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Towards the Diffusion of Photovoltaic Power Generation Systems

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It is a great honor for me to be asked to give the keynote speech on behalf of the photovoltaic power industry at this IEA/PVPS International Conference here today.

First I would like to express my sincere thanks to our sponsor, the New Energy and Industrial Technology Development Organization (NEDO), and to everyone else whose tremendous efforts have made this conference possible, and my deep respect for all those connected with the IEA, which has continued to work so hard to promote the diffusion of PV power generation.

Today I am meeting many of you for the first time, so I would like to begin by telling you a little about the work I have been doing.

I have been involved in the management of two corporate groups — the Kyocera Group and the KDDI Group.

Kyocera Corporation was founded in 1959 as a maker of fine ceramics. Based on our management rationale, “To provide opportunities for the material and intellectual growth of all our employees, and through our joint effort, contribute to the advancement of society and humankind,” Kyocera has grown to become a comprehensive manufacturing company during the past 44 years. With fine ceramics as our core technology, we now make a wide variety of products, including PV power generation systems, cellular phones, photocopying machines, printers, and cameras.

KDDI Corporation was founded in 1984, following the deregulation of Japan's telecommunications industry, as a domestic long-distance carrier that could provide communication services to citizens at low charges. Since then it has developed its business extensively into the fields of international telecommunications and mobile communications

such as cellular phones, and has become Japan's second largest telecommunications carrier.

The combined sales of these two corporate groups whose management I have been involved in — the Kyocera Group and the KDDI Group — currently amount to about 4 trillion yen. Business related to solar energy still does not account for a high proportion of these sales, but I am convinced that it will become a major business in the future and that it will contribute significantly to the further development of humankind.

My own involvement with PV power generation goes back to 1973, when I first encountered sapphire crystal growth technology. Thinking that this technology could be applied to the growth of silicon crystals, we began research and development on photovoltaic cells. But just at that moment, the first oil shock occurred at the end of 1973.

Against the background of this grave crisis, particularly since Japan is so poor in energy resources, the development of a new energy source that could replace petroleum was strongly urged as a national policy. This led, among other things, to the launching of the Sunshine Plan as a national project.

I thought that if we could use this silicon crystal growth technology for the mass production of PV cells that convert the inexhaustible energy of the sun into electrical energy, we could make a very significant contribution to society in the field of energy supply. And so we embarked on the commercial production of silicon PV cells.

In 1978, Kyocera became the first company in the world to succeed in mass-producing ribbon crystalline silicon cells using the edge-defined film-fed growth (EFG) method. In 1986, we were also the first to mass-produce polycrystalline silicon cells with the casting method, which is now the main technique used throughout the world. In these ways, Kyocera has positively pursued the development and mass production of PV cells for about 30 years up to the present.

In 1987, to further promote the diffusion of PV power generation, I held a meeting attended by representatives from industry, universities, and the government. Considering it essential to establish a forum for technological development and the exchange of information, I brought together promoters from 11 organizations and established the Japan Photovoltaic Energy Association (JPEA). I became the first representative of the JPEA and during the

following 12 years I strove to promote the diffusion of PV power generation. The JPEA now has 69 member organizations and is actively working towards the diffusion of PV power generation.

In the course of this dialogue between the public and private sectors through the JPEA, a system of subsidies was commenced for the diffusion of PV power generation systems for public facilities and industrial use in 1992 and for use in residential housing in 1994. In response to this diffusion promotion system, we have seen successive capital investment and new participants from Japanese industry in the PV power generation field.

We are holding this conference in the 10th anniversary year of the establishment of the IEA/PVPS Photovoltaic Power Systems Programme. During these 10 years, rapid progress has been made in the introduction of PV power generation systems. As a result of growth at a rate of more than 35% a year, the total global production of PV cells reached 512 megawatts in 2002 and production in Japan accounted for about half of this total.

Nevertheless, the size of the world PV power generation market is only 3.6 billion dollars and as an industry it is still only at the developing stage.

Various measures will be necessary to promote the further diffusion of PV power generation and I am sure we will be discussing specific measures at this conference. However, as a basic prerequisite for this, I believe that it will be necessary to change society itself.

By this I mean that we will have to realize a shift from a mass production and mass consumption society that destroys the global environment to a society that makes it possible for us to coexist with nature — a society in which we are content with what we have.

The destruction of the global environment by humankind has been going on since ancient times. When we lived in forests and survived by hunting and gathering, human beings coexisted harmoniously with nature. But with the birth of civilization came farming and cattle-breeding, and as trees were cut down to clear fields for cultivation and land for grazing, the forests were destroyed.

Forests are basically renewable, but with the development of civilization the amount that people consumed exceeded the amount they regenerated and the forests gradually disappeared from the areas around towns and cities. Indeed, the regions where the world's

four great ancient civilizations once stood are now mostly desert. This was the result of human beings removing the regenerative capacity that the land originally possessed.

And now we are faced with the very real danger that rapid industrialization on a global scale will destroy not only natural ecosystems but may even destroy our civilization itself. This has happened because humankind has successively developed and mass-produced new technologies and products for the purpose of satisfying our constantly growing desires.

Based on the belief that it is good to produce more and consume more, we use vast amounts of energy to create an economic system founded on mass production and mass consumption.

Through this economic system, people in industrial countries can now enjoy advanced consumer lifestyles and until recent years we have never really doubted that the application of this way of thinking to economic activities would make our lives rich and affluent.

But as a result of this economic system that places priority on the satisfaction of our limitless desires, the environment has been destroyed at an ever-increasing pace and the survival of humankind itself has come under threat.

Floating in the universe, our earth is biologically a completely closed system in which millions of species of living organisms coexist in a very delicate balance. But the rapidly progressing destruction of the earth's environment has now begun to upset this balance and many species have already become extinct. And there is no reason for us to believe that humankind will be an exception.

Should we not interpret this as a warning from nature that our constant yearning for limitless economic growth is imposing too great a burden on the earth's environment?

The time has come for humankind to reflect very seriously on a society that places priority on economic growth based on mass production and mass consumption. For the sake of future generations, I think we must ask ourselves whether it is really a good thing to continue consuming fossil fuels in vast quantities and pursuing economic growth to satisfy our own desires.

When we ask ourselves this question, I believe there is an attitude of mind that can serve as

our guide. This is the Buddhist teaching that you should be content with what you have.

Since human desires will always increase without limit, there can be no end to the pursuit of their satisfaction. We must think very seriously about the tragic outcome that is likely to result from this. Surely the time has come for us to abandon ways of thinking aimed mainly at satisfying our ever-increasing desires and to search for a way of life that can keep them in check.

I believe that the attitude of being content with what you have contains the key to solving global environmental problems and promoting the further diffusion of PV power generation.

Today, in advanced countries where an affluent society has already been achieved, economic policies pursuing even greater affluence are being implemented, but is it really possible for advanced countries to continue their economic growth forever?

Many developing countries too are making efforts to achieve economic development so that they can acquire the advanced cultural life that citizens of advanced countries now enjoy. Of course, people in developing countries have the right to seek a rich and cultural life just as we in advanced countries do, and the use of the resources and energy required for this has to be accepted.

But if people both in developing and advanced countries continue to pursue material wealth and to consume resources and energy in vast quantities, this will, as I said before, lead to the further deterioration of the global environment and may well be the path of destruction for humankind itself.

I think that the citizens of advanced countries, which are now said to consume 80% of the world's energy, should now consider the wealth they already have as sufficient, restrain themselves from pursuing even greater affluence and devote their energies to conserving the earth's environment.

This attitude of being content with what you have is also a new way of looking at the nature of society. That is to say, it represents a fundamental shift from a selfish society that aims to satisfy our desires to an altruistic society whose aim is the harmonious coexistence of all living things.

I believe that if people's consciousness can change towards aiming at a society in which all living things coexist without destroying the natural environment, while maintaining the current level of affluence, the opportunities for the use of environment-friendly renewable solar energy will increase and the diffusion of PV cells will advance rapidly.

In the world's advanced countries the diffusion of PV power generation is being promoted through preferential measures such as subsidies. In Japan, for instance, as I mentioned earlier, the government is providing subsidies for the introduction of PV power generation systems in residential housing and a system aimed at promoting this is already in operation. Unfortunately, however, while the general public continue to place priority on economic efficiency, and since the subsidies themselves are tending to decrease, the targets for diffusion are not always being reached.

It is certainly true that PV power generation is still not as economically efficient as fossil fuels, but if people's awareness were to change so that they placed a higher priority on contributing to the global environment, even at some sacrifice to themselves, this would undoubtedly give a great boost to diffusion.

At present, the world's unelectrified population is 1.64 billion. In other words, about one quarter of the world population are still not enjoying the benefits of electricity.

I believe that advanced countries should actively provide assistance for the electrification of these villages so that people living in unelectrified villages in developing countries can attain a level of cultural life where they can enjoy watching television together as a family and young people keen on studying can use electric lights to read at night.

The use of PV power generation is particularly suitable for these unelectrified villages. In June 1983 I visited the village of Kankoi in Pakistan and donated to it a PV power electrification system. I was deeply moved to see how delighted the people of the village were. Following that we donated a solar pumping system to Thailand and a village electrification system to the city of Lanzhou in China.

I think that the advanced countries should take positive steps to utilize PV power generation technology in this way to bring electricity to the world's unelectrified villages. Since the IEA/PVPS Programme is an essentially agreement for the provision of assistance for research, the development of technology has been its central theme over the past 10 years.

However, I would like to express my strong hope that during the next 10 years, based on the concept of coexistence I have just outlined, it will step up its activities placing priority on the diffusion of PV power generation throughout the world, including developing countries.

For our part, we in the industrial world will make even more positive efforts to enhance research and development and mass production technologies aimed at diffusion, to improve the module conversion efficiency of PV cells, and to cut costs.

At present the efficiency of PV cells is 13-14% for bulk-type silicon cells and 8-10% for thin film-type cells, but if we actively promote the development of new materials, I think we can increase these efficiency levels to 20% for bulk-type silicon cells and 13-16% for thin film-type cells by the period 2015 to 2020. It is essential that PV cell manufacturers make assiduous efforts to realize further improvements in the efficiency so that these targets can be achieved.

At the same time, the way we use energy is expected to change from carbon-based energy utilizing hydrocarbons such as petroleum and natural gas to hydrogen-based energy utilizing environment-friendly hydrogen.

I am convinced that in this hydrogen age PV power generation can play a very important role in the supply of hydrogen.

One of the themes we will be discussing at this IEA/PVPS conference is research on the potential of large-scale PV power generation using deserts and other regions that have not yet been exploited. For example, if a PV power generation system could be laid out over a large desert region and hydrogen produced by electrolyzing the water underground, the desert would become a vast energy supply base, and if such a system could eventually be downscaled, it would also be possible to turn every household into a hydrogen supply base.

By this I mean that by performing electrolysis using the direct current generated by the PV cells installed in each house, hydrogen can actually be produced and stored in the home. It should then be possible for this hydrogen to be used, through fuel cells, not only as a power source for households or automobiles, but also as a heat source in the kitchen, for example.

If we could conduct research and development on electrode materials and catalysts for the efficient electrolysis of water, it would be possible to produce hydrogen more efficiently and

cheaply in the home. This is only the dawn of the hydrogen age, but I am sure that regenerative fuel cells combining PV power generation systems with fuel cells will further promote the development and diffusion of PV cells and accelerate our progress towards this environment-friendly hydrogen age.

I very much hope that this conference beginning today will help to promote the diffusion of PV power generation systems on a global scale through such technological innovations as these. I also hope that this is going to be an historic conference that will stimulate a change in human consciousness from a society that pursues material wealth to a new kind of society in which all living things can coexist in harmony. This is the only way we can protect our beautiful earth.

The aim of this conference is to contribute to the progress of humankind by promoting, through international cooperation, the use of PV power generation as an important renewable energy source in the near future. I would like to conclude this keynote speech by expressing my strong hope that we will have free, lively and passionate discussions during these two days and that our dialogue will prove to be very fruitful.