

Key Technology to Create a Low-Carbon Society

Heat Pumps Save the Earth

on the Verge of Global Warming

In November 2007, the Intergovernmental Panel on Climate Change (IPCC) clearly stipulated that human activity, such as burning fossil fuel, is causing global warming. In the Fourth Assessment Report, the U.N. panel on climate change said there is little doubt that emissions from the burning of fossil fuels are raising the earth's temperature for potentially disastrous consequences.

The IPCC report was followed by a U.N.-sponsored conference on climate change held in December 2007 in Bali, Indonesia, where participants from around the world held spirited discussions and negotiations regarding a new climate change treaty to succeed the Kyoto Protocol.

In July 2008, leaders of G8 will assemble at the Lake Toya resort in Hokkaido, Japan, for their annual summit where the issue of how to tackle global warming will be high on the agenda.

One big question for us is what can and should be done to help the world meet the huge challenge of global sustainability by using its cutting-edge environmental technologies. Three of the brightest minds in Japan's intellectual community recently discussed this question.

Proposal

Let's Save the Earth with Heat Pumps!

Now, our life built upon the heavy use of limited and precious natural resources such as gas and oil is reaching a turning point. For human beings to survive through the 21st century, technology that makes use of the inexhaustible ambient heat for air-conditioning and for hot-water supply, greatly reducing CO₂ emissions, is essential. Can you believe that such technology already exists and has been widely used? That is "Heat Pump" technology!

By spreading the use of Heat Pumps technology, a reduction of 130 million tons in annual CO₂ emissions can be expected in Japan. That is equivalent to 10% of Japan's annual CO₂ emissions. As the leading country of this highly efficient, revolutionary technology for energy conservation and CO₂ emission reduction, we entreat the world to widely utilize Heat Pumps. Together we can save the Earth on the brink of a global warming crisis.

Hiroshi Komiyama

President, the University of Tokyo

Kiyoshi Kurokawa

Special Advisor to the Cabinet and former president of Science Council of Japan

Hiroshi Kato

Chairman, the Heat Pump & Thermal Storage Technology Center of Japan



Aiming for a "Low Carbon" Society through Immediate and Effective Efforts for Global Warming

Kato: In 1995, Prof. Komiyama published a book titled, "Answering Global Warming Questions." Back then, public awareness of global warming was not as high as it is now.

Komiyama: In the mid 1980s, a consensus was already forming among scientists that the greenhouse effect from CO₂ emissions was raising the earth's temperature. Society has finally caught up with the scientific community.

Kurokawa: Scientists from various organizations, including IPCC, which was awarded the Nobel Peace Prize in 2007, have continued to warn about the crisis of climate change. However, these warnings didn't attract much public attention. Over the past several years, however, the situation has changed dramatically as politicians have begun to get involved. As the ice in the Arctic and Himalayas begins to melt, being able to visualize the situation has connected to a sense of crisis.

Kato: Until several years ago, I myself was not fully convinced that global warming was actually occurring. Over the past several years, however, I have actually felt the effects

of a rapidly changing climate, such as extreme hot summers. If nothing is done, we could end up shifting the

burden of handling the consequences of global warming to future generations. Concrete and effective measures to deal with the situation are needed, and in particular, measures to build a low carbon society

An Amazing Technological Breakthrough for Daily Life — Heat Pumps for the Hot Water Supply

Komiyama: Five years ago, I rebuilt my home into a so-called eco-house. The double-glazed windows and wall insulation keep heat out in the summer and in during the winter. It also prevents water condensation. My new house is very comfortable. I have also installed an Eco-Cute water heater that utilizes heat pump technology. As a result of these changes, I have reduced my houses' energy consumption by approximately one sixth.

Kato: By using heat pumps, you can not only save on energy but also sharply reduce CO₂ emissions. Since Eco-Cute is a heat pump system that collects ambient heat in the air to supply hot water, it doesn't burn fuel. Therefore, no CO₂ emissions are released where it is used.

Kurokawa: Efforts to reduce CO₂ emissions in daily life, like the use of

heat pumps, are very important. Over the past 15 years, the increase in Japan's CO₂ emissions has not come from the industrial sector, but from the increase of homes and offices. Therefore, insulating buildings and using technology, such as heat pumps, will be effective for reducing Japan's overall CO₂ emissions.

Komiyama: I think legally requiring that all newly built houses be equipped with double-glazed windows would be a good idea. Japanese houses are generally rebuilt in 30 to 40 years, which means most of the existing houses will be rebuilt by 2050. We should adopt long-term strategy to create a new, low-carbon society by that time.

Kato: Prof. Komiyama's "Vision 2050" proposal calls for tripling energy efficiency and doubling the share of alternative energy by 2050.

"Issue-Challenged" Japan Can Reduce Energy Consumption and CO₂ Emissions

Kato: One of the reasons that international recognition of Japanese environmental technologies is low is that they are not accurately understood even within Japan. In May 2007, former Prime Minister of Japan, Shinzo Abe, proposed a policy to reduce CO₂ emissions called "One Person, One Day, One Kilogram," calling for national efforts to reduce CO₂ emissions by 1 kilogram per person per day. However, he proposed specific measures for reducing 610 grams of the amount, inviting the public to offer ideas for the remaining 390 grams. Using a heat pump, however, reduces CO₂ emissions from heating by 650 grams and those from hot water supply by 515 grams. That means 1 kg target from former Prime Minister Abe's policy can be achieved simply by using heat pumps.

The government should do more to make such outstanding Japanese technologies more widely known within Japan and throughout the rest of the world.

Komiyama: I agree. I regard Japan as a country on the front lines of tackling a wide range of social and economic challenges that are going to become increasingly urgent in countries around the world, such as environmental and energy problems, depletion of resources, industrial waste disposal, an aging populations, and falling birthrates. No country has found a solution to any of these new challenges. The rest of the world will face these same challenges between 2030 and 2050. If Japan can find ways to overcome these challenges, it can set an example for other countries. Using heat pumps to slash CO₂ emissions could be one such model.

Kurokawa: A large portion of the energy consumption market, over 90% in some cases, is outside Japan. In addition, it seems strange that Japanese companies are not eagerly marketing their cutting-

edge environmental technologies to potential customers overseas. Japanese companies should be more serious about doing business in the global market. I served as chairman of the "Innovation 25 Strategic

Japan Should Lead the World in Tackling Environmental Challenges with Heat Pump Technology

Kato: There are some encouraging signs as well. China, Vietnam and Russia are showing great interest in heat pump technology.

Kurokawa: Many countries want to acquire environmental technology from Japan. They hope to see Japan provide international leadership for dealing with environmental challenges. Currently, Japan has a tremendous opportunity to spur economic growth and make contributions on an international level.

Council" set up by the Cabinet Office. The council's report to the Prime Minister said Japan should use its leading-edge energy and environmental technology as an engine of economic growth and the centerpiece of its international contributions. I sincerely hope this becomes a reality.

Kato: The government and businesses should be more active in taking advantage of this opportunity.

Komiyama: Of course, the main problem is a lack of understanding. People will act when they really understand. For Russia, we can propose a geothermal heat pump that transfers heat between homes and the ground through underground pipes, which is suitable for their cold climate. Vietnam and other Asian countries, which are similar in terms

that can reduce CO₂ emissions sharply without hindering economic development.

Komiyama: Comprehensive efforts are needed to prevent global warming, including wider use of alternative energies and steps to build a recycling-oriented society. Under the current circumstances, reducing the consumption of energy is the most immediately effective measure. Energy conservation and improving the efficiency of technology are two ways to do that. Both are important, however, improving efficiency in terms of reducing consumption and overall outcome would have a far greater impact.

Kato: One little-known fact is that in the last 30 years, Japan has reduced its dependency on oil by nearly half. Much of the credit goes to improve-

ments in technology.

Kurokawa: Energy efficiency in Japanese industry is among the highest in the world. That is the result of ferocious efforts aimed at higher energy efficiency in this country, which has experienced serious environmental problems and an oil crisis. Since 1975, CO₂ emissions from the Japanese manufacturing sector have hardly changed, while Japan's GDP has continuously grown.

Komiyama: Some people in Japan have negative views of science and technology, probably because of arguments that link environmental destruction to scientific and technological progress. Yet, the only way to solve the problem of global warming is with science and technology. I hope people will begin to understand that fact.

If we achieve these targets, we can prevent global warming, even if energy consumption in developing countries increases.

Komiyama: That's right. Heat pump technology is essential for achieving these targets. Theoretically, by utilizing heat pumps, hot water can be produced using only 1/33 the amount of energy used by combustion systems. In fact, currently available Eco-Cute systems are very energy efficient, capable of providing up to 4 times the amount of heat energy that they consume. Even if the overall efficiency (fuel-to-electricity conversion rate) were 40%, that would still mean these systems can provide 1.6 times as much heat energy as they consume. That is twice the efficiency of conventional water heaters that directly burn fuel. Eco-Cute can supply hot water up to 90 degrees centigrade using ambient heat. This is amazing because it is realized by using natural refrigerant. Such heat

pump systems are now widely used for water heaters and for air conditioners in homes and offices, or for industrial heating.

Kurokawa: Developing this kind of equipment is Japan's speciality. The question is how Japan can make such technologies widely known in the world. For example, a town where heat pumps are provided for all the heating supply systems, in other words, creating a "heat pump town." Japan should launch such large-scale projects to promote its environmental technologies internationally. Otherwise, Japan will only end up being merely a parts supplier to other countries.

Komiyama: It is very important to marshal all the intellectual resources available to launch initiatives that could have a great impact, such as heat pump town. Universities should play a central role in such efforts. We need more academic-industrial cooperation to promote such projects.



Hiroshi Komiyama

Hiroshi Komiyama became a professor of engineering at the University of Tokyo in 1988. After serving as Dean of the Faculty of Engineering, Komiyama was elected president of the university in 2005. He announced "The University of Tokyo Action Plan" and launched bold university reforms. He is an expert in chemical systems engineering, environmental engineering and the structure of knowledge. He is the author of many books, including "Kadai Taikoku Nippon (Japan: A Country on the Front Line of Tackling Big Challenges)."



Kiyoshi Kurokawa

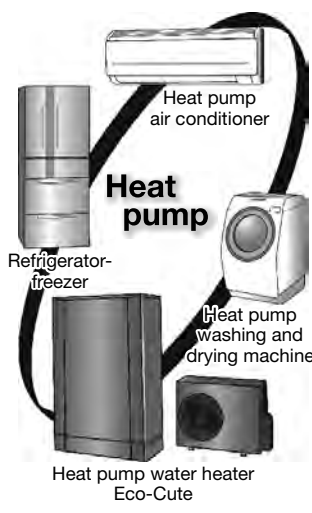
Dr. Kurokawa received his MD in 1962 from the University of Tokyo. In 1979, he was appointed to Professor of Medicine at the UCLA School of Medicine. In 1989, he was named Professor and Chairman of the Department of Medicine (I) at the University of Tokyo, and then Professor Emeritus in 1997. He then moved on to become Dean of the Tokai University School of Medicine in 1996 and President of the Science Council of Japan in 2003. Since 2006, he has served as Professor of National Graduate Institute for Policy Studies, and Special Advisor to the Cabinet. His most recently published books include: "Toward Global Careers: A message to People in Their 20s and 30s" and "Daigaku Byoin Kakumei (University Hospital Revolution)."



Hiroshi Kato

Hiroshi Kato joined Keio University's Faculty of Economics as a professor in 1966. In 1990, he became Dean of the university's Faculty of Policy Management and then professor emeritus in 1994. He has served as President of the Japan Economic Policy Association and as a member of various government advisory councils, including "Gyozaisai many books. He has authored many books, including "Gyozaisai Kaikaku eno Shougen (Testimony for Administrative and Fiscal Reform)" and "Keikaku Keizai no Seicho Hoshiki (Growth Formula for a Planned Economy)."

What is a Heat Pump?



Carbon emissions from the burning of oil, gas and other fossil fuels are raising the temperature of the earth. Meanwhile, the price of these fuels is soaring, putting a financial strain on households and businesses. The situation is increasing the urgency of reducing the world's dependence on fossil fuels.

Renewable energy sources like solar and wind power are increasingly drawing attention as potential alternatives to fossil fuels. Technology has also been developed to make use of ambient heat — an inexhaustible source of energy.

A broad array of home electric appliances based on heat pump technology can be seen on display at electronics retail stores, including heat pump water heaters and heat pump washers and dryers. A heat pump is a device that extracts thermal energy from the environment.

One especially efficient product based on this technology is Eco-Cute, a heat pump water heater that use a natural refrigerant developed

jointly by the Central Research Institute of Electric Power Industry, Denso and Tokyo Electric Power Company. A third of the energy consumed by households is used to heat water for use in bathrooms and kitchens.

Since it pulls heat out of the air to heat water, Eco-Cute can provide 3 times the heat energy it consumes and produces less than half the CO₂ emissions of conventional boiler.

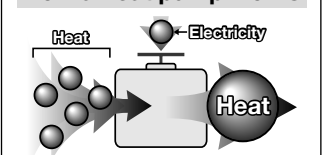
If heat pumps were used for all air conditioning, water heating and other heating devices in Japan, the potential to reduce energy consumption would be great and annual CO₂ emissions could be reduced by 130 million tons, or about 10% of the total yearly CO₂ emissions.

Japan is the world leader in the development of heat pump technology. However, some European countries are already promoting governmental policies for the use of heat pump technology as a renewable energy source.

Since its structure is more compli-

cated than that of conventional water heaters, Eco-Cute requires sizable initial investment. Nevertheless, Japan can make the greatest contribution to the fight against global warming by launching a national drive to overcome cost and other obstacles to spread the use of heat pumps and introduce use of this technology to households, office buildings and factories.

How a heat pump works



5/6 (heat from the air) + 1/6 (electricity) = 1 (thermal energy for heating)
A heat pump obtains five-sixths of the energy needed for heating from the heat in the air and uses electricity for only the remaining one-sixth.