

The Business Case for Sustainable Urban Practices, 3Rs

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Choudhury R.C. Mohanty
Environment Programme Coordinator, UNCRD

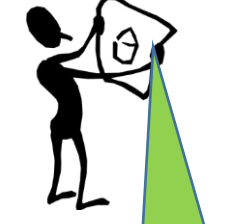
United Nations Centre for Regional Development



R & D/Engineering



Energy Efficiency



Energy service companies (energy audit, energy efficient system design /equipment manufacturing, specialty engg. services, etc.)

Nano tech market:
more than US\$1 trillion



Green Chemistry & Nano Technology

- cosmetics, baby lotion, computer chips, paints, medical equipments, etc.

Water Efficiency

- Water saving devices
- distribution efficiency
- Zero leakage,
- Waste water treatment,
- Rain water harvesting, etc.



Waste-Water-reuse for urban agriculture practices

- Water purification technologies, waste water treatment (ecological engineering: constructed wetlands for pre-treatment of urban run off water & river water)
- Distributed sewage treatment systems, etc.



Green Buildings

- Engineering, design & construction materials



Sustainable Transportation

- ITS, IFS, BRT, Railways, walkways & bicycle ways
- Fuel efficiency measures
- Vehicle I/M
- Alternative fuels, PPP for urban transport, etc.



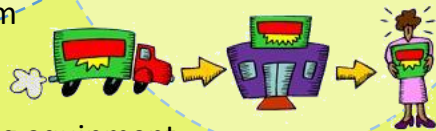
Bio-economy (high value processing/conversion of biomass)

- Bio-products
- Bio-energy
- Bio-Engineering
- Landscape trimming, etc.



Sustainable Farming Support Companies

- Efficient water & nutrient management system
- Water & nutrient delivery system
- Biomass energy company
- Energy efficient cultivating, harvesting, hauling equipment
- Compost industry (e.g. Dhaka Community-based Composting System)
- Roof top agriculture (urban greening) for food security



Synthetic fibers/oil, bioplastics, materials from fiber by-products, composts, animal feeds, bio-chemical

Resource Recovery/3R

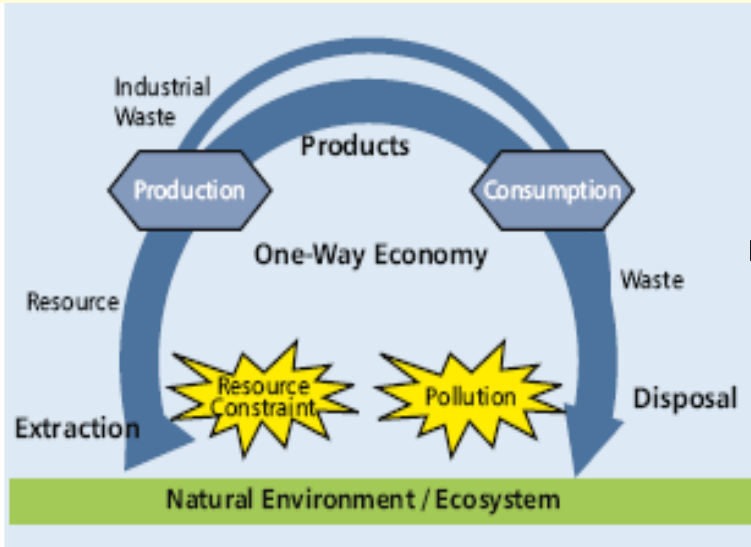


CH4 & fertilizer from animal manure /sewage sludge with anaerobic or aerobic digesters, refused-derived fuel (RDF), etc.

Urban Services and Supplies

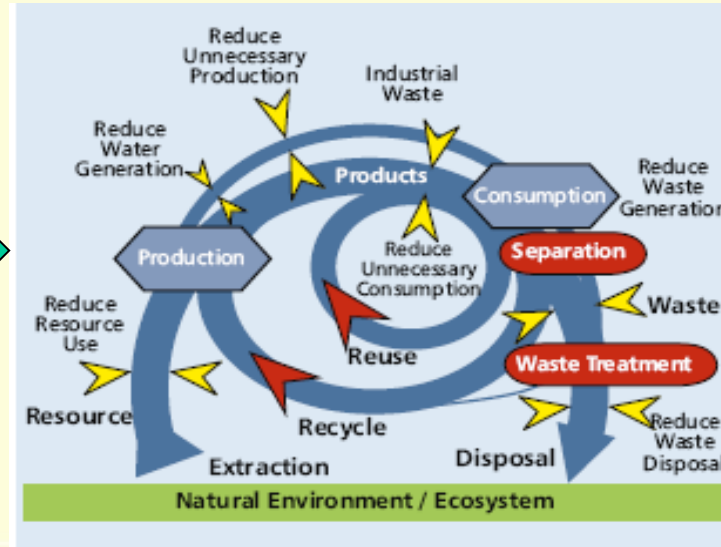
Nature of economy is key driver for creating green businesses for sustainable urban practices

1. One-way/conventional Economy



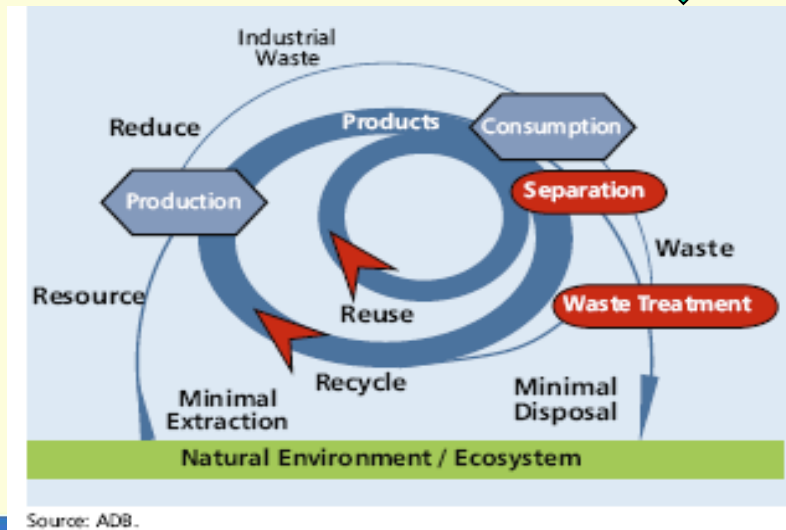
Source: ADB.

2. More resource efficient economy



Source: ADB.

3. Closed Loop Economy



Source: ADB.

1. **one way economy** -> a little effort is made to reduce the amount of materials consumed in production and hence the wastes are produced. Also little effort is made to reuse or recycle those wastes which mainly go for landfill.
2. **greater resource efficiency** -> by reducing consumption and waste of materials, and by reusing and recycling waste/byproducts minimize (per unit of product or services) – quantity of input raw material/energy /water as well as pollution /emission/environmental impact of the residual materials flow that flow to disposal sites.
3. **closed-loop economy** -> nearly all waste/outputs either become inputs to other manufacturing processes or are returned to natural systems as benign emissions rather than as pollutants, e.g, a closed-cycle processing plant takes in freshwater and does not discharge any liquid effluents. Rather, the water is constantly recycled and possibly utilized in the final product itself.

A Major Driver => Macro-Economic/Development Policies Integrating Resource Efficiency and 3Rs

- **Japan**: Fundamental Law for Establishing a Sound Material Cycle Society (2001); New Growth Strategy (2010) which places green innovations as top of seven strategic areas; Finance initiatives to build a Low Carbon Society (providing grants, investments, financing, interest subsidies for – (i) promotion of Green Buildings, (ii) development of Low Carbon Cities, (iii) bilateral offset Credit Mechanism, and (iv) enhancement, commercialization, and R&D of Low Carbon Technologies;
- **Republic of Korea**: National Strategy and Five Year Plan for Low Carbon and Green growth (2008); Framework Act and Presidential Decree on Low Carbon, Green Growth; Green New Deal policy – 2% of GDP investments in Green Growth (2009); Resource Recirculation Policy;
- **PR China**: Circular Economic Law (2009) led by NDRC-China; Long Term Renewable Energy Development Plan (2007); Chinese Circular Economic Law offers a long term plan for transformation that seeks to integrate economic, environmental, and social strategies to achieve high resource efficiency as the way of sustaining improvement in quality of life within natural and economic constraints; circular economy is now a trillion dollar opportunity
- **India**: National Solar Mission; National Mission on Enhanced Energy Efficiency;
- **Malaysia**: National Green Technology Policy (2009); Green Building Index (2009); National Renewable Energy Policy and Action Plan (2010);
- **Singapore**: Green Mark Incentive Scheme for buildings (2005); Water Efficiency Fund (2008);
- **Thailand**: Alternative Energy Development Plan and Target (2008); Thailand Climate Change Master Plan (2012–2050), etc.
- **EU**: Waste Framework Directive (2008); waste management is a public health priority as well as an economic industry, e.g., in Germany



Partnerships are key to expand sustainable urban businesses ...

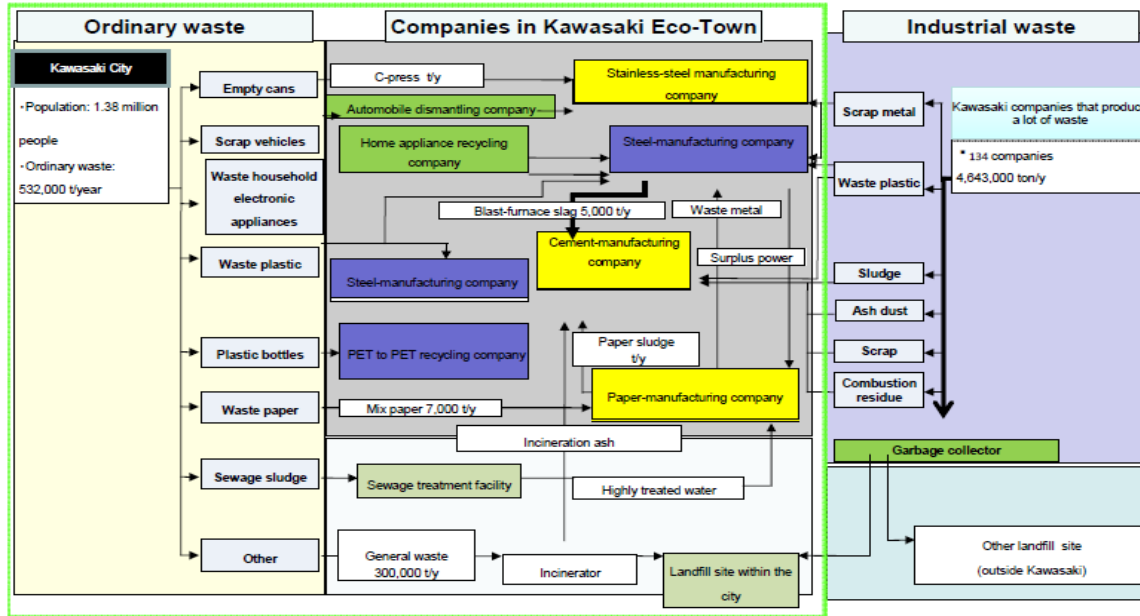
- **Partnerships** offer alternatives in which governments and private companies assume co-responsibility and co-ownership for the delivery of solid waste management services. Waste disposal is expensive – financially and in lost resources (substantial inputs of labour, material, energy, land resources for land filling, etc.)
- **Partnerships** combine the advantages of the private sector (dynamism, access to financial resources and latest technologies, managerial efficiency, and entrepreneurial spirit, etc.) with social concerns and responsibility of the public sector (public health and better life, environmental awareness, local knowledge and job creation, etc.).
- **Partnerships** (PPP) are indispensable for creating and financing adaptation measures towards resilient cities which in turn are more attractive for private investments.
- **Partnerships** provide win-win solutions both for the public utilities and private sector—if duly supported by appropriate policy frameworks. Such partnerships could lead to savings in municipal budgets where waste management usually consumes a large portion. The private sector, on the other hand, may use this opportunity to convert waste into environmentally friendly products and energy that could also serve as income generating opportunities.



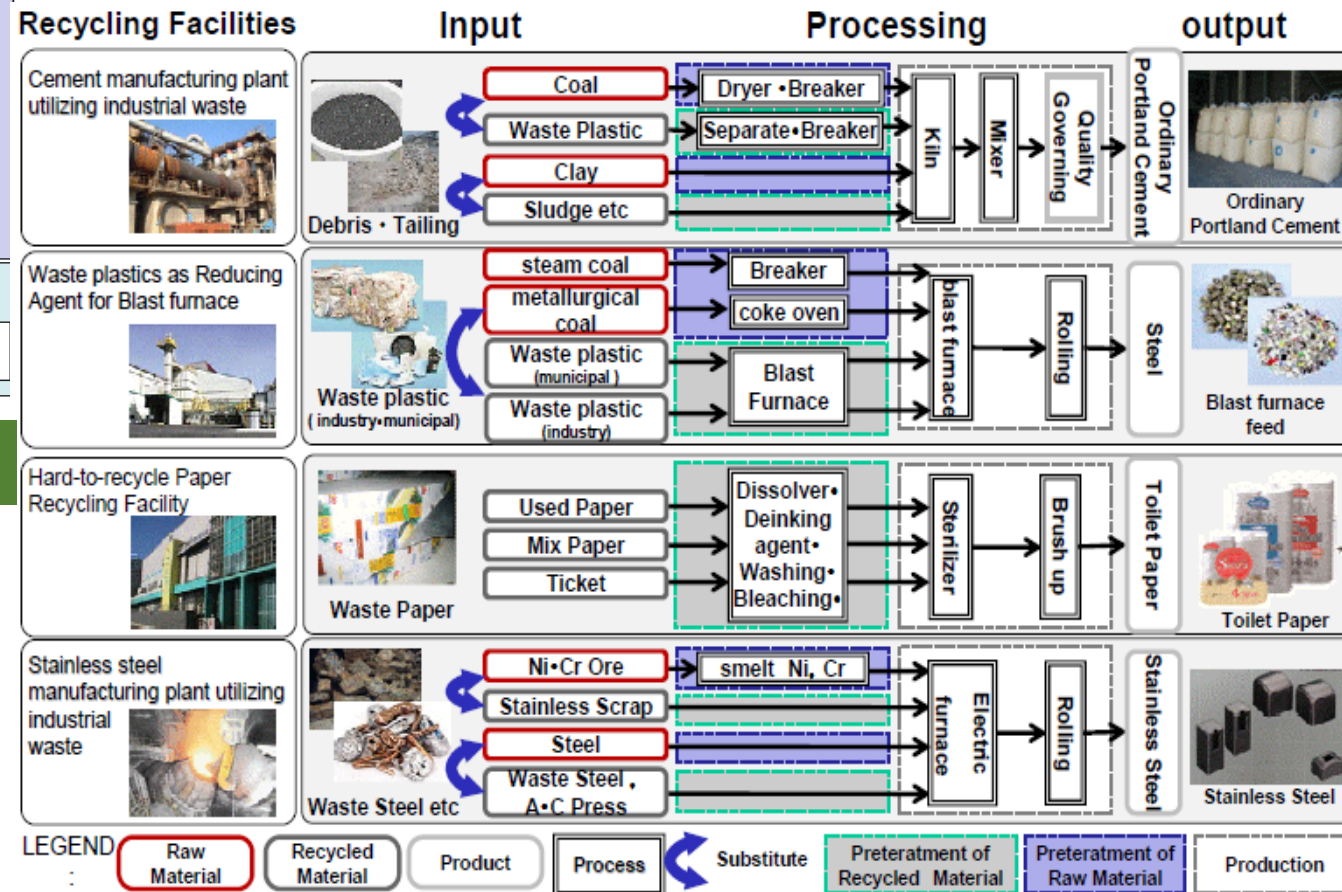
e.g., Shifting the roles of municipalities from being a 'service provider' to 'facilitator of service', by focusing its activity on planning and management, while a private company takes up the actual day-to-day operation.



Kawasaki Eco-Town where economy and environment are integrated to create sustainable business opportunities...



Formation of a Regional Network for Resource Recycling

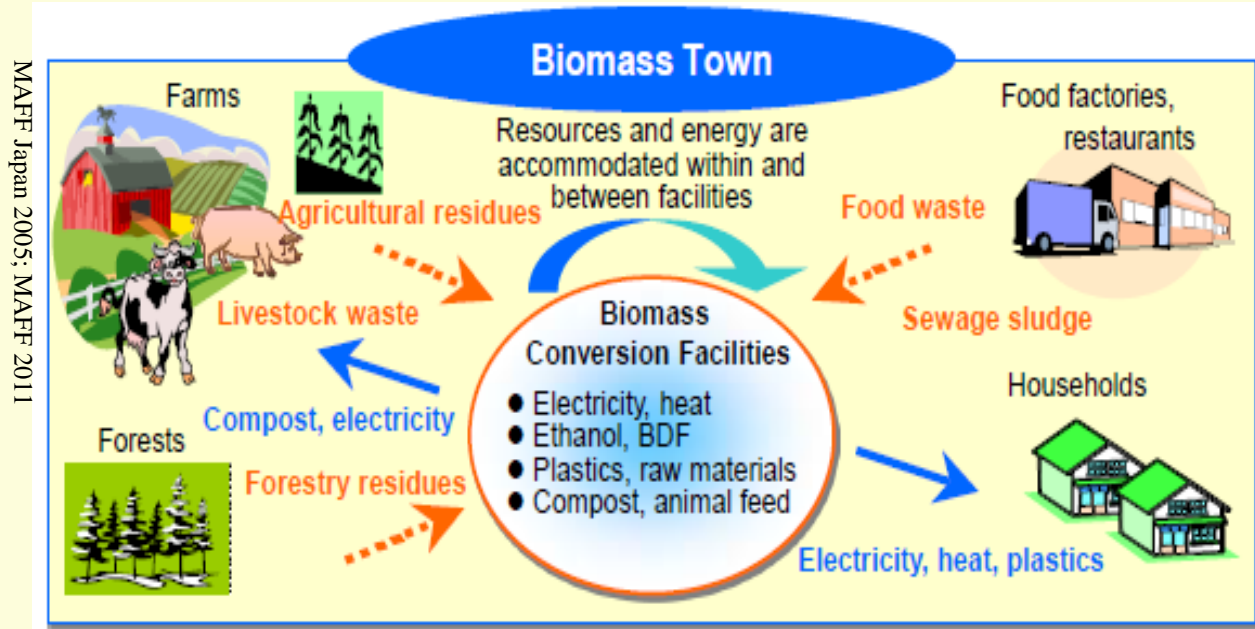


Key Features of Kawasaki Eco-Town

1. revitalization through environmental technologies accumulated in traditional industries
2. Industrial symbiosis through a regional network for resource reuse/recycling
3. local private companies take their own initiative in environmentally sound business operations and contribute to preventing local and global environmental pollution.
4. strong collaboration between R&D industries and private companies on environmental technologies
5. international cooperation in technology transfer

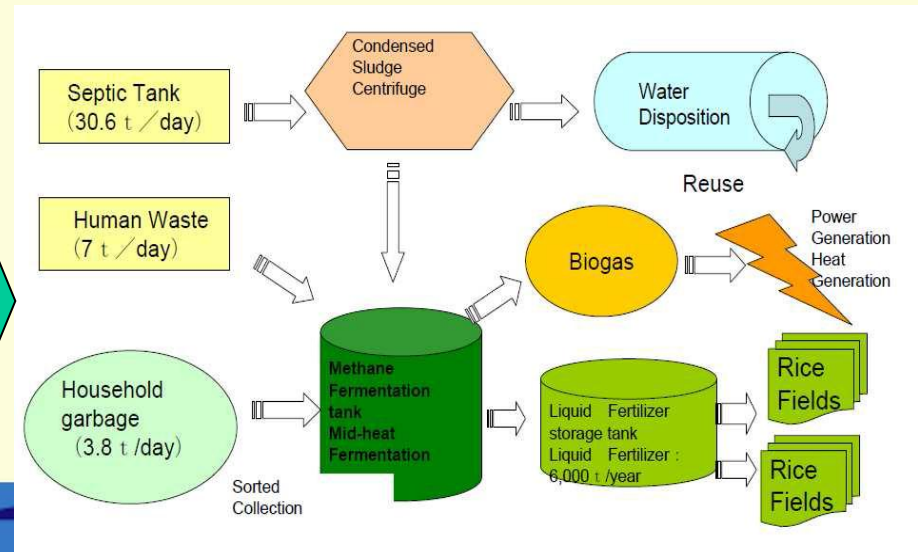
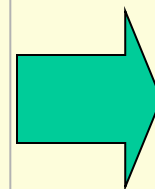
Quantified material accounting for Symbiosis in Kawasaki

A complete inbuilt zero waste system - Biomass Town Concept, Oki Town, Japan



Case study: Oki town / Fukuoka Pref. (17,500 inhabitants):

- Methane fermentation from household garbage.
- 166,209 kWh for self utilization
- Production liquid fertilizer: 6000 tons per year
- Fertilizing 100ha of paddy field
- Reduction of 44% in house hold waste generation
- Reduction of 20 million yen in incineration cost (Approx. 205,000 US\$) per year.
- generating new green jobs



Urban agriculture in Singapore ~ as buy local movement grows social entrepreneurs get into urban agri-business

- Shrinking agricultural lands: 10% in 1960s to < 1% currently (Pao, 2014).
- Self-sufficiency: food security with reduced carbon footprint (Astee & Kishnani, 2010).
- Vertical agriculture: rooftop gardens and farms (Pao, 2014).
- 2.5-acre 'Sky Green' vertical farm: 1,000 ton/year, five-folds than conventional farming and 1% of the nation's leafy demand (Seneviratne, 2012).
- From passive food importer to active regional food supplier: (Kassim, 2011)
 - ① R&D advantages: implementing intellectual property and pro-enterprise tax system.
 - ② Establish as international agribusiness hub for food security: agri-MNC headquarters.
 - ③ Urban food resilience: \$20 million Govt. fund to local farmers for yield improvement



The Sky Green vertical farm

Energy efficient buildings in Singapore driving green business

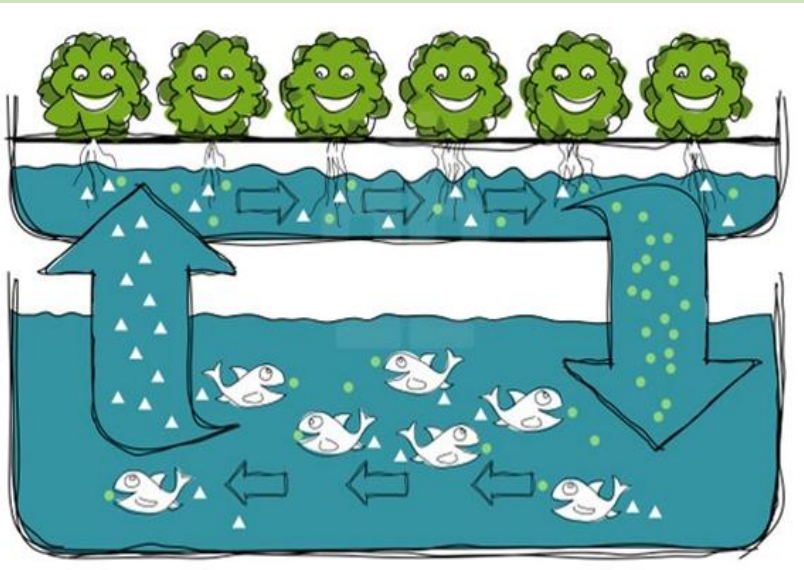
- Electricity demand from buildings in Singapore: 16% of the nation's energy consumption (Lee & Rajagopalan, 2008).
- Buildings with rooftop gardens: temperature difference up to 18°C; resulting 1-15% save in annual energy consumption (Wong et al., 2007) .
- Singapore's Energy Smart Labelling system: (Lee & Rajagopalan, 2008)
 - ① Energy Smart Office Label: only for nationally top 25% energy-efficient buildings.
 - ② Prompts innovative environmental design in the building industry.
 - ③ Enhance energy efficiency and reduce carbon emission.
 - ④ Stabilize financial costs of infrastructure construction.
 - ⑤ Apply to other building types and business activities: hotel and hospitals.
 - ⑥ Contribute to generation of green business and green job opportunities



Rooftop park on the top of Marina Bay Sands

Bioengineering adding urban food sufficiency in London

- Aquaponics/bioengineering farming system: GrowUp Box (Shemkus, 2014)
- Commercial potentials: (GrowUp Urban Farms Ltd., 2014).
 - ① Boost local economies: niche market with high profits.
 - ② Enhance self-sufficiency in cities and reduce reliance on rural areas.
 - ③ Efficient use of narrow urban space and solar energy during summer time.



Aquaponics system in GrowUp Box

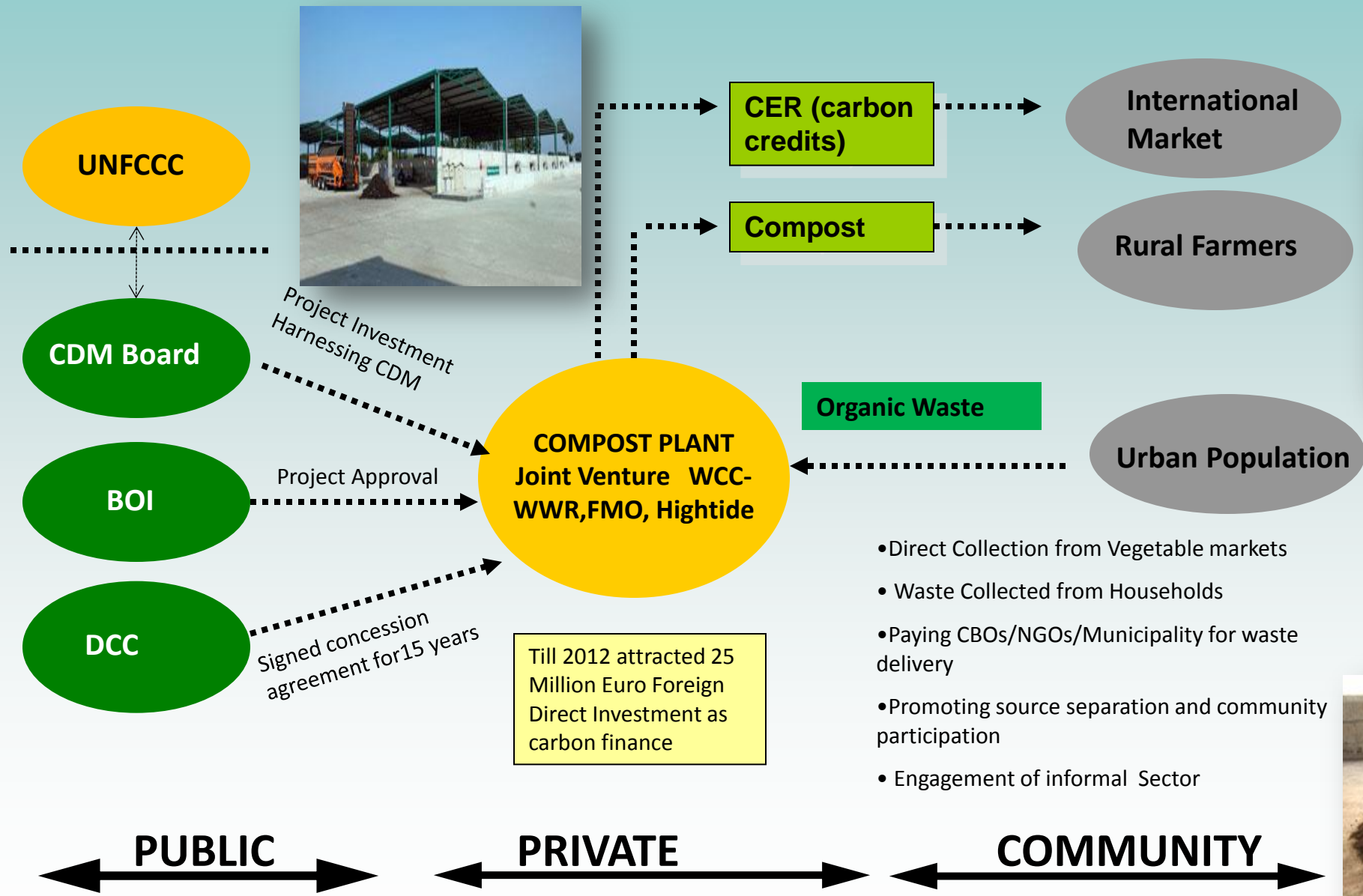


Giant pak choi for local restaurant



Efficient use of urban space

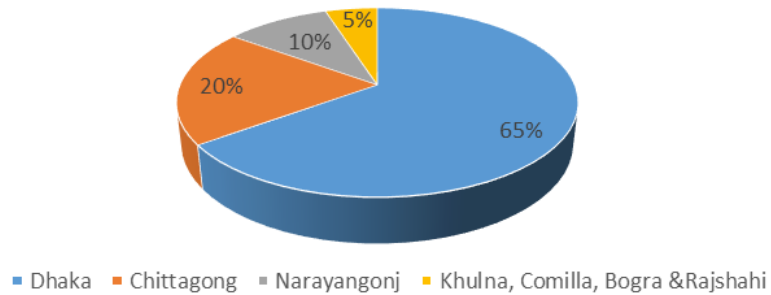
PPP Model for Centralized Community Based Composting in Dhaka



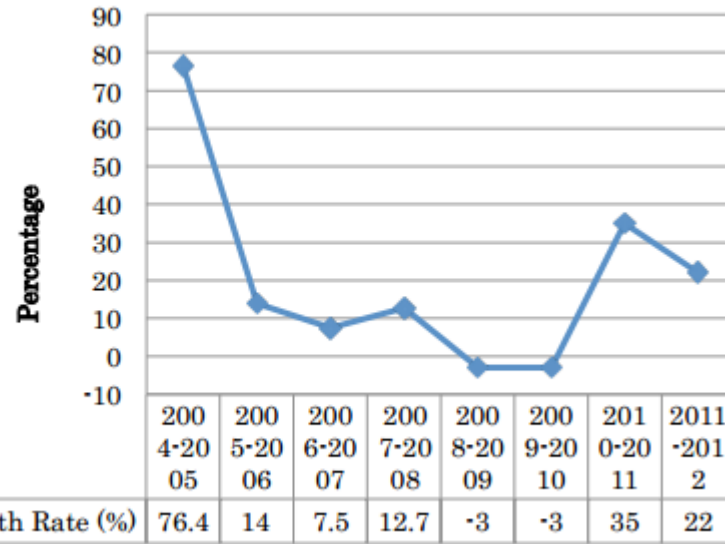
Source: Presented by Waste Concern at 2012 IPLA Global Forum, 5-6 Sep 2012, Seoul, Rep. of Korea

Business opportunity: Recycling of plastic waste in Bangladesh

Plastic Industries in Bangladesh



Plastic waste is ranked **12th** in terms of **export oriented sectors** of the country



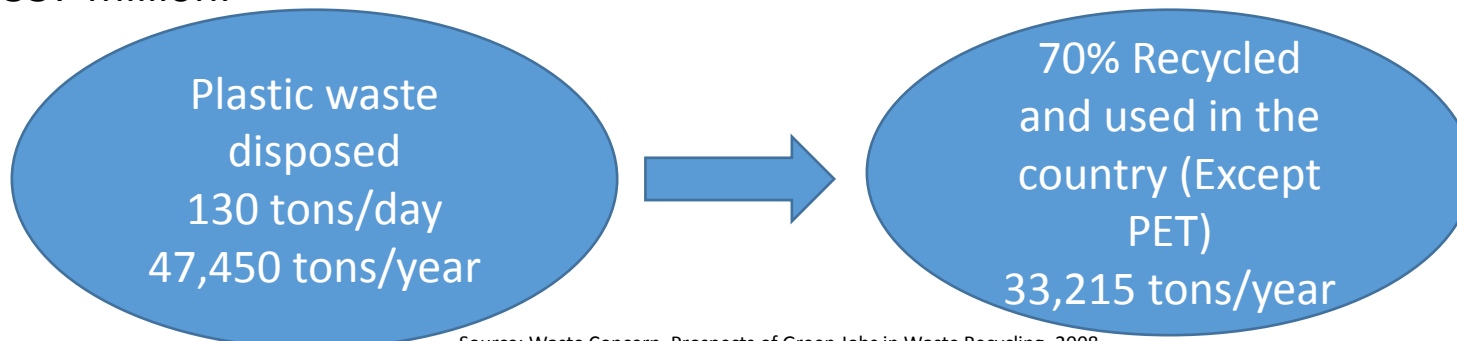
Growth rate of plastic export



Plastic waste recycling follows direct economic benefit

- (a) **Less landfilling** requirement
- (b) **Large recycling industry jobs and economic output**
- (c) **Direct savings** of foreign currency

❖ Per capita consumption of plastics in Bangladesh is 5 kg per year. The plastic sector constitutes **1.0 of GDP** and provides **employment for half a million people**. Total export earning for both direct and deem exports is about US \$ 337 million.



- ❑ **Generating 21,000 jobs**
- ❑ **Saving expenditure** of Tk3.08 crore by avoiding plastic waste
- ❑ **Saving Foreign currency** of US \$51 million/ year by avoiding import of virgin plastic.

Source: Waste Concern, Prospects of Green Jobs in Waste Recycling, 2008.

Business opportunity: Recycling of Lead acid battery in Bangladesh

- ❖ Recycling of lead acid batteries are taking place in an **environmental sound manner** to adopt public policy for **economically efficient** and also keeping in view the **health hazards arising from exposure to lead**.
- ❖ Lead acid battery has more than **ten parts** such as, plates, separator, hard rubber container, lead, bitumen, battery cap, cork, connectors, electrolyte, electrical accumulator, negative plate or anode positive plate or cathode, sealant and chemical compound: CFCs, carbon tetrachloride, halons, methyl chloroform, lead, Sulphuric acid.
- ❖ Approximately, **3,420 tons of lead are recovered per year** from ULABs in Bangladesh. This allows to meet **60%** of the total lead requirement of the country **from secondary lead**.

In recycling process, the price of used battery is increasing by about 100% in each stage of transfer.

Small buyers → Broker → Separator → Re-builder/Smelter

❑ **Recovered Lead:** 6000 ton/Year

❑ **Savings:** 4.73 million US\$/year

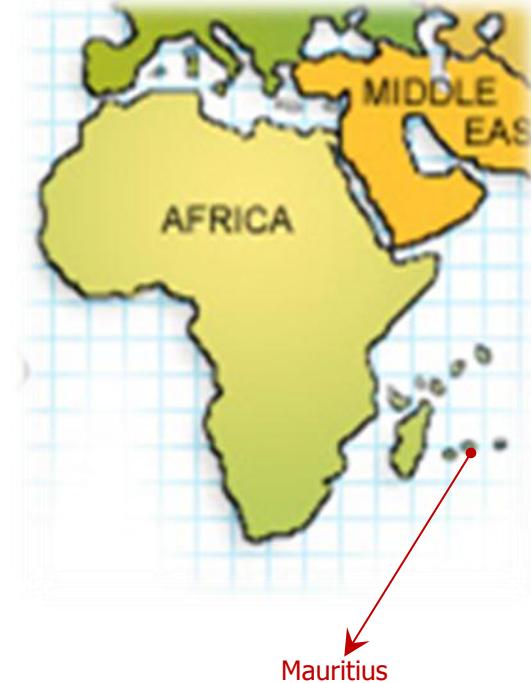
(avoiding lead import using foreign currency (60% recycling rate at present)

❑ **Jobs Created:** 6000 new jobs



PET Bottle Recovery and Recycling Business in Mauritius involving NGOs, Local Residents and Schools

- Mauritius is an ecologically sensitive Small Island Developing State (SIDS). Growth of tourism establishments and inflow of tourists, generation of solid waste has been rapidly growing in the island.
- With the voluntary take back system in place, the collection rate was low – only 4% in 2005
- **GOVERNMENT:** Enacted Environment Protection Regulation that established “deposit-refund system”.
- **COMPANIES AND BUSINESS SECTOR:** In response to Environment Protection Regulation, 4 big producers of soft drinks in Mauritius, Phoenix Camp Mineral, Quality Beverages Ltd and Compagnie Industrielle des Pailles, regrouped themselves into the Mauritius Bottlers’ Association, which was contracted for collection, processing and recycling of PET bottles to a private company called Polypet Recyclers.
- **NGOs:** Bottlers’ Association promotes community initiatives with NGOs to create an opportunity for local residents to get additional revenue obtained from reselling PET waste
- **LOCAL RESIDENTS:** Even housewives of low income families organized themselves and went from house to house to nearby communities to collect used PET bottles, since this gave them a fair source of income in return.
- **SCHOOLS:** Initiative was supported by the Ministry of Environment which further promoted separation of waste in all primary and secondary schools. Four different bins were distributed and the school community was encouraged to separate their wastes into plastic bottles, paper, biodegradable waste and other wastes. The schools entered into an agreement with the private company for collection of used PET bottles
- **MAJOR IMPACTS:** Up to 34% of the 3,000 metric tonnes of PET used on the island (or about 80 million bottles) are being successfully recycled
- The initiative created about 100 indirect jobs on the collection side and also hired more than 30 workers directly in the recycling company.



Waste-Freshwater Nexus in India – offer many business opportunities in waste sector for water security in India



- ❑ The Energy and Resources Institute in New Delhi has estimated that **by 2047**, waste generation in India's cities will increase **five-fold to touch 260 million tones per year**.
- ❑ The CSE survey, released earlier this year, shows that **70-80 percent** of India's wastewater was ending up in its rivers and lakes. **"We are drowning in our excreta,"** Sunita Narain, Director of CSE.



3R Developments in Asia: Informal Resource recovery and recycling



- ❑ Nearly **80 percent** of the river's pollution is the result of raw sewage. The river receives **more than three billion liters of waste per day**.
- ❑ **Highly contaminated** leachate seeps untreated into groundwater, a source of drinking water....

Clean India Mission (Swachh Bharat Abhiyaan) and 100-smart cities programme by Prime Minister Narendra Modi offer tremendous business opportunities in waste sector for water security of India

Need for change and attitudes to view “Waste” as “Resource”

- Link between “waste” and “resource” is not well understood /waste is traditionally thought of having no value.
- Too much emphasis on “downstream” waste management limiting many business opportunities.
- Limited efforts on “upstream” resource management and waste reduction aspects

Business opportunities in India and South Asia taking benefit of huge informal sector

As the appetite for consumer goods rises in India, so too does the amount of packaging waste, which gives its **nascent recycling industry** massive scope for growth

- ❑ 410 billion USD (UNEP 2008)*Up to 15 million people, with an economic Impact of 100s of millions
- ❑ Informal Waste Collectors (door-to-door), rag pickers who collect waste from streets, scavengers who pick waste from dumpsites and informal middlemen such as recycling dealers, brokers, wholesalers
- ❑ Typically 1% of the urban population in developing countries involved in informal scavenging

Major opportunity for win-win solutions through partnership with massive informal sector

- Improve resource recovery and recycling rates
- Move towards a zero waste society
- Improve livelihoods of urban poor
- Improve working conditions, health, safety of informal workers
- Save and divert municipality money to other useful areas
- Eliminate illegal engagement of children

*Value of informal market not estimated <http://www.theguardian.com/avery-dennison-partner-zone/2014/dec/09/india-consumption-environment-consumers-waste-recycling>

Source: Modak P. (2011). Synergizing Resource Efficiency with Informal Sector towards Sustainable Waste Management, Building Partnerships for Moving Towards Zero Waste, A Side Event for CSD19 held on 12 May 2011, Tokyo



Country	No. of informal waste collectors
China	10 million
India	Over 1 million
Brazil	Half a million



Business opportunities in Brazil ~ Green Building

- In 2014, Brazil ranked 4th, outside of the US, for number of LEED-certified projects (mostly Rio de Janeiro and São Paulo). Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings, homes and neighborhoods, developed by the U.S. Green Building Council (USGBC).
- Number of LEED projects multiplied from 1 (2007) to 829 (2014).
- Only 8.3% of the country's buildings are green building.
- Increasingly national production of the materials used in the constructions.
- Additional costs over traditional projects have reduced from 30% to 5,1%.



• “Even though the sustainable construction sector grows at an annual average of 30% in Brazil, it only represents 4% of country's construction business. There's still a lot of space to grow.” (Casado, Sustentech).

Advanced business opportunities in Green Chemistry (waste prevention/treatment/reduce)



Green chemistry, also called **sustainable chemistry**, is a philosophy of **chemical research and engineering** that encourages the design of products and processes that **minimize the use and generation of hazardous substances** in the manufacturing process.

Aiming

- ❑ Making chemical products that do not harm either our health or the environment,
- ❑ Using industrial processes that reduce or eliminate hazardous chemicals, and
- ❑ Designing more efficient processes that minimize the production of waste materials and decreases the amount of non-renewable energy used.

❖ Prevent waste rather than treating it

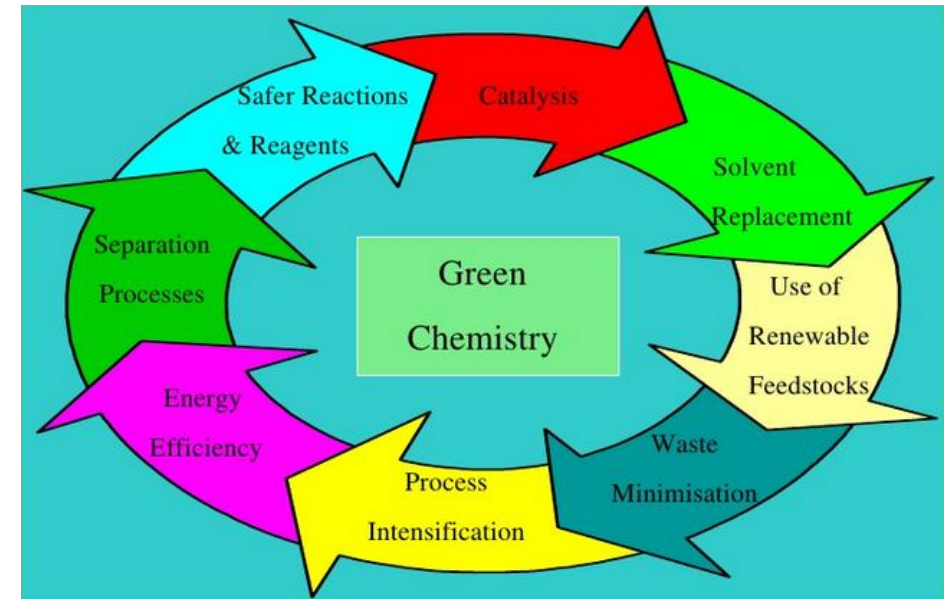
❖ Use renewable source of energy

Reducing lead pollution

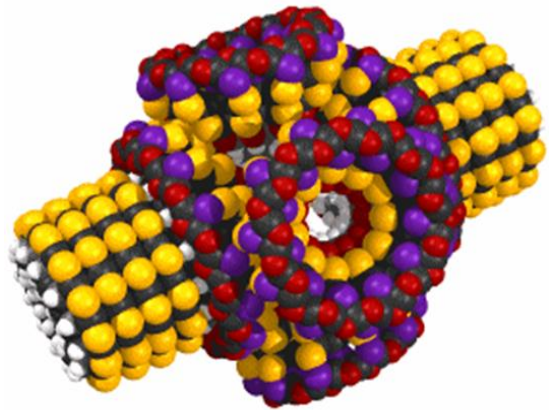
- Replacing lead in paint with safe alternatives, and
- Replacing tetraethyl lead with less toxic additives (e.g., “lead-free” gasoline).

Chemical foams to fight fires

- A new foam called **Pyrocol FEF** has now been invented to put out fires effectively without producing the toxic substances found in other fire-fighting materials.



Advanced business opportunities in Nanotechnology (waste prevention/treatment/3Rs)



Macroscopic
Microscopic
NANO
Molecular



Nanotechnology is the **second coming of the industrial revolution** that seizes the initiative of **technology capital** in the world. One of the main obstacles to achieving the goal will be **to control, reduce, and ultimately eliminate environmental and environmental related problems** associated with this technology; the success or failure of this new use may well **depend on the ability to effectively and efficiently address these environmental issues.**

Nano-remediation has been most widely used for groundwater treatment, with additional extensive research in wastewater treatment.

Nanotechnology – the promise

(nano market growth to 1 trillion € over the next 10 years)

Fields of application potential:

- **Membrane filtration** (drinking and wastewater)
- **Anti-microbial nanoparticles** for disinfection and microbial control
- **Removal of arsenic and heavy metals**
- **Nano sensors** for water quality monitoring

Nanomaterials Waste Streams

- Pure Nanomaterials Manufactured (e.g., Carbon Nanotubes)
- Nano By-products with organic or inorganic
- Liquid Suspensions Containing Nanomaterials
- Items Contaminated with Nanomaterials (e.g., Wipes/PPE)
- Solid matrixes with Nanomaterials

Nanomaterials during disposal/recycling

- Intrinsic Toxicity (for example Arsenic or Cadmium)
- Recyclability Properties such as thermal, mechanical, chemical properties of nano composites.

Source: Musee, N. Nanowastes and the environment: Potential new waste management paradigm. Environment International, 37: 112-128, 2011.

Source: Theron, J.; J. A. Walker; T. E. Cloete (2008-01-01). "Nanotechnology and Water Treatment: Applications and Emerging Opportunities". Critical Reviews in Microbiology 34 (1): 43-69. doi:10.1080/10408410701710442. ISSN 1040-841X. Retrieved 2014-07-29

Source: Dr. Lou Theodore, July 2006 Symposium on Nanotechnology and the Environment: Waste Management of Nanomaterials: Biography

Conclusions & Recommendations

- 1. Businesses and cities are closely tied to each other for their own success and survival. Uncertain impacts of climate change, increasing vulnerabilities in urban environment, increasing frequency and magnitude of natural disasters might hamper the businesses opportunities of cities. A city which is not resilient might reduce investment willingness from the private sector, and further pose hindrance on urban finance and development, such as maintaining tax base and building urban infrastructure**
- 2. Sustainable urban practices can lead to highly profitable business opportunities if local governments or urban local bodies create enabling policies, institutions, partnerships and investment regime for expanding market of environmental goods (equipment, technologies, eco-products, green energy, etc.) and services.**
- 3. 3R as an economic industry offers competitive solutions to many urban environmental issues provided 3Rs and resource efficiency are integrated into the macro-economic development policies (e.g., circular economic policy of China).**
- 4. Eco-town, eco-industrial parks and industrial symbiosis could significantly contribute to regional development as has been demonstrated by Japanese cities like Kawasaki, Kitakyushu, and others.**
- 5. The city government and urban local bodies should recognize and publicize the excellent performance of private companies that carry out environmentally sound operations.**
- 6. R&D-oriented industrial structure and environmental efforts by companies are critical to foster sustainable urban businesses.**
- 7. Consumers' awareness (green consumerism) is a critical driver to sustainable urban practices and related green business opportunities.**

