Proposal by the Special Committee for Action Plans Against Global Warming, Japan Society of Civil Engineers:

Summary for policymakers

How should civil engineers confront global warming?

A. Climate change will lead to infrastructure crises

The effects of global warming are already broad and extensive, and if current trends continue, global warming is likely to pose a serious threat to society. The following statements can be made concerning the future impacts of climate change.

1. Even a small amount of warming, increasing ocean temperatures by 1°C, would have a significant effect on the terrestrial and marine ecosystems that support human society. In addition, a change of 1.5 to 2.5°C would have a significant effect in many areas, including Japan's water resources, disaster prevention, agriculture, public health, and tourism.

2. In places such as cities with well-developed infrastructure, economic activities and other factors are also causing significant environmental changes; therefore, it is difficult to isolate the effects of climate change. However, if meteorological aberrations escalate beyond the urban capacity for disaster prevention, the resulting damage will be severe.

3. From the standpoint of civil engineering, the effect of climate change is the following four aspects: the safety and performance of civil engineering structures and systems; the execution and efficiency of civil engineering projects; the functioning of civil engineering structures as infrastructure; and effects on the national environment and people's lives in terms of safety, security, and environmental conservation, both regionally and nationally.

4. There are two types of changes in global warming and climate change. First, there are changes in average values such as air temperature and sea level; and second, there are changes in extreme phenomena such as meteorological aberrations and typhoons. Changes of magnitude and frequency in extreme phenomena can directly affect the design standards for facilities, including anticipated external forces. However, many uncertainties still remain on this matter.

5. Effects of climate change are wide-ranging, complex and involving interactions among multiple effects. In addition, they appear in combination with other problems facing today's society such as earthquakes and other natural disasters, the aging population and declining birth rate, problems of resources and energy, and problems of food and water.

6. In developing countries, the infrastructure is less well developed, making these countries more vulnerable to climate change.

B. What should civil engineers do?

Because a wide range of mitigative and adaptive measures against climate change exists in the field of civil engineering, the problems of climate change induce new issues and missions for civil engineers. The following are the summary of what we should do.

1. Dual strategies:

The purpose of global warming countermeasures is to keep the human society and natural environment away from dangers caused by climate change. Therefore, it is necessary to appropriately combine the two pillars of mitigative and adaptive measures.

2. Mainstreaming countermeasures within social and economic policies:

Global warming countermeasures should be incorporated as a major policy area in social and economic policy.

3. **Considering special characteristics of civil engineering structures:**

Once a civil engineering structure is built, it lasts a long time. Since these structures are so long-lived, the area of civil engineering should contribute both to the creation of a low-carbon society and low-carbon land formation, which is the goal of mitigative measures, and to making the national environment safe and secure on the long term, which is the goal of adaptive measures.

4. **Realization of maximum co-benefits by policy integration:**

It is important to devise effective steps that can "kill two birds with one stone" for both mitigative and adaptive measures. Individual measures should also have subsidiary effects and compound effects.

5. **Establishment of strong national leadership and specialized departments for climate change in public and private sectors:**

It is necessary to implement global warming countermeasures as a national project, and to indicate guidelines for the future of Japan as a low-carbon society with a safe and secure national environment, as soon as possible. Smart policies must be devised, including the establishment of legal, economical, and technological mechanisms that are needed for this purpose, as well as finances, organizations, and human resources. Civil engineers should strongly initiate and support citizens and policy makers into this movement. It is also necessary to build a strong framework for implementation, including the establishment of specialized public and private organizations to handle these issues.

6. **Establishing an eminent persons council on global warming:**

Policies must be studied from a preventive standpoint in order to avoid devastating future risks amid the uncertainties of prediction. Therefore, a council consisting of high-ranked eminent persons on global warming should be established as an organization in which various experts will cooperatively study ways to deal with global warming, providing political and administrative leaders with various types of information and proposals to support effective decisions.

7. **Integrating civil engineering technologies and contributing to the community:**

It is necessary to integrate nationwide civil engineering technologies towards climate change mitigation and adaptation. An active participation to regionally specified studies and implementation of global warming countermeasures is also needed by all civil engineers.

8. **Collaboration with citizens:**

Collaboration with local residents, NGOs, and related communities is important. Therefore, it is necessary to build proper framework, institutions, and instruments for collaboration, such as creating databanks and information and facilitation centers that anyone can freely approach to obtain relevant information on global warming, and to discuss on promoting countermeasures.

9. **International contributions:**

Measures to reduce carbon dioxide emissions in developing countries are extremely important, because emissions from developing countries are expected to increase significantly in the future. The participation of developing countries will be indispensable in the international framework of the post-Kyoto accord. Meanwhile, since major disasters, food crises, and the emergence of environmental refugees can lead to international instability, it is necessary for developing countries to incorporate adaptive measures for climate change in their economic development policies, and to make adaptive measures into mainstream policies. Civil engineers should act strongly towards such movement.

10. **More intensive and concrete implemention of JSCE action plans:**

It is necessary to adopt an effective and concrete action roadmap in accordance with "JSCE Action Plans Against Global Warming: JSCE Agenda 21."

11. **Building a strong framework for implementation:**

The Japan Society of Civil Engineers should organize a task force to handle strategies on global warming throughout all activities of JSCE. This would not be a research and survey committee. Rather, it is

necessary to arrange one of the directors to be in charge of strategies against global warming, convenes the task force, and answers directly to the Board of Directors, JSCE.

C. Mitigation of climate change

The most important mitigative measures for climate change is to reduce greenhouse gas emissions caused by energy consumption. The basic strategy for this purpose is twofold: reducing energy consumption, and developing and using low-carbon renewable energy sources as far as possible in the supply of energy. Because carbon dioxide is emitted in civil engineering projects, and because civil engineering is closely related to carbon dioxide emissions on the medium and long term due to the use of civil engineering structures as infrastructure, civil engineers should contribute to the reduction of greenhouse gas emissions as one of his basic strategies.

In research and development as well, civil engineering is related practically to all areas of climate change problems. In relation to mitigative measures, it is necessary to engage in research and development that makes use of the breadth of the field of civil engineering with regard to the linkage of various measures, scenario research, and issues of policy, industrial structure changes, social factors, and economic aspects.

Considering these characteristics, it is both effective and necessary for the field of civil engineering to develop and implement strategies toward the formation of a low-carbon society and lifestyle. These strategies can be roughly classified into the following eight categories.

1. **Reducing GHG emissions in civil engineering projects:**

   Reducing greenhouse gas emissions through energy conservation in civil engineering projects, including the use of higher-efficiency construction machinery and the development of energy-saving construction technologies.

2. **Reducing GHG emissions from the life cycle of civil engineering materials:**

   Identifying and reducing greenhouse gas emissions throughout the life cycle of civil engineering materials, for example, by using recycled cement and steel and other recycled materials, conversion to lumber and other low-carbon materials.

3. **Reducing GHG emissions through the entire lifetime of civil engineering facilities:**

   Constructing longer-lived civil engineering facilities, developing and widespread adoption of energy-recovery technologies, and energy-saving technologies for the operation of water supply and sewage facilities, etc.

4. **Implementation of lowering mechanisms of environmental burden from government procurement:**

   Public procurement by the government should be based on a system that evaluates not only the cost, but also the life-cycle environmental burden, including greenhouse gas emissions and the use of recycled materials.

5. **Promotion of more efficient energy saving civil engineering structures:**

   Developing and promoting the widespread adoption of technologies that contribute to energy conservation in the use of transportation facilities, including measures to reduce traffic bottlenecks at railroad and street crossings, and measures using ITS to facilitate the flow of road traffic.

6. **Development and promotion of innovative low-carbon energy technologies:**

   Supporting the development and widespread adoption of innovative and lower environmental load technologies. Candidates are, for example, water power and wind power, steady promotion of nuclear power. Promoting technological development for high-efficiency thermal power plants and carbon capture and storage are the others.

7. Developing low-carbon urban systems through city planning and transportation planning:

Forming low-carbon urban infrastructures and urban structures, shifting transport mode to lower CO_2 emission through city planning and transportation planning.

8. Support for developing countries:

Contributing to the reduction of greenhouse gas emissions in developing countries through support with regard to technologies and planning, supported by related institutional, political, economical mechanisms and so on, such as clean development mechanisms.

D. Adaptation to climate change

Sustainable societies can be achieved by ensuring security in the following three areas: water, food, and energy. It is necessary to adopt wise political and technological countermeasures in the uncertainties with regard to global warming, climate change, and social change. Adaptive measures will play an extremely important role in ensuring water security. Because civil engineering technologies have an extensive historical track record in relation to problems of water and flooding, civil engineers can offer many options in accordance with social changes and the advance of global warming, and are developing various methods for analysis and evaluation to enable wise choices in goal-oriented policies and technologies.

The options that should be selected need to have strong functionality so that they are resistant to damage and can be rapidly restored if damaged. Civil engineers have developed a great deal of technological expertise in this regard. In addition to the general aims described in part B, the following points are also important.

1. Mainstreaming and highlighting adaptive measures within social policies:

There are two aspects of adaptive measures. They are 1) physical facility developments/improvement, 2) managing/operating the facilities and institutions towards climate change adaptation. Both aspects are indispensable, and it is important for both to be performed smoothly, effectively, and efficiently to avoid confusion or misunderstandings among the general public. Therefore, it is necessary to mainstream the adaptation measures within many other social, economic, and national security measures. Also it is necessary to account clearly the costs of adaptive measures, and to highlight these measures in order not to be buried within business as usual public administration.

2. Innovations and their promotion of related technologies:

It is realistic to incorporate adaptive measures when renovating a structure or during disaster recovery. Therefore, it is necessary to improve the accuracy of prediction of external forces and evaluation of their impact; to reflect these improvements in design standards and achieve other related technological advances; to establish programs to cover the costs; and to develop systems such as databases regarding impacts and the handling of adaptive measures.

3. Implementation of well delivered, sustainable, and robust measures for adaptation:

To achieve wise choices and adaptive measures that will endure, it is necessary to integrate civil engineering technologies which is strongly supported by a council consisting of well-organized higher-classed and eminent persons on global warming.

4. Adaptive measures in hydraulic engineering, coastal engineering, and environmental engineering:

In hydraulic engineering, it is necessary to utilize the existing stock, develop and publish innovative methods to evaluate flood risk, transform water resource policies, provide support for adaptive measures in foreign countries, and reform education regarding water issues. In coastal engineering, it is necessary to minimize damage and achieve multiple effects through protection, acclimatization, withdrawal, and combinations of those types of measures, and to implement the measures with consideration for the anticipated timeline of the effects of climate change. In environmental engineering, it is necessary to improve the water metabolism system, to improve evaporative functions in cities, to contribute to food production by improving the nutrient cycle, and to promote countermeasures against pathogens and tropical diseases.