

Summary

Energy supply and demand outlook

- Under the “Reference Scenario” (REF), in which the prevailing changes from the past continue, energy consumption in 2050 will increase by 1.2 times over 2021. Energy demand in China, which has thus far driven global demand growth, will peak around 2030, with India, the Association of Southeast Asian Nations (ASEAN), the Middle East and Africa becoming the main regions for demand growth.
- Energy consumption under the “Advanced Technologies Scenario” (ATS), in which the introduction of energy and environmental technologies is strengthened to ensure a stable supply of energy and combat climate change, will plateau around 2030, and consumption in 2050 will be roughly 0.9 times that in 2021. It should be noted that this outlook is a forecast-type future projection that is based on assumptions about technology and policy trends, and contrasts with a backcast-type analysis that defines a future “landing point” and charts a path to reach it.
- In the Reference Scenario, global energy-related carbon dioxide (CO₂) emissions will remain roughly flat until 2050, and in the Advanced Technologies Scenario, they will be 14.7 Gt (down 56% from 2021), indicating that the world is halfway to achieving carbon neutrality. Reducing to the point of almost eliminating emissions in the non-power generation sectors and Emerging Market and Developing Economies remains a challenge.
- Electricity generation will double from the current level due to economic growth, electrification, and a boost in demand for green hydrogen. As the expansion of variable renewable energy is expected to continue for the foreseeable future, measures such as electricity storage and thermal power generation (with carbon capture and storage [CCS], hydrogen, etc.) will become extremely important to provide stabilisation and balance between electricity supply and demand.
- Oil and natural gas will increase throughout the Reference Scenario but, in the Advanced Technologies Scenario, they will start to decline in the 2020s and the 2030s, respectively. Still, fossil fuels together account for 73% of primary energy consumption (2050) in the Reference Scenario and 53% in the Advanced Technologies Scenario. Along with efforts to improve efficiency and reduce emissions with technologies such as CCS, securing a stable supply will continue to be an important issue.

Toward fulfilling the role of LNG and natural gas

New investment needed for stable supply of LNG and natural gas

- Cumulative required investments in the natural gas production sector from 2022 to 2050 are \$9.8 trillion in the Reference Scenario and \$7 trillion in the Advanced Technology Scenario. The liquefied natural gas (LNG) production sector will require an annual capacity addition ranging from 8 Mt/year (ATS) to 18 Mt/year (REF) on average, during the outlook period up to 2050.

- There is also uncertainty over those projects for which investment decisions have already been made, with possible delays and failures to materialise.

Cost trends in LNG production projects and challenges in procuring LNG for Japan

- Since 2021, supply chain disruptions triggered by the pandemic have caused delays and rising costs in the construction of LNG production projects. The overall cost pressures associated with the Russo-Ukrainian war are growing. Even after investment decisions have been made, rising instability factors in host countries of LNG production projects have caused delays.
- At the same time, technological innovations in small- and medium-scale liquefaction facilities and the expansion of modular systems (“design-one-and-build-many” strategies) are being introduced to control cost increases.
- In order to secure Japan’s necessary LNG procurement in the 2030s and beyond, it will be important to form procurement partnerships such as joint purchasing and volume optimisation between multiple buyers, to make Japanese companies semi-portfolio players, and to provide public-private cooperation and policy support in these areas.

Clarification of LNG role and need for stronger security presented at G7 and at LNG Producer-Consumer Conference

- Whilst the Group of Seven (G7) recognised the importance of natural gas and LNG, it will be crucial to establish standards for acceptable ‘abated’ LNG in the energy transition. The importance of an internationally aligned approach for measurement and reporting of methane and greenhouse gas (GHG) emissions and their mitigations was emphasised at the G7 Ministerial Meeting and at the LNG Producer-Consumer Conference in 2023.
- The enhancement of the International Energy Agency’s (IEA) role in strengthening gas and LNG security, which was presented at the LNG Producer-Consumer Conference, is also noteworthy.
- Furthermore, close dialogue between LNG producing and consuming countries through bilateral government-level consultations, procurement cooperation among consuming countries, and promotion of emergency accommodation cooperation will be important to strengthen gas and LNG security.

Issues for long-term stabilisation and development of the LNG market

- In the international LNG market, LNG investment and construction activities are advancing, especially in the United States, partly supported by LNG offtake commitments under long-term contracts. On the other hand, projects for which investment decisions were made in the past also face uncertainty and delays. Therefore, there is no guarantee that buyers’ procurement of LNG with a combination of measures including long-term contracts, as well as suppliers’ capability of LNG delivery, are secured yet.
- It is necessary to develop a variety of financial instruments to meet the funding needs of LNG production projects.
- Building partnerships between LNG buyers from the same and/or different countries, including joint procurement, will be effective in light of the buyers’ desire for flexibility, especially from emerging LNG markets with the expanding composition of buyers. Such partnership will also contribute to ensuring the stability of Japan’s LNG requirements, including long-term contracts.

Growing importance of negative emissions technology

- Interest in negative emission technologies (NETs), which capture GHGs from the atmosphere and store them elsewhere to stay over long periods of time, has increased in recent years both domestically and internationally. It is extremely difficult to achieve carbon neutrality without the contribution of NETs, especially in the industry and long-haul transport sectors, where the use of fossil fuels is certain to continue. Countries should more clearly and specifically position the use of NETs in their emissions reduction plans for long-term carbon neutrality.
- There are a wide variety of NETs, but many will take time to be commercialised. For individual NETs, countries need to take early steps to understand the potential for carbon removal in their countries, consider accurate and transparent methods for measuring removal, reduce removal costs, establish the value chains required for the introduction of each NETs, and assess the impact on surrounding ecosystems.
- International cooperation is also essential to the full-scale introduction of NETs. First, there is a need to widely share international recognition that NETs are an essential means of achieving carbon neutrality, and to accelerate preparatory work towards the establishment of internationally shared measurement, reporting and verification (MRV) systems and carbon removal certification and removal credit systems. At the same time, it is important to deepen discussions at the intergovernmental level in the future with a view to creating a mechanism to realise cross-border removal projects and their reflection in Nationally Determined Contributions (NDCs).

Paths towards ASEAN's energy transition

- ASEAN, with its remarkable economic development, will be at the centre of future global energy demand growth, and of the emission reductions. ASEAN will affect the success or failure of the global decarbonisation. As such, cost reductions are essential for achieving both economic growth and carbon neutrality, while an economically rational energy mix should be pursued.
- Assumptions about future economic growth and energy efficiency improvements will make a big difference in projecting future energy demand. It is not enough to focus only on the 'ratio' of renewable energy, because the total amount of energy demand will significantly change the energy mix we should be aiming for.
- The power generation cost by renewable energy is expected to be low among zero-emission power sources, making it a promising power source. However, it should be kept in mind that there is a possibility of higher electricity costs if the power facilities are spread beyond the suitable area, and that integration costs for stabilising electricity supply and demand will increase if variable renewables account for the majority of the power supply. It is necessary to determine the optimal quantity according to demand, weather conditions and land availability.
- Natural gas plays a major role in reducing emissions in the industry sector (especially for high temperature demand that is difficult to be electrified) and balancing electricity supply and demand. It can be an affordable fuel, especially in reducing emissions during the

transition period toward zero emissions. Expansion of supply capacity and stabilisation of the natural gas supply will contribute to reducing energy transition costs.