

Developing a Closed Resource Cycle Economy

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The Issue as it Stands: Emergence of New Environmental Concerns

Environmental issues previously confined to industrial pollution have in recent years expanded both geographically, to assume global proportions, and chronologically with effects being sustained over extended periods of time. Moreover, environmental issues are deeply related to various facets of our daily lives and business activities, calling on each of us to consider every possible measure in collaboration with respective entities making up the society to assist in resolving environmental problems.

The waste/recycling agenda is one of the most significant issues. While our lifestyles and economic activities are strongly dependent on resources in danger of becoming depleted, Japanese households produce roughly 50 million tons of waste annually, and various industrial activities result in an additional 400 million tons of waste. Although the recycling rate is still climbing, the growth has leveled off in both household and industrial waste. Land is limited in Japan, and there is only enough landfill space for the next 8.5 years for household waste, and only 3 years for industrial waste. The sense of impending crisis is prominent in metropolitan areas, especially in Tokyo.

Constraints in available natural resources are also becoming evident. Since the industrial revolution, petroleum, metal and other nonrenewable mineral resources have been squandered at a blinding pace, and the lavish consumption has become particularly striking into the 20th century.

In 100 years — an eyeblink in the existence of planet earth or even the history of our species — a tremendous amount of the earth's reserves were consumed in such a relatively short

period of time. For instance, the energy resources accumulated by this planet over the 5 billion-years of its history were rapidly exploited, and the currently available reserves of petroleum and natural gases are estimated to be depleted in 43 and 65 years respectively. Japan is a major consumer of mineral resources, using over 10% of the world's copper and zinc, as well as a significant portion of rare metals to produce automobiles, electric appliances, and information-processing devices which dominate a primary share of the world market. In contrast, the domestic supply of copper 0.04% of the necessary amount, and Japanese mines provide 4.1% of lead, 10.2% of the zinc and 0% of the iron, aluminum or nickel that the country needs. Entirely dependent on foreign countries for its primary supply of minerals, Japan is the world's largest importer of these resources. The global deposits of these metals are running out rapidly, and based on the current estimate, copper will be available for only 56 years. The supply of lead will last for about 43 years, and zinc about 62. In addition, these resources are only available in a limited number of countries. Thus, the constraints pertaining to natural resources will grow more conspicuous for the coming century.

Another major environmental concern is the problem of global warming. The gravity of its predicted effects makes this one of the most pressing global environmental issues facing us today. The Kyoto Protocol to the United Nations Framework Convention on Climate Change (COP3) in December 1997, an international agreement for the prevention of global warming, requests Japan to reduce its overall emissions of carbon dioxide and other greenhouse gases

(GHGs) to a level 6% lower than the standard for 1990 by the the period from 2008 to 2012. Such efforts to cope with global warming have served to enhance the overall awareness of the urgent necessity to address global environmental problems among the general public, and aggressive measures are now being implemented, with the government and industry as the key players.

Efforts for waste reduction and promotion of recycling are being implemented through diverse approaches. The enactment or enforcement of necessary regulations is one such approach. The Law for the Promotion of Utilization of Recycled Resources and the Law for the Promotion of Sorted Collection and Recycling of Containers and Packaging are now in place, and the Law for Recycling of Specified Kinds of Home Appliances is also enacted. In addition, various voluntary efforts are being implemented on behalf of the industrial sector, as represented by programs like the Keidanren (Japan Federation of Economic Organizations) Voluntary Environmental Action Plans. Energy conservation, introduction of new energy sources and construction of nuclear power plants with a rigid emphasis on safety are being promoted to address global warming from the aspects of supply and demand of energy. Other lines of effort based on the Outline of Measures to Prevent Global Warming adopted in June 1998 include the emission of CFC (chloro-fluorocarbon) alternatives etc. (HFC, PFC, and SF6); as well as the promotion of innovative new technical development and international cooperation.

Should environmental problems amplify their significance, the limitations in terms of available resources and environmental conservation could

have a major constraining effect on economic activities. The inevitable downscaling could impair industrial competitiveness, inhibiting our continuous growth into the 21st century.

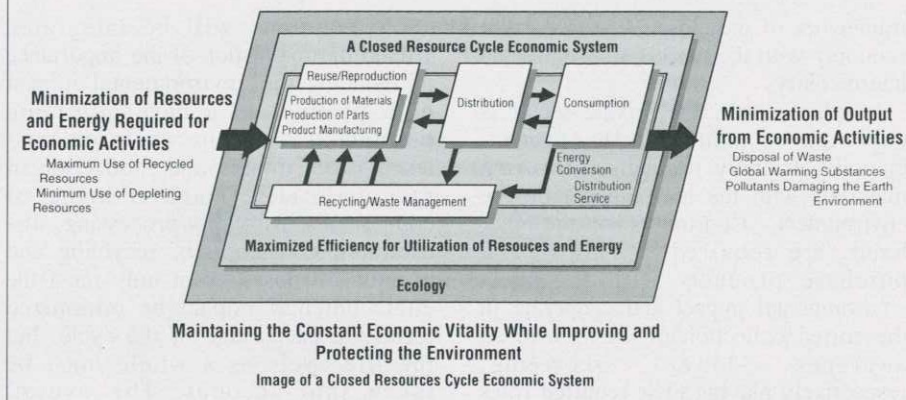
Minimized input of non-renewable natural resources, the active promotion of effective utilization of available resources, turning to regenerable sources of energy and recycling of mineral resources are imperative in maintaining sustained economic growth into the future on a mid to long-term perspective.

As we stand at the threshold of the 21st century, we must turn away from our present economic system based on mass production, mass consumption and massive waste to concurrently maintain a healthy environment while attaining uninterrupted economic growth. In other words, social rules and customary codes of conduct of the conventional economic system, with no appropriate measures or limitations concerning rational use of resources and the environment, must now be changed, to be urgently replaced by a CLOSED RESOURCE CYCLE ECONOMY which integrates the environment with the economy.

Traditional business approaches tended to regard environmental protection and the conservation of resources only from the terms of cost, reacting to problems symptomatically. Such *modus operandi* must be outmoded, evaluating and implementing technically and/or economically feasible plans as an integral society. Selection criteria for prioritizing areas of effort shall be explicitly designated, defining responsibilities pertaining to the establishment of rules and legislation among the entities concerned, and selecting the appropriate political measures.

A closed resource cycle economy would form the basis for providing a sound environment, which will enable us and future generations to enjoy and share the wealth of the earth. It is up to the present generation to make this concept a reality.

Integration of the Economy and the Environment A Closed Resource Cycle Economy Where the Functional Market Structure is "Built-in"



Concept of Closed Resource Cycle Economic System

(1) The Shape of a Closed Resource Cycle Economy: Integrating the Environment with the Economy

Two factors are the key elements in attaining a closed resource cycle economy capable of leading human civilization to sustainable development into the 21st century. Namely:

(i) *Minimization of Input:* To reduce the use of non-renewable resources and sources of energy to an absolute minimum, concurrently exploiting replenishable resources and energy sources to the maximum extent possible, thus minimizing the input of resources and energy to be newly introduced into economic activities.

(ii) *Minimization of Output:* To minimize the industrial waste produced from economic activities, GHGs including carbon dioxide, pollutants such as dioxin, heavy metals, nitrogen oxide, and other hazardous substances destroying the ozone layer.

The inefficiencies in our use of resources and energy must be completely minimized, prolonging the duration until resources are ultimately rendered to waste as much as possible throughout the entire production-consumption cycle. The idea of consuming things must be converted to the rational use of the function, "maximizing the effective use of resources and energy" by "taking just enough of only what is needed" and striving to "efficiently circulate" in both production and consumption.

The goals of closed resource cycle

economic systems would be the achievement of the integration of the environment and the economy by incorporating the concept of circulation into the marketing structure. In other words, economic activities oriented to "closed circulation" should be respectfully accepted as an appropriate market principle, internalizing the cost of protecting the environment within the society as a whole, and thus sustaining economic vitality in harmony with providing a healthy living environment.

As society based on closed resource cycle economic principles accepts methods of production and consumption that adhere to eliminating waste from the very beginning. Waste is categorized and collected for recycling, and the products/components are designed for durability and reusability. The system upholds the preservation of a sound environment for future generations and the establishment of a society capable of sustainable growth as its ultimate objectives.

(2) Partnership Spanning the Industry, the Consumer and the Government

In the structure of a closed resource cycle economy, the entities involved — firms, consumers, the nation and major local governments — are required to work together, forming partnerships. The relationship between the industrial sector and consumers is particularly important, for together these two make up the market. Rather than standing opposed as adversaries, the two must form a partnership within the

framework of the closed resource cycle economy with the market serving as the intermediary.

In other words, the private sector is expected to manufacture environmentally friendly products, procuring materials with the least impact on the environment. Consumers, on the other hand, are required to choose and purchase products with the least environmental impact and cooperate in the sorted collection of waste with an awareness toward recycling, respectively playing their required roles as partners.

As the third key player within this structure, the public sector is responsible for the promotion of a framework in which the industry and the consumer — the “main body of economic activity” — and partnerships among businesses can work together to harmoniously conduct economic activities with the “market” as the intermediary. For instance, the government needs to provide action plans enhancing the effective circulation between the partners, with the disclosure of the environmental impact of products, and to support and vitalize the flow of information between businesses. The public sector should actively procure environmentally friendly products and promote the acceptance of such products by industry and consumers, thus encouraging the creation of new markets. In addition, the public sector is required to support the development of revolutionary technologies in case inherent risks are too high to be undertaken under market principles alone.

The formation of these partnerships will provide each of the entities with a suitable role to play in the closed resource cycle economy; each entity assuming its responsibility voluntarily and positively, acting for the greatest good of society as a whole.

(3) Establishment of a New Architecture for Industrial Technology: Core Technologies in a Closed Resource Cycle Economy

Composed on a new system of industrial technology, the closed resource

cycle economy will be integrated around the realization of the importance of reducing the environmental impact of a product to a bare minimum throughout its entire cycle of existence, from mining and production of raw materials, manufacturing of components, assembly/processing, distribution, consumption, recycling and eventual disposal. Not only must the environmental impact be minimized locally at each stage of the cycle, but the life cycle as a whole must be taken into account. The overall environmental impact shall be minimized by establishing a closed cycle system capable of mitigating the environmental load with a perspective for the entire life cycle from the initial design/development phase of materials to spanning the production-distribution-consumption-recycling-disposal of products.

The flow of raw materials and products in the 21st century must be transformed into a system engineered to maximize the benefits of the society as a whole, maintaining coexistence with the global environment. Along with a withdrawal phase in which technology provides capabilities to sort and dispose of massive waste from mass production, the system of recycling used products as materials also requires a new environmental technology system minimizing the input of resources and energy. Concurrently, the arterial flows of human activities defined during the designing/manufacturing phases for materials and products needs to be harmonized with the natural circulation of substances on a global scale.

The circulation-based engineering system should bring about a fundamental innovation to conventional recycling measures, expanding beyond the reuse of basic materials such as metals and chemical products, to encompass every aspect of the envisioned closed resource cycle economy.

The new face of environmental technology will include: (1) The establishment of life cycle assessment



The integration of a closed resource cycle economy into our society will enable us and future generations to enjoy the wealth of the earth

technology; leading to (2) the development of Reduce & Reuse technologies, — development of basic materials with enhanced environmental affinity, technologies to reduce waste through improved functionality encouraging consumers to use products over longer periods of time, the development of technologies aimed at encouraging the recycling of parts and products by estimating the remaining product life and the management of usage records; (3) the development of recycling technologies including the sophisticated material sorting methods and the development of easy-to-recycle materials and products, finding new uses for recycled products; (4) production process technologies minimizing the input of material and energy by reusing waste generated during the production process and the promotion of inter-industry recycling; and (5) technology to enhance the efficiency of recovery linking waste production to reuse and recycling during the distribution flow. In terms of energy sources, the future will see increased utilization of hydrogen and bio-energy. These technologies offer the keys to the transformation from the

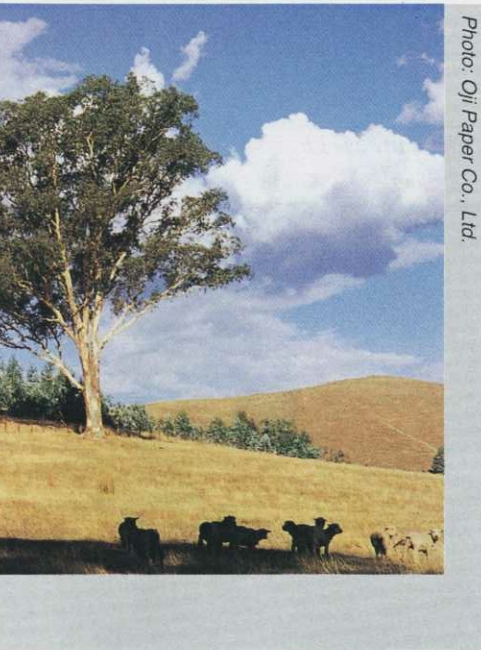


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products within the manufacturing industry (e.g. clean energy based automobiles, fuel-cell batteries, environmentally friendly homes, refillable products and biodegradable plastics), for instance, effectively reduces environmental impact without compromising our quality of life. The uprise of environment-related services as represented by environmental consulting will spark the creation of a new environment-related service industry.

Recycling of copying machine components and, the birth of new repair-reuse services (e.g. distribution networks for used automobile parts, upgrade services available for personal computers) are elementary attempts at circulation-oriented production. Efforts to turn away from the 20th century economic model of mass production, mass consumption and massive waste, thus paving the way to a closed resource cycle economy also includes attempts to introduce sophisticated methods for the reuse and recycling of garbage. These are represented by the propagation of gasifying fusion furnaces, the application of waste and used material to alternative purposes as seen in RDF (refuse-derived fuel) and the introduction of waste plastic for fuel to steel-making blast furnaces. The development of these new businesses also drives the creation of new markets and new jobs, maximizing the efficiency of resource and energy utilization, contributing to minimizing the input of resources and energy newly introduced, and to minimize the resulting output from these economic activities.

(5) Prospects for the Closed Resource Cycle Economy into the 21st Century

The growth of environment-related industries is consequentially accompanied by developments in industrial technology. Initiatives in addressing environmental concerns by establishing technologies for the minimization of environmental impact throughout the product life cycle, and by providing environmentally friendly materials and

products, leads to increased competitiveness in businesses and the exploration of new industrial frontiers. Furthermore, such developments contribute to resolving constrictions pertaining to environment and resource issues, problems to be overcome internationally. It is suggested that the development of energy saving technologies and economic reform triggered in Japan in the past by the oil crisis, actually resulted in the country's industrial competitiveness. Forerunning the global stride to establish the closed resource cycle economy at this stage will be a vital issue for Japan in order to achieve sustainable economic growth concurrently with the conservation of a healthy environment into the 21st century.

Concerns raised about the possibility of the balanced contraction of the economy, voiced in relation to the extended product life and the recycled components/products essential to the establishment of a closed resource cycle economy, may be resolved from the following grounds:

(i) As industrial activities shift their focus from "offering products" to the "offering of functionality" in an economic system based on closed-cycling of resources, diverse industrial fields including environment-related segments can be expected to enhance new business opportunities and new seed technologies, significantly expanding the growth of frontiers on the supply side as these industries mature and develop.

(ii) Negative impacts on the environment — lack of landfill space and emission of toxic substances — will be reduced within an economic system based on closed-cycling of resources, thus releasing the resources previously devoted to resolving these issues, allowing them to be re-invested in new assets and services, awakening potential demand and distributing the benefits of such investment throughout the society. These arguments demonstrate the ample possibility for the achievement of stable, sustainable growth in the closed resource cycle economy. JTI

conventional economic system to the new closed resource cycle system.

(4) Integrating Industry to the Environment and Progress in Environment-related Industries

The pressure demanding businesses to increase their efforts and accept additional responsibility is mounting, both at home and abroad. The private sector will come to assume a vital role in the participation of the closed resource cycle economy by turning to offerings with low environmental impact and environment-conscious business activities.

Faced with the increased costs of waste disposal and reducing environmental impact, the need to attend to new environmental regulations and environmental awareness within the business world, the inevitable responsibilities of the closed resource cycle at all stages of the product life cycle — resource collection, material and product manufacture, distribution, consumption, processing, recycling, and final disposal, are emerging in response to create new business opportunities.

The increasing prominence of environmentally friendly materials and