

INDONESIA

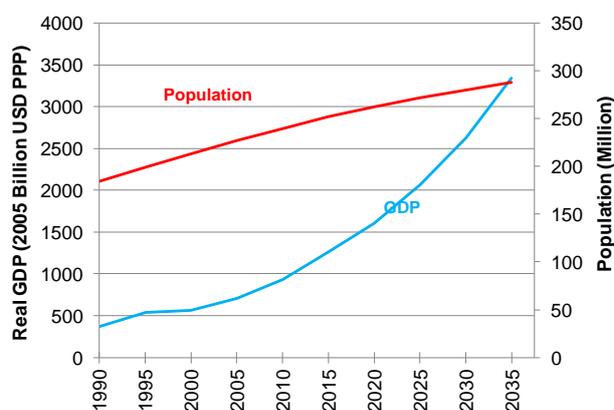
- Under business-as-usual assumptions that include strong economic growth, Indonesia's primary energy demand (including biomass) is projected to increase at an average annual rate of 3% over the outlook period, to reach 429 Mtoe in 2035. This is in line with the expected improvements in economic and living conditions spurred by the implementation of the Masterplan for Acceleration and Expansion of Indonesia Economic Development (MP3EI).
- Coal production is expected to continue a dominant role in the economy throughout the outlook period, with exports of coal rising to 333 Mtoe in 2035. Indonesia is already a net oil importer, and is expected to become a natural gas importer during the outlook period.
- CO₂ emissions will almost triple over the outlook period, reaching 1031 million tonnes of CO₂ by 2035. However, Indonesia's final energy intensity is predicted to decrease by 52% from 2005 levels.

ECONOMY

The Republic of Indonesia is a large archipelago located south-east of mainland South-East Asia. The economy covers about 1 910 931 square kilometres of land. It is made up of five large islands—Sumatra, Java, Kalimantan, Sulawesi and Irian Jaya—and over 17 000 smaller islands, of which only 7% are permanently inhabited. The terrain is mostly coastal plains with mountainous interiors, and the climate is characteristically tropical with abundant rainfall, high temperatures and high humidity. Indonesia shares land boundaries with Malaysia, Papua New Guinea and East Timor.

The population of Indonesia in 2010 was estimated to be 239.9 million, making it the world's fourth most populous economy. About half of the population still lives in rural areas and are involved mainly in agriculture-related activities. The UN predicts that 60.3% of the population will be urbanized by 2025 (UNPD, 2012). Most of the urban population lives on Java Island, making it the most populous island in the world, congregating in Indonesia's capital city Jakarta as well as the cities of Surabaya, Bandung and Semarang.

Figure INA1: GDP and Population



Sources: Global Insight (2012) and APERC Analysis (2012)

Indonesia was profoundly affected by the 1997 Asian financial crisis. The economy's GDP growth plummeted from 7.8% in 1996 to negative 13% in 1998. In the past five years, Indonesia has revived its economy to achieve consistent growth of about 6% annually, and was even able to stay resilient during the 2009 global financial crisis. In 2010, Indonesia had the largest economy in ASEAN, with overall GDP of USD 930.7 billion (in 2005 USD PPP), although the per capita GDP of USD 3880 (in 2005 USD PPP) is much lower than that of other ASEAN countries like Thailand (USD 7674 per capita) or Singapore (USD 51 800 per capita). This outlook expects Indonesia's GDP to increase at an average annual rate of 5% over the outlook period, reaching USD 3340 billion (in 2005 USD PPP) by 2035. In 2011, Indonesia gained an international investment grade credit rating and hit a record of USD 19.3 billion in foreign direct investment (Wall Street Journal, 2012), almost four times higher than the 2009 foreign direct investment of USD 4.87 billion (The World Bank, 2012).

However, poverty remains a challenge and the unemployment rate is still relatively high at 6.3% in 2012 (Jakarta Post, 2012c). Access to the basic services of electricity, water, sewage, transport, trade, education and health is still limited (IEA, 2008). For instance, in 2010 only 48% of households had sustainable access to improved drinking water, 52% to basic sanitation and the electrification ratio was at 67.2% (BAPPENAS, 2010; DGE, 2011). Furthermore, in the past decade, Indonesia has been beset by a string of natural disasters, including the massive tsunami in 2004, several major earthquakes registering over seven on the Richter scale, and the Mt Merapi volcanic eruption in 2010.

In order to meet its manifold challenges, in 2011 the Indonesian Government issued the Masterplan for Acceleration and Expansion of Indonesia Economic Development (MP3EI). The MP3EI

integrates three key objectives: to develop regional economic potential in six Indonesia Economic Corridors (Sumatra, Java, Kalimantan, Sulawesi, Bali-Nusa Tenggara, and Papua-Maluku Island); to strengthen economy-wide connectivity locally and internationally; and to strengthen human resource capacity and the economy's science and technology to support the development of programs in every economic corridor.

Indonesia's current economic structure is primarily focused on agriculture and industries that extract and harvest natural resources. With its vast natural resources, Indonesia has become a major global producer of a broad range of commodities. The economy is the world's largest producer and exporter of palm oil, and the second largest producer of coal, cocoa and tin. It is also a major producer of nickel, bauxite, steel, copper, rubber and fish products (CMEA, 2011). Under MP3EI, the economy aims to further develop its local resources to create a sustainable upstream and downstream activity chain; this includes biofuels and oleochemicals from palm oil, and tyres and gloves from rubber, as well as a steel-smelting industry from iron ore. To support the development of MP3EI's main economic activities, the Indonesian Government estimates a total investment of IDR 4012 trillion (USD 437 billion) (CMEA, 2011).

Indonesia's economic portfolio is fairly diverse. In 2010, the manufacturing sector accounted for the largest share of Indonesia's GDP at 24.82%, followed by the agricultural sector (15.34%), the mining sector (11.15%) and the services sector (10.19%) (MOI, 2011). Indonesia manufactures textiles and apparel, furniture, cement, fertilizer, steel and glassware. In the high technology area, Indonesia has the most sophisticated aircraft industry in South-East Asia and a growing range of automotive, shipping and electronic manufacturing capabilities. For instance, car manufacturers like Toyota, General Motors, Ford and Tata are not only increasing production in terms of output, but will also be rolling out new models to meet the increasing domestic demand (Jakarta Post, 2012a). The steel industry is also currently expanding its capacity, with several new steel mills expected to come online by 2015. These include the Krakatau Steel mill with an initial capacity of 3 million tonnes per year, the PT Meratus Jaya Iron Steel plant with production capacity of 315 000 tonnes per year and the PT Indoferro plant capable of producing 500 000 tonnes per year of steel billet (Kuo, 2012).

Vehicle ownership (excluding motorcycles) in this economy is still low at 79 vehicles per 1000 people (The World Bank, 2012). However, average annual growth of number of vehicles (excluding

motorcycles) in Indonesia is very high at about 11% annually, and this trend is expected to continue in the mid-term. Motorcycles are by far the most popular choice of vehicle in Indonesia, accounting for 79.4% of the 76.9 million vehicles registered with the State Police of Indonesia in 2010 (BPS, 2012).

Indonesia has a total of 355 856 km of roads, of which 57% are paved and 0.2% are toll roads (MOT, 2010). The economy's rail network is still underdeveloped. There are currently only four rail networks: one in Java, which is passenger oriented, and three in Sumatra, which are mostly used for transporting goods like coal, cement and palm oil (The World Bank, 2011). In the capital city of Jakarta, urban public transportation consists of a range of bus services including public minibuses operated by Metromini and Kopaja, public minivans, and the TransJakarta bus rapid transit (BRT) system, as well as two- and four-wheeled taxis. A rail-based mass rapid transit (MRT) system is also under development and is expected to commence operation in 2016.

As an archipelago, Indonesia relies heavily on air and sea transport for inter-island transportation. As of 2010, the economy has more than 300 ports scattered over the archipelago, and each of the major islands has at least one significant port city. While inland waterways are also used as transport routes, this is limited to the river systems in Eastern Sumatra and Kalimantan. The domestic airline network is quite extensive, providing quick and affordable access to areas not serviced by water and land transport networks.

The Indonesian Government recognizes that connectivity within the region is important to support economic activities; thus strengthening local and global connectivity is one of the four main strategies of the MP3EI. Roughly 10% of the IDR 4012 trillion (USD 437 billion) investment in MP3EI is directed toward basic infrastructure provision, such as roads, seaports, airports, railways and power generation (CMEA, 2011). This translates to increasing demand for energy in the form of fossil fuel and electricity in the coming years.

ENERGY RESOURCES AND INFRASTRUCTURE

Indonesia has substantial coal and gas reserves but its oil reserves are depleting. According to the Handbook of Energy and Economic Statistics Indonesia 2011, as of January 2010, proven reserves of coal stood at 21.13 billion tonnes, proven reserves of crude oil at 4.23 billion barrels and proven reserves of natural gas at 3.07 trillion cubic metres (tcm) (108.4 trillion standard cubic feet) (ESDM,

2011, pp. 60, 66 and 78). At current production rates, Indonesia's coal reserves are sufficient for 77 years, oil reserves for 12 years and gas for 32 years.

About 60% of Indonesia's coal reserves are sub-bituminous while the rest are lignite coals (29%) and bituminous (11%) (Lucarelli, 2010). Kalimantan and Sumatra each holds roughly 49% of the coal reserves (CMEA, 2011); however, Kalimantan accounts for over 90% of Indonesia's coal production and export. This can be attributed to Kalimantan's higher quality coal, ease of extraction and transportation through navigable rivers and coastal areas, as well as its proximity to large power markets. Currently, about 20% of annual production is consumed domestically, while the rest is exported to coal-consuming countries like Japan, China, India, South Korea and other ASEAN countries (CMEA, 2011). Coal production in Indonesia is very attractive due to strong demand and strong reserves, and as such is projected to continue growing throughout the outlook period.

A very different situation can be observed in the Indonesian oil industry. Crude oil production has been on a downward trend for the past decade, culminating in Indonesia becoming a net oil importer in 2004. This can be attributed to natural maturation of producing oilfields combined with a slower reserve replacement rate and decreased exploration and investment in the industry. The economy actually has a fairly sizable oil reserve potential—the proven reserve in 2011 is 4.2 billion barrels, and out of the 128 estimated oil basins, only 38 have been extensively explored (PWC, 2011c). Most of the existing wells are in Sumatra and Kalimantan.

The Indonesian Government is promoting exploration further offshore and in frontier regions, providing incentives such as encouraging three-dimensional seismic surveys and agreeing to a change to the production-sharing contract—to increase oil companies' share from 15% to 35%. Other incentives also proposed include waiving land and building taxes as well as import duties for capital goods (Oil and Gas Technology, 2012). These incentives may improve Indonesia's oil outlook, but given that no new significant finds have been made in the past decade, and in the light of Indonesia's rapidly growing demand, the economy is expected to remain an oil importer in the long term.

Indonesia has the largest proven natural gas reserves in the Asia-Pacific region, estimated to be about 2% of the world's total estimated proven natural gas reserves (OGJ, 2011). The economy's major production sites are Arun in Aceh, Bontang in

South Kalimantan, and Tangguh in Papua (Jakarta Globe, 2011).

Indonesia's archipelago geography and the distributed nature of its gas reserves complicate the transportation process; this is mitigated through a combination of LNG facilities and a localized pipeline network (Hutagalung et al., 2011). Indonesia has three LNG liquefaction facilities in operation, one under construction in Donggi-Senoro and another planned at Abadi (Global LNG Info, 2012). In anticipation of rising domestic demand, especially from islands without their own natural gas sources, three regasification terminals will be constructed: the Nusantara LNG FSRU terminal, the East-Central Java LNG FSRU terminal, and the Lampung LNG FSRU terminal (Global LNG Info, 2012). In 2011, Indonesia exported its LNG to Mexico, Chile, China, Japan, South Korea, Chinese Taipei and Thailand (BP, 2012).

Indonesia's natural gas pipeline network is operated by the government-owned Perusahaan Gas Negara (PGN). It consists of high-pressure transmission pipelines totalling 2160 km in length, and a distribution pipeline network stretching more than 3500 km (PGN, 2012a; PGN, 2012b). Natural gas pipelines connect the economy to its neighbours Singapore and Malaysia, enabling pipeline gas exports to these economies. There are plans to further extend and interconnect the existing pipeline network so that eventually the islands of Sumatra, Java and Kalimantan will be linked via a 4184-km pipeline.

Maturing gas fields and rapidly increasing domestic demand are issues that have led the Indonesian Government to support the exploitation of several large pockets of natural gas, including the Abadi gas field in the Masela block (estimated 65 bcm (2.3 tcf) of gas) and the East Natuna block (estimated 1.3 tcm (46 tcf) of gas) (Jakarta Globe, 2012). There are initiatives in place to promote the extraction of coal bed methane (CBM) gas and shale gas. Indonesia has an estimated 12.8 tcm (453 tcf) of CBM in place, which is one of the largest resources in the world. CBM production started in March 2011 from the Sanga-Sanga PSC, and is being exported from the Bontang LNG facility (CBM Asia, 2012).

Indonesia also has the largest geothermal energy capacity in the world, estimated to be equivalent to 29 038 MW of electricity and spread across more than 270 locations (ESDM, 2011, p. 94). Geothermal energy is a special focus of Indonesia's USD 400 million Clean Technology Fund, which is co-financed by the World Bank and the Asian Development Bank. By 2011, 1.2 GW of thermal capacity had been successfully installed (PWC,

2011a). In addition to geothermal energy, Indonesia possesses a variety of renewable energy resources, including up to 75 670 MW of potential hydropower, 769 MW of potential micro-hydro and 49 810 MW of potential biomass, as well as solar, wind and uranium capabilities (BPPT, 2011).

Indonesia's power sector recently began to make meaningful investment after a decade of delay due to the extended impact of the 1997 Asian financial crisis. The initial priorities are to end severe power deficiencies in all the regions, and to improve electricity access from the current electrification ratio of 67% in 2010 to 99% by 2020. With these priorities in place, the Indonesian Government has mandated the government-owned electric company Perusahaan Listrik Negara (PLN) to implement fast-track programs to accelerate development of generating facilities.

Phase I of the 10 000 MW Accelerated Power Program was launched in 2006. PLN was required to build 9551 MW of new coal-based generation capacity by the end of 2009. Due to several reasons, the Indonesian Government delayed the final completion date for Phase I of the 10 000 MW Accelerated Power Program to 2014 (ESDM, 2012a). By the end of November 2012, 4520 MW of power generation capacity had been successfully completed and begun operation.

In 2010, the government mandated PLN to implement Phase II of the program. In this second phase, it is intended that PLN add 11 144 MW of capacity, based on 68% coal, 19% geothermal, 10% combined cycle gas, and 3% hydropower (ESDM, 2010). The two-phase accelerated power development program is expected to rapidly increase generating capacity, encourage renewable energy utilization, and at the same time eliminate oil-based power plants, except in regions where there are no other competitive alternative energy sources.

The composition of the generation capacity mix for the Phase II of the 10 000 MW Accelerated Power Program is updated as and when required to better ensure sustainability and energy security. In 2012, the Ministry of Energy and Mineral Resources (MEMR) has announced the 10 000 MW Phase II will add 10 047 MW capacity, of which 49% will be developed from geothermal, 30% from coal, 17% from hydropower, 3% from gas, and 1% from gassified coal (ESDM, 2012a).

Currently, Indonesia's power network consists of a central system connecting the islands of Java, Bali and Madura, as well as several isolated and partially interconnected systems on other islands. Plans are already in place to connect the partially integrated

power systems and isolated grids within the growing demand regions of Sumatra, Sulawesi, and Kalimantan. In 2012, PLN has begun initial construction for two transmission lines that will connect the Indonesia and Malaysia power grids. The first transmission line would be 122 km long, with a capacity of 275 kV, and will connect West Kalimantan to Sarawak in Borneo Island; it is expected to be completed by 2014. The second transmission line will be a 250-kV high voltage direct current (HVDC) subsea cable linking Sumatra to Peninsular Malaysia and is expected to begin operation in 2017 (Jakarta Post, 2012b).

ENERGY POLICIES

Indonesia's current National Energy Policy (KEN for its acronym in Indonesian) was formulated under the Presidential Decree No. 5 of 2006. At the core of the KEN are several policies setting out five key objectives: diversification, rational energy pricing, energy conservation, energy sector reform, and rural electrification. KEN sets economy-wide targets for the optimal energy mix in 2025, with the aim of reducing oil's share while increasing the coal and renewable energy shares. KEN also established an economy-wide target to reduce the energy elasticity target to less than 1—in this case, energy elasticity is defined as the rate of change of total primary energy over rate of change of GDP.

The National Energy Council (DEN for its acronym in Indonesian) has been mandated to formulate and monitor the implementation of the KEN as well as to lead responses to energy crises and emergency situations. The immediate responsibility for regulating Indonesia's energy sector lies with the Ministry for Energy and Mineral Resources (MEMR) and its sub-agencies.

Indonesia's oil and gas industry is currently undergoing regulatory changes. The industry was reformed in 2001 under the Oil and Gas Law (Law No. 21/2001). BP Migas and BPH Migas were created as regulatory bodies for upstream and downstream activities, respectively. Exploration and production activities were conducted based on a fiscal contractual system that relies mainly on production sharing contracts (PSC) between government and private investors, which may include foreign and domestic companies, as well as the government-owned Pertamina.

However, on 13 November 2012, the Constitutional Court declared the existence of BP Migas was in conflict with the Constitution of 1945 and ordered the dissolution of BP Migas. As at the time of writing, the government is drafting a new Oil

and Gas Law that will determine the new industry structure. Until this law can be enacted, an Interim Working Unit for Upstream Oil and Gas Business Activities (SKSPMIGAS) has been established under MEMR to undertake all of BP Migas roles and responsibilities (ESDM, 2012b). SKSPMIGAS was later renamed to Working Unit for Upstream Oil and Gas Business Activities (SKKMIGAS) (ESDM, 2013).

The Indonesian mining sector is governed by the Constitution of 1945, which stipulates that Indonesia's natural resources are to be controlled by the government and must be used for the maximum benefit of the Indonesian people. Therefore, under the Law on Mineral and Coal Mining (Law No. 4/2009), the government holds the title to mining deposits and grants licenses for exploration and sale. The Mining Business Licenses are open to both Indonesian citizens and foreign investors who own Indonesian companies. To protect Indonesian interests, all license holders are required to pay production royalties to the government and to carry out coal processing and refining within Indonesia. License holders are also obligated to sell a percentage of coal production to the domestic market, which mostly consists of the power generation sector. This Domestic Market Obligation (DMO) percentage is determined annually by the MEMR, based on forecast domestic requirements. In 2010 the DMO percentage was set to 24.75%; in 2011 it was 24.17% (PWC, 2011b).

The industry was partially deregulated in 1985 when limited private participation in electricity generation was permitted in the form of Independent Power Producers (IPP). Electricity transmission and distribution remained a monopoly under the government-owned utility PLN, and IPPs were obliged to sell generated electricity exclusively to PLN. The new Electricity Law (Law No. 30/2009) enacted in September 2009, fully deregulated the power market by allowing IPPs to generate and sell electricity to end users. However, until 2011, PLN remained the sole owner of transmission and distribution assets and controlled over 80% of generation assets. The same law mandated central and regional government to regulate the electricity industry within their respective jurisdictions. This is done through these electricity regulatory authorities: the Directorate General of Electricity (DGE) and the Directorate General of New Energy, Renewable Energy and Energy Conservation (DGNREEC) under MEMR.

While subsidies on fuels for power generation and industry, and high-octane gasoline for transport, have been removed, substantial subsidies remain for lower-octane gasoline and diesel oil for transport,

kerosene and a certain class of electricity use in households. In 2011, it was estimated that the Indonesian Government spent a total of IDR 137 trillion (USD 14.8 billion) on energy subsidies, including fuel and electricity subsidies (IISD, 2011). The Indonesian Government is making progress towards fuel subsidy reforms; this includes significantly reducing kerosene subsidies through the kerosene-to-LPG program introduced in 2007.

In May 2012, the Indonesian President announced five policies under the National Saving Program that restricts access to subsidized fuel and introduces new energy diversification and conservation measures (Republika Online, 2012). The policies are:

1. Subsidized fuel consumption will be monitored through automated data collection at every fuelling station.
2. Government vehicles will be prohibited from using subsidized fuel.
3. Vehicles owned by plantation and mining owners will also be banned from using subsidized fuel.
4. Natural gas will be introduced as an alternative fuel in the transportation sector; as a start 33 natural-gas fuelling stations will be constructed and 15 000 converter kits will be distributed to launch the program.
5. Water and electricity savings measures will be implemented at the central and district offices (BUMN and BUMD for the acronyms in Indonesian) as well as in street lighting.

A more comprehensive strategy is being formed to gradually phase out all fossil fuel subsidies while minimizing the social impact of that change (IISD, 2012).

The Indonesian Government is also looking at further reducing the effect of fuel subsidies by developing alternative fuels for transportation. To drive this initiative, Ministerial Regulation No. 32/2008 was enacted regarding the Supply, Use and Commerce of Bio-fuels as Other Fuel. This makes biofuel consumption mandatory from 2009 (APEREC, 2011). So far, the initiative has been quite successful; as of 2010, there are several biofuel producers in the economy, capable of producing 4 506 629 kilolitres of biodiesel and 286 686 kilolitres bioethanol annually (DGNREEC, 2012).

In 2009, during the G20 Finance Ministers and Central Bank Governors Summit at Pittsburgh and the COP15 forum in Copenhagen, Indonesian President Yudhoyono pledged to voluntarily and unilaterally cut carbon emissions by 26% relative to

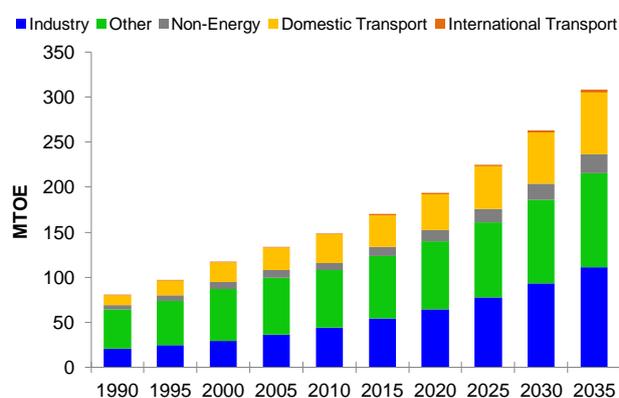
business-as-usual levels by 2020. Further emissions reductions of 41% are expected with international support (MOE, 2010). In line with this pledge, Indonesia's DEN is currently drafting a revised National Energy Policy (KEN). Early drafts propose that Indonesia will no longer build oil-fired power plants (ESDM, 2012c) and the renewable energy share of total primary energy consumption will be increased to around 25% by 2025, compared to the original target of 10% (Balia, 2011). The new policy also sees a paradigm shift to demand-side management with more emphasis on energy conservation to improve energy utilization. Through energy conservation measures, the DGNREEC expects to achieve a 17% reduction in final energy consumption by 2025, compared to consumption in 2009 (DGNREEC, 2012).

BUSINESS-AS-USUAL OUTLOOK

FINAL ENERGY DEMAND

Indonesia's final energy demand under business-as-usual (BAU) assumptions is projected to increase at an average annual rate of 3% over the outlook period to reach 305 Mtoe in 2035 (International transport sector was excluded from this total). Demand is expected to increase across all sectors and all fuel types, with the exception of new renewable energy (NRE).

Figure INA2: BAU Final Energy Demand

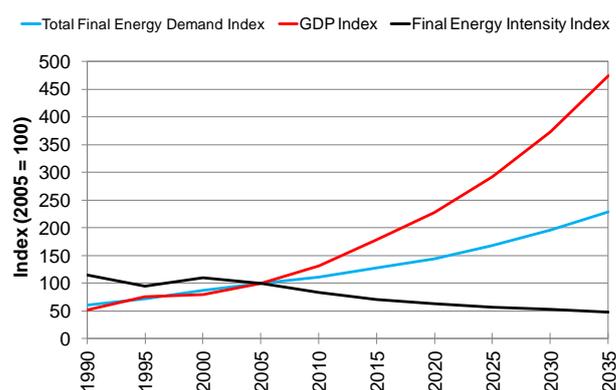


Source: APERC Analysis (2012)

Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Final energy intensity is expected to halve by 2035 compared to the final energy intensity in 2005. This is a positive indicator of the improving economic performance and better management of energy utilization in Indonesia.

Figure INA3: BAU Final Energy Intensity



Source: APERC Analysis (2012)

Industry

Based on current trends for capacity and productivity expansion in Indonesia, industrial energy demand in the economy is projected to experience strong growth, almost tripling from 43.3 Mtoe in 2009 to over 110 Mtoe in 2035. Each type of fuel experiences similar rates of growth from 2010 to 2035 (of about 3–5%), with the exception of NRE, which will decline from 6.5 Mtoe in 2009 to 3.8 Mtoe in 2035. This indicates that as Indonesia's industrial sector becomes more sophisticated, biomass will be replaced by other commercial fuel like electricity and natural gas. Industrial energy intensity is projected to reduce by 36% from 2005 to 2035.

Transport

Road vehicle ownership in Indonesia is far from saturation level, and given the economy's accelerating economic development, growth in vehicle ownership is expected to be very rapid. This will translate to a corresponding increase in energy demand in the transport sector. The same increasing energy demand growth can be expected in other types of transportation. In total, rail, road, aviation and water-based transportation will require about 71 Mtoe of energy by 2035, compared to 32 Mtoe in 2009. In 2009, virtually all of this demand was for oil, but with the introduction of alternative fuels and vehicles in the economy, demand for other fuels will gradually increase throughout the outlook period. By 2035, demand for other types of fuel will account for about 4% of the total demand. The gradual shift to more efficient fuel and transportation modes will contribute towards the expected 40% improvement in transportation energy intensity from 2010 to 2035.

Other

The 'other' sector (combining the agricultural, commercial and residential sub-sectors) is expected to

experience strong growth in the 25 years from 2010 to 2035, given Indonesia's rapidly increasing economic and population growth. Each year should see an average growth of about 2% in the 'other' final energy demand, rising from 63.7 Mtoe in 2009 to 104 Mtoe by 2035.

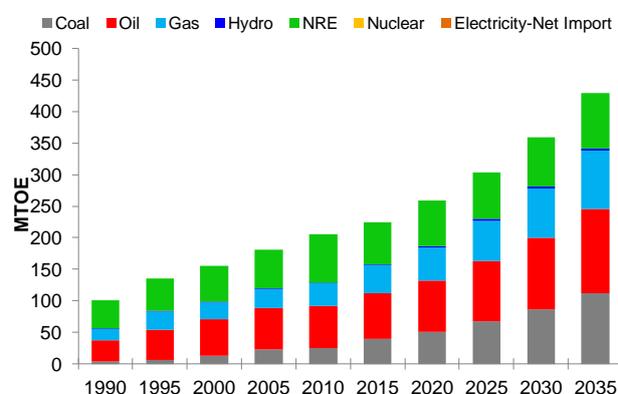
The demand will be primarily for NRE in the form of biomass, and for electricity and oil. This projection assumes that PLN is able to realize its target of improving the electrification ratio from 67.2% in 2010 to 99% in 2020. As a result, growth in electricity demand is expected to be the most rapid, at an annual average of 6%, as access to electricity will be complemented by increasing use of electrical appliances in both the commercial and residential sectors.

Energy intensity in the 'other' sector will improve significantly during the outlook period, achieving a 65% reduction from the 2005 to 2035. This can be attributed to the various energy efficiency and conservation measures currently in place in Indonesia. This includes the formation of government-owned service companies (ESCO); publication of energy benchmark and best practice guides for energy use in commercial buildings; updating of energy standards and labelling system for electrical appliances; subsidization of an energy-efficient lighting program in the residential sector; and promotion of research and development in energy efficiency and conservation.

PRIMARY ENERGY SUPPLY

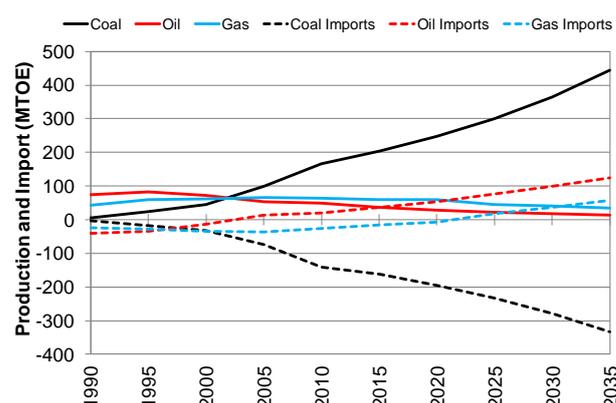
Indonesia's primary energy supply is expected to more than double during the outlook period, reaching 429 Mtoe in 2035. In 2035, the fuel mix will mostly be distributed among four fuels—oil (31%), coal (26%), natural gas (22%) and NRE (20%).

Figure INA4: BAU Primary Energy Supply



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure INA5: BAU Energy Production and Net Imports



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Indonesia will continue to produce coal, oil and gas; however, by the latter half of the outlook period, oil and gas production will begin to dwindle. Indonesia became a net oil importer in 2004, and unless new, viable natural gas resources can be developed, Indonesia will begin to import natural gas after 2020. On the other hand, given its substantial coal reserves and established coal industry, Indonesia will remain a major coal exporter throughout the 2010–2035 period.

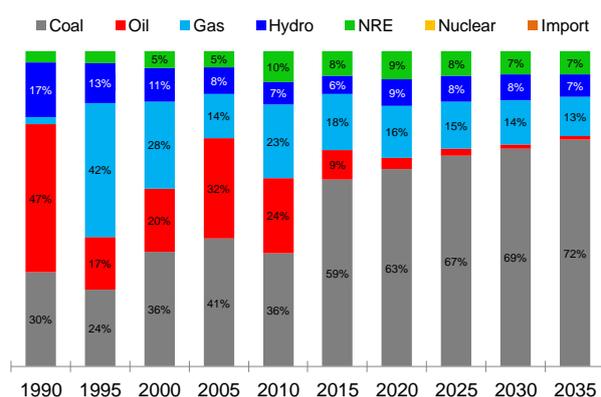
ELECTRICITY

Indonesia's electrification ratio and per capita electricity consumption were pretty low in 2010 at 67.2% of total households and 620 kWh per capita respectively (DGE, 2011, p. viii). There is much room for growth, and considering that annual electricity consumption growth has been high at 6–7%, it is not surprising Indonesian authorities have embarked on the two-phase 10 000 MW Accelerated Power Program to meet this anticipated surge in electricity demand.

This huge influx of capacity rapidly shrinks oil's share in power generation from 24% in 2010 to 1% by 2035. Coal and gas are the preferred investment choices for thermal power plants, especially coal since Indonesia has vast but under-utilized coal deposits. This will lead to coal dominating the generation mix from 2015 onwards.

In line with Indonesian government programs, it is projected that NRE (in the form of solar, wind, geothermal and biomass) will contribute an increasing share to the generation mix over the outlook period, reaching 7% by 2035. Most of this contribution will be from geothermal power plants, in which Indonesia has significant potential (estimated about 29 GW).

Figure INA6: BAU Electricity Generation Mix

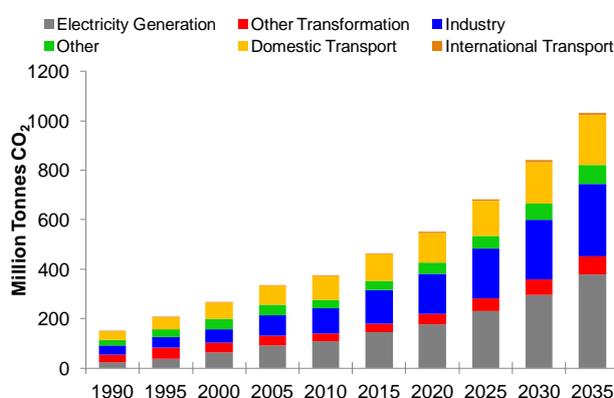


Source: APERC Analysis (2012)
Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

CO₂ EMISSIONS

Over the outlook period, Indonesia’s CO₂ emissions from combustion of fossil fuels is projected to reach 1031 million tonnes of CO₂ in 2035, which is a 175% increase from 2010 emission levels. Fossil-fuel-based electricity generation is expected to be the main source of CO₂ emissions, followed by the industrial and domestic transport sectors.

Figure INA7: BAU CO₂ Emissions by Sector



Source: APERC Analysis (2012)

Table INA1: Analysis of Reasons for Change in BAU CO₂ Emissions from Fuel Combustion

	(Average Annual Percent Change)				
	1990-2005	2005-2010	2005-2030	2005-2035	2010-2035
Change in CO ₂ Intensity of Energy	1.5%	-0.1%	1.0%	0.9%	1.1%
Change in Energy Intensity of GDP	-0.5%	-3.0%	-2.5%	-2.3%	-2.1%
Change in GDP	4.4%	5.7%	5.4%	5.3%	5.2%
Total Change	5.5%	2.4%	3.8%	3.8%	4.1%

Source: APERC Analysis (2012)

The decomposition analysis illustrated in Table INA1 shows that Indonesia’s CO₂ emissions are affected most by economic growth, and to a lesser degree by the change in CO₂ intensity of energy (as a result of fuel switching, especially to coal). The total increase in CO₂ emissions will be moderated by the

reduction in energy intensity of GDP (due to increased energy efficiency). The latter indicates overall better economic efficiency in terms of energy use.

CHALLENGES AND IMPLICATIONS OF BAU

Under BAU assumptions, Indonesia will continue to experience strong economic growth, which will lead to rapidly increasing domestic energy requirements. Indonesia has ample indigenous resources of coal and geothermal, and plans are underway to effectively harness these resources to meet growing demand. It is projected that under existing policies, Indonesia will likely reduce its final energy intensity by half from 2005 to 2035; however, the absolute amount of carbon emissions will almost triple during the same period. There remain significant opportunities for improving environmental sustainability, particularly in the power generation, industry and transport sectors.

ALTERNATIVE SCENARIOS

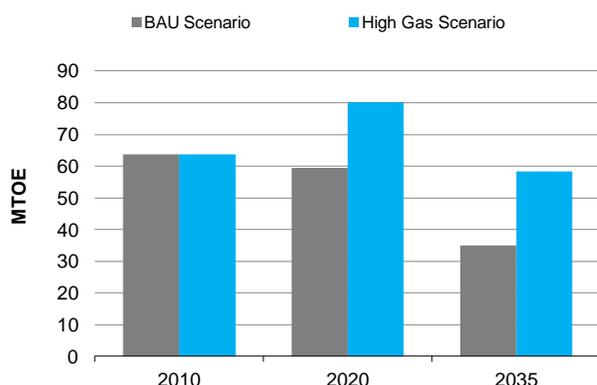
To address the energy security, economic development, and environmental sustainability challenges posed by the business-as-usual (BAU) outcomes, three sets of alternative scenarios were developed for most APEC economies.

HIGH GAS SCENARIO

To understand the impacts higher gas production might have on the energy sector, an alternative ‘High Gas Scenario’ was developed. The assumptions behind this scenario are discussed in more detail in Volume 1, Chapter 12. The scenario was built around estimates of gas production that might be available at BAU prices or below, if constraints on gas production and trade could be reduced.

The High Gas Scenario for Indonesia assumed the production increase shown in Figure INA8, which is 67% by 2035. Indonesia has ample natural gas resources, estimated to be the largest in the Asia-Pacific region, but limited technology and infrastructure for gas extraction and transport. For this High Gas Scenario, it was assumed that Indonesia was able to attract sufficient investment to overcome these challenges, which would spur construction of the necessary infrastructure and development of major gas projects such as the Natuna D-Alpha gas field. Note these estimates can be considered conservative as the potential for unconventional gas like shale gas and coal bed methane (CBM) was not included.

Figure INA8: High Gas Scenario – Gas Production

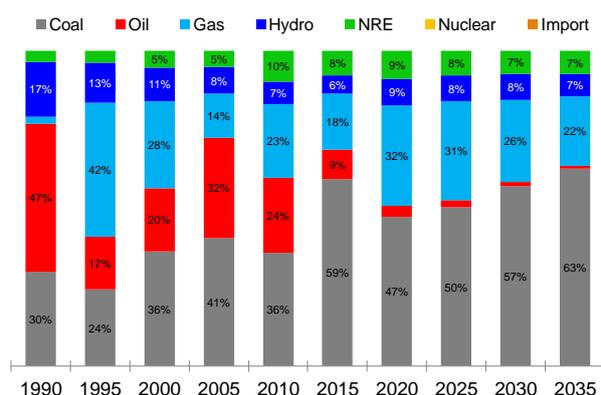


Source: APERC Analysis (2012)

Additional gas consumption in each economy in the High Gas Scenario will depend not only on the economy’s own additional gas production, but also on the gas market situation in the APEC region. For Indonesia, the economy would likely export most of the additional gas produced as LNG to maximise economic benefits, while the remainder will replace coal to reduce local air pollution and CO₂ emissions.

Additional gas in the High Gas Scenario was assumed to replace coal in electricity generation. Figure INA9 shows the High Gas Scenario electricity generation mix. This graph may be compared with the BAU scenario shown in Figure INA6. It can be seen that the gas share has increased by 9% by 2035, while the coal share has declined by the same amount.

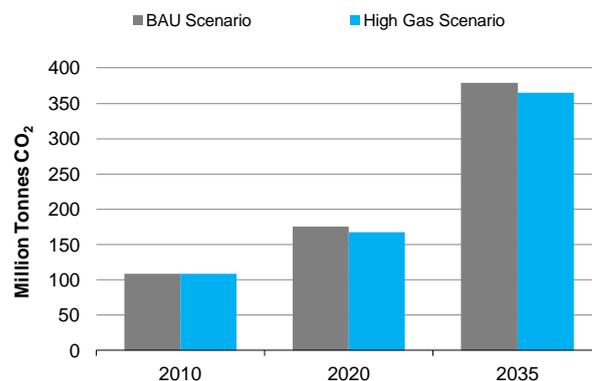
Figure INA9: High Gas Scenario – Electricity Generation Mix



Source: APERC Analysis (2012)
Historical Data: World Energy Statistics 2011 © OECD/IEA 2011

Since gas has roughly half the CO₂ emissions than coal per unit of electricity generated, this reduces CO₂ emissions in electricity generation by 3.8% in 2035. Figure INA10 shows this CO₂ emission reduction.

Figure INA10: High Gas Scenario –CO₂ Emissions from Electricity Generation



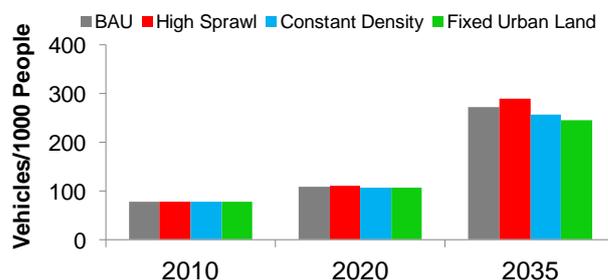
Source: APERC Analysis (2012)

ALTERNATIVE URBAN DEVELOPMENT SCENARIOS

To understand the impacts of future urban development on the energy sector, three alternative urban development scenarios were developed: ‘High Sprawl’, ‘Constant Density’, and ‘Fixed Urban Land’. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure INA11 shows the change in vehicle ownership under BAU and the three alternative urban development scenarios. The impact of urban planning on vehicle ownership is relatively small. Since vehicle ownership is well below saturation level, vehicle purchasing will continue to grow almost regardless of urban planning. By 2035, vehicle ownership is about 6% higher in the High Sprawl scenario compared to the BAU, and about 10% lower in the Fixed Urban Land scenario.

Figure INA11: Urban Development Scenarios – Vehicle Ownership

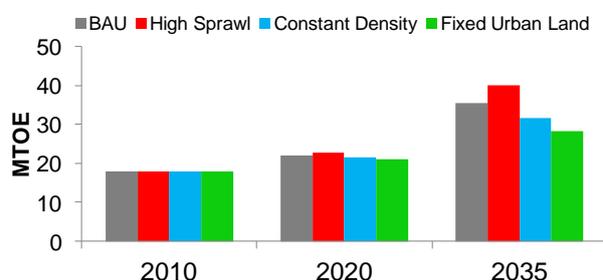


Source: APERC Analysis (2012)

Figure INA12 shows the change in light vehicle oil consumption under BAU and the three alternative urban development scenarios. Better urban planning has a more pronounced impact on light vehicle oil consumption than on vehicle ownership because compact cities reduce both the need for vehicles and the distances they must travel. Light vehicle oil

consumption would be 13% higher in the High Sprawl scenario compared to BAU in 2035, and about 20% lower in the Fixed Urban Land scenario.

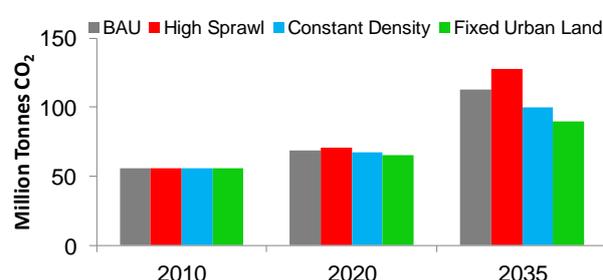
Figure INA12: Urban Development Scenarios – Light Vehicle Oil Consumption



Source: APERC Analysis (2012)

Figure INA13 shows the change in light vehicle CO₂ emissions under BAU and the three alternative urban development scenarios. The impact of urban planning on CO₂ emissions is similar to the impact of urban planning on energy use, since there is no significant change in the mix of fuels used under any of these scenarios.

Figure INA13: Urban Development Scenarios – Light Vehicle Tank-to-Wheel CO₂ Emissions



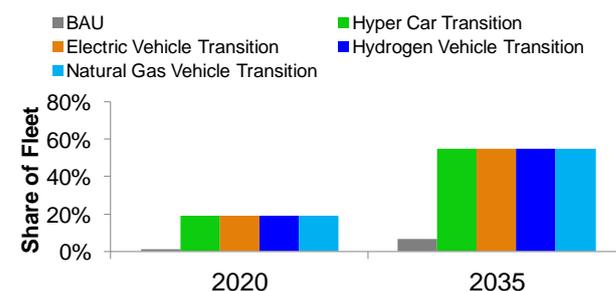
Source: APERC Analysis (2012)

VIRTUAL CLEAN CAR RACE

To understand the impacts of vehicle technology on the energy sector, four alternative vehicle scenarios were developed: ‘Hyper Car Transition’ (ultra-light conventionally-powered vehicles), ‘Electric Vehicle Transition’, ‘Hydrogen Vehicle Transition’, and ‘Natural Gas Vehicle Transition’. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure INA14 shows the evolution of the vehicle fleet under BAU and the four Virtual Clean Car Race scenarios. By 2035, the share of the alternative vehicles in the fleet reaches around 55% compared to about 6% under BAU. The share of conventional vehicles in the fleet is therefore only about 45%, compared to about 94% in the BAU scenario.

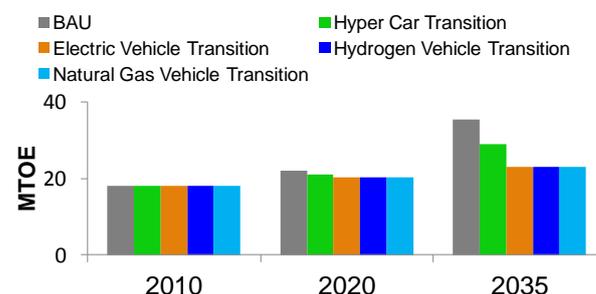
Figure INA14: Virtual Clean Car Race – Share of Alternative Vehicles in the Light Vehicle Fleet



Source: APERC Analysis (2012)

Figure INA15 shows the change in light vehicle oil consumption under BAU and the four alternative vehicle scenarios. Oil consumption drops by 36% in the Electric Vehicle Transition, Hydrogen Vehicle Transition, and Natural Gas Vehicle Transition scenarios compared to BAU in 2035. The drop is large as these alternative vehicles use no oil. Oil demand in the Hyper Car Transition scenario is also significantly reduced compared to BAU—down 23% by 2035—even though these highly efficient vehicles still use oil.

Figure INA15: Virtual Clean Car Race – Light Vehicle Oil Consumption



Source: APERC Analysis (2012)

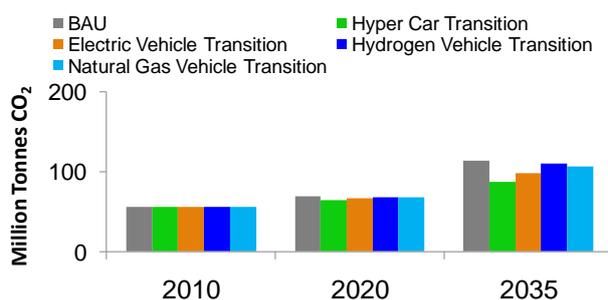
Figure INA16 shows the change in light vehicle CO₂ emissions under BAU and the four alternative vehicle scenarios. To allow for consistent comparisons, in the Electric Vehicle Transition and Hydrogen Vehicle Transition scenarios the change in CO₂ emissions is defined as the change in emissions from electricity and hydrogen generation. The impact of each scenario on emission levels may differ significantly from its impact on oil consumption, since each alternative vehicle type uses a different fuel with a different level of emissions per unit of energy.

In Indonesia, the Hyper Car Transition scenario is the winner in terms of CO₂ emissions reduction, with an emission reduction of 23% compared to BAU in 2035. The Electric Vehicle Transition, Natural Gas Vehicle Transition and Hydrogen

Vehicle Transition scenarios offer lower emission reductions (13%, 6% and 3% respectively).

Hyper cars rely on their ultra-light carbon fibre bodies and other energy-saving features to reduce oil consumption. In the other alternative vehicles oil combustion is replaced by other fuels: electricity for electric vehicles, hydrogen for hydrogen vehicles and gas in natural gas vehicles. The additional demand for electricity and hydrogen generation would produce more CO₂ emissions and this offsets some of the benefits gained from oil replacement.

Figure INA16: Virtual Clean Car Race – Light Vehicle CO₂ Emissions



Source: APERC Analysis (2012)

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