Part II: GIES for Addressing the Global Issues

Itaru Yasui (Chair)
Senior Fellow, Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)

I will serve as moderator for the second portion of the session.

The Need for Clean Energy: The Photovoltaic Power Generation Era is Coming

Yukinori Kuwano
President, Photovoltaic Power Generation Technology Research Association

I will speak on the topic of natural energy. For over 40 years scientists have been working to harness solar energy. Photovoltaic energy has the potential to deliver global innovation and help resolve global issues caused by human consumption of fossil fuels, both alleviating CO2 emissions and providing sufficient energy to sustain the growing human populations.

The amount of solar energy that reaches the earth in an hour is enough to supply our energy needs for a year, and it is clean energy, not finite. Development of PV began about 50 years ago, and picked up in earnest in many countries after the "oil shock." Around 1990 it was made available for power generation; performance improved, costs fell, and it was made available to be used on the ordinary rooftop. PV is now becoming a basic energy for the 21st century.

Solar cells generate no noise and require no fuel. In addition, recent developments allow these cells to be fabricated at lower temperatures, and research has greatly improved conversion efficiency.

For many years PV was stuck in the intermediate zone mentioned by Dr. Ikoma. This was accomplished by commercializing PV in a calculator before the technology was ready for larger application. This helped to establish public acceptance of the technology, and eventually led to the development of the first reverse flow PV photovoltaic system in a private house.

Through PV, what seems to be an ordinary rooftop is actually a social innovation. When excess electricity is generated by the cell, it can be sold to a utility company using technology to store electricity as a result of discussion among private individuals, the power industry and the government. Initially PV cells were very expensive, and Japan took an early lead in their adoption thanks to government subsidies. This small innovation has spread to other countries Germany and Korea.

Energy payback time (EPT) describes the energy required to fabricate solar cells and how many years would be required to generate enough energy to recover the initial expenditure. PV reduces CO2 emissions and provides a domestic energy reserve even to countries such as Japan, which lack oil. If PV systems were installed in all possible places in Japan, they could generate 30% of the nation's annual power supply.

Since the first PV technology, efficiency has risen from four to 10 times, while cost is 1% of what it used to be. Future challenges include reducing cost further, enhancing reliability and extending the life of PV systems.

If an international grid connected PV systems, then during the night in Japan energy could be transferred from a large-scale panel in the African desert, for example, through a low-resistance, superconductive grid. A PV system able to meet global energy demand would require only 4% of the desert area on the earth. The technology has already begun spreading; the next step is to create national superconductive networks, and then international networks. Japan has recently produced a breakthrough technology in this area, and experiments have begun in the US.

Amongst all the potential renewable energies, solar energy in the form of generated power could be transmitted and distributed all over the world. The hope is that not only Japan but as many countries as possible will adopt this technology in order to reduce CO2 emissions and save the environment.

Toward the Realization of Society for Sustainable Mobility

Hiroyuki Watanabe
Senior Technical Executive, Toyota Motor Corporation

I will speak about innovation in the transport sector from a future perspective. Transport comprises 21% of the total energy CO2 emission. The automotive industry would like to reduce this to close to zero. Already, fuel efficiency regulations, improved traffic flow and an increasing eco-drive mindset among the public have contributed to decreased emissions.

The WBCSD is an organization with a membership of around 200 companies worldwide in which top management gathers to think about environmental issues and social ethics and promoting industry development. In the automotive industry, business as usual cannot lead to sustainable mobility. In the market the various companies are competing, but in the foundation level they are trying to share a common understanding in terms of policies and goals in the future.

Development of transportation is necessary in order to lead to the growth of the country and prosperity of citizens. However, automobiles generate an environmental burden. In Japan, the top runner in the market for fuel efficiency serves as a benchmark for the next-generation vehicle development and that has been the approach for a long time. By 2015, the target is 23% or more reduction in CO2 emission.

In 1997, Toyota launched the hybrid car Prius, with 50% of CO2 emissions of a conventional car. Outcomes depend on the energy mix of a given country; in the case of Japan, driving the Prius results in a 13% CO2 emission reduction, while in France, where the electricity power generation mix in France is quite dependent on atomic energy, it can lead to 50% reduction. Thus automotive technology is very important, but generation of the primary energy supply must also be improved.

Electronic controls offer further potential for controlling CO2 emissions by making cars into robots that behave for the optimal balance between and energy consumption for each type of driving condition. In addition to this smart driving, drivers must be smart as well, and choose not to use their cars when there are alternative or more appropriate modes of transportation, such as buses, bicycles or walking.

Lower energy consumption is needed to create innovation for this new sustainable mobility, which required reduction in vehicle weight and size. Modes of driving, such as automated driving and platoon driving can increase efficiency and reduce factors such as wind resistance. Such systems have to be developed in parallel with the transportation infrastructure. Toyota worked to restructure traffic in Toyota City, replacing 2,000 cars with public transportation, walking or bicycles by reorganizing shifts to reduce congestion and restructuring roads to the factories. Quality of life and quality of transportation were both greatly improved.

Nance in France has also initiated a system combining well-planned parking lots with frequent public trams to cut down on traffic and reduce the amount of time needed to get to the center of town. Citizens prefer it because it is comfortable and convenient. If this were introduced in Japan, it would incorporate advanced technology to allow precise scheduling of a trip.

Two major goals for improving competitiveness are reducing CO2 by half and minimizing traffic accidents. Japan is particularly hard pressed by high prices compared to the US and Europe. Lowering costs could lead to the revitalization of areas outside of Tokyo. This would require changes to infrastructure, new communication infrastructure, innovations in auto bodies, citizen and government activities, and strategic policies and implementation.

Members of the Council on Competitiveness Nippon have engaged in crosscutting communication, generating a proposal to be fed into the general science and technology conference project and accelerating reduction to the society. Various agencies and ministries have been implementing these plans. In the system that is emerging right now, in designated model cities, municipalities are taking the major role and the corporations are supporting them.

Innovation going forward is not something that is likely to happen in a single product. The Prius, in the history of vehicles, will likely be the last of its kind as a single product innovation. Trial and error in demonstrative tests is important, because public acceptance is crucial. Technologically speaking, demonstrative tests are very demanding. They must be visible to the citizens, and progress along the PDCA cycle to continue to improve and compete with the global community in the global arena. In fact, competition for transportation performance between cities could be built into the system.

Technology is changing, and as it changes the way that our towns look and our quality of life will also change. It would be ideal to invigorate towns and enhance quality of life for future generations.

Water Resources Management in Thailand: Problems And Challenges

Monthip S. Tabucanon
Director General, Department of Environmental Quality Motion, Ministry Of Natural Resources and Environment , Thailand

I would like to present a paper on "Water Resources Management in Thailand: Problems and Challenges." Thailand is an agricultural country, primarily rice farming. In the past there were ample water resources. In the past 50 years, rapidly increasing water use in the agricultural sector in addition to population growth and concentration of economic activities has increased water demand.

In past development, natural resources were exploited without clear control measures, with great impacts on water quality, aggravated by conflicts and limitations on water resource development, so Thailand is now faced with increasingly frequent and severe water-related problems such as floods, droughts, water shortage and water pollution more frequently. These problems have caused great damage in affected regions.

Thailand has therefore developed a National, Economic and Social Development Plan for 2007 to 2011, emphasizing a green society and people-based centers and following the self-sufficiency philosophy of His Majesty the King. The direction of national development under the plan is to focus on reliable change of people and adapting to various dimensional changes under a self-sufficient economy. The national plan is the starting point for providing direction of development based on the existing and genuine potential of Thai society.

The main objective of the development strategy is to add value to existing economic, social, and natural resources and environment capital as the strong foundation for sustainable development and to strengthen the economic structure through development based on long-term bio-diversity development and integrated water resource management. The National Water Resources Committee under the office of the prime minister submits to the Cabinet for approval policies on water resources. More local River Basin Subcommittee, appointed by the national committees, consist of government officials, state enterprises, local government representatives, water use organizations, and resident stakeholders. Their role is to compile data on water resources and other relevant resources to propose work plans.

Guidelines for flood mitigation include protection and rehabilitation of forest conditions and preserving forest ecological conditions as much as possible from soil erosion prevention and reduction, and improvement of various laws. Guidelines for drought and water shortages consist of watershed conservation for sustainable and equitable use of water resources in each area with public participation in conservation and rehabilitation. Water allocation should be controlled according to the priority of various activities.

Natural water resource conservation involves legislation on natural water bodies. Enhancement of water use efficiency should be accomplished through different activities such as awareness raising, education, prioritization of water use.

There are a number of measures in place to improve treatment of domestic, industrial and agricultural wastewater and to ensure and improve water quality in rivers and reservoirs. In addition to these, social measures which include public participation are also necessary.

Under the National Water Mission, by 2025 Thailand will achieve sufficiency in water supply of the whole country through good governance system with effective sustainable and equitable use of water. In sustainable economy strategies focus is on the protection, restoration and rehabilitation of watershed areas, storage of sufficient water and efficient water use, and reduction of flood prone areas and flood risk.

According to calculations, the total cost for the water management under the strategic plan will be about 970 billion baht; solving Thailand's water problems will therefore require significant budget allocation.

A New Strategy on Food and Agriculture in the 21st Century

Yoshihiro Hayashi
Professor, Graduate School of Agricultural and Life Sciences/ Faculty of Agriculture; Director, the University Museum, the University of Tokyo

I will speak about the impact of global warming on agriculture and the necessity for a stable supply of high value-added food in the 21st century. In Japan, food production is on the decrease, and accounts for a relatively low amount of value in the economy. At the same time, Japan's population is also decreasing. Rural and agricultural areas face a particularly large drop in population, an urgent issue for Japan. The government has therefore been making efforts to revitalize rural villages. One way to tackle this issue is enhance the added value of agricultural products.

Forests play a role in absorbing CO2, and in order to comply with the commitment of the Kyoto Protocol, Japan needs to cultivate new trees to absorb CO2. Agricultural land may also be able to function to absorb CO2. Development of technology for this purpose could also be of use to countries with more agricultural land.

Creating higher added value for food is a matter that concerns

not only Japanese agriculture, but the world food supply and food safety in general. In Japan, because the food production industry is relatively small, there is relatively little private funding available for agriculture research compared with engineering and other industrial research; consequently, the government bears 100% of the cost. There is a council within the Ministry of Agriculture that plays the role of linking research laboratories and administrative offices.

Not only is Japan's population shrinking, but it is also aging. Japan needs to save labor and increase energy efficiency. Japan has strong robotics technology which could be improved to this end. Robots could be employed in agricultural functions. This could comprise a second agricultural revolution, reducing the labor needed for agriculture and accommodating the shrinking and aging population.

Another place to make improvements is in high quality agricultural products for which consumers will be willing to pay a premium. This could include special organic foods or genetically modified products enhanced to improve human health and nutritional value, or even tailored for specific individuals. There are also possibilities for using agricultural products for medical purposes, such as creating edible vaccines for people and animals. There are, however, some public acceptance issues with genetically modified foods.

When considering the possibilities for function foods, however, it is important not only to consider premium products for consumers in developed countries. Of the 6.5 billion people on earth, one billion are becoming sick due to overeating, while more than one billion others lack proper food. For those suffering the effects of famine, use of transgenic plants that are able to grow successfully in even harsh conditions such as alkaline soils or dry areas could offer a solution.

Recently, due to globalization, there have been problems with mislabeled food and falsification of food labels. DNA technology can be used to accurately identify high-quality foods.

Japan is proud to be spreading its agricultural technology all over the world. Very little thought was given to IP rights until a few years ago, however, which had the effect of injuring Japanese farmers in global competition. There is now a committee in the Ministry of Agriculture concerned with intellectual property.

Agricultural innovation not only can play a role in mitigating global warming, but it must also adapt to changing environmental conditions that make it difficult to continue growing traditional crop varietals. This has already happened with rice in Japan, and a new type of rice has been developed that is better suited to a warmer climate.

I. Yasui
I would like to offer comments on the presentations given throughout the day.

In the first presentation Dr. Suzuki mentioned former Prime Minister Abe's Cool Earth 50 plan, a starting point for measures at least in Japan for global warming. It was unusual for a Japanese prime minister to promote a plan so far in the future, but now Prime Minister Fukuda is going on to follow up on the Toyako G8 Summit. The contents of this plan, however, are quite complex and challenging. Reduction of emissions will be required at a much faster pace than previously anticipated.

In Japan, energy consumption is increasing, but there have been drops in emissions, which have remained more or less steady, as a result of fuller utilization of atomic power plants. In the US a similar trend is seen; the plateauing of the line indicates a maturing of the system. Realistically, in order to meet our goals we must use renewable energy and increase energy efficiency. While emissions from developed economies such as Japan and the US have peaked and then plateaued, if highly efficient technology can be transferred to countries like China and Korea, they may be able to avoid the peak altogether. GIES offers one way of providing that pathway to such countries.

The number of automobiles in the world is expected to triple by 2050 from 2000 levels, with gains primarily in China and India. Sustaining tripled energy consumption will be impossible. Furthermore, increased automobile production places massive demands on the steel industry, which also produced CO2 emissions. We must not only develop new technologies such as electric cars and increase fuel efficiency, but also reconsider the entire social rationale behind using private cars as opposed to shared cars or public transportation.

A grand design is needed to globally balance economic development, resource and food availability, and environmental effects. GIES is aiming to establish an interaction field for such global issues.

Water issues, as mentioned by Dr. Tabucanon, are often very

local. Water is unique in that it is difficult to transport, so local measures are needed. In addition, much disaster is linked to water. The GIES system may be able to transfer flood and water disaster prediction know how from countries like Japan to countries like Vietnam where it is crucial.

Agriculture, as mentioned by Dr. Hayashi, is on a linear growth track. Despite warnings about corn being converted into bio ethanol, there does not appear to be a looming famine crisis. In many parts of the world the population is booming, while in other areas it is shrinking. Due to natural causes, population growth may be lower than previously predicted, which could alleviate certain issues. The United Nations' MDGs were to be met by 2015. By meeting these goals of reduction of extreme poverty and hunger, universal primary education, gender and female empowerment, education for women, and reduced child mortality, the birth rate would be reduced and natural attrition of population can be achieved.

In terms of water issues, there is water pollution, which was a major issue for Japan in the 1970s, and then was cleaned up over the next 10 to 15 years. Overall today pollution is decreasing and other issues are increasing, including landfills. Developing countries face natural destruction of forests and natural disasters, waste issues, and then, globally, CO2 issues. It will also be necessary to further address biodiversity; developed countries with expertise in this area should transfer it through GIES.

There is no doubt that technology is key to solving many of the problems, but research and data collection must continue to identify emerging but still unrecognized problems that could grow into the scale of global warming. Once these needs are identified, key technologies can be selected and products developed.

Ultimately the mindset of global citizens must change and the social framework be strengthened in an upward spiral. External factors contributing to this spiral include industrial structure, pricing of energy and resources, and population trends. The survival of humans will be dependent on rainfall, food, and temperatures, and the limited capacity of various natural resources. A good social framework must be established to adapt to these factors. The example of Germany raised by Dr. Kuwano is very advanced, and can be learned from.

By 2020, we will need to establish "Eco-tech 2.0" technologies that combine higher efficiency of technology with the joint effort by users. For instance, users must make good choices in purchasing eco-friendly products. Products can also be calibrated to interface with users, such as a television that turns off automatically when no one is watching it.