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Japan's Eco-Towns and Innovation Clusters: Synergy towards Sustainability*

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Historical background

The Johannesburg Earth Summit of 2002 recognised the role of sustainable consumption and production in reducing the burden of economic growth on the global environment.[1] A principal indicator of sustainable consumption is resource productivity (GDP produced

per unit of material input), which varies considerably between countries. Japan's resource productivity exceeds that of other OECD countries and is also substantially higher than in industrializing countries such as China.[2] There are historical reasons for this going back to the Edo era, when the country's isolation led to a presumption towards making the most of its limited natural resources. However, following the oil shocks of the 1970s, these historical tendencies have been supplemented by specific government policies promoting energy and resource efficiency. Although initially motivated by economic and energy/resource security considerations, since the 1992 Earth Summit and the 1997 Kyoto Protocol commitments, energy and resource productivity policies have become part of the Government's sustainability and greenhouse gas emission reduction strategies.

In parallel, a second trend throughout OECD economies has been the shift in the role of government policy towards industry from direct support of firms towards stimulating competitiveness and innovation. In particular, the 1990s saw considerable interest in the role of innovation clusters in regional development. This paper will describe how the two themes of resource productivity stimulation and clusters of innovation can work together, and consider the wider international opportunities opened up by Japan's experience.

Policies on Resource Productivity

Japan's first legislation targeted at increasing resource productivity was the Law for the Promotion of Effective Utilisation of Recycled Resources (1991), which has since evolved into the comprehensive

* The authors wish to acknowledge the help of Dr H. Ikeda of METI for supplying data on Eco-town performance used in this paper.

[1] This started a 10-Year Programme by the UN to support regional and national initiatives to promote sustainable consumption and production (the Marrakech Process).

[2] M. Xu, T. Zhang. "Material Flows and Economic Growth in Developing China", in *Journal of Industrial Ecology*, 11, 1, 2007, pp. 121-140 (One ton of Direct Material Input generated GDP of $2188 in Japan in 1996, $730 in the EU in 2000 and $178 in China in 2002).

framework in figure 1 focused on improving the "3Rs": Reduce, Reuse and Recycle.[3] The objective is to increase productivity and the cyclical use rate by 40% from 2000 to 2010, while halving the amount of waste for final disposal; these targets appear likely to be met (tab. 1).

Policy on "3Rs" has evolved in parallel with an increasing emphasis on industrial policy addressing social as well as economic objectives in an integrated way.[4] Key emphases since the 1990s have been the need to revitalise regional economies and stimulate new businesses through innovation. These two policy strands have combined in the Eco-town initiative, which seeks to encourage locally generated initiatives to meet both economic development and environmental objectives. Eco-town is related to the UNEP Initiative on Environmentally Sustainable Industrial Development, whose main objectives are recycling, integrated waste management and "Industrial Ecology" aimed at zero emissions.[5] The Eco-town policy, implemented since 1997, seeks to support local innovation and entrepreneurship aimed at local recycling and zero emission strategies. The key concept of this approach − which brings together aspects of previously advocated eco-industrial parks and eco-cities[6] − is to simultaneously stimulate the local economy and promote environmental sustainability. There are now 26 Eco-towns in Japan (tab. 2).

The Ministry of Economy Trade and Industry (METI) and the Ministry of Environment (MoE) are jointly responsible for Eco-towns and apply the following criteria:

1. They should be based on the principle that companies create

[3] Government of Japan, *Fundamental Plan for Establishing a Sound Material-Cycle Society*, 2003, http://www.env.go.jp/en/recycle/smcs/f_plan.pdf.

[4] K. Higuchi, "The Ecotown Project: A New Approach to Regional Development", in *Shinshu University Annals of Environmental Science*, 25, 2005, pp. 13-20.

[5] H. Srinivas, "Summary and Recommendations", in *Environmentally Sustainable Industrial Development: The Concept of Eco-Towns in the Asia Pacific Region*, UNEP conference, Singapore 2006.

[6] M. Chertow, "Industrial Symbiosis and Taxonomy", in *Annual Review of Energy and Environment*, 25, 2000, pp. 313-337.

Table 1. Targets for increasing Resource Productivity, Cyclical Use Rate and reducing Final Disposal

Target	FY 2000	FY2010	Achieved by FY2006
Resource productivity	¥280,000/ton	¥390,000/ton	¥336,000/ton
Cyclical use rate	10%	14%	12.7%
Final disposal	56 million tons	28 million tons	35 million tons

Sources: Government of Japan, *Fundamental Plan for Establishing a Sound Material-Cycle Society*, March 2003.
Central Environmental Council, *3rd Annual Review of Progress in Implementing the Fundamental Plan for Establishing a Sound Material-Cycle Society*, Ministry of Environment press release, Feb 27, 2007.
Cyclical use rate is the amount of recycled material used divided by the sum of recycled and virgin raw material use in the economy.

Table 2. Japan's Eco-towns and Year of Designation

1997	1998	1999	2000	2001	2002	2003	2004	2005
Iida	Omuta	Chiba	Minamata	Yamaguchi	Aomori	Tokyo	Okayama	Osaka
Kitakyushu	Sapporo	Uguisuzawa	Hiroshima	Naoshima	Toyama	Hyogo	Aichi	Ehime
Kawasaki		Akita	Kochi				Suzuka	Yokkaichi
Gifu			Hokkaido				Kamaishi	

an environmental industry cluster aimed at zero emissions (sustainable enterprise).

2. The idea for each candidate area must be creative and not just a duplicate of another Eco-town activity; it must also include some novel aspect where success may be applicable to other locations.

3. Grants (generally 1/3 but up to 50% when a project is particularly innovative) allow the Eco-town to develop both material assets and equipment ("hardware") and also establish networking, information and promotional organisations ("software").

METI's Industrial Cluster Project was launched in 2001 following the debate in OECD countries triggered by Porter's work on clusters.[7] Its objectives are to support autonomous development and

[7] See: M.E. Porter, *The Competitive Advantage of Nations*, The Free Press, New York; OECD, *Boosting Innovation: the Cluster Approach*, OECD publications, Paris 1999; OECD, *Innovative Clusters: Drivers of National Innovation Systems*, OECD publications, Paris 2001.

international competitiveness in regional economies by stimulating innovation, improving productivity and fostering new business creation.[8] Innovation Clusters thus share similar objectives to Eco-towns, as part of overall policies to stimulate local and regional innovation and enterprise. The Cluster Policy also directly links with resource productivity because four of the 17 cluster projects are encouraging innovation in environmental technologies and are thus related to recycling and resource productivity.[9]

Japan thus has two strands of local economic development and innovation policy aimed at sustainable industry. Let us examine the results so far.

Results

METI's survey of Eco-towns established by FY2004/5 provides an overview of the project's achievements.[10] With the help of Government subsidies, over 62 installations have been built which either deal with products covered by the various recycling laws (fig. 1), process domestic wastes or deal with difficult-to-recycle wastes. 29 of these facilities have a combined capacity of 534,000 ton/yr of which 456,000 was used in 2004 (see fig. 2 for a breakdown of the categories handled). The main product recovered was raw material (79%), with only 1% directly reused; the remainder was incinerated (6% with thermal recovery) or land-filled.

Investment in recycling/disposal facilities in the 21 eco-towns established at the time of the survey totalled ¥2023 x10^8 ($1840m at ¥110/$). Turnover related to 37 of the businesses totalled ¥521x10^8/yr of which ¥266 x10^8 was the businesses' own turnover and ¥255 x10^8 triggered in related businesses. When the benefits of reduced waste, re-

[8] METI, *Second Term Medium-range Industrial Cluster Plan*, Regional Economic and Industrial Policy Group, 2006, http://www.meti.go.jp/policy/local_economy.

[9] METI, *Industrial Cluster Study Report*, Industrial Cluster Study Group, 2005, http://www.cluster.gr.jp/en/relation/data/pdf/Cluster_Kenkyu_houkoku_english.pdf.

[10] METI, "Ecotowns: After 10 Years Moving Towards a New Style of Development", in *Indust*, 21, 7, July 2006, pp. 2-7.

Figure 1. Legislative Framework on Recycling-Oriented Society

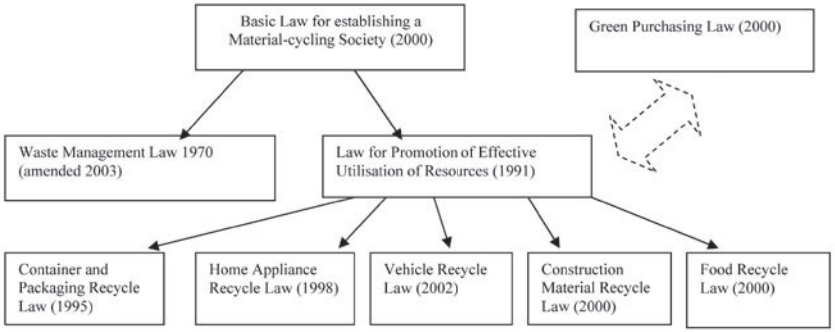
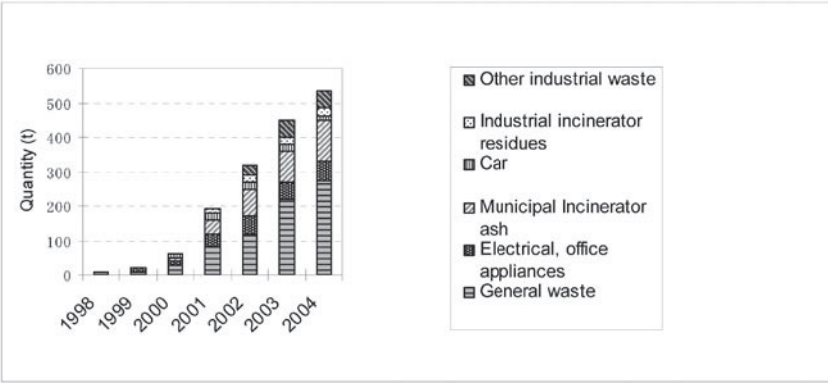


Figure 2. Capacity at 29 Eco-town Facilities



Source: METI, *Eco-towns. After 10 Years* cit.

duced CO_2 emissions etc. are taken into consideration, the cumulative benefits from the 37 waste-recycling facilities since they were established rise by 55% – from ¥4534 x10^8 to ¥7036 x10^8($6.4 billion at ¥110/$). In addition, the towns have had a significant impact on education/awareness – just half of the facilities recorded over 35,000 visitors.

Two of the first Eco-towns to be approved, Kitakyushu and Kawasaki, have been studied in some detail, so we will use them to illustrate the range of activities and approaches used.

Kitakyushu

The Eco-town originated from the area's heavy industry seeking diversification into environmental industries as their main markets became subject to increasing international competition. With a large area of reclaimed land and relevant research expertise at Fukuoka University, Kitakyushu City saw a new focus for economic development and developed plans to promote environmental industries.[11] As a result, Kitakyushu obtained approval as an Eco-town in 1997. Under the separate cluster programme, the *Kyushu Recycling and Environmental Industry* cluster was awarded in 2001 to a collaboration extending from Kitakyushu to other locations throughout Kyushu Island.

The Kitakyushu Eco-town has three components[12]:

1. "Kitakyushu Academic and Research City" includes local academic (including Fukuoka University and its Research Center for Recycling Systems, University of Kitakyushu) as well as international links. It carries out research into natural resources and environmental engineering, and provides teaching and training.

2. The 6.5ha "Practical Research Area" is devoted to the scale up and development of research ideas on recycling technologies, disposal of toxic wastes, final disposal strategies, etc. It has waste handling and treatment equipment, an incinerator, the recycling development facilities of Fukuoka University (Institute for Resource Recycling and Environmental Pollution Control) and an "Eco-Town Center" to promote information exchange and engage local citizens.

3. A "Business Development Area", comprising two locations (the Comprehensive Environmental Complex and the Hibiki recycle area), is used by recycling and venture businesses.

[11] The City received the UN's Global 500 award in 1990 for its work on transferring environmental technologies to Developing Countries and The Mayor (Koichi Sueyoshi) received the "Sustainable Government Award" at the 2002 Earth Summit.

[12] K. Sueyoshi, *Kitakyushu Eco-town*, UN University Zero Emission Forum, 1999, p. 16; GECF, *Eco-towns in Japan: Implications and Lessons for Developing Countries and Cities*, Global Environment Centre Foundation, Osaka 2005.

Table 3. Recycling Businesses in the Kitakyushu Eco-town

Source Material	Recycling process	Uses	Role of Local Authority
PET bottle	PET Flake, textile fibres	Clothes, new plastics	Collection and Green purchasing
Office equipment, Home Appliances	Disassembly, sorting	Metals, plastic raw material, fuel	
Cars	Shredder-less disassembly to spares, steel, aluminium, copper, plastics, fuel	Spares, raw materials	Contributes to cooperative organisation promoting a car recycling cluster
Fluorescent tubes	Glass, metal	New tubes, raw materials (glass, metal)	Collection and use of recycled tubes in offices
Medical equipment	Metals, plastics, paper	Fuel and raw materials	
Construction waste (2 sites)	Making and separation into would, steel, concrete	Road base, raw materials, fuel, boards	
Solvents	Distilled	Clean solvent, fuel	
Paper	De-inking	Toilet paper, paper sheets for animal husbandry	
Food residues (Tofu)	Drying and purification	Bread, cooking	
Styrene foam packaging	Broken up and reformed	Insulating material for floors and walls	

Kitakyushu Eco-town has the most extensive range of recycling and environmental industries in Japan (tab. 3). Total investment has been about ¥430 $x10^8$ ($390m at ¥110/$), of which ¥82 $x10^8$ came from national and ¥56 $x10^8$ from local public sources. Points worthy of emphasis include:

Collection and Awareness. Economic recycling depends on ensuring a supply of sufficient raw material of acceptable quality. This requires citizens' cooperation in providing sorted waste free of contamination. Kitakyushu worked with other local authorities to establish a sufficiently large catchment area to supply recycling businesses. Many villages have obtained ISO accreditation to extend the environmental-friendly area beyond the Eco-town boundaries. Such cooperation has been achieved through extensive public outreach activities.

Markets. In the case of PET bottles, the city helped develop higher added-value markets for clothes using PET-derived fibre – city employees use PET-derived uniforms; even the Mayor's suit is derived from PET! The city also acts as a "green" purchaser for other recycled materials including recycled fluorescent lights. The area's

cement and steel industries allow low grade recycled plastics and other combustibles to be used locally for fuel.

Process innovation. By sorting out office equipment into over 20 types before disassembly, the recycle rate has been raised to 96% and experience has reduced disassembly time from over 1 to less than 1/2 hour per machine. Some 3500 machines per month are recycled; high-quality recycled material is returned to make new equipment, while low quality plastics are used as fuel. Experience in disassembly allows feedback into materials selection and design so that the next generation of equipment can be designed to optimise efficiency over the whole life cycle.

A *"cluster within a cluster"* focuses on car recycling. At the Hibiki site, a group of companies have formed a Cooperative to provide common services to vehicle recycling businesses. This includes a *Joint Storage and Logistics Center* to store used parts and a *Cooperative Organization Center* to manage joint tasks – for instance collection and sales/distribution of recovered parts, recovered metals etc., as well as joint research on automobile recycling.

In addition to the Eco-town project, the Industrial Cluster Project had, by 2005, created 177 collaborations between companies, 531 projects or commercial products and 29 new or secondary businesses.[13] Eco-town participants are linked into the industrial cluster project by networks via a support organisation (Kyushu Recycling and Environmental Industry Plaza - KRIP) with 274 company members, 95 academic members, 54 individual members and 22 local authority groups. By engaging the local education and research base, innovation is encouraged. Examples of new products from these initiatives include:

— A dry powder moulding technology to make ceramics (e.g. ceramic tiles) by a non-thermal process with the option of utilising waste ash from power stations.
— A soil-irrigation system for reducing costs and improving the effectiveness of rooftop gardens (used to counter the heat-island effect in major cities).

[13] METI, *Industrial Cluster Study Report* cit., pp. 56-57.

— A solar-powered water aeration system.
— The first authorised Government-approved process for recycling concrete as aggregate for use in construction including buildings.

Kawasaki

Kawasaki (Japan's ninth largest city) also received Eco-town status in 1997. The City's "Environmental Harmony Plan" followed a long period of discussion on how to resolve existing problems, including what to do with land made available by the contraction of heavy industry and the close proximity and intermingling of heavy industry and residential areas. Planners were particularly inspired by UNEP's vision of zero emission industrial areas (inspired by the earlier Danish Industrial Symbiosis Project). Accordingly, Kawasaki Eco-town's initial focus was on cooperation between existing companies to reduce emissions by using wastes and by-products from one industry as useful resources in another.[14]

At the outset, 15 companies formed the *Zero Emissions Industrial Complex Association* to encourage a better use of energy and material recycling. Members undertake that: (1) each company should have its own environmental policy; (2) they should adopt tougher targets for environmental protection than required by law; (3) they should facilitate effective and beneficial links within the Association; (4) as far as possible, wastes should be dealt with within and between Association companies; (5) with wastes that cannot be dealt with, opportunities will be sought to reuse or recycle nearby. Grants have totalled around ¥250x10^8 for investment into recycling plants and the necessary support organisations.

Major projects include:

[14] S. Kato, "Kawasaki Eco-Town: Moving Forward with the Kawasaki Action Plan", in *Environmentally Sustainable Industrial Development: The Concept of Eco-Towns in the Asia Pacific Region*, UNEP conference, Singapore, 1st November 2006; KCEIRS (Kawasaki City Environment Industry Reform Society), *Kawasaki Eco-town*, UN University Zero Emission Forum, 2004.

— Waste plastics processed into:
  - substitute for coke in blast furnaces;
  - pyrolysed to make ammonia;
  - form-work boards for construction.
— Difficult-to-recycle waste paper is recycled to toilet paper, with residual metals and sludge recycled. The large quantities of water required comes from the Kawasaki waste treatment plant, which was upgraded to provide water of sufficient quality.
— Plant to recycle PET bottles into new PET bottles.
— Use of waste materials in cement manufacture includes sewage sludge, waste wood, plastics, tyres and oil as substitute for fuel; incinerator ash, blast furnace slag and waste shells (from seafood manufacture) can also be used.
— Recycling of home appliances and fluorescent tubes (provides a source of plastics, metals and glass to adjoining processes).
— Metals recycling into stainless steel manufacture.

The City-supported *Liaison Centre for Creation of Industry and Environment* – comprising university researchers, research institutes and over 70 companies, including new recycle-oriented companies – promotes the extension of environmentally-friendly practice to companies outside the original Association. Projects include: waste heat and electricity recovery in industries and urban areas; redesigning the regulatory system to encourage energy and environmental improvement; and developing the industrial symbiosis and eco-efficiency model. The Centre links to Toyo University, which has created a database of wastes and by-products to allow companies to see potential sources of raw materials. The database provides a matching service and helps to identify possible technology and market opportunities.[15]

Outreach programmes raise environmental consciousness and introduce environmentally-friendly measures such as energy conserva-

[15] T. Fujita, L.F. Wong, K. Kurihara, "Framework of Environmental Evaluation of Industrial Symbiotic Collaboration in Eco-industrial Estates", in *Proceedings of the 32 Meeting of the Committee on Environmental Systems of the Japanese Society of Civil Engineers*, 2004, pp. 75-80, http://cris.eng.toyo.ac.jp/result/detail/pdf/pdf1_7.pdf.

tion, use of waste low-grade heat in neighbouring office and building heating, organic waste composting, rainwater use, local generation and joint management of electricity supply, cars powered by natural gas, etc. A global environment and environmental education programme has been implemented in area schools – including an energy monitoring system to allow students to target specific reductions and measure progress. In addition, a Geographical Information System maps the location of different sources of materials such as plastics, wood, organic wastes and metals. This allows the effects of expanding boundaries for collection networks and possible new cooperative relationships between urban and industrial sectors to be assessed in terms of their environmental and economic feasibility.[16]

Kawasaki City is involved with the UNEP zero emissions programme (International Environment Special District initiative) and Eco-town Training Course, and also hosted the 3rd Asia-Pacific Eco-Business Forum. It is seeking to develop international links to assist industrializing countries to use environmental technologies operated by its companies, and learn from the City's experience in environmental conservation.

Other Locations

In addition to the two detailed examples above, 24 other Eco-towns in table 2 are applying their own particular mixture of strategies towards more sustainable use of resources. In addition, under the Industrial Cluster Project, innovation-support programmes are continuing in the:

Tohoku Industry Promotion Project for a Recycling-oriented Society (with a focus on nonferrous metal recycling: some 54 projects are currently under way).

Kansai Environment Business Green Cluster Promotion Project with a special focus on technology and equipment to use organic resources and wastes, and on environment purification equipment, sensors, and services.

Chukoku Cluster on a Recycling-Oriented Society to encourage re-

[16] Ibid., p. 79.

cycling, energy, and environment purification innovation − up to 2005, 159 new businesses or products had been created.

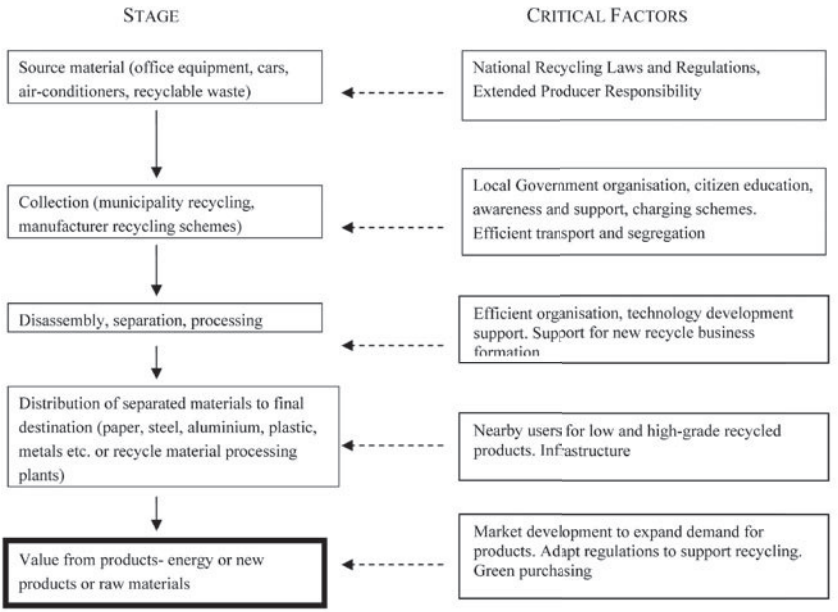
Developing a "Vein Industry"

The recycling industry has been likened to the veins in the human body which return with waste products to be purified; whereas traditional industry is analogous to the arteries which carry fresh materials (oxygen, sugars, etc) for consumption. As long as raw material prices fail to reflect externalities such as future scarcity, environmental impacts of extraction, emissions and disposal, the spontaneous development of a "vein industry" will be slowed. The economic viability of the recycling industry is also undermined by barriers such as search and transaction costs, information failures etc.[17] Governments address these market failures through legislation and regulation (e.g. laws requiring safe disposal, landfill taxes, recycling targets), but Japan's approach is notable in using regulatory and other tools in a coordinated and holistic way with the aim of creating an environment in which a private sector "vein industry" can develop. Motives are both environmental (resource conservation and emission reduction) and economic (stimulating local economies and supporting the development of technology and companies that may have a competitive advantage as the priority of recycling/re-use rises globally).

Creating an environment hospitable to a "vein industry" requires thinking in terms of systems and the relationships and interconnections between the various parts and players in the system. The generic system for recycling can be represented as in figure 3. It requires the collection and supply of waste materials to be matched with the processing capacity and market for recycled products. Finding mechanisms through which one company can enjoy a symbiotic relationship with another requires a coordinated and cooperative approach which is unlikely to result from market forces alone.[18] Consistent government policy and support at both the national and the local level, together

[17] OECD, *Improving Recycling Markets*, OECD Policy Brief, Jan. 2007.
[18] KCEIRS, *Kawasaki Eco-town* cit., pp. 32-35.

Figure 3. Generic System for Recycling



with corporate social responsibility, extended producer responsibility (EPR), and socially responsible investment are also needed.[19] In the case of both Eco-town and cluster policies, government support has been critical for setting up and running the organisational "software" of networks and local support organisations, as well as facilitating investment in the "hardware" of recycling facilities (Eco-towns), or development projects and new business formation (Clusters).

Figure 3 also lists some of the critical factors involved at the various stages of the recycling process which can be inferred from the experience described earlier. Success requires a high degree of cooperation, coordination and motivation on the parts of national government, local government, companies and citizens. Policies on the 3Rs and Eco-towns have avoided confrontation between the regulators and the

[19] H. Srinivas, "Summary and Recommendations" cit., pp. 4-5.

regulated, and forged an effective partnership between the many stakeholders. In addition, the Eco-town policy has often empowered those communities which had enthusiasm for overcoming the legacy of historical environmental damage in their local area. Thus Kawasaki and Kitakyushu were able to add momentum to their efforts to make heavy industry more environmentally friendly. Others such as Minamata and Oomuta had a historical legacy of severe pollution problems where the Eco-town policy boosted a strong motive for local area regeneration.

In summary, the key roles of the *National Government* include:

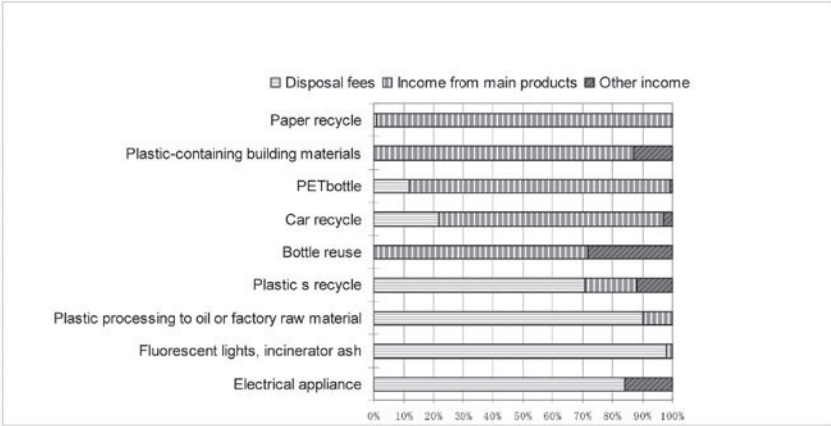
- provide leadership on the need for recycling: Japan now has recycling laws or guidance covering 35 categories of waste materials;
- stimulate the industry: the Eco-town policy (METI and MoE) provided the essential grants for hardware and software that enabled Eco-towns to develop their own versions of sustainable industries and communities. Disposal fees create a revenue stream for recycling businesses;
- support basic research and education - the Ministry of Education (MEXT) supports research groups at Toyo and Fukuoka Universities linked to the Eco-town research groups at Kawasaki and Kitakyushu, respectively;
- stimulate innovation: METI's environmentally-focused Industrial Cluster Projects.

Local Government initiative is also critical. As discussed above, it played a critical role in ensuring supply of materials for recycle, developing some markets for products, and the essential area of engaging the local public and ensuring they collaborate in recycling.

Problems and Future Challenges

Ultimately, initial grants are designed to lead to a self-sufficient system where corporate social responsibility, extended producer responsibility and the socially responsible investments of banks maintain the development of locally sustainable ("vein") industry. Eco-town subsidies were available from 1997 to April 2005. Grants from METI for over 50 facilities totalled ¥345 $x10^8$ and (together with

Figure 4. Market Competitiveness of Recycling Business. Sources of Income



Source: METI, *Eco-towns. After 10 Years* cit.

¥7 x10^8 from local government) was exceeded by private business investment (¥403 x10^8). In addition, grants by MoE (6 facilities) and spending by other businesses in the Eco-town areas created a further ¥1268 x10^8 investment between 1997 and 2004. The overall stimulus to local economies from the Government's Eco-town policy was thus ¥2023 x10^8 – over 6 times the METI grants. METI estimate that the effect of a grant on an individual business is to bring forward by 4 years the date by which the initial investment is recovered, contributing significantly to company viability.

While the Eco-town policy has been successfully launched with introductory subsidies, long-term viability has yet to be demonstrated. Key problems and challenges include:

Revenues. Eco-town business revenues (fig. 4) show some businesses (e.g. paper recycle) to be financed by sales of recycled product, while others depend on disposal fees (e.g. electrical appliances). This underlines the importance of consumers accepting responsibility to pay a recycle fee at the end of a product's life.[20] Consumer resistance

[20] Charges are refrigerator ¥4,500; washing machine ¥2,400; air conditioner ¥4,500; TV set ¥2,700.

leading to significant evasion not only would negate the environmental benefits of recycling but threaten economic viability as well.

Raw material supply. In a 2005 survey, 74% expressed concerns over adequacy of supply or raw materials for recycle and 47% over quality.[21] Increased exports of collected recyclables such as paper or PET bottles instead of in-country processing would threaten long-term viability if processing plants are forced to run significantly below their economically viable capacity.

Business Viability. Eco-town businesses report that overall economic performance is mostly more difficult than they expected (52%), compared with only 11% who found it better than and 37% as expected.[22]

Innovation. The Japanese recycling system is based on collaboration between manufacturers, retailers and government. However the emphasis on collaboration rather than competition has led some observers to question whether the current system sufficiently encourages innovation to achieve further reductions in recycling costs.[23]

Implementation. Eco-towns themselves also point to problems over different stakeholders' views of how to define Eco-town missions and success (e.g. what is the definition of zero emission), over-dependence on basic packaging or consumer goods recycling, and difficulty in finding new creative approaches.[24]

International Implications

The substantial gap between Japan's level of resource productivity and that of other countries suggests scope for improvement across both industrialized and industrializing countries. The policy lesson of fusing innovation and environmental policies is one very relevant to the former, many of which have innovation and cluster policies.[25]

[21] METI, *Next Steps in Creating Environmentally-oriented Communities*, Press release, 26 Oct. 2005.

[22] *Ibid.*

[23] DTI, *Waste electrical and electronic equipment (WEEE): Innovating novel recovery and recycling technologies in Japan*, Report of a Global Watch mission, Sept. 2005.

[24] K. Higuchi, "The Ecotown Project" cit., p. 16.

[25] OECD, *Boosting Innovation* cit.; OECD, *Innovative clusters* cit.

Other lessons from the Eco-town programme are the importance of[26]:

- Strong relationships among industries, commercial activities and society.
- A policy framework including legislation and incentives to enable various actors to operate in an environmentally sustainable manner and move towards a recycling-based society.
- A large and rapidly expanding eco-business market including research, development and increasing use of eco-friendly products in public and private sectors.
- Strong focus on environmentally sound technologies and innovative/cutting-edge solutions to solve environmental problems.
- Focus on energy and material conservation, and integrated waste management.
- Social and community responsibility from companies.

OECD countries are seeking to improve recycle rates and recycle market viability[27], and the Japanese experience demonstrates that a clear government policy and funding supported by close cooperation between the stakeholders (national and local governments, industry and public) is an effective mechanism to that end.

The international dimension however poses not just an opportunity for the spread of best practice, but also a threat to Eco-town viability since rising demand in neighbouring countries for PET and other wastes, makes it difficult for Eco-town facilities to find sufficient raw material.[28] Policy priority has thus moved towards the regional dimensions. METI's Industrial Structure Council set out a vision *Towards a sustainable Asia based on the 3Rs* in 2004[29], pointing out the criti-

[26] K. Sueyoshi, *Kitakyushu Eco-town* cit.; KCEIRS, *Kawasaki Eco-town* cit., GECF, *Eco-towns in Japan* cit.

[27] OECD, *Improving Recycling* cit.

[28] A. Treazono, "Japanese Recycling Laws and International Trade in Recyclable Resources", in M. Kojima (ed.), *International Trade of Recyclable Resources in Asia*, IDE-JETRO, Chiba 2005.

[29] METI Working Group on Enhancing International Recycling, Waste Prevention and Recycling Sub-committee, Industrial Structure Council, *Toward a*

cal role resource productivity has to play in moderating the growth in resource demand and environmental emissions in industrializing countries. As consumption increases, so does the disposal burden – 28 million TV sets now need to be disposed of annually in China. Accordingly, China is preparing its own "Circular Economy" Law taking into consideration Japanese (as well as other countries') experience.[30]

Lessons from Japan point to the importance of strengthening the capabilities of domestic recycling businesses and their links with potential users of recovered materials such as the cement, nonferrous metal, iron and steel, and chemical industries. As Japanese companies increasingly locate final assembly and component supply in other countries, this also offers potential for transferring best practice in resource use. Furthermore, seeing the recycle system in terms of a regional system may allow a wider market which may offer more efficient and economically attractive uses for recycled materials.[31] At the same time, the increasing trade in recyclable materials underlines the challenge in making a regional recycling system environmentally sound.

Japan is therefore promoting the 3Rs through an initiative at the G8 summit in 2004, followed by a Ministerial Conference in 2005 and a meeting of senior officials (in Japan) in 2006. This has revealed extensive activities throughout the 20 countries participating and a wide range of potential policies on international collaboration. There is acceptance that: "Promotion of an adequate recycling industry is considered important for economic development and job

Sustainable Asia Based on the 3Rs, Tokyo 2004, http://www.meti.go.jp/policy/recycle/main/english/council/reports/report_sutainableasia_en.pdf .

[30] Y. Geng, "Developing the Circular Economy in China: Challenges and Opportunities for Achieving Leapfrog Development", in *Workshop on Material Flows and Environmental Impacts associated with Massive Consumption of Natural Resources and Products*, Tsukuba 2006, p. 1.

[31] One example is the case of use of glass cullet. In Japan, CRT-based TV sets are no longer manufactured but 3.5 million sets are being collected each year. CRT glass cullet could provides a high-quality resource for manufacturing CRT sets overseas instead of virgin raw material, reducing resource consumption.

creation both for developed and developing countries."[32] However, as recently reviewed,[33] many barriers remain to be overcome, including; problems of mislabelling; harmonisation of definitions of waste and recyclables; export/import regulation and enforcement; recycle vs. second-hand use; trade barriers; applying EPR across borders; and the danger of the economic viability of Eco-town recycling facilities being undercut by low-cost informal recycling.

[32] MoE, *Record of the Senior officials' Meeting on the 3R Initiative*, Ministry of Environment, Tokyo 2006, http://www.env.go.jp/recycle/3r/en/s_officials/01.pdf.

[33] Y. Hotta, M. Elder, H. Mori, M. Tanaka, "Policy Considerations for Establishing Environmentally-sound Regional Material Flow in East Asia", in *Sustainable Resource Management, Raw Material Security, Factor X RP: Tools for Delivering Sustainable Growth in the EU*, Bruges (Belgium) 2006.