Zero Emissions Manual

― Realizing a Zero Emissions-based Regional Community ―

First edition

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Zero Emissions Manual Drafting Committee

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1. OBJECTIVES

1-1 Background and objectives of this manual

The unidirectional economic and social system of mass production, mass consumption, and mass waste disposal that brought about the 20th century's material wealth has also caused great destruction of the global environment and resulted in the severe depletion of natural resources. For the first time in history, we are faced with the fact that the Earth's resources are limited. In order to live with this fact, we must take immediate steps toward a socioeconomic system that is based on resource recycling.

In 1994, the United Nations University launched "the Zero Emissions" concept, whose ideas and methodologies can play an important role in realizing a resource-recycling society. Zero Emissions aims at the achievement of socioeconomic systems, regional communities, and corporate management styles that do not create any waste products. It is not a concept in the narrow sense of "reusing waste as a recycled resource" Rather, it is an innovation that aims for zero waste by means of mutual collaboration between the various actors of the socioeconomic system. (Figure 1)

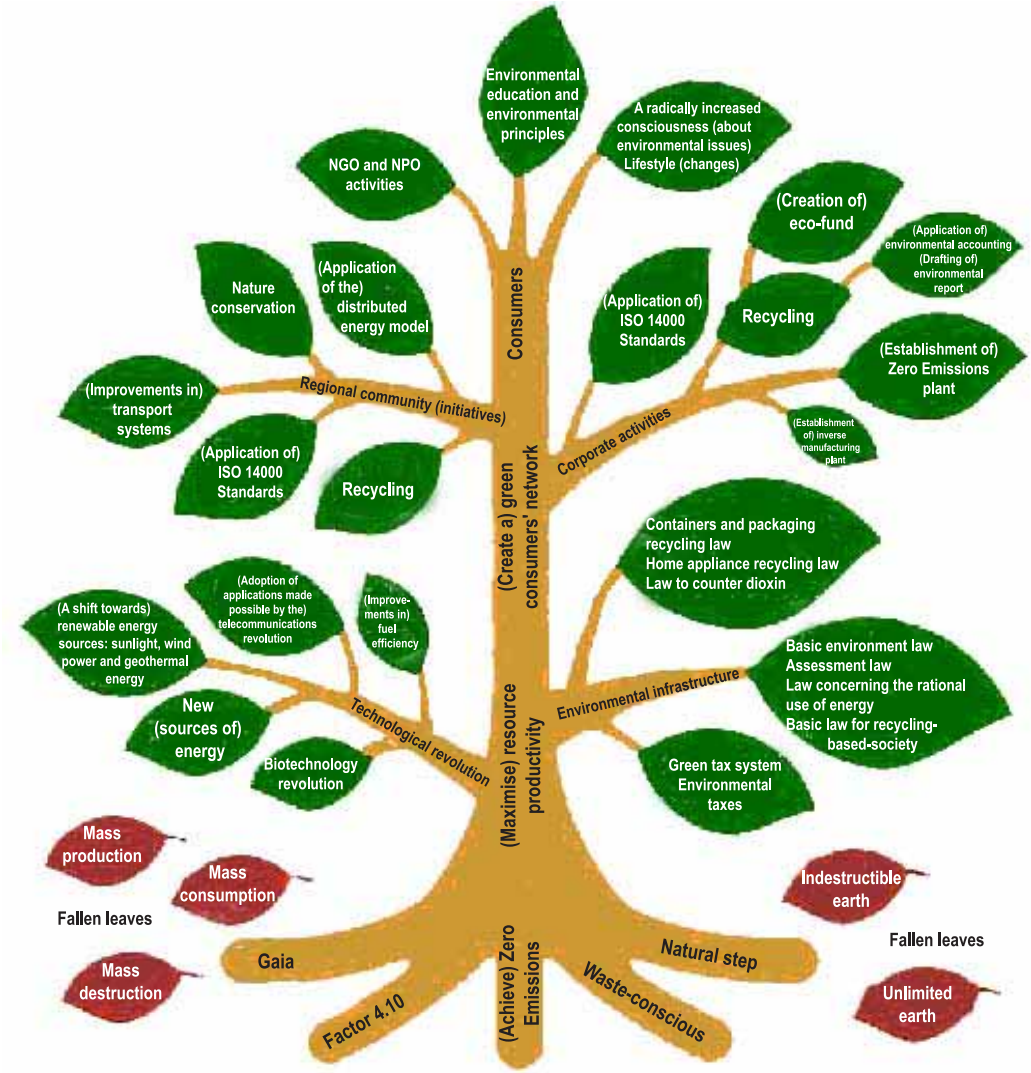
Nature maintains a sustainable eco-system that does not release any waste products. It is based on mutual collaboration between its constituents who serve in the roles of producers (plants), consumers (animals), and decomposers and detritivores (microbes). Hence, it constitutes the ultimate Zero Emissions system. When considering this principle, Zero Emissions aims at and insists upon the construction of a recycling-based socioeconomic system through mutual collaboration among different types of industry and sectors as well as among different regions and generations. In other words, it aims to establish a new socioeconomic system based on an industrial eco-system.

This manual sets forth the procedure for building a Zero Emissions-based society. In explaining the procedure, focus is placed primarily on industrial parks. However, this same procedure can also be applied to various other cases, such as efforts to build communities and to revitalize local businesses based on the Zero Emissions concept.

(This manual is prepared by the members of the Zero Emissions Manual Drafting Committee. Their names are listed at the end of the manual.)

"Environment tree" (vision for a resource-recycling society)

- The concept of "Zero Emissions" is an indispensable part of efforts to construct a resource-recycling society. The "environmental tree" (eco-tree) shown below is a concrete illustration of a resource-recycling socioeconomic system, which is an important aim in the 21st century.
- The branches and leaves of the eco-tree grow as the result of specific projects. It thus demonstrates how a resource-recycling society can be developed.



Principles	Components	Support unit	Implementers
- **Symbiosis with nature system** - **De-materialization (resource productivity)** - **Recycling** - **The limitations of the Earth capacity**	- **Resource productivity** - **Networked society** - **"Green consumers"**	- **Technological revolution (e.g., IT revolution)** - **Environment-friendly system infrastructure**	- **Consumers (individuals)** - **The regional community** - **Private sectors**

Source: Tadahiro Mitsuhashi, "A Discussion about Japan's Environmentally Sustainable Economic National Wealth", Toyo Keizai Inc.

- The construction of a resource-recycling society is based on four pillars: principles, components, support units and implementers.
- The eco-tree, appeared on page 33, illustrates progress towards the realization of a Zero Emissions-based society.

- 1-2 About Zero Emissions

In order to promote Zero Emissions, it is essential to understand the Zero Emissions concept. This section explains the background and current status of Zero Emissions as well as the scope of Zero Emissions as adopted in this manual.

Background and ideas

In 1994, the United Nations University launched the Zero Emissions concept under the Zero Emissions Research Initiative (ZERI). Its basic philosophy rests on the construction of a socioeconomic system that does not release waste products through collaboration between various types of industry (companies). In concrete terms, this means that waste products emitted by Company A are utilized as raw materials by Company B, and that waste products emitted by Company B are utilized as raw materials by Company C. In this way, an attempt is made to eliminate all waste products by constructing a new integrated industrial cluster that allows for resource optimization of waste products. To realize this, it is necessary to design and manufacture goods without releasing waste products. If this is not possible and waste products are emitted nonetheless, it is then advisable to utilize these products as value-added inputs for other goods. It is also important to create integrated industrial clusters that make use of waste products as resources possible.

Another important objective of Zero Emissions is the improvement of resource productivity by using energy and resources more effectively in the upstream where raw materials are procured and goods are manufactured, along with reducing downstream waste products to zero.

One must recognize that Zero Emissions, in essence, is a comprehensive principle for constructing a resource-recycling society through the collaboration of various economic agents. In the beginning, Zero Emissions was put forward as a principle, but it is now also serving as an effective set of measures to construct a resource-recycling society.

Existing circumstances and challenges

Zero Emissions is a methodology that realizes the effective use of waste products as resources. In recent times, an increasing number of plants are successfully reducing waste materials that go to landfill sites. However, a “zero waste plant” is not the same as a “zero emissions plant”. For a “zero waste plant” to become a zero emissions plant, it should have a clear position in an integrated industrial cluster by confirming how the plant’s waste products—which have been separated and removed from the plant site—are utilized as resources in other plants of the industrial cluster, and at the same time, what kinds of waste product (produced at other plants of the industrial chain) the company’s factories utilize as inputs. However, this is different from handing over waste materials to a final waste processing company. Plants that willingly trace the destination of emitted waste products and utilize them effectively as resources to the extent possible can make a significant contribution towards a Zero Emissions-based society.
In this way, it is necessary to examine the existing circumstances of Zero Emissions .

The scope of this manual

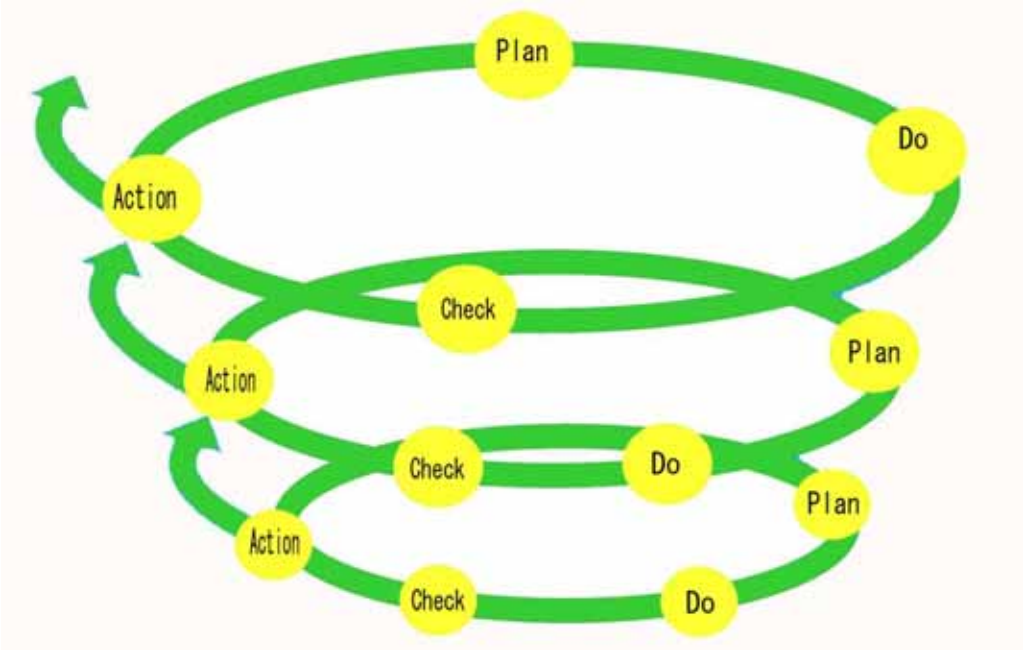
The Zero Emissions procedure set forth in this manual is primarily directed at the production process. It does not cover the selling of goods or the recycling process of reclaimed goods. The selling of goods exceeds the scope of this manual because it is not bound to the limits of an industrial park or a region but, instead, is national or even global in scale. However, the selling of goods will have to be included in the Zero Emissions framework in the future.

In light of this, it is desirable for organizations tackling Zero Emissions to consider the proactive introduction of a new business model, involving such items as a lease and rental systems, which is based on the idea of not only selling goods but also providing functions and services associated with these goods.

1-3 What is focused in this manual?

- Mutual collaboration between different types of industry and sectors as well as between different regions and generations is crucial for the promotion of Zero Emissions. Consequently, this manual is based on the premise that companies and local governments will not act independently but, rather, that various economic agents will work together in partnership.
- This manual tells you that one can gradually reduce waste materials by increasing efforts in the implementation phase through a series of PDCA (i.e.: "Plan, Do, Check, Act") cycles, illustrated below. (More information on PDCA cycles is provided on page 7. A detailed picture of PDCA cycles adopted in this manual is presented on the following page.)

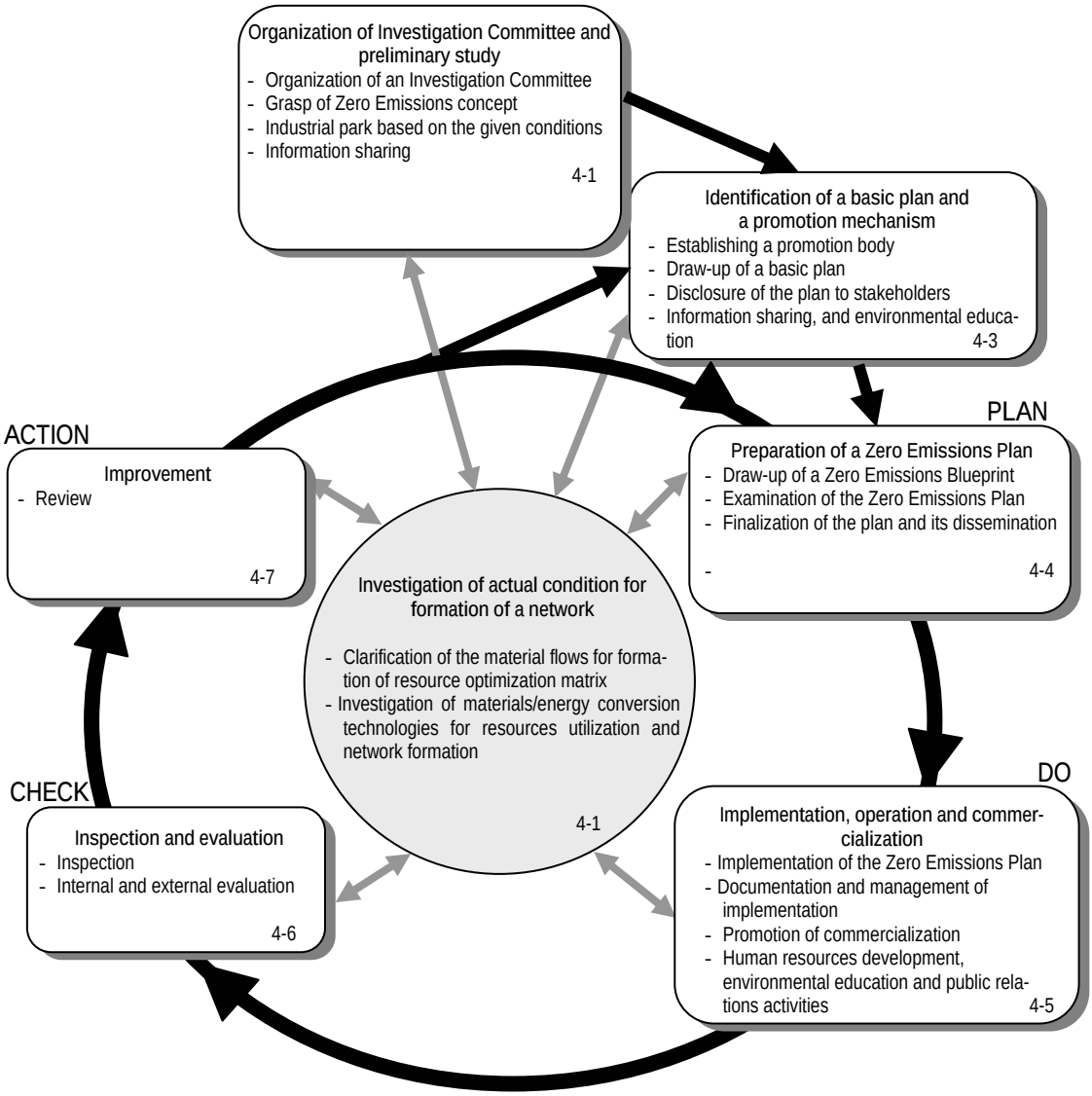
Process toward reinforcing Zero Emissions



- This manual draws upon the philosophy of the ISO 14001 "Environmental Management System." ISO 14001 aims to develop a systematic management approach to the environmental concerns of each company or organization, based on the PDCA cycles. The Zero Emissions concept takes this approach a step further. Based on cooperation and collaboration between various organizations, it aims to create a resource-recycling socioeconomic system with a limited overall impact on the environment. Whereas the acquisition of ISO 14001 requires that an organization collect environment-related data on itself, the promotion of Zero Emissions allows for the effective utilization of these data.
- This manual consists of two parts: Main text and an annex volume. The main text illustrates the concepts which can be applied to various types of industrial parks as well as to communities facing a variety of conditions. The annex volume introduces typical cases of Zero Emissions application, examples of publicly disclosed materials flow, and tools for a more profound understanding of Zero Emissions. The manual, covering every step in the procedure, is a reference guide that all organizations concerned with Zero Emissions can individually refer whenever necessary.

PDCA cycles for the promotion of Zero Emissions

- The structure of the PDCA cycles adopted in this manual is shown below. This model can be applied to the continual realization of Zero Emissions in industrial parks and regional communities.



2. TARGET GROUP

- The target group of this manual includes all organizations of industrial parks and regional communities who plan to tackle Zero Emissions.
- Since industrial parks are considered to be the regional "core" when promoting Zero Emissions, this manual goes along with the case of industrial parks. However, the same approach may also be applied to local governments, companies, and resident groups of a regional community that are tackling Zero Emissions.

Target group of this manual

3. GLOSSARY

Definitions of Zero Emissions-related terms are provided below.

■ **Resource-recycling society**

For the first time in its five million year-history, mankind is facing the fact that the Earth has limited resources. Phenomena, such as environmental destruction and depletion of resources, are intensifying rapidly, and the model of one-way society—based on the principles of mass production, mass consumption, and mass waste disposal of energy and resources—has failed. The "resource-recycling society" is an innovative concept that serves as a substitute. It aims to form sustainable social systems that reduce burden on the environment and increase resource productivity.

■ **Eco-system**

The ecological system. Nature maintains a sustainable "society" that does not release any waste products. It is based on the mutual collaboration of constituents that serve differing roles: producers (plants) and consumers (animals), decomposers and detritivores (microbes).

■ **Waste materials**

Waste materials can largely be divided into industrial waste products and general waste products. In Japan, the total of general waste products equals 51.45 million tons per year (representing a mountain of approximately 139 times the size of Tokyo Dome). The total of industrial waste products equals 400 million tons (eight times more than general waste products and representing a mountain of approximately 1,100 times the size of Tokyo Dome). (Source: Ministry of Environment Data-1999 Achievements)

Industrial waste products are mainly emitted by factories. General waste products, on the other hand, are mainly produced by households. While local governments (such as cities, towns, and villages) have responsibility of collecting general waste products, industrial waste products are disposed of on a private basis. Because of a sudden rise in disposal fees for industrial waste products, illegal dumping is becoming a emerging problem. (More information on Japan's material balance is available in the Additional Volume.)

■ **ISO 14001**

ISO 14001 is an Environmental Management System that was established in 1996 by the International Organization for Standardization (ISO). It is a mechanism by which each industrial enterprise a) reduces its environmental burden through various activities and b) makes efforts for continual improvement using the PDCA cycles to help reduce this burden. It is implemented through the integration of an environmental policy into management policies. Based on this policy, an environmental management plan is drawn up, implemented, examined, and reviewed. ISO 14001 is founded on the premise that each company collects data to measure its burden on the environment. We intend to use these data effectively in this manual.

■ **PDCA cycles**

A cyclic model showing the procedure to be followed by each organization for the continual promotion of Zero Emissions. It is a systematic and persistent approach to strengthen Zero Emissions activities and involves rotation along four steps: PLAN (setting a plan) - DO (implementation and operation of the plan) - CHECK (evaluation) - ACT (review).

■ **Local community**

Local community includes all the stakeholders of a certain region (e.g., local governments, neighborhood councils, companies, local citizens, and waste processing companies). It is important that the regional community as a whole tackles Zero Emissions, as collaboration among different economic agents is the premise of Zero Emissions.

■ **Final landfill site**

A site where waste products undergo final disposal by means of landfill. Sites are categorized according to the impact level of the final waste products to the environment: (1) strictly controlled landfill sites, (2) stably controlled landfill sites and (3) controlled landfill sites. In recent years there has been a sharp decline in the remaining capacity of final landfill sites. Construction of new sites is also becoming increasingly difficult due to the vast burden they have on the environment and resistance from local citizens. In this context, the decline of final landfill sites is becoming a serious problem and there rises expectation toward Zero Emissions which aims at the resource optimization of waste products.

■ **NPO (private non-profit organization) and NGO (non-governmental organization)**

Private-sector organizations that do not aim to earn a profit. An NPO is a private-sector organization that acts in a voluntary and non-commercial way. Organizations targeting environmental problems, in particular, are called environmental NPOs. NGO is a non-commercial private-sector organization that coordinates international activities based on a standpoint of ordinary citizens. In Japan, the two terms are often used indistinctively.

■ **Resource recycling**

The reuse of waste products and goods as resources. In this manual, it includes the reutilization and recycling of waste products as well as their use as fuel.

The resource-recycling ratio measures the proportion of materials included in the resource-recycling process.

■ **Material and energy flow**

This is a chart that shows how the various materials and energy that are used for industrial activities or by the regional community are procured and utilized.

■ **Resource optimization matrix**

This matrix shows what types of waste product and waste energy are released at which economic sectors. It also shows how waste product is effectively utilized as resources in other sectors or in different regions.

■ **Waste processing**

The disposal of waste materials through evaporation, drying, crushing, compressing, and sorting processes for the reduction, purification, and detoxification of waste products.

■ **An explanation of the following terms is available in the Additional Volume:**

Tools to reach a deeper understanding of Zero Emissions:

- Gaia Theory
- The Natural Step
- Resource productivity/Factor 4, Factor 10
- Environmental effectiveness
- Eco-ruecksack

Tools to evaluate the achievement level:

- Social cost
- LCA (Life Cycle Assessment)
- Environmental label
- Eco-design

4. THE PROCEDURE

The steps and "action items" for promotion of Zero Emissions are specified below. Each item in the procedure corresponds to the PDCA cycle model to promote Zero Emissions (explained on page 5.)

The procedure for Zero Emissions efforts

Step		Actions	Actors	Annex Volume
1.	**Organization of an Investigation Committee and prepartie investigation**	**1. Organizing an Investigation Committee:** recruit core partners and form an Investigation Committee	Volunteers	2. Tools to reach a deeper understanding of Zero Emissions
		2. Grasping the Zero Emissions concept: understand the background, content, and benefits of tackling Zero Emissions	Volunteers/ Investigation Committee	
		3. Grasping actual conditions; formulating an industrial park framework: consider social costs; grasp actual conditions and formulate an industrial park framework	- Investigation Committee - Companies and local citizens, etc.	
		4. Information sharing: share information about the process, progress made so far, and forthcoming plans	- Investigation Committee - Companies and local citizens, etc.	
2.	**Investigation of actual conditions***	**1. Clarifying material flows for formulation of a resource optimization matrix:** understand the flow of waste products, raw materials, water, energy, goods, and costs; form a resource optimization matrix based on this understanding	- Public disclosure by each organization (companies, etc.) - Analysis by Investigation Committee/promotion body	3. Understanding the flow of materials 1. Existing application cases (Kokubo Industrial Park, Nairiku Industrial Park)
		2. Investigating material/energy conversion technologies for resources utilization; establishing a network: thoroughly investigate on conversion of materials and energy and on methods for recycling resources	- Investigation Committee - Promotion body - Each organization (companies, waste processing companies, etc.)	
3.	**Identification of a basic plan and a promotion mechanism**	**1. Establishing a promotion body:** elect leadership; position it clearly; establish an executive office and an advisory board	Investigation Committee	1. Cases of existing Zero Emissions application: - Kokubo Industrial Park - Nairiku Industrial Park - Kawasaki Zero Emissions Industrial Park - Honjo International Research Park - Fujisawa Eco-Industrial Park etc.
		2. Drawing up a basic plan: draw up a basic plan by clarifying the purpose of the action, the actors, the action policy, the target group, the numerical objectives, collaboration between various types of industry, the scope of implementation, the time schedule, and the promotion schedule	Promotion body/all members	
		3. Disclose the plan to stakeholders: publicize the promotion system and the basic plan to each organization and to the administrative authorities of neighboring regions, etc.	Promotion body/all members	
		4. Information sharing and environmental education: share information and provide environmental education in order to draw up a basic plan and to encourage smooth development of later activities	Coordinated by promotion body and all members	
4.	**Preparation of a Zero Emissions Plan**	**1. Drawing up a Zero Emissions Blueprint:** draw up a blueprint by examining target selection, administration methods, and classification and collection methods	- Promotion body - Cooperation from each organization (companies, etc.) - Responsible persons	1. Cases of existing Zero Emissions application (Kokubo Industrial Park and others)
		2. Examining the Zero Emissions Plan: verify the feasibility of the blueprint by practicing the Zero Emissions Plan on a small scale basis	Each organization (companies etc.)	
		3. Finalizing the Zero Emissions Plan and its dissemination: finalize and publicize the basic plan, the Zero Emissions Plan and the implementation plan including the schedule	Promotion body and each organization (companies, etc.)	
5.	**Implementation, operation and commercialization**	**1. Implementing the Zero Emissions Plan:** promote the plan in accordance with the implementation plan report	Each organization (companies, etc.)	1. Cases of existing Zero Emissions application (Kokubo Industrial Park and others)
		2. Documenting and managing the implementation: each organization (companies, etc.) keeps the record of its progress for submission to the promotion body	- Prepared by each organization (companies etc.) - Stored by promotion body	
		3. Promoting commercialization: investigate the profitability of the Zero Emissions plan from various perspectives	Each organization (companies, etc.) and promotion body	
		4. Human resources development, environmental education and public relations activities: provide training and environmental education for continuous development of Zero Emissions; promote internal and external PR activities	Coordinated by promotion body and all members	
6.	**Inspection and evaluation**	**Inspection and evaluation:** set and adopt evaluation standards that are appropriate for each industrial park and region	Established by each organization (companies etc.)	2. Tools to reach a deeper understanding of Zero Emissions
7.	**Improvement**	**Review:** carry out a review based on the results of the evaluation and propose improvements	- Promotion body - Each organization (companies etc.)	

*"2. Investigation of actual conditions" is interlinked with all the steps.

4-1 Prepartie investigation

4-1-1 Organization of an Investigation Committee

Recruit volunteers and form an Investigation Committee in order to establish a Zero Emissions promotion body.

- No one organization can promote Zero Emissions on its own. That is why collaboration among different industries and sectors as well as among different regions and generations is essential. For this purpose, a small number of members initially share responsibility for this item and consider gradual increases of members who actively cooperate.
- The actual procedures are as follows:

(1) Recruit core partners
- Approach various stakeholders, such as companies and citizens, and increase the members who actively cooperate.
- Share problems that industrial parks and regional communities are currently facing.

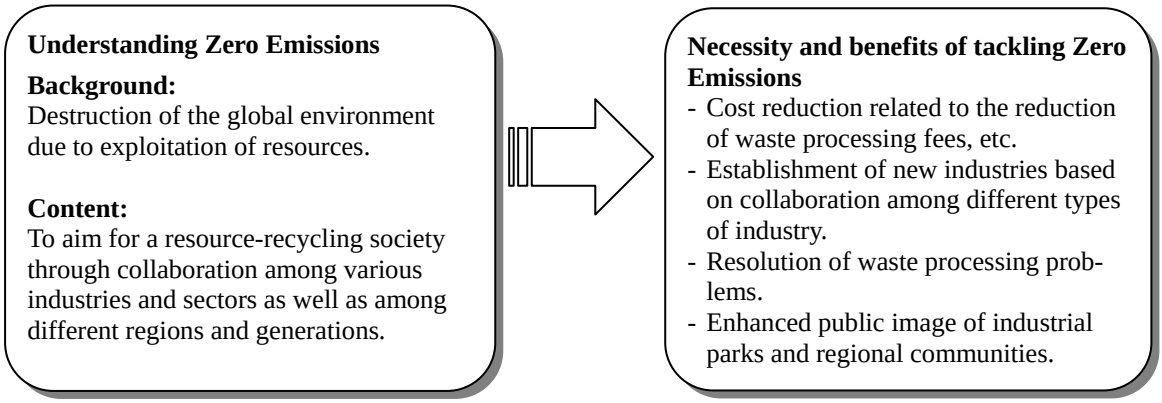
(2) Form a Zero Emissions Investigation Committee
- At this stage, you may start with a small number of participants (members). When a promotion body is established later, the members will become more or less fixed.
- Share the objective of promoting Zero Emissions and discuss necessary efforts.

4-1-2 Grasp of the Zero Emissions concept

Achieve a Zero Emissions-oriented mindset by understanding the Zero Emissions concept while recognizing the necessity and benefits of tackling Zero Emissions.

- One needs to understand the following aspects. A more detailed overview is provided in **Section 1-2 "About Zero Emissions" on page 3**.

- Background: Recognize that mass production, mass consumption, and mass waste disposal have caused the destruction of the global environment and that depletion of natural resources is intensifying. Understand the necessity of Zero Emissions.
- Concept: Zero Emissions is not limited to the processing of waste products; it also includes energy issues. Furthermore, it is important to understand the necessity of recycling resources by eliminating upstream waste products, in addition to downstream waste materials, to the greatest degree possible. This is because the Zero Emissions concept targets the entire flow, from upstream to downstream materials.
- Necessity and benefits of tackling Zero Emissions in industrial parks and in the regional community as a whole.
  (1) Cost reduction by re-using waste products and selling reclaimed goods and as a result of a decline in waste processing fees.
  (2) Creation of new industries based on a new type of collaboration among different industries.
  (3) Resolution of waste processing problems caused by the limited capacity of final waste-disposal sites.
  (4) Enhancement of the public image of industrial parks (individual companies and the industrial park as a whole) and of regional communities (each organization and the community as a whole).



- Industrial parks and regional communities are made up of different economic agents who all have different opinions. It is therefore necessary to aim for a high-quality Zero Emissions plan that is based on a consensus among these different agents.
- First, the people who strive to promote Zero Emissions must understand the Zero Emissions concept. These same people must also have a clear image why one should tackle this issue now and what are the benefits for the organizations involved.

Please see the Additional Volume: "3. Tools to reach a deeper understanding of Zero Emissions."

4-1-3 Industrial park based on the given conditions

The Investigation Committee plays a leading role in estimating social costs while also grasping actual conditions and formulating an industrial park framework.

Common subject: consider social costs

- Consider the social costs of waste processing.

  In order to consider collaboration with other stakeholders(regions and industrial parks), one must have a correct understanding of the quantity of waste materials sent to final disposal sites outside a region or industrial park as well as the necessary costs.

  Example: make efficient use of statistics on the amount of processed waste at the city, town, or village level.

Existing industrial parks

- The Investigation Committee plays a leading role in understanding current conditions of industrial parks. Currently available information on the flow of materials, energy and waste products is enough at this phase, because a detailed investigation will be carried out after drawing up a basic framework. .
- Identify the items indicated below based on existing data and hearings with each company.

Features of the industrial park	Environment of the site, number of companies within the industrial park, characteristics of the industrial diversification, number of plants, size of plants
Features of companies	Number of employees, site area, revenue, characteristics of manufactured goods, characteristics of manufacturing processes
Efforts for environmental issues	- Number of companies that have acquired ISO 14001 certification and number of zero-waste plants (refer to explanatory note) - Efforts by individual companies toward ISO 14001 certification - Recycling ratio, problematic issues - needs and challenges for Zero Emissions:

New industrial parks

- When a new industrial park is developed, make sure that a framework is appropriate for the promotion of Zero Emissions at the park.
- It is advisable to consider the following activities:

◆ Develop an industrial park with a balanced participation of companies from various industries.

◆ When recruiting companies, carefully design application requirements and make an elaborated list of recruitment needs for the industrial park.

◆ Reflect upon ways to cooperate with the regional community.

◆ Effectively use equipment and techniques in raw materials-based industries (such as nonferrous metals, paper manufacturing, and cement) as an instrument of Zero Emissions.

◆ Invite waste processing and recycling-related businesses to the industrial park and its surrounding area to support the park with resource-recycling equipment, etc.

◆ Grasp the conditions of each company in operation as generally done in the existing industrial parks.

Regional community

- The Invesitigation Committee must know well about current conditions in the region.
- Currently available information on the flow of materials, energy and waste products is enough at the preliminary research stage because a detailed examination will be carried out after drawing up a basic framework. Consider linkages with environmental publicity efforts, ordinances, frameworks, basic environmental plans, and local agents of local governments.
- Examine cooperation with industrial parks.
- Identify the items indicated below based on available data and hearings with each company.

Regional outline	- Regional resources (including farming, fishing and forestry, culture, etc.) - Locational conditions of companies, NGO and NPO activities
Efforts for environmental issues	- Status of actors that have acquired ISO 14001 (including local governments, companies, research institutes, etc.) - Number of companies that acquired ISO 14001 - Needs and challenges for Zero Emissions

Note: Comparison of Zero Emissions as it is understood in this manual and as found in existing zero-waste plants.

	Zero waste plant	**Zero Emissions**
Targets and objectives	In many cases, companies aim to achieve a resource-recycling ratio of 100% by reducing waste materials from their plants that are otherwise disposed of at landfill sites. While striving for resource recycling, there are also many entities that achieve Zero Emissions by sending the entire amount of waste materials to a waste processing company.	Based on the principle of "clean production" (reduced impact on the environment through increased energy and production efficiency) within a company, various actors from industrial parks and regional communities aim to realize complete Zero Emissions by recycling resources.
Measures	The main measures are reduction, resource optimization, and reutilization of waste products.	In addition to recycling and reutilization, it is necessary to examine the replacement of raw materials.
Relation to ISO 14001	The main focus is reducing, reusing and utilizing waste.	In support of Zero Emissions, it is desirable to adopt the PDCA cycle model of ISO 14001 and to acquire corporate data.

4-1-4 Information-sharing

Share information among all relevant agencies in order to enhance promotion of Zero Emissions activities.

- When there is certain progress in understanding current conditions and drafting a framework for the industrial park, organize meetings to report the progress to the top management of each company.

  What to report: progress made up to now, forthcoming policies and plans, etc.

- Zero Emissions activities will go efficiently and smoothly by sharing information, not only among the on-site parties concerned but also among corporate managers

4-2 Investigation of actual conditions

One may proceed with this item simultaneously with Item 4.3 (identification of a basic plan and a promotion mechanism). Remember that understanding of current conditions is interlocked with all steps, and thus, reviewing this section at each step is very important.

4-2-1 Clarification of material flows for formulating a resource optimization matrix

Clarify the flow of materials, energy, etc., from each agent and form a resource optimization matrix in order to promote Zero Emissions based on collaboration and cooperation among various types of industry.

- Analyze the flow from each company in order to explore possibilities for collaboration and cooperation among different types of industry. Be aware that public disclosure of the flow of each actor is essential to promote Zero Emissions. It is important to encourage flow disclosure based on a common awareness of issues.

- The procedure is indicated below.

(1) Understanding the flows from/to companies and houses within an industrial park and the region in concern:

- Each actor identifies the materials and energy input and output as well as the following items, and reports to the promotion body.

Waste materials	Types, quantities, characteristics, destinations of emitted waste, final waste processing quantities, waste-disposal methods, resource-recycling ratios
Raw materials	Content, imported quantities, consumed quantities, amounts invested in recycled resources and recycled parts
Water and energy	Used quantities
Manufactured goods	Types, outgoing quantities
Costs	Costs (refer to explanatory remark), water and energy fees, waste processing fees (including waste processing commission fees).

- When each actor tries to understand the above aspects, a template is needed. One may use the inserted inventory (see Additional Volume), which was put into practical use at the Kokubo and Nairiku Industrial Parks, as an example of this template.
- It is desirable to identify the flow of water to the maximum extent possible, as it is directly related to the input and output of an individual plant.

(2) Clarifying the flow of each actor outside an industrial park or a region.

- The achievement of Zero Emissions solely within an industrial park or a region is often difficult. This is why one may be required to investigate the above-mentioned aspects regarding surrounding industrial parks, regions, and companies at the largest possible scope. .

(3) Formulating a resource optimization matrix by Investigation Committee/promotion body:

- The promotion body creates a resource optimization matrix based on the flows submitted by each actor.
- Since it is impossible to fully understand all the items involved from the beginning, one may begin with easy-to-understand items, such as waste products that are emitted in large quantities.

When public disclosure of flow does not proceed smoothly, the promotion body will take the following steps.

- ◆ Explain once more to relevant companies and parties that understanding of the flow is for promoting Zero Emissions. Then, conclude a specific confidentiality agreement with the promotion body to ease burden of disclosure.
- ◆ Encourage each actor to acquire ISO 14001 certification and promote use of the publicly disclosed data that each provides to the inspection mechanism at the time of ISO acquisition.

Reference sections in the Additional Volume:
"1 Existing cases of Zero Emissions application" and "2 Understanding the material flow"

Remark: Regarding the understanding of costs: investigate whether a company does not purchase instances found in waste products released by other companies. Furthermore, it is desirable to examine the costs for utilizing the waste products of another company as raw materials.

Example: Kalundborg (Denmark): an industrial network is being established mainly by coal-fired thermal power stations, oil refining enterprises, and pharmaceutical manufacturers. A plasterboard plant was able to reduce costs by switching from gypsum that was purchased from virgin resources in Spain to gypsum waste from a power plant. (For a detailed overview, refer to "1 Existing cases of Zero Emissions application" in the Additional Volume.)

4-2-2 Investigation of material/energy conversion technologies for resources utilization and network formation

Investigate on conversion of materials and energy and on methods to recycle resources. Establish a Zero Emissions network.

- The promotion body investigates on methods for recycling resources and replacing raw materials. This investigation is based upon the flows and the resource optimization matrix submitted by each company. Based on the results gained from the investigation, construct a network of the recipients who take waste sources and recycled resources.
- In the initial stage, information (e.g., waste processing methods of waste processing companies) that can be gained from information exchanges among the relevant stakeholders is valuable.
- With reference to material and energy, one needs to develop measures for improvement, such as restraints on resource consumption and reductions of environmental burden.
- Since Zero Emissions relates to not only resource recycling but also the conversion of raw materials, its realization within a single industrial park or region is often difficult. This is why collaboration with surrounding industrial parks, regions, and companies is worth considering. In any case, with the promotion body at the core, it is important to conduct a wide-area study of resource-recycling methods and development of channels for marketing the recycled/remanufactured products.
- Consider the following points as examples of items that should be investigated.

<table>
<tr><th></th><th>Zero Emissions in an Industrial park</th><th>Zero Emissions in a region</th></tr>
<tr><td rowspan="2">Investigation item (examples)</td><td>■ Find partners within the industrial park: similar sectors, different sectors, related companies, etc.
■ Explore suitable collaboration outlets outside the industrial park: companies, waste processing companies, retailers in raw materials, recycled resource companies, local governments, industrial groups, commercial groups, universities, research organizations, etc.</td><td>■ Explore suitable collaboration outlets within the region: local governments, companies, waste processing companies, recycled resource companies, universities, research organizations, industries of the regional community (farming, fishing, and forestry), NPOs/NGOs
■ Explore suitable collaboration outlets outside the region: companies, waste processing companies, recycled resource companies</td></tr>
<tr><td colspan="2">■ Investigate technical information related to Zero Emissions
■ Investigate equipment for the conversion of energy
<u>Examples:</u> installment costs, maintenance costs, and sizing of equipment etc. intended for gasification melting furnaces or composting (refer to remark),</td></tr>
<tr><td>Investigation methods (examples)</td><td colspan="2">■ Organize research and information exchange meetings; exchange information
■ Organize hearings for research organizations, including administrative authorities and universities as well as specialized organizations
■ Gather information from academic papers and newspapers
■ Entrust universities and specialized organizations with research tasks</td></tr>
</table>

Furthermore, keep in mind following items when investigating.

- Examine how and what kinds of waste products are how much created inside and outside the region.
- With reference to particular waste products (refer to remark), consider collection throughout an even wider area and intermediate waste processing.
- Secure demand for goods that are remanufactured by recycling.
- Although each actor needs to draw up surveys and plans without depending on administrative authorities, various forms of survey data, plans, and fact-finding surveys, and public assistance means from local governments should be proactively utilized.
- Recognizing that we are heading for the biomass-based society, one must consider collaboration with regional industries such as farming, fishing, and forestry.
- Consider collaboration with industrial parks and regional actors such as NPOs and NGOs.
- If, in spite of having considered all options, it is impossible to process waste products within a region or its surroundings, search for a waste processing company that performs recycling in the nearest area as possible in order to reduce transportation costs.
- Share information databases.

Reference: "1 Existing cases of Zero Emissions application" in the Additional Volume

Remarks:

Gasification melting furnace
This is a system that turns waste heat into electric power while processing dioxin, disposing HCl, and appropriately processing ash through partial combustion and gasification (decomposition reaction…burning and incineration) of waste products in a single furnace. Furthermore, the system allows the utilization of construction materials that are created by molten ashes at 1,300°C then cooled down and collected as slag. This technology is beginning to produce results in a variety of areas, and plant construction costs are approximately equal those of traditional incinerators. A gasification melting furnace in Kawasaki City generates electric power of 11,700 kW at 430 t/d. In addition, third-generation gasification melting furnaces are already coming out. These furnaces separate items to be incinerated (such as items for gasification, char, and tar) in a single furnace so as to efficiently collect only useful gasses, such as methane and hydrogen.

Compost
This refers to products generated through fermentation by microbes, etc., using organic waste products such as raw waste and agricultural waste products. After fermentation, the generated compost can be used as a natural fertilizer.

Examples of particular waste products
"Specially controlled waste" and "specially controlled industrial waste": these refer to toxic, infectious, explosive, and other products that may cause harm to a person's health or the living environment. (Source: Ministry of the Environment)

4-3 Identification of a basic plan and a promotion mechanism

4-3-1 Establishing a promotion body

Establish a Zero Emissions promotion body as a single organization.

- In order to continuously work toward Zero Emissions, it is desirable to establish a promotion system within an industrial park association with a clear stance.
- The ideal members of the promotion body are those who are highly motivated for playing a central role in promoting Zero Emissions and who have prominent leadership in their organizations.
- A system should be designed to allow different actors (such as companies, local governments, research organizations, and local citizens) to collaborate and share responsibilities.
- The Investigation Committee is dissolved once the promotion body is launched.

Examples for establishment of a promotion body

Industrial park

In the case of an existing industrial park:	The subordinate organization of the industrial park's administrative organization, cooperatives, private organizations, etc.
In the case of a new industrial park:	Research and study committees formed within a local government or an industrial park's development agency.

Regional society

Consultative associations/committees (collaboration with local governments, companies, and research organizations such as universities), lower branch of agricultural cooperatives, etc.

- Position the promotion body as a single organization within the administrative organization. When simultaneously establishing an executive office and an advisory board, one can consider adopting the following procedure:

(1) Select leadership

- Select the leadership of the promotion body. It is advisable to choose persons who are able to coordinate various economic actors and who can motivate the entire body.

(2) Give the promotion body a clear position

- Since various actors from different types of industry participate in the promotion of Zero Emissions, it is better to have a setup that secures the validity of the promotion body.
- In the case of industrial parks, consider positioning the promotion body as a single entity within the park's administrative organization.
- In the case of regional communities, it is one idea to establish an association with the collaboration of industries, academia, and government officials.
- In the case of industrial parks, try to address the Zero Emissions initiative at general assemblies of cooperatives, etc.
- Consider ways for raising operating funds when positioning the promotion body.

(3) Establish an executive office

- The function of the executive office is to support the activities and proposals of the promotion body.

(4) Create an advisory board

- Create an advisory board that is in charge of advising and evaluating each step of Zero Emissions efforts. The board should include external experts.
- It is desirable to obtain the cooperation of researchers from nearby universities who specialize in environmental issues, administrative authorities, environmental NPOs/NGOs, etc.

Remark:

- When positioning the promotion body in an organization, consensus-building is a key element. Develop a bottom-up procedure that encourages taking up ideas from the lower echelons to the higher echelons of the organization. Ultimately, it is desirable that a decision-making procedure reflects the views of top management.

Reference: “1 Existing cases of Zero Emissions application” in the Additional Volume

4-3-2 Draw-up of a basic plan

Draw up a basic plan that demonstrates the goals of the industrial park, based upon clarification of purposes, the actors, the action policy, the targets, the numerical objectives, collaboration between various types of industry, the scope of implementation, technical innovation, and the promotion schedule.

- The basic framework must clearly state the Zero Emissions vision. Considering each actor (companies, etc.) faces a different situation, it is advisable to decide on an overall policy first. Each actor concerned can then implement Zero Emissions along its lines.
- Once understand the following items, draw up a basic framework.
- The basic plan is not meant to serve short-term objectives. Reflecting a mid-to-long-term view, it aims at far-reaching objectives that promote Zero Emissions. (The concrete numerical values of the objectives targeted for within one year are specified in **Section 4-4 "Preparation of a Zero Emissions plan" on page 24**.)

Items to be clarified	Content
Purposes	Identify the purpose of promoting Zero Emissions. Consider linking this to the objectives of different actors, including regional communities and industrial parks. Examples: - Encourage the recycling of materials over a wide area. - Promote Zero Emissions based on collaboration between companies from different types of industry. - Reduce the amount of waste products emitted. - Review product design in order to reduce the amount of waste products. - Encourage the collection of goods and the reutilization of parts.
Actors	- Spell out the industrial sectors, the types of business, and the scale of the participating companies, etc. - Confirm whether a link has been established between the company and the promotion body.
Action policy	- Clarify each company's line of thinking with regard to how it will tackle Zero Emissions. Aim for a common understanding of Zero Emissions.
Targets	- Understand that not only waste products but also the flow of materials and energy, which is a much wider concept, can serve as a target. Take steps to examine the targets. - Regarding each company's own harmful waste products, begin by making an effort to stop emission by using substitute raw materials.
Numerical objectives	Examine numerical objectives that are appropriate for each industrial park or regional community based on the results of efforts to understand current conditions. Examples: - Reduction ratio of waste products - Resource-recycling ratio - CO_2 reduction ratio
Collaboration among various types of industry	Consider the creation of a resource optimization matrix among different types of industry as a way to establish a recycling system that interlinks different types of industry. Recognize the importance of public disclosure by each company.
Scope of implementation	Examine the geographic scale on which to tackle Zero Emissions and the scope and the routes for waste product collection.
Technical innovation	- Recognize the fact that the time needed to implement resource recycling will differ depending on the targets. - Recognize the fact that the quality and quantity of waste products can change due to, for instance, changes in production methods associated with technical innovation.
Promotion schedule	Draw up a rough schedule for attaining the numerical objectives.

- Elucidate the Zero Emissions vision of the industrial park or regional society by clarifying the above items.

4-3-3 Disclosure of the plan to stakeholders

Disclose the Zero Emissions promotion system and the basic plan to the public in order to build a system of collaboration and cooperation with neighboring regions and all stakeholders.

- Because Zero Emissions aims for resource recycling through the collaboration of different types of industry, its promotion is not necessarily limited to a single region or industrial park. It is thus important to consider far-reaching collaboration and cooperation at all times.
- In this context, efforts to publicize the promotion body and the basic framework of Zero Emissions are the key to encouraging smooth and extensive collaboration and cooperation among different types of industry.
- The content, targets, and methods to be disclosed are presented below.

	Examples	
Content of public disclosure	- Progress made in tackling Zero Emissions - Formation of the promotion body - Concrete content of the basic plan (purposes, actors, action policy, targets, numerical objectives, etc.) - Outline schedule - Current progress	
Targets of public disclosure	**Industrial park** - Administrative organizations (industrial associations, local governments, etc.) - Companies within the industrial park (employers and employees) - Waste processing companies (within the industrial park and the surrounding area) - Others: groups and individuals connected with the industrial park, etc.	**Regional community** - Administrative organizations (neighborhood councils, local governments, etc.) - Companies (employers and employees) - Local residents - Waste processing companies (within the region) -NPOs/NGOs - Others: groups and individuals connected with the regional community, etc.
Methods for public disclosure	- Distribution of written materials - Organization of explanatory sessions for local residents - Organization of environmental events - Organization of explanatory sessions on Zero Emissions - Preparation of pamphlets, etc.	

- Portions that are covered in the confidentiality agreements mentioned in **Section 4-2 "Investigation of actual conditions"** need not be disclosed.
- Public disclosure relates not only to the basic plan but also to the Zero Emissions plan.
  → **4-4-3 "Finalization of the plan and its dissemination" (page 27)**.

4-3-4 Information-sharing and environmental education

Establish an exchange forum with the aim of fostering a common awareness among all parties; provide environmental education designed to enhance awareness.

- In order to promote Zero Emissions, the people involved must attain a common awareness of the issue. Therefore, the promotion body is expected to not only encourage Zero Emissions but also to build trust between the industrial park and the regional community as a whole. In this context, the promotion body serves as a coordinator and promotes exchanges among all stakeholders by establishing a venue to hear the opinions of leaders of industrial parks and regional communities that have already begun tackling Zero Emissions as well as of researchers who specialize in environmental issues. As such, the promotion body expands awareness of Zero Emissions.
- Deepened understanding by information-sharing will facilitate the process of drawing up of a basic framework and actions to be taken later.
- Furthermore, Zero Emissions cannot be achieved in a short period of time. Efforts toward this goal must be developed continually. Consequently, it is necessary to educate leaders who will be responsible for future generations. Practical information on this topic is provided in **Section 4-5-4 "Human resources development, environmental education and public relations activities" (page 30)**.

- With regard to the content of information-sharing and environmental education, the following items can be taken into consideration.

- Information-sharing

  Examples (regional community):
  - Organize events and contests relating to the environment
  - Hold exchange sessions organized by administrative authorities, companies, local residents, and research organizations.

  Examples (industrial park):
  - Organize information exchange sessions and exchange-meetings among companies within the industrial park, other companies, waste processing companies, etc.

  Examples (for both of the above):
  - Study the existing application cases included in this manual
  - Coordinate guided tours of Zero Emissions sites and hold briefing meetings

- Environmental education

  Examples:

  Organize the following:
  - Lectures on Zero Emissions (by speakers from the promotion body, external research organizations, environmental groups, etc.)
  - Courses on ISO 14001
  - Environmental symposiums
  - Workshops
  - Environmental courses, preparation of brochure
    - The audience can be invited according to the position, e.g. managers of companies from within the industrial park or persons in charge of Zero Emissions.
    - Consider linking up with environmental NPOs/NGOs that specialize in environmental education.

4-4 Preparation of a Zero Emissions plan

4-4-1 Draw-up of a Zero Emissions Blueprint

Draw up a Zero Emissions blueprint that covers a target group, administrative operations, and classification and collection methods.

- Based on the information acquired so far, the promotion body draws up a Zero Emissions blueprint for the further promotion of Zero Emissions.
- It is advisable not to target all waste products at once, but rather to start with those waste products that all companies have in common and expand gradually. In this way, consensus-building among all relevant companies and actors is easier. (One can refer the case of the Kokubo Industrial Park indicated on the following page.)
- Keep in mind that, as months and years pass by, the efforts must be elaborated and become more substantial and waste products must be reduced gradually.
- When drawing up the Zero Emissions blueprint, one may be required to examine various recycling methods for the targeted waste products and to select the best methods based on a comparison of the environment burdens and costs.

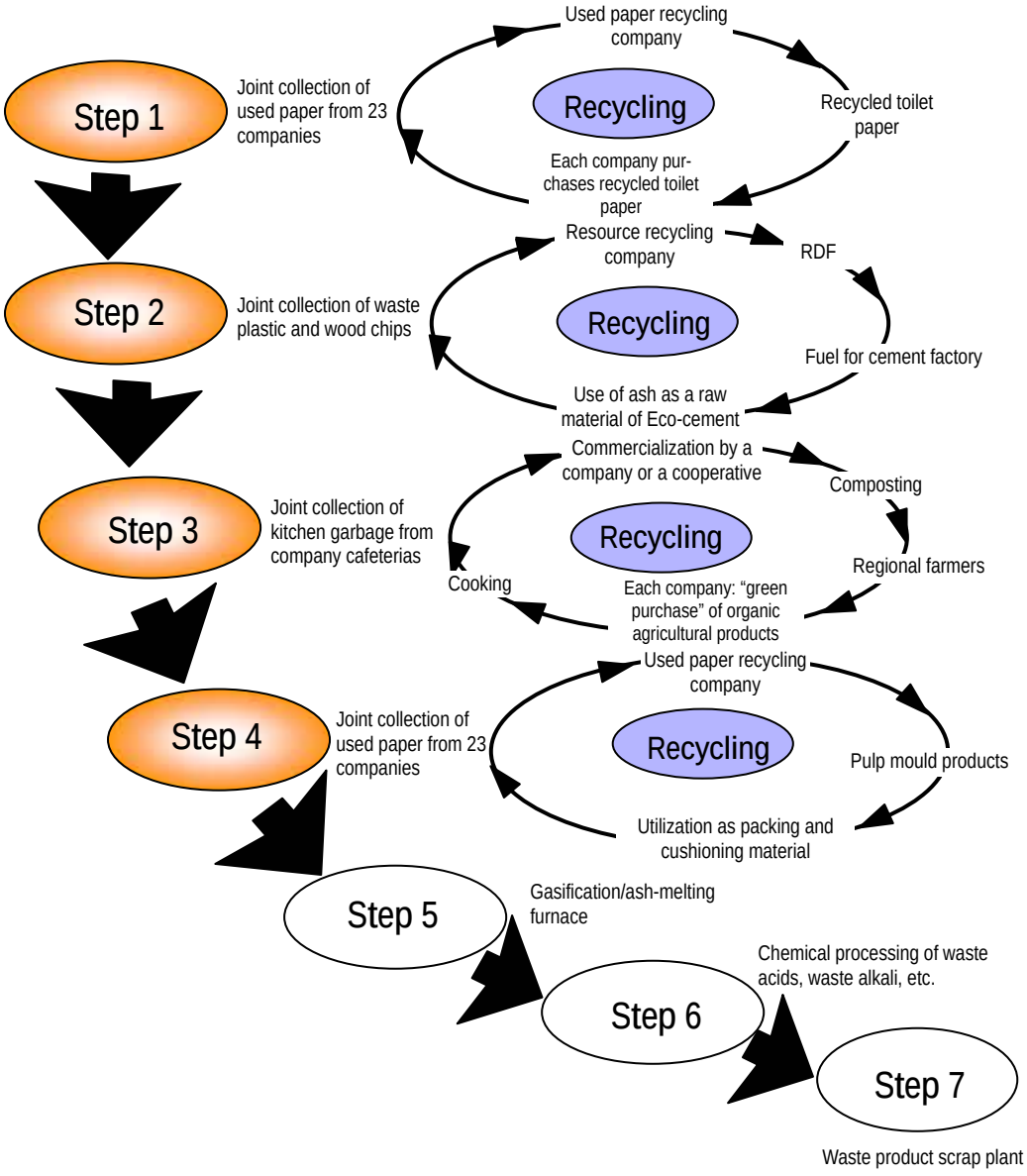
Example: Paper recycling :	Simple incineration Collect used paper → Utilize as recycled paper after processing, pulp molding, RDF, etc.

- The promotion body and the individual actors should study the following items.

Targets	It is advisable not to target everything at once, but to start with those waste products that are common to all agents involved. The targeted scope can be expanded later.
Administrative operations	1. Set-up of an administration system for each actor involved. Clarify the responsibilities of the promotion body and each company. 2. Costs Decide on methods to share responsibilities among all actors involved with regard to collection fees, transportation costs, and costs relating to Zero Emissions. 3. Study a scale-up plan for commercialization Examine the profitability of the Zero Emissions plan, the use of recycled goods, and the creation of markets for recycled goods. 4. Legal restrictions Consider legal controls that may be needed after implementation of the plan. 5. Government support and assistance Study preferential treatments provided by the national and local governments and make use of them as much as possible.
Classification and collection methods	1. Classification and collection methods Decide on classification and collection methods as well as a burden-sharing method for all companies. 2. Location of classification and collection sites Identify common collection sites for waste products and recyclable waste within the industrial park. 3. Equipment installation Decide on the types and scale of equipment to be installed.

Example: Steps taken at the Kokubo Industrial Park (for a detailed overview, refer to the Annex 5-1.)

Begin with recycling activities based on the joint collection of paper materials—physically easy to gather and immediately available at any companies. Gradually expand efforts to RDF (Refuse Derive Fuel) processing through the joint collection of waste plastic and wood chips, compost processing through the joint collection of kitchen garbage, and utilization of used-paper pulp mould in the manufacturing of products.



Reference: "1 Previous examples of Zero Emissions" in the Additional Volume

Remark: There are two ways of recycling paper: reutilization as raw material for manufacturing recycled paper or utilization in other purposes. In the former, pulp is prepared from used paper after classification and collection processes and is reused as raw material for paper production. Typical examples of the latter are pulp mould (which can be applied as a substitute for Styrofoam in industrial packing, etc.), RDF (solid fuel with excellent storage and transportation characteristics), and used paperboard. It is desirable to select the appropriate way of recycling in accordance with the circumstances.

4-4-2 Examination of the Zero Emissions Plan

Practice the blueprint on a small-scale basis in order to determine whether the plan is feasible.

- Before implementing the Zero Emissions plan throughout the entire industrial park, examine the plan on a small-scale basis and confirm issues such as profitability of a commercialized system and the period needed for implementation.
- In case problems arise, review the items of **Section 4-4-1 "Draw-up of a Zero Emissions Blueprint" (page 24)**.
- Confirm the following items at the time of the examination.

Targets	Examine whether the targets selected can be easily addressed by all actors.
Administrative operations	1. Set-up of an administrative system for each actor Determine whether a system is articulate and not too complicated to manage. 2. Costs Look into the costs for implementing Zero Emissions, including collection and transportation costs. 3. Examination of the commercialization plan Examine the profitability of the Zero Emissions plan, the use of recycled goods, and the development of markets. 4. Legal regulations Examine environmental laws and ordinances, etc. This is particularly important when installing large-scale equipment. 5. Government support and assistance Consider financial support and aid when large costs are involved.
Classification and collection methods	1. Classification and collection methods Examine whether said methods are appropriate. Are they adapted to the quantity of waste materials? 2. Location of classification and collection sites Are they easy to recognize? 3. Equipment installation Is the size of equipment appropriate for the quantity of wastes generated?

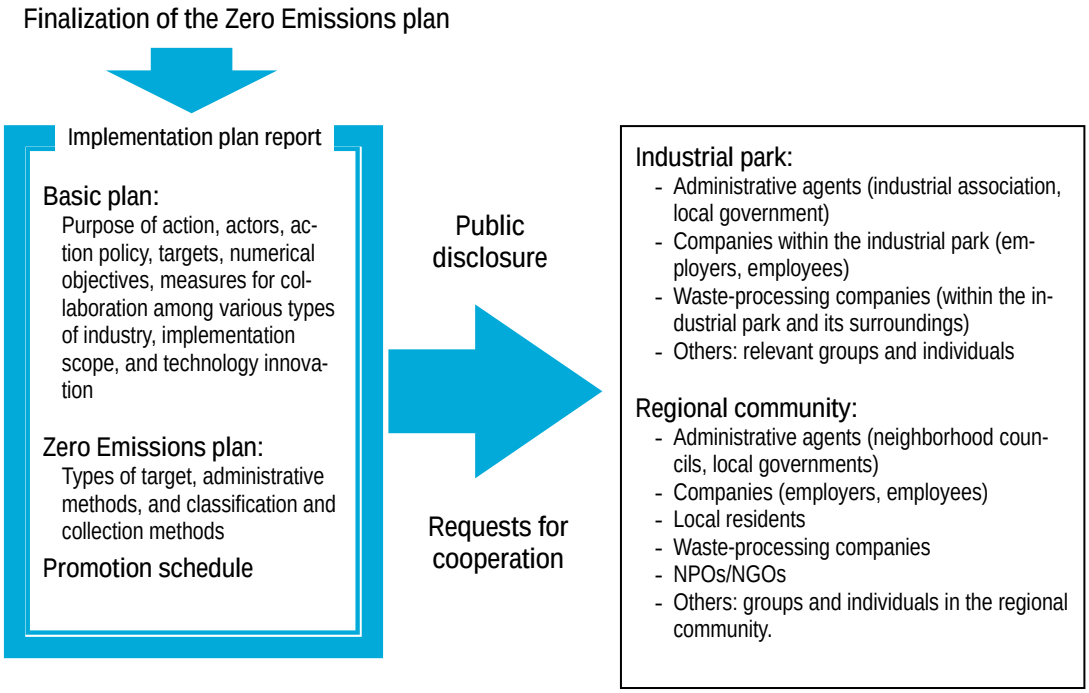
4-4-3 Finalization of the plan and its dissemination

When the Zero Emissions plan and the implementation plan are finalized, inform all relevant actors.

- Finalize the Zero Emissions plan based on the Zero Emissions blueprint and the results of the pre-examination.
- For an understanding of the overall Zero Emissions plan, prepare an implementation plan report that includes the basic plan and implementation plan, and inform all the stakeholders and government authorities of how the Zero Emissions plan is proceeded.

- The implementation plan report shall include the following items.

- Basic plan: purpose of actions, actors, action policies, targets, numerical objectives, measures for collaboration among various types of industry, implementation scope, and technology innovation.
- Zero Emissions plan: types of target, administrative methods, and classification and collection methods
- Promotion schedule



4-5 Implementation, operation and commercialization

4-5-1 Implementation of the Zero Emissions plan

Promote the Zero Emissions plan in accordance with the implementation plan report.

The following two-step procedure is recommended when implementing the Zero Emissions plan.

Step 1

- Verify whether or not each actor can implement and operate the responsibilities as formulated in the implementation plan report. Make minor adjustments if necessary.
- Promote Zero Emissions by establishing the promotion systems in each implementation unit (companies, etc.).
- If the participation of all members is difficult, start from the portions in which members are most motivated to tackle and expand gradually.
- Prepare partnerships with waste-processing companies. (Reference: Kokubo Industrial Park)

Step 2

- Based on the Step 1, clarify what actions to be taken next, and consider further exploration of approaches.
  (Reference: steps taken in the case of the Kokubo Industrial Park.)
- When implementing the plan, it is desirable to examine the following items and improve the content.

Targets	Do not try to do everything from the beginning. Start small and expand, starting with waste products that are common to each company.
Administrative operations	1. Verify the administrative system of each actor 2. Costs (method for sharing responsibility) 3. Examine the commercialization plan 4. Legal regulations: Consider legal regulations that will arise as a result of plan implementation 5. Government support and assistance: Study preferential strategies of national and local governments, and make use of said strategies as much as possible.
Classification and collection methods	1. classification and collection methods (methods and responsibilities of each company) 2. Location of classification and collection sites 3. Installation of equipment (type and scale of equipment to be installed)

Reference: “1 Existing cases of Zero Emissions application” in the Additional Volume

4-5-2 Documentation and management of implementation

Each individual implementation unit (companies, etc.) should keep the record of its progress for submission to the promotion body. The promotion body stores these records for use when necessary.

- Each actor should determine whether or not the progress is made as planned in the implementation plan report and reports to the promotion body.
- While asking each implementation unit to submit records, the promotion body stores these records and uses them for evaluations or in the event of an emergency.

4-5-3 Promotion of commercialization

Make efforts for the establishment of Zero Emissions as a business (selling reclaimed goods, etc.)

- The Zero Emissions plan must achieve profitability. For this purpose, examine the following items.
  - ◆ Reduction of materials costs based on the reutilization of waste products
  - ◆ Generation of revenues based on the selling of reclaimed goods
  - ◆ Reduction of waste-disposal fees based on resource optimization
- Consider revenue generation by the creation of new environmental businesses.

4-5-4 Human resources development, environmental education and public relations activities

Provide human resources development and environmental education for the continual promotion of Zero Emissions. At the same time, carry out internal and external public relations activities.

- Zero Emissions cannot be completed in a short period of time; it must be developed incrementally and continually starting with easy-to-tackle areas. Consequently, it is necessary to educate leaders who will be in charge of Zero Emissions for future generations.
- It is desirable to continuously carry out the items discussed in **Section 4-3-4 "Information-sharing and environmental education" (page 23)**.
- Consider the following items as examples of human resources development and environmental education.
  - ◆ Link up with NPOs and NGOs that organize training courses and provide relevant information, etc.
  - ◆ Participate in seminars on human resources development organized by Zero Emissions promotion organizations.

- With regard to public relations activities, resource collection sites should be announced and the progress of Zero Emissions activities should be reported by using the following media.

  Examples: Newspapers of cooperatives (industrial parks)
  Publication of community papers (regions)
  The Internet (WEB, mailing lists, etc.)
  Others

4-6 Inspection and evaluation

Each actor (companies, etc.) reports its progress of the plan to the promotion body. The promotion body and the advisory board inspect the said progress, compare it with desired values, and evaluate the level of achievement. The promotion body also considers requesting an external evaluation.

- Using evaluation standards suitable for each industrial park, evaluate how far Zero Emissions has been achieved. When collaborating with actors within and outside the industrial park, the evaluation should include the surrounding area, not just the industrial park.

- The evaluation procedure is as follows.

(1) Companies, etc.: submitting a report on plan implementation progress
One may use the same records that were submitted to the promotion body in **Section 4-5-2 "Documentation and management of implementation" (page 29)**.

(2) Evaluation

Self-evaluation

Each implementation unit (companies, etc.), the promotion body, and the advisory board evaluate a level of Zero Emissions achievement, particularly the following aspects.

- ◆ Cost comparison
- ◆ Percentage of waste-product reduction
- ◆ Resource-recycling ratio
- ◆ Comparison of social costs (before and after Zero Emissions activities)
  - Compare the amount of waste products, costs, and amount of virgin raw materials used after Zero Emissions activities with the case that a waste-disposal site is constructed.
  - Reduction of emitted CO_2

External evaluation

Based on an external inspection mechanism (ISO 14001 inspection mechanism, etc.), conduct a specialized external evaluation. The external evaluation should be linked with the self-evaluation for securing objectiveness of the data, by having an external evaluation of the self-evaluation results.
In the case of an industrial park, consider having an evaluation by the local residents.

- ◆ Assessment of social costs
- ◆ LCA
- ◆ Environmental labels; "eco-designs"
- ◆ Ecological footprint, etc.

Reference: "3. Tools for reaching a deeper understanding of Zero Emissions" in the Additional Volume

4-7 Improvement

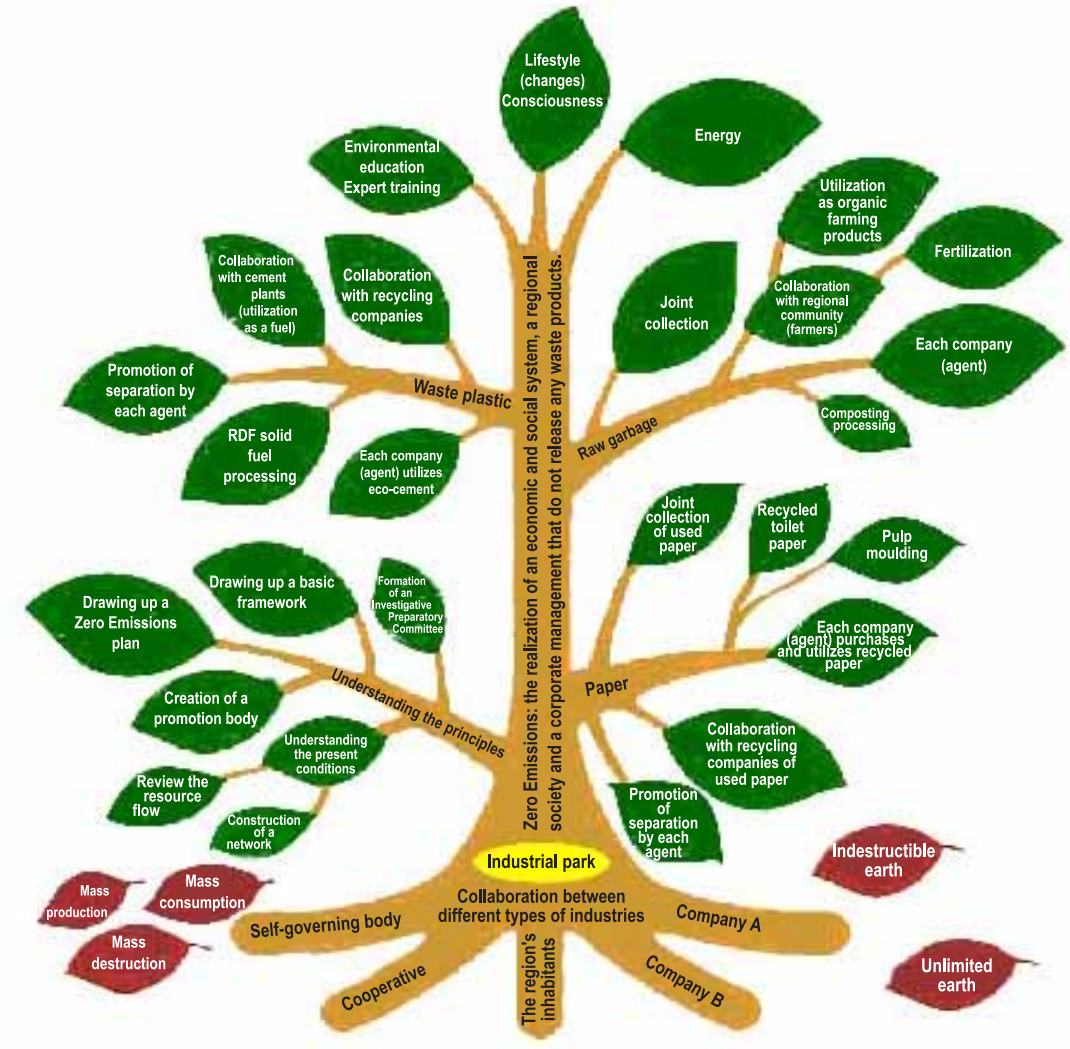
Review the Zero Emissions plan in order to continuously improve Zero Emissions.

- Zero Emissions are promoted through continuous efforts. In this context, with regard to the items examined in **Section 4-4-1 "Drawing-up of a Zero Emissions Blueprint"**, the promotion body takes a lead in reviewing and improving, based on the results of evaluations. Reviews should be performed regularly.
- At the same time, make continuous efforts to increase the motivation of each company.
- The content of the Zero Emissions plan is to be reviewed.

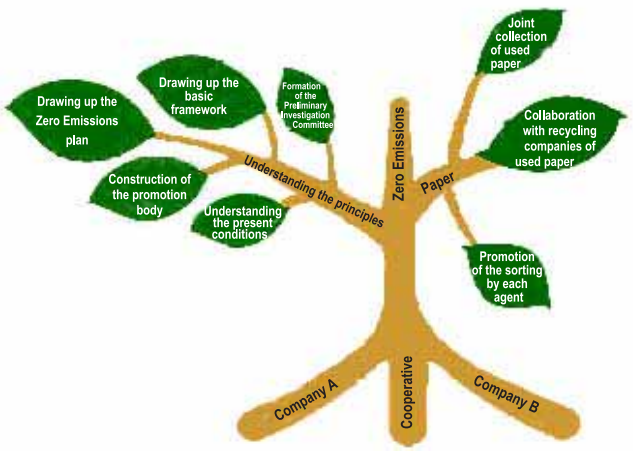
Target	Review of selection of targets
Administrative operations	1. Each actor's administrative system 2. Costs 3. Examination of commercialization plans 4. Legal regulations 5. Government support and assistance
Classification and collection methods	1. Classification and collection methods 2. Location of classification and collection sites 3. Equipment installation

- When necessary, the promotion body may be reorganized after reviewing the above items. If so, go through the PDCA cycles again for the continuous promotion of Zero Emissions.
- It is important to strive for continuous development of Zero Emissions and to deepen its content.

- **Environment tree (vision of the Zero Emissions manual)**
- It is important to enhance the various aspects of Zero Emissions. Thus, new branches and leaves should be added through promotion of actual projects.



Present situation (as of 2002)



10 years ago

Zero Emissions Manual Drafting Committee: members

("○" denotes chairman)

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Zero Emissions Manual (English version)
— Realizing a Zero Emissions-based Regional Community —
First edition

February 2004

Prepared by the Zero Emissions Manual Drafting Committee
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Zero Emissions Manual
Annex Volume

First Edition

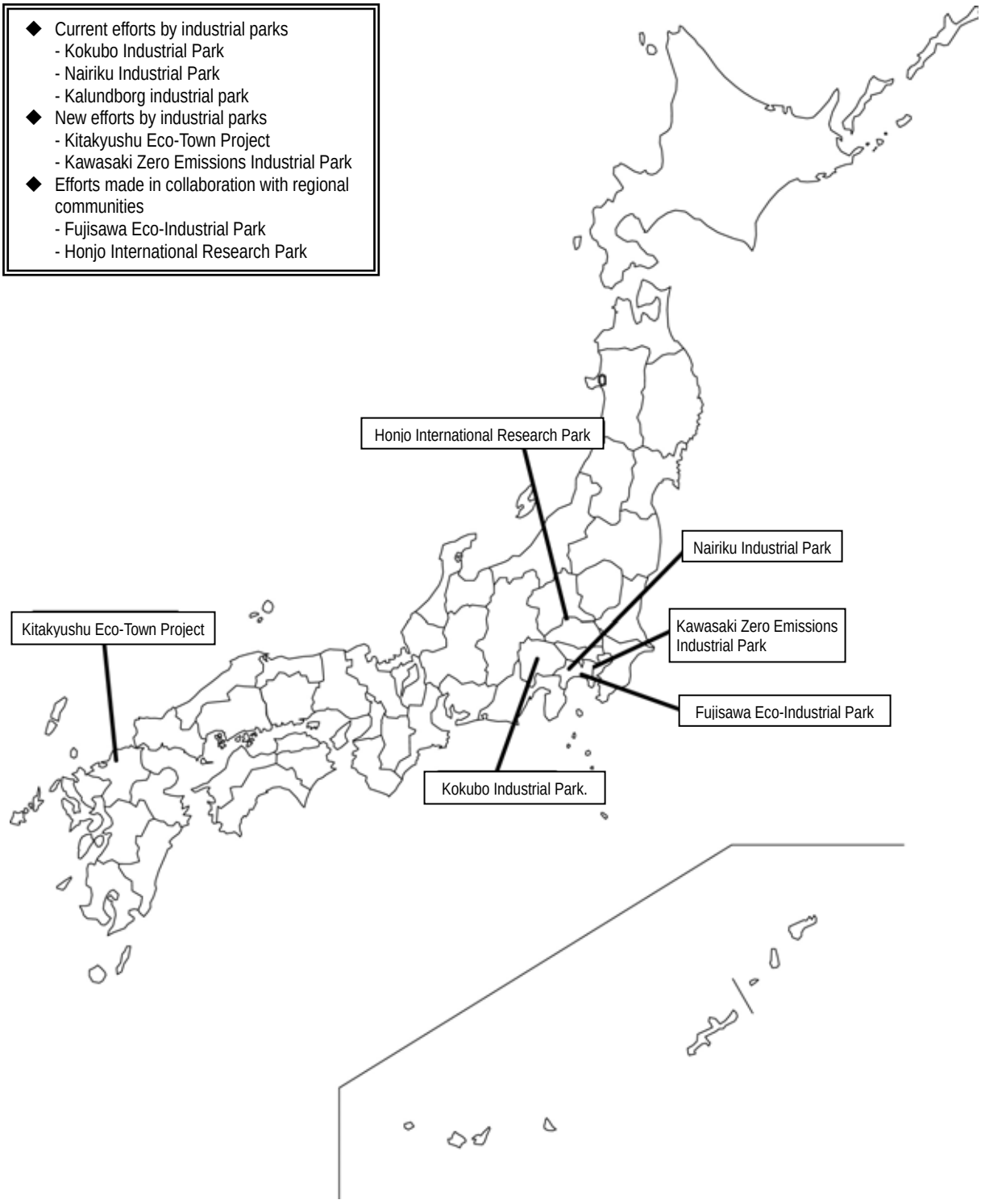
January 2003

Zero Emissions Manual Drafting Committee

Table of Contents

1. ZERO EMISSIONS: EXISTING CASES OF ZERO EMISSIONS APPLICATION

This section presents existing cases of Zero Emissions application by industrial parks and regional communities. While each industrial park or regional community has different ways of approaching and dealing with Zero Emissions, and some have only just started their efforts, they all should be used as references in the creation of promotion bodies and other steps of the Zero Emissions procedure.



1-1 Kokubo Industrial Park (Yamanashi Prefecture)

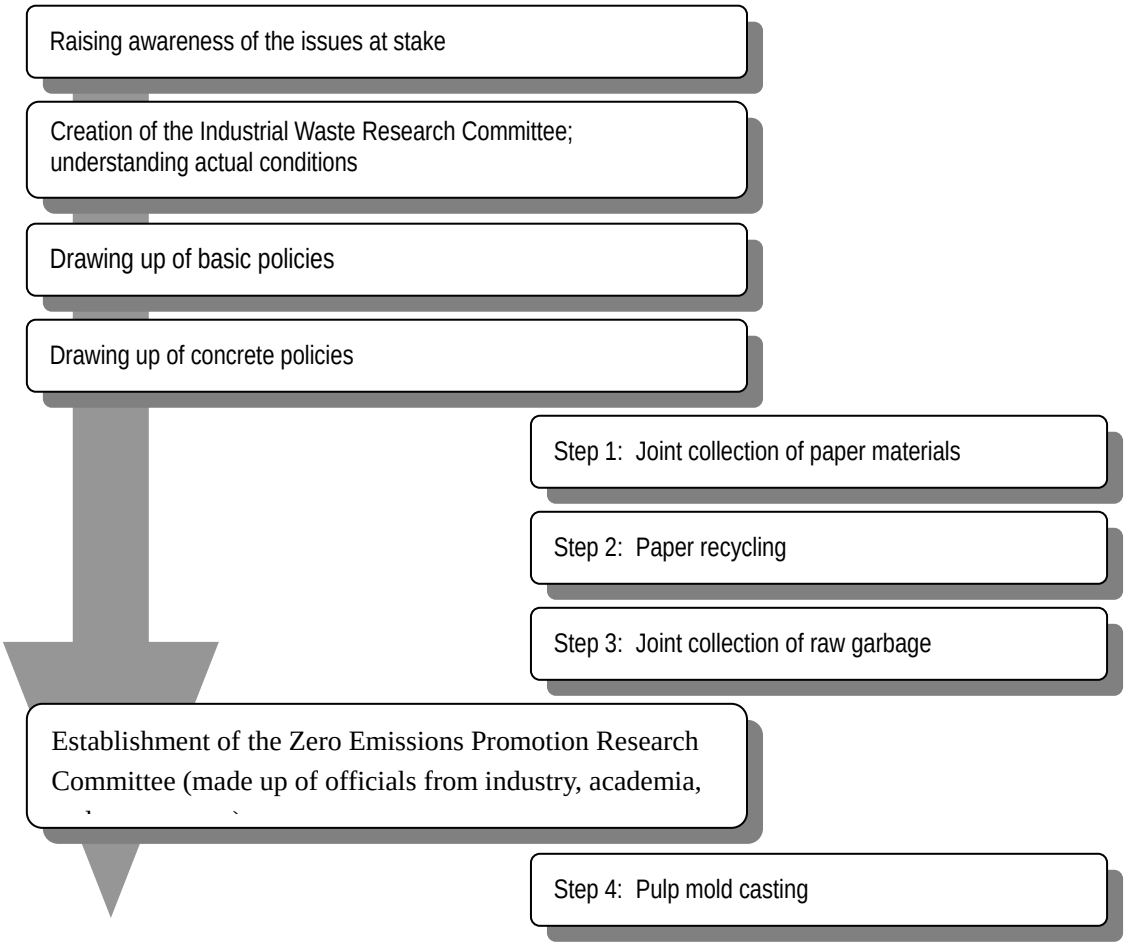
Outline

Total area:	95.84 ha
Location:	Tamaho Town, Showa Town, and Kofu City; Yamanashi Prefecture
Companies:	24 companies (electricity industry; small- and medium-size enterprises involved in steel, wood processing, and food.)
Number of employees:	5,075 (at present: April 2001)
Annual turnover of production:	JPY 268.3 billion (1999)
Industrial Association:	Cooperative union: Kokubo Industrial Park Industrial Association (union member companies: 24 companies)

Business background

1974	Completion of formation and construction
1978	Cooperative union; foundation of Kokubo Industrial Park Industrial Association
1990	Foundation of the Industrial Waste Research Society
1995	Start of joint collection of paper
1997	Start of joint collection of waste plastic
1998	Start of joint collection of raw garbage; establishment of the Zero Emissions Promotion Research Society, (made up of officials from industry, academia, and government)
2000	Pulp mold casting

1. Steps undertaken by Kokubo Industrial Park



2. OUTLINE OF EFFORTS

(1) Raising awareness of issues at stake

Previously, Yamanashi Prefecture had no final disposal site for industrial waste products, a situation that made it dependent on other prefectures for disposal. Consequently, a sense of imminent crisis began to arise in Kokubo Industrial Park because it was believed that this problem might become an obstacle to future production. It was from this fear that efforts toward Zero Emissions in the park were commenced. In 1992, the companies of the industrial park established a policy that was oriented toward creating an environmentally friendly industrial park that does not depend on a waste disposal site. And they inaugurated an "Industrial Waste Research Committee," which serves as the promotion body of Zero Emissions activities in the Industrial Association.

(2) Creation of the Industrial Waste Research Committee

Companies that release a large amount of waste products—which include both large companies and small- and medium-size companies—played a central role in the creation of the Industrial Waste Research Committee. At the time of its formation, the committee was made up of eight companies out of the then total number of 23 in the industrial park. One person was appointed as the Head of the Secretariat. The research committee was based on a proposal by Mr. Michio Ishii, who served as the Head of the Yokogawa Electric Corporation's Kofu Operations Office at the time. (Mr. Ishii is currently Director of the Yokogawa Research Institute.) He played a decisive role by taking the lead in establishing the Committee and by serving as its representative.

Convening about once a month, the Committee gained an understanding of existing conditions and drew up basic policies (please see the following section). Another important characteristic of Committee is its positioning within the cooperative union entitled "Kokubo Industrial Park Industrial Association", which serves as the administrative body of the industrial park. (More information about the formation of the Industrial Association is provided at the end of this section.)

(3) Understanding actual conditions

Based on each company's annual report on the amount of waste products it released as well as the expenses involved to the Industrial Waste Research Committee, it became possible to achieve an understanding of actual conditions. At first, there were many companies that did not proactively submit this data. However, information exchanges and acquisition of data progressed as companies strove to obtain ISO 14001 certification, and this facilitated understanding of actual conditions and reporting on the flow of waste products.

(4) Drawing up of basic policies

Based on its activities mentioned in Part (2) above, the Committee summarized its fundamental line of thinking (as indicated below) and embarked upon specific activities.

Fundamental line of thinking

(1) Reduction of resource flow
Each company reduces the amount of waste it produces internally. This is linked to the acquisition of the ISO 14001 certification.

(2) Collection, reutilization, and resource-recycling
With regard to waste products that are still generated despite attempts to reduce them, carry out joint collection and aim for reutilization and resource recycling. Carry out separated collection and disposal of waste materials thoroughly.

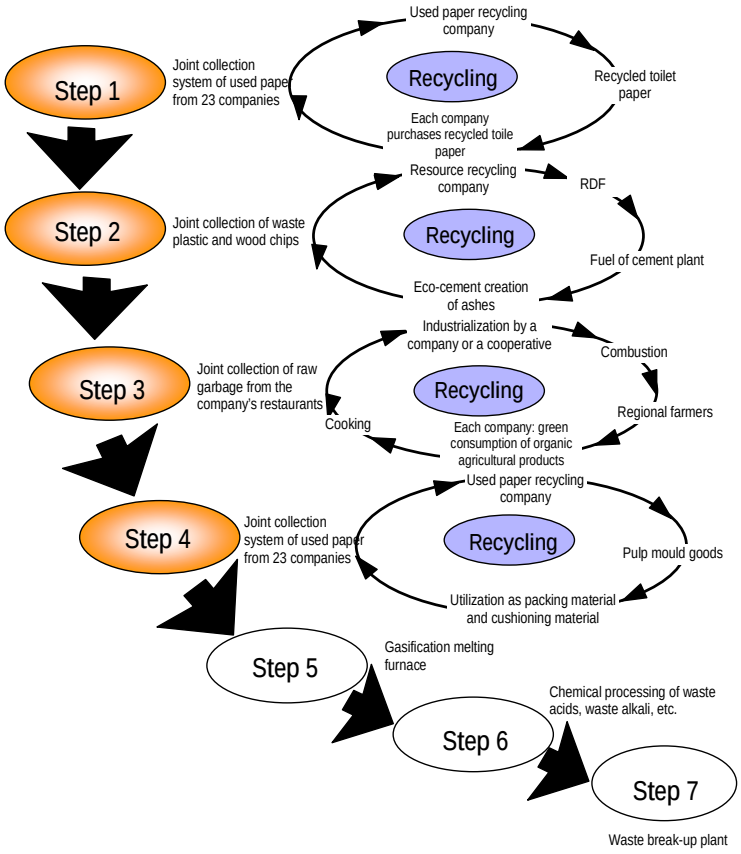
(3) Quantity reduction (waste processing)
With regard to waste products for which reutilization or resource recycling is impossible, reduce their quantity based upon waste processing techniques such as neutralization.

(4) Construction of a recycling system
With regard to reutilization and resource recycling, pursue the construction of a circulation-based recycling system based on recognition of the importance of circulation within the industrial park.

(5) Drawing up of concrete policies

Kokubo Industrial Park began its Zero Emissions effort with recycling based on the joint collection of easy-to-handle paper materials, which are common to all companies and are immediately available. An important characteristic of this effort was the gradual evolution of plans that included 1) RDF (Refuse Derived Fuel) processing, which is based on the joint collection of waste plastic and wood chips, 2) composting, which is based on the joint collection of raw garbage, and 3) manufacturing of products with pulp mold made of used paper. A recycling system for each step of the process—which allows waste products to be converted into a form in which they can be used as a resource and then returned to their original sites—is also being constructed (illustrated below).

Moreover, the creation of a cooperative with waste companies in the planning phase unified waste-related contact personnel. This made it easier to gain the understanding of companies, and it facilitated the smooth promotion of the Committee's plans.



Steps undertaken by Kokubo Industrial Park

Source: Kokubo Industrial Park interview data

Step 1: Joint collection of paper materials

This refers to a system for collecting used paper that is being carried out in cooperation with used-paper-collection companies in the region. In specific terms, the collection companies are at the hub of the joint collection system. With a "recycling promotion van", they collect paper from each company and transport it to a paper mill. In this way, high-quality paper is converted into recycled paper while other pa-

per materials, such as newspapers, magazines and pamphlets, are transformed into toilet paper. Each company makes a maximum effort to purchase this recycled toilet paper, which is manufactured at a paper mill within the prefecture. Thus, a recycling system is formed.

From a cost perspective, the benefits include reduced incineration costs and waste-processing commission fees (for each company in the park) as well as reduced collection costs (for processing companies). The system also guarantees demand for reclaimed goods (for processing companies).

Step 2: Joint collection of various kinds of waste plastic

Plants are established in the prefecture with the cooperation of used-paper-collection companies, and various kinds of waste plastic, wood chips, and general waste (all of which were previously disposed of by means of landfill or incineration) are jointly collected. After applying the RDF (Refuse Derived Fuel) processing method, these items are supplied as fuel for cement factories (in Saitama Prefecture).

Step 3: Joint processing of raw garbage

After undergoing treatment by means of a composting machine in the industrial park, raw garbage is transported to farmers in the neighborhood. After reheating, it is effectively used as fertilizer. A recycling system is thus developed because the waste is returned to the industrial park in the form of farm products that were grown with the fertilizer and that are now sold at restaurants or used in cooking. Since the collection facilities are operated by means of a leasing arrangement, collection costs for raw garbage are reduced to 10 yen per kilo.

Step 4: Setting up of pulp mold equipment

Equipment needed for "pulp mold" within the facilities of used-paper-collection companies is installed. And, a reutilization system among companies that is based on transforming used paper to packaging and cushioning materials is constructed.

Zero Emissions Promotion Research Committee (made up of officials from industry, academia, and government)

From Step 5 and onwards, it becomes necessary to tackle Zero Emissions more extensively, not just within the industrial park. This spurred the formation of the Zero Emissions Promotion Research Committee, which is made up of prefectural universities and other universities within the prefecture. The Committee is studying waste processing methods.

Issues to be examined henceforth

Step 5: Introduction of gasification melting facilities

A study is currently looking at introduction methods that will accompany technical innovations being made to gasification melting furnaces.

Step 6: Chemical processing of waste acids and waste alkali

A study is examining processing methods in collaboration with other industrial parks and prefectures, etc.

Step 7: Breakup of waste products

A study is looking at the collection and breakup of not only waste products that are emitted by the industrial park but also used products. It is also focusing on reutilization and resource-recycling methods.

Joint energy collection system

Efforts to examine the construction of energy supply systems and electric-power generation systems using natural gas pipelines from other prefectures are underway.

3. KEY INSIGHTS

(1) Strong basis for collaboration, clear promotion system

Vigorous activities by the Industrial Association, which has a history of more than 20 years, resulted in the formation of a strong basis for collaboration. This is essential to the promotion of Zero Emissions activities. Furthermore, it should be noted that the clarity of the promotion system for Zero Emissions activities is a result of the promotion body's positioning within the industrial association.

(2) Cooperation and collaboration among different types of industry and enterprise

Firm cooperation and collaboration is taking place among companies from different types of industries. This cooperation is not limited to companies within the industrial park; rather, it has been cleverly extended to include external actors, such as unionized industrial-waste product companies, neighboring farmers, and neighboring industrial parks. Furthermore, companies within the industrial park are gaining a clear environmental awareness, which is enhancing synergetic effects. This is due to a heightened level of consciousness within each company that has arisen through acquisition of ISO 14001 certification and the establishment of a sorting system based on the participation of all members. On the other hand, there are also examples of companies whose awareness of environmental issues has deteriorated due to the turnover of managers or personnel changes in the promotion body. Hence, it is necessary to consider how a responsible mindset towards the environment can be maintained.

(3) Profitability

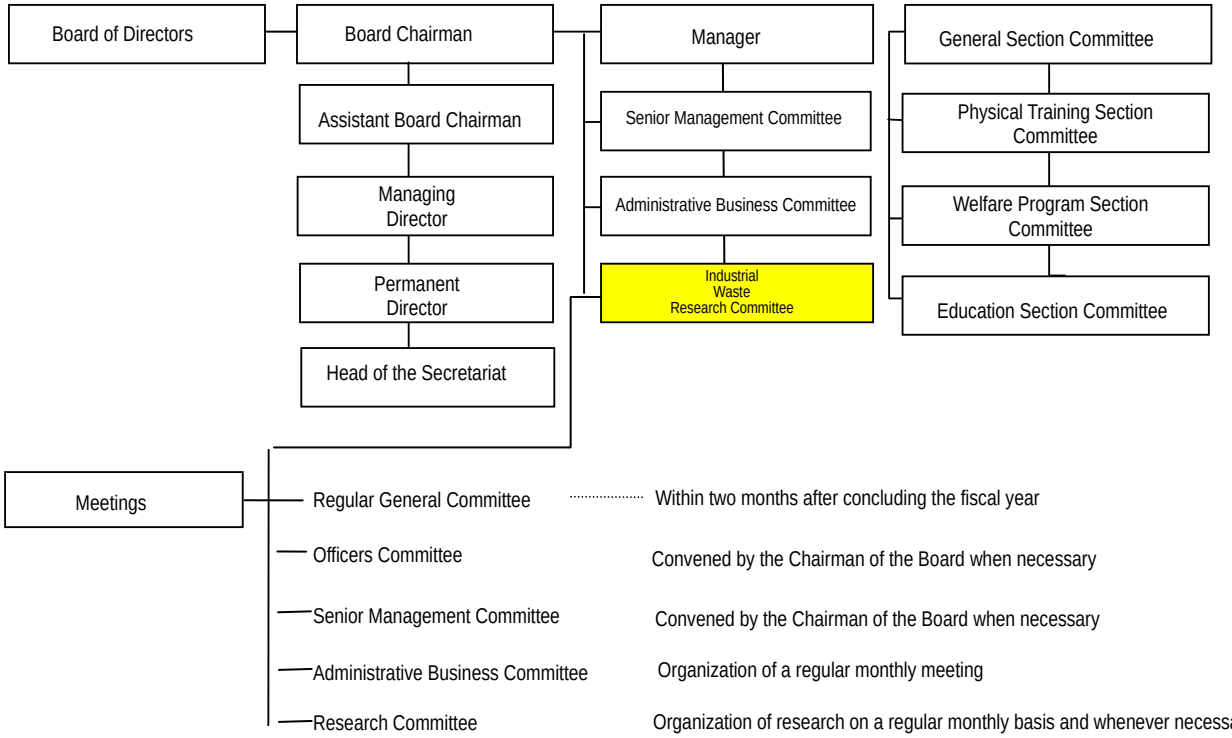
Efforts toward Zero Emissions are contributing to lower waste-processing fees and energy use fees, and this in turn has become a driving force for further activities. However, since there are limits to the efforts that a company can make by itself, there is a continuing need to receive subsidies from administrative authorities and to promote commercialization.

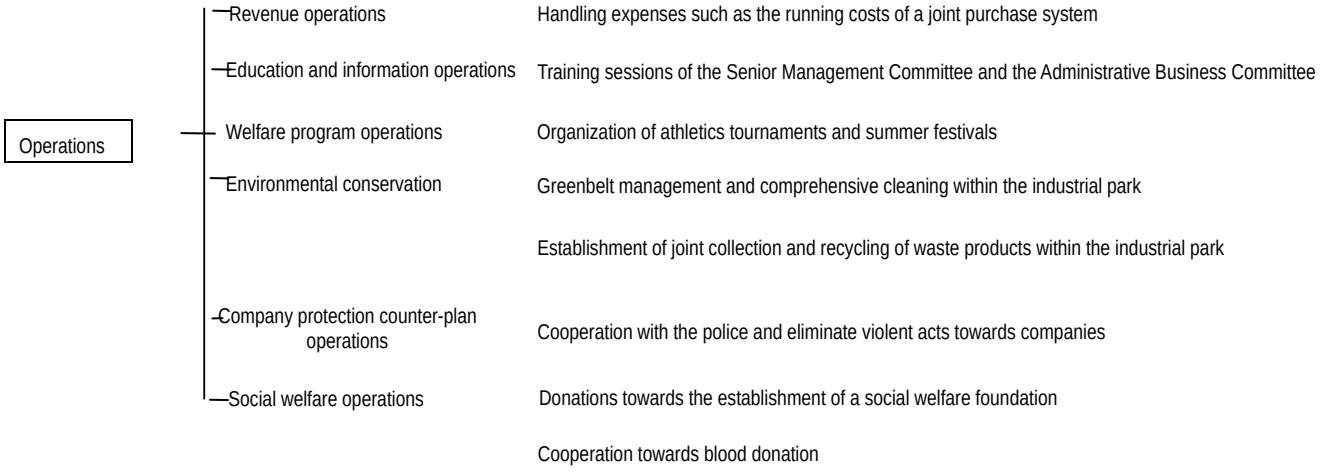
Reference materials:

- Kokubo Industrial Park interviews
- Industrial Waste Research Committee, Kokubo Industrial Park Industrial Association
  "Pursuing an Industrial System for a Resource-Recycling Society: Efforts toward Zero Emissions by Kokubo Industrial Park"
- Norihiro Mitsuhashi (1997), "Zero Emissions and the Japanese Economy", Iwanami Shinsho
- Motoo Yoshimura (2000), "Regionally Developed Zero Emissions," Gakugei Publishing Company
  Various other materials

(Reference) Kokubo Industrial Park Industrial Association: organizational structure and activities

- Office location: 1017 Showa-cho, Nakakoma-gun, Yamanashi Prefecture
- In principle, companies within the industrial park join the Industrial Association.
- The Senior Management Committee (a high-level committee consisting of factory managers and presidents) and the Administrative Business Committee (a practical business-level committee consisting of directors of general affairs and section heads) play a central role in management.
- The Industrial Waste Research Committee, which serves as the promotion body of Zero Emissions activities, is positioned within the Industrial Association.





Source: Kokubo Industrial Park interview data

1-2 Nairiku Industrial Park (Kanagawa Prefecture)

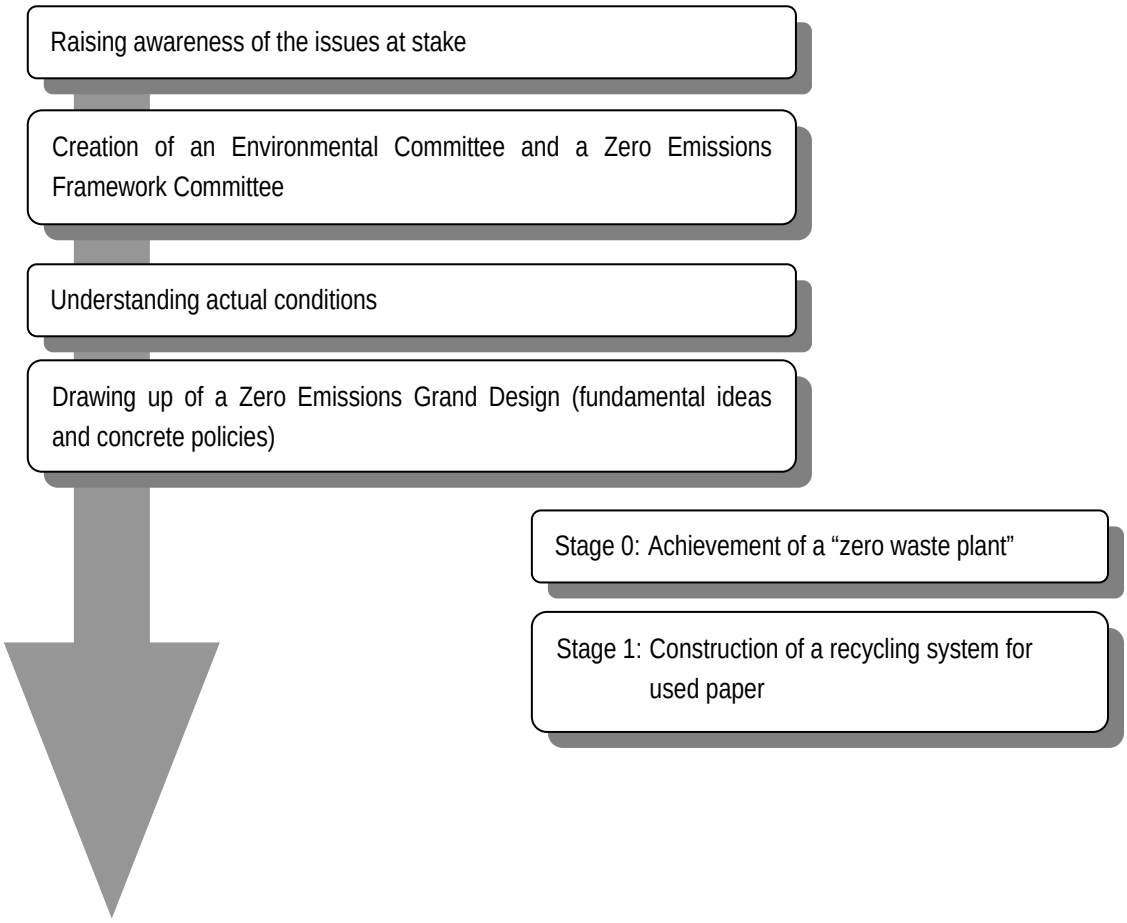
Outline

Total area:	234.7 ha
Location:	Aikawa Town, Aiko-gun, Atsugi City, Kanagawa Prefecture
Companies:	152 (manufacturing industry, distribution industry, and others)
Number of employees:	13,000 (as of April 2001)
Industrial Association:	Kanagawa Prefecture Nairiku Industrial Park Cooperative Union (Regular union members: 108 companies; preliminary union members: 44 companies) (Location: 3001 Kamiichi, Atsugi City, Kanagawa Prefecture, Tel: 046 (285) 0128, Homepage: http://www.kanagawa.nairiku.jp)

Business background

1966	Creation of the industrial park Establishment of the Kanagawa Prefecture Nairiku Industrial Park Cooperative Union
2000	Launch of an independent questionnaire
2002	Start of the Zero Emissions plan

1. Steps undertaken by Nairiku Industrial Park



2. Outline of efforts

(1) Raising of awareness about the issues at stake

For various reasons, such as the closure of plant incinerators and a steep rise in industrial waste processing fees, companies within the industrial park placed increasing pressure on the cooperative union to reduce waste processing fees. This issue was taken up by the Board of Directors, which conducted a voluntary questionnaire on the environment. This questionnaire allowed the Environmental Conservation Committee to gain an understanding of actual conditions and stimulated efforts to tackle Zero Emissions.

(2) Creation of a promotion body

The two committees mentioned below were positioned as organizations within the cooperative union to promote Zero Emissions activities.

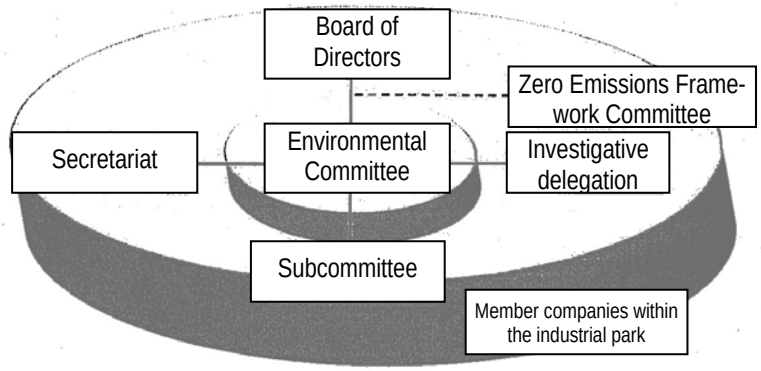
◆ Environmental Committee

The Environmental Conservation Committee, which was mainly responsible for the conservation of green tracts of land and other issues, was renamed the Environmental Committee. It serves as a promotion body for Zero Emissions activities and it is positioned as a subordinate committee to the Board of Directors, which is the cooperative's highest decision-making organ. It is made up of seven external specialist members and representatives of five union companies. With the cooperation of external research organizations, it carried out a study of actual conditions and conducted further research based on the results of this study.

From 2002, waste processing specialists have been added to the Committee, and a subcommittee is examining concrete measures for actual projects. Leading companies of the industrial park that have acquired the ISO certification (or that are in the process of acquiring this certification) participate in the subcommittee. Besides holding two or three meetings a month for study of specific plans, the subcommittee meets once monthly to report on the current progress to the Environmental Committee.

◆ Zero Emissions Framework Committee

The Zero Emissions Framework Committee serves as a consultative organ to the Board of Directors. It makes suggestions concerning issues that are beyond the responsibility of the Environmental Committee. It is made up of 10 members representing local governments (environment-related units of prefectural and municipal governments) and research organizations. The committee operates with the cooperation of officials from industry, academia, and government.



Nairiku Industrial Park Zero Emissions promotion system

Source: Nairiku Industrial Park Report "Efforts by the Industrial Park towards a Recycling Society"

(3) Understanding actual conditions

In order to gain an understanding of current conditions and difficult issues with regard to resource recycling (such as the content of waste processing activities and recycling mechanisms of companies affiliated with the cooperative union), a questionnaire survey and interviews targeted company representatives and persons in charge of administrative affairs.

The questions touched upon such issues as problems connected with waste processing, the quantity of emitted waste products and the expenses involved, waste disposal sites, etc., and aimed to identify each company's circumstances in as much detail as possible. Simultaneously, a questionnaire was sent around to companies within the industrial park and to companies in the surrounding area. This questionnaire contained questions regarding progress in waste processing and recycling, people's image of Zero Emissions, etc.

Furthermore, with regard to efforts to understand actual conditions, subsidies from the National Federation of Small Business Associations were used to entrust an external consulting organization with tasks related to the survey. The results were summarized as the "Zero Emissions Grand Design" (please see the following section).

(4) The Zero Emissions Grand Design: the drawing up of fundamental concepts

Based on the fundamental ideas of Nairiku Industrial Park cooperative union, which were based on "The Construction of a Pollution-free and Environmentally-sound Industrial Park in Harmony with Nature" and the survey results, the following fundamental ideas, action guidelines, and action targets were drawn up.

◆ **Fundamental ideas**

Recognize that preservation and improvement of the global environment are of utmost importance for all people. Based on this, aim to realize a rich human and natural environment through the pursuit of a production and distribution system that minimizes environmental burden by constructing an industrial park that emits Zero Emissions.

◆ **Action guidelines**

1. Observe environmental laws and the continual improvement of waste management
2. Promote proactive participation in joint projects with the union
3. Encourage joint efforts aimed at reducing waste products
4. Encourage the acquisition of ISO 14001 certification
5. Realize a recycling society through proactive and effective utilization of technology and information
6. Carry out the union's organizational operation of waste management and of environmental education
7. Proactively disclose environment-related information to the public

◆ **Action targets**

1. Create successful application cases, starting with areas that are feasible within the Grand Design
2. Conduct operations that are within current general waste processing costs. Aim to reduce general waste processing costs by 50% as a mid-term target.
3. Aim to realize a recycling system within the plants of each enterprise, within the industrial park, and within the administrative region.
4. Aim to realize a recycling society model at existing large-scale industrial parks.

(5) Environmental education

◆ Courses for acquisition of ISO 14001 certification

Efforts are underway to organize courses for presidents, personnel in charge of general business affairs, and internal auditors of companies in the industrial park.

As many as 20 companies in Nairiku Industrial Park have acquired ISO 14001 certification, and it is expected that these companies will form a union to lead Zero Emissions activities. (This union is an inseparable part of Zero Emissions and ISO 14001.)

◆ Panel discussions and lectures on the environment

Awareness-raising on Zero Emissions that targets companies within the industrial park is being carried out through the holding of lectures by speakers from the United Nations University Zero Emissions Forum, lectures by the union's Board Chairman concerning efforts that need to be taken henceforth, and panel discussions by personnel from both inside and outside the industrial park.

(6) The implementation of a concrete plan

Nairiku Industrial Park is formulating successful examples of Zero Emissions application, starting with areas that are feasible within the Zero Emissions Grand Design. At present, research is directed towards recycling systems that involve joint collection of used paper and its utilization as recycled paper, and joint collection of waste plastic and scrap metal.

Stage 0:

Among the companies located in the industrial park, there is one leading firm that has achieved "zero waste". By commissioning specialized companies with the task of processing sorted waste products, and by utilizing this processed waste as raw materials for the manufacturing of reclaimed goods, a reduction of 20% to 30% in recycling costs has been attained.

Stage 1:

Efforts toward the construction of a resource recycling system are being carried out that target waste products that are emitted in large quantities and for which there are significant processing costs, such as paper waste, metal waste and waste plastic.

Based on an understanding of waste output, a plan is currently being formulated to create joint collection routes for used paper that focuses on the more than 50 waste-processing companies located in the industrial park. An examination is also being conducted on the creation of recycling routes intended to return these goods to the industrial park.

Furthermore, in response to requests, the park is trying out new ideas, such as a small-scale trial of joint fluorescent light tube collection. In this way, the park is laying the groundwork for active participation by all union members.

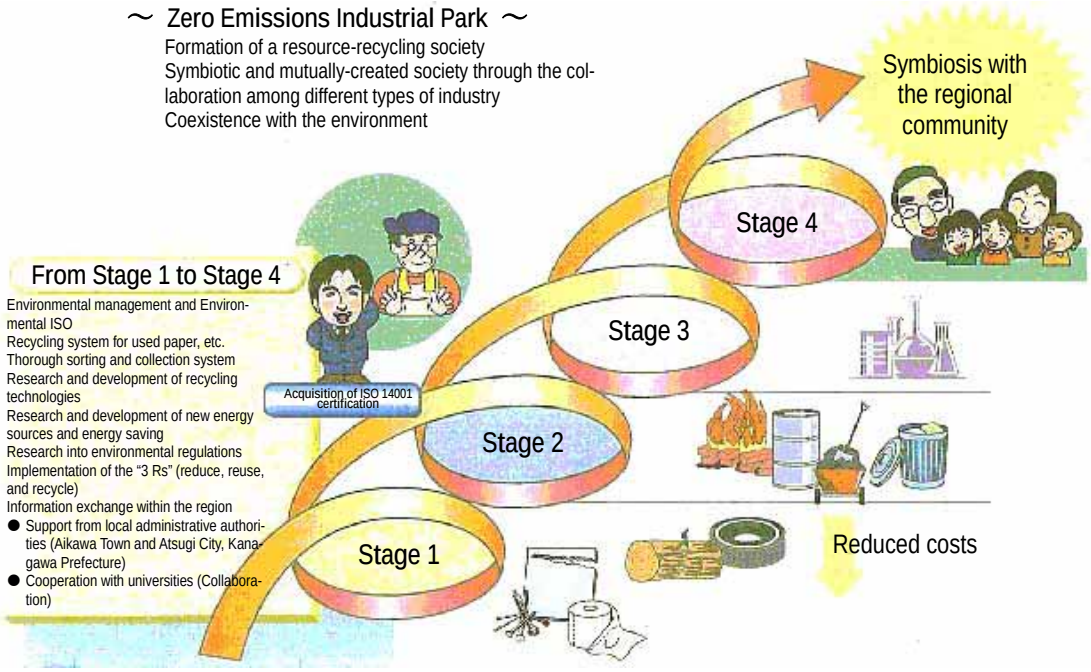
Issues to be investigated in the future

Stage 2: Recycling of woodchips, rubber waste, and raw garbage

Stage 3: Recycling of articles not included in Stages 1 and 2

Glass shavings, embers, waste acids and waste alkali, sludge, etc.

Stage 4: Symbiosis with the regional community



Steps undertaken by Nairiku Industrial Park

Source: Nairiku Industrial Park Report "Efforts by the Industrial Park towards a Recycling Society"

3. Key insights

(1) A clear promotion system

The responsibilities of the Environmental Committee (which serves as the Zero Emissions promotion body), the Zero Emissions Framework Committee (which serves as an advisory board), and the subcommittee (which is in charge of the drawing up of concrete projects) are clearly defined.

Two other important points regarding the implementation of the Zero Emissions plan are the fact that the union's Board Chairman announces the promotion of Zero Emissions at the general meeting of the cooperative union, and the fact that role of the promotion system has been clarified to all companies of the industrial park.

(2) Collaboration with external organizations

Using subsidies from the National Federation of Small Business Associations, the industrial park was able to reach a detailed understanding of important issues by commissioning an external consultant to perform an actual survey during the fact-finding stage.

Furthermore, although the Zero Emissions plan is being implemented under the initiative of the private sector, Zero Emissions Framework Committee meetings are attended by representatives of government authorities in order to ensure smooth collaboration with government.

Reference materials:

- Nairiku Industrial Park interview data
- Nairiku Industrial Park Report "Efforts by the Industrial Park towards a Recycling Society"

Various other materials

1-3 Kalundborg Industrial Park (Denmark)

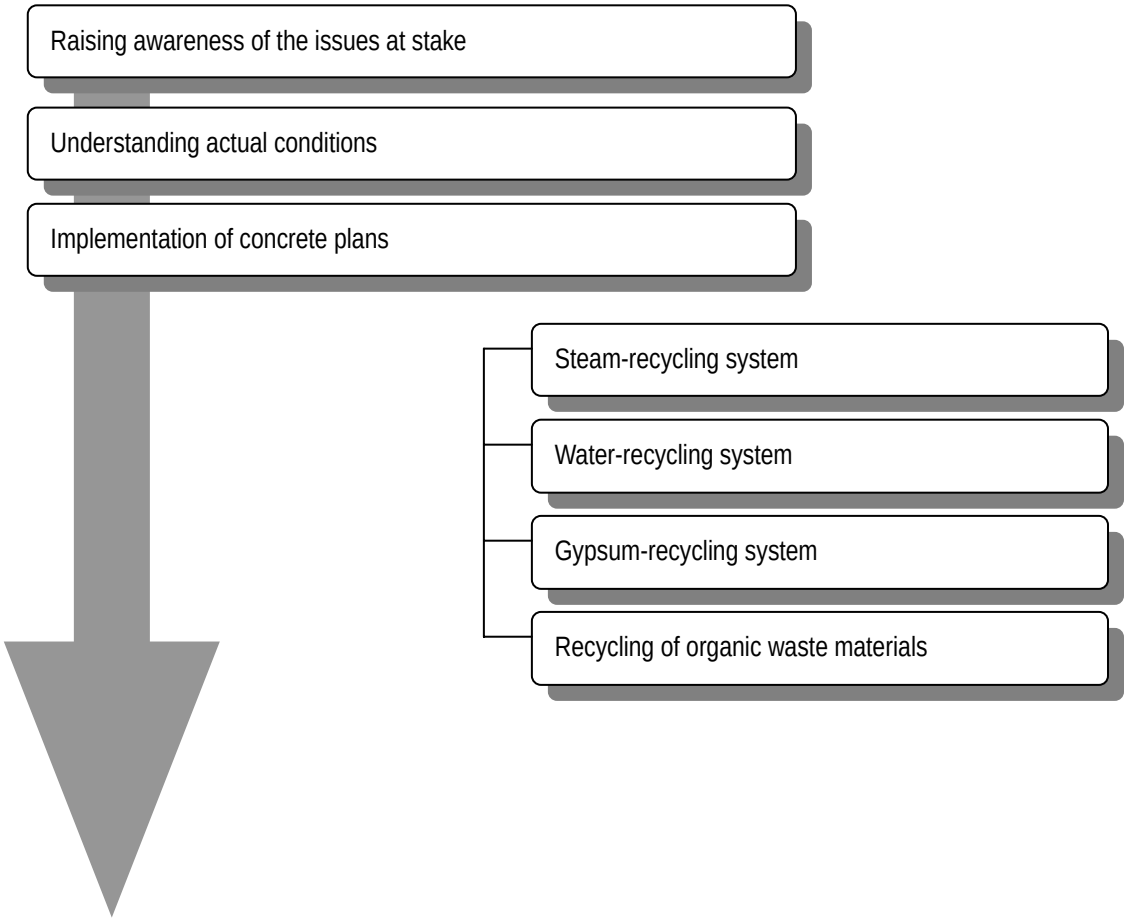
Outline

Location:	Denmark coastal region
Composition of the industrial park:	Five companies, Kalundborg

Business background

1976	Promulgation of environmental regulations by the Danish Government
1989	Establishment of networked cooperation among small- and medium-size enterprises based on the collaboration between government and the industry
1996	Foundation of the Industrial Symbiosis Research Institute
2000	The Industrial Symbiosis Research Institute begins providing expertise

1. Steps undertaken by Kalundborg Industrial Park



2. Outline of efforts

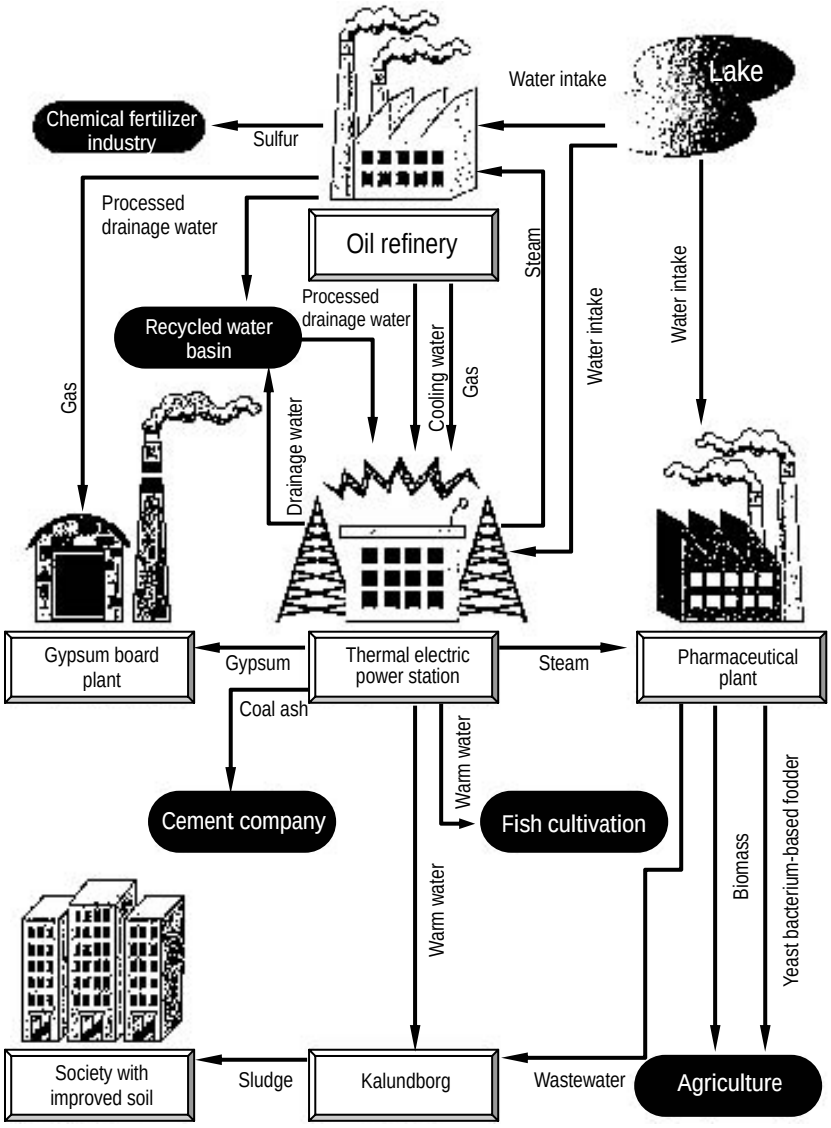
(1) Raising awareness of the issues at stake

The companies within the Kalundborg region's industrial park initiated cooperation with each other as a means to improve profitability.

(2) Understanding actual conditions

Each company gained an increased awareness that it must understand the material and energy flow of other companies in order to reduce costs in goods manufacturing. This was the turning point in advancing understanding of actual conditions.

(3) Implementation of concrete plans



The current state of the industrial symbiosis of Kalundborg Industrial Park

Source: Norihiro Mitsuhashi, "A Discussion of Japan's Environmentally Sustainable Economic Wealth", Toyo Keizai Inc.

The coal-based thermal electric power station, the oil refinery, and the pharmaceutical plant took the lead in forming an inter-company network. Examples of specific projects presented below.

Steam-recycling system

The thermal electric power station sells the steam it releases while generating electricity to the oil refinery and the pharmaceutical plant. Whereas the oil refinery uses it as a heat source to warm up its pipes, the pharmaceutical plant uses it as a heat source to disinfect the raw materials for producing medicine.

Water-recycling system

The cooling water released by the oil refinery is sold to the thermal electric power station, which uses it as water for its boilers.

Gypsum-recycling system

Gypsum, which is a byproduct of the thermal electric power station's Flue Gas Desulfurization (FGD) process, is sold to the gypsum board plant. By using this supply, the gypsum board plant, which used to be dependent on imports from Spain, has shifted to high-quality resources that can be supplied in a stable manner.

Recycling organic waste materials

The pharmaceutical plant supplies organic waste (a byproduct of its production process) to farmers in the surrounding area, who use it effectively as fertilizer.

3. Key insights

(1) Improvement in operational profitability

By setting up plants that use waste materials, it has become possible to establish new sources of income. Based on the commercial exchange of waste materials between all the companies, there has been an increase in the overall efficiency of the park.

(2) Thorough public disclosure by all companies

At first, public disclosure of information was not done for the preservation of the environment, but rather for efficiency reasons. Nevertheless, it should be noted that mutual exchange between the companies and the region became possible as a result of this disclosure, and this has made the park a model for Zero Emissions.

(3) Formation of an industrial cluster encompassing industries and local residents

An industrial cluster was formed that involves not only companies but also local governments and farmers.

Reference materials:

- Mitsuhashi. Norihiro. *A Discussion of Japan's Environmentally Sustainable Economic Wealth*: Toyo Keizai Inc., (2000)
- Yoshimura, Motoo. *Regional Development and Zero Emissions*: Gakugei Shuppan Sha Co., Ltd., 2000
- Environmental Management Strategy Encyclopedia Editing Committee. *Environmental Management Strategy Encyclopedia*: Industrial Survey Committee, 2003

Various other materials

1-4 Kitakyushu Eco-Town Project (City of Kitakyushu, Fukuoka Prefecture)

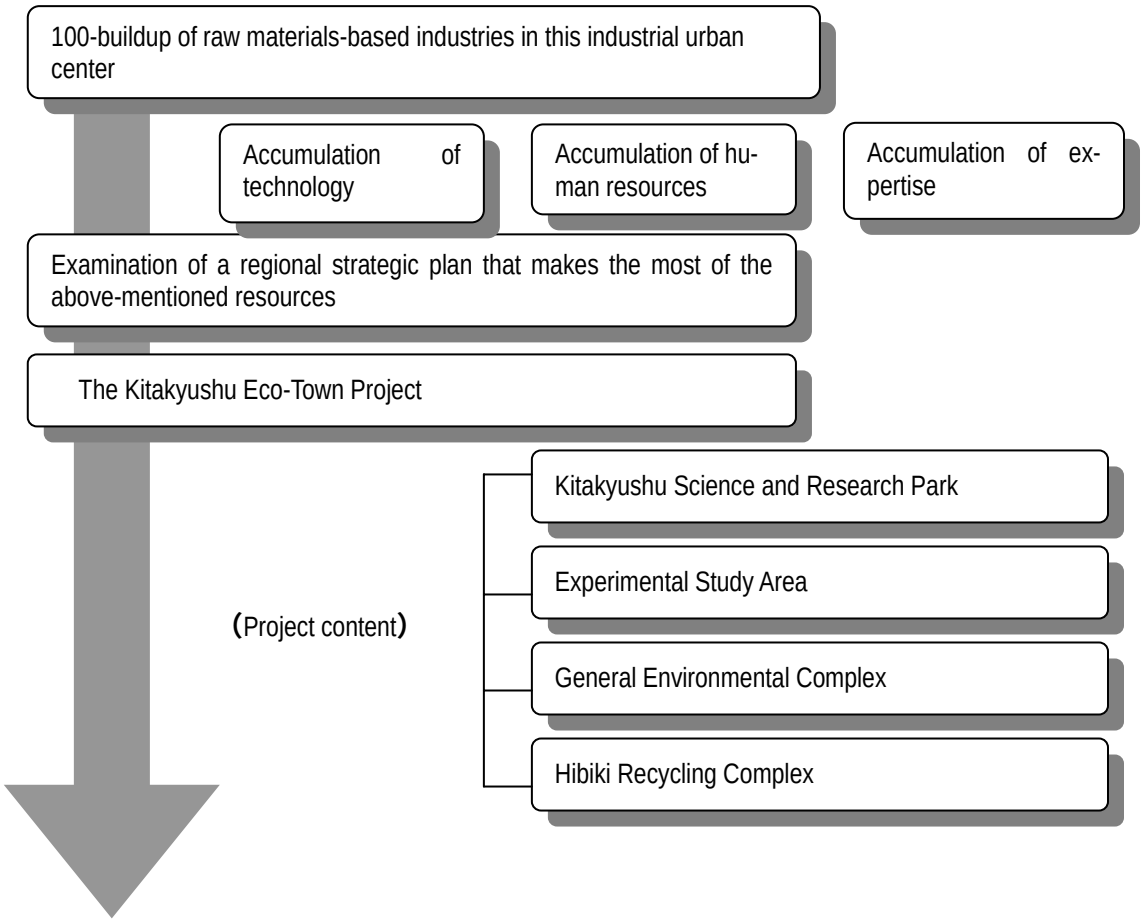
Outline

First-phase program:	41 ha Second-phase program: approximately 100 ha
Location:	Wakamatsu-Hibikinada areas, City of Kitakyushu, Fukuoka Prefecture
Project agency:	The City of Kitakyushu
Administrative agency:	All companies located in the Eco-Town

Business background

1989	Start of study meetings
1997	Drawing up and approval of a "Kitakyushu Eco-Town Plan"
1998	Drawing up of an "Implementation Program for the Kitakyushu Eco-Town Plan"
2002	Drawing up of a second-phase program for the Kitakyushu Eco-Town Plan

1. Steps taken by Kitakyushu Eco-Town



2. Outline of efforts

(1) Background of efforts

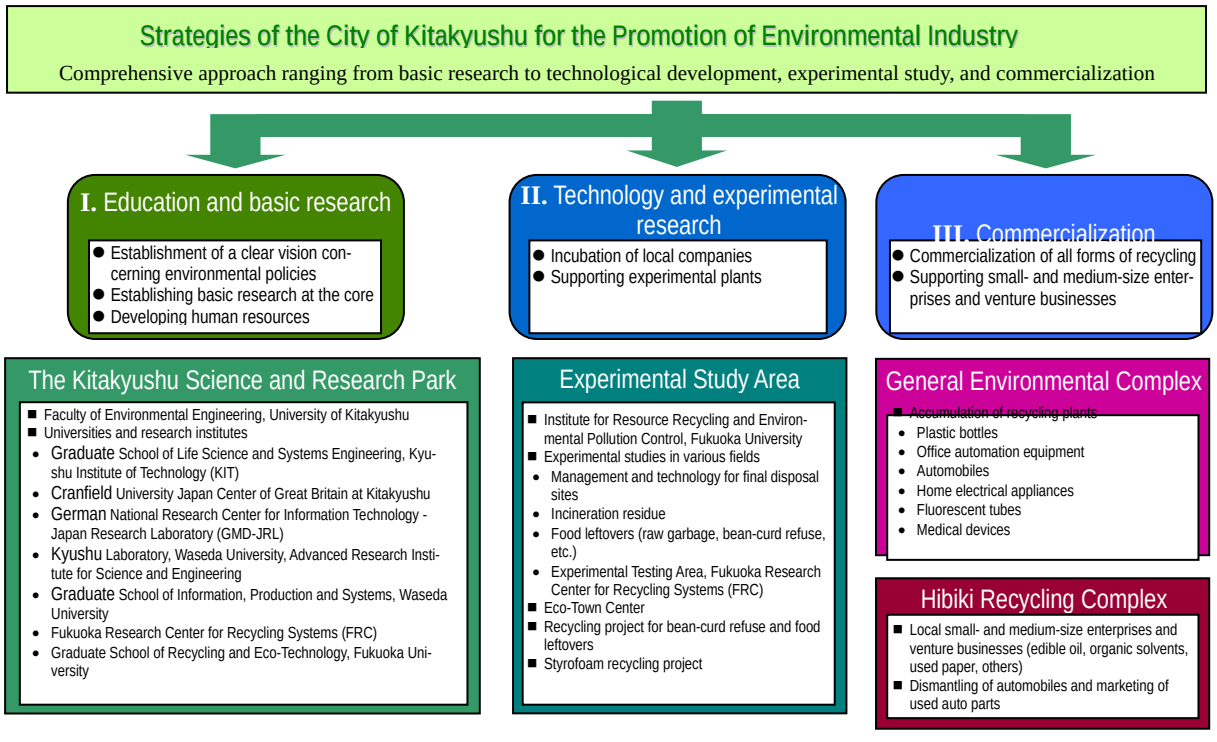
The industrial zone of Kitakyushu, which is known as a "manufacturing town", was a cornerstone of Japan's economic growth. The operations of the government-run Yahata Steel Works, established in 1901, played a leading role in this feat. In the 1960s, however, there was an escalation of serious industrial pollution-related problems. In response, the city's residents, government authorities, and local industries united to make various efforts to stem pollution. As a result, the ocean and air of Kitakyushu have been restored to a state of cleanliness. Kitakyushu is currently promoting "environmental industry" as a regional policy by making full use of the collaboration among industry, academia, government authorities, and residents that was achieved during this process as well as by applying the human resources, technology, and expertise that had already been cultivated by this manufacturing city.

(2) The start of study meetings

From 1989, Kitakyushu has been organizing study meetings built around academics. Discussions have been geared toward the construction of new industries that make the best use of technologies and human resources as well as the network of industry, academia, government authorities, and local residents that was created during the process of overcoming the pollution problem. Furthermore, from around 1995, study meetings have been organized between the city and companies as well as within city offices that have deepened these discussions. Based on the concrete target of "promoting recycling-oriented industries" (so-called "vein industries"), various projects have been started.

(3) The formulation of concepts and concrete plans

After receiving approval for the Eco-Town Plan, Kitakyushu built three pillars for "promoting environmental industry": (1) basic research and development of human resources, (2) experimental research, and (3) commercialization. The city then began implementation of projects.



Three pillars for the buildup of environmental industry

Source: Kitakyushu City homepage

Kitakyushu Science and Research Park

The national, municipal, and private universities of Japan, overseas universities and graduate schools, and research institutes are conducting research on "the environment" and "information".

Experimental Study Area

Based on collaboration among companies, government authorities, and universities, the aim of the experimental study area is to serve as a development base for environment-related technology by bringing organizations that carry out experimental research with regard to ultra-advanced waste-processing technologies and recycling technologies. The Kitakyushu Eco-Town Center, which is located within the experimental study area, receives visitors and provides opportunities for environmental study and training sessions.

General Environmental Complex

The aim of the complex is to serve as a resource recycling base by commercializing environmental industry and by setting up a Zero Emissions-based environmental industrial complex. This General Environmental Complex was built through mutual collaboration among all the companies of the park. A Plant Liaison Committee (which has a secretariat in Kitakyushu) was established as a collaborative organization within the complex to promote the exchange of waste products and materials between plants.

In concrete terms, the following forms of cooperation can be regarded as examples the complex's activities. It is expected that the number of examples will increase in the future. Furthermore, regarding the promotion of mutual cooperation, attention should be drawn to the Eco-Town Project's second-phase program (please refer to following section).

Cooperation among all companies and application of complex core facilities

Cooperation between all the companies of the Eco-Town	1. Old engines that are discharged from automobile cooperatives are turned into ingots by the aluminum melting-furnace of automobile recycling operations.
	2. Home electrical appliances, office automation equipment, and electric wire materials of automobiles are separated into copper and insulation materials by nugget processing machinery of automobile recycling operations.
	3. Cathode-ray tubes of personal computers that are discharged from fluorescent tube-recycling operations are recycled by home electrical appliance-recycling operations.
	4. Waste plastic that is discharged from various factories, such as automobile factories, home electrical appliances factories, and plastic bottle factories, is recycled through waste plastic recycling operations.
	5. Waste plastic that is discharged from office automation equipment, home electrical appliances, and pachinko parlors is recycled through waste plastic oilification and recycling operations.
	6. Used fluorescent tubes that are discharged within the area are recycled through fluorescent tube-recycling operations.
	7. Styrofoam that is discharged from packing materials from all companies in the area is recycled through Styrofoam recycling operations.
	8. Newspapers, used paper, and cardboard boxes that are discharged throughout the area are recycled through used paper-recycling operations.
Activities by complex core facilities	1. Processing of residues (such as plastic) released by factories.
	2. Processing of remaining paper and wood, etc., discharged by PCB processing facilities.
	3. Processing of Freon gas from automobiles.

	4. Supply of electric power to all companies within the complex by generating electricity (through thermal recycling).

Source: Koichi Sueyoshi "Kitakyushu Eco-Town. Efforts toward Zero Emissions: Environmental Conservation and Promotion of Industrial Development".

Hibiki Recycling Complex

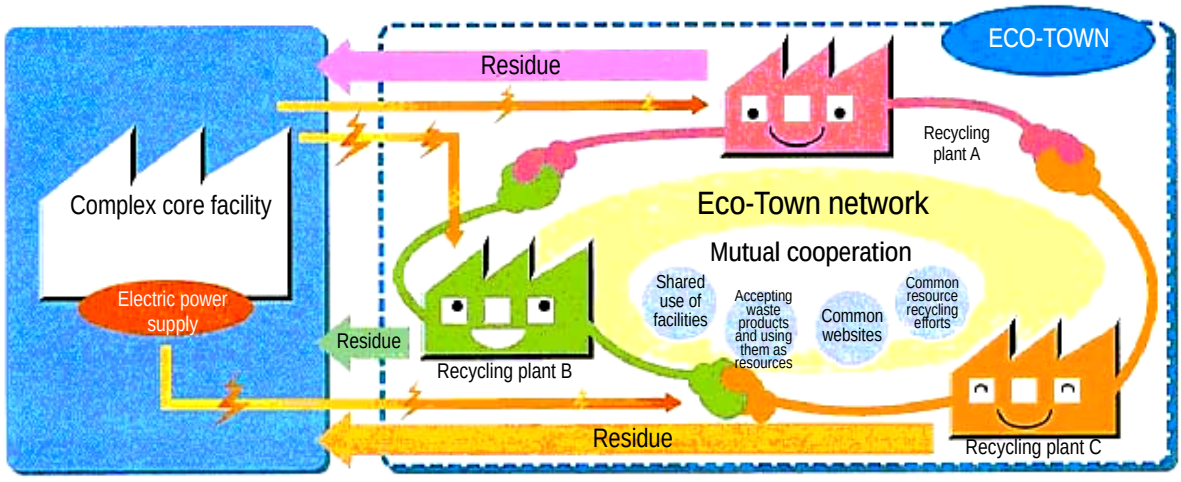
This is an area made up of two zones: an automobile recycling zone and a frontier zone (recycling of edible oil, recycling of used paper litter, etc.). It supports the recycling activities of local small- and medium-size companies as well as venture businesses.

Eco-Town Project: second-phase program

After Kitakyushu set a target for when it would achieve the overall objectives of the initial Eco-Town program, it drew up a program for a second phase, targeting the year 2010. This program aims to develop the city into an "International Resource-Recycling and Environmental Industrial Base" in Asia by expanding previous efforts in the Eco-Town district (horizontal development) and by developing new industries and technologies that are related to resource recycling on the basis of new strategies (vertical development). It should be noted that the three points mentioned below are intended to further encourage mutual collaboration in promoting Zero Emissions.

(1) Enlargement of projects by solicitation (reusing and rebuilding, etc.)
In addition to recycling projects, the idea is to attract new environmental industries (reuse projects, etc.)

(2) Further promotion of Zero Emissions
In addition to promoting mutual collaboration among the companies that are located in the Eco-Town, the aim of this activity is to increase the recycling percentage and to minimize final waste residue generated in the district.



Efforts made towards Zero Emissions in the second-phase program

Source: "The Kitakyushu Eco-Town Project: Second-Phase Program Outline"

(3) Strengthening research and training capacity

There are plans to strengthen research capacity by establishing a support system intended for research and development projects. Furthermore, strengthened education and training and human resource development in the environment sector are planned.

3. Key insights

(1) Promotion of Zero Emissions

Because, in this example, there is a significant concentration of highly developed recycling-based industries (so-called "vein industries"), conditions are different than for cases where an existing industrial park promotes Zero Emissions. Nevertheless, this example is noteworthy in the sense that it promotes collaboration among local enterprises that are connected with recycling while also making promotion of Zero Emissions among "vein industries" possible.

(2) Effective utilization of the Earth's resources

The use of idle coastal landfill made it possible to obtain cheap project sites and to resolve problems regarding waste disposal at the same time.

Another important factor has been the effective application of technologies, human resources, and expertise that Kitakyushu's industries have accumulated over the past 100 years and from past efforts to overcome pollution-related problems.

(3) Collaboration among industries, academia, government authorities, and local residents

A collaborative system made up of industry, academia, government authorities, and local residents that was created during the process of overcoming pollution-related problems is currently in place. Furthermore, project promotion has been facilitated by a heightened level of understanding on the part of local residents vis-à-vis environmental industry.

Reference materials:

- Interview data
- Homepage: http://www.city.kitakyushu.jp/~k2602010/sesaku/ecotown.html
- Sueyoshi, Koichi. *Kitakyushu Eco-Town. Efforts toward Zero Emissions: Environmental Conservation and Promotion of Industrial Development*: Kaizosha Co., 2002
- Takasugi, Shingo. *Recycling-based Industrial Urban Model: The Example of Kitakyushu Eco-Town*: Diamond, Inc.

Various other materials

1-5 Kawasaki Zero Emissions Industrial Park (Kanagawa Prefecture)

Outline

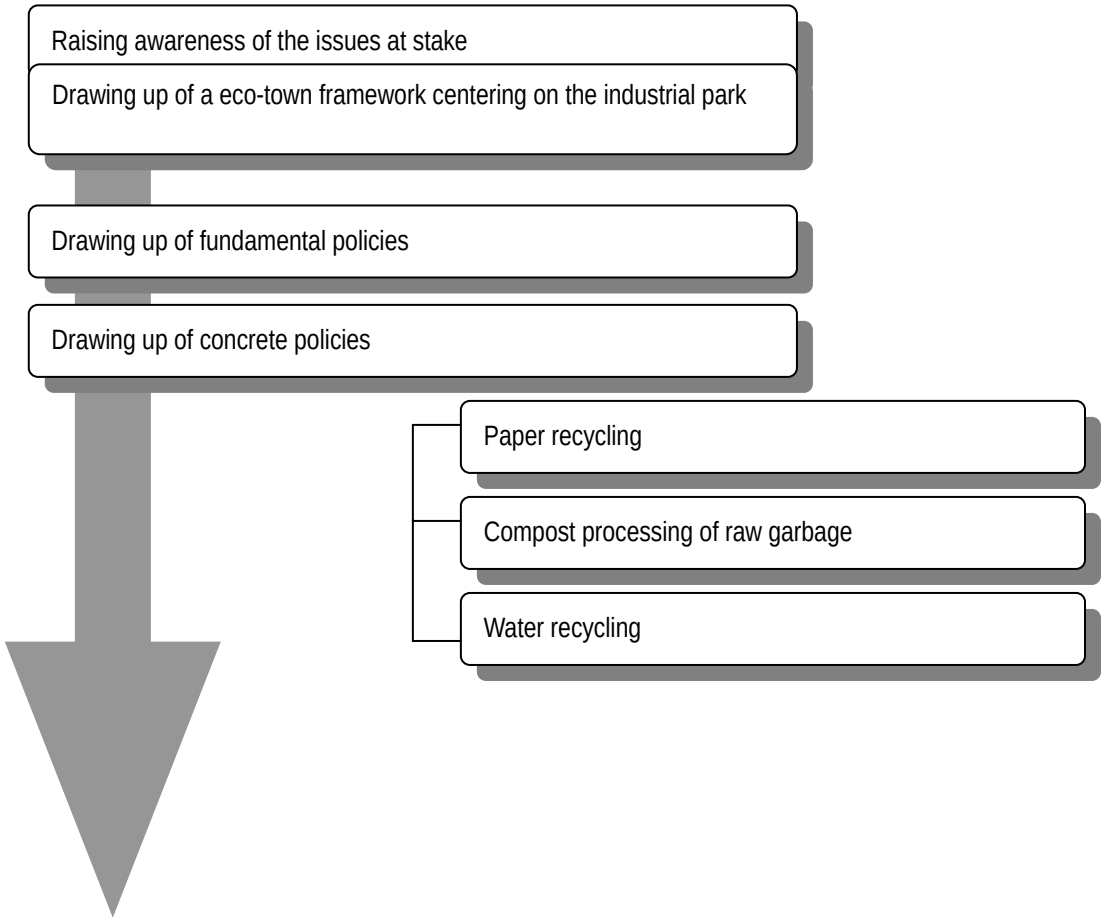
Total area:	7.7 ha ("eco-town" as a whole: 2,800 ha)
Location:	Mizue-cho, Kawasaki City, Kanagawa Prefecture (purchase of an NKK factory site)
Number of involved companies:	Approximately 17 companies (metal processing industry, paper manufacturing industry, metal plating industry, press, and others)
Number of employees:	300
Cooperative union:	Kawasaki Zero Emissions Industrial Park Cooperative Union (number of union members: 13 companies)

* Collaborative project applying the "Japan Environment Corporation (JEC)" system

Business background

1998	Eco-Town certification (Kawasaki coastal area)
1999	Establishment of the Kawasaki Zero Emissions Industrial Park Cooperative Union
2000	Start of construction
2001	Beginning of exchange with a group of companies from the iron and steel industry and various other industries
2002	Beginning of exchange within a used-paper recycling group

1. Steps taken by Kawasaki Zero Emissions Industrial Park



2. Outline of efforts

(1) Background of efforts

Kawasaki's coastal region has supported industrial activities and the urban activities of the Tokyo Metropolitan Area. However, due to the deindustrialization phenomenon (so-called "industrial hollowing") and the appearance of idle sites in recent years, it has become necessary to shift toward sites that group together industries and are based on environmental conservation. As a result of this, various schemes have been laid down for the promotion of a resource-recycling society based on the "Kawasaki New Era Plan for 2010" (drawn up in 1996).

(2) Framework of the industrial park

Upon the certification of the coastal industrial zone as an "eco-town", the City of Kawasaki drew up its "Basic Framework for Environmentally-Friendly Urban Development in Kawasaki City." The industrial park has been positioned as an important project in the basic framework. The fundamental guidelines for the park are indicated are below.

◆ Kawasaki Eco-Town Framework – Fundamental Policies

1) The eco-conversion process is promoted by companies themselves.
2) Eco-conversion the district is promoted through the collaboration among companies.
3) Research is conducted for the attainment of a continually developing district that has the environment as its core concern.
4) Results from companies and the district are computerized so that they may make a contribution to society and developing countries.

(3) Drawing up of fundamental policies

Kawasaki Zero Emissions Industrial Park has been positioned as a leading implementation project in the district's eco-conversion program established within Point 2 of the above-mentioned framework. Companies that wish to advance must meet the following fundamental concepts.

Kawasaki Zero Emissions Industrial Park – Fundamental Concepts

(1) Companies have an internal environmental policy.
(2) Efforts are made to reach even higher targets (toward Zero Emissions) through emissions standards on generated environmental burden, etc.
(3) Highly efficient approaches are taken through collaboration with other companies in the industrial park.
(4) For matters for which it is impossible to attain Zero Emissions within the industrial park, the aim shall be the complete realization of Zero Emissions by creating partnerships and linking up with recycling mechanisms in the surrounding area.

(4) Understanding actual conditions

So as to gain an understanding of the flow of materials of all companies, submission of flow data is a precondition for entering the park. This is based on the fact that the industrial park is being started from scratch. Although no specific agreements are made (such as those obliging confidentiality), entry into the park is based on the understanding that there are no outward flows other than those disclosed.

(5) Drawing up of concrete policies

Kawasaki Zero Emissions Industrial Park has drawn up the following specific policies for the industrial park as a whole and for each individual company.

◆ **Efforts to be taken by the industrial park**

1) Fix targets and carry out thorough control of waste products that are generated by the companies.
2) Paper waste materials generated within the companies shall be collected by the union and recycled by the companies in the industrial park.
3) Plastic waste materials generated by the companies shall be collected by the union and used as fuel for facilities in the industrial park.
4) Energy from the waste heat of incineration facilities shall be reused.
5) The highly processed water of Kawasaki City's Iriezaki Water Treatment Center and water treated in factories shall be reused.
6) Water resources shall be recycled as much as possible within the companies and the burden of wastewater treatment facilities shall be reduced.
7) Incineration ash shall be used as raw materials for cement.
8) Raw garbage generated within the companies shall be processed through composting and be reutilized as a fertilizer on shared green areas of the industrial park.
9) Rainwater shall be used as water to extinguish fires or to irrigate plants in the industrial park.
10) Company-generated electric power shall be used effectively among joint electricity receivers through joint reception of electricity with neighboring companies.

◆ **Concrete efforts to be taken by each individual company**

1) Use of natural gas automobiles.
2) Use of hydroelectric power generation facilities within factories.
3) Implementation of industrial chemical and water recycling.
4) Recycle of difficult-to-reclaim used paper (colored or laminated paper).

Furthermore, concrete plans for each type of waste product and expected quantity for Zero Emissions are indicated below.

	Type		Processing method	Generated amount (in tons per year)	Output (in tons per year)
General waste products	Paper materials		Reclamation by paper mill group in the industrial park	9	3
	Kitchen waste		Composting in the industrial park	1	0
	Recyclable objects (cans and glass materials)		Collection by automatic vending machine operators	2	2
	Others		Consigned to Kawasaki City	5	5
Industrial waste products	Industrial waste products	Wastepaper	Reclamation by paper mill group in the industrial park	6	2
		Waste plastic materials	Recycle into raw material for a raw material transformation blast furnace within the eco-town district	7,232	4
		Scrap metal	Sort and collect iron and aluminum; forward to resource recovery companies	767	767
		Glass and ceramics scrap	Consign to a specialized company	3	3
		Soot	Used by cement manufacturing plants in the eco town district	14,364	14,364
		Sludge	Combustion, process into a valuable material	46,200	84
		Waste oil	Consign to a specialized company	5	5
		Embers	Consign to a specialized company	672	672
	Special management	Waste acids (chromic acids)	Consign to a specialized company	4	4
		Waste acids (copper sulfate liquid mixture)	Consign to a specialized company	4,800	4,800

Source: Japan Environment Corporation (JEC): Outline of Environmental Impact and Evaluation Report

3. Key insights

(1) Existence of companies that take the lead in recycling

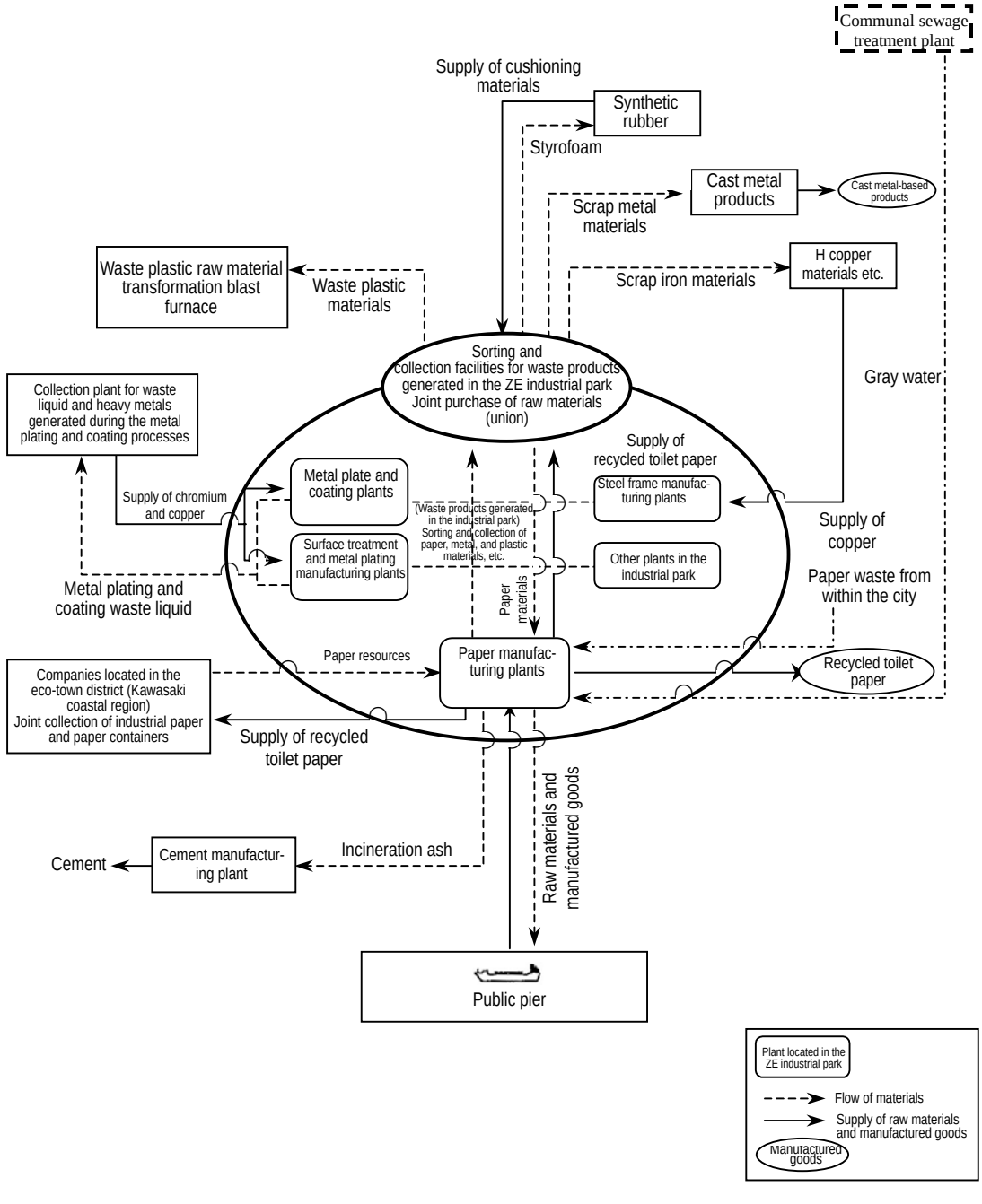
The industrial park contains paper manufacturing-related companies that possess highly advanced technologies. By accepting used paper from surrounding districts and the city as well as from within the industrial park, these companies play a leading role in the promotion of Zero Emissions.

(2) Cooperation with existing companies

Although the industrial park is new, surrounding districts accommodate a number of large companies, such as NKK. For waste products that cannot be processed in the park, cooperation with various companies in the region (starting with NKK) is established in order to carry out resource recycling, etc.

(3) High awareness of companies entering the park

An important aspect is that, from the moment they enter the park, participating companies understand that they are entering an industrial configuration that focuses on the control of waste production and promotes cooperation among different industries in reusing and recycling waste. Each company strives towards “eco transformation” both within the industrial park and the region. It is believed that this keen awareness is helping to promote Zero Emissions.



Locational Image of Kawasaki Zero Emissions Industrial Park

Source: Japan Environment Corporation (JEC) data.

Reference materials:

- Kawasaki Zero Emissions Industrial Park data
- Environmental Operations Organization interviews
- United Nations University symposium materials

  Various other materials

1-6 Fujisawa Eco-Industrial Park (Kanagawa Prefecture)

Outline

Total area:	95.84ha
Location:	Fujisawa City, Kanagawa Prefecture
Scope:	Housing (100 company-owned houses, 400 houses obtained through leasing and land lots, 200 dormitory rooms), research institute, "eco-center", "eco-supermarket", biotope
Estimated population	1,800
Management	Ebara Corporation

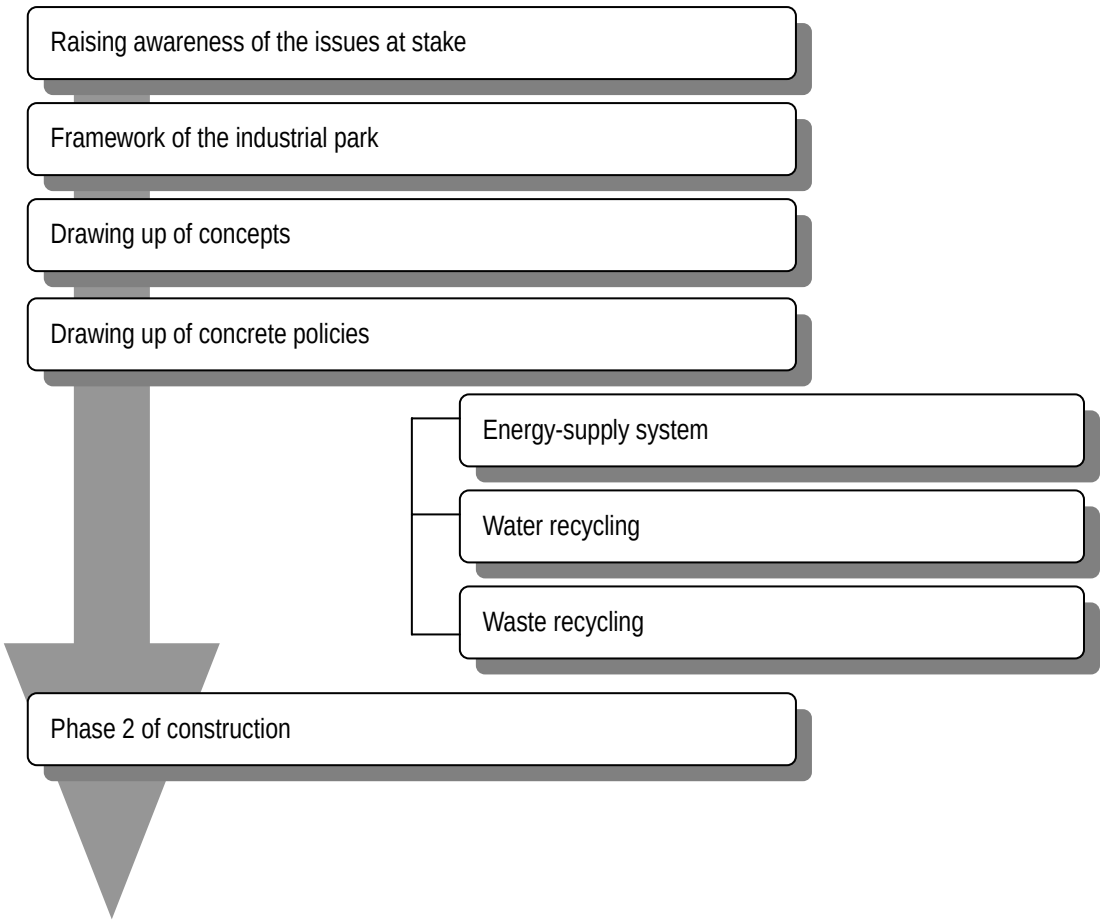
Business background

2000	Drawing up of a fundamental plan for an "eco-industrial park"
2001	Phase 1 of construction (related to welfare facilities); start of construction
2005	Phase 2 of construction (related to housing); start of construction (scheduled)

Eco-industrial park: definition

An "eco-industrial park" is a developing industrial park in which residential areas, industry, and agriculture are united in a manner that strives to coexist with the environment. In cooperation with various other facilities in the surrounding area, it recycles energy, resources, and water while aiming to become a town that imposes minimum environmental burden. (Source: Ebara Corporation data)

1. Steps taken by Fujisawa Eco-Industrial Park



2. Background of efforts

(1) Background

The construction plan for the eco-industrial park is the result of an independent effort by Ebara Corporation. In concrete terms, the objective is to create an experimental site for "a composite and integrated town that connects residential areas with the industrial zone" and "the construction of a town that coexists with the environment and is centered on resource recycling systems for water, energy, materials, etc." By interconnecting residences, distribution, industry, and agriculture, it is hoped that waste materials and energy utilization will be reduced through the recycling of materials. The reconstruction of company-owned houses and training establishments in Fujisawa was the impetus for current efforts to advance the plan.

(2) Formulation of fundamental concepts

The construction of the park took place in accordance with a fixed set of concepts and fundamental policies.

◆ **Concepts**

1. Demonstration of the feasibility of living in coexistence with the environment.
2. Contribution to the region through the Eco-Industrial Park (EIP)
3. Site for the construction of a new industrial cluster.
4. Partial demonstration of a recycling society through linkage with factories.
5. Site for research and development of next-generation environmental machinery and tools.

◆ **Fundamental policies**

- Adoption of flexible and integrated administrative methods that involve various ecological lifestyles
- Fee rules shall put ecological lifestyle into practice and reflect energy savings that are a product of this lifestyle
- Adoption of a form of administration and ownership that is easily certified and that provides a supply of electric power from fuel cells as specified by the Electricity Enterprises Law
- Integrated control and administration within the industrial park of water and sewer services, the gray-water system, the collection of waste, etc., are possible

(3) Drawing up a concrete plan

Various Zero Emissions technologies have been introduced into the park. A key attribute of the park is the importance it places on water and energy. Concrete aspects are indicated below.

Lifeline

Electric power:	purchase electricity from fuel cell-, solar power-, and electric power companies
Water supply:	direct water supply
Drainage:	waste water treatment and gray-water system, heat pump, compost, vacuum sewerage, vacuum toilet, methane fermentation
Hot water supply:	fuel cell waste heat, gasification melting furnace waste heat
Waste material:	gasification melting furnace, disposers
Information:	regional LAN (LAN= Local Area Network), Internet (outside the area)

Living environment: rainwater recycling, biotope

Electric power supply system

In the construction of an electric power supply system, power generation equipment is provided that takes the environment into consideration. This includes equipment such as solar power generators, fuel cells, and wind power generators. The basic philosophy is as follows:

- A solar battery (panel) shall be installed at an optimum angle on the rooftop of each building as a source of energy. The buildings upon which such solar batteries will be installed shall be determined after considering combination with rooftop tree planting.
- Small windmills shall be installed on the rooftop of the eco-center. They shall be used effectively as a source of electricity.
- Fuel cells shall be installed to generate electricity. (Waste heat shall be effectively applied as a source for electricity generation in the district.)
- Connection of fuel cell-generated electricity and commercial electricity shall take place by bringing them into the wiring system at a single place for the entire industrial park. Shared use of electrical sources shall boost the rate of operation of fuel cells.
- The small wind-power generator and the solar battery on the rooftop of the eco-center shall be used effectively as independent electricity sources. They shall make use of a storage battery that serves as an electricity source for stream recycling facilities.

Water recycling

Water that has been used in the park is released into ponds and streams after it has run through a wastewater treatment recycling system. Furthermore, plans call for rainwater that is collected on rooftops, in gutters, and in rainwater basins to be stored cisterns or other containers and released into ponds and streams.

Waste recycling

There are plans to carry out resource recycling at a rate of 96% of the generated amount of waste (which amounts to 590 grams per day per person). This will be achieved through resource recovery, heat recovery using a gasification melting furnace, and utilization of gray-water, compost, methane, etc., by means of a disposer.

By making use of the various Zero Emissions technologies mentioned above, it is hoped that the amount of CO_2 emitted will be reduced by 30%, energy consumption by 38%, water use by 28%, and amount of waste products produced by 96% compared with conventional urban development.

3. Key insights

(1) Clear establishment of quantitative objectives

Starting from the preliminary planning phase, reduced used water use, reduced emission of waste products, and reduced CO_2 emissions have been considered important issues.

(2) The involvement of residents, industry, and agriculture

Efforts have been geared toward reducing waste products by constructing a resource-recycling system that is based on the integration of residents, industry, and agriculture. Since a cooperative relationship with the local residents is of vital importance, collaboration with NPOs is encouraged.

Reference materials:

- Ebara Corporation. *Fujisawa Eco-Industrial Park*
- Environmental Management Strategy Encyclopedia Editing Committee. *Environmental Management Strategy Encyclopedia*: Industrial Investigative Committee, 2003
- *Construction of a Complex Recycling System on a Social Experimentation Site and Development of Environmentally-friendly Technologies* (Research representative: Toru Morioka), 2001

Various other materials

1-7 Honjo International Research Park (Saitama Prefecture)

Outline

Total area:	(Entire core municipal area: 230.5 km^2; Waseda Research Park district: 65ha)
Location:	Honjo City, Misato Town, Kodama Town, Kamikawa Town, Kamiizumi Village, Kamisato Town, and Okabe Town, Saitama Prefecture
Scope:	Consolidation of a wide-reaching exchange system that includes employees, residents, the entertainment sector, and academia in the Honjo regional core municipal area (a district with 10 core areas)

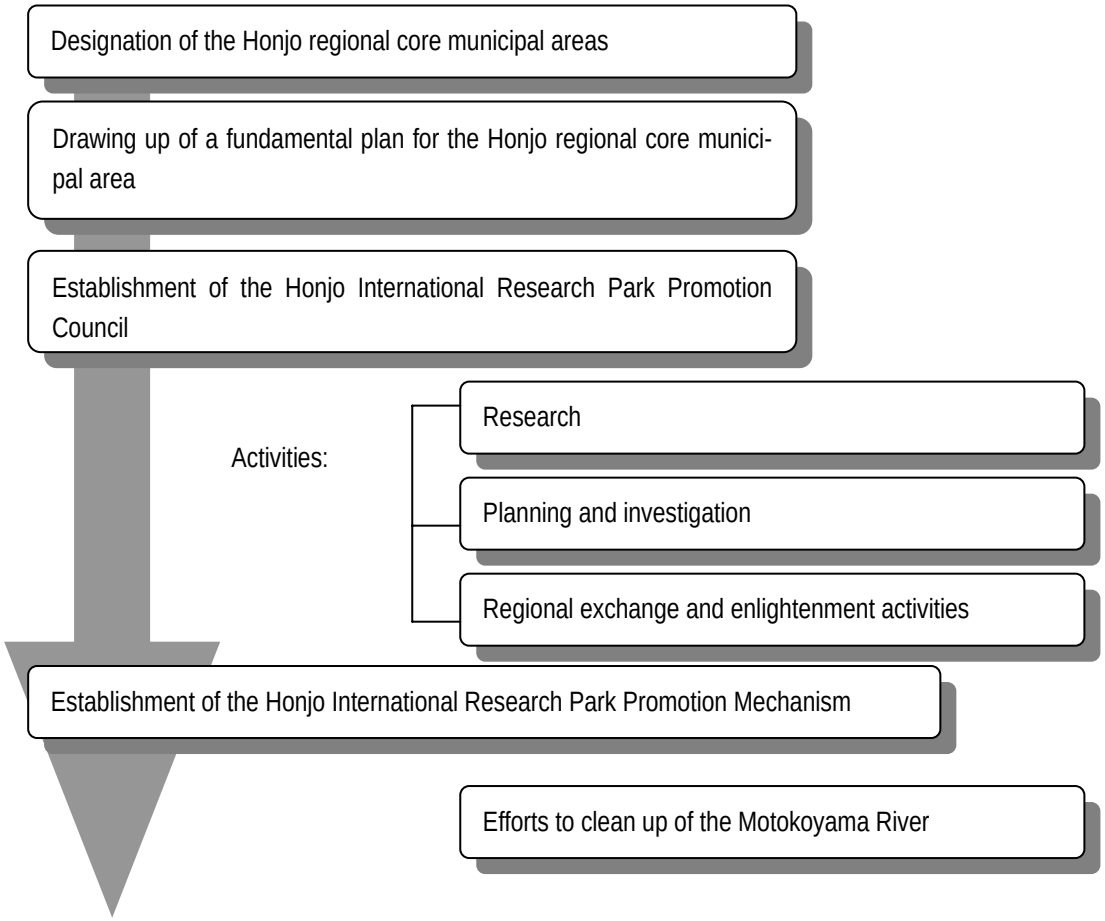
Business background

1993 Designation of the "Honjo regional core municipal area"
1994 Drawing up of a fundamental plan for the Honjo regional core municipal area
1998 Establishment of the Honjo International Research Park Promotion Council
2002 Establishment of the Honjo International Research Park Promotion Mechanism
2004 Planned opening of a new Shinkansen station

Regional core municipal areas: definition

A "regional core municipal area" aims to create an attractive place in which professional, residential, entertainment, and academic functions are united by bringing together various advanced urban functions and facilities and by forming a sound living environment. This is intended to promote the region's independent growth as well as the balanced development of the nation.

1. Efforts taken by the Honjo International Research Park



2. Outline of efforts

(1) Background

The Honjo regional core municipal area has been designated under laws on regional core cities. The aim is the formation of a regional core municipal area that provides professional, residential, entertainment, and academic functions and that effectively uses resources within the region. To achieve this, there are plans for the establishment of a new station along the Joetsu Shinkansen (bullet train) line and for local promotion of research and development facilities led by Waseda University. In particular, the aim is to build a community of research institutions in the Waseda Research Park, which is centered on the Honjo New Urban District with the new Shinkansen station at its core. Another objective is to establish housing facilities, etc., in neighboring areas through a land readjustment project and to extend the effects of this project to surrounding areas. It follows that the Honjo International Research Park, with the Waseda Research Park at its center, targets the entire zone made up of individual core municipal areas. In this context, the objective is collaboration between industry and academia along the themes of "telecommunications" and "the environment". The Honjo International Research Park promotion council also carries out research sessions on other relevant topics (please refer to following section).

(2) Formation of a promotion body

- Honjo International Research Park Promotion Council

  This council was inaugurated in 1998 with the aim of promoting collaboration between industry and academia in the Honjo regional core municipal area, and of improving the technical capacity of companies in the region. Approximately 170 groups from Saitama Prefecture are affiliated with the council as well as seven municipalities from the regional core municipal area, Waseda University, the Saitama Institute of Technology, local economic organizations, companies, groups, and individuals.

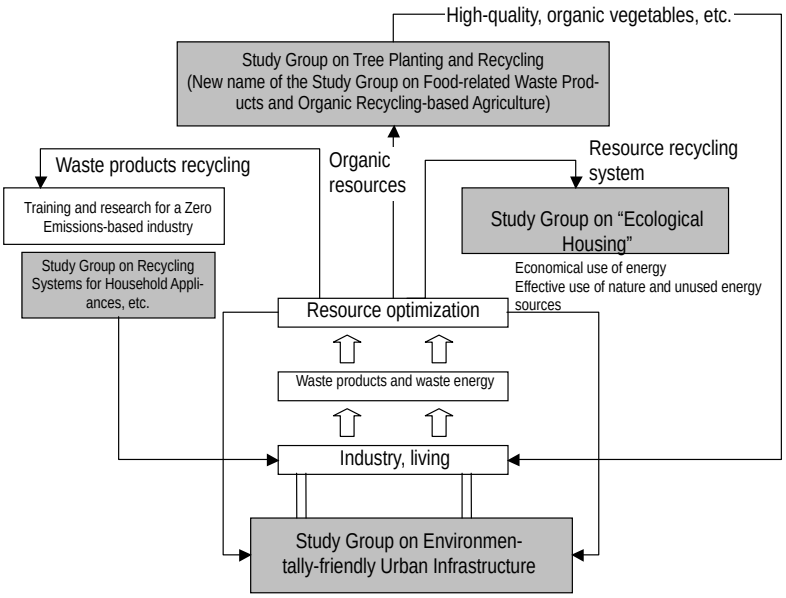
  Its work includes research on cutting-edge activities in the areas of environment, information, and medical care and the organization of research sessions that look into application methods for the Honjo area. Furthermore, it undertakes a wide range of projects, such as the drawing up of a framework for R&D-based regional advancement, promotion of regional exchange using the Internet, and classes on technical experimentation for children as an educational activity.

- The Research Promotion Committee for Urban Development founded on the Honjo-based Zero Emissions Model

  This committee is an operational body of the promotion council. It was established with the aim of constructing, through research projects related to Zero Emissions, a sustainable new urban system that is based on reduced environmental burden in the Honjo regional core municipal area and efficient energy management.

  The committee is made up of some 70 persons from local governments, private companies, universities, and private think tanks that desire to participate. In 2002, the committee carried out the five research activities listed below. Each study group has about 10 to 20 members that study policies for putting research results to practical use in the Honjo area.

(1) Study group on tree planting and recycling (research on tree planting projects and composting methods for raw garbage, etc.)
(2) Study group on "ecological housing" (research on housing that is in harmony with the environment)
(3) Study group on environmentally-friendly urban infrastructure (research on next-generation transportation systems that are in harmony with the environment)
(4) Study group on regional environment currency and community business (research on the commercialization of regional environment currency and construction of a relevant system)
(5) Study group on Zero Emissions recycling systems for home appliances, etc. (research on recycling methods for home appliances and automobiles)



Water recycling system, resource recycling-based energy supply, transportation system with low environmental burden , etc.

Research Promotion Committee for Urban Development founded on the Honjo-based Zero Emissions Model

Source: Website of Honjo City

Until now, these environment-related study groups have carried out research for the Research Promotion Committee for Urban Development founded on the Honjo-based Zero Emissions Model. They are expected to continue this kind of independent research for the Promotion Council in the future.

◆ Juridical foundation: the Honjo International Research Park Promotion Mechanism

Centered on the Waseda Research Park, this mechanism was established in 2002 to promote collaboration between industry and academics and to construct a model city for the further development of the area. Under the leadership of Waseda University, the mechanism focuses mainly on the environment and information and is expected to carry out activities related to collaboration between industry and academics as well as to the construction of new industries.

(3) Environmental education, human resources development

◆ The Honjo-based Environment University (an educational project to train environmental experts for the Honjo regional core municipal area.)

Aimed at local residents, the University was established to train regional environmental experts who are able to think independently in tackling the area's environmental problems. Courses were inaugurated in 2000 and attract from 30 to 40 participants each year. In addition to lectures by environmental specialists and government authorities, the courses include some 7 to 8 on-site study tours. These activities aim at fostering awareness of environmental issues among the participants.

◆ Environmental symposia

Environmental symposia have been held three times to date. In 2002, the third symposium (entitled "Efforts towards Environmentally-friendly and Mutually-created Urban Development")

was organized to study concrete and practical directions for constructing a recycling society that is based on involvement at the local level. The symposium was organized by Waseda University and the Honjo International Research Park's Research Promotion Organization in cooperation with the Honjo International Research Park Promotion Council and the Research Promotion Committee for Urban Development founded on the Honjo-based Zero Emissions Model.

(4) Future development

Efforts to clean up the Motokoyama River

The Motokoyama River, which runs through the center of Honjo City, is seen as a community symbol. Recently, however, the quality of the river's water has deteriorated due to household waste. In order to address this problem, local residents, companies, government authorities, and universities have worked together to carry out clean up operations with the ultimate goal of turning Honjo into a center for environmentally urban development. Current activities include enlightenment activities on wastewater and roundtable discussions on river cleanup. Henceforth, it is expected that these efforts will be further enhanced as a part of activities by the Honjo International Research Park's Research Promotion Organization.

3. Key insights

Collaboration among industry, academia, the public sector, and regional communities

A key phrase in promoting projects in this area is "collaboration between industry, academia, the public sector, and regions". The aim is to develop the entire region based on the wide-reaching participation of industry, beginning with local companies, and institutions such as Waseda University, the Saitama Institute of Technology, government authorities that promote the establishment of regional core municipal areas, and regional inhabitants and groups. The intention is to encourage independent and proactive participation of local residents by increasing educational and PR activities of the Council and research promotion organizations.

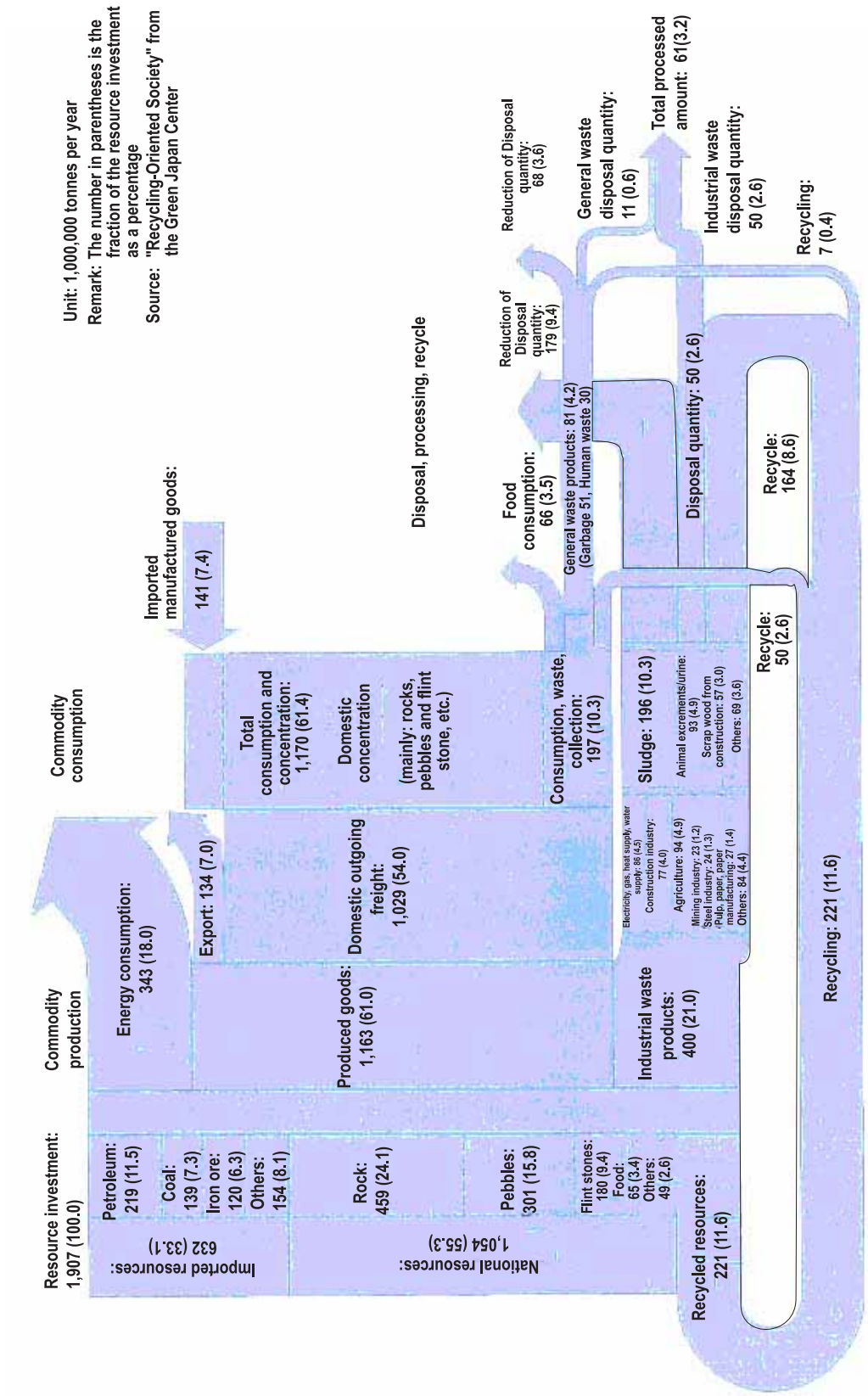
Reference materials:

- Office for Core Cities, Department of Policy and Planning, Saitama Prefecture – Hearing survey data
- Honjo International Research Park Promotion Mechanism – Interview survey data

Various other materials

2. UNDERSTANDING MATERIALS FLOW

2-1 The material balance of Japan (1999)



2-2 Material flow cost accounts

(1) Outline

This involves identification of the quantity of resources (materials) used and analysis of how materials circulate within the company or throughout the manufacturing process. It is an evaluation technique that works by recording the names of consumed materials and the quantity of resources consumed by site where loss occurs, not by how they relate to finished goods. (Source: Ministry of Economy, Trade and Industry: Environmental Managerial Accounting Techniques Workbook)

In attempting to attain Zero Emissions after understanding flow, it is important to first make improvements so as to reduce loss and then to proceed in encouraging the exchange of materials. Since the material flow cost accounting technique makes it possible to clarify the flow and the stock contained in waste products, it can be an extremely efficient measure for promoting Zero Emissions. However, many problems remain with regard to the efficiency of this technique, such as problems in determining the utilization of materials by other industries, because analysis currently occurs only in raw materials-based industries.

(2) Calculation method

Three aspects are important in this technique: (1) "material costs" consisting of all the raw materials consumed throughout the manufacturing process, (2) "system costs" consisting of overall processing costs, such as depreciation costs and labor expenses, and (3) "delivery and processing costs" consisting of the delivery and processing expenses related to waste products. It is important to measure the quantity of raw materials that constitute the "material loss."

Collected data: examples

- Consumed raw materials: amount consumed in each process, unit price, total cost
- Calculated quantity: calculated quantity for each process
- Stock: quantity for each process

With regard to the material flow cost accounts, it is desirable to refer to following materials.

Reference materials:

- "Ministry of Economy, Trade and Industry: Environmental Managerial Accounting Techniques Workbook"
- Nakajima, Michiyasu and Katsuhiko Kunibe. *Material Flow Cost Accounting: Liberal Methods for Environmental Managerial Accounting*: Nihon Keizai Shinbun Inc., 2002

2-3 Understanding material flow: concrete examples

In order to plan collaboration among various industries with regard to Zero Emissions, it is essential to establish a classification system based on an understanding of the material flow of each actor involved. A possible approach to this issue is to carry out a questionnaire and interview survey with each company or actor.

This section presents a questionnaire used by Nairiku Industrial Park to gain an understanding of actual conditions surrounding material flow. Taking the results of this survey, Nairiku Industrial Park drew up its "Zero Emissions Grand Design", which contains a fundamental framework and a concrete blueprint for the park. This is followed by a table that was utilized by Kokubo Industrial Park as a product classification system.

It is important to use these references to produce methods that are suitable for each region or industrial park.

Sample questionnaire for identifying actual conditions (Nairiku Industrial Park)

Fact-finding study

Through this questionnaire, we are asking for specific information from persons responsible for daily operations. We intend to use the questionnaire to gain an understanding of actual conditions in the entire industrial park, as this will be useful in our efforts to promote waste processing and recycling in cooperation with the industrial park's union. We guarantee strict confidentiality in handling this information and declare that we will not use it for any other purpose.

1. Monthly amounts of waste products generated and means of processing (disposal)

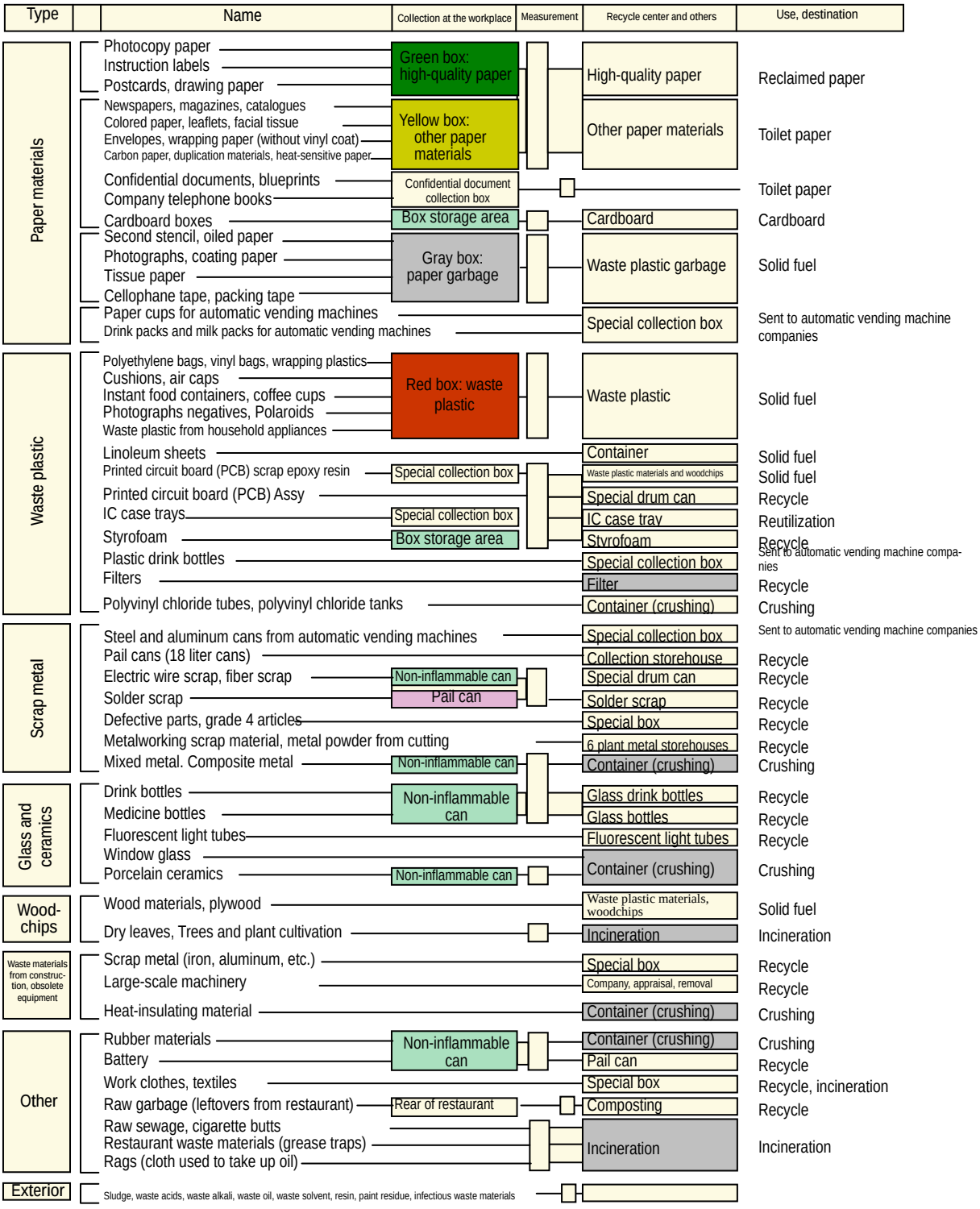
Please provide amounts of waste for each product, classifying waste into applicable categories as accurately as possible. When classification is impossible, provide only the total amount on the "(Total)" line. Rather than providing the cubic volume of generated waste, we request that you convert this volume into weight (kilograms) when possible.

Waste product categories		Monthly generated quantity	Disposed quantity (kg)			Processing expenses	Recycling ratio	
			Disposal within the company	Recycling company	Waste products industry		At present	Feasible recycling ratio
1. Wastepaper	High-quality paper							
	Newspaper							
	Cardboard							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
2. Woodchips	Cushioning materials							
	Woodchips from manufacturing process							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
3. Textiles and fibers	Natural textiles and fibers							
	Synthetic textiles and fibers							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%

4. Waste plastic	Heat plasticity resin							
	Chlorine-based heat plasticity resin							
	Heat-hardening resin							
	Refuse, other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
5. Waste rubber	Natural and synthetic rubber							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
6. Scrap metal	Scrap iron							
	Non-iron scrap metal							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
7. Waste oil	Mineral oil							
	Animal oil							
	Chlorine-based oil							
	Other							
	(Total)	Kg	kg	kg	kg	¥ ,000	%	%
8. Sludge	Organic							
	Inorganic							
	Other							
	(Total)	Kg	kg	kg	kg	¥ ,000	%	%
9. Embers	Embers							
	Soot							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
10. Waste acids, alkali	Waste acids							
	Waste alkali							
	Other							
	(Total)	kg	kg	Kg	kg	¥ ,000	%	%
11. Glass, Ceramics	Glass shavings							
	Ceramic scrap							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
12. Raw garbage	Animal residue							
	Plant residue							
	Restaurant kitchen residue							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
13. Others	Shredder dust							
	Construction-related waste products							
	Other							
	(Total)	kg	kg	kg	kg	¥ ,000	%	%
14. Specially controlled industrial waste products	Waste oil (volatile oil, kerosene, light oil)	kg	kg	kg	kg	¥ ,000	%	%
	Waste acid (pH 2.0 and lower)	kg	kg	kg	kg	¥ ,000	%	%
	Waste alkali (pH 12.5 and higher)	kg	kg	kg	kg	¥ ,000	%	%
	Infectious industrial waste (from medical care, etc.)	kg	kg	kg	kg	¥ ,000	%	%
	Waste PCB, organic halogen–related substance	kg	kg	kg	kg	¥ ,000	%	%
	Waste asbestos, etc.	kg	kg	kg	kg	¥ ,000	%	%

Example of a waste product classification system (Kokubo Industrial Park)

Waste product classification system



2-4 Clustering matrix

In order to promote Zero Emissions, it is necessary to construct a Zero Emissions network. This can be done after identifying and classifying amounts of waste products. The network should be based upon horizontal collaboration among the actors involved. In this context, this section presents an example of a "clustering matrix" drawn up by Taiheiyo Cement Co. It shows from an overall perspective the industries for which waste materials generated by a certain type of industry can be used as raw materials or resources in another industry. The horizontal axis shows the waste generating side (output) and the vertical axis shows the waste receiving side (input). The more circles are shown on the horizontal axis, the higher the possibility for receipt of waste products from other industries.

When creating a Zero Emissions plan, matrixes of this sort should be prepared on both the regional and industrial park level. (Since it is difficult to realize everything from the start, it is acceptable to begin with those items that are easily understandable, such as waste products that are generated in large amounts.)

Output

Input \ Output	Cement	Iron and steel	Non-ferro	Paper	Petroleum	Chemistry	Con-struction	Electric household appliances	Electric power	Auto mobiles	Electronic communi-cation	Construc-tion materials	City
Cement		○	○	○	○	○	○	○	○	○	○	○	○
Iron and steel				○	○	○	○	○	○	○			○
Non-ferro	○	○			○	○	○	○	○	○	○	○	○
Paper													○
Petroleum						○							
Chemistry			○		○						○		○
Con-struction		○				○			○				○
Electric household appliances													
Electric power													○
Auto-mobiles													
Electronic communi-cation						○							
Construc-tion materials		○		○			○		○				
City	○			○									

Clustering matrix

Source: Materials prepared by Mr. Seiji Taniguchi, Yakushima Denko, Inc.

3 TOOLS FOR A DEEPER UNDERSTANDING OF ZERO EMISSIONS

3-1 Gaia theory

The Gaia theory represents a concept in which the earth as a whole constitutes "one living organism." This organism is made up of all living things ranging from bacteria to human beings, and the non-living environment, such as the atmosphere and ocean. The idea was launched by the British climate scientist Dr. James Lovelock, who, while taking part in the planning of a study program on life on Mars, was inspired by the thought that it is possible to confirm the existence of life from the composition of the atmosphere. In 1979, he published a book entitled "A New Look at Life on Earth" in which he developed the Gaia theory.

An important characteristic of the Gaia theory is that living things do not adapt passively to the environment; instead, living things influence the environment and they have a large function in producing clean water and air. Thus, the theory proposes that the earth as a whole functions as a large living system.

3-2 The Natural Step

The Natural Step is an environment-related educational organization that originated in Sweden. It was established in 1989 by Dr. Karl-Henrik Robert, a medical specialist in the field of pediatric cancer. The organization has extended internationally, including to Japan. The Natural Step has launched a framework that can be used as a method by organizations and regional communities for realizing a sustainable society. This framework includes four "system conditions" (presented below) that are the principles for constructing a sustainable social system.

The Four System Conditions

Source: The Natural Step Japan Homepage (http://www.tnsj.org)

(1) Nature is not subjected to the continuous increase of concentrations of substances extracted from the Earth's crust

Minerals are generated through a slow process within the earth's crust and one should not extract minerals, including petroleum, coal, metal, and phosphorous, beyond the equivalent of this amount. The significance of this condition for companies and self-governing bodies is that it encourages the change to the systematic use of scrap and other resources that can be regenerated as raw materials in all manufacturing and consumption processes.

(2) Nature is not subjected to the continuous increase of concentrations of substances produced by society.

This means that all things produced by a society, including desirable goods as well as non-desirable goods, such as smoke pollution and drainage, are produced and emitted at the rate in which they can be reutilized as new resources by recycling them through society's technology or by natural recycling. For this reason, we must economize on the utilization of resources to the utmost extent and we must remove substances that are foreign to the natural environment and for which biodegradation is difficult, such as PCB, fluorocarbon, chlorine paraffin, etc.

(3) Nature is not subjected to degradation by physical means

This refers to preventing the impoverishment of the soil area by means of artificial origin, such as asphalt, deforestation, chlorine pollution, and the violation of arable land. Companies should utilize the soil area as efficiently as possible, and beginning with scrutiny of the necessity of the company's own permanent core establishments, it is necessary to consider the influence caused by development on the productive green tracts of land.

(4) In society, the needs of people in the world should be met.

In order to satisfy Conditions 1 to 3, society must make sure that resources are used efficiently and fairly with a serious frame of mind toward resource conservation. For this purpose, it is necessary to make efforts to look for more refined methods and techniques to fulfill the needs of people in all aspects of society and to economize on resources. At the same time, we must avoid unfair resource distribution between wealthy countries and poor countries.

This emphasizes the method of "back casting", which solves problems by first establishing a long-term vision for the future that covers the actions of each company, and then reflecting this vision on the present. In Japan, Matsushita Electric Industrial Co., Ltd., and others have put environment-related efforts into practice by working in step with The Natural Step and by mentioning the third-party opinions of The Natural Step in their environmental reports.

3-3 Resource productivity/Factor 4.10

F. Schmidt Bleek and Ernst U Von Weizsacker from the German Wuppertal Institute insist that, judging from the present limits of the environmental capacity of the Earth, it is necessary for the industrialized countries, which account for the majority of resource utilization, to multiply "resource productivity" by 10. Resource productivity refers to the amount of utility produced in financial and service terms (also known as social welfare) per amount of used resources. Said reversely, this means a reduction to 1 tenth of the necessary use of the earth's environmental capacity. In 1994, researchers, politicians, and company managers from Europe and the US who agree with this view formed the "Factor Ten Club". The Club announced what it calls the Kannur Declaration, which proposes that resource productivity in industrialized countries must be increased ten times during the next 30 to 50 years.

Furthermore, in 1995, the Club of Rome announced "Factor Four", which aims to multiply resource productivity fourfold by "doubling wealth and halving resource use," as was suggested by Von Weizsacker, Amory B. Lovins, and others. Factor Four includes the following: a) 20 examples in which the energy productivity of household appliances. etc., is multiplied fourfold by reducing electricity consumption by 3/4, b) 20 examples in which productivity for materials of durable furniture, etc., is multiplied by four, and c) 10 examples in which transportation productivity is multiplied by four by means of car pooling, etc.

3-4 "Ecological Footprint"

The concept of Ecological Footprint was developed at the University of British Columbia. It is a representation of "the environmental capacity of the Earth expressed in the area of the Earth needed by a person to carry on a continuous livelihood based on the supply of food and wood and the absorption of carbon dioxide by forests." In other words, it is the area in which the economic activity of humankind has displaced the ecosystem. It compares environmental impact by focusing on the area used for the production of goods (services).

Based on the calculations of the World Wildlife Fund (WWF), economic activities surpassed the environmental capacity of the earth from the 1970s, and this trend has continued ever since. If economic activity continues to grow in this manner, what is equivalent to several times the earth's current capacity will be required. Put another way, given the limitations of the earth, the only way people will be able to maintain their present livelihood will be to reduce economic activity or its environmental impact.

3-5 Environmental efficiency

The concept of environmental efficiency was put forward in a publication entitled "Changing Course", which was released immediately prior to the 1992 Earth Summit by the World Business Council for Sustainable Development (WBCSD). The WBCSD is a coalition of some 150 companies, among which 22 are from Japan, including Toyota Motor Corporation (Mr. Charles O. Holliday Jr., Chairman and CEO of Dupont, acts as the Council's chairman.)

In 1997, the WBCSD published “Eco Agency”, in which the idea of environmental efficiency is defined “as being achieved by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing their ecological impacts and resource intensity throughout the life cycle to a level at least in line with the Earth’s estimated carrying capacity.” It suggests the following five themes as important pillars: “the importance of the utility value (service)”, “the importance of needs and the quality of life,” “efforts made over the entire life cycle of goods”, “awareness of the Earth’s limits” and “the process concept”. It follows that companies must develop goods based on environmental considerations and that they must adopt the following seven fundamental guidelines for environmental efficiency. These guidelines must be taken into account when coping with, for example, changes in production processes.

(1) Reduction of the material intensity of goods and services
(2) Reduction of the energy intensity of goods and services
(3) Control of the diffusion of toxic substances
(4) Improvement of the recycling potential of materials
(5) Maximum use of resources that can be regenerated based on sustainable usage rules
(6) Improvement of the durability of goods
(7) Improvement of the utility density of goods and services

In order to realize a sustainable society, efforts are made to increase environmental efficiency to a point at which improvement is seen in all of these guidelines and at which compatibility between the environment and economic activity becomes established. Examples of companies that are increasing their environmental efficiency include Anderson, Ebara Corporation, SC Johnson Wax, Kvaerner, Ontario Hydro, Philips, Roche, Statoil, Swiss Bank, Dow Chemical, and 3M. In Japan, too, a number of companies are taking the lead in introducing indicators of the environmental efficiency concept (although the names of these indicators tend to be varied). These include Mitsui Chemicals, Ricoh, Sony, NEC, Fujitsu, and Fuji Xerox.

3-6 “Eco-rucksack”

The “eco-rucksack” is the sum of all impacts a manufactured good (e.g., 1 ton of metal) has in the course of its lifecycle in terms of material quantities. It takes into account, for example, mining, manufacturing, transportation, and environmental burden. This quantity is calculated in terms of the degree of material intensity per unit of service (MIPS: Material Input per Unit of Service). In this case, the lower the value, the lower the impact. Furthermore, MIPS refers to the degree of material intensity per unit of service or per unit of function. This value is obtained by measuring the degree to which materials are consumed in a process by dividing the process in phases that include manufacturing, utilization, repair, reutilization, regenerated utilization, assembly and storage, processing of waste products, and transportation. Because the eco-rucksack expresses extent of environmental impact in terms of mass, it is possible to obtain the eco-rucksack value of a good by adding the masses of all raw material constituents of the good after multiplying these figures by the eco-rucksack factor of those materials.

When obtaining the eco-rucksack value, it is necessary to calculate the total environmental impact, not only for the metal mining stage but also for materials and energy, etc., that are used over the entire process of manufacturing a finalized good or service. F. Schmidt Bleek presents an approach towards a “dematerialized economy” that shifts focus from “object ownership” to “utilization of functions and services”, such as renting and joint utilization, in order to improve resource productivity and to reduce MIPS.

$$MI = \Sigma (Mi \cdot Ri)$$

Eco-rucksack material density	Mass of materials (in kilograms)	Rucksack factor

Remark: Rucksack factor
In order to obtain 1 kilogram of a raw material, one needs to take into account the mass of the raw materials that have been displaced in nature.
Examples: steel 21, aluminum 85, recycled aluminum 3.5, Gold 540,000, diamond 53,000,000
(Wuppertal Institute data)

3-7 Social costs

"Social costs" refer to costs that, as opposed to the normal costs borne by a company, are borne by society as external non-economic costs (i.e., not borne by the company). Social costs may result, for instance, when the economic activities of a company cause it to emit environmental contaminants that cause damage to agriculture and fisheries. One company tackling this issue is Taiheiyo Cement Co., which calculates the "social environmental conservation impact" (social cost) that emerges from its use of external waste products in its cement factories. It then announces the results to the public. By comparing inventory that would result if cement were to be produced without using any waste products with that resulting when waste products are used, it calculates its external economic effect. (The inventory includes the amount of waste products emitted into the environment, including the amount of consumed resources and energy used in all unit processes that make up the lifecycle of the good.) This method is generally applied as an analytical process that makes comparisons based on replacement of social costs with their monetary value.

In addition to the social cost method, there are other similar methods to analyze benefits. Examples are a) the so-called "CMV method", which is a virtual market method that takes into account people's awareness of social cost, b) the "travel cost method" (TCM), which calculates the cost that people incur in traveling, c) analysis of the labor market with emphasis on wages, and d) the hedonic method, which calculates land price.

Also used is an analytical method that compares the effect and cost for each unit by prioritizing each item denoted in various units according to its importance, without translating it to monetary units. This method is called the "cost-effect method" (analysis of cost versus effect).

3-8 LCA

In order to increase resource productivity and environmental efficiency in the manufacturing of goods, it is necessary to make an effort to reduce environmental impact at each step: from the supply of raw materials to the design, manufacturing, distribution, sales, and product utilization to waste and recycling. For this purpose, it is first necessary to quantitatively evaluate consumed resources, amount of emitted energy, and environmental burden at each step. It is then important to quantitatively analyze environmental impact on the earth.

Since the latter half of the 1980s, Life Cycle Assessment (LCA) has been considered a means for evaluating these factors. LCA is a technique that has been developed in Europe, as is evidenced by, for example, the eco-indicators of the Netherlands, and it has subsequently been standardized by the International Standard Organization (ISO). It is a method that makes the implementation of quantitative and objective evaluation possible. However, only a portion of the evaluation items has been developed because of difficulties in obtaining data needed for the quantification of inputs and their environmental impacts. Many problems remain as to how assessment of environmental impact on the earth should be prioritized among other phenomena, such as the greenhouse effect, water pollution, and the depletion of resources.

Research towards standardization is also being carried out in Japan, mainly by the Japan Environmental Management Association for Industry (JEMAI).

LCA provides basic data and an evaluation method needed for putting inverse manufacturing into practice. This alone justifies the need for further research and standardization of LCA.

3-9 Environmental labeling

To help consumers make judgments about the advantages and disadvantages of goods that have been designed with concern for the environment, ISO has standardized the provision of information concerning goods and services through “environmental labeling.”

Efforts toward environmental labeling began in the former West-Germany in 1978. These efforts, which were based on certification from the independent organization Blue Angel, have been extended to various countries around the world. There are currently 25 systems in operation.

Under the guidance of the Environment Agency, Japan’s “eco-mark” was adopted in 1989 as the first ISO Type I environmental label recognized by the Japan Environmental Association. Today, the eco-mark embraces the LCA philosophy and is established as a comprehensive environmental indicator. As of late March 2002, 5,014 products have been certified to bear the eco-mark. Expectations are high that this label will serve as an adequate source of information in efforts to promote “green purchases”, by which consumers give preference to goods and services with lower environmental impact than others on the market.

3-10 Eco-design

It is necessary to create product designs and production systems, such as LCA, that are based on input and environmental impact forecasts that cover the entire lifecycle of products. With this in mind, the Dutch public organization UNEP proposed the following 8 methods based on the concept of “eco-design”:

(1) Concept development for new products
(2) Selection of materials with small environmental impact
(3) Reduction in the amount of materials used
(4) Application of the most suitable production technologies
(5) Increased efficiency of recycling
(6) Reduction in environmental impact at the time of utilization
(7) Extension of life span
(8) Systemization of the most suitable processing methods after utilization

Within the ISO framework, the "Guide for Inclusion of Environmental Aspects in Product Standards" (ISO Guide 64), which supports the introduction of the eco-design, came into effect in 1997. Furthermore, development of the DfE (Design for Environment) concept, which develops and designs goods and services based on consideration for the environment and technological developments for environmental conservation, is progressing.

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Weizsacker, Ernst U Von, Amory B. Lovins, and L. Hunter Robins. *Factor Four. Doubling Wealth, Halving Resource Use*: The Energy Conservation Center, Japan

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Hidano, Noboru. *Economic Evaluation of the Environment and Social Capital: Theory and Practice of the Hedonic Approach*: Keiso-shobo, 2002

Various other references/documents

4. REFERENCE LITERATURE

This section presents publications that are useful for the understanding of Zero Emissions. They should be used as reference materials for raising awareness when starting Zero Emissions activities or during study meetings by groups and local residents.

	Author	Title	Publisher	Publication date
General	Norihiro Mitsuhashi	United Nations University Forum Booklet "Zero Emissions Guidelines: Aiming for an Economic Society without Waste Products."	Kaizosha Co.	2001
	Keizo Yamaji	United Nations University Forum Booklet "Practical Manual for Environmental Management: from ISO 14001 to Zero Emissions."	Kaizosha Co.	2001
	Masaji Taniguchi	United Nations University Forum Booklet "Considering Environmental Problems from Resource Mining: Towards an Economic Society with High Resource Productivity."	Kaizosha Co.	2001
	Yoshihisa Obayashi	United Nations University Forum Booklet "Green Strategies for the Construction Industry: from Zero Emissions to Measures Coping with Global Warming."	Kaizosha Co.	2001
	Norihiro Mitsuhashi	A Discussion about Japan's Environmentally Sustainable Economic Wealth: The Manufacturing Industry of the 21st Century.	Toyo Keizai Inc.	2000
	Norihiro Mitsuhashi	Zero Emissions and the Japanese Economy.	Iwanami Shinsho	1997
Technology	Motoyuki Suzuki (Editorial Supervisor)	Striving for Zero Emissions-based Industry: Movement by Industry Toward Resource Recycling of Waste Products."	CMC	2001
	Environmental Partnership Club Industrial Ecology Section Committee Compilation	The Challenge of Zero Emissions: Efforts of Companies towards a Recycling-based Society.	Nippo Publishing Company	2001
Examples	Koichi Sueyoshi	United Nations University Forum Booklet "Kitakyushu Eco-Town. Efforts toward Zero Emissions: Environmental Conservation and Promotion of Industrial Development."	Kaizo-sha Co.	2002
	Motoo Yoshimura	Regional Development and Zero Emissions.	Gakugei Publishing Company	2000
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