30**	**100**	**100**	**100**	**100**	**100**	**0.7**	**2.5**	**1.2**	**0.3**	**1.4**
Coal	12.95	20.47	24.25	26.97	25.10	40.8	60.8	53.7	52.9	48.0	5.9	1.4	1.1	-0.7	0.6
Oil	0.74	0.38	0.21	0.08	0.00	2.3	1.1	0.5	0.2	0.0	-8.0	-4.7	-9.7	-100.0	-100.0
Natural gas	18.03	12.82	20.70	23.93	27.20	56.8	38.1	45.8	47.0	52.0	-4.2	4.1	1.5	1.3	2.4

Thermal Efficiency

	%					AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.8**	**36.3**	**39.2**	**41.5**	**44.6**	**1.7**	**0.6**	**0.6**	**0.7**	**0.6**
Coal	28.4	32.5	34.0	35.8	38.5	1.7	0.4	0.5	0.7	0.5
Oil	42.6	23.7	33.2	33.5	-	-7.1	2.9	0.1	-	-
Natural gas	33.8	42.9	45.3	48.0	50.3	3.0	0.5	0.6	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**187.0**	**221.5**	**276.4**	**296.9**	**294.8**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.9**	**0.7**	**-0.1**	**0.9**
Coal	58.5	88.2	103.9	115.0	107.6	31.3	39.8	37.6	38.7	36.5	5.3	1.4	1.0	-0.7	0.6
Oil	65.8	73.1	83.8	82.3	77.7	35.2	33.0	30.3	27.7	26.4	1.3	1.1	-0.2	-0.6	0.2
Natural Gas	62.6	60.1	88.6	99.6	109.4	33.5	27.1	32.1	33.5	37.1	-0.5	3.3	1.2	0.9	1.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	255	382	640	912	1,229	5.2	4.4	3.6	3.0	3.7
Population (millions of people)	28.2	31.5	36.1	38.8	40.6	1.4	1.1	0.7	0.5	0.8
GDP per capita (thousands of 2010 USD/person)	9.04	12.12	17.73	23.53	30.30	3.7	3.2	2.9	2.6	2.9
Primary energy consumption per capita (toe/person)	2.57	2.96	3.62	3.82	3.87	1.8	1.7	0.5	0.1	0.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	284	245	204	162	128	-1.9	-1.5	-2.3	-2.4	-2.0
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	164	164	137	109	88	0.0	-1.4	-2.3	-2.1	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	733	580	432	326	240	-2.9	-2.4	-2.8	-3.0	-2.7
CO_2 emissions per unit of primary energy consumption (t/toe)	2.58	2.37	2.11	2.01	1.88	-1.0	-1.0	-0.5	-0.7	-0.7

Table A.5: Energy Supply and Demand of Myanmar (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.90**	**23.83**	**38.44**	**50.24**	**61.38**	**100**	**100**	**100**	**100**	**100**	**7.0**	**4.1**	**2.7**	**2.0**	**3.0**
Coal	0.41	0.88	3.03	5.26	8.11	2.9	3.7	7.9	10.5	13.2	10.0	10.9	5.7	4.4	7.2
Oil	1.28	6.86	13.07	18.83	24.18	9.2	28.8	34.0	37.5	39.4	23.3	5.5	3.7	2.5	4.0
Natural gas	1.28	4.12	12.02	17.50	22.98	9.2	17.3	31.3	34.8	37.4	15.7	9.3	3.8	2.8	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.44	1.21	1.49	1.79	2.02	3.2	5.1	3.9	3.6	3.3	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.48	10.76	8.83	6.87	4.09	75.4	45.1	23.0	13.7	6.7	0.3	-1.6	-2.5	-5.0	-3.0
Biomass	10.48	10.96	10.46	9.13	6.83	75.4	46.0	27.2	18.2	11.1	0.6	-0.4	-1.3	-2.9	-1.5
Solar, WMYA, Ocean	0.00	0.00	0.07	0.19	0.46	0.0	0.0	0.2	0.4	0.8	-	44.3	10.2	9.3	21.6
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Electricity	0.00	-0.20	-1.70	-2.45	-3.20	0.0	-0.9	-4.4	-4.9	-5.2	-	19.4	3.7	2.7	9.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**12.85**	**20.16**	**28.51**	**35.83**	**42.46**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.4**
Industry	1.28	3.69	6.85	10.46	13.49	9.9	18.3	24.0	29.2	31.8	14.2	5.3	4.3	2.6	4.1
Transportation	0.81	2.10	4.04	6.37	9.09	6.3	10.4	14.2	17.8	21.4	12.6	5.6	4.7	3.6	4.7
Others	10.64	13.89	16.94	18.09	18.77	82.8	68.9	59.4	50.5	44.2	3.4	1.7	0.7	0.4	0.9
Non-energy	0.12	0.48	0.70	0.91	1.11	0.9	2.4	2.4	2.5	2.6	19.2	3.2	2.7	2.1	2.7
Total	**12.85**	**20.16**	**28.51**	**35.83**	**42.46**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.4**
Coal	0.23	0.26	0.39	0.50	0.57	1.8	1.3	1.4	1.4	1.3	1.4	3.3	2.4	1.4	2.5
Oil	1.04	6.81	12.92	18.68	24.08	8.1	33.8	45.3	52.1	56.7	26.5	5.5	3.8	2.6	4.0
Natural gas	0.60	0.57	0.77	1.01	1.23	4.6	2.8	2.7	2.8	2.9	-0.5	2.5	2.7	2.0	2.4
Electricity	0.54	1.59	4.02	6.56	9.79	4.2	7.9	14.1	18.3	23.1	14.5	8.0	5.0	4.1	5.8
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.44	10.91	10.42	9.09	6.79	81.3	54.1	36.5	25.4	16.0	0.6	-0.4	-1.4	-2.9	-1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**7.54**	**24.55**	**77.65**	**121.23**	**172.88**	**100**	**100**	**100**	**100**	**100**	**15.9**	**10.1**	**4.6**	**3.6**	**6.3**
Coal	0.67	1.54	11.16	21.68	36.53	8.9	6.3	14.4	17.9	21.1	11.0	17.9	6.9	5.4	10.4
Oil	0.03	0.08	0.27	0.21	0.00	0.4	0.3	0.3	0.2	0.0	11.2	11.0	-2.3	-100.0	-100.0
Natural gas	1.73	8.80	48.04	76.37	107.52	23.0	35.8	61.9	63.0	62.2	22.5	15.2	4.7	3.5	8.1
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	5.11	14.13	17.34	20.76	23.48	67.7	57.5	22.3	17.1	13.6	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.00	0.01	0.83	2.21	5.36	0.0	0.0	1.1	1.8	3.1	-	44.2	10.2	9.3	21.6

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**0.73**	**3.35**	**13.08**	**20.43**	**28.40**	**100**	**100**	**100**	**100**	**100**	**21.1**	**12.0**	**4.6**	**3.3**	**6.9**
Coal	0.18	0.47	2.49	4.62	7.39	24.6	14.0	19.0	22.6	26.0	12.8	15.0	6.4	4.8	9.0
Oil	0.01	0.02	0.07	0.06	0.00	1.1	0.6	0.6	0.3	0.0	12.3	10.9	-2.4	-100.0	-100.0
Natural gas	0.54	2.86	10.52	15.76	21.01	74.2	85.4	80.4	77.1	74.0	23.2	11.5	4.1	2.9	6.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**28.9**	**26.8**	**39.1**	**41.3**	**43.6**		**-1.0**	**3.2**	**0.6**	**0.5**	**1.5**
Coal	32.3	28.4	38.6	40.4	42.5		-1.6	2.6	0.5	0.5	1.3
Oil	34.3	31.6	32.1	32.2	-		-1.0	0.1	0.0	-	-
Natural gas	27.7	26.5	39.3	41.7	44.0		-0.6	3.3	0.6	0.5	1.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**8.0**	**31.4**	**76.7**	**115.3**	**155.2**	**100**	**100**	**100**	**100**	**100**	**18.6**	**7.7**	**4.2**	**3.0**	**5.1**
Coal	1.7	2.9	11.5	20.5	31.9	20.6	9.3	15.0	17.8	20.5	7.4	12.1	5.9	4.5	7.8
Oil	3.4	19.8	37.9	54.8	70.4	42.7	62.9	49.5	47.5	45.4	24.5	5.6	3.7	2.5	4.1
Natural Gas	3.0	8.7	27.2	40.1	52.9	36.8	27.8	35.5	34.7	34.1	14.5	9.9	3.9	2.8	5.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	41	71	143	238	369	6.9	6.0	5.3	4.5	5.3
Population (millions of people)	50.6	53.7	58.5	61.2	62.3	0.7	0.7	0.5	0.2	0.5
GDP per capita (thousands of 2010 USD/person)	0.82	1.32	2.44	3.90	5.92	6.1	5.3	4.8	4.3	4.8
Primary energy consumption per capita (toe/person)	0.27	0.44	0.66	0.82	0.99	6.2	3.3	2.2	1.8	2.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	335	337	269	211	166	0.1	-1.9	-2.4	-2.3	-2.2
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	310	285	200	150	115	-1.0	-2.9	-2.8	-2.6	-2.8
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	194	445	538	483	421	10.9	1.6	-1.1	-1.4	-0.2
CO2 emissions per unit of primary energy consumption (t/toe)	0.58	1.32	2.00	2.30	2.53	10.9	3.5	1.4	1.0	2.1

Table A.6: Energy Supply and Demand of Philippines (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**40.40**	**60.05**	**93.96**	**118.94**	**145.25**	**100**	**100**	**100**	**100**	**100**	**5.1**	**3.8**	**2.4**	**2.0**	**2.8**
Coal	7.63	17.94	24.35	29.74	34.01	18.9	29.9	25.9	25.0	23.4	11.3	2.6	2.0	1.4	2.0
Oil	13.60	19.99	34.78	48.64	65.02	33.7	33.3	37.0	40.9	44.8	4.9	4.7	3.4	2.9	3.8
Natural gas	3.05	3.63	6.28	9.01	11.78	7.6	6.0	6.7	7.6	8.1	2.2	4.7	3.7	2.7	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.67	0.81	1.10	1.21	1.32	1.7	1.3	1.2	1.0	0.9	2.3	2.6	1.0	0.9	1.6
Geothermal	8.54	8.97	17.17	19.40	21.36	21.1	14.9	18.3	16.3	14.7	0.6	5.6	1.2	1.0	2.7
Others	6.91	8.72	10.29	10.94	11.75	17.1	14.5	11.0	9.2	8.1	2.9	1.4	0.6	0.7	0.9
Biomass	6.90	8.51	9.51	9.33	8.95	17.1	14.2	10.1	7.8	6.2	2.7	0.9	-0.2	-0.4	0.2
Solar, WPHL, Ocean	0.01	0.21	0.78	1.61	2.80	0.0	0.3	0.8	1.4	1.9	57.6	11.7	7.6	5.7	8.5
Biofuels	0.18	0.48	0.98	1.42	1.96	0.5	0.8	1.0	1.2	1.3	12.7	6.2	3.8	3.2	4.5
Electricity	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**23.71**	**33.83**	**54.96**	**73.70**	**95.17**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Industry	6.41	7.63	11.41	14.09	16.89	27.0	22.6	20.8	19.1	17.8	2.2	3.4	2.1	1.8	2.5
Transportation	8.04	12.28	23.81	34.81	48.50	33.9	36.3	43.3	47.2	51.0	5.4	5.7	3.9	3.4	4.4
Others	9.14	12.65	17.52	21.26	24.17	38.5	37.4	31.9	28.9	25.4	4.2	2.7	2.0	1.3	2.0
Non-energy	0.12	1.26	2.22	3.52	5.61	0.5	3.7	4.0	4.8	5.9	34.2	4.8	4.7	4.8	4.8
Total	**23.71**	**33.83**	**54.96**	**73.70**	**95.17**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Coal	1.88	2.52	3.49	4.13	4.73	7.9	7.4	6.4	5.6	5.0	3.7	2.8	1.7	1.4	2.0
Oil	11.46	18.21	32.69	46.36	62.76	48.3	53.8	59.5	62.9	65.9	6.0	5.0	3.6	3.1	3.9
Natural gas	0.07	0.06	0.13	0.18	0.23	0.3	0.2	0.2	0.2	0.2	-2.0	6.8	3.4	2.3	4.3
Electricity	4.75	7.10	11.86	16.51	21.44	20.0	21.0	21.6	22.4	22.5	5.2	4.4	3.4	2.6	3.5
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	5.55	5.93	6.78	6.50	6.01	23.4	17.5	12.3	8.8	6.3	0.8	1.1	-0.4	-0.8	0.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**67.74**	**99.19**	**164.57**	**226.08**	**288.89**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.3**	**3.2**	**2.5**	**3.4**
Coal	23.30	51.93	79.83	107.95	132.68	34.4	52.4	48.5	47.7	45.9	10.5	3.6	3.1	2.1	3.0
Oil	7.10	3.17	3.40	2.82	1.15	10.5	3.2	2.1	1.2	0.4	-9.6	0.6	-1.9	-8.6	-3.1
Natural gas	19.52	21.33	38.23	58.20	80.01	28.8	21.5	23.2	25.7	27.7	1.1	5.0	4.3	3.2	4.2
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	7.80	9.38	12.75	14.03	15.36	11.5	9.5	7.7	6.2	5.3	2.3	2.6	1.0	0.9	1.6
Geothermal	9.93	10.44	19.97	22.56	24.85	14.7	10.5	12.1	10.0	8.6	0.6	5.6	1.2	1.0	2.7
Others	0.09	2.93	10.38	20.52	34.84	0.1	3.0	6.3	9.1	12.1	54.6	11.1	7.1	5.4	8.0

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**9.74**	**18.97**	**26.93**	**34.25**	**40.30**	**100**	**100**	**100**	**100**	**100**	**8.7**	**3.0**	**2.4**	**1.6**	**2.4**
Coal	5.51	14.90	20.34	25.11	28.79	56.6	78.5	75.5	73.3	71.5	13.2	2.6	2.1	1.4	2.1
Oil	1.48	0.73	0.72	0.62	0.26	15.2	3.8	2.7	1.8	0.6	-8.5	-0.1	-1.5	-8.4	-3.2
Natural gas	2.75	3.35	5.87	8.53	11.25	28.2	17.7	21.8	24.9	27.9	2.5	4.8	3.8	2.8	3.9

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**44.0**	**34.6**	**38.8**	**42.4**	**45.6**		**-3.0**	**0.9**	**0.9**	**0.7**	**0.9**
Coal	36.3	30.0	33.7	37.0	39.6		-2.4	1.0	0.9	0.7	0.9
Oil	41.2	37.5	40.8	39.2	38.6		-1.2	0.7	-0.4	-0.2	0.1
Natural gas	61.0	54.8	56.0	58.7	61.2		-1.3	0.2	0.5	0.4	0.3

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**76.4**	**132.5**	**205.1**	**270.0**	**335.7**	**100**	**100**	**100**	**100**	**100**	**7.1**	**3.7**	**2.8**	**2.2**	**2.9**
Coal	29.8	70.0	95.5	117.0	134.1	39.0	52.8	46.6	43.4	39.9	11.3	2.6	2.1	1.4	2.1
Oil	39.4	54.1	94.9	131.9	174.1	51.6	40.8	46.3	48.8	51.9	4.0	4.8	3.4	2.8	3.7
Natural Gas	7.1	8.5	14.7	21.1	27.5	9.3	6.4	7.2	7.8	8.2	2.2	4.7	3.7	2.7	3.7

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	200	322	613	907	1,290	6.2	5.5	4.0	3.6	4.4
Population (millions of people)	94.0	106.7	123.7	135.6	144.5	1.6	1.2	0.9	0.6	1.0
GDP per capita (thousands of 2010 USD/person)	2.12	3.02	4.96	6.69	8.93	4.5	4.2	3.0	2.9	3.4
Primary energy consumption per capita (toe/person)	0.43	0.56	0.76	0.88	1.01	3.4	2.5	1.4	1.4	1.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	202	186	153	131	113	-1.0	-1.6	-1.5	-1.5	-1.6
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	119	105	90	81	74	-1.5	-1.3	-1.0	-1.0	-1.1
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	383	411	334	298	260	0.9	-1.7	-1.2	-1.3	-1.4
CO2 emissions per unit of primary energy consumption (t/toe)	1.89	2.21	2.18	2.27	2.31	1.9	-0.1	0.4	0.2	0.1

Table A.7: Energy Supply and Demand of Thailand (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**117.86**	**135.81**	**171.19**	**190.55**	**205.21**	**100**	**100**	**100**	**100**	**100**	**1.8**	**1.9**	**1.1**	**0.7**	**1.3**
Coal	16.36	15.83	16.54	17.20	15.49	13.9	11.7	9.7	9.0	7.5	-0.4	0.4	0.4	-1.0	-0.1
Oil	44.95	55.36	64.20	69.18	72.15	38.1	40.8	37.5	36.3	35.2	2.6	1.2	0.8	0.4	0.8
Natural gas	32.97	35.51	44.25	46.54	46.05	28.0	26.1	25.8	24.4	22.4	0.9	1.9	0.5	-0.1	0.8
Nuclear	0.00	0.00	0.00	1.83	6.21	0.0	0.0	0.0	1.0	3.0	-	-	-	13.0	-
Hydro	0.48	0.65	0.82	0.92	0.98	0.4	0.5	0.5	0.5	0.5	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	23.10	28.45	45.38	54.87	64.32	19.6	20.9	26.5	28.8	31.3	2.6	4.0	1.9	1.6	2.6
Biomass	22.61	25.70	38.89	45.34	51.53	19.2	18.9	22.7	23.8	25.1	1.6	3.5	1.5	1.3	2.2
Solar, WTHA, Ocean	0.00	0.54	2.29	4.32	6.59	0.0	0.4	1.3	2.3	3.2	87.7	12.8	6.6	4.3	8.1
Biofuels	0.65	1.94	2.75	4.21	6.10	0.6	1.4	1.6	2.2	3.0	14.6	2.9	4.4	3.8	3.6
Electricity	0.49	2.21	4.21	5.21	6.21	0.4	1.6	2.5	2.7	3.0	20.8	5.5	2.2	1.8	3.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**84.90**	**100.16**	**120.85**	**135.56**	**146.07**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.7**	**1.2**
Industry	26.48	30.31	39.49	45.54	48.82	31.2	30.3	32.7	33.6	33.4	1.7	2.2	1.4	0.7	1.5
Transportation	19.92	27.56	29.18	31.60	33.46	23.5	27.5	24.1	23.3	22.9	4.1	0.5	0.8	0.6	0.6
Others	20.43	17.72	21.02	22.64	23.75	24.1	17.7	17.4	16.7	16.3	-1.8	1.4	0.7	0.5	0.9
Non-energy	18.07	24.57	31.17	35.77	40.05	21.3	24.5	25.8	26.4	27.4	3.9	2.0	1.4	1.1	1.5
Total	**84.90**	**100.16**	**120.85**	**135.56**	**146.07**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.7**	**1.2**
Coal	9.21	6.83	7.46	7.29	6.71	10.8	6.8	6.2	5.4	4.6	-3.7	0.7	-0.2	-0.8	-0.1
Oil	43.84	54.69	62.10	66.77	69.52	51.6	54.6	51.4	49.3	47.6	2.8	1.1	0.7	0.4	0.8
Natural gas	4.59	7.21	10.19	12.68	14.93	5.4	7.2	8.4	9.4	10.2	5.8	2.9	2.2	1.6	2.3
Electricity	12.84	16.17	23.30	28.74	33.10	15.1	16.1	19.3	21.2	22.7	2.9	3.1	2.1	1.4	2.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	14.42	15.27	17.80	20.06	21.82	17.0	15.2	14.7	14.8	14.9	0.7	1.3	1.2	0.8	1.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**159.52**	**182.30**	**247.34**	**303.34**	**345.24**	**100**	**100**	**100**	**100**	**100**	**1.7**	**2.6**	**2.1**	**1.3**	**2.0**
Coal	30.05	36.41	39.09	45.96	42.88	18.8	20.0	15.8	15.2	12.4	2.4	0.6	1.6	-0.7	0.5
Oil	1.18	0.18	0.00	0.00	0.00	0.7	0.1	0.0	0.0	0.0	-21.1	-100.0	-	-	-100.0
Natural gas	119.35	115.64	136.66	142.29	131.13	74.8	63.4	55.2	46.9	38.0	-0.4	1.4	0.4	-0.8	0.4
Nuclear	0.00	0.00	0.00	7.03	23.83	0.0	0.0	0.0	2.3	6.9	-	-	-	13.0	-
Hydro	5.54	7.57	9.51	10.75	11.46	3.5	4.1	3.8	3.5	3.3	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.01	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	3.41	22.51	62.08	97.32	135.94	2.1	12.3	25.1	32.1	39.4	26.6	8.8	4.6	3.4	5.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**29.87**	**30.65**	**34.35**	**35.47**	**31.60**	**100**	**100**	**100**	**100**	**100**	**0.3**	**1.0**	**0.3**	**-1.1**	**0.1**
Coal	6.92	8.99	9.09	9.92	8.80	23.2	29.3	26.5	28.0	27.8	3.3	0.1	0.9	-1.2	-0.1
Oil	0.26	0.05	0.00	0.00	0.00	0.9	0.2	0.0	0.0	0.0	-18.8	-100.0	-	-	-100.0
Natural gas	22.68	21.61	25.26	25.55	22.80	75.9	70.5	73.5	72.0	72.2	-0.6	1.3	0.1	-1.1	0.2

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**43.3**	**42.7**	**44.0**	**45.6**	**47.4**		**-0.2**	**0.2**	**0.4**	**0.4**	**0.3**
Coal	37.3	34.8	37.0	39.9	41.9		-0.9	0.5	0.7	0.5	0.6
Oil	38.4	30.5	-	-	-		-2.8	-	-	-	-
Natural gas	45.2	46.0	46.5	47.9	49.5		0.2	0.1	0.3	0.3	0.2

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**219.7**	**238.2**	**268.9**	**278.7**	**267.7**	**100**	**100**	**100**	**100**	**100**	**1.0**	**1.0**	**0.4**	**-0.4**	**0.4**
Coal	65.2	63.9	66.7	69.4	62.5	29.7	26.8	24.8	24.9	23.4	-0.2	0.4	0.4	-1.0	-0.1
Oil	79.8	95.1	107.5	112.0	111.5	36.3	39.9	40.0	40.2	41.6	2.2	1.0	0.4	0.0	0.5
Natural Gas	74.7	79.1	94.6	97.3	93.7	34.0	33.2	35.2	34.9	35.0	0.7	1.5	0.3	-0.4	0.5

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	341	442	656	907	1,191	3.3	3.3	3.3	2.8	3.1
Population (millions of people)	67.2	69.4	70.3	69.0	65.9	0.4	0.1	-0.2	-0.5	-0.2
GDP per capita (thousands of 2010 USD/person)	5.08	6.36	9.32	13.14	18.07	2.9	3.2	3.5	3.2	3.3
Primary energy consumption per capita (toe/person)	1.75	1.96	2.43	2.76	3.11	1.4	1.8	1.3	1.2	1.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	346	307	261	210	172	-1.4	-1.4	-2.1	-2.0	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	249	227	184	149	123	-1.2	-1.7	-2.1	-2.0	-1.9
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	644	539	410	307	225	-2.2	-2.3	-2.8	-3.1	-2.7
CO2 emissions per unit of primary energy consumption (t/toe)	1.86	1.75	1.57	1.46	1.30	-0.8	-0.9	-0.7	-1.1	-0.9

Table A.8: Energy Supply and Demand of Viet Nam (REF)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**58.60**	**83.46**	**139.30**	**183.30**	**232.39**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.4**	**2.8**	**2.4**	**3.3**
Coal	14.65	36.74	62.19	80.22	99.78	25.0	44.0	44.6	43.8	42.9	12.2	4.5	2.6	2.2	3.2
Oil	18.35	22.50	35.65	46.51	59.83	31.3	27.0	25.6	25.4	25.7	2.6	3.9	2.7	2.6	3.1
Natural gas	8.12	7.94	19.83	27.34	36.68	13.9	9.5	14.2	14.9	15.8	-0.3	7.9	3.3	3.0	4.9
Nuclear	0.00	0.00	0.00	4.21	8.58	0.0	0.0	0.0	2.3	3.7	-	-	-	7.4	-
Hydro	2.37	7.23	9.86	11.00	11.65	4.0	8.7	7.1	6.0	5.0	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	15.11	9.04	11.78	14.03	15.87	25.8	10.8	8.5	7.7	6.8	-6.2	2.2	1.8	1.2	1.8
Biomass	14.71	8.91	9.59	10.48	10.79	25.1	10.7	6.9	5.7	4.6	-6.1	0.6	0.9	0.3	0.6
Solar, WVNM, Ocean	0.00	0.04	1.61	2.71	4.00	0.0	0.1	1.2	1.5	1.7	34.0	34.7	5.4	4.0	15.1
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	9.6	5.9	-
Electricity	0.40	0.09	0.59	0.84	1.09	0.7	0.1	0.4	0.5	0.5	-17.5	17.4	3.6	2.7	8.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**48.51**	**60.27**	**103.14**	**134.52**	**169.66**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Industry	17.42	32.54	62.16	79.53	97.36	35.9	54.0	60.3	59.1	57.4	8.1	5.5	2.5	2.0	3.5
Transportation	10.32	12.06	18.28	24.06	31.04	21.3	20.0	17.7	17.9	18.3	2.0	3.5	2.8	2.6	3.0
Others	18.51	14.19	20.38	27.78	37.19	38.2	23.5	19.8	20.6	21.9	-3.3	3.1	3.1	3.0	3.1
Non-energy	2.26	1.48	2.32	3.15	4.06	4.7	2.5	2.2	2.3	2.4	-5.2	3.8	3.1	2.6	3.2
Total	**48.51**	**60.27**	**103.14**	**134.52**	**169.66**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Coal	9.81	14.17	21.94	26.60	30.12	20.2	23.5	21.3	19.8	17.8	4.7	3.7	1.9	1.2	2.4
Oil	16.81	20.75	33.91	44.59	57.67	34.7	34.4	32.9	33.1	34.0	2.7	4.2	2.8	2.6	3.2
Natural gas	0.49	0.99	6.14	7.89	9.42	1.0	1.6	6.0	5.9	5.6	9.1	16.5	2.5	1.8	7.3
Electricity	7.47	16.28	32.43	45.85	62.57	15.4	27.0	31.4	34.1	36.9	10.2	5.9	3.5	3.2	4.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	13.91	8.08	8.72	9.59	9.88	28.7	13.4	8.5	7.1	5.8	-6.6	0.6	1.0	0.3	0.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**94.90**	**240.94**	**440.75**	**610.19**	**823.06**	**100**	**100**	**100**	**100**	**100**	**12.4**	**5.2**	**3.3**	**3.0**	**3.9**
Coal	19.69	114.18	218.95	302.24	412.82	20.7	47.4	49.7	49.5	50.2	24.6	5.6	3.3	3.2	4.1
Oil	3.41	0.26	0.00	0.00	0.00	3.6	0.1	0.0	0.0	0.0	-27.6	-100.0	-	-	-100.0
Natural gas	44.15	41.73	88.26	132.04	194.96	46.5	17.3	20.0	21.6	23.7	-0.7	6.4	4.1	4.0	4.9
Nuclear	0.00	0.00	0.00	16.16	32.94	0.0	0.0	0.0	2.6	4.0	-	-	-	7.4	-
Hydro	27.55	84.13	114.65	127.95	135.49	29.0	34.9	26.0	21.0	16.5	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.11	0.65	18.89	31.80	46.85	0.1	0.3	4.3	5.2	5.7	25.5	32.5	5.3	4.0	14.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.63**	**29.52**	**53.78**	**72.87**	**96.68**	**100**	**100**	**100**	**100**	**100**	**10.1**	**5.1**	**3.1**	**2.9**	**3.8**
Coal	4.84	22.57	40.16	53.49	69.49	35.5	76.5	74.7	73.4	71.9	21.2	4.9	2.9	2.7	3.6
Oil	1.16	0.07	0.00	0.00	0.00	8.5	0.2	0.0	0.0	0.0	-30.2	-100.0	-	-	-100.0
Natural gas	7.63	6.89	13.61	19.38	27.19	56.0	23.3	25.3	26.6	28.1	-1.3	5.8	3.6	3.4	4.4

Thermal Efficiency

	%					AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**42.4**	**45.5**	**49.1**	**51.2**	**54.1**	**0.9**	**0.6**	**0.4**	**0.5**	**0.5**
Coal	35.0	43.5	46.9	48.6	51.1	2.8	0.6	0.4	0.5	0.5
Oil	25.3	34.0	-	-	-	3.8	-	-	-	-
Natural gas	49.7	52.1	55.7	58.6	61.6	0.6	0.6	0.5	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.8**	**227.0**	**394.8**	**515.2**	**653.2**	**100**	**100**	**100**	**100**	**100**	**7.8**	**4.7**	**2.7**	**2.4**	**3.4**
Coal	60.0	150.4	254.7	328.5	408.6	48.1	66.3	64.5	63.8	62.6	12.2	4.5	2.6	2.2	3.2
Oil	45.7	58.1	93.7	122.7	158.5	36.6	25.6	23.7	23.8	24.3	3.0	4.1	2.7	2.6	3.2
Natural Gas	19.1	18.5	46.4	64.1	86.1	15.3	8.1	11.8	12.4	13.2	-0.4	8.0	3.3	3.0	4.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	116	188	375	624	985	6.2	5.9	5.2	4.7	5.3
Population (millions of people)	88.0	95.5	104.2	107.8	109.6	1.0	0.7	0.3	0.2	0.4
GDP per capita (thousands of 2010 USD/person)	1.32	1.96	3.60	5.79	8.99	5.1	5.2	4.9	4.5	4.9
Primary energy consumption per capita (toe/person)	0.67	0.87	1.34	1.70	2.12	3.4	3.6	2.4	2.2	2.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	506	445	371	294	236	-1.6	-1.5	-2.3	-2.2	-2.0
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	418	321	275	216	172	-3.3	-1.3	-2.4	-2.2	-1.9
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	1,076	1,210	1,052	826	663	1.5	-1.2	-2.4	-2.2	-1.9
CO2 emissions per unit of primary energy consumption (t/toe)	2.13	2.72	2.83	2.81	2.81	3.1	0.3	-0.1	0.0	0.1

Table A.9: Energy Supply and Demand of Total of the Seven EAS Countries

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,205.70**	**1,547.16**	**2,408.90**	**3,045.27**	**3,629.73**	**100**	**100**	**100**	**100**	**100**	**3.2**	**3.8**	**2.4**	**1.8**	**2.7**
Coal	364.52	563.45	657.99	698.63	668.38	30.2	36.4	27.3	22.9	18.4	5.6	1.3	0.6	-0.4	0.5
Oil	332.98	446.25	690.47	918.09	1,197.26	27.6	28.8	28.7	30.1	33.0	3.7	3.7	2.9	2.7	3.1
Natural gas	169.84	181.33	557.26	851.00	1,104.14	14.1	11.7	23.1	27.9	30.4	0.8	9.8	4.3	2.6	5.8
Nuclear	6.84	9.85	43.04	63.36	86.68	0.6	0.6	1.8	2.1	2.4	4.7	13.1	3.9	3.2	7.0
Hydro	16.75	27.02	39.46	48.58	57.04	1.4	1.7	1.6	1.6	1.6	6.2	3.2	2.1	1.6	2.4
Geothermal	24.63	33.08	75.12	95.75	117.47	2.0	2.1	3.1	3.1	3.2	3.8	7.1	2.5	2.1	4.0
Others	290.13	286.17	345.56	369.85	398.77	24.1	18.5	14.3	12.1	11.0	-0.2	1.6	0.7	0.8	1.0
Biomass	286.77	273.60	303.26	300.03	286.95	23.8	17.7	12.6	9.9	7.9	-0.6	0.9	-0.1	-0.4	0.1
Solar, Wind, Ocean	2.01	10.81	39.53	66.57	108.06	0.2	0.7	1.6	2.2	3.0	23.4	11.4	5.3	5.0	7.5
Biofuels	1.07	6.57	8.61	12.72	17.73	0.1	0.4	0.4	0.4	0.5	25.5	2.3	4.0	3.4	3.2
Electricity	1.35	1.76	2.76	3.26	3.76	0.1	0.1	0.1	0.1	0.1	3.4	3.8	1.7	1.4	2.4

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**836.15**	**1,039.59**	**1,606.87**	**2,046.89**	**2,497.01**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.4**	**2.0**	**2.8**
Industry	267.22	349.93	610.25	771.63	876.63	32.0	33.7	38.0	37.7	35.1	3.4	4.7	2.4	1.3	2.9
Transportation	148.97	233.11	356.26	506.62	729.67	17.8	22.4	22.2	24.8	29.2	5.8	3.6	3.6	3.7	3.6
Others	351.38	356.20	471.97	552.03	626.12	42.0	34.3	29.4	27.0	25.1	0.2	2.4	1.6	1.3	1.8
Non-energy	68.59	100.34	168.39	216.61	264.59	8.2	9.7	10.5	10.6	10.6	4.9	4.4	2.5	2.0	3.1
Total	**836.15**	**1,039.59**	**1,606.87**	**2,046.89**	**2,497.01**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.4**	**2.0**	**2.8**
Coal	127.35	146.91	253.05	316.70	357.92	15.2	14.1	15.7	15.5	14.3	1.8	4.6	2.3	1.2	2.8
Oil	290.24	412.11	641.47	855.01	1,119.46	34.7	39.6	39.9	41.8	44.8	4.5	3.8	2.9	2.7	3.2
Natural gas	46.51	76.77	150.55	200.70	243.74	5.6	7.4	9.4	9.8	9.8	6.5	5.8	2.9	2.0	3.7
Electricity	109.74	179.62	338.76	476.98	615.05	13.1	17.3	21.1	23.3	24.6	6.4	5.4	3.5	2.6	3.9
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	262.32	224.17	223.03	197.49	160.84	31.4	21.6	13.9	9.6	6.4	-1.9	0.0	-1.2	-2.0	-1.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,599.05**	**2,584.44**	**4,798.53**	**6,590.06**	**8,283.72**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.3**	**3.2**	**2.3**	**3.7**
Coal	842.95	1,604.77	1,473.73	1,288.60	891.94	52.7	62.1	30.7	19.6	10.8	8.4	-0.7	-1.3	-3.6	-1.8
Oil	67.21	27.46	37.49	39.98	32.59	4.2	1.1	0.8	0.6	0.4	-10.6	2.6	0.6	-2.0	0.5
Natural gas	409.08	384.43	2,052.56	3,488.70	4,874.28	25.6	14.9	42.8	52.9	58.8	-0.8	15.0	5.4	3.4	8.3
Nuclear	26.27	37.81	165.17	243.19	332.66	1.6	1.5	3.4	3.7	4.0	4.7	13.1	3.9	3.2	7.0
Hydro	194.85	314.29	458.88	564.95	663.34	12.2	12.2	9.6	8.6	8.0	6.2	3.2	2.1	1.6	2.4
Geothermal	19.29	24.46	53.68	66.97	80.74	1.2	0.9	1.1	1.0	1.0	3.0	6.8	2.2	1.9	3.8
Others	39.41	191.22	557.01	897.68	1,408.16	2.5	7.4	11.6	13.6	17.0	21.8	9.3	4.9	4.6	6.4

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**330.28**	**481.35**	**738.16**	**924.12**	**1,025.95**	**100**	**100**	**100**	**100**	**100**	**4.8**	**3.6**	**2.3**	**1.1**	**2.4**
Coal	225.75	392.87	360.91	316.33	220.14	68.4	81.6	48.9	34.2	21.5	7.2	-0.7	-1.3	-3.6	-1.8
Oil	19.37	12.18	11.23	11.35	8.73	5.9	2.5	1.5	1.2	0.9	-5.6	-0.7	0.1	-2.6	-1.0
Natural gas	85.15	76.30	366.02	596.44	797.09	25.8	15.9	49.6	64.5	77.7	-1.4	14.0	5.0	2.9	7.6

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.3**	**36.0**	**41.5**	**44.8**	**48.6**						**0.6**	**1.2**	**0.8**	**0.8**	**0.9**
Coal	32.1	35.1	35.1	35.0	34.8						1.1	0.0	0.0	-0.1	0.0
Oil	29.8	19.4	28.7	30.3	32.1						-5.2	3.3	0.5	0.6	1.6
Natural gas	41.3	43.3	48.2	50.3	52.6						0.6	0.9	0.4	0.4	0.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**2,596.9**	**3,714.3**	**5,522.1**	**6,928.3**	**8,118.4**	**100**	**100**	**100**	**100**	**100**	**4.6**	**3.4**	**2.3**	**1.6**	**2.5**
Coal	1,440.6	2,225.9	2,599.6	2,759.7	2,639.3	55.5	59.9	47.1	39.8	32.5	5.6	1.3	0.6	-0.4	0.5
Oil	834.9	1,145.9	1,783.7	2,392.4	3,160.3	32.2	30.8	32.3	34.5	38.9	4.0	3.8	3.0	2.8	3.2
Natural Gas	320.8	340.7	1,137.0	1,774.4	2,317.0	12.4	9.2	20.6	25.6	28.5	0.8	10.6	4.6	2.7	6.2

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	3,378	5,383	10,662	17,171	25,805	6.0	5.9	4.9	4.2	5.0
Population (millions of people)	1,804.1	1,977.1	2,195.8	2,324.0	2,393.3	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.87	2.72	4.86	7.39	10.78	4.8	4.9	4.3	3.9	4.4
Primary energy consumption per capita (toe/person)	0.67	0.78	1.10	1.31	1.52	2.0	2.9	1.8	1.5	2.1
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	357	287	226	177	141	-2.7	-2.0	-2.4	-2.3	-2.2
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	248	193	151	119	97	-3.1	-2.0	-2.3	-2.1	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	769	690	518	403	315	-1.3	-2.4	-2.5	-2.5	-2.4
CO_2 emissions per unit of primary energy consumption (t/toe)	2.15	2.40	2.29	2.28	2.24	1.4	-0.4	-0.1	-0.2	-0.2

Table A.10: Energy Supply and Demand of India

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**700.76**	**919.44**	**1,500.60**	**1,930.29**	**2,321.22**	**100**	**100**	**100**	**100**	**100**	**3.5**	**4.2**	**2.6**	**1.9**	**2.9**
Coal	279.03	414.21	494.86	539.97	530.44	39.8	45.1	33.0	28.0	22.9	5.1	1.5	0.9	-0.2	0.8
Oil	162.07	235.25	401.37	568.53	788.64	23.1	25.6	26.7	29.5	34.0	4.8	4.6	3.5	3.3	3.9
Natural gas	54.40	52.41	294.36	483.17	634.90	7.8	5.7	19.6	25.0	27.4	-0.5	15.5	5.1	2.8	8.1
Nuclear	6.84	9.85	43.04	53.66	68.24	1.0	1.1	2.9	2.8	2.9	4.7	13.1	2.2	2.4	6.2
Hydro	10.74	13.00	21.00	27.69	34.51	1.5	1.4	1.4	1.4	1.5	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	187.67	194.72	245.97	257.27	264.49	26.8	21.2	16.4	13.3	11.4	0.5	2.0	0.5	0.3	1.0
Biomass	185.20	185.10	211.98	202.83	184.12	26.4	20.1	14.1	10.5	7.9	0.0	1.1	-0.4	-1.0	0.0
Solar, Wind, Ocean	1.99	9.95	34.30	54.77	80.71	0.3	1.1	2.3	2.8	3.5	22.3	10.9	4.8	4.0	6.8
Biofuels	0.05	0.88	1.38	2.69	4.31	0.0	0.1	0.1	0.1	0.2	41.8	3.8	6.9	4.8	5.1
Electricity	0.48	-0.33	-0.33	-0.33	-0.33	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**478.45**	**606.58**	**998.39**	**1,299.29**	**1,612.66**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Industry	151.62	206.09	390.51	499.42	559.01	31.7	34.0	39.1	38.4	34.7	3.9	5.5	2.5	1.1	3.2
Transportation	64.80	103.77	183.03	291.47	468.20	13.5	17.1	18.3	22.4	29.0	6.1	4.8	4.8	4.9	4.8
Others	227.92	245.92	336.23	388.45	434.55	47.6	40.5	33.7	29.9	26.9	1.0	2.6	1.5	1.1	1.8
Non-energy	34.12	50.81	88.63	119.95	150.90	7.1	8.4	8.9	9.2	9.4	5.1	4.7	3.1	2.3	3.5
Total	**478.45**	**606.58**	**998.39**	**1,299.29**	**1,612.66**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Coal	87.19	106.61	193.60	245.06	277.20	18.2	17.6	19.4	18.9	17.2	2.5	5.1	2.4	1.2	3.0
Oil	138.11	207.70	364.12	519.94	726.27	28.9	34.2	36.5	40.0	45.0	5.2	4.8	3.6	3.4	4.0
Natural gas	18.64	32.42	70.71	101.53	127.60	3.9	5.3	7.1	7.8	7.9	7.2	6.7	3.7	2.3	4.4
Electricity	61.94	103.29	208.92	296.16	379.28	12.9	17.0	20.9	22.8	23.5	6.6	6.0	3.6	2.5	4.1
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	172.56	156.56	161.04	136.61	102.30	36.1	25.8	16.1	10.5	6.3	-1.2	0.2	-1.6	-2.9	-1.3

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**974.80**	**1,583.22**	**3,113.24**	**4,250.55**	**5,242.75**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.8**	**3.2**	**2.1**	**3.8**
Coal	657.96	1,163.40	1,046.15	925.10	648.31	67.5	73.5	33.6	21.8	12.4	7.4	-0.9	-1.2	-3.5	-1.8
Oil	17.67	7.85	10.08	8.94	5.10	1.8	0.5	0.3	0.2	0.1	-9.6	2.1	-1.2	-5.4	-1.3
Natural gas	113.29	73.62	1,195.21	2,086.25	2,909.42	11.6	4.6	38.4	49.1	55.5	-5.2	26.1	5.7	3.4	12.2
Nuclear	26.27	37.81	165.17	205.94	261.88	2.7	2.4	5.3	4.8	5.0	4.7	13.1	2.2	2.4	6.2
Hydro	124.92	151.13	244.24	322.04	401.40	12.8	9.5	7.8	7.6	7.7	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	34.70	149.40	452.38	702.28	1,016.64	3.6	9.4	14.5	16.5	19.4	20.0	9.7	4.5	3.8	6.2

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**209.39**	**304.61**	**475.98**	**593.28**	**646.07**	**100**	**100**	**100**	**100**	**100**	**4.8**	**3.8**	**2.2**	**0.9**	**2.4**
Coal	177.27	284.97	258.32	230.43	164.07	84.7	93.6	54.3	38.8	25.4	6.1	-0.8	-1.1	-3.3	-1.7
Oil	7.25	4.18	4.74	4.16	2.39	3.5	1.4	1.0	0.7	0.4	-6.7	1.1	-1.3	-5.4	-1.7
Natural gas	24.87	15.46	212.92	358.69	479.61	11.9	5.1	44.7	60.5	74.2	-5.8	24.4	5.4	2.9	11.3

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**32.4**	**35.1**	**40.7**	**43.8**	**47.4**		**1.0**	**1.2**	**0.7**	**0.8**	**0.9**
Coal	31.9	35.1	34.8	34.5	34.0		1.2	-0.1	-0.1	-0.2	-0.1
Oil	21.0	16.2	18.3	18.5	18.4		-3.2	1.0	0.1	0.0	0.4
Natural gas	39.2	40.9	48.3	50.0	52.2		0.6	1.4	0.4	0.4	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,585.0**	**2,324.2**	**3,614.4**	**4,661.2**	**5,569.3**	**100**	**100**	**100**	**100**	**100**	**4.9**	**3.7**	**2.6**	**1.8**	**2.8**
Coal	1,083.7	1,628.4	1,945.7	2,123.2	2,085.7	68.4	70.1	53.8	45.5	37.4	5.2	1.5	0.9	-0.2	0.8
Oil	425.9	611.1	1,054.9	1,510.8	2,129.9	26.9	26.3	29.2	32.4	38.2	4.6	4.7	3.7	3.5	4.0
Natural Gas	74.7	83.5	612.5	1,026.0	1,352.4	4.7	3.6	16.9	22.0	24.3	1.4	18.1	5.3	2.8	9.1

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	1,670	2,831	6,146	10,304	15,988	6.8	6.7	5.3	4.5	5.6
Population (millions of people)	1,234.3	1,352.6	1,503.6	1,592.7	1,639.2	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.35	2.09	4.09	6.47	9.75	5.6	5.7	4.7	4.2	4.9
Primary energy consumption per capita (toe/person)	0.57	0.68	1.00	1.21	1.42	2.3	3.3	2.0	1.6	2.3
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	420	325	244	187	145	-3.2	-2.3	-2.6	-2.5	-2.5
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	287	214	162	126	101	-3.6	-2.3	-2.5	-2.2	-2.3
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	949	821	588	452	348	-1.8	-2.7	-2.6	-2.6	-2.6
CO_2 emissions per unit of primary energy consumption (t/toe)	2.26	2.53	2.41	2.41	2.40	1.4	-0.4	0.0	-0.1	-0.2

Table A.11: Energy Supply and Demand of Indonesia

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**201.69**	**231.14**	**340.48**	**435.03**	**523.23**	**100**	**100**	**100**	**100**	**100**	**1.7**	**3.3**	**2.5**	**1.9**	**2.6**
Coal	31.84	55.23	65.19	64.96	57.96	15.8	23.9	19.1	14.9	11.1	7.1	1.4	0.0	-1.1	0.2
Oil	67.39	77.31	105.19	129.66	151.68	33.4	33.4	30.9	29.8	29.0	1.7	2.6	2.1	1.6	2.1
Natural gas	38.82	38.93	89.25	140.60	186.90	19.2	16.8	26.2	32.3	35.7	0.0	7.2	4.6	2.9	5.0
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	1.50	1.86	2.19	2.65	3.11	0.7	0.8	0.6	0.6	0.6	2.7	1.4	1.9	1.6	1.6
Geothermal	16.09	24.11	57.94	76.35	96.10	8.0	10.4	17.0	17.6	18.4	5.2	7.6	2.8	2.3	4.4
Others	46.04	33.69	20.72	20.81	27.47	22.8	14.6	6.1	4.8	5.3	-3.8	-4.0	0.0	2.8	-0.6
Biomass	46.04	33.54	20.29	18.09	16.67	22.8	14.5	6.0	4.2	3.2	-3.9	-4.1	-1.1	-0.8	-2.2
Solar, WIDN, Ocean	0.00	0.02	0.30	2.59	10.68	0.0	0.0	0.1	0.6	2.0	65.4	23.3	24.1	15.2	21.0
Biofuels	0.17	2.83	3.12	4.02	4.98	0.1	1.2	0.9	0.9	1.0	41.7	0.8	2.5	2.2	1.8
Electricity	0.00	0.13	0.13	0.13	0.13	0.0	0.1	0.0	0.0	0.0	129.0	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**145.98**	**156.06**	**213.80**	**269.90**	**324.44**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Industry	49.08	50.16	74.46	93.43	109.32	33.6	32.1	34.8	34.6	33.7	0.3	3.3	2.3	1.6	2.5
Transportation	30.14	54.38	75.78	96.46	118.64	20.6	34.8	35.4	35.7	36.6	7.7	2.8	2.4	2.1	2.5
Others	56.55	43.03	48.32	60.44	72.62	38.7	27.6	22.6	22.4	22.4	-3.4	1.0	2.3	1.9	1.6
Non-energy	10.20	8.49	15.24	19.57	23.86	7.0	5.4	7.1	7.2	7.4	-2.3	5.0	2.5	2.0	3.3
Total	**145.98**	**156.06**	**213.80**	**269.90**	**324.44**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Coal	17.18	14.72	22.65	28.78	33.64	11.8	9.4	10.6	10.7	10.4	-1.9	3.7	2.4	1.6	2.6
Oil	55.01	75.67	102.58	124.96	146.35	37.7	48.5	48.0	46.3	45.1	4.1	2.6	2.0	1.6	2.1
Natural gas	15.86	16.68	31.29	41.13	49.70	10.9	10.7	14.6	15.2	15.3	0.6	5.4	2.8	1.9	3.5
Electricity	12.67	22.02	39.37	59.77	81.39	8.7	14.1	18.4	22.1	25.1	7.2	5.0	4.3	3.1	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	45.26	26.97	17.92	15.25	13.36	31.0	17.3	8.4	5.6	4.1	-6.3	-3.4	-1.6	-1.3	-2.2

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**169.76**	**283.77**	**510.58**	**775.95**	**1,055.30**	**100**	**100**	**100**	**100**	**100**	**6.6**	**5.0**	**4.3**	**3.1**	**4.2**
Coal	68.45	160.02	170.34	145.18	98.50	40.3	56.4	33.4	18.7	9.3	11.2	0.5	-1.6	-3.8	-1.5
Oil	34.15	14.88	22.92	27.71	26.34	20.1	5.2	4.5	3.6	2.5	-9.9	3.7	1.9	-0.5	1.8
Natural gas	40.25	59.42	251.25	493.07	708.36	23.7	20.9	49.2	63.5	67.1	5.0	12.8	7.0	3.7	8.1
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	17.46	21.64	25.46	30.84	36.22	10.3	7.6	5.0	4.0	3.4	2.7	1.4	1.9	1.6	1.6
Geothermal	9.36	14.02	33.70	44.41	55.89	5.5	4.9	6.6	5.7	5.3	5.2	7.6	2.8	2.3	4.4
Others	0.10	13.79	6.91	34.74	129.98	0.1	4.9	1.4	4.5	12.3	85.1	-5.6	17.5	14.1	7.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**35.21**	**60.59**	**95.58**	**130.47**	**151.63**	**100**	**100**	**100**	**100**	**100**	**7.0**	**3.9**	**3.2**	**1.5**	**2.9**
Coal	18.08	40.51	42.52	36.17	24.31	51.4	66.9	44.5	27.7	16.0	10.6	0.4	-1.6	-3.9	-1.6
Oil	8.47	6.75	5.48	6.43	6.08	24.1	11.1	5.7	4.9	4.0	-2.8	-1.7	1.6	-0.6	-0.3
Natural gas	8.65	13.32	47.58	87.87	121.24	24.6	22.0	49.8	67.3	80.0	5.5	11.2	6.3	3.3	7.1

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.9**	**33.3**	**40.0**	**43.9**	**47.2**						**-0.6**	**1.5**	**0.9**	**0.7**	**1.1**
Coal	32.5	34.0	34.4	34.5	34.8						0.5	0.1	0.0	0.1	0.1
Oil	34.6	18.9	36.0	37.0	37.2						-7.3	5.5	0.3	0.1	2.1
Natural gas	40.0	38.4	45.4	48.3	50.2						-0.5	1.4	0.6	0.4	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**396.0**	**539.5**	**761.0**	**939.9**	**1,073.0**	**100**	**100**	**100**	**100**	**100**	**3.9**	**2.9**	**2.1**	**1.3**	**2.2**
Coal	141.8	222.0	262.0	261.1	233.0	35.8	41.2	34.4	27.8	21.7	5.8	1.4	0.0	-1.1	0.2
Oil	174.7	234.6	310.9	378.3	439.5	44.1	43.5	40.9	40.3	41.0	3.8	2.4	2.0	1.5	2.0
Natural Gas	79.5	82.3	187.6	300.0	400.1	20.1	15.3	24.7	31.9	37.3	0.4	7.1	4.8	2.9	5.1

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	755	1,147	2,089	3,278	4,753	5.4	5.1	4.6	3.8	4.5
Population (millions of people)	241.8	267.7	299.4	318.9	331.4	1.3	0.9	0.6	0.4	0.7
GDP per capita (thousands of 2010 USD/person)	3.12	4.28	6.98	10.28	14.34	4.0	4.1	3.9	3.4	3.8
Primary energy consumption per capita (toe/person)	0.83	0.86	1.14	1.36	1.58	0.4	2.3	1.8	1.5	1.9
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	267	202	163	133	110	-3.5	-1.8	-2.0	-1.9	-1.9
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	193	136	102	82	68	-4.3	-2.3	-2.2	-1.9	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	524	470	364	287	226	-1.4	-2.1	-2.4	-2.4	-2.3
CO_2 emissions per unit of primary energy consumption (t/toe)	1.96	2.33	2.24	2.16	2.05	2.2	-0.4	-0.3	-0.5	-0.4

Table A.12: Energy Supply and Demand of Malaysia

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**72.49**	**93.43**	**129.97**	**145.98**	**153.56**	**100**	**100**	**100**	**100**	**100**	**3.2**	**2.8**	**1.2**	**0.5**	**1.6**
Coal	14.60	22.61	22.35	19.26	11.91	20.1	24.2	17.2	13.2	7.8	5.6	-0.1	-1.5	-4.7	-2.0
Oil	25.33	28.98	35.85	36.34	35.52	34.9	31.0	27.6	24.9	23.1	1.7	1.8	0.1	-0.2	0.6
Natural gas	31.20	38.78	67.03	81.03	93.77	43.0	41.5	51.6	55.5	61.1	2.8	4.7	1.9	1.5	2.8
Nuclear	0.00	0.00	0.00	3.66	3.65	0.0	0.0	0.0	2.5	2.4	-	-	-	0.0	-
Hydro	0.56	2.26	3.00	3.32	3.43	0.8	2.4	2.3	2.3	2.2	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.80	0.79	1.75	2.37	5.27	1.1	0.9	1.3	1.6	3.4	-0.1	6.8	3.1	8.3	6.1
Biomass	0.82	0.87	1.69	2.13	2.57	1.1	0.9	1.3	1.5	1.7	0.8	5.6	2.3	1.9	3.4
Solar, WMYS, Ocean	0.00	0.05	0.19	0.37	2.83	0.0	0.1	0.1	0.3	1.8	-	11.7	7.2	22.5	13.5
Biofuels	0.00	0.44	0.39	0.38	0.36	0.0	0.5	0.3	0.3	0.2	77.7	-1.0	-0.2	-0.4	-0.6
Electricity	-0.01	-0.13	-0.13	-0.13	-0.13	0.0	-0.1	-0.1	-0.1	-0.1	33.1	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**41.74**	**62.53**	**87.82**	**99.09**	**107.65**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Industry	14.92	19.51	25.38	29.15	31.74	35.8	31.2	28.9	29.4	29.5	3.4	2.2	1.4	0.9	1.5
Transportation	14.93	20.96	22.15	21.83	20.75	35.8	33.5	25.2	22.0	19.3	4.3	0.5	-0.1	-0.5	0.0
Others	8.19	8.80	12.17	14.37	16.16	19.6	14.1	13.9	14.5	15.0	0.9	2.7	1.7	1.2	1.9
Non-energy	3.70	13.26	28.12	33.74	39.00	8.9	21.2	32.0	34.0	36.2	17.3	6.5	1.8	1.5	3.4
Total	**41.74**	**62.53**	**87.82**	**99.09**	**107.65**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Coal	1.83	1.81	2.37	2.59	2.66	4.4	2.9	2.7	2.6	2.5	-0.1	2.3	0.9	0.3	1.2
Oil	23.96	28.28	32.82	33.33	32.61	57.4	45.2	37.4	33.6	30.3	2.1	1.2	0.2	-0.2	0.4
Natural gas	6.25	18.85	33.14	38.99	43.91	15.0	30.1	37.7	39.3	40.8	14.8	4.8	1.6	1.2	2.7
Electricity	9.53	13.15	18.93	23.55	27.77	22.8	21.0	21.6	23.8	25.8	4.1	3.1	2.2	1.7	2.4
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.17	0.44	0.55	0.63	0.70	0.4	0.7	0.6	0.6	0.6	12.3	2.0	1.2	1.1	1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.79**	**170.47**	**245.31**	**304.97**	**359.39**	**100**	**100**	**100**	**100**	**100**	**4.0**	**3.1**	**2.2**	**1.7**	**2.4**
Coal	42.84	77.29	74.90	61.91	33.98	34.3	45.3	30.5	20.3	9.5	7.7	-0.3	-1.9	-5.8	-2.5
Oil	3.67	1.05	0.83	0.30	0.00	2.9	0.6	0.3	0.1	0.0	-14.5	-2.0	-9.6	-88.7	-51.4
Natural gas	70.80	63.89	129.14	181.31	232.90	56.7	37.5	52.6	59.5	64.8	-1.3	6.0	3.5	2.5	4.1
Nuclear	0.00	0.00	0.00	14.05	14.02	0.0	0.0	0.0	4.6	3.9	-	-	-	0.0	-
Hydro	6.47	26.32	34.92	38.57	39.94	5.2	15.4	14.2	12.6	11.1	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	1.01	1.93	5.54	8.82	38.55	0.8	1.1	2.3	2.9	10.7	8.4	9.2	4.8	15.9	9.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.72**	**33.67**	**44.16**	**48.64**	**48.55**	**100**	**100**	**100**	**100**	**100**	**0.7**	**2.3**	**1.0**	**0.0**	**1.2**
Coal	12.95	20.47	19.64	16.33	8.92	40.8	60.8	44.5	33.6	18.4	5.9	-0.3	-1.8	-5.9	-2.6
Oil	0.74	0.38	0.21	0.08	0.00	2.3	1.1	0.5	0.2	0.0	-8.0	-4.7	-9.7	-88.7	-51.9
Natural gas	18.03	12.82	24.31	32.23	39.63	56.8	38.1	55.0	66.3	81.6	-4.2	5.5	2.9	2.1	3.6

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.8**	**36.3**	**39.9**	**43.1**	**47.3**		**1.7**	**0.8**	**0.8**	**0.9**	**0.8**
Coal	28.4	32.5	32.8	32.6	32.8		1.7	0.1	-0.1	0.1	0.0
Oil	42.6	23.7	33.2	33.5	33.7		-7.1	2.9	0.1	0.0	1.1
Natural gas	33.8	42.9	45.7	48.4	50.5		3.0	0.5	0.6	0.4	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**187.0**	**221.5**	**267.2**	**274.6**	**259.6**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**0.3**	**-0.6**	**0.5**
Coal	58.5	88.2	87.2	74.9	45.9	31.3	39.8	32.6	27.3	17.7	5.3	-0.1	-1.5	-4.8	-2.0
Oil	65.8	73.1	84.5	83.2	78.6	35.2	33.0	31.6	30.3	30.3	1.3	1.2	-0.1	-0.6	0.2
Natural Gas	62.6	60.1	95.6	116.4	135.1	33.5	27.1	35.8	42.4	52.0	-0.5	3.9	2.0	1.5	2.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	255	382	640	912	1,229	5.2	4.4	3.6	3.0	3.7
Population (millions of people)	28.2	31.5	36.1	38.8	40.6	1.4	1.1	0.7	0.5	0.8
GDP per capita (thousands of 2010 USD/person)	9.04	12.12	17.73	23.53	30.30	3.7	3.2	2.9	2.6	2.9
Primary energy consumption per capita (toe/person)	2.57	2.96	3.60	3.77	3.79	1.8	1.6	0.5	0.1	0.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	284	245	203	160	125	-1.9	-1.5	-2.4	-2.4	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	164	164	137	109	88	0.0	-1.5	-2.3	-2.1	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	733	580	418	301	211	-2.9	-2.7	-3.2	-3.5	-3.1
CO_2 emissions per unit of primary energy consumption (t/toe)	2.58	2.37	2.06	1.88	1.69	-1.0	-1.2	-0.9	-1.1	-1.1

Table A.13: Energy Supply and Demand of Myanmar

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.90**	**23.83**	**37.54**	**48.61**	**59.22**	**100**	**100**	**100**	**100**	**100**	**7.0**	**3.9**	**2.6**	**2.0**	**2.9**
Coal	0.41	0.88	0.74	0.85	0.87	2.9	3.7	2.0	1.7	1.5	10.0	-1.4	1.3	0.3	0.0
Oil	1.28	6.86	13.04	18.74	24.02	9.2	28.8	34.7	38.5	40.6	23.3	5.5	3.7	2.5	4.0
Natural gas	1.28	4.12	13.95	21.12	28.85	9.2	17.3	37.2	43.4	48.7	15.7	10.7	4.2	3.2	6.3
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.44	1.21	1.49	1.79	2.02	3.2	5.1	4.0	3.7	3.4	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.48	10.76	8.32	6.13	3.46	75.4	45.1	22.2	12.6	5.8	0.3	-2.1	-3.0	-5.6	-3.5
Biomass	10.48	10.96	9.95	8.39	6.20	75.4	46.0	26.5	17.3	10.5	0.6	-0.8	-1.7	-3.0	-1.8
Solar, WMYA, Ocean	0.00	0.00	0.07	0.19	0.46	0.0	0.0	0.2	0.4	0.8	-	44.3	10.2	9.3	21.6
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Electricity	0.00	-0.20	-1.70	-2.45	-3.20	0.0	-0.9	-4.5	-5.0	-5.4	-	19.4	3.7	2.7	9.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**12.85**	**20.16**	**27.88**	**34.78**	**41.28**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.7**	**2.2**	**1.7**	**2.3**
Industry	1.28	3.69	6.85	10.46	13.49	9.9	18.3	24.6	30.1	32.7	14.2	5.3	4.3	2.6	4.1
Transportation	0.81	2.10	4.04	6.37	9.09	6.3	10.4	14.5	18.3	22.0	12.6	5.6	4.7	3.6	4.7
Others	10.64	13.89	16.31	17.04	17.59	82.8	68.9	58.5	49.0	42.6	3.4	1.3	0.4	0.3	0.7
Non-energy	0.12	0.48	0.70	0.91	1.11	0.9	2.4	2.5	2.6	2.7	19.2	3.2	2.7	2.1	2.7
Total	**12.85**	**20.16**	**27.88**	**34.78**	**41.28**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.7**	**2.2**	**1.7**	**2.3**
Coal	0.23	0.26	0.42	0.56	0.65	1.8	1.3	1.5	1.6	1.6	1.4	4.0	2.8	1.7	2.9
Oil	1.04	6.81	12.89	18.59	23.91	8.1	33.8	46.2	53.5	57.9	26.5	5.5	3.7	2.6	4.0
Natural gas	0.60	0.57	0.73	0.93	1.13	4.6	2.8	2.6	2.7	2.7	-0.5	2.0	2.5	1.9	2.1
Electricity	0.54	1.59	3.93	6.35	9.42	4.2	7.9	14.1	18.3	22.8	14.5	7.8	4.9	4.0	5.7
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.44	10.91	9.91	8.35	6.15	81.3	54.1	35.5	24.0	14.9	0.6	-0.8	-1.7	-3.0	-1.8

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**7.54**	**24.55**	**76.49**	**118.45**	**168.04**	**100**	**100**	**100**	**100**	**100**	**15.9**	**9.9**	**4.5**	**3.6**	**6.2**
Coal	0.67	1.54	0.57	0.47	0.23	8.9	6.3	0.7	0.4	0.1	11.0	-8.0	-1.9	-7.1	-5.8
Oil	0.03	0.08	0.27	0.21	0.00	0.4	0.3	0.4	0.2	0.0	11.2	11.0	-2.3	-88.3	-47.2
Natural gas	1.73	8.80	57.47	94.80	138.98	23.0	35.8	75.1	80.0	82.7	22.5	16.9	5.1	3.9	9.0
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	5.11	14.13	17.34	20.76	23.48	67.7	57.5	22.7	17.5	14.0	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.00	0.01	0.83	2.21	5.36	0.0	0.0	1.1	1.9	3.2	-	44.2	10.2	9.3	21.6

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**0.73**	**3.35**	**12.73**	**19.65**	**27.06**	**100**	**100**	**100**	**100**	**100**	**21.1**	**11.8**	**4.4**	**3.3**	**6.7**
Coal	0.18	0.47	0.17	0.14	0.07	24.6	14.0	1.4	0.7	0.2	12.8	-8.0	-1.9	-7.2	-5.9
Oil	0.01	0.02	0.07	0.06	0.00	1.1	0.6	0.6	0.3	0.0	12.3	10.9	-2.4	-88.3	-47.3
Natural gas	0.54	2.86	12.48	19.45	26.99	74.2	85.4	98.1	99.0	99.8	23.2	13.1	4.5	3.3	7.3

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**28.9**	**26.8**	**39.4**	**41.8**	**44.2**		**-1.0**	**3.3**	**0.6**	**0.6**	**1.6**
Coal	32.3	28.4	28.4	28.5	28.8		-1.6	0.0	0.0	0.1	0.0
Oil	34.3	31.6	32.1	32.2	32.3		-1.0	0.1	0.0	0.1	0.1
Natural gas	27.7	26.5	39.6	41.9	44.3		-0.6	3.4	0.6	0.6	1.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**8.0**	**31.4**	**72.0**	**105.9**	**139.5**	**100**	**100**	**100**	**100**	**100**	**18.6**	**7.2**	**3.9**	**2.8**	**4.8**
Coal	1.7	2.9	2.4	2.8	2.9	20.6	9.3	3.3	2.6	2.1	7.4	-1.7	1.6	0.3	0.0
Oil	3.4	19.8	37.9	54.5	69.9	42.7	62.9	52.6	51.5	50.1	24.5	5.6	3.7	2.5	4.0
Natural Gas	3.0	8.7	31.8	48.6	66.7	36.8	27.8	44.1	45.9	47.8	14.5	11.4	4.3	3.2	6.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	41	71	143	238	369	6.9	6.0	5.3	4.5	5.3
Population (millions of people)	50.6	53.7	58.5	61.2	62.3	0.7	0.7	0.5	0.2	0.5
GDP per capita (thousands of 2010 USD/person)	0.82	1.32	2.44	3.90	5.92	6.1	5.3	4.8	4.3	4.8
Primary energy consumption per capita (toe/person)	0.27	0.44	0.64	0.79	0.95	6.2	3.1	2.2	1.8	2.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	335	337	263	204	161	0.1	-2.1	-2.5	-2.4	-2.3
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	310	285	195	146	112	-1.0	-3.1	-2.9	-2.6	-2.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	194	445	505	444	378	10.9	1.1	-1.3	-1.6	-0.5
CO_2 emissions per unit of primary energy consumption (t/toe)	0.58	1.32	1.92	2.18	2.36	10.9	3.2	1.3	0.8	1.8

Table A.14: Energy Supply and Demand of Philippines

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**40.40**	**60.05**	**91.57**	**113.91**	**137.88**	**100**	**100**	**100**	**100**	**100**	**5.1**	**3.6**	**2.2**	**1.9**	**2.6**
Coal	7.63	17.94	16.75	13.93	10.80	18.9	29.9	18.3	12.2	7.8	11.3	-0.6	-1.8	-2.5	-1.6
Oil	13.60	19.99	34.72	48.52	64.85	33.7	33.3	37.9	42.6	47.0	4.9	4.7	3.4	2.9	3.7
Natural gas	3.05	3.63	11.46	19.76	27.55	7.6	6.0	12.5	17.3	20.0	2.2	10.1	5.6	3.4	6.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.67	0.81	1.10	1.21	1.32	1.7	1.3	1.2	1.1	1.0	2.3	2.6	1.0	0.9	1.6
Geothermal	8.54	8.97	17.17	19.40	21.36	21.1	14.9	18.8	17.0	15.5	0.6	5.6	1.2	1.0	2.7
Others	6.91	8.72	10.37	11.10	11.99	17.1	14.5	11.3	9.7	8.7	2.9	1.5	0.7	0.8	1.0
Biomass	6.90	8.51	9.59	9.49	9.19	17.1	14.2	10.5	8.3	6.7	2.7	1.0	-0.1	-0.3	0.2
Solar, WPHL, Ocean	0.01	0.21	0.78	1.61	2.80	0.0	0.3	0.8	1.4	2.0	57.6	11.7	7.6	5.7	8.5
Biofuels	0.18	0.48	0.98	1.43	1.98	0.5	0.8	1.1	1.3	1.4	12.7	6.2	3.9	3.3	4.5
Electricity	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**23.71**	**33.83**	**54.95**	**73.68**	**95.16**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Industry	6.41	7.63	11.41	14.09	16.89	27.0	22.6	20.8	19.1	17.8	2.2	3.4	2.1	1.8	2.5
Transportation	8.04	12.28	23.81	34.82	48.50	33.9	36.3	43.3	47.3	51.0	5.4	5.7	3.9	3.4	4.4
Others	9.14	12.65	17.51	21.25	24.16	38.5	37.4	31.9	28.8	25.4	4.2	2.7	2.0	1.3	2.0
Non-energy	0.12	1.26	2.22	3.52	5.61	0.5	3.7	4.0	4.8	5.9	34.2	4.8	4.7	4.8	4.8
Total	**23.71**	**33.83**	**54.95**	**73.68**	**95.16**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Coal	1.88	2.52	3.56	4.24	4.87	7.9	7.4	6.5	5.8	5.1	3.7	2.9	1.8	1.4	2.1
Oil	11.46	18.21	32.63	46.25	62.59	48.3	53.8	59.4	62.8	65.8	6.0	5.0	3.6	3.1	3.9
Natural gas	0.07	0.06	0.09	0.12	0.15	0.3	0.2	0.2	0.2	0.2	-2.0	3.6	2.7	2.1	2.8
Electricity	4.75	7.10	11.86	16.51	21.42	20.0	21.0	21.6	22.4	22.5	5.2	4.4	3.4	2.6	3.5
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	5.55	5.93	6.81	6.57	6.13	23.4	17.5	12.4	8.9	6.4	0.8	1.2	-0.4	-0.7	0.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**67.74**	**99.19**	**164.53**	**225.97**	**288.72**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.3**	**3.2**	**2.5**	**3.4**
Coal	23.30	51.93	45.33	34.17	20.83	34.4	52.4	27.6	15.1	7.2	10.5	-1.1	-2.8	-4.8	-2.8
Oil	7.10	3.17	3.40	2.82	1.15	10.5	3.2	2.1	1.2	0.4	-9.6	0.6	-1.9	-8.6	-3.1
Natural gas	19.52	21.33	72.69	131.88	191.69	28.8	21.5	44.2	58.4	66.4	1.1	10.8	6.1	3.8	7.1
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	7.80	9.38	12.75	14.03	15.36	11.5	9.5	7.8	6.2	5.3	2.3	2.6	1.0	0.9	1.6
Geothermal	9.93	10.44	19.97	22.56	24.85	14.7	10.5	12.1	10.0	8.6	0.6	5.6	1.2	1.0	2.7
Others	0.09	2.93	10.38	20.52	34.84	0.1	3.0	6.3	9.1	12.1	54.6	11.1	7.1	5.4	8.0

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**9.74**	**18.97**	**24.49**	**29.14**	**32.80**	**100**	**100**	**100**	**100**	**100**	**8.7**	**2.2**	**1.8**	**1.2**	**1.7**
Coal	5.51	14.90	12.68	9.19	5.44	56.6	78.5	51.8	31.5	16.6	13.2	-1.3	-3.2	-5.1	-3.1
Oil	1.48	0.73	0.72	0.62	0.26	15.2	3.8	2.9	2.1	0.8	-8.5	-0.1	-1.5	-8.4	-3.2
Natural gas	2.75	3.35	11.10	19.33	27.10	28.2	17.7	45.3	66.3	82.6	2.5	10.5	5.7	3.4	6.8

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**44.0**	**34.6**	**42.6**	**49.8**	**56.0**						**-3.0**	**1.7**	**1.6**	**1.2**	**1.5**
Coal	36.3	30.0	30.7	32.0	32.9						-2.4	0.2	0.4	0.3	0.3
Oil	41.2	37.5	40.8	39.2	38.6						-1.2	0.7	-0.4	-0.2	0.1
Natural gas	61.0	54.8	56.3	58.7	60.8						-1.3	0.2	0.4	0.4	0.3

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**76.4**	**132.5**	**186.7**	**231.7**	**279.4**	**100**	**100**	**100**	**100**	**100**	**7.1**	**2.9**	**2.2**	**1.9**	**2.4**
Coal	29.8	70.0	65.2	54.0	41.5	39.0	52.8	34.9	23.3	14.8	11.3	-0.6	-1.9	-2.6	-1.6
Oil	39.4	54.1	94.7	131.5	173.6	51.6	40.8	50.7	56.8	62.1	4.0	4.8	3.3	2.8	3.7
Natural Gas	7.1	8.5	26.8	46.2	64.4	9.3	6.4	14.4	19.9	23.0	2.2	10.1	5.6	3.4	6.5

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	200	322	613	907	1,290	6.2	5.5	4.0	3.6	4.4
Population (millions of people)	94.0	106.7	123.7	135.6	144.5	1.6	1.2	0.9	0.6	1.0
GDP per capita (thousands of 2010 USD/person)	2.12	3.02	4.96	6.69	8.93	4.5	4.2	3.0	2.9	3.4
Primary energy consumption per capita (toe/person)	0.43	0.56	0.74	0.84	0.95	3.4	2.3	1.3	1.3	1.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	202	186	149	126	107	-1.0	-1.8	-1.7	-1.6	-1.7
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	119	105	90	81	74	-1.5	-1.3	-1.0	-1.0	-1.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	383	411	304	255	217	0.9	-2.5	-1.7	-1.6	-2.0
CO_2 emissions per unit of primary energy consumption (t/toe)	1.89	2.21	2.04	2.03	2.03	1.9	-0.7	0.0	0.0	-0.3

Table A.15: Energy Supply and Demand of Thailand

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**117.86**	**135.81**	**172.20**	**193.20**	**210.47**	**100**	**100**	**100**	**100**	**100**	**1.8**	**2.0**	**1.2**	**0.9**	**1.4**
Coal	16.36	15.83	14.16	11.67	8.81	13.9	11.7	8.2	6.0	4.2	-0.4	-0.9	-1.9	-2.8	-1.8
Oil	44.95	55.36	64.85	70.11	73.24	38.1	40.8	37.7	36.3	34.8	2.6	1.3	0.8	0.4	0.9
Natural gas	32.97	35.51	45.73	50.55	51.06	28.0	26.1	26.6	26.2	24.3	0.9	2.1	1.0	0.1	1.1
Nuclear	0.00	0.00	0.00	1.83	6.21	0.0	0.0	0.0	0.9	2.9	-	-	-	13.0	-
Hydro	0.48	0.65	0.82	0.92	0.98	0.4	0.5	0.5	0.5	0.5	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	23.10	28.45	46.64	58.12	70.17	19.6	20.9	27.1	30.1	33.3	2.6	4.2	2.2	1.9	2.9
Biomass	22.61	25.70	40.14	48.59	57.37	19.2	18.9	23.3	25.1	27.3	1.6	3.8	1.9	1.7	2.5
Solar, WTHA, Ocean	0.00	0.54	2.29	4.32	6.59	0.0	0.4	1.3	2.2	3.1	87.7	12.8	6.6	4.3	8.1
Biofuels	0.65	1.94	2.75	4.21	6.10	0.6	1.4	1.6	2.2	2.9	14.6	2.9	4.4	3.8	3.6
Electricity	0.49	2.21	4.21	5.21	6.21	0.4	1.6	2.4	2.7	2.9	20.8	5.5	2.2	1.8	3.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**84.90**	**100.16**	**120.95**	**135.77**	**146.45**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Industry	26.48	30.31	39.49	45.54	48.82	31.2	30.3	32.6	33.5	33.3	1.7	2.2	1.4	0.7	1.5
Transportation	19.92	27.56	29.18	31.60	33.46	23.5	27.5	24.1	23.3	22.8	4.1	0.5	0.8	0.6	0.6
Others	20.43	17.72	21.12	22.85	24.13	24.1	17.7	17.5	16.8	16.5	-1.8	1.5	0.8	0.5	1.0
Non-energy	18.07	24.57	31.17	35.77	40.05	21.3	24.5	25.8	26.3	27.3	3.9	2.0	1.4	1.1	1.5
Total	**84.90**	**100.16**	**120.95**	**135.77**	**146.45**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Coal	9.21	6.83	7.84	7.81	7.27	10.8	6.8	6.5	5.8	5.0	-3.7	1.2	0.0	-0.7	0.2
Oil	43.84	54.69	62.72	67.66	70.57	51.6	54.6	51.9	49.8	48.2	2.8	1.1	0.8	0.4	0.8
Natural gas	4.59	7.21	8.95	10.94	12.92	5.4	7.2	7.4	8.1	8.8	5.8	1.8	2.0	1.7	1.8
Electricity	12.84	16.17	23.37	28.90	33.41	15.1	16.1	19.3	21.3	22.8	2.9	3.1	2.1	1.5	2.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	14.42	15.27	18.06	20.46	22.29	17.0	15.2	14.9	15.1	15.2	0.7	1.4	1.3	0.9	1.2

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**159.52**	**182.30**	**248.18**	**305.33**	**349.17**	**100**	**100**	**100**	**100**	**100**	**1.7**	**2.6**	**2.1**	**1.4**	**2.1**
Coal	30.05	36.41	25.78	15.91	6.30	18.8	20.0	10.4	5.2	1.8	2.4	-2.8	-4.7	-8.8	-5.3
Oil	1.18	0.18	0.00	0.00	0.00	0.7	0.1	0.0	0.0	0.0	-21.1	-83.0	0.0	0.0	-48.6
Natural gas	119.35	115.64	150.80	174.32	171.64	74.8	63.4	60.8	57.1	49.2	-0.4	2.2	1.5	-0.2	1.2
Nuclear	0.00	0.00	0.00	7.03	23.83	0.0	0.0	0.0	2.3	6.8	-	-	-	13.0	-
Hydro	5.54	7.57	9.51	10.75	11.46	3.5	4.1	3.8	3.5	3.3	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.01	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	3.41	22.51	62.08	97.32	135.94	2.1	12.3	25.0	31.9	38.9	26.6	8.8	4.6	3.4	5.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**29.87**	**30.65**	**34.19**	**35.11**	**31.36**	**100**	**100**	**100**	**100**	**100**	**0.3**	**0.9**	**0.3**	**-1.1**	**0.1**
Coal	6.92	8.99	6.33	3.88	1.56	23.2	29.3	18.5	11.0	5.0	3.3	-2.9	-4.8	-8.7	-5.3
Oil	0.26	0.05	0.00	0.00	0.00	0.9	0.2	0.0	0.0	0.0	-18.8	-83.5	-0.7	-0.2	-49.2
Natural gas	22.68	21.61	27.86	31.23	29.81	75.9	70.5	81.5	89.0	95.0	-0.6	2.1	1.1	-0.5	1.0

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**43.3**	**42.7**	**44.4**	**46.6**	**48.8**		**-0.2**	**0.3**	**0.5**	**0.5**	**0.4**
Coal	37.3	34.8	35.0	35.3	34.8		-0.9	0.0	0.1	-0.1	0.0
Oil	38.4	30.5	41.0	44.1	44.9		-2.8	2.5	0.7	0.2	1.2
Natural gas	45.2	46.0	46.5	48.0	49.5		0.2	0.1	0.3	0.3	0.2

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**219.7**	**238.2**	**264.3**	**268.1**	**255.1**	**100**	**100**	**100**	**100**	**100**	**1.0**	**0.9**	**0.1**	**-0.5**	**0.2**
Coal	65.2	63.9	57.1	47.1	35.5	29.7	26.8	21.6	17.6	13.9	-0.2	-0.9	-1.9	-2.8	-1.8
Oil	79.8	95.1	107.7	112.3	111.8	36.3	39.9	40.7	41.9	43.8	2.2	1.0	0.4	0.0	0.5
Natural Gas	74.7	79.1	99.5	108.7	107.8	34.0	33.2	37.6	40.6	42.2	0.7	1.9	0.9	-0.1	1.0

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	341	442	656	907	1,191	3.3	3.3	3.3	2.8	3.1
Population (millions of people)	67.2	69.4	70.3	69.0	65.9	0.4	0.1	-0.2	-0.5	-0.2
GDP per capita (thousands of 2010 USD/person)	5.08	6.36	9.32	13.14	18.07	2.9	3.2	3.5	3.2	3.3
Primary energy consumption per capita (toe/person)	1.75	1.96	2.45	2.80	3.19	1.4	1.9	1.4	1.3	1.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	346	307	263	213	177	-1.4	-1.3	-2.1	-1.9	-1.7
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	249	227	184	150	123	-1.2	-1.7	-2.1	-2.0	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	644	539	403	296	214	-2.2	-2.4	-3.1	-3.2	-2.8
CO_2 emissions per unit of primary energy consumption (t/toe)	1.86	1.75	1.53	1.39	1.21	-0.8	-1.1	-1.0	-1.3	-1.1

Table A.16: Energy Supply and Demand of Viet Nam

(NNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**58.60**	**83.46**	**136.53**	**178.24**	**224.16**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.2**	**2.7**	**2.3**	**3.1**
Coal	14.65	36.74	43.95	48.01	47.59	25.0	44.0	32.2	26.9	21.2	12.2	1.5	0.9	-0.1	0.8
Oil	18.35	22.50	35.46	46.19	59.31	31.3	27.0	26.0	25.9	26.5	2.6	3.9	2.7	2.5	3.1
Natural gas	8.12	7.94	35.47	54.78	81.11	13.9	9.5	26.0	30.7	36.2	-0.3	13.3	4.4	4.0	7.5
Nuclear	0.00	0.00	0.00	4.21	8.58	0.0	0.0	0.0	2.4	3.8	-	-	-	7.4	-
Hydro	2.37	7.23	9.86	11.00	11.65	4.0	8.7	7.2	6.2	5.2	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	15.11	9.04	11.79	14.06	15.92	25.8	10.8	8.6	7.9	7.1	-6.2	2.2	1.8	1.2	1.8
Biomass	14.71	8.91	9.60	10.51	10.83	25.1	10.7	7.0	5.9	4.8	-6.1	0.6	0.9	0.3	0.6
Solar, WVNM, Ocean	0.00	0.04	1.61	2.71	4.00	0.0	0.1	1.2	1.5	1.8	34.0	34.7	5.4	4.0	15.1
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	12.0	7.6	-
Electricity	0.40	0.09	0.59	0.84	1.09	0.7	0.1	0.4	0.5	0.5	-17.5	17.4	3.6	2.7	8.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**48.51**	**60.27**	**103.08**	**134.38**	**169.38**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Industry	17.42	32.54	62.16	79.53	97.36	35.9	54.0	60.3	59.2	57.5	8.1	5.5	2.5	2.0	3.5
Transportation	10.32	12.06	18.28	24.06	31.04	21.3	20.0	17.7	17.9	18.3	2.0	3.5	2.8	2.6	3.0
Others	18.51	14.19	20.32	27.63	36.91	38.2	23.5	19.7	20.6	21.8	-3.3	3.0	3.1	2.9	3.0
Non-energy	2.26	1.48	2.32	3.15	4.06	4.7	2.5	2.3	2.3	2.4	-5.2	3.8	3.1	2.6	3.2
Total	**48.51**	**60.27**	**103.08**	**134.38**	**169.38**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Coal	9.81	14.17	22.61	27.67	31.62	20.2	23.5	21.9	20.6	18.7	4.7	4.0	2.0	1.3	2.5
Oil	16.81	20.75	33.72	44.28	57.16	34.7	34.4	32.7	33.0	33.7	2.7	4.1	2.8	2.6	3.2
Natural gas	0.49	0.99	5.63	7.07	8.34	1.0	1.6	5.5	5.3	4.9	9.1	15.6	2.3	1.7	6.9
Electricity	7.47	16.28	32.38	45.74	62.36	15.4	27.0	31.4	34.0	36.8	10.2	5.9	3.5	3.1	4.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	13.91	8.08	8.73	9.62	9.91	28.7	13.4	8.5	7.2	5.9	-6.6	0.6	1.0	0.3	0.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**94.90**	**240.94**	**440.21**	**608.84**	**820.35**	**100**	**100**	**100**	**100**	**100**	**12.4**	**5.2**	**3.3**	**3.0**	**3.9**
Coal	19.69	114.18	110.65	105.86	83.79	20.7	47.4	25.1	17.4	10.2	24.6	-0.3	-0.4	-2.3	-1.0
Oil	3.41	0.26	0.00	0.00	0.00	3.6	0.1	0.0	0.0	0.0	-27.6	-83.6	0.0	0.0	-49.2
Natural gas	44.15	41.73	196.01	327.07	521.28	46.5	17.3	44.5	53.7	63.5	-0.7	13.8	5.3	4.8	8.2
Nuclear	0.00	0.00	0.00	16.16	32.94	0.0	0.0	0.0	2.7	4.0	-	-	-	7.4	-
Hydro	27.55	84.13	114.65	127.95	135.49	29.0	34.9	26.0	21.0	16.5	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.11	0.65	18.89	31.80	46.85	0.1	0.3	4.3	5.2	5.7	25.5	32.5	5.3	4.0	14.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.63**	**29.52**	**51.02**	**67.83**	**88.48**	**100**	**100**	**100**	**100**	**100**	**10.1**	**4.7**	**2.9**	**2.7**	**3.5**
Coal	4.84	22.57	21.25	20.19	15.78	35.5	76.5	41.6	29.8	17.8	21.2	-0.5	-0.5	-2.4	-1.1
Oil	1.16	0.07	0.00	0.00	0.00	8.5	0.2	0.0	0.0	0.0	-30.2	-83.4	-0.7	-0.9	-49.2
Natural gas	7.63	6.89	29.78	47.64	72.70	56.0	23.3	58.4	70.2	82.2	-1.3	13.0	4.8	4.3	7.6

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**42.4**	**45.5**	**51.7**	**54.9**	**58.8**						**0.9**	**1.1**	**0.6**	**0.7**	**0.8**
Coal	35.0	43.5	44.8	45.1	45.7						2.8	0.2	0.1	0.1	0.2
Oil	25.3	34.0	29.1	31.1	34.0						3.8	-1.3	0.7	0.9	0.0
Natural gas	49.7	52.1	56.6	59.0	61.7						0.6	0.7	0.4	0.4	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.8**	**227.0**	**356.3**	**446.9**	**542.4**	**100**	**100**	**100**	**100**	**100**	**7.8**	**3.8**	**2.3**	**2.0**	**2.8**
Coal	60.0	150.4	180.0	196.6	194.9	48.1	66.3	50.5	44.0	35.9	12.2	1.5	0.9	-0.1	0.8
Oil	45.7	58.1	93.2	121.7	157.0	36.6	25.6	26.1	27.2	28.9	3.0	4.0	2.7	2.6	3.2
Natural Gas	19.1	18.5	83.2	128.6	190.5	15.3	8.1	23.4	28.8	35.1	-0.4	13.3	4.4	4.0	7.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	116	188	375	624	985	6.2	5.9	5.2	4.7	5.3
Population (millions of people)	88.0	95.5	104.2	107.8	109.6	1.0	0.7	0.3	0.2	0.4
GDP per capita (thousands of 2010 USD/person)	1.32	1.96	3.60	5.79	8.99	5.1	5.2	4.9	4.5	4.9
Primary energy consumption per capita (toe/person)	0.67	0.87	1.31	1.65	2.05	3.4	3.4	2.4	2.1	2.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	506	445	364	286	228	-1.6	-1.7	-2.4	-2.2	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	418	321	275	215	172	-3.3	-1.3	-2.4	-2.2	-1.9
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	1,076	1,210	950	716	551	1.5	-2.0	-2.8	-2.6	-2.4
CO2 emissions per unit of primary energy consumption (t/toe)	2.13	2.72	2.61	2.51	2.42	3.1	-0.3	-0.4	-0.4	-0.4

Table A.17: Energy Supply and Demand of Total of the Seven EAS Countries

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,205.70**	**1,547.16**	**2,324.37**	**2,862.73**	**3,394.25**	**100**	**100**	**100**	**100**	**100**	**3.2**	**3.5**	**2.1**	**1.7**	**2.5**
Coal	364.52	563.45	654.39	693.16	661.83	30.2	36.4	28.2	24.2	19.5	5.6	1.3	0.6	-0.5	0.5
Oil	332.98	446.25	684.33	908.98	1,186.54	27.6	28.8	29.4	31.8	35.0	3.7	3.6	2.9	2.7	3.1
Natural gas	169.84	181.33	396.63	483.98	603.76	14.1	11.7	17.1	16.9	17.8	0.8	6.7	2.0	2.2	3.8
Nuclear	6.84	9.85	43.04	63.36	86.68	0.6	0.6	1.9	2.2	2.6	4.7	13.1	3.9	3.2	7.0
Hydro	16.75	27.02	39.46	48.58	57.04	1.4	1.7	1.7	1.7	1.7	6.2	3.2	2.1	1.6	2.4
Geothermal	24.63	33.08	75.12	95.75	117.47	2.0	2.1	3.2	3.3	3.5	3.8	7.1	2.5	2.1	4.0
Others	290.13	286.17	431.41	568.92	680.95	24.1	18.5	18.6	19.9	20.1	-0.2	3.5	2.8	1.8	2.7
Biomass	286.77	273.60	303.85	301.05	287.82	23.8	17.7	13.1	10.5	8.5	-0.6	0.9	-0.1	-0.4	0.2
Solar, Wind, Ocean	2.01	10.81	124.80	264.61	389.37	0.2	0.7	5.4	9.2	11.5	23.4	22.6	7.8	3.9	11.9
Biofuels	1.07	6.57	8.61	12.72	17.73	0.1	0.4	0.4	0.4	0.5	25.5	2.3	4.0	3.4	3.2
Electricity	1.35	1.76	2.76	3.26	3.76	0.1	0.1	0.1	0.1	0.1	3.4	3.8	1.7	1.4	2.4

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**836.15**	**1,039.59**	**1,609.50**	**2,052.49**	**2,504.81**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Industry	267.22	349.93	610.25	771.63	876.63	32.0	33.7	37.9	37.6	35.0	3.4	4.7	2.4	1.3	2.9
Transportation	148.97	233.11	356.28	506.65	729.73	17.8	22.4	22.1	24.7	29.1	5.8	3.6	3.6	3.7	3.6
Others	351.38	356.20	474.59	557.61	633.86	42.0	34.3	29.5	27.2	25.3	0.2	2.4	1.6	1.3	1.8
Non-energy	68.59	100.34	168.39	216.61	264.59	8.2	9.7	10.5	10.6	10.6	4.9	4.4	2.5	2.0	3.1
Total	**836.15**	**1,039.59**	**1,609.50**	**2,052.49**	**2,504.81**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Coal	127.35	146.91	249.23	310.87	350.89	15.2	14.1	15.5	15.1	14.0	1.8	4.5	2.2	1.2	2.8
Oil	290.24	412.11	635.73	846.50	1,109.44	34.7	39.6	39.5	41.2	44.3	4.5	3.7	2.9	2.7	3.1
Natural gas	46.51	76.77	161.25	217.19	263.67	5.6	7.4	10.0	10.6	10.5	6.5	6.4	3.0	2.0	3.9
Electricity	109.74	179.62	339.68	479.42	619.09	13.1	17.3	21.1	23.4	24.7	6.4	5.5	3.5	2.6	3.9
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	262.32	224.17	223.61	198.50	161.71	31.4	21.6	13.9	9.7	6.5	-1.9	0.0	-1.2	-2.0	-1.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,599.05**	**2,584.44**	**4,811.82**	**6,624.31**	**8,338.66**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.3**	**3.2**	**2.3**	**3.7**
Coal	842.95	1,604.77	1,474.39	1,289.67	893.34	52.7	62.1	30.6	19.5	10.7	8.4	-0.7	-1.3	-3.6	-1.8
Oil	67.21	27.46	37.49	39.98	32.59	4.2	1.1	0.8	0.6	0.4	-10.6	2.6	0.6	-2.0	0.5
Natural gas	409.08	384.43	1,070.39	1,220.20	1,668.57	25.6	14.9	22.2	18.4	20.0	-0.8	8.9	1.3	3.2	4.7
Nuclear	26.27	37.81	165.17	243.19	332.66	1.6	1.5	3.4	3.7	4.0	4.7	13.1	3.9	3.2	7.0
Hydro	194.85	314.29	458.88	564.95	663.34	12.2	12.2	9.5	8.5	8.0	6.2	3.2	2.1	1.6	2.4
Geothermal	19.29	24.46	53.68	66.97	80.74	1.2	0.9	1.1	1.0	1.0	3.0	6.8	2.2	1.9	3.8
Others	39.41	191.22	1,551.82	3,199.35	4,667.42	2.5	7.4	32.3	48.3	56.0	21.8	19.1	7.5	3.8	10.5

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**330.28**	**481.35**	**567.06**	**540.98**	**506.12**	**100**	**100**	**100**	**100**	**100**	**4.8**	**1.4**	**-0.5**	**-0.7**	**0.2**
Coal	225.75	392.87	361.14	316.70	220.62	68.4	81.6	63.7	58.5	43.6	7.2	-0.7	-1.3	-3.6	-1.8
Oil	19.37	12.18	11.23	11.35	8.73	5.9	2.5	2.0	2.1	1.7	-5.6	-0.7	0.1	-2.6	-1.0
Natural gas	85.15	76.30	194.69	212.93	276.78	25.8	15.9	34.3	39.4	54.7	-1.4	8.1	0.9	2.7	4.1

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.3**	**36.0**	**39.2**	**40.5**	**44.1**						**0.6**	**0.7**	**0.3**	**0.8**	**0.6**
Coal	32.1	35.1	35.1	35.0	34.8						1.1	0.0	0.0	-0.1	0.0
Oil	29.8	19.4	28.7	30.3	32.1						-5.2	3.3	0.5	0.6	1.6
Natural gas	41.3	43.3	47.3	49.3	51.8						0.6	0.7	0.4	0.5	0.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**2,596.9**	**3,714.3**	**5,114.3**	**6,021.2**	**6,890.3**	**100**	**100**	**100**	**100**	**100**	**4.6**	**2.7**	**1.6**	**1.4**	**1.9**
Coal	1,440.6	2,225.9	2,585.4	2,738.0	2,613.4	55.5	59.9	50.6	45.5	37.9	5.6	1.3	0.6	-0.5	0.5
Oil	834.9	1,145.9	1,772.2	2,375.6	3,141.2	32.2	30.8	34.7	39.5	45.6	4.0	3.7	3.0	2.8	3.2
Natural Gas	320.8	340.7	755.0	905.8	1,133.9	12.4	9.2	14.8	15.0	16.5	0.8	6.9	1.8	2.3	3.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	3,378	5,383	10,662	17,171	25,805	6.0	5.9	4.9	4.2	5.0
Population (millions of people)	1,804.1	1,977.1	2,195.8	2,324.0	2,393.3	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.87	2.72	4.86	7.39	10.78	4.8	4.9	4.3	3.9	4.4
Primary energy consumption per capita (toe/person)	0.67	0.78	1.06	1.23	1.42	2.0	2.5	1.5	1.4	1.9
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	357	287	218	167	132	-2.7	-2.3	-2.6	-2.3	-2.4
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	248	193	151	120	97	-3.1	-2.0	-2.3	-2.1	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	769	690	480	351	267	-1.3	-3.0	-3.1	-2.7	-2.9
CO_2 emissions per unit of primary energy consumption (t/toe)	2.15	2.40	2.20	2.10	2.03	1.4	-0.7	-0.4	-0.4	-0.5

Table A.18: Energy Supply and Demand of India

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**700.76**	**919.44**	**1,439.45**	**1,795.11**	**2,152.55**	**100**	**100**	**100**	**100**	**100**	**3.5**	**3.8**	**2.2**	**1.8**	**2.7**
Coal	279.03	414.21	492.31	536.05	525.73	39.8	45.1	34.2	29.9	24.4	5.1	1.4	0.9	-0.2	0.7
Oil	162.07	235.25	397.99	563.40	782.59	23.1	25.6	27.6	31.4	36.4	4.8	4.5	3.5	3.3	3.8
Natural gas	54.40	52.41	178.60	212.69	279.01	7.8	5.7	12.4	11.8	13.0	-0.5	10.8	1.8	2.8	5.4
Nuclear	6.84	9.85	43.04	53.66	68.24	1.0	1.1	3.0	3.0	3.2	4.7	13.1	2.2	2.4	6.2
Hydro	10.74	13.00	21.00	27.69	34.51	1.5	1.4	1.5	1.5	1.6	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	187.67	194.72	306.52	401.61	462.47	26.8	21.2	21.3	22.4	21.5	0.5	3.9	2.7	1.4	2.7
Biomass	185.20	185.10	212.28	203.40	184.59	26.4	20.1	14.7	11.3	8.6	0.0	1.1	-0.4	-1.0	0.0
Solar, Wind, Ocean	1.99	9.95	94.57	198.55	278.21	0.3	1.1	6.6	11.1	12.9	22.3	20.6	7.7	3.4	11.0
Biofuels	0.05	0.88	1.38	2.69	4.31	0.0	0.1	0.1	0.1	0.2	41.8	3.8	6.9	4.8	5.1
Electricity	0.48	-0.33	-0.33	-0.33	-0.33	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**478.45**	**606.58**	**1,000.39**	**1,303.69**	**1,618.72**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.3**	**2.7**	**2.2**	**3.1**
Industry	151.62	206.09	390.51	499.42	559.01	31.7	34.0	39.0	38.3	34.5	3.9	5.5	2.5	1.1	3.2
Transportation	64.80	103.77	183.04	291.50	468.26	13.5	17.1	18.3	22.4	28.9	6.1	4.8	4.8	4.9	4.8
Others	227.92	245.92	338.22	392.82	440.55	47.6	40.5	33.8	30.1	27.2	1.0	2.7	1.5	1.2	1.8
Non-energy	34.12	50.81	88.63	119.95	150.90	7.1	8.4	8.9	9.2	9.3	5.1	4.7	3.1	2.3	3.5
Total	**478.45**	**606.58**	**1,000.39**	**1,303.69**	**1,618.72**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.3**	**2.7**	**2.2**	**3.1**
Coal	87.19	106.61	190.83	240.78	272.02	18.2	17.6	19.1	18.5	16.8	2.5	5.0	2.4	1.2	3.0
Oil	138.11	207.70	360.97	515.16	720.64	28.9	34.2	36.1	39.5	44.5	5.2	4.7	3.6	3.4	4.0
Natural gas	18.64	32.42	77.64	112.51	141.00	3.9	5.3	7.8	8.6	8.7	7.2	7.5	3.8	2.3	4.7
Electricity	61.94	103.29	209.64	298.06	382.28	12.9	17.0	21.0	22.9	23.6	6.6	6.1	3.6	2.5	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	172.56	156.56	161.33	137.17	102.78	36.1	25.8	16.1	10.5	6.3	-1.2	0.3	-1.6	-2.8	-1.3

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**974.80**	**1,583.22**	**3,123.85**	**4,277.78**	**5,284.07**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.8**	**3.2**	**2.1**	**3.8**
Coal	657.96	1,163.40	1,046.82	926.17	649.71	67.5	73.5	33.5	21.7	12.3	7.4	-0.9	-1.2	-3.5	-1.8
Oil	17.67	7.85	10.08	8.94	5.10	1.8	0.5	0.3	0.2	0.1	-9.6	2.1	-1.2	-5.4	-1.3
Natural gas	113.29	73.62	503.60	442.86	664.51	11.6	4.6	16.1	10.4	12.6	-5.2	17.4	-1.3	4.1	7.1
Nuclear	26.27	37.81	165.17	205.94	261.88	2.7	2.4	5.3	4.8	5.0	4.7	13.1	2.2	2.4	6.2
Hydro	124.92	151.13	244.24	322.04	401.40	12.8	9.5	7.8	7.5	7.6	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	34.70	149.40	1,153.94	2,371.83	3,301.47	3.6	9.4	36.9	55.4	62.5	20.0	18.6	7.5	3.4	10.2

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**209.39**	**304.61**	**353.52**	**312.19**	**277.27**	**100**	**100**	**100**	**100**	**100**	**4.8**	**1.2**	**-1.2**	**-1.2**	**-0.3**
Coal	177.27	284.97	258.55	230.80	164.55	84.7	93.6	73.1	73.9	59.3	6.1	-0.8	-1.1	-3.3	-1.7
Oil	7.25	4.18	4.74	4.16	2.39	3.5	1.4	1.3	1.3	0.9	-6.7	1.1	-1.3	-5.4	-1.7
Natural gas	24.87	15.46	90.23	77.23	110.32	11.9	5.1	25.5	24.7	39.8	-5.8	15.8	-1.5	3.6	6.3

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**32.4**	**35.1**	**38.0**	**38.0**	**40.9**						**1.0**	**0.6**	**0.0**	**0.8**	**0.5**
Coal	31.9	35.1	34.8	34.5	33.9						1.2	-0.1	-0.1	-0.2	-0.1
Oil	21.0	16.2	18.3	18.5	18.4						-3.2	1.0	0.1	0.0	0.4
Natural gas	39.2	40.9	48.0	49.3	51.8						0.6	1.3	0.3	0.5	0.7

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,585.0**	**2,324.2**	**3,322.7**	**3,995.7**	**4,697.5**	**100**	**100**	**100**	**100**	**100**	**4.9**	**3.0**	**1.9**	**1.6**	**2.2**
Coal	1,083.7	1,628.4	1,935.7	2,107.8	2,067.2	68.4	70.1	58.3	52.8	44.0	5.2	1.5	0.9	-0.2	0.7
Oil	425.9	611.1	1,047.6	1,500.0	2,117.8	26.9	26.3	31.5	37.5	45.1	4.6	4.6	3.7	3.5	4.0
Natural Gas	74.7	83.5	338.2	386.7	511.3	4.7	3.6	10.2	9.7	10.9	1.4	12.4	1.3	2.8	5.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	1,670	2,831	6,146	10,304	15,988	6.8	6.7	5.3	4.5	5.6
Population (millions of people)	1,234.3	1,352.6	1,503.6	1,592.7	1,639.2	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.35	2.09	4.09	6.47	9.75	5.6	5.7	4.7	4.2	4.9
Primary energy consumption per capita (toe/person)	0.57	0.68	0.96	1.13	1.31	2.3	2.9	1.6	1.5	2.1
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	420	325	234	174	135	-3.2	-2.7	-2.9	-2.5	-2.7
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	287	214	163	127	101	-3.6	-2.3	-2.5	-2.2	-2.3
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	949	821	541	388	294	-1.8	-3.4	-3.3	-2.7	-3.2
CO_2 emissions per unit of primary energy consumption (t/toe)	2.26	2.53	2.31	2.23	2.18	1.4	-0.8	-0.4	-0.2	-0.5

Table A.19: Energy Supply and Demand of Indonesia

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**201.69**	**231.14**	**330.26**	**411.84**	**491.46**	**100**	**100**	**100**	**100**	**100**	**1.7**	**3.0**	**2.2**	**1.8**	**2.4**
Coal	31.84	55.23	64.75	64.30	57.15	15.8	23.9	19.6	15.6	11.6	7.1	1.3	-0.1	-1.2	0.1
Oil	67.39	77.31	104.22	128.21	149.97	33.4	33.4	31.6	31.1	30.5	1.7	2.5	2.1	1.6	2.1
Natural gas	38.82	38.93	71.44	97.19	124.97	19.2	16.8	21.6	23.6	25.4	0.0	5.2	3.1	2.5	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	1.50	1.86	2.19	2.65	3.11	0.7	0.8	0.7	0.6	0.6	2.7	1.4	1.9	1.6	1.6
Geothermal	16.09	24.11	57.94	76.35	96.10	8.0	10.4	17.5	18.5	19.6	5.2	7.6	2.8	2.3	4.4
Others	46.04	33.69	29.72	43.14	60.16	22.8	14.6	9.0	10.5	12.2	-3.8	-1.0	3.8	3.4	1.8
Biomass	46.04	33.54	20.39	18.23	16.83	22.8	14.5	6.2	4.4	3.4	-3.9	-4.1	-1.1	-0.8	-2.1
Solar, WIDN, Ocean	0.00	0.02	9.20	24.78	43.20	0.0	0.0	2.8	6.0	8.8	65.4	64.1	10.4	5.7	26.4
Biofuels	0.17	2.83	3.12	4.02	4.98	0.1	1.2	0.9	1.0	1.0	41.7	0.8	2.5	2.2	1.8
Electricity	0.00	0.13	0.13	0.13	0.13	0.0	0.1	0.0	0.0	0.0	129.0	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**145.98**	**156.06**	**213.86**	**269.99**	**324.64**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Industry	49.08	50.16	74.46	93.43	109.32	33.6	32.1	34.8	34.6	33.7	0.3	3.3	2.3	1.6	2.5
Transportation	30.14	54.38	75.78	96.46	118.64	20.6	34.8	35.4	35.7	36.5	7.7	2.8	2.4	2.1	2.5
Others	56.55	43.03	48.38	60.53	72.82	38.7	27.6	22.6	22.4	22.4	-3.4	1.0	2.3	1.9	1.7
Non-energy	10.20	8.49	15.24	19.57	23.86	7.0	5.4	7.1	7.2	7.4	-2.3	5.0	2.5	2.0	3.3
Total	**145.98**	**156.06**	**213.86**	**269.99**	**324.64**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Coal	17.18	14.72	22.22	28.12	32.83	11.8	9.4	10.4	10.4	10.1	-1.9	3.5	2.4	1.6	2.5
Oil	55.01	75.67	101.66	123.60	144.74	37.7	48.5	47.5	45.8	44.6	4.1	2.5	2.0	1.6	2.0
Natural gas	15.86	16.68	32.58	43.05	52.00	10.9	10.7	15.2	15.9	16.0	0.6	5.7	2.8	1.9	3.6
Electricity	12.67	22.02	39.40	59.84	81.55	8.7	14.1	18.4	22.2	25.1	7.2	5.0	4.3	3.1	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	45.26	26.97	18.01	15.39	13.52	31.0	17.3	8.4	5.7	4.2	-6.3	-3.3	-1.6	-1.3	-2.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**169.76**	**283.77**	**510.98**	**776.83**	**1,057.32**	**100**	**100**	**100**	**100**	**100**	**6.6**	**5.0**	**4.3**	**3.1**	**4.2**
Coal	68.45	160.02	170.34	145.18	98.50	40.3	56.4	33.3	18.7	9.3	11.2	0.5	-1.6	-3.8	-1.5
Oil	34.15	14.88	22.92	27.71	26.34	20.1	5.2	4.5	3.6	2.5	-9.9	3.7	1.9	-0.5	1.8
Natural gas	40.25	59.42	146.43	234.87	331.49	23.7	20.9	28.7	30.2	31.4	5.0	7.8	4.8	3.5	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	17.46	21.64	25.46	30.84	36.22	10.3	7.6	5.0	4.0	3.4	2.7	1.4	1.9	1.6	1.6
Geothermal	9.36	14.02	33.70	44.41	55.89	5.5	4.9	6.6	5.7	5.3	5.2	7.6	2.8	2.3	4.4
Others	0.10	13.79	112.13	293.82	508.87	0.1	4.9	21.9	37.8	48.1	85.1	19.1	10.1	5.6	11.9

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**35.21**	**60.59**	**76.49**	**85.15**	**87.39**	**100**	**100**	**100**	**100**	**100**	**7.0**	**2.0**	**1.1**	**0.3**	**1.2**
Coal	18.08	40.51	42.52	36.17	24.31	51.4	66.9	55.6	42.5	27.8	10.6	0.4	-1.6	-3.9	-1.6
Oil	8.47	6.75	5.48	6.43	6.08	24.1	11.1	7.2	7.6	7.0	-2.8	-1.7	1.6	-0.6	-0.3
Natural gas	8.65	13.32	28.48	42.54	57.00	24.6	22.0	37.2	50.0	65.2	5.5	6.5	4.1	3.0	4.6

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.9**	**33.3**	**38.2**	**41.2**	**44.9**						**-0.6**	**1.2**	**0.8**	**0.9**	**0.9**
Coal	32.5	34.0	34.4	34.5	34.8						0.5	0.1	0.0	0.1	0.1
Oil	34.6	18.9	36.0	37.0	37.2						-7.3	5.5	0.3	0.1	2.1
Natural gas	40.0	38.4	44.2	47.5	50.0						-0.5	1.2	0.7	0.5	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**396.0**	**539.5**	**715.0**	**832.0**	**920.5**	**100**	**100**	**100**	**100**	**100**	**3.9**	**2.4**	**1.5**	**1.0**	**1.7**
Coal	141.8	222.0	260.3	258.5	229.7	35.8	41.2	36.4	31.1	25.0	5.8	1.3	-0.1	-1.2	0.1
Oil	174.7	234.6	308.7	375.0	435.6	44.1	43.5	43.2	45.1	47.3	3.8	2.3	2.0	1.5	2.0
Natural Gas	79.5	82.3	145.6	198.0	254.7	20.1	15.3	20.4	23.8	27.7	0.4	4.9	3.1	2.6	3.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	755	1,147	2,089	3,278	4,753	5.4	5.1	4.6	3.8	4.5
Population (millions of people)	241.8	267.7	299.4	318.9	331.4	1.3	0.9	0.6	0.4	0.7
GDP per capita (thousands of 2010 USD/person)	3.12	4.28	6.98	10.28	14.34	4.0	4.1	3.9	3.4	3.8
Primary energy consumption per capita (toe/person)	0.83	0.86	1.10	1.29	1.48	0.4	2.1	1.6	1.4	1.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	267	202	158	126	103	-3.5	-2.0	-2.3	-1.9	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	193	136	102	82	68	-4.3	-2.3	-2.2	-1.9	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	524	470	342	254	194	-1.4	-2.6	-2.9	-2.7	-2.7
CO_2 emissions per unit of primary energy consumption (t/toe)	1.96	2.33	2.17	2.02	1.87	2.2	-0.6	-0.7	-0.8	-0.7

Table A.20: Energy Supply and Demand of Malaysia

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**72.49**	**93.43**	**128.08**	**141.88**	**147.75**	**100**	**100**	**100**	**100**	**100**	**3.2**	**2.7**	**1.0**	**0.4**	**1.4**
Coal	14.60	22.61	22.14	18.98	11.61	20.1	24.2	17.3	13.4	7.9	5.6	-0.2	-1.5	-4.8	-2.1
Oil	25.33	28.98	35.03	35.18	34.17	34.9	31.0	27.3	24.8	23.1	1.7	1.6	0.0	-0.3	0.5
Natural gas	31.20	38.78	64.39	74.08	82.89	43.0	41.5	50.3	52.2	56.1	2.8	4.3	1.4	1.1	2.4
Nuclear	0.00	0.00	0.00	3.66	3.65	0.0	0.0	0.0	2.6	2.5	-	-	-	0.0	-
Hydro	0.56	2.26	3.00	3.32	3.43	0.8	2.4	2.3	2.3	2.3	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.80	0.79	3.53	6.66	12.00	1.1	0.9	2.8	4.7	8.1	-0.1	13.2	6.6	6.1	8.9
Biomass	0.82	0.87	1.69	2.13	2.57	1.1	0.9	1.3	1.5	1.7	0.8	5.6	2.3	1.9	3.4
Solar, WMYS, Ocean	0.00	0.05	1.96	4.66	9.55	0.0	0.1	1.5	3.3	6.5	-	35.9	9.0	7.4	17.9
Biofuels	0.00	0.44	0.39	0.38	0.36	0.0	0.5	0.3	0.3	0.2	77.7	-1.0	-0.2	-0.4	-0.6
Electricity	-0.01	-0.13	-0.13	-0.13	-0.13	0.0	-0.1	-0.1	-0.1	-0.1	33.1	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**41.74**	**62.53**	**87.90**	**99.30**	**108.04**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Industry	14.92	19.51	25.38	29.15	31.74	35.8	31.2	28.9	29.4	29.4	3.4	2.2	1.4	0.9	1.5
Transportation	14.93	20.96	22.15	21.83	20.75	35.8	33.5	25.2	22.0	19.2	4.3	0.5	-0.1	-0.5	0.0
Others	8.19	8.80	12.25	14.58	16.56	19.6	14.1	13.9	14.7	15.3	0.9	2.8	1.8	1.3	2.0
Non-energy	3.70	13.26	28.12	33.74	39.00	8.9	21.2	32.0	34.0	36.1	17.3	6.5	1.8	1.5	3.4
Total	**41.74**	**62.53**	**87.90**	**99.30**	**108.04**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Coal	1.83	1.81	2.16	2.31	2.36	4.4	2.9	2.5	2.3	2.2	-0.1	1.5	0.7	0.2	0.8
Oil	23.96	28.28	32.07	32.28	31.39	57.4	45.2	36.5	32.5	29.0	2.1	1.1	0.1	-0.3	0.3
Natural gas	6.25	18.85	34.11	40.33	45.46	15.0	30.1	38.8	40.6	42.1	14.8	5.1	1.7	1.2	2.8
Electricity	9.53	13.15	19.01	23.75	28.14	22.8	21.0	21.6	23.9	26.0	4.1	3.1	2.3	1.7	2.4
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.17	0.44	0.55	0.63	0.70	0.4	0.7	0.6	0.6	0.6	12.3	2.0	1.2	1.1	1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.79**	**170.47**	**246.26**	**307.52**	**364.20**	**100**	**100**	**100**	**100**	**100**	**4.0**	**3.1**	**2.2**	**1.7**	**2.4**
Coal	42.84	77.29	74.90	61.91	33.98	34.3	45.3	30.4	20.1	9.3	7.7	-0.3	-1.9	-5.8	-2.5
Oil	3.67	1.05	0.83	0.30	0.00	2.9	0.6	0.3	0.1	0.0	-14.5	-2.0	-9.6	-88.7	-51.4
Natural gas	70.80	63.89	109.18	133.58	158.94	56.7	37.5	44.3	43.4	43.6	-1.3	4.6	2.0	1.8	2.9
Nuclear	0.00	0.00	0.00	14.05	14.02	0.0	0.0	0.0	4.6	3.8	-	-	-	0.0	-
Hydro	6.47	26.32	34.92	38.57	39.94	5.2	15.4	14.2	12.5	11.0	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	1.01	1.93	26.45	59.10	117.32	0.8	1.1	10.7	19.2	32.2	8.4	24.4	8.4	7.1	13.7

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.72**	**33.67**	**40.55**	**40.34**	**36.11**	**100**	**100**	**100**	**100**	**100**	**0.7**	**1.6**	**-0.1**	**-1.1**	**0.2**
Coal	12.95	20.47	19.64	16.33	8.92	40.8	60.8	48.4	40.5	24.7	5.9	-0.3	-1.8	-5.9	-2.6
Oil	0.74	0.38	0.21	0.08	0.00	2.3	1.1	0.5	0.2	0.0	-8.0	-4.7	-9.7	-88.7	-51.9
Natural gas	18.03	12.82	20.70	23.93	27.20	56.8	38.1	51.0	59.3	75.3	-4.2	4.1	1.5	1.3	2.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.8**	**36.3**	**39.2**	**41.7**	**45.9**		**1.7**	**0.6**	**0.6**	**1.0**	**0.7**
Coal	28.4	32.5	32.8	32.6	32.8		1.7	0.1	-0.1	0.1	0.0
Oil	42.6	23.7	33.2	33.5	33.7		-7.1	2.9	0.1	0.0	1.1
Natural gas	33.8	42.9	45.3	48.0	50.3		3.0	0.5	0.6	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**187.0**	**221.5**	**258.6**	**255.3**	**231.1**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.3**	**-0.1**	**-1.0**	**0.1**
Coal	58.5	88.2	86.4	73.8	44.7	31.3	39.8	33.4	28.9	19.3	5.3	-0.2	-1.6	-4.9	-2.1
Oil	65.8	73.1	83.6	82.1	77.5	35.2	33.0	32.3	32.2	33.5	1.3	1.1	-0.2	-0.6	0.2
Natural Gas	62.6	60.1	88.6	99.4	109.0	33.5	27.1	34.3	38.9	47.2	-0.5	3.3	1.2	0.9	1.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	255	382	640	912	1,229	5.2	4.4	3.6	3.0	3.7
Population (millions of people)	28.2	31.5	36.1	38.8	40.6	1.4	1.1	0.7	0.5	0.8
GDP per capita (thousands of 2010 USD/person)	9.04	12.12	17.73	23.53	30.30	3.7	3.2	2.9	2.6	2.9
Primary energy consumption per capita (toe/person)	2.57	2.96	3.55	3.66	3.64	1.8	1.5	0.3	0.0	0.6
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	284	245	200	156	120	-1.9	-1.7	-2.5	-2.5	-2.2
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	164	164	137	109	88	0.0	-1.4	-2.3	-2.1	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	733	580	404	280	188	-2.9	-3.0	-3.6	-3.9	-3.5
CO_2 emissions per unit of primary energy consumption (t/toe)	2.58	2.37	2.02	1.80	1.56	-1.0	-1.3	-1.1	-1.4	-1.3

Table A.21: Energy Supply and Demand of Myanmar

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.90**	**23.83**	**36.82**	**47.26**	**56.83**	**100**	**100**	**100**	**100**	**100**	**7.0**	**3.7**	**2.5**	**1.9**	**2.8**
Coal	0.41	0.88	0.73	0.83	0.85	2.9	3.7	2.0	1.8	1.5	10.0	-1.5	1.3	0.3	-0.1
Oil	1.28	6.86	13.04	18.76	24.07	9.2	28.8	35.4	39.7	42.4	23.3	5.5	3.7	2.5	4.0
Natural gas	1.28	4.12	12.02	17.50	22.97	9.2	17.3	32.7	37.0	40.4	15.7	9.3	3.8	2.8	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.44	1.21	1.49	1.79	2.02	3.2	5.1	4.1	3.8	3.6	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.48	10.76	9.53	8.39	6.92	75.4	45.1	25.9	17.7	12.2	0.3	-1.0	-1.3	-1.9	-1.4
Biomass	10.48	10.96	10.30	8.90	6.62	75.4	46.0	28.0	18.8	11.7	0.6	-0.5	-1.5	-2.9	-1.6
Solar, WMYA, Ocean	0.00	0.00	0.93	1.94	3.50	0.0	0.0	2.5	4.1	6.2	-	78.7	7.6	6.1	29.6
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Electricity	0.00	-0.20	-1.70	-2.45	-3.20	0.0	-0.9	-4.6	-5.2	-5.6	-	19.4	3.7	2.7	9.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**12.85**	**20.16**	**28.32**	**35.50**	**42.07**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.3**
Industry	1.28	3.69	6.85	10.46	13.49	9.9	18.3	24.2	29.5	32.1	14.2	5.3	4.3	2.6	4.1
Transportation	0.81	2.10	4.04	6.37	9.09	6.3	10.4	14.3	17.9	21.6	12.6	5.6	4.7	3.6	4.7
Others	10.64	13.89	16.74	17.76	18.38	82.8	68.9	59.1	50.0	43.7	3.4	1.6	0.6	0.3	0.9
Non-energy	0.12	0.48	0.70	0.91	1.11	0.9	2.4	2.5	2.6	2.6	19.2	3.2	2.7	2.1	2.7
Total	**12.85**	**20.16**	**28.32**	**35.50**	**42.07**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.3**
Coal	0.23	0.26	0.41	0.54	0.64	1.8	1.3	1.5	1.5	1.5	1.4	3.9	2.7	1.6	2.8
Oil	1.04	6.81	12.89	18.61	23.96	8.1	33.8	45.5	52.4	57.0	26.5	5.5	3.7	2.6	4.0
Natural gas	0.60	0.57	0.77	1.00	1.22	4.6	2.8	2.7	2.8	2.9	-0.5	2.4	2.7	2.0	2.4
Electricity	0.54	1.59	3.99	6.50	9.67	4.2	7.9	14.1	18.3	23.0	14.5	7.9	5.0	4.1	5.8
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.44	10.91	10.26	8.85	6.58	81.3	54.1	36.2	24.9	15.6	0.6	-0.5	-1.5	-2.9	-1.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**7.54**	**24.55**	**77.29**	**120.37**	**171.30**	**100**	**100**	**100**	**100**	**100**	**15.9**	**10.0**	**4.5**	**3.6**	**6.3**
Coal	0.67	1.54	0.57	0.47	0.23	8.9	6.3	0.7	0.4	0.1	11.0	-8.0	-1.9	-7.1	-5.8
Oil	0.03	0.08	0.27	0.21	0.00	0.4	0.3	0.4	0.2	0.0	11.2	11.0	-2.3	-88.3	-47.2
Natural gas	1.73	8.80	48.04	76.37	107.52	23.0	35.8	62.2	63.4	62.8	22.5	15.2	4.7	3.5	8.1
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	5.11	14.13	17.34	20.76	23.48	67.7	57.5	22.4	17.2	13.7	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.00	0.01	11.07	22.56	40.08	0.0	0.0	14.3	18.7	23.4	-	78.9	7.4	5.9	29.5

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**0.73**	**3.35**	**10.76**	**15.96**	**21.08**	**100**	**100**	**100**	**100**	**100**	**21.1**	**10.2**	**4.0**	**2.8**	**5.9**
Coal	0.18	0.47	0.17	0.14	0.07	24.6	14.0	1.6	0.9	0.3	12.8	-8.0	-1.9	-7.2	-5.9
Oil	0.01	0.02	0.07	0.06	0.00	1.1	0.6	0.7	0.4	0.0	12.3	10.9	-2.4	-88.3	-47.3
Natural gas	0.54	2.86	10.52	15.76	21.01	74.2	85.4	97.7	98.8	99.7	23.2	11.5	4.1	2.9	6.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**28.9**	**26.8**	**39.1**	**41.5**	**43.9**		**-1.0**	**3.2**	**0.6**	**0.6**	**1.6**
Coal	32.3	28.4	28.4	28.5	28.8		-1.6	0.0	0.0	0.1	0.0
Oil	34.3	31.6	32.1	32.2	32.3		-1.0	0.1	0.0	0.1	0.1
Natural gas	27.7	26.5	39.3	41.7	44.0		-0.6	3.3	0.6	0.5	1.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**8.0**	**31.4**	**67.4**	**97.4**	**125.8**	**100**	**100**	**100**	**100**	**100**	**18.6**	**6.6**	**3.7**	**2.6**	**4.4**
Coal	1.7	2.9	2.3	2.7	2.8	20.6	9.3	3.5	2.8	2.2	7.4	-1.8	1.6	0.3	-0.1
Oil	3.4	19.8	37.9	54.6	70.1	42.7	62.9	56.1	56.1	55.7	24.5	5.6	3.7	2.5	4.0
Natural Gas	3.0	8.7	27.2	40.1	52.9	36.8	27.8	40.4	41.1	42.0	14.5	9.9	3.9	2.8	5.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	41	71	143	238	369	6.9	6.0	5.3	4.5	5.3
Population (millions of people)	50.6	53.7	58.5	61.2	62.3	0.7	0.7	0.5	0.2	0.5
GDP per capita (thousands of 2010 USD/person)	0.82	1.32	2.44	3.90	5.92	6.1	5.3	4.8	4.3	4.8
Primary energy consumption per capita (toe/person)	0.27	0.44	0.63	0.77	0.91	6.2	3.0	2.1	1.7	2.3
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	335	337	258	198	154	0.1	-2.2	-2.6	-2.5	-2.4
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	310	285	198	149	114	-1.0	-3.0	-2.8	-2.6	-2.8
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	194	445	473	408	341	10.9	0.5	-1.5	-1.8	-0.8
CO_2 emissions per unit of primary energy consumption (t/toe)	0.58	1.32	1.83	2.06	2.21	10.9	2.8	1.2	0.7	1.6

Table A.22: Energy Supply and Demand of Philippines

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**40.40**	**60.05**	**89.30**	**109.43**	**131.63**	**100**	**100**	**100**	**100**	**100**	**5.1**	**3.4**	**2.1**	**1.9**	**2.5**
Coal	7.63	17.94	16.75	13.91	10.78	18.9	29.9	18.8	12.7	8.2	11.3	-0.6	-1.8	-2.5	-1.6
Oil	13.60	19.99	34.70	48.49	64.82	33.7	33.3	38.9	44.3	49.2	4.9	4.7	3.4	2.9	3.7
Natural gas	3.05	3.63	6.27	9.01	11.77	7.6	6.0	7.0	8.2	8.9	2.2	4.7	3.7	2.7	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.67	0.81	1.10	1.21	1.32	1.7	1.3	1.2	1.1	1.0	2.3	2.6	1.0	0.9	1.6
Geothermal	8.54	8.97	17.17	19.40	21.36	21.1	14.9	19.2	17.7	16.2	0.6	5.6	1.2	1.0	2.7
Others	6.91	8.72	13.31	17.42	21.58	17.1	14.5	14.9	15.9	16.4	2.9	3.6	2.7	2.2	2.9
Biomass	6.90	8.51	9.57	9.47	9.17	17.1	14.2	10.7	8.7	7.0	2.7	1.0	-0.1	-0.3	0.2
Solar, WPHL, Ocean	0.01	0.21	3.74	7.95	12.41	0.0	0.3	4.2	7.3	9.4	57.6	27.3	7.8	4.6	13.7
Biofuels	0.18	0.48	0.98	1.43	1.98	0.5	0.8	1.1	1.3	1.5	12.7	6.2	3.9	3.3	4.5
Electricity	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**23.71**	**33.83**	**54.94**	**73.67**	**95.16**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Industry	6.41	7.63	11.41	14.09	16.89	27.0	22.6	20.8	19.1	17.8	2.2	3.4	2.1	1.8	2.5
Transportation	8.04	12.28	23.81	34.82	48.50	33.9	36.3	43.3	47.3	51.0	5.4	5.7	3.9	3.4	4.4
Others	9.14	12.65	17.50	21.24	24.16	38.5	37.4	31.9	28.8	25.4	4.2	2.7	2.0	1.3	2.0
Non-energy	0.12	1.26	2.22	3.52	5.61	0.5	3.7	4.0	4.8	5.9	34.2	4.8	4.7	4.8	4.8
Total	**23.71**	**33.83**	**54.94**	**73.67**	**95.16**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Coal	1.88	2.52	3.55	4.23	4.85	7.9	7.4	6.5	5.7	5.1	3.7	2.9	1.7	1.4	2.1
Oil	11.46	18.21	32.61	46.22	62.56	48.3	53.8	59.4	62.7	65.7	6.0	5.0	3.6	3.1	3.9
Natural gas	0.07	0.06	0.13	0.18	0.22	0.3	0.2	0.2	0.2	0.2	-2.0	6.5	3.3	2.2	4.1
Electricity	4.75	7.10	11.85	16.50	21.42	20.0	21.0	21.6	22.4	22.5	5.2	4.4	3.4	2.6	3.5
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	5.55	5.93	6.80	6.55	6.10	23.4	17.5	12.4	8.9	6.4	0.8	1.1	-0.4	-0.7	0.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**67.74**	**99.19**	**164.43**	**225.87**	**288.73**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.3**	**3.2**	**2.5**	**3.4**
Coal	23.30	51.93	45.33	34.17	20.83	34.4	52.4	27.6	15.1	7.2	10.5	-1.1	-2.8	-4.8	-2.8
Oil	7.10	3.17	3.40	2.82	1.15	10.5	3.2	2.1	1.2	0.4	-9.6	0.6	-1.9	-8.6	-3.1
Natural gas	19.52	21.33	38.23	58.20	80.01	28.8	21.5	23.2	25.8	27.7	1.1	5.0	4.3	3.2	4.2
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	7.80	9.38	12.75	14.03	15.36	11.5	9.5	7.8	6.2	5.3	2.3	2.6	1.0	0.9	1.6
Geothermal	9.93	10.44	19.97	22.56	24.85	14.7	10.5	12.1	10.0	8.6	0.6	5.6	1.2	1.0	2.7
Others	0.09	2.93	44.75	94.10	146.52	0.1	3.0	27.2	41.7	50.7	54.6	25.5	7.7	4.5	13.0

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**9.74**	**18.97**	**19.27**	**18.33**	**16.95**	**100**	**100**	**100**	**100**	**100**	**8.7**	**0.1**	**-0.5**	**-0.8**	**-0.4**
Coal	5.51	14.90	12.68	9.19	5.44	56.6	78.5	65.8	50.1	32.1	13.2	-1.3	-3.2	-5.1	-3.1
Oil	1.48	0.73	0.72	0.62	0.26	15.2	3.8	3.7	3.4	1.5	-8.5	-0.1	-1.5	-8.4	-3.2
Natural gas	2.75	3.35	5.87	8.53	11.25	28.2	17.7	30.5	46.5	66.4	2.5	4.8	3.8	2.8	3.9

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**44.0**	**34.6**	**38.8**	**44.6**	**51.8**		**-3.0**	**1.0**	**1.4**	**1.5**	**1.3**
Coal	36.3	30.0	30.7	32.0	32.9		-2.4	0.2	0.4	0.3	0.3
Oil	41.2	37.5	40.8	39.2	38.6		-1.2	0.7	-0.4	-0.2	0.1
Natural gas	61.0	54.8	56.0	58.7	61.2		-1.3	0.2	0.5	0.4	0.3

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**76.4**	**132.5**	**174.5**	**206.4**	**242.4**	**100**	**100**	**100**	**100**	**100**	**7.1**	**2.3**	**1.7**	**1.6**	**1.9**
Coal	29.8	70.0	65.2	53.9	41.4	39.0	52.8	37.4	26.1	17.1	11.3	-0.6	-1.9	-2.6	-1.6
Oil	39.4	54.1	94.6	131.4	173.5	51.6	40.8	54.2	63.7	71.6	4.0	4.8	3.3	2.8	3.7
Natural Gas	7.1	8.5	14.7	21.0	27.5	9.3	6.4	8.4	10.2	11.3	2.2	4.7	3.7	2.7	3.7

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	200	322	613	907	1,290	6.2	5.5	4.0	3.6	4.4
Population (millions of people)	94.0	106.7	123.7	135.6	144.5	1.6	1.2	0.9	0.6	1.0
GDP per capita (thousands of 2010 USD/person)	2.12	3.02	4.96	6.69	8.93	4.5	4.2	3.0	2.9	3.4
Primary energy consumption per capita (toe/person)	0.43	0.56	0.72	0.81	0.91	3.4	2.1	1.1	1.2	1.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	202	186	146	121	102	-1.0	-2.0	-1.9	-1.7	-1.9
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	119	105	90	81	74	-1.5	-1.3	-1.0	-1.0	-1.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	383	411	284	227	188	0.9	-3.0	-2.2	-1.9	-2.4
CO_2 emissions per unit of primary energy consumption (t/toe)	1.89	2.21	1.95	1.89	1.84	1.9	-1.0	-0.4	-0.2	-0.6

Table A-23: Energy Supply and Demand of Thailand

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**117.86**	**135.81**	**170.89**	**190.47**	**207.22**	**100**	**100**	**100**	**100**	**100**	**1.8**	**1.9**	**1.1**	**0.8**	**1.3**
Coal	16.36	15.83	13.96	11.40	8.52	13.9	11.7	8.2	6.0	4.1	-0.4	-1.0	-2.0	-2.9	-1.9
Oil	44.95	55.36	64.07	69.01	71.95	38.1	40.8	37.5	36.2	34.7	2.6	1.2	0.7	0.4	0.8
Natural gas	32.97	35.51	44.19	46.35	45.72	28.0	26.1	25.9	24.3	22.1	0.9	1.8	0.5	-0.1	0.8
Nuclear	0.00	0.00	0.00	1.83	6.21	0.0	0.0	0.0	1.0	3.0	-	-	-	13.0	-
Hydro	0.48	0.65	0.82	0.92	0.98	0.4	0.5	0.5	0.5	0.5	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	23.10	28.45	47.84	60.94	73.83	19.6	20.9	28.0	32.0	35.6	2.6	4.4	2.5	1.9	3.0
Biomass	22.61	25.70	40.05	48.47	57.27	19.2	18.9	23.4	25.5	27.6	1.6	3.8	1.9	1.7	2.5
Solar, WTHA, Ocean	0.00	0.54	3.58	7.26	10.36	0.0	0.4	2.1	3.8	5.0	87.7	17.1	7.3	3.6	9.7
Biofuels	0.65	1.94	2.75	4.21	6.10	0.6	1.4	1.6	2.2	2.9	14.6	2.9	4.4	3.8	3.6
Electricity	0.49	2.21	4.21	5.21	6.21	0.4	1.6	2.5	2.7	3.0	20.8	5.5	2.2	1.8	3.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**84.90**	**100.16**	**121.02**	**135.93**	**146.68**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Industry	26.48	30.31	39.49	45.54	48.82	31.2	30.3	32.6	33.5	33.3	1.7	2.2	1.4	0.7	1.5
Transportation	19.92	27.56	29.18	31.60	33.46	23.5	27.5	24.1	23.3	22.8	4.1	0.5	0.8	0.6	0.6
Others	20.43	17.72	21.19	23.01	24.36	24.1	17.7	17.5	16.9	16.6	-1.8	1.5	0.8	0.6	1.0
Non-energy	18.07	24.57	31.17	35.77	40.05	21.3	24.5	25.8	26.3	27.3	3.9	2.0	1.4	1.1	1.5
Total	**84.90**	**100.16**	**121.02**	**135.93**	**146.68**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Coal	9.21	6.83	7.65	7.54	6.98	10.8	6.8	6.3	5.5	4.8	-3.7	1.0	-0.1	-0.8	0.1
Oil	43.84	54.69	61.98	66.61	69.34	51.6	54.6	51.2	49.0	47.3	2.8	1.0	0.7	0.4	0.7
Natural gas	4.59	7.21	10.01	12.42	14.59	5.4	7.2	8.3	9.1	10.0	5.8	2.8	2.2	1.6	2.2
Electricity	12.84	16.17	23.42	29.02	33.59	15.1	16.1	19.3	21.3	22.9	2.9	3.1	2.2	1.5	2.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	14.42	15.27	17.97	20.35	22.18	17.0	15.2	14.8	15.0	15.1	0.7	1.4	1.3	0.9	1.2

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**159.52**	**182.30**	**248.82**	**306.78**	**351.46**	**100**	**100**	**100**	**100**	**100**	**1.7**	**2.6**	**2.1**	**1.4**	**2.1**
Coal	30.05	36.41	25.78	15.91	6.30	18.8	20.0	10.4	5.2	1.8	2.4	-2.8	-4.7	-8.8	-5.3
Oil	1.18	0.18	0.00	0.00	0.00	0.7	0.1	0.0	0.0	0.0	-21.1	-83.0	0.0	0.0	-48.6
Natural gas	119.35	115.64	136.66	142.29	131.13	74.8	63.4	54.9	46.4	37.3	-0.4	1.4	0.4	-0.8	0.4
Nuclear	0.00	0.00	0.00	7.03	23.83	0.0	0.0	0.0	2.3	6.8	-	-	-	13.0	-
Hydro	5.54	7.57	9.51	10.75	11.46	3.5	4.1	3.8	3.5	3.3	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.01	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	3.41	22.51	76.86	130.80	178.74	2.1	12.3	30.9	42.6	50.9	26.6	10.8	5.5	3.2	6.7

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**29.87**	**30.65**	**31.59**	**29.43**	**24.35**	**100**	**100**	**100**	**100**	**100**	**0.3**	**0.3**	**-0.7**	**-1.9**	**-0.7**
Coal	6.92	8.99	6.33	3.88	1.56	23.2	29.3	20.0	13.2	6.4	3.3	-2.9	-4.8	-8.7	-5.3
Oil	0.26	0.05	0.00	0.00	0.00	0.9	0.2	0.0	0.0	0.0	-18.8	-83.5	-0.7	-0.2	-49.2
Natural gas	22.68	21.61	25.26	25.55	22.80	75.9	70.5	80.0	86.8	93.6	-0.6	1.3	0.1	-1.1	0.2

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**43.3**	**42.7**	**44.2**	**46.2**	**48.5**		**-0.2**	**0.3**	**0.4**	**0.5**	**0.4**
Coal	37.3	34.8	35.0	35.3	34.8		-0.9	0.0	0.1	-0.1	0.0
Oil	38.4	30.5	41.0	44.1	44.9		-2.8	2.5	0.7	0.2	1.2
Natural gas	45.2	46.0	46.5	47.9	49.5		0.2	0.1	0.3	0.3	0.2

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**219.7**	**238.2**	**258.0**	**254.4**	**238.3**	**100**	**100**	**100**	**100**	**100**	**1.0**	**0.7**	**-0.1**	**-0.7**	**0.0**
Coal	65.2	63.9	56.3	46.0	34.4	29.7	26.8	21.8	18.1	14.4	-0.2	-1.0	-2.0	-2.9	-1.9
Oil	79.8	95.1	107.2	111.5	110.9	36.3	39.9	41.5	43.8	46.6	2.2	1.0	0.4	-0.1	0.5
Natural Gas	74.7	79.1	94.5	96.9	93.0	34.0	33.2	36.6	38.1	39.0	0.7	1.5	0.3	-0.4	0.5

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	341	442	656	907	1,191	3.3	3.3	3.3	2.8	3.1
Population (millions of people)	67.2	69.4	70.3	69.0	65.9	0.4	0.1	-0.2	-0.5	-0.2
GDP per capita (thousands of 2010 USD/person)	5.08	6.36	9.32	13.14	18.07	2.9	3.2	3.5	3.2	3.3
Primary energy consumption per capita (toe/person)	1.75	1.96	2.43	2.76	3.14	1.4	1.8	1.3	1.3	1.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	346	307	261	210	174	-1.4	-1.4	-2.1	-1.9	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	249	227	185	150	123	-1.2	-1.7	-2.1	-1.9	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	644	539	393	281	200	-2.2	-2.6	-3.3	-3.3	-3.1
CO_2 emissions per unit of primary energy consumption (t/toe)	1.86	1.75	1.51	1.34	1.15	-0.8	-1.2	-1.2	-1.5	-1.3

Table A.24: Energy Supply and Demand of Viet Nam

(NNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**58.60**	**83.46**	**129.58**	**166.74**	**206.81**	**100**	**100**	**100**	**100**	**100**	**4.5**	**3.7**	**2.6**	**2.2**	**2.9**
Coal	14.65	36.74	43.74	47.68	47.18	25.0	44.0	33.8	28.6	22.8	12.2	1.5	0.9	-0.1	0.8
Oil	18.35	22.50	35.29	45.92	58.97	31.3	27.0	27.2	27.5	28.5	2.6	3.8	2.7	2.5	3.1
Natural gas	8.12	7.94	19.72	27.16	36.44	13.9	9.5	15.2	16.3	17.6	-0.3	7.9	3.3	3.0	4.9
Nuclear	0.00	0.00	0.00	4.21	8.58	0.0	0.0	0.0	2.5	4.1	-	-	-	7.4	-
Hydro	2.37	7.23	9.86	11.00	11.65	4.0	8.7	7.6	6.6	5.6	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	15.11	9.04	20.97	30.77	43.98	25.8	10.8	16.2	18.5	21.3	-6.2	7.3	3.9	3.6	5.1
Biomass	14.71	8.91	9.57	10.46	10.76	25.1	10.7	7.4	6.3	5.2	-6.1	0.6	0.9	0.3	0.6
Solar, WVNM, Ocean	0.00	0.04	10.82	19.47	32.13	0.0	0.1	8.3	11.7	15.5	34.0	58.0	6.1	5.1	22.8
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	12.0	7.6	-
Electricity	0.40	0.09	0.59	0.84	1.09	0.7	0.1	0.5	0.5	0.5	-17.5	17.4	3.6	2.7	8.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**48.51**	**60.27**	**103.07**	**134.41**	**169.51**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Industry	17.42	32.54	62.16	79.53	97.36	35.9	54.0	60.3	59.2	57.4	8.1	5.5	2.5	2.0	3.5
Transportation	10.32	12.06	18.28	24.06	31.04	21.3	20.0	17.7	17.9	18.3	2.0	3.5	2.8	2.6	3.0
Others	18.51	14.19	20.32	27.66	37.04	38.2	23.5	19.7	20.6	21.9	-3.3	3.0	3.1	3.0	3.0
Non-energy	2.26	1.48	2.32	3.15	4.06	4.7	2.5	2.3	2.3	2.4	-5.2	3.8	3.1	2.6	3.2
Total	**48.51**	**60.27**	**103.07**	**134.41**	**169.51**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Coal	9.81	14.17	22.40	27.36	31.22	20.2	23.5	21.7	20.4	18.4	4.7	3.9	2.0	1.3	2.5
Oil	16.81	20.75	33.56	44.02	56.82	34.7	34.4	32.6	32.7	33.5	2.7	4.1	2.8	2.6	3.2
Natural gas	0.49	0.99	6.03	7.71	9.18	1.0	1.6	5.8	5.7	5.4	9.1	16.3	2.5	1.8	7.2
Electricity	7.47	16.28	32.38	45.77	62.45	15.4	27.0	31.4	34.0	36.8	10.2	5.9	3.5	3.2	4.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	13.91	8.08	8.70	9.56	9.84	28.7	13.4	8.4	7.1	5.8	-6.6	0.6	1.0	0.3	0.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**94.90**	**240.94**	**440.19**	**609.15**	**821.59**	**100**	**100**	**100**	**100**	**100**	**12.4**	**5.2**	**3.3**	**3.0**	**3.9**
Coal	19.69	114.18	110.65	105.86	83.79	20.7	47.4	25.1	17.4	10.2	24.6	-0.3	-0.4	-2.3	-1.0
Oil	3.41	0.26	0.00	0.00	0.00	3.6	0.1	0.0	0.0	0.0	-27.6	-83.6	0.0	0.0	-49.2
Natural gas	44.15	41.73	88.26	132.04	194.96	46.5	17.3	20.1	21.7	23.7	-0.7	6.4	4.1	4.0	4.9
Nuclear	0.00	0.00	0.00	16.16	32.94	0.0	0.0	0.0	2.7	4.0	-	-	-	7.4	-
Hydro	27.55	84.13	114.65	127.95	135.49	29.0	34.9	26.0	21.0	16.5	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.11	0.65	126.62	227.14	374.41	0.1	0.3	28.8	37.3	45.6	25.5	55.2	6.0	5.1	22.0

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.63**	**29.52**	**34.87**	**39.57**	**42.97**	**100**	**100**	**100**	**100**	**100**	**10.1**	**1.4**	**1.3**	**0.8**	**1.2**
Coal	4.84	22.57	21.25	20.19	15.78	35.5	76.5	60.9	51.0	36.7	21.2	-0.5	-0.5	-2.4	-1.1
Oil	1.16	0.07	0.00	0.00	0.00	8.5	0.2	0.0	0.0	0.0	-30.2	-83.4	-0.7	-0.9	-49.2
Natural gas	7.63	6.89	13.62	19.38	27.20	56.0	23.3	39.1	49.0	63.3	-1.3	5.8	3.6	3.4	4.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**42.4**	**45.5**	**49.1**	**51.7**	**55.8**		**0.9**	**0.6**	**0.5**	**0.8**	**0.6**
Coal	35.0	43.5	44.8	45.1	45.7		2.8	0.2	0.1	0.1	0.2
Oil	25.3	34.0	29.1	31.1	34.0		3.8	-1.3	0.7	0.9	0.0
Natural gas	49.7	52.1	55.7	58.6	61.6		0.6	0.6	0.5	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.8**	**227.0**	**318.0**	**379.9**	**434.7**	**100**	**100**	**100**	**100**	**100**	**7.8**	**2.8**	**1.8**	**1.4**	**2.1**
Coal	60.0	150.4	179.1	195.3	193.2	48.1	66.3	56.3	51.4	44.4	12.2	1.5	0.9	-0.1	0.8
Oil	45.7	58.1	92.7	121.0	156.0	36.6	25.6	29.1	31.8	35.9	3.0	4.0	2.7	2.6	3.1
Natural Gas	19.1	18.5	46.2	63.7	85.5	15.3	8.1	14.5	16.8	19.7	-0.4	7.9	3.3	3.0	4.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	116	188	375	624	985	6.2	5.9	5.2	4.7	5.3
Population (millions of people)	88.0	95.5	104.2	107.8	109.6	1.0	0.7	0.3	0.2	0.4
GDP per capita (thousands of 2010 USD/person)	1.32	1.96	3.60	5.79	8.99	5.1	5.2	4.9	4.5	4.9
Primary energy consumption per capita (toe/person)	0.67	0.87	1.24	1.55	1.89	3.4	3.0	2.2	2.0	2.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	506	445	345	267	210	-1.6	-2.1	-2.5	-2.4	-2.3
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	418	321	275	215	172	-3.3	-1.3	-2.4	-2.2	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	1,076	1,210	847	609	441	1.5	-2.9	-3.2	-3.2	-3.1
CO_2 emissions per unit of primary energy consumption (t/toe)	2.13	2.72	2.45	2.28	2.10	3.1	-0.9	-0.7	-0.8	-0.8

Table A.25: Energy Supply and Demand of Total of the Seven EAS Countries (HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,205.70**	**1,547.16**	**2,426.30**	**3,087.38**	**3,688.84**	**100**	**100**	**100**	**100**	**100**	**3.2**	**3.8**	**2.4**	**1.8**	**2.8**
Coal	364.52	563.45	757.75	929.51	989.16	30.2	36.4	31.2	30.1	26.8	5.6	2.5	2.1	0.6	1.8
Oil	332.98	446.25	689.73	916.64	1,195.23	27.6	28.8	28.4	29.7	32.4	3.7	3.7	2.9	2.7	3.1
Natural gas	169.84	181.33	477.62	669.90	857.25	14.1	11.7	19.7	21.7	23.2	0.8	8.4	3.4	2.5	5.0
Nuclear	6.84	9.85	43.04	63.36	86.68	0.6	0.6	1.8	2.1	2.3	4.7	13.1	3.9	3.2	7.0
Hydro	16.75	27.02	39.46	48.58	57.04	1.4	1.7	1.6	1.6	1.5	6.2	3.2	2.1	1.6	2.4
Geothermal	24.63	33.08	75.12	95.75	117.47	2.0	2.1	3.1	3.1	3.2	3.8	7.1	2.5	2.1	4.0
Others	290.13	286.17	343.60	363.64	386.02	24.1	18.5	14.2	11.8	10.5	-0.2	1.5	0.6	0.6	0.9
Biomass	286.77	273.60	301.30	293.80	274.17	23.8	17.7	12.4	9.5	7.4	-0.6	0.8	-0.3	-0.7	0.0
Solar, Wind, Ocean	2.01	10.81	39.53	66.58	108.09	0.2	0.7	1.6	2.2	2.9	23.4	11.4	5.4	5.0	7.5
Biofuels	1.07	6.57	8.61	12.72	17.73	0.1	0.4	0.4	0.4	0.5	25.5	2.3	4.0	3.4	3.2
Electricity	1.35	1.76	2.76	3.26	3.76	0.1	0.1	0.1	0.1	0.1	3.4	3.8	1.7	1.4	2.4

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**836.15**	**1,039.59**	**1,607.59**	**2,049.89**	**2,502.32**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Industry	267.22	349.93	610.25	771.63	876.63	32.0	33.7	38.0	37.6	35.0	3.4	4.7	2.4	1.3	2.9
Transportation	148.97	233.11	356.27	506.64	729.72	17.8	22.4	22.2	24.7	29.2	5.8	3.6	3.6	3.7	3.6
Others	351.38	356.20	472.69	555.02	631.39	42.0	34.3	29.4	27.1	25.2	0.2	2.4	1.6	1.3	1.8
Non-energy	68.59	100.34	168.39	216.61	264.59	8.2	9.7	10.5	10.6	10.6	4.9	4.4	2.5	2.0	3.1
Total	**836.15**	**1,039.59**	**1,607.59**	**2,049.89**	**2,502.32**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Coal	127.35	146.91	248.23	310.79	352.28	15.2	14.1	15.4	15.2	14.1	1.8	4.5	2.3	1.3	2.8
Oil	290.24	412.11	640.79	853.67	1,117.58	34.7	39.6	39.9	41.6	44.7	4.5	3.7	2.9	2.7	3.2
Natural gas	46.51	76.77	156.30	208.89	252.90	5.6	7.4	9.7	10.2	10.1	6.5	6.1	2.9	1.9	3.8
Electricity	109.74	179.62	338.98	478.31	617.89	13.1	17.3	21.1	23.3	24.7	6.4	5.4	3.5	2.6	3.9
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	262.32	224.17	223.29	198.24	161.67	31.4	21.6	13.9	9.7	6.5	-1.9	0.0	-1.2	-2.0	-1.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,599.05**	**2,584.44**	**4,801.64**	**6,608.54**	**8,322.18**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.3**	**3.2**	**2.3**	**3.7**
Coal	842.95	1,604.77	1,966.44	2,429.76	2,506.31	52.7	62.1	41.0	36.8	30.1	8.4	1.7	2.1	0.3	1.4
Oil	67.21	27.46	37.49	39.98	32.59	4.2	1.1	0.8	0.6	0.4	-10.6	2.6	0.6	-2.0	0.5
Natural gas	409.08	384.43	1,562.96	2,366.01	3,298.36	25.6	14.9	32.6	35.8	39.6	-0.8	12.4	4.2	3.4	6.9
Nuclear	26.27	37.81	165.17	243.19	332.66	1.6	1.5	3.4	3.7	4.0	4.7	13.1	3.9	3.2	7.0
Hydro	194.85	314.29	458.88	564.95	663.34	12.2	12.2	9.6	8.5	8.0	6.2	3.2	2.1	1.6	2.4
Geothermal	19.29	24.46	53.68	66.97	80.74	1.2	0.9	1.1	1.0	1.0	3.0	6.8	2.2	1.9	3.8
Others	39.41	191.22	557.02	897.69	1,408.16	2.5	7.4	11.6	13.6	16.9	21.8	9.3	4.9	4.6	6.4

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**330.28**	**481.35**	**757.34**	**971.64**	**1,096.33**	**100**	**100**	**100**	**100**	**100**	**4.8**	**3.8**	**2.5**	**1.2**	**2.6**
Coal	225.75	392.87	465.49	553.13	546.56	68.4	81.6	61.5	56.9	49.9	7.2	1.4	1.7	-0.1	1.0
Oil	19.37	12.18	11.23	11.35	8.73	5.9	2.5	1.5	1.2	0.8	-5.6	-0.7	0.1	-2.6	-1.0
Natural gas	85.15	76.30	280.62	407.16	541.04	25.8	15.9	37.1	41.9	49.4	-1.4	11.5	3.8	2.9	6.3

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.3**	**36.0**	**40.5**	**42.8**	**45.8**		**0.6**	**1.0**	**0.6**	**0.7**	**0.8**
Coal	32.1	35.1	36.3	37.8	39.4		1.1	0.3	0.4	0.4	0.4
Oil	29.8	19.4	28.7	30.3	32.1		-5.2	3.3	0.5	0.6	1.6
Natural gas	41.3	43.3	47.9	50.0	52.4		0.6	0.8	0.4	0.5	0.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**2,596.9**	**3,714.3**	**5,729.2**	**7,414.7**	**8,806.0**	**100**	**100**	**100**	**100**	**100**	**4.6**	**3.7**	**2.6**	**1.7**	**2.7**
Coal	1,440.6	2,225.9	2,995.0	3,674.0	3,910.4	55.5	59.9	52.3	49.5	44.4	5.6	2.5	2.1	0.6	1.8
Oil	834.9	1,145.9	1,784.6	2,392.8	3,160.0	32.2	30.8	31.1	32.3	35.9	4.0	3.8	3.0	2.8	3.2
Natural Gas	320.8	340.7	947.8	1,346.2	1,733.8	12.4	9.2	16.5	18.2	19.7	0.8	8.9	3.6	2.6	5.2

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	3,378	5,383	10,662	17,171	25,805	6.0	5.9	4.9	4.2	5.0
Population (millions of people)	1,804.1	1,977.1	2,195.8	2,324.0	2,393.3	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.87	2.72	4.86	7.39	10.78	4.8	4.9	4.3	3.9	4.4
Primary energy consumption per capita (toe/person)	0.67	0.78	1.10	1.33	1.54	2.0	2.9	1.9	1.5	2.1
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	357	287	228	180	143	-2.7	-1.9	-2.3	-2.3	-2.2
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	248	193	151	119	97	-3.1	-2.0	-2.3	-2.1	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	769	690	537	432	341	-1.3	-2.1	-2.2	-2.3	-2.2
CO_2 emissions per unit of primary energy consumption (t/toe)	2.15	2.40	2.36	2.40	2.39	1.4	-0.1	0.2	-0.1	0.0

Table A.26: Energy Supply and Demand of India

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**700.76**	**919.44**	**1,512.76**	**1,961.88**	**2,365.94**	**100**	**100**	**100**	**100**	**100**	**3.5**	**4.2**	**2.6**	**1.9**	**3.0**
Coal	279.03	414.21	565.89	709.11	758.88	39.8	45.1	37.4	36.1	32.1	5.1	2.6	2.3	0.7	1.9
Oil	162.07	235.25	401.32	568.16	787.96	23.1	25.6	26.5	29.0	33.3	4.8	4.6	3.5	3.3	3.8
Natural gas	54.40	52.41	236.98	350.04	459.52	7.8	5.7	15.7	17.8	19.4	-0.5	13.4	4.0	2.8	7.0
Nuclear	6.84	9.85	43.04	53.66	68.24	1.0	1.1	2.8	2.7	2.9	4.7	13.1	2.2	2.4	6.2
Hydro	10.74	13.00	21.00	27.69	34.51	1.5	1.4	1.4	1.4	1.5	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	187.67	194.72	244.53	253.23	256.83	26.8	21.2	16.2	12.9	10.9	0.5	1.9	0.4	0.1	0.9
Biomass	185.20	185.10	210.54	198.77	176.43	26.4	20.1	13.9	10.1	7.5	0.0	1.1	-0.6	-1.2	-0.1
Solar, Wind, Ocean	1.99	9.95	34.31	54.78	80.73	0.3	1.1	2.3	2.8	3.4	22.3	10.9	4.8	4.0	6.8
Biofuels	0.05	0.88	1.38	2.69	4.31	0.0	0.1	0.1	0.1	0.2	41.8	3.8	6.9	4.8	5.1
Electricity	0.48	-0.33	-0.33	-0.33	-0.33	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**478.45**	**606.58**	**998.70**	**1,301.36**	**1,616.45**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Industry	151.62	206.09	390.51	499.42	559.01	31.7	34.0	39.1	38.4	34.6	3.9	5.5	2.5	1.1	3.2
Transportation	64.80	103.77	183.03	291.49	468.24	13.5	17.1	18.3	22.4	29.0	6.1	4.8	4.8	4.9	4.8
Others	227.92	245.92	336.53	390.50	438.30	47.6	40.5	33.7	30.0	27.1	1.0	2.6	1.5	1.2	1.8
Non-energy	34.12	50.81	88.63	119.95	150.90	7.1	8.4	8.9	9.2	9.3	5.1	4.7	3.1	2.3	3.5
Total	**478.45**	**606.58**	**998.70**	**1,301.36**	**1,616.45**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Coal	87.19	106.61	190.02	240.66	273.07	18.2	17.6	19.0	18.5	16.9	2.5	4.9	2.4	1.3	3.0
Oil	138.11	207.70	364.07	519.59	725.63	28.9	34.2	36.5	39.9	44.9	5.2	4.8	3.6	3.4	4.0
Natural gas	18.64	32.42	74.45	106.97	133.70	3.9	5.3	7.5	8.2	8.3	7.2	7.2	3.7	2.3	4.5
Electricity	61.94	103.29	209.03	297.07	381.18	12.9	17.0	20.9	22.8	23.6	6.6	6.1	3.6	2.5	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	172.56	156.56	161.12	137.08	102.86	36.1	25.8	16.1	10.5	6.4	-1.2	0.2	-1.6	-2.8	-1.3

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**974.80**	**1,583.22**	**3,114.88**	**4,263.56**	**5,269.01**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.8**	**3.2**	**2.1**	**3.8**
Coal	657.96	1,163.40	1,392.33	1,750.32	1,776.34	67.5	73.5	44.7	41.1	33.7	7.4	1.5	2.3	0.1	1.3
Oil	17.67	7.85	10.08	8.94	5.10	1.8	0.5	0.3	0.2	0.1	-9.6	2.1	-1.2	-5.4	-1.3
Natural gas	113.29	73.62	850.68	1,274.04	1,807.65	11.6	4.6	27.3	29.9	34.3	-5.2	22.6	4.1	3.6	10.5
Nuclear	26.27	37.81	165.17	205.94	261.88	2.7	2.4	5.3	4.8	5.0	4.7	13.1	2.2	2.4	6.2
Hydro	124.92	151.13	244.24	322.04	401.40	12.8	9.5	7.8	7.6	7.6	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	34.70	149.40	452.39	702.28	1,016.65	3.6	9.4	14.5	16.5	19.3	20.0	9.7	4.5	3.8	6.2

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**209.39**	**304.61**	**489.48**	**628.26**	**697.17**	**100**	**100**	**100**	**100**	**100**	**4.8**	**4.0**	**2.5**	**1.0**	**2.6**
Coal	177.27	284.97	332.94	403.98	396.65	84.7	93.6	68.0	64.3	56.9	6.1	1.3	2.0	-0.2	1.0
Oil	7.25	4.18	4.74	4.16	2.39	3.5	1.4	1.0	0.7	0.3	-6.7	1.1	-1.3	-5.4	-1.7
Natural gas	24.87	15.46	151.80	220.12	298.13	11.9	5.1	31.0	35.0	42.8	-5.8	21.0	3.8	3.1	9.7

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**32.4**	**35.1**	**39.6**	**41.5**	**44.3**		**1.0**	**1.0**	**0.5**	**0.6**	**0.7**
Coal	31.9	35.1	36.0	37.3	38.5		1.2	0.2	0.4	0.3	0.3
Oil	21.0	16.2	18.3	18.5	18.4		-3.2	1.0	0.1	0.0	0.4
Natural gas	39.2	40.9	48.2	49.8	52.1		0.6	1.4	0.3	0.5	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,585.0**	**2,324.2**	**3,759.2**	**5,013.2**	**6,054.5**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.1**	**2.9**	**1.9**	**3.0**
Coal	1,083.7	1,628.4	2,225.2	2,788.6	2,984.4	68.4	70.1	59.2	55.6	49.3	5.2	2.6	2.3	0.7	1.9
Oil	425.9	611.1	1,056.1	1,511.8	2,130.6	26.9	26.3	28.1	30.2	35.2	4.6	4.7	3.7	3.5	4.0
Natural Gas	74.7	83.5	476.7	711.5	938.2	4.7	3.6	12.7	14.2	15.5	1.4	15.6	4.1	2.8	7.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	1,670	2,831	6,146	10,304	15,988	6.8	6.7	5.3	4.5	5.6
Population (millions of people)	1,234.3	1,352.6	1,503.6	1,592.7	1,639.2	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.35	2.09	4.09	6.47	9.75	5.6	5.7	4.7	4.2	4.9
Primary energy consumption per capita (toe/person)	0.57	0.68	1.01	1.23	1.44	2.3	3.3	2.0	1.6	2.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	420	325	246	190	148	-3.2	-2.3	-2.5	-2.5	-2.4
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	287	214	163	126	101	-3.6	-2.3	-2.5	-2.2	-2.3
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	949	821	612	487	379	-1.8	-2.4	-2.3	-2.5	-2.4
CO_2 emissions per unit of primary energy consumption (t/toe)	2.26	2.53	2.49	2.56	2.56	1.4	-0.1	0.3	0.0	0.0

Table A.27: Energy Supply and Demand of Indonesia

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**201.69**	**231.14**	**342.81**	**440.57**	**531.20**	**100**	**100**	**100**	**100**	**100**	**1.7**	**3.3**	**2.5**	**1.9**	**2.6**
Coal	31.84	55.23	76.61	92.60	97.52	15.8	23.9	22.3	21.0	18.4	7.1	2.8	1.9	0.5	1.8
Oil	67.39	77.31	104.92	129.23	151.12	33.4	33.4	30.6	29.3	28.4	1.7	2.6	2.1	1.6	2.1
Natural gas	38.82	38.93	80.40	118.95	155.99	19.2	16.8	23.5	27.0	29.4	0.0	6.2	4.0	2.7	4.4
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	1.50	1.86	2.19	2.65	3.11	0.7	0.8	0.6	0.6	0.6	2.7	1.4	1.9	1.6	1.6
Geothermal	16.09	24.11	57.94	76.35	96.10	8.0	10.4	16.9	17.3	18.1	5.2	7.6	2.8	2.3	4.4
Others	46.04	33.69	20.76	20.79	27.35	22.8	14.6	6.1	4.7	5.1	-3.8	-4.0	0.0	2.8	-0.6
Biomass	46.04	33.54	20.34	18.07	16.55	22.8	14.5	5.9	4.1	3.1	-3.9	-4.1	-1.2	-0.9	-2.2
Solar, WIDN, Ocean	0.00	0.02	0.30	2.59	10.68	0.0	0.0	0.1	0.6	2.0	65.4	23.3	24.1	15.2	21.0
Biofuels	0.17	2.83	3.12	4.02	4.98	0.1	1.2	0.9	0.9	0.9	41.7	0.8	2.5	2.2	1.8
Electricity	0.00	0.13	0.13	0.13	0.13	0.0	0.1	0.0	0.0	0.0	129.0	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**145.98**	**156.06**	**213.86**	**270.04**	**324.68**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Industry	49.08	50.16	74.46	93.43	109.32	33.6	32.1	34.8	34.6	33.7	0.3	3.3	2.3	1.6	2.5
Transportation	30.14	54.38	75.78	96.46	118.64	20.6	34.8	35.4	35.7	36.5	7.7	2.8	2.4	2.1	2.5
Others	56.55	43.03	48.37	60.58	72.86	38.7	27.6	22.6	22.4	22.4	-3.4	1.0	2.3	1.9	1.7
Non-energy	10.20	8.49	15.24	19.57	23.86	7.0	5.4	7.1	7.2	7.3	-2.3	5.0	2.5	2.0	3.3
Total	**145.98**	**156.06**	**213.86**	**270.04**	**324.68**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Coal	17.18	14.72	22.17	28.17	33.02	11.8	9.4	10.4	10.4	10.2	-1.9	3.5	2.4	1.6	2.6
Oil	55.01	75.67	102.32	124.56	145.83	37.7	48.5	47.8	46.1	44.9	4.1	2.5	2.0	1.6	2.1
Natural gas	15.86	16.68	31.98	42.10	50.80	10.9	10.7	15.0	15.6	15.6	0.6	5.6	2.8	1.9	3.5
Electricity	12.67	22.02	39.40	59.88	81.58	8.7	14.1	18.4	22.2	25.1	7.2	5.0	4.3	3.1	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	45.26	26.97	17.99	15.34	13.46	31.0	17.3	8.4	5.7	4.1	-6.3	-3.3	-1.6	-1.3	-2.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**169.76**	**283.77**	**510.96**	**777.29**	**1,057.77**	**100**	**100**	**100**	**100**	**100**	**6.6**	**5.0**	**4.3**	**3.1**	**4.2**
Coal	68.45	160.02	223.08	275.31	288.73	40.3	56.4	43.7	35.4	27.3	11.2	2.8	2.1	0.5	1.9
Oil	34.15	14.88	22.92	27.71	26.34	20.1	5.2	4.5	3.6	2.5	-9.9	3.7	1.9	-0.5	1.8
Natural gas	40.25	59.42	198.89	364.28	520.60	23.7	20.9	38.9	46.9	49.2	5.0	10.6	6.2	3.6	7.0
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	17.46	21.64	25.46	30.84	36.22	10.3	7.6	5.0	4.0	3.4	2.7	1.4	1.9	1.6	1.6
Geothermal	9.36	14.02	33.70	44.41	55.89	5.5	4.9	6.6	5.7	5.3	5.2	7.6	2.8	2.3	4.4
Others	0.10	13.79	6.91	34.74	129.98	0.1	4.9	1.4	4.5	12.3	85.1	-5.6	17.5	14.1	7.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**35.21**	**60.59**	**97.94**	**136.11**	**159.81**	**100**	**100**	**100**	**100**	**100**	**7.0**	**4.1**	**3.3**	**1.6**	**3.1**
Coal	18.08	40.51	54.42	64.42	64.49	51.4	66.9	55.6	47.3	40.4	10.6	2.5	1.7	0.0	1.5
Oil	8.47	6.75	5.48	6.43	6.08	24.1	11.1	5.6	4.7	3.8	-2.8	-1.7	1.6	-0.6	-0.3
Natural gas	8.65	13.32	38.04	65.26	89.24	24.6	22.0	38.8	47.9	55.8	5.5	9.1	5.5	3.2	6.1

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.9**	**33.3**	**39.1**	**42.2**	**45.0**						**-0.6**	**1.3**	**0.8**	**0.6**	**0.9**
Coal	32.5	34.0	35.2	36.7	38.5						0.5	0.3	0.4	0.5	0.4
Oil	34.6	18.9	36.0	37.0	37.2						-7.3	5.5	0.3	0.1	2.1
Natural gas	40.0	38.4	45.0	48.0	50.2						-0.5	1.3	0.7	0.4	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**396.0**	**539.5**	**785.6**	**999.4**	**1,158.4**	**100**	**100**	**100**	**100**	**100**	**3.9**	**3.2**	**2.4**	**1.5**	**2.4**
Coal	141.8	222.0	307.9	372.2	392.0	35.8	41.2	39.2	37.2	33.8	5.8	2.8	1.9	0.5	1.8
Oil	174.7	234.6	310.4	377.5	438.3	44.1	43.5	39.5	37.8	37.8	3.8	2.4	2.0	1.5	2.0
Natural Gas	79.5	82.3	166.7	249.2	327.6	20.1	15.3	21.2	24.9	28.3	0.4	6.1	4.1	2.8	4.4

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	755	1,147	2,089	3,278	4,753	5.4	5.1	4.6	3.8	4.5
Population (millions of people)	241.8	267.7	299.4	318.9	331.4	1.3	0.9	0.6	0.4	0.7
GDP per capita (thousands of 2010 USD/person)	3.12	4.28	6.98	10.28	14.34	4.0	4.1	3.9	3.4	3.8
Primary energy consumption per capita (toe/person)	0.83	0.86	1.15	1.38	1.60	0.4	2.4	1.9	1.5	2.0
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	267	202	164	134	112	-3.5	-1.7	-2.0	-1.8	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	193	136	102	82	68	-4.3	-2.3	-2.1	-1.9	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	524	470	376	305	244	-1.4	-1.8	-2.1	-2.2	-2.0
CO_2 emissions per unit of primary energy consumption (t/toe)	1.96	2.33	2.29	2.27	2.18	2.2	-0.2	-0.1	-0.4	-0.2

Table A.28: Energy Supply and Demand of Malaysia

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**72.49**	**93.43**	**130.43**	**147.03**	**155.22**	**100**	**100**	**100**	**100**	**100**	**3.2**	**2.8**	**1.2**	**0.5**	**1.6**
Coal	14.60	22.61	24.45	24.31	19.72	20.1	24.2	18.7	16.5	12.7	5.6	0.7	-0.1	-2.1	-0.4
Oil	25.33	28.98	35.52	35.86	34.95	34.9	31.0	27.2	24.4	22.5	1.7	1.7	0.1	-0.3	0.6
Natural gas	31.20	38.78	65.73	77.60	88.40	43.0	41.5	50.4	52.8	57.0	2.8	4.5	1.7	1.3	2.6
Nuclear	0.00	0.00	0.00	3.66	3.65	0.0	0.0	0.0	2.5	2.4	-	-	-	0.0	-
Hydro	0.56	2.26	3.00	3.32	3.43	0.8	2.4	2.3	2.3	2.2	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.80	0.79	1.73	2.28	5.05	1.1	0.9	1.3	1.6	3.3	-0.1	6.7	2.8	8.3	5.9
Biomass	0.82	0.87	1.67	2.04	2.36	1.1	0.9	1.3	1.4	1.5	0.8	5.5	2.0	1.4	3.1
Solar, WMYS, Ocean	0.00	0.05	0.19	0.37	2.83	0.0	0.1	0.1	0.3	1.8	-	11.7	7.2	22.5	13.5
Biofuels	0.00	0.44	0.39	0.38	0.36	0.0	0.5	0.3	0.3	0.2	77.7	-1.0	-0.2	-0.4	-0.6
Electricity	-0.01	-0.13	-0.13	-0.13	-0.13	0.0	-0.1	-0.1	-0.1	-0.1	33.1	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**41.74**	**62.53**	**87.86**	**99.21**	**107.89**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Industry	14.92	19.51	25.38	29.15	31.74	35.8	31.2	28.9	29.4	29.4	3.4	2.2	1.4	0.9	1.5
Transportation	14.93	20.96	22.15	21.83	20.75	35.8	33.5	25.2	22.0	19.2	4.3	0.5	-0.1	-0.5	0.0
Others	8.19	8.80	12.21	14.49	16.41	19.6	14.1	13.9	14.6	15.2	0.9	2.8	1.7	1.2	2.0
Non-energy	3.70	13.26	28.12	33.74	39.00	8.9	21.2	32.0	34.0	36.1	17.3	6.5	1.8	1.5	3.4
Total	**41.74**	**62.53**	**87.86**	**99.21**	**107.89**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Coal	1.83	1.81	2.18	2.37	2.46	4.4	2.9	2.5	2.4	2.3	-0.1	1.6	0.9	0.4	1.0
Oil	23.96	28.28	32.51	32.90	32.10	57.4	45.2	37.0	33.2	29.8	2.1	1.2	0.1	-0.2	0.4
Natural gas	6.25	18.85	33.65	39.65	44.64	15.0	30.1	38.3	40.0	41.4	14.8	4.9	1.7	1.2	2.7
Electricity	9.53	13.15	18.97	23.67	28.00	22.8	21.0	21.6	23.9	25.9	4.1	3.1	2.2	1.7	2.4
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.17	0.44	0.55	0.63	0.70	0.4	0.7	0.6	0.6	0.6	12.3	2.0	1.2	1.1	1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.79**	**170.47**	**245.81**	**306.49**	**362.38**	**100**	**100**	**100**	**100**	**100**	**4.0**	**3.1**	**2.2**	**1.7**	**2.4**
Coal	42.84	77.29	85.35	87.02	73.22	34.3	45.3	34.7	28.4	20.2	7.7	0.8	0.2	-1.7	-0.2
Oil	3.67	1.05	0.83	0.30	0.00	2.9	0.6	0.3	0.1	0.0	-14.5	-2.0	-9.6	-88.7	-51.4
Natural gas	70.80	63.89	119.18	157.72	196.65	56.7	37.5	48.5	51.5	54.3	-1.3	5.3	2.8	2.2	3.6
Nuclear	0.00	0.00	0.00	14.05	14.02	0.0	0.0	0.0	4.6	3.9	-	-	-	0.0	-
Hydro	6.47	26.32	34.92	38.57	39.94	5.2	15.4	14.2	12.6	11.0	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	1.01	1.93	5.54	8.82	38.56	0.8	1.1	2.3	2.9	10.6	8.4	9.2	4.8	15.9	9.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.72**	**33.67**	**44.66**	**49.81**	**50.46**	**100**	**100**	**100**	**100**	**100**	**0.7**	**2.4**	**1.1**	**0.1**	**1.3**
Coal	12.95	20.47	21.94	21.61	16.93	40.8	60.8	49.1	43.4	33.5	5.9	0.6	-0.2	-2.4	-0.6
Oil	0.74	0.38	0.21	0.08	0.00	2.3	1.1	0.5	0.2	0.0	-8.0	-4.7	-9.7	-88.7	-51.9
Natural gas	18.03	12.82	22.51	28.13	33.53	56.8	38.1	50.4	56.5	66.5	-4.2	4.8	2.3	1.8	3.1

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.8**	**36.3**	**39.5**	**42.3**	**46.0**						**1.7**	**0.7**	**0.7**	**0.8**	**0.7**
Coal	28.4	32.5	33.4	34.6	37.2						1.7	0.3	0.3	0.7	0.4
Oil	42.6	23.7	33.2	33.5	33.7						-7.1	2.9	0.1	0.0	1.1
Natural gas	33.8	42.9	45.5	48.2	50.4						3.0	0.5	0.6	0.4	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**187.0**	**221.5**	**271.9**	**285.9**	**277.3**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.7**	**0.5**	**-0.3**	**0.7**
Coal	58.5	88.2	95.5	95.0	76.8	31.3	39.8	35.1	33.2	27.7	5.3	0.7	-0.1	-2.1	-0.4
Oil	65.8	73.1	84.2	82.8	78.2	35.2	33.0	31.0	29.0	28.2	1.3	1.2	-0.2	-0.6	0.2
Natural Gas	62.6	60.1	92.2	108.1	122.3	33.5	27.1	33.9	37.8	44.1	-0.5	3.6	1.6	1.2	2.2

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	255	382	640	912	1,229	5.2	4.4	3.6	3.0	3.7
Population (millions of people)	28.2	31.5	36.1	38.8	40.6	1.4	1.1	0.7	0.5	0.8
GDP per capita (thousands of 2010 USD/person)	9.04	12.12	17.73	23.53	30.30	3.7	3.2	2.9	2.6	2.9
Primary energy consumption per capita (toe/person)	2.57	2.96	3.61	3.79	3.83	1.8	1.7	0.5	0.1	0.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	284	245	204	161	126	-1.9	-1.5	-2.3	-2.4	-2.0
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	164	164	137	109	88	0.0	-1.5	-2.3	-2.1	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	733	580	425	313	226	-2.9	-2.6	-3.0	-3.2	-2.9
CO_2 emissions per unit of primary energy consumption (t/toe)	2.58	2.37	2.08	1.94	1.79	-1.0	-1.1	-0.7	-0.8	-0.9

Table A.29: Energy Supply and Demand of Myanmar

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.90**	**23.83**	**37.99**	**49.43**	**60.33**	**100**	**100**	**100**	**100**	**100**	**7.0**	**4.0**	**2.7**	**2.0**	**2.9**
Coal	0.41	0.88	1.88	3.05	4.51	2.9	3.7	4.9	6.2	7.5	10.0	6.5	5.0	4.0	5.2
Oil	1.28	6.86	13.06	18.79	24.10	9.2	28.8	34.4	38.0	40.0	23.3	5.5	3.7	2.5	4.0
Natural gas	1.28	4.12	12.99	19.31	25.92	9.2	17.3	34.2	39.1	43.0	15.7	10.0	4.0	3.0	5.9
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.44	1.21	1.49	1.79	2.02	3.2	5.1	3.9	3.6	3.3	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.48	10.76	8.58	6.50	3.78	75.4	45.1	22.6	13.2	6.3	0.3	-1.9	-2.7	-5.3	-3.2
Biomass	10.48	10.96	10.21	8.76	6.53	75.4	46.0	26.9	17.7	10.8	0.6	-0.6	-1.5	-2.9	-1.6
Solar, WMYA, Ocean	0.00	0.00	0.07	0.19	0.46	0.0	0.0	0.2	0.4	0.8	-	44.3	10.2	9.3	21.6
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Electricity	0.00	-0.20	-1.70	-2.45	-3.20	0.0	-0.9	-4.5	-5.0	-5.3	-	19.4	3.7	2.7	9.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**12.85**	**20.16**	**28.20**	**35.31**	**41.89**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.8**	**2.3**	**1.7**	**2.3**
Industry	1.28	3.69	6.85	10.46	13.49	9.9	18.3	24.3	29.6	32.2	14.2	5.3	4.3	2.6	4.1
Transportation	0.81	2.10	4.04	6.37	9.09	6.3	10.4	14.3	18.0	21.7	12.6	5.6	4.7	3.6	4.7
Others	10.64	13.89	16.62	17.57	18.20	82.8	68.9	58.9	49.8	43.5	3.4	1.5	0.6	0.4	0.8
Non-energy	0.12	0.48	0.70	0.91	1.11	0.9	2.4	2.5	2.6	2.7	19.2	3.2	2.7	2.1	2.7
Total	**12.85**	**20.16**	**28.20**	**35.31**	**41.89**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.8**	**2.3**	**1.7**	**2.3**
Coal	0.23	0.26	0.40	0.53	0.63	1.8	1.3	1.4	1.5	1.5	1.4	3.7	2.7	1.7	2.8
Oil	1.04	6.81	12.91	18.64	23.99	8.1	33.8	45.8	52.8	57.3	26.5	5.5	3.7	2.6	4.0
Natural gas	0.60	0.57	0.75	0.96	1.17	4.6	2.8	2.7	2.7	2.8	-0.5	2.2	2.6	2.0	2.2
Electricity	0.54	1.59	3.97	6.46	9.61	4.2	7.9	14.1	18.3	22.9	14.5	7.9	5.0	4.1	5.8
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.44	10.91	10.17	8.72	6.48	81.3	54.1	36.0	24.7	15.5	0.6	-0.6	-1.5	-2.9	-1.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**7.54**	**24.55**	**77.08**	**119.87**	**170.56**	**100**	**100**	**100**	**100**	**100**	**15.9**	**10.0**	**4.5**	**3.6**	**6.2**
Coal	0.67	1.54	5.87	11.08	18.38	8.9	6.3	7.6	9.2	10.8	11.0	11.8	6.6	5.2	8.0
Oil	0.03	0.08	0.27	0.21	0.00	0.4	0.3	0.4	0.2	0.0	11.2	11.0	-2.3	-88.3	-47.2
Natural gas	1.73	8.80	52.76	85.61	123.35	23.0	35.8	68.5	71.4	72.3	22.5	16.1	5.0	3.7	8.6
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	5.11	14.13	17.34	20.76	23.48	67.7	57.5	22.5	17.3	13.8	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.00	0.01	0.83	2.21	5.36	0.0	0.0	1.1	1.8	3.1	-	44.2	10.2	9.3	21.6

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**0.73**	**3.35**	**12.90**	**20.04**	**27.74**	**100**	**100**	**100**	**100**	**100**	**21.1**	**11.9**	**4.5**	**3.3**	**6.8**
Coal	0.18	0.47	1.33	2.37	3.73	24.6	14.0	10.3	11.8	13.4	12.8	9.1	6.0	4.6	6.7
Oil	0.01	0.02	0.07	0.06	0.00	1.1	0.6	0.6	0.3	0.0	12.3	10.9	-2.4	-88.3	-47.3
Natural gas	0.54	2.86	11.50	17.61	24.02	74.2	85.4	89.2	87.9	86.6	23.2	12.3	4.4	3.2	6.9

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**28.9**	**26.8**	**39.3**	**41.6**	**43.9**						**-1.0**	**3.2**	**0.6**	**0.6**	**1.6**
Coal	32.3	28.4	38.1	40.1	42.4						-1.6	2.5	0.5	0.6	1.3
Oil	34.3	31.6	32.1	32.2	32.3						-1.0	0.1	0.0	0.1	0.1
Natural gas	27.7	26.5	39.5	41.8	44.2						-0.6	3.4	0.6	0.5	1.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**8.0**	**31.4**	**74.3**	**110.6**	**147.4**	**100**	**100**	**100**	**100**	**100**	**18.6**	**7.4**	**4.1**	**2.9**	**4.9**
Coal	1.7	2.9	6.9	11.6	17.4	20.6	9.3	9.3	10.5	11.8	7.4	7.5	5.3	4.1	5.7
Oil	3.4	19.8	37.9	54.7	70.2	42.7	62.9	51.0	49.4	47.6	24.5	5.6	3.7	2.5	4.0
Natural Gas	3.0	8.7	29.5	44.3	59.8	36.8	27.8	39.7	40.1	40.6	14.5	10.7	4.2	3.0	6.2

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	41	71	143	238	369	6.9	6.0	5.3	4.5	5.3
Population (millions of people)	50.6	53.7	58.5	61.2	62.3	0.7	0.7	0.5	0.2	0.5
GDP per capita (thousands of 2010 USD/person)	0.82	1.32	2.44	3.90	5.92	6.1	5.3	4.8	4.3	4.8
Primary energy consumption per capita (toe/person)	0.27	0.44	0.65	0.81	0.97	6.2	3.2	2.2	1.8	2.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	335	337	266	207	164	0.1	-2.0	-2.5	-2.3	-2.2
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	310	285	198	148	114	-1.0	-3.0	-2.8	-2.6	-2.8
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	194	445	521	464	400	10.9	1.3	-1.2	-1.5	-0.3
CO_2 emissions per unit of primary energy consumption (t/toe)	0.58	1.32	1.96	2.24	2.44	10.9	3.3	1.3	0.9	1.9

Table A.30: Energy Supply and Demand of Philippines

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**40.40**	**60.05**	**92.73**	**116.35**	**141.47**	**100**	**100**	**100**	**100**	**100**	**5.1**	**3.7**	**2.3**	**2.0**	**2.7**
Coal	7.63	17.94	20.51	21.78	22.37	18.9	29.9	22.1	18.7	15.8	11.3	1.1	0.6	0.3	0.7
Oil	13.60	19.99	34.76	48.57	64.90	33.7	33.3	37.5	41.7	45.9	4.9	4.7	3.4	2.9	3.7
Natural gas	3.05	3.63	8.87	14.39	19.68	7.6	6.0	9.6	12.4	13.9	2.2	7.7	5.0	3.2	5.4
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.67	0.81	1.10	1.21	1.32	1.7	1.3	1.2	1.0	0.9	2.3	2.6	1.0	0.9	1.6
Geothermal	8.54	8.97	17.17	19.40	21.36	21.1	14.9	18.5	16.7	15.1	0.6	5.6	1.2	1.0	2.7
Others	6.91	8.72	10.32	11.01	11.84	17.1	14.5	11.1	9.5	8.4	2.9	1.4	0.6	0.7	1.0
Biomass	6.90	8.51	9.54	9.39	9.04	17.1	14.2	10.3	8.1	6.4	2.7	1.0	-0.2	-0.4	0.2
Solar, WPHL, Ocean	0.01	0.21	0.78	1.61	2.80	0.0	0.3	0.8	1.4	2.0	57.6	11.7	7.6	5.7	8.5
Biofuels	0.18	0.48	0.98	1.43	1.97	0.5	0.8	1.1	1.2	1.4	12.7	6.2	3.9	3.3	4.5
Electricity	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**23.71**	**33.83**	**54.96**	**73.70**	**95.18**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Industry	6.41	7.63	11.41	14.09	16.89	27.0	22.6	20.8	19.1	17.7	2.2	3.4	2.1	1.8	2.5
Transportation	8.04	12.28	23.81	34.82	48.50	33.9	36.3	43.3	47.2	51.0	5.4	5.7	3.9	3.4	4.4
Others	9.14	12.65	17.52	21.27	24.18	38.5	37.4	31.9	28.9	25.4	4.2	2.7	2.0	1.3	2.0
Non-energy	0.12	1.26	2.22	3.52	5.61	0.5	3.7	4.0	4.8	5.9	34.2	4.8	4.7	4.8	4.8
Total	**23.71**	**33.83**	**54.96**	**73.70**	**95.18**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Coal	1.88	2.52	3.52	4.20	4.83	7.9	7.4	6.4	5.7	5.1	3.7	2.8	1.8	1.4	2.1
Oil	11.46	18.21	32.66	46.30	62.64	48.3	53.8	59.4	62.8	65.8	6.0	5.0	3.5	3.1	3.9
Natural gas	0.07	0.06	0.11	0.14	0.18	0.3	0.2	0.2	0.2	0.2	-2.0	5.1	3.0	2.0	3.5
Electricity	4.75	7.10	11.86	16.52	21.44	20.0	21.0	21.6	22.4	22.5	5.2	4.4	3.4	2.6	3.5
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	5.55	5.93	6.80	6.54	6.09	23.4	17.5	12.4	8.9	6.4	0.8	1.1	-0.4	-0.7	0.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**67.74**	**99.19**	**164.56**	**226.08**	**288.95**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.3**	**3.2**	**2.5**	**3.4**
Coal	23.30	51.93	62.58	71.06	76.76	34.4	52.4	38.0	31.4	26.6	10.5	1.6	1.3	0.8	1.2
Oil	7.10	3.17	3.40	2.82	1.15	10.5	3.2	2.1	1.2	0.4	-9.6	0.6	-1.9	-8.6	-3.1
Natural gas	19.52	21.33	55.47	95.10	136.00	28.8	21.5	33.7	42.1	47.1	1.1	8.3	5.5	3.6	6.0
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	7.80	9.38	12.75	14.03	15.36	11.5	9.5	7.7	6.2	5.3	2.3	2.6	1.0	0.9	1.6
Geothermal	9.93	10.44	19.97	22.56	24.85	14.7	10.5	12.1	10.0	8.6	0.6	5.6	1.2	1.0	2.7
Others	0.09	2.93	10.38	20.52	34.84	0.1	3.0	6.3	9.1	12.1	54.6	11.1	7.1	5.4	8.0

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**9.74**	**18.97**	**25.68**	**31.64**	**36.50**	**100**	**100**	**100**	**100**	**100**	**8.7**	**2.6**	**2.1**	**1.4**	**2.1**
Coal	5.51	14.90	16.48	17.08	17.05	56.6	78.5	64.2	54.0	46.7	13.2	0.8	0.4	0.0	0.4
Oil	1.48	0.73	0.72	0.62	0.26	15.2	3.8	2.8	2.0	0.7	-8.5	-0.1	-1.5	-8.4	-3.2
Natural gas	2.75	3.35	8.49	13.94	19.19	28.2	17.7	33.1	44.1	52.6	2.5	8.1	5.1	3.3	5.6

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**44.0**	**34.6**	**40.7**	**45.9**	**50.4**		**-3.0**	**1.3**	**1.2**	**0.9**	**1.2**
Coal	36.3	30.0	32.7	35.8	38.7		-2.4	0.7	0.9	0.8	0.8
Oil	41.2	37.5	40.8	39.2	38.6		-1.2	0.7	-0.4	-0.2	0.1
Natural gas	61.0	54.8	56.2	58.7	60.9		-1.3	0.2	0.4	0.4	0.3

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**76.4**	**132.5**	**195.8**	**250.6**	**307.3**	**100**	**100**	**100**	**100**	**100**	**7.1**	**3.3**	**2.5**	**2.1**	**2.7**
Coal	29.8	70.0	80.2	85.3	87.6	39.0	52.8	41.0	34.0	28.5	11.3	1.1	0.6	0.3	0.7
Oil	39.4	54.1	94.8	131.7	173.7	51.6	40.8	48.4	52.5	56.5	4.0	4.8	3.3	2.8	3.7
Natural Gas	7.1	8.5	20.7	33.6	46.0	9.3	6.4	10.6	13.4	15.0	2.2	7.7	5.0	3.2	5.4

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	200	322	613	907	1,290	6.2	5.5	4.0	3.6	4.4
Population (millions of people)	94.0	106.7	123.7	135.6	144.5	1.6	1.2	0.9	0.6	1.0
GDP per capita (thousands of 2010 USD/person)	2.12	3.02	4.96	6.69	8.93	4.5	4.2	3.0	2.9	3.4
Primary energy consumption per capita (toe/person)	0.43	0.56	0.75	0.86	0.98	3.4	2.4	1.4	1.3	1.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	202	186	151	128	110	-1.0	-1.7	-1.6	-1.6	-1.6
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	119	105	90	81	74	-1.5	-1.3	-1.0	-1.0	-1.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	383	411	319	276	238	0.9	-2.1	-1.4	-1.5	-1.7
CO_2 emissions per unit of primary energy consumption (t/toe)	1.89	2.21	2.11	2.15	2.17	1.9	-0.4	0.2	0.1	0.0

Table A.31: Energy Supply and Demand of Thailand

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**117.86**	**135.81**	**171.63**	**191.33**	**206.36**	**100**	**100**	**100**	**100**	**100**	**1.8**	**2.0**	**1.1**	**0.8**	**1.3**
Coal	16.36	15.83	15.35	14.46	12.22	13.9	11.7	8.9	7.6	5.9	-0.4	-0.3	-0.6	-1.7	-0.8
Oil	44.95	55.36	64.58	69.72	72.77	38.1	40.8	37.6	36.4	35.3	2.6	1.3	0.8	0.4	0.9
Natural gas	32.97	35.51	44.99	48.60	48.91	28.0	26.1	26.2	25.4	23.7	0.9	2.0	0.8	0.1	1.0
Nuclear	0.00	0.00	0.00	1.83	6.21	0.0	0.0	0.0	1.0	3.0	-	-	-	13.0	-
Hydro	0.48	0.65	0.82	0.92	0.98	0.4	0.5	0.5	0.5	0.5	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	23.10	28.45	45.90	55.79	65.26	19.6	20.9	26.7	29.2	31.6	2.6	4.1	2.0	1.6	2.6
Biomass	22.61	25.70	39.40	46.26	52.47	19.2	18.9	23.0	24.2	25.4	1.6	3.6	1.6	1.3	2.3
Solar, WTHA, Ocean	0.00	0.54	2.29	4.32	6.59	0.0	0.4	1.3	2.3	3.2	87.7	12.8	6.6	4.3	8.1
Biofuels	0.65	1.94	2.75	4.21	6.10	0.6	1.4	1.6	2.2	3.0	14.6	2.9	4.4	3.8	3.6
Electricity	0.49	2.21	4.21	5.21	6.21	0.4	1.6	2.5	2.7	3.0	20.8	5.5	2.2	1.8	3.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**84.90**	**100.16**	**120.90**	**135.76**	**146.60**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Industry	26.48	30.31	39.49	45.54	48.82	31.2	30.3	32.7	33.5	33.3	1.7	2.2	1.4	0.7	1.5
Transportation	19.92	27.56	29.18	31.60	33.46	23.5	27.5	24.1	23.3	22.8	4.1	0.5	0.8	0.6	0.6
Others	20.43	17.72	21.06	22.85	24.28	24.1	17.7	17.4	16.8	16.6	-1.8	1.4	0.8	0.6	1.0
Non-energy	18.07	24.57	31.17	35.77	40.05	21.3	24.5	25.8	26.3	27.3	3.9	2.0	1.4	1.1	1.5
Total	**84.90**	**100.16**	**120.90**	**135.76**	**146.60**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Coal	9.21	6.83	7.66	7.60	7.08	10.8	6.8	6.3	5.6	4.8	-3.7	1.0	-0.1	-0.7	0.1
Oil	43.84	54.69	62.47	67.29	70.12	51.6	54.6	51.7	49.6	47.8	2.8	1.1	0.7	0.4	0.8
Natural gas	4.59	7.21	9.51	11.67	13.69	5.4	7.2	7.9	8.6	9.3	5.8	2.3	2.1	1.6	2.0
Electricity	12.84	16.17	23.33	28.90	33.53	15.1	16.1	19.3	21.3	22.9	2.9	3.1	2.2	1.5	2.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	14.42	15.27	17.93	20.31	22.17	17.0	15.2	14.8	15.0	15.1	0.7	1.4	1.3	0.9	1.2

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**159.52**	**182.30**	**247.75**	**305.28**	**350.75**	**100**	**100**	**100**	**100**	**100**	**1.7**	**2.6**	**2.1**	**1.4**	**2.1**
Coal	30.05	36.41	32.43	30.93	24.59	18.8	20.0	13.1	10.1	7.0	2.4	-1.0	-0.5	-2.3	-1.2
Oil	1.18	0.18	0.00	0.00	0.00	0.7	0.1	0.0	0.0	0.0	-21.1	-83.0	0.0	0.0	-48.6
Natural gas	119.35	115.64	143.71	159.24	154.93	74.8	63.4	58.0	52.2	44.2	-0.4	1.8	1.0	-0.3	0.9
Nuclear	0.00	0.00	0.00	7.03	23.83	0.0	0.0	0.0	2.3	6.8	-	-	-	13.0	-
Hydro	5.54	7.57	9.51	10.75	11.46	3.5	4.1	3.8	3.5	3.3	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.01	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	3.41	22.51	62.08	97.32	135.94	2.1	12.3	25.1	31.9	38.8	26.6	8.8	4.6	3.4	5.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**29.87**	**30.65**	**34.26**	**35.43**	**32.04**	**100**	**100**	**100**	**100**	**100**	**0.3**	**0.9**	**0.3**	**-1.0**	**0.1**
Coal	6.92	8.99	7.70	6.88	5.16	23.2	29.3	22.5	19.4	16.1	3.3	-1.3	-1.1	-2.8	-1.7
Oil	0.26	0.05	0.00	0.00	0.00	0.9	0.2	0.0	0.0	0.0	-18.8	-83.5	-0.7	-0.2	-49.2
Natural gas	22.68	21.61	26.56	28.56	26.88	75.9	70.5	77.5	80.6	83.9	-0.6	1.7	0.7	-0.6	0.7

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**43.3**	**42.7**	**44.2**	**46.2**	**48.2**		**-0.2**	**0.3**	**0.4**	**0.4**	**0.4**
Coal	37.3	34.8	36.2	38.7	41.0		-0.9	0.3	0.7	0.6	0.5
Oil	38.4	30.5	41.0	44.1	44.9		-2.8	2.5	0.7	0.2	1.2
Natural gas	45.2	46.0	46.5	48.0	49.6		0.2	0.1	0.3	0.3	0.2

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**219.7**	**238.2**	**266.7**	**273.8**	**262.7**	**100**	**100**	**100**	**100**	**100**	**1.0**	**0.9**	**0.3**	**-0.4**	**0.3**
Coal	65.2	63.9	61.9	58.4	49.3	29.7	26.8	23.2	21.3	18.8	-0.2	-0.3	-0.6	-1.7	-0.8
Oil	79.8	95.1	107.7	112.2	111.7	36.3	39.9	40.4	41.0	42.5	2.2	1.0	0.4	0.0	0.5
Natural Gas	74.7	79.1	97.1	103.3	101.8	34.0	33.2	36.4	37.7	38.7	0.7	1.7	0.6	-0.2	0.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	341	442	656	907	1,191	3.3	3.3	3.3	2.8	3.1
Population (millions of people)	67.2	69.4	70.3	69.0	65.9	0.4	0.1	-0.2	-0.5	-0.2
GDP per capita (thousands of 2010 USD/person)	5.08	6.36	9.32	13.14	18.07	2.9	3.2	3.5	3.2	3.3
Primary energy consumption per capita (toe/person)	1.75	1.96	2.44	2.77	3.13	1.4	1.9	1.3	1.2	1.5
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	346	307	262	211	173	-1.4	-1.3	-2.1	-2.0	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	249	227	184	150	123	-1.2	-1.7	-2.1	-1.9	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	644	539	407	302	220	-2.2	-2.3	-2.9	-3.1	-2.8
CO_2 emissions per unit of primary energy consumption (t/toe)	1.86	1.75	1.55	1.43	1.27	-0.8	-1.0	-0.8	-1.2	-1.0

Table A.32: Energy Supply and Demand of Viet Nam

(HNC, Natural Gas Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**58.60**	**83.46**	**137.94**	**180.79**	**228.32**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.3**	**2.7**	**2.4**	**3.2**
Coal	14.65	36.74	53.05	64.20	73.95	25.0	44.0	38.5	35.5	32.4	12.2	3.1	1.9	1.4	2.2
Oil	18.35	22.50	35.58	46.31	59.41	31.3	27.0	25.8	25.6	26.0	2.6	3.9	2.7	2.5	3.1
Natural gas	8.12	7.94	27.66	41.02	58.83	13.9	9.5	20.1	22.7	25.8	-0.3	11.0	4.0	3.7	6.5
Nuclear	0.00	0.00	0.00	4.21	8.58	0.0	0.0	0.0	2.3	3.8	-	-	-	7.4	-
Hydro	2.37	7.23	9.86	11.00	11.65	4.0	8.7	7.1	6.1	5.1	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	15.11	9.04	11.79	14.05	15.89	25.8	10.8	8.5	7.8	7.0	-6.2	2.2	1.8	1.2	1.8
Biomass	14.71	8.91	9.60	10.50	10.81	25.1	10.7	7.0	5.8	4.7	-6.1	0.6	0.9	0.3	0.6
Solar, WVNM, Ocean	0.00	0.04	1.61	2.71	4.00	0.0	0.1	1.2	1.5	1.8	34.0	34.7	5.4	4.0	15.1
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	12.5	8.9	-
Electricity	0.40	0.09	0.59	0.84	1.09	0.7	0.1	0.4	0.5	0.5	-17.5	17.4	3.6	2.7	8.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**48.51**	**60.27**	**103.12**	**134.50**	**169.63**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Industry	17.42	32.54	62.16	79.53	97.36	35.9	54.0	60.3	59.1	57.4	8.1	5.5	2.5	2.0	3.5
Transportation	10.32	12.06	18.28	24.06	31.04	21.3	20.0	17.7	17.9	18.3	2.0	3.5	2.8	2.6	3.0
Others	18.51	14.19	20.36	27.76	37.16	38.2	23.5	19.7	20.6	21.9	-3.3	3.1	3.1	3.0	3.1
Non-energy	2.26	1.48	2.32	3.15	4.06	4.7	2.5	2.2	2.3	2.4	-5.2	3.8	3.1	2.6	3.2
Total	**48.51**	**60.27**	**103.12**	**134.50**	**169.63**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Coal	9.81	14.17	22.27	27.26	31.20	20.2	23.5	21.6	20.3	18.4	4.7	3.8	2.0	1.4	2.5
Oil	16.81	20.75	33.84	44.40	57.26	34.7	34.4	32.8	33.0	33.8	2.7	4.2	2.8	2.6	3.2
Natural gas	0.49	0.99	5.86	7.39	8.72	1.0	1.6	5.7	5.5	5.1	9.1	16.0	2.4	1.7	7.1
Electricity	7.47	16.28	32.41	45.83	62.54	15.4	27.0	31.4	34.1	36.9	10.2	5.9	3.5	3.2	4.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	13.91	8.08	8.73	9.61	9.90	28.7	13.4	8.5	7.1	5.8	-6.6	0.6	1.0	0.3	0.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**94.90**	**240.94**	**440.59**	**609.98**	**822.77**	**100**	**100**	**100**	**100**	**100**	**12.4**	**5.2**	**3.3**	**3.0**	**3.9**
Coal	19.69	114.18	164.80	204.05	248.31	20.7	47.4	37.4	33.5	30.2	24.6	3.1	2.2	2.0	2.5
Oil	3.41	0.26	0.00	0.00	0.00	3.6	0.1	0.0	0.0	0.0	-27.6	-83.6	0.0	0.0	-49.2
Natural gas	44.15	41.73	142.25	230.02	359.19	46.5	17.3	32.3	37.7	43.7	-0.7	10.8	4.9	4.6	7.0
Nuclear	0.00	0.00	0.00	16.16	32.94	0.0	0.0	0.0	2.6	4.0	-	-	-	7.4	-
Hydro	27.55	84.13	114.65	127.95	135.49	29.0	34.9	26.0	21.0	16.5	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.11	0.65	18.89	31.80	46.85	0.1	0.3	4.3	5.2	5.7	25.5	32.5	5.3	4.0	14.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.63**	**29.52**	**52.42**	**70.35**	**92.60**	**100**	**100**	**100**	**100**	**100**	**10.1**	**4.9**	**3.0**	**2.8**	**3.6**
Coal	4.84	22.57	30.69	36.80	42.56	35.5	76.5	58.5	52.3	46.0	21.2	2.6	1.8	1.5	2.0
Oil	1.16	0.07	0.00	0.00	0.00	8.5	0.2	0.0	0.0	0.0	-30.2	-83.4	-0.7	-0.9	-49.2
Natural gas	7.63	6.89	21.73	33.55	50.04	56.0	23.3	41.5	47.7	54.0	-1.3	10.1	4.4	4.1	6.4

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**42.4**	**45.5**	**50.4**	**53.1**	**56.4**						**0.9**	**0.9**	**0.5**	**0.6**	**0.7**
Coal	35.0	43.5	46.2	47.7	50.2						2.8	0.5	0.3	0.5	0.4
Oil	25.3	34.0	29.1	31.1	34.0						3.8	-1.3	0.7	0.9	0.0
Natural gas	49.7	52.1	56.3	58.9	61.7						0.6	0.6	0.5	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.8**	**227.0**	**375.6**	**481.3**	**598.2**	**100**	**100**	**100**	**100**	**100**	**7.8**	**4.3**	**2.5**	**2.2**	**3.1**
Coal	60.0	150.4	217.2	262.9	302.8	48.1	66.3	57.8	54.6	50.6	12.2	3.1	1.9	1.4	2.2
Oil	45.7	58.1	93.5	122.1	157.3	36.6	25.6	24.9	25.4	26.3	3.0	4.1	2.7	2.6	3.2
Natural Gas	19.1	18.5	64.9	96.3	138.1	15.3	8.1	17.3	20.0	23.1	-0.4	11.0	4.0	3.7	6.5

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	116	188	375	624	985	6.2	5.9	5.2	4.7	5.3
Population (millions of people)	88.0	95.5	104.2	107.8	109.6	1.0	0.7	0.3	0.2	0.4
GDP per capita (thousands of 2010 USD/person)	1.32	1.96	3.60	5.79	8.99	5.1	5.2	4.9	4.5	4.9
Primary energy consumption per capita (toe/person)	0.67	0.87	1.32	1.68	2.08	3.4	3.5	2.4	2.2	2.8
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	506	445	368	290	232	-1.6	-1.6	-2.4	-2.2	-2.0
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	418	321	275	216	172	-3.3	-1.3	-2.4	-2.2	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	1,076	1,210	1,001	771	607	1.5	-1.6	-2.6	-2.4	-2.1
CO_2 emissions per unit of primary energy consumption (t/toe)	2.13	2.72	2.72	2.66	2.62	3.1	0.0	-0.2	-0.2	-0.1

Table A.33: Energy Supply and Demand of Total of the Seven EAS Countries

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,205.70**	**1,547.16**	**2,383.46**	**2,994.00**	**3,568.87**	**100**	**100**	**100**	**100**	**100**	**3.2**	**3.7**	**2.3**	**1.8**	**2.6**
Coal	364.52	563.45	755.66	926.26	985.24	30.2	36.4	31.7	30.9	27.6	5.6	2.5	2.1	0.6	1.8
Oil	332.98	446.25	686.14	911.25	1,188.93	27.6	28.8	28.8	30.4	33.3	3.7	3.7	2.9	2.7	3.1
Natural gas	169.84	181.33	397.76	485.20	604.68	14.1	11.7	16.7	16.2	16.9	0.8	6.8	2.0	2.2	3.8
Nuclear	6.84	9.85	43.04	63.36	86.68	0.6	0.6	1.8	2.1	2.4	4.7	13.1	3.9	3.2	7.0
Hydro	16.75	27.02	39.46	48.58	57.04	1.4	1.7	1.7	1.6	1.6	6.2	3.2	2.1	1.6	2.4
Geothermal	24.63	33.08	75.12	95.75	117.47	2.0	2.1	3.2	3.2	3.3	3.8	7.1	2.5	2.1	4.0
Others	290.13	286.17	386.30	463.60	528.83	24.1	18.5	16.2	15.5	14.8	-0.2	2.5	1.8	1.3	1.9
Biomass	286.77	273.60	301.38	294.15	274.58	23.8	17.7	12.6	9.8	7.7	-0.6	0.8	-0.2	-0.7	0.0
Solar, Wind, Ocean	2.01	10.81	82.15	166.19	250.50	0.2	0.7	3.4	5.6	7.0	23.4	18.4	7.3	4.2	10.3
Biofuels	1.07	6.57	8.61	12.72	17.73	0.1	0.4	0.4	0.4	0.5	25.5	2.3	4.0	3.4	3.2
Electricity	1.35	1.76	2.76	3.26	3.76	0.1	0.1	0.1	0.1	0.1	3.4	3.8	1.7	1.4	2.4

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**836.15**	**1,039.59**	**1,608.41**	**2,052.22**	**2,506.35**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Industry	267.22	349.93	610.25	771.63	876.63	32.0	33.7	37.9	37.6	35.0	3.4	4.7	2.4	1.3	2.9
Transportation	148.97	233.11	356.27	506.65	729.75	17.8	22.4	22.2	24.7	29.1	5.8	3.6	3.6	3.7	3.6
Others	351.38	356.20	473.50	557.33	635.38	42.0	34.3	29.4	27.2	25.4	0.2	2.4	1.6	1.3	1.8
Non-energy	68.59	100.34	168.39	216.61	264.59	8.2	9.7	10.5	10.6	10.6	4.9	4.4	2.5	2.0	3.1
Total	**836.15**	**1,039.59**	**1,608.41**	**2,052.22**	**2,506.35**	**100**	**100**	**100**	**100**	**100**	**2.8**	**3.7**	**2.5**	**2.0**	**2.8**
Coal	127.35	146.91	246.01	307.32	348.07	15.2	14.1	15.3	15.0	13.9	1.8	4.4	2.2	1.3	2.7
Oil	290.24	412.11	637.43	848.63	1,111.69	34.7	39.6	39.6	41.4	44.4	4.5	3.7	2.9	2.7	3.1
Natural gas	46.51	76.77	162.38	218.42	264.60	5.6	7.4	10.1	10.6	10.6	6.5	6.4	3.0	1.9	3.9
Electricity	109.74	179.62	339.23	479.27	619.90	13.1	17.3	21.1	23.4	24.7	6.4	5.4	3.5	2.6	3.9
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	262.32	224.17	223.36	198.58	162.08	31.4	21.6	13.9	9.7	6.5	-1.9	0.0	-1.2	-2.0	-1.0

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,599.05**	**2,584.44**	**4,805.29**	**6,622.09**	**8,349.63**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.3**	**3.3**	**2.3**	**3.7**
Coal	842.95	1,604.77	1,966.84	2,430.43	2,507.20	52.7	62.1	40.9	36.7	30.0	8.4	1.7	2.1	0.3	1.4
Oil	67.21	27.46	37.49	39.98	32.59	4.2	1.1	0.8	0.6	0.4	-10.6	2.6	0.6	-2.0	0.5
Natural gas	409.08	384.43	1,070.39	1,220.20	1,668.57	25.6	14.9	22.3	18.4	20.0	-0.8	8.9	1.3	3.2	4.7
Nuclear	26.27	37.81	165.17	243.19	332.66	1.6	1.5	3.4	3.7	4.0	4.7	13.1	3.9	3.2	7.0
Hydro	194.85	314.29	458.88	564.95	663.34	12.2	12.2	9.5	8.5	7.9	6.2	3.2	2.1	1.6	2.4
Geothermal	19.29	24.46	53.68	66.97	80.74	1.2	0.9	1.1	1.0	1.0	3.0	6.8	2.2	1.9	3.8
Others	39.41	191.22	1,052.85	2,056.38	3,064.53	2.5	7.4	21.9	31.1	36.7	21.8	15.3	6.9	4.1	9.1

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**330.28**	**481.35**	**671.55**	**777.64**	**832.37**	**100**	**100**	**100**	**100**	**100**	**4.8**	**2.8**	**1.5**	**0.7**	**1.7**
Coal	225.75	392.87	465.63	553.36	546.87	68.4	81.6	69.3	71.2	65.7	7.2	1.4	1.7	-0.1	1.0
Oil	19.37	12.18	11.23	11.35	8.73	5.9	2.5	1.7	1.5	1.0	-5.6	-0.7	0.1	-2.6	-1.0
Natural gas	85.15	76.30	194.69	212.93	276.78	25.8	15.9	29.0	27.4	33.3	-1.4	8.1	0.9	2.7	4.1

Thermal Efficiency

	%										AAGR (%)				
	2010	2018	2030	2040	2050						2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.3**	**36.0**	**39.4**	**40.8**	**43.5**						**0.6**	**0.7**	**0.4**	**0.6**	**0.6**
Coal	32.1	35.1	36.3	37.8	39.4						1.1	0.3	0.4	0.4	0.4
Oil	29.8	19.4	28.7	30.3	32.1						-5.2	3.3	0.5	0.6	1.6
Natural gas	41.3	43.3	47.3	49.3	51.8						0.6	0.7	0.4	0.5	0.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**2,596.9**	**3,714.3**	**5,523.7**	**6,954.0**	**8,181.2**	**100**	**100**	**100**	**100**	**100**	**4.6**	**3.4**	**2.3**	**1.6**	**2.5**
Coal	1,440.6	2,225.9	2,986.7	3,661.1	3,894.9	55.5	59.9	54.1	52.6	47.6	5.6	2.5	2.1	0.6	1.8
Oil	834.9	1,145.9	1,777.6	2,382.4	3,148.4	32.2	30.8	32.2	34.3	38.5	4.0	3.7	3.0	2.8	3.2
Natural Gas	320.8	340.7	757.6	908.7	1,136.1	12.4	9.2	13.7	13.1	13.9	0.8	6.9	1.8	2.3	3.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	3,378	5,383	10,662	17,171	25,805	6.0	5.9	4.9	4.2	5.0
Population (millions of people)	1,804.1	1,977.1	2,195.8	2,324.0	2,393.3	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.87	2.72	4.86	7.39	10.78	4.8	4.9	4.3	3.9	4.4
Primary energy consumption per capita (toe/person)	0.67	0.78	1.09	1.29	1.49	2.0	2.8	1.7	1.5	2.0
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	357	287	224	174	138	-2.7	-2.1	-2.5	-2.3	-2.3
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	248	193	151	120	97	-3.1	-2.0	-2.3	-2.1	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	769	690	518	405	317	-1.3	-2.4	-2.4	-2.4	-2.4
CO_2 emissions per unit of primary energy consumption (t/toe)	2.15	2.40	2.32	2.32	2.29	1.4	-0.3	0.0	-0.1	-0.1

Table A.34: Energy Supply and Demand of India

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**700.76**	**919.44**	**1,481.81**	**1,892.42**	**2,279.88**	**100**	**100**	**100**	**100**	**100**	**3.5**	**4.1**	**2.5**	**1.9**	**2.9**
Coal	279.03	414.21	564.40	706.74	756.01	39.8	45.1	38.1	37.3	33.2	5.1	2.6	2.3	0.7	1.9
Oil	162.07	235.25	399.31	565.04	784.35	23.1	25.6	26.9	29.9	34.4	4.8	4.5	3.5	3.3	3.8
Natural gas	54.40	52.41	179.39	213.56	279.67	7.8	5.7	12.1	11.3	12.3	-0.5	10.8	1.8	2.7	5.4
Nuclear	6.84	9.85	43.04	53.66	68.24	1.0	1.1	2.9	2.8	3.0	4.7	13.1	2.2	2.4	6.2
Hydro	10.74	13.00	21.00	27.69	34.51	1.5	1.4	1.4	1.5	1.5	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	187.67	194.72	274.67	325.73	357.11	26.8	21.2	18.5	17.2	15.7	0.5	2.9	1.7	0.9	1.9
Biomass	185.20	185.10	210.56	198.91	176.63	26.4	20.1	14.2	10.5	7.7	0.0	1.1	-0.6	-1.2	-0.1
Solar, Wind, Ocean	1.99	9.95	64.44	127.16	180.82	0.3	1.1	4.3	6.7	7.9	22.3	16.8	7.0	3.6	9.5
Biofuels	0.05	0.88	1.38	2.69	4.31	0.0	0.1	0.1	0.1	0.2	41.8	3.8	6.9	4.8	5.1
Electricity	0.48	-0.33	-0.33	-0.33	-0.33	0.1	0.0	0.0	0.0	0.0	-	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**478.45**	**606.58**	**999.45**	**1,303.21**	**1,619.67**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Industry	151.62	206.09	390.51	499.42	559.01	31.7	34.0	39.1	38.3	34.5	3.9	5.5	2.5	1.1	3.2
Transportation	64.80	103.77	183.04	291.50	468.27	13.5	17.1	18.3	22.4	28.9	6.1	4.8	4.8	4.9	4.8
Others	227.92	245.92	337.28	392.34	441.49	47.6	40.5	33.7	30.1	27.3	1.0	2.7	1.5	1.2	1.8
Non-energy	34.12	50.81	88.63	119.95	150.90	7.1	8.4	8.9	9.2	9.3	5.1	4.7	3.1	2.3	3.5
Total	**478.45**	**606.58**	**999.45**	**1,303.21**	**1,619.67**	**100**	**100**	**100**	**100**	**100**	**3.0**	**4.2**	**2.7**	**2.2**	**3.1**
Coal	87.19	106.61	188.39	238.07	269.90	18.2	17.6	18.8	18.3	16.7	2.5	4.9	2.4	1.3	2.9
Oil	138.11	207.70	362.20	516.69	722.28	28.9	34.2	36.2	39.6	44.6	5.2	4.7	3.6	3.4	4.0
Natural gas	18.64	32.42	78.43	113.38	141.65	3.9	5.3	7.8	8.7	8.7	7.2	7.6	3.8	2.3	4.7
Electricity	61.94	103.29	209.29	297.86	382.77	12.9	17.0	20.9	22.9	23.6	6.6	6.1	3.6	2.5	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	172.56	156.56	161.13	137.22	103.06	36.1	25.8	16.1	10.5	6.4	-1.2	0.2	-1.6	-2.8	-1.3

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**974.80**	**1,583.22**	**3,118.78**	**4,274.95**	**5,290.93**	**100**	**100**	**100**	**100**	**100**	**6.2**	**5.8**	**3.2**	**2.2**	**3.8**
Coal	657.96	1,163.40	1,392.73	1,750.98	1,777.22	67.5	73.5	44.7	41.0	33.6	7.4	1.5	2.3	0.1	1.3
Oil	17.67	7.85	10.08	8.94	5.10	1.8	0.5	0.3	0.2	0.1	-9.6	2.1	-1.2	-5.4	-1.3
Natural gas	113.29	73.62	503.60	442.86	664.51	11.6	4.6	16.1	10.4	12.6	-5.2	17.4	-1.3	4.1	7.1
Nuclear	26.27	37.81	165.17	205.94	261.88	2.7	2.4	5.3	4.8	4.9	4.7	13.1	2.2	2.4	6.2
Hydro	124.92	151.13	244.24	322.04	401.40	12.8	9.5	7.8	7.5	7.6	2.4	4.1	2.8	2.2	3.1
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	34.70	149.40	802.96	1,544.19	2,180.82	3.6	9.4	25.7	36.1	41.2	20.0	15.0	6.8	3.5	8.7

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**209.39**	**304.61**	**428.05**	**485.60**	**509.67**	**100**	**100**	**100**	**100**	**100**	**4.8**	**2.9**	**1.3**	**0.5**	**1.6**
Coal	177.27	284.97	333.07	404.21	396.95	84.7	93.6	77.8	83.2	77.9	6.1	1.3	2.0	-0.2	1.0
Oil	7.25	4.18	4.74	4.16	2.39	3.5	1.4	1.1	0.9	0.5	-6.7	1.1	-1.3	-5.4	-1.7
Natural gas	24.87	15.46	90.23	77.23	110.32	11.9	5.1	21.1	15.9	21.6	-5.8	15.8	-1.5	3.6	6.3

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**32.4**	**35.1**	**38.3**	**39.0**	**41.3**		**1.0**	**0.7**	**0.2**	**0.6**	**0.5**
Coal	31.9	35.1	36.0	37.2	38.5		1.2	0.2	0.4	0.3	0.3
Oil	21.0	16.2	18.3	18.5	18.4		-3.2	1.0	0.1	0.0	0.4
Natural gas	39.2	40.9	48.0	49.3	51.8		0.6	1.3	0.3	0.5	0.7

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**1,585.0**	**2,324.2**	**3,612.3**	**4,674.3**	**5,610.4**	**100**	**100**	**100**	**100**	**100**	**4.9**	**3.7**	**2.6**	**1.8**	**2.8**
Coal	1,083.7	1,628.4	2,219.3	2,779.3	2,973.2	68.4	70.1	61.4	59.5	53.0	5.2	2.6	2.3	0.7	1.9
Oil	425.9	611.1	1,051.6	1,505.0	2,123.1	26.9	26.3	29.1	32.2	37.8	4.6	4.6	3.6	3.5	4.0
Natural Gas	74.7	83.5	340.1	388.8	512.9	4.7	3.6	9.4	8.3	9.1	1.4	12.4	1.3	2.8	5.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	1,670	2,831	6,146	10,304	15,988	6.8	6.7	5.3	4.5	5.6
Population (millions of people)	1,234.3	1,352.6	1,503.6	1,592.7	1,639.2	1.2	0.9	0.6	0.3	0.6
GDP per capita (thousands of 2010 USD/person)	1.35	2.09	4.09	6.47	9.75	5.6	5.7	4.7	4.2	4.9
Primary energy consumption per capita (toe/person)	0.57	0.68	0.99	1.19	1.39	2.3	3.1	1.9	1.6	2.3
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	420	325	241	184	143	-3.2	-2.5	-2.7	-2.5	-2.5
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	287	214	163	126	101	-3.6	-2.3	-2.5	-2.2	-2.3
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	949	821	588	454	351	-1.8	-2.7	-2.6	-2.5	-2.6
CO_2 emissions per unit of primary energy consumption (t/toe)	2.26	2.53	2.44	2.47	2.46	1.4	-0.3	0.1	0.0	-0.1

Table A.35: Energy Supply and Demand of Indonesia

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**201.69**	**231.14**	**337.63**	**428.90**	**515.20**	**100**	**100**	**100**	**100**	**100**	**1.7**	**3.2**	**2.4**	**1.9**	**2.5**
Coal	31.84	55.23	76.38	92.24	97.07	15.8	23.9	22.6	21.5	18.8	7.1	2.7	1.9	0.5	1.8
Oil	67.39	77.31	104.34	128.40	150.14	33.4	33.4	30.9	29.9	29.1	1.7	2.5	2.1	1.6	2.1
Natural gas	38.82	38.93	71.55	97.31	125.07	19.2	16.8	21.2	22.7	24.3	0.0	5.2	3.1	2.5	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	1.50	1.86	2.19	2.65	3.11	0.7	0.8	0.6	0.6	0.6	2.7	1.4	1.9	1.6	1.6
Geothermal	16.09	24.11	57.94	76.35	96.10	8.0	10.4	17.2	17.8	18.7	5.2	7.6	2.8	2.3	4.4
Others	46.04	33.69	25.23	31.95	43.71	22.8	14.6	7.5	7.4	8.5	-3.8	-2.4	2.4	3.2	0.8
Biomass	46.04	33.54	20.36	18.13	16.63	22.8	14.5	6.0	4.2	3.2	-3.9	-4.1	-1.2	-0.9	-2.2
Solar, WIDN, Ocean	0.00	0.02	4.74	13.69	26.96	0.0	0.0	1.4	3.2	5.2	65.4	55.3	11.2	7.0	24.5
Biofuels	0.17	2.83	3.12	4.02	4.98	0.1	1.2	0.9	0.9	1.0	41.7	0.8	2.5	2.2	1.8
Electricity	0.00	0.13	0.13	0.13	0.13	0.0	0.1	0.0	0.0	0.0	129.0	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**145.98**	**156.06**	**213.75**	**270.01**	**324.70**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Industry	49.08	50.16	74.46	93.43	109.32	33.6	32.1	34.8	34.6	33.7	0.3	3.3	2.3	1.6	2.5
Transportation	30.14	54.38	75.78	96.46	118.64	20.6	34.8	35.5	35.7	36.5	7.7	2.8	2.4	2.1	2.5
Others	56.55	43.03	48.27	60.55	72.88	38.7	27.6	22.6	22.4	22.4	-3.4	1.0	2.3	1.9	1.7
Non-energy	10.20	8.49	15.24	19.57	23.86	7.0	5.4	7.1	7.2	7.3	-2.3	5.0	2.5	2.0	3.3
Total	**145.98**	**156.06**	**213.75**	**270.01**	**324.70**	**100**	**100**	**100**	**100**	**100**	**0.8**	**2.7**	**2.4**	**1.9**	**2.3**
Coal	17.18	14.72	21.94	27.81	32.56	11.8	9.4	10.3	10.3	10.0	-1.9	3.4	2.4	1.6	2.5
Oil	55.01	75.67	101.77	123.77	144.90	37.7	48.5	47.6	45.8	44.6	4.1	2.5	2.0	1.6	2.1
Natural gas	15.86	16.68	32.69	43.17	52.10	10.9	10.7	15.3	16.0	16.0	0.6	5.8	2.8	1.9	3.6
Electricity	12.67	22.02	39.34	59.85	81.60	8.7	14.1	18.4	22.2	25.1	7.2	5.0	4.3	3.1	4.2
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	45.26	26.97	18.01	15.41	13.54	31.0	17.3	8.4	5.7	4.2	-6.3	-3.3	-1.6	-1.3	-2.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**169.76**	**283.77**	**510.17**	**776.91**	**1,057.99**	**100**	**100**	**100**	**100**	**100**	**6.6**	**5.0**	**4.3**	**3.1**	**4.2**
Coal	68.45	160.02	223.08	275.31	288.73	40.3	56.4	43.7	35.4	27.3	11.2	2.8	2.1	0.5	1.9
Oil	34.15	14.88	22.92	27.71	26.34	20.1	5.2	4.5	3.6	2.5	-9.9	3.7	1.9	-0.5	1.8
Natural gas	40.25	59.42	146.43	234.87	331.49	23.7	20.9	28.7	30.2	31.3	5.0	7.8	4.8	3.5	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	17.46	21.64	25.46	30.84	36.22	10.3	7.6	5.0	4.0	3.4	2.7	1.4	1.9	1.6	1.6
Geothermal	9.36	14.02	33.70	44.41	55.89	5.5	4.9	6.6	5.7	5.3	5.2	7.6	2.8	2.3	4.4
Others	0.10	13.79	58.58	163.77	319.32	0.1	4.9	11.5	21.1	30.2	85.1	12.8	10.8	6.9	10.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**35.21**	**60.59**	**88.39**	**113.39**	**127.57**	**100**	**100**	**100**	**100**	**100**	**7.0**	**3.2**	**2.5**	**1.2**	**2.4**
Coal	18.08	40.51	54.42	64.42	64.49	51.4	66.9	61.6	56.8	50.6	10.6	2.5	1.7	0.0	1.5
Oil	8.47	6.75	5.48	6.43	6.08	24.1	11.1	6.2	5.7	4.8	-2.8	-1.7	1.6	-0.6	-0.3
Natural gas	8.65	13.32	28.48	42.54	57.00	24.6	22.0	32.2	37.5	44.7	5.5	6.5	4.1	3.0	4.6

Thermal Efficiency

	%					AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**34.9**	**33.3**	**38.2**	**40.8**	**43.6**	**-0.6**	**1.2**	**0.7**	**0.7**	**0.8**
Coal	32.5	34.0	35.2	36.7	38.5	0.5	0.3	0.4	0.5	0.4
Oil	34.6	18.9	36.0	37.0	37.2	-7.3	5.5	0.3	0.1	2.1
Natural gas	40.0	38.4	44.2	47.5	50.0	-0.5	1.2	0.7	0.5	0.8

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**396.0**	**539.5**	**762.4**	**945.1**	**1,081.7**	**100**	**100**	**100**	**100**	**100**	**3.9**	**2.9**	**2.2**	**1.4**	**2.2**
Coal	141.8	222.0	307.0	370.8	390.2	35.8	41.2	40.3	39.2	36.1	5.8	2.7	1.9	0.5	1.8
Oil	174.7	234.6	309.0	375.6	436.1	44.1	43.5	40.5	39.7	40.3	3.8	2.3	2.0	1.5	2.0
Natural Gas	79.5	82.3	145.8	198.3	255.0	20.1	15.3	19.1	21.0	23.6	0.4	4.9	3.1	2.5	3.6

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	755	1,147	2,089	3,278	4,753	5.4	5.1	4.6	3.8	4.5
Population (millions of people)	241.8	267.7	299.4	318.9	331.4	1.3	0.9	0.6	0.4	0.7
GDP per capita (thousands of 2010 USD/person)	3.12	4.28	6.98	10.28	14.34	4.0	4.1	3.9	3.4	3.8
Primary energy consumption per capita (toe/person)	0.83	0.86	1.13	1.34	1.55	0.4	2.3	1.8	1.5	1.9
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	267	202	162	131	108	-3.5	-1.8	-2.1	-1.9	-1.9
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	193	136	102	82	68	-4.3	-2.3	-2.1	-1.9	-2.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	524	470	365	288	228	-1.4	-2.1	-2.3	-2.3	-2.2
CO_2 emissions per unit of primary energy consumption (t/toe)	1.96	2.33	2.26	2.20	2.10	2.2	-0.3	-0.2	-0.5	-0.3

Table A.36: Energy Supply and Demand of Malaysia

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**72.49**	**93.43**	**129.47**	**144.95**	**152.23**	**100**	**100**	**100**	**100**	**100**	**3.2**	**2.8**	**1.1**	**0.5**	**1.5**
Coal	14.60	22.61	24.34	24.16	19.56	20.1	24.2	18.8	16.7	12.8	5.6	0.6	-0.1	-2.1	-0.5
Oil	25.33	28.98	35.07	35.22	34.20	34.9	31.0	27.1	24.3	22.5	1.7	1.6	0.0	-0.3	0.5
Natural gas	31.20	38.78	64.45	74.14	82.93	43.0	41.5	49.8	51.2	54.5	2.8	4.3	1.4	1.1	2.4
Nuclear	0.00	0.00	0.00	3.66	3.65	0.0	0.0	0.0	2.5	2.4	-	-	-	0.0	-
Hydro	0.56	2.26	3.00	3.32	3.43	0.8	2.4	2.3	2.3	2.3	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.80	0.79	2.62	4.45	8.46	1.1	0.9	2.0	3.1	5.6	-0.1	10.4	5.5	6.6	7.7
Biomass	0.82	0.87	1.67	2.04	2.36	1.1	0.9	1.3	1.4	1.5	0.8	5.5	2.0	1.4	3.1
Solar, WMYS, Ocean	0.00	0.05	1.08	2.53	6.24	0.0	0.1	0.8	1.7	4.1	-	29.3	8.9	9.4	16.3
Biofuels	0.00	0.44	0.39	0.38	0.36	0.0	0.5	0.3	0.3	0.2	77.7	-1.0	-0.2	-0.4	-0.6
Electricity	-0.01	-0.13	-0.13	-0.13	-0.13	0.0	-0.1	-0.1	-0.1	-0.1	33.1	0.0	0.0	0.0	0.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**41.74**	**62.53**	**87.89**	**99.30**	**108.06**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Industry	14.92	19.51	25.38	29.15	31.74	35.8	31.2	28.9	29.4	29.4	3.4	2.2	1.4	0.9	1.5
Transportation	14.93	20.96	22.15	21.83	20.75	35.8	33.5	25.2	22.0	19.2	4.3	0.5	-0.1	-0.5	0.0
Others	8.19	8.80	12.24	14.58	16.57	19.6	14.1	13.9	14.7	15.3	0.9	2.8	1.8	1.3	2.0
Non-energy	3.70	13.26	28.12	33.74	39.00	8.9	21.2	32.0	34.0	36.1	17.3	6.5	1.8	1.5	3.4
Total	**41.74**	**62.53**	**87.89**	**99.30**	**108.06**	**100**	**100**	**100**	**100**	**100**	**5.2**	**2.9**	**1.2**	**0.8**	**1.7**
Coal	1.83	1.81	2.07	2.22	2.29	4.4	2.9	2.4	2.2	2.1	-0.1	1.1	0.7	0.3	0.7
Oil	23.96	28.28	32.10	32.32	31.41	57.4	45.2	36.5	32.5	29.1	2.1	1.1	0.1	-0.3	0.3
Natural gas	6.25	18.85	34.17	40.39	45.50	15.0	30.1	38.9	40.7	42.1	14.8	5.1	1.7	1.2	2.8
Electricity	9.53	13.15	19.00	23.74	28.15	22.8	21.0	21.6	23.9	26.1	4.1	3.1	2.3	1.7	2.4
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.17	0.44	0.55	0.63	0.70	0.4	0.7	0.6	0.6	0.6	12.3	2.0	1.2	1.1	1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.79**	**170.47**	**246.15**	**307.48**	**364.33**	**100**	**100**	**100**	**100**	**100**	**4.0**	**3.1**	**2.2**	**1.7**	**2.4**
Coal	42.84	77.29	85.35	87.02	73.22	34.3	45.3	34.7	28.3	20.1	7.7	0.8	0.2	-1.7	-0.2
Oil	3.67	1.05	0.83	0.30	0.00	2.9	0.6	0.3	0.1	0.0	-14.5	-2.0	-9.6	-88.7	-51.4
Natural gas	70.80	63.89	109.18	133.58	158.94	56.7	37.5	44.4	43.4	43.6	-1.3	4.6	2.0	1.8	2.9
Nuclear	0.00	0.00	0.00	14.05	14.02	0.0	0.0	0.0	4.6	3.8	-	-	-	0.0	-
Hydro	6.47	26.32	34.92	38.57	39.94	5.2	15.4	14.2	12.5	11.0	19.2	2.4	1.0	0.4	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	1.01	1.93	15.89	33.95	78.22	0.8	1.1	6.5	11.0	21.5	8.4	19.2	7.9	8.7	12.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.72**	**33.67**	**42.85**	**45.62**	**44.13**	**100**	**100**	**100**	**100**	**100**	**0.7**	**2.0**	**0.6**	**-0.3**	**0.8**
Coal	12.95	20.47	21.94	21.61	16.93	40.8	60.8	51.2	47.4	38.4	5.9	0.6	-0.2	-2.4	-0.6
Oil	0.74	0.38	0.21	0.08	0.00	2.3	1.1	0.5	0.2	0.0	-8.0	-4.7	-9.7	-88.7	-51.9
Natural gas	18.03	12.82	20.70	23.93	27.20	56.8	38.1	48.3	52.5	61.6	-4.2	4.1	1.5	1.3	2.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**31.8**	**36.3**	**39.2**	**41.6**	**45.2**		**1.7**	**0.6**	**0.6**	**0.8**	**0.7**
Coal	28.4	32.5	33.4	34.6	37.2		1.7	0.3	0.3	0.7	0.4
Oil	42.6	23.7	33.2	33.5	33.7		-7.1	2.9	0.1	0.0	1.1
Natural gas	33.8	42.9	45.3	48.0	50.3		3.0	0.5	0.6	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**187.0**	**221.5**	**267.6**	**276.1**	**262.8**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**0.3**	**-0.5**	**0.5**
Coal	58.5	88.2	95.1	94.4	76.1	31.3	39.8	35.5	34.2	29.0	5.3	0.6	-0.1	-2.1	-0.5
Oil	65.8	73.1	83.7	82.2	77.5	35.2	33.0	31.3	29.8	29.5	1.3	1.1	-0.2	-0.6	0.2
Natural Gas	62.6	60.1	88.7	99.5	109.1	33.5	27.1	33.2	36.0	41.5	-0.5	3.3	1.2	0.9	1.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	255	382	640	912	1,229	5.2	4.4	3.6	3.0	3.7
Population (millions of people)	28.2	31.5	36.1	38.8	40.6	1.4	1.1	0.7	0.5	0.8
GDP per capita (thousands of 2010 USD/person)	9.04	12.12	17.73	23.53	30.30	3.7	3.2	2.9	2.6	2.9
Primary energy consumption per capita (toe/person)	2.57	2.96	3.59	3.74	3.75	1.8	1.6	0.4	0.0	0.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	284	245	202	159	124	-1.9	-1.6	-2.4	-2.5	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	164	164	137	109	88	0.0	-1.5	-2.3	-2.1	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	733	580	418	303	214	-2.9	-2.7	-3.2	-3.4	-3.1
CO_2 emissions per unit of primary energy consumption (t/toe)	2.58	2.37	2.07	1.90	1.73	-1.0	-1.1	-0.8	-1.0	-1.0

Table A.37: Energy Supply and Demand of Myanmar

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.90**	**23.83**	**37.57**	**48.77**	**59.19**	**100**	**100**	**100**	**100**	**100**	**7.0**	**3.9**	**2.6**	**2.0**	**2.9**
Coal	0.41	0.88	1.87	3.05	4.50	2.9	3.7	5.0	6.2	7.6	10.0	6.5	5.0	4.0	5.2
Oil	1.28	6.86	13.05	18.79	24.13	9.2	28.8	34.7	38.5	40.8	23.3	5.5	3.7	2.5	4.0
Natural gas	1.28	4.12	12.02	17.50	22.97	9.2	17.3	32.0	35.9	38.8	15.7	9.3	3.8	2.8	5.5
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.44	1.21	1.49	1.79	2.02	3.2	5.1	4.0	3.7	3.4	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.48	10.76	9.13	7.64	5.57	75.4	45.1	24.3	15.7	9.4	0.3	-1.4	-1.8	-3.1	-2.0
Biomass	10.48	10.96	10.33	9.03	6.78	75.4	46.0	27.5	18.5	11.5	0.6	-0.5	-1.3	-2.8	-1.5
Solar, WMYA, Ocean	0.00	0.00	0.50	1.07	1.99	0.0	0.0	1.3	2.2	3.4	-	69.7	7.8	6.4	27.3
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Electricity	0.00	-0.20	-1.70	-2.45	-3.20	0.0	-0.9	-4.5	-5.0	-5.4	-	19.4	3.7	2.7	9.0

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**12.85**	**20.16**	**28.36**	**35.69**	**42.37**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.3**
Industry	1.28	3.69	6.85	10.46	13.49	9.9	18.3	24.1	29.3	31.8	14.2	5.3	4.3	2.6	4.1
Transportation	0.81	2.10	4.04	6.37	9.09	6.3	10.4	14.2	17.8	21.4	12.6	5.6	4.7	3.6	4.7
Others	10.64	13.89	16.78	17.95	18.68	82.8	68.9	59.2	50.3	44.1	3.4	1.6	0.7	0.4	0.9
Non-energy	0.12	0.48	0.70	0.91	1.11	0.9	2.4	2.5	2.5	2.6	19.2	3.2	2.7	2.1	2.7
Total	**12.85**	**20.16**	**28.36**	**35.69**	**42.37**	**100**	**100**	**100**	**100**	**100**	**5.8**	**2.9**	**2.3**	**1.7**	**2.3**
Coal	0.23	0.26	0.40	0.52	0.62	1.8	1.3	1.4	1.5	1.5	1.4	3.6	2.7	1.7	2.7
Oil	1.04	6.81	12.90	18.65	24.02	8.1	33.8	45.5	52.2	56.7	26.5	5.5	3.7	2.6	4.0
Natural gas	0.60	0.57	0.77	1.01	1.23	4.6	2.8	2.7	2.8	2.9	-0.5	2.5	2.7	2.0	2.4
Electricity	0.54	1.59	3.99	6.53	9.76	4.2	7.9	14.1	18.3	23.0	14.5	8.0	5.0	4.1	5.8
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	10.44	10.91	10.29	8.98	6.74	81.3	54.1	36.3	25.2	15.9	0.6	-0.5	-1.3	-2.8	-1.5

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**7.54**	**24.55**	**77.36**	**120.86**	**172.53**	**100**	**100**	**100**	**100**	**100**	**15.9**	**10.0**	**4.6**	**3.6**	**6.3**
Coal	0.67	1.54	5.87	11.08	18.38	8.9	6.3	7.6	9.2	10.7	11.0	11.8	6.6	5.2	8.0
Oil	0.03	0.08	0.27	0.21	0.00	0.4	0.3	0.4	0.2	0.0	11.2	11.0	-2.3	-88.3	-47.2
Natural gas	1.73	8.80	48.04	76.37	107.52	23.0	35.8	62.1	63.2	62.3	22.5	15.2	4.7	3.5	8.1
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	5.11	14.13	17.34	20.76	23.48	67.7	57.5	22.4	17.2	13.6	13.6	1.7	1.8	1.2	1.6
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.00	0.01	5.85	12.45	23.16	0.0	0.0	7.6	10.3	13.4	-	69.6	7.8	6.4	27.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**0.73**	**3.35**	**11.91**	**18.19**	**24.74**	**100**	**100**	**100**	**100**	**100**	**21.1**	**11.2**	**4.3**	**3.1**	**6.5**
Coal	0.18	0.47	1.33	2.37	3.73	24.6	14.0	11.1	13.1	15.1	12.8	9.1	6.0	4.6	6.7
Oil	0.01	0.02	0.07	0.06	0.00	1.1	0.6	0.6	0.3	0.0	12.3	10.9	-2.4	-88.3	-47.3
Natural gas	0.54	2.86	10.52	15.76	21.01	74.2	85.4	88.3	86.6	84.9	23.2	11.5	4.1	2.9	6.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**28.9**	**26.8**	**39.1**	**41.4**	**43.8**		**-1.0**	**3.2**	**0.6**	**0.5**	**1.5**
Coal	32.3	28.4	38.1	40.1	42.4		-1.6	2.5	0.5	0.6	1.3
Oil	34.3	31.6	32.1	32.2	32.3		-1.0	0.1	0.0	0.1	0.1
Natural gas	27.7	26.5	39.3	41.7	44.0		-0.6	3.3	0.6	0.5	1.6

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**8.0**	**31.4**	**72.0**	**106.3**	**140.5**	**100**	**100**	**100**	**100**	**100**	**18.6**	**7.2**	**4.0**	**2.8**	**4.8**
Coal	1.7	2.9	6.9	11.6	17.4	20.6	9.3	9.6	10.9	12.4	7.4	7.4	5.3	4.1	5.7
Oil	3.4	19.8	37.9	54.7	70.2	42.7	62.9	52.6	51.4	50.0	24.5	5.6	3.7	2.5	4.0
Natural Gas	3.0	8.7	27.2	40.1	52.9	36.8	27.8	37.8	37.7	37.6	14.5	9.9	3.9	2.8	5.8

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	41	71	143	238	369	6.9	6.0	5.3	4.5	5.3
Population (millions of people)	50.6	53.7	58.5	61.2	62.3	0.7	0.7	0.5	0.2	0.5
GDP per capita (thousands of 2010 USD/person)	0.82	1.32	2.44	3.90	5.92	6.1	5.3	4.8	4.3	4.8
Primary energy consumption per capita (toe/person)	0.27	0.44	0.64	0.80	0.95	6.2	3.1	2.2	1.8	2.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	335	337	263	204	161	0.1	-2.0	-2.5	-2.4	-2.3
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	310	285	199	150	115	-1.0	-3.0	-2.8	-2.6	-2.8
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	194	445	505	446	381	10.9	1.1	-1.2	-1.6	-0.5
CO2 emissions per unit of primary energy consumption (t/toe)	0.58	1.32	1.92	2.18	2.37	10.9	3.2	1.3	0.9	1.9

Table A.38: Energy Supply and Demand of Philippines

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**40.40**	**60.05**	**91.59**	**114.10**	**138.34**	**100**	**100**	**100**	**100**	**100**	**5.1**	**3.6**	**2.2**	**1.9**	**2.6**
Coal	7.63	17.94	20.51	21.77	22.36	18.9	29.9	22.4	19.1	16.2	11.3	1.1	0.6	0.3	0.7
Oil	13.60	19.99	34.75	48.56	64.88	33.7	33.3	37.9	42.6	46.9	4.9	4.7	3.4	2.9	3.7
Natural gas	3.05	3.63	6.28	9.01	11.77	7.6	6.0	6.9	7.9	8.5	2.2	4.7	3.7	2.7	3.7
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	0.67	0.81	1.10	1.21	1.32	1.7	1.3	1.2	1.1	1.0	2.3	2.6	1.0	0.9	1.6
Geothermal	8.54	8.97	17.17	19.40	21.36	21.1	14.9	18.7	17.0	15.4	0.6	5.6	1.2	1.0	2.7
Others	6.91	8.72	11.79	14.16	16.64	17.1	14.5	12.9	12.4	12.0	2.9	2.6	1.8	1.6	2.0
Biomass	6.90	8.51	9.54	9.38	9.02	17.1	14.2	10.4	8.2	6.5	2.7	1.0	-0.2	-0.4	0.2
Solar, WPHL, Ocean	0.01	0.21	2.26	4.78	7.62	0.0	0.3	2.5	4.2	5.5	57.6	22.1	7.8	4.8	11.9
Biofuels	0.18	0.48	0.98	1.43	1.97	0.5	0.8	1.1	1.3	1.4	12.7	6.2	3.9	3.3	4.5
Electricity	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**23.71**	**33.83**	**54.95**	**73.69**	**95.18**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Industry	6.41	7.63	11.41	14.09	16.89	27.0	22.6	20.8	19.1	17.7	2.2	3.4	2.1	1.8	2.5
Transportation	8.04	12.28	23.81	34.82	48.50	33.9	36.3	43.3	47.2	51.0	5.4	5.7	3.9	3.4	4.4
Others	9.14	12.65	17.51	21.26	24.18	38.5	37.4	31.9	28.9	25.4	4.2	2.7	2.0	1.3	2.0
Non-energy	0.12	1.26	2.22	3.52	5.61	0.5	3.7	4.0	4.8	5.9	34.2	4.8	4.7	4.8	4.8
Total	**23.71**	**33.83**	**54.95**	**73.69**	**95.18**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**3.0**	**2.6**	**3.3**
Coal	1.88	2.52	3.52	4.19	4.82	7.9	7.4	6.4	5.7	5.1	3.7	2.8	1.8	1.4	2.1
Oil	11.46	18.21	32.65	46.28	62.62	48.3	53.8	59.4	62.8	65.8	6.0	5.0	3.5	3.1	3.9
Natural gas	0.07	0.06	0.13	0.18	0.22	0.3	0.2	0.2	0.2	0.2	-2.0	6.6	3.3	2.1	4.2
Electricity	4.75	7.10	11.86	16.51	21.44	20.0	21.0	21.6	22.4	22.5	5.2	4.4	3.4	2.6	3.5
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	5.55	5.93	6.79	6.53	6.08	23.4	17.5	12.3	8.9	6.4	0.8	1.1	-0.4	-0.7	0.1

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**67.74**	**99.19**	**164.52**	**226.05**	**288.94**	**100**	**100**	**100**	**100**	**100**	**4.9**	**4.3**	**3.2**	**2.5**	**3.4**
Coal	23.30	51.93	62.58	71.06	76.76	34.4	52.4	38.0	31.4	26.6	10.5	1.6	1.3	0.8	1.2
Oil	7.10	3.17	3.40	2.82	1.15	10.5	3.2	2.1	1.2	0.4	-9.6	0.6	-1.9	-8.6	-3.1
Natural gas	19.52	21.33	38.23	58.20	80.01	28.8	21.5	23.2	25.7	27.7	1.1	5.0	4.3	3.2	4.2
Nuclear	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Hydro	7.80	9.38	12.75	14.03	15.36	11.5	9.5	7.8	6.2	5.3	2.3	2.6	1.0	0.9	1.6
Geothermal	9.93	10.44	19.97	22.56	24.85	14.7	10.5	12.1	10.0	8.6	0.6	5.6	1.2	1.0	2.7
Others	0.09	2.93	27.59	57.38	90.81	0.1	3.0	16.8	25.4	31.4	54.6	20.5	7.6	4.7	11.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**9.74**	**18.97**	**23.06**	**26.23**	**28.55**	**100**	**100**	**100**	**100**	**100**	**8.7**	**1.6**	**1.3**	**0.9**	**1.3**
Coal	5.51	14.90	16.48	17.08	17.05	56.6	78.5	71.4	65.1	59.7	13.2	0.8	0.4	0.0	0.4
Oil	1.48	0.73	0.72	0.62	0.26	15.2	3.8	3.1	2.4	0.9	-8.5	-0.1	-1.5	-8.4	-3.2
Natural gas	2.75	3.35	5.87	8.53	11.25	28.2	17.7	25.5	32.5	39.4	2.5	4.8	3.8	2.8	3.9

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**44.0**	**34.6**	**38.8**	**43.3**	**47.6**		**-3.0**	**1.0**	**1.1**	**0.9**	**1.0**
Coal	36.3	30.0	32.7	35.8	38.7		-2.4	0.7	0.9	0.8	0.8
Oil	41.2	37.5	40.8	39.2	38.6		-1.2	0.7	-0.4	-0.2	0.1
Natural gas	61.0	54.8	56.0	58.7	61.2		-1.3	0.2	0.5	0.4	0.3

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**76.4**	**132.5**	**189.7**	**238.0**	**288.8**	**100**	**100**	**100**	**100**	**100**	**7.1**	**3.0**	**2.3**	**2.0**	**2.5**
Coal	29.8	70.0	80.2	85.3	87.6	39.0	52.8	42.3	35.8	30.3	11.3	1.1	0.6	0.3	0.7
Oil	39.4	54.1	94.7	131.6	173.6	51.6	40.8	50.0	55.3	60.1	4.0	4.8	3.3	2.8	3.7
Natural Gas	7.1	8.5	14.7	21.1	27.5	9.3	6.4	7.7	8.8	9.5	2.2	4.7	3.7	2.7	3.7

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	200	322	613	907	1,290	6.2	5.5	4.0	3.6	4.4
Population (millions of people)	94.0	106.7	123.7	135.6	144.5	1.6	1.2	0.9	0.6	1.0
GDP per capita (thousands of 2010 USD/person)	2.12	3.02	4.96	6.69	8.93	4.5	4.2	3.0	2.9	3.4
Primary energy consumption per capita (toe/person)	0.43	0.56	0.74	0.84	0.96	3.4	2.3	1.3	1.3	1.7
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	202	186	149	126	107	-1.0	-1.8	-1.7	-1.6	-1.7
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	119	105	90	81	74	-1.5	-1.3	-1.0	-1.0	-1.1
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	383	411	309	262	224	0.9	-2.3	-1.6	-1.6	-1.9
CO_2 emissions per unit of primary energy consumption (t/toe)	1.89	2.21	2.07	2.09	2.09	1.9	-0.5	0.1	0.0	-0.2

Table A.39: Energy Supply and Demand of Thailand

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**117.86**	**135.81**	**170.98**	**189.87**	**204.45**	**100**	**100**	**100**	**100**	**100**	**1.8**	**1.9**	**1.1**	**0.7**	**1.3**
Coal	16.36	15.83	15.24	14.31	12.05	13.9	11.7	8.9	7.5	5.9	-0.4	-0.3	-0.6	-1.7	-0.8
Oil	44.95	55.36	64.15	69.10	72.04	38.1	40.8	37.5	36.4	35.2	2.6	1.2	0.7	0.4	0.8
Natural gas	32.97	35.51	44.29	46.45	45.79	28.0	26.1	25.9	24.5	22.4	0.9	1.9	0.5	-0.1	0.8
Nuclear	0.00	0.00	0.00	1.83	6.21	0.0	0.0	0.0	1.0	3.0	-	-	-	13.0	-
Hydro	0.48	0.65	0.82	0.92	0.98	0.4	0.5	0.5	0.5	0.5	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	23.10	28.45	46.48	57.26	67.37	19.6	20.9	27.2	30.2	33.0	2.6	4.2	2.1	1.6	2.7
Biomass	22.61	25.70	39.35	46.19	52.40	19.2	18.9	23.0	24.3	25.6	1.6	3.6	1.6	1.3	2.3
Solar, WTHA, Ocean	0.00	0.54	2.93	5.86	8.76	0.0	0.4	1.7	3.1	4.3	87.7	15.1	7.2	4.1	9.1
Biofuels	0.65	1.94	2.75	4.21	6.10	0.6	1.4	1.6	2.2	3.0	14.6	2.9	4.4	3.8	3.6
Electricity	0.49	2.21	4.21	5.21	6.21	0.4	1.6	2.5	2.7	3.0	20.8	5.5	2.2	1.8	3.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**84.90**	**100.16**	**120.95**	**135.87**	**146.75**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Industry	26.48	30.31	39.49	45.54	48.82	31.2	30.3	32.6	33.5	33.3	1.7	2.2	1.4	0.7	1.5
Transportation	19.92	27.56	29.18	31.60	33.46	23.5	27.5	24.1	23.3	22.8	4.1	0.5	0.8	0.6	0.6
Others	20.43	17.72	21.12	22.95	24.43	24.1	17.7	17.5	16.9	16.6	-1.8	1.5	0.8	0.6	1.0
Non-energy	18.07	24.57	31.17	35.77	40.05	21.3	24.5	25.8	26.3	27.3	3.9	2.0	1.4	1.1	1.5
Total	**84.90**	**100.16**	**120.95**	**135.87**	**146.75**	**100**	**100**	**100**	**100**	**100**	**2.1**	**1.6**	**1.2**	**0.8**	**1.2**
Coal	9.21	6.83	7.55	7.44	6.91	10.8	6.8	6.2	5.5	4.7	-3.7	0.8	-0.1	-0.7	0.0
Oil	43.84	54.69	62.05	66.69	69.42	51.6	54.6	51.3	49.1	47.3	2.8	1.1	0.7	0.4	0.7
Natural gas	4.59	7.21	10.11	12.52	14.67	5.4	7.2	8.4	9.2	10.0	5.8	2.9	2.2	1.6	2.2
Electricity	12.84	16.17	23.37	28.97	33.65	15.1	16.1	19.3	21.3	22.9	2.9	3.1	2.2	1.5	2.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	14.42	15.27	17.88	20.24	22.10	17.0	15.2	14.8	14.9	15.1	0.7	1.3	1.3	0.9	1.2

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**159.52**	**182.30**	**248.18**	**306.25**	**352.24**	**100**	**100**	**100**	**100**	**100**	**1.7**	**2.6**	**2.1**	**1.4**	**2.1**
Coal	30.05	36.41	32.43	30.93	24.59	18.8	20.0	13.1	10.1	7.0	2.4	-1.0	-0.5	-2.3	-1.2
Oil	1.18	0.18	0.00	0.00	0.00	0.7	0.1	0.0	0.0	0.0	-21.1	-83.0	0.0	0.0	-48.6
Natural gas	119.35	115.64	136.66	142.29	131.13	74.8	63.4	55.1	46.5	37.2	-0.4	1.4	0.4	-0.8	0.4
Nuclear	0.00	0.00	0.00	7.03	23.83	0.0	0.0	0.0	2.3	6.8	-	-	-	13.0	-
Hydro	5.54	7.57	9.51	10.75	11.46	3.5	4.1	3.8	3.5	3.3	4.0	1.9	1.2	0.6	1.3
Geothermal	0.00	0.00	0.00	0.00	0.01	0.0	0.0	0.0	0.0	0.0	-4.4	9.9	1.2	1.0	4.3
Others	3.41	22.51	69.57	115.25	161.23	2.1	12.3	28.0	37.6	45.8	26.6	9.9	5.2	3.4	6.3

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**29.87**	**30.65**	**32.97**	**32.43**	**27.96**	**100**	**100**	**100**	**100**	**100**	**0.3**	**0.6**	**-0.2**	**-1.5**	**-0.3**
Coal	6.92	8.99	7.70	6.88	5.16	23.2	29.3	23.4	21.2	18.4	3.3	-1.3	-1.1	-2.8	-1.7
Oil	0.26	0.05	0.00	0.00	0.00	0.9	0.2	0.0	0.0	0.0	-18.8	-83.5	-0.7	-0.2	-49.2
Natural gas	22.68	21.61	25.26	25.55	22.80	75.9	70.5	76.6	78.8	81.6	-0.6	1.3	0.1	-1.1	0.2

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**43.3**	**42.7**	**44.1**	**45.9**	**47.9**		**-0.2**	**0.3**	**0.4**	**0.4**	**0.4**
Coal	37.3	34.8	36.2	38.7	41.0		-0.9	0.3	0.7	0.6	0.5
Oil	38.4	30.5	41.0	44.1	44.9		-2.8	2.5	0.7	0.2	1.2
Natural gas	45.2	46.0	46.5	47.9	49.5		0.2	0.1	0.3	0.3	0.2

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**219.7**	**238.2**	**263.6**	**266.6**	**252.9**	**100**	**100**	**100**	**100**	**100**	**1.0**	**0.8**	**0.1**	**-0.5**	**0.2**
Coal	65.2	63.9	61.5	57.7	48.6	29.7	26.8	23.3	21.7	19.2	-0.2	-0.3	-0.6	-1.7	-0.8
Oil	79.8	95.1	107.4	111.7	111.2	36.3	39.9	40.7	41.9	43.9	2.2	1.0	0.4	-0.1	0.5
Natural Gas	74.7	79.1	94.7	97.1	93.1	34.0	33.2	35.9	36.4	36.8	0.7	1.5	0.3	-0.4	0.5

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	341	442	656	907	1,191	3.3	3.3	3.3	2.8	3.1
Population (millions of people)	67.2	69.4	70.3	69.0	65.9	0.4	0.1	-0.2	-0.5	-0.2
GDP per capita (thousands of 2010 USD/person)	5.08	6.36	9.32	13.14	18.07	2.9	3.2	3.5	3.2	3.3
Primary energy consumption per capita (toe/person)	1.75	1.96	2.43	2.75	3.10	1.4	1.8	1.2	1.2	1.4
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	346	307	261	209	172	-1.4	-1.4	-2.2	-2.0	-1.8
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	249	227	184	150	123	-1.2	-1.7	-2.1	-1.9	-1.9
CO2 emissions per unit of GDP (t/million 2010 US Dollars)	644	539	402	294	212	-2.2	-2.4	-3.1	-3.2	-2.9
CO2 emissions per unit of primary energy consumption (t/toe)	1.86	1.75	1.54	1.40	1.24	-0.8	-1.1	-0.9	-1.3	-1.1

Table A.40: Energy Supply and Demand of Viet Nam

(HNC, Renewables Substitution Case)

Primary energy consumption

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**58.60**	**83.46**	**134.41**	**174.99**	**219.58**	**100**	**100**	**100**	**100**	**100**	**4.5**	**4.1**	**2.7**	**2.3**	**3.1**
Coal	14.65	36.74	52.92	64.00	73.70	25.0	44.0	39.4	36.6	33.6	12.2	3.1	1.9	1.4	2.2
Oil	18.35	22.50	35.48	46.15	59.20	31.3	27.0	26.4	26.4	27.0	2.6	3.9	2.7	2.5	3.1
Natural gas	8.12	7.94	19.78	27.23	36.49	13.9	9.5	14.7	15.6	16.6	-0.3	7.9	3.2	3.0	4.9
Nuclear	0.00	0.00	0.00	4.21	8.58	0.0	0.0	0.0	2.4	3.9	-	-	-	7.4	-
Hydro	2.37	7.23	9.86	11.00	11.65	4.0	8.7	7.3	6.3	5.3	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	15.11	9.04	16.37	22.40	29.96	25.8	10.8	12.2	12.8	13.6	-6.2	5.1	3.2	2.9	3.8
Biomass	14.71	8.91	9.58	10.47	10.76	25.1	10.7	7.1	6.0	4.9	-6.1	0.6	0.9	0.3	0.6
Solar, WVNM, Ocean	0.00	0.04	6.21	11.10	18.11	0.0	0.1	4.6	6.3	8.2	34.0	50.8	6.0	5.0	20.6
Biofuels	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	12.5	8.9	-
Electricity	0.40	0.09	0.59	0.84	1.09	0.7	0.1	0.4	0.5	0.5	-17.5	17.4	3.6	2.7	8.3

Final energy demand

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**48.51**	**60.27**	**103.07**	**134.46**	**169.62**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Industry	17.42	32.54	62.16	79.53	97.36	35.9	54.0	60.3	59.1	57.4	8.1	5.5	2.5	2.0	3.5
Transportation	10.32	12.06	18.28	24.06	31.04	21.3	20.0	17.7	17.9	18.3	2.0	3.5	2.8	2.6	3.0
Others	18.51	14.19	20.31	27.71	37.15	38.2	23.5	19.7	20.6	21.9	-3.3	3.0	3.2	3.0	3.1
Non-energy	2.26	1.48	2.32	3.15	4.06	4.7	2.5	2.3	2.3	2.4	-5.2	3.8	3.1	2.6	3.2
Total	**48.51**	**60.27**	**103.07**	**134.46**	**169.62**	**100**	**100**	**100**	**100**	**100**	**2.8**	**4.6**	**2.7**	**2.3**	**3.3**
Coal	9.81	14.17	22.15	27.07	30.95	20.2	23.5	21.5	20.1	18.2	4.7	3.8	2.0	1.3	2.5
Oil	16.81	20.75	33.74	44.24	57.05	34.7	34.4	32.7	32.9	33.6	2.7	4.1	2.7	2.6	3.2
Natural gas	0.49	0.99	6.09	7.77	9.22	1.0	1.6	5.9	5.8	5.4	9.1	16.4	2.5	1.7	7.2
Electricity	7.47	16.28	32.38	45.80	62.54	15.4	27.0	31.4	34.1	36.9	10.2	5.9	3.5	3.2	4.3
Heat	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	13.91	8.08	8.71	9.58	9.85	28.7	13.4	8.5	7.1	5.8	-6.6	0.6	1.0	0.3	0.6

Power generation Output

	TWh										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**94.90**	**240.94**	**440.13**	**609.59**	**822.67**	**100**	**100**	**100**	**100**	**100**	**12.4**	**5.1**	**3.3**	**3.0**	**3.9**
Coal	19.69	114.18	164.80	204.05	248.31	20.7	47.4	37.4	33.5	30.2	24.6	3.1	2.2	2.0	2.5
Oil	3.41	0.26	0.00	0.00	0.00	3.6	0.1	0.0	0.0	0.0	-27.6	-83.6	0.0	0.0	-49.2
Natural gas	44.15	41.73	88.26	132.04	194.96	46.5	17.3	20.1	21.7	23.7	-0.7	6.4	4.1	4.0	4.9
Nuclear	0.00	0.00	0.00	16.16	32.94	0.0	0.0	0.0	2.7	4.0	-	-	-	7.4	-
Hydro	27.55	84.13	114.65	127.95	135.49	29.0	34.9	26.1	21.0	16.5	15.0	2.6	1.1	0.6	1.5
Geothermal	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
Others	0.11	0.65	72.41	129.39	210.98	0.1	0.3	16.5	21.2	25.6	25.5	48.2	6.0	5.0	19.8

Power generation Input

	MTOE										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**13.63**	**29.52**	**44.31**	**56.18**	**69.75**	**100**	**100**	**100**	**100**	**100**	**10.1**	**3.4**	**2.4**	**2.2**	**2.7**
Coal	4.84	22.57	30.69	36.80	42.56	35.5	76.5	69.3	65.5	61.0	21.2	2.6	1.8	1.5	2.0
Oil	1.16	0.07	0.00	0.00	0.00	8.5	0.2	0.0	0.0	0.0	-30.2	-83.4	-0.7	-0.9	-49.2
Natural gas	7.63	6.89	13.62	19.38	27.20	56.0	23.3	30.7	34.5	39.0	-1.3	5.8	3.6	3.4	4.4

Thermal Efficiency

	%						AAGR (%)				
	2010	2018	2030	2040	2050		2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**42.4**	**45.5**	**49.1**	**51.4**	**54.6**		**0.9**	**0.6**	**0.5**	**0.6**	**0.6**
Coal	35.0	43.5	46.2	47.7	50.2		2.8	0.5	0.3	0.5	0.4
Oil	25.3	34.0	29.1	31.1	34.0		3.8	-1.3	0.7	0.9	0.0
Natural gas	49.7	52.1	55.7	58.6	61.6		0.6	0.6	0.5	0.5	0.5

CO_2 emissions

	Mt-CO_2										AAGR (%)				
	2010	2018	2030	2040	2050	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
Total	**124.8**	**227.0**	**356.3**	**447.5**	**544.1**	**100**	**100**	**100**	**100**	**100**	**7.8**	**3.8**	**2.3**	**2.0**	**2.8**
Coal	60.0	150.4	216.7	262.1	301.8	48.1	66.3	60.8	58.6	55.5	12.2	3.1	1.9	1.4	2.2
Oil	45.7	58.1	93.2	121.6	156.7	36.6	25.6	26.2	27.2	28.8	3.0	4.0	2.7	2.6	3.2
Natural Gas	19.1	18.5	46.3	63.8	85.6	15.3	8.1	13.0	14.3	15.7	-0.4	7.9	3.3	3.0	4.9

Energy and economic indicators

						AAGR (%)				
	2010	2018	2030	2040	2050	2010-2018	2018-2030	2030-2040	2040-2050	2018-2050
GDP (billions of 2010 US dollars)	116	188	375	624	985	6.2	5.9	5.2	4.7	5.3
Population (millions of people)	88.0	95.5	104.2	107.8	109.6	1.0	0.7	0.3	0.2	0.4
GDP per capita (thousands of 2010 USD/person)	1.32	1.96	3.60	5.79	8.99	5.1	5.2	4.9	4.5	4.9
Primary energy consumption per capita (toe/person)	0.67	0.87	1.29	1.62	2.00	3.4	3.3	2.3	2.1	2.6
Primary energy consumption per unit of GDP (toe/million 2010 US Dollars)	506	445	358	280	223	-1.6	-1.8	-2.4	-2.3	-2.1
Final energy consumption per unit of GDP (toe/million 2010 US Dollars)	418	321	275	216	172	-3.3	-1.3	-2.4	-2.2	-1.9
CO_2 emissions per unit of GDP (t/million 2010 US Dollars)	1,076	1,210	949	717	552	1.5	-2.0	-2.8	-2.6	-2.4
CO_2 emissions per unit of primary energy consumption (t/toe)	2.13	2.72	2.65	2.56	2.48	3.1	-0.2	-0.4	-0.3	-0.3