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Inter-municipal Network and cooperation for Recycling, Remanufacturing and Industrial Symbiosis

(Short Background Paper for Plenary Session 6 of the Programme)

Final Draft

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Short Background paper

On

Inter-municipal Network and cooperation for Recycling, Remanufacturing and Industrial Symbiosis

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1.0 Introduction

Waste recycling is one of the important strategies in the paradigm of 3Rs (Reduce, Reuse, and Recycle). Although recycling should be considered as the last option, it is today widely practiced and preferred as it often leads to innovation, green investments, job creation apart from the advantage of avoiding extraction, transportation and transformation of virgin resources.

Waste recycling is often influenced by the following

a. Composition or characteristics of the waste
b. Quantity and certainty of the waste supply
c. Purchasing costs of the waste if any
d. Efforts/costs needed in storage, segregation and transportation of the waste
e. Costs of converting the waste into useful products that can be sold in the market,
f. Price competitiveness
g. Environmental regulations on storage, transportation, processing and recycled products
h. Incentives offered for promoting recycling such provision of land, tax holidays and financing schemes

The waste recycling business faces risks on account of

a. Uncertainties in the waste supply and changing characteristics/composition of waste
b. Price fluctuations in the purchase of waste as well as market of recycled materials
c. Difficulties in waste segregation
d. High costs of waste transportation
e. Environmental issues, health and safety concerns
f. Difficulties in working with the informal sector of waste-pickers
g. Non-availability of land for expansion (The NIMBY syndrome)

Listed below are some of the waste streams and materials of interest for recycling in and around the Urban Local Bodies (ULBs)

a. Municipal Solid Waste - MSW (organic and inorganic fractions)
b. Metals (as from MSW, e.g. cans)
c. Plastic (as from MSW, e.g. bottles, bags)
d. Paper
e. Glass
f. Construction and Demolition (C&D) waste
g. Electronic waste (E-waste)

Industrial estates are often located in the peri-urban areas. These industrial estates generate various kinds of waste streams that have potential of recycling. Some of the waste streams of interest for recycling include

a. Packaging waste (bags, cartons, barrels, boards)
b. Sludges (arising from tank bottoms, effluent treatment plants)
c. Dilute acids/alkali
d. Metal scrap (arising from decommissioning)
e. Reject products

2.0 Need for a Strategic Approach

In order to address the risks and opportunities in the waste recycling business, there is a need to adopt a strategic approach

The strategies may be based on the following principles

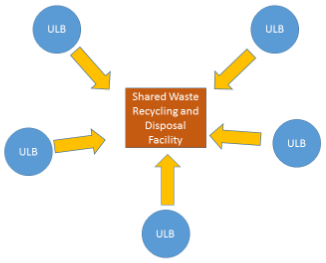
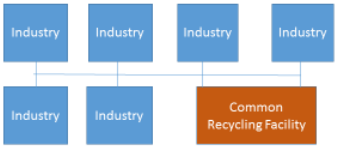
a. Achieve economies of scale:

In order to ensure adequate supply of waste, reduce fluctuations and uncertainties in waste quantities and composition, it may be useful to adopt a **regional** approach. This would mean that ULBs could consider working in cooperation and consider building a common recycling facility that may be shared.

A similar strategy can be applied at an industrial estate. An electroplating industrial cluster could build a common metal recycling facility. An industrial estate of tanners could operate a chromium recycling facility taking advantage of the economies of scale.

Economies of scale not only help in cutting down the investment and costs of operation per ton or m^3 of waste; but allows application of resource efficient and climate friendly technologies.

See Figures 1(a) and 1(b)

Figure 1(a) **ULBs in Partnership**	**Figure 1(b)** **Industries in Partnership**
	

b. Minimize waste transportation:

Waste transportation is one of the major costs of waste processing and can be a deterrent to the economics of waste recycling. Efforts should be made therefore adopt a **hybrid approach** i.e. **combination of decentralized and centralized waste recycling facilities.** The decentralized recycling facilities (DRFs) help in reducing the net residual waste that requires transportation to the centralized recycling facility (CRF). The materials recycled at the DRFs help in generating local employment (especially for the informal sector), are recycled materials are proximal to the market.

In Industrial Estates, waste transportation can be minimized by

a. “Designing” the industry mix such that waste from one industry could potentially be raw material to other industries. This strategy is also called as **industrial symbiosis** (IS) and has received fair amount of success
b. Including a **Material Recovery Facility** (MRF) within the industrial estate itself. This MRF helps in containing the waste in the estate itself as a resource and minimizes the transportation of waste outside the industrial estate
c. Promoting **waste exchange** by providing information on the available waste streams to the members of the industrial estate

See Figure 2(a) and 2(b)

Figure 2(a)
Decentralized and Centralized Strategies

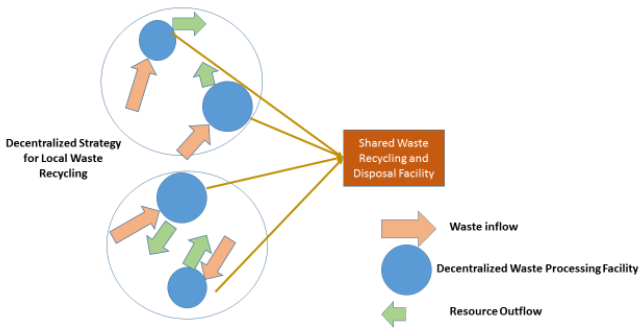
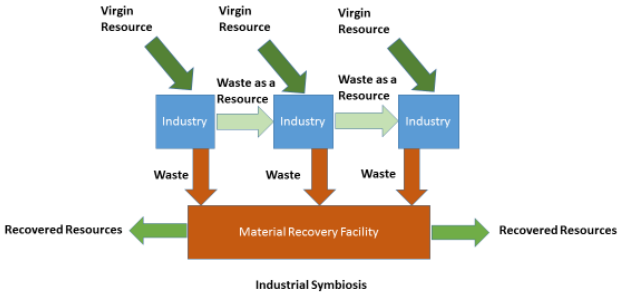


Figure 2(b)
Industrial Symbiosis with MRF



c. Take advantage of diverse waste streams in the waste ecosystem:

It may be worthwhile that joint solutions are found to the diverse waste streams arising from cities and those generated in the industrial estate. Considering these waste streams as a “system” helps in maximizing waste to resource flows. The inert fractions in the MSW often contain higher calorific value and when recycled to the industries it helps in reducing auxiliary fuel consumption in kilns and furnaces. The paper waste in the cities and the packaging waste from the industrial estates when handled together gives an opportunity to make products such as construction boards, street furniture such as benches. Dilute acid streams from industrial operations can be used to make house cleaning products. See Figure 3

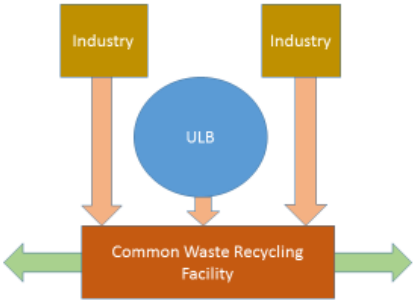


Figure 3 – ULB and Industries Cooperation for Waste Recycling

d. Increase involvement of Private Sector and Cooperatives:

Private sector and cooperatives of waste-pickers play an important role in ensuring efficiency and effectiveness of waste recycling. Private sector brings the investments, technology and professional management while the cooperatives help in ensuring waste supply, waste segregation and sale of segregated waste materials (glass, metal, plastic, paper etc.) and recycled products (e.g. compost).

e. Create an enabling framework:

It is important that an enabling framework is created to promote, grow and sustain waste recycling. A leadership needs to be taken either by local government, national government or by the industry association. This enabling framework should consist of **3Is** such as

a. incentives (on taxes for instance)
b. information sharing (e.g. available waste in the region, waste characteristics, technologies and service providers) and
c. investments (sources of funds)

3.0 Case Studies

Boxes 1 to 3 below present few inspirational case studies that demonstrate application of the strategies described

Box-1 National Industrial Symbiosis Programme, UK
The National Industrial Symbiosis Programme (NISP) was developed in 2005 in the United Kingdom as an '**independent facilitator' to help businesses in various sectors** and of various sizes come together to find uses for unwanted materials, aiming to divert significant waste loads from landfill and produce bottom line benefits for companies through reduced disposal costs and new commercial opportunities, by sharing assets, resources, logistics

and expertise. **NISP is regionally based program, facilitating material exchange over a given geographic area.**

Since the launch of NISP in 2005, the programme has diverted more than 5.2 million tons of industrial waste from landfill, eliminated 357,000 tons of hazardous waste, prevented the use of 7.9 million tons of raw materials and 9.4 million tons of industrial water. Members of NISP were benefited by cost savings of £131 million and generated £151 million through sales

From its inception, NISP was created as a business opportunity programme and the strap-line developed back in 2003 remains as relevant today: "Connecting Industry, Creating Opportunity". NISP developed into a national network open to businesses from all industry sectors that provided a mechanism to share knowledge and ideas on how companies were addressing resource efficiency. Using this cross-sector and disruptive supply chain approach, NISP identified opportunities to reuse underused or undervalued resources, converting previously wasted materials, energy or water into bottom line benefit whilst generating environmental benefits.

In 2007 International Synergies successfully began applying the NISP model internationally, starting in Brazil, China and Mexico. NISP has now been replicated at regional and multi-regional level in 30 countries across five continents, all with support from International Synergies.

Visit http://www.nispnetwork.com/

Box- 2 Inter-municipal Waste Management of Greater Porto LIPOR

Founded in 1982, LIPOR is an **inter-municipal association** for waste management of Greater Porto. LIPOR is responsible for the **integrated waste management** of the municipal waste generated in eight municipalities that include Espinho, Gondomar, Maia, Matosinhos, Porto, Póvoa de Varzim, Valongo and Vila do Conde. LIPOR has developed waste management infrastructure and has organized public awareness campaigns.

LIPOR's jurisdiction covers 648 sq. kms. As per 2013 statistics, LIPOR handles waste from 1 million inhabitants who on average generate 1.38 kg of waste per day amounting to a total of 47 million tons of waste annually. LIPOR focuses on three strategies - Multi-material Recovery, Organic waste recovery and energy recovery from waste.

Through these three strategies, LIPOR aims to recover 99% of the waste and send only 1% of waste for disposal. This is a very ambitious target when compared to only 46% recovery in Portugal. In 2016, LIPOR achieved 82% waste is converted to energy, 9% is waste valorization (composting), 9% recycling and less than 1% disposal.

Some of the projects undertaken by the municipalities are:

- Door-to-door collection from 50,000 households in different categories paper, packaging and glass
- Portugal's first pay-as-you-throw system
- Ecofone, door-to-door collection of recyclables from restaurants and offices

- Restauração 5 Estrelas, door-to-door selective collection of organic material from restaurants and canteens of the region
- Cemitérios, selective collection of flowers and green waste in cemeteries of the region
- Terra-à-Terra, home composting in residences

LIPOR recognizes that Research and Development is an important strategy to foster innovation, creativity and knowledge growth in the organization. Some of the innovative strategies developed are Eco-shop, a loyalty card for citizens who deliver waste to recycling facilities, pay as you throw policy to incentivize reduction in waste generation, a transparent system to monitor LIPOR's performance, waste management at public events like races, concerts. LIPOR aims to adopt the principle of circular economy which views waste as a resource and to maximize process, product and resource efficiency by maximizing their life cycle and re-use of waste products.

Visit http://www.cewep.eu/m_1323

Box -3 Industrial and Urban Symbiosis in the Recycling sector: Case of Eco-Towns in Japan

Ministry of Economy Trade and Industry (METI) and the Ministry of Environment (MoE) launched Japan's Eco-town program jointly to promote regional economic development and environmental sustainability.

The objective of the program was to create resource-recycling socio-economic systems by driving local industries towards recycling and suppressing the generation of waste. To meet this objective, the initiative promoted local innovation and entrepreneurship with focus on **integrated waste management.**

Grants up to 50% were awarded to the Eco-town projects. **A key criterion was to create an industry cluster that aimed at zero emissions using wastes and by-products from one industry as useful resources in another. This initiative necessitated adoption of resource productivity, innovation in environmental technologies and instilled competition in regional markets.**

With the help of Government subsidies, over 62 facilities have been built that either deal with products covered by the various recycling laws like packaging, home appliances, vehicles, construction material or food wastes, process domestic wastes or deal with difficult-to-recycle wastes.

Kitakyushu Eco-town has the most extensive range of recycling and environmental industries in the country. Some of the initiatives undertaken were increasing public awareness to increase collection of raw material (waste), use of PET bottles fiber for clothes manufacture, high-quality material for new equipment production and low-grade material as fuel in cement and steel industries, process innovation to reduce equipment disassembly time, a co-operative for focused vehicle recycling. For this, industrial collaborations and academic research were key in addition to government subsidies to set-up infrastructure.

In another Eco-town, *Kawasaki,* 15 companies formed an association to improve energy efficiency and material recycling. They collaborated to deal with waste, both within and

outside the association, developed individual environmental policies and more stringent environmental targets. Some of the more interesting projects included, use of waste plastics as fuel, as construction material, hard to recycle waste paper to toilet paper, use PET bottles to new PET bottles, use of waste material from cement industries as fuel, recycling of home appliances and fluorescent tubes. Energy and water conservation was also undertaken by the industries and promoted amongst citizens and schools through outreach programs.

Fuelled by government policies, subsidies and private funding, the program launch was an initial success. However, its sustainability is quite challenging and is a good learning experience for Japan and other countries vying to go down this path. Some of the problems incurred were consumer's resistance to paying recycle fee at the end of their product's useful life, quality and supply of raw materials (74% business were concerned about this), difficulty in achieving long-term economic viability, implementation challenges and adverse impact of the collaborative approach on innovation.

Despite the challenges, the Eco-town initiative highlights the importance of:

- Collaboration between government, industries and society
- Need for a policy framework which includes legislation and economic incentives
- Academic or research activities for technological and process innovations in the environmental industry
- Need for focus on energy, water and material conservation as part of integrated waste management
- Engaging community and consumers is critical for success and sustainability of businesses

Visit http://www2.gec.jp/gec/en/Activities/ietc/fy2011/EcoTown/Penang111207-01.pdf

4.0 Reverse Logistics & Refurbishing - Way ahead

Three several areas that seem to be critical as well as exciting for "waste recycling in cooperation" the next few years to come.

These are

a. Reverse logistics based on PRO (Producer Responsibility Organization) and
b. Refurbishing with strategy of building knowledge assets

Reverse Logistics and PRO

Reverse logistics is the process management of backward flows of raw materials, in-process inventory, packaging and finished goods from the point of manufacture, sales or consumption point to a point of recovery or disposal.

Reverse Logistics concept has been in use since the Extended Producer Responsibility (EPR) principle has been introduced as an important waste management strategy in many countries. This principle states that producers of products such as plastic, vehicles, consumer electronics and other products have the responsibility of management of their products at the end of their useful life.

Producer Responsibility Organization (PRO) has been one of the successful cooperative models in this regard with success stories in Switzerland. Taiwan is one of the first Asian countries to implement the concept of EPR in 1988. Taiwan set a fund called recycling management (RMF) for management electronic and electrical waste (WEEE). Producers were obliged to contribute to this fund in the form of a recycling fee to support end of life management of their products. Operated by the Environment Protection Administration (EPA), this is sole PRO in Taiwan to handle end of life products thus eliminating the adverse impact of competition between PROs and does not require producers to physically get involved in the operations. India's new E-Waste regulation is also promoting the PRO concept.

Refurbishing using Reverse Logistics

Refurbishing is an important segment of waste recycling where a PRO links with the producers and develops a secondary market to "extend life cycle" of the defective goods. Here, reverse logistics plays an important role.

Apart from the advantage of building secondary market and "delaying" consumption of virgin resources, refurbishing provides an insight to the producers on the reason of deflects. The PRO engaged builds these "knowledge assets" based on experience gained in refurbishing. These knowledge assets when "sold" to the producers, a better product design and packaging happens what often leads to innovations. Box -4 below illustrates a success story on refurbishing in India.

Box-4 Refurbishing – skills – innovation: Case Study - GreenDust in India– 'A hospital for gadgets'

Founded in 2008, GreenDust is a reverse logistics company in the business of collecting and refurbishing electronics that are returned due to damage or defect by customers to their manufacturers or unused electronics are collecting dust in manufacturer's warehouses due to various reasons. GreenDust had the first mover advantage in the Indian electronics industry since few companies had heard of or practiced reverse logistics. With a return rate of 4-6% in India, electronic products worth $12-$15 billion like IT, home appliances, mobile, consumer electronics is the refurbishing market.

GreenDust conducted a study that helped companies realize that they were losing money by not focusing on reverse logistics and that the cost to get back a returned product was higher than its original value. All the products that GreenDust collects and refurbishes undergo a 50-point quality check before putting it up again for sale with a GreenDust factory second certification.

GreenDust has partnered with brands like Apple, Toshiba, LG, Samsung, Lenovo, Haier, Dell, Philips, Whirlpool and retailers like Croma, Amazon.com, Homehop18 to refurbish rejected or damaged electronics and re-sell them at a 30-50% lower cost than the market price.

One of the key services that GreenDust provides its client are the potential causes for product failure or defects. Clients can use this information as knowledge capital to improve their products, its design thus ensuring lower return rate and diversion from the waste and recycling streams, which are resource intensive.

GreenDust's main customer base is Tier II and Tier III cities where people are vying for brands. In three years, the company set-up 200 stores and 14 warehouses and repair units across the country and boasts of a customer base of 250 million in India. GreenDust is looking to other international markets like Thailand, Bangladesh, Philippines, Sri Lanka and replicate their business model.

5.0 Concluding remarks

Waste recycling is a multi-stakeholder driven activity that must operate on a cooperative basis. To achieve this, ULBs and Industries must work together. There are several success stories to tell but we need their distillation and communication to inspire others across the world. Emergence of service providers like PROs in the cooperative recycling domain is very important. Facilitation by the Government by providing concessions, incentives and catalytic funds will also play a key role.