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**Science and Technology in the 21<sup>st</sup> Century  
— Toward an Affluent and Sustainable Society—**

Takamitsu Sawa  
Ritsumeikan University

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**Ritsumeikan University**

**Graduate School of Policy Science**

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# Introduction

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- **2007 has been a year of climate change: It has been 10 years since the Kyoto Protocol, 15 years since the Rio Earth Summit and 20 years since *Our Common Future* was published. The IPCC's Fourth Assessment Report was published and Al Gore's film, *An Inconvenient Truth* made headlines. Recent years have seen damage caused by climate change and made the phenomenon a reality for many.**
- **Meanwhile, Japan is in the midst of revising its action plan for reaching reductions pledged under the Kyoto Protocol.**
- **Prime Minister Abe proposed in Heiligendamm that world greenhouse gas emissions should be halved by 2050. This debate is certain to intensify at next year's Toyako Summit.**

# 1. What is sustainability?

- The term “sustainable development” was coined in *Our Common Future*, the 1987 report authored by the U.N. Brundtland Commission (named after the former Norwegian prime minister and chair of the World Commission on Environment and Development).
- Subsequently, debate raged on the various interpretations of this term; however, in the commission’s report it is defined as: “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. In addition, sustainable development has also been defined as improving people’s way of life without exceeding the bounds of the ecological carrying capacity of the environment to support it. (*Caring for the Earth: A Strategy for Sustainable Living*, 1990).
- Consequently, 20th century industrial civilization—with its pattern of mass production, mass consumption, and mass disposal—and its attendant problems of natural resource depletion, global environmental pollution, and the increasingly serious North–South divide came to be viewed as unsustainable in the 21st century.

## 2. Global environmental problems are an important G7 agenda item

- The Brundtland Commission's conclusion that, if unchanged, the pace of 20th century industrial civilization would harm the welfare of future generations, was a clarion call to action that found greater traction than anticipated and resulted in global environmental issues being put on the agenda of the Toronto Summit in June 1988, the first time that this had happened.
- Immediately following the seven-nation summit, the Canadian government held a national assembly (also in Toronto) focusing on global environmental issues, at which shocking results from simulations indicated that if carbon dioxide continued to be released at current levels, the average global temperature would rise by three degrees and sea levels would rise by 60 cm.
- The following year (1989) at the Paris Arche Summit, interest was such that one-third of the economic declaration was dedicated to global environmental issues, and interest in the issue seemed to be growing daily.

### 3. Kyoto Protocol's entry into force

- Subsequently, in 1992 the United Nations Framework Convention on Climate Change was adopted at the UN Conference on Environment and Development in Rio de Janeiro. Following the treaty's entry into force, the First Conference of Parties to the convention (COP1) was held in Berlin from late March to early April 1995. In December 1997, COP3 was held in Kyoto and the Kyoto Protocol was adopted.
- After dragging its feet on ratifying the protocol, Russia finally did so in November 2004 and the Kyoto Protocol went into force on February 16, 2005.
- Abe Initiative (May 24, 2007): 1) Halve GHG emissions by 2050; 2) include all major emitters in one agreement; 3) balance emissions cuts with economic growth; and 4) require innovative technological development.

## 4. The 20th century—economic growth and development

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- If asked to say what it was that characterized the 20th century, how would you respond? One answer might be that it was a century of economic growth and development.
- Why did the 100 years of the 20th century witness such explosive economic growth and development? One answer to this question would be the constant technological innovation. In one sense, the 20th century could also be called the century of innovation.
- When comparing the Japanese way of life in 1901 with that of the Japanese today, there is clearly an immense gap. Innovation is the engine that drives economic development.

## 5. 20th century was a century of carbon dioxide

- Why did technological innovation take off in the 20th century? One answer is that in the 19th century, mankind discovered two sources of energy: oil and electricity. This technological progress has made our lives more convenient and given us a steady stream of new products that make life more enjoyable. However, these run on either electricity or oil. In this sense, it is fair to say that the 20th century was a century of electricity and oil.
- However, the other side of this is that the 20th century was also a century of carbon dioxide. In other words, our affluence came at the cost of emitting ever greater amounts of carbon dioxide.



## 6. 20th-century industrial civilization already unsustainable

- As the 20th century was coming to an end, nearly 160 countries gathered in Kyoto in 1997 and agreed to cut greenhouse-gas emissions (in terms of CO<sub>2</sub>-equivalent value) in the five-year period from 2008 to 2012. The pledged cut of at least 5 percent by the 40 developed nation signatories reinforced the idea that the 20th century model of industrialized civilization was truly unsustainable.
- Science and technology in the 20th century was pursued for the sake of economic growth and development. However, in the 21st century science and technology need to foster sustainable development. If the watchword for the 20th century was “growth,” then that for the 21st century must be “sustainability.”

## 7. Plotting the progress of science and technology

- Until the world was hit by the Oil Shock of 1973, the trajectory of technological progress was towards things that are bigger, faster, and more powerful, as epitomized by the Jumbo Jet and Concorde.
- However, in the last quarter of the 20th century, the trajectory of technological progress underwent significant change. In other words, technological progress came to be defined as the development of new devices or equipment, such as those with improved fuel economy or better cost–performance. As global environmental issues burst onto the radar in the 1990s, this trend accelerated.

## 8 . Technological innovation: spurred by constraints and shortages

- In general, technological innovation is spurred when there is a constraint or a shortage. When the 21st century is called the “century of the environment” this has two meanings. The first is that environmental problems will only become more serious. The second is that environmental constraints will spur technological innovation.
- People often say that the world is awash with things, thanks to technological innovation. When speaking of goods that involve the transportation of people or objects (such as vehicles and airplanes), home electronics, communication devices, or computers, it might be fair to say that these technologies are approaching maturity. Put another way, from a material perspective the “shortage” or lack of things has nearly disappeared.
- Two examples of what might constitute future “constraints” or “shortages” which will fuel technological innovation are offered. First, the dream of perfect health and immortality. Second, environmental limitations. It seems reasonable to assume that only technological progress that overcomes the limitations of the environment will enable corporations to survive in the 21st century.

## 9. The irreversibility of science and technology

- Next is the topic of the irreversibility of science and technology. There are few examples of technologies that, once unleashed, have been truly removed from the market. Whether this technology harms life and the environment, is banned legally, or is rejected by people, such cases are very uncommon. As far as I am aware, instances such as this have been limited to a number of harmful chemicals, such as DDT, the sedative Thalidomide, ozone-depleting fluorocarbons, and asbestos.
- Why is science and technology irreversible? The reasons for this are that 1) there is a group of experts and engineers that will make a technological innovation their area of expertise; and 2) industries arise that are dedicated to manufacturing new products using this technological innovation.

## 10. Trade-offs and the precautionary principle

- It is safe to say that all technologies come with trade-offs. Some examples are as follows: the effects and side-effects of medicine, embryonic stem-cell research and bioethics, nuclear power plants and the risk of accidents, large-scale public-works projects and the destruction of nature, and the positive and negative effects of digital devices on society.
- Clearly, future deliberation on science and technology must employ the precautionary principle more aggressively. In the areas of genetically-modified crops and the early implementation of climate change measures (CO<sub>2</sub> reduction measures), the question of whether decisions should be based on the precautionary principle or should be rooted in sufficient scientific knowledge is being raised. The former carries with it the possibility of having to pay unnecessary costs, while the latter raises the prospect that we will find ourselves in a situation which cannot be undone.

## 11. Affluence and intellectual development: preconditions for creating a society that puts a priority on the environment

- There is a gradual, yet steady transformation afoot in which environmental soundness, whether in lifestyles or business, is coming to be viewed as “cool.” Historically, in Japan lifestyles embodying the ideas of thrift, simplicity, and durability were valued. However, with the inflation of the bubble economy, the social aesthetic took an about-face and extravagance came to be regarded as “cool.”
- Yale University historian Paul Kennedy has asked what commonalities exist between the various countries of Northwestern Europe, such as Sweden, Norway, Finland, Denmark, and Holland, that make their societies so keen on environmental protection. He answers that one common theme is their achievement of sufficient affluence, while another factor is their high level of education.

## 12. What will define affluence in the 21st century?

- Zeal for protecting the environment is one sign of affluence. That the Japanese do not embrace environmental protection so enthusiastically hints that, while on paper per-capita GDP is on a par with that of the five countries mentioned, affluence in Japan has not reached a level that allows people the luxury of considering the environment. In terms of the percentage of students that pursue higher education, Japan's educational levels are high; however, doubts remain about Japan's actual intellectual level.
- With the shortage or lack of things having been virtually overcome, the trigger of economic growth in the 21st century will be environmental constraints. Tackling environmental constraints will be necessary to increase per-capita GDP.
- Addressing environmental constraints will spur economic affluence, and increased quality of life (QOL) will heighten enthusiasm for environmental protection. For Japan to become an affluent society, improving QOL and raising the intellectual level will be essential, as will successful technological innovation that overcomes environmental constraints.