TATSUO MASUDA

Professor, Nagoya University of Commerce and Business Graduate School, Japan

Donald JOHNSTON

I turn to you now, Mr Masuda. Tell us how are going to decarbonise the atmosphere. Are you are going to talk about solar radiation management too?

Tatsuo MASUDA

Don, it is very nice to work with you again. I really enjoyed our relationship at the OECD many years ago. Let me start my presentation. I have five job titles and a few others to do. Quite interestingly, along with these 5-6 jobs, there is one key word that always comes to my mind. That is technology. Maybe technology is the solution to all the problems that we face regarding energy and climate change. That is why I am here.

Starting with the history of humans in association with energy, in the last 1 million years, we have been through several phases of revolution. The first one is catching fire, and then we moved on through several stages, including coal, oil, electricity and more recently nuclear. Nuclear came under our command on the eve of World War Two. Now we are getting into a completely different phase of the decarbonising revolution, just because of climate change. This is where we are.

Energy issues were relatively simple until about two decades ago. We only had to worry about economy, policy, technology and last but not least, geopolitics. But today, we are encompassed by a large red circle called climate change. Climate change dominates the entire spectrum of energy discussions, including economics, politics and social acceptance. Just because two-thirds of human-related CO2 emissions come from energy use, energy decarbonisation holds the entire key.

What about the role of technology? I have given a short list of technologies already in place and those about to come. This chart is a snap-shot of a White Paper by the World Economic Forum named “Scaling Technologies to Decarbonise Energy. This was published in October 2015, and I was the lead-author on medium-term technology. We discussed solar PV, wind power, third-generation nuclear and others. Those are already in place playing a big role, but the world is not enough with those technologies.

The medium-term technologies are those to become commercial within 15 years. Advanced batteries are among the most important ones coming on the horizon. There is also next-generation power electronics and advanced geothermal or large-scale ocean power and large-scale offshore wind power. Actually, the Japanese government is launching a big project off the coast of Fukushima, known for the nuclear accident in March 2011. They are building a huge offshore wind power demonstration plant with 7 megawatts in one unit. It has a wingspan diameter of 164m, and the total height is 105m. It is planned to install many more this scale of wind power in the years to come, to make a 2-3 gigawatt power generation complex. This is meant to replace the power generation from nuclear in Fukushima.

Also, carbon capture storage and carbon utilisation (CCS and CCUS) should be in place before it is too late. There is no way to dramatically curb the use of fossil fuels in line with climate initiatives without CCS and CCUS. Despite its high costs, there are very aggressive initiatives all over the world, and roughly 80 large-scale demonstration plants or commercial plants are already in place. However, the cost barrier still has to be overcome, which should be done through technological innovation over time. Hydrogen technology is flourishing albeit at a demonstration level in Japan,

ahead of the Tokyo Olympic Games. Next-generation biofuels should also be in place. Artificial photosynthesis is very interesting, but it is too early to be placed as medium-term technologies.

What is important here is that there could be many technologies yet to surface hiding behind those already identified and foreseen. This is the most important point of my presentation today, which I will make a bit later. In the interest of time, I will pick up three examples of medium-term technologies. Power storage is the real key to fully utilising intermittent renewable technologies like wind and solar, but the development of storage is annoyingly slow to my knowledge. This is partly because it is chemical reactions that cause power generation. It is very hard to control by human knowledge yet. However, because of increased investment and the race towards a better battery, the problem could be solved in a matter of a decade or so. If effective power storage becomes very easily affordable by any people, even in Africa or part of Asia, decentralized mini-grid will spread very quickly. Two examples. These are a lithium-sulfur battery by US DOE and a lithium-air battery by AIST Japan. However, there will be more, like zinc air and others, competing for excellence.

The next one is next-generation power electronics. This is probably not common knowledge and it is only for electronic technicians, but very interesting and important. Any electricity supplied should be converted in terms of voltage, current and frequency, by using semi-conductors. They are called converters and inverters, but they themselves consume a lot of electricity. This poses a very big problem. Convergence efficiency should be dramatically improved, to make the best use of electricity as we are living in the world of electrification.

There are technologies using two key materials, which are silicon carbide (SiC) and gallium nitrite (GaN). Gallium nitrite is famous for blue LEDs, which gave the Nobel Prize to three Japanese professors. If you use those new devices, convergence efficiency can improve six-fold or 10-fold. It may take several years for this technology to be fully commercialised. The contribution to electricity saving will be huge. For example, in the year 2023, if all computer routers were replaced with this type, the world can save electricity equivalent with the total annual consumption of electricity in Japan. The impact is that big, so this should be the focus of heavy investment by companies and governments.

The last one is advanced nuclear reactors. The large-scale nuclear power plants now in place are in a way too large. In terms of security and safety requirements, they are getting more and more expensive, and the lead time for construction is becoming longer. The issue of political and social perception and acceptance is added to such already difficult situation. Because of these, we are thinking of small modular reactors which can be prefabricated in a factory, transported in a lorry overnight and installed quietly in a smaller space. Some of them could be installed under the ground, offering a better protection against attacks by terrorists or airplane accidents.

These types have a better waste profile as well. In certain types, for example, a cartridge containing fuels will be put into the system and taken out when exhausted, then the cartridge can be buried under the ground directly. In terms of non-proliferation, it has a better profile, but there are two downsides. There are yet not enough serious investors to support this technology to go through the pilot phase or demonstration phase. Also, if they produce this commercially, the orders should be several hundred units per module. Otherwise, it does not make enough economic sense.

Donald JOHNSTON

Can I ask you a question on this though? This is very important and interesting, and I think we will hear about nuclear in a moment, but this is what you are saying. You are using the term decarbonise by using alternative energies and not putting carbon up there. However, there are also other technologies. As I understand it, they are working to actually take the carbon out of the atmosphere. There is a big study at Harvard and elsewhere. Can you tell us about that? If we do not do that, as I understand it from the people who are here, there is enough carbon up there now to

take us above the 2° limit that we are talking about. It is still going up. Most of the technologies you are talking about are not commercialised and will not be for some time, as you have just admitted yourself.

Tatsuo MASUDA

There is a technology to capture carbon in the air. A company called Blue Planet in the US has developed a technology to capture carbon in the air and transform into usable materials. They mimicked the natural reactions, but the cost seems to be still high. However, already, people have their eyes on capturing carbon that has already been spread into the air.

The last two points are about going beyond projected energy futures. IEA's scenario of energy futures is like this. Even in 2040, the fossil share will be 75%. However, IEA cannot take into account technologies yet to surface. They pick up technologies that are already there and are credible ones. However, efforts like those of Bill Gates to create the Breakthrough Energy Coalitions are focusing on investing in dream technologies, which are not visible yet. If we are able to engage with all these new and dream technologies for decarbonisation, we can go beyond IEA's scenario about decarbonisation. This is what I like to see. Bill Gates says energy needs a miracle and we really have to bring miracles.

The last point is that there is a fight between the green empire and the black empire. On one side, there is the black empire, which likes the status quo and loves to stick to hydrocarbons. On the other side is the green empire, which likes to push greener energy and decarbonization. However, the biggest enemy to greening is basic human nature. We are lazy, we like wealth and we like pleasure, and by nature, we do not like to conserve much. How can we tackle with this human nature? There is short-term political populism, shown by Donald Trump, such as walking out of the Paris Agreement or powering the fossil fuel industry. There is cost competitiveness of fossil fuels although the costs of renewables are coming down quickly, as discussed. There is also mistrust regarding climate initiatives among players.

However, we have a good chance of decarbonization, because there is increased climate risk awareness and political will towards climate initiatives, as shown in Paris. There is also climate compatibility as a rule of the game. The most important rule in doing business today is climate compatibility everywhere. Renewable energy will become an economic necessity before long. The cost reduction in renewable energy is remarkable. For example, the cost of silicon solar panel has declined by 80% from 2008 to 2015. The bottom line is scaling decarbonizing technology. The last point is that, unlike humans, technologies will not complain. Once they are put in the right place at the right timing, they will do the job without any complaints.

Donald JOHNSTON

I think we have to bring this part to a close, but the thing is I think the public has to understand what this challenge is. Until they do, then you are not going to get the political will that you need, because politicians are short term, especially in our four-year cycles. You mentioned that number regarding renewables, including hydro and I guess including nuclear too. I think today, you can tell us these figures, but I think today, wind and solar represent about 3% of global base-load energy.

How are we going to go from that to having people keep fossil fuels in the ground, before we hit that magic number of 2°, which was where we started? I am going to ask panellists at the end to give me their candid opinion as to whether we are going to be successful in that or not.