

NKK's Environmental Solutions: New Stage for Environment-Related Businesses

Yasutsugu Ogura*

* General Manager, Planning and Marketing Dept., Environmental Solutions Center

In April 2000, NKK announced the “Environmental Solutions” concept and set up a new organization called the “Environmental Solutions Center”, which is composed of highly sophisticated professionals in the field of the environment and energy. NKK’s environmental solutions businesses offer solutions for environment- and energy-related issues faced by all societies, based on rich experience and know-how accumulated by NKK and its group companies.

1. Introduction

NKK has long been engaged in compound management in the two business fields of steel production and engineering, producing numerous synergistic effects in the environment- and energy-related fields. NKK’s steel sector has firmly established sophisticated technologies for environmental conservation and high-temperature combustion through steel production, as represented by the industry’s first waste plastics blast furnace feeding operation. NKK’s engineering sector has a history spanning over more than 40 years, designing and constructing environmental equipment such as waste incinerators and waste recycling & sorting systems. Some 30 companies in the NKK group are also involved in various environment-related businesses. Thus, NKK and its group of companies have rich and wide-ranging experience in environmental businesses. In April 2000, NKK set up a new organization called the “Environmental Solutions Center” to meet the social needs of establishing a recycling-oriented society, solving far-flung environmental and energy problems facing society in the 21st century by fully utilizing technologies and business experience accumulated in the company and its group of companies.

2. Development of environmental solutions businesses

NKK set up the “Environmental Solutions Center” to promote environmental businesses of the entire NKK group and further expand the business areas and scales. The Center is expected to function as the headquarters of environmental businesses of the entire NKK group.

As shown in **Fig.1**, the basic concept of NKK’s environmental solutions businesses is to respond to business opportunities related to the environment and eco-energy with the entire potentiality of NKK and its group companies, and provide total solutions. The objective is to develop solutions businesses that integrally cover a whole spectrum of issues related to the environment and energy, including both software and hardware, and meet the needs of the national and local governments promoting environmental administration and private-sector companies promoting environmental management. The areas covered by NKK’s environmental solutions businesses are illustrated in **Fig.2**. The areas covered are wide-ranging from recycling solutions and eco-energy solutions to environmental management solutions. In these wide areas, solutions are provided based on environmental equipment and products nurtured by the NKK group over a long period of time. Recycling solutions respond to the needs of the national and local governments promoting the establishment of recycling-oriented society and private-sector companies promoting the establishment of production systems that accompany less emissions. Eco-energy solutions respond to society’s eco-energy needs utilizing NKK’s energy-saving and clean energy technologies and know-how. Environmental management solutions support environmental management activities such as environmental assessment, acquisition of ISO14001 certification, and soil cleanup. Representative cases of environmental solutions businesses are introduced in the following chapters.

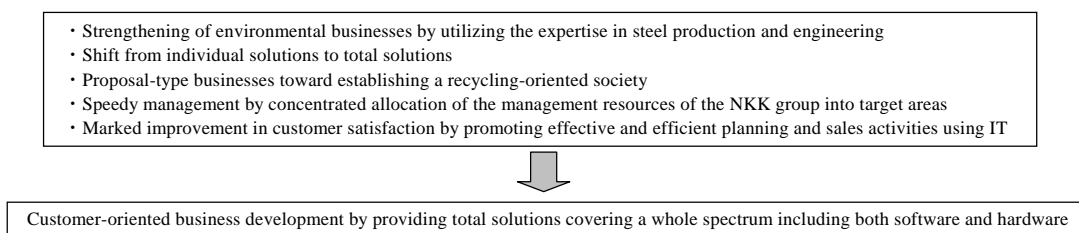


Fig.1 Basic concept of environmental solutions businesses

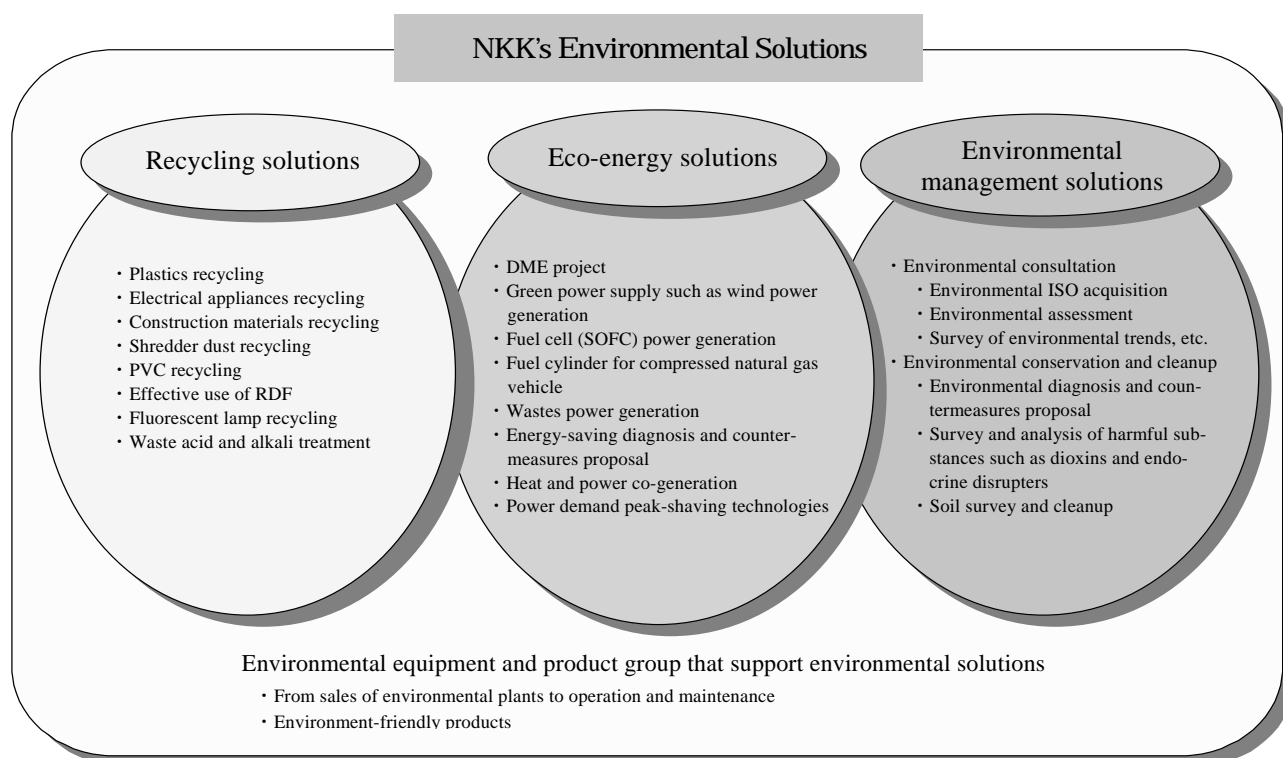


Fig.2 Areas covered by environmental solutions businesses

3. Dealing with recycling solutions

A typical example of recycling solutions is the participation in the Eco-Town projects promoted in various areas in Japan. The Eco-Town projects aim at realizing the Zero Emissions Concept promoted by the national government. NKK has been participating in two Eco-Town projects, each promoted by Kawasaki City and Hiroshima Prefecture, actively performing environmental solutions activities covering all stages from planning and proposal to specific business operations in the areas designated Eco-Towns.

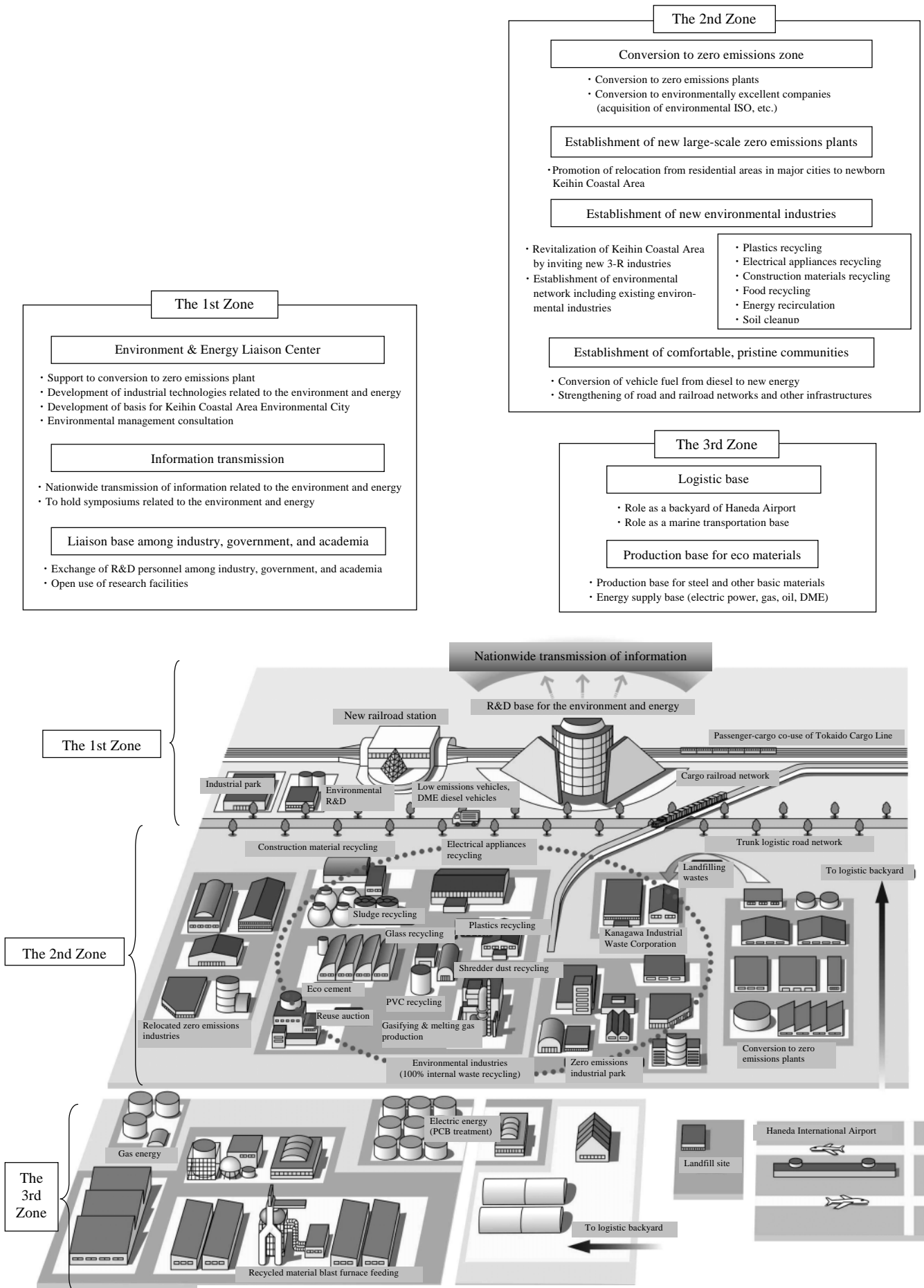
3.1 Keihin Coastal Area Environmental City Concept and urban revitalization^{1),2)}

3.1.1 Concept formation in cooperation with local government

Cooperation among industry, government, academics, and the local community is indispensable for establishing a

recycling-oriented society. Based on this understanding, NKK is actively promoting recycling solutions.

Kawasaki City developed the Environment City Concept aiming at revitalizing the industry in the Keihin Coastal Area while making this area more environment-friendly. The concept is schematically illustrated in **Fig.3**. NKK has been participating in this plan since its concept-forming stage, and has been playing an important role in proposal of various plans and development of business operations. According to the Environment City Concept, the Keihin Coastal Area is divided into three zones. The first zone near the commercial and residential areas is to be utilized as a base for research and development activities. The second zone is to be a field for cultivating new environment-friendly industries based on the environmental network of existing industries. The third zone is to be a base for production of materials and energy, transportation and logistics services.



The Keihin Coastal Area has the first class potentialities for establishing recycling-oriented society. It is very near to the major metropolitan area, and has various manufacturing industries and logistic infrastructures. The characteristics of NKK's activities for providing recycling solution is to set up a ground design for revitalizing this area in cooperation with the local government and other parties concerned. NKK has a capability of the realization these projects by fully using the technologies basis and steel-producing infrastructures.

NKK has already established a series of environmental business bases in this area that contribute to realizing the Environmental City Concept as shown in Fig.4. In the 1st Zone of the Keihin Coastal Area, NKK has established research and development bases such as the Environment & Energy Liaison Center, which performs liaison functions related to the environment and energy. In the 2nd Zone, the company has established a series of environmental bases for recycling waste plastics, electrical appliances, and PET bottles as well as verification plants for developing new technologies of recycling shredder dust and PVC. In the 3rd Zone, the company has steel-making facilities such as blast furnaces and steelmaking furnaces for recycling large amounts of waste.

NKK's recycling businesses and technologies have been established by using the steel-production and the engineering technologies. These technologies can recycle large amounts of waste at lower cost in comparison with other recycling systems. Especially the Keihin Works takes full advantage of its location as an urban steelworks in close proximity to the Tokyo metropolitan area.

3.1.2 Scenario for urban revitalization through environmental approach

NKK has been participating in the project to revitalize the Keihin Coastal Area from the concept-forming stage in both aspects of the environment and urban development. In June 2001, Kawasaki City formed the "Liaison & Research Committee for Kawasaki Coastal Area Revitalization". This committee composed of representatives of local companies, public administration officers, and academics. It aims at revitalizing the Kawasaki Coastal Area by utilizing the technologies and facilities of manufacturing industries as shown in Fig.5.

In June 2001, NKK established the "Environment & Energy Liaison Center" in the 1st Zone of the Keihin Coastal Area. This center contributes towards the creation of new ideas and concepts for environmental business activities. It acts as a core for integrating private sectors, public authorities, academics, and local organizations for promoting research and development on the environment and energy. It also acts as a transmission source of relevant information (Fig.6). It currently holds the Research Committee of Environment and Energy Network comprised of the companies located in the Keihin Coastal Area, and promotes the resources recycling among different type of industries.

The advantages of Keihin Coastal Area is that already has a large accumulation of various industries. If the network among these industries is advanced and integrated in the Eco-Town project, it will surely provide a large impetus to urban revitalization in the metropolitan area.

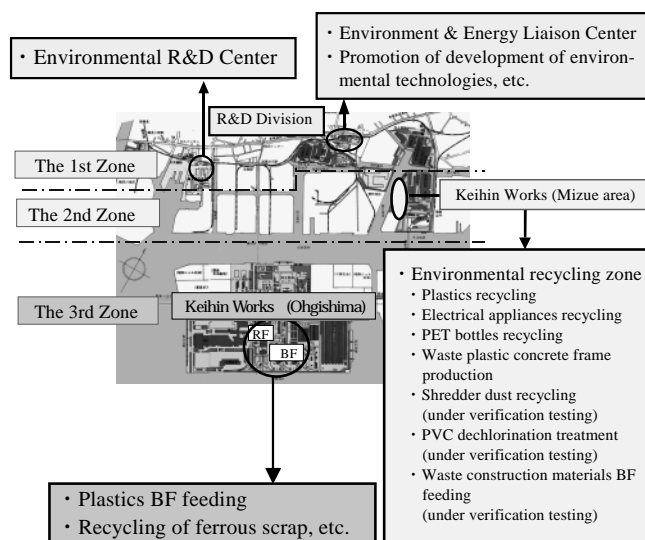


Fig.4 NKK's environmental business activities in Keihin Coastal Area

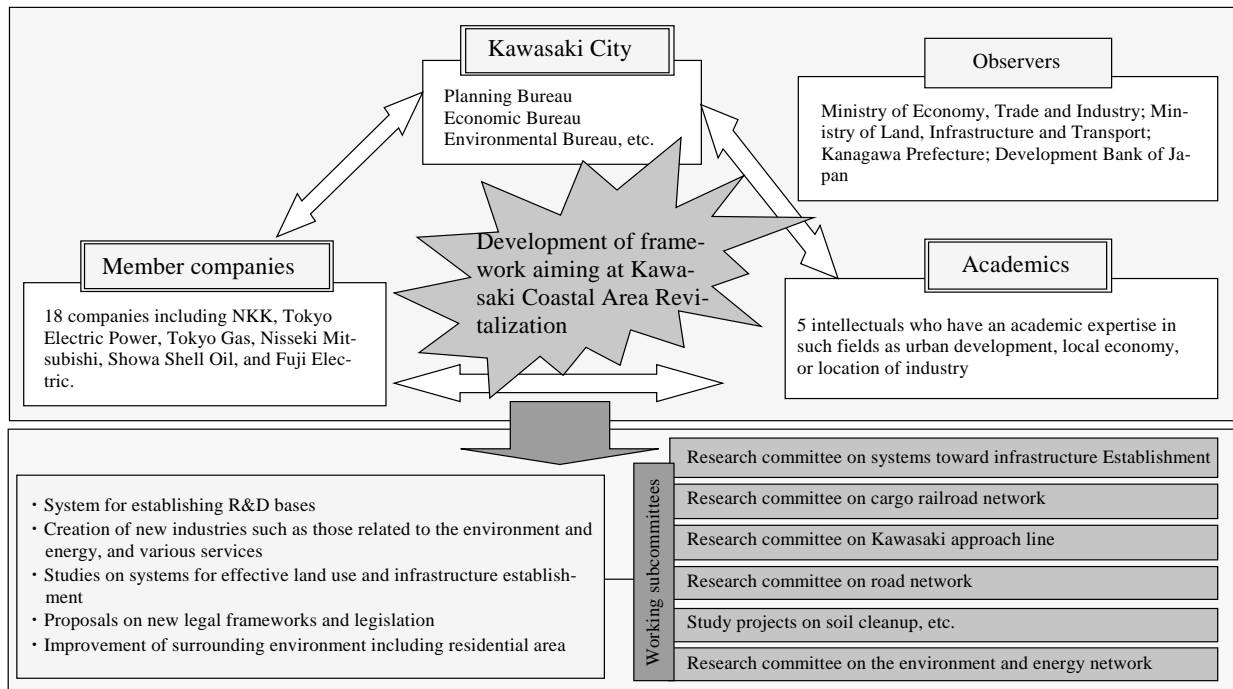


Fig.5 Liaison & Research Committee for Kawasaki Coastal Area Revitalization

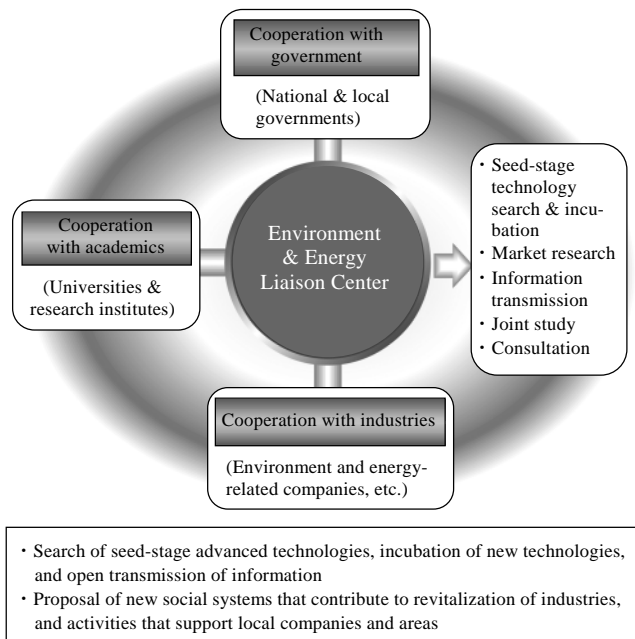


Fig.6 Role of Environment & Energy Liaison Center

3.2 Activities in Hiroshima Eco-Town Area

The Bingo Area of Hiroshima Prefecture has been admitted to be called “Eco-Town” area by METI in 2000. NKK has its Fukuyama Works in this Eco-Town area. As such, NKK has been actively promoting the activities that contribute to the establishment of a recycling-oriented society in this area, as represented by the waste plastics Blast

Furnace feeding at the Fukuyama Works. New recycling projects to be initiated in the Bingo Eco-Town Area include the Fukuyama Waste Recycling Power Generation Project, which is expected to begin operation in 2004. This project involves producing RDF (Refuse Derived Fuel) at 7 facilities from municipal wastes collected from 16 municipalities in Hiroshima Prefecture, and melting and gasifying it for power generation at a melting & gasifying power generation facility to be constructed in Fukuyama City (Fig.7). NKK is constructing the melting & gasifying furnace, which allows high-efficiency power generation. NKK is also responsible for O&M (Operation and Maintenance) of the facility. Thus, NKK is in charge of the core management of this project while playing a major technical role. This facilities, which is one of the largest gasifying & melting furnace in the world, can treat around 310 tons of RDF per day and generate around 20MW of electric power. This project is a model case of a wide-area municipal waste treatment system. Waste treatment projects with new financial scheme such as PFI (Private Finance Initiative) are being promoted in various parts of Japan. The Fukuyama Waste Recycling Power Generation Project is the first case in which NKK had equity investment in RDF power generation, and a good example which shows NKK as a forerunner of new development in its recycling solutions business.

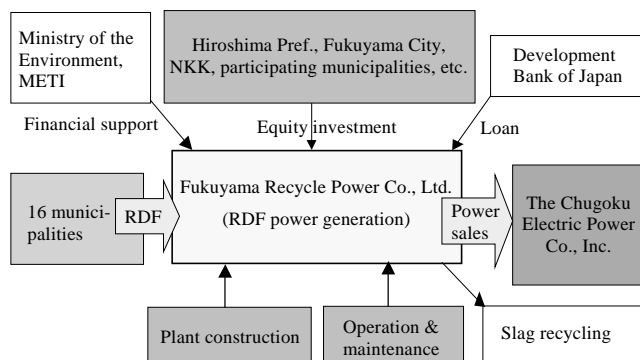


Fig.7 Scheme of Fukuyama Waste Recycling Power Generation Project

4. Eco-energy solutions

4.1 Clean energy for the 21st century - DME³⁾

Much is expected of DME (dimethyl ether) as clean energy for the 21st century in applications such as a clean fuel for power generation, a soot-free fuel for diesel vehicles, a substitute for LPG, and a fuel for fuel cells.

NKK has been promoting the commercialization of direct synthesis of DME from a wide variety of natural resources such as natural gas, coal-bed methane, and coal. In the fall of 1999, NKK succeeded in achieving the world's first direct synthesis of DME from coal-bed methane using a large-scale bench plant (5 tons/day). This technology is characterized by the revolutionary process where DME is directly synthesized in a catalytic slurry reactor as shown in Fig.8.

Activities are currently underway for early commercialization using a pilot plant capable of producing 100 tons per day.

In 1997, the company started investigating the combustion characteristic of DME as well as the fuel feeding system for a diesel engine vehicle, and in 1998, a small truck was successfully run by DME for the first time in the world. As part of the effort to promote the development of DME-powered motor vehicles, the first DME trial vehicle in Japan (Fig.9) was certified by the Minister of Land, Infrastructure and Transport in February 2002, and trial operation on public roads commenced.

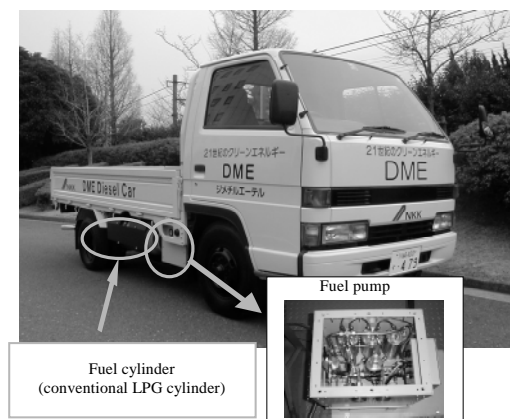


Fig.9 DME vehicle for public road tests

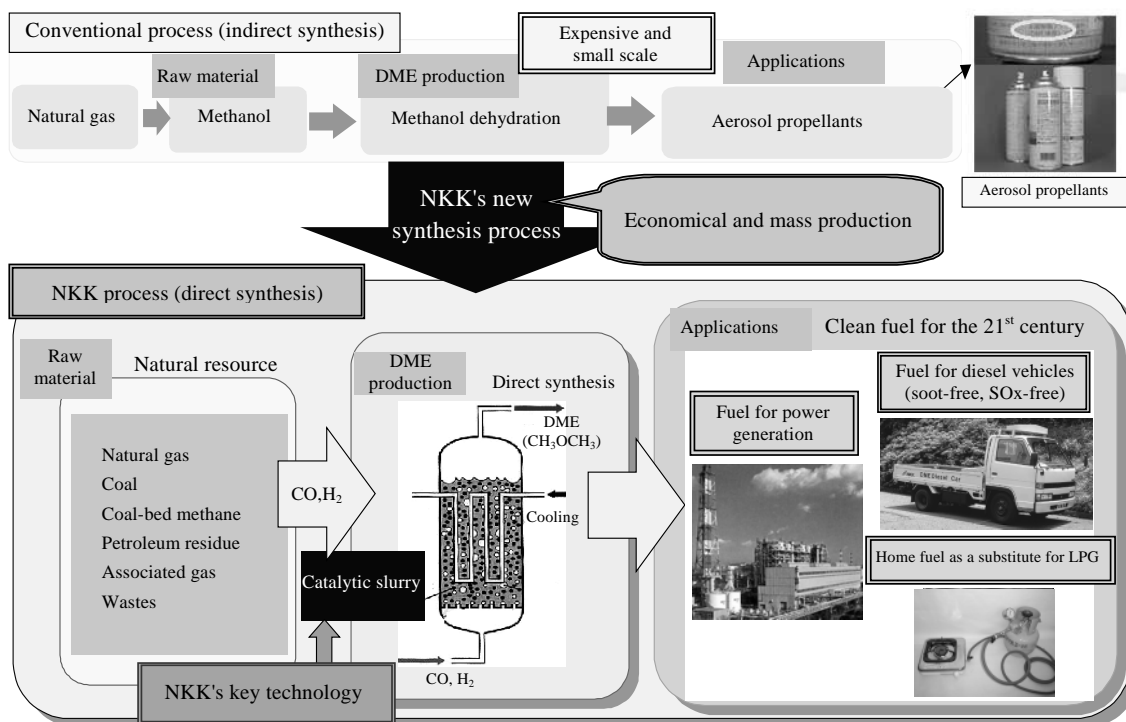


Fig.8 NKK's DME direct synthesis process

The national government is planning to impose strict regulation on the emissions of PM (Particulate Matter) from diesel vehicles as shown in Fig.10. It has already been confirmed by tests that DME vehicles can clear the new long-term regulation value.

In parallel with the development of the production technology of DME, its economic feasibility is being investigated. In October 2001, a new company called DME International Corporation was established for performing feasibility studies on commercialization at a scale of several thousand tons per day. This corporation is composed of nine partners (NKK, Toyota Tsusho, Hitachi, TotalFinaElf, Marubeni, Idemitsu Kosan, INPEX, Nippon Sanso and LNG Japan), and performs commercialization feasibility studies targeting its first delivery of DME in 2006. In December 2001, the same nine partner companies

also established a research company called DME Development Co., Ltd. Thus, the organizational structures are now in place for facilitating early commercialization of DME on both the technological development side and economic feasibility study side.

The time schedule toward the commercialization of DME is shown in Fig.11. NKK's DME direct synthesis technology allows production of DME not only from natural resources but also from synthesis gas obtained by gasifying municipal wastes or waste plastics, and methane gas obtained by fermenting livestock excreta or sewage sludge. Thus, the DME project can contribute to both resource recycling and clean energy supply, and as such is representative of NKK's eco-energy solutions.

4.2 High-efficiency distributed power generation system - SOFC⁴⁾

Fuel cells convert the chemical energy directly into electricity, generating power with high efficiency and low environmental impact. NKK collaborates with SWPC (Siemens Westinghouse Power Corporation) of the US in commercialization of, and market development for, the SOFC (Solid Oxide Fuel Cell) systems. This system is able to generate electricity at high efficiencies of 50% or more at an output of 250 kW, and 60% or more at outputs of several MW, and as such is the subject of much attention as a demand-side power source with extremely low environmental impact (Fig.12).

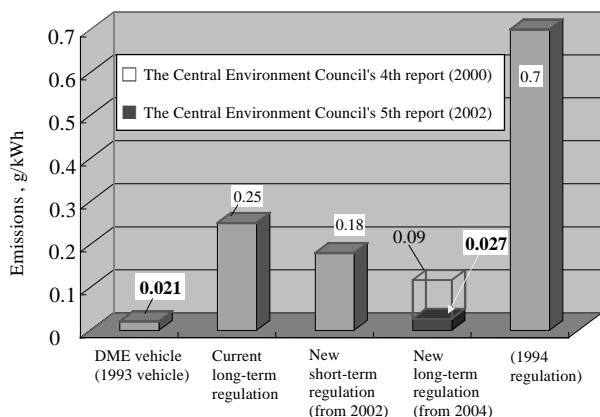


Fig.10 PM regulation plan and PM value of DME diesel vehicle

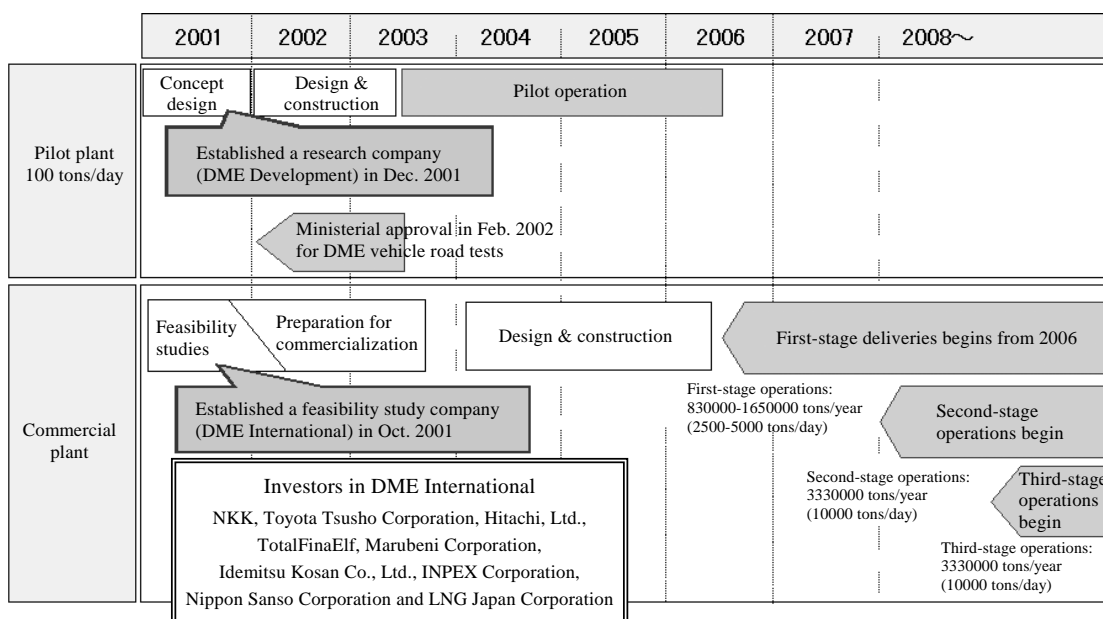


Fig.11 Time schedule toward the commercialization of DME

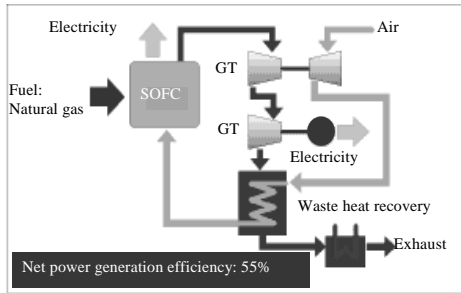


Fig.12 SOFC hybrid power generation system

Further, in December 2001, NKK cooperated with Fuel Cell Technologies Corporation of Canada, which is in alliance with SWPC for developing small-scale systems, in the commercialization of SOFC systems of up to 50 kW output for residential and small-scale industrial use. Thus, NKK is now in a position to be able to market the full lineup of SOFC systems from small-scale systems of several kW to large-scale systems of several MW(Figs.13, 14). The aforementioned DME has excellent properties as a fuel for fuel cells, and research is currently underway for the development of DME fueled SOFC systems.

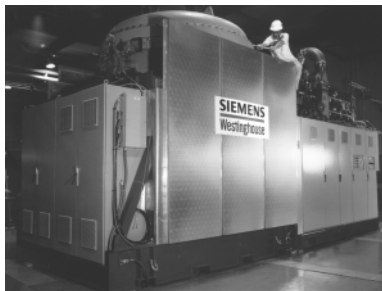


Fig.13 220 kW SOFC gas turbine hybrid system



Fig.14 5 kW SOFC system

5. Formation of environmental network using IT⁵⁾

NKK started a new website for environmental solutions in February 2001. This integrated website for environmental information is the first in the industry to be created for the express purpose of providing environmental information. As shown in Fig.15, it provides a wide range of information on matters related to the environment and energy through the Q&A format. It now has a monthly access of about 10000, and receives numerous questions and requests for reference materials on the environment and energy. All environment-related information will ultimately be obtainable at this site. It also provides a forum for bilateral communication between the parties concerned aiming at establishing a bilateral communication network on environmental issues.

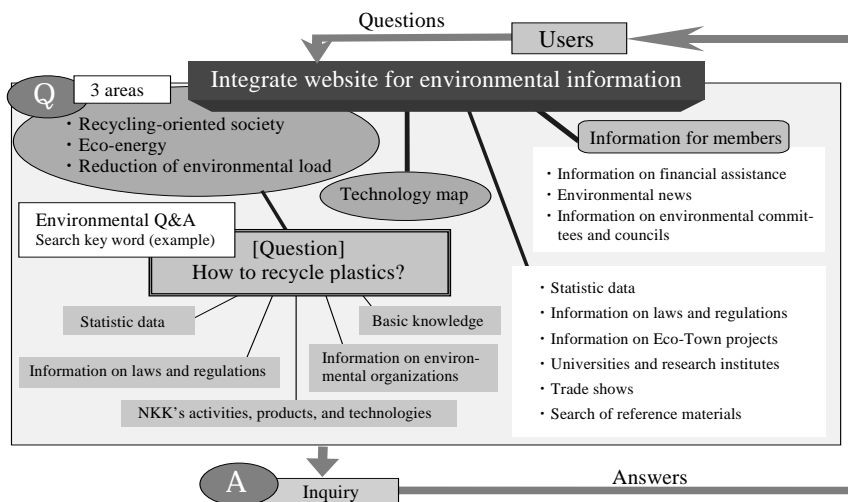


Fig.15 Integrate website for environmental information

URL: <http://e-solutions.nkk.co.jp> (note: currently in Japanese only)

References

6. Conclusions

NKK is expanding its business horizon into new fields related to the environment and energy, utilizing the technological capability it has built up over the years. From the concept formation for realizing the recycling-oriented society to the solutions to various issues related to the environment and energy, NKK provides total solutions under the motto "NKK proposes ways to a better living environment based on innovative concept and technology" and aims at being a company relied on by society on matters related to the environment and energy.

NKK and its group of companies intend to be an environmentally advanced corporate group that contribute to the establishment of the recycling-oriented, energy-saving society.

As of September 2002, NKK consolidated its business with Kawasaki Steel, and took an epoch-making first step as the JFE Group. We believe that the JEF Group can make even greater contributions to society in the fields of the environment and energy through the large synergistic effects expected to be produced by the business consolidation of NKK and Kawasaki Steel.

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