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US liquefied natural gas attracting attention

Structure of Fluctuations in Residential City Gas Sales Volume in Recent Years

Future Energy Landscape - Global Energy Agenda -

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- Carbon Pricing
  : Concerning the Strategic Utilization of Revenue – A Discussion
- Lessons Drawn from Poland on the Key to Supply Chain Development in the Wind Energy Industry
  : Leveraging Local Industries

The Institute of Energy Economics, Japan

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US liquefied natural gas attracting attention

Development and enhancement of competitive LNG procurement environment is important

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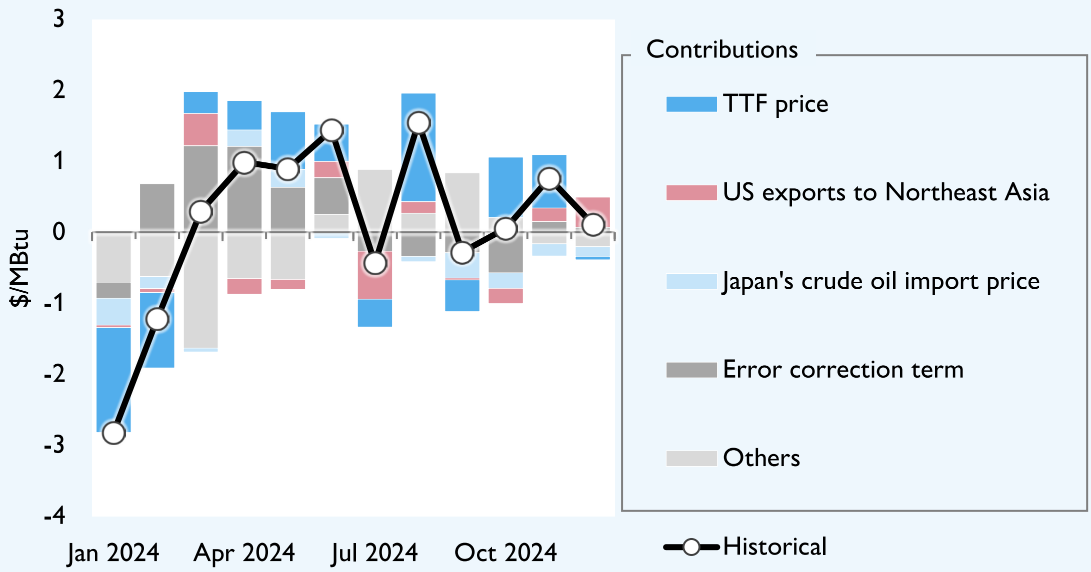
Summary

The United States-Japan Joint Leaders' Statement for the bilateral summit meeting in February 2025 attracted attention by noting that 'the two leaders announced their intention to strengthen energy security … by increasing exports of U.S. liquefied natural gas to Japan'. US LNG has been discussed at such a high level not only for Japan.

While the US LNG trade, which characteristics are different from those of traditional LNG trade under long-term contracts, is increasing, Northeast Asian LNG spot prices have been increasingly co-moved to European natural gas prices due mainly to Europe's rapid expansion of LNG imports after Russia's invasion of Ukraine. When the Dutch Title Transfer Facility, the leading European benchmark for natural gas prices, changes by $1 per million British thermal units in a month, the Northeast Asian LNG spot price fluctuates by an average $0.75/MBtu in the same month. When US LNG exports to Northeast Asia increase by 1 billion cubic metres, the Northeast Asian LNG spot price falls by $0.56/MBtu.

Figure 1 | Breakdown of contributions to Northeast Asian LNG spot price fluctuations



The rise of US LNG has reportedly enhanced the co-movement between the Northeast Asian LNG spot and TTF prices, while falling short of strengthening the linkage between the Northeast Asian LNG spot price and the US benchmark Henry Hub natural gas price. The quantitative expansion of US LNG does not necessarily guarantee the Northeast Asian LNG spot price's convergence (decline) to the HH price.

Keywords: Liquefied natural gas (LNG), United States, Asia LNG spot, Title Transfer Facility (TTF), Henry Hub (HH)

If Northeast Asia aims to lower natural gas procurement costs through US LNG imports, the quantitative expansion alone may not be enough to achieve the aim. Unless a natural gas supply system is developed for Northeast Asia to procure natural gas at competitive prices from countries other than the United States, Northeast Asia may fail to fully benefit from the lower HH price.

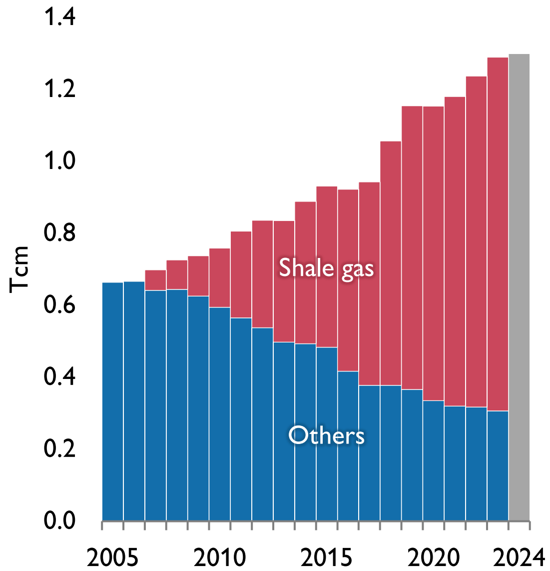
Interest growing in US liquefied natural gas over Trump tariff hikes

In February 2025, Japanese Prime Minister Shigeru Ishiba held his first meeting with US President Donald Trump. Regarding bilateral economic relations, their published joint statement called for increasing Japan's investment in the United States to $1 trillion, for promoting business opportunities and significantly increasing bilateral investment and employment, and for bilateral collaboration to lead the world in developing critical technologies, such as artificial intelligence (AI), quantum computing and leading-edge semiconductors[1]. As for the energy area, the statement attracted attention by noting that 'the two leaders announced their intention to strengthen energy security … by increasing exports of U.S. liquefied natural gas to Japan'.

US liquefied natural gas (LNG) has been discussed at such a high level not only for Japan. In November 2024, European Commission President Ursula von der Leyen cited the European Union's potential expansion of US LNG imports to prevent the United States, concerned about its trade deficit with the European Union, from launching a trade war with the union. At a joint press conference by Indian Prime Minister Narendra Modi and US President Trump after their meeting in February 2025, Mr Trump said that India could increase US LNG and crude oil imports to offset a US trade deficit with India.

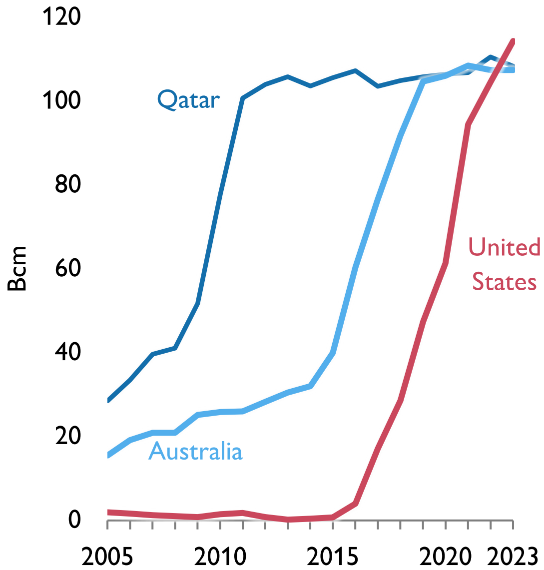
The US shale revolution has brought about such potential trade measures. The United States has explosively increased natural gas and crude oil production (Figure 2). After achieving self-sufficiency in natural gas, the United States launched LNG exports from its 48 mainland states in 2016 and became the world's largest LNG exporter in several years (Figure 3).

Figure 2 | US natural gas production



Note: The breakdown in 2024 remains unknown.
Source: U.S. Energy Information Administration

Figure 3 | LNG exports from major countries

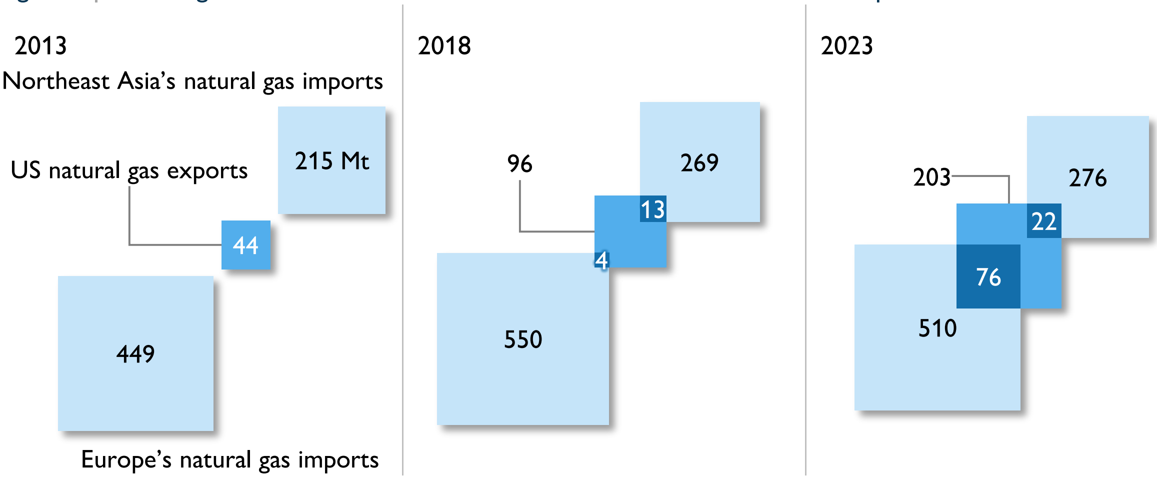


Source: Energy Institute "Statistical Review of World Energy"

[1] Ministry of Foreign Affairs 'United States-Japan Joint Leaders' Statement', https://www.mofa.go.jp/files/100791691.pdf.

The rise of US LNG has brought about major changes in Northeast Asia and, more recently, in Europe. Both regions, which had no interest in US LNG a decade ago, now import US LNG in the order of 10 million tonnes or 10 billion cubic metres (Figure 4). Russia's invasion of Ukraine in 2022 prompted Europe to reverse its policy and phase down its dependence on Russian energy. Nevertheless, Europe has avoided any critical natural gas shortage thanks to natural gas consumption savings (including those attributable to warmer winter weather) and substitute imports from the United States and other countries. However, Europe's desperate buying of US LNG amid LNG production equipment troubles affected Asian and other weaker economies in the midst of the Ukraine crisis.

Figure 4 | Natural gas trade between the United States, Northeast Asia and Europe



Notes: LNG and pipeline gas are covered. Northeast Asia covers China, Japan, Korea and Chinese Taipei. Data include regional trade.
Sources: bp "Statistical Review of World Energy" and Energy Institute "Statistical Review of World Energy"

Europe and Northeast Asia have become the United States' major natural gas export destinations. The two regions account for nearly 90% of US LNG exports. Such concentration is remarkable for the United States as an exporter rather than for Europe and Northeast Asia as importers.

US LNG export expansion has increased co-movement between Northeast Asian LNG spot and TTF prices

The expansion of US LNG export volume and US LNG's characteristic differences from traditional LNG under long-term contracts have caused major changes. Europe's rapid expansion of LNG imports has accelerated the trend and been coupled with other factors[2] to cause major changes in Northeast Asia, the world's largest LNG market, following those in Europe. The link between the Northeast Asian LNG spot market and the European natural gas market has been strengthened. Arbitrage trade has prospered through spot transactions, reselling, export destination changes and other measures, contributing to increasing the co-movement between the two regional markets that were respectively independent and based prices on local supply and demand conditions.

For example, the Northeast Asian LNG spot price and the Dutch Title Transfer Facility (TTF) price[3], known as the leading European benchmark natural gas price, have increased their co-movement. Until the first half of the 2010s, they had no strong relationship, with a low correlation coefficient[4] (the upper part of Figure 5). The ratios of a monthly changes in the Northeast Asian LNG spot price to those in the TTF price varied by month (the lower part of Figure

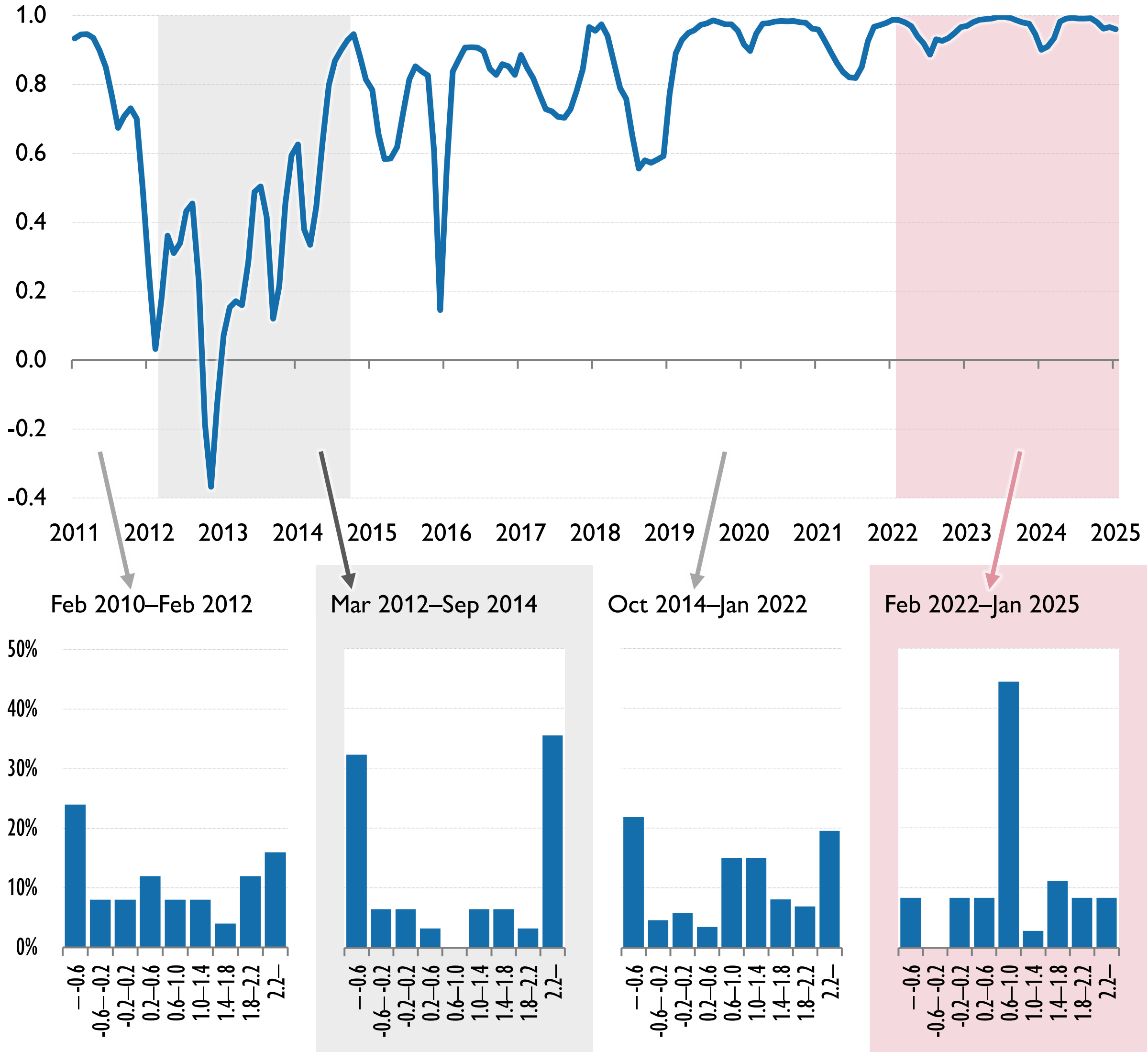
[2] The other factors include an increase in LNG supply (capacity) in gas-producing countries other than the United States, gas-consuming countries' development of LNG reception and regasification terminals, and the Japan Fair Trade Commission's opinion that destination clauses and profit distribution for traditional long-term LNG procurement contracts could have problems regarding the Antimonopoly Act.

[3] Prices of the front-month futures contracts

[4] 12-month moving correlation

5). In recent years, however, their co-movement has increased. Their correlation coefficient has risen close to 1. Ratios of changes in the Northeast Asian LNG price to those in the TTF price have concentrated in the 0.6–1.0 range.

Figure 5 | Correlation coefficient between the Northeast Asian LNG spot and TTF prices (upper) and distribution of ratios of changes in the Northeast Asian LNG spot price to changes in the TTF price (lower)



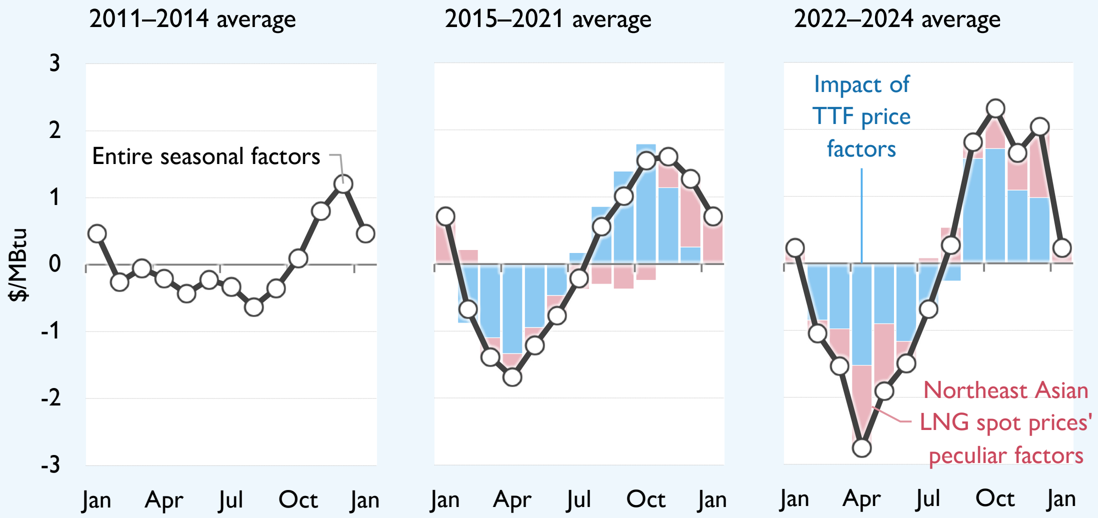
Note: The correlation coefficient represents the 12-month moving correlation.
Source: Computed from Independent Commodity Intelligence Services (ICIS), Intercontinental Exchange and European Central Bank data

Box 1 | Seasonality of the Northeast Asian LNG spot price

As natural gas demand is greatly affected by temperature changes, natural gas prices are identified as having some seasonality. Given that the seasonality is based on changing demand, the pattern and degree of the seasonality may change in line with structural demand changes, instead of staying constant permanently. As natural gas-fired power generation has expanded, the Northeast Asian LNG spot price remarkably tends to decline in spring, when demand for electricity and therefore natural gas for power generation decreases. In winter, when demand for natural gas for heating (for direct combustion or power generation) increases, however, the price tends to rise. On the other hand, the TTF price begins to rise as early as September, reflecting Europe's cool climate and stock building towards winter.

The increasing co-movement between the Northeast Asian LNG spot and TTF prices may affect their seasonality. If the link between the Northeast Asian and European markets becomes closer, the pattern and fluctuations of the seasonality of the Northeast Asian LNG spot price may change under the greater influence of the TTF price.

Figure 6 | Seasonal factors in the Northeast Asian LNG spot price



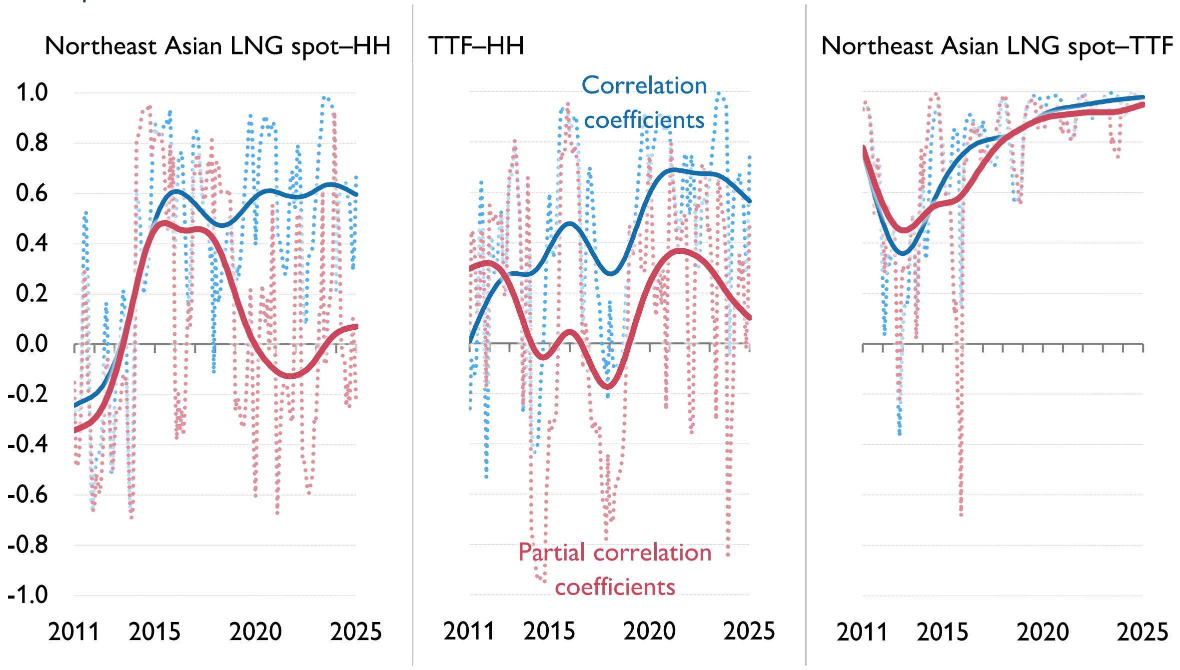
Notes: Based on the X-13ARIMA-SEATS seasonal adjustment program. The 'entire seasonal factors' are for the case in which the user-defined regression variable is not used. 'Northeast Asian LNG spot price's peculiar factors' are for the case in which the TTF price is used as the user-defined regression variable. The 'impact of TTF price factors' is the gap between the entire seasonal factors and the Northeast Asian LNG spot price's peculiar factors. The breakdown of seasonal factors is not made available for the 2011–2014 period, when the correlation between the Northeast Asian LNG spot and TTF prices was low.

The Henry Hub price's co-movement with the Northeast Asian LNG spot price and the TTF price has not increased

The rise of US LNG is considered a factor behind the increased co-movement between the Northeast Asian LNG spot and TTF prices. Contrary to a kind of instinctive expectation, however, the US benchmark Henry Hub (HH) natural gas price[5] has failed to increase its co-movement with the Northeast Asian LNG spot price or the TTF price. The Northeast Asian LNG spot and TTF prices, though posting a high correlation with the HH price occasionally, have not necessarily maintained such correlation over the medium term (Figure 7).

[5] Spot

Figure 7 | Correlation coefficients and partial correlation coefficients of the Northeast Asian LNG spot, TTF and HH prices



Notes: 12-month moving correlation. Dotted lines refer to original data and solid lines to trends.
Source: Computed from ICIS, Intercontinental Exchange, European Central Bank and U.S. Energy Information Administration data

The partial correlation coefficient[6] between the Northeast Asian LNG spot and HH prices, which was computed with consideration given to potential correlations between the Northeast Asian LNG spot, TTF and HH prices, failed to consistently post any large value, similar to the correlation coefficients. It has not increased so far; rather, its trend has remained close to 0.

The partial correlation coefficient between the TTF and HH prices shows a similar trend. Since the HH price is determined by supply and demand in the whole of North America, where the United States is connected to Canada and Mexico via pipelines, the HH price is still considered very local and is fluctuating differently from Asian and European natural gas market prices.

In contrast, the partial correlation coefficient between the Northeast Asian LNG spot and TTF prices posts almost the same trend as their correlation coefficient. Given the above, US LNG might have contributed to the growing co-movement between the Northeast Asian LNG spot and TTF prices, whilst the HH price itself has had no direct relation with them. Even if prices of US LNG exports bound for Northeast Asia[7] are considered roughly indexed to the HH price, it may be concluded that US LNG has played no role in directly determining the equilibrium price on the Northeast Asian LNG spot market. The supply and demand environment for the entire Northeast Asian LNG market is considered a key determinant of the Northeast Asian LNG spot price.

[6] For example, the partial correlation coefficient between the Northeast Asian LNG spot and HH prices indicates their correlation by excluding the TTF price's correlations with the Northeast Asian LNG spot and HH prices.

[7] Computed from data in U.S. Energy Information Administration "U.S. Natural Gas Exports and Re-Exports by Country". It must be noted that the computed prices are not limited to spot ones.

As the European natural gas price fluctuates by $1/MBtu, the Northeast Asian LNG spot price fluctuates by $0.75/MBtu

We used an error correction model[8] for an analysis to evaluate the current Northeast Asian LNG spot price in detail[9]. The following are the characteristics of the Northeast Asian LNG spot price as indicated by parameters gained through the analysis:

1/ It fluctuates by an average $0.75/MBtu in a month when the TTF price fluctuates by $1/MBtu,

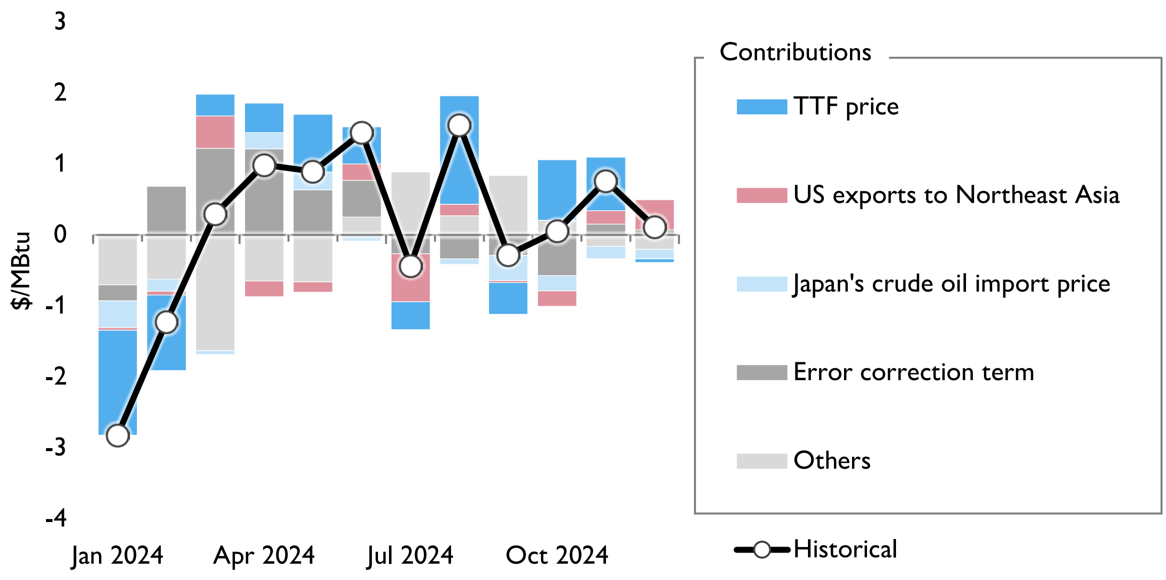
2/ It declines by $0.56/MBtu as US LNG exports to Northeast Asia increase by 1 Bcm, and

3/ It is identified as being somewhat affected by crude oil prices[10], increasing by $0.08/MBtu as the Japan crude cocktail (JCC) price rises by $1/bbl (about $0.17/MBtu).

When the TTF price declines in a month, only 65% of the deviation from the medium-term equilibrium level for the Northeast Asian LNG spot price is covered within the same month. The deviation takes one and a half months to be covered. When the TTF price increases, however, the deviation for the Northeast Asian LNG spot price is almost covered in one month. When the TTF price rises, market participants pay greater attention to the relatively high or low Northeast Asian LNG spot price, making it easier for the TTF price rise to be reflected in the Northeast Asian LNG spot price.

A breakdown of fluctuations in the Northeast Asian LNG spot price in 2024 based on the above characteristics indicates that a considerable portion of each fluctuation can be explained by the contribution of the TTF price fluctuation (Figure 8). Of the average $0.9/MBtu fluctuation in the Northeast Asian LNG spot price, the TTF price's contribution to the fluctuation accounted for an average as high as $0.7/MBtu. From March to December, when LNG prices were rising, as much as $4.3/MBtu of the $5.4/MBtu increase in the Northeast Asian LNG spot price was explained by the TTF price hike.

Figure 8 | Breakdown of contributions to Northeast Asian LNG spot price fluctuations



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8 The model's explanatory variables include an error correction term to indicate how a deviation (error) between an actual price level and the medium-term equilibrium price level is covered later.

9 The period for modelling is between February 2022 and December 2024.

10 Crude oil prices can be viewed as a substitute benchmark for LNG prices indexed to crude oil prices under many long-term LNG import contracts for Northeast Asia.

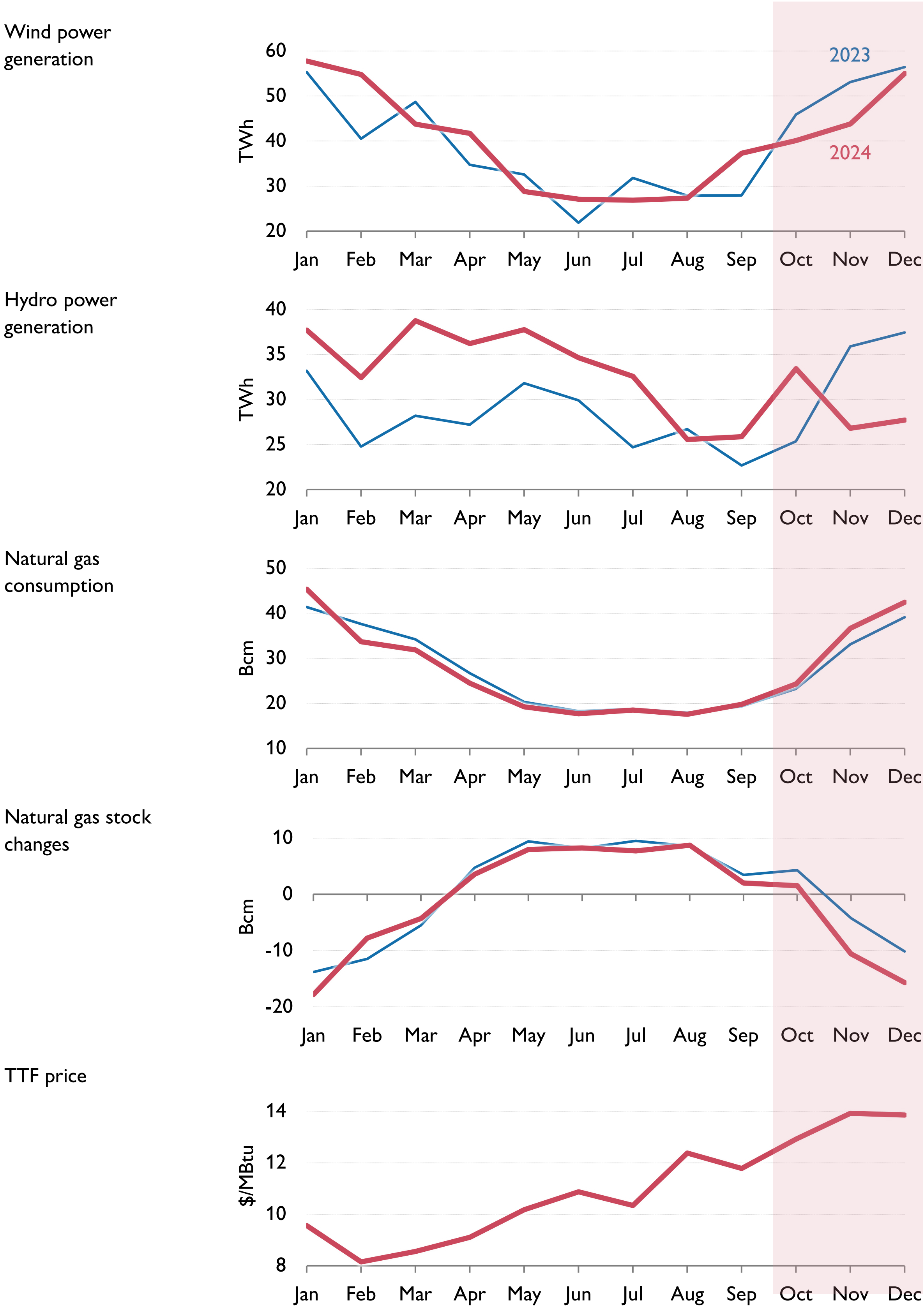
In contrast, the contribution of fluctuations in US LNG export volume is smaller than that of TTF price fluctuations. In a joint press conference with Japanese Prime Minister Ishiba, US President Trump said that Japan would soon begin to import US LNG at an unprecedented scale. While volume, timing and other specifics or the feasibility of such US LNG exports to Japan are uncertain, we have no choice but to conclude that it is difficult to expect that the direct impact of an increase in such US LNG exports alone would bring about a substantial decline in the Northeast Asian LNG spot price under the current market structure. If a massive increase in US LNG supply contributes to easing the supply-demand balance in the global natural gas/LNG market, it can be expected that LNG prices would generally decline.

Northeast Asian LNG spot price changes depending on European weather conditions

The average TTF price in the first half of 2024 stood at $9.4/MBtu, the lowest after Russia's invasion of Ukraine in February 2022. However, it followed an uptrend in the second half of 2024, topping $10/MBtu in each month of the half-year period. Particularly, it came to $13.9/MBtu in November and December, posting a 70% rise from the year's low of $8.2/MBtu in February. Behind the price hike was a sharp increase in natural gas demand. From autumn, especially in November, temperatures declined rapidly from relatively high levels, coinciding with a fall in wind power generation (in October and November) and in hydro power generation (in November) in the European Union (Figure 9). Reportedly, these developments led to a clear year-on-year increase in natural gas consumption and a steep dip in natural gas stock, affecting the market. Such a weather factor not only led to the TTF price rebound but also contributed to a $0.8/MBtu increase in the Northeast Asian LNG spot price in November through the co-movement.

This was not the first time that sluggish wind power generation triggered a rise in natural gas prices in Europe. In 2021, when affordable pipeline gas supply from Russia was decreasing, the TTF price shot up from $7.3/MBtu in January to $38.3/MBtu in December. When a long spell of windless and cloudy days in Europe leads to a decline in renewable energy power generation and a rapid increase in natural demand and prices, the developments exert a spillover impact on the Northeast Asian LNG spot price. Given that variable renewable energy power generation is certain to increase further, such a spillover effect or risk may become more frequent and greater.

Figure 9 | European Union's wind power generation, natural gas consumption and stock changes, and TTF price



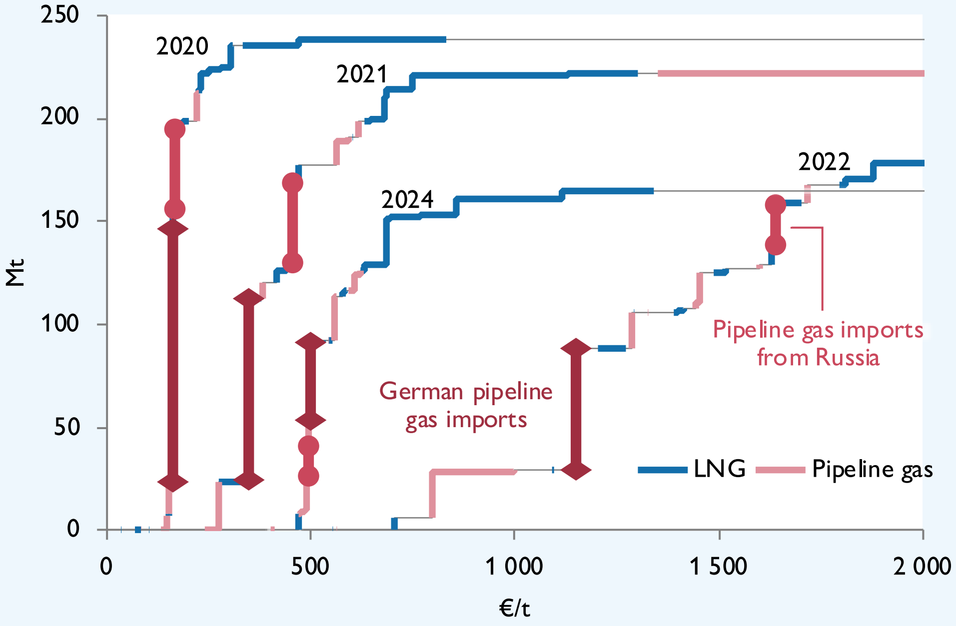
Note: Stock building is shown as positive values of stock changes and withdrawing as negative values.
Sources: Eurostat [Power generation, natural gas consumption and natural gas stock changes], computed from Intercontinental Exchange and European Central Bank data [TTF price]

Box 2 | Transformed European Union's natural gas import composition

The European Union depends on imports for about 90% of its supply of natural gas, the second largest energy source after oil in the region, as regional production has decreased. The composition of its natural gas imports has been greatly transformed in response to recent situational changes.

Earlier, the European Union, including Germany, had heavily depended on pipeline gas imports from Russia and benefited from their affordability. Reflecting European countries' policy of phasing down dependence on Russia for energy supply, however, the union's pipeline gas imports from Russia and Germany's overall pipeline gas imports, including those from Russia, in 2024 declined substantially (Figure 10). In place of pipeline gas, relatively expensive LNG (including Russian LNG) now plays an increasing role in Europe's natural gas supply.

Figure 10 | Composition of European Union's natural gas imports

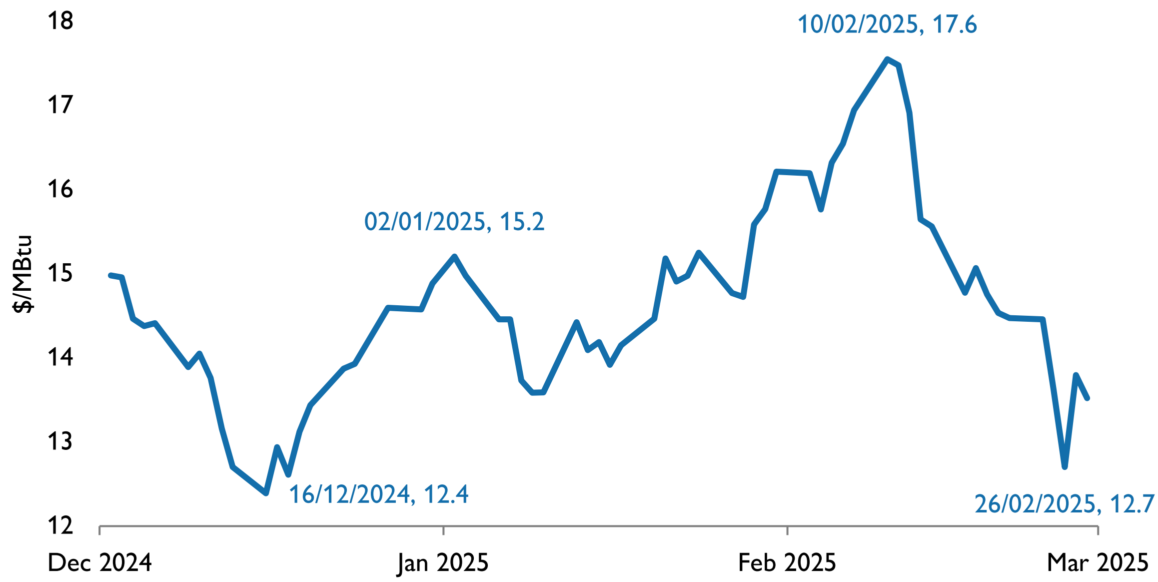


Notes: The figure covers published statistical data alone, failing to encompass all European Union's natural gas imports. Germany's pipeline gas imports, which are kept secret in Eurostat, have been roughly estimated based on the overall import average under the assumption of 48 MJ/kg. Data are annual.
Source: Computed from Eurostat pipeline/LNG import data by partner and data in Statistisches Bundesamt "Yearly natural gas imports"

The import curve's great rightward shift (price hike) seen in 2022 has been partially reversed. The curve's horizontal position may shift leftward or rightward depending on supply and demand conditions. It may shift leftward from the current position, reflecting price falls. On the other hand, the 30-year Europe-Russia relations after the Cold War have collapsed. Their early reconstruction cannot be expected. Even if a temporary ceasefire in Ukraine is realised, the structural vertical shift (regarding import sources) of the European Union's natural gas import curve may remain unchanged for the immediate future.

Recently, the TTF price has fluctuated wildly in response to rapid changes in the Ukraine situation[11] (Figure 11). After falling to $12.4/MBtu on 16 December 2024, the TTF price soared by $2.8/MBtu or 23% to $15.2/MBtu in only two weeks and rose by an additional $2.3/MBtu or 15% to 17.6/MBtu in one month. In only two weeks, however, the price dropped by $4.8/MBtu or 28% to $12.7/MBtu. Such TTF fluctuations spill over to the Northeast Asian LNG spot price.

Figure 11 | TTF price



Source: Computed from Intercontinental Exchange and European Central Bank data

The Northeast Asian LNG spot price narrowing the gap with the TTF price

Over the medium term, meanwhile, the Northeast Asian LNG spot price's excess[12] over the TTF price has gradually shrunk (Figure 12).

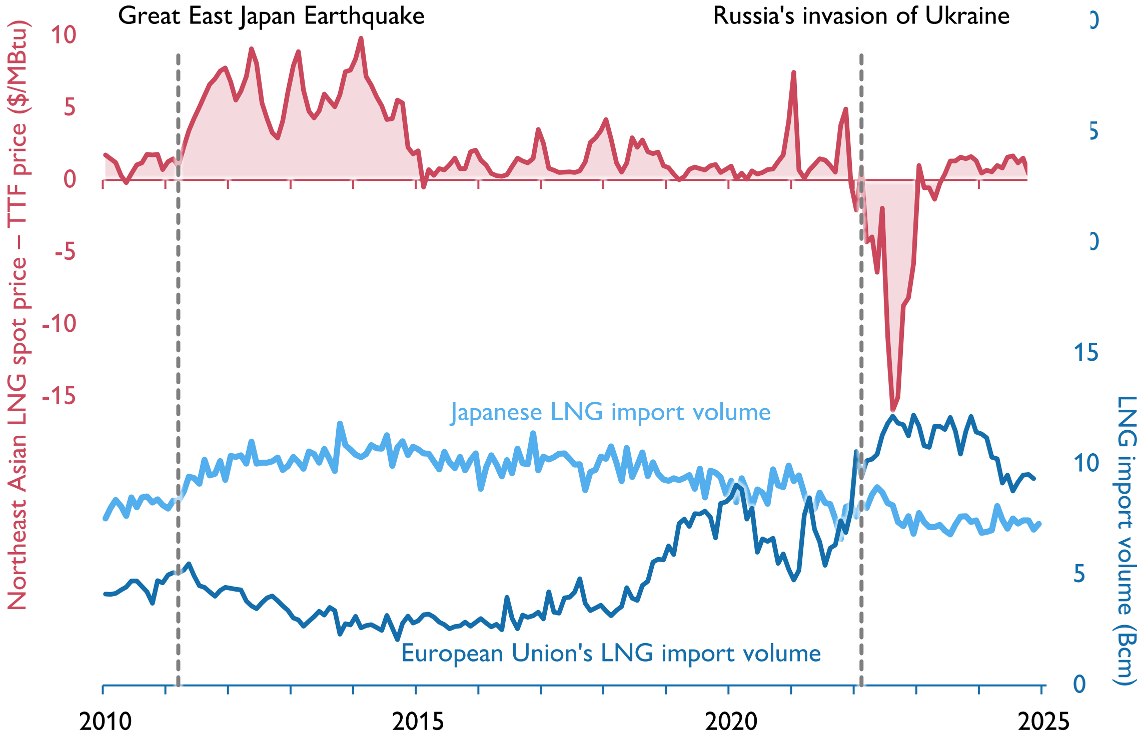
Between 2011 and 2014, the Northeast Asian LNG spot price was an average $5.5/MBtu higher than the TTF price. Then, a link between the Northeast Asian LNG spot market and the European natural gas market was weak, due partly to the LNG market's low liquidity and flexibility. Against this background, Japan increased its LNG demand by the order of 10 Mt or 10 Bcm per year to make up for a steep fall in nuclear power generation following the Great East Japan Earthquake, apparently contributing to the high Northeast Asian LNG spot price.

Recently, however, the Northeast Asian LNG spot price's excess over the TTF price has considerably narrowed, with the exception of the period in which the TTF price shot up as European countries desperately bought natural gas in the wake of Russia's invasion of Ukraine in 2022. Whilst price spikes were seen occasionally, the Northeast Asian LNG spot price's gap with the TTF price shrank to an average $0.9/MBtu in 2024.

[11] In late 2024, the Russi-Europe pipeline gas supply route via Ukraine was shut down in addition to the Nord Stream and another via Belarus that were closed earlier. In February 2025, the US and Russian foreign ministers held talks on a ceasefire in Ukraine. In the same month, Ukrainian President Volodymyr Zelensky met with US President Donald Trump, but their relations worsened then. In March, the US and Ukrainian foreign ministers met to discuss a ceasefire.

[12] Liquefaction and other processes, which are not required for pipeline gas, are necessary for LNG supply. Given such cost gap, the Northeast Asian LNG spot price cannot be expected to become equal to the TTF price represented by pipeline natural gas supply under the same conditions in peacetime.

Figure 12 | The Northeast Asian LNG spot price's gap with the TTF price, and Japanese and European Union's LNG import volume



Notes: Import volume data are seasonally adjusted. The European Union's import volume covers gross trade, including trade between the union members.
Sources: Computed from ICIS, Intercontinental Exchange and European Central Bank data [price gap]. Computed from Ministry of Finance "Trade Statistics" and JODI-Gas World Database [import volume]

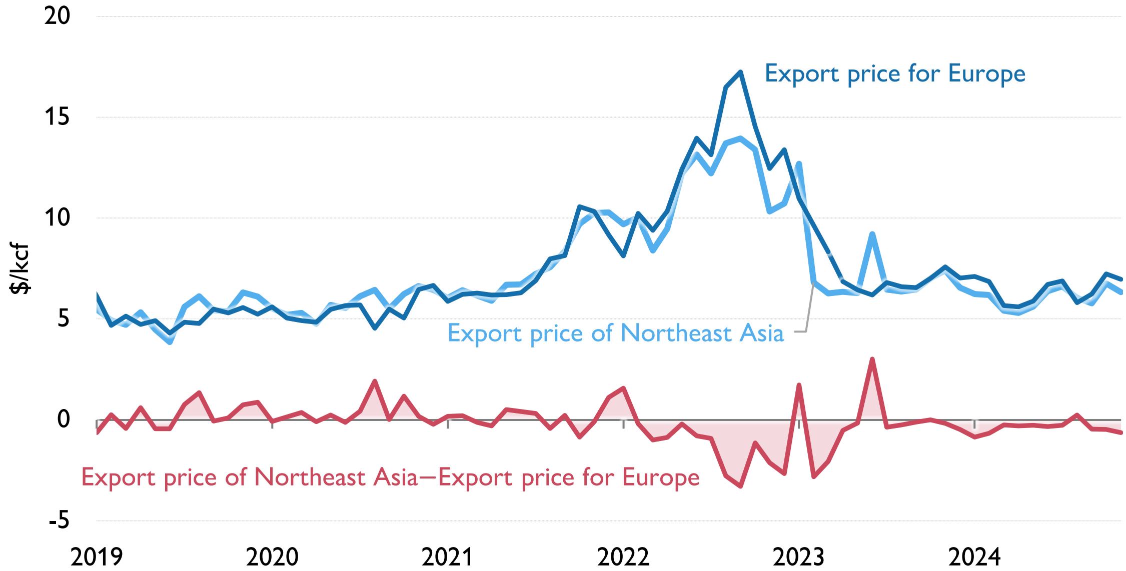
Will US LNG contribute to lowering the Northeast Asian LNG spot price?

As the United States has emerged as a thick, soft 'brace', the link between the Northeast Asian LNG spot and TTF prices has increased. Northeast Asian natural gas users may now expect that the price gap between the Northeast Asian and North American markets will narrow through a decline in Northeast Asian prices. However, whether US LNG's quantitative expansion could bring about the convergence of North American and Northeast Asian market prices must be carefully examined.

The HH price has had little correlation with the Northeast Asian LNG spot price, as shown earlier. While US LNG links the Northeast Asian LNG spot and European natural gas markets, US LNG is not necessarily shipped to the two markets at the same price (Figure 13). Certainly, the US LNG price is benchmarked to the HH price. When LNG prices are high in LNG export destinations, however, LNG sellers may not choose to sell LNG on a spot basis at low prices based on the HH price (or to abandon excessive profits).

Northeast Asia's expansion of US LNG imports alone may not be enough for the region to procure LNG at affordable prices on a spot basis. Unless a supply structure is developed for Northeast Asia to procure natural gas (or alternative energy sources) at competitive prices from suppliers other than the United States, the region may fail to benefit fully from the low HH price through US LNG imports.

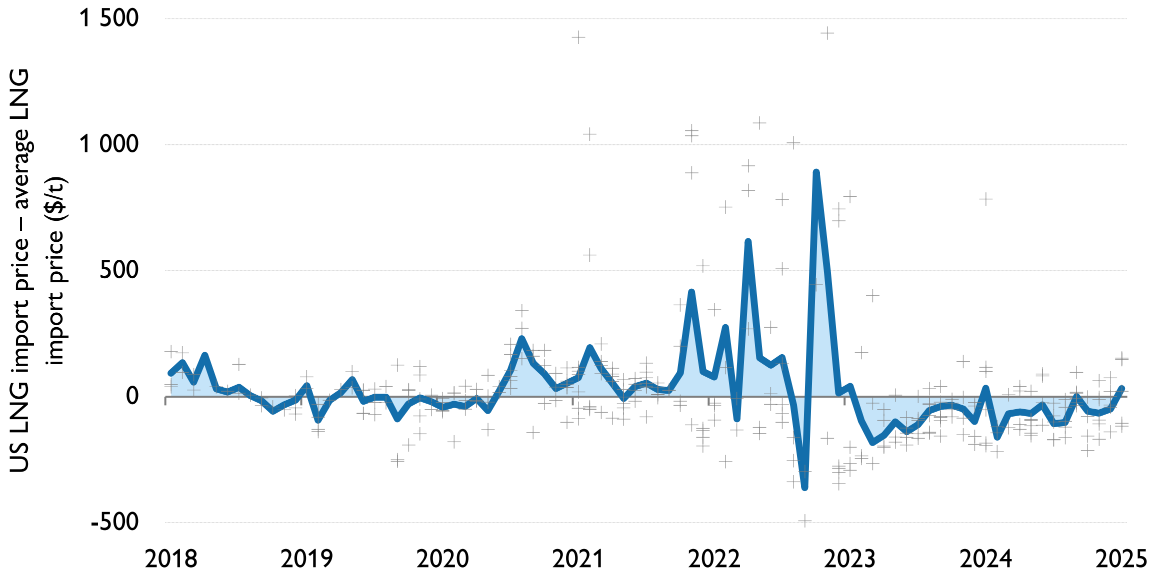
Figure 13 | Gaps between prices of US LNG exports to Northeast Asia and Europe



Note: Data cover both spot and long-term contract transactions.
Source: Computed from U.S. Energy Information Administration data

Contrary to some people's expectations, US LNG is not always affordable (Figure 14). US LNG supply to Japan will be required to be implemented in line with the United States-Japan Joint Leaders' Statement: 'The two leaders announced their intention to strengthen energy security by unleashing the United States' ***affordable and reliable*** energy and natural resources, and by increasing exports of U.S. liquefied natural gas to Japan ***in a mutually beneficial manner***'. This naturally refers not only to LNG shipments from existing US plants but also to those from an Alaskan LNG project that Mr Trump at the meeting with Mr Ishiba cited as subjected to talks on US-Japan cooperation.

Figure 14 | Gaps between US and average LNG import prices



Notes: Cross-shaped points represent US LNG import price data by customs office and the line indicates their averages. Both spot and long-term transaction prices are covered.
Source: Computed from Ministry of Finance "Trade Statistics" and other data

In constructing better relations with the United States as Japan's ally, Japan may have to brush up by developing and enhancing a competitive LNG procurement environment.

Structure of Fluctuations in Residential City Gas Sales Volume in Recent Years

Rino Hirose *

1. Introduction

City gas is an energy source used in households for water heating, air conditioning, and cooking. According to the FY2022 General Energy Statistics of Japan, 23% of the energy consumed in Japan's residential sector is city gas, highlighting the importance of city gas as an energy source for residential use.

This paper focuses on the sales volume of residential city gas and examines the qualitative and quantitative factors behind the fluctuations in sales volume.

2. Trends in Residential City Gas Sales Volume

Figure 1 shows the trends of city gas sales volume in the residential sector from 2016 to 2024 (Current Survey of Production Concerning Gas Industry). Residential city gas sales volume[1] was 388 PJ (10,192 million m3) in 2016, 375 PJ (9,391 million m3) in 2023, and 378 PJ (9,470 million m3; estimated and calculated by the author for December 2024) in 2024. Focusing on the year-on-year rate of change, residential city gas sales volume fell by 1.9% in 2016, increased by 4.9% in 2017, and decreased by 3.2% in 2018. It increased for three consecutive years from 2019, which included a notable 2.3% increase in 2020, the year when the COVID-19 pandemic started. Thereafter, it decreased for two years running from 2022, and most recently, it is estimated to have risen by 0.8% in 2024. Residential city gas sales volume fell by 2.5% compared to 2016 and 8.1% compared to 2021, when residential city gas sales volume was at its highest over the past nine years. Although residential city gas sales volume recorded year-on-year increases in the short term, it has decreased slightly or remained largely unchanged at about 400 PJ since around FY2000.

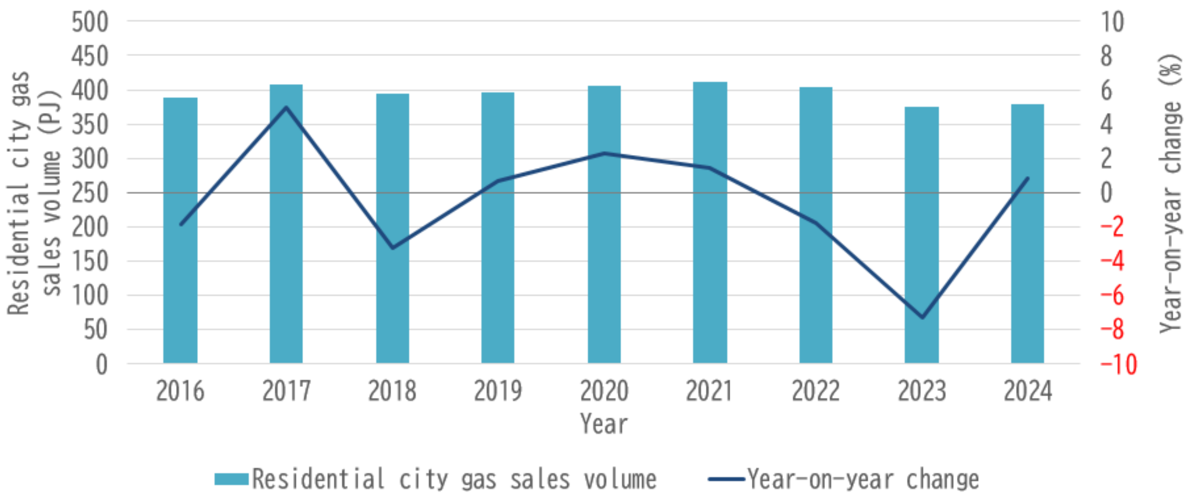


Figure 1 Trends of city gas sales volume in the residential sector in recent years

(Source: Estimated based on Current Survey of Production Concerning Gas Industry. The figure for December 2024 is an estimate.)

* Economist, Econometric and Statistical Analysis Group (ESA), Energy Data and Modelling Center (EDMC), IEEJ

[1] Converted at 1 m^3 = 39.964 MJ based on the Standard Calorific Value (General Energy Statistics of Japan) revised in 2020.

3. Relationship between Residential City Gas Sales Volume and Temperature

There is a significant relationship between temperature and residential city gas sales volume. According to the *EDMC Handbook of Japan's & World Energy & Economic Statistics* (2024), in FY2022, 66% of city gas consumption per household in the residential sector was used for water heating, 17% for space heating, and 17% for cooking use, while city gas was rarely used for space cooling homes. City gas for cooking use is less susceptible to being affected by temperature, while use for space heating and water heating are significantly affected by temperature (water temperature). Specifically, when temperatures are high, there is lower demand for water heating. Similarly, when temperatures are high in winter, demand for space heating is low. In other words, residential city gas sales volume generally decreases when average temperatures rise.

Figure 2 shows the relationship between average monthly temperature and average monthly residential city gas sales volume for the nine-year period from January 2016 to December 2024. The monthly average temperature was calculated by taking into account the effect of meter reading discrepancies[2] and calculating the monthly average temperature for each year by taking the average temperature of the previous month x 0.5 + the average temperature of the current month x 0.5 to determine the monthly average temperature for the nine-year period. We can infer that the residential city gas sales volume is closely related to temperature, based on data indicating that sales volume is lowest in summer and highest in winter, as much as four times higher than in the summer months. At the same time, we can also infer that residential city gas sales volume is higher in the first half of the year than in the second half of the year, even when temperatures are similar, for example, between March and December. This is likely due to the effect of changes in water temperature lagging behind air temperature.[3]

[2] Although remote meter reading is becoming increasingly widespread, meter readings taken by visiting households and checking the gas meter is still practiced in some areas. For this reason, the amount of gas used across months is included in the city gas sales volume (for example, the amount used in January is included in the sales volume for February).

[3] Water has a high specific heat capacity, which makes it difficult to heat up and cool down.

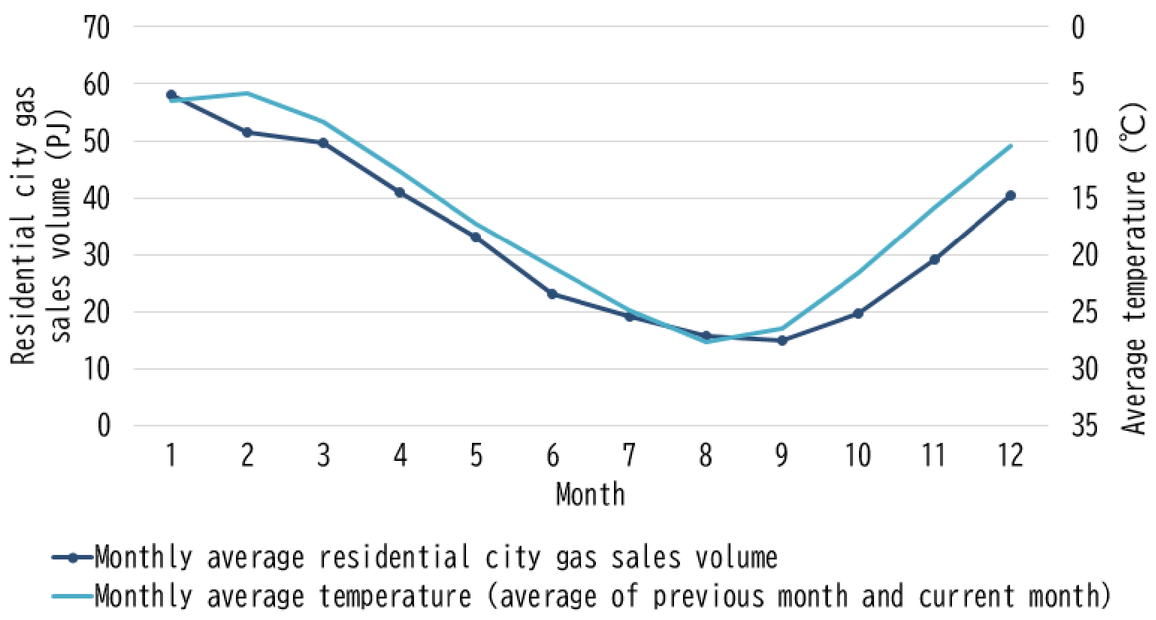


Figure 2 Relationship between average monthly temperatures and average monthly residential city gas sales volume

(Source: Estimated based on Current Survey of Production Concerning Gas Industry and Japan Meteorological Agency. The figure for December 2024 is an estimate.)

4. Contribution of Various Factors to Residential City Gas Sales Volume

In order to see not only the relationship of residential city gas sales volume with average temperatures, as examined earlier, but also its relationship with other factors, the factors contributing to fluctuations in residential city gas sales volume (monthly) were determined quantitatively. A multiple regression analysis was carried out using data from January 2016 to November 2024 to calculate the contribution of each factor.

The assumed factors used in this paper were temperature, the COVID-19 pandemic, time trends, number of assessed bills per household,[4] number of households, number of days, and others. Gas price factors were also considered, but since multiple regression analysis did not yield economically meaningful values,[5] the decision was made not to address them explicitly in this paper.

Residential city gas sales volume fluctuates with the number of households, the number of assessed bills, and the number of days in the month,[6] and these relationships can be expressed by the following formula.

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[4] The number of bills assessed refers to the number of meters for which gas bills are issued.

[5] Due to the nature of energy as a daily necessity, it is extremely difficult for households to curb their usage even when prices rise. Support for reducing gas bills was provided through the "Emergency Assistance to Survive the Severe Heat" from August to October 2024 and the "Electricity and Gas Fee Burden Reduction Support Program" from January to March 2025. Given the inelastic nature of city gas prices, we can say that these measures were effective from the viewpoint of reducing the burden on people's lives. On the other hand, since support to reduce gas bills will no longer be provided from April 2025, the burden of gas bills on households is set to increase amid the momentum of rising prices.

[6] Calculated by taking number of days in the previous month × 0.5 + number of days in the current month × 0.5

$$\boldsymbol{Residential\ city\ gas\ sales\ volume} =$$
$$\frac{Residential\ city\ gas\ sales\ volume}{No.of\ bills\ assessed\ \times\ no.of\ days} \times \frac{No.of\ bills\ assessed}{No.of\ households} \times No.of\ households \times No.of\ days$$

The daily average residential city gas sales volume per unit of bills assessed, which is calculated by dividing residential city gas sales volume by the number of bills assessed and the number of days in the month, can be further broken down by factors including temperature, the COVID-19 pandemic, time trends, and others. The temperature factor corresponds to the monthly average temperature. As in the previous section, the effect of meter reading discrepancies was taken into account, and the monthly average temperature for each month was calculated by taking the average temperature of the previous month x 0.5 + average temperature of the current month x 0.5.[7] Dummy variables were set for the COVID-19 pandemic factor, with the assumption that there was an effect from April 2020 to March 2022, which was when the second round of priority measures to prevent the spread of the disease ended. Time trend factors include changes in trends such as fuel substitution between city gas and electricity or kerosene (or other forms of fuel), improvements in the energy efficiency of appliances, downsizing of households, and lifestyle changes. Other factors refer to factors not included in the abovementioned, including the contribution of changes in multiple factors at the same time.

Figure 3 shows the month-on-month difference in residential city gas sales volume from January to November 2024 and the contribution of each factor. The temperature factor contributed to an increase in sales volume from January to February and from September to November 2024, as temperatures were falling month to month; conversely, the temperature factor contributed to a decrease in sales volume from March to August. This confirms that temperature has a significant impact on residential city gas sales volume, with the exception of February and September when the month-on-month temperature difference was small. Other factors were the next most important, coming after temperature, so it can be said that residential city gas sales volume is largely determined by the conditions of each month.

Figure 4 shows the contribution of each factor to the month-on-month difference in residential city gas sales volume from January to November 2024, excluding temperature and other factors. In February, when there are fewer days in the month, residential city gas sales volume decreased the most by 1.8 PJ, due to the number of days. The number of assessed bills per household and the number of households increase or decrease from month to month. Residential city gas sales volume increased by 0.12 PJ in March, 0.12 PJ in April, and 0.10 PJ in May due to changes in the number of households; in relation to the number of bills assessed per household, sales volume increased by 0.08 PJ in April

[7] Similarly, for the number of days, the effect of meter reading discrepancies was taken into account, and the average number of days in the previous and current months was used as an assumption in the analysis of the degree of contribution.

2024 and decreased by 0.09 PJ in the following month of May. In other words, factors related to the number of customers in the residential sector show a relatively large increase or decrease during the period when many people move houses or change their lifestyles in preparation for the new fiscal year. In addition, the time trend factor contributes to a monthly decrease in residential city gas sales volume ranging from 0.01 PJ to 0.04 PJ. As explained above, this is likely to reflect changes in trends such as fuel substitution, improvements in the energy efficiency of appliances, and downsizing of households.

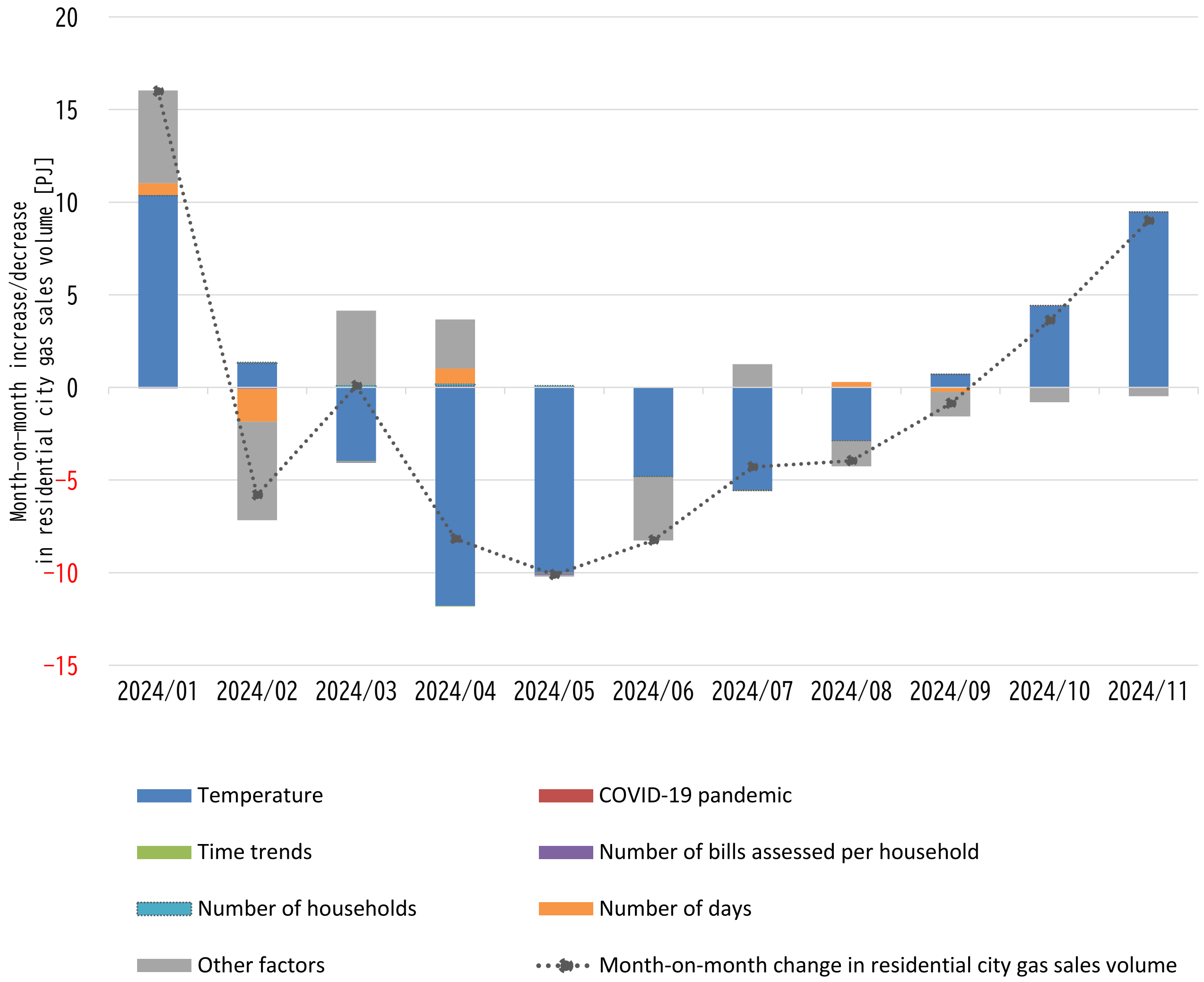


Figure 3 Month-on-month difference in residential city gas sales volume in 2024, and contribution of each factor

(Source: Estimated based on Current Survey of Production Concerning Gas Industry, Japan Meteorological Agency, and Labour Force Survey)

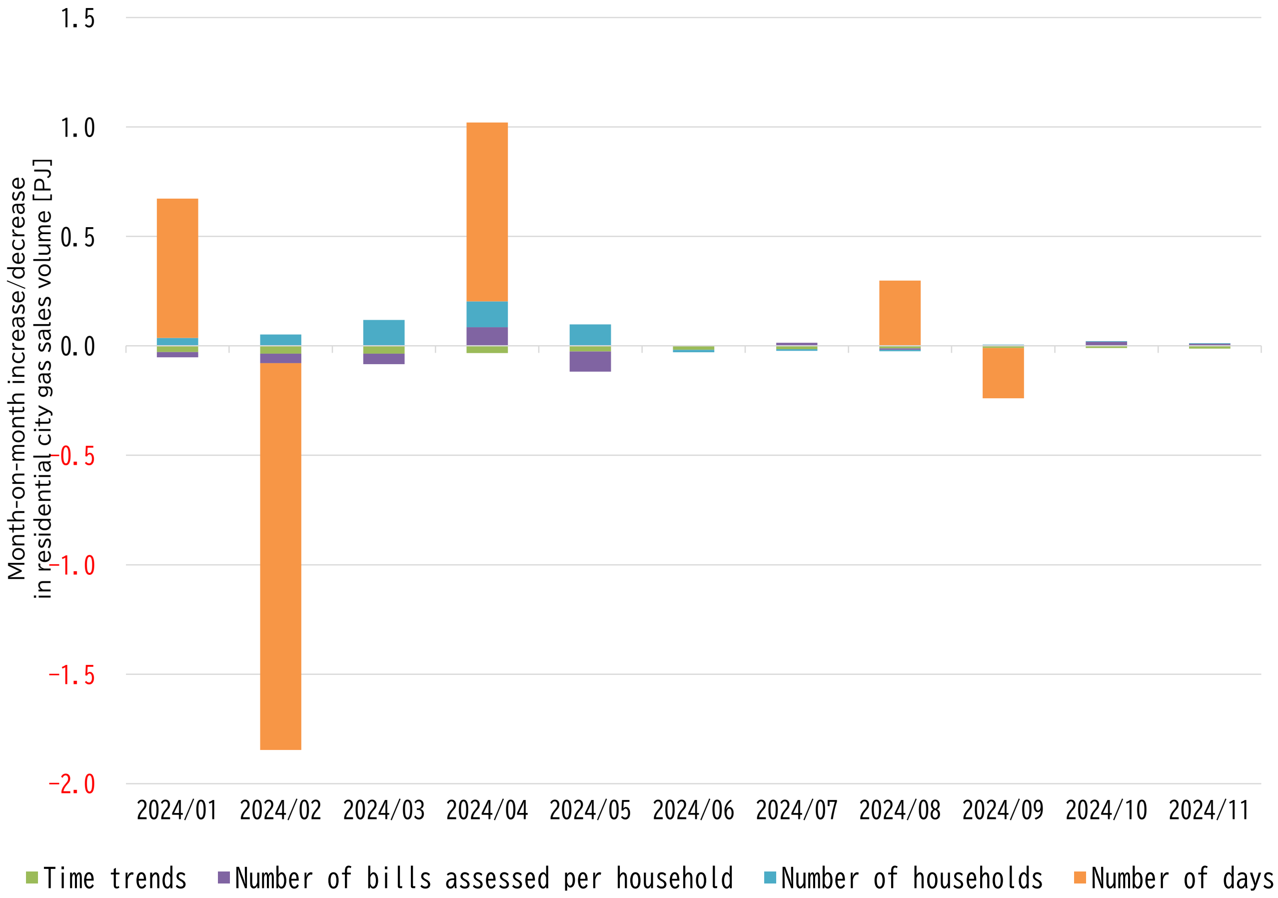


Figure 4 Month-on-month difference in residential city gas sales volume in 2024, and contribution of each factor (excluding temperature and other factors)

(Source: Estimated based on Current Survey of Production Concerning Gas Industry, Japan Meteorological Agency, and Labour Force Survey)

So far, this paper has looked at the fluctuations by month in 2024. Next, to examine the factors contributing to fluctuations in residential city gas sales by year, **Figure 5** shows the year-on-year differences and contributions from 2016.

The temperature factor contributed significantly from 2016 to 2017 and from 2017 to 2018; from 2018 to 2019, although the temperature factor contributed to reducing residential city gas sales volume, the increase in the number of households contributed significantly at 4.8 PJ which, along with the upward contribution of other factors, resulted in an overall year-on-year increase in residential city gas sales volume. As the percentage of people staying home increased due to the spread of the COVID-19 pandemic, the COVID-19 pandemic factor led to an increase of 20 PJ from 2019 to 2020, contributing to an increase in residential city gas sales volume in 2020. From 2020 to 2023, the opportunities to go out increased every year as the COVID-19 pandemic subsided, contributing to a decrease in residential city gas sales volume of up to 15.5PJ (from 2021 to 2022). From 2023 to 2024, temperature contributed to a fall in sales volume, but an increase in the number of households, the number of days due to a leap year, and other factors contributed to an overall year-on-year increase.

To further examine the long-term impact, **Figure 6** shows the cumulative contribution from 2016 to 2024, in order from the factors with the largest cumulative contribution over the eight-year period: time trends, number of households, temperature, other, number of bills assessed per household, and COVID-19. The time trend factor maintained a decrease of 3.1 PJ to 3.3 PJ each year, resulting in a cumulative decrease in sales volume of 26.0 PJ. The number of households was on a rising trend due to the shift toward nuclear families, contributing to a 23.8 PJ increase in sales volume. The number of bills assessed per household was also on a slight upward trend except from 2023 to 2024, and contributed 3.8 PJ to the increase in sales volume. Therefore, when looking at long-term changes in residential city gas sales volume, the range of fluctuation due to temperature is relatively small, as increases and decreases are offset. For this reason, it is also important to note the contribution of fuel substitution, improvements in the energy efficiency of appliances, and downsizing of households to a decrease in sales volume, and the contribution of the number of bills assessed, for example, due to an increase in households or expansion in city gas supply areas, to an increase in sales volume.

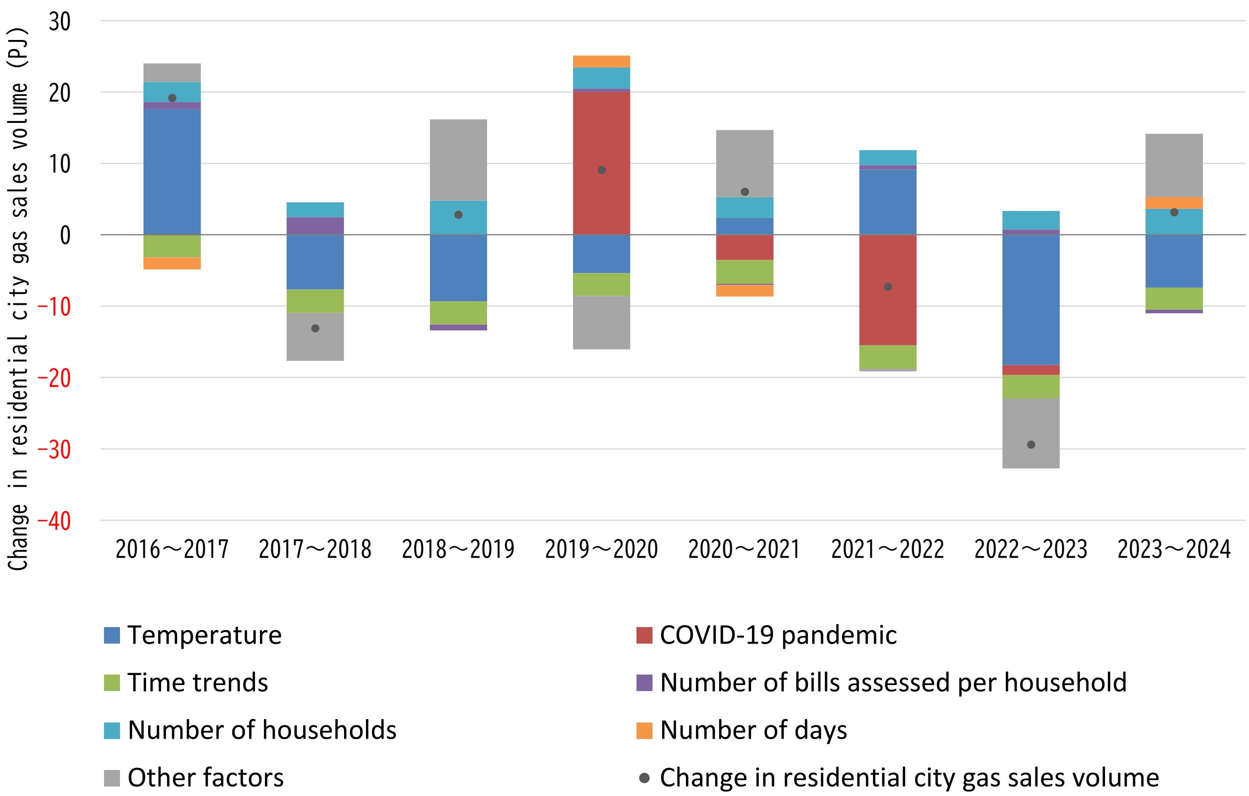


Figure 5 Year-on-year difference in residential city gas sales volume, and contribution of each factor

(Source: Estimated based on Current Survey of Production Concerning Gas Industry, Japan Meteorological Agency, and Labour Force Survey)

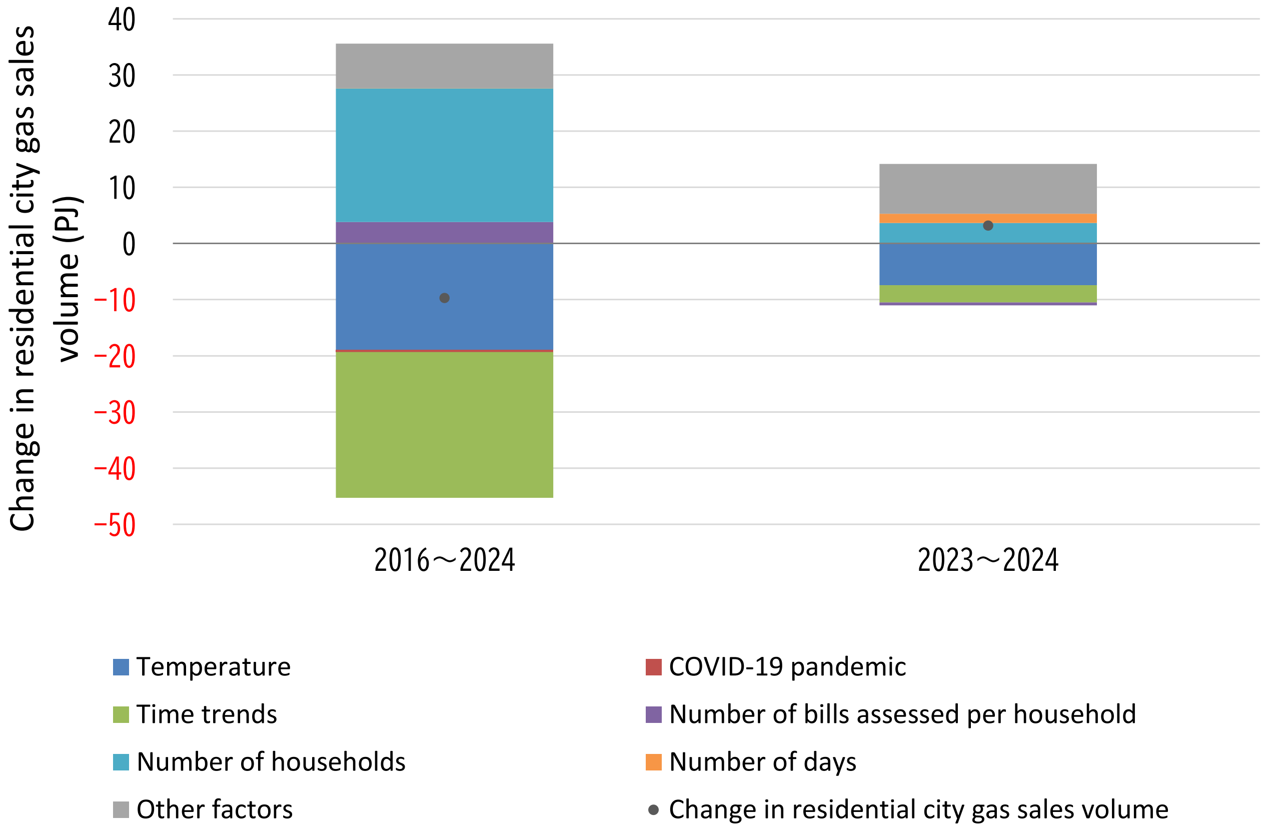


Figure 6 Changes in residential city gas sales volume, and contribution of each factor

(Source: Estimated based on Current Survey of Production Concerning Gas Industry, Japan Meteorological Agency, and Labour Force Survey)

5. Conclusion

This paper examined the factors behind the fluctuations in residential city gas sales volume in recent years.

Since city gas is used for water heating and air conditioning, lower temperatures have the effect of increasing residential city gas sales volume. Regarding this effect of temperature, it is necessary to consider not only the average temperature of the current month, but also the average temperature of the previous month, while taking into account the effect of meter reading discrepancies from meter readings taken through house visits.

Seasonal fluctuations in residential city gas sales volume can be attributed to changes in the number of households, the number of bills assessed, and the number of days. Changes in the number of households and the number of bills assessed are relatively large, particularly at the end and the beginning of a fiscal year. Moreover, the number of households is increasing year by year, and although there are also periods when the number of bills assessed per household decreases by month, it is on a rising trend on an annual basis, and is therefore making a small but steady contribution to the increase in residential city gas sales volume.

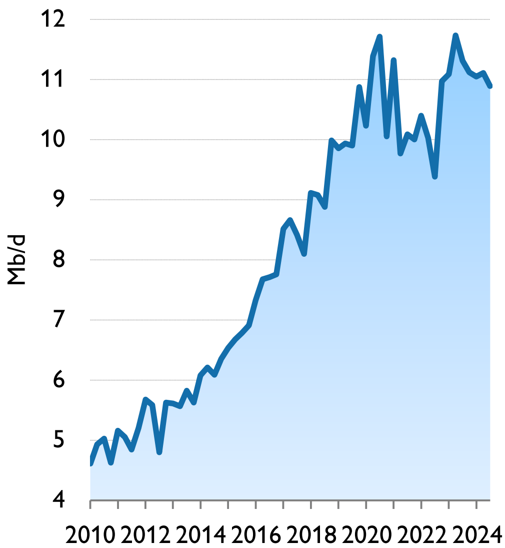
In the long term, trends such as fuel conversion, improvements in the energy efficiency of appliances, and downsizing of households, as well as changes in the number of households, will contribute to increases or decreases in residential city gas sales volume. Residential city gas sales volume is on a declining trend due to the aforementioned factors. While the number of households has been increasing to date, according to the Household Projections for Japan published by the National Institute of Population and Social Security Research, the number of private households will begin to decline from 2031. The outlook for the extreme long term suggests the possibility of a further decline in residential city gas sales volume, particularly due to the growing shift toward electrification of water heating, space heating, and cooking appliances with a view to enhancing convenience and contributing to decarbonization. Therefore, there is a need to continue monitoring the trends closely.

China's crude oil imports peaked?

YANAGISAWA Akira | The Energy Data and Modelling Center, The Institute of Energy Economics, Japan

Oil price (WTI futures, front month) are in the box range of $70/bbl. On 15 January 2025, it hit the $80/bbl level for the first time in five months due to supply concerns caused by new US and UK sanctions against Russia. However, it returned to the $70/bbl level as early as the next day. One reason is the bearish catalyst on the demand side, i.e. slower growth in China. China's crude oil imports have not increased as much as they had until 2020, after the reactionary increase due to the abandonment of the zero-Covid-19 policy in December 2022 had run its course (Figure 1). Not only that, but they have declined after peaking in the third quarter of 2023.

Figure 1 | China's crude oil imports

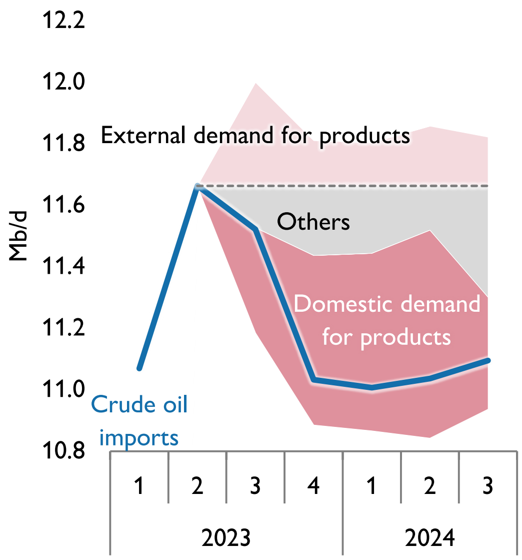


Note: Quarterly values
Source: JODI-Oil

Given crude oil imports from China, the world's largest importer of crude oil, are faltering, then the market may be concerned about whether the imports have entered a downward trend. The Reference Scenario in the IEEJ Outlook 2025 projects the imports will increase until around 2030. However, some believe that the peak will occur earlier than that. There is some talk that the time has already come.

In the short term, the volume of crude oil imports is largely determined by trends in economic and industrial activity and temperature. The medium- to long-term direction is defined by changes in economic, social and energy systems. Precisely these are through the demand for petroleum products that are refined from crude oil and actually used by consumers. When the current change in crude oil imports is decomposed into domestic demand for petroleum products, external demand for petroleum products and other contributions, the fall in domestic demand for products has in fact a major effect (Figure 2).

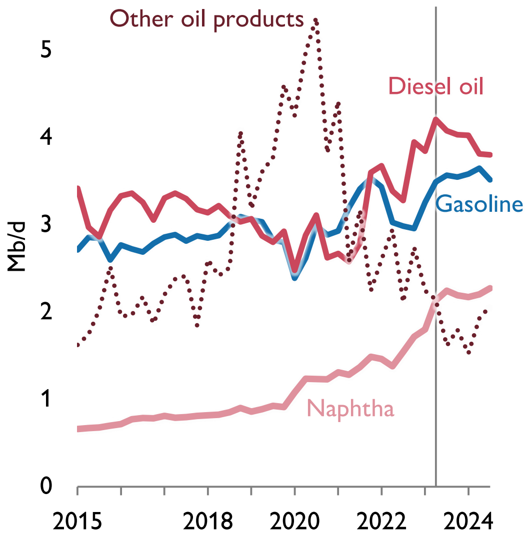
Figure 2 | China's crude oil imports and contribution to changes [vs. 2Q2023]



Notes: Quarterly values. Seasonally adjusted.
Source: Compiled from JODI-Oil .

Electric vehicles are cited as a rationale for the peak in crude oil imports—i.e. petroleum products demand. Sales of electric vehicles and plug-in hybrid vehicles are expanding more rapidly in China than in any other large automotive market. These 'new energy vehicles' accounted for 49% of passenger new car sales in 2024 (China Association of Automobile Manufacturers, CAAM). The trend is likely to exert downward pressure on crude oil imports through downward pressure on demand for gasoline and diesel oil. It should also be noted, however, that new car sales are related to the number of cars owned, which is closely related to energy consumption, but on a different scale. In addition, the road sector accounts for only about one-third of petroleum product demand. It should not be taken in the sense of the United States, in which the road sector accounts for three-quarters, and advanced European countries, in which the sector accounts for half. As a matter of fact, Gasoline demand has not slowed down much (Figure 3). It was only in August 2024 that it started to fall below the same month of the previous year this time.

Figure 3 | China's demand for selected petroleum products

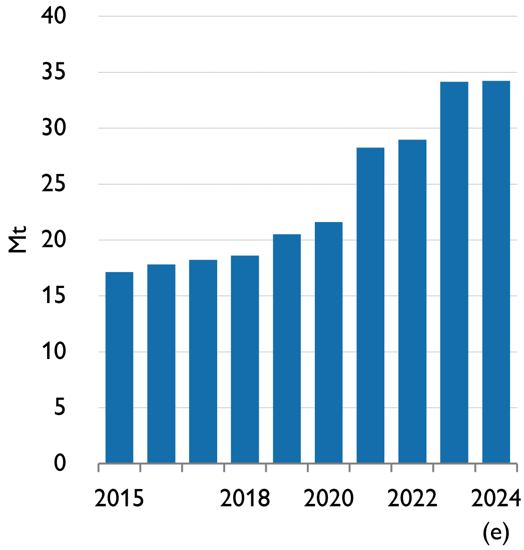


Notes: Quarterly values. Seasonally adjusted. 'Other oil products' is 'Other oil products' in JODI-Oil, does not include kerosene, heavy fuel oil, etc.
Source: Compiled from JODI-Oil.

Demand for gasoline is steady, whereas diesel oil appears to have reached a plateau. It, however, may be premature to attribute this to the impact of new energy vehicles. Diesel-oil-fuelled vehicles are dominated by trucks and other heavy vehicles. The share of new energy vehicles in commercial new car sales in 2024 was 18% (CAAM), meaning that new energy vehicles are not as widespread as in passenger cars. In addition, diesel oil is most commonly used in the road sector but is also widely used elsewhere. It seems straightforward to see that the economic slump triggered by the real estate recession is contributing to the suppression of growth in diesel oil consumption through a slowdown in transportation and production activity.

The reasons for the stagnant increase in demand for petroleum products can be sought in naphtha and other oil products, etc. Naphtha is exclusively used as a petrochemical feedstock. Petrochemical plants are being built on a large scale in China, but overproduction is a business performance issue. Production of ethylene, a representative basic petrochemical product, in 2024 is likely to have remained at the previous year's level despite capacity expansion (and catch-up production in December?) (Figure 4). This makes the significant increase in past years in naphtha demand disappear.

Figure 4 | China's ethylene production



Note: 2024 is an estimate.
Source: National Bureau of Statistics, China [–2023]

For other oil products, the detailed items are not available from the JODI-Oil, but the volumes of products such as petroleum coke and bitumen appear to be relatively much. The same applies to heavy fuel oil, the slowdown in production activity is likely to have had an impact.

The recent decline in China's crude oil imports can be attributed to the current slump in economic and production activity. It seems natural to assume that there is still time for China's crude oil imports to enter a full-scale downward trend once the government's economic measures are successful and the consumption slump is resolved—although the timing of that is also a matter of debate.

Future Energy Landscape - Global Energy Agenda –

Insurance being reconstructed by weather-related natural disasters

Takahiko Tagami *

In 2025, from January 1, all companies in Italy became required to buy insurance to cover their assets in the event of natural disasters. Additionally, on January 7, a wildfire broke out in Southern California and is estimated to have caused $50 billion or more in losses. When large-scale economic losses occur as a result of weather-related natural disasters, there is a risk they will destabilize the financial system.

According to Munich Re, from 2010 the amount of losses (nominal price) arising from natural disasters worldwide reached peaks in 2011 ($380 billion) and 2017 ($330 billion), and over the 2020-2024 period, the amount of losses ($210 billion to $320 billion per year) successively exceeded the average over the last 30-year period ($181 billion). Of the losses suffered in 2011, $210 billion are attributable to the Great East Japan Earthquake, while the 2017 figure includes the losses caused by hurricanes Harvey ($85 billion), Irma ($67 billion) and Maria ($63 billion). Large-scale weather-related disasters continued from 2010 to 2024, including the hurricanes Ian ($100 billion) in 2022, Ida ($65 billion) in 2021, Helene ($56 billion) in 2024, and the European floods in 2021 ($54 billion).

Even in 2018 and 2019, when the sizes of losses were comparatively small, Japan in 2018 suffered torrential rain (known as the “Heavy rain of July, Heisei 30”) that triggered $10 billion in losses, along with Typhoon Jebi (Typhoon No. 21), which caused damage centered on the Kinki region and triggered $13 billion in losses, and then in 2019 it suffered the Boso Peninsula Typhoon (Typhoon No. 15; $9 billion) and East Japan Typhoon (Typhoon No.19; $17 billion).

In Italy, from January 1, 2025, it became mandatory under new legislation for companies to purchase insurance (there are no penalties for non-compliance, however) and for insurance companies to draw up policies. This regulation will be underpinned by a EUR5 billion reinsurance fund set up by a government-controlled financial institution. Under this legislation, Italian insurance companies must accept all customers, and as a result, the insurance industry is grappling with the problem of how to go about setting prices for insurance premiums. Additionally, there is the concern that if a major calamity occurs, the losses could potentially end up exceeding the value of this reinsurance fund.

On December 18, 2024, the European Central Bank and the European Insurance and Occupational Pensions Authority (EIOPA) released a joint paper in which they proposed a solution for mitigating the economic impact of natural disasters. The joint paper’s EU-level solution comprises two pillars. One is an “EU public-private reinsurance scheme” that would pool private-sector risks across the EU with the goal of broadening the coverage of insurance for natural disasters. The other is an “EU fund for public disaster financing” that would receive funding through contributions from EU Member States and help rebuild public infrastructure following natural disasters.

On January 30, 2025, EIOPA proposed recalibrating the risk factors in a standard formula used to calculate

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insurance companies' capital requirements with regard to floods, windstorms, hails and other risks while also expanding the number of countries covered. Additionally, EIOPA is also analyzing whether natural disasters such as wildfires, coastal floods and droughts be included in standard formula calibrations. EIOPA has submitted this proposal to the European Commission.

In the US, homeowner insurance premiums are climbing substantially in states where there is a high risk of flooding and other disasters driven by weather events. Additionally, it is also giving rise to a situation where insurers end up leaving from high-risk regions.

The cat bond (catastrophe bond) market has also been growing in recent years. Cat bonds were developed as an alternative solution to reinsurance for large-scale natural disasters, and are issued by insurance companies. Investors are able to obtain substantial interest if large-scale hurricanes, for example, do not occur, but once natural disasters meet specified trigger conditions, the bonds' principal is not repaid, and the insurance companies use the money obtained to cover their insurance payouts.

In Japan also, companies in the energy and other sectors are beginning to face hikes in insurance premiums, reductions in payout caps, contractions in coverage and other changes that were triggered by the torrential rains and typhoons of 2018 and 2019. The EU is attempting to respond to losses arising from natural disasters by strengthening regulations and systems, while the US, where the scale of losses is larger, is seeking to respond through the market. When it comes to which approach Japan should take, it will be important to grasp unique characteristics, such as the scale and frequency of the impact that Japan's natural disasters have on companies and then consider responses appropriate to them. In order to insure themselves efficiently and effectively, companies, too, will need to enhance their capacity to assess vulnerabilities in their supply chains, as well as pursue measures to increase their resilience.

Future Energy Landscape - Global Energy Agenda –

China’s peak oil demand and the international oil market

Tetsuo Morikawa *

China is the world’s largest importer of crude oil, and its import volume and demand significantly influence the crude oil prices. In recent years, factors such as the COVID-19 pandemic and the Ukraine War have caused crude prices to fluctuate substantially, but it appears that the market responds to China’s economy as a price-lowering factor. In particular, in 2024, when the demand finally recovered from the pandemic and China’s economic slowdown grew more severe, Chinese factors often lowered crude prices. This is not a short-term phenomenon. Since it is only a matter of time before China’s oil demand peaks, and as such, the country’s impact on the crude oil market will also continue over the medium- to long-term. In that sense, the oil outlook in December 2024 by CNPC Research Institute of Economics and Technology that China’s oil demand will peak out around 2025 carried considerable impact. On the other hand, in “China's crude oil imports peaked?”, a paper by my colleague, Akira Yanagisawa suggested that it may still be some time before China’s crude oil imports enter a full-fledged contraction phase. Indeed, even if a peak in demand has been reached, it does not necessarily mean demand will begin falling immediately. Nevertheless, even combining India and ASEAN, the next growth center of oil demand, the demand growth over the coming 20-year period will not match the growth of China over the past 20-year period.[1] That being the case, even if China’s demand was to track sideways in the medium- to long-term, that is likely to have an impact on the international oil market.

The short-term impact is already visible in the form of constraints on oil price rises. That is good news for importing countries but poses a major problem for exporting countries. According to the IMF, the fiscal breakeven oil prices needed for the main Middle East OPEC countries as of 2024 range from $53.9/barrel for the UAE to $121.8/barrel for Iran. In the case of Saudi Arabia, the largest producer, the price is $98. However, the Brent price has not recovered to $98 since 2022, and Saudi Arabia continues to run a budget deficit. Of even greater note is the risk that the OPEC+ production cut will fall apart. The production cut will likely continue as long as Saudi Arabia and Russia, two major producer countries, remain committed, but if Saudi Arabia, which has been vacillating between emphasizing price (reducing production) and emphasizing market share (increasing production), sees more merits in expanding its market share than a price crash, the possibility of the OPEC+ falling apart will increase.

The medium- to long-term impact harbors the potential to become serious even for importer countries. If low oil prices continue, the high cost producers will be forced to decrease production, leading to more dependence on low cost Middle East OPEC producing countries. The U.S. boasts the world’s largest production volume, but given that shale production costs are relatively high and that shale drillers emphasize financial soundness, the U.S. is more likely to reduce production amid low price than Middle East OPEC. Even if global demand for oil has begun

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1 China’s oil demand increased by 10.2 million barrels/day from 2004 to 2024, but in the Reference Scenario of the IEEJ Outlook 2025, India and ASEAN’s total demand is forecast to increase by 6.6 million barrels/day from 2024 to 2044.

declining in the medium- to long-term, if the production declines faster, the market will tighten, and prices will rise. Additionally, if the market share of Middle East producers increases, there is also a possibility the price of oil will react more sensitively to geopolitical risk in the Middle East. On the other hand, when it comes to petroleum products China is the biggest exporter east of Suez, but there is already a refinery capacity glut and refinery utilisation rates are estimated to have fallen below 80% in 2024. Nevertheless, according to the IEA, a further 921,000 b/d of refining capacity is expected to be added by 2030. If demand in China does not grow, this will likely spur a drive to export more products. If product prices fall, then it will be good news for importer countries, but for Asia’s refining industries, including Japan’s, a weak product market could become a serious matter. In the event that Japan’s refinery closures will be faster than the demand decrease, Japan’s import dependence on oil products will be higher. At that point, Japan may face a new type of oil supply risk, namely, a greater reliance on Chinese products.

Future Energy Landscape - Global Energy Agenda –

Kirkuk oil field development agreement

– BP's strategy shift and Iraq's intention to rapidly utilize its petroleum resources align

Akiko Yoshioka *

On March 10 Iraq's Ministry of Oil and UK major BP formally signed an agreement on developing the Kirkuk oil field in northern Iraq. Both parties concluded an MOU in the summer of 2024, and also agreed upon the final details of the agreement in February. At that juncture, BP Executive Vice President William Lin said "This agreement …delivers access to a material new resource opportunity, within one of the world's most prolific hydrocarbon provinces." "This opportunity is fully in line with our priority of pursuing new growth opportunities for bp as we strengthen and high-grade our portfolio across the world."[1]

In outline, the agreement includes carrying out the rehabilitation of existing wells and facilities in the Kirkuk oil field (a major oil field located in northern Iraq) along with oil fields in its vicinity, the construction of new infrastructure, new drilling and exploration, gas expansion projects, and the construction of a 400-MW power plant. BP will not form a consortium with other companies; it will undertake the work in cooperation with Iraqi state-owned enterprises such as the North Gas Company (NGC) and North Oil Company (NOC).

The Kirkuk oil field was discovered in 1927 and is one of Iraq's oldest oil fields. It is also one of its largest. In its heyday, it was producing 1.4 million b/d but due to the impact of war damage, insufficient maintenance, and a lack of investment, production is currently sitting at 200,000-plus b/d. BP has a deep relationship with the Kirkuk field, and when the Turkish Petroleum Company discovered the field in 1927, BP's predecessor, the Anglo-Persian Oil Company, was a co-owner of that company. Iraq's petroleum industry was nationalized in the 1970s but following the Iraq War in 2003 entries by foreign players moved forward once again. BP too has been serving as an operator of the Rumaila oil field in southern Iraq since 2009. Where the Kirkuk field is concerned also, in the 2010s BP carried out a reserve survey and entered a preliminary agreement to expand the field's production, but it had yet to reach the point of a full-fledged development agreement.

The timing of BP's decision to make serious inroads at the Kirkuk oil field is not unrelated to a strategy shift at the company. Murray Auchincloss, who was officially appointed as BP's CEO in January 2024, is pursuing a policy shift toward reappraising petroleum and gas assets, away from the

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[1] BP press release, February 25, 2025 https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-and-iraq-reach-final-agreement-for-redevelopment-in-kirkuk.html

company's proactive devotion to renewable energies up to now, and prioritizing projects that can be expected to generate earnings in the shorter term. Although Iraq's Kirkuk oil field is ageing, it is a field that BP is well-familiar with and is a major field with remaining reserves of 9 billion barrels as of 2010. As it is located on level ground, conceivably the production costs are comparatively low, and if a pipeline to Turkey that is currently suspended reopens it will be possible to secure an export route. BP appears to have concluded that even if global petroleum demand begins falling in the future, it will be able to secure sufficient earnings up to then. Even within Iraq, the vicinity of Kirkuk is a region where it would be difficult to argue that security challenges have been eliminated even today, but nevertheless, the security situation has improved dramatically compared to the 2010s when terrorist attacks were a frequent occurrence. Coupled with the fact that the political environment has also settled down, BP no doubt judged this to be a good opportunity to enter Iraq.

For Iraq also, this agreement represents an important project toward making prompt and effective use of its petroleum resources. The Iraqi government is reliant on revenue from petroleum exports to cover 90% of its public finances. Although the country is steadily making progress with developing structural gas fields and solar power generation projects in order to rid itself of this overreliance on petroleum and promote a decarbonization strategy, that move has only just begun, and Iraq is still at the consideration stage when it comes to many non-carbon energy sources such as hydrogen and nuclear power. As a new economic pillar, the Iraqi government has come out with the Development Road project, which involves establishing a road and rail network from the southern Port of Basra to the Turkish border to the north, in order to build a major logistics route as an alternative to the Suez Canal, but inevitably, it will still be a long time before this can be realized. In order also to move forward with freeing itself from this reliance on petroleum and diversifying its economy, it will be essential for Iraq to promptly make effective use of the petroleum assets it has directly on hand, as an important source of capital. BP's entry can thus be expected to present Iraq with a valuable opportunity as well.

Future Energy Landscape - Global Energy Agenda –

Energy Policy under the Trump Administration

: Enhanced linkage with national security

Shoichi Itoh [*, **]

In accordance with its public pledges during the 2024 presidential campaign, the Trump administration has rapidly launched a series of policies to repudiate clean energy policies emphasized by the preceding Biden administration. On January 20, the day of his inauguration, President Trump signed four executive orders (EOs) relating to energy.[1] EO 14156, "Declaring a National Energy Emergency," orders maximum use of domestic energy resources, including fossil fuels, while EO 14162, "Putting America First in International Environmental Agreements," orders the re-withdrawal of the United States from the Paris Agreement. Meanwhile, EO 14153, "Unleashing Alaska's Extraordinary Resource Potential," abolishes a number of regulations in the State of Alaska (one of the areas which had been subject to the stringent regulations under the previous administration) in order to bring about maximum development of the state's resources. Finally, EO 14154, "Unleashing American Energy," declaring the termination of the Green New Deal, orders the pausing of the disbursement of climate-related funds through the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA) which had provided leverage behind the deployment of clean energy during the Biden era; far-reaching environmental deregulation; elimination of the mandate on electric vehicle (EV) deployment; and the restarting of reviews of applications for approvals of new liquefied natural gas (LNG) export projects for non-FTA (free trade agreement) signatories.

The heads of those government agencies pertaining to the field of energy are now occupied by climate change skeptics, who have moved rapidly to take action in line with the above-mentioned EOs. On February 3, Secretary of the Department of the Interior Doug Burgum signed six Secretary's Orders (SOs) which aim to accelerate legal provisions and deregulation for promoting the development and export of energy resources and critical minerals; to reduce domestic energy prices; and to establish the United States as the global leader in the field of energy. Key items set out in Unleashing the Golden Age of American Energy Dominance, a SO issued by Secretary of the Department of Energy Christopher Wright on February 5, include the expansion of energy production regardless of greenhouse gas (GHG) emissions; the strengthening of research and development (R&D) with an aim to promote innovations in the area of energy, including nuclear fusion, quantum computing and artificial intelligence (AI); exertion of US leadership in the global civilian nuclear

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** This text expresses the author's personal opinions, and does not in any regard represent the views held by any organizations with which the author is affiliated.

[1] On the same day, President Trump also signed a Memorandum, aside from those EOs, which temporarily withdrew the federal government's leasing and permitting processes for wind projects on public land.

sector to meet the growing demand for energy; and to expand energy production by streamlining federal permitting processes for the sake of reinforcing international competitiveness and national security.

On February 14, the National Energy Dominance Council (NEDC) was established by another EO (EO 14213) with Secretary of the Interior Burgum as Chair and Secretary of Energy Wright as Vice Chair. With “energy dominance” being one of the most important slogans established by the Trump administration, the goals set out for the NEDC include securing the stability and affordability of energy prices by maximizing domestic energy production and de-risking the energy supply chain for the United States as well as its allies.

One of the hallmarks of Trump administration 2.0 goes beyond simply rejecting the decarbonization policies promoted by the previous administration, and underscores the linkage between energy policies and national security.

Firstly, given the projected growth of demand for electricity against the backdrop of the widespread deployment of AI and data centers, the administration aims to substantially raise the energy self-sufficiency rate of the United States through the use of fossil fuels and nuclear energy. Strengthening energy independence, regardless of its impacts on the environment, by making use of every kind of energy is the goal. “Declaring a National Energy Emergency” (EO 14156, cited above) notes that, in the face of a growing need to protect the United States’ energy security from hostile foreign powers, the securing of an affordable and reliable domestic supply of energy is a pressing issue from the perspectives of national and economic security.

Secondly, vigilance against China is evident throughout energy policies. On March 14, the Environmental Protection Agency (EPA) announced that it was commencing work on far-reaching environmental deregulation, including the relaxation of regulations concerning coal-fired thermal power generation. Subsequently, President Trump emphasized the need for countermeasures against China, which maintains its economic supremacy over the United States by way of increasing electricity production from coal-fired thermal power generation. EO 14241, “Immediate Measures to Increase American Mineral Production,” signed by President Trump on March 20, states that the national and economic security of the United States is threatened by its reliance upon hostile foreign powers’ mineral production. Its related Fact Sheet stresses the indispensability of critical minerals for manufacturing military products, noting that the status of China, Iran and Russia as holders of large-scale deposits of several mineral resources critical to the United States poses a security risk, and sounds the alarm in particular about US reliance on China for 70% of its rare earth imports. Meanwhile, with Russia providing 27% (as of 2023) of the United States’ imports of low-enriched uranium, an essential mineral for nuclear power generation, securing an alternative source for the supply of this mineral is becoming a pressing issue.

Thirdly, the Trump administration emphasizes the diplomatic significance of increasing LNG exports from the United States, while its allies, including Europe, are seeking to reduce their dependence on Russian gas. When announcing EO 14213, the White House explained that the United States had warned Western Europe about the need to rely on US rather than Russian gas in 2017 (i.e. at the time of the first Trump administration), and that the increased LNG exports from the United States has actually helped to reduce Europe's level of reliance on Russian gas. With regard to the development of Alaska, the second Trump administration highlights the US's role to exercise global energy dominance and to prevent the weaponization of energy supplies by foreign powers in the event of a geopolitical conflict.

Fourthly, the inextricability of maintaining a presence in the international nuclear market and nuclear non-proliferation issues is stressed. The above-noted SO from the Energy Secretary addresses the importance of the rapid commercialization, deployment and export of next-generation nuclear reactors while also emphasizing the role that the DOE will play in the peaceful use of nuclear technology and nonproliferation.

At the Japan-US Summit Meeting, held in Washington, D.C. on February 7, the two countries agreed to strengthen their energy security, including increasing LNG exports to Japan, in a mutually beneficial manner); to diversify critical mineral supply chains; and to collaborate on developing and deploying cutting-edge small modular reactors (SMRs) and other advanced nuclear reactor technology. Japan and the United States could expand collaboration beyond the bilateral sphere into the global domain, including opening up new markets for LNG and nuclear power in third countries, and policy coordination on increasing the supply of critical minerals with non-Chinese origins in the international market. Rather than passively reacting to unpredictable moves of the Trump administration, it is more important for Japan to proactively present a strategic concept on the geopolitical benefits of energy cooperation as well as the long-term energy security of both countries.

Future Energy Landscape - Global Energy Agenda –

Carbon Pricing: Concerning the Strategic Utilization of Revenue – A Discussion

Junko Ogawa *, **

1. Introduction

Japan is moving ahead with adopting growth-oriented carbon pricing, with the aim of achieving its 2050 carbon neutral objective. Utilizing the financial resources generated from carbon pricing for developing decarbonization technologies will no doubt have some effect in reducing greenhouse gas emissions and accelerating the uptake of clean energy technologies. However, the climate change problem is an extremely long-running and highly uncertain challenge, and given that the course of the world's climate policies has been growing uncertain, particularly in recent years, I believe that in order for Japan to realize a sustainable, decarbonized society, a strategy for strengthening the economic and social base that "appears circuitous but is in fact a shortcut" will be needed.

In "Carbon Pricing – The limits of the price elasticity coefficient and the policy considerations based on that – " (September 2024), a previous discussion in this series by the author, I indicated that as a result of energy's low price elasticity, the direct price effects of carbon pricing will be limited. Accordingly, in order to maximize the cost-effectiveness of carbon pricing, it will be necessary to focus on how those financial resources are applied. With that in mind, in this paper, I would like to consider resource allocation that is conducive to economic growth and decarbonization.

2. Changes in international climate change measures

From fiscal 2023, Japan began issuing GX economic transition bonds with the goal of investing 20 trillion yen in decarbonization measures over the coming 10-year period, as one part of its growth-oriented carbon pricing scheme. However, as Ogawa (2024)[1] points out, the future of the world's climate policies is in an extremely uncertain state. The energy crisis sparked by Russia's invasion of Ukraine (spring 2022) has drawn out, and furthermore, far right political parties gained significant ground in the European Parliament election (June 2024). Around that time, far right administrations came into being even within Europe, in Italy, the Netherlands, France and Austria, for example. In addition, in the US in January 2025, President Trump signed, on his first day in office, an executive order to once again withdraw from the Paris Agreement. Trends such as these signify that the momentum of international climate change policies is weakening, and the risk is mounting that excess, focused investment in decarbonization policies is not completely guaranteed to generate economic returns. In circumstances such as this, where uncertainty is on the rise, it will be crucial for Japan to adopt "no regrets" measures that ensure it does not incur losses even if the intensity of global climate

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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] Junko Ogawa (2024) "The path to carbon neutrality", Capital Markets Monthly, December 2024 edition https://www.camri.or.jp/files/libs/2148/202501160955261566.pdf

change measures eases.

3. The structural challenges facing Japan

In addition to energy security and climate change issues, Japan is facing a variety of challenges that include a gravely declining birth rate and ageing population, regional disparity, a cumulative fiscal deficit, and a mounting social security burden. A variety of socioeconomic challenges exist, but the declining birthrate is particularly serious. According to preliminary figures (2025)[2] from the Ministry of Health, Labour and Welfare, there were 720,000 babies born in 2024, down 5% on the previous year and the smallest figure recorded in the 125-year period since records began being kept. Furthermore, according to the National Institute of Population and Social Security Research (2023),[3] the number of births is predicted to fall below 700,000 in 2038 (2.09 million babies were born in Japan's second baby boom of 1973), and the total population of Japanese nationals is predicted to fall below 100 million people in 2048. A decline in population such as this will heighten the risk of medium- to long-term economic stagnation through a shrinking labor supply and declining productivity. Above all, the development of new technologies and cultivation of new industries will be essential for supporting a decarbonized society, and securing and training the human resources equipped with the advanced knowledge and skills to take charge of that will be more important than ever before.

4. The importance of investing in human resources

In order to sustain economic growth, to begin with it is essential to maintain the amount of human resources. According to the neoclassical growth model (Solow-Swan growth model)[4] in economics, the economic growth rate is determined by labor input, capital input and technological innovation, and because population growth contributes to increases in production output through increases in the labor force, it is considered to be one element of economic growth. In particular, decreases in labor input will be directly linked to declines in the growth rate, unless supplemented by other elements. In endogenous growth theory (Romer),[5] population growth promotes an expansion in market scale and the accumulation of knowledge, and is considered to contribute to economic growth through technological innovation and enhanced productivity. In this way, securing the "amount" of human resources is a fundamental premise to the sustainable growth of the economy.

Furthermore, the "quality" of human capital is also extremely important. Human capital theory (Becker)[6] suggests that lifting the knowledge and skills of individuals through education and training

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[2] Cabinet Office (2024) "Public Opinion Survey on the Life of the People (August 2024 survey)" https://survey.gov-online.go.jp/202412/r06/r06-life/gairyaku.pdf

[3] National Institute of Population and Social Security Research (2023) "Population Projections for Japan (2023 projections)" https://www.ipss.go.jp/pp-zenkoku/j/zenkoku2023/pp2023_gaiyou.pdf

[4] Solow, Robert M. (1956). "A Contribution to the Theory of Economic Growth," Quarterly Journal of Economics, 70(1), 65–94. https://academic.oup.com/qje/article-abstract/70/1/65/1903777
Swan, Trevor W. (1956). "Economic Growth and Capital Accumulation," Economic Record, 32(2), 334–361. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-4932.1956.tb00434.x

[5] Romer, Paul, (1990) "Endogenous Technological Change," Journal of Political Economy, 98(5), S71–S102. https://www.aeaweb.org/articles?id=10.1257/jep.8.1.3

[6] Becker, Gary S., (1964) "Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education," University of

is directly linked to improved productivity of workers and so promotes the growth of the economy as a whole. Even in Japan's case studies, Fukao et al. (2020)[7] report that the accumulation of human capital through education contributes to long-term economic growth. Maeda (2019)[8] points out that enhancing the skills of workers through education and training contributes to improvements in Total Factor Productivity (TFP) by industry and for the macro economy. In this way, these theories and this prior research imply that lifting both the "amount" and "quality" of human capital will potentially lead in the long term to the training of human resources to take charge of decarbonization innovation, and to sustainable economic growth.

As a reverse example, there are more than a few cases of resource-rich countries that have failed to focus sufficiently on training human resources and diversify their industries as a result of being overly reliant on their resource revenue, thus falling into a "resource curse".[9] For example, in Venezuela and Nigeria, a reliance on oil resources has invited economic stagnation, and the countries are failing at sustainable economic growth.[10]

In contrast to this, as a country not blessed with energy and mineral resources, Japan has a history of constructing the world's second-largest economy by training and utilizing its human resources to the utmost. In Japan, investment in measures to counter the declining birthrate, education,[11] human capital and reskilling[12] remains at a low level when compared to other developed nations, and there is a need to refortify the country's human resources through bold investment.

Advances with diverse new technologies and industries, including improvements in energy efficiency, the spread of renewable energies and the cultivation of low carbon industries, will be vital to realizing a decarbonized society. The author believes that human resources possessing sophisticated knowledge and skills will support those technologies and industries, or in other words, that human resources themselves will be the largest source of decarbonization technological innovation in the long term.

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7 Kyoji Fukao, Tokihiko Settsu, Tatsuji Makino, "Human Capital and Economic Growth in Japan: 1885-2015", "Economic Review", Vol. 71, No. 2, Apr. 2020
https://hermes-ir.lib.hit-u.ac.jp/hermes/ir/re/31239/keizaikenkyu07102175.pdf

8 Yasunobu Maeda, House of Councilors' Research Information Office, "Essay on TFP (Total Factor Productivity) – including experimental simulations using an economic macro model –" "formerly Economy Prism" No. 183, December 2019
https://www.sangiin.go.jp/japanese/annai/chousa/keizai_prism/backnumber/h31pdf/201918302.pdf

9 Sachs, Jeffrey D., Warner, Andrew M., "Natural Resources and Economic Development-The Curse of Natural Resources," European Economic Review Volume 45, Issues 4–6, May 2001, Pages 827-838
https://www.sciencedirect.com/science/article/abs/pii/S0014292101001258

10 Junko Ogawa, Shohei Kawakatsu (1998), "The role of infrastructure that attracts foreign direct investment in developing countries – foreign direct investment and infrastructure in a virtuous cycle of economic growth", Aoyama International Business Journal, 1998, No. 6

11 Cabinet Office's Children and Child-rearing Administration (2023) "Survey on the declining birth rate situation etc. in Japan and other countries"
https://www.cfa.go.jp/resources/research/other/shogaikoku

12 Ministry of Economy, Trade and Industry (2024), "Regarding the basic structure of the 'new axis of economic and industrial policy' – unifying macro policy and micro policy"
https://www.meti.go.jp/shingikai/sankoshin/shin_kijiku/pdf/024_s01_00.pdf

5. Considering strategic investment allocation

A Cabinet Office public opinion survey (2024)[13] found that a large number of citizens recognize measures to deal with Japan's ageing population and declining birthrate as one of the country's most important challenges. Furthermore, a national survey (2023)[14] by the National Institute of Population and Social Security Research points out that of the reasons that married couples cite for not having the ideal number of children, the biggest reason is that the burden of education costs is too large.[15]

Consequently, it could be said that investing revenue from carbon pricing not only in the development of decarbonization technologies directly but also in measures to counter the declining birthrate, education reform, and reskilling support would make it easier to gain the consent of citizens. If an expansion in the future working age population and improvements in productivity can be promoted, it will lead to an expansion in the domestic market, increased tax revenue and a strengthening of the fiscal base, and may potentially lead to a virtuous cycle in which the fruits of that growth are again reinvested in energy security and the development of decarbonization technologies. For the very reason that responding to global warming is a long-term challenge that will take centuries, an investment strategy that adopts a long-term perspective of "more haste, less speed" will be important.

That is to say, the author believes that carbon pricing revenue should be invested strategically according to a cycle of: "strengthening the economic base → promoting decarbonization technological innovation → realizing a decarbonized economy → …"

Carbon pricing is not simply assigning a price to carbon; it has the power to change the socioeconomic approach itself. Furthermore, how that revenue can be strategically utilized will have a major impact on the course of realizing a decarbonized and sustainable society. In light of that, in this paper, I have proposed that there be a focused allocation of resources into measures to counter the declining birthrate and train human resources as one means of strengthening the economic base, in addition to the current investment in developing decarbonization technologies. This is based on the belief that restrengthening the human capital that forms the base for economic growth, as outlined in this paper, will be essential to a sustained and flexible engagement with the long-term challenge that is decarbonization. Strengthening the economic base is a challenge that Japan should address, irrespective of progress with measures to counter climate change, and in that respect, it is a no regrets measure. To begin with, it will be important to consistently strengthen the foundation of the current economy and society, and the author believes that this is the very thing that will generate the greatest and surest returns, and provide the path to a sustainable decarbonized society.

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[13] Cabinet Office (2024) "Public Opinion Survey on the Life of the People (August 2024 survey)" https://survey.gov-online.go.jp/202412/r06/r06-life/gairyaku.pdf

[14] National Institute of Population and Social Security Research (2023) "Marriage and Childbirth in Japan Today: The Sixteenth Japanese National Fertility Survey, 2021" https://www.ipss.go.jp/ps-doukou/j/doukou16/JNFS16_ReportALL.pdf

[15] Among couples where the wife is aged below 35, close to 80% said the reason they do not have their ideal number of children is "because childrearing and education costs are too high", an overwhelmingly higher percentage than the other reasons cited, such as "it would hinder work" (20%) or "unable to bear the psychological and physical burden" (20%).

Future Energy Landscape - Global Energy Agenda –

Lessons Drawn from Poland on the Key to Supply Chain Development in the Wind Energy Industry: Leveraging Local Industries

Tomoko Murakami *

In April 2025, the Global Wind Energy Council (GWEC) published a position paper titled "An Industry Perspective on Localization."[1] This paper calls on countries to build strong, future-proof wind energy industry strategies, including easing Local Content Requirements (LCR) with a view to promoting the international development of the wind energy industry's supply chain.

The same may also be said for other industries, but if LCR is not properly designed or applied excessively when a country imports technology from other countries, it can increase project costs, hinder appropriate investment, and prevent the country from achieving its renewable energy adoption targets.

GWEC studied the cases of several countries that have introduced wind power from other countries and expanded their wind energy industries, analyzed the positive aspects of LCR along with its challenges, and made the following seven policy recommendations toward localizing production in a way that is aligned with policy goals such as economic efficiency, technological innovation, and energy transition.

- **Harness international competition:** Avoid supplier lock-in by maintaining open, competitive procurement practices.
- **Ensure policy coherence:** Align industrial, energy, and grid policies across all governance levels.
- **Provide long-term certainty (stability):** Guarantee auction visibility and stable market signals.
- **Leverage local strength**s: Build on existing industrial capabilities and transferable skills within the local economy.
- **Offer market-based incentives:** Use grants, tax credits, and infrastructure investment to encourage local supply chain development.
- **Empower the workforce:** Invest in training, apprenticeships, and technology transfer programs.
- **Promote regional collaboration:** Develop resilient, interconnected supply chains across borders.

All the policy recommendations contain valuable hints for Japan, which aims to promote the wind energy industry going forward. However, in this paper, I would like to focus on "leveraging local strengths."

Many countries that are introducing and expanding wind power generation are also often simultaneously attempting to make the transition from traditional industries, such as coal and steel, to next-generation energy. In doing so, rather than simply abolishing the existing local industries, the

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[1] Global Wind Energy Council, *An Industry Perspective on Localization: Pro-business Measures to Drive Local Industrial Development*, April 2025, < https://www.gwec.net/reports/global/industry-perspective-on-localization >.

proposal is to identify and make full use of local industries that have skills and assets (facilities) that are compatible with wind energy technology. GWEC also states that it would be ideal for such efforts to be implemented within a framework of collaboration, not only with government agencies and the industry, but also with civil society. This also suggests the importance of treating industries that the people of the region are familiar with, which have formed the foundation of their lives, with due respect.

In this respect, GWEC cites the port city of Esbjerg, located on the west coast of Denmark, as a success story. Port Esbjerg, which used to be a marine infrastructure base for oil and gas development, became an installation hub for the world's first large-scale commercial offshore wind farm, Horns Rev 1 (2001). Since then, it has been involved in the installation and maintenance of around 50 offshore wind farms in Denmark and across Europe. By 2024, approximately 10% of Europe's offshore wind power capacity is said to have been shipped from Port Esbjerg.

The fundamental factors for this lie not only in Esbjerg's strategic location and suitable port infrastructure, but also the Danish government's strong commitment to green transition and the presence of local companies that had utilized their workforces, highly skilled in the fields of marine engineering and offshore operations, in the offshore wind industry in a timely manner.

Similar examples can be seen not only in Denmark but also in other countries that have adopted and expanded the scale of wind power generation. For example, Poland's wind power capacity, which was only 4 MW in 2000, has expanded rapidly since the late 2000s, reaching 9,307 MW in 2023.[2] In contrast to Japan, where growth has stagnated since the 2010s, Poland has seen a prominent rate of growth in its installed capacity, suggesting that there are likely to be significant factors behind this.

The recommendations on Poland's offshore wind energy and the optimization of its development,[3] published by the Polish Wind Energy Association (PSEW) in 2021, bring up interesting points about how the country's supply chain has developed. Częstochowa in southern Poland is a city that developed through its steel industry during the communist era. Its steelworks (Częstochowa Steelworks) became an important supplier of steel sheets to wind turbine manufacturers from 2008 to around 2015 and contributed greatly to the rapid expansion of wind power generation facilities in Poland. Despite the significant economic downturn around this time in the shipbuilding sector, which was an important customer of the steelworks until 2011, it was able to maintain production (Częstochowa Steelworks filed for bankruptcy in 2019 but resumed steel production after being acquired by Sunningwell in the same year.[4])

The wind energy industry covers a wide range of supporting industries and creates employment at

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[2] IRENA, *IRENASTAT Online Data Query Tool,* 2025. < https://www.irena.org/Data/Downloads/IRENASTAT >.

[3] PSEW, *diagnoza obecnej sytuacji i potencjału krajowego łańcucha dostaw dla lądowej energetyki wiatrowej w polsce oraz rekoMendacje na rzecz optyMalizacji jego rozWoju*, 2021, <https://www.psew.pl/wp-content/uploads/2023/12/DIAGNOZA_E_BOOK-PL-1.pdf >.

[4] Sunningwell, *Częstochowa Steelworks,* < https://www.sunningwell.pl/en/czestochowa-steelworks/ >.

many stages of design and manufacturing. To understand the elements of job creation quantitatively and foster the skills required, leveraging industries that are rooted in the local community can be the most effective and acceptable approach. Since the main components of wind power generation facilities, including towers, turbines, and nacelles, are transported over long distances by ferry, production bases do not necessarily have to be located in areas suitable for wind power generation.

Japan and Poland have numerous local industries in common, such as steel, coal, and aircraft parts. Shipbuilding, which shares many technologies with offshore wind power generation, is also one of the traditional industries that Japan takes pride in. Examples of local industries being leveraged in Denmark and Poland may serve as important case studies for establishing the direction for the development of Japan's wind energy industry.

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