IRENA
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# Socio-economic footprint of the energy transition

# INDONESIA

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## About IRENA

The International Renewable Energy Agency (IRENA) serves as the principal platform for international co-operation, a centre of excellence, a repository of policy, technology, resource and financial knowledge, and a driver of action on the ground to advance the transformation of the global energy system. An intergovernmental organisation established in 2011, IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.
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## Disclaimer

# Contents

# Figures

# Tables



# Boxes

# Abbreviations

**°C** degrees Celsius

**ASEAN** Association of Southeast Asian Nations

**BAPPENAS** Ministry of National Development Planning

**$CO_2$** carbon dioxide

**$CO_2$ eq** carbon dioxide equivalent

**DEN** National Energy Council

**DMC** domestic material consumption

**EV** electric vehicle

**FIT** feed-in tariff

**G20** Group of 20

**GHG** greenhouse gas

**GDP** gross domestic product

**$GtCO_2$** gigatonnes of carbon dioxide

**GW** gigawatt

**IDR** Indonesian rupiah

**IRENA** International Renewable Energy Agency

**KDPDTT** Ministry for Villages, Development for Disadvantaged Regions and Transmigration

**KEN** National Energy Policy

**kW** kilowatt

**kWh** kilowatt hour

**LCOE** levelised cost of electricity

**LCR** local content requirement

*Exchange rate used throughout the report: USD 1 = IDR 14 761 as of 15 August 2022 UN operational rates of exchange.*

**LULUCF** land use, land-use change and forestry

**MEMR** Ministry of Environment and Mineral Resources

**Mt** million tonnes

**MW** megawatt

**NDC** Nationally Determined Contribution

**NREEC** Directorate General of New, Renewable Energy and Energy Conservation

**OECD** Organisation for Economic Co-operation and Development

**PES** Planned Energy Scenario

**PLN** Perusahaan Listrik Negara (state-owned utility)

**PPP** purchasing power parity

**PV** photovoltaic

**R&D** research and development

**RPJMN** Medium Term Development Plan 2020-2024

**RUEN** General Planning for National Energy

**RUPTL** Electricity Supply Business Plan

**TFEC** total final energy consumption

**TPES** total primary energy supply

**USD** United States dollar

# Executive summary

**With more than 270 million inhabitants (UN, 2022) and more than 17 500 islands (MOFARI, 2017), Indonesia is the fourth-most-populous country in the world and the largest economy in Southeast Asia** (World Bank, n.d.). The country has enjoyed impressive growth over the years. Rapid economic growth has led to a reduction in poverty in recent decades and supported socio-economic development. As an archipelago nation, Indonesia is exceptionally vulnerable to climate change. This is in addition to the large environmental footprint of rapid growth, which in Indonesia is closely tied to natural resources, including the country's energy resources, waters, land and forests. The ongoing COVID-19 pandemic as well as other external factors such as slowing global economic growth, and geopolitical shocks all increase short-term pressures on Indonesia in the midst of the larger, unfolding climate crisis.

**The government of Indonesia has realised the urgency of addressing climate change and begun to establish different sets of national targets and action plans directed at energy efficiency, greenhouse gas (GHG) emissions and renewable energy deployment.** In 2016, the country submitted its first Nationally Determined Contribution (NDC) towards reducing GHG emissions under the Paris Agreement, announcing the target of reducing GHG emissions unconditionally to 29% and conditionally to 41% compared to the business-as-usual (BAU) scenario by the year of 2030 (UNFCCC, 2016). Under the BAU Indonesia would release approximately 2.869 gigatonnes of carbon dioxide equivalent ($GtCO_2eq$) by 2030. In the conditional scenario, Indonesia is projected to produce 132.74 terawatt hours of renewable energy by 2030, which is equivalent to 21.65 gigawatts of capacity (about one-third of Indonesia's current installed power capacity). In the unconditional scenario, 19.6% of generated power could come from renewables by 2030. The NDC also stipulates the implementation of biodiesel blending mandates in the transport sector: 90% in the unconditional scenario and 100% in the conditional. Indonesia's updated NDC in 2021 does not change this target but does propose new carbon tax policies to support it, in addition to setting a net-zero target by 2060 (UNFCCC, 2021).

**Several policies and incentives have been put in place to support Indonesia's climate targets (Figure S.1),** including the latest presidential decree in September 2022 that aims to increase the share of renewables to 23% by 2025 (Presidential Regulation No. 112 of 2022). In the electricity sector, the country has introduced policy instruments such as feed-in tariffs, auctions and net metering to advance deployment of renewables and minimum local content requirements to localise socio-economic benefits. In the heating and cooling sector, initiatives distribute clean biomass stoves and provide electric stoves to millions of households. In the transport sector, biofuel blending mandates play an important role. Implementation of these policies, however, has been mixed, with often subpar outcomes, and the electricity sector remains critically dependent on coal for the next decade. For Indonesia to maximise the socio-economic benefits of the energy transition, effective policy design and implementation will be needed.

**Figure S.1** Incentives for renewable energy in Indonesia

| Tax allowance | Import duty facility | Tax holiday |
| --- | --- | --- |
| • Government regulation no. 78/2019 | • MoF regulation no. 176/PMK.011/2009 jo.<br>• MoF regulation no. 76/PMK.011/2012 jo.<br>• Mo regulation 188/PMK.010/2015 | • MoF regulation no, 150 PMK. 101/2018 |
| • 30% investment value<br>• Reduction of corporate net income tax for 6 years, 5% each year<br>• 183 Business segments eligible for tax allowance, expanded from 129 segments in the previous regulation | • Import duty on machinery and equipment, goods, and raw materials for production<br>• Exemption of import duty on machinery and equipment<br>• 2 years exemption of import duty on raw materials<br>• Additional 2 years import duty exemption for raw materials if company using locally produced machisery and equipment (minimum 30%) | • 5-20 years Tax relief facility starting from the commencement of commercial production. Can be extended for a maximum of 20 years under certain conditions<br>• IDR 100 billion minimum investment plan<br>• 50-100% reduction of corporate income tax for pioneer industry<br>• 2 years relaxation (tax reduction) after facility period, with provisions: 25% for investment IDR 100-500 billion<br>• 50% should be more than IDR 50 billion |

Source: Adapted from MEMR (2020).

Note: MoF = Ministry of Finance; jo. = in conjunction with

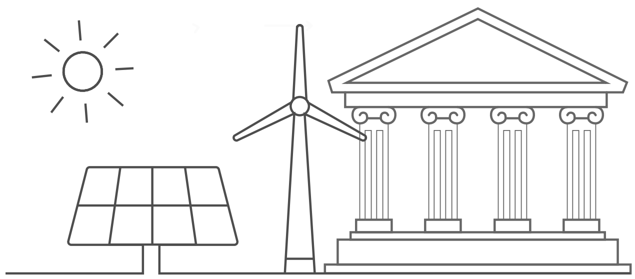
**In power purchase parity terms, Indonesia has the world's seventh-largest economy and the biggest in Southeast Asia.** The country has weathered some severe challenges, like the Asian financial crisis, but due to the composition of its exports, it remains vulnerable to the volatility of international commodity prices and negative environmental externalities (deforestation, forest degradation and air pollution). Indonesia is a major exporter of land-based commodities, particularly agricultural products such as palm oils, natural rubber, coconut, coffee and wood products, and energy transition minerals like nickel, tin and bauxite (USGS, n.d.). Deforestation linked to resource extraction constitutes a major environmental problem as well as a major source of carbon dioxide ($CO_2$) emissions. Thus, the country needs to find a balance between creating economic opportunities while also preserving its natural environment and reducing land-based emissions, which in turn is essential to safeguard livelihoods in the coming decades. The energy transition offers Indonesia a critical avenue to decouple socio-economic development from energy use and GHG emissions, thereby protecting livelihoods and supporting prosperity. With declining revenues from the oil and gas sector, which was a major contributor to gross domestic product (GDP), Indonesia will need to diversify its economy to reap benefits from the energy transition.

**A just and inclusive energy transition ensures that its benefits accrue to the majority.** This means that the technological changes inherent in the energy sector's transition need to be accompanied by effective policies securing livelihoods and economic resilience, and protecting the environment on which much of Indonesia's modern-day development is based. Energy equity and justice, the guiding principles behind the country's energy law, are yet to be achieved. More than 15% of the population continued to lack access to clean cooking and 3% (mainly in remote areas) lacked access to modern electricity in 2020, while many more had no access to modern health care services and education (WHO, n.d.; UN, n.d.). Indonesia is the world's fifth-largest emitter of GHGs (WRI, 2022), and the tenth-largest emitter of $CO_2$ emissions according to the IPCC/EDGAR[1] emissions database (Crippa et al., 2021). Material consumption is the second lowest among the G20[2] countries (OECD, n.d.), but as Indonesia continues to develop, this figure is expected to rise.

**Indonesia's energy fiscal policies need to support the energy transition.** Subsidies consume a significant portion of national expenditure; coupled with a low tax base, resulting fiscal deficits have hindered necessary investment in better, more efficient infrastructure, as well as in public education and health services, leaving a sizeable portion of the population far behind. High youth unemployment is also a key issue, and foreign investment flows have been quite low.

A more ambitious energy transition pathway will help Indonesia address many of its social, economic and environmental challenges. The energy transition presents great potential to improve Indonesia's performance on broader socio-economic indicators and to alleviate some of the existing challenges. This is shown by the analysis in this report that compares an ambitious 1.5-degree compatible pathway (1.5°C Scenario) and a reference Planned Energy Scenario (PES) in terms of $CO_2$ emission reductions, lower local air pollution, welfare, jobs and GDP.

**The country's economy performs better under a more ambitious energy transition scenario.** In per capita terms, Indonesia's GDP is expected to increase from the current USD 4 189 to more than USD 22 535 in 2050 (2019 USD). Under the 1.5°C Scenario, the country's economy will perform even better during the first decade. The second decade of the transition period sees similar GDP under the 1.5°C Scenario and PES, while in the last decade, GDP under the 1.5°C Scenario is lower than under the PES (with this maximum difference by 2050) (Figure S.2). Nevertheless, the 1.5°C Scenario yields a GDP that is 0.5% higher on average over the 2021-2050 period than what can be expected under the PES. In the year 2050, GDP would be 2.5% lower in the 1.5°C Scenario than in the PES, given that the initial benefits of more ambitious policies fade over time.

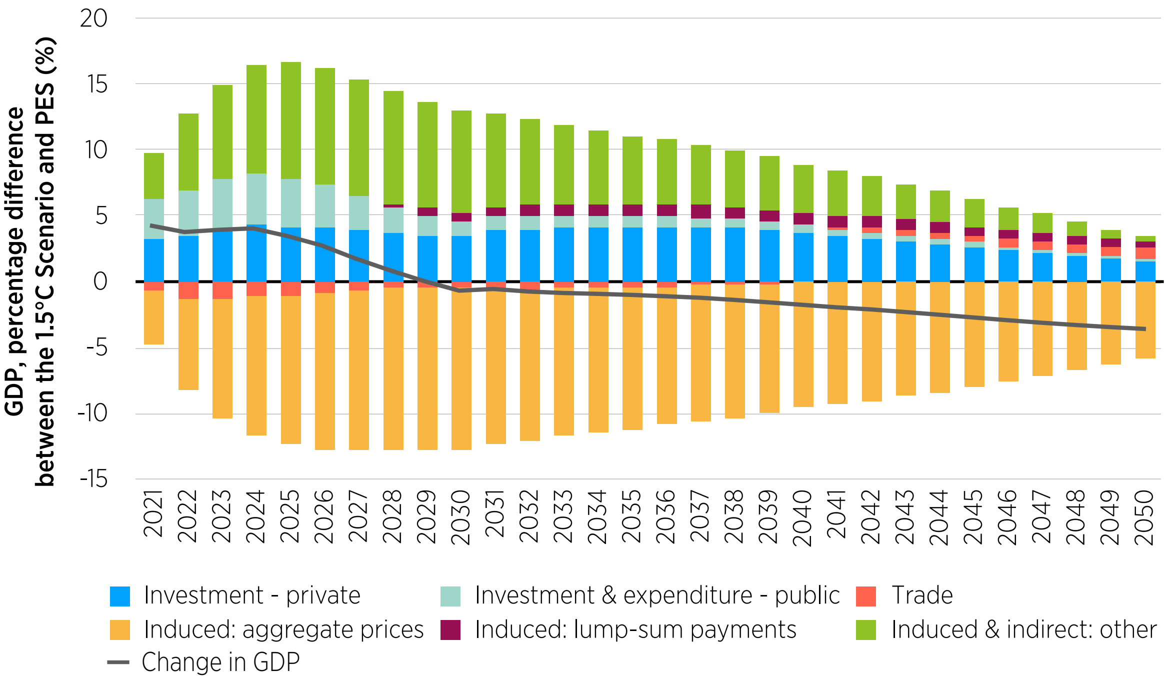


*[1] IPCC: Intergovernmental Panel on Climate Change; EDGAR: Emissions Database for Global Atmospheric Research.*

*[2] The Group of 20 comprises Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russian Federation, Saudi Arabia, South Africa, Republic of Korea, Türkiye, the United Kingdom, the United States and the European Union.*

**Some of the key drivers of the difference in GDP growth between the PES and 1.5°C Scenario are indirect and induced effects and investment, while trade has a minor impact (Figure S.2).** In the first half of the transition period (*i.e.* 2021-2035), investment plays the biggest role, while induced and indirect effects are the main drivers in the second half. Indonesia reaps economic benefits from investment stimulus through indirect and induced effects such as those arising from increases in labour income. This process generates additional real income and thus spending. But the effects dissipate by the end of the period as investment drops, which has a negative impact on employment and labour income. Regarding trade, the negative impacts of changes in trade in the first half of the transition period are later slightly outweighed by the positive contribution of net trade in fuels. The additional revenues from carbon pricing and international co-operation receipts play a central role in enabling Indonesia to overcome the loss of fossil fuel revenues, fund transition-related investments and support just transition programmes. Being one of the beneficiaries of global transition flows, Indonesia sees an increase in government social spending in the 1.5°C Scenario of around USD 7 billion (2019 PPP) more than under the PES by 2050. This allows increased spending on social services, predominantly by the government, including on public administration, health care and education, resulting in welfare gains.

**Figure S.2** Indonesia's GDP, percentage difference between 1.5°C Scenario and PES by driver, 2021-2050



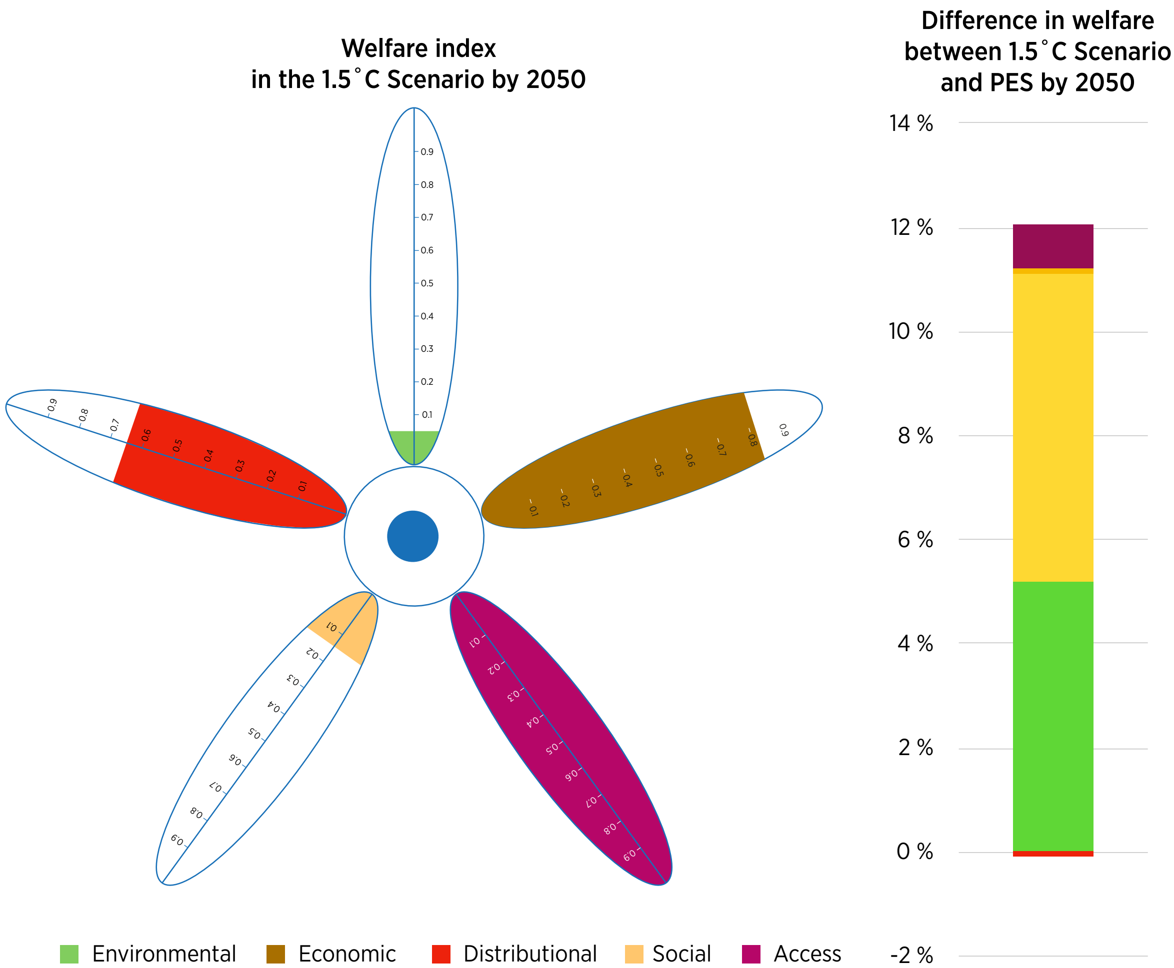

Note: GDP = gross domestic product; PES = Planned Energy Scenario.

**Driven by social and environmental factors, the improvement in welfare in Indonesia under the 1.5°C Scenario, relative to the PES, improves by 12% by 2050** (right panel of **Figure S.3**). This is a result of the reduced negative health effects of local air pollution, paired with reduced cumulative $CO_2$ emissions. **Access** also benefits from the energy transition. Basic energy access improves significantly under the PES, reaching an index value of 0.92 by 2050, and Indonesia achieves universal energy access under the 1.5°C Scenario, reaching a maximum value of 1 in 2030 (left panel of Figure S.3). Under both the PES and 1.5°C Scenario, Indonesia's energy consumption reaches the level of sufficiency, assumed to be 20 kilowatt hours/capita/day in line with literature (Millward-Hopkins *et al*., 2020),[3] in the first half of the first decade (*i.e.* 2021-2025). By contrast, the **economy** sees only marginal improvement, due to a

[3] *Sufficiency level estimated between 11.6 and 30.4 kilowatt hours/capita/day across all 119 countries depending on the scenarios considered.*

slight change in the non-employment indicator.[4] By 2050, income is distributed more effectively under the 1.5°C Scenario than under the PES, but only by a slight margin, with wealth **distribution** dragging the intra-distributional index down. This is due to limited available fiscal space. Indeed, while benefiting from international co-operation flows, carbon tax revenues are reduced due to decreasing reliance on fossil fuels, loss of value in the oil and gas sector and increased public expenditures (subsidies to support the transition, and public investment related to it).

**Figure S.3** Welfare index for 1.5°C Scenario (left) and difference in welfare between 1.5°C Scenario and the PES (right), 2050



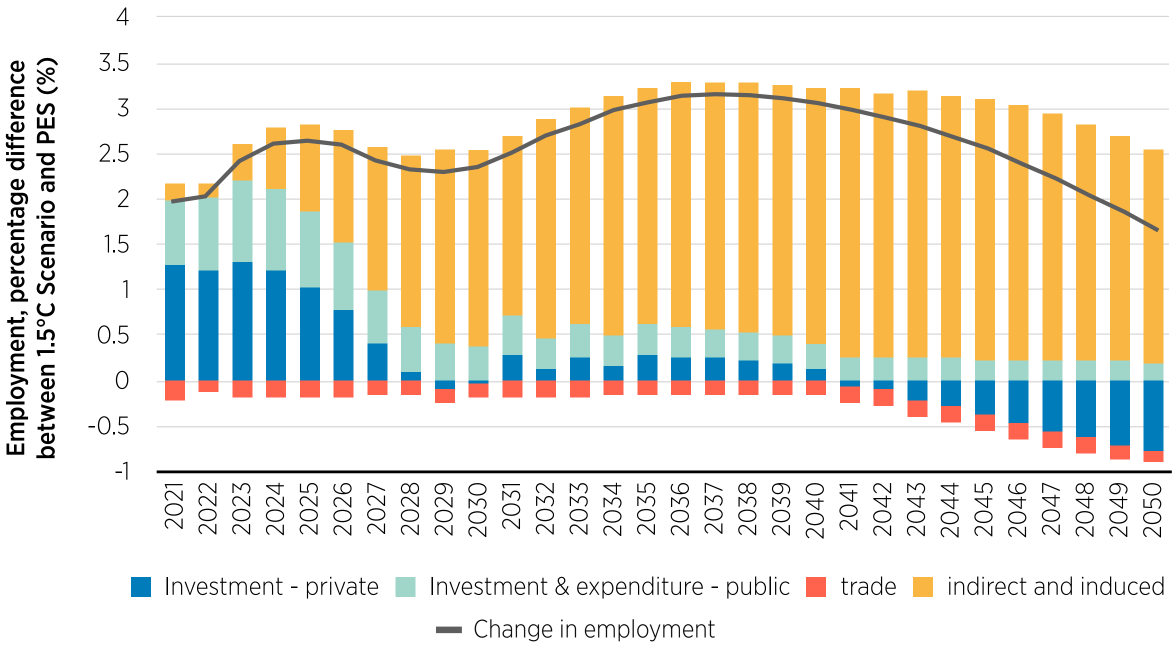

Note: PES = Planned Energy Scenario.

**The analysis suggests that additional policy actions would be needed to further improve human welfare indicators in Indonesia** (left panel of **Figure S.3**). The environmental and social dimensions offer the greatest room for improvement, which could be realised mainly by reducing material consumption and implementing policies that better target social spending. The economic and distributional dimensions also offer significant room for improvement, such as policies that improve wealth distribution and provide additional fiscal space that, in turn, increases income distribution (through lump-sum payments). Finally, additional policy efforts are needed towards enhancing access, to achieve a consumption level beyond sufficiency of energy access.

[4] *The share of people without paid work, excluding young people (aged 15 to 24 years) getting an education. Non-employment is thus calculated as the share of the working-age population (15 to 64 years) that is neither employed nor young (aged 15-24) and gaining an education. Non-employment is used instead of the unemployment or employment metrics because of its more comprehensive gauging of the social implications of paid work, which is the main goal of a welfare index. Indeed, while unemployment and employment are evaluated as shares of the labour force, non-employment is defined on the basis of the whole working-age population (not only the part of it belonging to the labour force), and hence beyond the short-term lack of paid work also captures the long-term lack of paid work (which is excluded from the labour force).*

**Under the 1.5°C Scenario, economy-wide employment is higher than in the PES by an average of 2.6% over the 2021-2050 period**. During this period, the differential reaches as high as 3.2% by the middle of the second decade but settles at 1.7% in 2050 (which translates into 2.7 million additional jobs in absolute numbers). The wave-like trend results from factors related to **indirect and induced effects and investment (Figure S.4)**. Front-loaded investment, both public and private in capital-intensive transition technologies (including renewables), is the principal driver of the additional jobs in the first five years. But soon after, this effect dissipates as front-loaded investment tapers off. The indirect and induced effects of consumer expenditure then become the main driver; these are mainly the ripple effects from front-loaded transition-related investments.

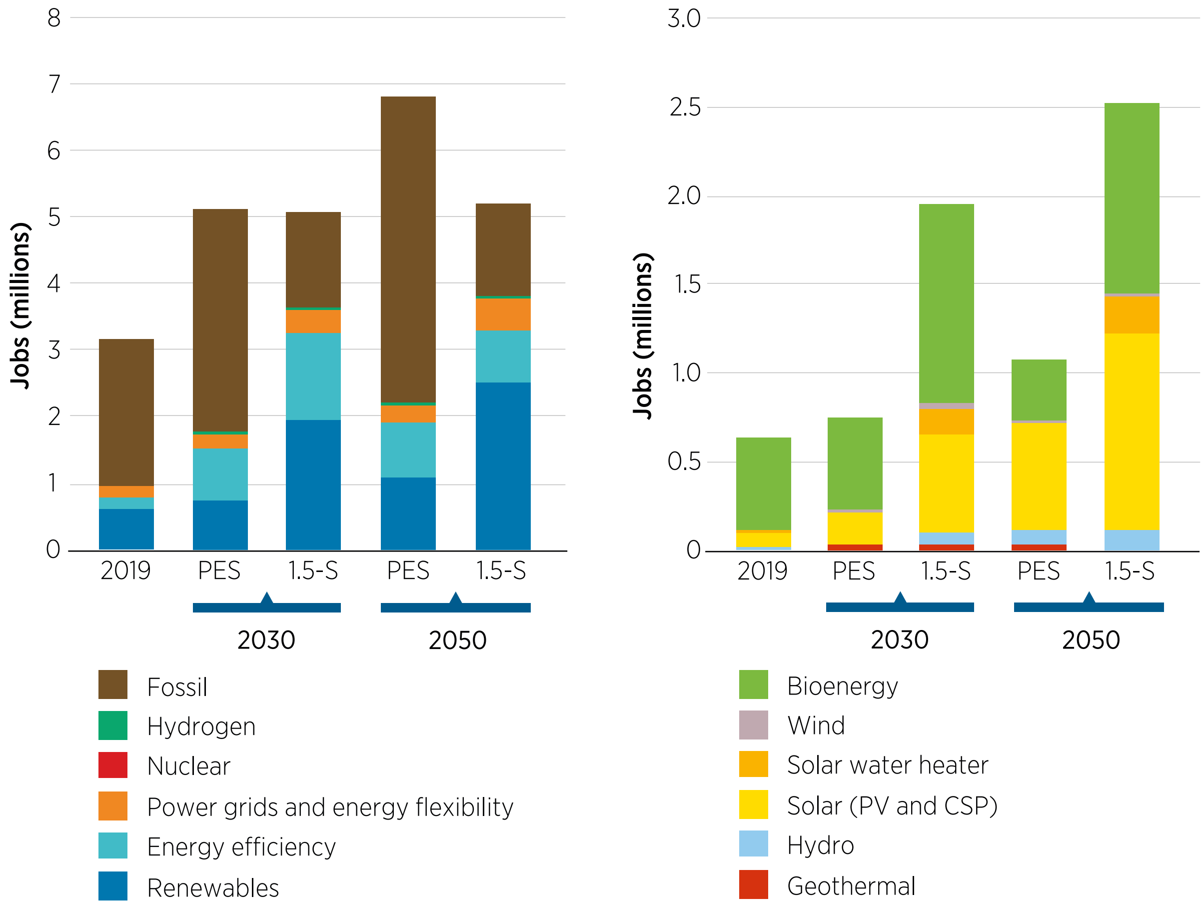
**Figure S.4** Employment in Indonesia, percentage difference between the 1.5°C Scenario and the PES by driver, 2021-2050




Note: PES = Planned Energy Scenario.

The number of people working in the Indonesian energy sector by 2030 could reach around 5.1 million in both the PES and 1.5°C scenarios, compared to 3.4 million currently (left graph in Figure S.5). The high losses of conventional energy jobs (*i.e.* fossil fuels and nuclear) are almost entirely offset by gains in jobs related to renewables and other energy-transition-related technologies (*i.e.* energy efficiency, power grids and flexibility, renewable hydrogen) by 2030. Reversing the decline in energy sector jobs would require dedicated policies to address the structural dependency on fossil fuels and to galvanise a more ambitious approach to the energy transition. The negligible increase in jobs under the 1.5°C Scenario in 2050 compared to 2030 is a result of the front-loaded implementation of new transition-related technologies (mainly energy efficiency) and an increase in productivity. By 2050, moving from the PES to the 1.5°C Scenario would imply a decline in fossil fuels of more than 70%. At that point, just a quarter of total energy jobs (1.3 million) would centre on fossil fuels, while those focused on renewables would double to nearly 2.5 million jobs.

**Figure S.5** Energy sector (left) and renewable energy (right) jobs in the PES and the 1.5°C Scenario, 2019, 2030 and 2050




Note: 1.5-S = 1.5°C Scenario; CSP = concentrated solar power; PES = Planned Energy Scenario; PV = photovoltaic.

**The number of renewable energy jobs in Indonesia is expected to significantly increase throughout the transition** (right graph in **Figure S.5**). At the end of the first decade, bioenergy (biogas and biomass) technologies are dominant, accounting for 69% (510 000 jobs) and 58% (1.1 million jobs) of renewable jobs by 2030 under the PES and 1.5°C Scenario, respectively. Their share decreases to 32% (387 000 jobs) and 43% (slightly less than 1.1 million) by 2050 under the PES and 1.5°C Scenario, respectively. Nevertheless, a rapid development of solar technologies would ensue, with jobs rising from more than 79 000 currently, to 177 000 in 2030 and 595 000 in 2050 under the PES, while under the 1.5°C Scenario they reach around 565 000 in 2030 and over 1.1 million in 2050.

**In short, a more ambitious energy transformation (1.5°C Scenario) will benefit Indonesian society**. To secure the benefits involved, the country will need to diversify its economy and reduce its reliance on fossil fuel exports. A sustainable economic development pathway would require Indonesia to transition away from its current structural dependencies on all natural resources. The energy transition involves far-reaching changes along different dimensions of the economy, society and the surrounding natural ecosystem. It also presents many benefits in terms of energy security, greater savings on imports and reduced exposure to price volatility. Maximising these benefits will require fine-tuning existing support policies and addressing some policy gaps, as discussed in the report.

# 01 Introduction

With more than 270 million inhabitants (UN, 2022) and more than 17 500 islands (MOFARI, 2017), Indonesia is the fourth-most-populous country in the world and the largest economy in Southeast Asia. Indonesia is the seventh-largest economy in the world in terms of purchasing power parity (PPP) (World Bank, n.d.) and a member of the Group of Twenty (G20). Its rapidly growing population is relatively young; by 2030 more than two-thirds of the country's inhabitants are projected to be of productive age (15-64 years).

In recent years, the country has experienced impressive economic growth. The poverty rate[5] fell by three-quarters, from 82% in 1999 to 22% in 2021 (World Bank, 2020a). Indonesia is rich in mineral and other natural resources. Agriculture contributes around 14% of the gross domestic product (GDP) (World Bank, n.d.), and palm and palm kernel oil have become the most important export commodities. Indonesia is one of the world's largest exporters of coal and natural gas, though it relies on net imports of oil. The country has strengthened mineral processing since 2014. An expanding middle class, and growing manufacturing and trade are some of the structural drivers of its GDP growth. However, slower global growth, the ongoing global pandemic, inflation and geopolitical shocks have been magnifying economic vulnerability in recent times.

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[5] *The poverty headcount ratio, at USD 3.65 a day, is the percentage of the population living on less than USD 3.65 a day at 2017 purchasing power adjusted prices.*
*The commonly used USD 1 a day standard (1985 PPP) was chosen for the World Development Report 1990 because it was typical of the poverty lines in low-income countries at the time (World Bank, 1990). As differences in the cost of living across the world evolve, the international poverty line has been updated to reflect these changes. The last change was in September 2022, when the World Bank adopted USD 2.15 (2017 PPP) as the international poverty line, which represents the mean of the poverty lines found in 15 of the poorest countries ranked by per capita consumption. The USD 3.65 poverty line is derived from typical national poverty lines in countries classified as lower middle income as in the case of Indonesia. The USD 6.85 poverty line is derived from typical national poverty lines in countries classified as upper middle income (World Bank, 2020a).*

Current economic challenges, both globally and for Indonesia, add to the challenge of climate change. The island geography of Indonesia's archipelago and its heavy economic reliance on natural ecosystems make the country highly vulnerable to rising sea levels, altered rainfall patterns and extreme weather events like floods and droughts, and rising temperatures. This is in addition to vast, existing environmental problems associated with Indonesia's rapid growth, and the exploitation of its natural assets such as forests for agriculture and other industries. High population density in hazard-prone areas, and its archipelago structure mean the threat of climate change is very real in Indonesia. In monetary terms, climate change has been estimated by the Asian development Bank (ADB) to cost Indonesia anywhere from 2.5% to 7% of the country's GDP by 2100, with the poorest people bearing the brunt of the financial burden and loss of livelihoods (Orecchia *et al.*, 2016).

Indonesia's primary energy supply is heavily dominated by oil, gas and coal, with a combined share of 85.6% in 2020 (MEMR, 2021; IRENA, 2020c). While bioenergy is the largest renewable energy contributor to the total primary energy supply mix and responsible for a large share of the country's renewable energy employment (IRENA, 2021a, 2020d), sustainability issues loom in view of deforestation trends.

The COVID-19 pandemic has provided governments with an opportunity to build sustainable, inclusive and resilient economies as they lay the groundwork for their financial, economic and social recovery. Investments that foster employment and economic activity, safeguard biodiversity and ecosystem services, fortify resilience and advance the decarbonisation of economies should be given top priority in both the immediate and long-term phases of recovery.

The Government of Indonesia is committed to implementing adaptation measures towards a climate-resilient economy, which integrates economic, social and environmental dimensions (MNDP/NDPA, 2021). The 2014 National Energy Policy (Kebijakan Energi Nasional, KEN) targets at least a 23% renewable share in the total primary energy supply by 2025 and at least 31% by 2050 (KEN 2014/79, 2014). The government and the national power utility (Perusahaan Listrik Negara, PLN) recently launched the new Electricity Supply Business Plan (Rencana Usaha Penyediaan Tenaga Listrik, RUPTL) 2021-2030, touted as the "greenest" RUPTL to date, which reaffirms the net-zero ambition by 2060 in line with the country's updated Nationally Determined Contribution (CEFIM, 2021a; Joshi, 2021). The government also pledged not to build any new grid-connected coal plants after 2023 (Jong, 2021; Bloomberg, 2021), though it will complete planned coal capacity before turning to renewables (Witt and Prasetiyo, 2021), implying Indonesia is locking itself into coal dependence for several more decades.

Indonesia has the resource potential for a more ambitious transition towards renewable energy, particularly since renewable electricity generation has become globally cost competitive with most fossil fuel-based generation (IRENA, 2021b). Solar photovoltaic (PV), bioenergy and hydropower could lead the way in transforming the Indonesian electricity sector. Solar PV can be a major generation source, with installed capacity of around 210 megawatts today out of an estimated potential capacity of around 3 000 gigawatts (GW) (IRENA, 2022a).. Bioenergy and wind, too, could increase sharply (with current installed capacity of 1.9 GW and 0.2 GW, respectively) given their estimated theoretical potential of 32.6 GW and 61 GW (IRENA, 2022a) (see Annex 1).

Understanding the socio-economic consequences of not transitioning or transitioning (and at different levels of ambition) is a fundamental aspect of proper planning and policy making. Policy makers need to be aware of how such choices will affect people's well-being and overall welfare, and of the potential gaps and hurdles that could affect progress. Exploring these complex issues in a series of studies since 2016 (IRENA, 2016, 2018a, 2020a, 2020b, 2021a), the International Renewable Energy Agency (IRENA) has analysed key drivers and impacts, providing insights to support energy transition planning and implementation at global, regional and national levels. In these studies, IRENA has emphasised that a holistic global policy framework is needed for the energy transition to be successful and broadly beneficial. Different policy elements complement and reinforce one another, covering a broad spectrum of technical, social and economic issues to accelerate the transition and ensure that its benefits are broadly shared, and its burdens minimised.

The socio-economic analysis is carried out using a macroeconometric model (E3ME)[6] that links the energy system and the world's economies within a single quantitative framework. It analyses the impact of the energy transition on variables such as GDP, employment and welfare to inform energy system planning and policy making to ensure a just and inclusive energy transition at the global, regional and national levels.

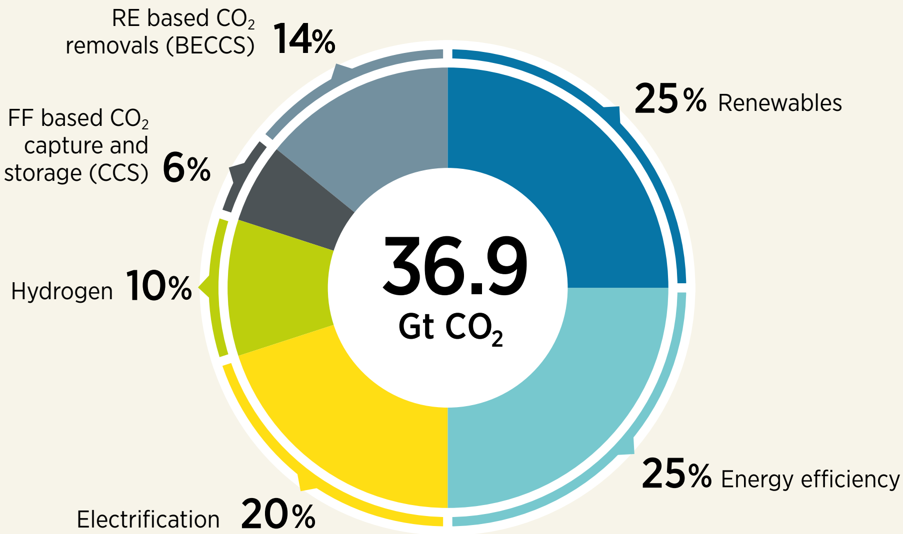
### **BOX 1** WORLD ENERGY TRANSITIONS OUTLOOK: 1.5°C PATHWAY


The *World energy transitions outlook* (2021 and 2022 editions) outlines a pathway for the world to achieve the goals of the Paris Agreement and halt the pace of climate change by transforming the global energy landscape. The reports present options to limit global temperature rise to 1.5 degrees Celsius (°C) and to bring $CO_2$ emissions closer to net zero by mid-century at the global level. They offer high-level insights on technology choices, investment needs, accompanying policy needs and the socio-economic implications to achieve a sustainable, resilient and inclusive energy future.

IRENA's 1.5°C Scenario considers today's proven technologies, as well as innovative technologies that are still under development but that could play a significant role by 2050. Figure 1 shows the six main components of $CO_2$ emissions abatement based on the most recent edition of the *World energy transitions outlook*, released in March 2022. Renewable energy plays a key role in the decarbonisation effort. Over 90% of the solutions in 2050 involve renewable energy through direct supply, electrification, energy efficiency, green hydrogen, and bioenergy with carbon capture and storage (Figure 1). Fossil-based carbon capture and storage has a limited role to play, and the contribution of nuclear remains at the same levels as today.

The report presents analysis at a globally aggregated level.

**Figure 1** Reducing emissions by 2050 through six technological avenues

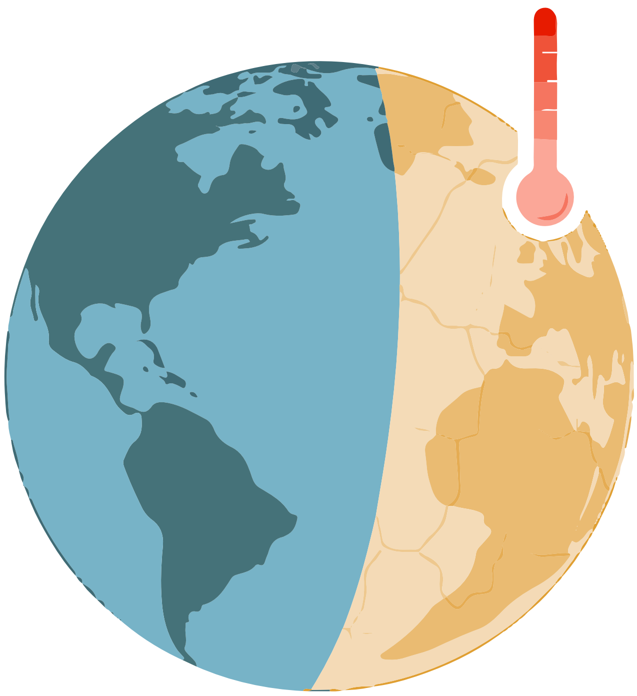



Note: CCS = carbon capture and storage; BECCS = bioenergy with carbon capture and storage; FF = fossil fuels; $GtCO_2$ = gigatonnes of carbon dioxide; RE = renewable energy.

Source: IRENA, 2022b.

[6] *The E3ME global macroeconometric model (www.e3me.com) is used for the assessment of socio-economic impacts. Energy mixes and related investment, based on the World energy transitions outlook 2022 (IRENA, 2022b), are used as exogenous inputs for each scenario, as well as climate- and transition-related policies.*

At the global level, IRENA explored these issues in its flagship report, the *World energy transitions outlook: 1.5°C scenario pathway* (IRENA, 2021a, 2022b) (see Box 1). Two energy roadmaps are analysed: (1) a scenario based on current plans, the Planned Energy Scenario (PES)[7]; and (2) an ambitious energy transition scenario (1.5°C Scenario)[8] that aims to reach the global 1.5°C goal. The timeframe of the analysis is until 2050. It finds that transforming the energy sector can yield widespread benefits: GDP growth averaging an additional 0.5% over the PES through 2030, and energy sector employment reaching 139 million, which is 33 million more than in the PES. Of those 139 million jobs, 38 million would be in renewable energy. Global welfare would be around 20% higher than in the PES. However, these global impacts will be unevenly distributed across countries and regions, depending on local socio-economic structures, the degree of reliance on fossil fuels and other commodities, and the depth of the renewables supply chain, among other factors. Zooming in from the global level, the report provides country-level results specific to Indonesia. The socio-economic footprint of Indonesia's energy transition depends on its accompanying policy framework that addresses parallel challenges in the energy system on the one hand, and the wider economy and social systems on the other. Its findings were used as inputs to the E3ME model for the socio-economic analysis in this report. Annex 2 lists some of the key policy assumptions underlying each scenario and considers how indicators vary (or not) across them. Chapter 2 presents the country's macroeconomic overview and trends and discusses some of the key trends and the current status of the energy sector and related policies. Chapter 3 presents the main results of the macroeconometric modelling (PES and 1.5°C Scenario) to evaluate the socio-economic impacts of the energy transition in Indonesia and shows the extent to which the transformation would affect economic growth (GDP), employment and welfare. Chapter 4 summarises the findings and provides policy recommendations for achieving the energy transition in a just and inclusive manner.



[7] *It is the reference case for this study, providing a perspective on energy system developments based on governments' energy plans, as well as other planned targets and policies as of 2019, including Nationally Determined Contributions (NDCs) under the Paris Agreement. This report considers policy targets and developments until April 2019. Policy changes and targets announced since then are not considered in the modelling exercise but are mentioned in the chapters to provide insights on latest developments.*

[8] *This scenario describes an energy transition pathway by which the increase in global average temperature by the end of the present century is limited to 1.5°C, relative to pre-industrial levels. It prioritises readily available technology solutions including all sources of renewable energy, electrification measures and energy efficiency, which can be scaled up at the necessary pace for the 1.5°C goal.*

# 02 Energy, welfare, and economic status and trends in Indonesia

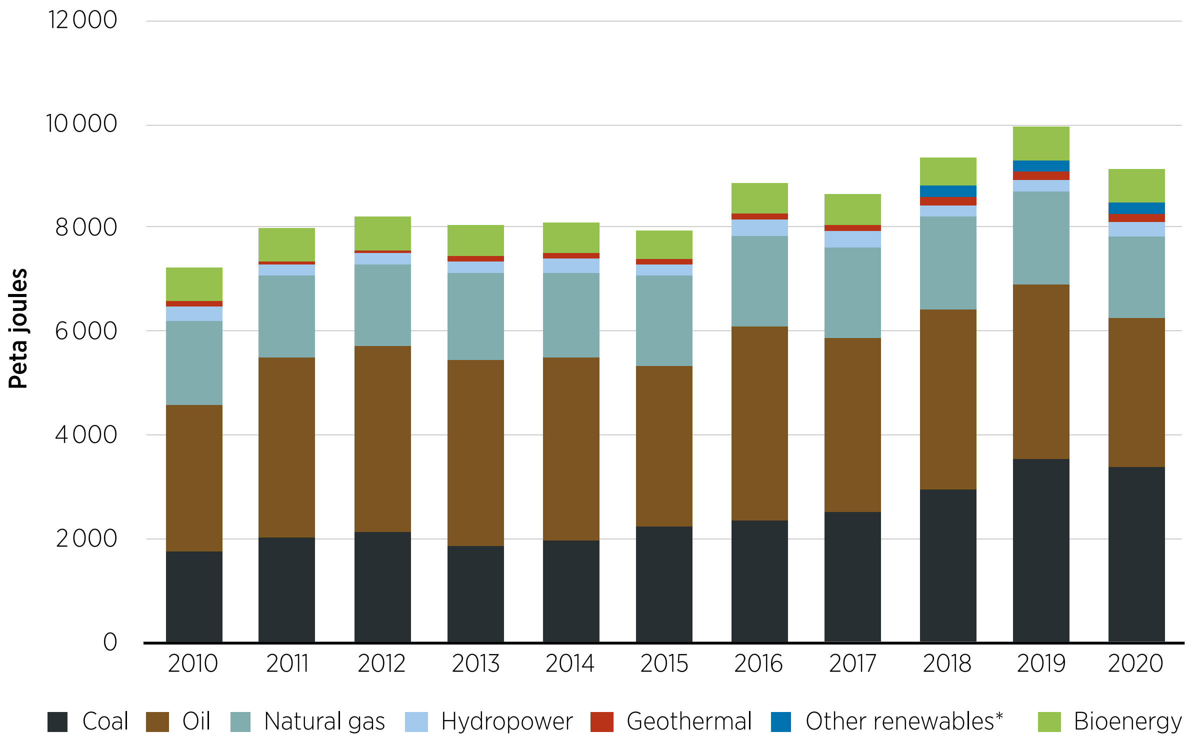
The socio-economic footprint analysis seeks to anticipate challenges and barriers, and explore the means to overcome them and thus streamline the transition. It is essential to understand the potential implications of the energy transition for individuals, society and the economy. These implications vary by country, given diverging economic structures, social contexts and historical developments.

This chapter discusses the status, trends and past performance of the most relevant energy-related, economic and social indicators, namely: economic performance measured by GDP, employment (economy-wide, in the energy sector and along the energy sector's value chain) and welfare. These indicators are then analysed under different scenarios (Planned energy scenario and 1.5°C scenario) to shed light on the impact of the energy transition throughout 2050 in Chapter 3.

## 2.1 THE CURRENT ENERGY MIX

Indonesia is a resource-rich country, with abundant energy resources including oil, coal, natural gas and renewables (see Annex 1). The country has been successful in exploiting these resources, which have contributed significantly to its GDP. Indonesia's total primary energy supply (TPES) increased by 26.2% between 2010 and 2020, reaching 9 137 petajoules in 2020 (Figure 2) (MEMR, 2021). Indonesia currently represents about 40% of the total primary energy supply of the Association of Southeast Asian Nations (ASEAN) (UNSD, n.d.). Fossil fuels dominate the TPES with a share of 85.6% as of 2020, which was a slight decrease from 86.0% in 2010. Coal is the biggest source of energy; its share of TPES actually grew over the past decade, from 23.9% in 2010 to 37.1% in 2020. On the other hand, the share of oil and natural gas decreased over the same time period, from 39.3% and 22.8% to 31.7% and 16.8%, respectively. The availability of fossil fuels at a comparably low cost has played a key role in the historical evolution of the country's energy mix.

**Figure 2** Indonesia's total primary energy supply, by source, 2010-2020



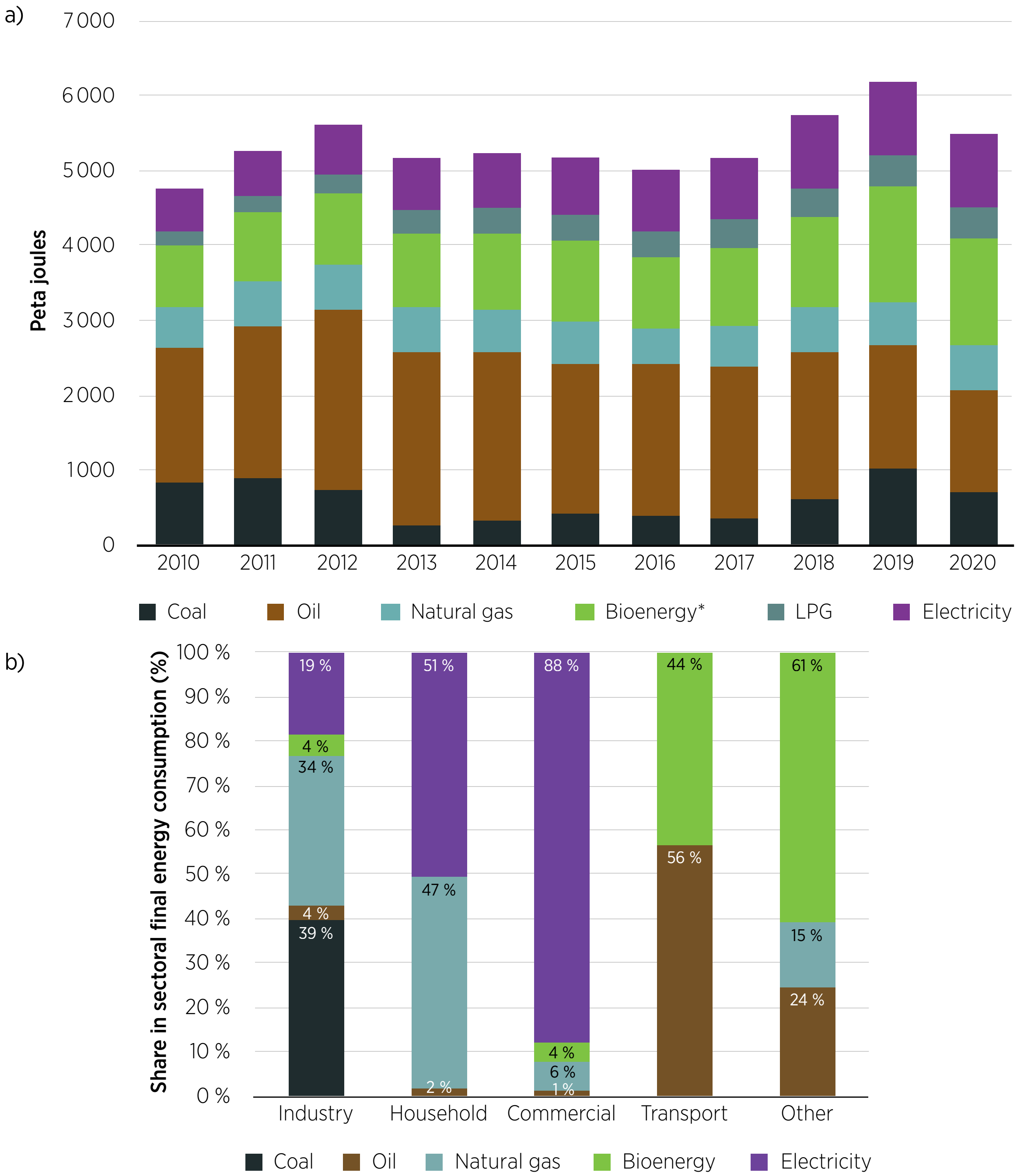

Source: MEMR, 2021.

Note: *"Other renewables" includes solar and wind.

Renewables accounted for the remaining share of about 14.4% of TPES in 2020. Biomass has shifted from traditional uses to modern applications in the form of biofuels and biogas: in 2020, the share of traditional biomass use was 5.6%, down from 9.1% in 2010. Thanks to supportive biofuel blending mandates for transport, the share of modern biofuels increased from 0.1% in 2010 to 3.7% in 2020, though not all of it was sustainably sourced. Wind and solar accounted for 0.1% of Indonesia's TPES in 2020 (**Figure 2**).

The share of renewables in the TPES fluctuated in the past decade between 11.0% and 13.0%, before increasing to 14.4% in 2020 owing primarily to the COVID-19 pandemic, which reduced total energy supply. Traditional biomass consumption declined from around 9.1% in 2010 to 5.6% in 2019 with the development of biofuels and biogas.

**Figure 3** Indonesia's total final energy consumption by (a) source, 2010-2020; and (b) sector and source, 2020



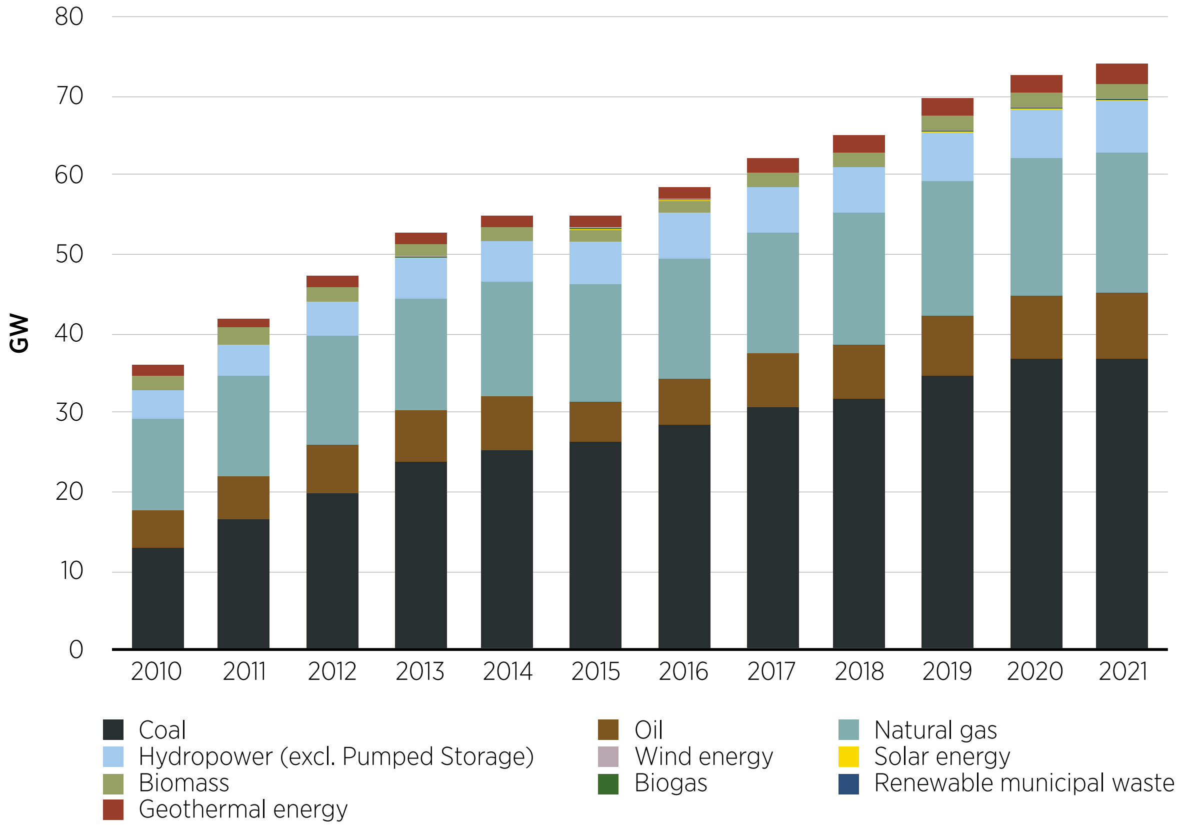

Source: MEMR, 2021.

Note: *Fuel oil is the lowest order of refinery product – heavy distillate, residue and their mixture – and is used to fuel industrial furnaces and electric power plants. **Bio gasoil is a blending product of biodiesel. LPG = liquefied petroleum gas.

Indonesia is the largest consumer of energy in the ASEAN region, accounting for 36% of the region's total final energy consumption (TFEC) (UNSD, n.d.). TFEC increased by 15.6% between 2010 and 2020, reaching 5 497 petajoules in 2020 (*i.e.* more than one-third of ASEAN's overall TFEC) (**Figure 3a**) (MEMR, 2021). Electricity accounted for 18.0% of the country's TFEC in 2020, indicating a significant increase from 11.7% in 2010. Nevertheless, the electrification of the energy system was still below the average of the ASEAN region at around 20% in 2019 (UNSD, n.d.). The transport and industry sectors dominated TFEC, with shares of 43.1% and 34.1%, respectively. Households and commercial sectors accounted for around 16.8% and 4.8%, respectively, in 2020. Other sectors such as forestry, fishing and agriculture represented around 1.2%. The transport sector features large shares of bioenergy because of the establishment of biofuel mandates (**Figure 3b**). Commercial and household consumers are the most electrified, with an electricity share in their TFEC of 88.1% and 50.8%, respectively.

By the end of 2020, Indonesia had a total installed power capacity of 72.8 gigawatts (GW) (MEMR, 2021; IRENA, n.d.). The power sector was still dominated by fossil-based power plants at 85.6% of total installed capacity (50.4% for coal, 24.2% for natural gas and 11.0% for oil) (**Figure 4**). Coal's share increased from 28.1% in 2010 due to a three-fold increase in coal-based power plants' capacity over the decade, while oil and natural gas decreased from their 2010 level of 29.5% and 28.0%, respectively. In 2020, almost two-thirds of total on-grid power generation was concentrated in the state-owned utility, Perusahaan Listrik Negara (PLN), while independent power producers accounted for almost one-third. A total of 2.7 GW of off-grid power plant capacity (mainly biomass and hydro at 58.8% and 34.1%, respectively) were installed by 2020, representing 5.9% of total power generation (on- and off-grid) (MEMR, 2021).

**Figure 4** Indonesia's total installed power capacity (GW), 2010-2020

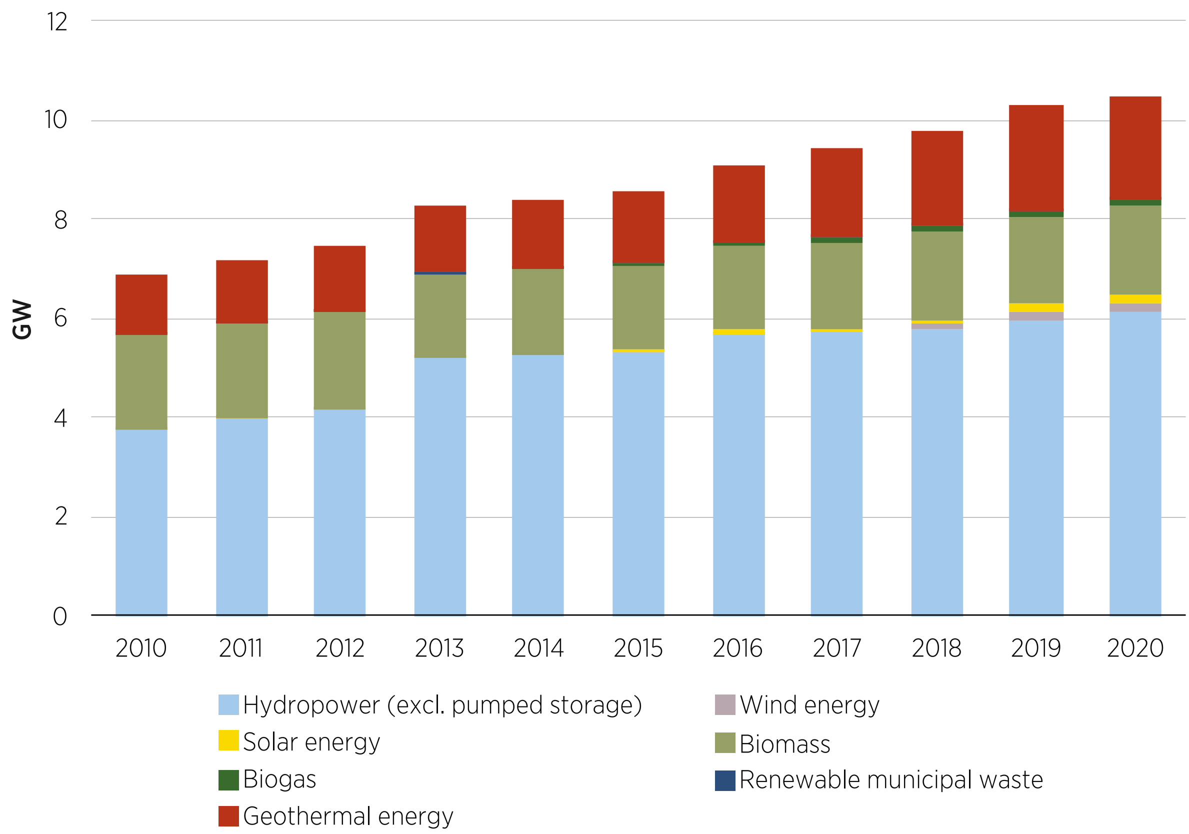



Source: MEMR, 2021.

Note: GW = gigawatt.

Renewable capacity, although small in the overall picture, increased by more than 50%, from 6.9 GW in 2010 to 10.6 GW in 2020. This is mainly due to the installed capacity of hydropower and geothermal, which almost doubled (IRENA, 2021c). Although the installed capacities of solar and wind both increased substantially from 15 MW and 0.3 MW to 185 MW and 154 MW, respectively, between 2010 and 2020, in sum they contributed only 1.3% of overall installed capacity of solar and wind in ASEAN in 2020 (25.8 GW) (**Figure 5**).

**Figure 5** Indonesia's renewable energy capacity (GW), 2010-2020




Source: IRENA, 2021c.

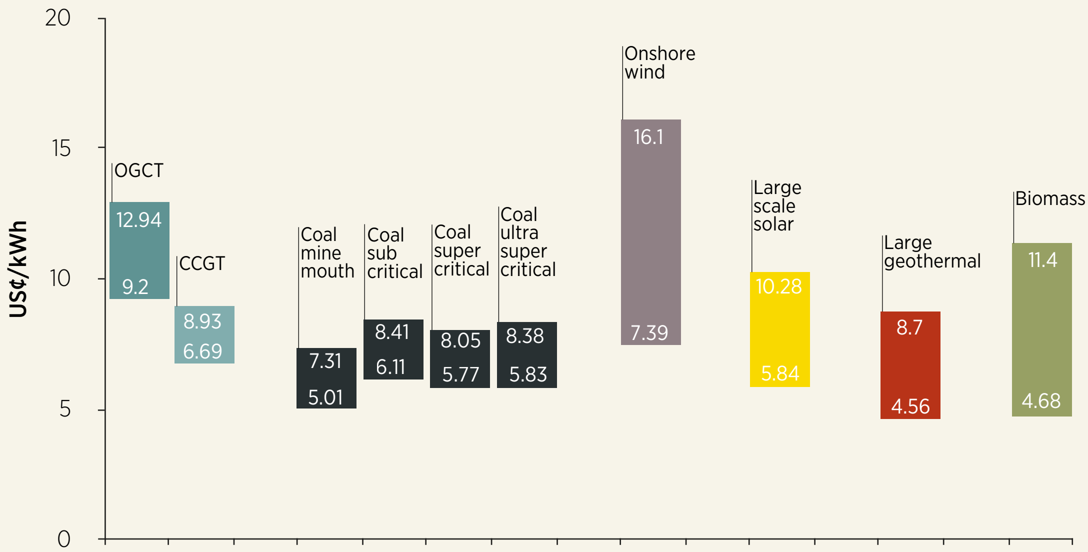
Note: GW = gigawatt.

Compared to the global average, Indonesia faces high renewable generation costs, especially for geothermal, solar and wind, as the country has yet to exploit economies of scale. If renewable energy deployment continues in Indonesia, these costs are expected to fall and to become comparable to international prices. However, it is clear that the overall cost of new coal projects is higher than renewable energy generation from new wind, solar, geothermal and hydropower projects when the costs are broken down into costs to the PLN (which has a monopoly over electricity distribution), subsidies and often-ignored externalities like local air pollution and global climate costs (BAPPENAS, 2019) (Box 2).

## **BOX 2** COST OF RENEWABLES IN INDONESIA

The levelised cost of electricity (LCOE) of some renewable energy technologies in Indonesia is not too far from that of conventional technologies. As seen in **Figure 6**, the cost range of large-scale solar photovoltaic (PV) (>10 megawatts) is already on a comparable range with that of new coal power plants. Costs of some biomass and geothermal plants are already lower than those of fossil-fuel-based plants. With a suitable regulatory framework, for example, bringing financing costs down to levels in other markets, there is significant room for reducing costs.

**Figure 6** Levelised cost of electricity generation (in US cents per kWh) in Indonesia, 2019




Source: IESR and Agora, 2019.

Note: CCGT = combined cycle gas turbine; US¢/kWh = US cents per kilowatt hour; OCGT = open cycle gas turbine.

Despite the competitive LCOE, renewables are cited as expensive sources of electricity in Indonesia (IESR and Agora, 2019). The capital costs of solar PV projects are much higher in Indonesia than in many other countries, averaging above USD 1 260 per kilowatt (kW) in 2021 (**Figure 7**). Costs of wind projects are much higher than in many other countries, at close to USD 2 250 per kW in 2021 (IRENA, 2022c). According to a study by the Asian Development Bank, Indonesia has the highest financing costs for renewable energy projects in the region for numerous reasons, including uncertain and unbalanced contract risk allocation, in part due to the practice of renegotiating contracts and power purchase agreements; design; stringent local content requirements and risks from renewable energy developers who lack experience (ADB, 2020a).

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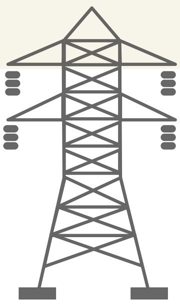
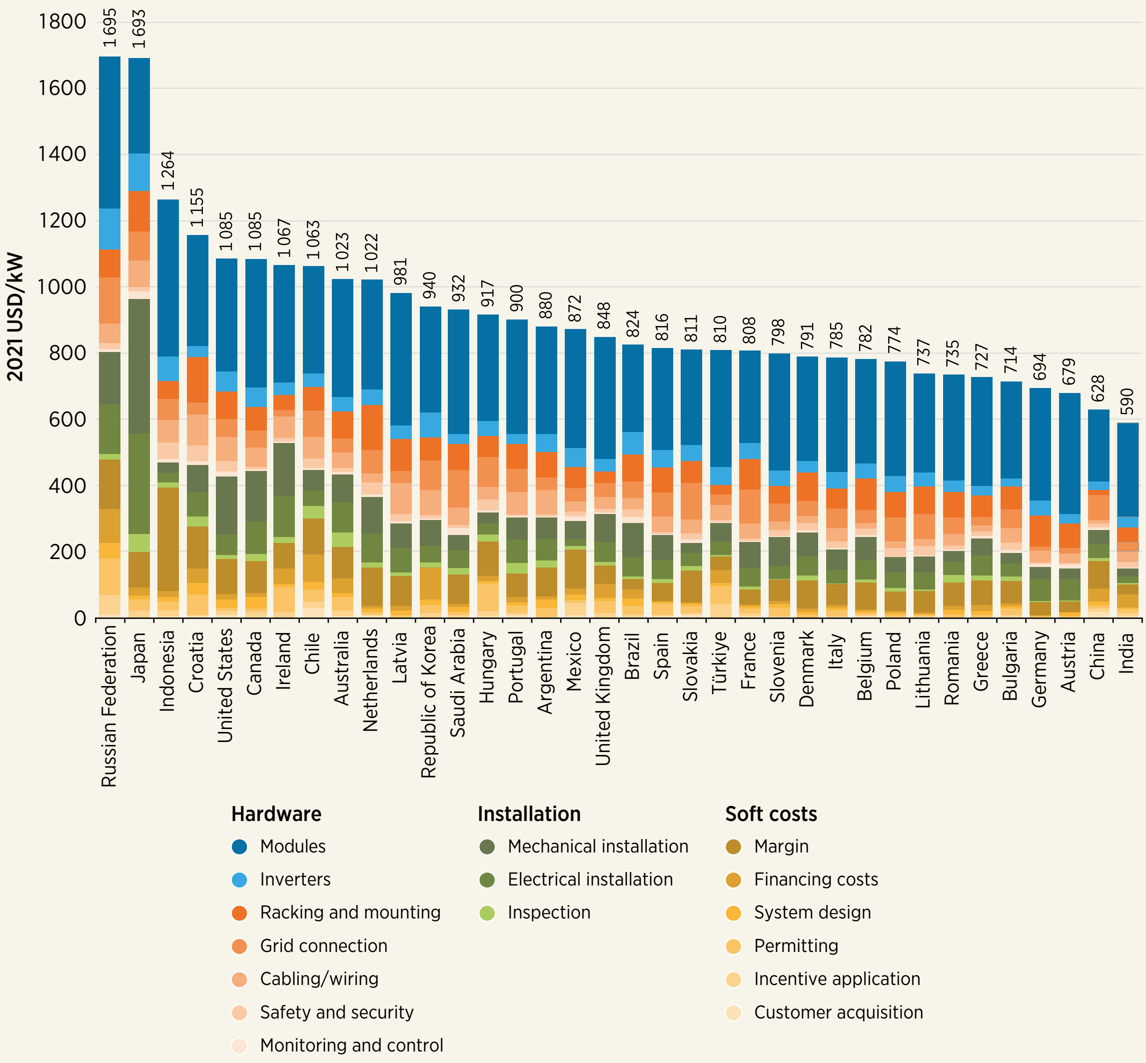


**Figure 7** Utility-scale solar photovoltaic total installed costs by country, 2021



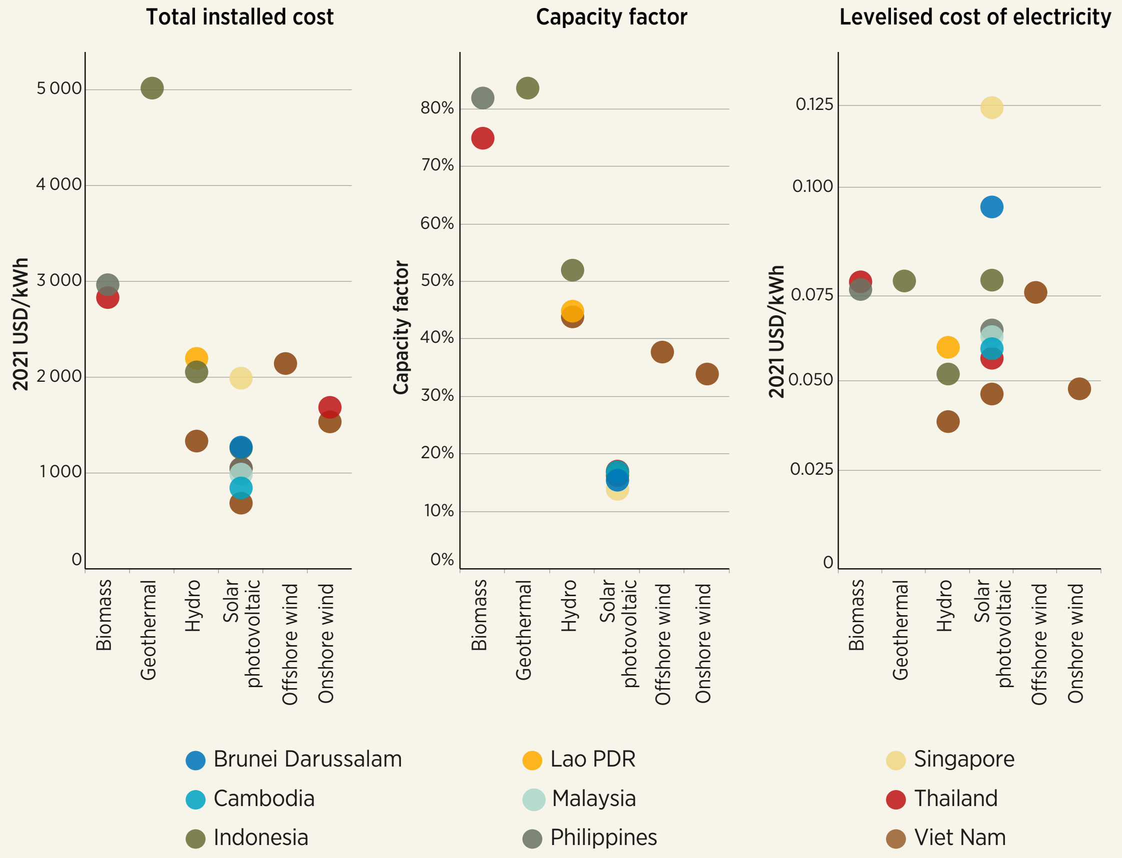

Source: IRENA, 2022c.

Note: USD/kW = US dollars per kilowatt.

The global weighted average LCOE of newly commissioned utility-scale solar PV projects declined by 88% between 2010 and 2021, while that of onshore wind and concentrated solar power (CSP) did so by 68% and of offshore wind by 60% (IRENA, 2022c). **Figure 8** shows the total installed costs, capacity factors and LCOE for projects commissioned in the countries of the Association of Southeast Asian Nations in 2021. Indonesia saw the highest cost per kW for geothermal and hydropower. In terms of LCOE, the country lies in the upper range for most technologies while Viet Nam has achieved some of the most competitive cost structures in the region, with costs for hydropower, utility-scale solar PV and onshore wind below USD 0.05/kilowatt hour in 2021.

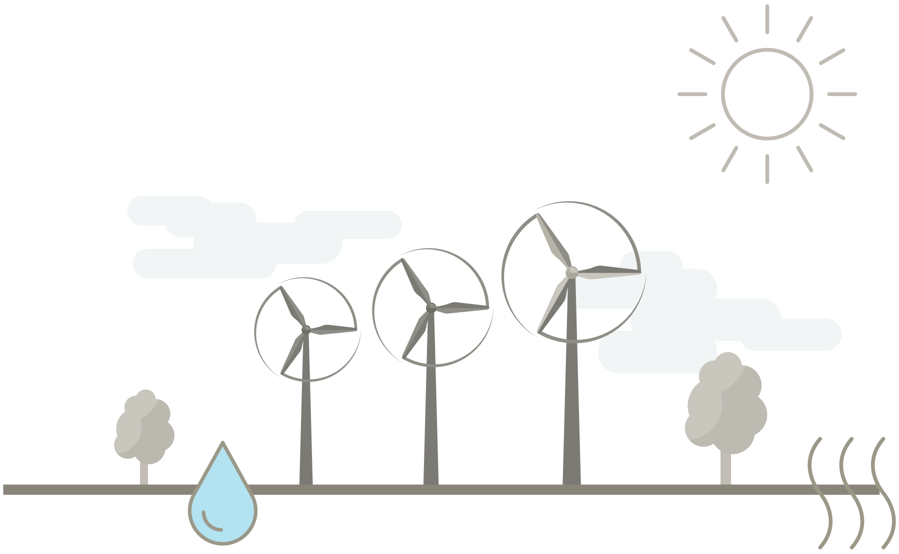
*Continued*

**Figure 8** Total installed costs, capacity factors and cost of electricity by country in the ASEAN region, 2021




Source: IRENA Renewable Cost Database.

Note: Data are the weighted-average (by capacity) for projects in the database, which are a subset of total projects commissioned in 2021. USD/kW = US dollars per kilowatt.



Installed capacity remains unevenly distributed. Across Indonesia, some regions have large amounts of installed electricity capacity while others do not. More than 60% of total installed capacity is in the Java-Bali system (40 GW) (Tumiwa, 2019). The next most extensive system is on the island of Sumatra, with 8.6 GW, followed by Kalimantan and Sulawesi. Electricity supply has grown faster than demand (MEMR, 2021), mainly due to the overestimation of the load, a slower-than-expected economic growth, and a lack of interconnections among islands. The impact of COVID-19 has worsened the situation, and some islands (especially bigger islands) could have an overcapacity of more than 200%. Meanwhile, the country still grapples with energy access issues. The use of an appropriate planning tool can help mitigate such risks, and IRENA is currently supporting countries in electricity planning through its FlexTool product (Box 3).

### **BOX 3** IRENA'S FLEXTOOL

IRENA's FlexTool was developed to assist IRENA members in making a relatively quick yet thorough assessment of potential flexibility gaps as well as highlighting the most cost-effective mix of solutions to fill in such gaps. It is the only publicly and freely available (open-source) tool that performs both capacity expansion and dispatch with a focus on power system flexibility.

FlexTool assessments reflect full power system dispatch and offer a detailed view of flexible generation options, demand flexibility and energy storage, along with sector-coupling technologies such as power-to-heat, electric vehicles and hydrogen production through electrolysis.

Note: More information is available at www.irena.org/energytransition/Energy-System-Models-and-Data/IRENA-FlexTool.

While some regions have overcapacity (*e.g.* Java-Bali has a high reserve margin compared to other islands), around 2 million people continue to lack access to electricity (MEMR, 2021). The electricity access rate is estimated at 97% in Indonesia in 2020 (UN, n.d.). While most regions are close to 100%, a few islands have less than 95% electrification in the southeast part of the country (*i.e.* Nusa Tenggara Timur, Sutra), or the eastern part of Indonesia (*i.e.* Papua, Maluku) (**Figure 9**).

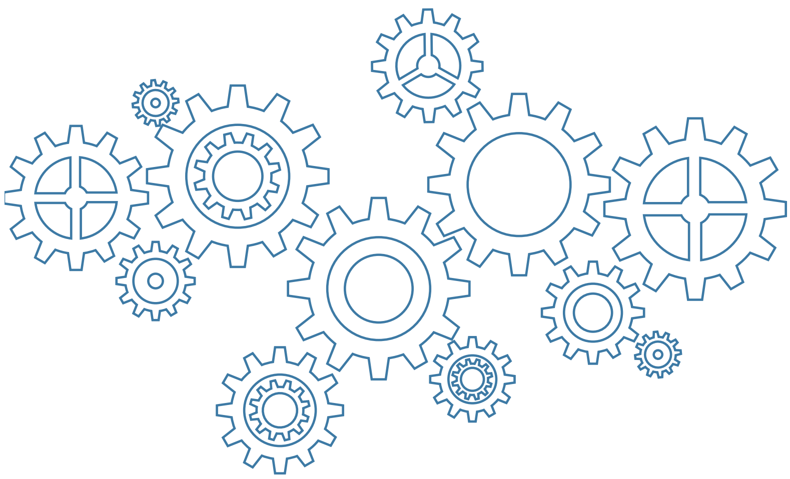
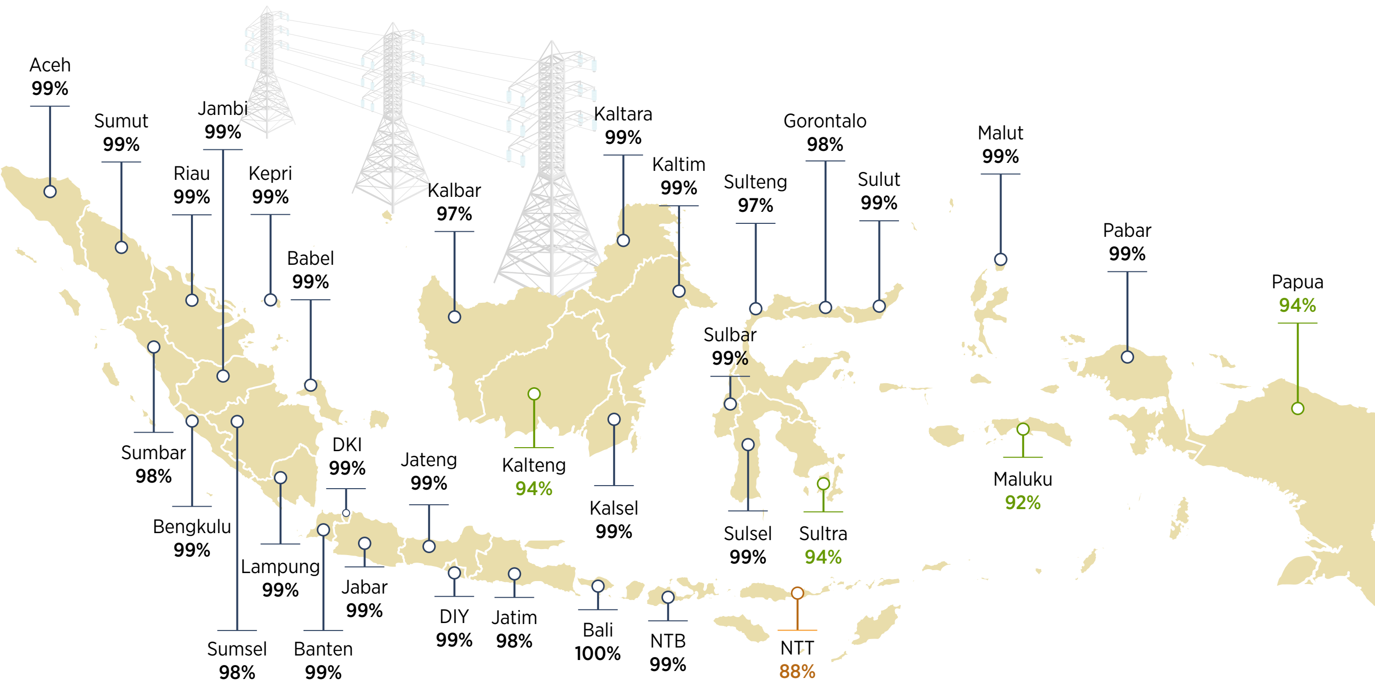


**Figure 9** Electricity access across islands, 2020

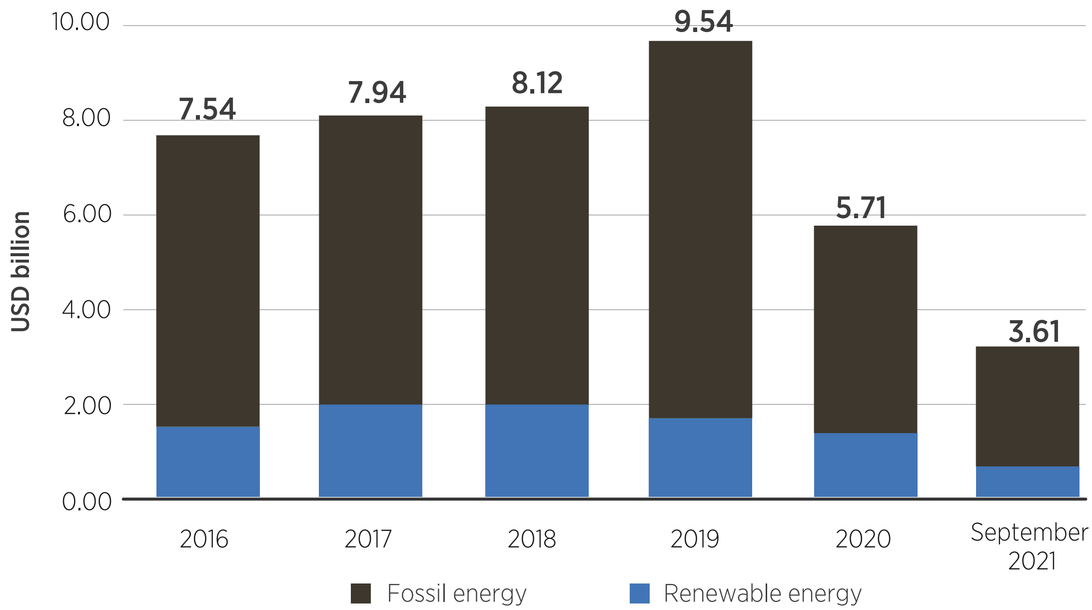



*Disclaimer:* This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Source: MEMR, 2021.

A reliable, efficient, resilient and clean energy system in Indonesia will require high levels of investment in the coming years. Overall energy investment in 2020 shrunk due to project delays, but also because lower commodity prices triggered by lower energy demand during the COVID-19 pandemic have made new investments unattractive (IESR, 2021). Most of the money remains focused on fossil fuels rather than renewables (**Figure 10**).

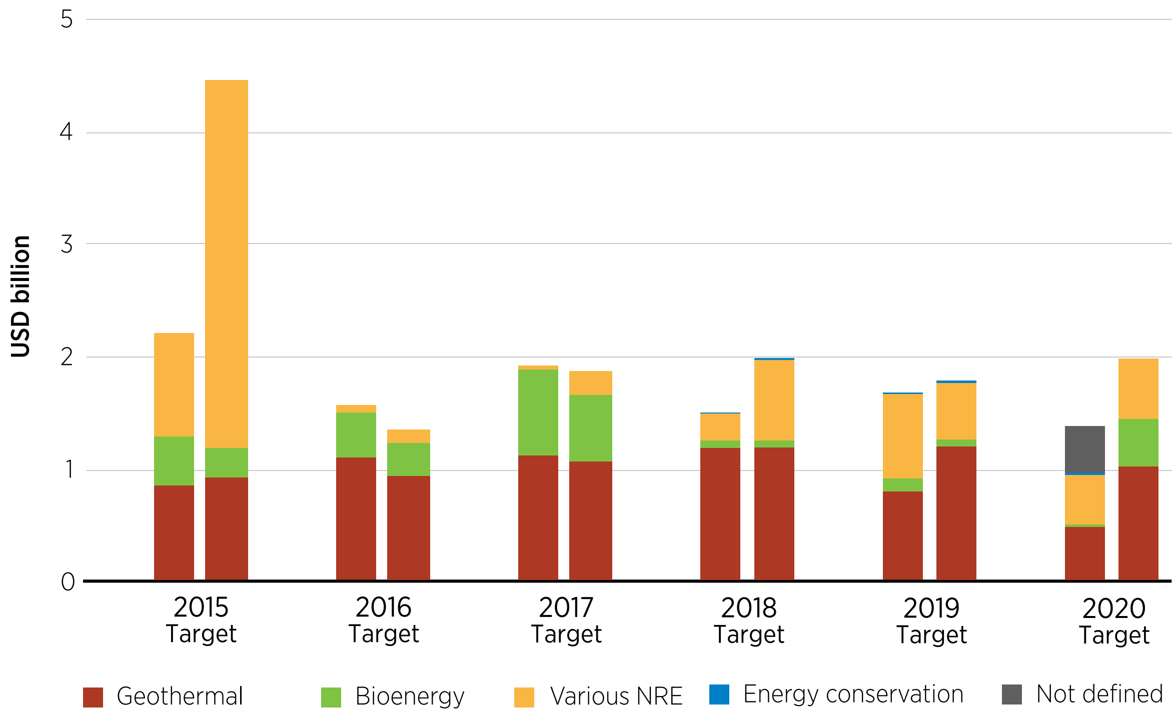
**Figure 10** Fossil and renewable energy investments in Indonesia's power sector, 2016-2020




Source: IESR, 2022.

Investment in renewables and energy efficiency has been stagnant over the past five years, indicating the low investment attractiveness of renewable energy in Indonesia. In 2020, total investment in renewables and energy efficiency reached USD 1.4 billion, accounting for 60% of the investment target in the Ministry of Energy and Mineral Resources' (MEMR's) Renstra (IESR, 2021). More than 50% of the investments in renewables are in the power sector. While investment targets for geothermal and bioenergy were always met or surpassed in the past, this was not the case in the last two years (2019 and 2020). Actual bioenergy investments in 2020 were only 1% of the target sum (**Figure 11**)

**Figure 11** Investment in renewables and energy conservation in Indonesia, 2015-2020




Note: NRE = new and renewable energy.

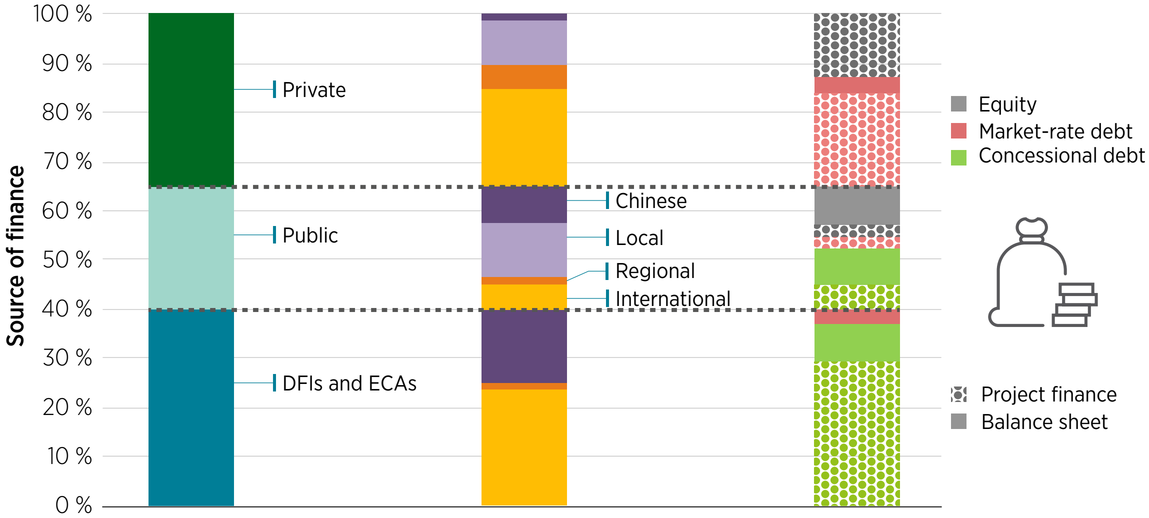
Source: Adapted from IESR (2021).

In addition to a lack of investment, potentially due to the COVID-19 pandemic, it is important to recognise that there has not been a significant change in the country's regulatory framework, which is considered the main obstacle to growth in renewables (IESR, 2021).

Also, low tariffs, high interest rates of loans and high collateral requirements are considered to be the main challenges to financing renewable energy investments in the country (ADB, 2020a). A "build-own-operate-transfer" structure in power purchase agreements, rather than a "build-own-operate" structure, is perceived to create challenges for project developers. According to PLN, the state-owned utility with a monopoly on the power system, however, loan interest and collateral have not been barriers (ADB, 2020a).

The main lenders of project finance in Indonesia are international commercial banks, multilateral development agencies (such as the Asian Development Bank) and export credit agencies (such as the Korean Exim Bank, China Exim Bank and Japan Bank for International Co-operation). Typically, export credit agencies from the international sponsor's jurisdiction will be involved in providing financing, especially if the sponsor is also the project contractor (**Figure 12**). This has made it difficult for local banks to engage in project financing because they have limited liquidity for long-term debt, limited experience and there is no derivatives market. Project developers also face unreasonably high risks because of uncertainty related to the requirements, timelines and outcomes of licensing and permitting procedures, which could be addressed through consistent and co-ordinated institutional arrangements (ADB, 2020a).

**Figure 12** Share of sources of finance in the power generation sector of projects commissioned, 2016-2019



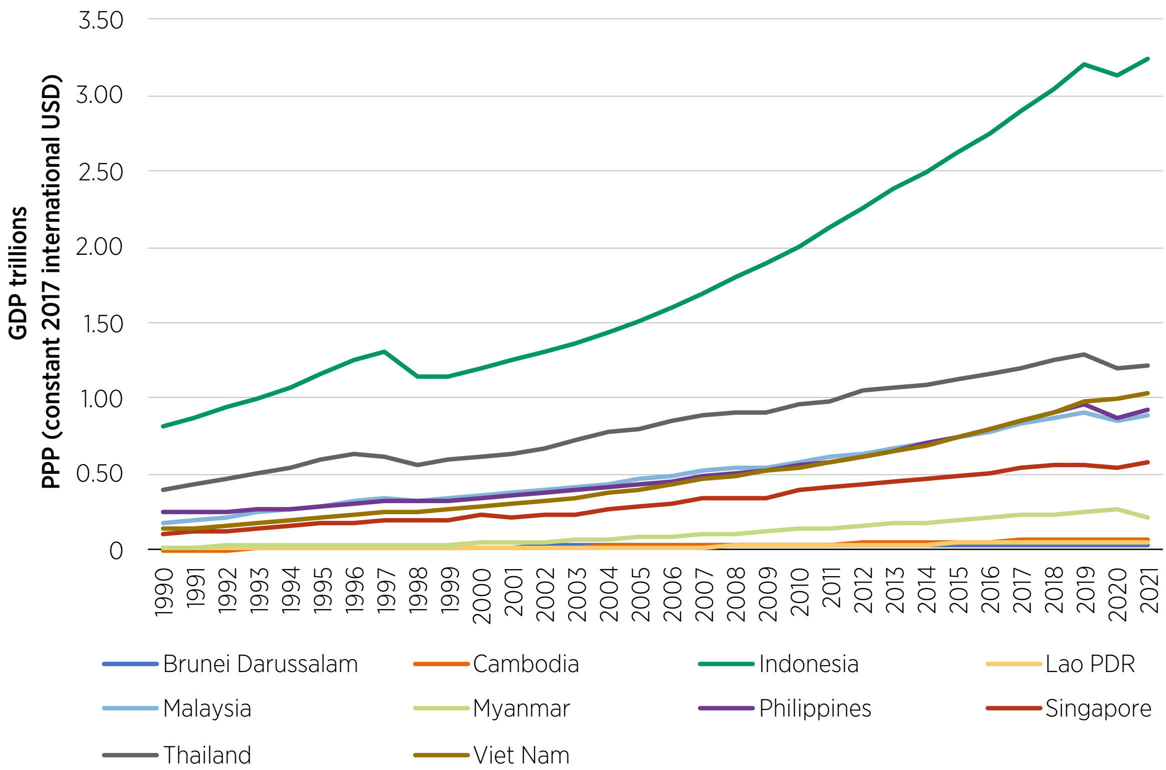

Source: IEA, 2020.

Note: DFIs = development financial institutions; ECAs = export credit agencies.

## 2.2 ECONOMIC GROWTH AS MEASURED BY GDP

Indonesia is the world's seventh-largest economy, measured in terms of purchasing power parity (World Bank, n.d). It is the biggest economy in Southeast Asia and a member of both ASEAN and the G20. The country has achieved impressive economic growth since overcoming the Asian financial crisis of the late 1990s, sustaining a strong recovery until the COVID-19 crisis (World Bank, 2015; Breue, Guajardo and Kinda, 2019; IFC and World Bank, 2019; World Bank, 2020b). Even during the international financial crisis of the late 2000s and the decline in commodity prices, Indonesia maintained macroeconomic stability in terms of inflation, public finances, the balance of payments and debt (BAPPENAS, 2019). Supported by manufacturing, domestic demand, growing commodity exports and tourism, GDP grew at an average of 5.3% from 2000 to 2019, widening the gap with other regional economies (**Figure 13**).

**Figure 13** Evolution of GDP in ASEAN countries, 1993-2021




Source: World Bank, n.d.

Note: GDP = gross domestic product; PPP = purchasing power parity.

The COVID-19 pandemic affected most economies worldwide. Indonesia's GDP fell by 2.1% in 2020 (IMF, 2022). It is, however, expected to recover. Real GDP increased by 3.7% in 2021 and was projected to increase by 5.3% in 2022 (IMF, 2022). It is essential that Indonesia's path to recovery be sustainable and inclusive (IRENA, 2020b). GDP per capita more than doubled from USD 5 689 to USD 11 746 (2017 PPP) between 2000 and 2021. The Indonesian GDP per capita is still below the ASEAN average of USD 12 258 in 2021. Nevertheless, its growth (an average of 3.5% per year) was slightly above the ASEAN average at 3.4% per year on average between 2000 and 2021 (World Bank, n.d.). During the same period, poverty also decreased (**Box 4**).

### **BOX 4** POVERTY IN INDONESIA

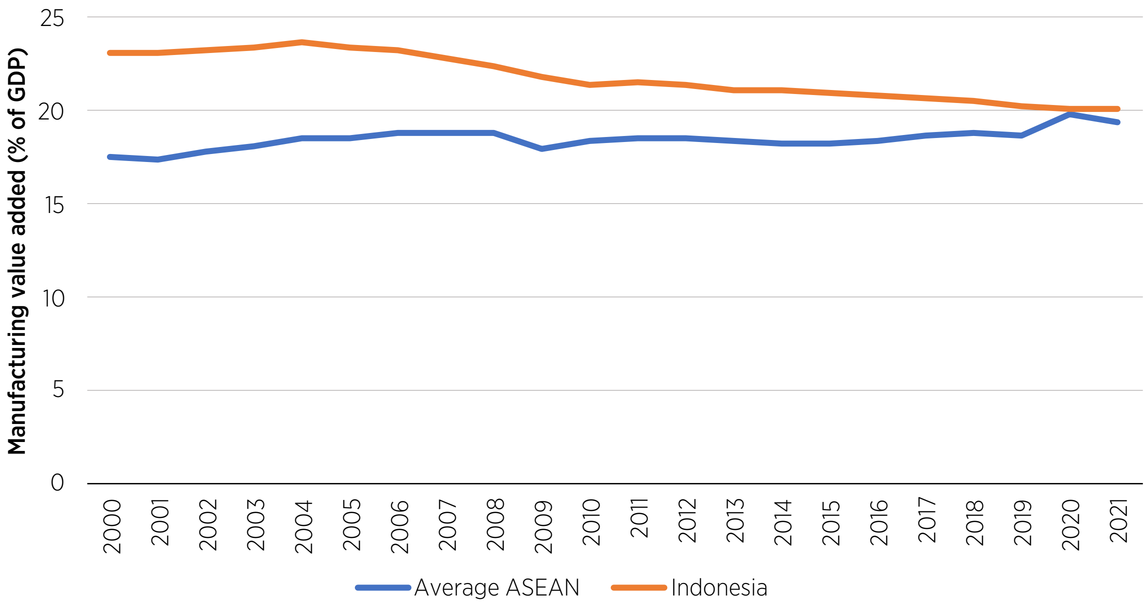
Between 1999 and 2019, Indonesia cut its poverty rate by more than half, to 9.8%. Similarly, between 1990 and 2018, extreme poverty fell from 59% to just below 5% (World Bank, n.d.). Yet these "low" rates still translate into around 25.1 million Indonesians living below the poverty line. Worryingly, around 20.6% of the population is vulnerable to falling back into poverty, as they have an income just slightly above the national poverty line (World Bank, 2020b). Even before the COVID-19 crisis, this risk was foreseen (IFC and World Bank, 2019). Indonesia remains vulnerable to the pandemic and its aftermath, which threaten to partly undo years of progress in curbing poverty (IRENA, 2020b).

While poverty reduction in Indonesia was driven by high global commodity prices in the 2000s (World Bank, 2015), poverty alleviation efforts will become increasingly challenging if the economy remains reliant on commodities whose prices may undergo large up-and-down swings (IFC and World Bank, 2019).

Expectations that Indonesia's GDP would grow at a compound annual growth rate of 5.2% between 2018 and 2023 (CEBR, 2018) gave way amid a much slower pace of only 2.2% per year between 2018 and 2021 due to the COVID-19 pandemic (World Bank, n.d.). Indonesia responded to the COVID-19 crisis in March 2020 with a fiscal package equivalent to 3.8% of GDP, which focused on lower-income households and strongly affected sectors such as health and tourism (IMF, 2021a).

Prior to recent years, Indonesia was contributing to the region's status as a major industrial hub, strong in petrochemicals, food and beverages, pulp and paper, textiles, equipment, and steel and cement, among other industries (IRENA, 2018b). However, the country's manufacturing competitiveness has since decreased and as evident in the contribution of manufacturing to GDP (Figure 14). While the share of manufacturing value-added in ASEAN's GDP increased slightly (from 17.5% in 2000 to 19.4% in 2021), the share of Indonesia's manufacturing reduced from 23.2% in 2000 to 20.1% in 2021 (ADB, n.d.). Because the Indonesian economy relies on exports of minerals and agricultural products, it is exposed to volatile commodity prices and environmental risks (IFC and World Bank, 2019). That said, fossil fuels have played a less relevant role in the economy in recent years (**Box 5**).

**Figure 14** Manufacturing value added as percentage share of gross domestic product, 2000-2021



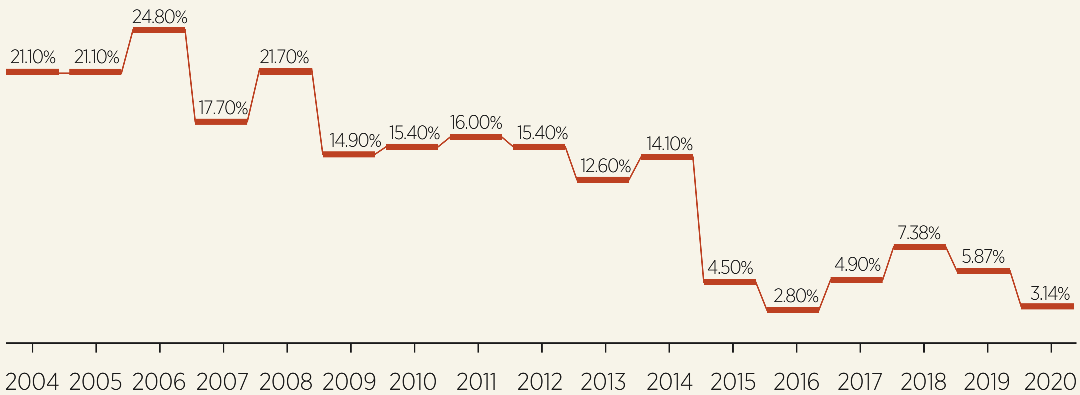

Source: ADB, n.d.

Note: ASEAN = Association of Southeast Asian Nations; GDP = gross domestic product.

## **BOX 5** THE DECLINING CONTRIBUTION OF FOSSIL FUELS TO INDONESIAN GOVERNMENT REVENUES

The oil and gas sector was the bedrock of Indonesia's government budget and economic growth for decades. However, in recent years the sector's contribution decreased sharply, shadowing the decline in reserves and production. Between 2014 and 2020, government oil and gas revenues plummeted nearly 80%, from IDR 217 trillion (USD 14.7 billion; 14% of state revenues) to an estimated IDR 53 trillion (USD 3.6 billion; 3.1% of state revenues)[9] (**Figure 15**). The mineral and coal contributed to 5% of the GDP in 2019 (EITI, 2021).

**Figure 15** Contribution of oil and gas sector as a share of Indonesia's government revenues, 2004-2020



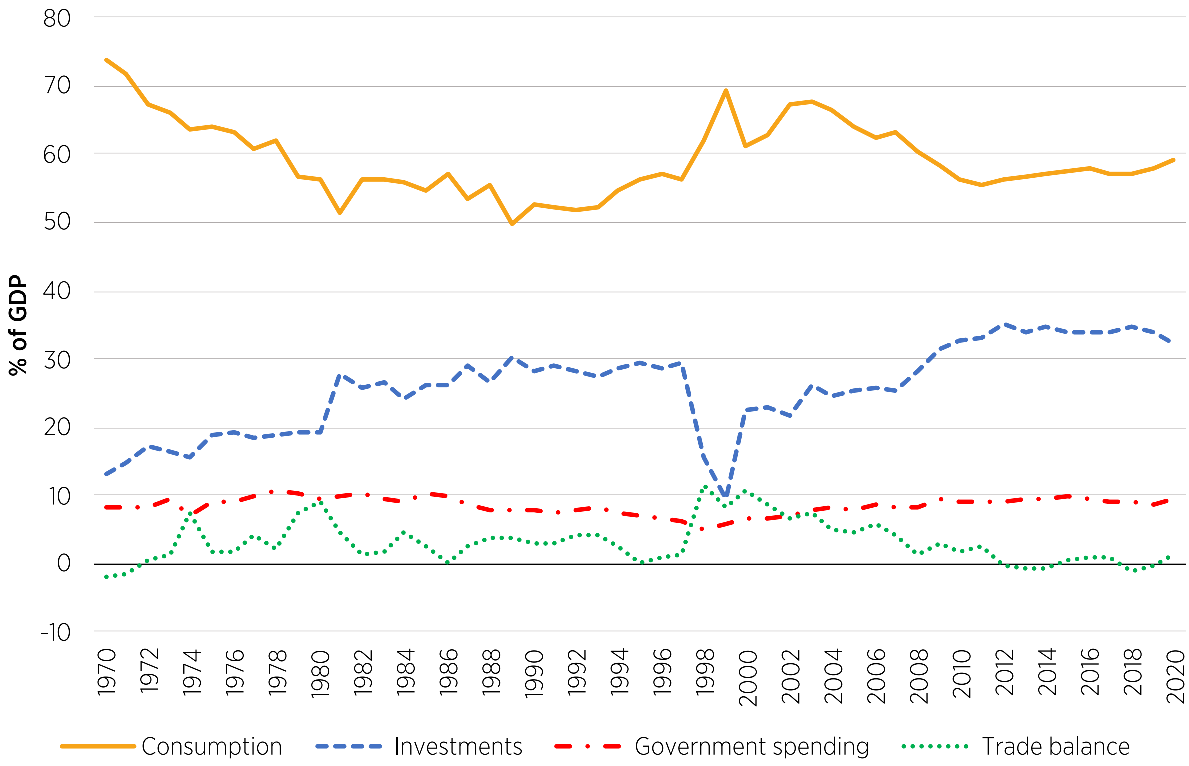

Source: Adapted from PwC (2020).

Indonesia's GDP is driven foremost by **household consumption** (**Figure 16**). The peak in 1999 can be explained by investments falling sharply, rather than by increased consumption.

The second-largest GDP share is **capital investments** (**Figure 16**). Indonesia observes the second-highest ratio of investment to GDP in the region, only behind Brunei Darussalam (UN, n.d.). Under the energy transition scenarios proposed, this propensity to invest will be crucial. Indonesia's manufacturing competitiveness has deteriorated, diminishing the country's attractiveness for export-oriented foreign direct investment (IFC and World Bank, 2019). Foreign direct investment to Indonesia has moved away from efficiency-seeking investments in export-oriented sectors in favour of investments in natural resources and production for the domestic market. The energy sector is in urgent need of increased investments to meet rapid growth in energy demand, and the private sector will need to play a crucial role given that the national budget will not be sufficient to finance it.

[9] *Exchange rate used throughout the report: USD 1 = IDR 14 761 as of 15 August 2022, UN operational rates of exchange.*

**Figure 16** Household consumption, capital investments, government spending and trade balance in Indonesia, 1970-2020




Source: UN, n.d; World Bank, n.d.

Note: household consumption = household consumption expenditure (including non-profit institutions serving households); government spending = general government final consumption expenditure; capital investments = gross capital formation; trade balance = exports of goods and services minus imports of goods and services. See UN (n.d.) and World Bank (n.d.) for more information. GDP = gross domestic product.

The Medium-Term Development Plan 2020-2024 (RPJMN) signalled the deployment of infrastructure projects with record-high values. The plan earmarked, among others, 60% of the total expenditure (USD 412 billion) for transport infrastructure and 17% for expanding electricity generation. It foresaw 35% of this expenditure coming from private investors. In 2021, Indonesia also reformed its investment law to open hundreds of previously closed economic sectors to foreign companies. In the electricity sector, for example, tax incentives are available for foreign investments to build micro power plants, as well as to manufacture components for power plants or equipment for the transmission and distribution grids. Nonetheless, implementation of the new investment law may experience challenges, such as difficulties in acquiring land, and unforeseeable project delays and legal uncertainty.

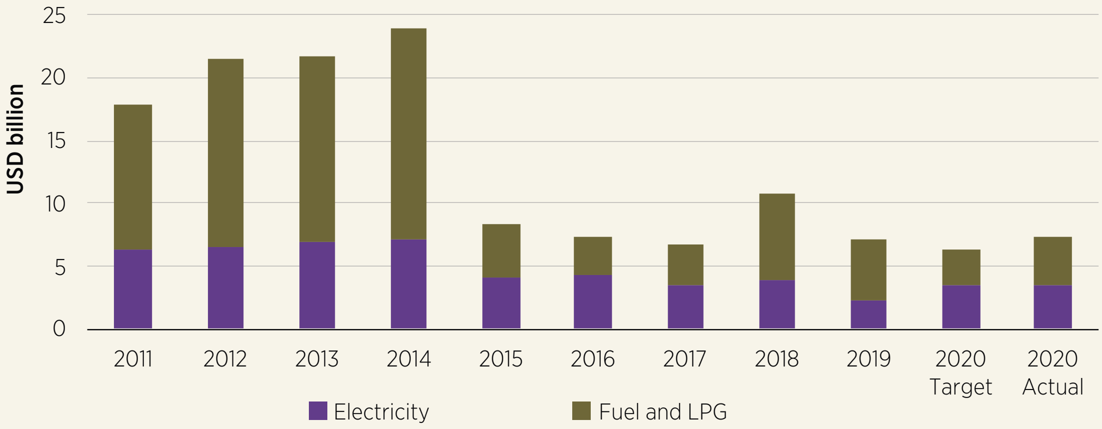
Public infrastructure investment initially benefited from the reallocation of inefficient energy subsidies, but its allocated budget is growing only moderately and slowly. In addition, energy subsidies have increased in the aftermath of the COVID-19 crisis, further recapturing substantial government funds. Therefore, the infrastructure gap, which reflects years of underinvestment in the energy and transport sectors, is likely to continue to widen. Especially in the energy sector, subsidised and regulated prices have exacerbated inadequate electricity supply, which in turn weakens investment incentives (IFC and World Bank, 2019).

**Government spending** represents the third-largest share of Indonesia's GDP but is lower than in most ASEAN countries (**Figure 16**). Low government revenues in Indonesia reflect both the narrow tax base and low collection efficiency (IMF, 2019). Beyond hurting growth, low tax revenue hinders state building and weakens the social contract (Breue, Guajardo and Kinda, 2019; IMF, 2019). It is also the main constraint to scaling up infrastructure and improving public services such as health, education and social safety nets (Breue, Guajardo and Kinda, 2019). Government revenues have declined since 2018 (World Bank, n.d.), stressing public finances further. In addition, spending on energy subsidies, which had decreased between 2015 and 2017 (Box 6), increased in 2020. Indonesia broadened the coverage of electricity subsidies to face the COVID-19 crisis, mainly in low-tariff categories. The 2020 subsidy requirement of the utility PLN to the government increased by 13%, whereas PLN had planned to request only a 4% increase before the crisis. This was compounded with the increases in fuel subsidies in 2018, which were driven by the relaxation of previously frozen tariffs (IEA, 2020).

## **BOX 6** FOSSIL FUEL SUBSIDIES IN INDONESIA

Indonesia has long been subsidising end-user prices for petrol, diesel, electricity and other energy products (in particular liquefied petroleum gas for cooking), with the aim of increasing energy access, raising household purchasing power and keeping energy affordable for the poor. Figure 17 displays total fossil fuel subsidies, which peaked in 2014 at IDR 341.8 trillion (USD 23.8 billion) in absolute values, then significantly declined after the subsidy reform.

**Figure 17** Government subsidies to the energy sector in Indonesia, 2011-2020




Source: MEMR, 2021.

Note: LPG = liquefied petroleum gas.

In 2015, Indonesia began implementing a major energy subsidy reform. Whereas energy subsidies reached more than 30% of government spending in 2014 (equal to 4% of GDP), in 2015 total energy subsidies were cut by over 60%. This greatly benefited the government, allowing it to reallocate money towards infrastructure, health and education. Additionally, the new revenues of the government could specifically target poor households and their energy access issues.

Indonesia made considerable efforts towards subsidy reform between 2014 and 2017. Nevertheless, the reform was not carried out to the full extent announced and recent years have seen backsliding. While petrol subsidies were totally removed in 2015, diesel subsidies were increased in mid-2018. A “single fuel price” policy was announced in 2017, which mandated that the fuel price of gasoline, diesel and petrol would be the same in all regions of the country. This was expected to boost purchasing power (and thus reduce inequality) in some of the poorest and remote regions (such as Papua), which had been paying a higher price for fuels. While subsidies had decreased at that point, they have still been considerable in recent years, preventing competition on a level playing field between fossil fuels and renewable energy, as evident in the lack of large-scale deployment of renewables, and the growing use of fossil fuels in the country. In 2018, the increase in global fuel prices and the devaluation of the national currency led Indonesia’s president to interrupt the price reform and promise a constant electricity and petrol price in the whole country. This led to an increase in energy subsidies for kerosene, liquefied petroleum gas and electricity, from IDR 107 trillion in 2016 to IDR 153.5 trillion in 2018 (10% of the tax revenue in the same year), representing a total of USD 3.5 billion in government spending. In 2019, energy subsidies reduced slightly to IDR 136.9 trillion, an amount higher than health spending of IDR 113.6 trillion and lower than education spending of IDR 460.3 trillion in the same year (IISD, 2021; World bank, n.d.).

In response to the COVID-19 crisis, despite the decline in both energy demand and prices, reducing the demand for governmental support on the end-user side, Indonesia raised its financial support, especially in the area of electricity consumption. On the production and delivery side, the government allocated more than USD 5 billion in support to the petroleum company Pertamina and the electricity company Perusahaan Listrik Negara (PLN), the state-owned utility.

Source: OECD, 2019; OECD and IEA, 2021.

The **trade balance** has only a small impact on GDP. Between 2013 and 2018, exports showed no annual average growth, slowing overall economic growth (**Figure 16**). The government's objective is to have a positive trade balance. To achieve this, it exerts strict control over imports – including those of fossil fuels – allowing only products that the country urgently needs to cross the borders (Malerius, 2021).

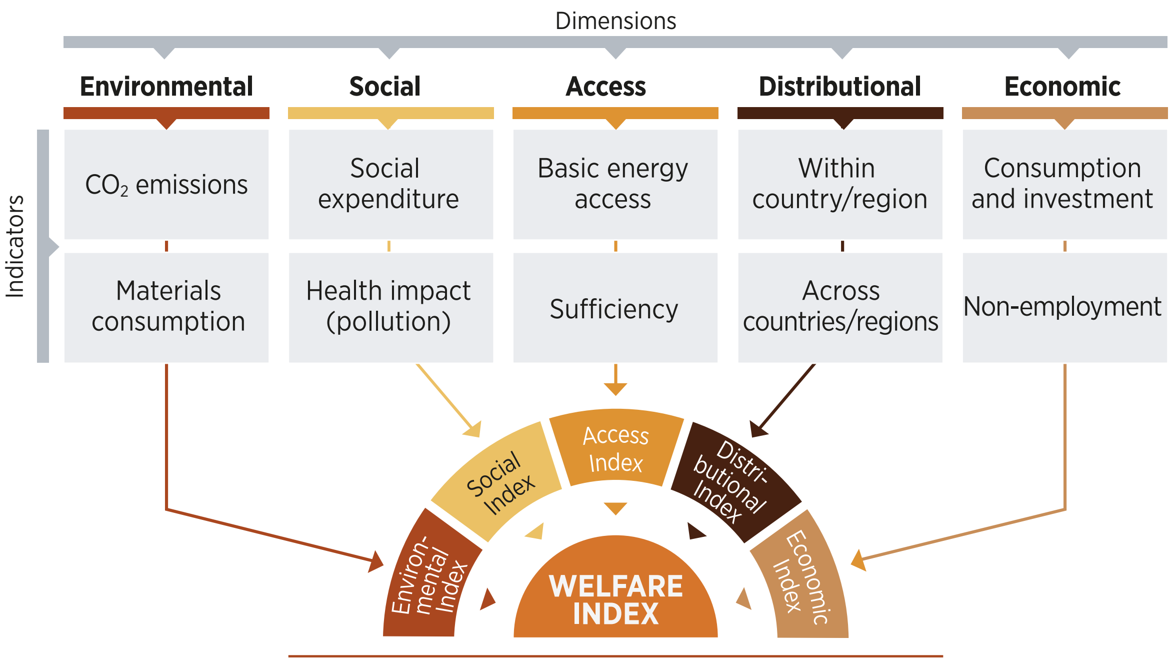
To successfully diversify its economy, Indonesia must continue to build on existing capabilities and know-how. Currently, the country continues to rely on mineral fuels and low-technology industries (Breue, Guajardo and Kinda, 2019), and more efforts domestically and internationally are required for the country to benefit from diversifying and strengthening domestic supply while moving up the segments of the value chains.

## 2.3 THE DIMENSIONS OF IRENA'S WELFARE INDICATOR

GDP is the standard measure of economic output, but the well-being of citizens goes beyond GDP, which ignores factors that are not priced in the market such as environmental quality. GDP also fails to consider other aspects that are significant to communities/societies, such as housing conditions, opportunities for youth, pollution, noise, sense of security, social connections, political voice and the quality of jobs (Stiglitz, Fitoussi and Durand, 2018). Communities that have strong social trust and connections are more resilient than others to economic crises and natural disasters (Aldrich and Meyer, 2015), and they cope better with illness, unemployment, low income, discrimination, family breakdown and insecurity (Helliwell *et al.*, 2020). Therefore, more indicators are needed to capture social costs (or benefits) that communities value highly.

To incorporate some of these aspects of social well-being, IRENA developed a welfare index (IRENA, 2016) that provides wider analyses of potential impacts. It has been since updated (IRENA, 2021a) and currently covers five dimensions: economic, distributional, social, environmental and access (**Figure 18**).

**Figure 18** Structure of IRENA's Energy Transition Welfare Index




Source: IRENA, 2021a.

Note: $CO_2$ = carbon dioxide.

The **economic dimension** has two indicators. The first measures consumption (a measure of present welfare) and investment (the benefits of a more efficient and sustainable future economy) per capita. The second tracks non-employment: those unemployed and those of working age outside the labour force.

Indonesia's household consumption grew exponentially from 1998 until 2019, growing more than 2.5 times. Investments, in contrast, were negative from 1998 until 2006, but have seen positive growth rates from 2011 until 2019 (World Bank, n.d.). Despite the progress, in per capita terms, the value of Indonesia's consumption and investment in 2019, USD 3 662, was almost three times lower than that of Malaysia's at USD 9 530, and slightly lower than the ASEAN region's at USD 3 690 (CE, n.d.).

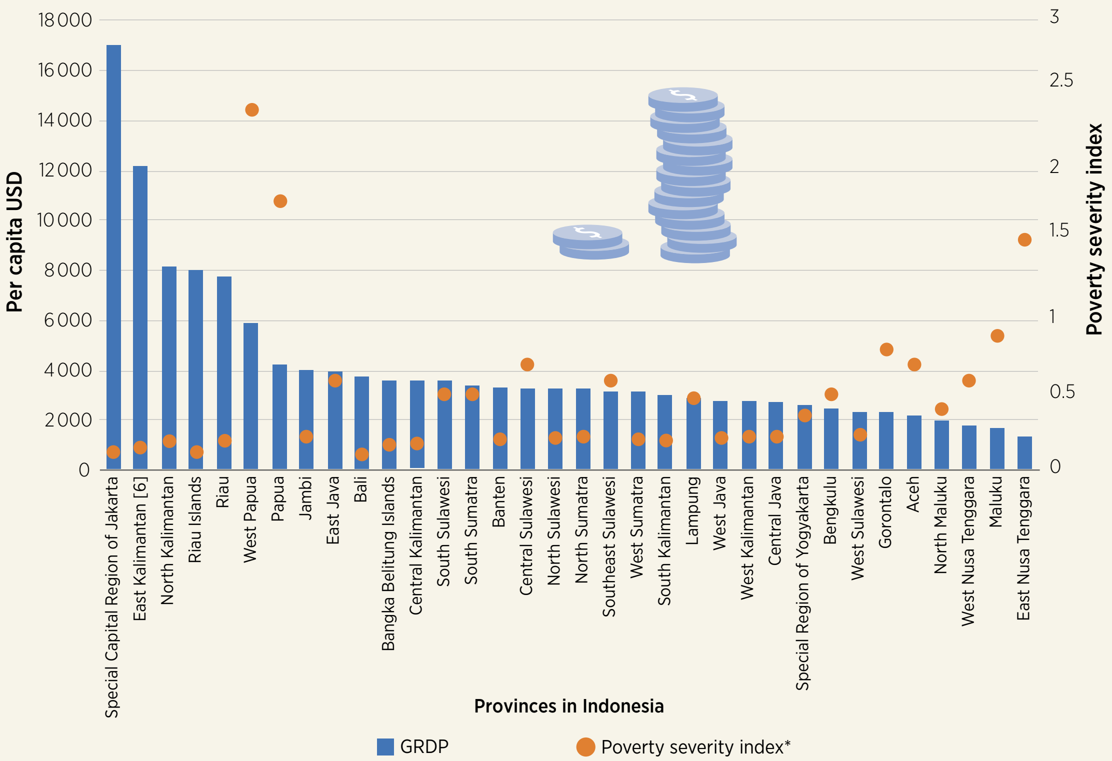
The unemployment rate in Indonesia is low, at 4.4% in 2021, and is higher in Indonesia than all other ASEAN countries except for Brunei Darussalam at 7.6% (World Bank, n.d.). Thus, so is non-employment: 8.5% compared, for example, to 17.3% in Malaysia or 12.6% in Southeast Asia in 2019 (CE, n.d.). However, unemployment figures should be taken with caution as the majority of jobs created are either jobs in the informal economy or short-term contracts. The informal sector in Indonesia still employs more than 50% of workers, and a high level of informality is likely to persist with the growth of the gig economy and e-commerce in the country (OECD, 2021a). Youth unemployment, which was at 11.1% in 2020, is the second highest after Brunei Darussalam in the ASEAN region (ILO, n.d.). Although regular wage employment has overall increased and informal employment has declined with the growth of manufacturing and services (OECD, 2021a), the large share of workers employed with short-term contracts and the persistence of informality are worrying indications of labour market issues.

The **distributional dimension** measures income and wealth inequalities within and across regions and countries. Indonesians doubled their income and quadrupled their wealth between 1999 and 2019 (WID, n.d.). But important differences exist across regions (Box 7).

## **BOX 7** REGIONAL INEQUALITIES IN INDONESIA

Economic disparities between regions complicate greater equality within Indonesia, compounded by broad differences across local governments in the quality of public service provision. For instance, Jakarta's per capita regional gross domestic product is around 13 times higher than that of East Nusa Tenggara (Figure 19), while 26.5% of the residents of Papua are below the national poverty line (compared with 3.4% in Jakarta and 9.2% nationwide) (ADB, 2020b).

**Figure 19** Inequality and poverty index across regions In Indonesia




Source: OECD, 2020a, 2020b.

Note: *Poverty severity is defined as the total of the squared income/expenditure shortfall of families/individuals with income/expenditure below the poverty threshold, divided by the total number of families/individuals.
GRDP = gross regional domestic product.

The distributional dimension of this study is based on quintile ratios; that is, the ratio of total income or wealth received by the 20% of the population with the highest income or wealth (the top quintile) to that received by the 20% of the population with the lowest income or wealth (the bottom quintile). By this measure, income inequality in Indonesia, at 14.5 in 2019, is slightly lower than the region's value at 15.8, but is, for example, significantly higher than that of Malaysia's at 10.3 (CE, n.d.).

The **social dimension** has two indicators: social spending and health effects from air pollution. Overall, the expansion of public funding for health care and education drove the rapid growth of social spending globally in the second half of the 20th century (Ortiz-Ospina and Roser, 2016). Education, for example, contributes greatly to people's well-being. Besides its effects on income, citizens with more education enjoy better health, have more social connections, show greater engagement in political and civil life, and have lower rates of unemployment (Sen, Fitoussi and Stiglitz, 2010). Air quality affects human health substantially, and, depending on how the adverse health effects are monetised, they can exceed GDP growth estimates (Ackerman and Daniel, 2014).

The share of public expenditure on health in Indonesia's government expenditure was around 8.7% in 2019, just above the ASEAN average of 8.5%, or the lower-middle-income countries average of around 5.5%. This health expenditure is equivalent to 1.4% of Indonesia's GDP in 2019, which is below the ASEAN average of 1.8%, and in the average range of low-middle-income countries (World Bank, n.d.). These two indicators of health expenditure have seen an increasing trend over the past decade in Indonesia. Although increasing health expenditure is associated with better health outcomes, especially in low-income countries, there is no "recommended" level of spending on health. The larger the per capita income, the greater the expenditure on health (WHO, 2022). Indonesia is the fifth country in terms of GDP per capita (as seen in GDP section) within the ASEAN region, while it is the sixth country in terms of public expenditure per capita (USD 175.3, which is above the low-middle-income average of USD 109.3 [PPP]). On the other hand, government expenditure on education has also been increasing as a share of total state expenditure over the past decade, reaching 19.2% in 2020, the highest in the ASEAN region (whose average is 14.5%). In fact, there is a mandate to allocate 20% of the state budget to education. But not every district fulfils it (World Bank, 2020b). Overall, social spending per capita in Indonesia is below that of the Southeast Asian region. In 2019 and in per capita terms, Indonesia was at USD 252.6, while Malaysia or the average of the ASEAN region was significantly higher at USD 822.2 and USD 350, respectively (CE, n.d.).

Indonesia's reliance on fossil fuels, and its unsustainable use of natural resources, including large-scale deforestation for land conversion has significant impacts on the population's health. Deforestation is responsible for a significant part of Indonesia's $CO_2$ emissions, added to by subsequent GHG emissions from the industries that utilise that land that has been converted. Air pollution is an increasing problem, both outdoors and indoors (IFC and World Bank, 2019). Lack of access to clean cooking fuels and technologies exacerbates respiratory disease; in 2015, for example, the number of premature deaths in Indonesia alone was estimated at 70 000 from outdoor pollution and 140 000 from indoor air pollution (IRENA, 2018b).

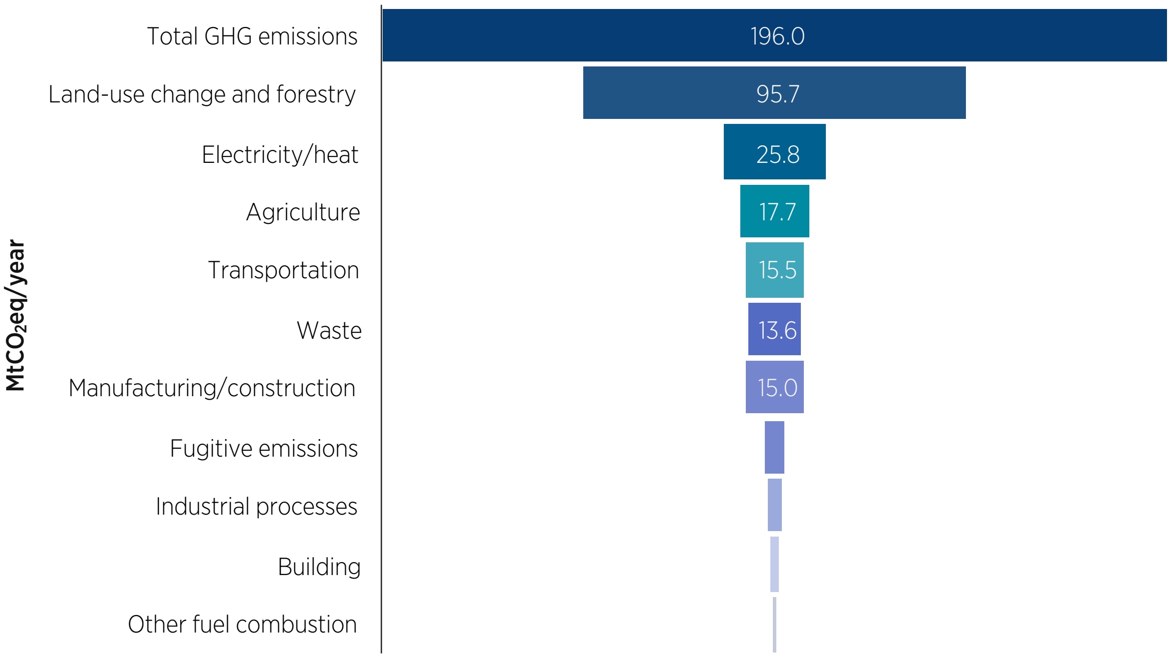
Outdoor air pollution caused by combustion of fuels for transport and electricity is also lethal for humans. In Indonesia, the standards in place for coal power plants are significantly lower than the current standards in other countries. The high level of coal use, coupled with the current emissions standards, was estimated to cause 7 480 excess deaths per year in Indonesia, almost twice the level estimated for Viet Nam and more than six times that of Thailand (Koplitz *et al.*, 2017; UN, 2020). Jakarta is one of the most polluted cities in the world, owing to traffic congestion, industrial pollution, open waste burning and coal-fired power plants (The Guardian, 2019).

Indoor air pollution causes various diseases such as ischaemic heart disease, stroke, lung cancer, chronic obstructive pulmonary disease (18 years+) and acute lower respiratory infections (under 5 years). The World Health Organization had already estimated in 2012 that indoor air pollution was responsible for about 45% percent of an estimated 25 300 child deaths in Indonesia, due to acute lower respiratory infections (WHO, 2016). The latest studies, such as that of the Low Carbon Development Initiative, estimate that annual deaths of more than 40 000 each year can be avoided with clean fuels (BAPPENAS, 2019). As a result of all this, health damages in Indonesia are slightly higher than in the ASEAN region, but still significantly lower than in Malaysia, for example. In 2019 and in per capita terms, health damages amounted to USD 207.3 in Indonesia, USD 192.1 in Southeast Asia and USD 641.8 in Malaysia (CE, n.d.). Without proper measures, however, these health damages can increase at an alarming rate in the future (see Chapter 4).

In sum, the environmental and health costs that the country is experiencing underscore the need to shift and develop more sustainable production methods and less-resource-intensive sectors wherever possible (IFC and World Bank, 2019).

The **environmental dimension** also considers GHG emissions along with vulnerability towards climate change, and the depletion of natural resources through consumption of materials (measured in domestic material consumption of metal ores, non-metallic minerals and biomass for food and feed). Indonesia is the world's tenth-largest $CO_2$ emitter from fuel combustion and the fifth-largest emitter of GHGs according to the EDGAR[10] and CAIT[11] databases (Crippa *et al.*, 2021; WRI, 2022). The largest portion of GHG emissions comes from land use changes and forestry, that is, the deforestation and destruction of carbon-rich peatlands for the benefits of agriculture and industry, followed by the power sector, and agriculture (Crippa *et al.*, 2021; WRI, 2022) (**Figure 20**). Compared to the emissions generated by the destruction of Indonesia's rainforests, the burning of fossil fuels for energy has played a smaller role in the country's emissions, although its impact remains large (WRI, 2022).

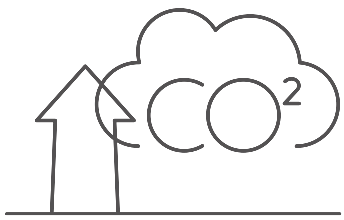
**Figure 20** Greenhouse gas emissions by sector in Indonesia, 2019




Source: WRI, 2022.

Note: GHG = greenhouse gas; $MtCO_2eq$ = million tonnes of carbon dioxide equivalent.

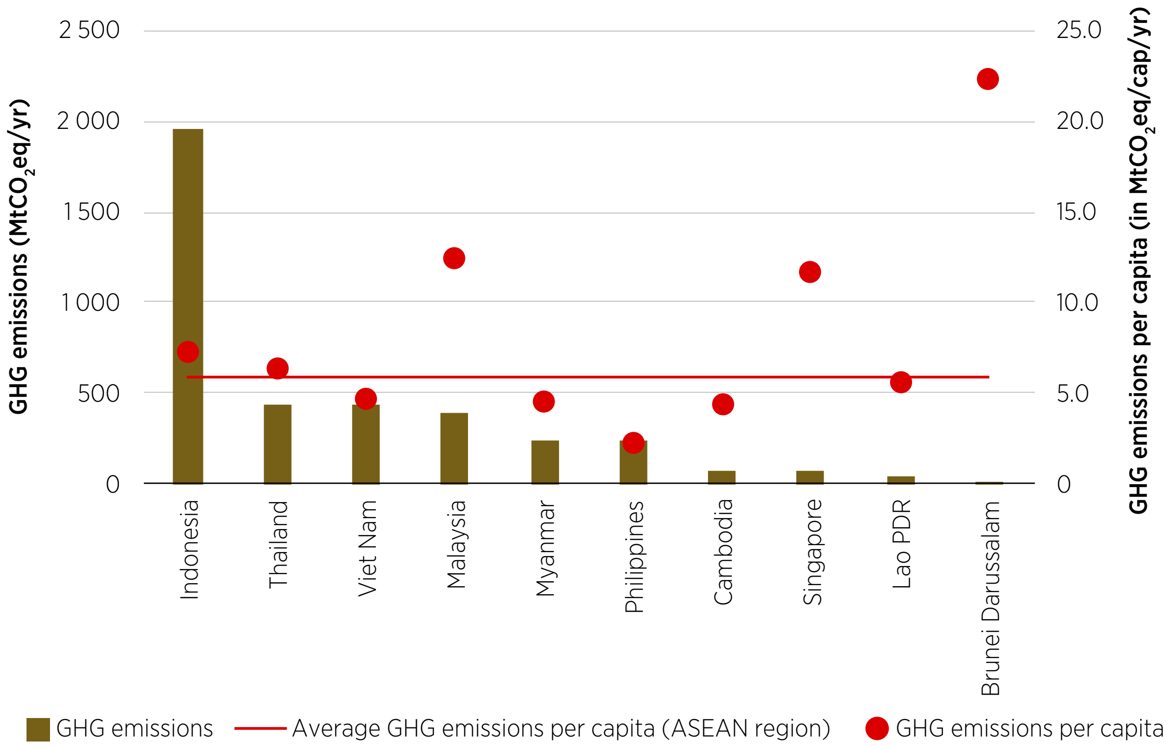
The country's land use, land-use change and forestry (LULUCF) sector released 957.4 million tonnes of carbon dioxide equivalent ($MtCO_2eq$) emissions in 2019, representing more than half of the global emissions from LULUCF (WRI, 2022). Also in 2019, the contribution of Indonesia to global GHG emissions (3.9%) was, for example, almost two-thirds that of the EU27 (6.3%).




[10] *Emissions Database for Global Atmospheric Research (version 6) provided by the Joint Research Center of the European Commission.*

[11] *Climate Analysis Indicators Tools provided by the World Resource Institute.*

**Figure 21** Greenhouse gas emissions per capita in Indonesia and in the other ASEAN countries, 2019



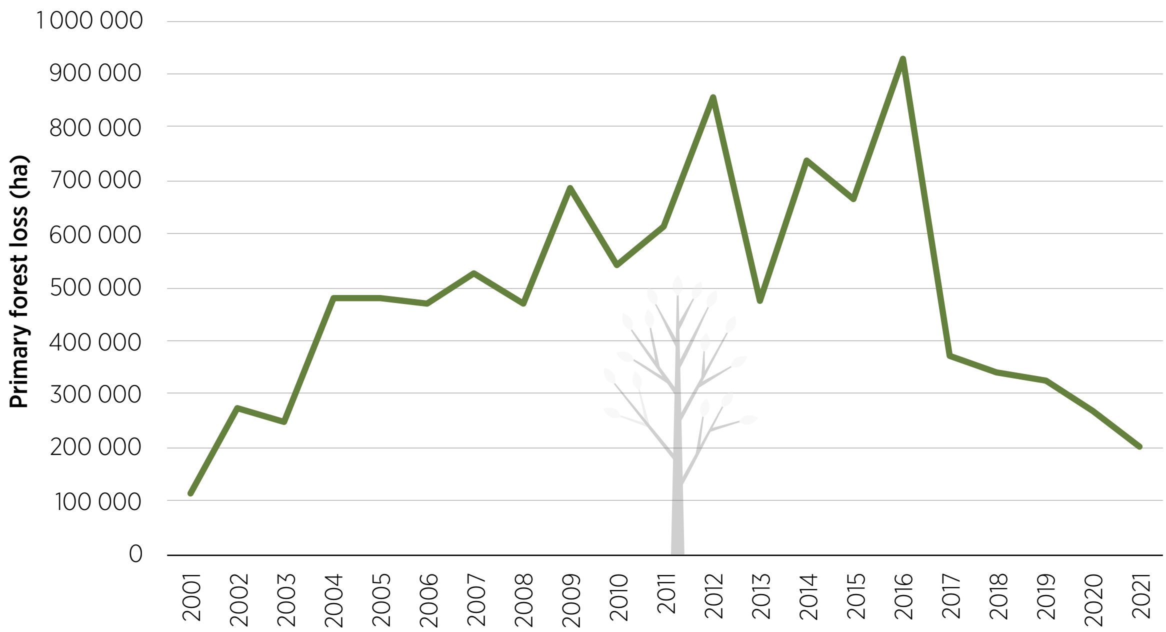

Source: WRI, 2022; UN, n.d.

Note: ASEAN = Association of Southeast Asian Nations; GHG = greenhouse gas; $MtCO_2eq/cap/yr$ = million tonnes of carbon dioxide equivalent per capita per year.

Considering the GHG emissions per capita in 2019, the richer countries of Brunei Darussalam, Malaysia and Singapore emitted significantly more than Indonesia and the rest of the ASEAN countries (**Figure 21**). There is still room for improvement for Indonesia to achieve the social and economic objectives of the Sustainable Development Goals and to reduce its emissions. There has been a strong relationship between development and GHG emissions, as historically both per capita and absolute emissions have risen with industrialisation. However, recent evidence shows countries can grow their economies while reducing emissions (IPCC, 2022).

There has been good progress in reducing deforestation in Indonesia with primary forest loss declining since 2015 (**Figure 22**), although Indonesia lost more than 0.9 million hectares (equivalent to the area of Cyprus or one-third that of Belgium) in 2016 following a year of major fires in 2015. Indonesia aims to limit annual deforestation to 325 000 hectares between 2020 and 2030 under the Paris Agreement on climate change. In recent years, Indonesia has strengthened law enforcement to prevent land clearing and forest fires, while working to restore degraded peatlands to reduce fire and emissions (EU REDD, n.d.). Yet Indonesia still suffered the fourth-highest rate of primary forest loss behind Brazil, the Democratic Republic of the Congo and Bolivia in 2021 (Global Forest Watch, n.d.).

**Figure 22** Evolution of primary forest loss in Indonesia (ha), 2001-2021




Source: Global Forest Watch, n.d.

Note: ha = hectare.

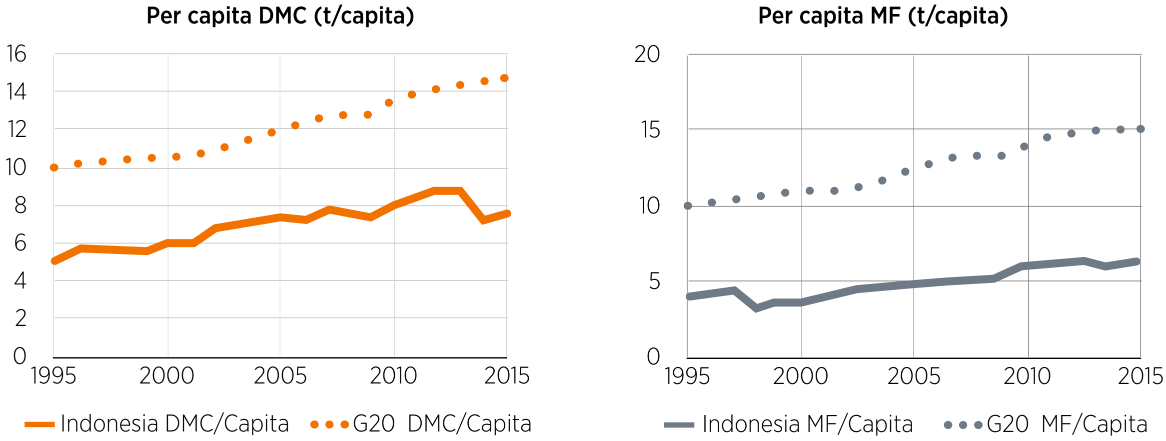
As an equatorial and archipelagic country, Indonesia is projected to be impacted greatly by climate change, which will in turn disproportionately affect the low-income population. People living in areas prone to drought or flooding and those who depend on climate-sensitive economic activities such as fisheries and agriculture will be impacted most (World Bank, 2015). Cumulative GHGs adjusted to vulnerability in Indonesia were estimated at 1 346 gigatonnes of carbon dioxide ($GtCO_2$) in 2019, close to Southeast Asia's 1 353 $GtCO_2$, but well above Malaysia's value of 1 077 $GtCO_2$ (CE, n.d.).

Domestic material consumption (DMC) in Indonesia was the second-lowest among G20 countries in 2017, at 7.5 tonnes per capita, compared with India (the lowest at 5.5 tonnes per capita) and Australia (the highest at 37.7 tonnes per capita) (OECD, 2021b).

The country's DMC per capita is higher than its material footprint, and both are significantly lower than the G20 average[12] (**Figure 23**). This suggests that Indonesia satisfies its resource demand mostly from domestic sources. After the Asian financial crisis, and unlike many countries in the region, Indonesia's resource efficiency (in terms of material footprint per GDP) did not deteriorate (UN, 2017). Around 50% of the country's material footprint comes from the consumption of biomass (IRP, 2019). Indonesia's material consumption – focused on metal ores, non-metallic minerals and biomass for food and feed – was significantly less than the global value: 3.8 tonnes per capita in 2019 vs 5.3 tonnes per capita, respectively. Southeast Asia's value was 3.5 tonnes per capita (CE, n.d.)

[12] *Material footprint (MF) is the attribution of global material extraction to the domestic final demand of a country. The total material footprint is the sum of the material footprint for biomass, fossil fuels, metal ores and non-metallic minerals. On the other hand, domestic material consumption (DMC) reports the actual amount of material in an economy. These two indicators cover the two aspects of the economy, production and consumption.*

**Figure 23** Domestic material consumption and material footprint per capita in Indonesia and the G20 countries, 1995-2015



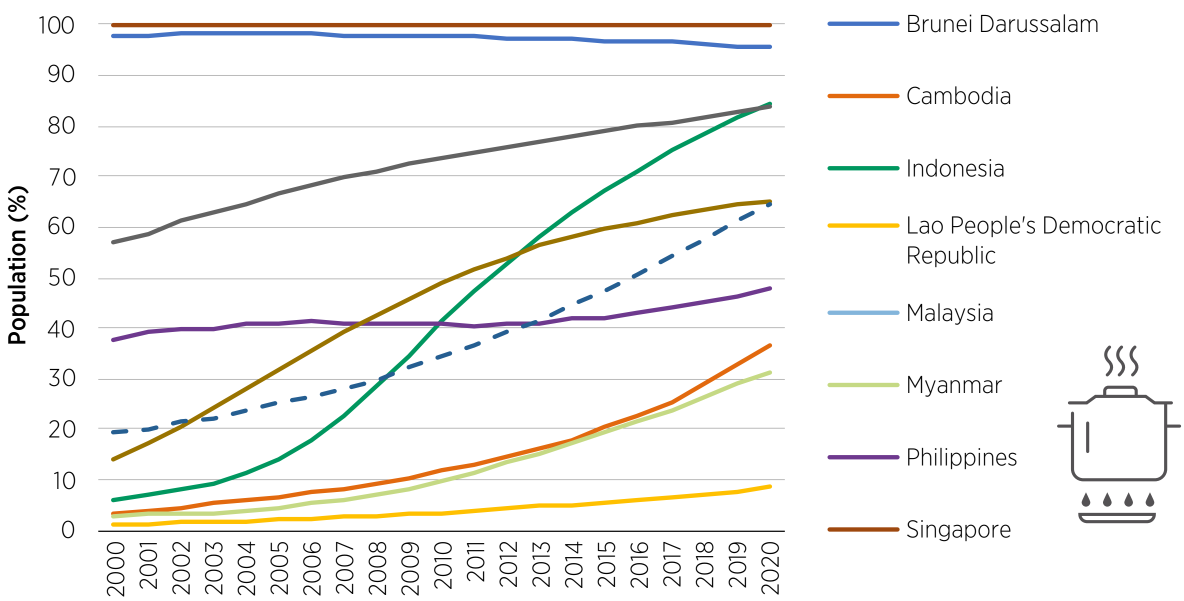

Source: Extracted from IRP (2019).

Note: With more ambitious policies, decoupling of domestic material consumption from GDP could take place by 2060. DMC = domestic material consumption; MF = material footprint; t = tonne.

The **access dimension** is measured by two subindicators. One measures the share of the population without access to basic energy services – electricity, but also clean cooking, heating and cooling technologies. The second is an evolution along the "energy ladder", which assesses the progression of energy use to cover energy services and provide energy sufficiency.

By 2020, Indonesia had not achieved universal electricity access: 3.1% of the population remained without electricity (World Bank, n.d.). However, Indonesia was among the only five countries that observed average access gains of two or more percentage points in clean cooking between 2016 and 2020 (IRENA, 2022a). Indonesia has the fourth-highest access rate (84.5%) for clean cooking in the region, behind Brunei Darussalam, Singapore and Malaysia (**Figure 24**) (WHO, n.d.). Overall, the population without access to basic energy in Indonesia was slightly lower than the regional average in 2019: 31.4% and 35.4%, respectively (CE, n.d.).

**Figure 24** Percentage of population with access to clean cooking, 2000-2020




Source: WHO, n.d.

But having access to energy tells only part of the story. Welfare can be improved further if low-income households can consume energy reliably, constantly, increasingly and affordably. In Indonesia, energy use per capita has increased inconsistently but significantly since the 1970s, but electricity consumption remains among the lowest in Southeast Asia, only above that of Cambodia, Myanmar and the Philippines (World Bank, n.d.). Indonesia's energy consumption was 15.5 kilowatt hours (kWh)/capita/day in 2019, below the region's 19.9 kWh/capita/day (CE, n.d.) and lower than the sufficiency level[13] of 20 kWh/ capita/ day in line with the literature (Millward-Hopkins *et al.*, 2020).[14]

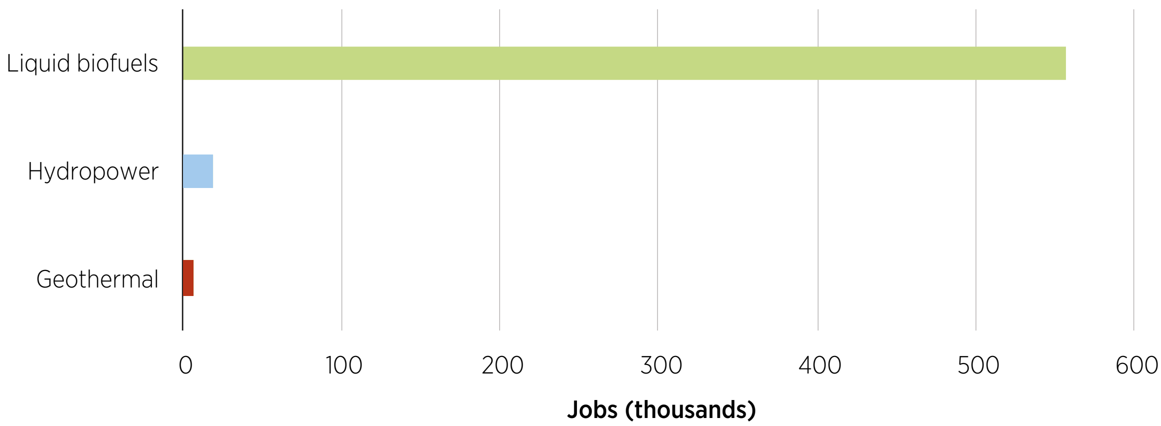
## 2.4 JOB CREATION

Across the economy, slow growth in the non-commodity tradable sectors[15] – due to moderate exposure to international trade and weak integration into global value chains due to structural dependencies long established in the global economic system – has translated into most of the newly created jobs being low-value-added, low-wage service jobs and some agricultural jobs (IFC and World Bank, 2019). Lower productivity, explained by a slowdown in human capital accumulation, has hurt potential output, despite steady capital accumulation and a growing workforce (Breue, Guajardo and Kinda, 2019). The mismatch between graduate skills and employer needs has been the major challenge for the education and training sector, and companies in Indonesia over the past few decades (ADB, 2021).

As the renewables sector expands and evolves, a skilled renewable energy workforce will need to emerge. To address potential skills gaps, a set of well-designed labour market policies and forward-looking education and training programmes will need to be put in place. Some of these skill sets can be leveraged from other domestic industries. For example, for solar photovoltaic (PV) and onshore wind, IRENA estimates that more than 60% of the workers need little training. These low requirements open employment opportunities for many, especially when on-the-job training is offered (IRENA, 2020d).

The renewable energy sector in Indonesia employed around 581 400 people in 2021, most of them in the agricultural supply chain for the liquid biofuels industry (**Figure 25**). In fact, globally, Indonesia provides the second-largest employment opportunities in liquid biofuels after Brazil. Indonesia's biodiesel employment rose to about 555 900 in 2021, driven by growing domestic consumption while export volumes remained at the marginal level of 2020 (IRENA, 2022d).

**Figure 25** Renewable energy jobs in Indonesia, 2021




Source: IRENA, 2022d.

[13] *This indicator has been defined as the required level of energy consumption for decent living, but no more.*

[14] *The authors estimated the sufficiency level between 11.6 and 30.4 kWh/capita/day according to the scenarios across all 119 countries of the Global Trade Analysis Project depending on the scenarios considered: www.gtap.agecon.purdue.edu/databases/regions.aspx?version=9.211.*

[15] *Non-tradable items are those which are not traded internationally. They include items such as services where the demander and producer must be in the same location, and commodities which have low value relative to either their weight or volume (Jenkins, Kuo and Harberger, 2011).*

## 2.5 INDONESIA'S ENERGY TRANSITION CHALLENGES AND INITIATIVES

Indonesia faces many challenges in enabling socio-economic development, while transitioning its economy, its use of natural resources and its energy mix towards a model that is sustainable in the long run.

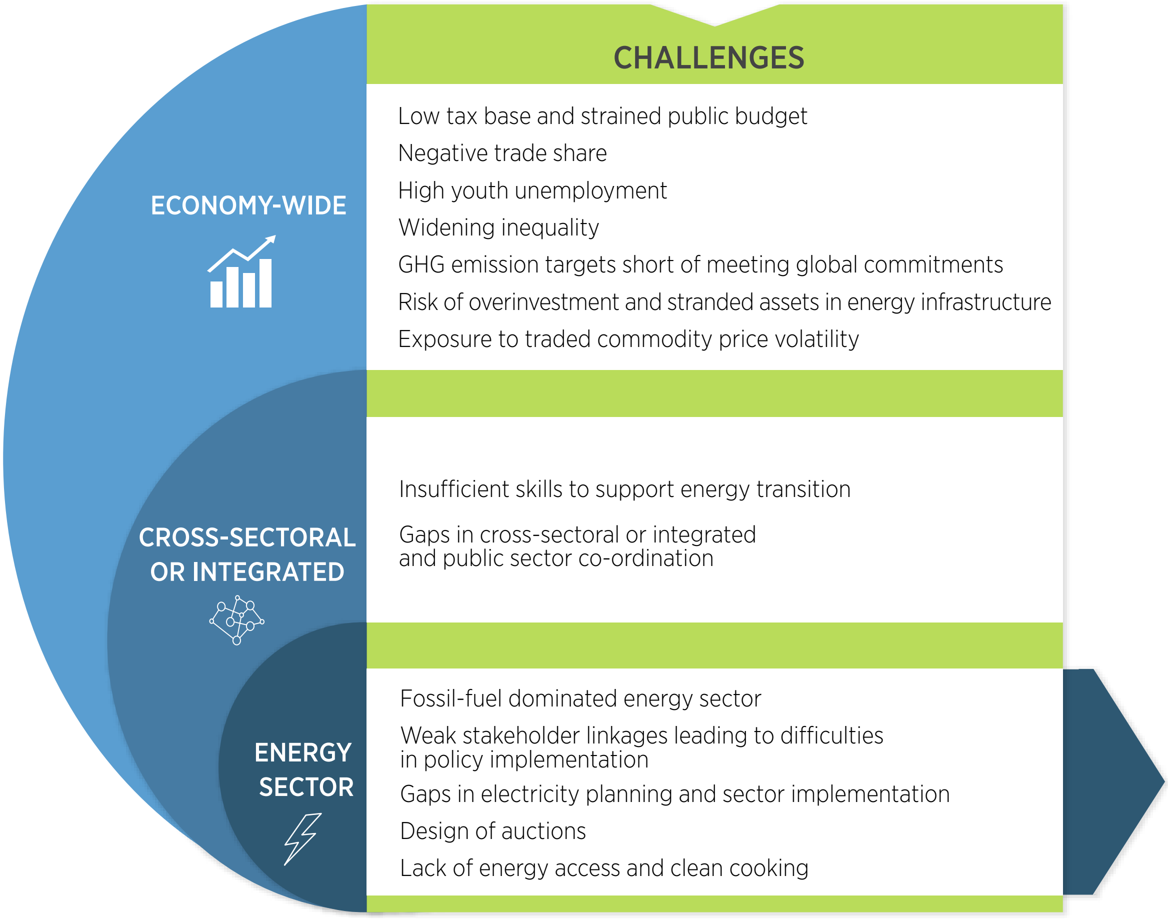
At the **economy-wide level**, the country had been experiencing economic growth rates of around 5%, at the low end of national expectations of 5-8%. Indonesia's GDP fell by 2.1% in 2020 due to the pandemic, its worst performance since the Asian financial crisis in 1997 (IMF, 2021b). There are several challenges the country faced in the midst of the pandemic. There is a risk of overinvestment energy infrastructure as we already discussed in section 2.1 and stranded assets for the new coal, city gas and DME infrastructure.

High dependency on traded commodities makes Indonesia vulnerable to price fluctuations on international markets. The country is a major exporter of raw materials, particularly agricultural products such as palm oil, natural rubber, coconut, coffee and wood products. The declining contribution of manufacturing value-added in GDP coupled with declining revenue from fossil fuels (as the country imports more to meet its demand) calls for policy-level action. Subsidies consume a significant portion of national expenditure. Foreign investments have limited opportunity because some sectors (such as tourism, banking, energy) are open to domestic companies only, amid concerns about policy implementation (AHK, 2022). High youth unemployment is also a key issue (ILO and ADB, 2020; OECD, 2021a).

At the **cross-sectoral level**, clean energy project finance and de-risking skills in the country appear to be limited, primarily in the private sector (CEFIM, 2021b). The government has made efforts to promote clean energy research and development (R&D) and innovation. However, these efforts have not shown desired success. In 2019, the actual budget for clean energy R&D was 80 times lower than the country's target under Mission Innovation.[16] Meanwhile, energy R&D activities remain focused on fossil fuel technologies, highlighting a major challenge in breaking Indonesia's dependence on fossil fuels. Stronger R&D and innovation policies and budget allocations are needed to foster the market, increase Indonesia's industrial competitiveness and support private sector innovation and job creation.

[16] *Mission Innovation is a global initiative to catalyse action and investment in research, development and demonstration to make clean energy affordable, attractive and accessible to all this decade. Through the initiative, 20 countries are committing to double their respective clean energy research and development (R&D) investment over five years. These countries include the top five most populous nations – China, India, the United States, Indonesia and Brazil (Bodnar and Turk, 2015).*

**Figure 26** Challenges of the energy transition in Indonesia




Note: GHG = greenhouse gas.

The **energy sector** faces a multitude of issues. First, energy equity and justice, which is the guiding principle behind the country's energy law, has not yet been fully achieved, as more than 15% of people continue to lack access to clean cooking. In addition, 3% of the population in remote areas lacked access to electricity in 2020 (WHO, n.d.; UN, n.d.). Second, fossil fuels continue to remain a dominant form of energy, perpetuated by fossil fuels supplied at a low price. The country already has a large coal fleet, expected to reach a total of 44 GW in 2030 according to the 2021-2030 RUPTL. Meeting the climate goal will require much commitment, including to retire old fossil fuel infrastructure and to abandon coal.

Regulated, artificially low electricity tariffs continue to pose a significant obstacle to renewable energy deployment and energy efficiency improvements in the sector, along with the high interest rates of loans and high collateral requirements for investment in the power sector. Persistent local content requirements for the uptake of clean energy need to be improved with careful assessments as they are important to develop domestic markets. Public funding of and investment in renewables are significantly lower than the investments dedicated to fossil fuels. Local financiers continue to face challenges due to the lack of supportive regulations. These challenges are summarised in **Figure 26**.

Indonesia's energy policy is "guided by the principles of fairness, sustainability and environmental soundness to achieve energy independence and energy security".[17] Indonesia has in place a relatively comprehensive renewable energy policy framework (IRENA, 2018b), although targets are far below capacity. At a national level, the targets set in the National Energy Policy (KEN) in 2014[18] include reducing energy consumption in the end-use sectors of industry by 17%, transport by 20%, and residential and commercial buildings by 15% each by 2025 compared to business as usual. The target shares of new[19] and renewable energy in the TPES are 23% by 2025 and 31% by 2050 (UNFCCC, 2016; IRENA, 2018b).

### **BOX 8** CARBON TAX IN INDONESIA

In October 2021, the Government of Indonesia passed a much-anticipated carbon policy. The carbon tax was issued through the Law on the Harmonization of Tax Regulations and is part of the fiscal policy instruments to combat climate change. The policy makes the country one of the first movers among emerging economies.

As an initial stage, a carbon tax was expected to be applied to the coal steam power plant sector on 1 April 2022 using a tax mechanism based on emission limits (cap and tax). A tariff of IDR 30 000 per tonne of carbon dioxide equivalent was estimated to be applied to the amount of emissions that exceeded the set cap. The imposition mechanism allows taxpayers to purchase carbon certificates on the carbon market to reduce their carbon tax obligations. However, citing global economic conditions and to give authorities time to prepare for it, the carbon tax scheme has been postponed[20] (Reuters, 2022).

The main objective of imposing a carbon tax is to change the behaviour of economic actors to switch to low-carbon green economic activities. This is in line with the government's efforts to achieve the target of reducing greenhouse gas emissions by 29% on its own and 41% with international support by 2030.

In addition, the imposition of a carbon tax is intended to provide a signal that drives the development of carbon markets, technological innovations and investments that are more efficient, low carbon and environmentally friendly. State revenues from carbon taxes can be used to increase development funds, invest in environmentally friendly technologies or provide support to low-income communities in the form of social programmes.

Source: GoI, 2021.

The Nationally Determined Contribution (NDC) stipulates the implementation of biodiesel blending mandates in the transport sector: 90% for the unconditional scenario and 100% for the conditional scenario. The updated NDCs in 2021 merely included Indonesia's aim to introduce new carbon tax policies to meet the targets (Box 8) but the enhanced NDC in September 2022 increased the emissions reduction targets for 2030, in addition to having set a net-zero target by 2060. Currently, the conditional NDC does not place Indonesia on track to reduce total GHG emissions (BAPPENAS, 2019). Through the National Energy Grand Strategy (GSEN) and the Long-Term Strategy for Low Carbon and Climate Resilience 2050, Indonesia shows that increasing ambitions towards GHG reduction, compared to its NDCs is essential and promises greater economic and social gains.

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[17] *See Law No. 30/2007.*

[18] *Government Regulation No. 79/2014.*

[19] *This can include nuclear, hydrogen, coal bed methane, liquefied coal and gasified coal.*

[20] *The carbon tax scheme was initially postponed to July and then further postponed in July until further notice.*

Several fiscal incentives exist for renewable power generation projects, such as tax allowances, import duty facilities, tax holidays and new incentives because of the COVID-19 impact (**Figure 27**). However, their effectiveness has been undermined by the challenging business environment and the incentives not being specially targeted to the needs of renewable energy.

**Figure 27** Incentives for renewable energy in Indonesia

| Tax allowance | Import duty facility | Tax holiday |
| --- | --- | --- |
| • Government regulation no. 78/2019 | • MoF regulation no. 176/PMK.011/2009 jo.<br>• MoF regulation no. 76/PMK.011/2012 jo.<br>• Mo regulation 188/PMK.010/2015 | • MoF regulation no, 150 PMK. 101/2018 |
| • 30% investment value<br>• Reduction of corporate net income tax for 6 years, 5% each year<br>• 183 business segments eligible for tax allowance, expanded from 129 segments in the previous regulation | • Import duty on machinery and equipment, goods, and raw materials for production<br>• Exemption of import duty on machinery and equipment<br>• 2 years exemption of import duty on raw materials<br>• Additional 2 years import duty exemption for raw materials if company using locally produced machisery and equipment (minimum 30%) | • 5-20 years Tax relief facility starting from the commencement of commercial production. Can be extended for a maximum of 20 years under certain conditions<br>• IDR 100 billion minimum investment plan<br>• 50-100% reduction of corporate income tax for pioneer industry<br>• 2 years relaxation (tax reduction) after facility period, with provisions: 25% for investment IDR 100-500 billion<br>• 50% should be more than IDR 50 billion |

Source: Adapted from MEMR, (2020).

Note: MoF = Ministry of Finance, jo. = in conjunction with

Income tax incentives exist for independent power producers involved in renewable energy, such as a reduction in taxable income of up to 30% of the amount invested; accelerated depreciation and amortisation rates; an extended tax loss carry-forward period for 5 and up to 10 years and a maximum dividend withholding rate to non-residents of 10%[21] (MEMR, 2017; PwC, 2018). Moreover, corporate income tax exemptions are available for "pioneer industries", which include renewable power plants. The tax exemption applies for years 5 to 15 after operation, if the project value is at least IDR 1 trillion (USD 69 million)[22] (MEMR, 2017). This high investment threshold prevents small-scale renewable energy projects to benefit from this tax exemption.

Other deployment policy instruments in Indonesia include feed-in tariffs (FITs), auctions and net metering. The FIT programme was introduced in 2002 for small-scale hydropower plants (IRENA, 2018b). It was capped at 60% of the utility's electricity cost if connected to a low-voltage network and 80% if connected to a medium-voltage grid. This resulted in problems with implementation, as it was hard to determine electricity production costs. Moreover, fossil fuels such as petroleum were heavily subsidised, and the utility had no incentive to prioritise renewable energy. Nevertheless, the FIT programme expanded gradually. In 2006, it included larger hydro plants (up to 10 megawatts), and in 2009 it revised its tariffs to make them more attractive; in 2011 it added geothermal, and between 2013 and 2014 it added solar PV and biomass (Yuliana, 2016).

[21] *Based on Government Regulation No. 9/2016, Ministry of Finance Regulation No. 89/PMK.010/2015 and Chairman of BKPM Regulation No. 18/2015.*

[22] *Based on Government Regulation No. 94/2010, Ministry of Finance Regulation No. 159/PMK.011/2015 and Chairman of BKPM Regulation No. 18/2015.*

A 2016 ruling by Indonesia's Supreme Court declaring the preferential FIT policy to be unconstitutional, led to a revision in the mechanism determining the tariffs. From a predetermined fixed tariff, the policy moved to one based on the regional cost of electricity generation (IRENA, 2018b; Hamdi, 2019). Regions with supply costs above the national average received a FIT capped at 85% of the average, and regions with supply costs lower than the national average could negotiate bilaterally between the developers and PLN (see **Figure 6** for costs). This change put solar power in an unfavourable position to compete directly with coal-fired power plants, the predominant form of power generation in Indonesia.

A previous IRENA report found the FIT programme has been "perceived as unattractive by most international developers, due to either unfavourable tariff levels or insufficient PPA templates" (IRENA, 2018b). In addition, if the local content requirement (LCR) was not met, the FIT was reduced by the percentage by which the developer came short. In other words, if the LCRs were met at only 60% of the total, the FIT would be lowered by 40% (MEMR, 2016). The tariffs were being reviewed in 2020 with regulations expected to be published (Richter, 2020).

Auctions have been conducted for solar PV and geothermal. Solar PV auctions, introduced in 2013, have been "under-contracted"[23] due to the overlap with the FIT scheme, in addition to the uncertainty and frequent changes in the technology's regulatory frameworks (Hamdi, 2019, 2020; Richter, 2020), especially regarding LCRs. In 2015, the Supreme Court mandated rolling back solar PV auctions, following a lawsuit from the Indonesian Solar Module Association arguing that solar developers were not meeting the LCR quotas. In turn, developers argued that the LCR criteria for the auctions lacked clarity and were ineffective in attracting project developers (Kenning, 2016).

As a result, the LCR for solar PV was updated between 2016 and 2017 (IRENA, 2018b). However, despite having attracted interest from 116 bidders (Petrova, 2017), the 2017 solar PV auction was cancelled due to PLN's concerns regarding grid reliability. Similarly, geothermal auctions have been postponed or cancelled due to the need for new studies or the lack of interested companies in the projects (PwC, 2018). Between December 2015 and July 2020, as many as 15 geothermal auctions were announced, but only three awarded contracts. Factors impeding successful geothermal auctions include the lack of clear auction documentation and information as well as uncertainty regarding ceiling prices and tariffs. In addition, lax pre-qualification requirements have increased the risk of unqualified developers underbidding (ADB and World Bank, 2015). IRENA analyses the Indonesian solar PV and geothermal auction design elements together with other auctions conducted in Southeast Asia (IRENA, 2022e). In short, FITs and auctions have not proved to be very successful in Indonesia. Following the government's announcement to install 35 GW of electricity capacity by 2019 and develop 210 power plants across the country, only just over 10% were assigned to renewable energy installations. The plan is now expected to be fulfilled by 2024. Although any newly built plant can be expected to be more efficient than the older plants, the foreseen share of renewable energy is surprisingly small.

In 2013, Indonesia introduced a net metering scheme for residential and commercial rooftops in which credits against PLN could be carried forward indefinitely (IRENA, 2018b). In 2017, the Solar Rooftop Electricity National Movement proposed a target of 1 GW-peak of rooftop solar PV before 2020 (Wijiatmoko, 2017). A first step in that direction has been taken. Indonesia is a clear example that the mere existence of (many) policies (Annex 2) has not translated into achieving the desired level of success. To be effective, policies need to be implemented. And for that, they need to be designed taking into account not only the technical correctness of the policy, but also the state's capability and the political feasibility (Andrews, Pritchett and Woolcock, 2017). Further, the quality of policy adoption and implementation is, to some extent, endogenous to national development. In other words, economic development is a main driver of effective policies (Pritchett, 2021). While Indonesia has observed strong performance in some macroeconomic indicators, it also started from a small base.

[23] *Meaning that the contracted amount is lower than the quantity demanded.*

# 03 Socio-economic footprint of the energy transition

To support transition planning and informed policy making, IRENA analyses the transition's socio-economic footprint using a macroeconometric model to measure impacts on GDP, employment and human welfare. This process provides insights into how the transition can be planned to attain the greatest possible benefits.[24]

This section presents the key findings of IRENA's socio-economic analysis for Indonesia's energy transition as per energy roadmaps consistent with the WETO (IRENA, 2022b), outlining potential impacts on economic growth (GDP), employment and welfare, including a discussion of the underlying drivers (Box 9) that lead to the results. These findings delineate the difference between the 1.5°C Scenario and the Planned Energy Scenario (PES).

### BOX 9 DRIVERS OF GDP AND EMPLOYMENT DIFFERENCES DURING THE TRANSITION*

The analysis presented in this report considers the specific impact of each structural element underlying the socio-economic footprint, and the extent to which this impact shifts over time. The structural elements included in the analysis are as follows:

**Public investment and expenditure**, in renewable energy, energy efficiency, power grids and flexibility, green hydrogen, electrification and other transition-related investments, subsidies and finance, as well as additional social spending and investment.

**Private investment in the energy transition** across all technologies and in fossil-fuel-related industries (such as exploration and production, refining, logistics), and crowding out effects in the private sector.

**Difference in net trade**, primarily through reductions in hydrocarbon imports and exports, although trade differences in other sectors are also included.

**Induced and indirect effects**, which have different components (aggregate prices, lump-sum payments and others). Induced lump-sum payments, that is, government recycling of fiscal surpluses in the form of lump-sum payments for lower-income groups to improve living standards. Induced aggregated prices, which reflect the effects of the energy transition on the price level. Prices can be higher or lower than under a less ambitious scenario because of the effects of factors such as carbon prices, the evolution of wages and the transition to less expensive fuels. It also includes other impacts of climate change mitigation policies, including fiscal tools, such as carbon prices, energy taxes or reduced fossil fuel subsidies; regulatory tools, such as efficiency standards; and redistribution.

Source: IRENA and AfDB, 2022.

Note: *In the case of employment, the "consumer expenditure" driver combines the impacts of taxes, indirect and induced effects and aggregated consumer price effects, while capturing other labour-related dynamic effects.

## 3.1 THE REFERENCE CONTEXT AND KEY ASSUMPTIONS

Energy mixes and the related investment, based on IRENA's flagship report *World energy transitions outlook: 1.5°C scenario pathway* (2022 edition), are used as exogenous inputs for the PES and the 1.5°C Scenario, as well as climate- and transition-related policies. In the context of current plans and policies,[25] implemented in the PES, Indonesia is expected to experience significant economic growth by a magnitude of almost seven times between 2021 and 2050, as envisioned in the baseline assumption of the E3ME model,[26] with the economy growing. Real GDP in the PES is assumed to grow by an average of 8.44% per year between 2021 and 2030 and by 5.69% and 6.02% per year in the 2031-2040 period and the 2041-2050 period, respectively.

[24] *See IRENA (2016, 2020a, 2021a and 2022b) for the methodology analysis.*

[25] *"Current plans and policies" means those in place before 2020.*

[26] *Baseline forecasts are constructed using a comprehensive set of international data sources. The main source for population data is the United Nations (World Population Prospects). The main source for GDP forecasts is the International Energy Agency (World Energy Outlook). These data are supplemented with data from the International Labour Organization, the Organisation for Economic Co-operation and Development (OECD) (STAN), the World Bank, the Asian Development Bank and the European Commission (AMECO, Eurostat, EC Annual Ageing Report, EU Reference Scenario reports). E3ME is a global, macroeconometric model owned and maintained by Cambridge Econometrics: https://www.e3me.com.*

The Indonesian population is projected to grow by a compound annual growth rate (CAGR) of 0.56% during the 2021-2050 period (Table 1), reaching 324.4 million in 2050. Economy-wide employment will also increase in the coming decades.

**Table 1** Indonesia's socio-economic estimations for the Planned Energy Scenario (CAGR %)

| Variable | 2021-2030 | 2031-2040 | 2041-2050 |
|---|---|---|---|
| **Real GDP** | 8.44 | 5.69 | 6.02 |
| **Economy-wide employment** | 0.00 | 0.45 | 0.39 |
| **Total population** | 0.84 | 0.44 | 0.44 |

Note: CAGR = compound annual growth rate.

## 3.2 POLICY INPUTS AND ASSUMPTIONS IN THE 1.5°C SCENARIO

Using the same inputs and assumptions as the 2022 edition of IRENA's annual flagship publication, the *World energy transitions outlook* (WETO), this chapter analyses the socio-economic differences between the PES and the 1.5°C Scenario in Indonesia.

IRENA's analysis explores the socio-economic footprint outcomes resulting from different combinations of energy transition roadmaps and climate policy baskets. The climate policy baskets include a range of tools – carbon pricing, international collaboration, subsidies, progressive fiscal regimes to address distributional aspects, investments in public infrastructure and spending on social initiatives – to support a just and inclusive transition. The baskets also contain policies that deploy, integrate and promote energy transition technologies.[27]

Carbon pricing under the 1.5°C Scenario is higher than under the PES. However, because of the regressive implications of carbon pricing, levels have been reduced by half compared to previous reports (IRENA, 2021a, 2020a). Under the 1.5°C Scenario carbon prices are higher for high-income countries than for less wealthy ones. For example, Indonesia's carbon price for 2030 (2019 PPP) is set at USD 105/t$CO_2$, while this carbon price is USD 30/t$CO_2$ in low-income countries and USD 150/t$CO_2$ in EU27 for example.

The macroeconomic modelling for most cases assumes revenue neutrality in governments' fiscal balances. The policies used to implement revenue neutrality depend on the progressiveness of the applied policy basket. In the PES, when government revenues increase (for instance, through carbon prices) income taxes decrease, and vice versa. This approach has regressive implications, however, as the wealthiest households generally pay the lion's share of income taxes and benefit accordingly from the tax cuts. By contrast, in the policy basket used for the 1.5°C Scenario revenues are recycled through lump-sum payments that target lower-income households progressively: 60% of the payments go to the lowest-income quintile, 30% to the second quintile and 10% to the third quintile.[28] Progressive distributional policies help mitigate the regressive effects of the energy transition and climate change itself.

Another key component of the climate policy baskets is the level of international collaboration. Whereas no additional collaboration is assumed in the PES, the 1.5°C Scenario policy basket does include enhanced levels to address the climate change challenge and the structural aspects underpinning an unequal distribution of burdens and responsibilities. Within this framework, all countries contribute to a joint

[27] *See Section 3.2 and Box 3.2 of the World energy transitions outlook (2022 edition) for more details.*

[28] *A quintile refers to any of five equal groups into which a population can be divided according to the distribution of values of a particular variable. Thus, the lowest-income quintile refers to the poorest 20% of a given population, the second quintile encompasses the next 20% moving up the income ladder, and so on.*

effort according to their respective capability and responsibility in terms of climate equity.[29] International collaboration under the 1.5°C Scenario is set at 0.7% of global GDP between 2021 and 2050. In contrast and given that current commitments and climate finance pledges have not been met, the PES does not consider international climate co-operation flows. Other policies are mentioned in Annex 3.

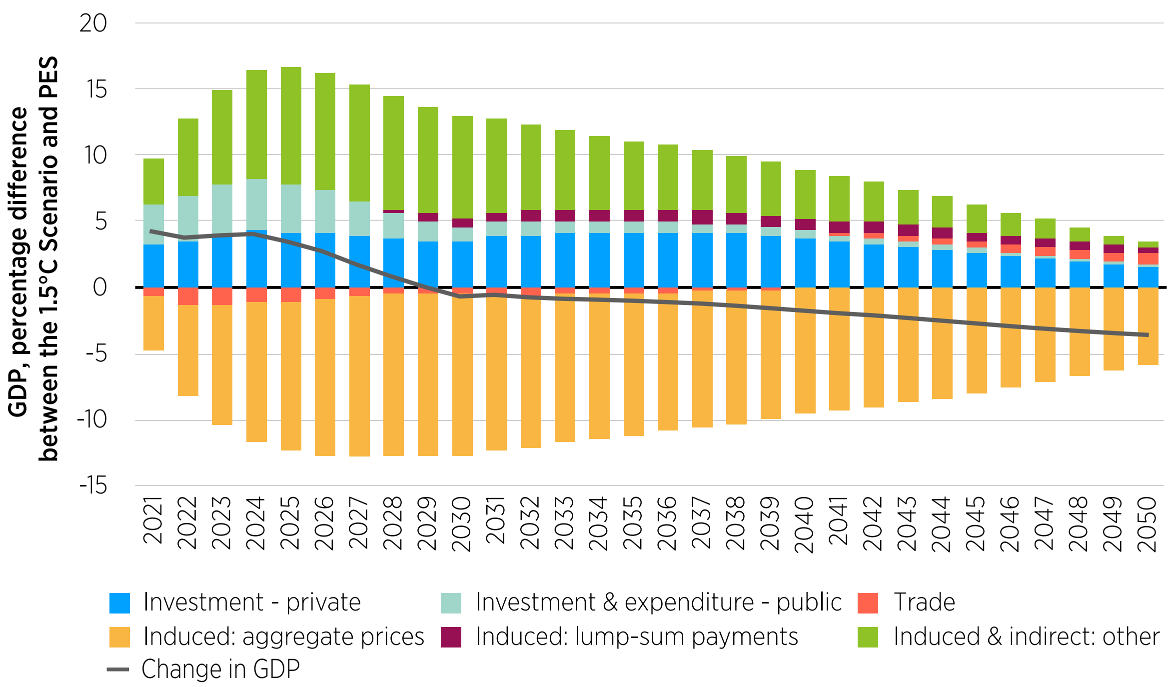
## 3.3 ECONOMIC GAINS, AS MEASURED BY GDP, UNDER THE 1.5°C SCENARIO

The International Monetary Fund's pre-pandemic forecast for Indonesia's GDP growth was 5.2% between 2019 and 2023 (IMF, 2018). As discussed in Section 3.1, Indonesia is expected to experience GDP growth of around 6.7% per year from now to 2050 under the PES. In per capita terms, Indonesia's GDP (2019 USD) would experience an increase from the current USD 4 189 to more than USD 22 535 in 2050. Under the 1.5°C Scenario, the country's economy will perform even better during the first decade. The second decade of the transition period sees similar GDP under the 1.5°C Scenario and PES, while in the last decade, GDP under the 1.5°C Scenario is lower than under the PES (with this maximum difference by 2050). Nevertheless, the 1.5°C Scenario yields a GDP that is 0.5% higher on average over the 2021-2050 period than what can be expected under the PES. In the year 2050, GDP would be 2.5% lower in the 1.5°C Scenario than in the PES, given that the initial benefits of more ambitious policies fade over time.

These differences in GDP have various drivers, such as household consumption, investment and energy prices, which are discussed below.

To gain a better understanding of the structural elements underlying the socio-economic footprint, IRENA's macroeconomic analysis disaggregates the outcomes by drivers and sectors. The main macroeconomic drivers that impact GDP differences between the PES and 1.5°C Scenario are indirect and induced effects, and investment, while trade has a minor impact. In the first half of the transition period, the investment driver plays the most important role in the difference in GDP, while indirect and induced effects are the main drivers in the second half. Induced and indirect effects have different components (aggregate prices, lump-sum payments and others), whose impact in driving differences in GDP is presented in **Figure 28**.

**Figure 28** Indonesia's GDP, percentage difference between the 1.5°C Scenario and PES by driver, 2021-2050




Note: GDP = gross domestic product; PES = Planned Energy Scenario.

[29] *Based on the Climate Equity Reference Calculator (https://calculator.climateequityreference.org/).*

**The drivers, induced and indirect (other)** and **induced aggregated prices,** considered separately, significantly impact the GDP difference in the initial years, although they cancel each other out when considering the indirect and induced effects as a whole. These last effects play the greatest role in the evolution of the difference in GDP in the last decade of the period (*i.e.* 2040-2050). As seen in the previous section, household consumption has historically accounted for the largest GDP share, while **induced and indirect effects** have the largest share in the additional GDP gain during the first decade. Indonesia reaps economic benefits from investment stimulus through indirect and induced effects such as those arising from increases in labour income. This process leads to additional real income and thus spending. But the ripple effects dissipate by the end of the period due to a significant decrease in investment, which has a negative impact on employment and labour income, and thus on spending.

Changes in income tax rates have a modest negative impact on the GDP difference in the overall induced effects. Income taxes are driven by general economic activity and by the requirement of revenue neutrality in government fiscal balances. The transition introduces significant modifications on both the revenue and spending sides of government fiscal balances. On the revenue side, carbon pricing and international co-operation receipts increase revenues in the 1.5°C Scenario compared to the PES. On the spending side, the loss of value in the oil and gas sector attributable to both lower global oil prices in the 1.5°C Scenario and lower extraction volumes, and subsidies to support the transition, and public transition-related investment, all increase public expenditure in the 1.5°C Scenario as compared to the PES. Differences in revenue and spending between the 1.5°C Scenario and PES throughout the transition period require increases of income taxes in the 1.5°C Scenario before 2027. As the carbon tax rate and international co-operation receipts increase, income tax falls. Higher lump-sum household subsidies are required within the last two decades in the 1.5°C Scenario to achieve government revenue neutrality.

The **induced effects of aggregate prices** have a strong negative impact on overall GDP difference throughout the transition period, reflecting among other things the changes in prices internationally and the consequences of carbon pricing. The oil and gas sector plays an important role in Indonesia's budget. As global oil prices and extraction volumes decline in the 1.5°C scenario, other sources of revenue, such as income taxes, need to be increased. This process exerts an increasingly negative influence on real household income in the 1.5°C Scenario compared to the PES. Energy prices increase in the 1.5°C Scenario compared to the PES, following the imposition of a carbon price and the deployment of transition-related technologies. This exerts a negative influence on real household consumption and GDP levels.

In the 1.5°C Scenario, the power sector technology transition is accelerated, compared to the PES. There is no expansion of coal capacity from 2021, and coal is completely phased out by 2050. Natural gas capacity increases up to 2040 at a faster rate than the PES but declines from 2040. Solar, large hydro, bioenergy (biogas and biomass) and geothermal are the most important technologies in the growing renewables share of capacity and generation. With the projected changes in energy sources, electricity prices are estimated to be higher than under the PES. This is driven partly by high-cost investment in geothermal and large hydro (which are being actively promoted by the state-owned utility provider PLN) (CEFIM, 2021a) and investment in enabling infrastructure (transmission and distribution) in the years before 2030. Solar will see significant investment and will be key to Indonesia's energy transition. In the long term, the cost of renewables is expected to continue to fall (due to learning-by-doing effects), bringing down the cost of electricity. As deployment of renewables increases at a faster rate in the 1.5°C Scenario, the effect of falling renewable energy costs translates into lower electricity costs in the 1.5°C Scenario by 2050 compared to 2030.

The **induced effects of lump-sum payments** have no impact in the GDP difference with PES in the first decade because the negative fiscal balance does not allow implementation of lump-sum payments, while it plays a positive but marginal role in the following decades. Lump-sum payments are introduced in the 1.5°C Scenario to address domestic distributional issues, and are driven by the resulting government fiscal balances and the requirement of revenue neutrality. As discussed above, the 1.5°C Scenario experiences significant increases in both the revenue and spending side of government fiscal balances. Since the increases in revenue and spending even each other out, there is limited room for lump-sum payments. Implementing higher carbon taxes in the 1.5°C Scenario, such as those considered in IRENA (2020a, 2021a) would increase the fiscal space for lump-sum payments and its socio-economic benefits.

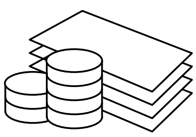
**Trade** is a negative driver of the GDP differences before 2035 and becomes a positive one in the long term, although its role is marginal over the entire transition period. As described in Chapter 2, the trade balance plays a small role in Indonesia's GDP, but at the same time, the government's objective is to have a positive trade balance by limiting imports (including those of fossil fuels). The evolution of the overall trade driver depends on two opposing contributions: changes in net trade in fuels and changes in other trade. The negative impact from the changes in other trade is driving the trade driver in the first two decades of the transition period before being outweighed by the positive contribution from changes in net trade in fuels.

Changes in net trade in fuels is noticeably positive throughout the transition, mainly due to a substantial reduction in demand for manufactured fuels in the 1.5°C Scenario, leading to lower demand for imports of these fuels. The improvement in the net trade balance in fuel reaches USD 102 billion by 2050 (2019 PPP). On the other hand, changes in other trade are negative throughout the years to 2050, mainly attributable to the increase in demand for imports, such as in machinery and electronics which are critical to the building of infrastructure to support the transition. This increase in demand for imports outweighs the positive impact from the increasing basic non-fuel manufactured product exports (including metals, wood and paper, and non-metallic minerals) throughout the years to 2050. These increasing exports are attributable to the endogenous investment response, which allows the economy to expand productive capacity and increase participation in the global supply chain.

The impact of **private investment** is positive throughout the transition. The driver is strong in the first decade of the transition (*i.e.* 2021-2030), while it is stable in the second decade before decreasing in the last decade. The greater initial impacts are partly because of the front-loaded nature of transition-related investment. There are strong and positive endogenous increases that offset the effect of investment in the power sector crowding out investment in other sectors and a loss of fossil fuel supply investment. This is mainly driven by the agriculture and "business services" sectors in response to households' spending budget. As seen previously, other sectors in the wider economy, such as basic manufacturing, engineering and transport equipment, and construction, experience positive impacts due to transition-related investments.

The **public investment and expenditure** driver plays an important role in the first decade of the transition. This is primarily due to the front-loaded investment needs of the energy transition.

Being one of the beneficiaries of the global transition fund with a relatively small financing contribution, Indonesia sees an increase in government social spending in the 1.5°C Scenario of around USD 7 billion (2019 PPP) more than the PES by 2050. This is forecasted to lead to increased spending on non-defence services predominantly provided by the government including public administration, health care and education, thus mainly benefiting "public and personal services".

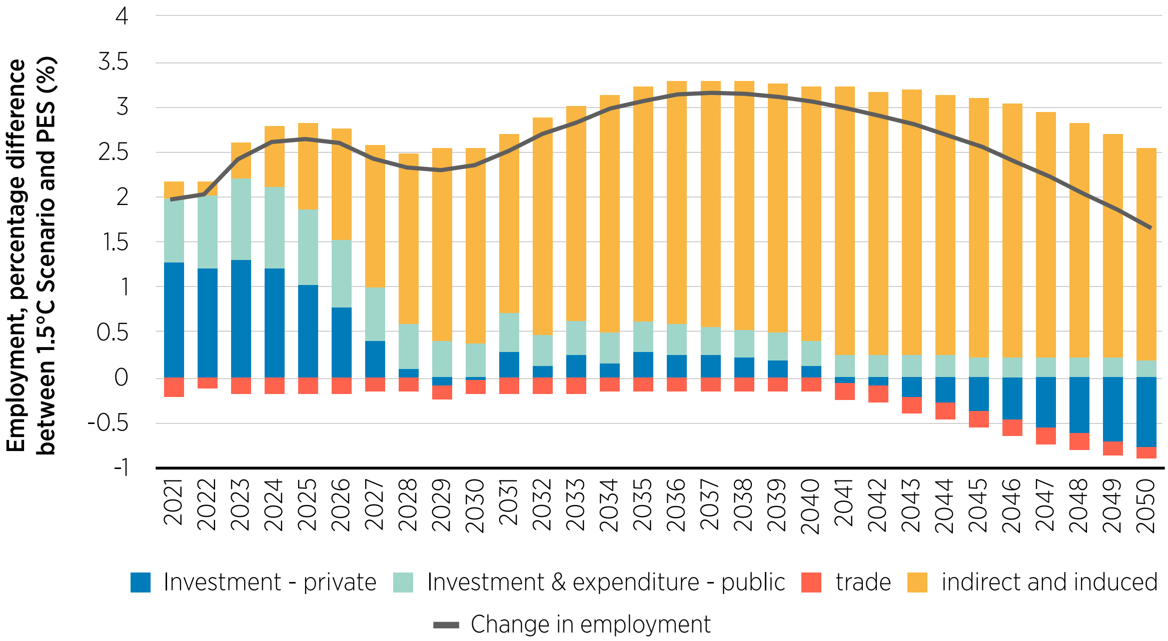


## 3.4 EMPLOYMENT

### Economy-wide employment

The energy transition in Indonesia creates a net gain of jobs. Under the 1.5°C Scenario, employment is higher than in the PES by an average of 2.6% over the 2021-2050 period, reaching a 1.7% difference (2.7 million in absolute numbers) in 2050 after achieving a maximum of 3.2% in the middle of the second decade. Similar to GDP, the difference in employment depends on indirect and induced effects, and investment and trade to a lesser extent (**Figure 29**). The role of drivers and their impacts on different sectors are described in the following paragraphs.

**Figure 29** Employment in Indonesia, percentage difference between the 1.5°C Scenario and PES by driver, 2021-2050




Note: PES = Planned Energy Scenario.

**Indirect and induced effects**. Compared with the PES, the 1.5°C Scenario sees an increase in economy-wide employment. This benefit is mainly driven by the positive contribution of wage effects and the indirect and induced effects of consumer expenditures in the first decade, while from the second decade onwards, it is mainly due to the indirect and induced effects of consumer expenditure and dynamic effects (such as sluggish responses in the employment market). In the first half of the first decade, wage effects are the main positive driver of the indirect and induced effects, mainly attributable to increased labour income. The indirect and induced effects of consumer expenditures become the main positive driver from the second half of the first decade, mainly the ripple effects from front-loaded transition-related investment. In 2050, indirect and induced effects are responsible for about 2.9 million additional jobs in the 1.5°C Scenario compared to the PES. As discussed above, this consumer expenditure response in the 1.5°C Scenario plays an important role in creating more jobs in sectors meeting consumer demand. The sectors which receive an increase in consumer expenditure (basic manufacturing, distribution and retail, hotels and catering and communications, business services, and public and personal services) create significantly more jobs. The transition sees a shift in consumption pattern from petroleum/diesel and gas to food, electricity, housing, communication and medical care.

Front-loaded investment, both public and private in capital-intensive transition technologies (renewables and other transition-related technologies), are the main driver of the additional jobs in the first years of the first decade. But soon after the first decade, this effect dissipates as the relative impact of front-loaded investment tapers off.

**Private investment** leads to increased employment in the 1.5°C Scenario during the first decade, contributing up to around 0.7% additional employment on average between 2021 and 2030. Its net effect on economy-wide employment is lessened by a reduction in fossil-fuel-related investment compared with the PES. The majority of jobs created are related to the power sector. Investment in energy efficiency, the power sector and other low-carbon measures foster investment elsewhere to support the transition. **Public investment** in transition-related technologies and sectors, as well as greater social spending linked to international co-operation, leads to substantial new employment across the country throughout the transition in comparison with the PES. The effects are greater in the short run, which suggests that the government contributes more to investments that are more employment intensive (such as energy efficiency) in the short term.

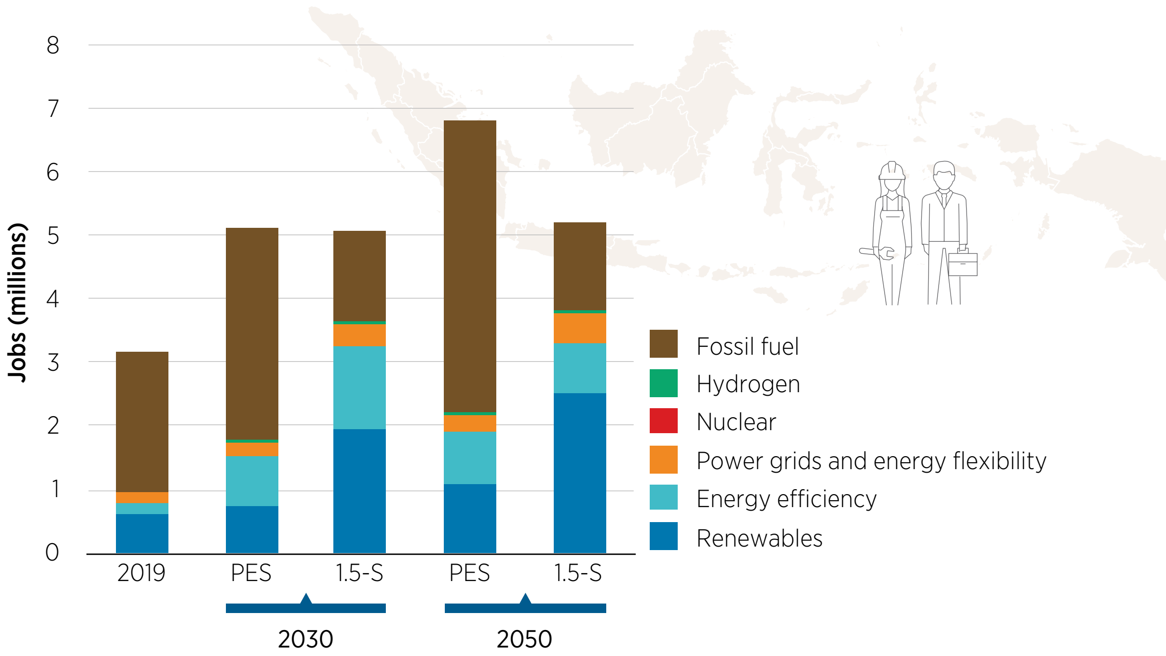
**Trade**. The employment impacts from trade are negative throughout the analysis period, although the impact is small in relative terms. Net trade effects on the employment difference are mainly attributable to the changes in net trade in non-energy sectors. The number of additional jobs created in the basic metals, wood and paper, and non-metallic minerals (in the "basic manufacturing" aggregate) is outweighed by the number of jobs displaced in machinery and electronics (part of the "engineering and transport equipment" aggregate). Non-energy trade is lower in the 1.5°C Scenario because of competitiveness changes in international markets (as aggregate prices have a negative impact on GDP) and a shift towards higher goods imports driven by increased consumer expenditure (as seen in the section on GDP with the trade driver).

## Energy sector jobs

The number of people working in the Indonesian energy sector by 2030 could reach around 5.1 million in both the PES and 1.5°C Scenario, compared to 3.4 million currently (**Figure 30**). The high job losses in conventional energy jobs (*i.e.* fossil fuels and nuclear) are almost entirely offset by job gains in renewables and other energy-transition-related technologies (*i.e.* energy efficiency, power grids and flexibility, hydrogen) by 2030. The loss of 1.94 million jobs in fossil fuels is almost overcome by the addition of 1.88 million transition-related jobs under the 1.5°C Scenario. In the following decades, total energy sector employment would be 6.8 million under the PES and 5.2 million under the 1.5°C Scenario.

Reversing the decline in energy sector jobs would require dedicated policies to address the structural dependency on fossil fuels and to galvanise a more ambitious approach to the energy transition. The negligible increase in jobs under the 1.5°C Scenario in 2050 compared to 2030 is a result of the front-loaded construction of new transition-related technologies (mainly energy efficiency) and an increase in productivity. A decline of more than 70% of jobs in fossil fuels is observed when moving from the PES to the 1.5°C Scenario in 2050, accounting for about one-quarter of total energy jobs (1.3 million jobs) under the 1.5°C Scenario, while renewables more than double to nearly 2.5 million jobs.

**Figure 30** Overview of energy sector jobs in Indonesia under the 1.5°C Scenario and PES, by sector, 2019-2050



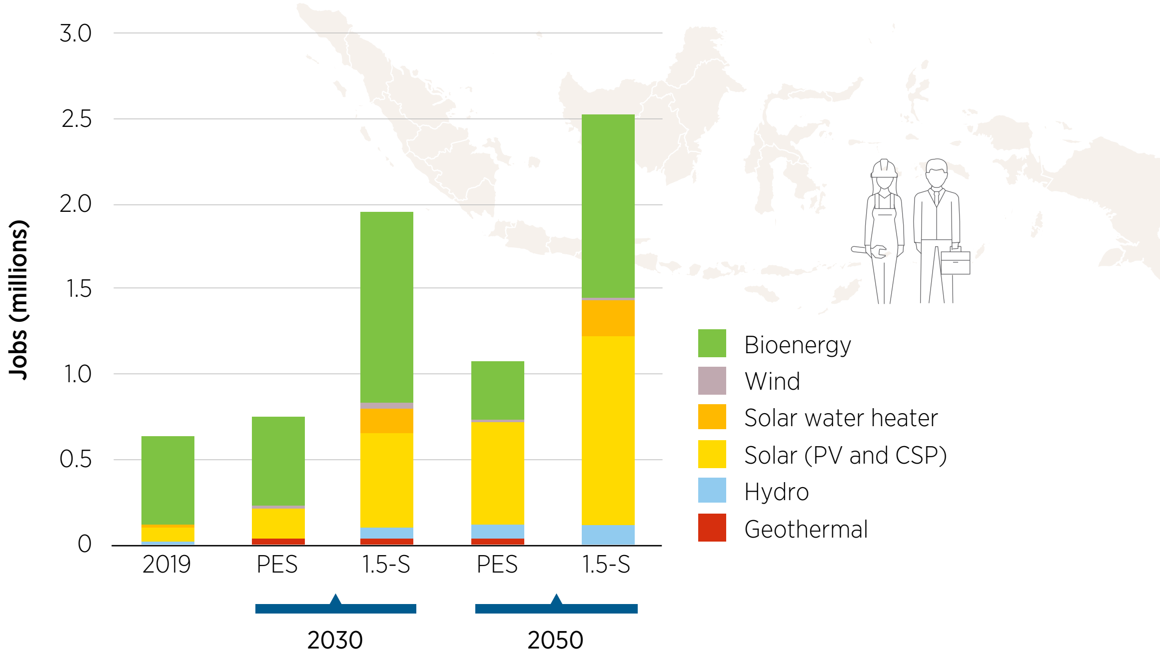

Note: 1.5-S = 1.5°C Scenario; PES = Planned Energy Scenario.

## Renewable energy jobs

Renewable energy jobs in Indonesia are expected to increase throughout the transition, from 0.63 million currently, to 0.74 million in 2030 and 1.07 million in 2050 under the PES. The rise observed in renewable energy jobs under the 1.5°C Scenario is more significant compared to the PES (**Figure 31**), reaching 2.5 million jobs by 2050.

At the end of the first decade, bioenergy (biogas and biomass) technologies still dominate renewable energy jobs in Indonesia, accounting for 69% (510 000 jobs) and 58% (1.1 million jobs) by 2030 under the PES and 1.5°C Scenario, respectively. Their share decreases to 32% (387 000 jobs) and 43% (slightly less than 1.1 million jobs) by 2050 under the PES and 1.5°C Scenario, respectively. Meanwhile, the rapid development of solar technologies is expected, rising from more than 79 000 jobs currently, to 177 000 jobs in 2030 and 595 000 jobs in 2050 under the PES – or 565 000 jobs in 2030 and over 1.1 million jobs in 2050 under the 1.5°C Scenario. Under the 1.5°C Scenario, solar technologies account for 29% and 44% of renewable energy jobs by 2030 and 2050, respectively, dominating the share of renewables at the end of the transition period. Comparing the 1.5°C Scenario with the PES in 2050, the greatest employment growth is seen in solar water heaters (almost 30-fold) (**Figure 31**). Solar water heaters represent around 8% (202 000 jobs) of renewable energy jobs under the 1.5°C Scenario by 2050 while they account for less than 1% (around 7 000 jobs) under the PES.

**Figure 31** Renewable energy jobs in the PES and 1.5°C Scenario, 2019, 2030 and 2050



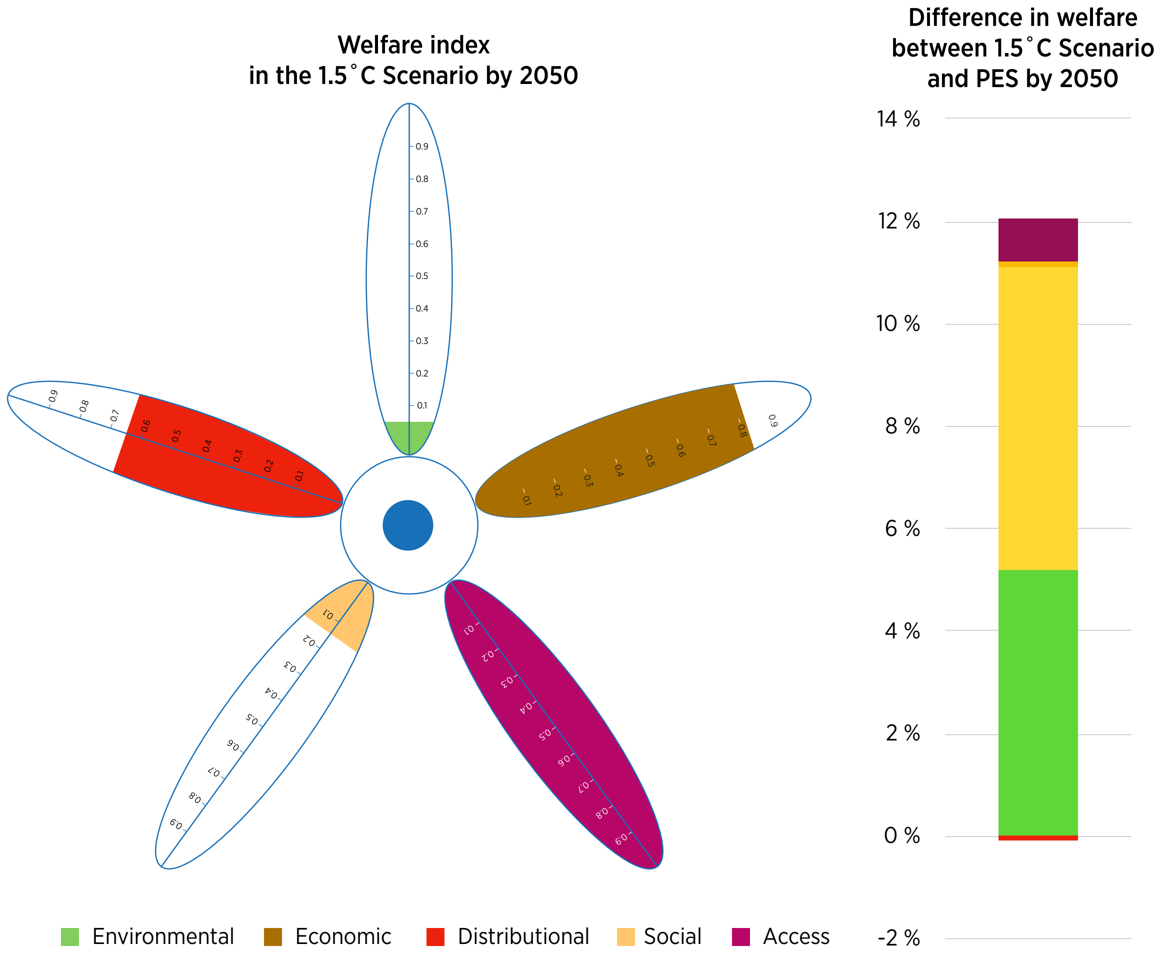

Note: 1.5-S = 1.5°C Scenario; CSP = concentrated solar power; PES = Planned Energy Scenario; PV = photovoltaic.

## 3.5 WELFARE

On top of the economic and employment benefits discussed above, the main promise of the energy transition is to improve overall welfare in Indonesia. IRENA quantifies the impact of the energy transition through its Welfare Index (IRENA, 2021a). The index captures five welfare dimensions: economic, social, environmental, distributional and energy access (see Section 2.3).

The Welfare Index in the 1.5°C Scenario by 2050 for Indonesia, and the difference between the PES and 1.5°C Scenario outcomes, broken down by dimensional contributions, are presented in **Figure 32**. The welfare improvement for Indonesia under the 1.5°C Scenario over the PES reaches 12% by 2050 (**Figure 32**, right panel).

**Figure 32** Welfare Index in the 1.5°C Scenario (left) and difference in welfare between the 1.5°C Scenario and PES (right), 2050




Note: PES = Planned Energy Scenario.

The biggest welfare improvements in the 1.5°C Scenario compared to the PES are in the **social and environmental dimensions** (**Figure 32**, right panel). The **social dimension** is informed by two indicators: health impact and social expenditure. Indonesia performs well on both indicators in the 1.5°C Scenario, with both health and social expenditure improving significantly (by more than a third) over the PES. Under the PES, continued reliance on fossil fuels is expected to worsen health impacts in Indonesia. By contrast, under the 1.5°C Scenario, fossil fuel use is reduced in Indonesia in favour of renewable energy and increased electrification of end uses, improved access to clean cooking fuels and technologies, and biofuels in the transport sector, which reduces indoor and outdoor air pollution, and thus improves welfare significantly compared with the PES. Reduced reliance on fossil fuels and international co-operation flows also free fiscal resources for other uses, notably social spending. The absolute social dimension reaches 0.14 under the 1.5°C Scenario by 2050, dragged down by the low contribution of social expenditure (**Figure 32**, left panel), indicating room for improvement for this indicator.

The **environmental dimension** is the second-largest driver of significant welfare improvements in the 1.5°C Scenario over the PES in Indonesia. The 1.5°C Scenario markedly reduces global cumulative $CO_2$ emissions compared to the PES, therefore helping mitigate climate change and its expected negative impacts on Indonesia. By contrast, material consumption, the other indicator of the environmental dimension, continues to grow under both the PES and the 1.5°C Scenario, dragging down the absolute environmental dimension (**Figure 30**, left panel). This means much more must be done to reduce material consumption in Indonesia in the future, with significant room to improve the absolute welfare index.

The energy transition also promises benefits in terms of **energy access** in Indonesia. Basic energy access improves significantly under the PES, reaching an index value of 0.92 by 2050, and Indonesia reaches universal energy access under the 1.5°C Scenario pathway from 2030, reaching its maximum value of 1 (**Figure 30**, left panel). Under both the PES and 1.5°C Scenario, Indonesia's energy consumption reaches the sufficiency level, assumed at 20 kWh/capita/day in line with the literature (Millward-Hopkins *et al.*, 2020),[30] in the first half of the first decade (*i.e.* 2021-2025). This implies that the energy accessed is not only basic, but also sufficient, under both scenarios, reaching the maximum index value of 1.

While the social, environmental and energy access dimensions significantly improve under the 1.5°C Scenario, the **economic dimension** of welfare is similar across the two scenarios, with a small improvement under the 1.5°C Scenario over the PES. As explained in Section 2.3, consumption and investment per capita in Indonesia are among the highest in the region. They will increase in the coming decades to get closer to the sufficiency limit due to increasing disposable incomes under the 1.5°C Scenario. The non-employment indicator is entirely responsible for the slight improvement in this dimension over the PES. The negligible improvement in the economic dimension of the welfare index is due to a slight improvement of the non-employment indicator.[31]

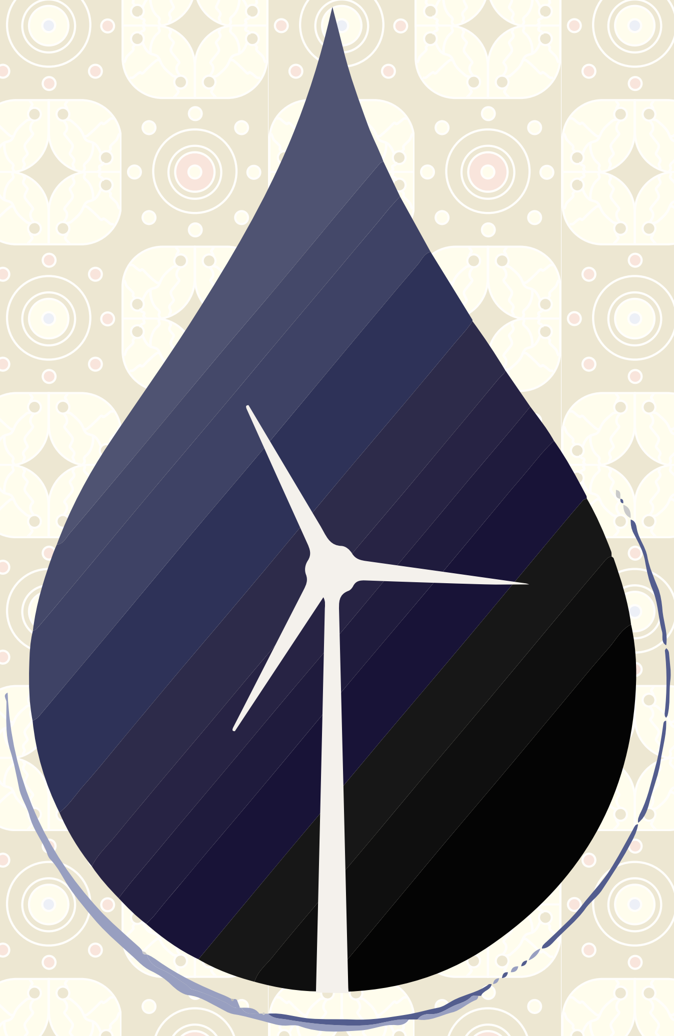
The **distributional dimension** observes by 2050 a negative but almost negligible difference between the 1.5°C Scenario and the PES in Indonesia (**Figure 30**, right panel), and hence does not make a significant contribution to the difference in welfare between the 1.5°C Scenario and PES. The income distribution experiences only a small improvement over the PES, with the wealth distribution dragging the intra-distributional index down. This is due to the limited available fiscal space. While receiving international co-operation flows, there are reduced carbon tax revenues with decreasing reliance on fossil fuels, a loss of value in the oil and gas sector (lower global oil prices and lower extraction volumes) and an increase of public expenditure (subsidies to support the transition, public transition-related investment). The absolute distributional index reaches 0.63 under the 1.5°C Scenario by 2050. This value is on the high end when considering the global index of 0.36 but also indicates significant room for improvement. The climate policy basket accompanying the 1.5°C Scenario includes policies directly targeting the improvement of income distributions (both intra and inter). Ultimately, more needs to be done to address distributional inequalities in Indonesia.

Finally, **Figure 30** (left panel) shows where to focus policy action to improve welfare in Indonesia. The overall welfare index reaches 0.34 by 2050 under the 1.5°C Scenario, which is a clear indication of significant room for improvement. The environmental and social dimensions are the ones that offer the greatest room for improvement, which could be achieved by focusing mainly on the reduction of material consumption and on the implementation of policies addressing increases in social spending. The economic and distributional dimensions also offer significant room for improvement by focusing on policies that improve wealth distribution and provide additional fiscal space that, in turn, allow for improvements in income distribution. Finally, additional policy efforts are needed in the access dimension to close the small remaining gap to achieve a consumption level beyond the sufficiency energy access.

[30] *Sufficiency level estimated between 11.6-30.4 kWh/capita/day across all 119 countries depending on the scenarios considered.*

[31] *The state of not having paid work, excluding young people (aged 15 to 24 years) getting an education. Non-employment is hence calculated as the share of the working-age population (aged 15 to 64 years) that is neither employed nor young (aged 15-24) and getting an education. Non-employment is used instead of unemployment or employment metrics because of its more comprehensive gauging of the social implications of paid work, which is the main goal of a welfare index. Indeed, while unemployment and employment are evaluated as shares of the labour force, non-employment is defined on the basis of the entire working-age population (not only the part of it belonging to the labour force), and hence beyond a short-term lack of paid work it also captures a long-term lack of paid work (which is excluded from the labour force).*

# 04 Conclusion



Indonesia has made large socio-economic strides in the past decade, halving poverty rates since the start of the millennium and witnessing the emergence of a dynamic middle class, which accounts for around 19% of the population (OECD, 2019). These improvements have been accompanied by a considerable increase in access to electricity, with the electrification rate sharply increasing from a mere 53% in 2000 to 99% in 2020, supported by rural electrification programmes as well as other national fast-track programmes for power infrastructure.

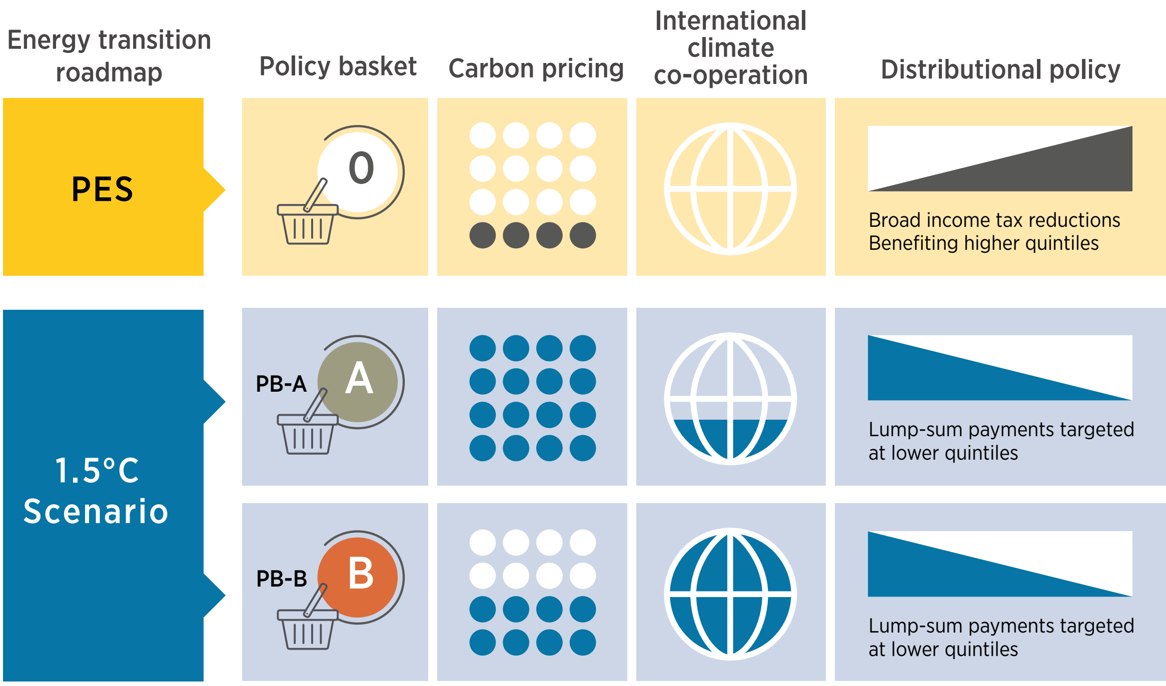
Despite impressive growth in recent years, Indonesia has not succeeded in diversifying its economy to the extent desired. The country remains highly reliant on emissions-intensive resource extraction and commodity exports, coupled with unsustainable land conversion that is itself a major source of emissions, in addition to environmental destruction. The high GHG emissions from these activities have externalities that are not accounted for in the GDP. COVID-19 has exaggerated the situation, pushing the government to spend more on subsidies and incentives at a time when economic conditions are worsening, with the greatest impacts on the poor.

IRENA's analysis has shown that a comprehensive and more ambitious energy transition will lead to improved socio-economic outcomes. Under the 1.5°C Scenario, the GDP of Indonesia is expected to be 0.5% higher than in the PES over the 2021-2050 period. Greater household consumption, lower oil revenues, carbon pricing, international co-operation funds as well as higher transition-related investments are the main drivers of this GDP difference. Economy-wide employment would be 2.6% higher under the 1.5°C Scenario over the PES in the same period, adding 2.7 million more jobs by 2050, while renewables add more than 1.45 million jobs and other transition-related technologies add 0.21 million jobs under the 1.5°C Scenario compared to the PES.

Welfare improves by 12% under the 1.5°C Scenario by 2050 compared to the PES, led by the social and environmental dimensions. The detailed results provided clear indications of where to focus policy action to improve welfare in Indonesia. This policy action should focus on the environmental, social, economic and distributional dimensions. The access dimension has almost reached its maximum index value but will need additional policy efforts to close the small remaining gap.

A successful energy transition capable of limiting climate change impacts and damages also requires an unprecedented global collaborative effort. And this collaborative effort, in turn, hinges on bringing all on board by successfully addressing the equity and justice dimensions of the transition. Policy action is a cornerstone to achieve these goals. Thus, IRENA has also studied the impact of different policy baskets to facilitate this needed co-operation (IRENA and AfDB, 2022; IRENA, 2022b). The analysis explores the socio-economic footprint of the 1.5°C Scenario energy transition roadmap with two different climate policy baskets (**Figure 33**), which differ in their level of carbon pricing and international collaboration. These baskets also include policy instruments to address improvements in domestic income distribution, which are not adopted in the PES. The socio-economic footprint results reported in Chapter 3 correspond to the more progressive policy basket (high international collaboration and low carbon taxes, *i.e.* policy basket B [1.5°C Scenario PB-B]).

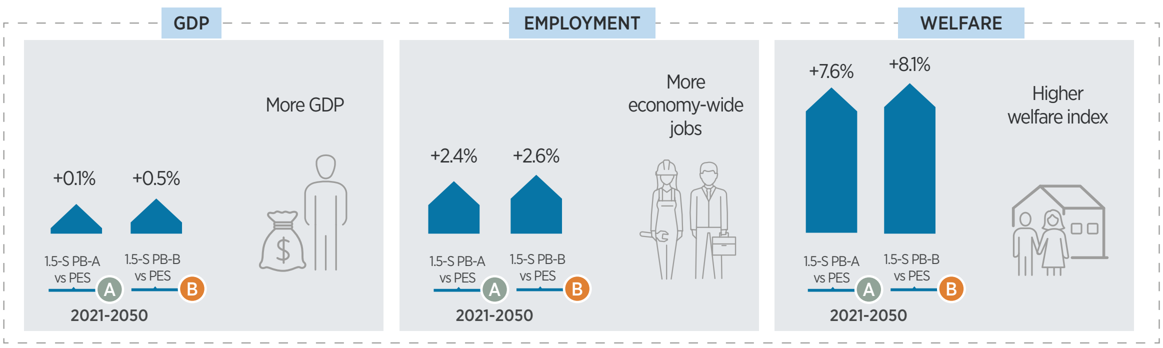
**Figure 33** Energy transition roadmaps and climate policy baskets




Source: IRENA, 2022b.

The analysis showcases the important role of international collaboration in enhancing the transition's socio-economic footprint in developing countries, while not imposing a significant negative effect on developed economies. In the case of Indonesia, better GDP, economy-wide employment and welfare results are obtained with the more progressive policy basket in average terms over the 2021-2050 period (**Figure 34**).

**Figure 34** Gross domestic product, economy-wide employment and welfare difference in Indonesia under the two 1.5°C Scenario variants compared with the PES, 2021-2050




Note: 1.5-S = 1.5°C Scenario; GDP = gross domestic product; PES = Planned Energy Scenario

To reap the benefits of the energy transition, a holistic and just transition policy framework must be implemented. This requires concerted action both from within Indonesia, and from international partners to support Indonesia in its transition. Political commitment by Indonesia's government at all levels will be a significant steppingstone. This should be backed by enhanced co-operation between, and capacity building in, different line ministries, government bodies and implementing agencies, including at the regional and local levels.

A supportive environment for investment should continuously be strengthened, including supportive policies, as well as efficient financial markets to encourage climate-conscious investment and incentives for climate-friendly investments. The Government of Indonesia has set a number of policies that open opportunities to increase the diversification of finance sources from both national and international, and public and private sources. At the national level, the opportunities to optimise the state budget are explored (*e.g.* using green Sukuk or green bonds and the recent announcement of the carbon tax on coal industry). Furthermore, Indonesia continues to mobilise international financial sources through bilateral, regional and multilateral channels, including result-based payments.

The Government of Indonesia has also put in place a number of policies and measures to support the transformation of its food and land-use systems to reduce GHG emissions and pollutants, reduce vulnerability and increase adaptive capacity to climate change, conserve biodiversity, promote healthy diets, strengthen rural livelihoods, ensure the sustainable use of freshwater resources, as well as to halt the loss of ecosystem services.

## Policy anchors for a successful transition

To achieve the central objective of the country, which is to bring energy justice to all, the energy transition policy framework should be holistic and act on three key fronts. It should aim to strengthen the deployment of renewables. It should capture cross-sectoral linkages and integrate them for a common purpose. Simultaneously, it should firmly embed the deployment of renewables in a wider socio-economic policy framework that makes energy a catalyst for inclusive and sustainable growth, with a focus on people and the environment.

The energy transition will require some of the workforce to shift to green jobs and will need well-designed capacity development and co-ordination in cross-cutting issues, such as gender, vulnerable groups and local and indigenous communities. An integrated approach to capacity development to support the energy transition should be developed and aligned with capacity needs.

To create a supportive ecosystem for promoting environmentally sound technologies, the existing international regulatory and political framework for trade and investment in such technologies needs to be re-visited. Other supports for creating good investment ecosystems – such as regulations and good legal capacity; capacity to enforce good laws (*e.g.* intellectual property rights); and infrastructure development – are also critical.

Policies to support all the essential technological pathways of the energy transition – namely, renewable energy for power and end uses (heating/cooling and transport), energy efficiency, electrification, sustainable bioenergy and green hydrogen – play a fundamental role in accelerating the adoption of related technologies. PLN's RUPTL 2021-2030 outlines aspirational plans for around 21 GW of renewable energy additions (around one-third of current total power installed capacity) over the next decade as well as a 30% biofuel blending mandate. Indonesia has adopted a Geothermal Resource Risk Mitigation programme and introduced two regulations to ease the development of both rooftop and floating solar PV projects. The government has mandated the development and production of domestic electric vehicle infrastructure, which should generate greater momentum to deploy a sustainable transport system (ADB, 2020a).

In addition to the transition of the energy sector, Indonesia will need to take decisive action to reduce emissions by ending further deforestation and the destruction of peat lands. Land acquisition remains crucial for renewable energy deployment but needs to be in line with existing land rights, and consider other pressing needs, such as to avoid further deforestation. Additional action needs to be taken to increase carbon sequestration from secondary forests, afforestation and reforestation. However, as the population increases, demand for land use – whether for housing, livestock or crops – will also increase. Proper mapping and balance of land use across Indonesia's archipelago will be a key prerequisite, including consideration of the trajectory of changes in population and the need to avoid deforestation during the development planning. This also includes respect for local community rights. Furthermore, creating a better environment for investment is required to comply with land use planning but must be guided by environmental impact assessments.

Finally, the energy transition will provide many benefits to Indonesia (in terms of welfare, employment, energy security, higher savings on imports and less exposure to geopolitical risks). These can help to address the challenges outlined in Chapter 2. **Figure 35** presents some of the key opportunities that arise from the energy transition and how they can be mapped with the main challenges faced by the country.

**Figure 35** Challenges and opportunities presented by the energy transition in Indonesia


Note: GHG = greenhouse gas.

An effective and inclusive transition coupled with sustainable land and forestry management, will help Indonesia lower GHG emissions and build a climate-resilient economy. With the technological options available now, sound policy design can provide the energy transition an opportunity to correct some of the misalignments in electricity planning. With this, people without access to modern energy services can gain access, freeing up time and money for other productive uses. At the same time, the transition can create new jobs, and help promote gender equality (IRENA, 2019, 2020e, 2022e).

However, these benefits are not automatically realised – they require a wide range of policy and regulatory changes. The country will need to embark on long-term integrated energy planning strategies, sometimes sacrificing short-term well-being for long-term welfare. The energy transition is a slow process, and policy makers will need to ensure harmony between energy policy and other areas of national policy.

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# Annex 1: Resource potential in Indonesia

**Coal**: The total coal reserve in Indonesia is 34.9 billion tonnes or 3.2% of the global total (BP, 2022). After a slight dip in 2020 of around 10%, coal production rebounded; following the increasing trend in recent years, coal production increased by a factor of 2.2 from 2010 to 2021, reaching around 614 million tonnes (BP, 2022). The global trend of moving away from coal could threaten Indonesia's coal future, as coal demand might start to decline (IESR, 2022). Indonesia's coal reference price set a new record high at around USD 215/tonne in November 2021. The high prices were mainly driven by increased coal demand from China and India as the global economy started to recover and coal supply was constrained amid extreme weather events such as flooding which disrupted coal production. Coal shortages were further worsened by Chinese policy that banned coal imports from Australia (IESR, 2022).

**Oil**: Commercially proven crude oil reserves in Indonesia amounted to 2.4 billion barrels by 2020 (BP, 2022). Indonesia was a net crude oil exporter before becoming a net importer from 2013. By 2019, the country's crude oil imports were three times its exports.

**Natural gas**: Commercially proven natural gas reserves in Indonesia amounted to 1.3 trillion cubic metres by 2020. Around 30% of all output was used to produce liquefied natural gas, and 9% (358 million of standard cubic feet per day) was exported through pipelines, down 30% from 2012 levels. Indonesia is predicted to become a net importer of natural gas as well by around 2030 (McKinsey, 2021). The government sets a target to increase the current gas production targets to 12 billion cubic feet per day by 2030 (IESR, 2021) (currently the production is at 5.7 billion cubic feet per day [BP, 2022]).

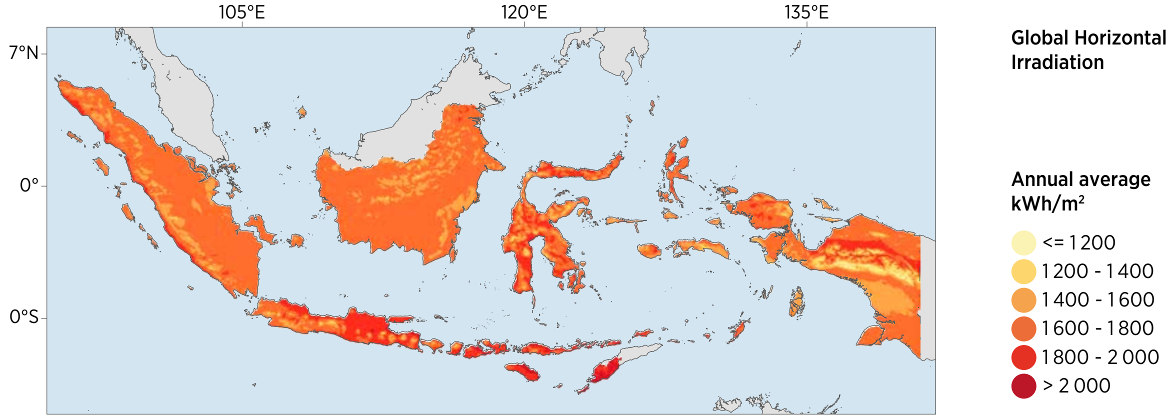
**Hydropower**: As of 2016, Indonesia had developed 6.1 gigawatts (GW) of hydroelectric capacity in 2020, making hydro the country's largest source of renewable energy. Hydropower is Indonesia's largest source of renewable energy today and has potential for 75 GW of capacity. Other estimates indicate up to 94.3 GW (National Energy Council, DEN) (IRENA, 2022a). Because the Indonesian archipelago is mountainous and tends to receive large amounts of rain, it hosts numerous sites for potential hydropower development. The greatest large-scale potential is in the northern and eastern regions, such as Kalimantan and Papua.

**Bioenergy**: Biomass represents the second-biggest renewable power source, with 1.9 GW of installed capacity in 2020, out of an estimated potential of 32.6 GW (IRENA, 2022a). Most of these plants (94%) are off-grid (MEMR, 2021). The country estimates the total potential of biofuel to be around 200 000 barrels per day (MEMR, 2020). Indonesia is the fourth-leading producer of biodiesel (Statista, 2021), around 90% of which is produced from palm sludge oil. Domestic biofuel production and use are encouraged through the "biofuel mandatory programme".

**Geothermal**: Indonesia's geothermal potential could total 28.5 GW, making the country the second-largest geothermal resource in the world (40% of the world's geothermal reserves) (IRENA, 2017, 2022a). The country's current geothermal power capacity is only 2.3 GW, or around 10% of the theoretical potential. Development of the sector has been slow, with only 10 active areas (mainly located in West Java) out of the 70 potential working areas that the government has explored thoroughly. In mid-2020, the Ministry of Energy and Mineral Resources (MEMR) released a geothermal power roadmap consisting of 177 geothermal projects planned until 2030 with a total capacity of 5.8 GW. The required investment is estimated at USD 29.39 billion (IESR, 2021).

**Solar**: The average solar irradiation in Indonesia is 4.62 kilowatt hours per square metre per day. The total installed capacity of solar has reached more than 210 megawatts (MW) out of an estimated potential capacity of around 3 000 GW (IRENA, 2022a), indicating great potential for market development in the sector. IRENA's geospatial resource assessment platform provides details on this potential by location (**Figure 36**).

**Figure 36** Solar resource potential in Indonesia




*Disclaimer:* This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Source: IRENA, 2022a.

**Wind**: Indonesia's current installed capacity for wind energy is only 154 MW, out of an estimated potential capacity of 61 GW (IRENA, 2022a). The Electricity Supply Business Plan (RUPTL 2019-2028) of the state-owned utility (PLN) sets a target of 1.8 GW by 2025. Although many regions feature wind speeds that are attractive for wind development, it is often reported that Indonesia has insufficient wind speeds for large-scale wind energy projects (ADB, 2020a).

Other renewable power capacity – such as marine energy (17.9 GW of ocean energy potential exists [IRENA, 2022a]) – also exists across the archipelago.

# Annex 2: Existing energy policies in Indonesia

In Indonesia's **cooking sector**, the Clean Stove Initiative set clean cooking targets in 2013 that aim to achieve 40% use of clean biomass stoves by 2020, and 100% by 2030 (World Bank, 2013). Later in 2013, performance standards were introduced for biomass fuel stoves[32] to complement the Clean Stove Initiative's efforts to improve health and energy efficiency. The minimum performance requirements included indicators related to (1) combustion efficiency, (2) thermal efficiency, (3) carbon monoxide emissions, (4) particulate matter and (5) safety aspects of the furnace, as well as the testing procedures (BSN, 2013). As of 2020, a pilot project had distributed nearly 10 000 improved cookstoves. The initiative also includes capacity building, scheme designing and funds allocation (Geres, 2020). The General Planning for National Energy (RUEN) set a target for 4.7 million households to use clean cooking fuels by 2025 and 7.7 million households by 2050, but it considers the use of natural gas as a clean cooking fuel for this purpose (MEMR, 2019). Additionally, PLN launched a new e-stove initiative in March 2020, which will provide electric stoves to 52 million households by 2060. The initiative estimates to reduce gas subsidies by IDR 4.8 trillion (or ~USD 330 million).[33]

MEMR together with HIVOS has launched the multi-stakeholder Indonesia Domestic Biogas Program, also known as BIRU. The programme's main objective is to contribute to poverty alleviation and bring economic prosperity through the provision of clean and affordable biogas energy. The programme aims to contribute to the ambitious national goal of net zero. So far, BIRU has supported the construction of 25 157 biodigester units and mobilised funding of over IDR 200 billion (USD 14 million) (BIRU, 2021).

In the **electricity sector**, renewable energy sources are, in principle, prioritised for power supply, in addition to allowing independent power producers to sell electricity to entities other than the utility PLN.[34] The use of renewable energy sources for the power supply was reinforced in 2017,[35] by requiring PLN to dispatch renewable plants below 10 MW on a must-run basis. In 2020, to follow up on a 2018 amendment[36] that did not address the main issues blocking investment in renewables, the MEMR amended the use of renewables for electricity supply for the second time,[37] aiming to attract more investment in the industry. This amendment brought three main changes: (1) PLN must dispatch renewables on a must-run basis, regardless of the plant's generation capacity; (2) it relaxes the requirement of projects being developed exclusively under "build-own-operate-transfer" schemes and (3) PLN can use the direct appointment mechanism for certain type of projects. The pricing regime, however, has not been updated since 2017 and remains a concern for investors (IESR, 2019; AHK, 2020; Ashurst, 2020).

[32] *See standard SNI 7926.*

[33] *Conversion rate of USD 1 = IDR 14 426 as of 5 December 2021.*

[34] *See Law No. 30/2009, namely the Electricity Law.*

[35] *See MEMR Regulation No. 50/2017.*

[36] *See MEMR Regulation No. 53/2018.*

[37] *See MEMR Regulation No. 4/2020.*

Minimum local content requirements (LCRs) for solar, hydro, geothermal and biomass power sources have been introduced (see Hogan Lovells [2018] for the full list and category breakdown by source).[38] For example, solar PV developers had to install modules with at least 50% domestic components by 2018, and this share increased to 60% by 2019 (PwC, 2018; Hamdi, 2019). The LCRs have been controversial, to the point that this led to the cancellation of renewable energy auctions (see below). The local manufacturing capacity was (and still is) in the early stages to meet these requirements (IEA, 2020). While developers and investors have identified the local content, licencing and permitting requirements as investment barriers, financial institutions have failed to acknowledge these as barriers (ADB, 2020c).

Machinery and capital goods for all investments, including power generation, are exempted from import duty (World Bank, 2019). More specifically, greenfield or expansion investments in power plants are exempted from the import duty on machinery and equipment for two years during the construction period, if these are not adequately produced in Indonesia.[39] Raw materials for production are also exempted from import duty for two years plus an additional two years (for a total of four years) if the company uses locally produced machinery and equipment (MEMR, 2017).[40] Geothermal projects have an exemption from the import value-added tax for both the exploration and exploitation phases, as well as value-added tax exemptions for the supply of both steam and electricity.

Regarding grid access and curtailment, renewable energy plants may be subject to the latter during low demand periods. Despite large projects usually having take-or-pay contracts, Indonesia needs a Renewable Energy Law that guarantees access and prioritises dispatch not only for plants below 10 MW (IESR, 2018). The micro-hydropower sector, which has been developed extensively, primarily with community engagement over more than two decades, is well positioned for grid interconnection (IRENA, 2018b; Tenenbaum, Greacen and Vaghela, 2018).

Biofuel consumption mandates play an important role in electricity, but more so in the **transport sector**. These were introduced in 2008 and were increased in 2013 and again in 2015. For instance, a biodiesel mandate of 30% by 2025 exists in both sectors (electricity and transport), but the mandates also apply to other sectors including industry and microbusinesses, fisheries, agriculture and public service (**Table 2**). The government also has a bioethanol target of 20% by 2025 for industrial/commercial and household use.

**Table 2** Indonesia's biodiesel mandate according to Ministerial Regulation No. 12/2015 (% of biofuel blending required)

| Sector | April 2015 | January 2016 | January 2020 | January 2025 |
|---|---|---|---|---|
| Micro- business, fisheries, agriculture and public service (subsidised) | 15% | 20% | 30% | 30% |
| Transportation | 15% | 20% | 30% | 30% |
| Industry and commercial | 15% | 20% | 30% | 30% |
| Electricity | 25% | 30% | 30% | 30% |

Source: Extracted from IRENA (2018b); ICCT (2020).

[38] *See Ministry of Industry Regulations No. 54/2012 and No. 05/2017.*

[39] *Based on Ministry of Finance Regulation No. 66/PMK.010/2015.*

[40] *Based on Ministry of Finance Regulations No. 176/PMK.011/2009, No. 76/PMK.011/2012 and No. 188/PMK.010/2015.*

In the transport sector, the biodiesel blend mandate is set at 30% by 2025, and the 10% bioethanol blend mandate in petrol set for 2020 will increase to 20% in 2025.[41] In 2015, the Indonesian government established a palm oil fund to contribute to research and development (R&D) on biodiesel and spur growth in the industry (IRENA, 2018b). These instruments aim to reduce imported fuel and encourage the growth of key industries (Climatescope, 2017; Transport Policy, 2017; IRENA, 2018b; Climate Policy Database, n.d.). However, only a 10.2% biodiesel blend level was reported in 2016 (Abdi, Wright and Rahmanulloh, 2017).

In 2019 the president of Indonesia announced the B30 programme to blend 30% palm-oil based fuel into its biodiesel (Kondalamahanty, 2021) and a new target of 100% biofuel blending by 2024 – a step-up in ambition as the 100% mandate is only a conditional target in the country's NDC (Jakarta Globe, 2019; ICCT, 2020).

Looking forward, the sustainability of palm oil must increase through environmentally sound production, including R&D to increase yields, enhancing the use of fruit bunches for biomass, creating safe corridors for wildlife and natural pest control methods. Because of sustainability concerns, the European Union (EU) has pledged to ban palm oil imports by 2030. IRENA points to the relevance of sustainable land-use policies to ensure that increased biofuel production does not jeopardise sustainable forest management (IRENA, 2018b).

Indonesia has also introduced fiscal and non-fiscal incentives for low-emission vehicles. The Low Carbon Emission Vehicles Program of 2017, for example, reduced the luxury sales tax for advanced technology vehicles (*e.g.* hybrid and alternative fuels) by 50%. In 2019, but to be implemented in 2021, four categories for low-carbon vehicles were introduced, each with its own luxury sales tax rate and a corresponding reduction. Also in 2019, key points to accelerate electric vehicle development in Indonesia were delineated.[42] These included exemptions on import duties, reductions in sales and vehicle ownership taxes and incentives to produce equipment for charging stations. The regulation included LCRs along with R&D support to build a local electric vehicle (EV) industry (IESR, 2019). LCRs vary depending on the number of wheels and are increased gradually to 80% by 2026 for two- and three-wheelers, and by 2030 for four or more wheels. The regulation also assigns PLN the responsibility to develop the charging infrastructure. However, complementary regulation will be needed to provide more detail on these incentives (Suhartono and Singgih, 2019).

Fiscal incentives also exist in Indonesia for **heating and cooling**. Since 2011-2012,[43] firms that seek to introduce renewable energy in cooling technology equipment manufacturing are eligible for deductions in their taxable income, as well as accelerated depreciation and amortisation. Deploying renewable energy in cooling systems has great potential for greenhouse gas emissions savings and myriad socio-economic benefits, making refrigeration and air conditioning key priorities for Indonesia's sustainable development plans. Sector coupling will also play a major role, as refrigeration and air conditioning are responsible for the largest share of electricity use in many Indonesian buildings (MEMR, 2017).

**Electricity access** has gained attention from the Government of Indonesia, and significant progress has been made over the years. The population with access to electricity increased from a mere 53% in 2000 to 99.2% in 2020. In 2016, the MEMR officially launched Ministerial Regulation No. 38/2016, which aims to accelerate electricity provision in the least developed, remote, border and inhabited islands. It targets the use of renewable energy technology of up to 50 MW capacity to electrify 2 510 villages by 2019. It also allows the private sector to distribute electricity to areas not yet covered by PLN or another concession right holder. The Government of Indonesia made a significant policy move (April 2017) through Presidential Regulation No. 47/2017, which seeks to accelerate the basic electrification of remote, border, small and inhabited islands through the provision of energy-efficient solar lamps.

[41] *There are also mandates for industry: 10% by 2020 and 20% by 2025.*

[42] *See Presidential Regulation No. 55/2019.*

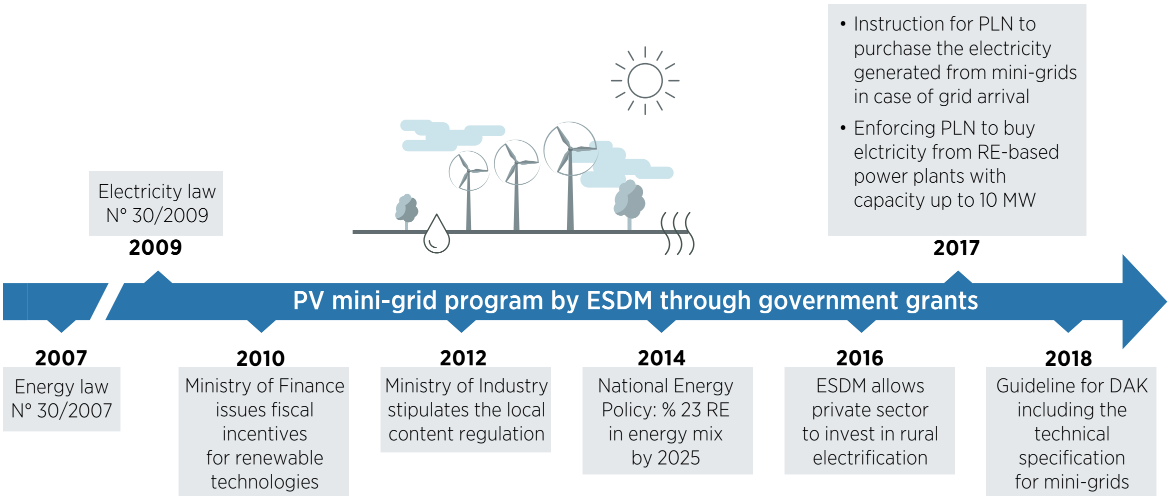
[43] *Under Government Regulation No. 52/2011 executed through the Regulation of the Ministry of Finance in 2012.*

In May 2017, the MEMR's Ministerial Regulation No. 39/2017 was launched to regulate the development of renewable energy mini-grids using the national budget (APBN), including the instruction for PLN to purchase the electricity generated from mini-grids in the case of main grid arrival. The electricity purchase price for this obligatory purchase is determined in the regulation and is to be implemented through a power purchase agreement prepared by PLN and valid for 20 years. Income from the purchase is to be used by mini-grid management for operation and maintenance purposes.

With regard to the regulatory framework tariffs and pricing are among the most sensitive issues in renewable energy investment and development. In 2017, MEMR released Regulation No. 12/2017 (as amended by MEMR Regulation No. 43/2017) with the view that there is little incentive for new investments for renewables in low-cost areas. Building on it, in August 2017, the MEMR launched Ministerial Regulation No. 50/2017, which mandated that PLN buys electricity from renewable power plants with capacities of up to 10 MW. As with auctions and feed-in tariffs, the tariff was set to be equal to 85% of the regional electricity generation cost if this regional cost were higher than the average national electricity generation cost. If the regional costs were equal to or lower than the national cost, the tariff was to be negotiated by the independent power producers and PLN. A build-own-operate-transfer scheme was applied in this arrangement. **Figure 37** shows policy developments in the sector until 2018, although many of these regulations have since been amended (see above).

In the context of planning and implementation, there are several bodies involved at the national and provincial level. At least five line ministries (*i.e.* DEN, Coordinating Ministry of Maritime and Investment Affairs, Coordinating Ministry of Economic Affairs, Ministry of National Development Planning [Badan Perencanaan Pembangunan Nasional, BAPPENAS] and the President's Staff Office) co-ordinate and report on progress towards clean energy goals. For example, the President's Staff Office and BAPPENAS[44] have all included the rural electrification programme (consisting of the development of renewable power plants in remote areas and small islands) in their broader policy programmes. Similarly, other ministries such as the Ministry of Cooperatives and Small and Medium Enterprises, the Ministry of Manpower and Transmigration, and the Ministry for Villages, Development for Disadvantaged Regions and Transmigration (KDPDTT) all run separate initiatives. Such initiatives, however, are found to feature different levels of detail as well as variance in technology types and project sizes. For consistency and to avoid policy and deployment overlaps, a way forward could be to set up as a one-stop shop that would enhance co-ordination across programmes and facilitate monitoring of their implementation.

**Figure 37** Policy development trend for mini-grids in Indonesia, 2007-2018




Source: IRENA, 2018b.

Note: DAK = specific grants; ESDM = Ministry of Energy and Mineral Resources (MEMR); MW = megawatt; PLN = state-owned utility; PV = photovoltaic; RE = renewable energy.

[44] *Focuses on small solar home systems.*

# Annex 3: E3ME policies

IRENA's socio-economic footprint analysis includes in its modelling a very diverse set of policies to enable and support a sustainable energy transition. Holistic planning and synergistic implementation can address the multiple angles of the interactions between the energy, economy and social systems more successfully than an approach that relies on a limited number of interventions.

The Integrated Assessment Models that have carbon pricing as the main (and often sole) policy to drive the transition are a case in point. The resulting needed carbon prices are too high to be socio-politically feasible. Since IRENA's analysis includes a diverse policy basket, the transition goals can be achieved with significantly lower carbon prices. It should be noted that with a diverse climate policy basket, the final level of carbon pricing needed to bring about an energy transition roadmap depends on the effective implementation of accompanying policies.

IRENA's socio-economic analysis assesses the following policies:

- International co-operation, supporting enabling social policies in all countries and addressing the international justice and equity dimensions.
- Domestic progressive redistributive policies.
- Carbon pricing, evolving over time with carbon prices differentiated by each country's income level and special treatment of sectors with high direct impacts on people (households and road transport).
- Fossil fuel phaseout mandates in all sectors.
- Phaseout of all fossil fuel subsidies.
- Regulations and mandates to deploy transition-related technologies and strategies, including renewables, EVs, hydrogen and system integration through electrification and P2X (power-to-X).
- Mandates and programmes for energy efficiency deployment in all sectors.
- Policies to adapt organisational structures to the needs of renewable-based energy systems (such as in the power sector).
- Subsidies for transition-related technologies, including for households and road transport.
- Direct public investment and spending to support the transition, with participation in all transition-related investments, but with special focus on enabling infrastructure deployment (EV charging stations, hydrogen infrastructure, smart meters, *etc.*), energy efficiency deployment and policy expenditure.
- Policies to align international co-operation with transition requirements: earmarking of funds to transition-related investments, increasing social spending.
- Public involvement in addressing stranded assets, both domestically and internationally.
- Policies to align government fiscal balances with transition requirements, addressing domestic distributional issues and aligning deficit spending with transition requirements.

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