Reduction of CO2 --- Our Challenges and Dreams---

Hello everyone. Our title is "Reduction of CO2 ---Our challenges and dreams---". OK, then let's begin. Let me show you four pictures first.（Show some picture slides of Kyoto, Heiligendamm Do you know who they are?, Nobel Peace Prize Do you know him?, Climate change...）What do all these pictures have in common? Can you guess? Yes, the answer is global warming. 'Kyoto' can remind us of the 1997 Kyoto Protocol, a 50% cut of CO2 emissions was discussed in the G8 summit in Heiligendamm, Germany, last year's Nobel Peace Prize was awarded to former US vice president Al Gore, who has been advocating the need for CO2 reduction ,and the Prize was also given to the Intergovernmental Panel on Climate Change. Global warming is, simply put, the increase in the average temperature of the Earth's near-surface air and oceans in recent decades. It will affect, or actually has already been affecting all of us in unpleasant ways --- devastating hurricanes, food and energy shortages and disease outbreaks to name a few. Global warming is caused by the so-called greenhouse gases, and the major component of these gases is carbon dioxide. As we have just observed, various international efforts to reduce the amount of CO2 emissions are already underway. As students of a college of technology, we are also doing, or considering promising research to promote these global efforts. My co-presenter Sakurako is going to talk about a new type of solar battery.
And Kazuya will discuss a possible unique way of CO2 reduction through genetic engineering. All right. Sakurako, the floor is yours now.

Thank you, Yuri. Electric power is extremely important to our modern society. It is not too much to say we can't live without electricity. However, we need to realize that a lot of CO2 is emitted during the process of power generation. Most notably, thermal power generation causes a lot of CO2 emission. Roughly speaking, a 25% of Japan's annual CO2 emissions are from thermal power generation. We believe we have to do something about it, and are trying to find a way out using clean energies. Do you know what clean energies are? Wind power, nuclear power and solar power are three major clean energy resources. No CO2 is emitted during the generation of energy from these resources, except for a small amount created during the construction and operation of those power plants. Among them, we are very much interested in solar energy because solar energy is more constant and stable than wind energy, and it is a lot safer than atomic energy. One big reason that solar power generation is not popular yet is its production cost. The key material for conventional solar batteries is highly pure silicon, but it is very expensive. So we are now doing research on the development of a new type of solar battery that uses not silicon but titanium dioxide or TiO2 for short. TiO2 is widely available in many parts of the world, and a solar battery made from it is expected to be produceable at a very low cost. Specifically, it takes 50 yen for silicon-based solar batteries to produce 1 kwh, but only 7 yen for TiO2-based solar batteries to create the same amount of electricity. The problem to overcome is the conversion ratio of sunlight into electric power, which is still very low now. Its current ratio is about 10 % at best, but in order to achieve that 7-yen per 1 kwh level, the conversion efficiency must be raised to at least 15 %. How can we improve the conversion efficiency? Our way is to dye the TiO2.　TiO2 itself is white, but the color white reflects light, instead of absorbing it. So we dye TiO2.　If, for example, we dye TiO2 battery materials red,

which has a wavelength of 610-750 nm, we can significantly increase the light-absorption sensitivity of TiO2. Another color or a combination of other colors also works well depending on the conditions of sunlight in given environments. Technically, those batteries are called dye-sensitized solar cells.　It is our dream to have buildings and cars decorated with colorfuf, beautiful pictures made of dye-sensitized solar cells. And remember, in theory, this promising engineering technique could lead to a 25 % reduction in Japan's total CO2 emissions. Isn't that wonderful? Now Kazuya, it's your turn.

Thank you, Sakurako. My challenge concerns genetically modified crops or GM crops. GM crops have a tremendous amount of potential, and their possible contribution to the global reduction of CO2 is part of that potential. As you all know, all plants produce sugar（or glucose）and oxygen out of water, sunlight and carbon dioxide. This process is called photosynthesis. According to the amount of carbon dioxide they take in, they are categorized into two groups, namely groups C3 and C4. Nearly 95% of the plant biomass on earth are C3 plants. For example, rice, sunflowers and most trees in the temperate zones such as Japanese cedars are C3 plants. Unfortunately, however, the amount of CO2 these plants absorb is not very great. On the other hand, tropical grasses such as sugar cane and maize are C4 plants, and their CO2 absorption abilities are very high. Now, what if, through genetic engineering, we can create new types of C3 plants which are capable of absorbing as much CO2 as C4 plants can take in? Taking the example of such C3 plants as temperate zone trees, 10 square centimeters of their leaves take in only 5-10 mg of CO2 every hour. On the other hand, the intake of C4 plants is about 60 mg per hour, which means C4 plants absorb at least 6 times more CO2 than C3 plants do. Do you remember me saying earlier that 95% of all the plants on earth are C3 plants? If this idea was put into prcatice on a global scale, plant lives on the planet would start absorbing probably about 5 times more, if not 6 times more, CO2 than they do now. This is not a mere armchair theory. In France, for example, research has started to see how this kind of genetic modification could be possible. I hear similar experiments have already started here in Japan too. Of course there will be some technical and logistic problems to overcome, but I think the idea itself is fantastic and its potential is immense. That's why I am interested in this research. That's all from me.（Yuri）

By now, our team hopes that you have some idea about what kinds of research we are working on at our school. We are well aware that our ideas sound almost like dreams at present, but we are studying with a dream for the future. Lastly we sincerely hope the amount of CO2 emission will be significantly reduced and that we can live in a far better environment in the near future. Thank you.