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REEXAMINING JAPAN IN GLOBAL CONTEXT

Suntory Foundation Research Project

SPECIAL FORUM REPORT 018

Update: The Future of Energy

December 2020

On December 7, 2020, forum members met with Nobuo Tanaka online for a wide-ranging discussion about global energy trends and Japan's energy future. Mr. Tanaka is a Distinguished Fellow at the Institute of Energy Economics Japan (IEEJ) and served as Executive Director of the International Energy Agency (IEA) from 2007 to 2011. Mr. Tanaka had spoken on the same themes at the first symposium in 2012, so this conversation offered a welcome update on his views.

The first question concerned the ongoing importance of fossil fuels, especially natural gas. Have Mr. Tanaka's views evolved since 2012?

Mr. Tanaka replied that 8 years ago, the golden age of natural gas had arrived, especially because of the shale gas boom in North America. Since then, exports from the United States, especially of Liquified Natural Gas (LNG), have changed the global energy market. In short, natural gas has been displacing coal-based greenhouse gas (GHG) emissions.

This trend will continue, but things are getting more complex for natural gas producers. Recent announcements from governments and industry related to carbon neutrality will force decarbonization in the natural gas sector as well, — and the timeline may move faster than expected. Two big challenges for the sector involve methane leaking from production sites and the viability of rapid, large-scale Carbon Capture and Storage (CCS).

Looking forward, hydrogen holds promise as a clean fuel for the future, despite high costs, since it only produces water vapour upon combustion. However, different methods of producing hydrogen involve different emissions profiles. Japan will pursue adding "blue" or "green" hydrogen to its energy mix.

"Green hydrogen" is produced from zero-emissions energy sources, like solar and wind, and uses electrolysis to split water into oxygen and hydrogen. "Blue hydrogen", on the other hand, is made using natural gas and relies on CCS to manage its emissions.

However, hydrogen can be difficult to store and transport. "Blue" or "green" ammonia may offer a solution, serving as a fuel, a store of energy, and a hydrogen carrier. Ammonia contains three hydrogen molecules and one nitrogen molecule, but it can be stored and transported more easily than pure hydrogen. Like hydrogen, ammonia can also be burned without direct C02 emissions, producing only water and nitrogen as combustion by-products. "Blue ammonia" is made from blue hydrogen; Saudia Arabia recently shipped 40 tons of blue ammonia to Japan. Relatedly, GHG-free "green ammonia" could be produced from green hydrogen.

Next, Mr. Tanaka was asked about the viability of CCS.

Mr. Tanaka replied that large-scale CCS deployment is possible. In Norway, for example, a mandatory carbon pricing regime of about $60 per tonne has incentivized storing CO2 in an aquifer. Fossil fuel companies around the world are also using CCS to increase oil recovery from aging wells.

With strong emissions-pricing mechanisms and government support, these types of projects will continue to scale. To make CCS economically viable, IEA scenarios assume carbon prices as high as $140 USD per tonne. This is simply the inevitable requirement of achieving carbon neutrality. Without such strong price signals, decarbonization cannot be achieved.

Next, Mr. Tanaka was asked whether target dates for decarbonizing will deter investment in CCS and natural gas, due to the risk that natural gas assets may become stranded.

Mr. Tanaka replied that there will be stranded assets unless blue hydrogen, blue ammonia, and carbon capture can be rapidly deployed at scale. To limit fossil fuel asset stranding, producer countries should quickly consider how to use their existing hydrocarbon resources within these emerging lower-emissions business models.

Saudi Arabia is an interesting example of a country wrestling with these trends. On the one hand, the kingdom hopes to scale production of green hydrogen and green ammonia

for global export and has built a large plant to support this goal. At same time, Saudi Aramco is trying to cooperate with Japan to produce Blue Ammonia.

Thus, Saudi Arabia understands the impending future quite well. Amid the global push to decarbonize in the face of rapid climate change, there are big questions about the future demand for fossil fuels. Hydrocarbon producers like Saudi Arabia see fossil fuel derived hydrogen as the answer to these questions.

Japan has also recently announced huge investments in the hydrogen economy, including plans to mix hydrogen or ammonia with coal for power generation to reduce C02 emissions and attempt to avoid stranding current coal assets. This model could be replicated elsewhere in Asia.

Next, Mr. Tanaka was asked about the feasibility of CCS in Japan, given Japan's porous geology.

Mr. Tanaka replied that it is feasible in certain places, both onshore and offshore, and there are several experimental projects already taking place. There have been some protests against CCS in Japan based on concerns that it could trigger earthquakes, although given the prevalence of earthquakes already in Japan, it is not clear that these fears are reasonable.

With that being said, it is very costly to do CCS when the underlying fossil fuel is burned. Thus, it probably makes more sense to deploy CCS on the production side, produce blue hydrogen or blue ammonia, and then transport that fuel to the end-user—in this case Japan. Scaling such a blue hydrogen economy will take time. Also, some energy users, such as steel mills and cement factories, may still need local CCS to decarbonize, since their carbon footprint is also heavily tied to the industrial process itself, not just the energy input. However, when considering full deployment of CCS, it makes the most sense to do this in the fossil fuel producing countries.

Next, Mr. Tanaka was asked about nuclear power. Have his views changed since 2012? How optimistic should we be about nuclear energy?

Mr. Tanaka replied by pointing out that energy observers such as Vaclav Smil were very pessimistic eight years ago, and continue to be pessimistic today. It seems that transforming the energy sector in favour of nuclear power would take a very long time.

Nuclear power's share of the global energy supply has never risen past about 5 percent. However, Mr. Tanaka stated that he is still cautiously optimistic about nuclear energy. Solar and other renewables are necessary, but nuclear power should be maintained as well.

With that being said, the large light-water reactor (LWR) paradigm is probably no longer viable because of the huge risk and impact of any accident associated with this reactor design. The cost of building and maintaining these systems is also getting higher; it is prohibitively expensive to build LWRs in Japan. The current Energy Minister recently indicated that it is currently unthinkable to replace old nuclear power plants with new ones of the same design.

The only hope for the nuclear industry is with small modular reactors (SMRs). Such reactors could have standardized designs and be factory-made. Such an approach could drive down costs and make it easier to regulate and license the technology. SMRs would have a flexible utilization rate, so they could also work well to support more intermittent renewable energy sources. This model has yet to be tested in any country, but if there is hope for nuclear energy production, a fleet of SMRs is the only answer. The United States is starting a "flexible nuclear" campaign, promoting the idea of using small modular nuclear technology as part of broader, decentralized energy mix.

Nuclear energy faces another challenge with waste. Extending the lifetime of current LWRs to 40, 60, or even 80 years will generate more and more radioactive waste. One way to mitigate this would be with an advanced nuclear system that burns plutonium from nuclear waste as fuel and thereby reduces the waste's radioactivity. An Integral Fast Reactor (IFR) would do precisely that. Japan has done a memorandum of understanding with the United States on this reactor design as Versatile Test Reactor (VTR). It is possible that IFR technology could even be applied to the melted debris from Fukushima. Japan could test this technology on Fukushima's waste; if it works, we could use it on spent fuel from anywhere in Japan. However, without public acceptance of the technology, this approach will not get off the ground.

Japan also has to consider proliferation risk. North Korea has a habit of shooting missiles over Japan. China, another nuclear power, is a big regional player. Iran is trying to develop nuclear weapons; if they are successful, Saudi Arabia is certain to follow. Terrorists and criminals are also a concern. These global proliferation risks must be reduced.

The IFR design is not proliferation-free, but it is proliferation-resistant. It is difficult to get pure plutonium from IFR plants. Thus, again, if we develop nuclear tech, this is the design approach we should take. Nonetheless, we may need to strengthen the International Atomic Energy Agency (IAEA)'s surveillance and compliance powers.

As part of any nuclear policy, Japan must also make clear that we are not interested in making weapons ourselves. We should proclaim this to the global community by joining the Treaty on the Prohibition of Nuclear Weapons. Historically, Japan has said we cannot join the Treaty because we need the protection of America's nuclear umbrella. However, Japan is an important country for a nuclear weapons-free world and should engage in non-proliferation diplomacy.

In thinking about denuclearizing the Korean peninsula, for example, Japan should offer the service of burning reprocessed plutonium in its LWRs. North Korea is thought to only have 40 kg of plutonium in their weapons. By comparison, Japan has 47 tons of waste, so 40 kg would be nothing for us. Such an approach would help show that our nuclear power is for peaceful use, by reducing North Korea's weap-

ons. Japan could also leverage this type of non-proliferation diplomacy and leadership to increase its influence at the United Nations.

The next question concerned the possibility for trilateral cooperation between Japan, the United States, and South Korea around nuclear energy and non-proliferation. Is there still a strong case on the merits for such an approach?

Mr. Tanaka agreed that there is, although politics tend to get in the way. Nonetheless, the three parties have common interests and could develop a common agenda around proliferation-resistant technology and denuclearization. South Korea has plenty of LWRs, so they could dilute enriched uranium from North Korea and burn it, however they are prohibited from using plutonium commercially; —only Japan and the five permanent members of the UN Security Council can do so. This leaves a unique opportunity for Japan to conduct anti-nuclear weapons diplomacy. Hopefully, the Biden administration will be more amendable to such an approach.

Next, Mr. Tanaka was asked how COVID-19 has affected global energy developments.

Mr. Tanaka pointed out that with lifestyle changes, remote working, and decreased air travel, oil demand has dramatically declined during the global pandemic. The question is, how lasting will these changes be, and will oil demand rebound as it has before?

Following the Lehman Brothers shock in 2008 there was a rebound and increase in oil demand. The pandemic is different because we have second and third waves to deal with, which are suppressing demand rebounds.

BP recently announced that oil demand has almost peaked and will soon level off. Depending on government and private-sector ambition around climate change, 2019 could even prove to have been the peak year for global oil demand. BP also announced plans to write off up to $17.5 billion in assets in response to changes to their demand forecasts and the pandemic-driven acceleration of the shift away from fossil fuels.

At the same time, with investors, lenders, governments, and companies around the world setting targets for carbon neutrality and sustainability, financing for fossil fuel projects is becoming scarcer and more expensive. The financial sector has been driving a lot of change, for example through the Financial Stability Board's Task Force on Climate-Related Financial Disclosure (TCFD), which sets a framework for disclosing climate-related risks and opportunities. This demand-side push is massive. The TCFD is now mentioned almost daily in The Nikkei. As more businesses respond to these demands for strengthened sustainability-linked disclosure and performance, they are increasingly asking their supply chains to do the same. This is driving widespread and rapid change.

COVID-19 is also accelerating digitalization throughout the economy. The big companies at the heart of this transformation, like Microsoft and Apple, are also committed to aggressive action on climate change, in some cases aiming for carbon neutrality by 2030. Thus, digitalization and decarbonization are in a sense happening together. These trends were already moving much faster than many had expected, and the pandemic has only accelerated these shifts.

Mr. Tanaka also raised another important issue: —gender balance. Although it might not immediately seem connected to energy and climate change, it is. Japan has had two related "shames" over the last few years. First, at COP25 in Spain, Japan was criticized for its continued use and export of coal and received the "Fossil of the Day" award twice. The second shame is that the World Economic Forum has indicated that Japan's gender balance index performance is 121st in the world. Japan's performance is even worse (144th) for women's participation in politics. The Abe government promoted gender balance, but did not really achieve it, unfortunately.

These two shames are linked, because climate change mitigation and gender are related. For one thing, the impacts of climate change are not gender-neutral: —women and girls are suffer more. Further, there are studies showing that companies with more gender balanced boards and management tend to show better climate leadership and take more serious action. Therefore, it would be helpful to have gender-balance reporting incorporated into TCFD frameworks for the sake of climate change mitigation.

Next, Mr. Tanaka was asked about the pressure Japan is facing from investors and CEOs looking to decarbonize. Recent reporting has highlighted that Japan does not have enough renewable energy to meet businesses' growing demand for low-carbon power, and as a result some major companies are considering relocating their operations to other countries. Is it possible that this growing pressure will change the political calculus of what is possible in terms of decarbonizing Japan's energy supply?

Mr. Tanaka responded that this is finally happening and will only get more serious. There are about 40 Japanese companies so far, including companies like Sony and Panasonic, that call themselves "100 percent renewable" companies. Amazon will likely join this group soon. This has introduced enormous demand-side pressures that will finally force utilities to increase the supply of lower-emissions energy, whether by adding ammonia or hydrogen to the mix to reduce emissions, or by abandoning coal entirely. Japan has good opportunities for offshore windmills, for example. A big challenge is that the power market is still composed of nine regional monopolies that are not connected with each other and are resistant to reform. However, to achieve carbon neutrality, a transformation of the power market is inevitable, and it is finally starting to move in that direction.

Next, Mr. Tanaka was asked whether peak oil demand might reduce our need to worry about energy security. If Japan becomes less dependent on imported fuels, can the country worry less about disruptions from overseas suppliers?

Mr. Tanaka replied that we should not be complacent, because there are huge opportunities for Japan in the changes that are underway. The digitalization and sustainability transformations are now happening much faster in other parts of the world. Japan had been delaying action, but COVID-19 is pushing us forward. We have to move from LNG to hydrogen. Japan's government has also announced plans for carbon neutrality and is putting resources into this goal.

Japan got into the hydrogen economy more than 10 years ago. However, our initial targets have yet to be achieved. In the meantime, China has been getting more serious about the hydrogen economy, increasing the use hydrogen for trucks and buses, for example. Europe's Green Deal also has hydrogen at its core. So, Japan's existing technologies and targets are already outdated; we need much more ambitious targets and policies, not only in transportation and mobility, but also with power generation and industrial applications.

The hydrogen economy may have been started by Japan, but it has been taken up by other countries and Japan has fallen behind. We cannot afford to be complacent.

One challenge is that government policies change when governments do. When new governments fail to follow past sustainability commitments, it makes it hard for the private sector to make long-term plans.

Next, Mr. Tanaka was asked about the vulnerability of the energy system to cyber-attacks. How should we assess the level of insecurity?

Mr. Tanaka replied that this question is increasingly important. As our dependence on digital infrastructure, electric vehicles, and so on increases, so too does the importance of avoiding cyber-security incidents. Although Mr. Tanaka pointed out that this is not his area of expertise, he indicated that Japan needs a more centralized government agency to monitor and manage cyber-related risks and threats. The Suga government is moving towards a digital transformation and establishing a Digital Ministry or Agency to plan for the future; cyber-security should be an important part of any new mandate.

A few weeks later, on December 21, 2020, forum members met with Dr. Cho-Oon Khong, the Chief Political Analyst with Shell International, to discuss Shell's energy and climate scenario planning work. The forum last met with Dr. Khong in 2013, following publication of Shell's "Oceans" and "Mountains" scenarios for imagining energy futures.

First, Dr. Khong was asked about how the previous Oceans and Mountains scenarios have played out and evolved over the last seven years. How should we assess the last seven years in view of the two scenarios?

Dr. Khong responded that the basic energy conclusions are sound; we are somewhere between the ranges set by the two scenarios. There are three elements to consider when we look at energy—supply, demand, and climate implications—and we are generally on track with how we see things.

The Shell scenarios team does not come up with its own climate models, but rather works with MIT scientists. However, when you have two scenarios, you are asked, "Is this the range of your thinking?," because neither scenario gets us to the goal of limiting average global warming to well below 2 degrees Celsius compared to pre-industrial levels. The Paris agreement, which was reached in 2016, formalized this goal. So, after the Paris Agreement was reached, we set out a scenario in 2018 that we called Sky. Our Sky scenario was aspirational in looking to see how the world could meet the Paris goals. According to the MIT scientists that we work with, our Sky scenario gets us to limiting average global warming to 1.7 degrees Celsius above the pre-industrial average.

The Sky scenario is underpinned by a technical analysis of what is required to meet the Paris goals. It is also important to recognize that Sky assumes that global energy demand will continue to rise, especially in the world's low-income countries, so this puts a further spur on the need to decarbonize. While energy demand may decline in places like Japan and Western Europe, it will necessarily increase in regions such as sub-Saharan Africa, the Middle East, and South Asia. We use UN population estimates for the analysis. As populations and living standards increase, energy demand inexorably rises as well. In our scenarios, we do not postulate any kind of materialistic nirvana or utopia. Instead, the scenarios assume a level of energy demand and standards of living that are not especially burdensome, and that give us a decent quality of life in all countries, but that do imply a doubling of energy demand over the course of the 21st century.

The Sky scenario also helps us think about plans for net zero emissions. There are a growing number of aspirational goals by governments, companies, banks and so on to reach net zero emissions by a given year. These goals put important stakes in the ground for all of us.

Shell's Sky scenario shows that it is actually possible to reach the Paris goals with the technology we have on the table today. There are also potential technologies, like nuclear fusion, that could be total game-changers if they can be successfully developed and scaled, but the scenario does not count on them since they remain unproven.

However, technological feasibility is only part of the equation. We also have to think about how we get to net zero emissions in terms of political will and mobilization. This remains an open question, and the Sky scenario calls for a shift in mindsets to enable it to happen. It is in this sense that the scenario is "aspirational." The Sky scenario was published in 2018. Since then, there have been demands for change from various climate groups. There has been gathering political debate and increasing policy seriousness in the United States and elsewhere around a "Green New Deal" and efforts to use sustainability to drive job creation and provide other social goods. If you can show people that taking action on climate change will help solve other problems and bring improve-

ment relative to the status quo, you have a shot at achieving the political mobilization required.

Then in 2020 the COVID-19 pandemic hit, raising a big question for the future: is what we are going through in 2020–2021 a blip that will fade away, followed by a reversion to previous behaviour? Or does it herald a major discontinuity in the status quo and in how governments and economies have been performing up until now? "Build Back Better" can mobilize people, and we need to address issues like inequality. Blowback and protests from groups like the French Yellow Vest movement, for example, show that we cannot tackle the climate crisis without also tackling inequality.

We have seen a similar lesson in dealing with the global COVID-19 pandemic. In several developed countries, social inequality, limited social protections, and ineffective governance have made the crisis worse than it needed to have been. Conversely, the countries that have best dealt with the pandemic so far include China, South Korea, Taiwan, Japan, Australia, Germany, and New Zealand. None of these countries is perfect in its response to the pandemic; but this group as a whole has shown that countries can deal very successfully with these types of complex challenges. A key question is whether the leaders are in touch with the public and have their attention and support. Thus, the way the pandemic develops will be key to understanding energy demand going forward, because the type of economy and society we move into will depend on how our ways of living have been transformed by COVID-19 and our responses to it.

Some things will possibly change. For example, maybe we could travel less. We will all work a lot more from home. Travel for leisure might also be curtailed to some extent. However, will the fundamentals change? That is much less certain. We should think in detail about how energy demand has changed in recent years. In 2013, we could already see that supply and demand were precariously balanced, even as the U.S. shale gas revolution was beginning to completely change the market. As supply shot up, this introduced a weakness in the market that has been very difficult to overcome. This culminated in the early days of the pandemic in the oil price war between Saudi Arabia and Russia. In the end, both sides had to back off because it was a lose-lose situation.

Everyone knows that we have to transition to a more diverse energy mix. However, we believe that the world will continue to rely on fossil fuels well into the future, as not all that we do can easily switch to renewable energy. So, while having specific targets is helpful and some energy transitions can happen quickly—as France showed in the 1970s on nuclear, for example—we will need to do this at global scale and across the board of our economies and societies. People often look at Norway as an example of a producer country that has diversified its economy, but it has its own characteristics, such as a small cohesive population, so it is not necessarily a relevant example to follow.

By and large, the major oil producing countries do recognize that they have to change. Oil companies also recognize that they have to move on the energy transition, but this requires a fundamental reshaping of the business model that has underpinned their operations over the decades. It is not impossible to accomplish this. There is a Danish company called Ørsted A/S (formerly Dong Energy A/S) that did successfully transition completely from fossil fuels to renewables. But you really have to imagine transforming the business model to make this happen. Fortunately, the Sky scenario suggests that there are many ways to play in the energy transition—not just renewables, but also electrification and sequestration of carbon dioxide. We are entering a transition tunnel from which not everyone will emerge. Some companies and business models will not survive the transition to a net zero economy, while others will not only survive but thrive amid the new opportunities.

In sum, a great deal has changed since the Mountains and Oceans scenarios were first published. Thinking about the pandemic, the energy transition, and the three scenarios (Mountains, Ocean, and Sky), much will depend on how we decide to work our way out of these overlapping health, economic, and climate crises. A short-term approach by governments is likely to further delay the energy transition. Alternatively, if governments take seriously the idea of a Green New Deal and "Building Back Better," this would allow us to move through the energy transition in a faster, more coherent way that also reduces inequality and addresses other social and economic concerns.

One of the key lessons of the pandemic is the critical importance of resilience. This flies in the face of much conventional economic wisdom about efficiency, short-term value maximization, and "just-in-time" manufacturing. Investing in resilience means you have to build up your whole economic structure in such a way that when a shock hits, the economy, society, and institutions are able to absorb it and keep standing. For example, Germany did better in the first wave of the pandemic in part because they had excess capacity built up in their medical system. But if you pare everything down to the bare minimum in the pursuit of short-term efficiency, you become more vulnerable to crises and you will struggle.

Economists such as Joseph Stiglitz and Mariana Mazzucato are talking about this important lesson about resilience. Inequality features prominently in this conversation too. Perhaps some have viewed inequality to be less critical in the short term, when we are focused on restoring growth going. But it fundamentally leaves societies in a very brittle state. Instead, we need to invest in building up the resilience that a focus on economic efficiency would seek to minimize.

Another factor to consider is that we see increasing friction and divisiveness in the global order, for example between the United States and China, both on geopolitics and on the economic front. Technology leadership is critical—this is an area

where both sides are starting to compete directly.

One commenter noted that it seems that scenario planning and futurism have always had an interpretive dilemma that exposes it to criticism: on the one hand, there is a need to be objective; but on the other hand, by engaging in the act of imagining the future, we set the parameters of what is possible.

Dr. Khong replied that scenarios are not predictions or forecasts, but they set out what is possible and what could happen. They need to be honest and based on a rigorous logic. And by projecting into the future, they make clear what needs to be done. He made the point with an observation about the path to net zero. We must achieve net zero emissions at some point in this century. In the Sky scenario, Shell imagined this happening by 2070, but you could move the timeline forward with more aggressive action. However, it is important to note that given where we are today and what we believe about an increase in energy consumption, we have to move beyond net zero to net negative emissions in the remaining decades of the century in order to stabilize the climate in a safe range for humanity. This has not been talked about enough yet, but we will need not only to limit emissions, but also to remove greenhouse gases (GHGs) from the atmosphere on a mass scale. This can be done, but will not be easy.

Next, Dr. Khong was asked about the need to limit average global warming to below 2 degrees Celsius relative to the preindustrial average. What kind of world should we expect if we overshoot this target, and what kind of contingency plans can we prepare in case we fail to meet it?

Dr. Khong replied that this is a question that a lot of people are struggling with. Even limiting warming just to 2.5 degrees will require a massive energy transition. If we stopped there, this might be an improvement on a business-as-usual trajectory, but it would be insufficient and would bring significant climate implications.

In fact, global temperature rise is already having significant implications for the world with the 1 degree of warming that we have now surpassed. For example, there were three recent articles in *The New York Times* dealing with climate migration. This is a big issue, but it is politically sensitive. We refer to climate-induced migration in our scenarios.

One example here might be the conflict in Syria. Prolonged drought drove a massive wave of people to cities. In the context of existing governance problems, climate change was like a match on dry tinder. We have now seen a multiyear civil war, regional destabilization, and a massive wave of refugees fleeing the country. Just imagine what this might look like on a much larger scale as the planet continues to warm. So, it is very important to note that climate change is happening already, it is serious, and if we are not aware of the problems, we are going to be very rapidly disillusioned in the near future.

Next, Dr. Khong was asked about technology. We have seen that shale gas and oil have changed the global energy landscape in recent years, but broader energy transitions take time for technology to roll out at scale. At the same time, technology must be both economically affordable and socially acceptable. Given these factors, what is the most promising technological development at the moment? For example, many industry players are pointing to hydrogen as a promising fuel as well as a way to store and transport energy.

Dr. Khong replied that it is very difficult to predict technology pathways, but given the seriousness of the situation, every technology is called for. For example, Shell's scenarios even show a significant increase in nuclear power, though from a very low baseline. With nuclear, it is important to keep the possibility of accidents in mind. What would happen if there was a major nuclear disaster in a country that is rapidly building up its nuclear power capacity? Battery technology has shown slow but steady progress, and given the resources that have been devoted to that area it is possible that there will be a breakthrough.

Overall, we find that taking a sectoral approach is important. Some sectors are easier to decarbonize than others. For example, air travel and high-temperature industrial processes are more difficult to decarbonize and will take longer. However, we are seeing some progress even with those challenging sectors. We should not underestimate how fast change can happen. Think of how the internet revolution has changed our lives, and the many varied applications of IT that have had an impact on everything that we do today.

There is also a suite of emerging technologies that people refer to as geoengineering. We should be extremely cautious about this. When you start messing with basic global parameters, you do not know what you are going to end up with. However, we have to be at least be aware that research is happening in this area.

Next, Dr. Khong was asked whether the Sky scenario takes GHGs other than carbon dioxide into account.

Dr. Khong replied that it does. The Shell team works very closely with the MIT climate science team on an ongoing basis to understand the complexity of global emissions and the range of warming associated with different emissions pathways. For example, methane is very serious. We are seeing methane emissions from shale production, but also from a feedback effect as the planet warms and the arctic tundra thaws. Concrete production is another major source of GHG emissions. So, there are all sorts of complex ways that different GHGs are released into the atmosphere from human activities, and lots of areas in which we need to intervene.

The next question was about the "Room to Maneuver" and "Trapped Transition" pathways. Is Shell still working with these? How have the pathways been reflected in different countries' performance over the last seven years?

Dr. Khong clarified that the Mountains and Oceans scenarios talked about governments having "Room to Maneuver" or getting stuck in a "Trapped Transition." The middle-

income trap was one potential roadblock to look out for. So middle income countries such as China have been very successful so far in developing their economies. But they will need to reform further if they are to move beyond the middle-income trap. China, for one, does have ambitious plans to do so. And what China does will have a massive impact on global energy demand.

Broadly, most countries have done well in terms of setting aspirational targets. The question is how do we get to meet the Paris targets? In the Sky scenario, Shell foresees carbon prices rising as high as $200 USD per tonne. If we think about what is happening in the pandemic, we are seeing that countries are willing to spend enormous amounts of money to respond to a crisis. We may set stretching targets, but we do have the means to reach them.

Next, Dr. Khong was asked about peak oil demand. BP recently raised the prospect that global oil demand may be peaking or may even have already peaked. What is Shell's view of future oil demand? Relatedly, some European oil companies have announced plans to move toward carbon neutrality, whereas some American companies have been slower to make such commitments. What accounts for these differences?

Dr. Khong addressed the issue of future oil demand. He is not in a position to comment on BP or other oil companies. As for the scenarios work that Shell does, the scenarios team was working hard in 2019 to produce new scenarios to renew Mountains, Oceans, and Sky. The refreshed scenarios were scheduled to be released in Q2 2020. But when the pandemic hit, the scenarios team recognised that it needed to take on board the implications of COVID-19 for energy transition. We will be launching these new scenarios in Q1 2021.

The Shell scenarios team engages extensively with climate scientists. We believe that an energy transition is inevitable. But what choices do we make that will affect the pace of that transition? Our position is that we want to be part of the energy transition. Previously, the thinking was that oil demand would peak in the 2020s, perhaps around 2025. COVID-19 may slow or accelerate the trend depending on the choices we all make. Ultimately, it is up to us to make the right choices.

Reexamining Japan in Global Context
Update: The Future of Energy

Online discussions, December 7 and 21, 2020

Interviewees

- Mr. Nobuo TANAKA, *CEO, Tanaka Global, Inc.*
- Dr. Cho-Oon Khong, *Chief Political Analyst, Shell International, Strategy and Business Development*

Project Directors

- Professor Masayuki TADOKORO, *Keio University*
- Professor David WELCH, *Balsillie School of International Affairs*

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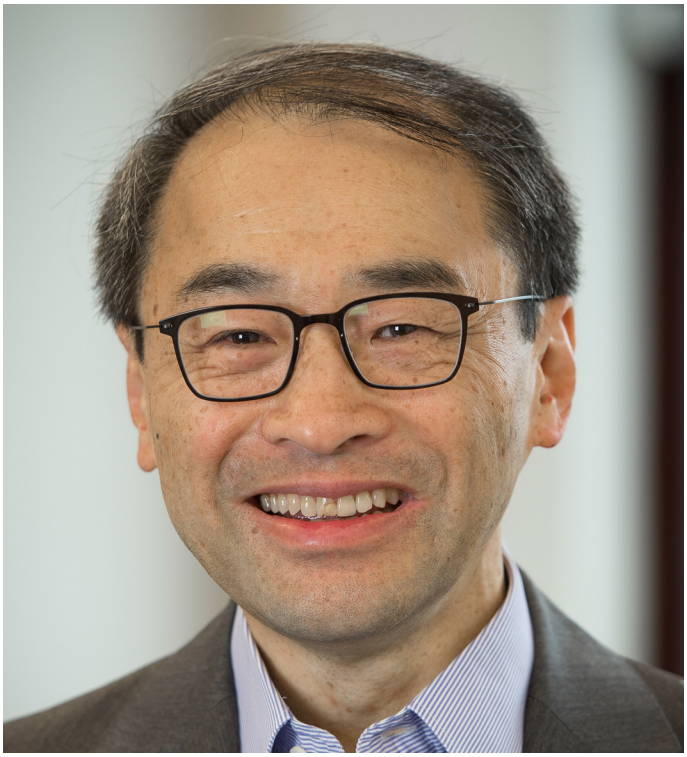
- Mr. Aladdin DIAKUN, *Crisis Century*
- Dr. Kazuki FUJIYAMA, *Kyoto University Graduate School of Law*
- Dr. LEE Seung Hyok, *Tohoku Gakuin University*

Mr. Nobuo Tanaka is former Chairman and currently Special Advisor of The Sasakawa Peace Foundation. He is also the chariman of the 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.



Dr. Cho-Oon Khong is Shell's Chief Political Analyst and a senior member of the Shell scenarios team, with over 25 years' experience advising on political trends and political risk, and leading the external environment assessments for Shell's country reviews. Dr. Khong has worked on scenario projects with international organizations, governments, universities, and businesses across the world. He is an Associate Fellow at the University of Oxford's Said Business School, where he teaches in the Oxford Scenarios Programme, and an Academy Adjunct Faculty member of the Royal Institute of International Affairs, Chatham House.

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