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B-9000 Gent, Belgium

*Council of Academies*  
**CAETS**  
*of Engineering and Technological Sciences*

**THE ROLE OF TECHNOLOGY IN  
ENVIRONMENTALLY SUSTAINABLE  
DEVELOPMENT**

**A Declaration of the  
Council of Academies of Engineering  
and Technological Sciences (CAETS)**

**June 21, 1995**

**Kiruna, Sweden**

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## **Preface**

The Council of Academies of Engineering and Technological Sciences (CAETS) was founded in 1978 and presently consists of 14 national academies. These academies represent the engineering and technological leadership in their respective countries.

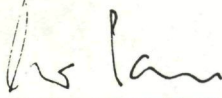
The Council agreed to the enclosed declaration on the important role of technology in a sustainable future for humanity at its biennial Convocation in Kiruna, Sweden, in June 1995. The theme of the conference was “Creating Wealth in Harmony with the Environment – the Role of Engineers and their Academies”.

The Council recognizes that many factors impinge on efforts to achieve sustainability. These include continuing population growth; the desire for improved quality of life; the need to eliminate poverty, and the desire for the economic benefits of industrialization. The Council’s declaration focuses on the critical role of technology in assisting society to achieve environmentally sustainable economic growth.

One of the major aims of CAETS is to promote the application of scientific and engineering knowledge and the advancement of new technologies, including those for sustainable development. One purpose of this declaration is to communicate the importance of engineering and technology to national and international organizations including governments. It is also intended to make them aware of the intellectual resources of the world’s engineering community, as represented by CAETS and its members, resources that could be made available both to help solve problems and to indicate the direction that should be taken to address society’s needs.

This declaration is also intended to communicate to colleagues in science and engineering throughout the world our views on technology and sustainable development.

Approved by Governing Board of CAETS in Kiruna, Sweden  
on June 21, 1995



Australian Academy of  
Technological Sciences and  
Engineering



Mexican Academies of  
Engineering

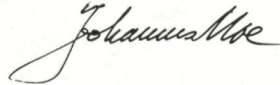


Belgian Royal Academy  
Council of Applied  
Sciences

Netherlands Society of  
Technological Sciences  
and Engineering



Canadian Academy of  
Engineering



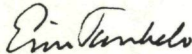
Norwegian Academy of  
Technological Sciences



Danish Academy of  
Technical Sciences



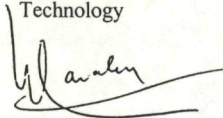
Royal Swedish Academy of  
Engineering Sciences



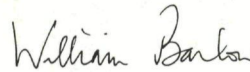
Finnish Academies of  
Technology



Swiss Academy of  
Engineering Sciences



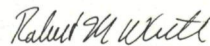
Committee on Applications  
of the Academy of Sciences  
of France



The Royal Academy of  
Engineering, United Kingdom



Engineering Academy of  
Japan



National Academy of  
Engineering, United States

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## Definitions and Guiding Principles

In the broadest sense, sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their needs. It means the balancing of economic, social, environmental and technological considerations, as well as the incorporation of a set of ethical values. Such a definition provides a useful intellectual framework for addressing issues of sustainability.

For the purposes of this document, however, more specific guiding principles for achieving sustainable development have been adopted. The Council, reacting to the needs of society, believes that sustainability can be achieved only if great attention is given to two key areas: environmental quality and economic development. In general, the primary opportunities to pursue these twin goals are technological in nature. Therefore, in both developed and developing economies, technology and engineering issues are pivotal. Producers' and consumers' choices about product technology, producers' choices about process technologies, levels of investments in research and development, the rates of diffusion of technologies, and the design of government regulations affecting innovation are critical as societies move toward sustainable development.

The Council subscribes to the following:

- Engineering and technology are key components of national and international efforts to achieve environmentally sustainable economic development for all nations;
- The goals of economic development and environmental protection can and should be compatible;
- The ability to achieve global sustainability is strongly influenced by population growth;
- Many natural systems are inherently variable. Such variability is easily confused with the impact of human activity on the environment. Distinguishing between inherent and man-made variability in natural systems and their capacity to respond to change is an important subject for research;
- For some environmental issues (for example, those involving the oceans and atmosphere), the planet must be regarded as a single complex system whose interests are best served by coordinated international action. Both developed and developing nations have a common interest in resolving global environmental issues;

- Most actions to achieve environmentally sustainable economic development will take place at the national or local level, while at the same time taking into account the interdependence of nations. Individual countries will need to develop approaches to solving sustainability problems that are tailored to their own rate of economic development, cultures, religions, and political systems;
- The achievement of environmentally sustainable economic development is dependent on adequate technical education at all levels and on education on how to balance economic, social, and environmental goals.

### **Technology as a Lever**

Local, regional, and global environmental degradation – such as loss of biodiversity, greenhouse gas emissions, worldwide deforestation, depletion of stratospheric ozone, urban air pollution, acid rain, pollution of freshwater and the oceans, contamination of arable land and loss of topsoil, and shortages of water, food, materials and fuels in many parts of the world – are of growing international concern. While there are great uncertainties about the causes and effects of global environmental changes, the consequences of these changes for national economies, human health and quality of life could be severe.

The Council believes that the development and use of technologies that do not harm the environment is critical to maintaining and improving quality of life. The Council also recognizes that the wise use of technology is a necessary but not sufficient prerequisite for sustainable development. We are convinced, however, that socially compatible and environmentally sound economic development is possible only by charting a course that makes full use of environmentally advantageous technologies. By this, we mean technologies that utilize resources as efficiently as possible and minimize environmental harm while increasing industrial productivity and improving quality of life.

Historically, new technologies have evolved in response to population and economic pressures and demands for increased safety, better health, more nutritious food, economic welfare, security, and a sound environment. Technological advances have made possible new sources of energy, new materials, improved health care, increased industrial productivity and food supplies, global communications, and remediation of environmental damage. These achievements, in turn, have helped rural areas, cities, and nations around the world to improve their standards of living and support growing populations.

Many aspects of economic development and environmental protection would not be possible without technology. Water-resources management, sanitation, transportation, energy production and use, manufacturing, communication, agriculture and aquaculture, education, and health care all have a significant technological basis. Similarly, the means to manage

population growth has been made possible by pharmaceutical technologies – drugs and medical devices that have helped reduce birth rates in many parts of the world.

One important aspect of global technological advance is the transfer of technology from developed to developing nations. Power generation is a good example. Plants already technically established and economical in the industrialized world offer potential for increasing energy efficiency in the emerging, densely populated areas of Asia, Africa and the Americas. While the technology clearly exists, investment incentives are called for if these capital intensive processes are to replace less efficient ones in the developing world as well as in the developed world.

To harness technologies for environmentally sustainable development, effective national and multilateral economic policies and management strategies that have sustainability as their primary objective are needed. In every region, the most important first step is to build indigenous technological capacity, which includes trained experts who can understand and take advantage of existing technological knowledge.

While governments play a critical part in the attainment of sustainable development, the extensive capabilities of the private sector – particularly in relation to technology development and technology transfer – also have a key role. For example, industry is designing and producing products that consume less energy and make systematic use and re-use of materials to contain them within the economic system. Industry is also developing technologies to restore, protect, and manage natural ecosystems. To encourage the participation of the private sector, markets need to be open and intellectual property must be protected.

## **Pathways to Sustainability**

Achieving sustainable economic development will require changes in industrial processes, in the type and amount of resources used, and in the products which are manufactured. The Council believes that the world must move to a more energy-efficient society, one that uses resources more responsibly and organizes industrial processes in ways that minimize and reuse wastes. While technologies affecting all societal activities must reflect the goals of sustainable economic development the following pathways to sustainability are among the most important:

### **Energy**

Sustainability depends on the evolution of energy technologies. In the short term, dependence on fossil fuels is unavoidable. Ultimately, however, the world will need to reduce the use of fossil fuels. Technical efforts must be directed to increasing the efficiency of energy supply and energy use, and to using fossil fuels in a less-polluting manner. Natural gas, which produces fewer pollutants than either oil or coal, is in abundant supply and can play an important role in the transition to an economy much less dependent on fossil fuels.

Increased energy efficiency in transportation systems will be of central importance throughout the world. Underway in many countries is the development of improved fuel-efficient automobiles and integrated urban mass transit arrangements. Important developments in energy storage and propulsion, such as electric, fuel cell, and hydrogen systems, are also in progress.

In the long term, there are a variety of possibilities for securing the world's energy future. These include renewable energy sources, which are fast becoming economic. For example, there have been rapid advances in efficient solar cell-based power generation. Biomass, wind, and other sources of renewable energy are also becoming realistic options for niche uses.

Public acceptance of nuclear power will depend on the safe operation of nuclear plants and the safe management of the radioactive wastes produced by these facilities. Safe nuclear power represents an indispensable resource, opening up new options for energy supply, use, and distribution. Nuclear fusion is a possible future source of energy.

### **Public Infrastructures**

Public infrastructures are essential to the efficient functioning of society and its ability to achieve sustainable development. These include water resource and supply systems, power systems, bridges, roads, as well as communications and transportation facilities. To a large extent the technologies are well developed. The essential challenge lies in the diffusion and use of such technologies to developing nations, where they are most needed.

### **Water**

Water treatment and re-use will have a decisive role in sustainable development in the public, industrial and agricultural sectors. In the public sector, securing public health will remain the basic feature of urban water systems; water transportation and treatment technologies must be chosen accordingly. Technologies now exist for controlling many types of pollutants. The future challenge will be the control of organic micropollutants and heavy metals. For the water – intensive industries, minimizing water consumption will become a necessity, and it will be a key factor determining market compatibility of industrial products. For the agriculture sector new technologies for irrigation will be needed that minimize water consumption and prevent unsustainable groundwater extraction.

### **Food**

Increased food production and the improved means of storage and distribution – necessary to support a burgeoning global population – will also depend on technological advances. Biotechnology has produced new strains of crops resistant to disease and drought. Further advances in producing crop varieties naturally resistant to pests will permit a further reduction in toxic chemicals used as pesticides. Genetic engineering holds

promise not only in agriculture, but also in aquaculture where it can lead to increased production of marine and freshwater seafood.

The negative environmental consequences of farming have been reduced in recent years, and environmentally sustainable farm practices appear to be within reach. The chemical industry is now producing pesticides that degrade more quickly, that have more focussed effects, and that can be applied in lower concentrations. Best management practices include crop rotation systems, the use of computers to guide chemical use, and integrated pest management. Such practices offer pathways to a sustainable future in the agricultural sector.

### **Manufacturing and Mining**

Manufacturers have begun to reduce, re-use, and recycle materials and products in a search for industrial ecosystems that can imitate natural ones. According to this concept, wastes from one part of the system are used as inputs to other parts of the system. Companies have begun to change product and process design in ways that give the environment the same level of consideration as worker safety and the cost and quality of products. Industrial uses of renewable agricultural and forestry resources are expanding.

The mineral extraction industry is adopting environmentally sound practices and is developing approaches and technologies for remediating past environmental damage. These technologies are now also increasingly applied to rehabilitating degraded landscapes.

### **Materials**

The materials revolution that is now underway has profound implications for the environment. Traditional materials, such as steel, concrete, and plastic, are undergoing significant changes that reduce the environmental impact of their manufacture and use. Scientists and engineers are also beginning to design new materials based on a better understanding of their properties and the possibility to manipulate them at the atomic level.

In the future, new technological capabilities will contribute to the creation of materials with very specific and closely controlled properties. These new materials will permit the development of products that are more energy efficient, that consume less of mineral resources for their manufacture, are lighter and stronger, and recyclable. Also under development are alloys lighter than aluminum and stronger than steel, and composites based on biological materials that are superior to other materials.

### **Information Technology**

The remarkably broad-based technological revolution now underway is made possible by information technology. Information technology has the potential to alter how and where people work and live, and thus the nature of urban areas of the future. It is changing the way that enterprises are managed. It is improving the efficiency of air-, land-, and water-based transportation systems, among other sectors of the economy.

Networks of fiber optic cables and systems of Earth-orbiting satellites are extending our ability to survey and protect the environment. These technologies permit real-time monitoring of environmental conditions. From automobiles to nuclear power plants, from chemical processing to mineral extraction, information technologies allow precise control of industrial processes, which improves our ability to minimize pollution and improve energy efficiency.

## **An Action Agenda**

Technological advances offer multiple paths to environmentally sound sustainable development. As nations pursue sustainability goals, they confront difficult trade-offs, often related to balancing demands for economic development, environmental protection and social acceptability. The selection of pathways will depend on the actions of governments, international agencies, consumers, private industry, and educational institutions. . While there are many obstacles to the transition to sustainable development, technology provides a means to overcome them.

The Council urges the actions below:

### **Governments, international agencies, universities, and industry should:**

- Take action to strengthen the indigenous technological capacity of developing nations to enable them to develop, adopt, and deploy environmentally advantageous technologies. Developed and developing countries should cooperate to increase and adapt the technological capacity of developing nations.

### **Governments should:**

- Encourage industry to develop environmentally advantageous technologies through provisions of incentives such as market-opening measures and intellectual-property protection,
- Support universities and other research institutions to develop environmentally advantageous technologies,
- Pursue arrangements for monitoring and assessing environmental conditions and their economic implications,
- Promote new generations of environmental technologies through international collaboration,
- Recognize opportunities and limitations of technology in making international agreements on environmental issues.

**Industry should:**

- Seek to balance the efficiency of its operations with its responsibilities for socially compatible environmental actions.
- Pursue the opportunities presented by the global market for environmentally advantageous technologies, thereby diffusing them throughout the world.

**International funding agencies should:**

- Pursue policies that encourage recipient governments and institutions to take advantage of environmentally sustainable technologies developed by both the public and the private sector.

**Educational institutions should:**

- Integrate sustainable development concepts into all levels of education.

**Engineering institutions should:**

- Advance the concepts of sustainable development as an important and integral part of their activities.



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