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SWITCH-ASIA BRIEFING

Photo: Silvia Sartori, SWITCH-Asia Network Facility

Waste Management and the Circular Economy in Asia

Moving municipal waste management up the 'waste hierarchy' […] is a key way of extracting more value from resources while reducing the pressures on the environment and creating jobs. However, while progress has been made, resource use is still largely unsustainable and inefficient, and waste is not yet properly managed.*

On 13 July 2016, the SWITCH-Asia Network Facility held a conference in Siem Reap, Cambodia, on the theme "Waste management and the circular economy in Asia" as part of the 12th Asia Pacific Roundtable on Sustainable Consumption and Production (APRSCP). The SWITCH-Asia event brought related projects together with industry experts and policy-makers to exchange experiences from the ground, address common challenges, identify solutions and ways forward in the spirit of broader SCP promotion in Asia.

With contributions from experts and projects present at the event, this paper intends to review and illustrate more in-depth some of the main points that were debated during the conference.

* www.eea.europa.eu/soer-2015/countries-comparison/waste#note1

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IDENTIFYING INNOVATIVE APPROACHES AND APPROPRIATE TECHNOLOGY APPLICATION FOR WASTE MANAGEMENT IN ASIA

By Agamuthu, P. and Fauziah S.H., University of Malaya, Malaysia

Asian nations generate about 2.5 billion tonnes per year of municipal solid waste (MSW) and this is expected to increase twofold by 2050 (World Bank, 2012), as a result of an increase in population, urban migration and better living standards. However, this reflects a loss in valuable material resources. Furthermore, 50% of this MSW is organic and could be well utilised via biological treatments to produce compost or biogas. The issues of concern are as follows:

1. increased waste generation of about 2-3% per annum (from a 2012 baseline);
2. complex waste composition including 1-2% hazardous materials;
3. ineffective mechanisms to tackle this problem;
4. lack of public participation; and
5. more importantly, lack of proper policy framework in many countries.

Most developing nations in the world still dispose of waste in landfill or dumpsites. Currently, only about 10% of disposal sites qualify as sanitary landfills. As a consequence, severe pollution of the surface water and soil is caused and global warming occurs due to methane emissions from anaerobic disposal. This causes health issues for the informal sector, where livelihoods often depend substantially on waste picking, as is the case in the Philippines, Indonesia, India and Cambodia.

Landfill is still the most commonly used system in Asia by both developed and developing nations. Value added options are now available to landfill managers thanks to technological developments, such as landfill bioreactors for biogas harvesting, sites for solar energy trapping from closed landfills, and recreational parks established on top of former landfill sites. Bioreactor landfills are seen in Korea and Hong Kong, while solar energy harvesting is seen in Malaysia. In Singapore, the Semakau island, previously used as an ash disposal facility, has been redeveloped into a tourist destination, while landfill sites converted to parks are seen in Japan and China. The management of waste is affected by institutional capacity and education level of human resources. Lack of sectoral regulations further reduces efficient waste recycling in many countries. Nevertheless, the need for separation at the source of waste generation is crucial in order to be able to retrieve the recyclables from the waste stream.


Photo: Silvia Sartori, SWITCH-Asia Network Facility

Technologies that could be of relevance to the Asian waste challenge include biological treatment (composting and anaerobic digestion) and biogasification. For example, at the Air Hitam landfill site in Malaysia, a 2MW electricity generation facility has been installed using landfill gas. Incinerator or pyrolysis are other viable options for some countries to generate energy. Waste to energy is the current strategy in several Asian countries, including Japan, Korea, Taiwan, and Singapore.

In any case, applying the 3R approach – reduce, recycle and reuse – is a priority in order to reduce the waste that needs to be treated or disposed of.

Drivers in waste management in Asia

There is much debate over the factors, issues and figures to be considered when formulating solid waste management policies or strategies for different locations. It has been common practice to adopt existing policies from different countries and integrate them into an overarching national policy. It is our opinion that this may not be a sustainable practice, especially considering solid waste management, because many unique, local drivers determine a policy's success: waste composition, local awareness, cultural paradigms, economic strengths, enforcement capability and the capacity for local research and technology advancement. Human, economic, institutional and environmental local drivers should be taken into consideration when devising strategies from the bottom-up. Each identified driver or barrier must be interpreted in a local perspective, with local customs and data. These drivers/barriers should become the basis for evidence-based policy making, which should be the ultimate goal of waste management planners.

Table 1: Waste generation in 2009, 2011 and waste projection for 2025 in selected countries in the Asia-Pacific region.
Adapted from: World Bank, 2012; Agamuthu et al, 2009

Country	Waste Generation Rate *(kg/cap/day)*		
	2009	2011	2025*
Brunei	0.66	0.87	1.30
Cambodia	0.52	N/A	1.10
India	0.34	0.50	0.70
Indonesia	0.76	0.88	1.00
Laos	0.55	0.70	1.10
Malaysia	1.30	1.50	1.90
Myanmar	0.45	0.44	0.85
Philippines	0.52	1.56	0.80
Singapore	1.10	1.49	1.80
Thailand	0.64	1.76	1.95
Vietnam	0.67	1.46	1.80
Nepal	0.40	0.50	0.70
Bangladesh	0.25	0.43	0.75
Mongolia	-	0.66	0.95
China	0.80	1.02	1.70
Sri Lanka	0.2-0.9	0.37 - 0.73	1.00
Republic of Korea	1.00	1.24	1.40
Japan	1.10	1.70	1.70

** Projection*

3R practices and waste reduction in Asia

The Republic of Korea introduced a volume-based fee system in the country's waste management in 1995. The implementation is aimed at promoting waste reduction in order to reduce the fees charged to the waste generators. The system successfully managed to reduce generation of daily solid waste per capita by 22% in 2003 as compared to 1994 [Ju, 2005].

The Singapore Government launched a National Recycling Programme in 2001. The public was encouraged to segregate their waste by separating recyclable items from other waste over a period of 14 consecutive days. The programme accomplished a reduction in the average daily municipal waste from 7700 tonnes/day in 2001 to 7000 tonnes/day in 2005 [National Environment Agency, Singapore, 2006].

However, the response to 3R was insignificant in many developing countries, due to inadequate orientation in governmental policy, low public awareness and the lack of pertinent technology.

In developing countries like Malaysia, Vietnam, Indonesia, Bangladesh, Thailand and the Philippines, waste reduction strategies are not as successful as in the economically-developed countries such as Japan, Singapore and Korea. These

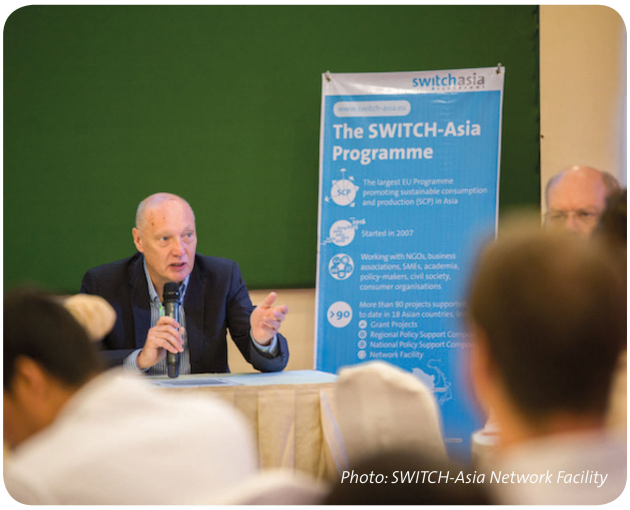


Photo: SWITCH-Asia Network Facility

developing nations depicted an increasing waste generation trend from 1996 to 2008. Table 1 compares the current daily per capita waste generation with the projection for 2025 of selected countries in the Asia-Pacific region.

On average, the current daily per capita generation of MSW by a Malaysian is 1.3kg, while in Vietnam and Laos it is approximately 0.7kg [Troschinetz and Mihelcic, 2008; Fauziah and Agamuthu, 2009; Nguyen, 2007|. In Bangladesh and Indonesia, the average daily per capita generation is 0.25kg and 0.75kg respectively, while in India and Pakistan it is 0.4kg [Pasang et al., 2007; Sujauddin et al., 2008; Troschinetz and Mihelcic, 2008; World Environment Day, 2005].

The increase in the per capita waste generation is highly dependent on a country's socio-economic factors. This signifies the failure to attain the waste reduction goal in the 3R strategy among most Asian developing countries, such as Malaysia.

Financial constraint is another challenge inhibiting the efficient implementation of integrated waste management in developing Asian countries. Unlike Singapore and Korea, lack of a suitable institutional framework has made waste management an unstable sector for investment in many Asian countries, particularly those with developing economies. Banks have been very reluctant to approve the majority of waste management related projects because of insecure economic perspectives. As a consequence, new waste-related developments, technologies and creative projects cannot be implemented. As a result, progress within the waste management sector in developing Asian countries is not as rapid as those of developed nations. Nevertheless, several challenges could be overcome by:

1. changing the attitude of the public and encouraging source separation;
2. organising more awareness campaigns;
3. using a "carrot and stick" approach, i.e. provision of incentives and effectively levying waste management fees;
4. establishing more recycling facilities; and
5. considering a holistic, integrated approach to waste management for Asia.

SWITCH-ASIA PROJECT CASE STUDY FROM CHINA

Photo: REWIN project

E-waste recycling: a comparison between Europe and China

Today, the management of e-waste, i.e. end-of-life electrical and electronic equipment, is a core element of waste management strategies. A key driver is the rapid increase in the quantity of e-waste, which is characterised by its partly hazardous nature (e.g. heavy metals, polychlorinated biphenyls, brominated flame retardants) and its content of valuable materials (copper, precious metals, and other metals, including "critical" metals).

Over the last years, Europe and China have developed specific regulations, such as the European and the Chinese WEEE Directives to address this challenge in order to push improvements for recycling technology. The SWITCH-Asia project REWIN *"Improving resource efficiency for the production and recycling of electronic products by adoption of waste tracking system"*, implemented between 2011-2015, accompanied this adaptation process. A key project task was to support the implementation of large-scale industrial recycling infrastructure in China along with a monitoring system that allows the tracking of the material streams going through the recycling plants. This was addressed both by technical developments, e.g. the design of the monitoring system, recycling guidelines, as well as training activities for the stakeholders involved, and by contributing to policy development.

The recycling process of e-waste typically includes dismantling, processing and end-processing. Driven by high costs of manual labour, in Europe, mechanical processing has been developed to replace manual dismantling as much as possible. For the subsequent processing, a wide spectrum of technologies (such as shredder facilities, fragmentisers and sorting stations) has been installed in the European recycling industry.

Along with the establishment of strict regulations for the treatment of WEEE, in China large capacities for e-waste treatment have been developed and installed. The China WEEE regulation further enabled a funding scheme, where recycling facilities are financially supported by a national subsidy programme. By mid-2015, 106 WEEE recycling plants were included in the funding scheme; WEEE treatment reached a volume of 1.458 million tonnes in 2014.

By helping to implement these recycling capacities, the project contributed to closing the materials cycle in the electronics industry, which has a large demand for raw materials such as copper, other metals and plastics. Establishing industrial recycling facilities allows the treatment of the increasing domestic waste stream and the provision of secondary raw materials to the industry in an environmentally friendly way.

As building this recycling infrastructure in China took place very recently (only starting in 2010), there is still room for improvement of technology, e.g. for the treatment of printed circuit boards or the handling of plastics containing flame retardants. Another challenge in the Chinese context is competition between this new recycling technology at higher treatment costs and recycling activities in the informal sector, which are extremely polluting, but operate at lower costs.

Photo: REWIN project

Photo: REWIN project

MUNICIPALITIES AND WASTE MANAGEMENT

By Mikael Boldt , IDA/LSI

Today, almost every municipality in EU has contracted waste collection activities out to private operators. The reason for doing so is that the municipalities cannot afford to tie municipal funds up in waste collection vehicles and containers, given the vast array of public services and infrastructures that they have to cover via their limited budgets. At the bottom line, annual operation costs remain the same whether the task is organised by the municipality or tendered to a private operator, when financial costs like interest and depreciation are considered.

Today's treatment of waste requires much more sophistication than just operating a dumpsite, but still this is seen as a municipal activity, or at least a municipal-financed activity. In some areas, regional facilities are constructed and operated by regional or national government. However, it is expected that municipalities pay for the transport to the facility as well as paying a gate fee to cover the operation costs. From an economical and a technological point of view, it is not advisable for municipalities to own and operate their own waste management facilities, as many municipalities are too small to optimise the operation of treatment facilities. For instance, the optimum size (measured by lowest cost per tonne of incoming waste) for a landfill site is a capacity of minimum 200 000 tonnes/year, a waste incineration site should receive a minimum of 500 000 tonnes/year, and a paper sorting facility should receive a minimum of 40 000 tonnes/year. A household in the EU generates, on average, approximately 1.2 tonnes of municipal solid waste per year, which gives an indication of the optimal population of a waste management catchment area.

The main constraints in a municipal waste management system

ECONOMY

Municipalities face two problems when it comes to economy:

- how to finance the investment for waste collection and treatment facilities and infrastructure; and
- how to finance related collection and treatment operations.

For municipalities in developing countries, it is often a matter of receiving donor funding to cover waste infrastructure investment. However, it is very unlikely that donors would finance the annual collection and treatment operations, which are in the range of 30-40% of the initial investment. Striving for financially sustainable waste management means that equipment is operated, maintained and depreciated accordingly, making it possible to perform the task intended and to replace the equipment at the end of the asset life.

Photo: "bonsai" / photocase.com

Municipalities finance these tasks through household waste fees. It is a generally accepted principle that the affordability ceiling for a solid waste handling service is 1-2% of average household income.

A key issue is that only countries with a GDP higher than EUR 13 000/capita/year are able to finance municipal waste management by household waste fees only. If, for example, the EU minimum requirement on the solid waste management system must be complied with and the abovementioned affordability ceiling is to be respected, then developing countries' municipal waste management systems are not able to be funded by household fees alone. Consequently, national or regional administrations need to cover the remaining cost from tax revenues.

One of the main issues in developing countries is to understand that any possible income from segregating and selling recyclable materials will never generate enough income to cover all solid waste management activities. Firstly, this is because in the current systems, the informal sector has already removed the most valuable elements from the waste before the waste is picked up by the organised municipal waste system. Formalising the informal sector would contribute to alleviating this aspect. Secondly, prices of recyclable materials are too low because the supply is higher than the demand from the processing industries.

PUBLIC-PRIVATE PARTNERSHIPS

One way of solving the problem of financing is for the municipality to enter into cooperation with a private enterprise. Public-private partnerships may be constituted by municipalities either by contracting out activities to the private sector and/or by sharing ownership of waste treatment and/or collection facilities with the private sector.


Photo: nild / photocase.com

Contracting

Not every municipal activity is suitable for contracting out. A municipality wishing to contract out certain activities has to be careful not to give the private enterprise a monopoly status, inadvertently. Collection and transport of waste is a suitable activity for privatisation because:

- it is a transport task, like delivering goods to shops or emptying mailboxes. Transport from A to B;
- asset life on vehicles is approximately 8 years. It is possible for a municipality to plan developments within the collection service, by entering contracts with a duration of 6 to 8 years;
- the transport company brings its own vehicles, and thereby optimises the collection task based on its experience. After the termination of a contract, both parties can agree to continue or to split up, or the contractor could use his vehicles to undertake collection service elsewhere;
- even though private transport companies are established to make profit, they are also prepared for competition. A private transport company has easier, and cheaper, access to financing their investment, compared with a public organisation. Moreover, the private transport companies perform other activities and have therefore their own workshops, mechanics, and spare drivers, which provides for an optimised performance.

Shared Ownership

A 50/50 shared ownership model between private and public enterprise is rarely used in waste management because of the risk of providing a private enterprise with a monopoly status.

In Germany, for example, 50/50 shared ownership is used for operation of sanitary landfills. The municipality provides land and permits (=50%) and the private partner designs, constructs, and provides equipment (=50%). Operating, and closing the landfill is also performed by the private partner, but financed by gate fees. After the landfill is closed and sealed, the site is handed back to the municipality.

The municipalities, entering these partnerships, do so in order to receive alternative financing of the investment and to gain access to expertise and knowledge. It is important to mention that municipalities do not enter partnerships to gain economic profit because such profit can only arise from one source: the household waste fee.

Sustainable consumption and production and waste management

Sustainability in waste management differs from sustainability in consumption and production. Sustainability in waste management has been defined in connection to a financial sustainable operation where funds are generated in order to operate, maintain and depreciate the equipment accordingly, which makes it possible to perform the task intended and to replace the equipment at the end of the asset life.

Using the word sustainable about waste management in its wider meaning is not adequate because generation of waste can only be considered sustainable if the main, or exclusive, activity is recycling. Moreover, it may even be questionable if recycling performed by a waste treatment organisation may be considered ultimately sustainable, because of the energy required for the process is lost – even if generated by renewables. For environmentalists, discussing the circular economy, material recycling as a part of waste handling or as an end-of-pipe solution, is not sustainable since these materials are not designed to be recycled from the onset. The process involves downgrading in material quality, which limits usability and maintains the linear, cradle-to-grave dynamic of the material flow system.

CRADLE-TO-GRAVE: PRODUCTION, CONSUMPTION, AND DISPOSAL

Our industrial economy has just started moving beyond one fundamental characteristic established in the early days of industrialisation: a linear model of resource consumption that follows a 'take-make-dispose' pattern: harvest and extract materials; use them to manufacture a product; and sell the product to a consumer – who then discards it when it no longer serves its purpose.

In this present context, waste management is the last step in the linear system and operates independently from the production and consumption.

THE WASTE HIERARCHY

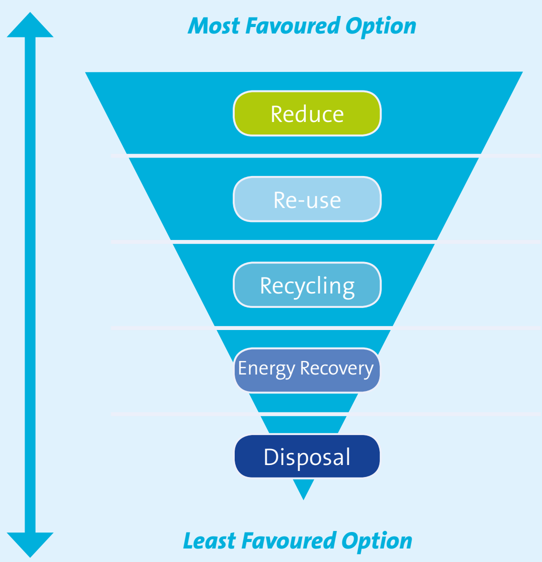
The aim of the waste hierarchy is to recover the maximum usable materials from discarded products and to generate the minimum amount of waste. The proper application of the waste hierarchy has several benefits: it can help prevent emissions of greenhouse gases, reduces pollutants, saves energy, conserves resources, creates jobs and stimulates the development of green technologies.

In 1975, The European Union's Waste Framework Directive (1975/442/EEC) introduced, for the first time, the waste hierarchy concept into European waste policy. It emphasised the importance of waste minimisation, and the protection of the environment and human health as a priority.

In 1989, it was formalised into a hierarchy of management options in the European Commission's Community Strategy for Waste Management and this waste strategy was further endorsed in the European Commission's review in 1996.

The Waste Hierarchy

Source: East Riding's Consultation Portal; http://eastriding.limehouse.co.uk/portal/ (Retrieved 22. 09 2016)



EXAMPLE 1: FOOD PRODUCTION

In 2010, it was estimated that, along the entire food supply chain, from the agriculture land to the dinner table, one-third of food produced for human consumption is lost and there is no indication that this figure has been reduced since. These losses occur during the different steps in the production of food:

- losses in the field due to pests or pathogens;
- losses during agricultural production due to poor efficiency;
- spills or leakages during transport;
- losses during storage and at the retailer's due to food surpassing its sell-by date or being stored in the wrong conditions; and
- products simply being unused by the end consumers.

Firstly, is it necessary to evaluate the entire supply chain in order to minimise food waste. Secondly, instead of using incineration or landfill, food waste should be treated properly – composting or bio gasification – to return valuable nutrients into the food production. Examples of treatment of food waste:

- the SWITCH-Asia supported this approach in the Cambodia Waste to Energy project, where rice mills generate their own energy via gasification of rice husks;
- in the 1990s, the EU supported the construction of simple biogas plants in Greece, Spain and Italy for the residues from the production of olive oil, wine, and orange pulp-juice, where the resultant gas was used for electricity production and the degassed waste was used as fertiliser;
- in 2016, northern Europe´s largest commercially-built biogas plant started operation in southern Denmark, with a sustainable production of gas, electricity and heat. Farmers in the area supply the plant with approximately 700 000 tonnes of manure annually. Some 230 000 tonnes of other organic material, mainly waste from dairies, slaughterhouses and other industrial companies, as well as sewage sludge and household food waste, is included in the production of biogas. The plant "borrows" the manure from the farmers and delivers back a better product to them when the fertilizer has been degassed.

In 2008, the European Parliament introduced a new five-step waste hierarchy to its waste legislation: waste prevention, as the preferred option, followed by reuse, recycling, and recovery including energy recovery, and, as a last option, safe disposal. When the waste hierarchy was established, it was seen as priority list for how to manage solid waste. The link between the production and the disposal products was not obvious before the revision of the Waste Framework Directive in 2008.

From the point of view of a municipal waste-handling organisation, waste reduction was something they were not responsible for, and therefore seen as an activity that should be taken care of by governmental organisations, through, for example, awareness campaigns. Establishing this waste hierarchy was nevertheless an important step towards a circular economy.

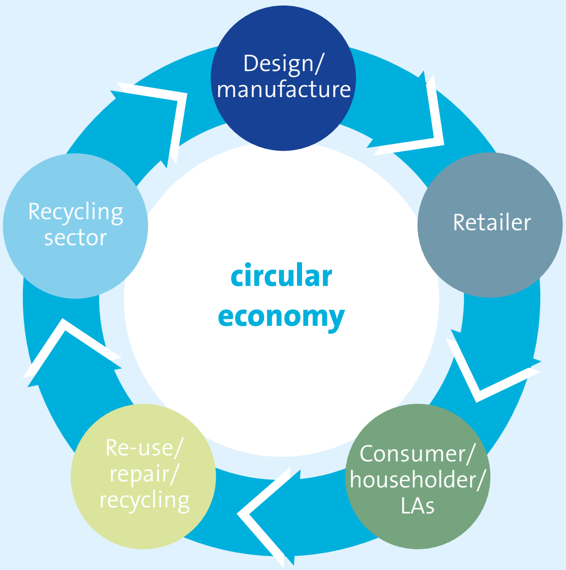
CIRCULAR ECONOMY AND WASTE MANAGEMENT

The circular economy refers to an industrial economy that is restorative by intention. It aims to rely on renewable energy, minimises, tracks and eliminates the use of toxic chemicals, and avoids waste through careful design.

The term goes beyond the mechanics of production and consumption of goods and services in the areas that it seeks to redefine. Examples include rebuilding capital, including social and natural, and the shift from consumer to user. The concept of the circular economy is grounded in the study of non-linear systems, particularly living ones. A major consequence of taking insights from living systems is the notion of optimising systems rather than components, which can also be referred to as 'design to fit'. It involves careful management of material flows, which, in the circular economy encompasses biological nutrients, designed to re-enter the biosphere safely and to build natural capital, and technical resources, which are designed to circulate at high quality without entering the biosphere.

Circular Economy

Source: Ellen Macarthur Foundation; www.ellenmacarthurfoundation.org/ (retrieved 22-09-2016)



EXAMPLE 2: CONSTRUCTION AND DEMOLITION WASTE

Rubble produced during the construction and demolition of buildings, which accounts for approximately 25% of total non-industrial solid waste generated, includes many recyclable materials, ranging from steel to wood to concrete. On average, only 20-30% of all construction and demolition waste (C&D waste) is ultimately recycled or reused, often because buildings are designed and built in a way that is not conducive to breaking down parts into recyclable, let alone reusable, components. The result is a significant loss of valuable materials within the system.

In Denmark and Sweden, active supervision during the construction period, where the rubble is sorted immediately into various waste elements, has shown that 80% of demolition waste and 95% of waste from a construction site can be recycled. The C&D waste have to be sorted into a minimum of 20 different categories, according to various municipal regulations on C&D waste in Denmark and Sweden. Moreover, the additional cost of establishing on-site sorting of waste is less than the cost of transporting unsorted materials to a landfill site.

Examples of recycling of C&D waste:

- ordinary recyclables (paper, cardboard, metals, glass, and plastics) enters the main recycling process;
- old asphalt is crushed and mixed into new asphalt;
- concrete and clay bricks are crushed and screened, and used as gravel, backfill, and road-base, replacing virgin materials.

It is not possible to recycle impregnated wood, chemically-coated materials and glued products. In a circular economy, is it therefore important to look for alternatives for such compound materials in today's construction.

SWITCH-ASIA PROJECT CASE STUDY FROM MONGOLIA

Photo: Greener Construction in Mongolia project

Greening construction and recycling demolition waste

In Mongolia, the construction industry has expanded rapidly in recent years but little attention has been paid to its environmental impact. The general public had no understanding of the concept of "green construction" and a proper construction waste management policy is not yet established. In the course of the current construction boom, from the design to the material used and the insulation techniques applied, there was little awareness of how to reduce the environmental impact of the construction process, and also of the positive economic consequences of green materials and technologies.

One of the main materials used by the construction industry in Mongolia is concrete, which is conventionally made of a mix of cement, water and aggregates. The substitution of the aggregate by waste material produced from the power plants (i.e. fly ash and bottom ash) would reduce the cost of the concrete and improve its insulation capacity. This substitution would also save natural raw materials and reduce the need for disposing of fly ash in landfill. Mongolia has numerous coal-fired power plants producing a huge quantity of fly ash (about 300 000 tonnes per plant per year), which is currently disposed of in landfill, with negative environmental impacts. However, the general public as well as the construction industry community lacked the basic knowledge on ash substituting aggregates in concrete. The public believed that power plant ash contained radioactive properties, thus, initially rejected ash-based concrete.

To address this gap, the SWITCH-Asia project *"Supporting a greener and more energy efficient construction sector in Mongolia"* was undertaken between 2012 and 2016. The project successfully identified and experimented ash-based construction materials and was able to create the standard of incorporating ash into construction material, which in turn became the basis for a new SWITCH-Asia project: started in 2016, *"Improving resource efficiency and cleaner production in the Mongolian construction sector through materials recovery"* focuses on the creation and production of waste-based construction materials using waste derived from the construction and demolition process.

The level of fly ash radioactivity (below EU and Mongolian standards) was tested; three commonly used construction materials have been identified (AAC blocs, aggregate blocs and dry mortar mixture), pilot production in real conditions and crosschecking the research in Mongolia were completed. A report detailing the properties of the different products ("Ash-based green product" handbook) has been published, and the standard for ash-based construction material was approved (MNS:3927:2015 Power Plant fly ash in Construction Material Production – General technical properties). Almost 800 professionals from 150 SMEs have been trained in greener construction practice. The "Green construction" training material produced by the project has been included officially in the curriculum of several technical vocational schools, the Construction Development Center and a more comprehensive version adopted by the Mongolian University of Science and Technology.

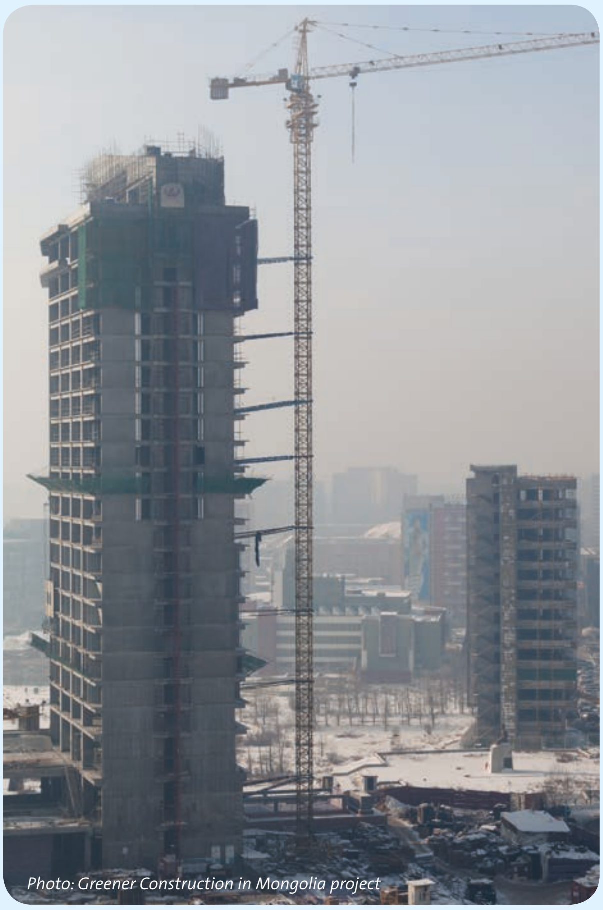


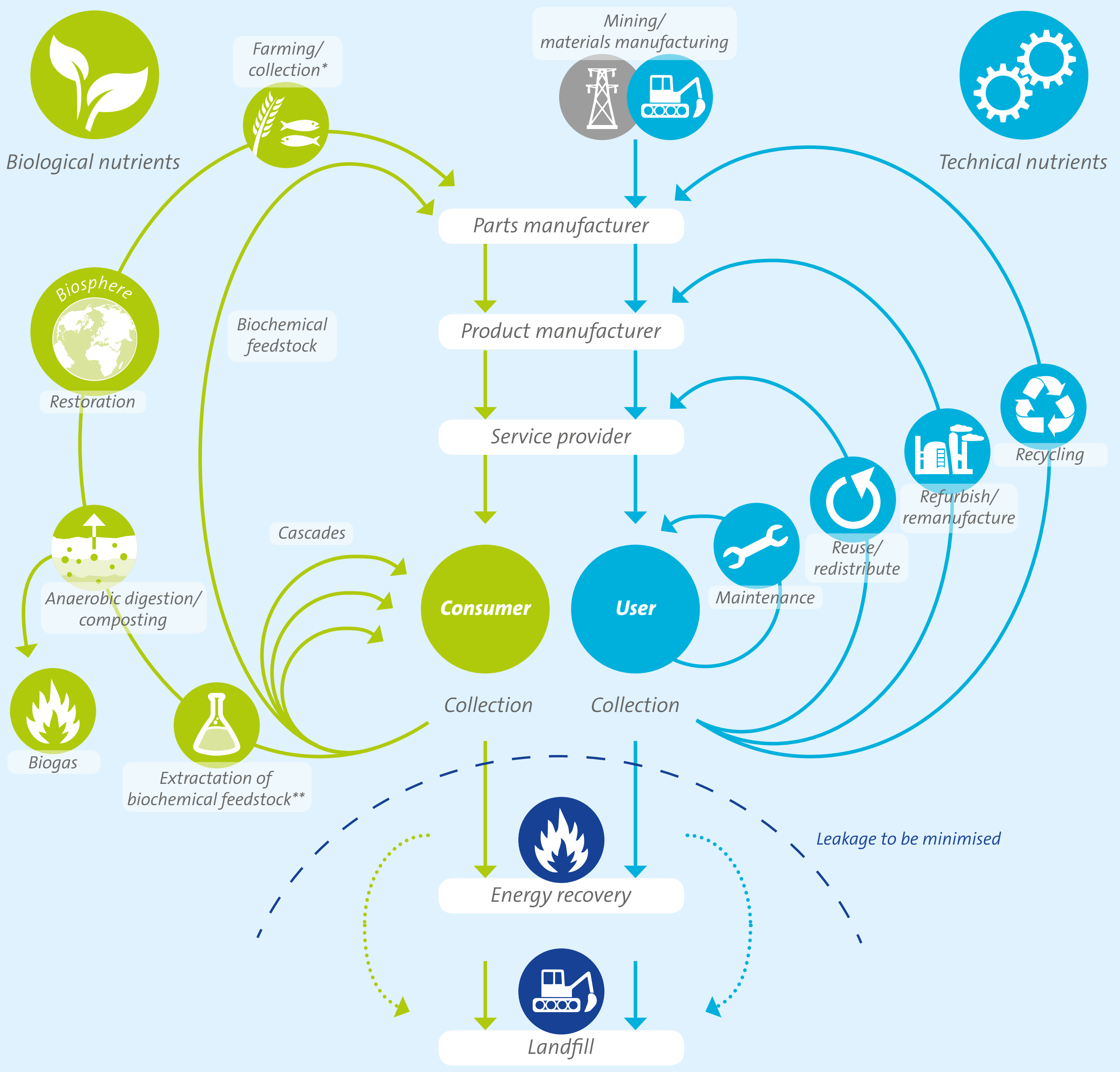
Photo: Greener Construction in Mongolia project

As a result, the circular economy draws a sharp distinction between the consumption and use of materials; the circular economy advocates the need for a 'functional service' model in which manufacturers or retailers increasingly retain the ownership of their products and, where possible, act as service providers selling the use of products, not their one-way consumption. This shift has direct implications for the development of efficient and effective take-back systems and the proliferation of product- and business-model design practices that generate more durable products, facilitate disassembly and refurbishment, and consider product/service shifts, where appropriate.

The circular economy connects production directly with disposal by defining that this should be avoided. The figure below illustrates that waste incineration and landfill practices are a leakage and therefore should be minimised.

The Circular Economy – an industrial system that is restorative by design

Source: From the Ellen MacArthur Foundation's report on the Economics of a Circular Economy: TOWARDS THE CIRCULAR ECONOMY www.ellenmacarthurfoundation.org/ (retrieved 22-09-2016)



* Hunting and fishing

** Can take both post-harvest and post-consumer waste as an input

SWITCH-ASIA PROJECT CASE STUDY FROM INDIA

Photo: ACIDLOOP project

Recycling of waste acid from metal finishing companies

Metal finishing operations, like electroplating in India, is an industrial sector involving primarily small and medium-sized enterprises (SMEs). The advantage of decentralised production is high flexibility. The disadvantages are varying levels of production efficiency and lack of know-how in resource and environmental issues, like energy saving, water use and acid recycling. In order to improve this situation, a SWITCH-ASIA project *ACIDLOOP* (2012-2016) was undertaken.

The aim of the project was to improve resource efficiency among metal finishing SMEs in India. It was addressed by offering a short training session on resource efficiency and the application of closed loop technologies for 385 companies in various regions of India, on-site customised technical consulting for 106 companies, and the demonstration of waste acid and rinsing water reuse by the means of mobile pilot plants in 9 SMEs (Figure 1a and 1b). These 106 companies were chosen from 385 companies who were exposed to resource efficiency principles and who made an application to be part of the project. The plants were used firstly for training purposes and secondly to prove the reliability of nanofiltration, retardation and diffusion dialysis under specific Indian climatic and operational conditions. Further project activities included the organisation of round tables to address policy, and discussion of the financial and technical challenges regarding implementation of resource efficiency strategies and technologies.

By the end of the project, among the 106 companies that were provided with on-site consulting and support for implementing resource efficiency measures, the average raw material demand reduced by 27%. The reduction in the average energy and water savings were 23% and 33% respectively. In case studies with pilot plants, it was demonstrated that the tested techniques were applicable to Indian SMEs. Up to 80% of rinsing water could be reused. Fresh acid consumption and sludge amounts were reduced by 15-30%. The demonstration plants also act as references for technology implementation in other companies.

The encountered challenges were technical, organisational and financial. In general, mismanagement of degreasing baths in most finishing lines causes increased consumption of rinsing water, acids and additional chemicals. As oil and particle separation is a crucial pre-treatment for sound operation of the rinsing water and acid recovery plants, it was important to train the companies on the necessity of pre-treatment systems and their efficient operation. Furthermore, for effective waste management, good analytical procedures, qualified personnel and monitoring system for water and acid use are necessary.

The reduction of oil contamination in process baths can be achieved by the integration of continuous oil separation from degreasing baths, e.g. by microfiltration. This technology is locally available. To overcome the further challenges, a simplified analytical procedure for acids and metals was developed and the importance of good accounting for company savings was demonstrated.

Currently available technical solutions for acid recovery are complex and have to be imported from other countries (e.g. Europe, Japan). The treatment plants for SMEs should be easily operable and with the minimum of adjustable features. From the technological point of view, this is possible. The key to affordable technology is local production of these treatment facilities. Further important factors facilitating investments are incentives by local authorities and functioning reference plants to win the trust of financial institutions and SMEs alike. Due to the active involvement of the network of industrial associations and technology suppliers, the project enabled breakthrough development in waste management of Indian metal finishing companies; further savings are expected in the coming years.

Photo: ACIDLOOP project

CONCLUSIONS & THE WAY FORWARD

Photo: SWITCH-Asia Network Facility

During the SWITCH-Asia conference on "Waste management and the circular economy in Asia", participants discussed waste management approaches in Asia and the contribution of effective waste management systems to national sustainability agenda. While individual, local and regional successful approaches were explained and are presented in this briefing, setting up waste management systems and processes aligned to internationally-accepted environmental standards remains a challenge for the region.

Currently, the waste management situation in Asian developing countries is characterised by a startling increase in waste generation, compounded by an increased toxicity and consequently adverse health and environmental impacts of waste. Latest projections foresee waste generation to increase by 60% by 2030, over 2014 levels[1]. This unfavourable condition is aggravated by the fact that 70% of all of this waste is dumped without any treatment and therefore about 20 million tonnes of plastic waste are currently washed into the ocean annually[2].

The SWITCH-Asia case-studies presented in this briefing provide an example of how a combination of capacity building for industry and policy makers, coupled with locally-adjusted technologies, effectively improve local waste management. However, for such solutions to generate large-scale and long-lasting impact, local industry, society and policy actors need to adopt them and scale up substantially. The financial means and human resources currently available in developing countries are not sufficient to expand the applications of such proven waste management practices. Thus, the role of local and central governments and regulators is also key to ensure that the right policies and resources are prioritised.

The way forward cannot be found in macroeconomic models like Circular Economy or Inclusive Green Economy alone nor will a reliance exclusively on technological solutions solve the problem. Rather the "basics of waste management" must be put in place, i.e. "clean streets, ubiquitous [waste] collections, safe disposal and intelligent recycling ... at all levels. Technology on its own is entirely insufficient"[3]. Stronger and more effective public institutions and administrations are needed to address the still "widening gap between policy formulation and implementation"[4].

It remains, therefore, a matter of responsible development cooperation design and policy formulation support to avoid the gap between policy development and implementation from further widening, and to help policy makers focus on the immediate waste management tasks at hand.

1) http://uneplive.unep.org/media/docs/assessments/GEO_6_Asia_Pacific_Factsheet.pdf
2) http://www.scmp.com/comment/insight-opinion/article/1975032/no-amount-technology-going-solve-worlds-waste-crisis
3) http://www.scmp.com/comment/insight-opinion/article/1975032/no-amount-technology-going-solve-worlds-waste-crisis
4) http://uneplive.unep.org/media/docs/assessments/GEO_6_Asia_Pacific_Factsheet.pdf

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