Fossil Gas Delaying Energy Transition

The Economic, Health and Environmental Impact of Fossil Gas Power Plant Expansion

2025

Fossil Gas Delaying Energy Transition

The Economic, Health and Environmental Impact of Fossil Gas Power Plant Expansion

Authors: Bhima Yudhistira Adhinegara, Shafa Kalila Aryanti, M. Bakhrul Fikri

Editors: Leonard Simanjuntak, Adila Isfandiari

Designer: Mazdan Maftukha Assyayuti

Publisher: Center of Economic and Law Studies (CELIOS) and Greenpeace Indonesia, Jakarta, Indonesia

Cover Photo: Greenpeace Indonesia

Table of Content

Key Findings

1. The utilization of gas turbine technology as a power plant will result in a cumulative loss of IDR941.4 trillion in economic output until 2040, whereas combined cycle gas-fired power plants will reduce output by IDR280.9 trillion by the same period.

2. Gas turbine power plants could reduce jobs by up to 6.7 million people, as this includes the impact on people’s incomes in affected sectors, such as the marine and fisheries sector.

3. The health impacts caused by fossil gas power plants with a 22 GW scenario will result in a burden of up to IDR89.8 - IDR249.8 trillion in the next 15 years.

4. Instead of pushing for the massive development of fossil gas power plants, renewable energy options can be a better option as it could contribute IDR2,627 trillion in 2040 to the economy.

5. The expansion of fossil gas power plants in the 2.68 GW scenario increases CO_2 by up to 5.97 million tons per year and the more dangerous Methane (CH_4) by up to 5,332 tons per year, while in the 22 GW fossil gas scenario CO_2 will spike to 49.02 million tons per year and Methane (CH_4) by up to 43,768 tons per year.

6. The BPJS Health claim risk burden in 2040 under a 2.68 GW fossil gas power plant scenario is projected to reach IDR1,462.6 - 1,473.9 trillion and could rise to IDR1,545.9 - 1,705.9 trillion under a 22 GW scenario. This burden comes from additional health costs caused by the expansion of fossil gas power plants.

7. The fluctuating trend in fossil gas prices tends to burden the state budget (APBN) for energy subsidies in the long term.

8. Reliance on fossil gas power plants increases the current account deficit, weakens the rupiah exchange rate, and worsens economic resilience.

9. Given the large economic, health and environmental losses, the government needs to cancel new fossil gas power plants in the 2025-2034 RUPTL.

10. International energy transition cooperation models such as AZEC (Asia Zero Emission Community) which include fossil gas as a false solution are more detrimental to Indonesia's interests.

Greenpeace Indonesia

01 Prelude

Global's commitment to transitioning away from fossil gas

The shift in the global urgency from the use of fossil fuels to energy that is considered more environmentally friendly has been expressed in various conferences at the global level. One of the actions that reflects energy transition efforts began with discussions at COP28, which emphasized the importance of transitioning from a heavy reliance on fossil gas, oil, and coal to a low-carbon economy (Federal Foreign Office Germany, 2023), achieving net zero, and building a more climate-resilient future (Marrakech Partnership for Global Climate Action, 2024). COP28 is an initial concrete step which then sparked further discussions regarding the energy transition at COP29 in Baku, Azerbaijan. One of the steps that emerged from this energy transition effort is the planned investment of USD116 billion annually in renewable energy power plants by The Utilities for Net Zero Alliance (UNEZA).

In Indonesia, discussions related to energy transition have also been spoken by Prabowo Subianto in the global discussion room of the G20 Summit in Brazil. There, Prabowo Subianto revealed that Indonesia will strive to achieve Net Zero Emission through the construction of 71 GW of renewable energy power plants and the retirement of coal-fired power plants. However, on a different occasion at the COP 29 conference, the President's envoy, Hashim Djojohadikusumo, sold a promise that Indonesia under President Prabowo Subianto would intensively carry out Carbon Capture Storage (CCS), or in other words, signaling a continued reliance on fossil energy.

Why does the government tend to choose natural gas?

Indonesia is one of the countries recorded as having the largest natural gas reserves in the world, even becoming one of the countries with the largest natural gas reserves in the Asia Pacific region in 2015 (Pertamina, 2020). Based on BPS data, natural gas production in Indonesia has experienced stable growth, with production value in 2022 at 1,962,929 Millions of Standard Cubic Feet (MMscf) (Statistics Indonesia, 2025), while the Ministry of Energy and Mineral Resources recorded natural gas production in Indonesia throughout 2024 at 6,635 Million Standard Cubic Feet per Day (MMSCFD) (Ministry of Energy and Mineral Resources, 2024).

The utilization of domestic natural gas itself has several developments. First, the government has proposed reducing fossil gas exports to prioritize domestic needs, particularly for power generation and industrial use. Second, there are plans to revise the price of fossil gas specifically for industrial sectors from USD 6 per mmbtu to USD 7 per mmbtu. This revision indicates that the subsidized fossil gas will later be prioritized to supply PLN's gas-fired power plants (on-grid). Third, the Asia Zero Emission Community (AZEC) agreement between Japan and the technical ministry for energy and investment has raised concerns about a potential surge in natural gas projects and fossil gas power plants. Japan has shown growing interest in fossil gas development in recent years, as reflected in its involvement in projects such as the Java-1 combined-cycle gas power plant PLTGU in West Java, the Donggi-Senoro LNG in Central Sulawesi, and the Tangguh LNG in West Papua which is financed by Japan Bank for International Cooperation (JBIC).

Comparing the potential of renewable energy to fossil gas energy

Indonesia has vast renewable energy potential that has not been optimally utilized until now, including solar, wind, and micro-hydro energy. This abundant energy source is recorded to have a total potential of 432 gigawatts (GW).

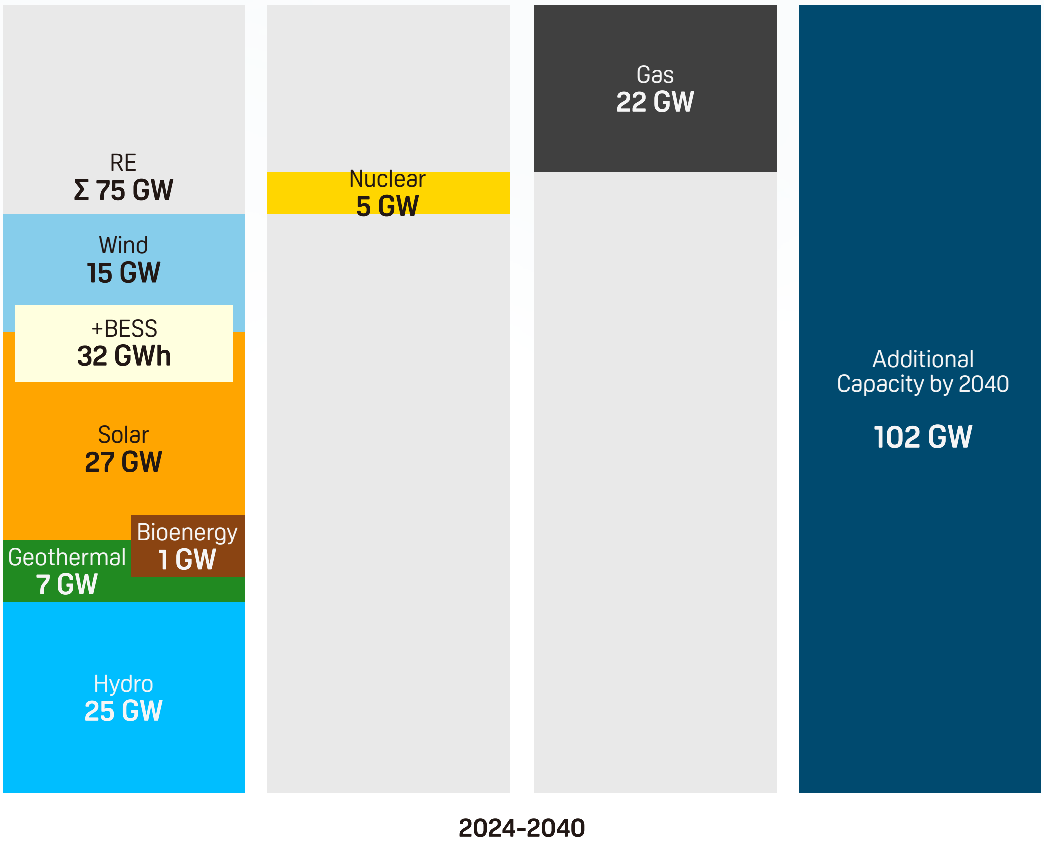
According to data from PT PLN's RUPTL in February 2024, there are plans to increase capacity in various renewable energy-based power plants. The Solar Power Plant (PLTS) will experience an additional capacity of 4.68 GW by 2030 with an estimated reduction in greenhouse gas emissions of 6.97 million tons of CO_2e; the Wind Power Plant (PLTB) is projected to add 597 MW capacity with an estimated reduction in greenhouse gas emissions of 2.22 million tons of CO_2e.

Celios and 350.org Indonesia's 2024 study revealed that the community-based renewable energy model was able to create a contribution to Gross Domestic Product (GDP) of IDR10,529 trillion over 25 years. Meanwhile, the impact on total economic output could reach up to IDR18,636 trillion. Additionally, the positive impact of community-based renewable energy was able to reduce poverty by more than 16 million people. The surplus profit obtained by business actors, especially on the MSME scale, was IDR9,750 trillion over 25 years. The total income of workers generated from support for community-based renewable energy is estimated to reach IDR3,645.61 trillion. As many as 96 million workers can be absorbed in various sectors from installation and operation to maintenance of small-scale renewable energy.

Greenpeace Indonesia

02 Discussion of the Power Sector Plan on the Fossil Gas Energy Mix

Graphic 1. **Accelerated Renewable Energy with Coal Phase Down Scenario [GW]**



Source: PLN 2024.

Graphic 2. **Electricity Investment Needs Plan 2024-2040**

2024-2040 Projects[1]	Capacity	Investment 2024-2040, in Billion USD
Additional renewable baseload[2]	-33 GW	80
Additional thermal baseload[3]	-28 GW	33
Additional VRE[4] (Wind & Solar)	-42 GW	43
Battery Energy Storage System (BESS)[5]	-32 GWh	6
Nuclear[6]	-5 GW	29
Transmission Line & Substation	-70,000 kms	36
End-to-end smart grid	5 region, 38 province	7
	Total Investment	235

Notes:
1. The "Additional renewable baseload" includes 33 GW capacity based on updated ARED 2024–2040.
2. Thermal baseload includes 28 GW capacity.
3. "Additional VRE" refers to wind and solar with 42 GW capacity.
4. Battery Energy Storage System (BESS) capacity assumes 4-hour storage.
5. Nuclear capacity uses LCOE < 10 cents USD/kWh.

Souce: PLN 2024.

The government has outlined a roadmap for Indonesia's energy transition through the Accelerated Renewable Energy Development (ARED), which includes the estimated investment needed for the energy transition process and coal phase-down. The program's blueprint states that at least USD235 billion is needed to build infrastructure, especially for renewable energy-based power plants. The largest proportion of investment needs, amounting to USD 80 billion, is allocated for the provision of additional renewable energy-based electricity, with a total capacity of 33 GW. The distribution of sources includes hydro energy (24.9 GW), geothermal energy (6.5 GW), and bioenergy (0.9 GW).

The portion of fossil gas power plants in the same plan is set to increase to 22 GW by 2040. This additional capacity of fossil gas power plants accounts for 20% of the total expected capacity or 102 GW. The government's reliance on fossil gas power plants as a solution in the energy transition is closely tied to the interests of developed countries, particularly Japan. The development of fossil gas power plants for electricity generation is directly linked to Japan’s commitments in LNG projects, including exploration, exploitation, and LNG terminals. Previously, Japanese investment in the fossil gas sector often encountered obstacles, including regulatory, economic, and social aspects. However, recently, Japan has increasingly confirmed its seriousness in fossil gas projects. For example, the Abadi Field project process, Masela Block, Maluku has entered the Front-End Engineering Design (FEED) stage or technical design or Onshore LNG (OLNG) engineering.

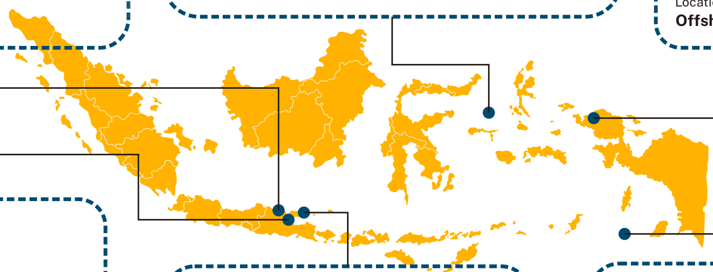
The large-scale Masela Block project is estimated to require an investment of up to USD 20 billion, equivalent to IDR336.9 trillion (exchange rate of IDR16,850 per USD) or approximately IDR340 trillion. The Japanese company involved is Inpex Corporation which holds a 65% participating interest. In addition to Inpex, there is Pertamina via PT Pertamina Hulu Energi Masela (PHE Masela) which has a PI of 20% and Petronas of 15% (CNBC, 2025).

Graphic 3. **Indonesia's LNG Terminal Plan Profile**

Terminal Name
Gresik LNG Terminal
Facility Type: **Import** | Status: **Proposed** | Delayed: **N/A**
Owner
BP Gas & Power Investments [unknown %]; PT AKR Corporindo [unknown %]
Parent
BP, United Kingdom [unknown %]; PT Arthakencana Rayatama, Indonesia [unknown %]
Capacity (mtpa): **N/A** | Capacity (Bcm/y): **N/A**
Proposal Year: **2023** | Construction Year: **N/A** | Start Year1: **2027**
Location
Gresik

Terminal Name
Sulawesi-Maluku LNG Cluster
Facility Type: **Import** | Status: **Proposed** | Delayed: **N/A**
Owner
AG&P Indonesia [unknown %]; KPMOG [unknown %]; PLN Energi Primer Indonesia [unknown %]; Suasa Benua Sukses [unknown %]
Parent
KPMOG, Indonesia [unknown %]; Nebula Energy, United States [unknown %]; Perusahaan Listrik Negara, Indonesia [unknown %]; Suasa Benua Sukses, Indonesia [unknown %]
Capacity (mtpa): **2,3** | Capacity (Bcm/y): **3,13**
Proposal Year: **2024** | Construction Year: **N/A** | Start Year1: **2026**
Location
Sulawesi-Maluku Cluster

Terminal Name
West Papua FLNG Terminal
Facility Type: **Export** | Status: **Proposed**
Owner
PT Layar Nusantara Gas [100.00%]
Parent
Genting Berhad, Malaysia [100.00%]
Capacity (mtpa): **1,2** | Capacity (Bcm/y): **1,63**
Proposal Year: **2023** | Construction Year: **N/A**
Start Year1: **2026** | Delayed: **N/A**
Location
Offshore West Papua



Terminal Name
Teluk Lamong LNG Terminal
Facility Type: **Import** | Status: **Construction**
Owner
PT Pelindo III [unknown %]; PT Perusahaan Gas Negara [unknown %]
Parent
PT Perusahaan Gas Negara, Indonesia [unknown %]; Pelindo, Indonesia [unknown %]
Capacity (mtpa): **0,3** | Capacity (Bcm/y): **0,41**
Proposal Year: **2019** | Construction Year: **2019 (delayed 2023)**
Start Year1: **2019** | Delayed: **Yes**
Location
Teluk Lamong, Surabaya

Terminal Name
Madura FLNG Terminal
Facility Type: **Export** | Status: **Proposed** | Delayed: **N/A**
Owner
Bumi Armada [unknown %]; Pertamina Internaional Shipping [unknown %]
Parent
Pertamina, Indonesia [unknown %]; Usaha Tegas, Malaysia [unknown %]
Capacity (mtpa): **N/A** | Capacity (Bcm/y): **N/A**
Proposal Year: **2023** | Construction Year: **N/A** | Start Year1: **N/A**
Location
Madura Gas Field

Terminal Name
Abadi LNG Terminal (Masela LNG Project)
Facility Type: **Export** | Status: **Proposed** | Delayed: **Yes**
Owner
INPEX Masela Ltd [100.00%]
Parent
INPEX, Japan [65.00%]; Pertamina, Indonesia [20.00%]; Petronas, Malaysia [15.00%]
Capacity (mtpa): **9,5** | Capacity (Bcm/y): **12,92**
Proposal Year: **2010** | Construction Year: **N/A** | Start Year1: **2030**
Location
Masela Block, Abadi Gas Field

Source: Global Energy Monitor, September 2024
Notes: Capacity in BCM/Y (Billion Cubic Meters per Year) is a standard unit used to measure the annual capacity of gas infrastructure, such as pipelines, LNG terminals, and storage facilities. It indicates how much natural gas can be transported, processed, or stored over the course of a year.

Greenpeace Indonesia

03 AZEC and Fossil Gas Ambitions in Indonesia

AZEC's brief history

The Asia Zero Emission Community (AZEC) was first proposed by Japanese Prime Minister Kishida Fumio in 2022. In 2023, AZEC was inaugurated with 11 partner countries including Indonesia. This community aims to support decarbonization efforts in Asia and achieve carbon neutrality targets through practical energy transitions by adjusting the conditions and challenges in each Asian country (Government of Japan, 2024).

The concept promoted by AZEC, namely "one goal, various pathways" reflects the recognition of the diversity of industrial structures, social contexts, geographic conditions, and development stages of its partner countries (ERIA, 2024). To accommodate this concept, AZEC has three important focuses that must be achieved simultaneously, namely decarbonization, economic growth, and energy security.

AZEC's Programs

The AZEC ministerial meeting, held in Tokyo on March 4, 2023, agreed that relevant ministers from 11 partner countries including Indonesia will share information, discuss, and carry out cooperative actions through the AZEC platform in the following areas, including but not limited to:

Development, testing, and implementation of decarbonization strategies, planning, business, and technologies such as energy efficiency, renewable energy, hydrogen, ammonia, energy storage, bioenergy, and carbon capture, utilization, and storage (CCUS).

Financial support for investments in decarbonization infrastructure, including electricity grids and the development of clean energy supply chains, including for critical raw materials and minerals.

Development, harmonization and ensuring interoperability of decarbonization technology standards, as well as strengthening human resource capacity in this field.

(*Ministry of Economy*, *Trade and Industry*, 2023)

From the results of the joint statement, AZEC partner countries reached an agreement to cooperate in the form of programs that include:

Demand-side energy efficiency and conversion

Renewable energy/ energy management

Natural gas and liquefied natural gas (LNG)

CCUS/Carbon Recycling

Hydrogen and Ammonia

Critical Minerals

(*Ministry of Economy, Trade and Industry*, 2023)

Indonesia is one of the AZEC partner countries that has the largest number of cooperation agreements among other AZEC partner countries. Several cooperation agreements are stated in the agenda of the second AZEC Summit in Vientiane, Laos on October 12, 2024.

Table 1. **List of Gas Power Plant Cooperation Agreements between Japan and Indonesia in AZEC**

Project	Japanese Companies/ Institutions	Azec Countries Partners	Description
MoU between 3 companies regarding feasibility study for CCGT power plant development in Indonesia	- Itochu Corporation - J-POWER	PT Adaro Power	To achieve a carbon-neutral future and zero-emission society in Indonesia, Electric Power Development Co., Ltd., PT Adaro Power, and Itochu Corporation will conduct a feasibility study to build a combined cycle gas turbine power plant in Central Java, Indonesia.
MoU between JERA and PLN EPI in LNG value chain collaboration	JERA	PLN EPI	Developing cooperation with PLN EPI to build the LNG value chain as the main energy transition fuel towards achieving net zero emissions by 2060 in Indonesia.
JDSA for feasibility study between PT PLN Indonesia Power and JPOWER related to existing PLTU conversion project to CCGT	J-POWER	PLN Indonesia Power	Joint Development Study Agreement (JDSA) is an agreement between PT PLN Indonesia Power and Electric Power Development Co., Ltd. (JPOWER) to conduct a feasibility study related to the conversion project of an existing subcritical coal-fired power plant into a state-of-the-art combined cycle power plant, which can reduce CO_2 emissions by approximately one-third of total emissions.
Efforts towards decarbonization and low-carbon industrial heat needs in Indonesia	- LNG Japan Corporation - Toho Gas Co., Ltd	PT Bayu Buana Gemilang	LNG Japan Corporation and Toho gas Co., Ltd. have invested in PT Bayu Buana Gemilang, a company that supplies natural gas to the industrial sector in Indonesia. The purpose of the investment is to develop natural gas infrastructure to reduce carbon emissions in the industrial sector.

Project	Japanese Companies/ Institutions	Azec Countries Partners	Description
MoU on cooperation to support the development of LNG and e-methane value chains	Tokyo Gas Asia	PT PLN EPI	PLN EPI, a subsidiary of PLN engaged in fuel procurement and transportation, together with Tokyo Gas Asia will accelerate the planning of small-scale LNG value chains throughout Indonesia, as well as conduct studies on decarbonization measures (e-methane)

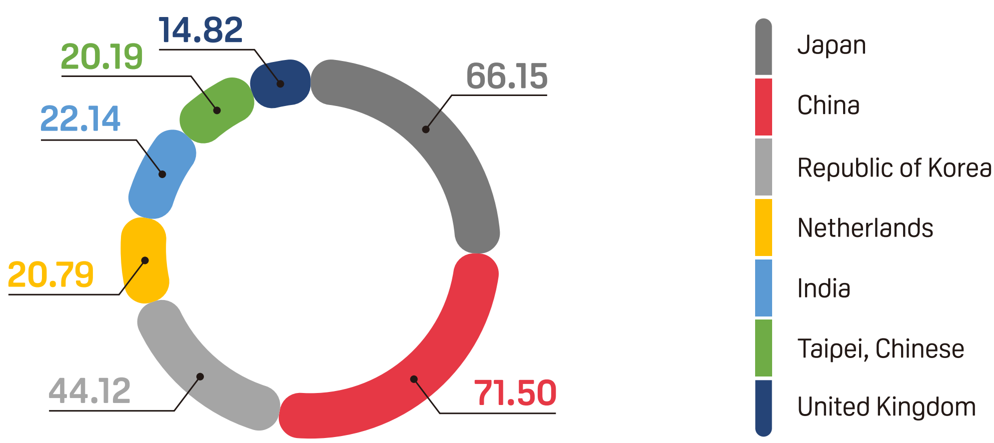
Source: Ministry of Economy, Trade and Industry, 2024

Of the 121 shortlists of AZEC leaders' meeting cooperation, Indonesia has 46 shortlists of cooperation that will be carried out with Japan through AZEC. Among the 46 shortlisted projects, there are 5 cooperation agreements between Indonesia and Japan related to the construction of gas-fired power plants (PLTG) and combined-cycle gas power plants (PLTGU) in Indonesia.

Fossil Gas Generation Specific Agenda in AZEC

Since the 1960s, Japan has been an importer of LNG to address air pollution, meet energy demand, and serve as an alternative to oil and coal-based fossil gas (CSIS, 2024). Limited domestic fossil gas resources have forced Japan to rely heavily on LNG imports. Even until 2023, Japan is still the second largest LNG importer in the world, although the volume has experienced a significant decline.

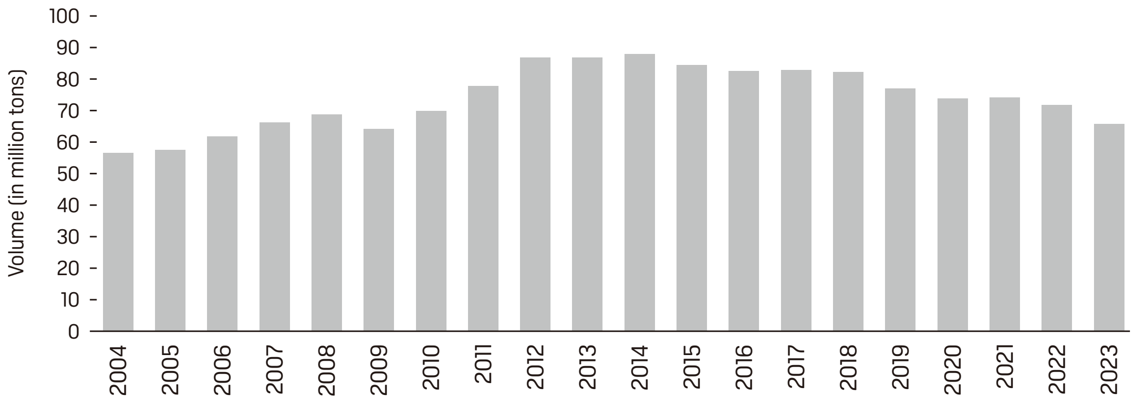
Graphic 4. **LNG importing countries in 2023 (Volume (in million tons))**



Source: Trade Map, 2025 (compiled)

However, the Fukushima earthquake and tsunami disaster in 2011 led to the shutdown of all nuclear power plants. As a result, LNG once again became the dominant source for electricity generation in Japan, replacing the role of nuclear power plants in meeting the country's energy and electricity needs (EIA, 2015).

Graphic 5. **Japan's LNG import volume 2004 - 2023**



Source: Trade Map, 2025 (compiled)

After the disaster, the volume of LNG imports continued to rise, reaching their peak in 2014 at 88.5 million tons to compensate for the loss of nuclear power plants in meeting electricity sector needs. However, since 2015, import volumes have declined as 12 nuclear reactors resumed operation and the use of new renewable energy sources, such as solar and wind, increased (IEEFA, 2024). It was recorded that in 2023 the volume of Japanese LNG imports only reached 66.2 million tons.

Japan's role as the initiator and leader of AZEC is the main reason for the presence of technologies such as carbon capture and storage (CCS), biomass, hydrogen and ammonia co-firing, and LNG in the AZEC energy transition agenda. This has caused AZEC partner countries to adopt these technologies, which are considered as false solutions, into their national decarbonization and energy transition plans. In addition, Japan is also known to have a major role in supporting infrastructure development in the Asia Pacific region through the expansion of Japanese companies and their technology. As a result, countries in the Asia Pacific region find it very difficult to escape from Japan's technological hegemony.

AZEC has proven to be a tool used by Japan to expand the LNG value chain in the energy transition agenda in Asia. Starting from Japan's participation in the Japan-ASEAN Summit and the ASEAN Strategic Program for Climate and Environment, the preparation of the Roadmap for the Transition of Asian Countries, and the launch of the Asia GX (green transformation) consortium to support transition financing (Zero Carbon Analytics, 2024).

Japan's ambitions within AZEC are inseparable from domestic conditions

At the same time, Japan has invested in building the LNG industry in Asia by helping develop LNG projects in Brunei, Malaysia, Australia, Indonesia, and Qatar. This motive underlies Japan's desire to further expand the LNG supply chain at the regional level in Asia. In the 2018 annual report of Tokyo Gas, Japan's largest fossil gas company, stated that "the main goal for the future is to establish an LNG value chain in Southeast Asia." (Tokyo Gas, 2018)

Greenpeace Indonesia

Greenpeace Indonesia

04 List of Candidate Fossil Gas Power Plant Projects in Indonesia

Global Energy Monitor (GEM) noted that there are 11 gas-fired power plant (PLTG) and combined-cycle power plant (PLTGU) projects scheduled to be built in Indonesia by 2030. The total capacity of the gas-fired power plant and combined-cycle power plant reaches 2,680 MW (2.68 GW) or 12.18% of the KEN RPP target of 22 GW in 2040.

The results of the carbon (CO_2) and methane (CH_4) emission estimates use

1. **The gas-fired power plant operates with a Capacity Factor (CF) of 70% or the equivalent of 6,000 hours per year**[1]
2. **Production of electrical energy annually:**

$$ENERGIoutput = Capacity \times CF \times 6{,}000\ hour/year$$

1 ESDM, 2024, *Technology Data for the Indonesian Power Sector*. March. https://gatrik.esdm.go.id/assets/uploads/download_index/files/c4d42-technology-data-for-the-indonesian-power-sector-2024-annoteret-af-kb-.pdf

3 The efficiency value of the gas-fired power plant system is 38%[2]

ENERGIinput = ENERGIoutput/Efficiency

4 Emission factor[3]

CO_2 = 0,056 ton/GJ
CH_4 = 50 g/GJ

5 CO_2 Emission estimated

CO_2 Emission = ENERGIinput x CO_2 Emission factor

6 CH_4 Emission estimated

CH_4 Emission = ENERGIinput x CH_4 Emission factor

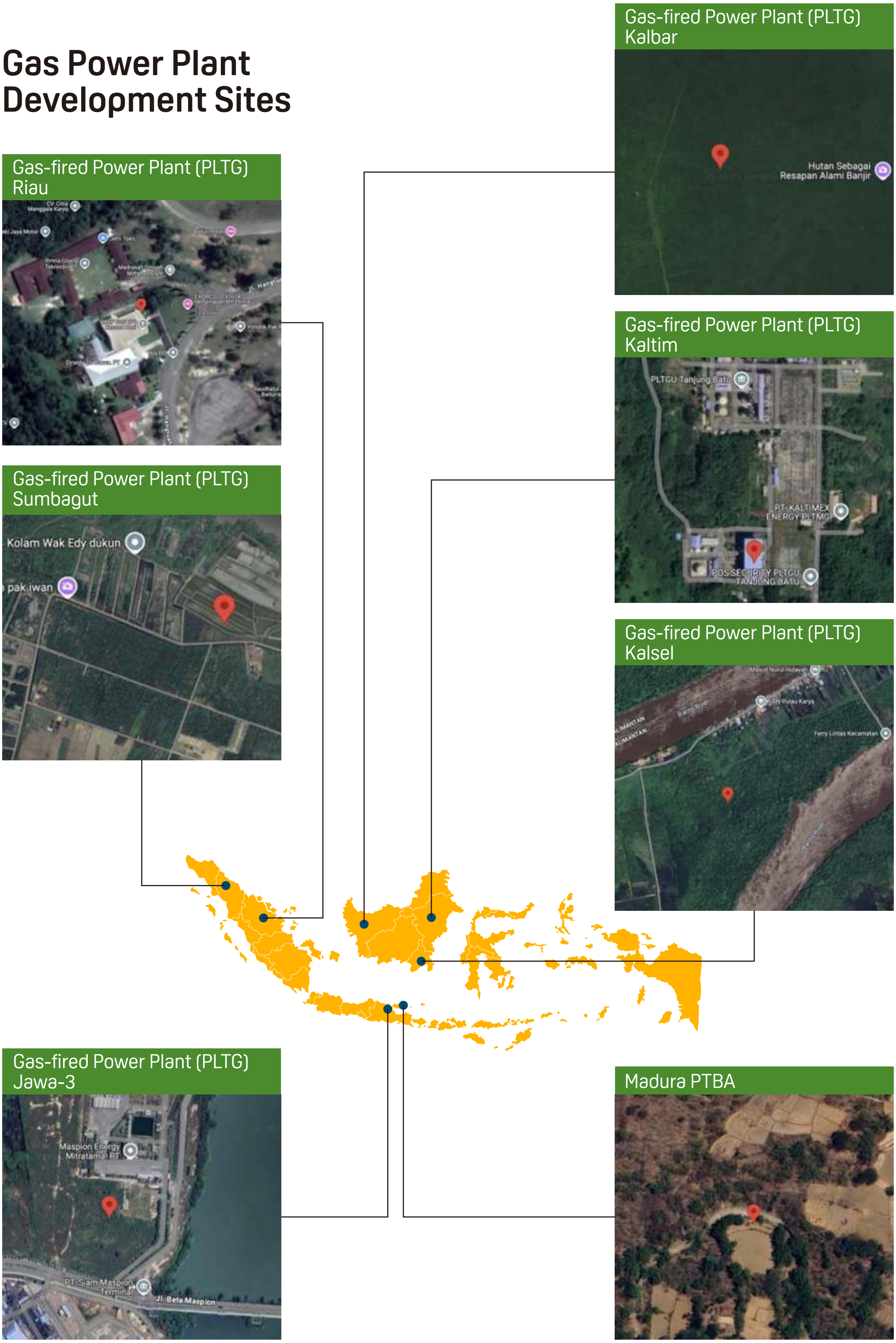
Table 2. **Estimated Impact of CO_2 and CH_4 Emissions from PLN's 2023 - 2030 Gas Power Plant Project Plan**

Gas Power Plant		Capacity (MW)	Emission CO_2 ton/annum	Emission CH_4 ton/annum
2,68 GW Scenario	Madura PTBA	300	668,463	597
	Kaltim 2-0	80	178,257	159
	Kaltim 2-1	50	111,411	99
	Kaltim 2-2	50	111,411	99
	Riau Peaker	200	445,642	398
	Kalsel-1	100	222,821	199
	Kalbar-2	300	668,463	597
	Jawa-3	800	1,782,568	1,592
	Sumbagut Gas and Steam (unit 1)	200	445,642	398
	Sumbagut Gas and Steam (unit 3)	300	668,463	597
	Sumbagut Gas and Steam (unit 4)	300	668,463	597
	Total	2,680	5,971,604	5,332
22 GW Scenario		**22,000**	**49,020,630**	**43,768**

Source: Global Energy Monitor, 2025[4] (processed)

2 Boyce, Meherwan P., 2001, *Gas Turbine Engineering Handbook Second Edition*, Gulf Professional Publishing, Woburn, Massachusetts. https://soaneemrana.org/onewebmedia/GAS%20TURBINE%20ENGINEERING%20HAND%20BOOK%20BY%20MEHERWAN%20P.%20BOYCE%20%282nd%20Edtion%29.pdf
3 Pusdatin, ESDM, 2015, *Data Inventory Emisi GRK Sektor Energi*, Jakarta, December. https://www.esdm.go.id/assets/media/content/KEI-Data_Inventory_Emisi_GRK_Sektor_Energi.pdf
4 GEM, 2025, *Global Oil and Gas Plant Tracker*, January. https://globalenergymonitor.org/projects/global-oil- gas-plant-tracker/

Gas Power Plant Development Sites



Source: Global Energy Monitor, 2025

Based on the estimation results, the 11 planned gas-fired power plant projects are projected to produce 5.97 million tons of carbon dioxide emissions per year and 5,332 tons of methane emissions per year. According to Global Energy Monitor (GEM) data in January 2025, carbon emissions from gas-fired power plants already operating in Indonesia have reached 33.6 million tons per year.

Thus, the potential carbon dioxide emissions of 5.97 million tons per year from the new 2.68 GW gas-fired power plant would increase carbon dioxide emissions from gas-fired power plants in Indonesia by 17.77%. This figure could rise even further if the government continues to realize the target of increasing gas-fired power plant capacity to reach 22 GW.

Greenpeace Indonesia

05 The Impact of Global Warming Due to Natural Gas

Recently, the Indonesian government has started to promote a gasification program, as an effort to shift away from the use of petroleum fuel towards fossil gas in various aspects of life, including the provision of electricity as stated in the Decree of the Minister of Energy and Mineral Resources (ESDM) number 249.K/MG.01/MEM.M/2022 concerning the Assignment of the Implementation of the Provision of Supply and Development of Liquefied Natural Gas Infrastructure, as well as the Conversion from the Use of Fuel Oil to Liquefied Natural Gas in the Provision of Electricity (Indonesia.go.id, 2024).

By definition, natural gas is a mixture of hydrocarbons consisting of several components, including methane and ethane (Britannica, 2025). Meanwhile, methane (CH_4) is a fossil gas component that traps about 82.5 times more heat in the atmosphere than carbon dioxide gas over a 20-year period (EMBER, 2023). It is recorded that there are around 110 million metric tons per year of methane produced from the extraction, transportation, and use of fossil fuels. With these high emission figures, the continued use of natural gas in the long term will clearly hinder Indonesia's 2060 Net Zero Emission target.

Although natural gas emits less CO_2 than coal combustion, it emits methane gas into the air which has a far greater impact on global warming (C2ES). Therefore, the scheme of switching from coal to natural gas as a justification for transition is a false solution.

Compared to renewable energy, which contributes to reducing 30-40% of carbon emissions, fossil gas power plants can, on the contrary, hinder the achievement of Net Zero Emission. The ambition of a 75% renewable energy mix by 2040 is threatened to be replaced by investment costs and policy support for fossil gas power plants (PLN, 2023). The term 'transition fuel' for fossil gas power is very misleading, diverting attention from the direct shift to renewable energy in line with the Paris climate commitment.

Greenpeace Indonesia

06 Economic and Health Impacts of Gas-fired Power Plants

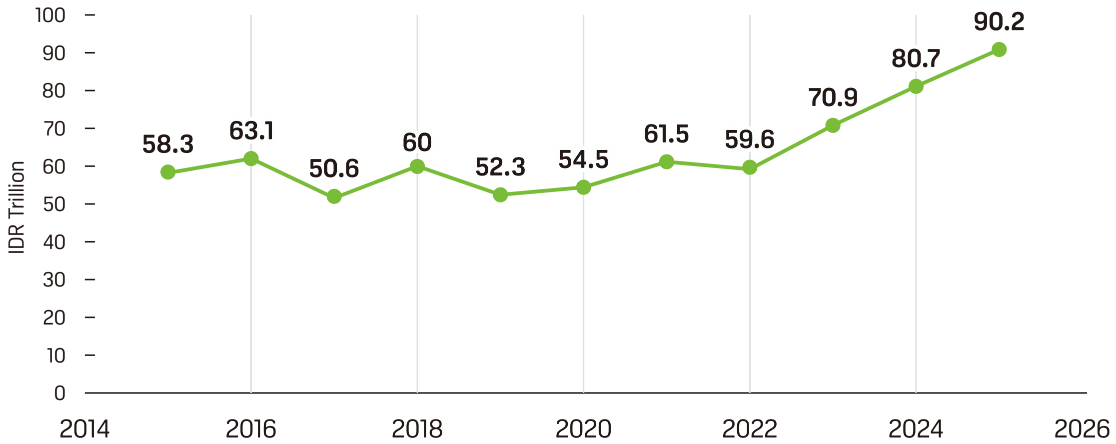
The Impact of Fossil Gas Energy Subsidies on Fiscal Space

Fossil gas energy subsidies play an important role in keeping energy prices affordable, especially for the power generation sector and small community consumers. In RUKN 2024, it is stated that the Government ensures the stability of primary energy costs by limiting the price of fossil gas for power plants to USD 6 per mmbtu through the Specific Natural Gas Price (HGBT), even though the domestic market price reaches USD 10 (RUKN, 2024). The price difference of approximately USD 4 is then borne by the Government in the form of subsidies distributed to electricity providers. This means that the larger the capacity of the the gas-fired power plant, the greater the costs borne by the Government to subsidize its operational costs. An estimate conducted by CERAH found that for every USD 1 difference in fossil gas prices, the government would need to allocate IDR26.7 trillion annually just for the operation of gas-fired power plants (CERAH, 2024).

This large subsidy burden can clearly limit the Government's fiscal space for long-term investment, such as the development of renewable energy that can hinder the energy transition. In addition, subsidies that are not well targeted could lead to inefficiency and waste of budget, while increased consumption due to subsidies could raise pressure on the state budget.

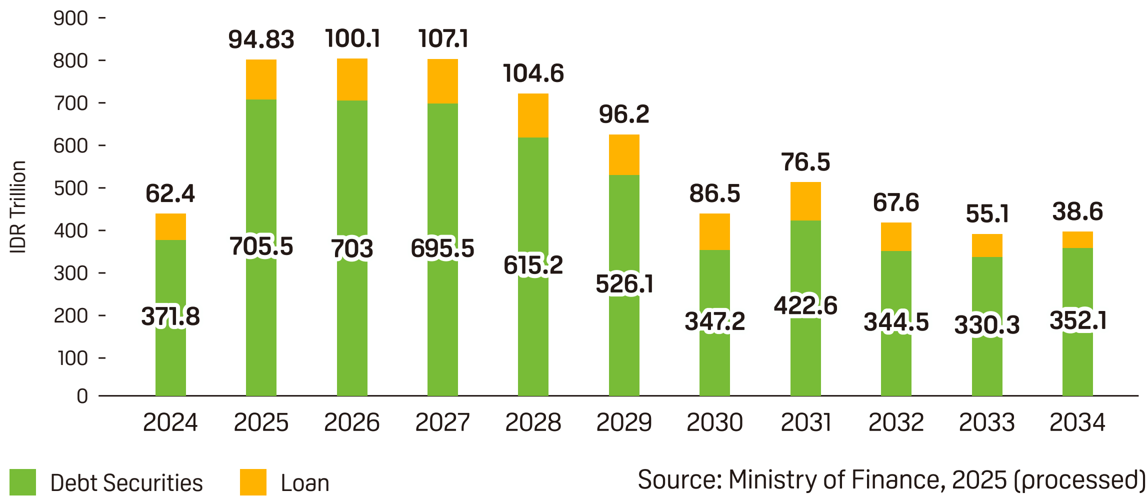
The pressure on the state budget is also evident in the rising burden of debt payments. By June 2025, total debt due will peak at IDR178.9 trillion, followed by IDR105.3 trillion in August 2025, and IDR100.7 trillion in October. The payment of this debt reduces fiscal space, partly due to the rising burden of subsidies and compensation funds for the energy sector.

Graphic 6. **Electricity Subsidy Expenditure 2015-2025**



Source: Ministry of Finance, 2025 (processed)

Graphic 7. **Government Debt Maturity Profile 2024-2029**



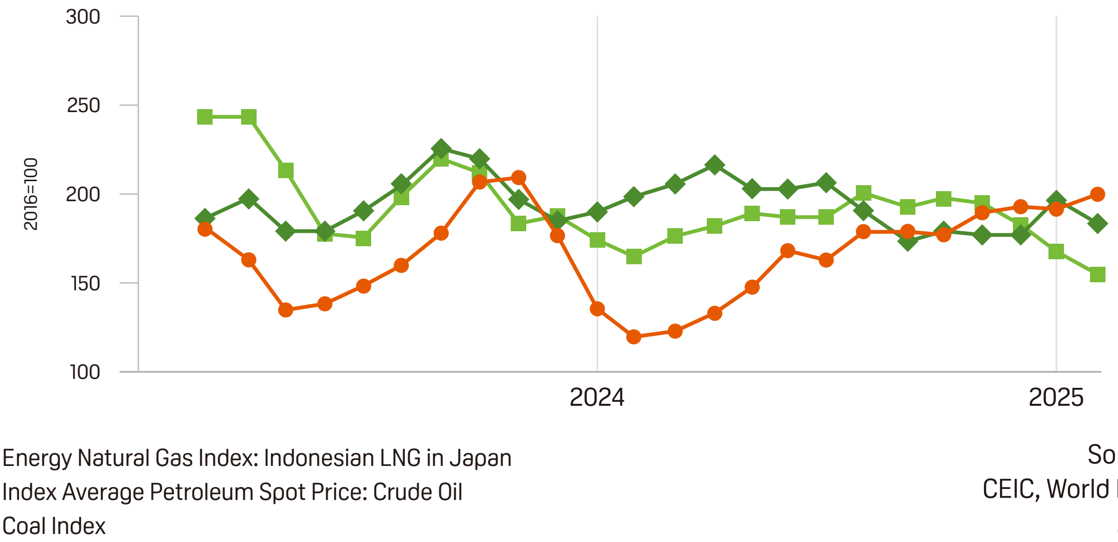
Source: Ministry of Finance, 2025 (processed)

The rising trend in electricity subsidies generated from fossil gas power plants is also influenced by fossil gas prices at the international level. Since mid-2022, LNG prices have increased more rapidly than other fossil fuels like coal and crude oil. Fossil gas price fluctuations tend to reverse sharply. The effects of the trade war and the threat of recession in the US have significantly reduced fossil gas prices, indicating that fossil gas is a source of energy with high volatility.

Compared to renewable energy, dependence on fossil gas poses a risk of economic turmoil in the short and long term.

Specifically, the Energy Information Administration (EIA) asserts that energy price volatility has harmful effects on both consumers and electricity providers simultaneously. The rise and fall of fossil gas prices cause drastic changes in contracts, adjustments in subsidy and compensation spending allocations, and pressure on the inflationary side if the increase in fossil gas prices is passed on to end consumers.

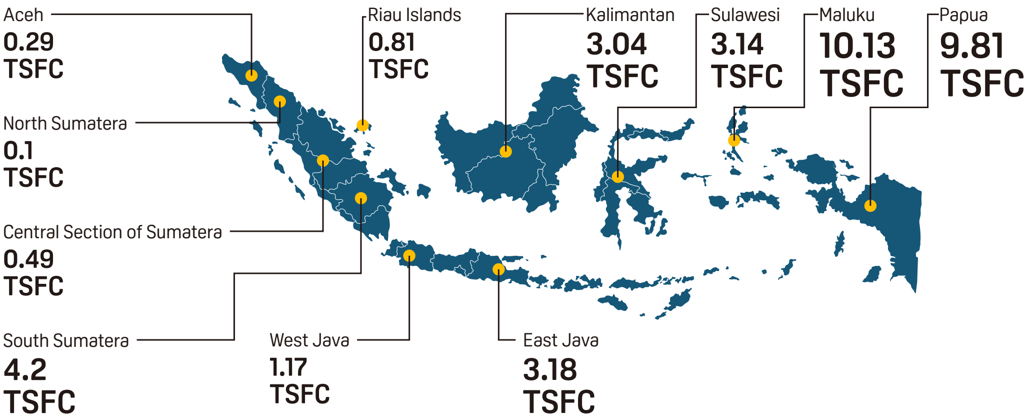
Graphic 8. **Gas, Coal, and Crude Oil Price Indexes**



Source:
CEIC, World Bank
2025

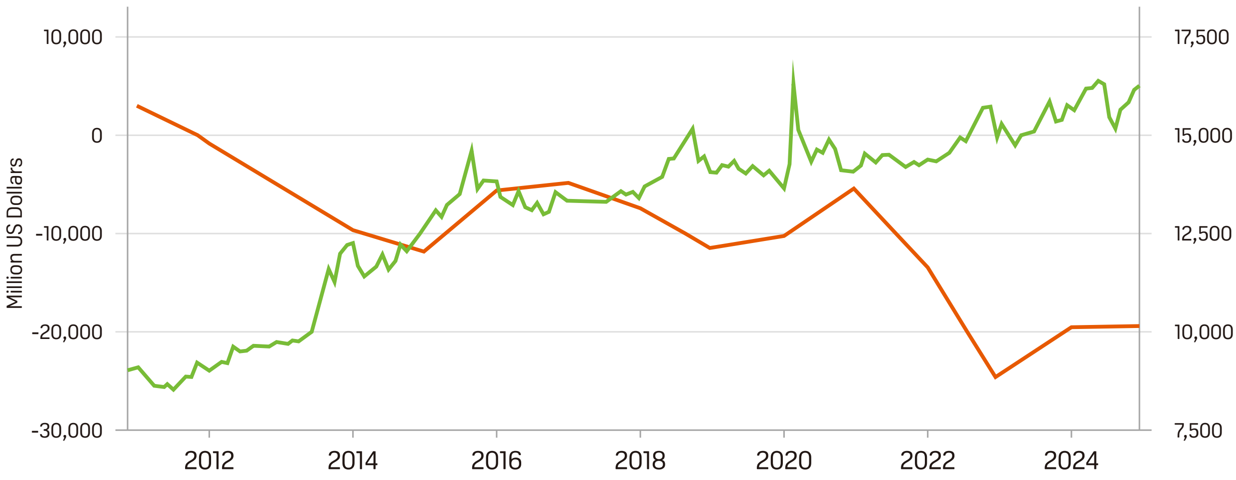
Current account data in the oil and gas sector also shows a widening deficit. The larger the current account deficit, the greater the need for foreign exchange. The impact on the rupiah exchange rate will be depressed in the long term. Economic resilience in the face of weakening external pressures is not a productive policy. The massive construction of fossil gas power plants is expected to worsen the current account deficit.

Graphic 9. **Map of Indonesia's Declining Gas Reserves**



Source:
PGN, 2025

Graphic 10. **Movement of Rupiah Exchange Rate and Current Account Balance of Fossil Oil and Gas Sector**



Oil and Gas Sector Current Account Balance
USD/IDR Exchange Rate

Source:
CEIC, Bank Indonesia 2025

Economic Impact Modeling of Fossil Gas Generation Scenarios

In this study, the author's team conducted a simulation to calculate the long-term economic impact projections on the planned increase in gas-fired power plant capacity until 2040. The estimation methodology used is the input-output (I-O) analysis model based on 185 products with the 2020 BPS I-O table database. The simulation will be carried out in two scenarios, where the first involves adding gas-fired power plant capacity using gas turbine technology, while the second involves using combined cycle technology. The assumptions used in this study include:

- There is an additional plan for 22 GW of gas-fired power plants by 2040 in accordance with the target of the renewable energy acceleration scenario with a coal phase down (PLN, 2024).
- There would be investment costs for gas turbine technology in 2020, 2030, and 2050 of USD770/kW, USD730/kW, and USD680/kW respectively (CIPP JETP, 2023).
- There would be investment costs for combined cycle gas-fired power plants in 2020, 2030, and 2050 of USD690/kW, USD660/kW, and USD610/kW respectively (CIPP JETP, 2023).
- The investment cost of gas turbine technology decreased from 2020 - 2050 with a CAGR of -0.53% (2020-2030) and -0.35% (2030-2050). Meanwhile, the investment cost for gas turbine technology over the same time period decreased with a CAGR of -0.44% (2020-2030) and -0.39% (2030-2050).[5]
- The environmental costs borne by gas-fired power plants with gas turbine technology are USD0.0244/kWh, while gas-fired power plants with combined cycle technology are USD0.0124/kWh (Hossein Yousefi, 2021).
- Convert USD to Rupiah using Bank Indonesia's JISDOR rate of February 14, 2025 of IDR16,285/USD.[6]

5 The author's estimated results using the compound annual growth rate (CAGR) calculation formula
6 Bank Indonesia, 2025, Exchange Rate Information *JISDOR*, 14 February.

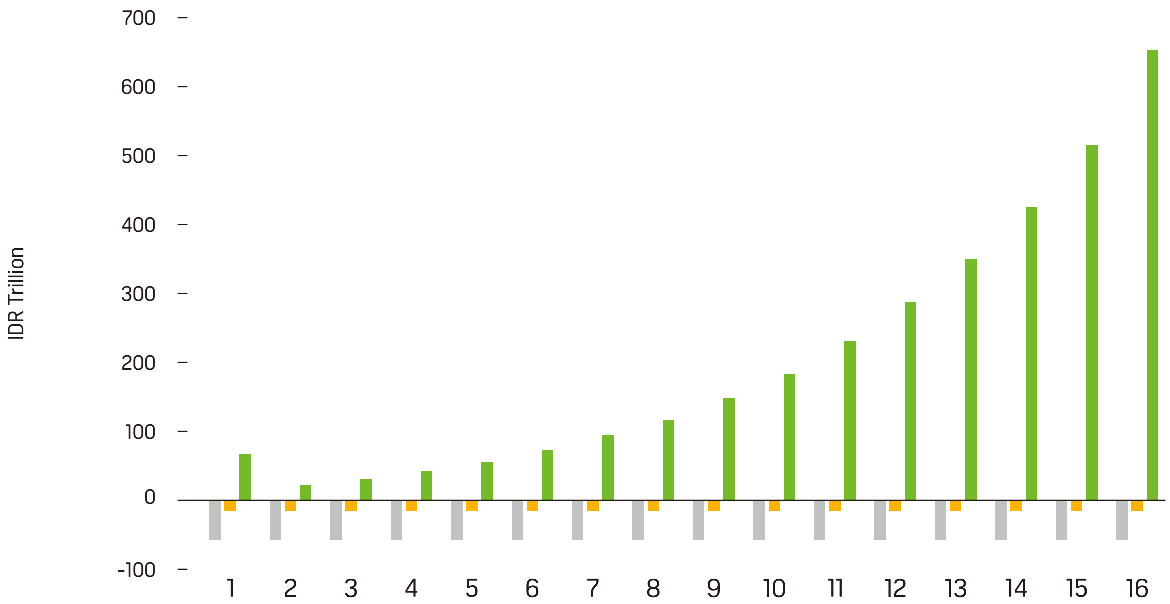
The results of modeling the economic impact of gas-fired power plant in aggregate on a national economic scale until 2040 are as follows:

Economic indicators	Gas Turbine Power Plant	Combined Cycle Gas Turbine (CCGT)	Community-based Renewable Energy*
National economic output (IDR trillion)	(941.4)	(280.9)	2,629.7
GDP (IDR trillion)	(603.6)	(154.3)	1,509.3
Community income (IDR trillion)	(600.8)	(153.7)	2,048
Business surplus (IDR trillion)	(221.1)	(25.3)	1,548.4
Labor income (IDR trillion)	(379.6)	(128.4)	499.6
Net tax** (IDR trillion)	(2.7)	(0.61)	20.2
Absorption of labor (in persons)	(6,761,404)	(2,433,160)	16,272,000

*Based on the results of the Celios and 350.org Indonesia, 2024 study (processed)
**net tax is tax revenue after being reduced by subsidy spending
***the numbers in brackets (...) indicate a decrease

Economic Impact Analysis of Gas Turbines, Combined Cycle vs Community Scale Renewables

Graphic 11. **Comparison of Economic Output**



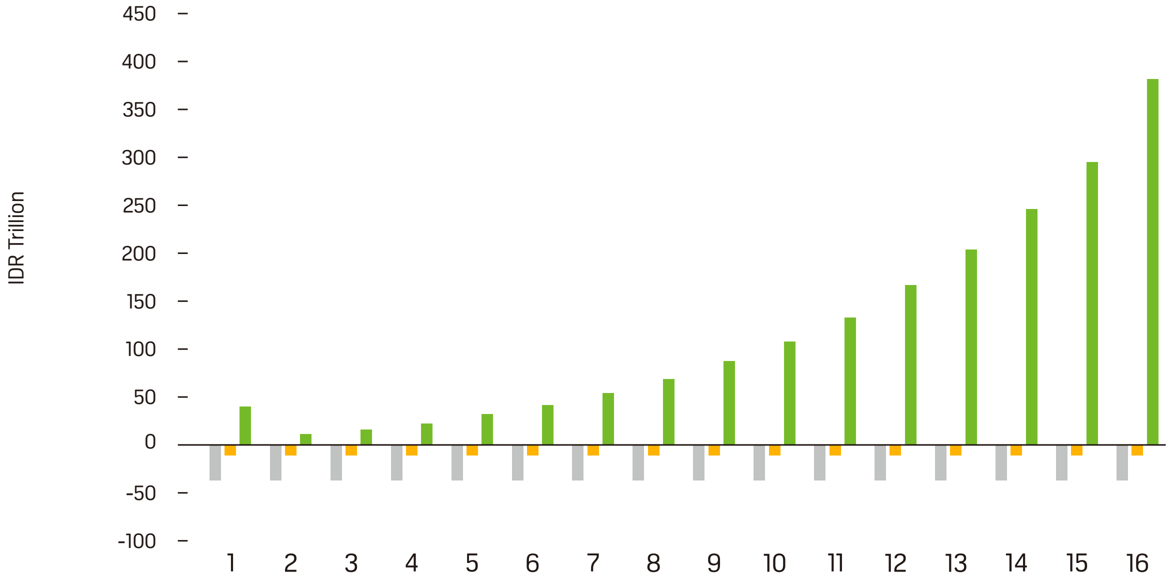
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-57.8	-57.9	-58.1	-58.3	-58.5	-58.6	-58.7	-58.8	-59.0	-59,1	-59.2	-59.3	-59.4	-59.5	-59.6	-59.7
Combined-cycle	-16.7	-16.8	-16.9	-17.0	-17.2	-17.3	-17.4	-17.5	-17.6	-17.7	-17.9	-18.0	-18.1	-18.2	-18.3	-18.4
Community-based renewable energy	68.2	20.8	29.7	40.9	54.7	71.7	92.4	117.5	147.7	184.0	228.8	285.7	348.5	424.1	515.0	655.1

Source: CELIOS, 2025

The graph shows that community-scale renewable energy has a positive impact on economic output in the long term. Over a 16-year period, community-scale renewable energy output has the potential to grow at a CAGR of 15.2% with a total value of IDR3,284.8 trillion or an average of IDR205.3 trillion per year. This growth is supported by various potential scenarios enabled by the implementation of community-based renewable energy. Some of them include increased employment in the installation and maintenance of solar, wind, and hydroelectric power generation facilities. In addition, the adoption of renewable energy contributes to the development and growth in local industrial production in areas that previously lacked access to electricity. Sectors such as tourism, crafts, and small and medium-scale manufacturing for specific products have the potential to experience growth as a result of the electrification of the area.

Meanwhile, over the same period, gas-fired power plants using gas turbine technology and combined cycle had a negative impact on economic output with a cumulative losses of IDR941.4 trillion and IDR280.9 trillion, respectively. This is because gas-fired power plants still produce greenhouse gas emissions from the combustion of fossil gas in the form of carbon dioxide and methane which have harmful impacts on the environment and human health. As a result, they accelerate the climate crisis, negatively affecting other economic sectors, especially the agriculture, forestry, and fisheries sectors.

Graphic 12. **Comparison of Gross Domestic Product Impact Scenarios**



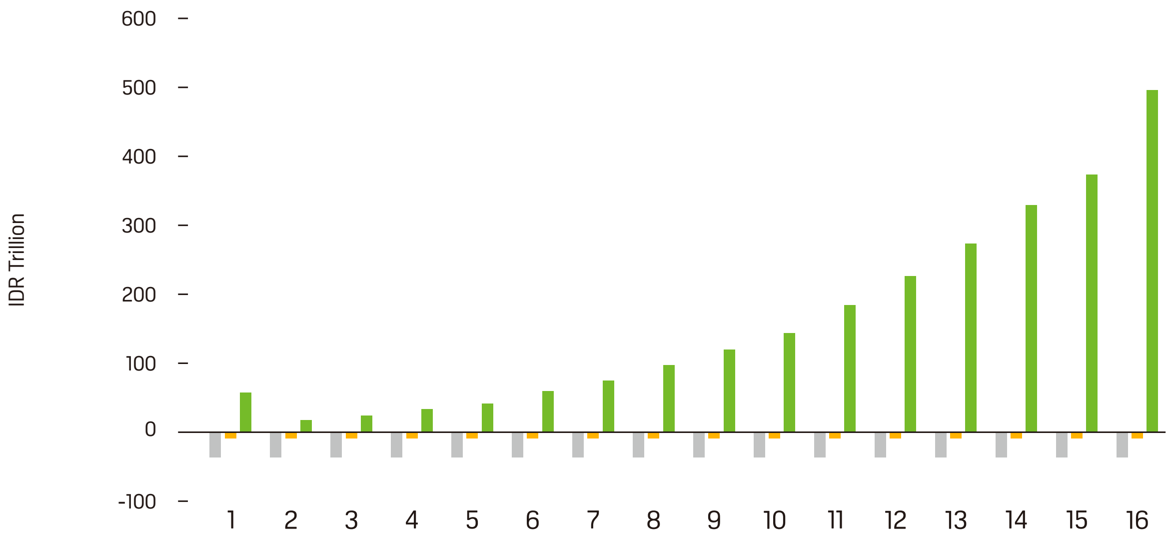
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-36.9	-37.0	-37.2	-37.3	-37.4	-37.6	-37.6	-37.7	-37.8	-37.9	-38.0	-38.1	-38.2	-38.2	-38.3	-38.4
Combined-cycle	-9.0	-9.1	-9.2	-9.3	-9.3	-9.4	-9.5	-9.6	-9.7	-9.8	-9.9	-10.0	-10.0	-10.1	-10.2	-10.3
Community-based renewable energy	38.5	10.2	15.7	22.4	30.7	40.9	53.1	67.8	85.4	106.3	132.3	166.3	201.7	243.8	294.2	380.7

Source: CELIOS, 2025

Similar to GDP, community-scale renewable energy has the potential to provide a positive multiplier effect and is estimated to increase by 15.4% (CAGR) over 16 years. The total cumulative impact reaches IDR1,890 trillion or an average of IDR118.1 trillion per year. As the development of renewable energy sources at the community level increases, investment is expected to increase, especially in the clean energy and microfinance sectors. In addition, the creation of new job opportunities will contribute to improve people's welfare and purchasing power, especially in areas that previously lacked access to electricity, including the underdeveloped, frontier, and outermost areas (3T). Increased domestic consumption in areas that have gained access to community-based renewable energy also has the potential to create a more stable energy supply, thereby supporting overall economic productivity.

Similar to the simulation of economic output, gas-fired power plants using gas turbine technology and combined cycle actually have the potential to erode GDP over the next 16 years with a total cumulative impact of IDR603.6 trillion and IDR154.4 trillion, respectively. The negative impact of gas-fired power plants using fossil gas turbine technology and combined cycle on GDP is caused by dependence on fossil fuels, which increases energy price volatility, especially with the risk of natural fossil gas price fluctuations in the global market. High fuel costs and supply uncertainty can burden the national energy budget and reduce the competitiveness of domestic industry.

Graphic 13. **Impact on the Community Income**



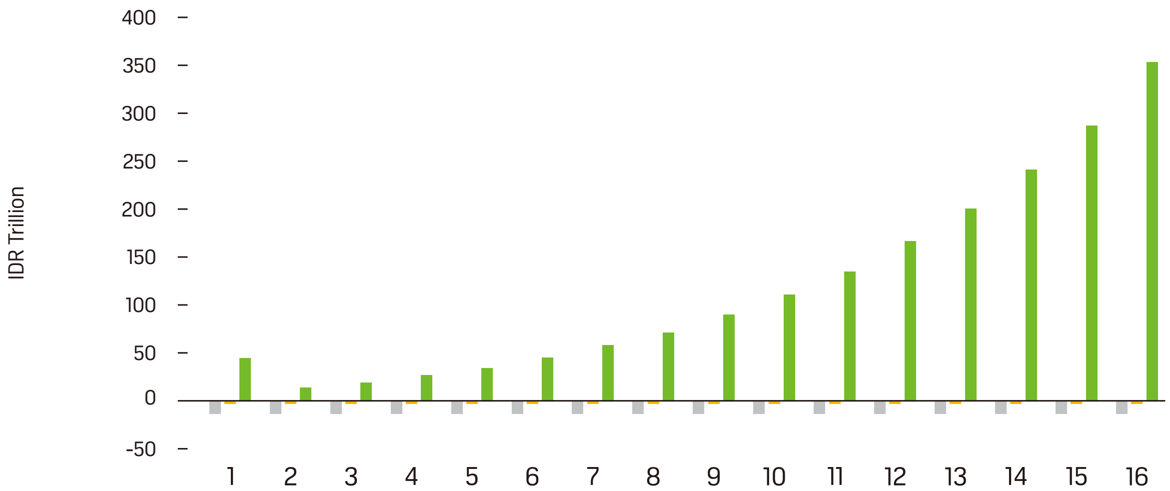
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-36.7	-36.9	-37	-37.1	-37.3	-37.4	-37.5	-37.6	-37.6	-37.7	-37.8	-37.9	-38	-38.1	-38.1	-38.2
Combined-cycle	-8.92	-9.02	-9.12	-9.21	-9.31	-9.41	-9.5	-9.58	-9.67	-9.75	-9.84	-9.92	-10	-10.1	-10.2	-10.3
Community-based renewable energy	57.3	16.8	24.3	33.7	42.2	58.8	75.6	95.8	119.6	140.6	182.4	226	272.6	327.6	374.7	495.6

Source: CELIOS, 2025

The development of community-based renewable energy could increase community income in the long term, with a CAGR of 14.4% over 16 years and a cumulative value of IDR2,543.6 trillion, or an average of IDR158.9 trillion per year. This is due to increased access to reliable and affordable energy, which then allows the growth of productive sectors at the local level. With access to electricity from community-based renewable energy, small and medium industries (SMEs), the agricultural sector, tourism, and micro businesses can grow more rapidly, thereby increasing the income of the community as a whole.

Meanwhile, the simulation of gas-fired power plants using both gas turbine and combined cycle technology show a negative impact on community income. The results of the I-O simulation of gas-fired power plants using gas turbine and combined cycle technology will reduce community income by IDR600.8 trillion and IDR153.7 trillion over 16 years respectively. This is because gas-fired power plants are unable to deliver a consistent economic impact across all sectors, especially for people in remote and less developed areas. Therefore, the scenario of using a gas-fired power plant is projected to reduce community income due to the high operational costs that must be borne, both in terms of fossil fuel prices and dependence on large-scale infrastructure that does not involve direct community participation.

Graphic 14. **Comparison of Business Surplus**



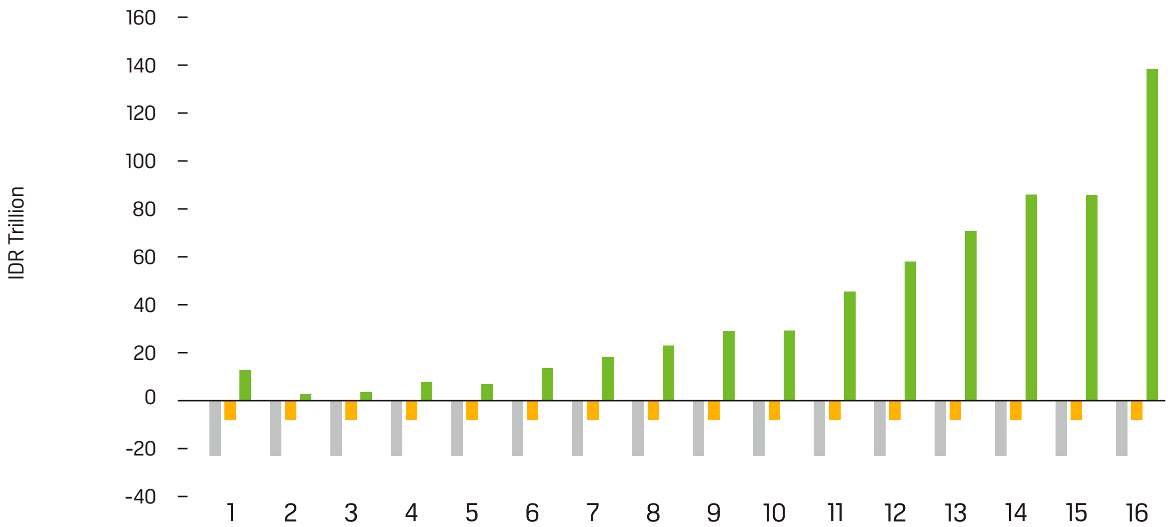
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-13.3	-13.4	-13.5	-13.6	-13.7	-13.7	-13.8	-13.8	-13.9	-13.9	-14.0	-14.0	-14.1	-14.1	-14.2	-14.2
Combined-cycle	-1.2	-1.2	-1.3	-1.4	-1.4	-1.5	-1.5	-1.6	-1.6	-1.7	-1.7	-1.8	-1.8	-1.9	-1.9	-2.0
Community-based renewable energy	44.1	13.5	19.1	26.1	34.6	44.9	57.4	72.4	90.1	111.1	136.2	167.5	201.5	241.4	288.5	356.5

Source: CELIOS, 2025

Community-based renewable energy could also provide a surplus of profit for business actors, with a cumulative estimate of IDR1904.9 trillion, or an average of IDR119.0 trillion per year. This condition can be achieved with wider opportunities for various parties, including cooperatives, BUMDes, and micro-enterprises, to participate and compete in creating added value in the energy sector. Thus, community-based energy has proven to be able to provide collective economic benefits for small business actors.

The development plan for gas-fired power plants using both gas turbine and combined cycle technology has the potential to provide less favorable economic impacts for small business actors and local communities. Simulation results show that gas turbine and combined cycle gas-fired power plants will reduce profits for the business sector by a cumulative value of IDR221.2 trillion and IDR25.3 trillion over a 16 year period. This is due to the nature of gas-fired power plants investment and operations which are more centralized in large companies, with high capital requirements and dependence on the fossil fuel supply chain. As a result, opportunities for cooperatives, BUMDes, and micro businesses to participate in the energy sector are very limited.

Graphic 15. **Labor Income Chart**



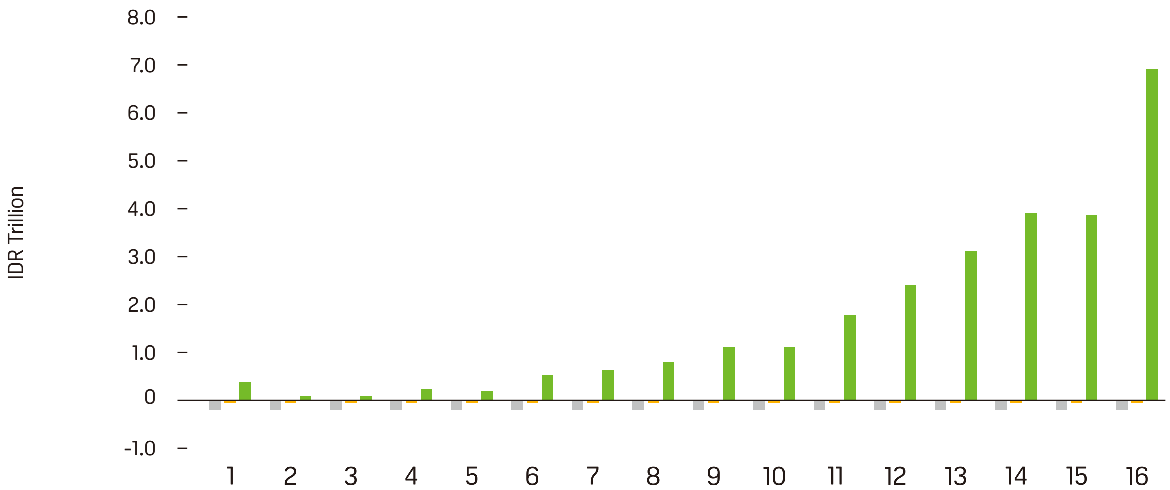
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-23.4	-23.4	-23.5	-23.5	-23.6	-23.7	-23.7	-23.7	-23.8	-23.8	-23.8	-23.9	-23.9	-23.9	-24.0	-24.0
Combined-cycle	-7.7	-7.8	-7.8	-7.9	-7.9	-7.9	-8.0	-8.0	-8.1	-8.1	-8.1	-8.2	-8.2	-8.2	-8.3	-8.3
Community-based renewable energy	13.2	3.3	5.2	7.6	7.6	13.9	18.2	23.4	29.5	29.5	46.2	58.5	71.1	86.2	86.2	139.1

Source: CELIOS, 2025

Over the same period, workers' income will also increase by IDR638.7 trillion or IDR39.9 trillion annually. The increase in workers' income is driven by the increasing number of workers absorbed and the increasing opportunities for jobs that require special skills. Funding for renewable energy, coupled with structured and evenly distributed education and training programs across various regions, could contribute to an overall increase in workers' income. Therefore, the government needs to prepare various initiatives, such as vocational training, optimizing the role of Job Training Centers (BLK), skills certification programs, and integrating renewable energy materials into the basic education curriculum.

On the other hand, the addition of 22 GW of gas turbine and combined cycle power plant capacity has a negative impact on workers' income overall. Over a 16 year period, gas turbine and combined cycle power plants could reduce workers' income by IDR379.7 trillion and IDR128.4 trillion, respectively. The main cause of the decline in workers' income due to gas turbine expansion is the limited job creation and low multiplier effects on the local economy. Negative externalities caused by environmental damage also contribute to the loss of local jobs, especially in the agriculture and fisheries sectors. So the presence of gas turbine power plants will actually reduce workers' income overall.

Graphic 16. **Net Tax Gain**

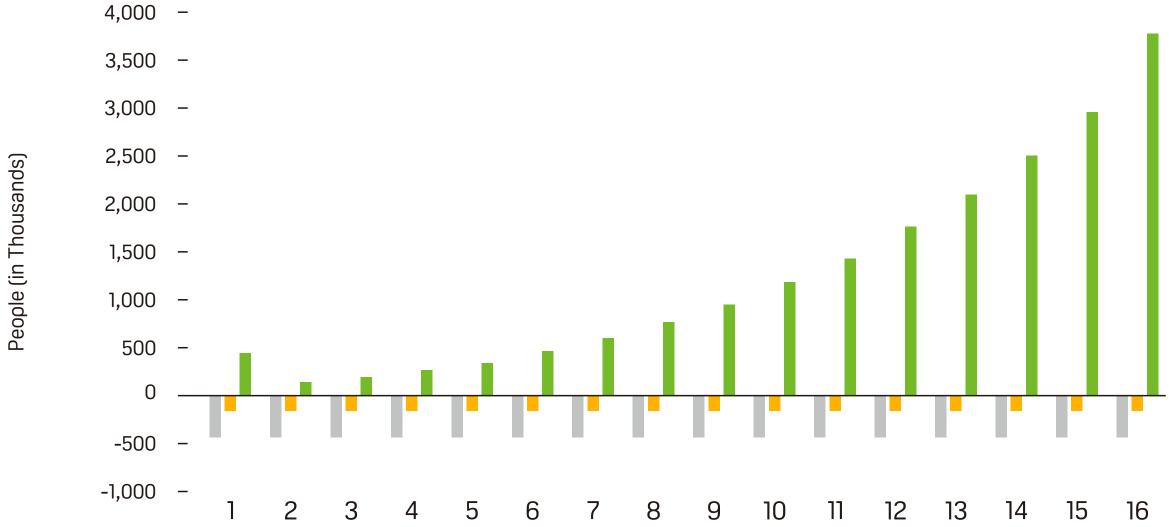


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Combined-cycle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Community-based renewable energy	0.4	0.1	0.1	0.2	0.2	0.5	0.6	0.8	1.1	1.1	1.8	2.4	3.1	3.9	3.9	6.9

Source: CELIOS, 2025

Community-based renewable energy could contribute to the country, as reflected in net tax revenues. Over a 16-year time interval, community-based renewable energy could contribute IDR27.1 trillion to net tax revenues. This is in contrast to the contribution of gas-fired power plants, both with gas turbine technology and combined cycles, which are actually projected to reduce net tax revenues by IDR2.8 trillion and 0.6 trillion respectively over 16 years. This stark contrast is due to community-based renewable energy driving local economic growth, expanding the tax base through MSMEs and labor, and having lower operating costs than gas-fired power plants which rely on fossil fuels and have a tax structure that is less profitable for the country. With more jobs and local economic activity, community-based renewable energy generates greater and more sustainable tax revenues.

Graphic 17. **Labor Absorption Graph**



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gas Turbine	-417	-418	-419	-420	-421	-421	-422	-423	-423	-424	-424	-425	-425	-426	-427	-427
Combined-cycle	-147	-148	-149	-149	-150	-151	-151	-152	-152	-153	-154	-154	-155	-155	-156	-156
Community-based renewable energy	447	143	204	279	372	484	619	779	967	1,186	1,451	1,770	2,109	2,503	2,959	3,769

Source: CELIOS, 2025

Employment is one of the important economic aspects. Simulation results show that the government's plan to increase the capacity of gas-fired power plants to 22 GW by 2040 has the potential to reduce the number of workers absorbed by 6.7 million people in the gas turbine technology scenario and 2.4 million people in the combined cycle technology scenario. Meanwhile, community-based renewable energy has the potential to increase labor absorption by 20 million people over the same period. This can occur due to differences in investment characteristics and labor needs between gas-fired power plants and community-based renewable energy.

Gas-fired power plants tend to be capital-intensive and rely on high technology with a high degree of automation, requiring less labor after the construction phase is complete. In addition, gas-fired power plant operations are more centralized in large companies with certain specializations, so they do not absorb much labor in the local sector, especially for low to medium-skilled workers.

In contrast, community-based renewable energy is more labor-intensive, especially in the installation, operation, and maintenance of energy infrastructure. Community-based renewable energy projects also open up more job opportunities for local workers, including in construction, maintenance, and related supply chains, such as the manufacturing industry of solar panels, wind turbines, or micro-hydro power plant components.

In addition, community-based renewable energy development encourages the emergence of new economic ecosystems, such as micro, small, and medium enterprises (MSMEs) engaged in the renewable energy sector, supporting equipment, and technical services. With the increasing community-based electrification, productive sectors such as agriculture, fisheries, and small industries can also develop more rapidly, creating a multiplier effect on job creation.
Therefore, in the long term, investment in community-based renewable energy is not only more

environmentally friendly but also more effective in creating sustainable jobs and supporting the welfare of the wider community.

Health impacts of fossil gas projects

Every production process of a commodity must have costs incurred, both those that appear on the surface and hidden costs, including the existence of power plants. This is because the costs arising from the presence of power plants in the community go beyond infrastructure, operational, and resource costs imposed on producers. They also include social and health costs experienced by the community due to emissions released from fossil gas power plants, often referred to as externalities.

Of course, the calculation or estimate to measure the health impact caused by gas-fired power plants will be different in each region. However, a study conducted by The Australian Academy of Technological Sciences and Engineering in 2009 found that the health costs borne by the community due to emissions from gas-fired power plants were AUD 0.74/MWh (ATSE, 2009) in 2009. Adjusting for the average annual inflation rate in Australia of 2.6%, these costs would amount to AUD 1.07/MWh or equivalent to IDR1,079,801/MWh in 2023. When converted into calculations in 2030, the figure obtained is AUD 1,235/MWh with an estimated inflation of 2.6% each year, or equivalent to IDR12,548.56/MWh.

Negative externalities resulting from the presence of gas-fired power plants on health include the formation of fine dust (Pm10), sulfur dioxide (SO2), and nitrogen oxide (NO). These three types of pollutants have the potential to cause respiratory and heart diseases (ATSE, 2009), irritation and red rashes on the skin (Rahman, et. al., 2024), increased potential for asthma especially for children, and high rates of poor births such as premature births (Buonocore, et al.., 2023) for people living around the gas-fired power plants site.

It is important to calculate negative externalities as the cost of health impacts that will arise from the planned addition of gas-fired power plants to be built in Indonesia. The simulation calculation used in this study is based on the results of the second version of the European Environment Agency (EEA) study in 2024 to calculate the external costs of industrial air pollution. Health impacts are calculated based on the cost of damage resulting from 1 unit of air pollutant type which is then referred to as the marginal damage cost (MDC). Specifically, the assumptions of this study use the value of a statistical life (VSL) and value of a life year (VOLY) approaches.

VSL is an estimation method based on individual perception and readiness that explains how much money each individual is willing to pay to reduce the risk of premature death from diseases caused by exposure to air pollution (OECD, 2012). Likewise, VOLY is an estimation method based on the potential years of life lost due to a particular risk, where in the context of this study is the potential years of life lost due to the risk of death caused by exposure to air pollution from gas-fired power plants (OECD, 2012). The results of these two methods are then used to calculate the range of the lowest to the highest health costs. The calculation results will be used to calculate the health costs arising from the planned addition of gas-fired power plant capacity of 2,68 GW[7] dan 22 GW[8] for the next 15 years. The assumptions used in this study include:

7 Berdasarkan basis data *Global Energy Monitor* yang dirilis pada Januari 2025 dengan ketentuan dimiliki oleh PT. PLN dan PT. PLN Nusantara serta berstatus dalam tahap pengumuman atau konstruksi.

8 Bisniscom, 2024, https://www.youtube.com/watch?v=quGM2xBXgjA

1 **The damage costs are calculated using the European average VOLY and VSL values per tonne of the main air pollutant types such as particulate matter (PM 2.5), sulphur dioxide (SO_2), ammonia (NH_3), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOCs).**

2 **Convert the average European VOLY and VSL values to Indonesian VOLY and VSL values using an estimation approach with the equation:**

$$\textit{VOLY or VSL}_{Indonesia} = \textit{VOLY or VSL}_{Europe} \left(\frac{\textit{GNI per capita}_{Indonesia}}{\textit{GNI per capita}_{Europe}} \right)^{elasticity}$$

3 **Convert Euro to Rupiah using the average exchange rate in 2021 of IDR16,942/EUR.**

4 **The average inflation in Indonesia from 2021 - 2024 is 2.92%.**

5 **The real Gross National Income (GNI) per capita of Indonesia in 2021 based on the base \ year 2015 is EUR3,164.90.**

6 **The real Gross National Income (GNI) per capita of the European Union in 2021 based on the base year 2015 is EUR30,868.79.**

7 **The growth rate of inflation in the Indonesian health sector until 2040 is estimated using the autoregressive integrated moving average (ARIMA) model with the most optimal parameters, namely (1,1,0), because it has the lowest Akaike information criterion (AIC) and Bayesian information criterion (BIC) values.**

8 **The average estimate of each type of pollutant per MW of gas-fired power plant is calculated using the Climate Trace database.[9]**

The following are the results of the estimated health impact costs in this study:

Table 3. **Average Health Impact Cost of Gas Power Plants in Indonesia (IDR2025/ton)**

Types of Pollutants	VOLY	VSL
PM 2.5	53,997,191	148,039,958
NOx	9,585,141	26,816,295
SO_2	10,121,430	23,939,442
NMVOC	1,151,241	2,796,941
NH_3	11,856,407	32,631,809
Total	**86,711,410**	**234,224,445**

9 Climate Trace, 2025, 2024: *Electricity Generation (Jan 2024 - Dec 2024)*. https://climatetrace.org/explore/#admin=Indonesia%20(IDN):126:IDN:country&gas=co2e&year=2024&timeframe=100&sector=&asset=

The largest average cost is generated from the type of pollutant PM 2.5 or the most dangerous fine particulates that can damage human health. The VOLY value of IDR53.9 million per ton reflects the high value of the risk of life lost due to premature death caused by PM 2.5. The VSL value of IDR148 million per ton reflects the amount of health costs that must be paid by each individual to reduce the risk of premature death due to exposure to the type of pollutant PM 2.5. This pollutant is in the form of fine dust that can enter the respiratory tract system to the blood vessels and cause or worsen chronic diseases such as cancer (OECD, 2016). The source of PM 2.5 comes from various sources including the transportation, industrial, and household sectors (EEA, 2024).

Ammonia (NH_3) and sulfur dioxide (SO_2) pollutants also have negative impacts on health, especially because both are precursors in the formation of secondary PM 2.5 in the atmosphere. NH_3 has been scientifically proven to contribute greatly to air quality degradation through chemical reactions with other pollutants (Amann, et al., 2011). Meanwhile, nitrogen oxides (NOx) also record quite high costs, because in addition to having a direct impact on respiratory health, this compound plays a role in the formation of tropospheric ozone and secondary PM. On the other hand, non-methane volatile organic compounds (NMVOC) show relatively low cost values compared to other pollutants. However, NMVOCs still have the potential to trigger the formation of surface ozone which can irritate the eyes, nose, and throat and worsen asthma (EPA, 2020).

Overall, the total health impact costs of the five pollutants reached IDR86.7 million per ton (VOLY) and IDR234.2 million per ton (VSL). This figure shows the magnitude of the health externality burden that must be borne by the community due to exposure to air pollutants in Indonesia.

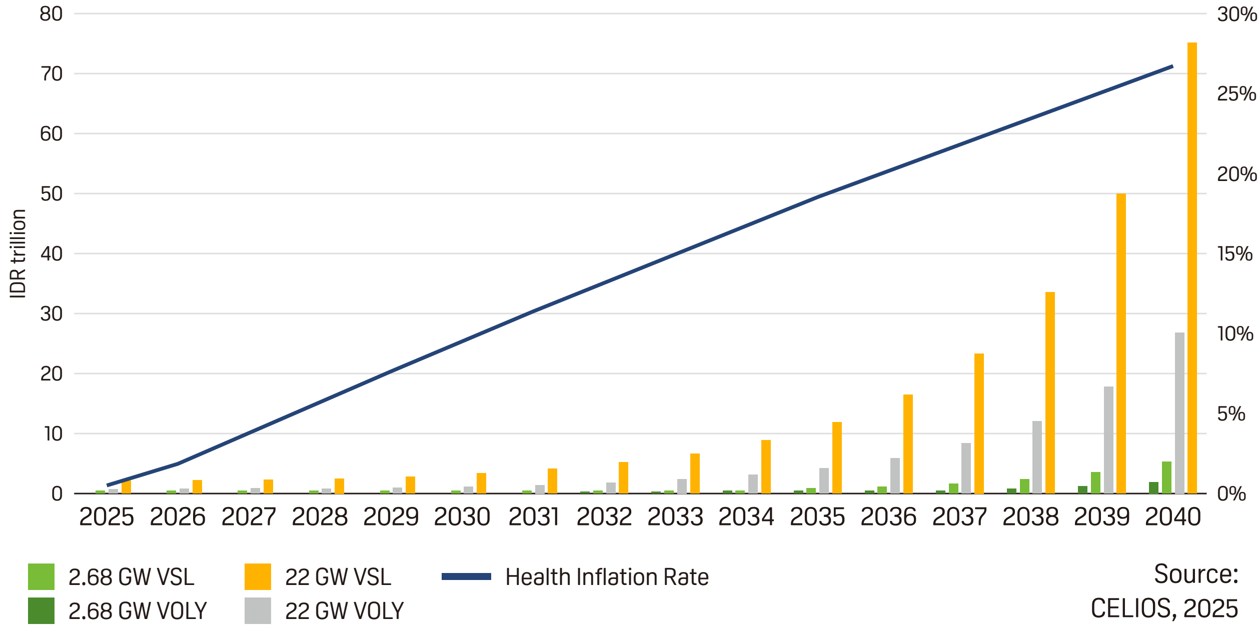
Table 4. **Aggregate Health Impact Costs of 2.68 GW and 22 GW Gas Power Plant Scenarios (in IDR)**

Types of Pollutants	2.68 GW		22 GW	
	VOLY	VSL	VOLY	VSL
PM 2.5	581.3 billion	1.6 trillion	3.8 trillion	10.5 trillion
NOx	4.8 trillion	13.3 trillion	79.2 trillion	221.7 trillion
SO_2	243.5 billion	575.9 billion	256.2 billion	606 billion
NMVOC	297.2 billion	721.9 billion	2.1 trillion	5.2 trillion
NH_3	592.6 billion	1.6 trillion	4.3 trillion	11.8 trillion
Total	**6.5 trillion**	**17.9 trillion**	**89.8 trillion**	**249.8 trillion**

The increase in gas-fired power plant capacity has a positive correlation with the cost of health impacts. The higher the gas-fired power plant capacity, the higher the health impact costs that must be borne by the community due to the impact of air pollution. The total cost increases sharply from the scenario of adding gas-fired power plant capacity of 2.68 GW with a VOLY value of IDR6.5 trillion to VSL of IDR17.9 trillion. If the addition of gas-fired power plant capacity is still increased by 22 GW until 2040, then the health impact costs that must be borne will increase drastically with a VOLY value of IDR89.8 trillion to VSL of IDR249.8 trillion.

Thus, the expansion of gas-fired power plant capacity will actually create a huge burden on public health and harm the economy in the long term. According to a study conducted by the European Environment Agency (EEA), the highest health impact cost in 2021 in Europe is nitrogen oxide (NOx) (EEA, 2024). Exposure to NOx in high concentrations can cause inflammation of the respiratory tract and decreased lung function, thus risking worsening respiratory disorders in vulnerable groups such as children and the elderly (EEA, 2024).

Graphic 18. **Increase in Health Impact Costs of 2.68 GW and 22 GW Gas Power Plant Scenarios**



Source:
CELIOS, 2025

Incrementally, the health impact costs of increasing the capacity of gas-fired power plants, both with the 2.68 GW and 22 GW scenarios, have started to increase drastically since 2035. This can occur along with the spike in the inflation rate in the health sector due to the increasing number of gas-fired power plants operating. The projection results also reflect that the larger the capacity of gas-fired power plants in Indonesia, the worse the air quality will be. As a result, more and more people suffer from chronic diseases such as bronchitis, asthma, heart disease, and lung cancer due to increased emissions of pollutants such as NOx, SO_2, and PM 2.5 from gas-fired power plants. This condition drives a spike in the price of health services such as medical services, medicines, and health insurance premiums due to the increasing demand in the health sector.

Table 5. **Health Impact Costs of Gas Power Plants on BPJS Health Insurance Burden**

Description	Health Insurance Burden
Total BPJS Health Claims 2024	IDR175.1 trillion*
BPJS Health Claim Projection in 2040 (Without gas-fired power plant)	IDR1,456.1 trillion**
Total BPJS Health Claims Scenario with Additional Health Costs for 2.68 GW Gas-fired Power Plant	IDR1,462.6 trillion - IDR1,473.9 trillion
Total BPJS Health Claims Scenario with Additional Health Costs for 22 GW Gas Power Plant	IDR1,545.9 trillion - IDR1,705.9 trillion

Source: *BPJS Health Data 2024 (Unaudited); **estimates based on BPJS Health claims growth of 15.17% in 2024, health inflation assumptions are not included in the estimate.

The table above proves that the expansion of gas-fired power plant has the potential to increase the financial burden of the health social security administration (BPJS Kesehatan) between IDR1,462.6 trillion to IDR1,473.9 trillion in the 2.68 GW gas-fired power plant development scenario. Meanwhile, if the gas-fired power plant development scenario is 22 GW, the estimated total BPJS Kesehatan claims per year will reach IDR1,545.9 trillion to IDR1,705.9 trillion. The health insurance burden that must be borne by BPJS Kesehatan will be even higher, so the government only has 2 options, namely charging contributions to the State Budget (APBN) and BPJS participants or stopping the construction of the gas-fired power plant project in both the 2.68 GW and 22 GW scenarios.

The risk of slow government efforts to reduce health costs due to the expansion of fossil gas projects poses a high risk to the burden on the APBN, BPJS Health, and membership fees borne by the community.

07 Why Are Renewable Energy Options More Competitive in Terms of Installation Costs?

Table 6. **Generation Cost Assumptions Based on Technology Type**

USD (2019/kW)	2020	2030	2050
Power plant			
Bioenergy (palm oil/rice husk)	2,000	1820	1,600
Geothermal energy (large)	4,000	3,440	2,840
Hydropower (large)	2,080	2,000	1,850
Hydropower (medium)	2,290	2,200	2,040
Solar PV (utility scale)	790	560	410
Solar PV (industry)	1,190	840	620
Onshore wind	1,500	1,280	1,080
Offshore wind	3,500	2,980	2,520
Coal (subcritical)	1,650	1,600	1,550
Coal (supercritical)	1,400	1,360	1,320
Coal (ultra-supercritical)	1,520	1,480	1,430
Fossil gas (gas turbine)	770	730	680
Fossil gas (combined-cycle)	690	660	610
CCUS installation	+1,950	+1,790	+1,420
Coal (subcritical) + CCUS	3,600	3,390	2,970
Coal (supercritical) + CCUS	3,350	3,150	2,740
Coal (ultra-supercritical) + CCUS	3,470	3,270	2,850
Fossil gas (gas turbine) + CCUS	2,720	2,520	2,100
Fossil gas (combined-cycle) + CCUS	2,640	2,450	2,030

Source: CIPP JETP 2023, Ministry of Energy and Mineral Resources 2021

Based on JETP's assumptions regarding the installation costs of renewable energy-based power plants such as hydropower, solar, or wind, it does appear higher when compared to gas power plants in the table above. However, the government in the Regulation of the Minister of Energy and Mineral Resources Number 10 of 2025 concerning the Road Map for the Electricity Sector Energy Transition has stipulated that there needs to be retrofitting of Gas-fired Power Plants with additional CCS/CCUS (carbon capture and storage/carbon capture, utilization, and storage) storage features.

The addition of CCS/CCUS features to fossil gas power plants means that there are additional costs that need to be allocated by the government in the installation of power plants. So, if referring to the data collected from JETP, it means that the costs required to install fossil gas-powered power plants will be greater than renewable energy-based power plants, because the installation of CCS/CCUS components in the gas-fired power plant is necessary.

For example, in 2030 the cost of installing utility-scale solar panels is USD 790 per kW, while the total cost of installing gas turbines plus CCS is USD 2,520 per kW or 3.1 times greater than solar panel generation.

Greenpeace Indonesia

Policy Recommendations

1. Cancel plans to add new fossil gas power plants in the 2025-2034 RUPTL.
2. Urge financial institutions involved in financing fossil gas power plants to withdraw funding, as such projects contradict climate commitments.
3. Develop a Roadmap for Retiring Power Plants from fossil gas and other fossil fuel power plants.
4. Revise international cooperation related to the acceleration of fossil gas power plants, one of which is AZEC (Asia Zero Emission Community), as it harms Indonesia's economic and environmental interests.
5. Prevent additional electricity subsidy burdens from both existing fossil gas power plants or new fossil gas power plants in the 2026 RAPBN Financial Note.
6. Provide greater fiscal and monetary incentives to renewable energy generators.
7. Promote economic transformation by focusing on renewable energy, especially solar and wind energy, not fossil gas power plants.
8. Canceling the exploration and exploitation of giant reserves fields the Government's plan.
9. Tightening emission standard on fossil gas-fired power plants.
10. Developing a monitoring system for methane leaks across the entire fossil gas supply chain, in line with the Global Methane Pledge agreement signed by Indonesia at COP26.

Reference

Amann, et. al., 2011, Cost-effective control of air quality and greenhouse gases in Europe: Modeling and policy applications, Environmental Modelling & Software, Volume 26, Issue 12. https://www.sciencedirect.com/science/article/abs/pii/S1364815211001733

Bank Indonesia, 2025, Informasi Kurs JISDOR, 14 Februari. https://www.bi.go.id/id/statistik/informasi-kurs/jisdor/Default.aspx

Biegler, Tom, 2009, The Hidden Costs of Electricity: Externalities of Power Generation in Australia, The Australian Academy of Technological Sciences and Engineering (ATSE), Victoria, Australia, Maret. https://www.researchgate.net/profile/Tom-Biegler/publication/292966840_The_Hidden_Costs_of_Electricity_Externalities_of_Power_Generation_in_Australia/links/56b2729b08ae56d7b06ccb2c/The-Hidden-Costs-of-Electricity-Externalities-of-Power-Generation-in-Australia.pdf

Bisniscom, 2024, Bisnis Indonesia Economy Outlook 2025 - Heading Towards an Inclusive and Sustainable Economy, Youtube. https://www.youtube.com/watch?v=quGM2xBXgjA

Boyce, Meherwan P., 2001, Gas Turbine Engineering Handbook Second Edition, Gulf Professional Publishing, Woburn, Massachusetts. https://soaneemrana.org/onewebmedia/GAS%20TURBINE%20ENGINEERING%20HAND%20BOOK%20BY%20MEHERWAN%20P.%20BOYCE%20%282nd%20Edtion%29.pdf

BPS, 2025, Produksi Minyak Bumi dan Gas Alam 1996-2003, Badan Pusat Statistik, Februari. https://www.bps.go.id/id/statistics-table/1/MTA5MiMx/produksi-minyak-bumi-dan-gas-alam--1996-2022.html

Buonocore, et. al., 2023, Air Pollution and Health Impacts of Oil & Gas Production in the United States, Environmental Research: Health, Mei. https://iopscience.iop.org/article/10.1088/2752-5309/acc886/pdf

C2ES, Natural Gas. https://www.c2es.org/content/natural-gas/

Celios & 350.org Indonesia, 2024, Peluang dan Tantangan Pendanaan Energi Terbarukan Berbasis Komunitas, Jakarta. https://celios.co.id/wp-content/uploads/2024/12/Peluang_dan_Tantangan_Pendanaan_energi_terbarukan_Berbasis_Komunitas_compressed_aa222bb374.pdf

Climate Trace, 2025, 2024: Electricity Generation (Jan 2024 - Dec 2024). https://climatetrace.org/explore/#admin=Indonesia%20(IDN):126:IDN:country&gas=co2e&year=2024&timeframe=100&sector=&asset=

CEIC Data

CSIS, 2024, How Japan Thinks about Energy Security, Mei. https://www.jstor.org/stable/pdf/resrep60345.pdf?refreqid=fastly-default%3A1793b1be15f4dbe7d6be7a77f80c6ceb&ab_segments=&initiator=&acceptTC=1#page=7

DJPPR Kemenkeu, 2024, Profil Jatuh Tempo Utang Pemerintah Pusat, April.

EEA, 2024, Estimating the External Costs of Industrial Air Pollution: Trends 2012-2021 v2, Technical Note on the Methodology and Additional Results From the EEA Briefing 24/2023, European Environment Agency.

EIA, 2003, Natural Gas Weekly Update Archive, Oktober. https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2003/10_23/Volatility%2010-22-03.htm

EIA, 2015, Japan restarts first nuclear reactor under new safety rules, Agustus. https://www.eia.gov/todayinenergy/detail.php?id=22472#

EPA, 2020, Integrated Science Assessment for Ozone and Related Photochemical Oxidants, Center for Public Health and Environmental Assessment Office of Research and Development, U.S. Environmental Protection Agency, NC, April. https://assessments.epa.gov/risk/document/&deid=348522#downloads

ERIA, 2024, Realising Asia Zero Emission Community, Strategic Research Programmes and Multi-Stakeholder Engagement, Agustus. https://www.eria.org/uploads/media/AZEC/ERIA-Asia-Zero-Emission-Center-Report.pdf
ESDM, 2024, Technology Data for the Indonesian Power Sector. Maret. https://gatrik.esdm.go.id/assets/uploads/download_index/files/c4d42-technology-data-for-the-indonesian-power-sector-2024-annoteret-af-kb-.pdf
Federal Foreign Office Germany, 2023, COP 28 Commits to Transitioning Away From Fossil Fuels. https://www.auswaertiges-amt.de/en/aussenpolitik/themen/klimaenergie/2638848-2638848#:~:text=The%20international%20community%20commits%20at,the%20period%20up%20to%202030.
GEM, 2025, Global Oil and Gas Plant Tracker, Januari. https://globalenergymonitor.org/projects/global-oil-gas-plant-tracker/
Government of Japan, 2024, AZEC: Asia's Various Pathways to Net Zero Co-Created by Japan, Februari. https://www.japan.go.jp/kizuna/_userdata/pdf/2024/spring2024/asias_various_pathways_to_net_zero.pdf
Hasil estimasi penulis dengan menggunakan rumus perhitungan compound annual growth rate (CAGR)
Hossein Yousefi, 2021, Effects of the Environmental Cost of Electricity Generation, Considering the LCOE Model, Environmental Energy and Economic Research, Faculty of New Sciences and Technologies, University of Tehran, Tehran, Iran, Oktober. https://www.eeer.ir/article_138806_6704e6ddcf2722b31c234f0508a2a99e.pdf
IEEFA, 2024, Japan's Largest LNG Buyers Have a Surplus Problem: As Domestic Gas Demand Falls, Japanese Utilities are Look to Offload Excess LNG Supply in South and South East Asia, Maret. https://ieefa.org/sites/default/files/2024-04/20240229%20-%20Report%20-%20Japan%27s%20largest%20LNG%20buyers%20have%20a%20surplus%20problem.pdf
JETP Indonesia, 2023, Rencana Investasi dan Kebijakan Komprehensif 2023, Nopember. https://jetp-id.org/storage/official-jetp-cipp-2023-vshare_f_id-1703731480.pdf
Kemenkeu, Nota Keuangan beserta Anggaran Pendapatan Belanja Negara Tahun Anggaran 2015-2025.
Kementerian ESDM, 2024, Produksi Gas Bumi Stabil, Menteri ESDM: Target 12 BCF Bisa Tercapai, Siaran Pers Nomor: 407.Pers/04/SJI/2024, Agustus. https://www.esdm.go.id/id/media-center/arsip-berita/produksi-gas-bumi-stabil-menteri-esdm-target-12-bcf-bisa-tercapai
Kementerian ESDM, 2025, Rencana Umum Ketenagalistrikan Nasional, Jakarta, Maret. https://gatrik.esdm.go.id/assets/uploads/download_index/files/28dd4-rukn.pdf
METI JP, 2023, Asia Zero Emission Community Joint Statement, Tokyo, Maret. https://www.meti.go.jp/press/2022/03/20230306005/20230306005-24.pdf
METI JP, 2023, Asia Zero Emission Community Ministerial Meeting, Tokyo, Maret. https://www.meti.go.jp/press/2022/03/20230306005/20230306005-24.pdf
METI JP, 2024, List of Cooperation Projects for the Second AZEC Summit, Vientiane, Oktober. https://www.meti.go.jp/policy/energy_environment/global_warming/azec/2nd_leaders_meeting/2nd_azec_leaders_meeting_cooperation_list_en.pdf
Muliawati, Firda Dwi, 2025, RI Bakal Punya Proyek Gas Raksasa Rp340 Triliun, Ini Pemiliknya, CNBC Indonesia, Jakarta, April. https://www.cnbcindonesia.com/news/20250410102022-4-624810/ri-bakal-punya-proyek-gas-raksasa-rp-340-triliun-ini-pemiliknya
OECD, 2012, Mortality Risk Valuation in Environment, Health and Transport Policies, OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2012/02/mortality-risk-valuation-in-environment-health-and-transport-policies_g1g1690a/9789264130807-en.pdf
OECD, 2016, The Economic Consequences of Outdoor Air Pollution, OECD Publishing, Paris. https://www.oecd.org/content/dam/oecd/en/publications/reports/2016/06/the-economic-consequences-of-outdoor-air-pollution_g1g68583/9789264257474-en.pdf
Pertamina Gas, 2020, Menilik Kekayaan Gas Alam Indonesia Sebagai Salah Satu Tumpuan Kebutuhan Energi Masyarakat Indonesia, Pertamina Gas, Oktober. https://pertagas.pertamina.com/Portal/content/Read/39
PLN, 2023, Di Konferensi Kelistrikan se-Asia Pasifik, PLN Paparkan Skenario Transisi Energi Menuju NZE 2060, Siaran Pers, Oktober. https://web.pln.co.id/media/siaran-pers/2023/10/di-konferensi-

kelistrikan-se-asia-pasifik-pln-paparkan-skenario-transisi-energi-menuju-nze-2060
Pusdatin, ESDM, 2015, Data Inventory Emisi GRK Sektor Energi, Jakarta, Desember. https://www.esdm.go.id/assets/media/content/KEI-Data_Inventory_Emisi_GRK_Sektor_Energi.pdf
Rahman, et. al., 2024, Particulate Matter Concentrations Around Natural Gas-fired Power Plants and Their Associated Health Impact Assessment, Journal of King Saud University - Science, Volume 36, Issue 7. https://www.sciencedirect.com/science/article/pii/S1018364724001824
Riva, Joseph P., et al., 2025, Natural Gas, Enyclopedia Britannica, April. https://www.britannica.com/science/natural-gas
Sabina, Assan, 2023, EU Backing Down From Real Action on Coal Mine Methane, Ember Energy, Oktober. https://ember-energy.org/app/uploads/2024/10/Report_EU-backing-down-from-real-action-on-coal-mine-methane.pdf
Tokyo Gas, 2018, Tokyo Gas Annual Report 2018: Business Overview. https://www.tokyo-gas.co.jp/en/IR/library/pdf/anual/18e11.pdf#page=3
Trade Map, 2025, List of importers for the selected product in 2023 Product : 2711 Petroleum gas and other gaseous hydrocarbons. https://www.trademap.org/Country_SelProduct.aspx?nvpm=1%7c%7c%7c%7c%7c2711%7c%7c%7c4%7c1%7c1%7c1%7c1%7c1%7c2%7c1%7c1%7c1
Trade Map, 2025, List of products imported by JapanMetadata detailed products in the following category: 271111 Natural gas, liquefied. https://www.trademap.org/Product_SelCountry_TS.aspx?nvpm=1%7c392%7c%7c%7c%7c271111%7c%7c%7c8%7c1%7c1%7c1%7c2%7c1%7c1%7c2%7c1%7c1
UNFCCC, 2024, Yearbook of Global Climate Action 2024, Marrakech Partnership for Global Climate Action, UNFCCC, Bonn, November. https://unfccc.int/sites/default/files/resource/Yearbook_GCA_2024.pdf
Waluyo, Dwitri, 2024, Saatnya Gasifikasi Pembangkit Listrik, Februari. https://indonesia.go.id/kategori/editorial/7936/saatnya-gasifikasi-pembangkit-listrik?lang=1
Yayasan Indonesia CERAH, 2024, Transisi Energi Indonesia: Lepas Landas Tanpa Gas, Juni. https://www.cerah.or.id/id/publications/report/detail/transisi-energi-indonesia-lepas-landas-tanpa-gas
Zero Carbon Analytics, 2024, Zero emissions or fossil fuels? Tracking Japan's AZEC projects, Oktober. https://zerocarbon-analytics.org/wp-content/uploads/2024/10/ZCA-briefing-Zero-emissions-or-fossil-fuels_-Tracking-Japans-AZEC-projects-Oct24.pdf

Appendix

Table. List of Fossil Gas Power Plant Development Plans in Indonesia

Generator	Fuel	Capacity (MW)	Technology	Status	Commercial Operation Date
Jawa-3	Nature Gas	800	Combined-cycle	Announced	2030
Kalbar-2	Nature Gas	300	Combined-cycle	Pre-construction	2024 (Delayed)
Kalsel 1	Nature Gas	100	Combined-cycle	Announced	2030
Kaltim 2	Nature Gas	80	Combined-cycle	Announced	2026
Kaltim 2-1	Nature Gas	50	Gas Turbine	Announced	2023 (Delayed)
Kaltim 2-2	Nature Gas	50	Gas Turbine	Announced	2023 (Delayed)
Madura PTBA	Nature Gas	300	Combined-cycle	Announced	2025
Muara Tawar	Natural Gas Exhaust Heat	250	Steam Turbine	Under-construction	2023 (Delayed)
Muara Tawar	Natural Gas Exhaust Heat	250	Steam Turbin	Under-construction	2023 (Delayed)
Pembangkit Riau	LNG	200	Internal Combustion Engines (ICEs)	Announced	2025
Sumbagut 1	Nature Gas	200	Combined-cycle	Announced	2030
Sumbagut 3	Nature Gas	300	Combined-cycle	Announced	2030
Sumbagut 4	Nature Gas	300	Combined-cycle	Announced	2030

Source: Global Energy Monitor, 2025

CELIOS

Center of Economic and Law Studies (CELIOS)
Jl. Banyumas, Menteng, Jakarta Pusat, Indonesia

website : celios.co.id

GREENPEACE

Greenpeace Indonesia
Jl. HOS. Cokroaminoto No. 19 RT 1 / RW 2 Gondangdia
Kecamatan Menteng, Jakarta Pusat, 10350

website : greenpeace.org