Follow-Up Peer Review on Energy Efficiency in Indonesia

Final Report for

APEC Energy Working Group (EWG)

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ABBREVIATIONS AND TERMS

APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
BEV	Battery electric vehicle
DSM	Demand Side Management
EE	Energy efficiency
EE&C	Energy efficiency and conservation
EEV	Energy Efficient Vehicle
EMS	Energy Management Systems
EPC	Energy performance certificate
ESCO	Energy Service Company
EV	Electric vehicle
FiT	Feed-in Tariff
GHG	Greenhouse Gasses
ICE	Internal combustion engine
IDR	Indonesia rupiah
IEA	International Energy Agency
IoT	Internet of Things
IPP	Independent power producer
ISO	International Organization for Standardisation
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MBOE	Million barrels of oil equivalent
MEMR	Ministry of Energy and Mineral Resources
MEPS	Minimum Energy Performance Standards
PLN	Indonesia's state electricity company
PREE	Peer Review on Energy Efficiency
RUEN	National Energy General Plan (Indonesia)
SUV	Sport utility vehicle
UNFCCC	United Nations Framework Convention on Climate Change
VA	Volt-ampere

PREFACE

According to the guidelines for the APEC Peer Review on Energy Efficiency (PREE), the objectives of PREE as endorsed by APEC Leaders at their 2007 meeting are to:

- Share information on energy efficiency performance as well as on policies and measures for improving energy efficiency.
- Provide opportunities for learning from the experiences of other economies and for broadening the network among energy efficiency policy experts.
- Explore how energy efficiency goals on an overall and/or sectoral basis and action plans could be effectively formulated in each economy under review, taking into account the range of possible strategies that could be used, according to the circumstance of each economy.
- Monitor progress on energy efficiency goals on an overall and/or sectoral basis and progress on action plans, if such goals and plans have been already formulated at the time of the review.
- Provide recommendations for voluntary implementation on how the action plans could be improved to achieve energy efficiency goals.

Two activities are undertaken as part of PREE:

- Peer Review of volunteer member economies.
- The Energy Efficiency Policy Workshop for capacity building of member economies.

The first PREE in Indonesia was conducted 10 to 14 October, 2011, and a report was published June 2012. Just over a decade later, this Follow-up PREE for Indonesia took place from 9 to 11 November, 2021, in an online capacity due to the COVID-19 pandemic. The follow-up focused on: industry, transport, buildings, appliances, electricity (and other energy supply), energy management systems in Industry 4.0, and energy service companies and energy efficiency financing. The Review Team consisted of five experts and five APERC staff and made 40 recommendations. Presentations on energy efficiency were made by representatives and experts from Indonesian government ministries and agencies, industrial associations, academia, and non-governmental organisations.

The Review Team wishes to thank all the presenters and key stakeholder who participated in the discussions. The Expert Team would like to especially thank officials from the Ministry of Energy and Mineral Resources and organising staff, including Ms Luh Nyoman Puspa Dewi (Director of Energy Conservation), Mr Florentius Fanny Hendro Gunawan, and Mr Kunaefi, without whom this event and report would not have been possible.

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EXECUTIVE SUMMARY

Energy efficiency remains an essential component of modern energy policy and is an indispensable tool for low carbon energy transitions. It is one of the key topics of the APEC Energy Working Group (EWG). The Peer Review on Energy Efficiency (PREE) has been a core part of the EWG's work to promote improvements in APEC energy intensity since its inception in 2007.

Indonesia has undertaken significant efforts to improve how it uses energy in almost all facets of its economy. Part of Indonesia's energy efficiency story has been occurring via well-designed markets and incentive structures, and another part of the energy efficiency story is occurring due to direct involvement by the Indonesian government. Indonesia's Energy Law, enacted in 2007, continues to provide a framework for multiple energy efficiency initiatives, with many policies drawing upon the initial Indonesia PREE recommendations from 2011.

Indonesia's economy is forecast to grow at a rapid pace through the 2020s (and beyond), and energy will be fundamental to drive this growth. This Follow-up PREE provides important insights and recommendations to ensure that the energy required to facilitate Indonesia's growth will be used as efficiently as possible.

The main part of this report is a considered response by the Review Team that attended the online PREE event in November 2021. After listening to, and asking questions of, presenters from Indonesian government ministries and agencies, industrial associations, academia, and non-governmental organisations, the Review Team have provided analysis and recommendations for the following topics, in an energy efficiency context:

- Industry sector (including energy management systems in Industry 4.0)
- Transport sector
- Building sector
- Appliances
- Electricity
- Institutional framework and other cross-sectoral issues

In all, there are 40 recommendations for consideration. The PREE Review Team were already impressed with energy efficiency initiatives currently occurring in Indonesia. They sincerely hope that each of the recommendations contributes to enhancing energy efficiency in Indonesia.

In this report, the Review Team recommendations are followed by background energy context for Indonesia, that acted as a basis for the delivered recommendations. The background section covers energy trends, regulations and policies, institutional organisation, and details of multiple in-place energy efficiency programs in Indonesia.

REVIEW TEAM REPORT AND RECOMMENDATIONS

The Follow-up PREE in Indonesia review team have provided recommendations across industry, transport, buildings, appliances, electricity (and other energy supply), and institutional framework and other cross-sectoral issues.

INDUSTRY SECTOR

ENERGY MANAGEMENT SYSTEMS

Indonesian companies that consume more than 6,000 tonnes of oil equivalent per year (69,780 MWh) are required to conduct energy management programs and activities.[1] This is a high threshold and currently limits energy management to very large industrial consumers only.

Recommendation 1

The Ministry of Energy and Mineral Resources (MEMR) should consider lowering the energy consumption threshold so that energy management systems are required to be implemented by a larger segment of Indonesia's industry sector.

In general terms, the Indonesian Government's policy requiring large energy users to adopt an ISO 50001 energy management system and undertake energy audits should provide continual improvement in energy performance at a relatively low cost. ISO50001:2018 is focused on obtaining genuine energy performance improvement.

In most cases, energy performance must be normalised to ensure the improvement is due to the energy management system, rather than other variables. Over time, the requirements in ISO50001 for energy performance to be considered in procurement, and plant and equipment design could provide significant benefits at a small cost.

ISO50001 is also consistent with effective management practices, which benefits businesses using the standard. One of the challenges will be maintaining the momentum once the accessible opportunities have been implemented. The energy audits should help to identify new opportunities.

The purpose of energy management systems is to reduce energy consumption by making use of energy data. Successful implementation is reliant on skilled individuals.

Recommendation 2

The MEMR should consider encouraging energy management system participation through an award or incentive system. The design of an imitation and copy system may prove effective, where good practices are rewarded by the government. These incentives can be regionally specific and awarded based on a competitive application process.

Recommendation 3

The MEMR should develop programs for talented persons and technical experts that improve their capacity as energy managers and energy auditors.[2] Talented persons must have experiences with

[1] Government Regulation No. 70 / 2009 on Energy Conservation.

[2] For example, this program could be facilitated through PSBE award program.

not only energy facilities, but also production, and combination of different facilities. There are opportunities for development of programs in multiple industrial settings, and for the development of programs to make use of MEMR training centres already established.

ENERGY AUDITS

Large energy consumers in Indonesia are required to undertake regular energy audits every six months. ISO50002 sets audit requirements that are based on an agreement between the auditor and the company being audited. This can lead to variable energy audit results if the audits lack rigour.

Basic energy audits are unlikely to be effective unless the business has a lot of easy opportunities. There could be benefits in setting specific requirements for energy audits and there may be benefits in having less frequent but more detailed audits with clear requirements.

Recommendation 4

To improve the consistency and effectiveness of energy audits, the Government of Indonesia could consider setting specific requirements for energy audits depending on the size of the organisation and the sector they operate in. Table A1 in ISO50002 (or the Australian Standards for energy audits [AS/NZS3598.1 – 3598.3]) could indicate potential requirements for detailed (type 2) audits. There may be benefits in having less frequent but more detailed audits.

Indonesian regulations require implementation of audit recommendations. Experience in Australia showed that it can be helpful to instead set a payback limit on the implementation requirement. For example, up to 4 years simple payback, and if the payback is longer, implementation is voluntary.

A less stringent implementation requirement incentivises the audit to identify the full range of opportunities without an obligation of implementation. Encouraging auditors to suggest long payback opportunities can assist businesses to make longer-term investments in improved energy efficiency as plants and equipment are replaced. This can be useful for meeting the ISO50001 requirements for energy performance in design and procurement.

Recommendation 5

To improve the effectiveness of energy audits, the Government of Indonesia should consider setting a payback limit on the requirement of the implemented program. For example, only requiring implementation of opportunities with simple paybacks of 4 years or less. This should encourage the identification of both longer-term opportunities and short-term opportunities that can be easily implemented.

The reason for not requiring implementation of all identified energy efficiency improvements (for all payback periods) is that such a requirement would disincentivise companies from identifying opportunities. With a less binding implementation requirement (for example, payback period of less than 4 years), companies will be more diligent in identifying energy efficiency opportunities, because they know they are not obligated to implement them (unless the payback period is short).

INDUSTRY 4.0

Industry 4.0 practices are being widely adopted. But Industry 4.0 is not necessarily used to improve energy efficiency. Therefore, it is essential to explain how Industry 4.0 can be applied to the energy field If Indonesia wants to compel industrial energy consumers to incorporate Industry 4.0.

Recommendation 6

The MEMR should consider specifying how Industry 4.0 is related to energy efficiency to facilitate industry sector energy efficiency opportunities.

ENERGY SERVICE COMPANIES (ESCO'S)

There are multiple challenges to promoting ESCO development. One of the challenges is limited internal capital for project investment. Mobilising commercial financing by linking the loan repayment schedule to savings from the energy efficiency investment is one way to ensure capital is available for energy efficiency projects.

Another challenge is that banks are usually conservative in the case of shared saving ESCO arrangements because the model is relatively new and not widespread. The business model is considered as a high-risk investment from the bank's perspective.

If an energy efficiency finance scheme can be established in Indonesia, it will provide an impetus for leasing companies, energy savings appliances providers, or financial institutions to grow the ESCO industry.

Recommendation 7

The MEMR should consider establishing an energy efficiency finance scheme for ESCO's. The scheme should allow the energy efficiency savings to act as the security for the energy efficiency project investment. To establish this scheme, the Government of Indonesia needs cooperation with related development partners which provide appropriate funding to be able to create and implement the pilot projects.

Financial institutions usually consider that energy efficiency and conservation (EE&C) projects are riskier than traditional investments. Risk-sharing facilities can be used to reduce this risk. It can be done by providing local investment partners, like public agencies, with partial risk coverage when extending loans for EE&C projects. These facilities can also help start-up ESCOs having limited performance records if the public agency can provide energy-savings warranties or some other insurance product protecting the investment partner against the poor performance of an energy performance certificate (EPC) project. More details can be found in Becqué et al. (2016).[3]

Recommendation 8

The Government of Indonesia should consider establishing risk-sharing facilities for EE&C investment and ESCO's.

Long-term shared savings contracts mean that there are risks such as continuity of both enterprises, the risk of not achieving savings, and unforeseen operational troubles. Risk-hedge policies must be discussed between ESCO's and financing companies. For example, in the loan-loss reserves program, the proportion of a loss or gain is shared between the private investment partner and the public agency. The agreements

[3] Becqué, R., Mackres, E., Layke, J., Aden, N., Sifan Liu, Managan, K., ... Graham, P. (2016). *Accelerating Action Efficient Buildings: A Blueprint for Green Cities*. World Resources Institute.

can also include a "first-loss" facility that absorbs a high proportion of the initial losses up to a pre-set amount (as high as 100%). Bulgaria and Singapore have such schemes in place.[4]

TRANSPORT SECTOR

PROMOTING ELECTRIC VEHICLES (EVS)

While battery electric vehicles (BEVs) can be promoted through subsidies, the most cost-effective ways to promote EV take-up are by addressing market failures affecting both demand and supply. The key driver of BEV production globally is fuel efficiency standards, especially in Europe. Without rigorous fuel efficiency standards, BEV subsidies would need to be higher to promote their adoption.

BEVs can be promoted by allowing 'super credits' within a fuel efficiency standard, and progressively tightening the standards over time. Super credits are designed to encourage manufacturers to supply ultra-low carbon via favourable accounting rules. They provide credits to ultra-low carbon vehicles by multiplying the value of the emissions credit by a factor larger than one. For example, if an electric vehicle has emissions of 100 grams per kilometre lower than the specified limit for that vehicle, a super credit value of 2 would provide the BEV manufacturer with 200g/km of credits. It is noteworthy that super credit policies may impair energy saving targets while promoting the market penetration of BEVs. Super credits are an interim measure and can be phased down over time. In any case, both super credits and tighter fuel efficiency standards can effectively encourage BEVs at a much lower cost than subsidies.

For example, in the European Union, a super credits system applies for passenger cars with emissions of less than 50 g CO2/km (NEDC). These vehicles are counted multiple times for the calculation of the average specific emissions of a manufacturer: as 2 vehicles in 2020, as 1.67 vehicles in 2021 and as 1.33 vehicles in 2022. Super credits are capped at 7.5 g/km per car manufacturer over the three years.[5]

Fuel efficiency standards might be best expressed as grams of CO2 per kilometre to encourage engines with better emissions management systems. Details of the fuel efficiency standards design can affect results, such as whether lighter vehicles have an advantage.[6]

Fuel efficiency standards encourage deployment of BEVs while also improving the efficiency of the internal combustion engine (ICE) vehicle fleet, which will be the most significant component of the market until at least 2040. Fuel efficiency standards also promote more hybrids, which are already cost-effective, and the improved fuel quality (for example lower sulphur, higher RON) encourages more efficient vehicles, including heavy vehicles. There are also significant health benefits that come with improved noxious emissions standards (for example, Euro 6).

Plug-in hybrids can be promoted by the same fuel efficiency standards mechanism, but there are uncertainties about the emissions benefits. As plug-in hybrids have limited electrical range their emissions

[4] Becqué, R., Mackres, E., Layke, J., Aden, N., Sifan Liu, Managan, K., ... Graham, P. (2016). *Accelerating Building Efficiency: Eight Actions for Urban Leaders*, World Resources Institute, pp. 108–109.

[5] See: https://ec.europa.eu/clima/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/co2-emission-performance-standards-cars-and-vans_en

[6] For a concise comparison of fuel efficiency standards design, see: https://www.climatechangeauthority.gov.au/reviews/light-vehicle-emissions-standards-australia/international-implementation-vehicle-emissions.

can rise significantly if they are not recharged frequently. As a result, plug-in hybrids might be given a lower super credit ratio.

Recommendation 9

To promote BEVs at negligible cost to government, the government should consider establishing rigorous fuel efficiency standards in grams of CO2-equivalent per kilometre rather than litres of fuel per 100 km. 'Super credits' for BEVs should be considered to encourage BEV supply at low budgetary cost. As in Europe, super credits could be reduced over time. Impacts on domestic automotive manufacturing may need to be considered in implementing this recommendation.

In some APEC economies, luxury EV brands have come to symbolise electric vehicles and to dominate media coverage of these vehicles. Indonesia could try to avoid luxury EV brands leading the marketing of BEVs. Luxury cars are expensive, and luxury car marketing encourages the general population to see electric vehicles as luxury cars. The perception of BEVs as luxury or high-performance vehicles reduces public support for government policies to promote BEVs.

Heavy marketing of luxury BEVs can also make other EVs much less attractive to buyers – and may reduce EV sales overall. This is because extensive media coverage of luxury or high performance EVs may result in consumers wanting lower cost EVs to also have these characteristics. From an infrastructure cost viewpoint luxury BEVs are typically heavy and have very large batteries, which increases the load on electricity networks.

The price premium for luxury EVs over ICE vehicles is low (estimated at around USD 3,500-5,000 in Australia) so there is little value in subsidising luxury EVs. By comparison, in Australia the premium for lower cost EVs is around USD 12,000. The premium for entry level BEVs may vary across economies depending on model availability and vehicle range.

Recommendation 10

To encourage public acceptance and support for BEVs, the government should focus policies and communication regarding BEVS on lower cost models. For example, government websites, reports, and other media, could provide pictures and examples of lower cost electric vehicles, rather than luxury or high-performance vehicles.

In general, subsidies for electric vehicles may not be needed. Analysts such as Bloomberg New Energy Finance expect BEV to reach price parity with ICE vehicles by the mid-2020s. Lower cost, practical EVs are beginning to emerge, both from Chinese manufacturers and from European manufacturers. As they become cost effective, consumers will buy BEVs if they think the charging infrastructure is sufficient.

If subsidies are considered, they should be for low cost BEVs only. However, the cost of abatement from BEVs is currently very high compared to energy efficiency. Fuel efficiency standards are the most powerful driver of electric vehicle supply as they force manufacturers to sell electric and hybrid vehicles. Standards can also be set to tighten over time, as BEVs reach price parity. These standards also raise the efficiency of new ICE vehicles, reducing fuel costs for all new vehicle purchasers.

Subsidies would be ineffective and cost more without rigorous fuel efficiency standards. For example, the US has about half the number of EV models compared to Europe, despite equivalent subsidies. EV take-up is also lower, partly because US fuel efficiency standards are weaker than in Europe.

An alternative to subsidies is to provide lower interest loans for lower-cost electric vehicle purchases, covering the price premium over ICE vehicles. The maximum loan amount could be updated every year

as the price premium declines. Consideration could be given to using luxury car taxes to raise the funds for any lower interest loan schemes that are being considered.

Recommendation 11

As BEVs approach price parity, the government should focus its policy support for electric vehicles on supporting provision of the required charging infrastructure rather than subsidising BEV purchases. An alternative form of financial support could be to fund lower interest loans covering the difference in price between BEVs and ICE vehicles, focusing on lower cost BEVs. Such a lower cost loan scheme could potentially be funded from luxury vehicle taxes.

CHARGING INFRASTRUCTURE

Consumers will not take-up BEVs unless they have confidence that they can charge them. Providing charging infrastructure allows consumers to buy BEVs as they become more cost competitive. The number and type of public chargers needed will depend on whether the owners have access to home charging.

Until a rigorous fuel efficiency standard is in place, it may be better to focus government investment on ensuring Indonesia has the EV charging infrastructure required to support increased uptake. Government support for charging infrastructure is likely to be needed at this early stage to provide consumers with confidence that they can charge their EVs easily and drive long distances when needed. Charging infrastructure investments could prioritise key highways and cities in the first instance.

Public support for public charging and home charging is good policy and a practical way to support BEV uptake. There could be benefits in undertaking some research on the availability of home charging and likely charging behaviours.

By enabling shorter range BEVs, charging infrastructure can reduce the cost of EVs. For example, the most popular BEV in China costs around USD 5,000 and has a range of around 120km.[7]

BEVs will require public charging infrastructure investment. Government may initially need to fund the bulk of this infrastructure. Lack of charging infrastructure and range concerns may reduce BEV take-up if consumers consider charging infrastructure to be inadequate.

The impacts of EVs on the grid are still uncertain. We note the Indonesian Government is already working to understand the potential impacts of BEVs on the electricity grid and is developing policies to manage these impacts. High BEV take-up requires consideration of electricity grid loads, and ways to better integrate BEVs into the grid (for example, smart charging).

Renewables may be a useful way to reduce charging network costs while reducing grid impacts. Charging infrastructure should be open access, using consistent plug types – either by agreement with the automotive industry, or by regulation. We understand the Indonesian Government is already looking at standardising plug types.

Indonesia should consider pricing systems for charging, to provide confidence for consumers. We note the Indonesian Government seems to already have regulations either under development or in place.

[7] see https://theconversation.com/what-electric-vehicle-manufacturers-can-learn-from-china-their-biggest-market-161536

In addition to regulating prices for BEV charging, parking charges in EV charging stations could be considered, to encourage drivers to move their cars when they are fully charged. This could increase the availability of public chargers for drivers, particularly for fast chargers.

Battery swapping for two wheelers might require local production unless global suppliers start using this approach.

Consideration could be given to incorporating electric vehicle charging into new commercial and residential buildings/apartment blocks. This could require, for example, for the switchboards and wiring to be installed to support a proportion of EVs (to avoid costly retrofitting). This can potentially be done using building/construction codes or standards.

As BEVs become more popular, policy measures may be required to support charging infrastructure, especially in rural and regional areas. Support will also be required for grid integration, smart charging, and network planning. For example, minimum energy performance standards (MEPS) for home chargers (requiring smart charging capability) could be considered. Charging infrastructure/readiness as part of building and construction regulations and ensuring consistent charging plug types so the whole network is fully usable would also be beneficial.

LIMITING ICE VEHICLES SALES THROUGH REGULATION

Indonesia's geography, as a large, distributed archipelago suggests that there will be less densely populated provinces and islands which may continue to need liquid fuels. Providing charging infrastructure for BEVs across 100% of Indonesian might not be practical until off the shelf renewable charging stations become available at reasonable cost.

Rather than limiting ICE vehicle sales, it may be preferable to set rigorous fuel efficiency standards and to tighten these standards every few years (for example, every 3 to 5 years). This could help to ensure that the transport needs of less populated areas and islands are met in future.

Recommendation 12

Given Indonesia's geographic dispersion and varying population density throughout the archipelago, it would be preferable if the Government of Indonesia set rigorous fuel efficiency standards and review them every five years rather than setting targets for reducing ICE vehicle sales.

ROAD VEHICLE EMISSIONS

Even the most optimistic forecasts indicate that ICE vehicles will still be 40-50% of the vehicle fleet in 2050. This makes fuel efficiency and fuel standards important for reducing transport emissions in the longer term.

It is noted that vehicle manufacturers will point out that Indonesia's fuel standards do not support the most efficient engine technologies. Although there are some vehicle technologies which require premium fuel with higher octane ratings, there are a range of ways to reduce vehicle emissions that do not require premium fuels. These include mild hybrid and parallel hybrid systems, continuously variable transmissions or simply increasing the number of gear ratios. Fuel standards could be phased in and improved over time to enable manufacturers to supply a wider range of more efficient engine options. It may also be

feasible for Government to provide some support to upgrade domestic refineries to adopt better fuel standards. This depends on the budgetary situation, but could be funded by a small levy on fuel sales.

Fuel efficiency standard 'limit curves' could be set differently for lighter and larger vehicles (for example, based on weight or footprint) so that larger/luxury passenger vehicles and SUVs have more rigorous standards. Lighter vehicles have lower emissions, meaning that standards for these types of vehicles could be phased in more slowly. The smallest, lower cost cars are typically becoming 'mild hybrids' to meet fuel efficiency standards in the European market. As battery costs decline, BEVs may become cost effective in this category.

Recommendation 13

To improve the fuel efficiency of the remaining road vehicle fleets, the Government of Indonesia should consider improving fuel standards over time by improving fuel quality (lowering sulphur content) and reducing noxious emissions (higher Euro standards such as Euro 5 or 6). This might require supporting domestic refineries to upgrade their plant to produce better fuels.

In at least one APEC economy without rigorous fuel efficiency standards, the average improvement in fuel efficiency has been close to zero in recent years due to a change from passenger vehicles to SUVs, which have been heavily marketed by automotive manufacturers. This is costing consumers money, as smaller cars are being withdrawn from this market, with manufacturers withdrawing their entry-level passenger cars since 2015.

For example, without a fuel efficiency standard, the 2021 Honda Jazz/Fit was sold in one APEC economy with the same engine and transmission for 13 years, from 2008 – 2021. Rather than supply the new hybrid version sold in Japan and Europe, Honda is removing the Jazz/Fit from this market. The smallest Honda in this market will be an SUV costing around USD 7,000 more than the Jazz. Media reports appear to indicate that the Jazz/Fit will also soon be withdrawn from the Indonesian market.

Vehicle registration charges can be used to complement fuel efficiency standards by setting lower rates for smaller vehicles. For example, in Italy they have registration charges based on power, with vehicles over 100kW paying higher rates per kW. Rates per kW are also higher for vehicles meeting lower Euro noxious emissions standards, with Euro 6 having the lowest per kW rate.

Vehicle registration charges could be used to promote smaller, lighter cars and discourage the unnecessary (and costly) shift to urban SUVs. This can also save consumers money and improve the trade balance, as SUVs cost more than passenger vehicles and use more resources and fuel.

The move to SUVs can offset fuel efficiency improvement and even increase emissions, even when vehicle drivetrain technology is becoming more efficient. Indonesia does not currently appear to have registration charges that encourage lighter, smaller vehicles. These charges could be updated to promote BEVs (especially smaller, lighter BEVs). In addition, fuel efficiency standards could be designed to encourage smaller, lighter cars.[8]

Recommendation 14

As lighter, more compact vehicles have inherently lower emissions and are also cheaper, the Government of Indonesia should consider reviewing vehicle registration charges to encourage

[8] Fuel efficiency standards use a 'limit curve' which allows larger vehicles to have somewhat higher emissions than smaller ones. Using a limit curve based on 'footprint' provides an advantage to lighter vehicles. Limit curves based on weight tend to reduce the benefits to manufacturers from supplying lighter vehicles.

lighter vehicles and vehicles with improved noxious emissions standards. Registration charges could potentially also be used to encourage smaller, lighter BEVs.

BEV emissions depend on the emissions intensity of the electricity supply, but even with a black coal-fired grid, BEVs provide a small emissions benefit over ICE alternatives. This is based on comparing equivalent EVs using standard test results. Brown coal powered EVs may not reduce emissions but may improve urban air quality and provide health benefits, depending on where the electricity generators are located.

The Australian experience is that with increasing renewables in the grid, it is useful to use an emissions factor averaged from official grid intensity projections over 10-15 years (for example). This significantly increases the emissions abatement estimates and makes them more indicative of emissions over the vehicle life. With a coal-fired grid hybrids provide similar abatement to BEVs, currently at much lower cost.

Recommendation 15

The Government of Indonesia should continue to support increased renewable energy generation to maximise the emissions reduction benefits from increased BEV take-up. When estimating the abatement available from BEVs, projected grid emissions intensities may provide more accurate results than using current values.

TRUCKING INDUSTRY

Given the variability of freight transport duty cycles, it is tough for fleet operators to predict the benefits of fuel efficiency improvements accurately. Driver training programs are a helpful approach as the driver influences approximately ±30% on fuel consumption. Other fuel consumption variables include load, load type (weight vs volume-based freight), traffic and velocity. Fuel consumption also varies based on the type of vehicle selected for the task.

In-service trials of the vehicle and operational improvements can provide fleet operators with the evidence they need to obtain funding approval to implement opportunities. Trials can also indicate when certain opportunities effectively reduce fuel consumption and when they are not effective. There may also be data from past energy audits funded by the Government that could be used to provide information on efficiency investments for the road freight industry.

Recommendation 16

The Government of Indonesia should consider improving efficiency information for the trucking industry, by, for example:

- *Supporting in service trials of different energy efficient technologies, in an Indonesian context, for different duty cycles,*
- *Publishing trial results to provide the evidence for other businesses to justify financing for energy efficiency,*
- *Supporting eco driving training.*

ENERGY AUDITS FOR TRANSPORT

Energy audits for transport have different characteristics than building or industrial audits. The influence of the driver is much larger, and operations are typically very variable. Fleet operators often lack data correlating energy consumption to the transport task, and oil price variability affects returns to energy efficiency.

As an example, Australia has a specific energy audit standard for transport fleets, AS/NZS3598.3:2014 Energy audits—Transport related activities.[9] One of the main differences between the industrial and transport standards is that the transport audit begins with an assessment of data availability to help determine the appropriate level of detail of the audit. This step reflects the different levels of energy and load data availability for different fleet operators. The standard also includes an assessment of energy management maturity to assist fleet operators to improve in this area.

Recommendation 17

The Government of Indonesia should consider adopting and applying a specific energy audit standard for transport, especially for large transport operations. In addition, for large companies, regulating the degree of detail of the energy audits could be considered, together with a longer period between audits.

LABELLING AND MINIMUM ENERGY PERFORMANCE STANDARDS (MEPS) FOR TRUCK AND CAR TYRES

The use of tyres will affect energy consumption for both ICE vehicles and EVs. Efficiency labelling and MEPS for tyres can reduce the energy consumption of existing vehicles and new vehicles. This reduces fuel costs for consumers, and tyres may last longer. The US and EU have tyre standards that could be considered for inclusion in labelling and/or MEPS. Labelling is an excellent option even if MEPS are not feasible, given that labels could provide an estimate of fuel cost savings to better inform consumers.

Recommendation 18

To reduce the emissions of all road vehicles at a low cost, the Government of Indonesia should consider developing labelling and MEPS for car and truck tyres, using European and US labelling standards as a guide.

SPEED LIMITS FOR TRUCKS ON HIGHWAYS

Trucks are not very aerodynamic and require a lot of energy to travel at high speeds, due to their higher aerodynamic drag coefficient when compared to cars. Energy consumption due to aerodynamic resistance is proportional to the square of the velocity, so lowering the speed brings a larger proportionate improvement in energy performance. One way to reduce emissions from trucks while improving safety is to have lower highway speed limits for trucks. For example, in Australia, the general highway limit is 110km/hr, while large trucks have a limit of 100 km/hr. There may be significant safety benefits and possibly road maintenance benefits from moderating truck speeds. There are productivity implications from reduced speed, so this should be considered.

[9] Available from https://store.standards.org.au/product/as-nzs-3598-3-2014

Recommendation 19

To reduce the emissions of large long-distance trucking at low cost, the Government of Indonesia should consider setting a lower speed limit for trucks, compared to cars, on highways. For example, trucks might have a speed limit 10km/hr lower than cars.

BUILDINGS SECTOR

In 2020, the commercial and residential sector accounted for 21.7% (15.9% in 2010) of the total final energy consumption of 898 MBOE (710 MBOE in 2010) in Indonesia, with the share of each sub-sectors being: commercial 41.8 MBOE (41.3 MBOE in 2010), and residential 153.7 MBOE (81.7 MBOE in 2010). Electricity consumption of the commercial and household sector contributes around 66%[10] of electricity consumption, and coal's share in Indonesia's power generation energy mix is about 64%[11]. Consequently, there are about 42% of electricity consumption of commercial and household sectors from coal-fired power plants. Hence, improving energy efficiency and conservation of commercial and residential buildings is one of the essential issues to cut CO_2.

Seven buildings sector recommendations were developed in the PREE Review in Indonesia in 2011. All recommendations, but 37, were adopted, and the corresponding regulations have been issued and enforced, shown in Table 1.

Table 1 – Buildings sector recommendations from PREE Indonesia in 2011

Recommendation number/descriptions	Existing conditions
Recommendation 32 & 35 The MEMR should play a more active role in energy conservation and energy efficiency improvement in the commercial and residential sectors, as the role of the Ministry of Public Works seems limited.	Set up the draft SNI for buildings and encourage building owners to apply the ISO:50001 for buildings;
Recommendation 34 *Emphasise energy management of large-scale public and government buildings.*	Energy conservation obligations for government buildings
Recommendation 33 Develop energy building codes and building EE&C regulations for commercial building, including regulatory compliance and enforcement processes	Green building regulation and standard had been issued by the Ministry of Public Works (Ministry of Public Works Regulation No. 2/2015); Developing and campaigning Net Zero Energy Building (NZEB) and smart metering for buildings
Recommendation 36 Enhance the foundation of EE&C in the building sector, including energy data collection and analysis, and energy-saving potential study, et cetera.	Preparing the data collection in the Revision of Gov. Reg. No. 70/2009 on Energy Conservation regarding the mandatory building 500 TOE

[10] MEMR (2020). Handbook of Energy & Economic Statistics of Indonesia, 2020.

[11] See: https://climatetracker.org/energy-mix-for-electricity-generation-in-indonesia/

Recommendation 38 Improve the EE&C awareness of the public, encourage the behaviour of energy saving through displays at shopping malls, schools and handing out pamphlets at public gatherings or places.	Conduct seminar/workshop and public advertisement through printed and electronic media, and dissemination of brochure on energy efficiency; Conduct economy-wide Energy Awards for the building sector. Energy Conservation Goes to Campuses introduces job opportunities for energy auditors and energy management.

Source: APERC (2012)

BUILDING CODES AND ENERGY PERFORMANCE CERTIFICATES

In addition to the implementation of recommendations from the 2011 Indonesia PREE, recommendation 37 is considered still valid in the current situation and is highlighted here once more.

> **Recommendation 20** (previously recommendation 37 from 2011 PREE)
>
> *The Government of Indonesia should consider developing building EE&C regulations or building energy codes for residential buildings, based on life cycle cost-effective energy-efficient measures. Enhance the implementation of these regulations.*

Similar observations can be found in an IEA report[12]. It mentioned that "Building codes in Indonesia only cover large commercial buildings. The lack of similar measures in residential buildings and combination with lower appliance ownership limits the coverage in buildings to 5%."

It is also recommended to develop a mandatory energy performance certificate (EPC) system for all building and apartment owners. The EPC can provide a valuable reference for public or private programs promoting energy-efficient buildings, such as tax incentives or rebates. All building and apartment owners, both new and existing, must be labelled when they are sold, like in the European Union. It can be extended to the rental market. For public buildings, the label must be displayed in view of the public.

> **Recommendation 21**
>
> *The Government of Indonesia should consider developing a mandatory energy performance certificate (EPC) system for all building and apartment owners.*

ONLINE BENCHMARKING

It may be beneficial for the usage of the Energy Management Online Reporting (POME) to be extended to all building and apartment owners. A predictive online benchmarking tool for the building sector could then be developed. Further extension focuses on Energy Management Internet of Things (IoT) Reporting system for building's smart devices.

The online benchmarking tool can predict energy savings which can provide more reliable information to the energy efficiency fund managers in the project conducted by ESCO's. An example can be found in the

[12]E4 Profile: Energy Efficiency Indonesia, 9 February 2021
https://www.iea.org/articles/e4-country-profile-energy-efficiency-indonesia

City of New York (2014)[13]. It may help standardise energy efficiency loan products and alleviate the information asymmetry of energy efficiency potential.

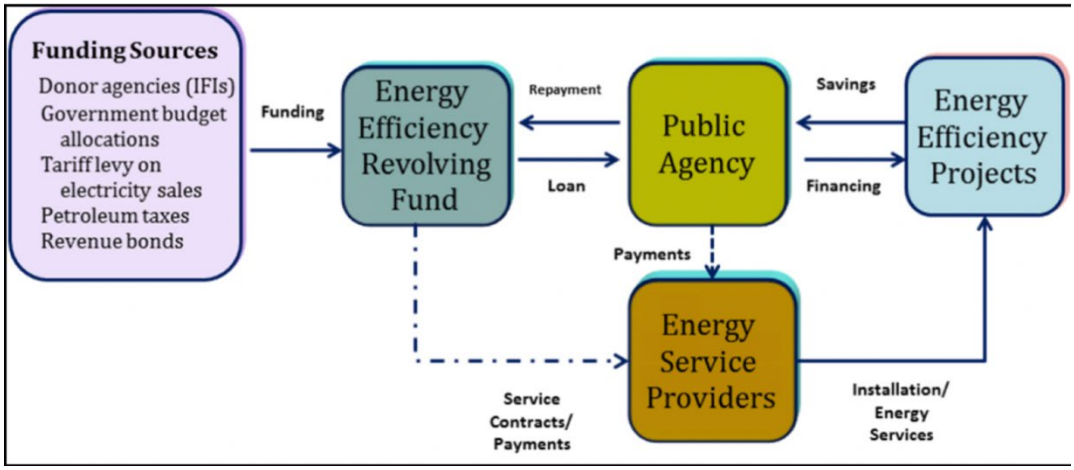
Recommendation 22

The Government of Indonesia should consider developing a predictive online benchmarking system for all building and apartment owners.

THE ENERGY EFFICIENCY REVOLVING FUND

The critical barriers to energy efficiency finance in Indonesia's building sector are summarised below. These barriers discussed in APEC-EWG (2017)[14] still exist. For financial institutions, the main barrier is the availability of funds and lack of capital in the energy efficiency (EE) project markets. For ESCO's, the main barrier is that it is difficult to show that the EE projects are profitable with low risk. For commercial building owners, the main barriers are low internal rates of return of EE projects (less than 20%) and lack of reference EE projects from ESCO's.

Figure 1-1 – EERF structure



Source: Limaye et al. (2014)[12]

The Energy Efficiency Revolving Fund (EERF) is used to finance energy efficiency loans that are repaid to a dedicated entity, like a public agency for public buildings, utility companies for household buildings, or financial institutions for commercial buildings. This dedicated entity collects and re-invests the funds in new energy efficiency projects conducted by ESCO's or similar professional service providers. For reducing administrative costs, it is suggested that the EERF provides capital at no cost to Indonesian banks, which are required to provide low-interest loans to ESCO projects with maximum loan terms of several years. The Fund can be financed by a tariff levy on electricity sales, like 0.1% of the current tariff. One of the

[13] City of New York. 2014. New York City Local Law 84 Benchmarking Report. http://www.nyc.gov/html/planyc/downloads/pdf/publications/2014_nyc_ll84_benchmarking_report.pdf.

[14] APEC-EWG (2017). Energy Efficiency Finance in Indonesia: Current State, Barriers and Potential Next Steps. Asia-Pacific Economic Cooperation, Energy Working Group. EWG 14 2016A. <https://www.apec.org/docs/default-source/Publications/2017/10/Energy-Efficiency-Finance-in-Indonesia-Current-State-Barriers-and-Potential-Next-Steps/217_EWG_APEC_Format_Incubator_EEFMapping_Indonesia_Report.pdf>

examples can be found in Limaye et al. (2014)[15], in which the revolving fund for the public buildings has been discussed, and the typical structure of the EERF is given in the Figure 1-1.

It has been pointed out that the Indonesian government needs a strategic funding scheme to catalyse the energy efficiency market.[16] This Fund can stimulate investments in large-scale energy efficiency projects by increasing the availability of debt financing while minimising the borrowing costs to project developers. As shown in Figure 1-1, funding sources can come from other arrangements. If necessary, a combination of different sustainable funding sources can be employed.

Recommendation 23

The Government of Indonesia should consider establishing the Energy Efficiency Revolving Fund (EERF) financed by sustainable sources, such as a tariff levy on electricity sales to inefficient buildings.

ENERGY AND CARBON TAX

Instead of tax credits for efficient materials and equipment, it is recommended to set up energy and carbon taxes to internalise the negative externalities of energy consumption in the final prices of goods and services. Customers are encouraged to reduce their energy consumption but left free to choose the means to do so. Returns from energy taxes can also be used for energy efficiency improvements and the funding source of EERF. In addition, the energy labels can be used to classify inefficient equipment. Enough commitment by the Government should be given to convince investors that the tax (or tax exemption) will exist for a long period.

Recommendation 24

The Government of Indonesia should consider the imposition of energy and carbon taxes on inefficient equipment, on top of VAT.

ON-BILL REPAYMENT

Utility companies are required to use on-bill repayment (OBR) to allow EE&C investments to be repaid as a line item on a customer's regular bill. Effective EE&C projects may take 5-10 years to pay back. It can ease barriers to the sale and lease of efficient buildings and apartments. By OBR, the new owner can take over the payments of the projects and will also receive the benefits of the lower utility costs.

OBR is a financing option in which a utility company supplies initial investment to a customer to fund energy efficiency projects and is repaid through regular payments on an existing utility bill. The advantages of OBR include low-interest rates, a simple contract structure, and streamlined repayment.

Recommendation 25

[15] Limaye, D., Singh, J., & Hofer, K. (2014). Establishing and Operationalizing an Energy Efficiency Revolving Fund: Scaling Up Energy Efficiency in Buildings in the Western Balkans.

[16] Setyawan, D. (2014). Formulating revolving fund scheme to support energy efficiency projects in Indonesia. *Energy Procedia*, *47*, 37-46.

The Government of Indonesia should consider establishing OBR with utility companies for conducting EE&C projects and allowing a longer payback period.

APPLIANCES

COOLING ACTION PLAN

Cooling efficiency has always been seen as one of the top priorities for energy efficiency improvement of household appliances, commercial and industrial equipment/systems/processes, and transportation (such as cold chain transportation, vehicle AC). Cooling efficiency is currently receiving worldwide attention with the enactment of the Kigali Amendment in which the low GWP refrigerant is emphasised. In this context, more and more economies have developed and released their cooling action plan including Rwanda, China, India, and multiple others, in which green and efficient cooling technologies, appliances and equipment are highly encouraged to be developed and deployed in almost all areas of buildings, traffic, industry, and so on. As a typical tropical economy, Indonesia has enormous energy consumption in cooling. The cooling energy consumption will increase rapidly with economic development. Indonesia has already ratified the Kigali Amendment. Therefore, developing an economy-wide cooling action plan in Indonesia is highly recommended.

Recommendation 26

The Government of Indonesia should consider conducting research on developing an economy-wide cooling action plan to promote the development and deployment of green and efficient cooling technologies and products in almost all areas. Different mechanisms and measures of policies, regulations, standards, technologies, engineering applications, markets and industries, finance, and so on, could be designed to improve cooling efficiency by promoting the deployment of green efficient cooling appliances, equipment, and technology.

MEPS SYSTEM

The current MEPS system in Indonesia only covers a subset of household appliances. The MEPS have not yet been applied to commercial and industrial equipment. The MEPS system in Indonesia would be more impactful if product coverage and energy efficiency requirement was expanded, especially given the rapidly growing economy and the accompanying increase in energy consumption. It is noted that the MEPS roadmap to 2023 mainly focuses on the revision and development of household appliances. Still, the international experiences show that the commercial and industrial equipment will account for more energy consumption with industrialisation and economic growth. The Indonesia MEPS roadmap indicates that MEPS for commercial and industrial equipment of chillers, electric motors, boilers and transformers will be developed in 2023. It would be beneficial to bring this forward. Also, MEPS for electronics and intelligence should be developed considering that we are now in a digitised and re-electrification era.

When it comes to the energy saving in commercial and industrial sectors, in most cases, the energy efficiency of the individual equipment is important but is not the most important. System optimisation is more important than the individual equipment optimisation, and so system optimisation in the industrial/commercial scenarios should occur alongside energy efficiency improvements of individual

equipment. Industrial or commercial energy system optimisation could be done along with Industry 4.0 by using the IoT or other digital or information technology.

Recommendation 27

The Government of Indonesia should consider conducting research to improve its MEPS system, particularly from the perspective of industrial and commercial equipment.

- *For commercial equipment, MEPS for commercial cooling equipment, including refrigerated display cabinets, chillers, cold storages, and commercial AC systems should be developed as a priority.*
- *For industrial equipment, MEPS for the typical industrial equipment such as electric motors, industrial pumps, and fans, should be prioritised because they are usually the main energy-using equipment in plants.*
- *For electronic and intelligent products/systems, such as computers, data centres, et cetera, which are widely used in different applications of household, commercial and industrial areas and are consuming more and more energy with the development of digitalisation and informatisation.*
- *System opitimisation in terms of energy efficiency should be considered alongside energy efficiency performance of individual pieces of equipment.*

OPTIMAL OPERATIONAL EFFICIENCY

The MEPS only regulate the rated energy efficiency of appliances and equipment for households, and commercial and industrial applications. In most cases, the energy-using equipment operates with the actual efficiency at the off-design condition rather than the rated efficiency at the design condition. With the accumulation of best practices, the efficient actual operation mode of the equipment could be developed and disseminated in the form of standards to enable the appliances and equipment to run in optimal operation mode to reach optimal actual efficiency.

There are existing energy assessment standards for common industrial systems that could provide a useful reference. These include ISO/ASME 14414:2019 Pump system energy assessment; ISO11011:2013 Compressed Air – Energy efficiency assessment; ASME EA-1-2009 Energy Assessment for Process Heating Systems; and ASME EA-3-2009 Energy Assessment for Steam Systems.

Recommendation 28

The Government of Indonesia should consider conducting research on the development of standards for the efficient operation of energy-using equipment, which accounts for actual energy efficiency under operational conditions and takes full use of the energy saving potential of the efficient appliances/equipment rated by MEPS.

LABELS FOR APPLIANCES AND EQUIPMENT

International practices prove that the energy labels are indispensable and crucial to the effective implementation of MEPS. We are now in an intelligent era. It is becoming an international trend to introduce QR codes to the energy label as in the major economies such as the EU and China. QR codes

can help consumers, market supervisors, and test labs, to identify efficient products and get much more information from the growing database behind the QR code.

Alongside benefits of energy labels, there is a trend for the major economies around the world to research and develop carbon labels in the context of coping with climate change.

Recommendation 29

The Government of Indonesia should consider conducting research on introducing QR codes to the traditional energy label and on the possibility of developing carbon labels.

ENERGY MANAGEMENT SYSTEM (EMS) AND STANDARDS

International practices prove that EMSs are very helpful for users to improve their energy performance. But it is difficult for many small and medium-sized companies to build up the complete EMS all at once, considering their limited resources. In many cases, a comprehensive and large EMS might be overqualified and less cost-effective for a small company even though the EMS is regarded as beneficial for them in the long-term perspective.

There may also be potential for Indonesian businesses to make use of *ISO50009:2021 Energy Management Systems – Guidance for implementing a common EMS in multiple organisations*. This may be applicable, for example, to businesses in a city district, form part of the same supply chain or form part of a wider business group.

Recommendation 30

The Government of Indonesia should consider conducting research on the development of EMS standards, particularly for small companies, to rapidly build up a cost-effective EMS. ISO/TC301 has developed and released the international standard of ISO 50005:2021 Energy management systems — Guidelines for a phased implementation. This standard is developed to establish a phased approach to implement an EMS. This phased approach is intended to support and simplify the implementation of an EMS for all types of organisations, including small and medium-sized organisations (SMOs), which might be helpful if Indonesia carried out the suggested research.

Recommendation 31

The Government of Indonesia should ensure that the lead agency stays abreast of the latest international developments in existing appliance standards (air conditioning, refrigerators, et cetera) and future standards (lighting, fans, washing machines, et cetera) for these technologies. This will ensure that these standards are international state-of-the-art.

ELECTRICITY

ELECTRICITY EFFICIENCY GOALS AND STANDARDS

PLN as a utility should not have any responsibility for setting efficiency standards and goals. Its primary objectives revolve around providing electricity to much of Indonesia and obtaining an economic benefit from those sales. The responsibility for developing and ensuring efficiency codes, goals, and standards should be the economy-wide governmental agency.

Recommendation 32

The MEMR should prepare and set the electricity sector's efficiency codes, goals, and standards, not PLN as a utility or system operator.

POWER PLANT EFFICIENCY

While some improvements to coal-fired power plants may be reasonable, the energy efficiency benefit is outweighed by the costs that could be better utilised for other energy efficiency projects. Efficiencies of older coal-fired power plants are generally in the area of 30%. Even improved systems, such as fluidised bed combustors, do not get too far beyond 40%. Funding is better invested in developing renewable resources for electricity production and the eventual retirement of older inefficient fossil-fired systems. However, there are still benefits in policies to help ensure that the older, less efficient plants are operated and maintained efficiently. Improvements to auxiliary systems, such as variable speed drives for cooling water and boiler feedwater pumps may have relatively short paybacks, especially where plants are operating at part load.

Recommendation 33

The MEMR should consider allocating greater proportion of time and funds to developing renewable resources for electricity production rather than increasing the efficiency of existing coal-fired power plants. Policies aimed at maintaining efficiency of older fossil fuel plants may also provide reasonably short paybacks, within the remaining plant life.

INSTITUTIONAL FRAMEWORK AND OTHER CROSS-SECTORAL ISSUES

GOVERNMENT AGENCY ON ENERGY EFFICIENCY

Planning for energy efficiency in Indonesia would benefit if there was one governmental institution that dealt with energy and energy efficiency. There seems to be possible confusion about the current roles of MEMR and the Ministry of the Environment. Other governmental organisations with roles in energy, such as BAPPENAS, are not integrated with energy issues in an optimal manner.

The lack of clarity also extends to certifying energy efficiency progress. An overarching regulatory, governmental body for developing standards and regulations for energy use would be beneficial. This will allow the government to focus its resources on developing appliances, building codes, and other energy use standards that will cut across all aspects of the economy and society. An overarching body would also ensure consistency and verifiability in analytical results that underpin energy efficiency policy. The following three recommendations should be read in the context of ensuring responsibility of Indonesia energy issues falls under the umbrella of one institution.

Recommendation 34

The Government of Indonesia should consider appointing or establishing one governmental institution that can deal with, and be responsible for, energy and energy efficiency.

Recommendation 35

The Government of Indonesia should consider nominating an existing body as the one governmental institution responsible for the energy efficiency certification process, with responsibility for also developing energy efficiency standards and regulations. If no existing bodies have the required capabilities, a new body could be established for this purpose.

Recommendation 36

The Government of Indonesia should consider appointing or establishing one governmental institution responsible for primary standards, chain-of-custody, and replication of results to ensure that any data are valid. An economy-wide testing and standardisation laboratory would provide the proper analytical methods and testing materials that can serve as the standards for any analyses done by others in ensuring energy efficiency data.

TRAINING, EDUCATION, AND PUBLIC AWARENESS

The government and other organisations should be complimented on the training efforts that are occurring in Indonesia. This is critical for the proper implementation of standards and codes and the proper overview of how the economy is becoming more energy efficient.

Indonesia is already doing a good job on training auditors and energy managers. Indonesia should work to expand these training and educational activities wherever possible. It will be important for the government to work with universities to ensure that there is a sufficient body of knowledge being transmitted. There should also be mechanisms for maintaining awareness of the latest development within energy efficiency technology and measurements.

Recommendation 37

The Government of Indonesia should consider expanding energy efficiency training and education, including for auditors and energy managers, by involving universities. Universities should develop programs and courses in energy systems technology and analysis. There should be a focus on renewable energy systems and end-use energy efficient technologies

Recommendation 38

The Government of Indonesia should consider developing programs for training appropriate and responsible managers and staff in governmental agencies. Frequently, government agencies can serve as roadblocks, because the staff and management within these agencies do not understand the technologies or the evaluation processes for energy technologies – in this case, energy efficiency.

This concept could include having a critical mass of engineering qualifications within Government, to support in depth understanding, provide independent technical advice, and ensure the government understands technical advice provided by contractors.

Recommendation 39

The Government of Indonesia should consider developing a public awareness program concerning climate change as a model for highlighting the need for sustainable practices among the broader population. Part of the public educational program in this area can focus on best practices in energy efficiency.

ECONOMY-WIDE GOALS

Indonesia has set reasonable, but not "stretch" goals for improving energy efficiency. Moreover, some of the goals that have been achieved in 2020 may be more due to the impact of COVID-19 than an improvement in overall economy due to energy efficiency.

Recommendation 40

The Government of Indonesia should consider setting a "stretch" energy efficiency goal of 2% per year, starting in 2023 and extending through 2030. This allows for sufficient time for the preparation of the economy, metrics to be employed, and enticements for meeting such a stretch goal.

BACKGROUND

INTRODUCTION

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

Indonesia has 34 provinces spread over five main islands and four archipelagos: Sumatera Island, Riau Archipelago, Bangka Belitung Archipelago, Jawa Island, Nusa Tenggara Archipelago, Kalimantan Island, Sulawesi Island, Maluku Archipelago and Papua Island. As an archipelagic economy, Indonesia consists of thousands of islands interconnected by straits and seas. Currently, there are 13,466 islands that have been registered with valid coordinates on United Nations (2012), with population density of the islands shown in Figure 2-1.

Figure 2-1: Indonesia Geographical Situation and Population Density

Source: Statistics of Indonesia 2021

Indonesia is the largest economy in Southeast Asia. It has undergone robust economic growth since overcoming the Asian and global financial crisis. Indonesia is projected to become a high-income economy by 2036, with the 2020 World Bank high-income threshold at just under USD 13,000 gross national income per capita. To realise that level of prosperity, four pillars of development have been established, consisting of (i) human development and mastery of science and technology, (ii) sustainable economic development, (iii) equitable development, and (iv) strengthening economy-wide resilience and governance.

The Indonesian Government has intensified infrastructure development, including energy infrastructure. Government spending on infrastructure projects in 2019 was double the amount of spending in 2014.

Notable infrastructure developments are 3 843 km of highways, 1 298 km of toll roads, subways, monorails, 18 ports, 58 km of bridges, and 61 hydro dams. Energy demand is expected to rise due to surging economic activity and improved infrastructure connectivity.

Indonesia had a gross domestic product (GDP) of USD 3 130 billion and GDP per capita of USD 11 812 in 2020 (2018 USD purchasing power parity [PPP]), which represents an annual decline of -2.1% and -3.1%, respectively, due to the COVID-19 pandemic (World Bank, 2021). The ability to sustain economic growth will be supported by implementing structural reforms, realising demographic bonuses, technological advances, and increased economic competitiveness. Positive trends were compounding prior to the pandemic, and these trends are projected to return from 2021 onwards.

STATISTICS AND TRENDS IN ENERGY

TRENDS IN ENERGY SUPPLY

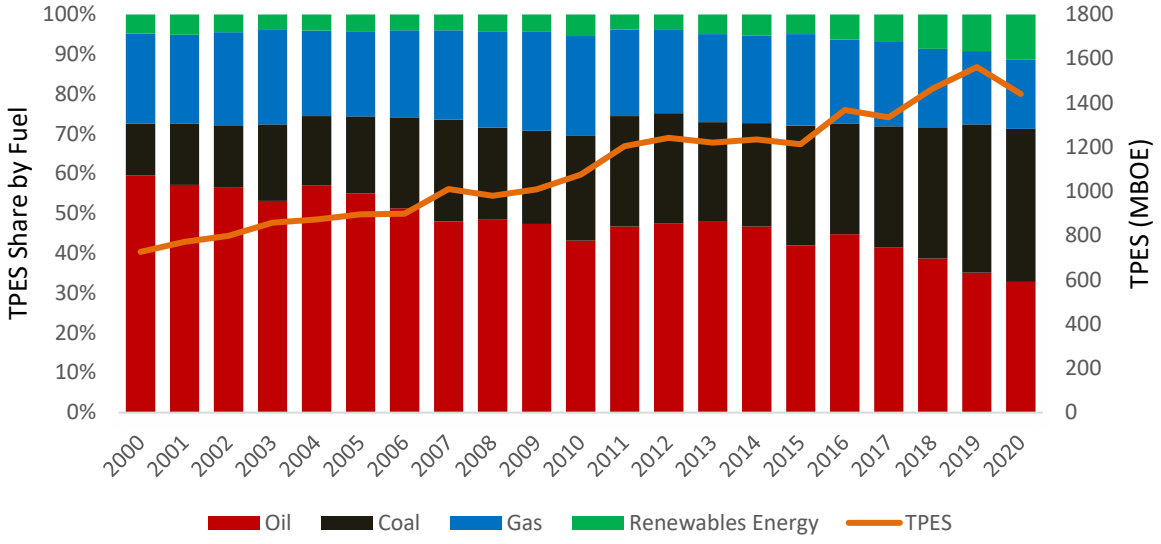
Indonesia has substantial and diverse energy resources of oil, natural gas, coal, and renewables. In 2019, Indonesia's commercial fossil energy reserves consisted of 3.8 billion barrels of oil (excluding sub commercial reserves of 3.7 billion barrels), 77.3 billion barrels of natural gas (excluding sub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

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

PRIMARY ENERGY SUPPLY

From 2000 to 2020, primary energy supply almost doubled from 727 million BOE to 1440 million BOE. Both gas and oil have been supplanted by larger shares of coal and renewables (Figure 2-2) with supply now consisting of oil 33%, coal 38%, gas 17%, and renewables 11% in 2020. Primary energy supply fell by 7.8% or 122 BOE in 2020 due to the COVID-19 pandemic and restrictions on economic activity.

Figure 2-2: Historical total primary energy supply (TPES), by fuel



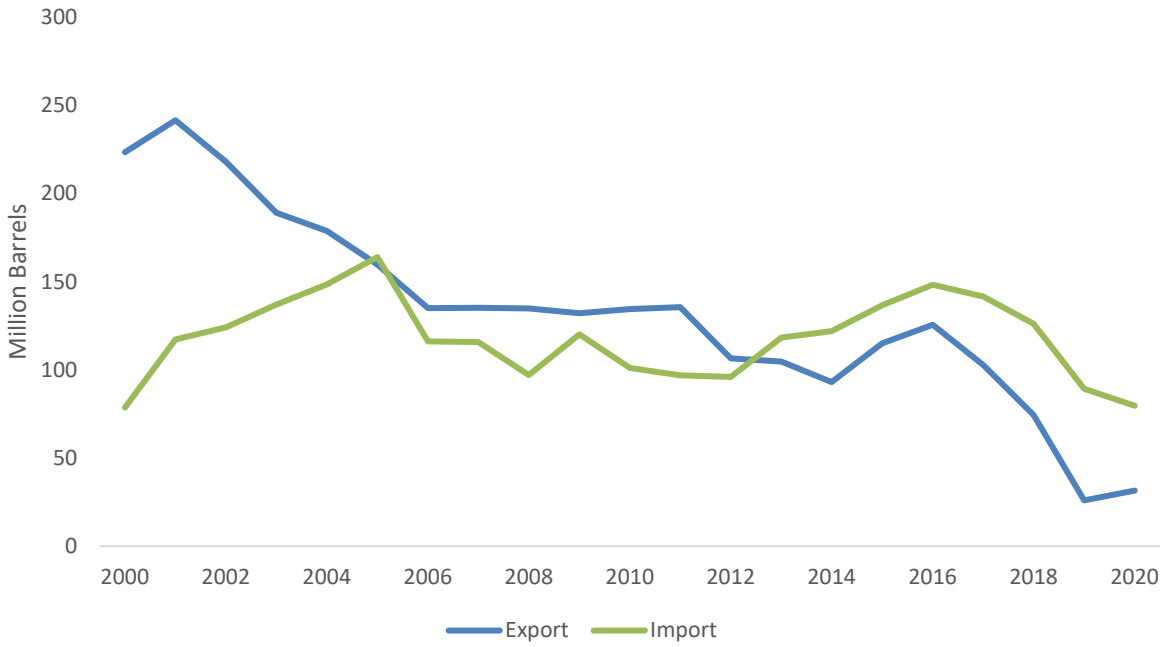
Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

In 2020, Indonesia produced crude oil (259 million barrels), natural gas (2 090 billion standard cubic feet), and coal (564 million tonnes). Indonesia is the world's largest exporter of steam coal and currently an LNG exporter. In 2020 Indonesia exported 405 million tonnes of coal, exported 31 million barrels of oil, and 507 million MMBTU of LNG.

TPES of commercial energy grew at an average rate of 3.5% from 2000 to 2020, with coal increasing most rapidly with a growth of 9.3%. The growth in coal was followed by renewable energy (8%), natural gas (2.1%), and oil (0.4%).

Indonesia's crude oil imports increased rapidly in the early-2000s, though have failed to exhibit a long-term growth trend, since then. Nevertheless, Indonesia became a net crude oil importer in 2013 (Figure 2-3). Indonesia has been attempting to reduce imports to increase energy security. Crude oil imports have been declining, moving from just under 150 million barrels in 2016 to 80 million barrels in 2020.

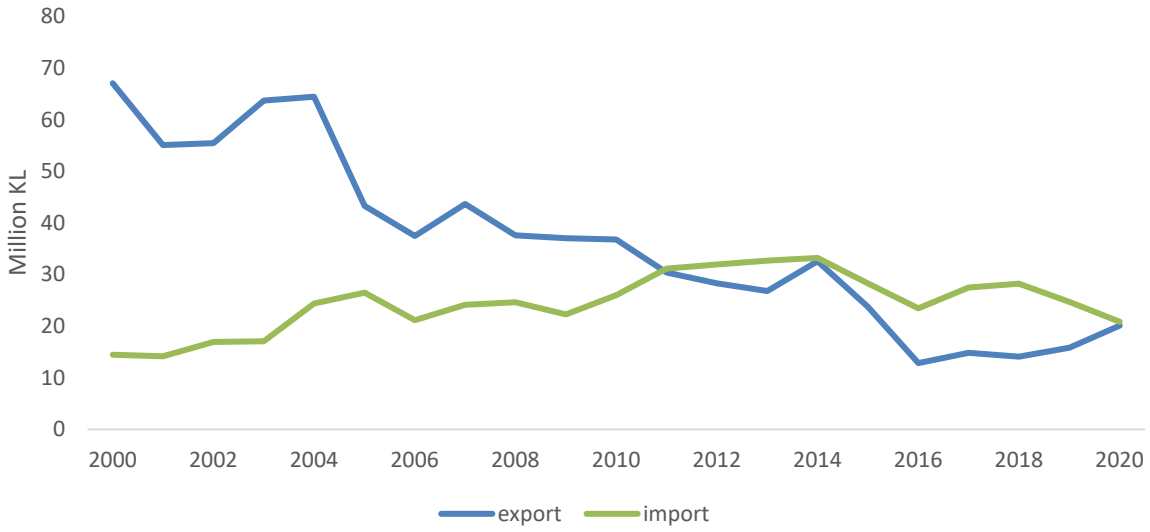
Figure 2-3: Crude oil export and import, 2000–2020



Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

Moving to refinery products, annual imports increased through to the mid-2010s (Figure 2-4), though have since moderated, and begun to decline. Refinery products imports were 21 million kiloliters in 2020, comprised of RON 88 and 90 gasoline (46%), Gasoline RON 92 (31%), and Gasoil (15%). Refinery products exports were close to import levels in 2020, at 20 million kiloliters. The highest share was Avtur (14%) in 2020.

Figure 2-4: Refinery product export and import, 2000–2020

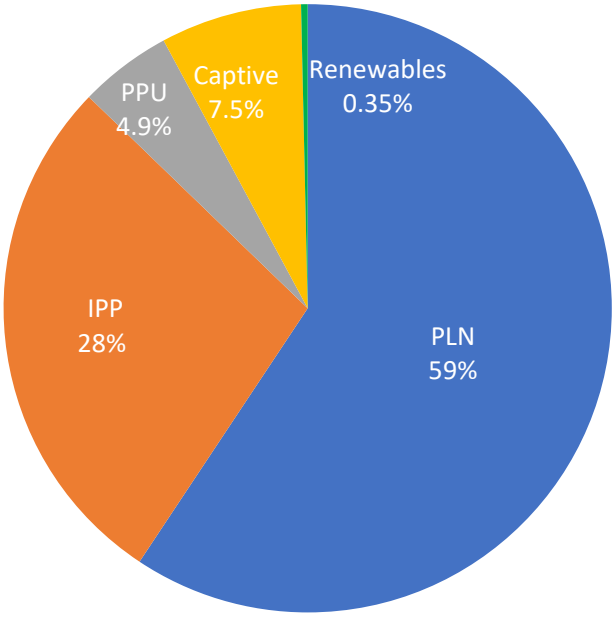


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

TRENDS IN THE POWER SECTOR

Electricity supply to the Indonesia electricity grid comes from generating capacities of the state electric company – PLN, IPPs (independent power producers), PPU (Private Power Utility) and captive power. As an integrated power market model, PLN is the single buyer of IPP power and captive power purchase. In 2020, Indonesia's total power generating capacity to the grid was 72.8 GW. PLN owns power plants with a total share of 59%, while IPPs is 28%, and PPU and Captive power own the rest (Figure 2-5).

Figure 2-5: Share of power generation capacity , 2020

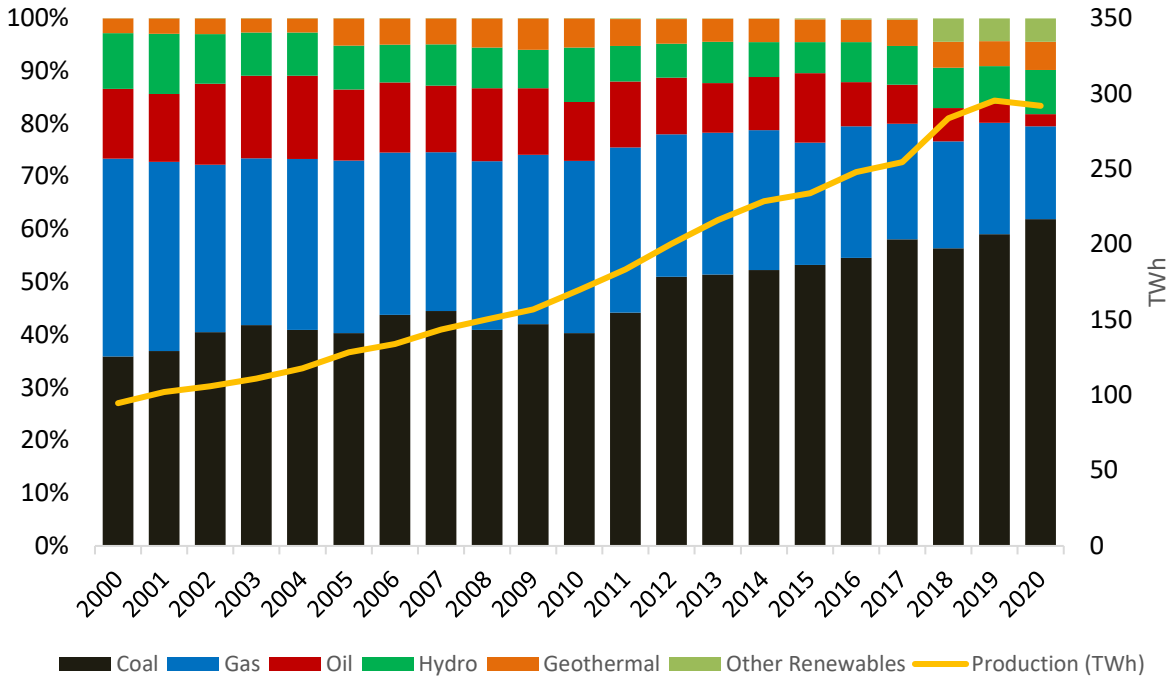


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

Notes: PLN is Indonesia's state electricity company; PPU (private power utility); IPP (independent power producer)

Electricity production in Indonesia is still very dependent on fossil fuels, with coal tracing a large rise since 2000 (Figure 2-6). In 2020, coal power generation produced 62% of the total power generation of 300 TWh, followed by Gas (18%). Oil's share is decreasing (2.3% in 2020), aligning with a shift from oil to cheaper fuels and a rise in renewable programs. The share of renewable energy is increasing, reaching 18%, including off-grid electricity production. The production of electricity from renewable energy is dominated by geothermal and hydro, which have considerable potential in Indonesia.

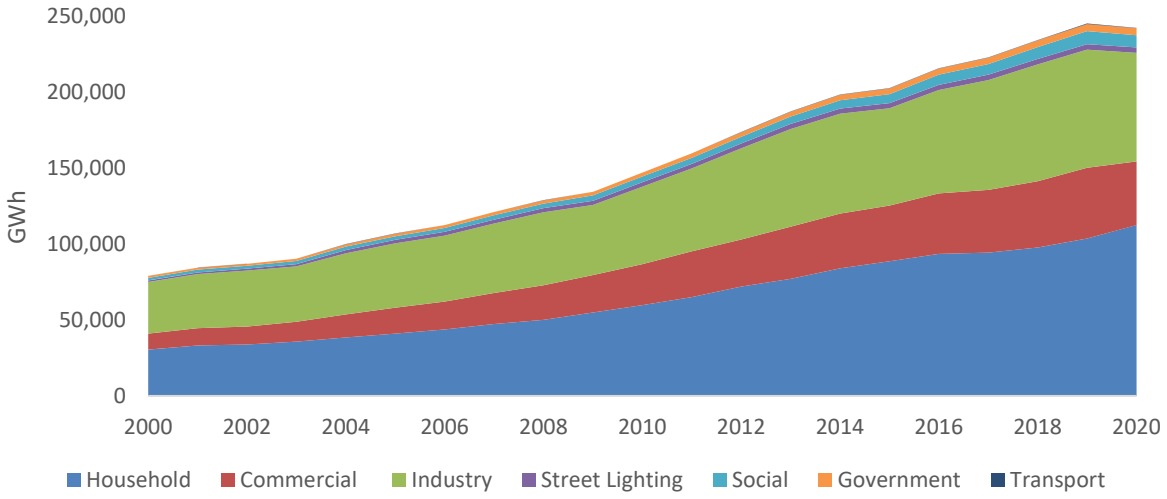
Figure 2-6: Electricity production by fuel, including off-grid generation, 2000–2020



Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

In 2020, the residential sector consumed the largest portion of electricity (46%), followed by industry (29%), and the commercial sector (17%). These shares have remained similar for the last two decades. Electricity consumption growth has reached by an average of 5.8% since 2000. The transport sector is also becoming a more prominent consumer of electricity, though is still a small consumer in comparison to the other sectors. Electricity consumption reached 243 TWh in 2020 which was a decrease of 1.2% compared to 2019 (as shown in Figure 2-7).

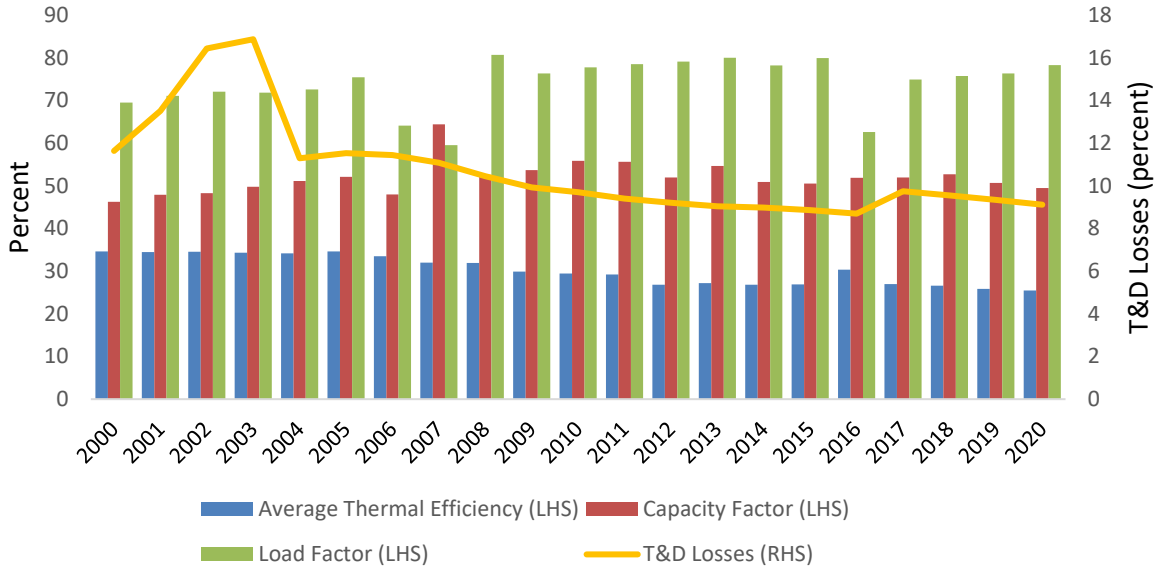
Figure 2-7: Electricity consumption by sector, 2000–2020



Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

Figure 2-8 shows the Indonesia electricity system performance trends, including thermal efficiency, capacity factor, load factor, and transmission and distribution losses. The load factor and capacity factor show an increasing trend in line with Indonesia's electricity demand. Meanwhile, thermal efficiency tends to decrease due to the operation of coal plants that utilise low calories with lower efficiency. For transmission and distribution losses, the trend tends to decrease along with network improvements and developments to improve the quality of electricity supply services. Transmission and distribution losses increased in 2018 compared to 2017, due to a change in the calculation formulation. From 2018, losses were recalculated to consider the energy used by customers with usage below the minimum hours of operation.

Figure 2-8: Electricity system performance, 2000–2020

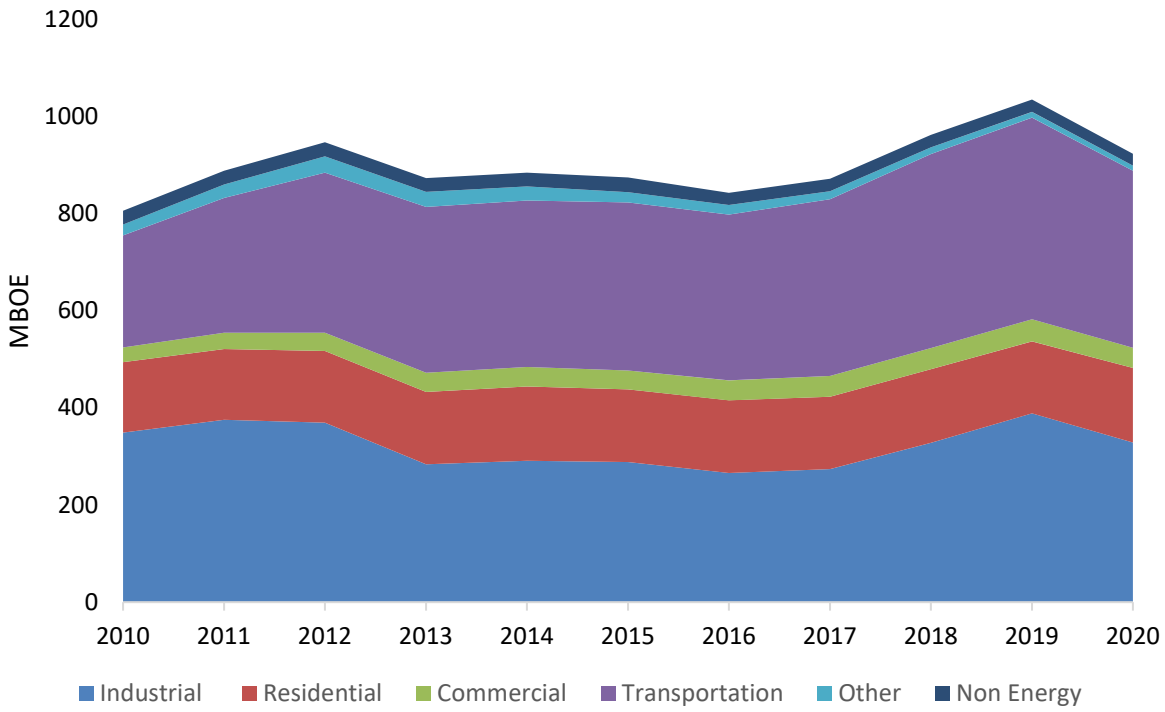


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

TRENDS IN ENERGY CONSUMPTION

Final consumption of energy (including consumption of energy products by the non-energy sector) has increased from just over 800 million BOE in 2010 to over 900 million BOE in 2020. The 11% decline in 2020 was mostly due to a decline in industry and transport consumption that resulted from the COVID-19 pandemic and was the end of 3 consecutive years of growth in consumption. In 2019, consumption peaked at almost 1 034 million barrels (shown in Figure 2-9).

Figure 2-9: Historical trend of final energy consumption by sector, 2000–2020

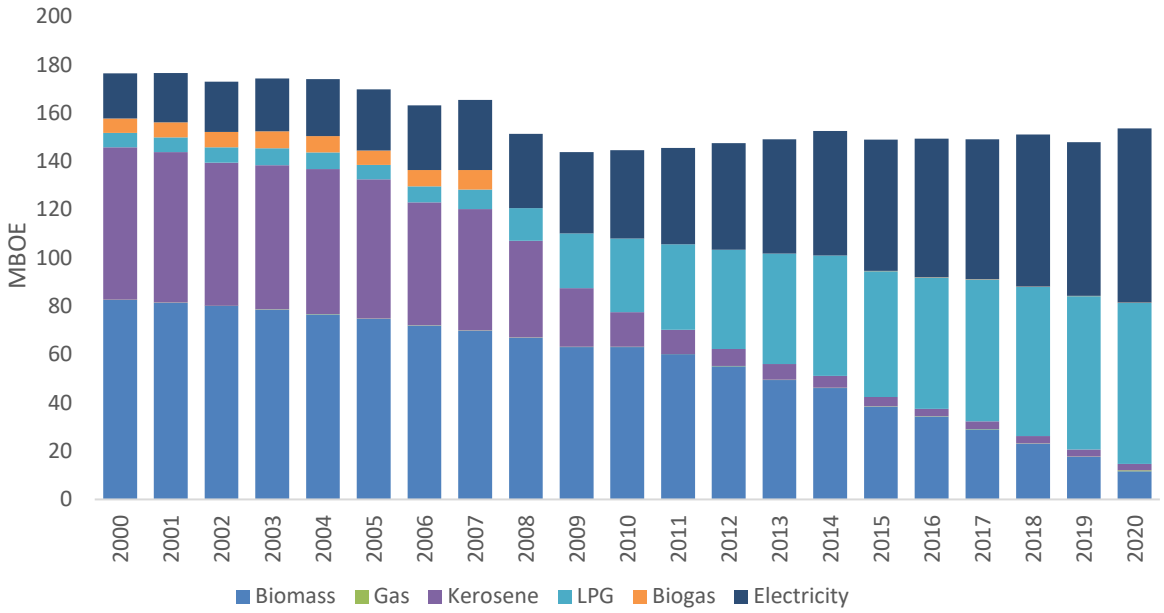


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

RESIDENTIAL SECTOR

Residential (household) sector final energy consumption has remained at similar levels for the decade prior to 2020, as shown in Figure 2-10. However, the sector has undergone significant structural change in energy consumption. Kerosene consumption declined from 63 million BOE in 2000 to less than 3 million BOE in 2020, whereas LPG consumption increased from 5.9 million BOE to more than 66 million BOE for the same period. Natural gas consumption by the residential sector has also increased to more than 72 million BOE in 2020 and is now the most prominent fuel used by Indonesian households. Biomass was the most prominent residential fuel, though has rapidly declined from 82 million BOE in 2000 to less than 12 million BOE in 2020. Natural gas and LPG accounted for more than 90% of Indonesia's residential energy consumption in 2020. The small uptick in residential energy consumption in 2020 is partly tied to the impacts of COVID-19 and greater time spent at home for many Indonesians.

Figure 2-10: Residential sector final energy consumption, 2000–2020



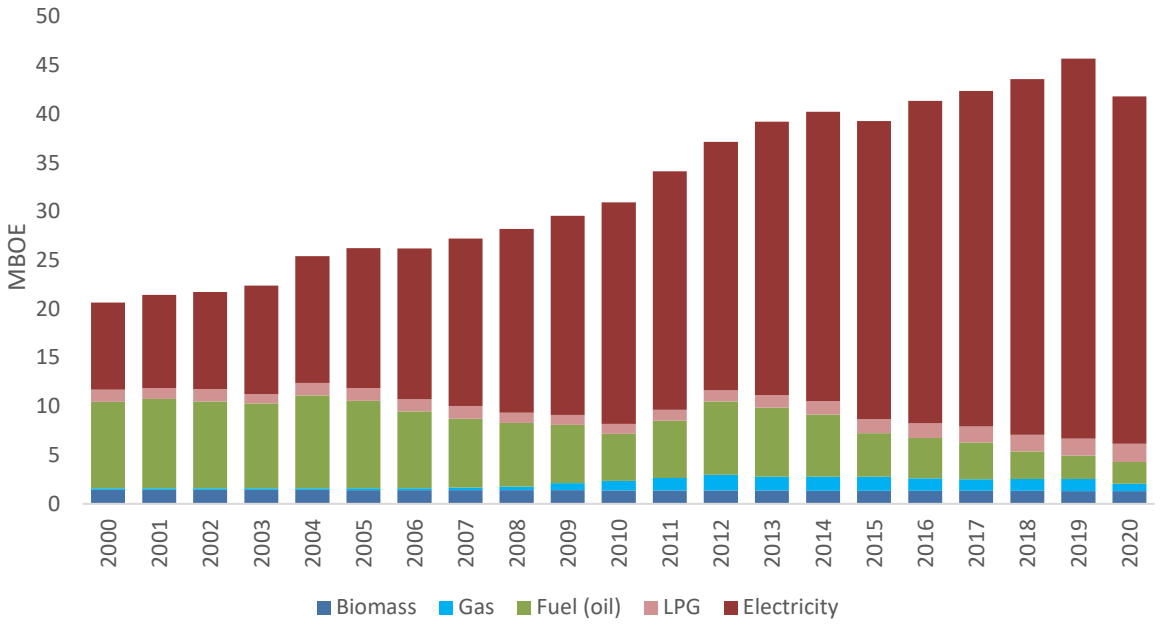
Note: Biomass based on Estimation Data. Biomass values prior to 2008 have been re-estimated to conform with a methodology change incorporated by Indonesia Statistic Agency for 2008 onwards

Source: Handbook of Energy and Economic Statistics of Indonesia 2020. APERC Analysis.

COMMERCIAL SECTOR

The commercial sector currently consumes less than a third of the energy that the residential sector consumes. However, in contrast to the residential sector's stable level of consumption, growth in commercial energy consumption has more than doubled since 2000. Electricity is the main consumption fuel, with direct consumption of non-electricity fuels less than 15% of Indonesia's commercial sector energy consumption in 2020 (as shown in Figure 2-11). Electricity has quadrupled from under 9 million BOE in 2000 to more than 36 million BOE in 2020. The 8.5% fall in commercial sector energy consumption in 2020 is associated with significantly reduced commercial activity that resulted from the COVID-19 pandemic.

Figure 2-11: Historical final energy consumption in commercial sector, 2000–2020

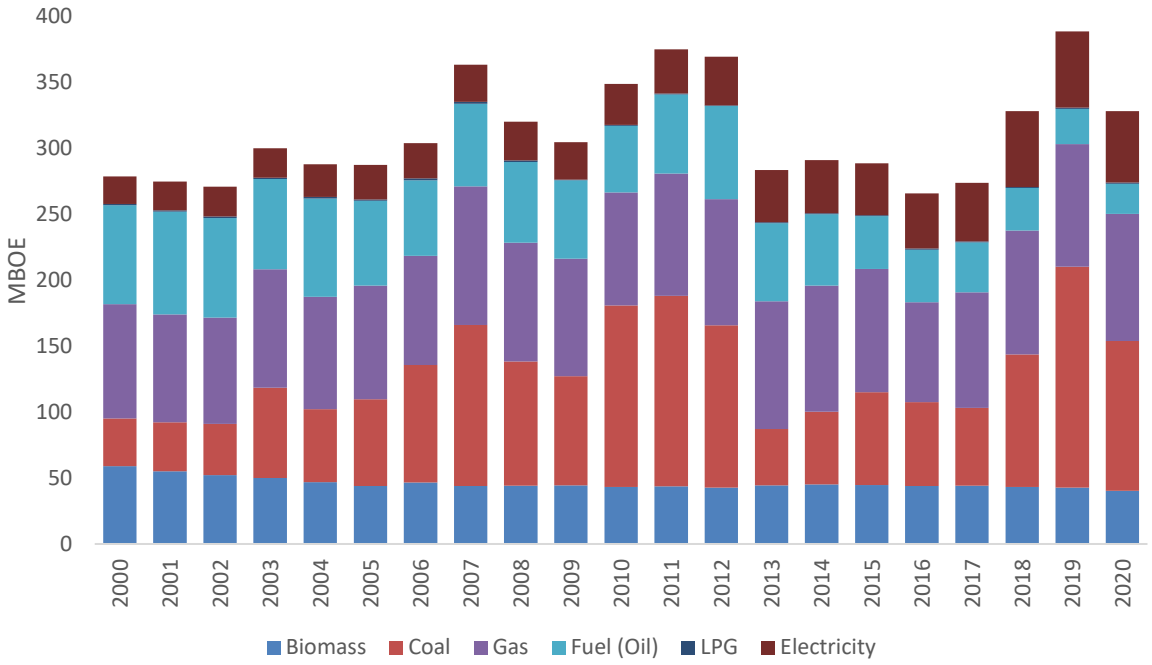


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

INDUSTRY SECTOR

Industry sector final energy consumption has been significantly more volatile than consumption by other sectors over the past two decades. There were peaks in consumption before and after the Global Financial Crisis of 2008 and 2009, and a more recent peak in 2019 before COVID-19, as evident in Figure 2-12. Coal use in industry notably increased from 36 million BOE in 2000 to more than 113 million BOE in 2020. However, it reached a much higher level of consumption of 167 million BOE in 2019. Natural gas supply to industry has been more consistent, with consumption mostly between 80 and 100 million BOE for the past two decades. Petroleum products use by industry has declined from 75 million BOE in 2000 to less than 23 million BOE in 2020. In contrast, electricity consumption had almost tripled since 2000, reaching almost 58 million BOE in 2019. In 2020, due to the COVID-19 pandemic, electricity fell to just over 54 million MBOE.

Figure 2-12: Historical final energy consumption in industry sector, 2000–2020

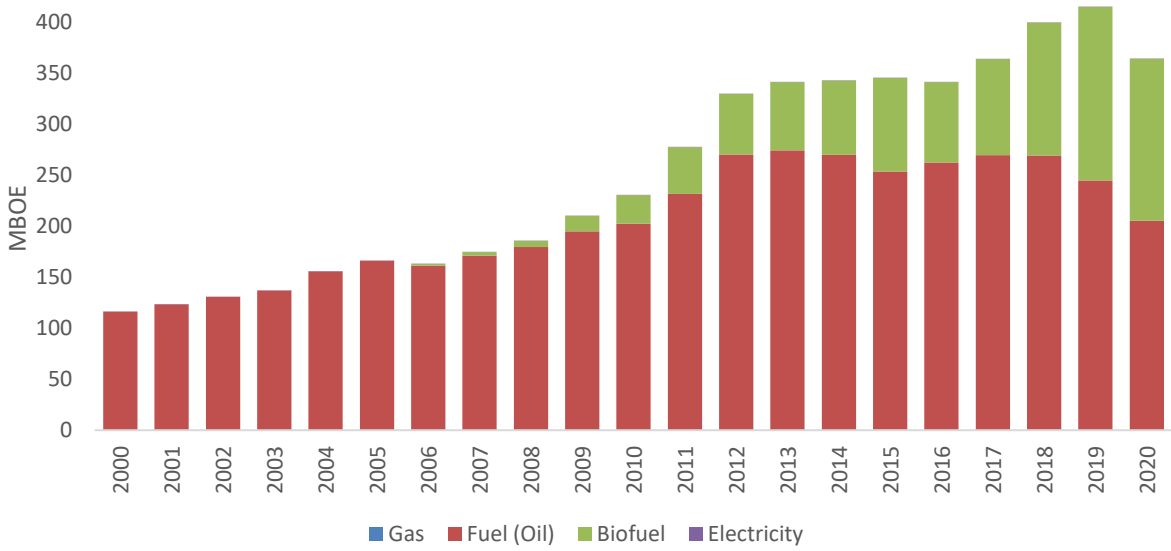


Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

TRANSPORT SECTOR

Transport sector final energy consumption has been more prominent than industry sector energy consumption since 2012. Consumption peaked in 2019, reaching almost 415 million BOE, before falling by more than 12% in 2020 due to a fall in economic activity that was caused by COVID-19 (as shown in Figure 2-13). One of the most prominent trends is the rise in biofuel since the late-2000s. The very large increase in biofuels is the result of the Indonesian government mandating that biodiesel reach a minimum blend rate of 30% by 2020. Natural gas consumption by Indonesia's transport sector is negligible, though electricity is expected to increase significantly over the next few decades, though will lag higher income economies.

Figure 2-13: Historical final energy consumption in Transport Sector, 2000–2020



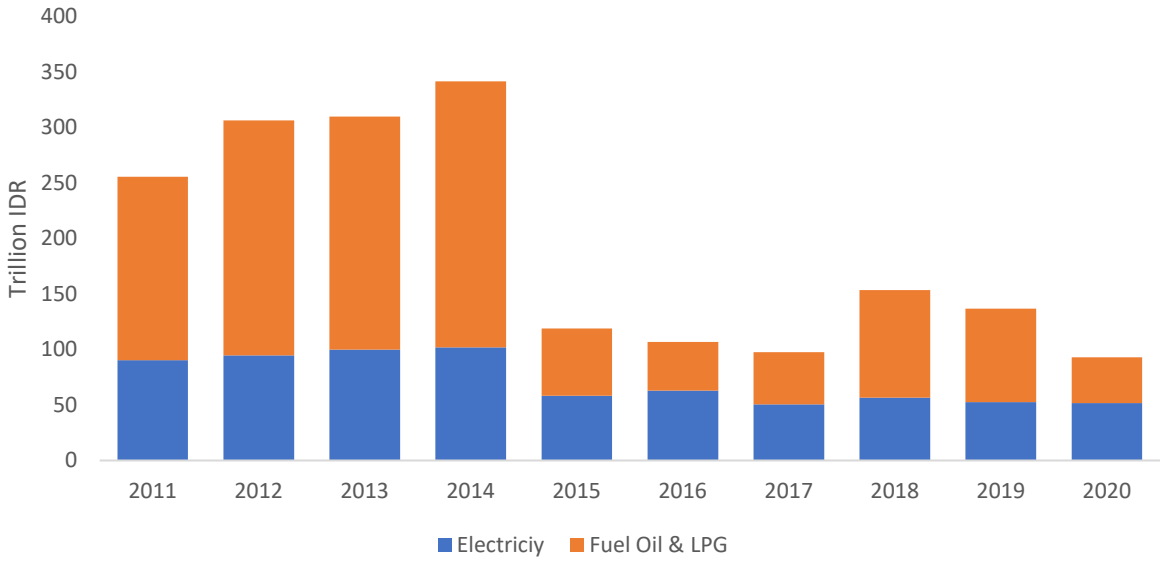
Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

OTHER INDICATORS

ENERGY SUBSIDIES

The presence of subsidy policies in Indonesia cannot be separated from the context of Indonesia as a welfare state. In a welfare state, the government is given very broad authority to intervene in the lives of its people with the aim of improving people's welfare, one form of such intervention is energy subsidies. Energy subsidies implementation has been one of the government's ways to increase purchasing power in the energy sector. Energy subsidies, including both fossil fuel and electricity subsidies, have constituted a large share of Indonesia's government expenditure. To reduce the state's financial burden, the Indonesian government has reformed the distribution of energy subsidies starting at the end of 2014 so that the 2015 subsidy budget is seen to be lower than in 2014. In 2017, electricity subsidies also underwent further reforms by removing 900 volt-ampere (VA) middle income residential customers from the list of electricity subsidy recipients. Energy subsidies historical data is shown in Figure 2-14.

Figure 2-14: Historical trend of energy subsidies, 2011–2020

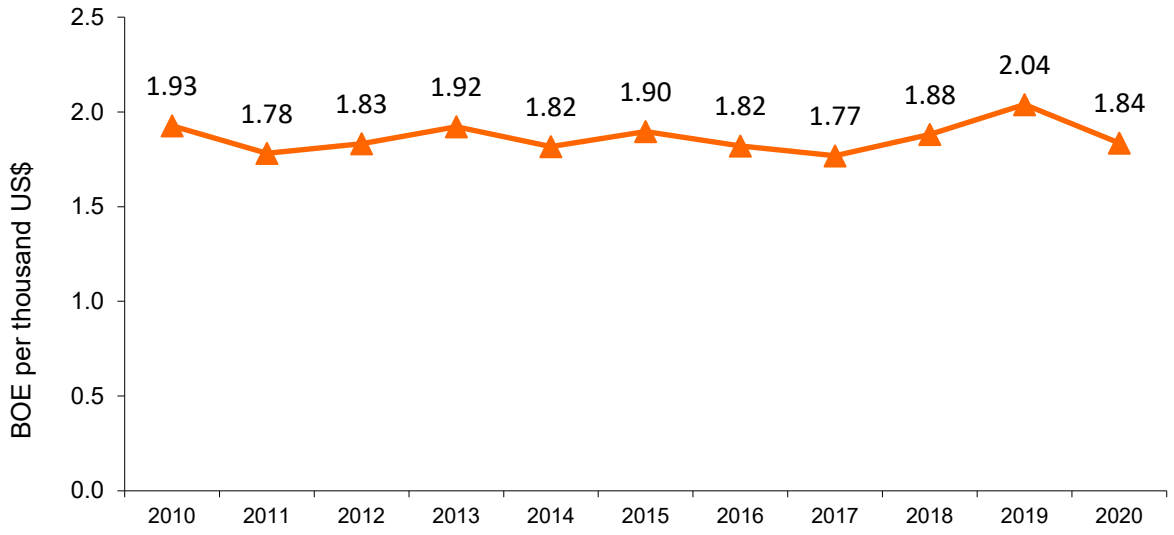


Source: Directorate of Energy Conservation, DGNREEC, MEMR
Note: IDR is Indonesia Rupiah

ENERGY INTENSITY

Efficiency of energy supply and levels of utilisation of energy in an economy can be measured by energy intensity. Primary energy intensity is the amount of the amount of energy consumption per unit of money output. Based on the historical data, primary energy intensity has maintained a plateau for the most recent decade, only slightly declining from 1.93 in 2010 to 1.84 in 2020 (as shown in Figure 2-15). Energy intensity was at its highest point of the previous decade in 2019.

Figure 2-15: Primary energy intensity, 2010–2020



Source: Handbook of Energy and Economic Statistics of Indonesia 2020.

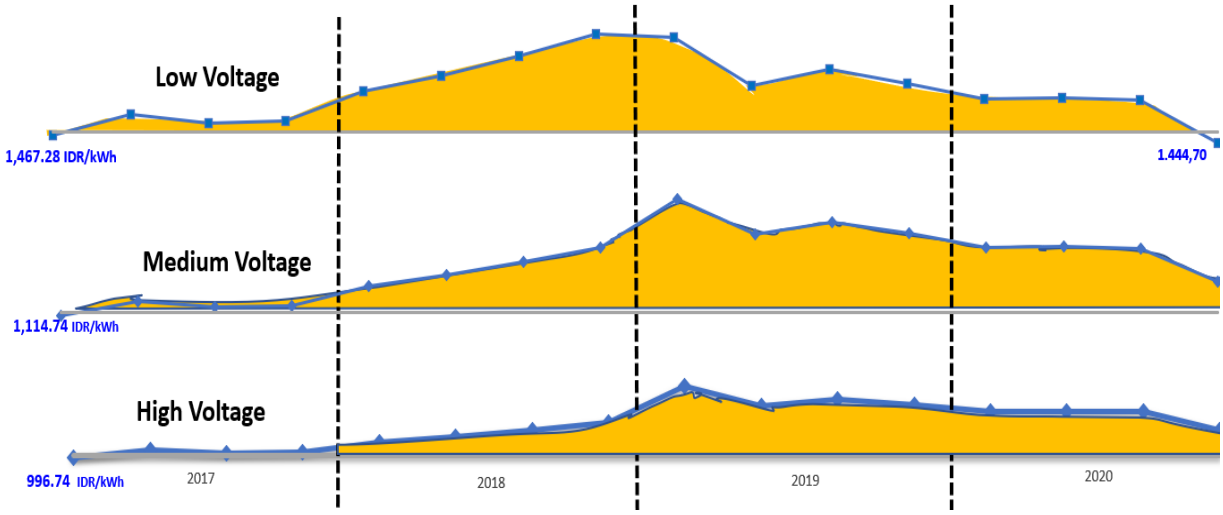
The lack of improvements in energy intensity is partly explained by the rapidly rising standard of living for people in Indonesia. Energy consumption per capita has been on an increasing trend, though fell due to the impacts of COVID-19 in 2020.

ELECTRICITY TARIFF

Currently, PLN, the largest utility in Indonesia with more than 90% share, has 38 tariff groups divided into eight categories. The categories include social, residential, business/commercial, industrial, government, traction, bulk, and special service customers with different levels of connected capacity. In addition to being distinguished by the connected capacity, these categories are also determined by their voltage levels, namely low, medium, and high voltages. Of the 38 groups, 25 of them are included in the categories that get subsidies.

Of the total annual sales, around 25% of PLN's electricity sales are allocated to subsidised customers, including residential customers of 450 VA and 900 VA with low income, including small businesses and industries. For non-subsidised customers, the tariff adjustment mechanism has been implemented for the last few years. Adjustment components are identified based on factors that affect the electricity production cost components beyond PLN's control, such as ICP (Indonesian Crude Oil Price), Exchange Rate, inflation, and coal prices. Tariff adjustment is expected to be adaptable to changes in cost components as an effort to achieve revenue requirement targets and create a healthy electricity business. Considering the people purchasing power and the competitiveness of commercial and industrial customers, since 2017, the Government has taken a policy to maintain this non-subsidised tariff even though there are tariff fluctuations. The difference between the fixed rate and the tariff according to the formula will be borne by the government through compensation given to PLN. Figure 2-16 shows the trend of non-subsidised electricity tariffs.

Figure 2-16: Non-subsidised electricity tarif, 2017–2020



Source: Directorate General of Electricity, MEMR

ENERGY PROJECTION AND PLANNING

The National Energy Policy (NEP) which is mandated by Government Regulation No. 79 of 2014 provides guidelines for formulating energy management policies to promote energy self-sufficiency and strengthen domestic energy security by making energy production equitable, sustainable, and environmentally friendly. Presidential Regulation No. 22/2017 on the General Plan of National Energy contains government policies on managing the NEP.

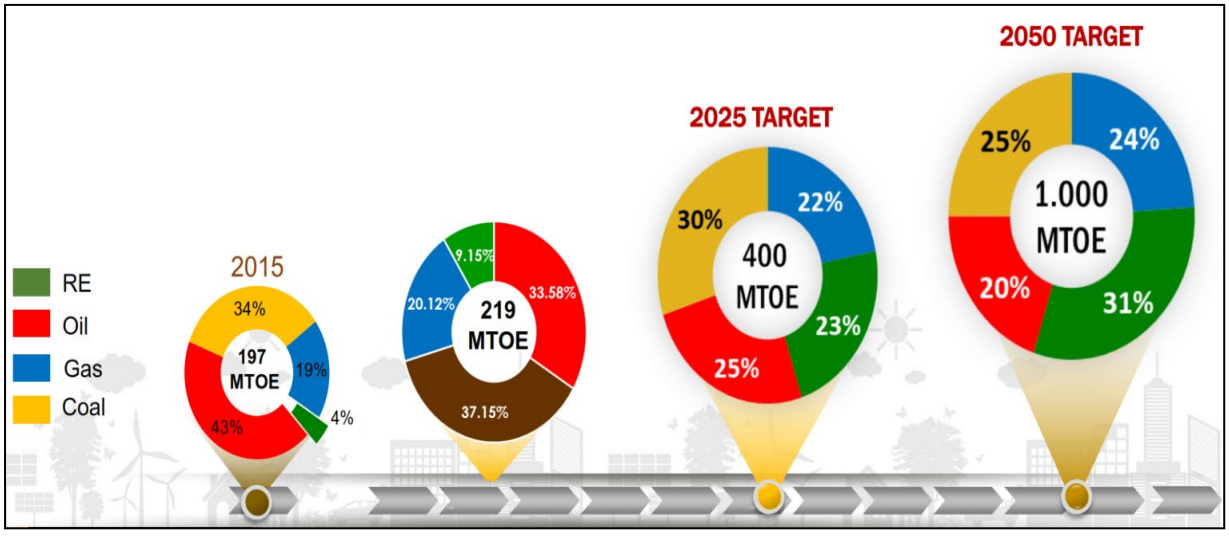
To encourage the use of domestic resources to meet domestic energy needs, the government uses policy instruments such as energy pricing, subsidies and incentives, particularly for renewables. It also supports R&D to help commercialise specific energy technologies. To ensure domestic energy needs are met, the government implements policies to gradually increase domestic use of fossil fuels (particularly coal and gas) and adjusts quotas for fossil energy exports accordingly. Mandatory blend rates for biofuels used in the transport and electricity sectors have also been introduced to improve energy security and support renewable energy.

The NEP also sets development priorities for domestic energy resources, encouraging the development and use of renewables and coal as well as optimising gas consumption while minimising the use of oil; it identifies nuclear as the last energy option due to safety concerns. The NEP aims to transform the primary energy supply mix by mandating the following shares (as shown in Figure 2-17):

- New low-carbon energy sources and renewables at least 23% in 2025 and 31% in 2050.
- Oil less than 25% in 2025 and less than 20% in 2050.
- Coal at least 30% in 2025 and 25% in 2050.
- Gas at least 22% in 2025 and 24% in 2050.

In addition, the NEP establishes numerous economy-wide targets, including to: reduce energy elasticity to less than 1 in 2025; reduce final energy intensity by 1% per year to 2025; achieve an economy-wide electrification rate approaching 100% in 2022; and increase per-capita electricity consumption to 2 500 kilowatt-hours (kWh) in 2025 and 7 000 kWh by 2050.

Figure 2-21: National Energy Policy energy supply targets

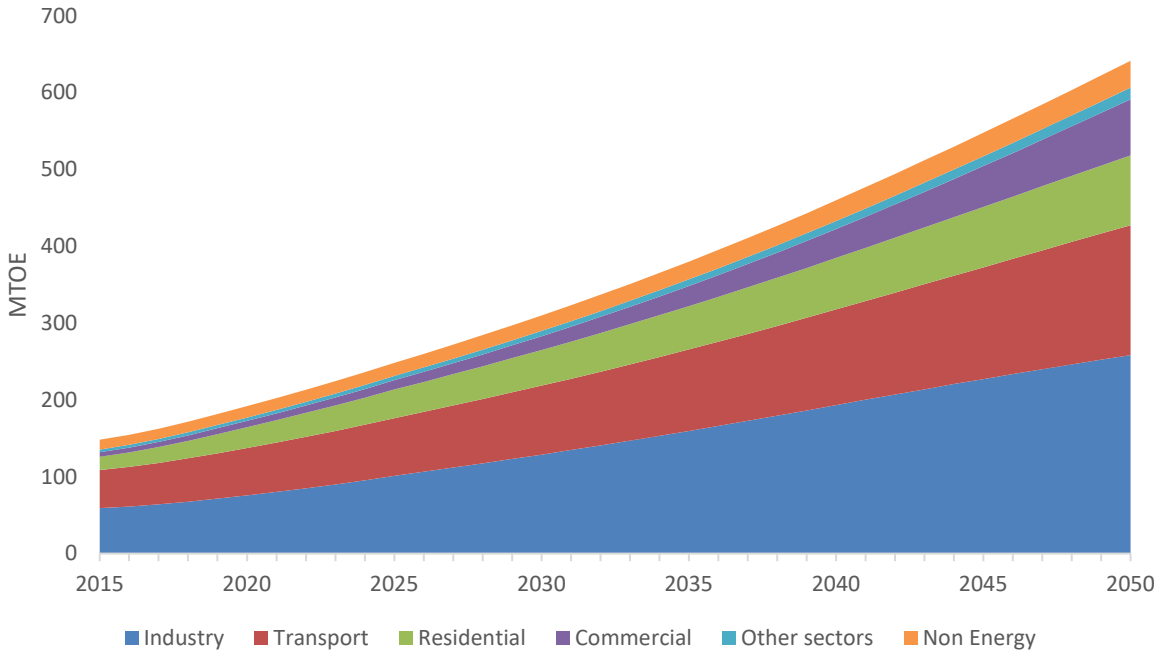


Source: Indonesia National Energy Planning, MEMR

National Energy General Plan (RUEN) is the mandate of Law No. 30 Year 2007 on Energy, is the policy of the Central Government regarding the economy-wide energy management plan which is the elaboration and implementation plan of the NEP that is cross-sectoral to achieve the NEP targets. RUEN is prepared by the Central Government and determined by the National Energy Council for a period of up to 2050 which includes, among others, expectations of future energy conditions, economy-wide energy goals and targets and economy-wide energy management policies and strategies.

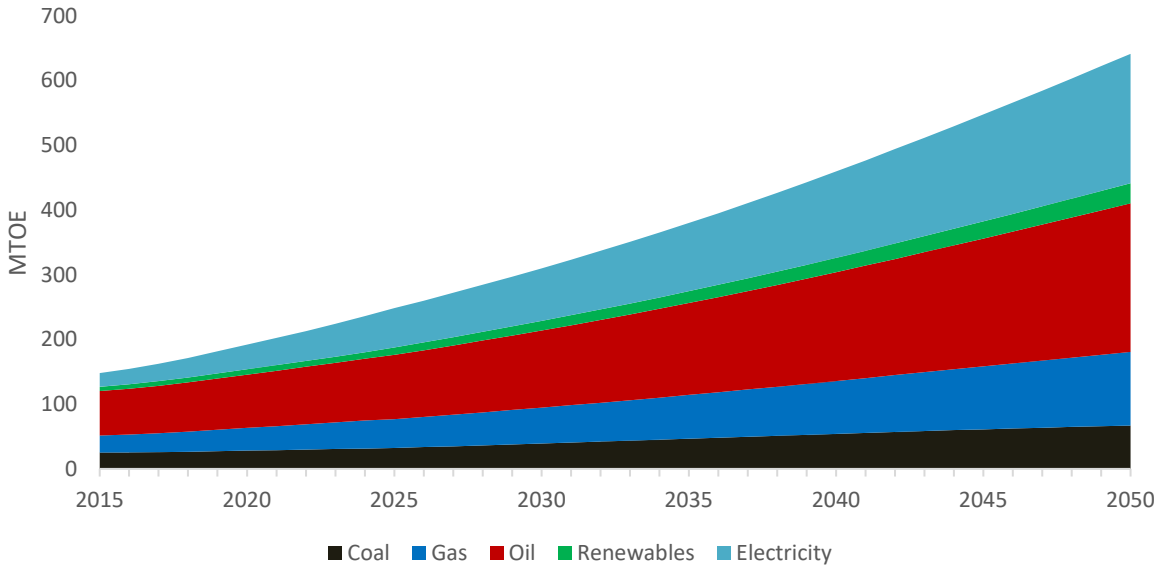
The projection of final energy demand in 2025 is to reach 248.4 MTOE with the industrial sector being the largest final energy user at 47.6% (including for raw materials feedstock), followed by the transportation sector at 30.3%. Other sectors which are quite large in using final energy is the residential sector at 15.0% and the commercial sector at 4.9%. For final energy demand by fuel, oil is projected to be dominant with 40%, followed by electricity 24%, and gas 18%. As in the 2025 projection, the largest final energy user sector in 2050 will be the industrial sector with a share of 45.7% (including raw materials feedstock). This is followed by the transportation sector with 26.3%, residential 14.2% and the commercial sector 11.4%. Oil is still dominant in 2050 to meet final energy demand with a 36% share while electricity increases to 31% and gas to 18% and coal fell to 10%. The final energy demand projections can be seen in Figure 2-18 and Figure 2-19.

Figure 2-18: Projection of total energy demand by sector, 2015–2050



Source: Indonesia National Energy Planning, MEMR

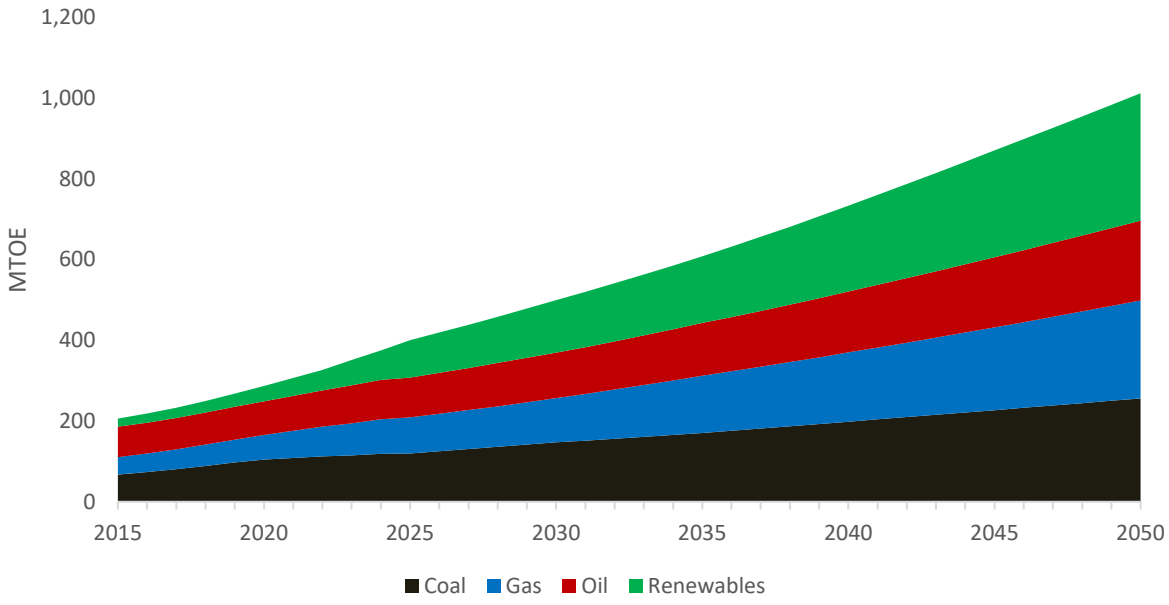
Figure 2-19: Projection of total energy demand by fuel, 2015–2050



Source: Indonesia National Energy Planning, MEMR

Modeling shows that primary energy supply will reach 400 MTOE in 2025, with a 23% renewable energy share, 25% for oil, 22% for natural gas, and coal at 30% (Figure 2-20). In 2050 the share of renewable energy will be 31%, coal 25%, gas 24% and oil 20%, with a total supply of primary energy reaching 1 012 MTOE. The reduction in GHG emissions is considered in the RUEN and is in line with Indonesia's Nationally Determined Contribution (NDC) of 29% reduction by 2030. This is part of Indonesia's commitment to support efforts to limit the increase in global average temperature to 2^0C.

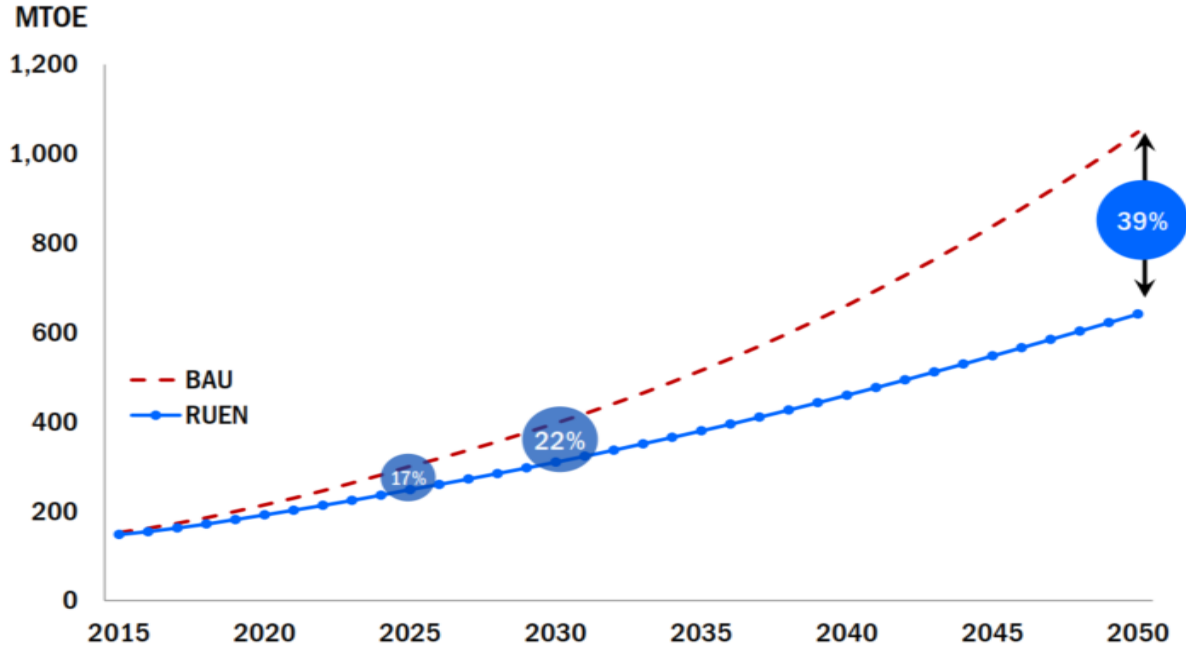
Figure 2-20: Projection of total primary energy supply, 2015–2050



Source: Indonesia National Energy Planning, MEMR

Energy conservation efforts have been considered for final energy demand projections. Energy conservation projections are carried out in all end-use sectors through: Implementation of energy management, fuel savings, equipment efficiency and equipment replacement in all sectors. By considering energy conservation and energy efficiency, the efficiency potential is around 52.3 MTOE in 2025, which is equivalent to 17.4% against the business-as-usual scenario. Meanwhile, in 2050, the potential efficiency is estimated at 407.6 MTOE, or equivalent to 38.9% efficiency. Figure 2-21 shows energy conservation and energy efficiency projections to 2050, with the savings that accrue if Indonesia follows the National Energy General Plan (RUEN).

Figure 2-21: Energy conservation in final energy demand, 2015–2050

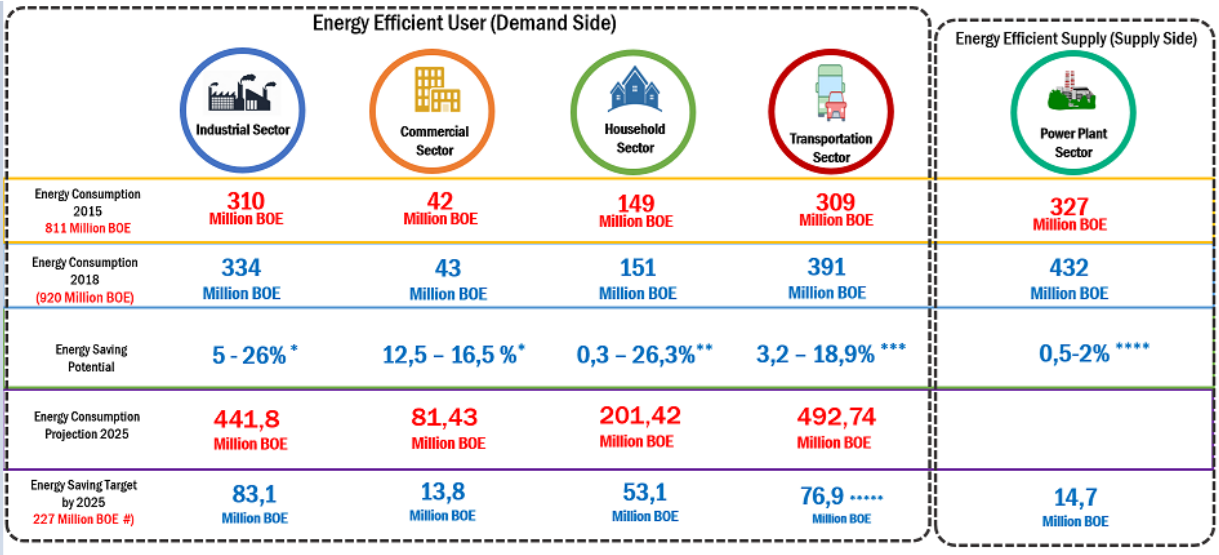


Source: Indonesia National Energy Planning, MEMR

Note: RUEN stands for National Energy General Plan; BAU is business-as-usual.

Figure 2-22 shows energy saving potential in Indonesia on both the demand side and supply side. By 2025, the industry sector has the largest energy savings target of 83 million BOE. This target is relative to projections of energy use under a business-as-usual scenario. The next largest energy savings targets are for the transport sector (77 million BOE) and the residential sector (53 million BOE). Commercial sector energy sector consumption is much smaller than these other three sectors. Nevertheless, there is an energy saving target for the commercial sector of almost 14 million BOE in 2025. There is an energy savings target for the power sector of almost 15 million BOE in 2025. This is a much smaller percentage savings and assumes that the power sector is already quite efficient. In terms of progress to achieving these 2025 targets, Figure 2-23 shows Indonesia's energy savings achievement up to 2020.

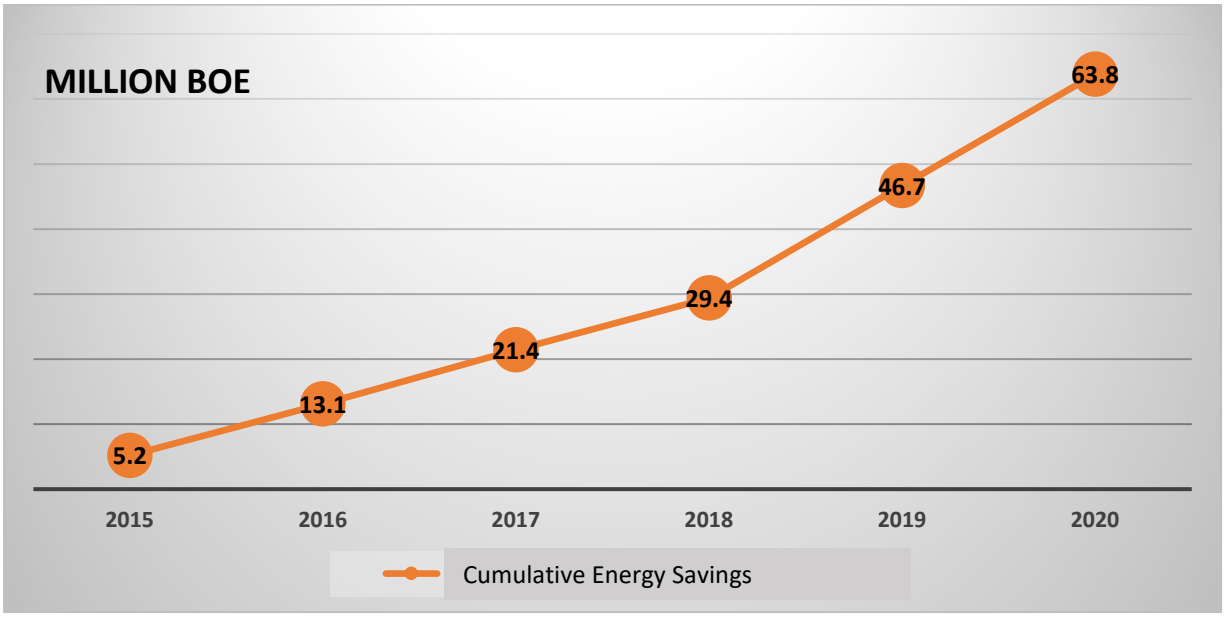
Figure 2-22: Energy saving potential



Note:
- Including Biomass (Source: Handbook of Energy and Economic Statistics of Indonesia 2018, KESDM)
*) Energy Audit Data for 2011-2018 consisted of 422 industries and 225 buildings
**) Study of Support to Monitoring and Estimation of Energy Conservation Policies Impact, Danida 2017
***) Outlook BPPT 2018
****) Energy management reporting data for 2017-2018 at 35 power plants, KESDM
*****) Data on energy saving potential in Jabodetabek land transportation, Outlook BPPT 2018
#) Saving targets in 2025 according to the projections of the Directorate of Energy Conservation Roadmap
#) outside the power generation sub-sector

Source: DGNREE, MEMR

Figure 2-23: Energy saving achievement, 2015–2020



Note: 63.8 million BOE savings is equal to 6.4% of energy use in the hypothetical BAU scenario in 2020

Source: DGNREE, MEMR

ENERGY EFFICIENCY INSTITUTIONS, POLICIES AND MAJOR PROGRAMS

Energy efficiency continues to receive attention from the Indonesia government through multiple energy related institutions, and different policies and programs. The Indonesia PREE recommendations from 2011 have been influential for energy legislation, though a comprehensive assessment of the success of the 2011 recommendations has yet to be undertaken.

REGULATIONS AND POLICIES

THE ENERGY LAW

Law No. 30 of the Year 2007 regarding Energy, also referred to as the Energy Law, is a historic law for Indonesia. The Energy Law calls for a new institutional framework in energy policy making. Indonesia enacted the Energy Law (Law No. 30/2007) 10 August 2007, which contains principles on energy resilience, security of energy supply, sustainable energy practices, energy conservation, and energy efficiency. The Energy Law outlines the NEP; the roles and responsibilities of the central government and regional governments in planning, policymaking, and regulation; energy development priorities; energy research and development; and the role of businesses. NEP addresses energy supply (to meet the economy's needs), energy development priorities, and the utilisation of indigenous energy resources and energy reserves.

The Energy Law Regulates energy management which includes the provision, utilisation, and exploitation which should be implemented in a just, sustainable, and optimally integrated manner. Energy management objectives are:

1. The achievement of independence of energy management.
2. Ensure the availability of domestic energy, from sources within the economy and abroad.
3. Availability of energy from domestic sources and/or abroad to meet domestic energy needs and promotes foreign exchange.
4. Ensure the management of energy resources in an optimal, integrated, and sustainable way.
5. Optimise energy efficiency across all sectors.
6. Achieve increased access to energy (including those living in remote areas) so that prosperity of the people is shared in a fair and equitable manner.
7. The achievement of the development of the energy industry capabilities and services to domestic energy independence and improve the professionalism of human resources.
8. The creation of employment, and preservation of the environment.

The Energy Law mandates the establishment of a National Energy Council (NEC, Dewan Energi Nasional). The tasks of the NEC are:

- Drafting and formulating the NEP
- Establishing the NEP, an economy-wide energy policy to meet long term economy-wide energy demand and to prioritise domestic energy resources development to improve energy security
- Establishing mitigation actions toward situations of energy crisis and emergency
- Supervising implementation of economy-wide and provincial energy policies.

The assembly of NEC members is chaired by the President of Indonesia. The NEC is headed by the minister responsible for energy affairs and has 15 members: seven ministers and high-ranking government officials

responsible for the supply, transportation, distribution, and use of energy; and eight members from industry, academia, expert groups, environmental groups, and consumer groups.

The government implemented NEP under Government Regulation No. 79/2014 after obtaining approval from the parliament. NEP is intended to create energy security and resilience through an energy management strategy that will be implemented through 2014–2050.

On 2 March 2017, the Rencana Umum Energi Nasional (RUEN) or General Plan of Energy was released. The RUEN is the implementation of the NEP. The RUEN is drafted by the government, through the Ministry of Energy and Mineral Resources (MEMR), in a process that involves related ministries, other government institutions, state-owned companies in the energy sector, and regional governments. Academia, other energy stakeholders, and public input are also considered. The RUEN is used by the central and provincial governments as a guideline for developing long-term electricity development plans and other relevant energy policies up to 2050.

Energy conservation is by Law obligatory and shall be the responsibility of the Government, the regional government, business entity, and the community. The Law mandates energy conservation shall cover all phases of energy management as defined by Law. The Energy Law is specific on the means to achieve energy conservation. The Law mandates the government and/or regional government to provide facilities and/or incentives to energy users and the producers of energy saving equipment, for conserving energy and producing energy reductions; in addition, government and/or regional government shall apply disincentives to energy users and producers of energy saving equipment for not implementing energy conservation. The incentive and disincentives mandate calls for government regulation for their execution.

The Energy Law states that matters regarding energy conservation shall be elucidated in further detail in a separate legally binding government regulation, as explanatory of the Energy Law. The government regulation to this effect is Government Regulation No. 70 of the Year 2009 regarding Energy Conservation. The implementation of Government Regulation No. 70 of the Year 2009 regarding Energy Conservation is regulated by legally binding Ministerial Regulations. By Law, the Ministerial Regulations regulating execution of energy conservation is issued by the government authority on energy matters.

GOVERNMENT REGULATION NO. 70/2009

Government Regulation No. 70 of the Year 2009 regarding Energy Conservation is a legally binding regulation explanatory of the Energy Law on matters of energy conservation. Government Regulation 70/2009 elucidates mandates of the Law specifically on policy and obligatory programs. This implementing regulation contains the norms of how to stipulate NEP which constitutes energy management policy based on justice, sustainability, and an environmental mindset, to achieve energy independence and economy-wide energy resilience.

Government responsibility

The regulation elucidates government responsibility in the three levels of government. The responsibility for all three levels is similar with the exception that the Government (there term referrers to Government, at the whole-of-economy level (central government)) has the responsibility to assess, construct and establish policies. The Government responsibility is to:

- Formulate and establish policies, strategies, and energy conservation program
- Develop human resources qualified in the field of energy conservation

- Conduct complete and comprehensive socialisation on the use of technology which apply principles of energy conservation
- Assess, construct, and establish policies, as well as allocate funds to implement the energy conservation program
- Streamline and/or provide incentives to implement the energy conservation program
- Provide technical guidance about energy conservation to entrepreneurs, energy source users, and energy users.
- Implement the program and establish energy conservation activities
- Conduct guidance and supervision on the implementation of energy conservation program.

By Law, Energy Conservation is Obligatory

The Regulation mandates energy conservation in the activity of energy resource production, resource use, supply, and final energy use. Any person or enterprise involved in energy resource production, resource use, and energy supply is obliged to implement energy conservation; to be achieved through use of energy efficient technology which meets standard by law and regulation; energy efficient equipment, materials, process, and system; and endeavour in planning to use energy efficient technology.

Specific regulation for the largest energy users

Energy resources users and final energy users that use energy equivalent to the amount equal to or more than 6000 ton of oil equivalent annually are obliged to implement energy conservation through energy management. Energy management Law involves:

- Appointing an energy manager
- Establishing an energy conservation plan
- Conducting routine energy audit
- Implementing the steps recommended by the result of energy audit
- Reporting implementation of energy conservation annually to the appropriate authority: the Minister, governor, or regent/mayor.

Easiness, Incentive, and Disincentive

Government Regulation No.70/2009 formulates and regulates the concept of Easiness, Incentive and Disincentive on energy conservation, as follows:

- Easiness: The Government and/or regional government shall provide easiness to large energy users and local manufacturers of energy-saving devices/equipment who had implemented energy conservation, in obtaining:
    - Access to information regarding energy efficient technology, their specifications, and energy efficient measures; and,
    - Consultation services regarding energy efficient measures
- Incentives: Government and/or regional government shall provide incentive to:
    - Energy users that use equal or greater than 6000 tons of oil equivalent annually; and
    - Local energy saving product manufacturers that can implement and produce energy saving within a certain period, as regulated by Government.

  Requisite: Incentives will be given towards successful implementation of energy conservation (through Energy Management) and qualify Criteria of Success. The Criteria of Success will be regulated by Ministerial Regulation.

Legally, the Incentives for energy users who qualify criteria of success are:

- tax facilities for energy saving products
- breaks, reliefs, or exemption of local taxes for energy-saving products
- import tax facility for energy-saving products
- low-interest financing for investment in energy conservation
- in accordance with existing laws and regulations
- energy audit in partnership paid by the government.

Legally, the Incentives for energy-saving product manufacture who qualify criteria of success are:

- tax facilities for components/spare parts and raw materials used for manufacturing energy-saving products
- breaks, reliefs, and exemptions, of local taxes for components/ spare parts and raw materials used to manufacture energy-saving products
- import tax facilities for components/spare parts and raw materials used to manufacture energy-saving products
- low-interest financing for investments to manufacture energy saving products
- in accordance with existing laws and regulations.

- Disincentive: Energy resource users and final energy users who fail to implement energy conservation through energy management will be subject to disincentives, imposed upon them by the Minister, governor, or regent/mayor, within their respective authority.

OTHER REGULATIONS

The Table 4.1 is a brief description of the various other regulations related to energy conservation.

Table 2-1: Energy conservation regulation

No	Regulation	Description
1	Presidential Instruction No. 13/2011 regarding Saving Energy and Water	• Directed to ministers, heads of the institutions of government, governors, regents/mayors, commander of the armed forces, and chief of the Indonesia police, to implement Policy to Save Energy and Water. • The Presidential Instruction mandate's goal to achieve 20% electricity saving: 10% water saving, and 10% gasoline saving. Presidential Instruction No. 13/2011 mandates creation of an economy-wide Team on Saving Energy and Water. The task of the Team is to formulate and prepare policies, strategy, and program to save energy and water including their conservation. • The economy-wide Team consists of the Coordinating Minister of Economic Affairs, as chairperson and member; the Minister of Energy and Mineral Resources as *daily chairperson* and member; 10 Ministers as members; the Head of the Agency for the Assessment and Application of Technology, as member; and the Director General of New Renewable Energy and Energy Conservation, as Secretary of the economy-wide Team.

No	Regulation	Description
		• Presidential Instruction No. 13/2011 mandates that the economy-wide Team on Saving Energy and Water shall establish an Executing Team, chaired by the Secretary. Members of the Executing Team are appointed by its chairperson. The measures on saving energy and water as mandated includes, allocation of government budget, training, energy audit and water audit, use of energy and water saving technologies and monitoring.
2	Instruction President. No. 2 Year 2008 on Saving Energy and Water	President Instructed to: 1) Cabinet Ministers. 2) Attorney General of the Republic of Indonesia. 3) Head of Non-Departmental Government Institution. 4) Commander of the Armed Forces of Indonesia. 5) Chief of Police of the Republic of Indonesia. 6) The leader of Secretary of State Institutions. 7) Governors. 8) Regents / Mayors, To carry out the following: • Perform the steps and the energy and water saving innovations in their respective environmental agencies and / or within State Owned Enterprises, and Regional-Owned Enterprises appropriate authority of each • Conduct socialisation and encourage the public, including private companies that are in their respective territories to implement energy and water savings • Establish a task force in each environment to oversee the implementation of energy and water savings.
3	The Minister of Energy and Mineral Resources Regulation No. 6 Year 2011 on Labeling in CFL	• Regulation of the Minister has signed on 19 April 2011 and entered into force 6 (six) months from the date of enactment. • Before the manufacturer or importer sign energy-efficient label on the CFL, they must issue a declaration of conformity stating that their product has been in accordance with applicable regulations. • Declaration of conformity was then submitted to the Ministry of Energy and Mineral Resources cq DGNREEC. • Violations of the provisions on statement of compliance will be sanctioned in accordance with the provisions of the legislation. • CFL domestic products that are not affixed with labels energy-efficient signs withdrawn from circulation.

No	Regulation	Description
		• CFL import products that do not bear labels energy-efficient signs are prohibited entry into the Indonesian customs area and must be re-exported or destroyed.
4	Pres. Reg. No. 61/2011 on Action Plan on Green House Gas Emission Reduction	• The Action Plan for Green House Gas Reduction (RAN-GRK) is a follow up from the Indonesian commitment to dealing with climate change issues as delivered by President before state leaders at Pittsburgh G-20 Summit, USA, on September 25, 2009. • Indonesia is committed to reducing GHG emission by 26% in 2020 from the BAU level with its own efforts and reaching 41% reduction if it secures international support. • RAN-GRK is the "plan of action" for Indonesia's emissions reductions targets. RAN-GRK requires the participation of government ministries and institutions to reduce GHG emissions. RAN-GRK identifies five major sectors that will be essential to achieve RAD-GRK's emission reduction target. These are: forestry and peatlands, agriculture, energy, industry, transportation, and waste. • The responsible government ministries are BAPPENAS, the ministries of environment, forestry, agriculture, public works, industry, transportation, energy and finance. Although RAN-GRK is an economy-wide action plan, it also lays the foundation for the actions of provinces, localities, and private enterprises to implement GHG reductions. • RAN-GRK mandates that Indonesia's provinces develop and submit a Local Action Plan (RAD-GRK). RAN-GRK provides capacity building, budgets and potential participation in domestic and international markets to local governments to incentivise them to contribute to RAN-GRK's goals.
5	MEMR Reg. No. 14/2012 on Energy Management	• This Regulation, consisting of 6 Chapters, establishes provisions for energy preservation and management by improving efficiency in energy use and control over its consumption, to achieve effective and rational use of energy resources. • Energy management is an integrated activity to make maximum output through technical action in a structured and economical method to minimise energy use including energy for the production process and minimise consumption of raw material and support material. • Regulates on the authority of implementation Energy Management owned by the government and regional government at levels of the province as well as regency/city. • Regulates energy resource user and energy user who use energy resources and/or energy more or equal to 6,000-ton oil equivalent

No	Regulation	Description
		per year is required to perform energy management. Energy resource user and energy user who use energy resource and/or energy less than 6,000 (six thousand) ton oil equivalent per year should implement energy management and/or implement energy saving. • Energy management is carried out by: 1) Appointing an energy manager. 2) Making an energy conservation program 3) Implementing a periodic energy audit and recommendations based on the energy audit result 4) Reporting the implementation of energy management every year to the Minister, Governor, or regent/mayor in accordance with their authority.
6	MEMR Reg. No. 18/2014 on Energy Saving Label for CFL	• Obligatory and applies to save energy sign label as described in Indonesia Standard Number 04-6958-2003 concerning Use of Electric Power for Household needs. • Domestic producers or importers can distribute Self-ballast lamp affixed with saving energy sign label. Self-ballast lamp importers shall be responsible for fulfilment of saving energy sign label affixing on self-ballast lamps distributed in Indonesia.
7	Pres. Reg. No. 38/2015 on Government Cooperation with Business Entities in Infrastructure Procurement (including infrastructure on energy conservation)	• Provides additional incentives such as the availability payment mechanism, which allows the government to commit to long-term payments for infrastructure services provided by business entities. It is expected that with this regulation, projects with slim margins, or projects with high demand risk, will still be considered appealing to and will be carried out by private investors. • Expected to accomplish five objectives, namely to (i) emphasise the authority of the parties involved in PPP, (ii) expand the scope in the implementation of PPP, (iii) accelerate the business process from preparation up to transaction, (iv) increase bankability and sustainability of projects, including the possibility of alternative financing, and (v) provide legal certainty in PPP processes (for example, the success fee mechanism, land acquisition, and environmental impact assessments).
8	Minister of Public Works and Housing Reg. No. 02/ PRT/M/2015 on Green Building	• Intended as guidelines for building operators in carrying out green building construction (green building). • The Regulation aims to promote green and sustainability in the construction of buildings and imposes green building requirements. There are 3 compliance levels of green building requirements for new and existing buildings, that is mandatory, recommended and voluntary.

No	Regulation	Description
9	MEMR Reg. No. 57/2017 MEPS Implementation and Energy Saving Label for AC	• Stipulates domestic producers and importers must apply SKEM and Save Energy Sign Label by attaching SKEM mark and Save Energy Sign Label on Air Conditioning Instrument which will go to the market in the territory of the state of the Republic of Indonesia. • Domestic producers and importers before affixing SKEM mark and save energy sign label are required to obtain the permit from General Director of NREE. • Domestic producers and importers are responsible for fulfilment of provisions of affixing SKEM mark and save energy sign label on air conditioning instrument in circulation in Indonesia.

POLICIES

Table 2-2: Energy conservation policy and action

Sector	Policy and Action
Household	• Minimum Energy Performance Standards (MPES) and energy saving marking labels for air conditioners. • MPES and energy saving labels for LED lamps. • MPES and energy saving labels for fans. • MPES and energy saving labels for refrigerators. • MPES and energy saving labels for washing machines. • MPES and energy saving labels for TV. • MPES and energy saving label for rice cooker. • MPES and energy saving label for water pump. • Improved energy efficiency for cooking stove. • Switching cooking stove fuel from biomass to LPG.
Industry	• Energy management mandatory for industrial sector energy users more than 6000 TOE and 4000 TOE per year. • Improved energy efficiency for boilers. • MPES and energy saving label for chiller. • MPES and energy saving labels for electric motors.
Buildings	• Energy conservation obligations for government buildings. • Green building obligations for new buildings. • Energy management obligations for commercial buildings.
Transportation	• Shifting modes of transportation from private vehicles to public transportation (bus).

Sector	Policy and Action
	• Shifting modes of transportation from private vehicles to Mass Rapid Transport (MRT). • Shifting modes of transportation from private vehicles to walking/cycling (non-energy). • Substitution of fuel from Gasoline to Gas (CNG). • Improved vehicle fuel efficiency standards. • Transportation management.

INSTITUTIONAL FRAMEWORK

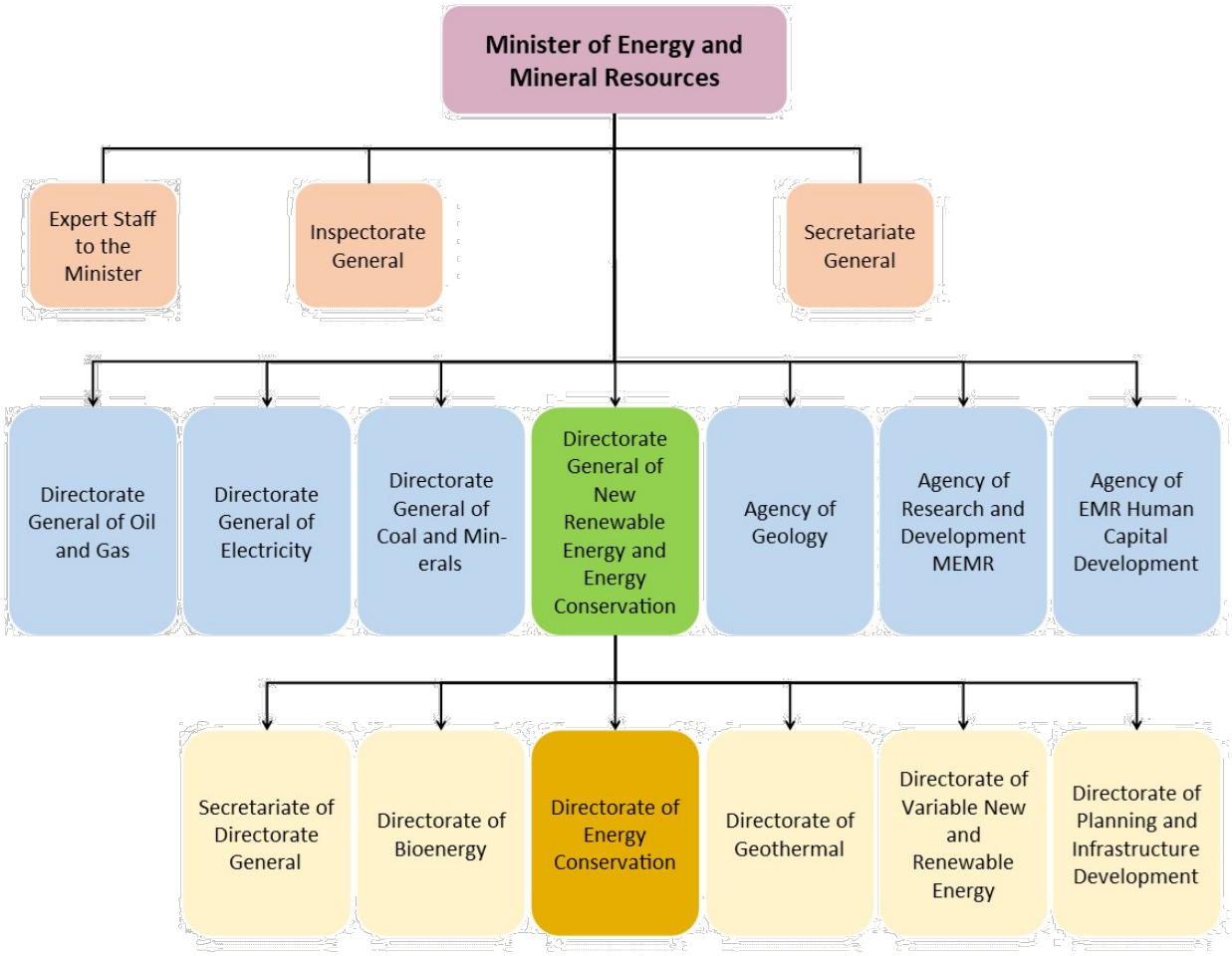
THE MINISTRY OF ENERGY AND MINERAL RESOURCES, DIRECTORATE GENERAL OF NEW RENEWABLE ENERGY AND ENERGY CONSERVATION, DIRECTORATE OF ENERGY CONSERVATION

The agency principally responsible for governing the Indonesian energy sector is the Ministry of Energy and Mineral Resources (MEMR). MEMR comprises directorate generals focusing on oil and gas, minerals and coal, electricity, and new and renewable energies and energy conservation. The MEMR is the primary government institution in charge of policy and decision-making concerning Indonesia's energy and mining assets, including implementation of technical programs and projects.

As a ministry that addresses problems in the energy sector, the Ministry of Energy and Mineral Resources (MEMR) is an institution that became a focal point implementation of energy conservation in Indonesia. Within the organisational structure of the MEMR there is the Directorate of Energy Conservation that implements and coordinates the energy conservation program.

The Directorate of Energy Conservation is one of five Directorates in the Directorate General of NREEC; The Directorate of Energy Conservation is currently staffed by 60 government officials of various ranks, its place in the organisation structure diagram of the MEMR is as shown in Figure 2-24.

Figure 2-24: The Directorate of Energy Conservation in the Organisation Structure of the MEMR



Source: MEMR Regulation 15/2021

The Directorate of Energy Conservation duty is to:

1) Formulate and establish policies, strategies and energy conservation programs;
2) As a coordinator and implementer in the preparation of regulations implementing energy conservation, consisting of: 1) Energy Conservation Master Plan, 2) Obligations Implementation of Energy Management, 3) Compulsory Standard on Energy Efficiency, 3) Energy Efficient Labeling, 4) Position Functional Conservation of Energy, 5) Fiscal Incentives and Development Energy Services Company (ESCO).
3) Socialise energy-saving measures to the public.
4) Create guidelines for the implementation of energy conservation as a reference for stakeholders and local governments such as 1) energy management, 2) the appointment of energy managers, 3) energy audit, 4) standardisation of energy efficiency 5) energy efficiency labeling.
5) Facilitate a forum for dialogue among stakeholders (central government, local governments, energy users and energy producers) in various energy conservation programs such as energy conservation partnership program.

6) Recommend energy efficient equipment or energy conservation projects are feasible given incentives.
7) Make benchmarking of energy efficiency / energy intensity in industry, transportation, and commercial buildings.
8) Provide technical assistance to local government energy conservation.
9) Monitoring and evaluating the implementation of economy-wide energy conservation.

Responsibility of related Ministries and Government Agencies

To further enhance the implementation of energy conservation program, the MEMR do not walk alone, but together with several other institutions, such as:

(a) Minstry of Industry

The main functions of the Ministry of Industry in the energy conservation programs is to make energy efficiency as part of the industry productivity benchmarks, including establishing guidelines to implement energy conservation in the industry sector and energy efficiency standard. Some activities have been done to carry out energy audits in industrial sector, carry out technical guidance on energy conservation as well as help in make industry standards in energy efficiency of energy utilisation equipment.

(b) Ministry of Public Works

The main functions of the Ministry of Public Works in the energy conservation program is to realise real energy conservation in facilities and infrastructure and make it part of the comfort, safety and airworthiness. Activities that have been completed include assisting to make a standards of energy conservation in buildings.

(c) Ministry of Trade

The main functions of the Ministry of Trade in the energy conservation programs are to make energy efficiency a part of benchmarking for outstanding items. Activities that have been completed include monitoring the application of labeling energy-efficient lighting.

(d) Ministry of Transport

The main functions of the Ministry of Trade in the energy conservation programs is to Implement energy saving principles in planning, operation and management of Indonesia's transport system.

(e) Ministry of Finance

The main functions of the Ministry of Finance in the energy conservation program are to encourage the implementation of energy conservation and make it part of Indonesia's development budget, including create budget allocation guidelines for government and regional governments where energy conservation programs are one of the criterions for budget allocation.

(f) National Development Planning Agency (BAPPENAS)

The main function of BAPPENAS in the energy conservation program is to make energy conservation activities as part of development planning.

(g) Ministry of National Education

The main function of the Ministry of National Education in the energy conservation program is to increase public awareness and knowledge about energy conservation. Some activities have been

completed include encouraging the implementation of energy saving measures at state universities and implementing energy-savings contests for high school students.

(h) the Agency for Assessment and Application of Technology (BPPT)

The main function of BPPT in the energy conservation program is to support the implementation of energy conservation and make it part of the assessment and application of technology. Activities include providing energy audit services, financing and energy efficiency standards and setting up a laboratory for testing energy-efficient appliances.

(i) Regional Government and Regency/City Government

The role of governments is to support the implementation of energy conservation in their region. Activities include energy conservation information dissemination, such as campaigns, training, seminars/workshops, and pilot projects.

(j) State-owned Enterprise in the field of Energy Supply (PT. Pertamina, PT. PLN dan PT. PGN)

As an implementer of energy-saving campaign, the energy provider conducts a thorough and comprehensive socialisation on measures of energy saving to society (PT Pertamina for fuel-efficient, PT. PLN for power saving and PT. PGN to gas saving).

ENERGY EFFICIENCY PROGRAMS

IMPLEMENTATION OF MANDATORY ENERGY MANAGEMENT FOR LARGE ENERGY USERS

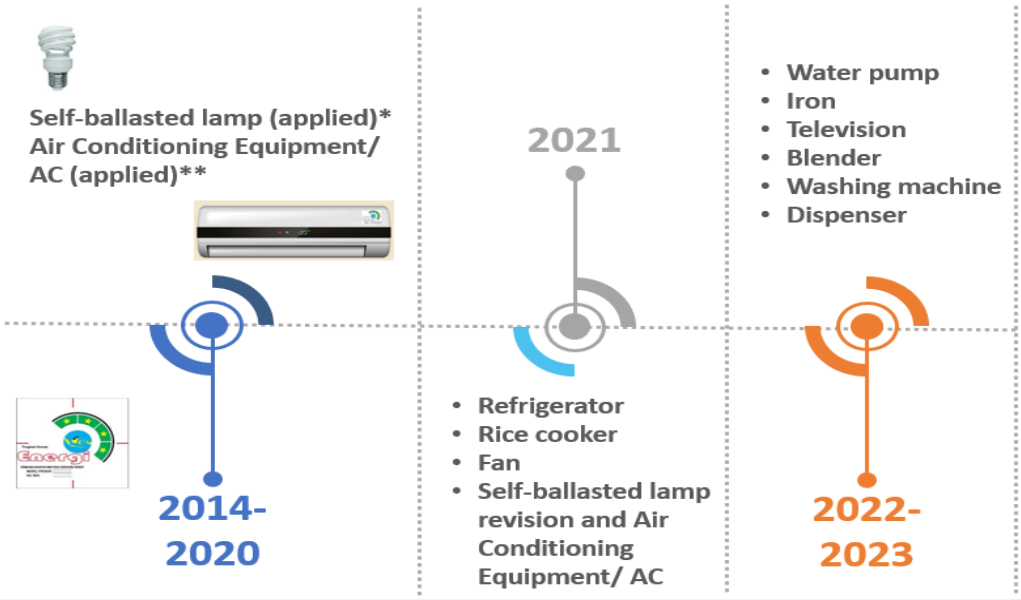
- Energy management involves integrated activities to control energy consumption. This is undertaken to achieve effective and efficient energy utilisation (maximise output in a structured and economic fashion that minimises consumption of raw and supporting materials). As a follow-up to the government regulation No. 70 / 2009 on Energy Conservation which provides that industries and buildings that consume greater than 6 000 TOE of energy per year should conduct energy management programs and activities, that is:
  - ✓ Appointing an energy manager
  - ✓ Preparing an energy conservation program
  - ✓ Conducting energy audits regularly,
  - ✓ Implementing audit result recommendations
  - ✓ Reporting energy conservation planning and measures to government

  In 2019, there were 148 companies which implements energy management system
- For Energy Manager and energy auditor, It has been published Minister of Manpower Decree 80/2015 on Establishment of Indonesian Working Competency Standard for Energy Manager Position in Industry and Buildings and Minister of Manpower Decree 53/2018 on Establishment of Indonesian Working Competency Standard for Energy Audit. Up to 2019 there are 795 certified Energy Managers and 903 certified energy auditors. Furthermore, there are 4 professional certification agencies (LSP) for energy manager and auditor.

MEPS AND ENERGY LABELLING PROGRAM

- The energy labelling program is a program of attaching Energy Saving Label to electrical appliances for household needs or any other usage, stating that the products meet the requirements of energy efficiency criteria. This program is intended to provide information to consumers about the energy efficiency level of a product, as well as to encourage manufacturers to increase the level of energy efficiency of products that they produce. Indonesia currently has an energy labelling system that uses a star-rating system of 4 stars (more stars means more efficient), which also includes information about the absolute energy efficiency of the product.
- In addition to labelling, the government also stipulates Minimum Energy Performance Standards (MEPS). MEPS is a specification that contains several MEPS requirements under certain conditions which are effectively intended to limit the maximum amount of energy consumption of permitted energy utilisation products. The aims of energy labelling and MEPS are to protect and provide information to consumers in the selection of energy-efficient and efficient household appliances and prevent inefficient household products from entering the Indonesian market. With the relevant stakeholders, Indonesia has developed test procedures and criteria on energy-efficient refrigerators and air conditioner. The energy-efficient labelling on CFL and air conditioners have been implemented.

Figure 2-25: MEPS and labelling program implementation



*MEMR Reg. No. 18/2014 on Energy Efficient Labeling for Self-ballasted Lamp
** MEMR Reg. No. 14/2021 on Minimum Energy Performance Standard (MEPS) Implementation and Energy Efficient Labeling for Air Conditioning Equipment

Source: DGNREE, MEMR

STANDARDS

- Indonesia has energy performance testing standards (EPTS) for select electrical appliances/devices, which are established as Indonesia National Standard (SNI) The purpose of these standards is to specify technical requirements on energy efficiency and safety, and for the

purpose of energy labelling. SNI standards on electrical appliances and equipment are drafted and registered under strict systems and guidelines of the National Standardization Agency (BSN). To support and provide guidelines in the implementation of energy efficiency, several standards have been issued, namely:

1) Standard of Energy Management Systems

- SNI ISO 50001:2018 on Energy Management System – Terms with Guidelines for Use.
- SNI ISO 50002:2014 on Energy Audit - Requirements with usage guide.
- SNI ISO 50006:2014 on Measuring Energy Performance using Energy Baseline (EnB) and Energy Performance Indicators (EnPI)-General principles and guidelines
- SNI ISO 50015:2014 on Energy management systems - Measurement and verification of an organisation's energy performance - General principles and guidelines.
- SNI ISO 50021:2019 on Energy management and energy saving – General guidelines for choosing an evaluator.
- SNI ISO 50045:2019 on technical guidelines for evaluating energy savings in thermal power plants.
- SNI ISO 50046: 2019 on General method for predicting energy saving.

2) Standard of Working Competency

- Minister of Manpower Decree 80/2015 on Establishment of Indonesian Working Competency Standard for Energy Manager Position in Industry and Buildings
- Minister of Manpower Decree 53/2018 on Establishment of Indonesian Working Competency Standard for Energy Audit.
- Minister of Manpower Decree 223/2020 on Establishment of Indonesian Working Competency Standard for Measurement and Verification of Energy Performance.

3) Standard of Energy Efficiency on Buildings

- SNI: 6196-2011 on Energy Audit Procedure for Building
- SNI: 6197-2011 on Energy Conservation for Lighting System
- SNI: 6389-2011 on Energy Conservation for Building Envelope
- SNI: 6390-2011 on Energy Conservation for Air Conditioner in Buildings
- SNI ISO: 817-2018 on Refrigerant: Names and Safety Classifications
- SNI: 6500-2018 on Fixed Installation Refrigeration System: Safety and Environmental Requirement
- SNI: 8476-2018 on Performance Testing and Evaluation Method for Chillers using Steam Vapor Compression System

CREATING PUBLIC AWARENESS

Public awareness pertaining to energy conservation is promoted by the MEMR, regional governments, and by the state-owned energy/electricity company, private companies, and NGOs. The public awareness campaign is by means of public advertisement, printed materials, and the internet; and through seminars and workshop. The activities that have been done, as follows:

1) Conduct seminar/workshop and public advertisement through printed and electronics media, and dissemination of brochure on energy efficiency.
2) Implemented by various parties, both the central government (MEMR), local government, state owned company in the field of energy providers, private company, and NGO
3) Conduct Energy Awards for building and industrial sector and participating in ASEAN Energy Awards
4) Developed "Energy Calculator", a web-based application, used to calculate energy cost of household electrical appliances and give energy saving recommendations. Benefits of energy calculator: knowing energy use, implementing energy conservation, and saving electricity bills.
5) Kampanye Potong 10% (10% Cut of Energy Use Campaign) - Targeting all stakeholders in energy sector including government institutions, industry, NGOs, and public to reduce energy consumptions by 10%. The program was launched in May 2016 and is funded by the MEMR.
6) Konservasi Energi Goes to Campus - (Energy Conservation Goes to Campuses) aims to introduce university students to the basic principles of energy efficiency, the ISO 50001: energy management systems, job opportunities for energy auditors and energy managers. The program is managed and funded by the MEMR.

EDUCATION AND TRAINING

Government officials could receive training on energy conservation at the Centre for Training and Education of the MEMR; and participate in energy conservation training abroad through bilateral programs and other international cooperation, such as JICA, ACE, *et cetera*.

INCENTIVE OF ENERGY CONSERVATION

- Minister of Finance Regulation (PMK) Number 176/PMK.011/2009 concerning Exemption of Import Duties on the Import of Machinery and Goods and Materials for Industrial Development or Development in the context of Investment (the regulation has been revised twice with PMK Number 76/PMK.011/2012 and PMK Number 188 /PMK.011/2015). The PMK was prepared by the Ministry of Finance to implement the mandate of the Customs Law, in particular Article 26 paragraph (1) letters a, b, and c, which at the same time can be used in practical terms to support investments related to Energy Conservation.
- In addition, the Ministry of Finance has also issued PMK No. 18/PMK.010/2018 concerning the Determination of Import Duty Tariffs in the Framework of the ASEAN-Japan Comprehensive Economic Partnership, where this PMK stipulates an import duty rate of 0% on imports from ASEAN member economies and Japan in the framework of the ASEAN-Japan Comprehensive Economic Partnership for the goods listed in the PMK attachment (industrial machines are also included). For example, if PLN brings in its new boilers from Japan or from ASEAN economies, then the import duty rate automatically becomes 0% or free in accordance with the provisions of the PMK.
- The Ministry of Finance has also issued PMK Number 268/PMK.03/2015 concerning Procedures for Providing Facilities for Exemption from the Imposition of Value Added Tax on Imports and/or Delivery of Certain Strategic Taxable Goods, to implement the mandate of Government Regulation (GR) 81/2015. In practical terms, it is very possible to access VAT exemption incentives for energy conservation investment purposes by utilising the GR and PMK.

MONITORING AND REPORTING

- Energy Management Online Reporting (POME) has been developed and applied. It is an energy management online reporting application that is required for energy users above 6000 TOE.
- The benefits that can be obtained by reporting energy to POME are as follows:
  1) Helping industry to benchmark energy efficiency performance,
  2) Get recommendations and advice on energy saving from the government,
  3) Get a recommendation to participate in the Subroto Award Program,
  4) Enhancing corporate innovation and supporting Indonesia's efforts towards sustainable development,
  5) Support Indonesia to achieve energy efficiency targets of 17% by 2025 and reduction of CO2 emissions by 29% from Business as Usual by 2030.

Directorate of Conservation, MEMR has developed energy management reporting using web-based application https://simebtke.esdm.go.id/sinergi. Some benefits that can be obtained from implementing Energy Management Online Reporting Application:

- Ease in Data Collection
- As a material for consideration in making policies related to energy conservation
- Provide convenience for industry sector in submitting reports
- The company has a data base on energy use from reports submitted every year
- Providing benefits for Industrial Managers through the IKE feature, so that they can benchmark against similar sectors
- Rewarding companies through certificates that can be used to meet points in awards related to energy savings

INTERNATIONAL COOPERATION

The MEMR has bilateral and regional/multilateral international cooperation specifically on energy efficiency and conservation. Some of the international cooperation involves multiyear programs.

a. ASEAN, regional/multilateral cooperation: Promotion of Energy Efficiency and Conservation (PROMEEC)

Activity:

- ASEAN Standards Harmonization Initiative for Energy Efficiency (ASEAN SHINE)
  Initiation of harmonisation of standards, policies, and Mutual Recognition Agreement for household appliances in the ASEAN Region. In 2020 Indonesia is involved in the Technical Working Group and Policy Working Group.
- ASEAN Energy Awards
  Indonesia sends representatives every year to participate in the ASEAN Energy Efficiency and Conservation Awards. In 2020, Indonesia sent 14 representatives which are divided into 3 categories of Energy Efficient Buildings; 9 categories of Energy Management for Industries and Buildings; and 2 categories of Green Building.
- AEMAS (ASEAN Energy Management Scheme)

Standard regional training and certification mechanism for ASEAN Energy Managers

- ASEAN-Japan Energy Efficiency Partnership (AJEEP)
  Exchange experiences in making best practices regarding technology and energy management systems in the field of energy efficiency and conservation.

b. *United Nations Development Program (UNDP)*
   - *Regional/multilateral cooperation: Barrier Removal on Energy Efficiency Standard and Labelling (BRESL), 2009-2014*.
     Activity: energy appliance energy efficiency standard, and labelling policy making; capacity building; manufacturing support; regional cooperation; policy research; and pilot project
   - *MTRE3 2017 – 2022*
     Activity: Commercial building SEC survey, Survey and socialisation of PV Rooftop Commercial buildings, Preparation of the Energy Sector GHG Inventory in 4 Provinces, Formulation of the Energy Sector GHG Mitigation Action Calculation Methodology, Mentoring and Certification ISO 50001 EBTKE Buildings and Implementation of IGA in 6 Buildings
   - *ADLIGHT 2020 – 2022*
     Activity: Improved quality, energy efficient and affordable locally-produced EEL products, Improved conditions for fair market competition of EE lighting products, informed by robust policy and institutional framework, Increased penetration of high quality and efficient lighting.

c. *Clean Energy Ministerial*.
   Activity: multilateral solar and wind working group, Energy management working group and energy management campaign, Super-efficient equipment and appliance development initiative, clean energy solution center and Global LEAP.

d. *Asia-Pacific Economic Cooperation*
   Activity: APEC Low Carbon Model Town, Peer Review Energy Efficiency -10

e. *ADB (ADB TA-930 INO: Scaling Up Energy Efficiency 2018-2020)*
   Activity: Technical Assistance Preparation of SKEM (iron, washing machine, water pump, dispenser), Database Website Creation and Online Reporting (Standards and Labels), Preparation of PPP-based street lightning Procurement Scheme, Review and Refinement of Academic Studies Revised GR 70/2009, and Certified Investment Grade Auditor and Certified Energy Savings Verifier Training and Certification.

f. *Global Green Growth Institute Phase II 2018-2019*.
   Activity: Technical Assistance Review and Assessment of Energy Sector NDC in Indonesia Socialisation of Rooftop Solar Power Plants and Smart Building Technology in Commercial Buildings.

g. *Indonesia – Japan (METI)*
   Activity: Japan appointed the Energy Conservation Center, Japan (ECCJ) as the Executor of Cooperation with the Ministry of Energy and Mineral Resources and the Ministry of Industry to compile the Energy Management System Guideline and Energy Consumption Benchmarking per Industrial Sub-Sector (cement and fertiliser for 2020-2021)

h. *Indonesia – Denmark bilateral cooperation*
   - *Energy Efficiency in Industry, Commercial, and Public Sector, 2008-2012*.
     Activity: Strengthen clearinghouse on energy conservation as information centre of energy conservation activities; Pilot project on energy efficient building to be adopted by new buildings.
   - *Improve Energy Efficiency in Power Plants in Indonesia: Assessment of specific Energy Efficiency measures in Power Plants in Indonesia*
     Activity: Energy saving study at Labuan 2 CFPP and PLTU Banten 3 Lontar CFP

i. Indonesia-Germany (GIZ)

- *NAMA Development of an Efficient Air-conditioning and Process Cooling Supply for the Indonesian Industry and Commerce (Green Chiller)*

  Activity: Green chiller pilot projects in the commercial and industrial sectors and RAC technician certification using hydrocarbon refrigerants.

- *Policy Advice for Environment And Climate Change*

  Activity: Revision of 3 SNI for Buildings (building envelopes, lighting systems, and air conditioning systems)

j. Indonesia – USA (USAID) The Indonesia Clean Energy Development II

Activity: Provide technical considerations for changing the CSPF calculation method on air conditioning, Assessment and Benchmarking of Performance and Emissions in the Power Generation Sector, and Facilitation of Mechanism Development in the field of Measurement and Verification (M&V)

APPENDIX A: REVIEW TEAM MEMBERS

Name	Position	Organisation	Economy	Primary role
Dr Kazutomo Irie	President	APERC	Japan	Team Leader
Dr Terry Surles	Professor	The University of Hawaii	USA	Electricity and other energy supply
Dr William Chung	Associate Professor	City University of Hong Kong	Hong Kong, China	Buildings
Dr Meng Liu	Associate Research Fellow	China National Institute of Standardization	China	Appliances
Prof Masaaki Bannai	Professor	Mie University	Japan	Industry
Mr Albert Dessi	Assistant Manager	Department of Industry, Science, Energy and Resources	Australia	Transport
Mr Munehisa Yamashiro	Vice President	APERC	Japan	MC
Mr Mathew Horne	Senior Researcher	APERC	Australia	Facilitator
Mr Eri Nurcahyanto	Senior Researcher	APERC	Indonesia	Facilitator
Mr Ario Jati	Senior Researcher	APERC	Indonesia	Facilitator
Dr Gigih Atmo	Senior Researcher	APERC	Indonesia	Facilitator

APPENDIX B: AGENDA

DAY 1 – TUESDAY, NOVEMBER 9, 2021

Time (Jakarta Time)	Topic	Speaker/PIC
07.30 – 08.30	**Registration, Test Run**	
08.30 – 08.35	*Welcoming Remarks*	Director General of New and Renewable Energy
08.35 - 08.40	*Opening Remarks*	President of APERC
08.40 – 08.45	*Photo Session Participants*	
08.45 – 08.55	*Overview Energy Efficiency (EE) Implementation in Indonesia*	Director of Energy Conservation, Ministry of Energy and Mineral Resources
08.55 – 09.05	*Follow Up Recommendation APEC PREE Review 2021*	Directorate of Energy Conservation (DKP), Ministry of Energy and Mineral Resources
Energy efficiency in Home Appliances Sector		
09.05 – 09.25	*Policy and Program of EE in Home Appliances*	Directorate of Energy Conservation (DKT), Ministry of Energy and Mineral Resources
09.25 – 09.50	*Supporting of test laboratories to implementation of minimum energy performance standards*	Chief of Test Laboratories Communication Forum
09.50 – 10.30	*Question and Answer*	*Reviewer* APERC
10.30 – 11.00	*Break*	
Energy efficiency in Commercial Building & Residential Sector		
11.00– 11.25	*EE Policy and Program in Building Sectors*	Directorate of Energy Conservation (DKK), Ministry of Energy and Mineral Resources
11.25 – 11.50	*Challenges in Implementation EE/Green Building*	Director of Building Management, Ministry of Public Works
11.50 – 12.40	*Question and Answer*	*Reviewer* APERC
12.40 – 12.45	*Closing Day 1*	

DAY 2 – WEDNESDAY, NOVEMBER 10, 2021

Time (Jakarta Time)	Topic	Speaker/PIC
07.30 – 08.30	**Registration, Test Run**	
Energy Management System in Industry 4.0		
08.30 – 09.00	*Implementation of Energy Management System in Indonesia*	Directorate of Energy Conservation (DKA), Ministry of Energy and Mineral Resources
09.00 – 09.30	*Progress of Industry 4.0 in Indonesia to Support EE Program*	Head of Green Industry Centre, Ministry of Industry
09.30 – 10.15	*Question and Answer*	*Reviewer* APERC
10.15 – 10.45	*Break*	
ESCO and energy efficiency Financing		
10.45 – 11.05	*Regulation Challenge in Development of ESCO in Indonesia*	Directorate of Energy Conservation (DKE), Ministry of Energy and Mineral Resources
11.05 – 11.25	*Green Taxonomy to Support EE*	*Senior Analyst at Financial Services Authority* - OJK
11.25 – 11.45	*Sharing of Difficulties to Implement ESCO's Scheme*	President Director of PT. WIKA Energi
11.45 – 12.05	*Sharia Model to Finance EE Project*	President Director of Bank Syariah Indonesia
12.05 – 12.35	*Question and Answer*	*Reviewer* APERC
12.35 – 12.45	*Closing Day 2*	

DAY 3 – THURSDAY, NOVEMBER 11, 2021

Time (Jakarta Time)	Topic	Speaker/PIC
07.30 – 08.30	**Registration, Test Run**	
Energy efficiency in Transportation Sector		
08.30 – 08.50	*Energy Conservation Policy in Transportation Sector*	Directorate of Energy Conservation (DKP), Ministry of Energy and Mineral Resources
08.50 – 09.10	*Electric Vehicle and Supporting*	Directorate of Electricity Technical and Environment, Ministry of Energy and Mineral Resources
09.10 – 09.30	*Energy Management in Transportation Sector*	Head of Sustainable Transport Development Centre – Ministry of Transportation
09.30 – 10.15 WIB	*Question and Answer*	*Reviewer APERC*
10.15 – 10.45 WIB	*Break*	Panelist
Energy efficiency on the Supply Side		
10.45 – 11.05	*Emission Cap and Trade in Power Plant*	Directorate of Electricity Technical and Environment, Ministry of Energy and Mineral Resources
11.05 – 11.25	*Energy Efficiency in Coal Power Plant*	General Manager PT. Indonesia Power PLTU Lontar
11.25 – 11.45	*ISO 50001 Implementation in Refinery*	General Manager PT. Pertamina RU IV
11.45 – 12.30 WIB	*Question and Answer*	*Reviewer APERC*
12.30 – 12.45 WIB	*Closing Remarks*	1. President APERC 2. Ministry of Energy and Mineral Resources

APPENDIX C: RECOMMENDATIONS

INDUSTRY SECTOR

Recommendation 1

The MEMR should consider lowering the energy consumption threshold so that energy management systems are required to be implemented by a larger segment of Indonesia's industry sector.

Recommendation 2

The MEMR should consider encouraging energy management system participation through an award or incentive system. The design of an imitation and copy system may prove effective, where good practices are rewarded by the government. These incentives can be regionally specific and awarded based on a competitive application process.

Recommendation 3

The MEMR should develop programs for talented persons and technical experts that improve their capacity as energy managers and energy auditors.[17] *Talented persons must have experiences with not only energy facilities, but also production, and combination of different facilities. There are opportunities for development of programs in multiple industrial settings, and for the development of programs to make use of MEMR training centres already established.*

Recommendation 4

To improve the consistency and effectiveness of energy audits, the Government of Indonesia could consider setting specific requirements for energy audits depending on the size of the organisation and the sector they operate in. Table A1 in ISO50002 (or the Australian Standards for energy audits [AS/NZS3598.1 – 3598.3]) could indicate potential requirements for detailed (type 2) audits. There may be benefits in having less frequent but more detailed audits.

Recommendation 5

To improve the effectiveness of energy audits, the Government of Indonesia should consider setting a payback limit on the requirement of the implemented program. For example, only requiring implementation of opportunities with simple paybacks of 4 years or less. This should encourage the identification of both longer-term opportunities and short-term opportunities that can be easily implemented.

Recommendation 6

The MEMR should consider specifying how Industry 4.0 is related to energy efficiency to facilitate industry sector energy efficiency opportunities.

Recommendation 7

The MEMR should consider establishing an energy efficiency finance scheme for ESCO's. The scheme should allow the energy efficiency savings that the ESCO is promised to act as the security for the energy efficiency project investment. To establish this scheme, the Government of Indonesia needs cooperation with related development partners which provide appropriate funding to be able to create and implement the pilot projects.

[17] For example, this program could be facilitated through PSBE award program.

Recommendation 8

The Government of Indonesia should consider establishing risk-sharing facilities for EE&C investment and ESCO's.

TRANSPORT SECTOR

Recommendation 9

To promote BEVs at negligible cost to government, the government should consider establishing rigorous fuel efficiency standards in grams of CO2-equivalent per kilometre rather than litres of fuel per 100 km. 'Super credits' for BEVs should be considered to encourage BEV supply at low budgetary cost. As in Europe, super credits could be reduced over time. Impacts on domestic automotive manufacturing may need to be considered in implementing this recommendation.

Recommendation 10

To encourage public acceptance and support for BEVs, the government should focus policies and communication regarding BEVS on lower cost models. For example, government websites, reports, and other media, could provide pictures and examples of lower cost electric vehicles, rather than luxury or high-performance vehicles.

Recommendation 11

As BEVs approach price parity, the government should focus its policy support for electric vehicles on supporting provision of the required charging infrastructure rather than subsidising BEV purchases. An alternative form of financial support could be to fund lower interest loans covering the difference in price between BEVs and ICE vehicles, focusing on lower cost BEVs. Such a lower cost loan scheme could potentially be funded from luxury vehicle taxes.

Recommendation 12

Given Indonesia's geographic dispersion and varying population density throughout the archipelago, it would be preferable if the Government of Indonesia set rigorous fuel efficiency standards and review them every five years rather than setting targets for reducing ICE vehicle sales.

Recommendation 13

To improve the fuel efficiency of the remaining road vehicle fleets, the Government of Indonesia should consider improving fuel standards over time by improving fuel quality (lowering sulphur content) and reducing noxious emissions (higher Euro standards such as Euro 5 or 6). This might require supporting domestic refineries to upgrade their plant to produce better fuels.

Recommendation 14

As lighter, more compact vehicles have inherently lower emissions and are also cheaper, the Government of Indonesia should consider reviewing vehicle registration charges to encourage lighter vehicles and vehicles with improved noxious emissions standards. Registration charges could potentially also be used to encourage smaller, lighter BEVs.

Recommendation 15

The Government of Indonesia should continue to support increased renewable energy generation to maximise the emissions reduction benefits from increased BEV take-up. When estimating the abatement available from BEVs, projected grid emissions intensities may provide more accurate results than using current values.

Recommendation 16

The Government of Indonesia should consider improving efficiency information for the trucking industry, by, for example:

- *Supporting in service trials of different energy efficient technologies, in an Indonesian context, for different duty cycles,*
- *Publishing trial results to provide the evidence for other businesses to justify financing for energy efficiency,*
- *Supporting eco driving training.*

Recommendation 17

The Government of Indonesia should consider adopting and applying a specific energy audit standard for transport, especially for large transport operations. In addition, for large companies, regulating the degree of detail of the energy audits could be considered, together with a longer period between audits.

Recommendation 18

To reduce the emissions of all road vehicles at a low cost, the Government of Indonesia should consider developing labelling and MEPS for car and truck tyres, using European and US labelling standards as a guide.

Recommendation 19

To reduce the emissions of large long-distance trucking at low cost, the Government of Indonesia should consider setting a lower speed limit for trucks, compared to cars, on highways. For example, trucks might have a speed limit 10km/hr lower than cars.

BUILDINGS SECTOR

Recommendation 20 (previously recommendation 37 from 2011 PREE)

The Government of Indonesia should consider developing building EE&C regulations or building energy codes for residential buildings, based on life cycle cost-effective energy-efficient measures. Enhance the implementation of these regulations.

Recommendation 21

The Government of Indonesia should consider developing a mandatory energy performance certificate (EPC) system for all building and apartment owners.

Recommendation 22

The Government of Indonesia should consider developing a predictive online benchmarking system for all building and apartment owners.

Recommendation 23

The Government of Indonesia should consider establishing the Energy Efficiency Revolving Fund (EERF) financed by sustainable sources, such as a tariff levy on electricity sales to inefficient buildings.

Recommendation 24

The Government of Indonesia should consider the imposition of energy and carbon taxes on inefficient equipment, on top of VAT.

Recommendation 25

The Government of Indonesia should consider establishing OBR with utility companies for conducting EE&C projects and allowing a longer payback period.

APPLIANCES

Recommendation 26

The Government of Indonesia should consider conducting research on developing an economy-wide cooling action plan to promote the development and deployment of green and efficient cooling technologies and products in almost all areas. Different mechanisms and measures of policies, regulations, standards, technologies, engineering applications, markets and industries, finance, and so on, could be designed to improve cooling efficiency by promoting the deployment of green efficient cooling appliances, equipment and technology.

Recommendation 27

The Government of Indonesia should consider conducting research to improve its MEPS system, particularly from the perspective of industrial and commercial equipment.

- *For commercial equipment, MEPS for commercial cooling equipment, including refrigerated display cabinets, chillers, cold storages, and commercial AC systems should be developed as a priority.*
- *For industrial equipment, MEPS for the typical industrial equipment such as electric motors, industrial pumps, and fans, should be prioritised because they are usually the main energy-using equipment in plants.*
- *For electronic and intelligent products/systems, such as computers, data centres, et cetera, which are widely used in different applications of household, commercial and industrial areas and are consuming more and more energy with the development of digitalisation and informatisation.*
- *System opitimisation in terms of energy efficiency should be considered alongside energy efficiency performance of individual pieces of equipment.*

Recommendation 28

The Government of Indonesia should consider conducting research on the development of standards for the efficient operation of energy-using equipment, which accounts for actual energy efficiency under operational conditions and takes full use of the energy saving potential of the efficient appliances/equipment rated by MEPS.

Recommendation 29

The Government of Indonesia should consider conducting research on introducing QR codes to the traditional energy label and on the possibility of developing carbon labels.

Recommendation 30

The Government of Indonesia should consider conducting research on the development of EMS standards, particularly for small companies, to rapidly build up a cost-effective EMS. ISO/TC301 has developed and released the international standard of ISO 50005:2021 Energy management systems — Guidelines for a phased implementation. This standard is developed to establish a phased approach to implement an EMS. This phased approach is intended to support and simplify the implementation of an EMS for all types of organisations, including small and medium-sized organisations (SMOs), which might be helpful if Indonesia carried out the suggested research.

Recommendation 31

The Government of Indonesia should ensure that the lead agency stays abreast of the latest international developments in existing appliance standards (air conditioning, refrigerators, et cetera) and future standards (lighting, fans, washing machines, et cetera) for these technologies. This will ensure that these standards are international state-of-the-art.

ELECTRICITY

Recommendation 32

The MEMR should prepare and set the electricity sector's efficiency codes, goals, and standards, not PLN as a utility or system operator.

Recommendation 33

The MEMR should consider allocating greater proportion of time and funds to developing renewable resources for electricity production rather than increasing the efficiency of existing coal-fired power plants. Policies aimed at maintaining efficiency of older fossil fuel plants may also provide reasonably short paybacks, within the remaining plant life.

INSTITUTIONAL FRAMEWORK AND OTHER CROSS-SECTORAL ISSUES

Recommendation 34

The Government of Indonesia should consider appointing or establishing one governmental institution that can deal with, and be responsible for, energy and energy efficiency.

Recommendation 35

The Government of Indonesia should consider nominating an existing body as the one governmental institution responsible for the energy efficiency certification process, with responsibility for also developing energy efficiency standards and regulations. If no existing bodies have the required capabilities, a new body could be established for this purpose.

Recommendation 36

The Government of Indonesia should consider appointing or establishing one governmental institution responsible for primary standards, chain-of-custody, and replication of results to ensure that any data are valid. An economy-wide testing and standardisation laboratory would provide the proper analytical methods and testing materials that can serve as the standards for any analyses done by others in ensuring energy efficiency data.

Recommendation 37

The Government of Indonesia should consider expanding energy efficiency training and education, including for auditors and energy managers, by involving universities. Universities should develop programs and courses in energy systems technology and analysis. There should be a focus on renewable energy systems and end-use energy efficient technologies

Recommendation 38

The Government of Indonesia should consider developing programs for training appropriate and responsible managers and staff in governmental agencies. Frequently, government agencies can serve as roadblocks, because the staff and management within these agencies do not understand the technologies or the evaluation processes for energy technologies – in this case, energy efficiency.

Recommendation 39

The Government of Indonesia should consider developing a public awareness program concerning climate change as a model for highlighting the need for sustainable practices among the broader population. Part of the public educational program in this area can focus on best practices in energy efficiency.

Recommendation 40

The Government of Indonesia should consider setting a "stretch" energy efficiency goal of 2% per year, starting in 2023 and extending through 2030. This allows for sufficient time for the preparation of the economy, metrics to be employed, and enticements for meeting such a stretch goal.

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USEFUL LINKS

Directorate General of Electricity – www.djk.esdm.go.id
Directorate General of New and Renewable Energy and Energy Conservation – www.ebtke.esdm.go.id
Ministry of Energy and Mineral Resources (KESDM) – www.esdm.go.id
Ministry of Transportation – www.dephub.go.id
Mistry of Industry – www.kemenperin.go.id

National Energy Council – www.den.go.id
PT Pertamina – www.pertamina.com
PT Pertamina Gas – www.pertagas.pertamina.com
PT PGN (Persero) – www.pgn.co.id
PT PLN (Persero) – www.pln.co.id
Statistics Indonesia (Badan Pusat Statistik, BPS) – www.bps.go.id