# ICT-based social communication on collaboration of renewable energy and nuclear for Carbon Neutral 50

Hidekazu Yoshikawa[1)]

1)Symbio Community Forum, co. Institute of Advanced Energy Science, Kyoto University, Gokasho, Uji, Kyoto, 611-0011 Japan (yosikawa@kib.biglobe.ne.jp)

***Abstract*— Effective use of advanced ICT for the social communication from academia is proposed in order to help general public to understand deeply energy and environmental issues by avoiding the influence of biased mass media which tends to focusing on agitating anti-nuclear campaign by environmentalists. The essential idea of outreach activity by researchers of advanced energy science is the effective use of social networking system (SNS) to promote active learning between researchers and general public.**

***Keywords— resilience; SDGs; carbon neutral 50; renewable energy; nuclear energy; SNS, outreach; active learning***

## I. INTRODUCTION

Many countries around the world including Japan expect much on renewable energy (RE) towards the goal to attain carbon neutral in 2050 (Carbon Neutral 50). [1] RE has abundant resource of no global warming gas emission, but it is distributed unevenly and varies in time for power generation. To realize Carbon Neutral 50 is not so easy task for many countries. Here arises a new word “resilience”. In this paper, the discussion starts on what “resilience” means because the word is referred in many places and many ways in the Sustainable Development Goals (SDGs) which all the member countries of United Nations (UN) adopted unanimously in 2015. [2]

Then the discussion follows on the unjustified argument from the spirit and its logical contradictions of the SDGs by environmental activists who insist to exclude nuclear power from clean energy at the United Nations (UN) Convention on the Prevention of Global Warming (COP). It is because their said clean RE alone cannot achieve the balance between supply and demand of electric power systems. The discussion on this point will proceed by some examples of energy mix with the impact of accident if the balance between supply and demand is lost.

We will look for the challenges for carbon neutral 50 through collaboration between RE and nuclear. We will introduce our outreach activities for the general public by researchers of advanced energy using Information Communication Technology (ICT) toward carbon neutral 50 through collaboration between RE and nuclear power.

## II. CARBON NEUTRAL 50 AND NUCLEAR

### *A. SDGs, 2030 Agenda, and Resilience*

SDGs stand for Sustainable Development Goals. The SDGs were formulated by UN on September 15, 2015, when the 2030 Agenda for Sustainable Development was adopted together with the SDG. [3] There are two pillars of the goal formulated: eliminate poverty from the world and to transform the modern unsustainable society, economy and environment into a sustainable ones by 2030. With 17 goals, 169 targets, and 232 indicators, the SDGs are inseparable and integrated goal that summarizes all social, economic, and environmental issues of the world. It does not legally bind UN member states like treaty, but it is a work of all the developed, emerging and developing countries of the world with "spirit of equality" that no one will leave behind in realizing it. The salient concept that goes through the 2030 Agenda is to transform our world on a sustainable, strong and supple (resilience) path. It is also noteworthy that the driving force for the adoption of the SDGs was not the already developed countries in Europe and the United States, but many countries that have traditionally been called developing countries.

Unlike the internationally enforceable efforts of the COPs on individual issues such as climate change and biodiversity, the SDG has been working on social, economic and environmental issues. It emphasizes the spirit of "people, by people, for people" participatory democracy, which recognizes wholeness and indivisibleness and provides an integrated solution without leaving anyone behind. And as an approach to change, the word resilience appears in many goals of the SDGs under the definition of resilience, restoring force, tolerance, supple strength. It aims to diminish the gap between rich and poor and to achieve resilience in agriculture, urban environment, social infrastructure, resource development, and marine environment with consistency.

In Japan, the Great East Japan Earthquake, an unprecedented disaster in March 2011, destroyed social infrastructure all at once. This experience strongly impressed the Japanese with the word resilience, and in 2015 a book entitled "What is Resilience" was published by Junko Edahiro [4]. In this book she gave a perspective on the concept of resilience that has spread from the fields of environmental ecology, to psychology of infants and adolescents, to the state of social infrastructure. Then resilience is defined as "the ability of a system to cope with disturbance without changing to a qualitatively different state". In 2017, Kazuo Furuta introduced a "system thinking" approach that mathematically formulates the mechanism and named it as resilience engineering[5].

Such a "system thinking" approach has recently evolved into computer simulation of global climate changes and is being used by the UN Intergovernmental Panel on Climate Change (IPCC) to prevent global

warming. In August 2021, the IPCC has released a report containing scientific predictions that the global average temperature rise since the Industrial Revolution will reach 1.5 ° C within the next 20 years.[6] The IPCC warned that the damage caused by heat waves, heavy rains, and droughts will occur frequently and will increases in many places around the world if no countermeasures are taken now. In the 2015 COP21 the Paris Agreement was adopted as a goal of keeping the temperature rise below 2 ° C, preferably 1.5 ° C, after the Industrial Revolution. However, the average for the past 10 years has already risen by 1.1 ° C.

The IPCC report envisions five future scenarios according to greenhouse gas emissions and predicts the rate of increase in the future. It was suggested that the temperature could return to 1.4 ° C at the end of this century, with the assumption that carbon neutrality will be achieved to reduce emissions to zero around 2050. At the COP26 which will begin on October 31, 2021 in Glasgow, UK, even more aggressive efforts to prevent global warming should be discussed to surpass the 2015 Paris Agreements.

In COP3 in December, 1997, Japan had actively contributed to the compilation of the Kyoto Protocol to set emission reduction targets for only the developed countries. Since then, the Japan's energy policy has been deepening turmoil due to the TEPCO Fukushima nuclear meltdown accident that occurred in March 2011.The future image to prevent global warming is still uncertain even 10 years after the Fukushima accident due to the decline of nuclear power which had played central role in power supply. However in response to the Paris Agreement in 2015, Japanese Government frequently had revised the Fifth Basic Energy Plan to reduce Japan's global warming gas emission. Then in December 2020, Prime Minister Suga announced the Japan's Carbon Neutral 50 declaration.[2] Then in July 2021, the draft of the 6th Basic Energy Plan [7] was announced with the following content:

(1) Outlook for energy supply and demand in 2030--Based on the new reduction target for 2030, we will promote thorough energy conservation and expand the use of non-fossil energy, aiming for 50% reduction of $CO_2$. The power composition is 36-38% for RE, 20-22% for nuclear power, 20% for LNG, 19% for coal, 2% for petroleum, and 1% for new hydrogen / ammonia.

(2) About nuclear power for 2030--With safety as our top priority, we respond to climate change issues and use it as a stable and inexpensive energy source. Even while achieving carbon neutrality in 2050, nuclear power will use the required scale.

Since the Kyoto Protocol at COP3 in December 1997, the Japanese government so far in the COP series has assumed nuclear power as top priority to reduce the greenhouse gases such as coal, oil, and natural gas to prevent global warming. The number of countries promoting nuclear power generation has increased in Western countries and Russia with Asian countries such as Japan, South Korea, and China. However, opinions to exclude nuclear power from clean energy to prevent global warming have been predominant at the scene of COP series conference in the past, where European environmentalists lead the debate. The background to this trend was due to the Chernoville nuclear accident occurred in the former Soviet Union Ukraine in May 1986.

### *B. Divided views on Nuclear for Carbon Neutral 50*

The countries that have declared carbon neutrality 50 have expanded to 120 countries and regions, including Japan, the United States, and developed countries in Europe, but there are some countries of major emitting countries such as India and Russia. Although there is still the possibility of achieving the 1.5 °C target, in reality it is essential to reduce emissions worldwide. At COP26 in Glasgow in October 2021, reduction rules through international cooperation will be discussed in addition to the discussions aimed at strengthening reduction targets in each country.

Since the Kyoto Protocol at COP3 in December 1997, the Japanese government so far in the COP series has assumed nuclear power as top priority to reduce the sources of greenhouse gases such as coal, oil, and natural gas to prevent global warming. The number of countries promoting nuclear power generation has increased in Western countries and Russia with Asian countries such as Japan, South Korea, and China. However, opinions to exclude nuclear power from clean energy to prevent global warming have been predominant at the scene of COP series conference in the past, where European environmentalists lead the debate. The background to this trend was due to the Chernoville nuclear accident occurred in the former Soviet Union Ukraine in May 1986.

In the 2000s, the revival of nuclear power known as nuclear renaissance, began in Europe and the United States. In response to this trend, in June 2010, Japan announced a drastic nuclear promotion plan through the Basic Energy Plan (50% nuclear power, 20% renewable energy), which focuses on nuclear power generation and RE. However, the situation surrounding nuclear in Japan changed completely due to the accident at the Fukushima Daiichi Nuclear Power Plant that occurred in March 2011.

How do you think about the Japanese failure, i.e., bad safety regulation of nuclear power plant before Fukushima disaster? You will see lessons from this but here, we focus only on the ratio of nuclear power (20-22%) recently set by Japanese government for carbon neutral 50, in order not to repeat the past failure. To tell the truth, it is actually very difficult to attain it in the energy mix. According to the public opinion poll, the Fukushima accident triggered a reversal of public opinion from the approval of nuclear to 60% against nuclear power (nuclear phase out), and this has been well established even 10 years after the accident.

According to The Asahi Shimbun, one of Japan's leading newspapers, the editorials has listed three reasons against nuclear power: (1) nuclear severe accident will destroy the foundation of the country. The enormous risk of nuclear accident is unacceptable, (2) The government

explained that nuclear power is cheap but it was liar as was seen by the Fukushima accident. (3)High risk of underground disposal of high level radioactive waste is unacceptable because the radioactive level will not decay even after 100,000 years.. This kind of anti-nuclear argument has been leading public opinion in Japan favoring nuclear phase-out.[8]

It is said that the COP26 management organization in Glasgow has declined the exhibition of World Nuclear Association (WNA) in the Green Zone for the exhibition of clean energy NPOs and companies, by saying the same reason as the Asahi Shimbun in Japan. [9] The author of this paper thinks that the biased anti-nuclear claim by European environmentalist who has dominated in the COP from the past, is a logical contradiction in terms of the purpose and spirit of the SDGs and the 2030 Agenda of the UN which states that "no one will be left behind" for the goal of preventing global warming and for the sustainable development. In short, there are many people in Japan and in the COPs who believe that global warming can be prevented by simplifying that nuclear power is bad and only RE is acceptable. But this is also not so easy to believe by seeing the real society both in Japan and around the world.

## III. ICT-BASED SOCIAL COMMUNICATION

The author of this paper will introduce our newly started outreach activity by using ICT technology for promoting carbon neutral 50 through the collaboration of nuclear power and RE.

### *A. Path to carbon neutral 50 through collaboration of nuclear and RE*

First, the author will simplify the problem of electric power management as explained below:

The electric power business constitutes an electric power network and provides electricity to society, where the both amounts of power generation and electricity usage must be adjusted so that they are always the same value. Whether or not the supply and demand is properly balanced all the time can be seen by looking whether the frequency of electricity flowing through the power grid is higher or lower than the commercial frequency (either 50 Hz or 60 Hz). As this frequency increases, power generation is reduced. If it decreases, vice versa. The company that operates the power grid makes such adjustments all the time.

In power generation using RE such as solar cells and wind power, the amount of power generation is determined by sunshine and wind blowing which are difficult to control. On the other hand, nuclear power is best to operate constantly at full power. Therefore, the both are difficult to adjust to follow the time-varying demand. Then what to do to balance the time changing power generation and usage? Here, natural gas power plant is used because it is suitable for changing power from moment to moment, In this way, different types of power generation methods are combined and adjusted so that the power generation and usage are always the same. This is called the energy mix.

But natural gas power plant emits carbon dioxide and to avoid global warming, it cannot be used. Then how do you adjust the power balance? Here comes pumped-storage hydroelectric power plant to be used only when electricity is needed: The sluice gate of the upper dam is opened to generate electricity. The water after the generator is stored in the pond below. When electric demand is below the power generated by RE or nuclear, the generator of hydroelectric power plant is switched to a pump, and the surplus electricity is used to turn the pump to pump up water from the pond below and store it in the dam. In this case, natural gas is not burned, and so global warming can be prevented.

It is not the choice between nuclear or RE but the question of how to combine different power generation in the energy mix. RE does not emit carbon dioxide (there is a time variation in power generation), and nuclear power generation also no $CO_2$ discharge (constant operation), and pumped storage power generation also no $CO_2$ discharge (operation only in time of need) in response to changes in the power demand of society (time fluctuations such as seasonal fluctuations and daily fluctuations). How to combine different power generation method effectively to meet with time varying social demand surely with low cost and low CO2 emission is the key to the collaboration between nuclear power and RE in the whole energy mix.

The author's explanation given above is a simplification of the problem. Tadashi Narabayashi gave a lecture on the real problems of Japan on the possibility of collaboration between nuclear and RE with the goal of carbon neutral 50 at a symposium held by Symbio Community Forum.[10] Narabayashi described the collaboration between nuclear and RE with the goal of carbon neutral 50 in Japan as follows:

(1) Before the Fukushima nuclear accident, Japan's power composition was nuclear power 25% and thermal power 65% in 2010, but after the accident nuclear power 1.7% and thermal power 84% in 2016. After that, nuclear power 6.2% with only 9 nuclear power plants in operation. Solar power now accounts for 7.6% of total electricity due to the preferential policy of feed-in-tariff (FIT). Both nuclear power and solar power increased by 4% in three years. As a result, $CO_2$ emissions has fallen by 9% in three years.

(2) The capacity factor of solar and wind power is low (solar power 13%, wind power 20%), and so the other power sources are absolutely necessary. It is difficult to use RE as the main power source. As an extreme example, if you try to meet 100% of the electricity demand with sunlight alone, you have to install solar panel with installed capacity of 770% of the electricity demand and store all the surplus electricity. It must be possible to supply electricity in the time zone when power generation is not possible). For that purpose, 1,000 trillion yen of electricity storage, livestock energy, hydrogen production equipment, and pumping equipment are required.

(3) Development of small modular reactors (SMRs) with improved nuclear safety is underway in the United

States and around the world. While no future image of nuclear power generation in Japan.

(4) Abnormal weather (cold waves, typhoons), strong earthquakes collapsed steel towers and power plant failures (windmill freeze, thermal power / nuclear power plant shutdown.), and they occur one after another. Resilience measures are needed to deal with the spread of various power system accidents and power outages.

### *B. Outreach activity for carbon neutral 50*

In Japan resources are scarce, and there are many mountains and natural disasters. Establishing resilience to Carbon Neutral 50 requires very complex systems thinking. It is not so easy to solve simply by nuclear phase-out as the biased media and environmental scholars recommend. The author of this paper believes that it is necessary to raise the knowledge level of general public and enlighten the next generation who will contribute to solving problems. Therefore, the author is going to organize outreach activities to society by advanced energy researchers.

Recently, the educational community has been proclaiming the promotion of active learning with the aim of improving the educational effect through mutual interaction between teachers and students in the classroom. However, in outreach activities by researchers, it is necessary to create a platform for mutual interaction with various layers of society, in addition to mutual interaction with students in the classrooms. Therefore, the author decided to use social network system (SNS) that is neither a mass media such as television or newspapers nor a personal media such as telephones, letters, and emails.

Actually, Mr. Narabayashi's lecture mentioned earlier was conducted by remote symposium by the use of ZOOM .It was not intended to promote active learning through mutual interaction between the speaker and the audience. The next symposium by ZOOM is scheduled to be held in December 2021, and we are introducing the following ways to enhance the effect of active learning.

(1) Take advantage of ZOOM's chat function and recording function to record mutual interactions between lecturers and audiences during lectures.

(2) Before and after the lecture, take questionnaire to the audience to see the change of interest and understanding of the theme.

(3) Analyze the data in (1) and (2) above and utilize them to improve the effective lecture method and lecture implementation by the instructor.

## IV. CONCLUSION

In Japan, as a result of the TEPCO's Fukushima nuclear power plant accident that occurred in March 2011, 53 nuclear power plants, which were responsible for 40% of total electric generation were all shut down, while the increase of thermal power generation had to meet the electricity demand. All 3E + S got worse. After that, the regulations on nuclear power plants were tightened to permit the restart of nuclear power plants, but public opinion was changed to nuclear phase-out. Currently, 10 nuclear power plants are restarting 10 years after the accident but it maintains just 6% of total electricity. During this period, the ratio of RE increased, but the reality is that it is impossible for RE to supply all the power demand.

Currently, the Japanese government has announced plans to achieve carbon neutral 50 by increasing RE to 46%, with assuming nuclear power ratio of 20-22%, with environmentalists and their supporting media speaking loudly total nuclear phase-out. However, the government's carbon-neutral 50 plan is impossible to realize their said nuclear power ratio.

In summary, the motivation, background and planning of outreach activities by researchers of advanced energy science are proposed on the collaboration of RE and nuclear, with the hope of promoting the general public's understanding of carbon neutral 50.

## ACKNOWLEDGEMENT

This work is supported by the "Joint Usage/Research Program on Zero-Emission Energy Research, Institute of Advanced Energy, Kyoto University (ZE2021D-02). This work is being carried out with the cooperation of Japan Industrial Location Center, which was commissioned by Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry.

## REFERENCES

[1] Toward the realization of carbon neutrality in 2050, Website of Ministry of the Environment Japan, https://www.env.go.jp/earth/2050carbon_neutral.html（As of September 21, 2021.）

[2] Hiroshi Minami and Masaki Inaba, SDGs-Compass in times of crisis Iwanami Shinsho 1854, Iwanami Shoten, November 20, 2020.

[3]Sustainable development goals, Website of United Nations Information Centre, https://www.unic.or.jp/activities/economic_social_development/sustainable_development/2030agenda/（As of September 21, 2021.）

[4]Junko Edahiro, What is resilience, Toyo Keizai Shinposha, 2015, March 26.

[5]Kazuo Furuta (Ed.), Introduction to resilience engineering, Nikka Giren Shuppansha, 2017, July 28.

[6]IPCC, Climate Change 2021: The Physical Science Basis.https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/（As of September 21, 2021.）

[7]Outline of basic energy plan (draft) Website of Ministry of Economy, Industry and International Trade,https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/2021/046/046_004.pdf（As of September 21, 2021.）

[8]Tomohiro Murayama, Still three reasons to aim for nuclear phaseout, J. AESJ, Vol.63(8), pp. 127-128, 2021.

[9] Top story, Nuclear group says it's barred from COP26 exhibit, American Nuclear Society SmartBief, August 20, 2021.

[10] Tadashi Narabayashi, Nuclear power and renewable energy- Challenges for collaboration, Webste of Symbio N&R, Vol10, No.1., 2021 http://symbio-newsreport.jpn.org/?type=report&action=view&id=165（As of September 21, 2021