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IEEJ Outlook 2026
Summary

Deepening uncertainties surrounding the challenges of energy transition: a widening gap between the ideal and the reality

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Summary

Global energy supply and demand outlook to 2050

Energy demand will continue to rise until 2050 under current conditions.

- This Outlook analyses global energy supply and demand projections through 2050 under two scenarios. Under the Reference Scenario, which assumes current policy and technological trends continue, global primary energy consumption will continue to grow steadily, primarily driven by Emerging and Developing Economies, increasing by 14% by 2050 compared to 2023 levels.
- On the other hand, under the 'Advanced Technologies Scenario'—which assumes the maximum deployment of various energy technologies to advance energy security and decarbonisation—emissions peak around 2030 before gradually declining, reaching a 6% reduction by 2050 compared to 2023 levels.

Under the Advanced Technologies Scenario, global CO_2 emissions will be reduced by 59% of current levels.

- Projections for carbon dioxide (CO_2) emissions vary significantly between the scenarios. Under the Reference Scenario, global emissions remain largely unchanged from current levels until 2050. This is because emissions reductions in Advanced Economies are largely offset by increased emissions associated with economic growth in Emerging and Developing Economies.
- Meanwhile, under the Advanced Technologies Scenario, global CO_2 emissions in 2050 would be reduced by 59% compared to 2023 levels. However, electrification remains challenging in non-power sectors, particularly industry (high-temperature heat) and transport (long-distance haulage), making decarbonisation in these sectors a major hurdle towards overall net-zero. Hydrogen and synthetic fuels represent promising alternatives, but high costs remain a challenge. Further technological advancement and cost reduction are essential going forward.

Significant increase in electricity demand and challenges to stable supply

- Global electricity generation continues to increase substantially under both scenarios. The Reference Scenario projects a 66% increase compared to 2023 levels, while the Advanced Technologies Scenario anticipates nearly double the increase, driven by electrification and expanding demand for hydrogen and carbon capture and storage (CCS). This growth stems from the rapid expansion of data centres, currently attracting global attention, alongside industry sector growth centred on Emerging and Developing Economies and rising space heating and cooling demand in residential sector.
- To meet this substantial increase in demand and ensure stable electricity supply, securing sufficient power generation capacity is essential. Solar photovoltaics and wind are expected to account for a large proportion of the overall increase in electricity generated. However, from around 2030, constraints such as a shortage of suitable sites and rising integration costs to manage supply fluctuations will become apparent. Consequently, investment in other

power sources such as thermal, nuclear and other renewable energies will also be indispensable.

Fossil fuel demand varies considerably depending on the scenario.

- The future of fossil fuel demand is subject to significant uncertainty. Oil demand varies considerably depending on the extent of electric vehicle (EV) penetration and efficiency improvements. Under the Reference Scenario, it continues to increase until 2050, whereas under the Advanced Technologies Scenario, it declines substantially. Consequently, among the three fossil fuels, oil exhibits the greatest variation depending on the scenario.
- Natural gas demand remains robust under both scenarios, with demand levels in 2050 remaining comparable to current levels even under the Advanced Technologies Scenario.
- Coal primarily supports power generation demand in Emerging and Developing Economies, but demand could decline significantly if the expansion of renewables progresses.
- Nevertheless, fossil fuels will continue to account for the bulk of energy consumption. Even under the Advanced Technologies Scenario, fossil fuels will constitute 54% of global primary energy consumption. Therefore, ensuring a stable supply of fossil fuels remains a critical challenge even as the energy transition progresses.

India and ASEAN: surging demand and supply-side constraints

- As energy demand declines in Advanced Economies and China, Emerging and Developing Economies—notably India and the Association of Southeast Asian Nations (ASEAN)—will drive new growth. India's annual income per capita is projected to approach $10 000 by 2050, with final energy consumption expected to nearly double from current levels under the Reference Scenario. ASEAN countries will also see sustained consumption growth alongside rising incomes and industrialisation.
- In India, driven by expanding demand in buildings and industry sectors, the Reference Scenario projects that electricity generated will more than triple over the next 25 years. While solar photovoltaics deployment is expected to increase, competition with agricultural land poses a challenge, making it difficult for solar photovoltaics alone to meet all electricity demand. Furthermore, addressing the social issue of improving transmission and distribution losses is also required.
- In Malaysia, one of the ASEAN members, the Reference Scenario projects a roughly 2.5-fold increase in electricity generated by 2050, driven by factors such as expanding data centre demand. An increase in natural gas-fired power generation utilising domestic resources is anticipated. To reduce CO_2 emissions, strengthening the power grid interconnection between the densely populated Malay Peninsula and Borneo Island—where suitable sites for renewables are concentrated—will be key.

Rising import dependence in Asia and its impact on the international energy market

- Increased domestic demand in India and ASEAN will heighten dependence on oil and natural gas imports. Furthermore, by 2050, 85% of crude oil interregional trade will be destined for Asia, with over half of this destined for South and Southeast Asia. Consequently, Asia will further enhance its presence in international energy trade.
- The CO_2 emissions reduction potential (the difference in emissions under the Reference and Advanced Technologies Scenarios) for India, ASEAN, and other Emerging and Developing Asia combined is comparable to that of all Advanced Economies or China. The investment

required to realise reductions in these three regions amounts to approximately $240 billion annually. This represents 80% of the total funding target for all emerging and developing countries agreed at the 29th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP29) ($300 billion per annum). Mobilising private capital is essential to achieve investment on this scale.

The potential of variable renewable electricity considering integration costs

Expectations and challenges for variable renewable energy

- Significant increases in carbon-free energy sources are required to achieve decarbonisation. Expectations are particularly high for the continued expansion of variable renewable energy (VRE) sources such as solar photovoltaics and wind, which have seen substantial growth until recently. The IEEJ Outlook 2026 projects that under the Reference Scenario, VRE power generation will increase approximately fivefold from current levels to 2050, rising to approximately sevenfold under the Advanced Technologies Scenario.
- As the output of VRE fluctuates significantly depending on natural conditions such as solar radiation and wind speed, the expansion of VRE will have a major impact on the stability of the electricity supply-demand balance. For instance, as already observed in some countries and regions (such as the Kyushu region in Japan), instances occur where output from some generation facilities is curtailed during periods of surplus electricity supply from VRE. Furthermore, when VRE power generation suddenly drops due to natural conditions, and if the thermal power plants serving as backup experience unplanned outages, instances of tight electricity supply and demand are also frequently observed.
- With the expansion of VRE certain to continue into the future, it is essential to build a power system capable of responding to VRE fluctuations. This requires not only accurate forecasting of VRE power generation but also flexible operation of power generation facilities, the introduction of storage batteries and grid enhancement.

Volume of VRE deployment and integration costs

- As a cost assessment for the energy transition era premised on the expansion of VRE, analysis focusing on the overall costs of the energy (particularly electricity) system is gaining attention. This analysis considers the costs required for grid integration to accommodate the supply fluctuations of VRE (integration costs).
- In analysing integration costs, emphasis is placed on comprehensively and holistically assessing the expenses required for introducing the necessary technologies for the new energy transition. This is achieved by considering factors such as the costs of introducing new equipment like storage batteries and grid upgrades, as well as the costs associated with flexible facility operation (such as maintaining and operating thermal power plants as backup).
- As an example of analysis concerning integrated costs in Japan, the Agency for Natural Resources and Energy's Working Group on Power Generation Cost Verification has conducted a factor decomposition of the difference between the levelised cost of electricity (LCOE) and the levelised cost of electricity adjusted for some integrated costs (LCOE*). This analysis indicates that charging and discharging losses and the impact of output curtailment

are significant factors. Furthermore, the analysis of the energy mix (power generation mix) for fiscal year 2040 within the Seventh Strategic Energy Plan also incorporates considerations of integrated costs.

Changes in system costs according to VRE deployment levels (ASEAN analysis example)

- IEEJ Outlook 2026 analysed the deployment volume and integration costs of VRE up to 2060 for ASEAN, as an analysis considering integration costs.
- This analysis indicates that for ASEAN, the VRE share minimising energy system costs will be approximately 30% in 2060. Increasing VRE beyond this cost-minimising share leads to the replacement of conventional power generation sources such as thermal. This reduces the capital costs and fuel expenses associated with conventional power generation. Conversely, the costs associated with introducing VRE increase, alongside rising integration costs for measures such as battery storage. These additional costs exceed the savings from conventional power generation, resulting in an overall increase in total costs.
- In ASEAN, if the share of VRE in electricity generated reaches approximately 80%, this would result in cumulative additional costs of around $1.3 trillion between 2030 and 2060, compared to the cost-minimising share of approximately 30%.
- Regarding the promotion of energy transition towards decarbonisation in ASEAN, strengthening national efforts alongside collaboration and cooperation at the ASEAN level is essential. On the other hand, concerning enhanced measures through the expansion of VRE, it is necessary to note that additional costs may vary significantly between countries. This stems from differences in geographical and natural conditions, as well as the state of infrastructure development, meaning the scope for additional VRE varies considerably across ASEAN countries.
- Furthermore, the capacity to bear additional costs varies depending on economic circumstances and national scale. To further utilise VRE, transnational cooperation is essential, alongside diverse decarbonisation pathways tailored to each country's specific circumstances.

The importance of climate change targets and adaptation grounded in reality

Recent developments concerning the 1.5°C target

- The Paris Agreement (2015) stipulates the global temperature rise mitigation target as well below 2°C and to pursue efforts to limit the increase to 1.5°C. Subsequently, driven by successive net-zero declarations from major nations around 2020, the pursuit of the 1.5°C target and the associated goal of net-zero greenhouse gas (GHG) emissions became the global trend. However, in reality, global GHG emissions continue to rise, making the prospects for achieving the 1.5°C target increasingly challenging. Against this backdrop, new realities illustrating the difficulty of realising the 1.5°C target are becoming apparent worldwide.
- For example, the Group of Seven (G7) excluding Japan and the European Union (EU) are currently exceeding the emissions pathway required to achieve net zero by 2050 from current levels. Furthermore, Canada's new 2035 Nationally Determined Contribution (NDC) target exceeds the emissions pathway required to achieve net zero by 2050 from current levels.

- Coal-fired power generation trends in China and India also merit attention. In China, final investment decisions (FID) were made for 100 GW of new coal-fired power plants in 2024 alone. This represents the largest scale in the past decade. Meanwhile, coal-fired power plant decommissioning over the past five years averaged just 4.7 GW annually. Similarly, India saw FIDs for 15 GW of new coal-fired power plants in 2024, again the largest scale in the past decade. The current reality presents a challenging situation for achieving net-zero GHG emissions.

Comparison of the Advanced Technologies Scenario and the 2°C target

- The remaining carbon budget[1] required to limit global temperature rise to 1.5°C with a 50% probability is rapidly diminishing with each year's emissions. Specifically, the Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report had estimated this budget at 500 $GtCO_2$ after 2020. However, the latest assessment by Indicators of Global Climate Change (IGCC) shows a significant reduction to 130 $GtCO_2$ after 2025. This figure represents less than four years' worth of current emissions. Under a simple calculation assuming linear emissions reductions, this implies the world would need to achieve net-zero by 2032. Given the latest remaining carbon budget assessment, the 1.5°C target can be considered effectively unattainable. Consequently, setting a 2°C target appears realistic as a goal consistent with the Paris Agreement. This does not necessarily signify a retreat but rather a return to the original objective of the Paris Agreement.
- The overall CO_2 emissions pathway estimated based on energy-related CO_2 emissions up to 2050 from the IEEJ Outlook 2026 Advanced Technologies Scenario achieves net zero in 2073. Furthermore, the cumulative emissions from 2025 onwards until net-zero is achieved would total 906 $GtCO_2$, a level comparable to the latest remaining carbon budget (1 050–1 110 $GtCO_2$) and sufficient to limit global temperature rise to 2°C with 50% probability. However, to meet the 2°C target with the highest possible probability, it remains crucial to explore and pursue reduction potentials exceeding those of the Advanced Technologies Scenario.

Adaptation

- Climate change countermeasures are broadly categorised into 'mitigation' and 'adaptation'. 'Mitigation' involves reducing GHG emissions and expanding sinks to prevent increased GHG emissions from exacerbating climate change. Adaptation, on the other hand, refers to the processes of adjustment and response to climate change and its impacts, aimed at reducing the effects and damage caused by climate change. The primary approach is to mitigate the impacts of climate change through mitigation; if this proves difficult, it becomes crucial to combine it with adaptation. With the 1.5°C target now effectively unattainable, the importance of adaptation will only continue to grow.
- However, according to the United Nations Environment Programme's "Adaptation Gap Report 2024", there is an 8 to 14-fold gap between the finances required for adaptation and the current level of finance provision. The adaptation finance gap is substantial, and closing this gap is a priority.
- Breaking down the climate finance provided and mobilised by advanced economies reveals that mitigation finance accounted for 72% of the total in 2016 and 60% in 2022. Meanwhile, the proportion allocated to adaptation has increased, rising from 17% in 2016 to 28% in 2022.

[1] The total amount of CO_2 emissions permitted globally going forward to achieve a target

Article 9, paragraph 4 of the Paris Agreement aims for a 'balance' between adaptation and mitigation finances, which can be understood as striving for a ratio close to one-to-one between adaptation and mitigation finances. However, the current situation remains far from balanced, necessitating efforts to achieve equilibrium between adaptation and mitigation finances.

- When examining the primary areas of adaptation in terms of finance requirements and modelled costs, the sectors with the highest finance needs are 'agriculture and fisheries', 'water and floods' and 'infrastructure, energy and settlement'. Other important sectors include 'coastal and marine resources', 'forests and ecosystems' and 'human health'. It is necessary to consider which areas of adaptation should be prioritised, considering both current and future needs.

The future of AI and energy demand

The relationship between AI and energy

- The close interrelationship between artificial intelligence (AI) and energy is attracting global attention. A symbolic example of this is the recent expansion in the use of generative AI and advances in digitalisation, which have led to a significant increase in data centres. Locally, this has raised future concerns that the pace of constructing power supply facilities may not keep up with the pace of building data centres.

- Meanwhile, AI is anticipated to deliver significant benefits within the energy demand sector. It holds the potential to fundamentally transform energy usage itself by enhancing productivity and enabling energy savings across industry, transport and buildings. Through demand forecasting, AI can guide optimal factory operations, thereby improve productivity and enhance ultimately the energy efficiency of facilities such as factories. In transport, autonomous driving achieves energy savings through improved fuel efficiency via optimised vehicle spacing and route selection, alongside reduced travel distances. In buildings, energy savings are realised by optimising the operation of air conditioning and other systems while maintaining comfort levels. Thus, the future of AI and energy will be closely intertwined.

Data centre electricity demand and energy saving potential

- Global data centre electricity demand is projected to expand by a factor of 2.1, rising from 497 TWh in 2025 to 1 080 TWh in 2035 under the IEEJ Outlook 2026 Reference Scenario. Data volumes over the same period are expected to increase by a factor of 2.9, growing from 230 Zettabytes (ZB) in 2025 to 660 ZB in 2035. AI computation-related electricity consumption in data centres will drive this increase in electricity demand, with its share doubling from the current 14% to 30% by 2035. Meanwhile, the pace of growth in data centre electricity consumption, which averaged 17.5% annually between 2020 and 2024, will moderate slightly to 8.1% between 2025 and 2035.

- Global data centre electricity demand could potentially be saved by approximately 20% by 2035 compared to the Reference Scenario under the Advanced Technologies Scenario, indicating significant energy-saving potential. Contributing factors include improvements in power usage effectiveness (PUE) through the adoption of high-efficiency cooling technologies in new data centres (4.5% savings), efficiency enhancements in information and communication technology (ICT) equipment (14.2% savings), and computational efficiency gains (1.3% savings). How to achieve this represents a key challenge for the future.

- In any case, how to supply the increasing demand for electricity under the new information revolution in a stable manner and at competitive prices will become one of the most critical issues in the world's energy challenges.

AI-based energy savings potential in the demand side

- AI is expected to deliver significant energy savings through its application in the demand sector. This study estimated the additional energy-saving potential achievable beyond the Advanced Technologies Scenario through AI-driven optimisation. In the industry sector, an additional 2% to 6% energy-saving potential is projected for 2035 compared to the Advanced Technologies Scenario. In the short to medium term (2025–2035), the primary focus will be on retrofitting existing equipment with AI for optimisation and efficiency improvements. By sector, the greatest benefits are expected from non-energy-intensive industries, including machinery manufacturing, yielding 68 million tonnes of oil equivalent (Mtoe). This is followed by chemicals at 26 Mtoe and steel at 21 Mtoe.
- By 2035, the additional energy-saving potential from AI-enabled autonomous driving for passenger cars, buses and lorries will amount to 36.5 Mtoe. In Advanced Economies, the additional energy-saving potential from the Advanced Technologies Scenario is approximately 2.9%, while China's is 2.6%. Conversely, the adoption of autonomous driving in other Emerging and Developing Economies will not progress significantly; consequently, the additional energy-saving potential from the Advanced Technologies Scenario will be around 0.9% to 1.8%.
- The additional energy-saving potential for space cooling and heating, ventilation and lighting in the commercial sector in 2035 amounts to 8.8 Mtoe (102 TWh) compared to the Advanced Technologies Scenario. This is equivalent to reducing the electricity demand of data centres in 2035 by approximately 10%. The energy-saving potential of AI in Advanced Economies in 2035 is 4.3 Mtoe, while China's is 2.6 Mtoe.
- The additional energy-saving potential of AI-equipped space heating and cooling and water heating appliances in the residential sector is estimated at 1.5 Mtoe in Advanced Economies (a 2.3% reduction compared to the Advanced Technologies Scenario) and 0.9 Mtoe in Emerging and Developing Economies (a 1.5% reduction) by 2035.

Towards future expansion and adoption

- The utilisation of AI on the demand side holds significant energy-saving potential. However, various challenges exist in achieving its widespread adoption and realising these savings. The primary issues include a shortage of personnel capable of leveraging AI and insufficient awareness of its benefits. Furthermore, to realise AI's full potential, data standardisation and the establishment of input rules are necessary. Additionally, operational considerations such as ensuring cybersecurity are required during AI deployment.
- The energy-saving potential of data centres is significantly influenced by improvements in ICT efficiency. Consequently, alongside the traditional focus on enhancing cooling efficiency, measures and strategies aimed at improving the efficiency of ICT equipment are required. This necessitates additional metrics for evaluating data centre energy savings, such as ICT efficiency (beyond PUE). Furthermore, collaboration is vital not only by data centre operators but also with diverse stakeholders, including semiconductor manufacturers and IT-related equipment manufacturers.

Gasoline demand is price-inelastic

Both the temporary impact of price rises and the muted response of falls soon converge towards equilibrium

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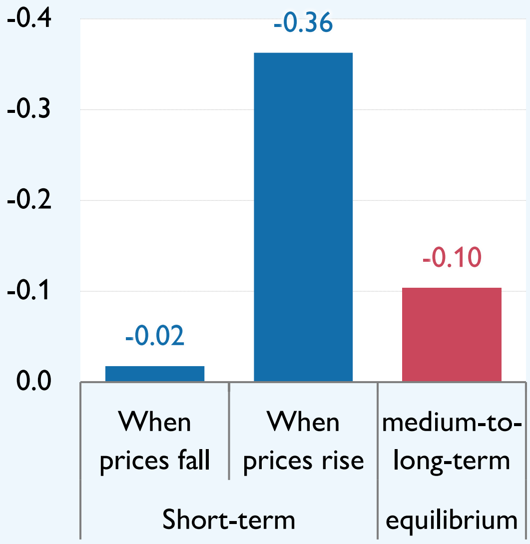
Summary

Amid persistently high gasoline prices in Japan, six ruling and opposition parties have agreed to abolish the provisional gasoline tax rate within 2025, intensifying the debate. The abolition of the provisional tax rate, which accounts for around 15% of the retail prices of regular gasoline, will have a significant impact.

The impact of price changes on demand is often examined through the price elasticity coefficient—the percentage change in demand resulting from a 1% change in the prices. Energy, possessing a strong character as a necessity, is considered inelastic with respect to price, and the absolute value of its price elasticity coefficient is small. The price elasticity of demand for gasoline, estimated based on the orthodox Koyck lag model, shows a short-term elasticity of −0.08 and a long-term elasticity of −0.10.

To escape the implicit constraint that demand in long-term is more price elastic than in short-term and considering the time-series characteristics of the target data, gasoline demand was formulated as an error correction model. The price elasticity coefficient obtained for the medium-to-long-term equilibrium state using this calculation method is −0.10, which is almost identical to the long-term elasticity coefficient derived from the orthodox calculation method. However, the short-term price elasticity coefficients differ significantly: when prices fall, the elasticity is only −0.02, whereas when prices rise, it reaches −0.36 (Figure 1). That is, even when gasoline becomes cheaper, there is scarcely any immediate upward impact in demand; conversely, price rises induce a certain degree of conservation behaviour. However, whether prices rise or fall, consumers' short-term behaviour patterns do not persist; equilibrium is restored before long.

Figure 1 | Price elasticity coefficients of demand for gasoline



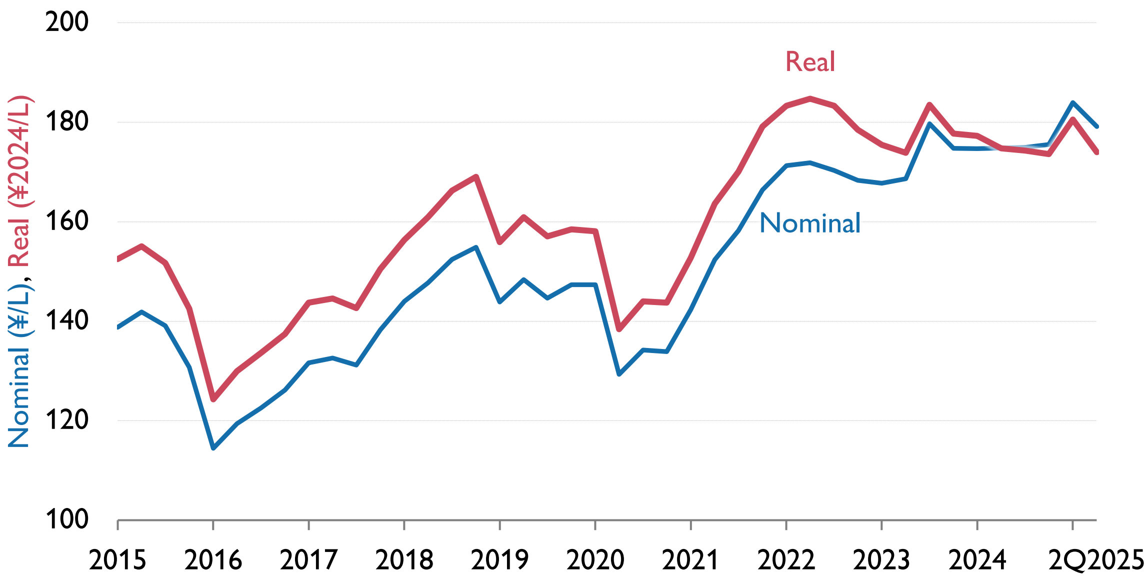
As indicated by the price elasticity coefficient in the medium-to-long-term equilibrium, demand for gasoline is considerably inelastic with respect to the price. Nevertheless, the subsidy (averaging ¥19.5/L) that has continued since 2022 is estimated to have increased gasoline demand, and consequently carbon dioxide emissions from its combustion, by 1.1%. Considering measures to offset this upward impact, the side effects of price intervention are far greater than perceived. Should the provisional tax rate of ¥25.1/L on gasoline be abolished entirely, the impact would exceed that of the subsidy. Unless we carefully consider not only immediate concerns but also the greater burdens that lie ahead, matters may well become increasingly difficult.

Keywords: gasoline, price elasticity coefficient, carbon dioxide emissions

Persistently high gasoline prices and mounting debate

Gasoline prices in Japan remain high (Figure 2). Whilst the real prices of regular[1] gasoline adjusted for general prices have fallen slightly compared to 2023, the nominal prices—the figures displayed at service stations—remain near record highs.

Figure 2 | Regular gasoline retail prices



Note: Real prices are deflated using the gross domestic product deflator.
Sources: Calculated from the Ministry of Economy, Trade and Industry 'Petroleum Product Price Survey' and the Cabinet Office 'National Accounts'

Under these circumstances, following the results of the 27th House of Councillors election in July 2025, six ruling and opposition parties agreed to abolish the 'provisional tax rate'[2] on gasoline taxes (gasoline tax and local gasoline tax) within 2025, intensifying discussions that had begun before the election. While the impact depends on the balance with the subsidies provided for major fuel oils, the complete abolition of the provisional tax rate, which accounts for approximately 15% of the retail prices of gasoline, would have a significant effect (Figure 3).

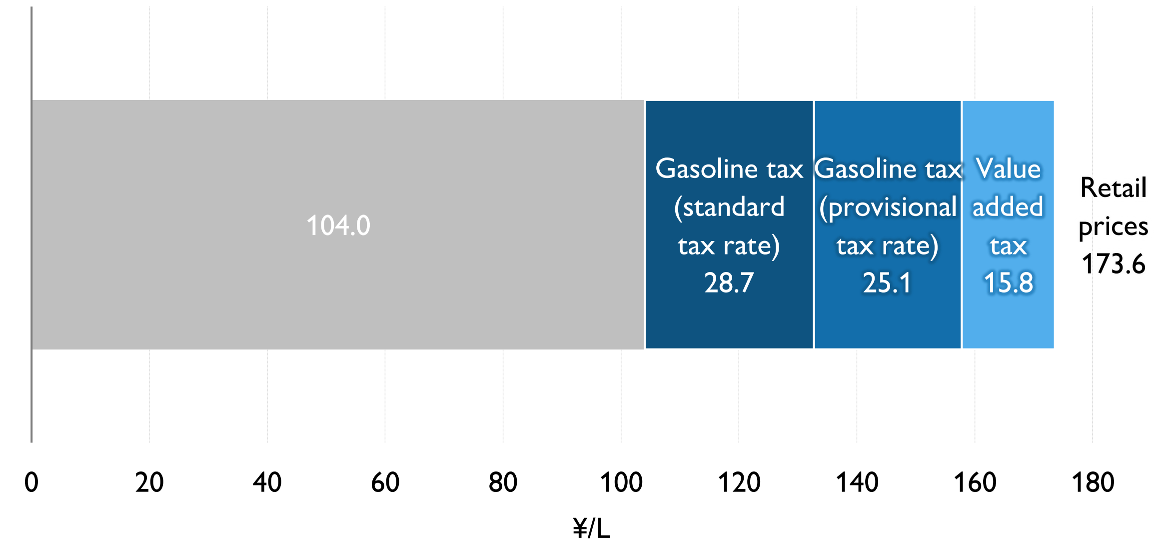
Should high gasoline prices ease, benefits for motorists—whether households or businesses—are certain to be felt. On the fiscal front, however, the challenge lies in how to compensate for the estimated ¥1 trillion reduction in tax revenue, with ruling and opposition parties divided on the issue. Furthermore, it must be noted that concerns exist that the government artificially lowering the prices through the abolition of the provisional tax rate, which has been in place for half a century, (or the subsidy) could generate undesirable announcement effects regarding climate change and resource conservation. Moreover, as a direct consequence, stimulating gasoline demand through price reductions will inevitably lead to an increase in carbon dioxide emissions associated with its combustion.

To what extent, then, do changes in gasoline prices affect the demand?

[1] The same shall apply hereinafter.

[2] The amount increased from the standard tax rate stipulated by the Gasoline Tax Act and the Local Gasoline Tax Act under the Special Taxation Measures Act: ¥25.1/L (¥24.3/L for Gasoline Tax, ¥0.8/L for Local Gasoline Tax)

Figure 3 | Cost structure of retail gasoline prices [July 2025]



Sources: Calculated from the Ministry of Economy, Trade and Industry 'Petroleum Product Price Survey'

Under orthodox valuation method, a 1% change in gasoline prices leads to a 0.1% change in demand over the long term

The impact of price changes on demand is often examined through the price elasticity coefficient—the percentage change in demand quantity in response to a 1% change in the prices. For necessities, it is difficult to curb demand sufficiently to offset or substantially mitigate the impact of increased payments resulting from the price rises. Consequently, necessities typically exhibit a low absolute value for price elasticity coefficient (being inelastic), meaning consumers perceive a significant burden from price increases. Furthermore, energy sources such as gasoline generally possess strong characteristics of necessities and are therefore considered inelastic to the prices—hence they are also regarded as excellent targets for taxation.

The orthodox method for calculating (constant) price elasticity efficient involves regression analysis using the natural logarithm of demand quantity as the dependent variable, alongside the natural logarithm of price, the natural logarithm of the dependent variable from the previous period (the Koyck lag), and other relevant indicators as independent variables. That is,

$$\ln \mathit{Demand} = \beta_0 + \beta_p \ln \mathit{Price} + \cdots + \beta_1 \ln \mathit{Demand}_{-1} + \mathit{Error}$$

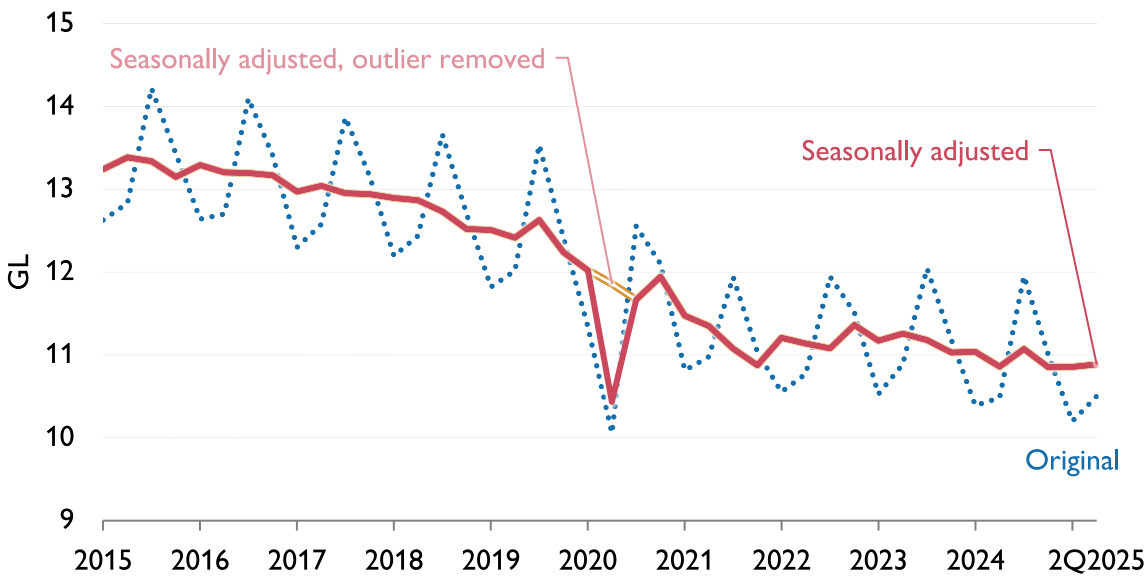
where the price elasticity coefficients are obtained from actual data. Specifically, β_p is the short-term price elasticity, representing the degree of impact on demand during the period when the prices changed. $\beta_p / (1-\beta_1)$ is the long-term price elasticity, representing the ultimate degree of impact on demand if the changed prices were to be maintained[3].

This chapter shall follow this approach. We used domestic gasoline sales (Ministry of Economy, Trade and Industry 'Resource and Energy Statistics') as demand volume, and realised retail gasoline prices (Ministry of Economy, Trade and Industry 'Petroleum Product Price Survey') deflated by the gross domestic product (GDP) deflator (Cabinet Office 'National Accounts') as the price. Furthermore, other independent variables included the average of real GDP (Cabinet Office 'National Accounts') for the current and previous periods, and a time trend adopted as a proxy variable for the effects of trend changes such as regulatory fuel efficiency improvements, demographic shifts, and the progression of car-free lifestyles. The frequency was set to quarterly due to data constraints and seasonally adjusted series were used

[3] $|\beta_1|$ must be less than 1.

for gasoline demand, GDP, and GDP deflator[4] (Figure 4). The target period was approximately 10 years, from the first quarter of 2015 (1Q2015) to the current 2Q2025.

Figure 4 | Domestic gasoline sales



Source: Calculated from the Ministry of Economy, Trade and Industry 'Resource and Energy Statistics'

The estimated equation is as follows, with the *t*-value in brackets:

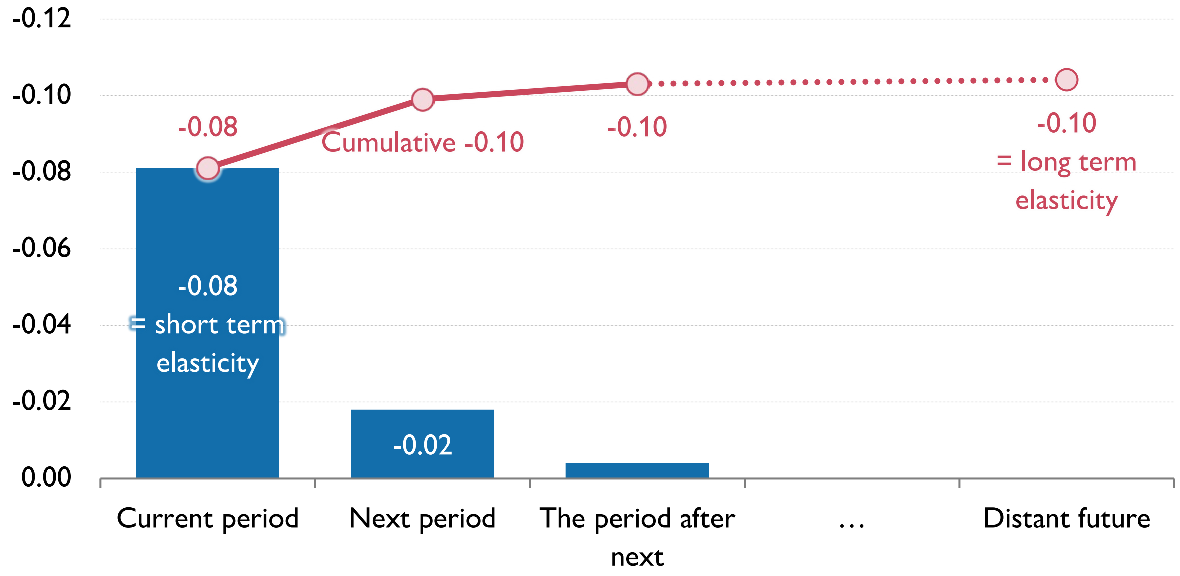
$$\begin{aligned} \ln \mathit{Gasoline\ demand} = & -4.112 + 1.334 \times \ln ((\mathit{Real\ GDP} + \mathit{Real\ GDP}_{-1})/2) \\ & \quad (-1.83) \quad (5.24) \\ & -0.08116 \times \ln \mathit{Real\ retail\ gasoline\ price} - 0.005062 \times \mathit{Time\ trend} \\ & \quad (-2.76) \qquad\qquad\qquad\qquad (-5.88) \\ & +0.2209 \times \ln \mathit{Gasoline\ demand}_{-1}. \qquad \text{(Equation 1)} \\ & \quad (1.70) \\ R^2 = & \ 0.982,\ 1Q2015\text{–}2Q2025 \end{aligned}$$

The resulting price elasticity coefficients of demand for gasoline are −0.08 for the short term and −0.10[5] for the long term (Figure 5). That is, a 10% reduction in real retail gasoline prices increases gasoline demand by 0.8% in the current period and by 1.0% in the distant future—though it approaches that level considerably in the following period.

[4] During the second quarter of 2020 (2Q2020), as part of measures to prevent the spread of COVID-19, strong encouragement was given to curb people's movement, specifically to refrain from non-essential and non-urgent outings. Economic and social activities faced extremely severe constraints, and the resulting sharp decline in passenger transport significantly depressed gasoline demand in particular. Whilst it would have been possible to handle such a 2Q2020 period using a dummy variable in regression analysis—effectively excluding the data from estimation—, the approach adopted was to correct for the outlier, considering the analysis using residuals described later. Specifically, the effect of the additive outlier (AO2020.2) detected during the seasonal adjustment process using the US Census Bureau's X-13ARIMA-SEATS Seasonal Adjustment Program was removed from the seasonally adjusted series. This measure was applied to gasoline demand, real GDP and nominal GDP.

[5] = −0.08116 ÷ (1 − 0.2209)

Figure 5 | Price elasticity coefficients of demand for gasoline estimated using orthodox calculation method



Note: Estimated using a model incorporating the Koyck lag as an independent variable

Price effects—delving into the relationship between short-term and long-term

Is the long term always more elastic than the short term?

The short-term price elasticity of demand for gasoline being merely −0.08 may strike supply-side stakeholders as an underestimate. One factor contributing to this discrepancy with perceived reality could be whether the focus is on nationwide demand or on one's own sales volume, which is also influenced by competition with rival outlets and companies.

However, simultaneously, one may also cite the potential for bias stemming from the formulation in regression analysis. Employing a Koyck lag model, a type of distributed lag model, implicitly assumes that the cumulative impact of prices increases over time as the sum of a geometric series, as depicted in Figure 5[6]. However, in reality, this pattern may be a reasonable approximation in some cases, but not in others. Therefore, this chapter will estimate short-term price elasticity independently of their medium-to-long-term counterparts.

The simplest method for this purpose is to adopt not only price in the current period but also lagged prices as independent variables, whilst omitting the Koyck lag. The estimation results when adopting the previous period's real retail gasoline prices are as follows[7]:

[6] Assume that the coefficient β_1 of the Koyck lag term is positive.

[7] By not using a distributed lag model, multicollinearity and insufficient degrees of freedom may exert a non-negligible influence in some cases. Fortunately, however, the variance inflation factor (VIF) in Equation 2, at a maximum of 6.3, suggests multicollinearity but does not appear to be severe.

$$\ln \mathit{Gasoline\ demand} = \underset{(-2.35)}{-5.396} \underset{(9.68)}{+1.685} \times \ln((\mathit{Real\ GDP} + \mathit{Real\ GDP}_{-1})/2)$$
$$\underset{(-3.69)}{-0.1507} \times \ln \mathit{Real\ retail\ gasoline\ price}$$
$$\underset{(1.52)}{+0.05373} \times \ln \mathit{Real\ retail\ gasoline\ price}_{-1}$$
$$\underset{(-26.9)}{-0.006500} \times \mathit{Time\ trend}. \qquad \text{(Equation 2)}$$
$R^2 = 0.981$, 1Q2015–2Q2025

In this case, while the short-term price elasticity is −0.15, the long-term price elasticity is −0.10[8], being less elastic than the short term due to a rebound effect occurring in the subsequent period. When prices rise, consumers may react excessively, causing demand to initially fall; however, demand subsequently recovers as consumers gradually adapt—though, of course, it does not return to its original level. The combination of short-term and long-term price elasticities described above can be interpreted as representing this pattern of demand.

More accurate estimates—error correction model

Although not previously mentioned, the natural logarithms of gasoline demand, real GDP and real gasoline retail prices each represent first-order integrated processes. Simultaneously, they are estimated to be in a cointegration relationship[9]. Consequently, Equation 3 linking them can be interpreted as representing a medium-to-long-term equilibrium relationship. The coefficient for real gasoline retail price indicates that the price elasticity in the equilibrium state—that is, over the medium to long term—is −0.10. This value is almost identical to the long-term price elasticity derived from the Koyck lag model in the previous chapter.

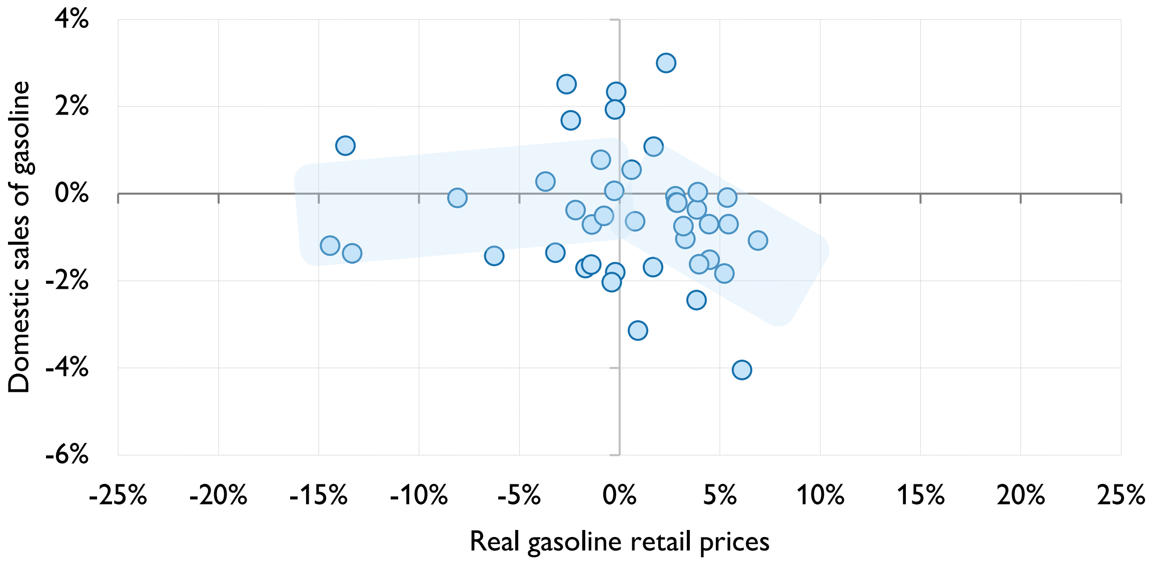
$$\ln \mathit{Gasoline\ demand} = \underset{(-1.97)}{-4.499} \underset{(9.43)}{+1.653} \times \ln((\mathit{Real\ GDP} + \mathit{Real\ GDP}_{-1})/2)$$
$$\underset{(-3.86)}{-0.1037} \times \ln \mathit{Real\ gasoline\ retail\ price}$$
$$\underset{(-26.5)}{-0.006466} \times \mathit{Time\ trend}. \qquad \text{(Equation 3)}$$
$R^2 = 0.980$, 1Q2015–2Q2025

If gasoline demand, real GDP and real gasoline retail prices are cointegrated, then their short-term relationship can be appropriately expressed using an error correction model comprising the respective differences in the previous period (Δ) and the previous period's residuals from Equation 3 as the error correction term. Moreover, as suggested by Figure 6, which plots the previous-period change in real gasoline retail prices and demand for gasoline in a straightforward manner, consumers' short-term behaviour patterns may differ when the prices rise and fall. Taking these factors into account, the formulation was adjusted, and regression analysis was performed.

[8] = −0.1507 + 0.05373

[9] By the Augmented Dickey-Fuller (ADF) test for each series and the residuals of Equation 3.

Figure 6 | Real gasoline prices and demand for gasoline



Note: Quarter-on-quarter, logarithmic change rates

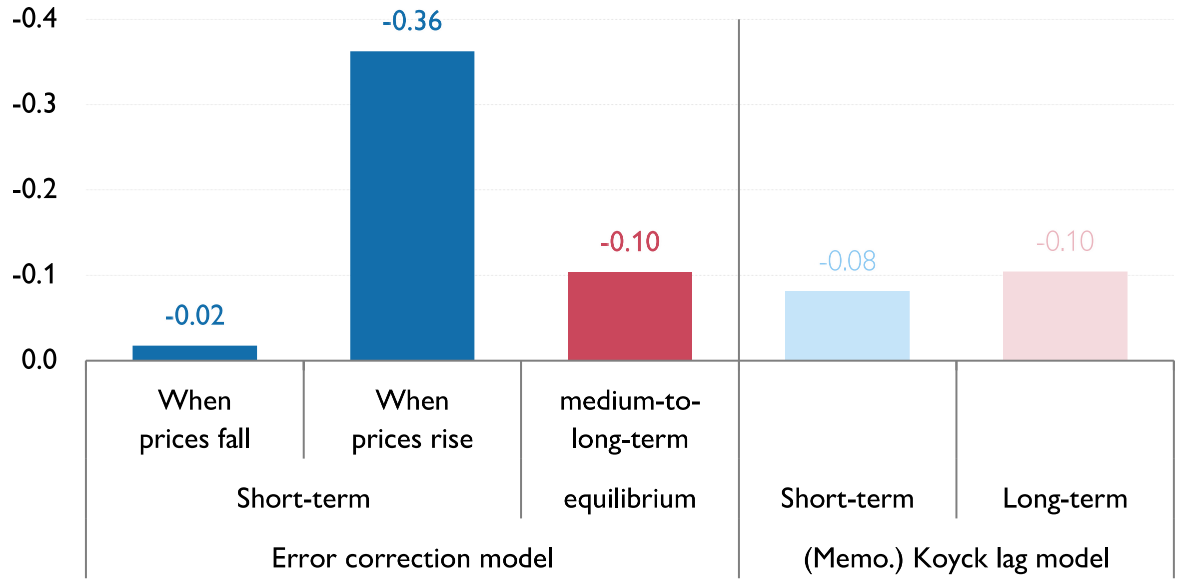
$$\Delta\ln \textit{Gasoline demand} = 1.157 \times \Delta\ln\left((\textit{Real GDP} + \textit{Real GDP}_{-1})/2\right)$$
(3.42)
$$-0.01757 \times \Delta\ln \textit{Real gasoline retail price}$$
(−0.42)
$$-0.3450 \times \textit{Price rise dummy} \times \Delta\ln \textit{Real gasoline retail price}$$
(−5.07)
$$-0.9124 \times \textit{Error correction term.} \qquad \text{(Equation 4)}$$
(−6.39)

$R^2 = 0.637$, 2Q2015-2Q2025

Equation 4 shows that the short-term price elasticity of demand for gasoline is only −0.02 when the prices fall, whereas it reaches −0.36[10] when the prices rise (Figure 7). Even when gasoline becomes cheaper, there is scarcely any immediate upward impact in demand, whereas price rises induce a certain degree of saving behaviour. However, in either case, these short-term behavioural patterns do not persist; demand eventually settles into the equilibrium state represented by Equation 3. The time taken to converge is not particularly long, as the coefficient of the error correction term is −0.91, which is quite close to −1.

[10] = −0.01757 + −0.3450

Figure 7 | Price elasticity coefficients of demand for gasoline



For reference, although the Koyck lag model estimated that price elasticity coefficients could differ when gasoline prices fall and rise, there was little difference between the two situations.

Can the side effects of the gasoline subsidy be ignored?

The subsidy scheme for gasoline and other fuel oils, established as a 'temporary, emergency measure to mitigate sudden price shocks and prevent soaring fuel oil prices from becoming a burden on the economic recovery from COVID-19', was launched in January 2022. Subsequently, the scheme has undergone multiple extensions and structural modifications, with the subsidy payments now continuing for over three and a half years. Much has been said about the significant fiscal burden this entails[11]. In contrast, quantitative discussion regarding the upward impact on gasoline demand resulting from price suppression via the subsidy has been scarce[12]. Therefore, this section evaluates the subsidy's impact using the price elasticity of demand for gasoline obtained in the previous chapter.

From 1Q2022 to 2Q2025, the average retail price of gasoline was ¥174.0/L, with subsidies amounting to ¥19.5/L. This indicates that the subsidy suppressed retail prices of gasoline by 10.1%[13]. Furthermore, the GDP deflator decreased by 0.2%[14], resulting in an estimated 9.9% suppression of real gasoline prices. In a medium-to-long-term equilibrium state, a 1% reduction in real gasoline prices boost demand by around 0.1%. Consequently, the subsidy is estimated to have increased gasoline demand, and consequently carbon dioxide emissions from its combustion, by 1.1%.

An increase in carbon dioxide emissions of just over 1% might be considered a negligible side effect. However, in a situation where reductions in carbon dioxide emissions through desirable measures such as the introduction of energy efficient technologies and the utilisation of low-carbon energy sources are not progressing as intended, it is hardly something to be welcomed.

Moreover, even seemingly minor upward impact upon first glance cannot be dismissed as insignificant when considering measures to offset them. In Japan, improving vehicle fuel efficiency is positioned as a key means to reduce carbon

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[11] The cumulative budget for support measures concerning fuel oil prices amounts to ¥8.1719 trillion (https://nenryo-teigakuhikisage.go.jp/assets/pdf/support_measures.pdf, accessed on 2 September 2025).

[12] Increased demand is generally considered favourable for many goods and services, but this is not typically the case for fossil fuels.

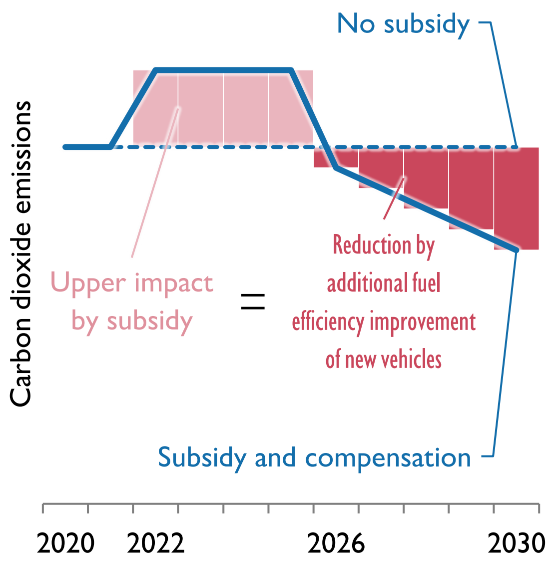
[13] The subsidy is assumed to be fully reflected in the retail prices.

[14] The impact of changes in gasoline prices on the prices of other goods and services is disregarded.

dioxide emissions from automobiles. Let us therefore consider offsetting the upward impact in carbon dioxide emissions caused by the subsidy through additional improvements in new vehicle fuel efficiency. Suppose the subsidy causes a 1.1% increase in carbon dioxide emissions over four years (2022–2025). Furthermore, suppose this cumulative increase is offset by 2030, in line with the earliest target under the Paris Agreement[15]. To achieve this, the fuel efficiency of new vehicles sold over the subsequent five years from 2026 would be further improved[16].

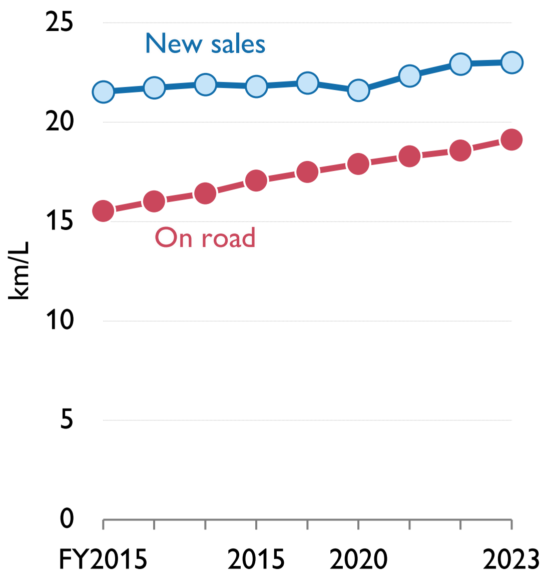
For the sake of simplification, each series determining gasoline demand (carbon dioxide emissions) is assumed to be in a steady state, excluding the impact of the subsidy and additional improvements in new car fuel efficiency (Figure 8). Assuming that vehicles aged between one and five years each account for 6% of the total fleet[17], the required additional improvement rate for new car fuel efficiency would reach 5.1%[18, 19]. In reality, gasoline demand (carbon dioxide emissions) exhibits a trend of gradual decline (Figure 4) due to factors such as regulatory improvements in vehicle fuel efficiency (Figure 9). To achieve the specified reduction target amidst a shrinking base, the required additional improvements in new vehicle fuel efficiency would need to be even greater than the value indicated above.

Figure 8 | Illustration of carbon dioxide emissions reduction through additional improvements in new vehicle fuel efficiency



Note: Additional improvements to new vehicle fuel efficiency shall be implemented such that the cumulative increase in carbon dioxide emissions attributable to the subsidy is offset by the cumulative reduction achieved through these improvements.

Figure 9 | Fuel efficiency of gasoline-fuelled passenger cars



Source: The Institute of Energy Economics, Japan 'EDMC Handbook of Japan's & World Energy & Economic Statistics'

15 The Nationally Determined Contributions (NDCs) under the Paris Agreement set reduction targets for greenhouse gas emissions by the FY2030. However, in terms of climate change mitigation, cumulative emissions are more significant than emissions in any specific year.

16 Measures to improve vehicle fuel efficiency (catalogue values) are difficult to implement for vehicles sold in the past. The possibility of implementing measures lies with newly sold vehicles. The available approaches are enhancing the performance of individual models and increasing the sales ratio of fuel-efficient vehicles. It should be noted that actual model changes for vehicles require a considerable amount of time.

17 Based on passenger cars (Japan Automobile Manufacturers Association 'The Japanese Automobile Industry').

18 $= (4 \times 1.1\%) \div (5 \times (5 + 1) \div 2 \times 6 - 4 \times 1.1\%)$

19 On the other hand, if this can be achieved, from 2031 onwards, the cumulative reduction in carbon dioxide emissions from the additional improvements in new vehicle fuel efficiency will yield a surplus exceeding the cumulative upward impact from the subsidy.

Gasoline demand is inelastic with respect to price, but…

Given gasoline's status as an essential goods, its demand is considerably inelastic to price. Nevertheless, the subsidy exerts a far greater influence than commonly perceived. Should the provisional tax rate of ¥25.1/L be abolished entirely, the resulting impact would surpass that of the subsidy (averaging ¥19.5/L). Unless we carefully consider not only immediate concerns but also the greater burdens that lie ahead, matters may well become increasingly difficult.

Expanding Import Share of US Crude Oil and LPG in Japan in FY2025

Ryo Eto *

1. Record High Middle East Dependency for Crude Oil Imports in FY2024

In FY2024, Japan's crude oil imports decreased by 8.51 million kL (5.9%) year-on-year to 136.29 million kL, falling below the level of FY2020 during the COVID-19 pandemic and reaching the lowest level since FY1967 (Figure 1). This decline can be attributed to factors such as improved fuel efficiency in automobiles, reduced ethylene production, and a decrease in domestic demand for petroleum products due to fuel switching to gas and electricity.

Despite the decrease in overall crude oil imports, the dependency on the Middle East increased to 95.9% in FY2024, the highest level since FY1965 when comparable statistics became available. The Middle East dependency had once decreased to 82.5% in FY2015, the lowest since FY1996, due to the highest import share from Sakhalin and Eastern Siberia in Russia. However, in FY2016, China expanded the eligibility for crude oil import licenses to smaller refineries, leading to increased imports from Russia. This, in turn, reduced Japan's imports from Russia and increased the Middle East dependency. Furthermore, in FY2020, the easing of supply and demand caused by the COVID-19 pandemic led to a prioritization of importing cheaper Middle Eastern crude oil, resulting in the Middle East dependency exceeding 90% for the first time since FY1968. In FY2022, the reduction of imports from Russia due to sanctions following the invasion of Ukraine further increased the Middle East dependency to 95.2%. While imports from the US increased in FY2023, they decreased in FY2024, causing the Middle East dependency to surpass the FY2022 level.

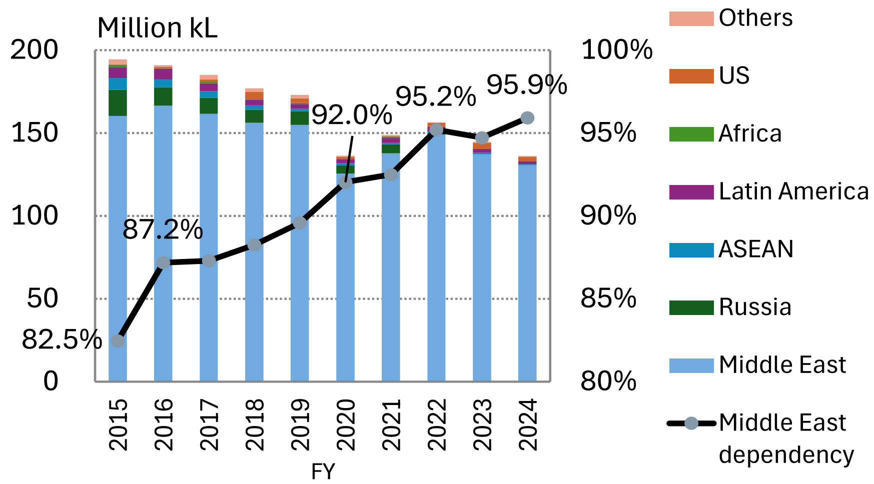


Figure 1: Volume of Japan's crude oil imports and Middle East dependency

Source: Ministry of Economy, Trade and Industry, "Yearbook of Mineral Resources and Petroleum Products Statistics"

* Senior Economist, Energy and Economic Analysis Group (EEA), Energy Data and Modelling Center (EDMC), IEEJ

2. Surge in Imports from the US in FY2025

However, the Middle East dependency has been declining since the beginning of FY2025 (Figure 2). From April to November, imports from the US have increased, resulting in the Middle East dependency of 93.0%, the lowest level for the same period since FY2020. Saudi Arabia experienced the largest decrease in volume, while Kuwait experienced the largest percentage decrease (Figure 3).

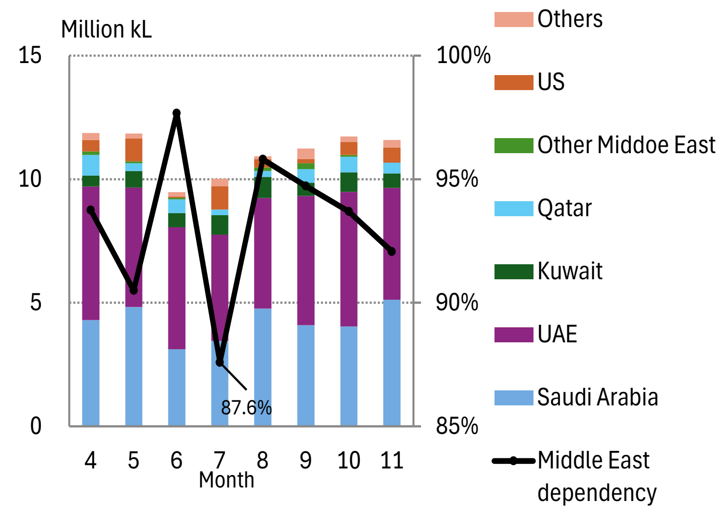


Figure 2: Japan's monthly crude oil imports and Middle East dependency from April to November 2025

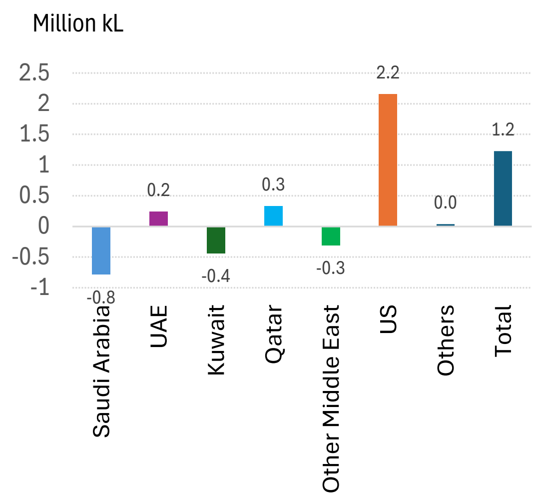


Figure 3: Japan's monthly crude oil imports and Middle East dependency from April to November 2025

Source: Ministry of Economy, Trade and Industry, "Monthly Report of Mineral Resources and Petroleum Products Statistics"

The increase in Japan's imports of US crude oil is indirectly influenced by the intensified US-China trade friction. The US has exported crude oil to China every month since March 2020, with the exception of August 2024 (Figure 4). However, due to China's retaliatory measures against Trump's tariffs in February 2025 (an additional 10% tariff on crude oil), US crude oil exports to China plummeted to zero in March 2025. This resulted in a surplus of US crude oil, leading the US to increase exports to Asian countries other than China, including Japan. Exports to Japan reached a record high in March 2025, and increased year-on-year in May, July, and August.

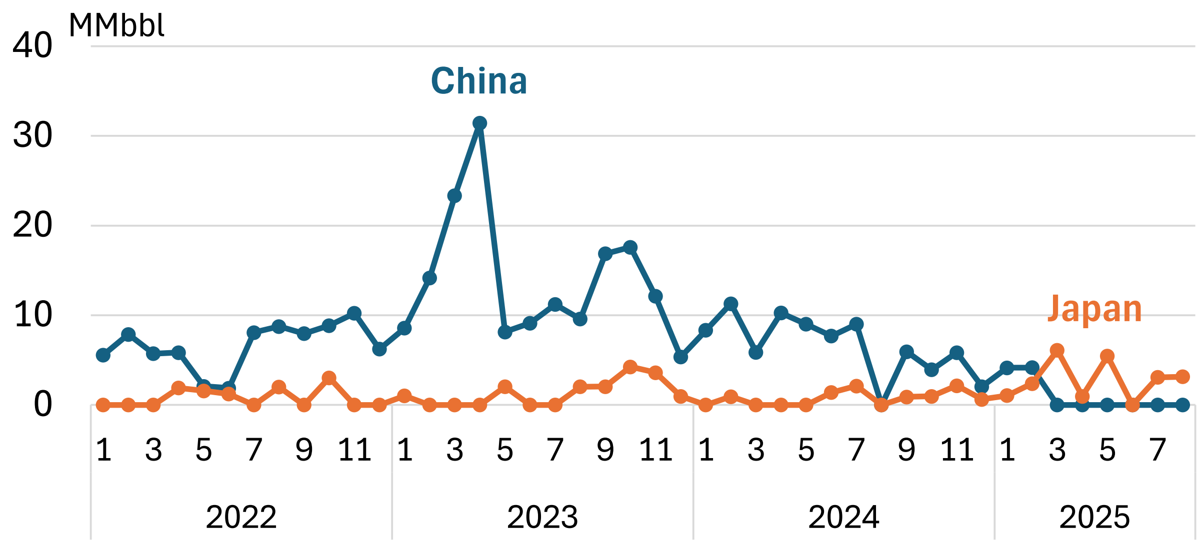


Figure 4: US crude oil exports to China and Japan

Source: EIA

However, replacing all crude oil with US crude oil is not feasible for Japan. Transportation from the US to Japan involves longer distances, resulting in longer lead times and higher freight costs. Furthermore, there are limitations in maritime transport through the Panama Canal. Additionally, Japanese refineries are often designed based on heavier Middle Eastern crude oil, with desulfurization and cracking units optimized for sulfur content and specific gravity. While US shale-derived light sweet crude oil yields higher proportions of gasoline and naphtha, it may not be optimally utilized in units designed for heavier oil. Indeed, the increased import volume from Qatar compared to the same period last year is due to increased imports of heavy Al-Shaheen crude oil (Figure 3).

3. Lowest Middle East ratio for Japan's LPG imports since FY1965 in FY2024

In FY2024, LPG imports increased by 0.4% year-on-year to 10.38 million tons, accounting for 81.8% of domestic sales (Figure 5). The Middle East ratio decreased by 1.4 percentage points to 3.6%, the lowest level since FY1965.

The Middle East ratio for LPG was 93.5% in FY2010, exceeding even that of crude oil. However, since FY2012, the expansion of imports from the US has led to a decline in the Middle East ratio. This is because LPG production in the US has increased as a byproduct of shale gas production. Moreover, LPG had relatively fewer obstacles to export, unlike crude oil, which was subject to a general export ban, and LNG, which lacked adequate export infrastructure.

Furthermore, LPG production in Australia increased as a byproduct of increased natural gas production, leading to increased imports from Australia since FY2017. In Canada, the development of shipping facilities on the Pacific coast in 2019 led to increased imports from Canada since FY2019. These factors have contributed to the continued decline in the Middle East ratio.

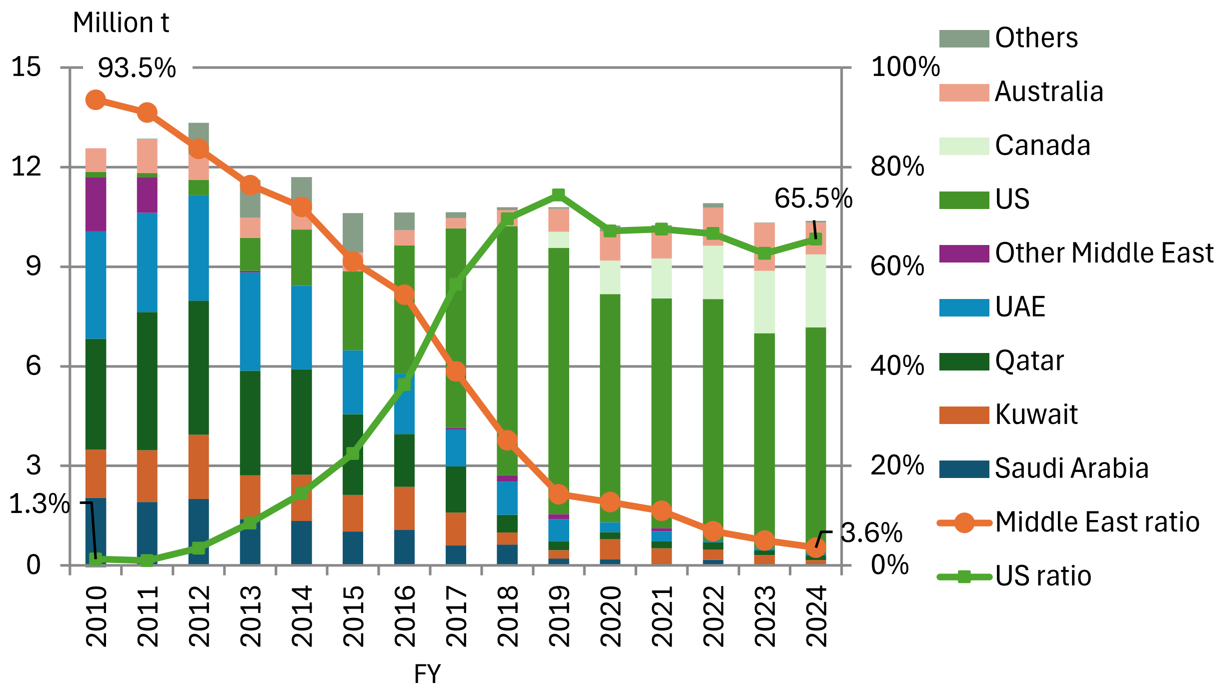


Figure 5: Volume of LPG Imports, Middle East Ratio, and US Ratio

Source: Ministry of Economy, Trade and Industry, "Yearbook of Mineral Resources and Petroleum Products Statistics"

4. Increased LPG imports from the US in FY2025

In FY2025, the US ratio has been rapidly increasing, partly due to decreased imports from Canada (Figure 6). Especially since June, the US share has exceeded 90% for six consecutive months, reaching 100% in September and October, indicating an over-reliance on the US as the sole import source. Similar to crude oil, the US-China trade friction prompted China to include LPG in its retaliatory measures in April 2025, causing China to increase imports from sources other than the US. As a result, the demand for US LPG from China weakened, leading to a relative decrease in the price of US LPG and an increase in exports to Asian countries other than China, including Japan.

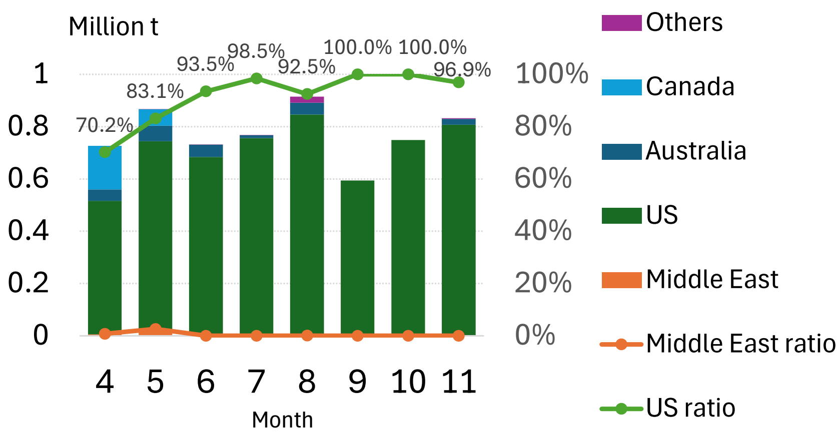


Figure 6: Monthly LPG Imports, Middle East Ratio, and US Ratio from April to November 2025

Source: Ministry of Economy, Trade and Industry, "Yearbook of Mineral Resources and Petroleum Products Statistics", Ministry of Finance, "Trade Statistics".

Note: Import volume for November 2025 is estimated from the country-specific import share of trade statistics.

5. Ensuring Stable Supply by Mitigating Geopolitical Risks

The potential risks to Japan's stable supply of crude oil are increasing. With the high level of reliance on the Middle East for crude oil, military tensions between Israel and Iran escalated in June 2025, raising concerns about the potential targeting of energy facilities and the possibility of Iran blockading the Strait of Hormuz. These events can trigger supply insecurity. Furthermore, the risk of piracy and other threats is rapidly increasing in the Strait of Malacca, raising concerns about navigational safety.

On the other hand, since FY2019, the US, Canada, and Australia have accounted for over 85% of the LPG import share, reducing the impact of potential geopolitical risks in the Middle East. While the US-China trade friction has a negative impact on the Japanese economy, US crude oil can be transported directly to Japan via the trans-Pacific route, contributing to the diversification of supply routes and risk mitigation. This may increase transportation costs, but it can improve supply stability. In the case of LPG, Japan has already benefited from the decline in prices due to the easing of US supply and demand, based on its experience in importing US products at a high rate and addressing handling challenges.

Moving forward, it is crucial to diversify supply networks, including the trans-Pacific route, to enable a quick response to unforeseen supply shortages. Furthermore, in anticipation of expanding imports of US light crude oil, it is necessary to address handling challenges by optimizing operating efficiency and product yields, as well as improving the flexibility of refinery processing capacity through modifications. By implementing these measures, it will be possible to further enhance the stability of crude oil supply.

Future Energy Landscape - Global Energy Agenda –

The significance of abolishing the provisional gasoline tax rate

: data reveals pain in the countryside

Junko Ogawa [*, **]

Both ruling and opposition parties are revving up over the abolition of the provisional tax rate on gasoline. On July 30, the Chair of the Diet Countermeasures Committee of the six ruling and opposition parties (the Liberal Democratic Party, Komeito, the Constitutional Democratic Party, Nippon Isshin, the National Democratic Party, and the Communist Party), signed an agreement to abolish the provisional gasoline tax rate by the end of the year. Working-level consultation also began on August 1 to consider points such as how to proceed with progressive subsidy increases, government revenue sources, and how to deal with local government finances. On the same day, the seven opposition parties (the Constitutional Democratic Party, Nippon Isshin, the National Democratic Party, the Communist Party, Sanseito, the Conservative Party of Japan, and the Social Democratic Party) submitted a bill to abolish the provisional gasoline tax rate from November 1.[1]

As summarized in my history of the provisional gasoline tax rate introduction and the debate about its abolition in a previous paper (December 2024) and in this magazine article (February 2025), it has continued to be levied since its imposition as an “emergency fiscal measure” in 1974. As of 2025, there is 53.8 yen in tax on a liter of gasoline, consisting of a statutory tax of 28.7 yen/L and a provisional tax of 25.1 yen/L. In this paper, the characteristics of gasoline taxes are outlined and consideration given to what the abolition of the provisional tax rate means, taking the impact on ordinary households as an example.

Firstly, an overview of the financial burden on households of gasoline by region. Fig. 1 shows the percentage of annual per capita consumer spending dedicated to gasoline by region. The bar graph is ordered from lowest annual per capita income to highest, with the trend line across it plotting the percentage of per capita consumer spending dedicated to gasoline. This line trends down from left to right as annual income rises, demonstrating that the bigger the city, the lighter the burden of gasoline spending.

Urban areas benefit from developed transit networks such as rail and bus, so selecting a means of transport other than a motor vehicle is simple. On the other hand, those in rural areas depend primarily on their own car to travel, and due to the distances covered, spending on gasoline is greater. Further, even within rural areas, households with higher incomes may buy cars with better fuel economy or have the ability to work from home,[2] further limiting their gasoline expenditures. By contrast, low-

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[**] This paper represents the personal views of the author, and does not necessarily represent the views of her place of work.

[1] The Act on Special Measures Concerning Taxation and the summary of the bill to partially amend the laws related to the Act on Temporary Special Measures of National Tax Related Acts for Victims of the Great East Japan Earthquake

[2] Ryota Mugiyama and Kyoko Komatsu, *Rising inequality in telework eligibility: evidence from before and after the COVID-19*

income households may not have the ability to buy a different car and face more difficulty in avoiding high gas prices due to long commutes, for example.[3]

Looking at the specific figures, Okinawa has the lowest average annual per capita income[4] at 1.84 million yen, but the highest average annual spending on gasoline at 4.2% per month for households. Shikoku incomes average 2.06 million yen, with gasoline taking up 3.7%, Kyushu at 2.06 million and 3.2%, followed by Tohoku at 2.09 million yen and 3.9%. Meanwhile, the big metropolitan areas of Kanto-Koshin, Tokai, and Kansai have higher average annual per capita incomes, especially Kanto-Koshin at 2.59 million yen, but with the lowest rate of gasoline spending at just 1.5%. Okinawa households bear roughly 2.8 times the burden of gasoline costs on their budget compared to those in the Tokyo metropolitan area. The burden per liter of gasoline may be uniform nationwide, but its "weight" is clearly very different depending on the region and household finances.

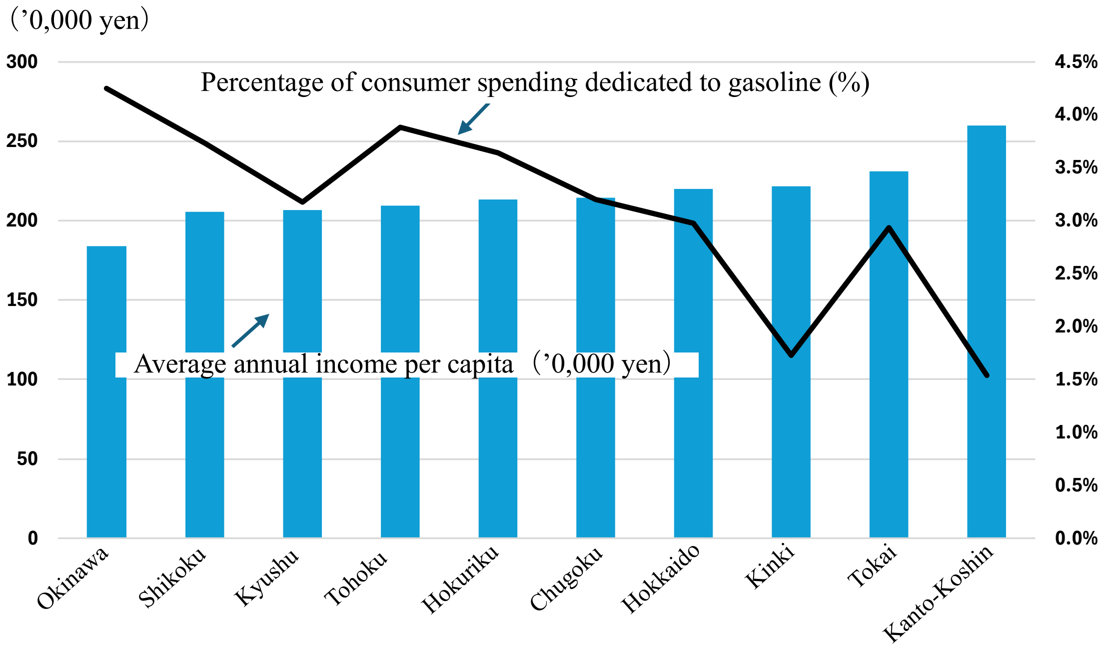

Fig. 1. Average per capita annual income by region and percentage of consumer spending dedicated to gasoline (2022)

Source: Estimated by the author from Family Income and Expenditure Survey, the Ministry of Internal Affairs and Communications, and the Survey on the Actual Conditions of Carbon Dioxide Emissions from the Residential Sector, the Ministry of the Environment

Note: The calculation of per capita annual income is arrived at by dividing the annual income per household of the region by the average number of people per household in the region. As such, the average income is lower than it would be if counting only working people, because non-working people (e.g., the elderly and children) are included in the figures.

outbreak in Japan. JILPT Discussion Paper Series 22-SJ-01, 2022

[3] Yuko Hoshino and Junko Ogawa, The impacts of energy price changes on household expenditure. 36th Energy Systems, Economy and Environment Conference, 2020

[4] Since the calculation of per capita annual income here includes unemployed individuals, it is lower than the average annual income of only employed individuals.

Fig. 2 shows the total per capita annual gasoline tax burden in each region (gasoline tax and the petroleum and coal tax). The highest tax total is paid by Tohoku at 16,500 yen per year, followed by Hokuriku and Shikoku at around 16,000 yen. This is more or less double the 8,000 yen paid in Kanto-Koshin and Kinki. Even if the tax rate is the same, more frequent car use means a widening differential in tax paid.

What this data shows is the danger of discussing what is "average" for Japan as a whole when it comes to gasoline tax. Averages on the same table conceal the different burdens of the urban office worker who fills up the car once a week and the office worker in a rural area who commutes 40km one-way to work. Living conditions such as per capita annual income, transport network density, and distance to workplace and shopping all differ by area. If these kinds of factors are ignored and the provisional gasoline tax rate is left in place, its regressive nature will only intensify.

When it comes to the abolition of the provisional gasoline tax rate, it is suggested that government revenues will be affected. The revenue raised by the provisional tax is in the order of 1 trillion yen. This is no trivial amount; therefore, the fiscal implications must be considered, a cost-benefit analysis conducted, and coordination with other expenditures planned. However, from the point of view of supporting life in the regions, there is much merit in considering the abolition of the provisional gasoline tax rate. Moreover, reducing a hidden factor in pricing would reduce logistics costs for regional economies, lower the hurdle for tourism promotion, and revitalize regional economies. The benefits may well end up rippling out to urban areas, too.

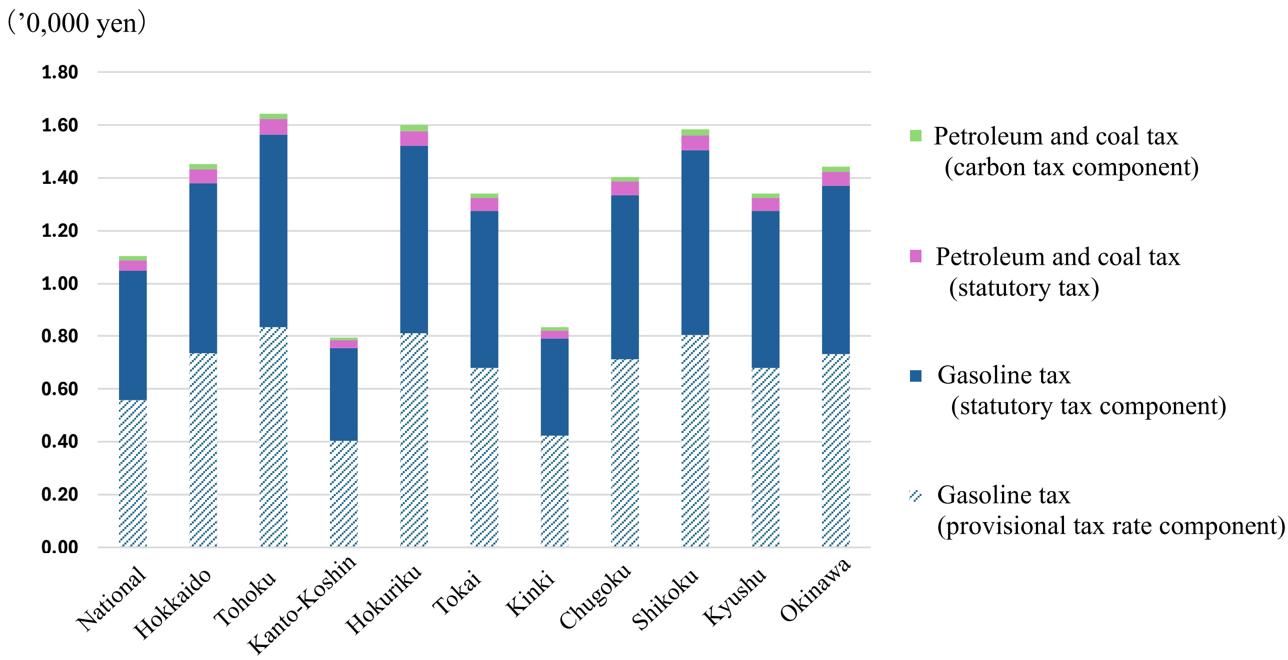

Fig. 2. Per capita annual gasoline tax burden by region (2022)

Source: Estimated by the author from Overview of automobile and energy-related taxes (national taxes), Ministry of Finance, and the Survey on the Actual Conditions of Carbon Dioxide Emissions from Residential Sector, Ministry of the Environment

Note: Gasoline tax includes local gasoline taxes. In Okinawa Prefecture, a measure reducing the provisional tax rate by 7,000 yen/KL is in place, based on the Act on Special Measures Incidental to Reversion of Okinawa. However, Okinawa Prefecture also levies its petroleum price adjustment tax of 1,500 yen/KL.

According to Fig. 2, while abolishing the provisional gasoline tax rate would bring a 4,000 yen saving per capita for the Tokyo region, the regions of Tohoku, Hokuriku, and Shikoku would reap a yearly tax reduction of 8,000 yen. This equates to an annual saving of 20,000-30,000 yen per household, so abolishing the provisional gasoline tax rate would likely bring a significant direct boost to the finances of rural and low-income households. If taxes on the fuels required for daily life place a heavy burden on the budgets of those who pay the taxes, the system was bound to face scrutiny at some point. Therefore, it is this writer's opinion that the termination of a 50-year "temporary measure" on this occasion is a first step towards correcting the imbalance in tax burden between urban and rural areas, and narrowing the inequitable cost-of-living gap between regions.

Future Energy Landscape - Global Energy Agenda –

The fate of local government wind turbines:

Considering the business feasibility of wind power generation

Tomoko Murakami *

At a consultative meeting of all town councilors in Tottori Prefecture's Hokuei Town on August 5, 2025, the councilors decided upon a plan[1] to transfer the Hojo Sand Dune Wind Farm, which is located in the town, to Enatex. The wind farm was constructed in 2005, and after the town council rejected the budget needed to apply for FIT certification, for a short time, there were plans to remove all the wind turbines.[2] However, in 2024, Enatex[3] approached the town saying it wanted to take on the wind farm, and after examining the company's income and expenditure plan and plan for maintaining and managing the facility, and plan for dismantling it in the future, the town arrived at this recent decision. Discussions and procedures towards the transfer are already underway in Hokuei Town, with a provisional agreement scheduled to be concluded at the beginning of 2026, and operations to commence from FY2026. However, it says there also remains a possibility that the transfer will not occur if the necessary procedures, conditions, and other elements are not in place by the end of FY2025.

The first peak in Japan's adoption of wind power generation occurred around the mid-2000s, when the Hojo Sand Dune Wind Farm was constructed. Prior to that, Japan's annual installed capacity had been sitting at around 100 MW a year, but from 2003 to 2010 it consistently exceeded 200 MW every year. The driving force behind the new uptake of wind power generation around this time was local government-led, publicly operated wind turbines. The RPS system that was launched in 2003 also provided momentum, and renewable energy sources such as solar and wind power were introduced in succession, particularly in municipalities without large-scale revenue sources.

20 years on from that, a variety of "winds" are blowing for these local government wind turbines. While there are examples of wind turbines being successfully transferred to the private sector, such as in Hokuei Town's case, there are also many examples where no entity could be found to take on the wind turbines, or where the wind turbines were removed before they could be transferred. Wind turbines that turn and wind turbines that do not turn—that fate is determined by their "business feasibility," and here I would like to consider that key phrase.

In 2020, Joetsu City in Niigata Prefecture decided to remove all four of its wind turbine generators within the city (Unit 1: 600 kW; Units 2 & 3: 750 kW x 2; Umiterasu Nadachi: 600 kW).[4] Work on

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[1] See https://www.e-hokuei.net/12582.htm; Hokuei Town, 5 August, 2025: Regarding the transfer of the Hojo Sand Dune Wind Farm,

[2] See https://www3.nhk.or.jp/lnews/tottori/20250805/4040021071.html; NHK, 5 August, 2025: Hokuei Town, Tottori – Town Mayor announces plan to transfer nine power generating wind turbines to company

[3] Enatex is a company headquartered in Kurayoshi City in Tottori Prefecture that undertakes electrical facility work and other projects. Recently it has also become involved in solar power generation facilities, energy conservation facility work, etc. https://www.enatex.co.jp/

[4] See https://www.joetsutj.com/articles/70762920; Joetsu Journal, 17 September, 2021: Removal of Joetsu City's "wind power

dismantling Units 1 to 3 was completed in 2021, while work on dismantling Umiterasu Nadachi was completed in 2023. Each of these turbines was installed from 2001 to 2003 in a park that city residents could enter as they wished, and they reportedly became a symbol that drove the local government's environmental governance. On the other hand, these turbines repeatedly underwent long-term shutdowns and repairs due to frequent damage caused by the lightning strikes that are a characteristic of the Sea of Japan in winter. In 2018, Joetsu City decided to cease the operation, saying, "The desired objectives have been achieved." From December 2019, the city put out a call for a private-sector operator to take on the wind turbine operation, but no such transfer was realized.

Prior research[5] reveals some deeply interesting analysis regarding what determines the fate of local government wind turbines. In 2017, the National Council of Municipalities for Promoting Wind Power Generation and the Japan Wind Power Association conducted a survey of local governments and asked whether or not they would replace their wind turbines, and the reasons for that decision. It is worth noting that at this time, the reasons the local governments cited for not being able to replace their turbines were not simply an inability to cope with the high costs or an inability to ensure their business feasibility at the present (FIT) purchase price. Alongside those reasons, the municipalities also noted that: "Wind conditions were poor to begin with, so we are unable to count on a capacity factor."

The goals behind local governments undertaking environmental-related operations (not limited to wind power operations) include using such operations to promote activities in their regions that raise awareness of renewable energy and to play a role in environmental and energy education, thus leaving behind a sustainable region for coming generations. Long-term business feasibility cannot be ignored either. Like other energy facilities, wind turbines do not end with their construction - they need to be maintained for several decades. However, setting aside that the first few years after operations commence will fall within the manufacturer's warranty, the locus of responsibility for turbine operation and maintenance following that is inadequate, and particularly in the case of wind turbines constructed by foreign manufacturers, it takes time and effort to procure replacement parts. The above-mentioned prior research calls a response such as this an "ad-hoc" response, and notes that "It is something that is seen frequently with local government wind turbines." Unlike large-scale operators that possess maintenance expertise, local governments do not have full-time maintenance personnel to begin with, and the fact that fundraising takes place every fiscal year also creates a bottleneck.

That being the case, the answer to the problem of wind power stations that local governments have run into problems maintaining would appear to be transferring the replacement, running, and all other aspects of these operations to specialist operators that possess the expertise. Where this solution runs aground, however, is one of the above-mentioned reasons that local governments cited for being unable to replace their turbines—namely, that "Wind conditions were poor to begin with." In establishing wind power turbines, it is expected that scrupulous business feasibility studies will be carried out, including examining the region's wind conditions, topography, and degree of

generation" begins Facilities approaching end of service life some 20 years after they were built

[5] See https://www.jstage.jst.go.jp/article/jweasympo/42/0/42_267/_pdf; Future of Local Government Wind Turbines, a lecture at the 42nd Wind Energy Symposium, November 27, 2020; Ideno et al (2022)

infrastructure development. Wind conditions do not change greatly over a period of 20 or so years, so for it to be said that "Wind conditions were poor to begin with" at a wind power station that has been running for over a decade must surely suggest, in other words, that the operation was embarked upon based on preliminary studies that were inadequate.

In Hokuei Town, which has succeeded in finding a private-sector operator to transfer its wind farm to, the actual operating data for every year since the project began operating in 2005 have been made public.[6] According to that data, the electricity sales achievement rate from 2005 to 2024 was 86.1%, and despite equipment malfunctions and other issues arising frequently, over a track record of almost 20 years, there was not a single instance of a long-term shutdown of over a month. It could surely therefore be described as a successful operation. Enatex, which proposed taking on the operation, no doubt concluded that Hokuei was an appropriate place to develop a business, while giving careful consideration to the wind conditions in the area and the operating track record.

On the other hand, when it comes to the wind turbines in Joetsu City, which were removed after efforts to transfer the operation failed to materialize, Unit 3 had an average annual capacity factor of around 7% in FY2019, prior to its operation being suspended.[7] In light of the fact also that ultimately the city was unable to find a company to hand over the operation to, it can be supposed that one reason a new operator could not be found was that even before considering the damage caused by the frequent lightning strikes, "Wind conditions were poor to begin with," so the operation held no appeal to private-sector operators in terms of its business feasibility.

20 years on from their installation, many local government wind turbines are standing at a crossroads, and the lesson they teach is the importance of "realistic, data-based preliminary studies." Undoubtedly, this is a lesson that can also be put to good use in new operations, including offshore wind power.

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[6] See https://www.e-hokuei.net/2382.htm; Hokuei Town, Hojo Sand Dune Wind Farm > Operating situation

[7] See https://www.city.joetsu.niigata.jp/soshiki/kankyo/sinnenerugi-.html; Koetsu City, Power generation situation for renewable energy

Future Energy Landscape - Global Energy Agenda –

Three Giants Leading the LNG Development in the United States

Hiroshi Hashimoto *

Introduction

In the LNG export industry in the United States, it has been quite evident in recent years that three LNG liquefaction and export infrastructure giants - Cheniere Energy, Sempra, and Venture Global, Inc. - have been emerging as dominant LNG exporters, carving out unique positions distinct from traditional international LNG majors.

The LNG export industry in the United States has, in less than a decade, transformed from an importer to the world's largest exporter, fundamentally reshaping the global LNG landscape. The paradigm shift has been driven by the new breed of agile, non-integrated players who have displaced traditional international behemoths. Their success is built on common strengths: low-cost, Henry Hub-indexed pricing; flexible, destination-free contracts; and a strategic location on the Gulf Coast.

The rise of the three giants has been a result of a combination of strategic advantages, specific business models, and a favourable market environment.

Individually, their paths have diverged: Cheniere pioneered the business model, Sempra leveraged a stable utility base to become a de-risked infrastructure player, and Venture Global disrupted the market with a modular, cost-effective construction strategy. These innovations are not without their challenges. The industry faces significant systemic risks, including the geographical concentration of infrastructure in the hurricane-prone Gulf region and a volatile domestic regulatory environment, exemplified by the 2024 pause on U.S. Department of Energy (DOE) permits (authorization to export to non-FTA [non-free trade agreement] countries).

Traditional players in the international LNG business (IOCs and NOCs) are not in retreat but are adapting, forging strategic partnerships, becoming long-term buyers, and reasserting their dominance through massive, low-cost projects like Qatar's North Field expansion. The coming years will be defined by a race to bring capacity to market, intensifying global competition, and the balancing act between domestic political pressures and the demands of international energy security.

The following questions naturally arise, regarding the LNG industry in the Inited States, focusing on the three giants, which are touched on the paper:

- ✓ What are major advantages of those three companies, including common strengths, as well as individual strengths, and disadvantages, if any?
- ✓ What are origins of those three LNG giants in the United States, as they have individually quite unique backgrounds to become the big players in the LNG industry?
- ✓ What did the three LNG giants in the United States achieve in the last couple of years and what challenges did they experience at the same time? What are future challenges ahead do they face for the next couple of years? What are potential pitfalls of those buyers who offtake LNG

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from their LNG projects?

- ✓ What are basic strategies (or tactics) of traditional international LNG players regarding business with the three giants in the United States?

1. Advantages of the Three Giants

1.1 Common Strengths

1.1.1 **Access to low-cost feedstock** natural gas allows them to offer LNG at a competitive price, often linked to the Henry Hub benchmark.

1.1.2 **Flexible commercial models** allow them to offer FOB (Free on Board) terms, where the buyer is responsible for shipping and can choose the destination of LNG.

1.1.3 **Strategic locations** on the U.S. Gulf Coast provide them with direct access to natural gas pipelines and access to both the Atlantic and Pacific basins, although concentration in a region may create some concern.

1.2 Individual Strengths

1.2.1 **Cheniere Energy** has a first-mover advantage and has one of the largest liquefaction platforms in the world with a diverse customer base. The company also has conducted proactive initiatives to better manage GHG emissions from its LNG value chain and to provide information.

1.2.2 **Sempra**'s LNG business is part of a broader strategy of infrastructure development, allowing it to leverage its existing assets and relationships.

1.2.3 **Venture Global** has an innovative, low-cost business model and rapid project execution, bringing new capacity online fast.

2. Origins of the Three Giants

2.1 **Cheniere Energy** was founded in 1996, previously focused on LNG imports. In the early 2010s the company started to transform itself into an LNG exporter.

2.2 **Sempra** was formed in 1998 from the merger of California utilities. Its LNG business is an extension of its energy infrastructure and utility-focused origins.

2.3 **Venture Global** was founded in 2013 by a team of energy professionals. The company pioneered the modular construction approach to build projects faster.

3. Recent Achievements and Some Challenges

3.1 **Cheniere Energy** has continued expanding its liquefaction capacity, achieving substantial completion on new trains at its Corpus Christi facility. Ontime and within budget expansion project implementation continues being important.

3.2 **Sempra** has made regulatory and commercial progress on its Port Arthur LNG project, securing financing and moving forward with construction.

3.3 **Venture Global** has demonstrated an "unprecedented" ability to bring new projects to market, achieving FIDs (final investment decisions) for multiple projects in a short period. The company has been embroiled in legal disputes with major customers over its delivery of commissioning cargoes.

4. Strategies of Traditional International LNG Players

Traditional international LNG players are not simply being "replaced" by the three giants but are adapting their strategies to the new market dynamics.

4.1 Many of these players have become long-term offtakers of U.S. LNG, diversifying supply portfolio and gain price stability.
4.2 Supply Portfolio expansions (by offtaking LNG in the United States) allow them to use the flexibility of U.S. LNG to their advantage, providing a flexible supply to their global customer base.
4.3 They sometimes acquire equity positions in LNG projects in the United States.
4.4 While they are active in the U.S. market, they continue to invest in traditional, large-scale LNG projects in other parts of the world, particularly in places like Qatar, Mozambique, and Australia, to maintain a diversified supply base.

Future Energy Landscape - Global Energy Agenda -

The energy consumption propensities of Generations Y and Z, who will lead the future

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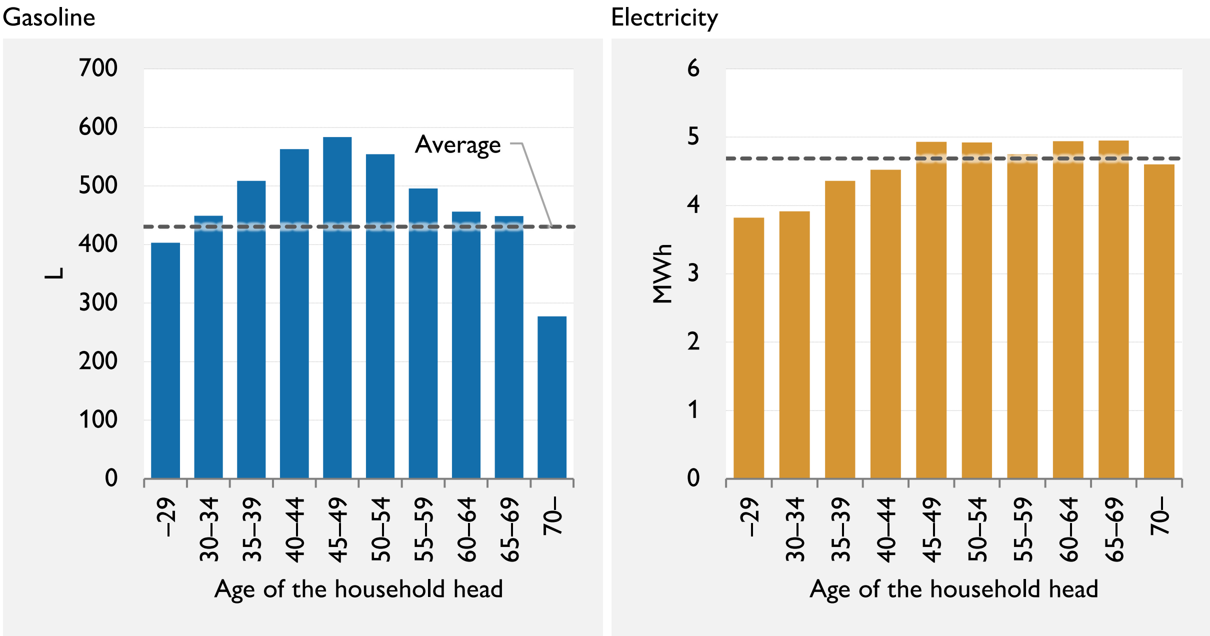
Generation Y (Millennials) and the subsequent Generation Z are considered to have a high level of concern regarding environmental and social issues. For example, households where the household head is aged 29 or under purchase less energy than many other groups (Figure 1). This appears to reflect the heightened awareness of climate change issues among these generations, as manifested in lower energy purchases (consumption).

Figure 1 | Household energy purchases [2024]



Note: Households with two or more persons
Source: Calculated from the Cabinet Office's "Family Income and Expenditure Survey"

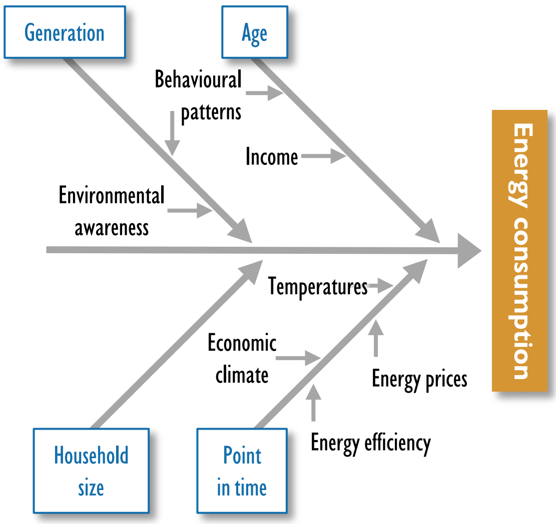
On the other hand, it is widely acknowledged that energy consumption among younger generations tends to be lower, not just today. This is influenced by factors such as household size (number of members), income, the number of appliances and vehicles owned, and time spent at home. Therefore, when considering why Generations Y and Z currently consume less energy than older generations, it is necessary to distinguish whether this is due to their present youth or to propensities specific to their generation (cohort).

Here, we assume that the energy consumption of households (with two or more members) headed by individuals in a given age group is determined by: 1/ the generation of the household head (year of birth), 2/ the age group of the household head at the time, 3/ the number of household members, and 4/ the point in time (Figure 2)[1]. Note that the

[1] Specifically, the energy consumption $E_{A,T}$ of households with a head in age group A at time T is assumed to be $\ln E_{A,T} = \beta + \sum_c \chi_c DumC_c + \sum_a \alpha_a DumA_a + \nu \ln N_{A,T} + \sum_t \tau_t DumT_t$. Here, $DumC_c$ denotes a dummy variable representing the household head's generation ($c = C$ for 1, $c \neq C$ for 0), $DumA_a$ denotes a dummy variable for the household head's age group, $N_{A,T}$ denotes household size, and $DumT_t$ denotes a dummy variable for the point in

manner in which factors 1/, 2/ and 3/ influence energy consumption remains consistent regardless of the point in time.

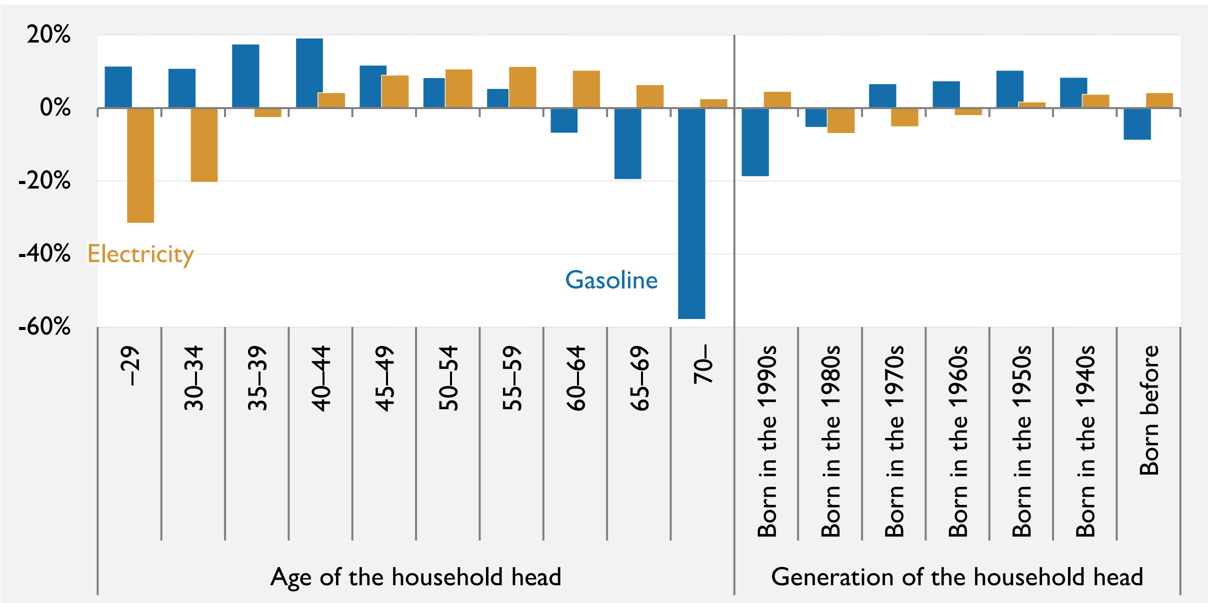
Figure 2 | Factors influencing household energy consumption



According to the results of the regression analysis, youth is a factor driving up gasoline consumption (Figure 3). This stems from a lifestyle and behaviour pattern involving frequent car use. Conversely, the generations born after the 1980s, particularly those born in the 1990s, exhibit a tendency to restrain consumption. In other words, the current low consumption levels among younger households reflect not their youth, but the distinctive propensity of these generations, also observed in their 'car avoidance'. Should their propensity remain unchanged, the generational turnover over time will significantly reduce Japan's gasoline consumption. Furthermore, the consumption restraint tendency among the generation born in the 1990s is more pronounced than among those born in the 1980s. If such a trend emerges across subsequent generations, consumption decline will accelerate further with generational turnover.

Electricity, however, differs structurally from gasoline. Youth—particularly being aged 29 or under and 30 to 34—is a significant factor suppressing consumption. On the other hand, the generation born in the 1990s lacks the consumption restraint exhibited by the preceding generations. Moreover, their propensity for high consumption is the most pronounced among all generations.

Figure 3 | Contribution to gasoline and electricity purchases



Notes: Difference from the average. The generation of the household head refers to, for example, those born in the 1980s being those born between 1981 and 1990.

time. The analysis utilised data from 2005, 2010, 2015, 2020 and 2024. Naturally, the number of observations for those born in the 1990s is small, and the results should be interpreted with a certain degree of caution.

Generations Y and Z are often described as being highly sensitive to social issues. However, at least concerning electricity, the major energy source for households, their awareness may not be matched by corresponding action. Further evidence exists: the percentage of respondents who answered that 'it is desirable that the situation be resolved without causing too much trouble, so I will wait and see for a while' to pollution, a local environmental problem, has increased across all age groups over the past 15 to 20 years, but most markedly among younger generations (NHK "Japanese public opinion survey"). The expectation placed upon the generations, who will be responsible for the future, to be 'environmentally conscious' may well be overstated.

Future Energy Landscape - Global Energy Agenda –

Will the decline and slowdown in CO2 emissions in China and India lead to a peak?

Takahiko Tagami *

A series of reports have been published showing that CO2 emissions in China and India have either declined or slowed in growth in the first half of 2025 compared to the same period last year. Have China and India peaked in their CO2 emissions, is this a persistent trend, or is it influenced by short-term factors such as weather?

According to the Carbon Monitor, an international initiative that provides scientific estimates of daily CO2 emissions, China's CO2 emissions decreased by 2.7% in the first half of 2025 compared to the same period last year. A breakdown of this figure shows that electricity and industry each contributed -1.4 percentage points. China's electricity generation increased 3.4% year-on-year in the first half of 2025, while coal-fired power generation decreased 3.3%. India's emissions decreased by 2.2%. A breakdown of this figure shows that electricity and residential contributed -2.0 percentage points and -1.5 percentage points, respectively, while industry contributed +1.2 percentage points. India's electricity generation increased by only 1.2%, largely due to the early arrival of the monsoon season in May and June, resulting in lower-than-average temperatures.

Meanwhile, according to the Finnish research institute Centre for Research on Energy and Clean Air (CREA), China's CO2 emissions fell 1% year-on-year in the first half of 2025. Emissions from coal use in the power sector fell by 69 million tons and in cement and other building materials fell by 20 million tons, while emissions from coal use in the chemical industry increased by 47 million tons. The report states that coal-fired power generation capacity could increase sharply by 80-100 GW in 2025, but coal-fired power generation will decline. The chemical industry, which produces synthetic fuels and chemicals from coal, is also experiencing rapid expansion.

CREA's analysis of India's CO2 emissions also found that emissions growth slowed to 1% year-on-year in the first half of 2025. Of the approximately 13 million tons increase in emissions, steel and cement accounted for an increase of approximately 13 million tons, power generation a decrease of approximately 6 million tons, and other sectors an increase of approximately 6 million tons. In the power sector, power generation increased by 9 TWh in the first half of 2025 compared to the same period last year, but CO2 emissions decreased by 1%. According to the data analysis, 65% of the decrease in fossil fuel power generation was due to a small increase in electricity demand, 20% to an increase in clean electricity other than hydropower, and 15% to an increase in output at existing hydropower plants.

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These reports point to a decline in CO_2 emissions in the power sector as a factor in the decline or stagnation of national-level CO_2 emissions. Let's examine the first question, based on data from each country's government on the power sector, whether China and India have reached the peak of their CO_2 emissions, whether this is a persistent trend, or whether it is influenced by short-term factors such as weather.

Let's start with China. In the first half of 2025, overall power generation increased by 2.4% year-on-year (National Bureau of Statistics of China), and thermal power generation capacity increased by 4.1% (National Energy Administration of China). However, thermal power generation decreased by 2.1% (National Bureau of Statistics of China) (coal-fired power accounts for around 95% of thermal power generation). The plant load factor for thermal power generation fell from 49.1% in the first half of 2024 to 46.5% in the first half of 2025. China has already introduced a capacity mechanism for coal-fired power plants and is also requiring them to have load adjustment capabilities.

Looking at monthly data, thermal power generation recovered from a year-on-year decrease of 29.4 TWh (down 5.4%) in January and February 2025 to an increase of 6.9 TWh in June (up 27.1 TWh in July). Overall power generation increased from a 2.5 TWh increase (up 0.3%) in January and February to an increase of 27.8 TWh in June (up 43.6 TWh in July). The national maximum power load reached 1,508 GW in July 2025, surpassing the previous record of 1,451 GW in 2024 (according to the National Energy Administration of China). The decrease in thermal power generation in January and February is likely temporary, due to stagnant electricity demand. Meanwhile, solar power generation capacity increased by 92 GW in the month of May due to last-minute installations ahead of the implementation of new renewable electricity pricing rules. In February 2025, the National Energy Administration of the National Development and Reform Commission issued a notice regarding the establishment of a contract for difference mechanism for new energy sources. For existing projects that began operation before June 1, electricity prices will be based on current pricing policies and will not exceed the local benchmark price for coal-fired power generation. For new projects that begin operation on or after June 1, the amount of electricity covered by the mechanism will be determined based on factors such as the Responsible Amount for Renewable Energy Consumption, and electricity prices will be determined through bidding. In July, the National Energy Administration of the National Development and Reform Commission issued a notice regarding the Responsible Amount for Renewable Energy Consumption, setting the mandatory green electricity consumption ratio for major energy-consuming industries. As such, renewable energy policies are still in a transitional period, and it is unclear how renewable energy will develop in the future.

Next is India. In the first half of 2025, compared to the same period last year, overall power generation increased by 1.2%, and coal-fired power plant capacity increased by 1.5%, while coal-fired power generation decreased by 2.8% (Central Electricity Authority of India). It has been pointed out that the decrease in coal-fired power generation was due to lower-than-average temperatures and a small increase in electricity demand. While the peak electricity demand to date was 250 GW on

May 24, 2024, the peak in 2025 is expected to remain at 241 GW on June 9, 2025 (Ministry of Power, India).

Looking at the data by month, coal-fired power generation decreased significantly compared to the same month last year, from an increase of 5.2 TWh in March 2025 to a decrease of 10.8 TWh in May (a decrease of 9.0% compared to the same month last year). Overall power generation also decreased from an increase of 11.1 TWh in March to a decrease of 8.3 TWh in May (a decrease of 5.0% compared to the same month last year). Coal-fired power generation recovered to an increase of 1.0 TWh in August. With regard to the future mix of power generation, (1) if electricity demand grows, coal-fired power is likely to remain the main source of electricity to address demand growth for the time being, and (2) although solar power generation capacity increased by 5.4 GW in the month of June, power purchase agreements have been delayed and output has been curtailed (the plant load factor for solar power generation fell from 16.1% in July 2024 to 13.8% in July 2025), and it has been reported that a decrease in bidding and permits is expected in the future, so it is thought that it will be some time before a decrease in CO2 emissions in the power sector becomes a trend.

Given the above, it is too early to say that there is a persistent trend of declining CO2 emissions in either China or India. We need to closely monitor the impact of short-term factors, such as recent policy changes.

Future Energy Landscape - Global Energy Agenda –

Now and the Future for Alaska LNG Project

Takafumi Yanagisawa *

On September 11, JERA announced that it had signed a Letter of Intent (LOI) with Glenfarne, the U.S. company promoting Alaska LNG project, to advance discussions about LNG offtake from the project.

Given the advantage of shipping Alaska LNG to Japan in just under 10 days, without through chokepoints, JERA has previously expressed the view that "if economically viable, this could be a promising option." The content of this LOI is in line with that view.

Furthermore, the content of this LOI is also in line with the statement in the joint statement on the Japan-U.S. tariff agreement on September 4, which stated that "exploring a new Alaskan offtake agreement for such LNG”.

When the two companies signed the LOI, Secretary of the Interior Doug Burgum and Secretary of the Department of Energy Chris Wright, who are said to have great influence on the energy policy of the Trump 2.0 administration, were also present, showing the administration's high expectations for Alaska LNG.

The Trump 2.0 administration issued an executive order titled “UNLEASHING ALASKA’S EXTRAORDINARY RESOURCE POTENTIAL” on its first day in January 2025, promoting the development of Alaska LNG, and has since sought involvement from Japan, Korea, Taiwan, Thailand, and so on. This is due in part to the expected decline in U.S. energy prices, a priority for the administration, the promotion of the project by Alaska's Republican governor and senators, and the strong influence of Hilcorp, the operator of the Prudhoe Bay oil field in northern Alaska, over the administration. However, ExxonMobil, ConocoPhillips, and Chevron, which also have investments in the Prudhoe Bay oil field, had previously considered involvement in Alaska LNG, but have now suspended their consideration.

Alaska LNG project is planned to purchase associated gas produced from the Prudhoe Bay oil field, transport it via a newly planned 1,300-kilometer pipeline to southern Alaska, and export it from a newly planned LNG terminal also in southern Alaska. The LNG production capacity will be 20 million tonnes per year, and the total cost is expected to be $44 billion as of 2023 in pre-FEED (Front End Engineering Design) phase. Glenfarne is currently implementing FEED with Australian engineering company Worley for the pipeline, aiming for the completion of FEED and the following final investment decision (FID) within 2025. The company also aims to reach an FID for the LNG export terminal within 2026.

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While the project is expected to provide shipping benefits to Asia, including Japan, as mentioned above, the cost estimation remains uncertain and is likely to increase further given current inflation trends and the impact of the “Trump tariff”. In addition, the start-up date is expected to be 2030-31 at the earliest, post-Trump 2.0, raising the potential risk of policy change. Furthermore, no effective public support measures have been concretely provided by the U.S. to address these uncertainties. Therefore, it is currently difficult for Japan to reach a binding commitment. The same applies to the letters of intent signed by Taiwan's CPC in March 2025 and Thailand's PTT in June 2025.

Actually, in September 2025, Korea's POSCO International and Glenfarne announced a more in-depth strategic partnership agreement, including the offtake of 1 million tonnes of LNG per year for 20 years, the supply of steel for pipeline construction, and the possibility of investment in the LNG project. While this agreement is also not considered binding, Glenfarne states that the comprehensive agreement with POSCO International “underscores the strategic, geographic, and economic competitive advantages” of the Alaska LNG project.

Meanwhile, another project called Qilak LNG is also underway in Alaska, which aims to purchase raw gas from another oil field (Point Thompson) in northern Alaska, build a new LNG terminal nearby, and export LNG by icebreaker. This project, with planned annual production capacity of 4 million tonnes, is estimated to cost $5 billion, and is scheduled to begin operations in 2033. However, like Alaska LNG, it is still in the pre-FEED phase.

As for the outlook for Alaska LNG, the economics of the project should be reassessed based on new cost estimations based on the FEED for the pipeline, which Glenfarne plans to complete by the end of the year. Furthermore, assessing the economics of the project will require updated cost estimation for the LNG export terminal, so progress on that part will also need to be clarified. Japan needs to put first priority on the economic viability from a corporate perspective, but it also needs to consider the possibility of governmental involvement in light of the ever-changing energy security situation around the country. Furthermore, it will likely be important to consider information exchange and collaboration both at public and private levels with Korea, Taiwan, Thailand, and other countries that are discussing Alaska LNG with the U.S.

Future Energy Landscape - Global Energy Agenda –

Iraq's Oil Exports to Turkey Resume Under Federal Control

Akiko Yoshioka *

At the end of September 2025, crude exports from northern Iraq to Turkey resumed for the first time in two and a half years. As of mid-October, about 200–205 kb/d are being exported through the pipeline to Turkey. In recent years, Iraq's crude exports have totaled roughly 3.25–3.45 mb/d, almost all via the southern port of Basra. The Turkish route, therefore, accounts for less than a tenth of national exports, but for Iraq it restores a valuable outlet that does not rely on passage through the Strait of Hormuz. More importantly, however, is the question of where the export revenues will flow—and, fundamentally, whose oil is being exported.

Northern Iraq is home to the giant Kirkuk oil field, whose crude historically moved through the Iraq–Turkey Pipeline (ITP) for export via Turkey's Ceyhan terminal. In the early 2010s, however, jihadist groups wreaked havoc across Iraq and Syria, repeatedly sabotaging pipelines inside Iraq. After 2013, the line became inoperable. Apart from roughly 10 kb/d trucked to Jordan, the Basra terminal in the south became the federal government's sole export outlet.

Also in northern Iraq lies the Kurdistan Region (KR), an autonomous area populated largely by Kurds. After the Iraq War, negotiations stalled over whether ultimate authority over hydrocarbon development and production in the KR rested with the federal government or with the Kurdistan Regional Government (KRG). With no consensus and talks on a federal hydrocarbons law deadlocked, the KRG enacted its own region-only oil law in 2007 and began courting international oil companies (IOCs). Dozens of firms—including majors such as ExxonMobil and Chevron—signed contracts with the KRG and entered the previously untapped upstream sector in the KR.

With Turkish support, the KRG also secured an export route. Despite the federal government's strong objections to both KRG-led field development and independent exports, the KRG laid a pipeline inside the KR and tied it into the ITP at the Turkish border, enabling full-scale pipeline exports from 2014. Capitalizing on the turmoil of battles with jihadist groups, the KRG also took control of the Kirkuk field, pushing peak exports above 600 kb/d. The KRG held an independence referendum in September 2017; however, the bid collapsed amid strong domestic and international backlash, and the KRG lost control over Kirkuk. Even so, because Turkey did not shut the pipeline, KRG exports continued at around 400 kb/d. Through development contracts and export agreements in which the federal government had no role, the KRG secured its own independent revenue base.

A turning point came in March 2023, when the International Court of Arbitration of the International Chamber of Commerce (ICC) in Paris ruled on a case brought by the federal government, which argued that Turkey's facilitation of KRG oil exports violated the ITP agreement. The tribunal awarded approximately USD 1.5 billion in damages against the Turkish government. While Ankara

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has contested the ruling and has not paid the damages, it did halt exports from the KR. The KRG's attempt to build an autonomous oil industry thus came to a halt.

To restart exports to Turkey via the ITP without running afoul of the award, the Iraqi side responsible for exports had to be the federal government, not the KRG. Yet production in the KR is carried out by IOCs under contracts with the KRG. This set the stage for protracted three-way negotiations among: (i) the federal government, which does not recognize the validity of KRG–IOC contracts; (ii) the IOCs, which insist on recovering costs and remuneration under their KRG contracts; and (iii) the KRG, which fell into fiscal distress after losing its independent export revenues due to the pipeline shutdown.

After roughly two and a half years of talks, the parties appear to have reached a provisional understanding: the federal government will conduct exports and receive the proceeds, from which it will make temporary payments to the IOCs covering costs (USD 16/b) and fees (USD 1/b). In parallel, Baghdad will continue the budget transfers to the KRG that are already in place. That said, the federal government still does not recognize the legal validity of the KRG's contracts with the IOCs, and it remains uncertain whether future cost true-ups will proceed smoothly under the new mechanism. If the framework proves stable, crude from the Kirkuk field—currently consumed domestically—could again be exported to Turkey through pipelines across the KR. Above all, the resumption of exports to Turkey marks the first instance in which the federal government will capture revenues from oil resources located in the KR—an emblematic first step, nearly two decades in the making, toward reasserting federal control over those resources.

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