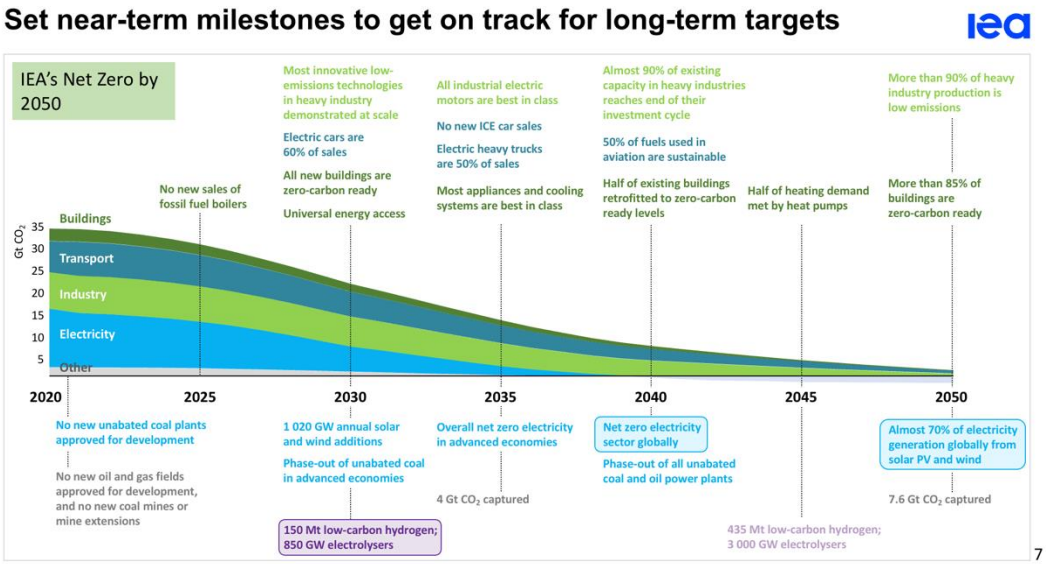
Net-Zero Emission Scenario and Energy Security

Nobuo Tanaka*

Net Zero 2050 (NZ2050): A Roadmap for the Global Energy Sector, a recent publication by the International Energy Agency (IEA), is causing controversy worldwide. A comment by Dr. Fatih Birol, Executive Director of the IEA, that all new oil and gas development projects must stop immediately if NZ2050 is to be achieved, attracted a barrage of criticism from oil-producing countries and oil and gas companies as an utterly unrealistic scenario. Saudi Energy Minister Abdulaziz bin Salman dismissed NZ2050 as a fantasy similar to the movie La La Land; Russia Energy Minister Alexander Novak mocked the scenario, stating that oil prices would surge to $200 if all investments were stopped immediately. Oil experts have criticized the IEA for being inconsistent: calling for halting long-term investments while backing the need for investment in oil in its short-term outlook. The IEA was established in 1973 as a strategic joint stockpiling mechanism following the oil shocks, but this time it was the Agency that caused a shock among oil and gas producers and companies.

First, we must note that the IEA scenario (roadmap) is not a forecast; it is a backcast drawn up by setting a policy target to be achieved at a certain date in the future and then working backwards based on a model to identify how the target can be achieved. So far, more than 120 countries including European countries, Japan, and the US have pledged to go carbon neutral by 2050. If this is to happen, the scenario estimates that at least 70% of power must come from wind and solar PV by 2050, the power sector must achieve net-zero emissions worldwide by 2040, new cars with



* Special Advisor, Sasakawa Peace Foundation / Distinguished Fellow, IEEJ

internal combustion engines (ICE) must be banned from 2035 (the EU has recently decided to do so), coal-fired thermal power must be banned from 2030, and new oil and gas development projects must be banned from 2021 (Table 1).

None of these milestones in the IEA roadmap is easy to achieve, if at all. The criticism that the roadmap's scenario is "easier said than done" is understandable. However, it is not the IEA but the governments that have pledged carbon neutrality that should be held accountable for setting unrealistic targets and misleading the public.

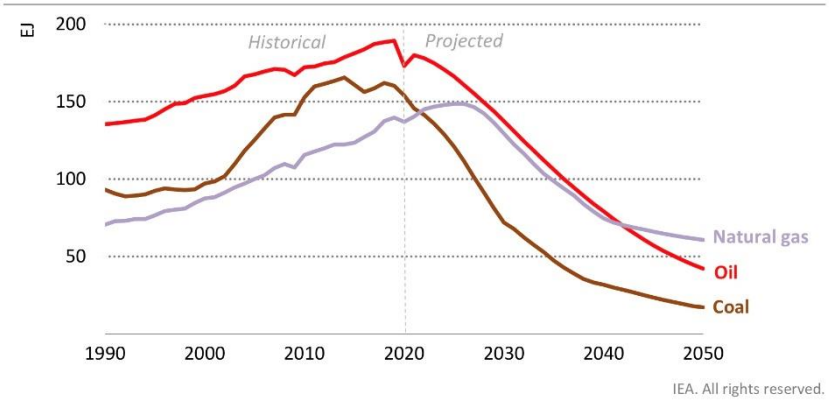
Is decarbonization possible? No one knows the future, and scenario analysis is a way of examining the uncertain future. We may not know the future, but we can at least prepare for it; this is the underlying principle of security. In the oil industry, oil major Royal Dutch Shell is renowned for its ability to create scenarios – it is believed to have drawn up scenarios anticipating the oil shocks and the collapse of the Soviet Union. But creating scenarios is only half the battle. The question is what Shell's management decided to do based on them. The decisions Shell made based on those scenarios are thought to include shifting from oil to liquefied natural gas (LNG) and investing in the Sakhalin LNG projects. Shell's 2050 net-zero emission scenario is named Sky 1.5. When its original version appeared 3 years ago, the Sky scenario astounded everyone with its boldness, and Shell themselves described it as visionary. However, with the recent revision of the scenario, the CEO of Shell pledged in February this year that the company would expand the scope of its 2050 net-zero emissions target to include all the products it sells, and declared that the company's oil production had peaked in 2019. While other European oil majors have also declared that they will decarbonize, the decision must have been momentous for Shell. Nevertheless, in May this year, a Dutch regional court ruled that the company's efforts to reduce carbon dioxide are not sufficient. The post-Covid world is moving quickly in search of safety and reassurance. Exxon Mobil has recently been forced by a general shareholder's meeting resolution to accept three board members recommended by environmental activist investors. It is easy to criticize the IEA's NZ2050 scenario as unrealistic and impossible, but it is up to the leaders of countries and companies to plan what to do in case the scenario is implemented and to take bold action.

Middle East oil-producing countries and their state-run oil companies are likely to be affected most by the trend toward carbon neutrality. Their enormous underground oil resources are at risk of becoming stranded assets. Former Saudi Oil Minister Ali Al-Naimi, with whom I often talked when I was the Executive Director of the IEA, said that "Saudi Arabia will aim to become a major solar power country rather than a major oil producer." He also said that the country will make not clean coal but "clean oil." It is possible to produce green hydrogen by using solar power, an inexhaustible energy source, to electrolyze water, and to produce blue hydrogen by extracting hydrogen from oil or gas and burying the emitted carbon dioxide back into oil wells. Ahmad Al-Khowaiter, CTO of Saudi Aramco, says that "the technology for utilizing hydrogen is maturing and Aramco considers that the hydrogen market is at an inflection point." Even if petroleum loses its value as a source of revenue for oil-producing countries, the carbon capture and storage (CCS) service, in which carbon

dioxide is stored in old oil wells, will begin to create value. US OXY is considering selling clean, negative-emission oil, produced by filling oil wells with carbon dioxide captured from the atmosphere (Direct Air Capture, DAC) and using the pressure of the gas to recover oil (Enhanced Oil Recovery, EOR). The oil produced this way locks away more carbon dioxide during production than is emitted when consumed. European oil majors are more serious about exiting oil than US oil companies. They appear to be taking the Covid shock-induced slump in oil demand not as a short-term phenomenon but a precursor to larger structural changes, in which decarbonization policies become the mainstream and changes in consumer behavior become the new normal. This is presumably why BP and Royal Dutch Shell announced massive write-offs of resources of $17.5 billion and $22 billion, respectively, in 2020 in quick succession. The conventional business model, in which the Seven Sisters oil majors and OPEC sell their underground resources drilled at a slow rate through their own cartel at high prices to earn an economic rent, is becoming a thing of the past.

Though its carbon dioxide concentration is lower than that of oil, natural gas will not remain unscathed as decarbonization progresses. It is true that the US has managed to reduce carbon dioxide emissions by replacing coal-fired thermal power with cheap and abundant supplies of natural gas derived from the North American shale gas revolution; this marked the dawn of the golden age of natural gas, which the IEA predicted 10 years ago. Indeed, gas-fired power will most likely survive as a bridge fuel until coal-fired power plants cease to exist, but thereafter, gas will also be required to decarbonize. Methane leakage is also a serious problem. An estimated 70 million tonnes of methane is leaking in the world each year, with a greenhouse gas impact equivalent to the entire CO_2 emissions of the EU. According to satellite images of the locations of leaks, the largest source is Russia, followed by the US. This situation must be addressed immediately. The EU is unlikely to accept natural gas as a clean energy unless it becomes free of methane and CO_2 emissions. Even Russia, a monoculture economy based on fossil fuels, has now begun to consider a strategy to convert oil and gas into blue hydrogen and export it. Also, in the world of liquefied natural gas trading, a product known as clean LNG, which has had carbon emissions offset with forestation and other means, has begun to appear in the market. NZ2050 estimated that oil demand peaked in 2019; natural gas demand is also due to peak before 2030 (Table 2).

Figure 3.2 ▷ Coal, oil and natural gas production in the NZE



Between 2020 and 2050, demand for coal falls by 90%, oil by 75%, and natural gas by 55%

If oil and gas suppliers are pinning their hopes on blue hydrogen, who will buy it? The biggest prospective importers are emerging Asian economies that have high growth potential. Heavy and chemical industries such as steel and cement are highly carbon-intensive and not easy to decarbonize. The region also has many coal-fired thermal power plants. These infrastructure facilities are still new compared to those of developed countries and will take several more decades to depreciate. Clean hydrogen is essential to move forward with decarbonization while using existing infrastructure. JERA, a thermal power joint venture by TEPCO and Chubu Electric, has declared the goal of becoming carbon neutral by 2050, and the key to achieving that goal is the mixed combustion of clean ammonia and coal in coal-fired power generation. A demonstration experiment for 20% mixed combustion is currently under way, and ammonia-only combustion is a future goal in sight. Natural gas turbines can also be decarbonized through mixed combustion of hydrogen and, eventually, pure hydrogen combustion. Thermal power has been regarded as an enemy by environmental NGOs, but with transformative ideas such as the use of clean ammonia and hydrogen, thermal power generation can help achieve the dual goals of carbon neutrality and economic growth. Innovative use of hydrogen is also entering the demonstration phase for the steel and cement industries, which are hard to decarbonize. For the CO_2 that will remain even then, it may be commercially feasible to launch a service for isolating the gas, transporting it through pipelines, and storing it underground, or transporting it in liquid form to oil-producing countries and sealing it in oil wells. The issue is cost. Fifty years ago, Japan successfully launched its first LNG project in which Alaskan natural gas was liquefied and transported to Japan. Japan accelerated the shift to natural gas by lowering the initial investment risk through guaranteeing long-term offtake and linking its price to oil prices; going forward, Japan will need to build clean hydrogen supply chains to meet the decarbonization demand of emerging Asian nations as well. Japan has three technologies for transporting and storing hydrogen that are most useful for this purpose: clean fuel ammonia, liquefied hydrogen carrier vessels, and organic hydride methylcyclohexane (MCH). All the technologies are undergoing demonstration testing for transportation with Saudi Arabia, Australia, and Brunei, respectively. Fuel ammonia will provide a means of transition for gradually decarbonizing existing coal-fired thermal power infrastructure. The advantage of MCH is that it can be handled in existing oil tanks and petroleum product carrier vessels as it is a liquid under normal temperature and air pressure. It will provide a strategic stockpile of electricity by storing it in oil tanks, of which there will be a surfeit going forward. Furthermore, liquefied hydrogen carrier vessels will be an economic mode of transport when the demand for hydrogen rises in the future. It will then be possible to create a business model that links hydrogen producer countries with Asian consumer countries and leverages the unique advantages of both. The future challenge is how to expand the scale and lower costs.

Along with transporting hydrogen and CO_2, another way to spur clean energy trade is to import renewable electricity through direct grid connection. The reason Europe can use large amounts of wind and solar power is because it can adjust fluctuations thanks to its large, Europe-wide electricity market. Europe is now planning to increase the storage of excess electricity

in batteries and in hydrogen form as a means to address output fluctuations. Japan's new Strategic Energy Plan includes plans to increase the share of renewables in the power mix to 36-38% in 2030. This is double the present level and is a daunting target. The grid coordination among Japan's nine power companies, which each have a regional monopoly, is poor, as symbolized by the country being split into two major frequency zones, East Japan with 50 Hz and West Japan with 60 Hz. This raises the risk of power cuts (as exemplified by the power cuts in the TEPCO area after the Fukushima Daiichi accident and the prefecture-wide power cut caused by the earthquake off the coast of Tomakomai in Hokkaido) and preventing the wider use of natural energies. With a timeframe of 15 years, for example, it would be possible to integrate the frequencies between East and West Japan, but will Japan make that decision? Dismantling the fragmented electricity markets, currently divided into nine, and strictly separating the ownership of the power generation business and the transmission business are the way to address Japan's energy security and global warming. This should also pave the way to establishing connections with the grids of other countries and importing cheap and clean electricity. Europe is also planning to utilize its existing infrastructure by injecting green hydrogen into its gas pipelines. At the Northeast Asia Gas Pipeline Forum (NAGPF), a forum for advancing the linkage of gas pipelines between the five countries of Japan, China, Russia, South Korea, and Mongolia of which I am the chairperson, we are planning to consider mutually providing clean electricity through an interconnected grid network, and hydrogen through pipelines. This will be a clean energy platform that can transform the energy geopolitics of Northeast Asia in the future.

Hydrogen will help achieve net-zero emissions, protect the global environment, and enhance energy security. The Golden Age of hydrogen is approaching.

Writer's Profile

Nobuo Tanaka

Mr. Tanaka is the Distinguished Fellow at the IEEJ. He is the chairman of the Steering Committee of Innovation for Cool Earth Forum (ICEF). As Executive Director of the International Energy Agency (IEA) from 2007 to 2011, he initiated a collective release of oil stocks in June 2011. He also played a crucial and personal role in the strengthening of ties with major non-Member energy players, including China and India. He began his career in 1973 in the Ministry of Economy, Trade and Industry (METI), and has served in a number of high-ranking positions, including Director-General of the Multilateral Trade System Department. He was deeply engaged in bilateral trade issues with the US as Minister for Industry, Trade and Energy at the Embassy of Japan, Washington DC. He has also served twice as Director for Science, Technology and Industry (DSTI) of the Paris-based international organization, OECD. He is currently CEO of Tanaka Global, Inc. He is also former Chairman of the Sasakawa Peace Foundation and serves as a Board member or an auditor at some corporations.