



# EU-ASIA PRO ECO II B Post -Tsunami Programme

Demonstrating ESTs for Building waste  
Reduction in Indonesia

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The DEBRI Project  
Technology Identification and Selection

*(Revised November 2007)*

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## Executive Summary

### Background

In the face of growing concerns regarding sustainability, a need for promotion of ESTs aiding sustainable development was recognized in the early 1990s. The Local Agenda 21 under the United Nations Conference on Environment and Development (UNCED) in particular, highlighted this issue. Further, a number of national and regional initiatives across the world focused on the incorporation of what have come to be known as Environmentally Sound Technologies or “ESTs” in the development process.

ESTs encompass technologies that have the potential for significantly improved environmental performance relative to other technologies. Broadly speaking, these technologies protect the environment, are less polluting, use resources in a sustainable manner, recycle more of their wastes and products, and handle all residual wastes in a more environmentally acceptable way than the technologies for which they are substitutes.

But in the complex relationship between disasters and the environment, technology provides a link between human action and the natural resource base. As a result, the application of new, resource efficient ESTs has become crucial for both disaster management and the environment.

In order for developing countries to make the best use of ESTs, however, they must increase their ability to assess, analyze and choose technologies based on their own needs and disaster management priorities, and adapt these technologies to specific local conditions. Of particular importance will be the building of capacities to integrate economic, social and environmental considerations in order to ensure resource efficiency and social acceptability.

It is with the above thinking that an activity on the development of a systematic process and methodology of technology identification and selection was included in the DEBRI project.

### Technology Identification and Selection

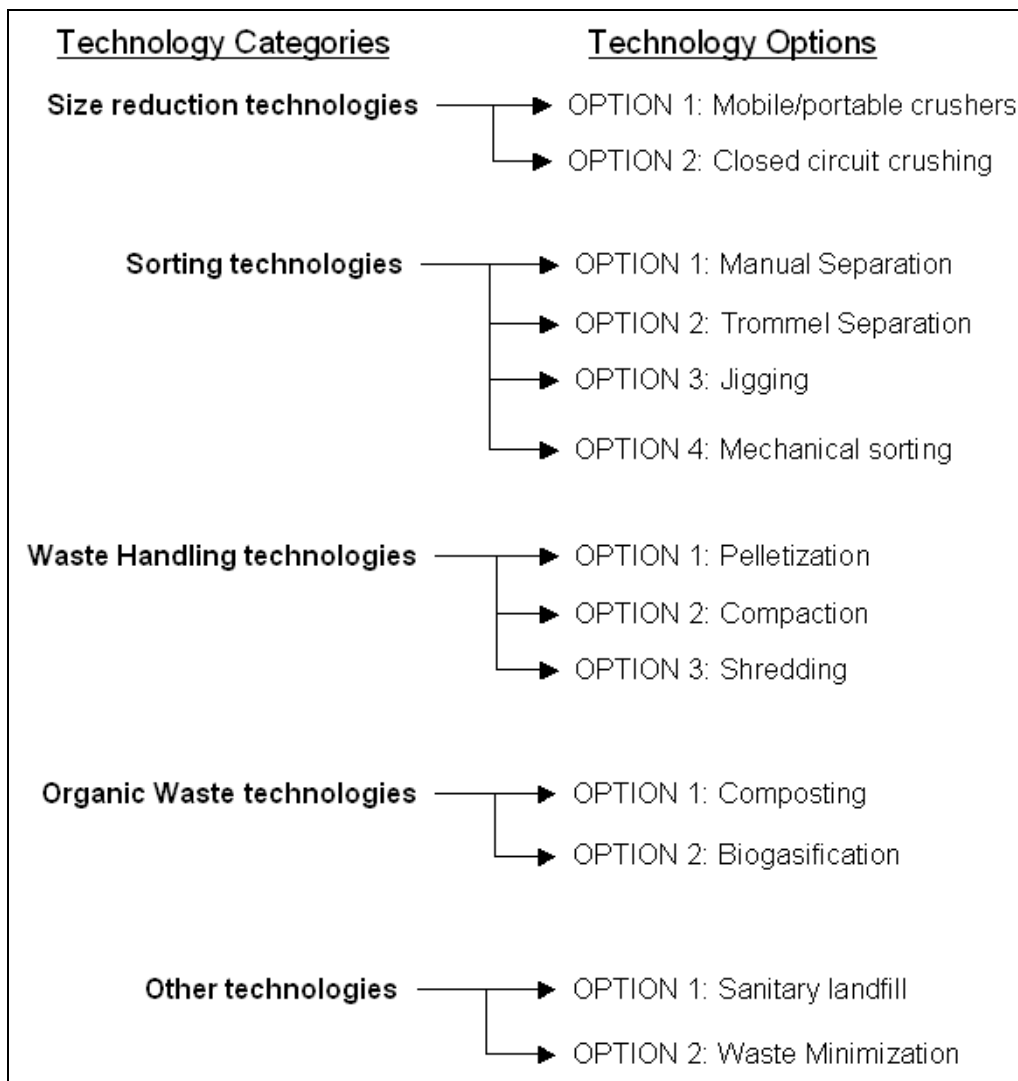
Technology identification and selection processes need to focus on environment and disasters together, positioning them at the centre of economic and political decision making at the strategic and operational levels. It is also adaptable to specific parameters and constraints of a locality.

Clearly, technology identification and selection processes for C&D waste management are undertaken at different levels for various purposes – (a) at the **strategic** level, in order to streamline development planning and policy making, (b) at the **operational** level, in order to assess alternative solutions and facilitate

implementation of programmes and projects, (c) at the **financial** level, in order to ensure financial viability and long-term sustainability of the technology and to also generate income and jobs for the local community, and (d) at the **community** level, in order to ensure community acceptability within its socio-cultural fabric.

Within the technologies to be procured under the DEBRI project, five groups of technologies were envisaged, namely – (1) size reduction technologies, (2) sorting technologies, (3) waste handling technologies, (4) organic wastes, and (5) other technologies.

The following chart shows the technology categories and options assessed:



*Chart: Technology Categories and Options*

Size reduction and crushing technology relate to systems that enable C&D wastes to be broken down to a size which enables their reuse and recycle for various purposes, particularly as aggregates or fill-ins, and sorting technologies, aggregation technologies, material handling technologies and other technologies.

Options for each technology system were assessed in terms of the strategic factors (including laws and legislation, future scenarios and plans etc.), the operational factors (including technical feasibility), financial factors (including the costs of operating the technology and potential jobs/income that can be generated), and socio-cultural factors (including community acceptability etc.)

An additional aspect to be taken into account was the subsidiarity of decisions to be taken, and the capacity development that will have to be instituted to make such informed choices. Identifying users of the methodology mentioned here, and their roles, formed an important part of the processes.

The process of identification and short-listing of technology options that was used in making a selection of the technology consisted of (a) reviewing technology systems that deal with C&D wastes, (b) applying sustainability assessment factors in order to short list technology systems, (c) presenting a short list of technology systems in order to facilitate final selection, and (d) preparing a report of technology selection in order to facilitate development of detailed technology specifications.

Based on the above process, a ranking system was used to identify and tabulate the results as shown below:

<b>Technology system</b>	<b>Best technology option</b>
Size reduction technologies	Mobile crushing
Sorting technologies	Manual separation on a conveyor belt
Waste handling technologies	Shredder
Organic wastes	Composting
Other technologies	Waste minimization

This report was prepared by a team led by Prof. P. Agamuthu of the Faculty of Science, University of Malaya, with inputs from the DEBRI Project Partners.

## INTRODUCTION

In the face of growing concerns regarding sustainability, a need for promotion of ESTs aiding sustainable development was recognized in the early 1990s. The Local Agenda 21 under the United Nations Conference on Environment and Development (UNCED) in particular, highlighted this issue. Further, a number of national and regional initiatives across the world focused on the incorporation of what have come to be known as Environmentally Sound Technologies or “ESTs” in the development process.

ESTs encompass technologies that have the potential for significantly improved environmental performance relative to other technologies. Broadly speaking, these technologies -

- protect the environment
- are less polluting
- use resources in a sustainable manner
- recycle more of their wastes and products
- handle all residual wastes in a more environmentally acceptable way than the technologies for which they are substitutes

Furthermore, as argued in Chapter 34 of Agenda 21, ESTs are not just "individual technologies, but total systems which include know-how, procedures, goods and services, and equipment as well as organizational and managerial procedures". This requires both the human resource development and local capacity building aspects of technology choices. There is also the need to ensure that ESTs are compatible with nationally determined socio-economic, cultural and environmental priorities and development goals.

In the complex relationship between disasters and the environment, technology provides a link between human action and the natural resource base. As a result, the application of new, resource efficient ESTs has become crucial for both disaster management and the environment.

The availability of ESTs for disaster risk reduction and mitigation will largely depend on willingness to pursue an environmental agenda and proper decision-making processes put in place at the national and local levels.

In order for developing countries to make the best use of ESTs, however, they must increase their ability to assess, analyze and choose technologies based on their own needs and disaster management priorities, and adapt these technologies to specific local conditions. Of particular importance will be the building of capacities to integrate economic, social and environmental considerations in order to ensure resource efficiency and social acceptability.

It is with the above thinking that an activity on the development of a systematic process and methodology of technology identification and selection was included in the DEBRI project.

The criteria for technology identification and selection presented in this document is based on earlier work of UNEP on ESTs. Among them, of particular interest is the list of core criteria and indicators for EST evaluation and assessment, summarized in the table below.

<b>Core Criteria and Indicators for EST Evaluation and Assessment</b>	
<b>Technological Suitability</b>	
1	Compliance with fundamental science and engineering principle
2	Appropriateness of service and efficiency
3	Certainty for forecast of service and environmental load
4	Sustainability of technical performance
5	Speed of service development
<b>Protects the Environment</b>	
1	Compliance with local, national and regional environmental standards or internationally recognized standards (e.g. ISO)
2	Compliance with Multilateral Environmental Agreements (MEAs)
3	Environmental impact relative to the product or service provided (Eco efficiency)
4	Ecological footprint
5	Overall impact on ecosystem health and integrity
6	Compatibility with immediate and adjoining facilities and systems
7	Potential for geomorphological, landscape and eco-hydrological impacts
8	Potential for long-range transport of pollutants
<b>Less polluting and handles wastes in a more acceptable manner</b>	
1	Total quantities of wastes (air, water and gaseous) generated
2	Cumulative air, water and waste emissions
3	Quantities of toxic waste produced
4	Potential for generation of secondary pollutants/ by products
5	Noise/ vibrations/ odour generation
6	Thermal emissions
7	Radiation emissions
8	Potential for climate change impacts
9	Potential for soil contamination
10	Appropriateness of waste (air, water and solid) treatment and disposal
<b>Uses all resources in a more sustainable manner</b>	
1	Efficiency of energy, water and material use, relative to the product of service provided

2	Useful life of technology, and of products/ services
3	Relative use of renewable/ non-renewable sources
4	Conservation of water, including portion of recycled water used
5	Use of 'environmentally friendly' materials
6	Sustainable use of local resources
7	Use of sparse resources
8	Space required for the technology investment
<b>Recycles more of its products and wastes</b>	
1	Use of recycled, reused and waste material and by products
2	Life cycle performance

The above criteria have been used as a guide to develop the key factors in technology identification and selection<sup>1</sup>.

## 2. Technology Identification and Selection

Technology identification and selection processes need to focus on environment and disasters together, positioning them at the centre of economic and political decision making at the strategic and operational levels. It is also adaptable to specific parameters and constraints of a locality.

Barriers to use of such ESTs and the information/knowledge needed to make informed choices on technologies, need to be identified for technologies for various purposes of construction and demolition waste management, including size reduction, crushing equipment, sorting equipment, aggregation equipment etc.

The 'umbrella' term "Construction and Demolition Waste" (C&DW) covers a very wide range of materials. The most obvious categories – particularly in the aftermath of a disaster – are:

- (i) debris arising from the total or partial demolition of buildings and/or civic infrastructure;
- (ii) waste arising from the construction of buildings and/or civic infrastructure;
- (iii) soil, rocks and vegetation arising from land leveling, civil works and/or general foundations;
- (iv) road planings and associated materials arising from road maintenance activities.

<sup>1</sup> These and other resources are available with UNEP-IETC for reference during the technology identification and selection process

C&DW usually consists of concrete, bricks, tiles, ceramics, and gypsum based materials; wood; glass; plastic; asphalt, tar and tarred products; metals (including their alloys); soil and dredged spoil; insulation materials; mixed construction and demolition waste; etc.

Clearly, technology identification and selection processes for C&D waste management are undertaken at different levels for various purposes:

- At the **strategic** level, in order to streamline development planning and policy making
- At the **operational** level, in order to assess alternative solutions and facilitate implementation of programmes and projects
- At the **financial** level, in order to ensure financial viability and long-term sustainability of the technology and to also generate income and jobs for the local community
- At the **community** level, in order to ensure community acceptability within its socio-cultural fabric

## About the preparation of this Report

This technology report was assembled by reviewing several established and economical environmentally sound technologies (ESTs) to be incorporated into a master plan to manage municipal solid wastes (MSW) and construction and demolition wastes (CDW) in Banda Aceh, Indonesia.

There are two objectives of this report: to identify several viable EST that will be incorporated into the master plan and to demonstrate ESTs for reduction of MSW and CDW in Indonesia.

A technology catalogue was also included and serves as a brief description of the technologies. Not all technologies listed in the catalogue were explored further.

Several main technology groups were identified: size reduction, separation, handling, bioconversion and miscellaneous technologies. These technology groups will assist in the aspects of waste processing, separation and disposal. A final disposal technology for non-recyclable MSW and CDW as well as a recommendation to reduce solid waste generation was put forward.

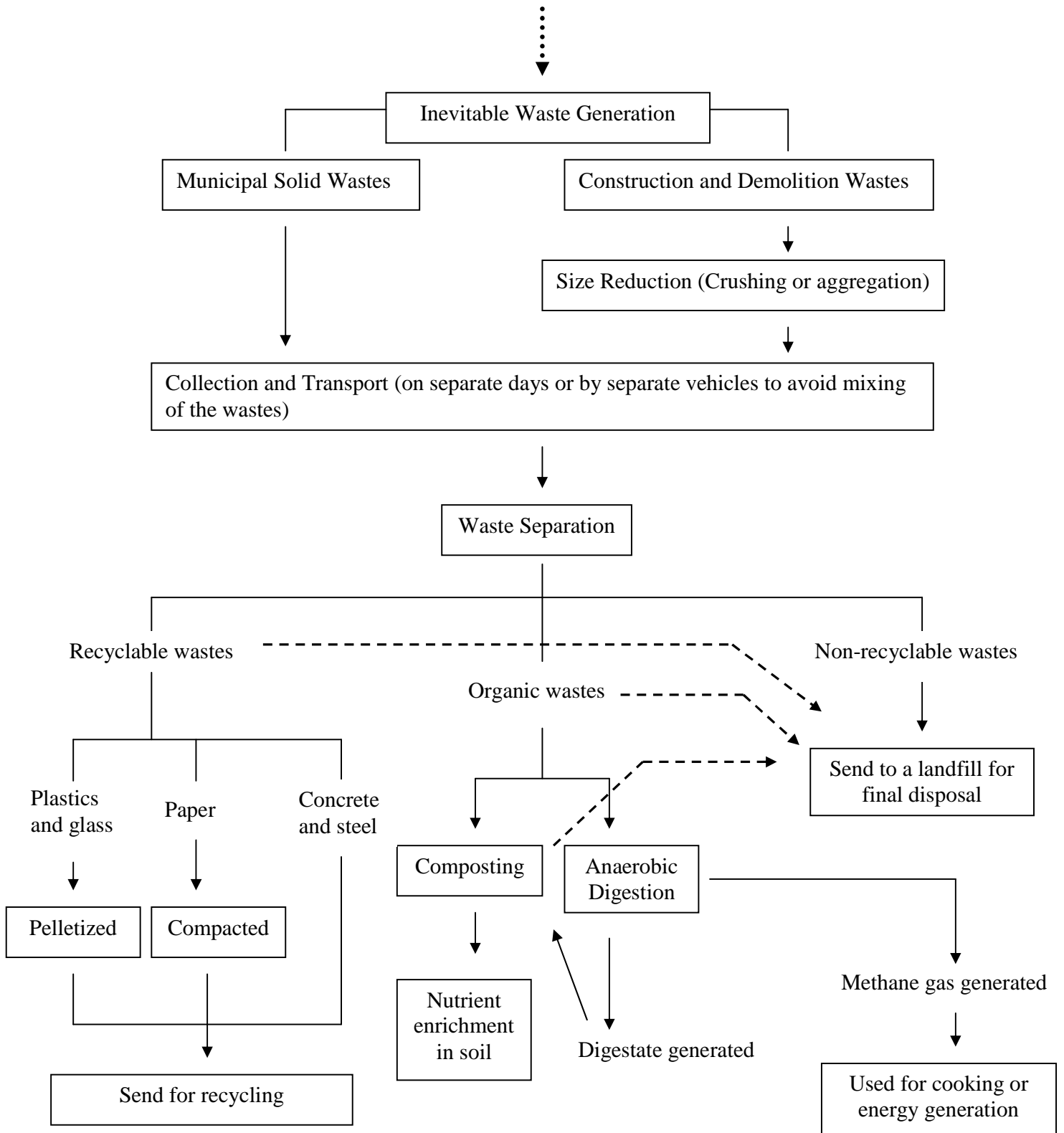
During the review, emphasis was placed on selecting ESTs that empowered local people with:

- a. income from the jobs created
- b. income from recycling activities
- c. a sense of pride and responsibility in preserving their environment and natural resources

The ESTs listed should be seen as part of an integrated solid waste management system, which incorporates solid wastes from both the municipal and construction/demolition streams. It is important that the MSW and CDW should not be mixed as it compromises the integrity of the recyclable wastes and leads to difficulty in waste separation. MSW and CDW generally require different technologies in their management. This is attributed to the differences in physical characteristics of the two waste types:

<b>Municipal Solid Wastes</b>	<b>Construction and Demolition Wastes</b>
light weight	heavy/bulky
soft/can be manipulated by hand	Hard
organic	mostly inorganic
non- or moderately toxic	some wastes are hazardous/toxic (concrete dust, lead etc.)

Governmental Policy Encouraging Waste Reduction and Environmental Education



**Figure 1:** Flow chart showing the proposed MSW and CDW management plan

A total of five technology categories were assessed for identification and selection of technology. These are listed in the table below:

No.	Technology Category	Technology Options
1.	Size reduction technologies	- mobile/portable crushers - closed circuit crushing
2.	Sorting technologies	- manual separation - trommel separation - jigging - mechanical sorting
3.	Waste handling technologies	- pelletization - compaction - shredding
4.	Organic waste technologies	- composting - biogasification
5.	Other technologies	- sanitary landfill - waste minimization

At a broad level, in identifying, assessing and selecting technologies, it is important for us to consider what the *inputs* are in terms of the costs, raw materials and other resources; the *outputs* in terms of items produced (including other issues such as pollution or emissions); the *outcomes* in terms of goals and objectives achieved; and the overall *impacts* of the technology within its lifecycle.

Furthermore, in any decision-making process, special attention needs to be given to the risks and restrictions associated with each choice, since these become crucial deciding factors in many instances.

Typically, risks and restrictions that need to be considered in making the technology choice include stability, flexibility, hazard, size/scale of operation, adaptability, skill levels needed, and other pre-requisites such as availability of space, etc.

These issues have been consolidated into four sets of factors to be used for identification and selection of technologies, summarized in the table below:

Category	Description
1 Strategic factors	Strategic factors are based on situational analyses, expert opinion and existing baseline data, and are used to assess the technology's conformity and compliance with policies, programmes and legislation.
2 Operational factors	Operational factors are based on a thorough technical analysis of the technology options that includes its potential environmental impacts.
3 Financial factors	Financial factors are based the costs incurred in procuring, installing, operating and maintaining the

		technology. Additional factors related to the potential of jobs created or incomes generated are also taken into consideration.
4	Socio-cultural factors	Socio-cultural factors cover issues related to the local community where the technology will be installed, and includes health and safety issues, acceptability of the technology and other related issues.

*Note: Details of the above factors are described in more detail in the annex.*

The scores (low, medium, high) given to each issue of the key factors of assessment were based on available statements in literature and the consultant's judgment and experience. Details of the scoring mechanism are given in Annex 1.

## SIZE REDUCTION TECHNOLOGIES

Based on the review, crushing encompasses several physical actions (in practical terms, carried out individually or in tandem with another) with the purpose of reducing the physical size of C&D wastes. It is a direct and effective method.

There are several methods of crushing (Pennsylvania Crusher, 2003).

- a. Impact – collision of one or two objects moving towards each other
- b. Attrition – target objects forced between two moving surfaces
- c. Shear – cleavage of target object(s)
- d. Compression – target object forced onto a surface

Aggregates are any kind particulate composite material used to reinforce the final product/material it is mixed into. Raw/virgin aggregates are either course or fine and consist of stone, sand or gravel, etc. However, many researchers (Poon & Chan, 2007; Mymrin & Correa, 2007; Rao, *et al.*, 2007; Vegas *et al.*, 2007) advocate the use of recycled C&D wastes as aggregates for construction materials.

These researchers utilize mechanical or manual crushing to produce aggregates. Thus, technologies to aggregate C&D wastes should be seen as analogous to crushing technologies, due to the physical similarity in the resulting product. More importantly, the C&D wastes in question that are collected for crushing should be considered for its potential as recycled aggregate construction material.

## SIZE REDUCTION TECHNOLOGIES

### *Technology 1: Mobile/Portable Crushers*

This technology physically reduces the size of solid wastes by crushing it. It is an integral part of solid waste management, especially of heavy and bulky construction or demolition wastes which are very difficult to maneuver in its original size. A mobile crusher can be driven to the waste site and work *in-situ*.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

## OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Moderate	Diesel fuel and several high-capacity electrical generators
	Mobility	High	A significant advantage for on-site crushing and C&D waste recycling operations
	Compatibility with local natural conditions (topographical, climate etc.)	High	Heavy-duty machinery is versatile, but mechanical parts will need maintenance/replacement due to humidity/exposure
	Compatibility with existing situations	High	Portable crushers are designed for maneuverability within demolition areas, further study may be required for operations in sandy coastal areas
	Extent of usage of local parts and components	Low	Will probably require parts from its manufacturing company for best performance
	Availability of local skills and capacities	Moderate	Training will result in local expertise for operational planning and execution
	Track record of performance and reliability	High	<b>As claimed by the manufacturer</b>
	Compatibility with existing situations	High	Machinery is mobile and well suited for condition at hand.
	Other technical factors:		

	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>Low</p> <p>High</p> <p>Moderate</p> <p>Moderate</p> <p>High</p>	<p>Has a maximum capacity, exceeded will cause premature wear.</p> <p><b>As claimed by the manufacturer</b></p> <p>Will require technical expertise</p> <p>Initial specifications will provide necessary service but on-site modification will be necessary if volume quality of waste changes</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> <li>• Airborne particles</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>High</p> <p>Moderate</p> <p>Moderate</p>	<p>Care must be exercised when around the portable crusher/aggregator</p> <p>Machinery and generator noise</p> <p>From combustion of fuel</p> <p>Resulting from crushing of concrete or wood</p>
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of</li> </ul>	<p>Low</p> <p>Moderate</p>	<p>Is not a permanent fixture</p> <p>Larger/costlier spare parts can be ordered just-</p>

	<p>technology components when not in use</p> <p>Other requirements such as support structures, covered building etc.</p>	High	<p>in-time</p> <p>When not in use, should not be exposed to the elements</p>
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	Depending on initial specification
Long-term factors	Operation and maintenance costs	Moderate	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	Revenue can be made from sale of recycled C&D wastes, associated human resource advantages (separation, collection, packaging, sales, etc.)
	Acceptability	Moderate	May meet opposition due to noise and possible air pollution, support could be due to economic/ employment reasons

## SIZE REDUCTION TECHNOLOGIES

### *Technology 2: Closed Circuit Crushing*

Close circuit crushing is an innovative crushing procedure that consists of one or more size reduction apparatus that end with a sieve and conveyor belt. Any C&D waste that cannot pass the sieve will be placed on the conveyor belt to be subjected to another round of size reduction (Pennsylvania Crusher, 2003).

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	High	High-capacity electrical generators
	Mobility	Low	Is based in one location
	Compatibility with local natural conditions (topographical, climate etc.)	High	Heavy-duty machinery and housed in a covered, reasonably dry location
	Compatibility with existing situations	High	Has high crushing/aggregation capacity, but wastes must be transported to it
	Extent of usage of local parts and components	Low	Will probably require parts from its manufacturing company for best performance
	Availability of local skills and capacities	Low	Training will result in local expertise for operational planning and execution
	Track record of performance and reliability	High	<b>As claimed by the manufacturer</b>
	Compatibility with existing situations	High	Machinery is well suited for condition at hand.
	Other technical factors:	Moderate	Has a high maximum

	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>High</p> <p>Moderate</p> <p>Moderate</p> <p>High</p>	<p>capacity, exceeded will cause premature wear.</p> <p>Simple and powerful concept</p> <p>Will require technical expertise</p> <p>Initial specifications will provide necessary service but on-site modification will be necessary if volume quality of waste changes</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> <li>• Airborne particles</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>High</p> <p>Moderate</p> <p>Moderate</p>	<p>Care must be exercised when around the crusher/aggregator</p> <p>Heavy machinery will require care and security</p> <p>Machinery and generator noise</p> <p>No odours from the machine, but from the crushing/aggregation cycles</p> <p>Resulting from crushing of concrete or wood</p>
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the</li> </ul>	<p>High</p>	

	<p>technology</p> <ul style="list-style-type: none"> <li>Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>Moderate</p> <p>High</p>	<p>Larger/costlier spare parts can be ordered just-in-time</p>
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	Depending on initial specifications
Long-term factors	Operation and maintenance costs	Moderate	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	Revenue can be made from sale of recycled C&D wastes, associated human resource advantages (separation, collection, packaging, sales, etc.)
	Acceptability	Moderate	May meet opposition due to noise and possible air pollution.

## WASTE SEPARATION TECHNOLOGIES

While it is known that certain portions of MSW are recyclable, it is estimated that approximately 80% of CDW can be recycled too (Residua, 1999; Cole, 2000). Sorting the wastes into manageable categories can be done either mechanically or manually. Waste separation is an integral part of managing solid wastes, especially if they are to be processed and recycled (Agamuthu, 2001; Poon, 2007).

To be thorough, the process must involve manual separation. Furthermore, sorting through wastes and collecting recyclable materials to be sold is a source of income. But, when the manual aspect of sorting is considered, proper care must be taken to ensure the safety of workers. Careful material handling must be exercised.

Several methods of solid wastes separation are proposed:

- a. Manual separation – Recommended to be done by waste pickers standing by a mechanical conveyor belt. This method is cost effective with the added advantages of job creation and thorough separation. However, this method may not be applicable to all kinds of un-processed solid wastes (e.g. bulky/heavy CDW will have to be reduced in size, toxic CDW or other hazardous solid wastes should be pre-separated or not allowed into the waste stream, etc.).
- b. Separation using a trommel – A trommel is a mechanically powered long cylinder with internal perforations. Mixed solid wastes fed into the trommel will be mixed and tumbled, causing the wastes to separate via the perforations. It reportedly has low capital and maintenance costs (Lau *et al.*, 2005).
- c. Jigging (Xing *et al.*, 2002) – A unique method to separate CDW, based on the densities of different waste materials in water. CDW can be placed inside a large water bath and pressure is applied onto the water by a large plunger. Particle sizes between 2 mm and >19 mm were reportedly separated. Jigging is not effective for finer particles (Earth Science Teacher's Association, 2007). However, certain technical knowledge may be necessary to determine flow and velocity of water bath (Mukherjee *et al.*, 2005).
- d. A mechanical sorting process (Huang *et al.*, 2002, Eerland, 1995) – A fairly common and reliable method for waste sorting, varying slightly according to the solid waste. Basically consists of vibration screening or tumbling on wire mesh to segregate the larger and smaller particles. The smaller particles which fall through the mesh will be subjected to magnetic belt or separator to remove ferrous materials. Air will be blown to further

separate the smaller materials (sand, glass or wood). The remnants will then be manually sorted to be recycled.

## WASTE SEPARATION TECHNOLOGIES

### *Technology 1: Manual Separation on a Conveyor Belt*

This is a cost-effective method to separate safe and maneuverable solid wastes. It is also a viable in job creation. The limitation here is that overly-large, heavy and hazardous wastes cannot be processed without endangering personnel.

#### **STRATEGIC FACTORS**

<b>Issue</b>	<b>Factor</b>	<b>Decision</b>	<b>Notes</b>
Compliance	Compliance with local laws	Yes	<b>Local laws on waste pickers may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

#### **OPERATIONAL FACTORS**

<b>Issue</b>	<b>Factor</b>	<b>Decision</b>	<b>Notes</b>
Technical Suitability	Energy/resource consumption	Low	
	Mobility	High	Waste pickers can be deployed to any waste site
	Compatibility with local natural conditions (topographical, climate etc.)	High	This technology is un-invasive to the environment
	Compatibility with existing situations	High	Provided the site is safe, the waste pickers can be easily deployed.
	Extent of usage of local parts and components	High	

	<p>Availability of local skills and capacities</p> <p>Track record of performance and reliability</p> <p>Other technical factors:</p> <ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>High</p> <p>Moderate</p> <p>High</p> <p>Moderate</p> <p>Moderate</p> <p>High</p> <p>Low</p>	<p>Reliability will depend on the waste site, prompt payment and protection from injury.</p> <p>Will require more manpower in the event of expansion.</p> <p>Stability will depend on safety of the waste site, prompt payment and protection from injury. Serious injuries or infections could be life threatening.</p> <p>Waste pickers will require training and briefing on their rights, recyclable material, identifying hazardous material, etc.</p>
<p>Environment, health and safety</p>	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> </ul>	<p>High</p> <p>Low</p>	<p>Waste pickers are exposed to dangerous materials.</p>

	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Low</p> <p>Low</p> <p>Low</p>	
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>High</p> <p>High</p> <p>High</p>	<p>The conveyor belt will need space to function and for its storage.</p> <p>Ideally, wastes should be transported to a safe, shaded site for separation, rather than allowing the waste pickers to work <i>in-situ</i>.</p>

### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	Moderate	Compared to other separation technologies, manual separation has intermediate start-up costs e.g. salaries for the waste pickers, transportation costs (of personnel, wastes, recyclables, etc.), maintenance of the conveyor belt, etc.

Long-term factors	Operation and maintenance costs	Moderate	
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### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	High	Jobs may not have truly long term appeal as the economy improves and other jobs become available.
	Acceptability	Moderate	

## WASTE SEPARATION TECHNOLOGIES

### *Technology 2: Separation using a Trommel*

A trommel appears like a giant pipe with perforations. Solid wastes are inserted into the trommel which rotates and this causes the separation of the waste, based on size.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Moderate	The trommel is a large machine, making its transport difficult.
	Mobility	Low	

	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	Moderate	
	Extent of usage of local parts and components	Low	Spare parts may have to be supplied from the supplier
	Availability of local skills and capacities	Moderate	Once the machine is mastered, local capacity for planning and maintenance can be developed.
	Track record of performance and reliability	High	<b>As claimed by the manufacturer</b>
	Other technical factors:	High	
	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration</li> </ul>	High	<b>A trammel has a considerable load capacity and is generally a simple and robust machine.</b>
		Moderate	
		Moderate	
		Moderate	

	requirements, if any		
Environ-ment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Low</p> <p>Low</p> <p>Low</p> <p>Moderate</p> <p>Moderate</p>	
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>High</p> <p>High</p> <p>High</p>	<p>The trommel will need a large building for its storage, operations and maintenance.</p>

### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	
Long-term factors	Operation and maintenance costs	Moderate	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	

	Acceptability	Moderate	Will not create many new jobs.
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## WASTE SEPARATION TECHNOLOGIES

### *Technology 3: Jigging*

Jigging is the separation of solid waste based on gravity acting on various solid wastes of the different densities. The wastes are placed in a large body of water and separated accordingly.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Moderate	Electricity powered
	Mobility	Low	The wastes need to be transported for separation
	Compatibility with local natural conditions (topographical, climate etc.)	High	Jigging is influenced by pressure applied onto water during the process
	Compatibility with existing situations	Moderate	
	Extent of usage of local parts and components	High	Simple but sturdy design will suffice. An opportunity to innovate or build from recycled materials. Controls may not to be purchased elsewhere.
	Availability of local	High	

	<p>skills and capacities</p> <p>Track record of performance and reliability</p> <p>Compatibility with existing situations</p> <p>Other technical factors:</p> <ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>High</p> <p>Moderate</p>	<p>Will require upgrades to accommodate larger quantities.</p> <p>Will not require significant modification.</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Low</p> <p>Moderate</p> <p>Moderate</p> <p>Moderate</p>	<p>Will need to be careful around the water bath</p> <p>Children must be secured from the area</p> <p>Possible threat of water pollution</p> <p>Due to machine generating water velocity.</p> <p>Water should be changed frequently</p>
Installation	Requirements for		



## STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

## OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	High	The wastes need to be transported for separation
	Mobility	Low	
	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	High	An opportunity for local innovation and building using recycled materials
	Extent of usage of local parts and components	Moderate	
	Availability of local skills and capacities	Moderate	
	Track record of performance and reliability	Moderate	
	Compatibility with existing situations	High	Reliable technology
	Other technical factors:	High	

	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>Low</p>	<p>The process should be able to accommodate increases in waste volume</p> <p>Various parts are used to form the entire process.</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Low</p> <p>Moderate</p> <p>Low</p>	<p>The process itself does not smell.</p>
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> <p>Other requirements such as support</p>	<p>High</p> <p>High</p> <p>High</p>	

	structures, covered building etc.		
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### **FINANCIAL FACTORS**

<b>Issue</b>	<b>Factor</b>	<b>Decision</b>	<b>Notes</b>
Economic / financial factors	Capital investment	Moderate	
Long-term factors	Operation and maintenance costs	Moderate	

### **CUTURAL FACTORS**

<b>Issue</b>	<b>Factor</b>	<b>Decision</b>	<b>Notes</b>
Socio-cultural aspects	Income generation and job creation potential	High	Creates many jobs as there are several facets to the procedure.
	Acceptability	High	

## WASTE HANDLING TECHNOLOGIES

Waste handling technologies are defined here as the intermediate processing of solid wastes by modifying the physical or chemical structure of the solid wastes to facilitate the next/final treatment or disposal procedure. The technologies proposed here function to modify recyclable MSW or CDW into denser forms which can be transported more efficiently to a recycling facility.

Two methods of handling solid wastes are proposed:

- a. Pelletization – A process that merges aggregates or small particles into pellets by a combination of tumbling in horizontal rotating drums or inclined discs (Tugrul *et al.*, 2007) and drying.
- b. Compaction – Done to reduce the size of solid wastes and increase its density, making its transportation more efficient.
- c. Shredding – Shredding helps to reduce the size of the solid wastes in preparation for more efficient use in subsequent processing. It would best be considered as part of a downstream processing flow for solid wastes (rather than a treatment/disposal method).

## WASTE HANDLING TECHNOLOGIES

### *Technology 1: Pelletization*

Pelletization uses several mixing, heating and drying techniques to form pellets out of solid waste particles.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Moderate	

	Mobility	Low	
	Compatibility with local natural conditions (topographical, climate etc.)	Moderate	
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	Low	Will need replacement/servicing parts from its manufacturer.
	Availability of local skills and capacities	High	This technology has been used in Aceh previously.
	Track record of performance and reliability	Moderate	
	Other technical factors:		
	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> </ul>	Moderate	Overuse at the maximum production capacity will encourage premature wear or damage.
	<ul style="list-style-type: none"> <li>• Process stability (perform in a stable manner in various situations)</li> </ul>	Moderate	
	<ul style="list-style-type: none"> <li>• Ease of maintenance</li> </ul>	High	
	<ul style="list-style-type: none"> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if</li> </ul>	Moderate	

	any		
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>Workers</li> <li>Local community</li> <li>Environment</li> <li>Noise</li> <li>Odours</li> </ul>	<p>Low</p> <p>Low</p> <p>Low</p> <p>Moderate</p> <p>Moderate</p>	
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>Amount of space required for installing and operating the technology</li> <li>Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>Low</p> <p>Moderate</p> <p>Moderate</p>	<p>Storage and operation of the technology does not require large space.</p> <p>Will need a dry area and a source of clean water for cooling of the pellet</p>

## FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	Moderate	
Long-term factors	Operation and maintenance costs	Moderate	

## CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Low	

	Acceptability	Moderate	
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<b>WASTE HANDLING TECHNOLOGIES</b>
<i>Technology 2: Compaction</i>

Compaction physically reduces the size of solid wastes and increases its density, making its transportation or further processing more efficient.

**STRATEGIC FACTORS**

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

**OPERATIONAL FACTORS**

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	High	Some compactors are mobile but with lower capacity and short-term storage.
	Mobility	Moderate	
	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	Moderate	
	Availability of local skills and capacities	Moderate	
		High	<b>As claimed by the</b>

	<p>Track record of performance and reliability</p> <p>Other technical factors:</p> <ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>Moderate</p> <p>High</p> <p>Moderate</p> <p>High</p> <p>Low</p>	<p><b>manufacturer</b></p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Low</p> <p>Low</p> <p>High</p> <p>High</p>	
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> </ul>	<p>Moderate</p> <p>High</p>	<p>The exact requirement will depend on the kind of compactor.</p> <p>Mobile or permanent-</p>

	<ul style="list-style-type: none"> <li>Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	High	fixtures, compactors are large and will require storage space.
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	
Long-term factors	Operation and maintenance costs	Moderate	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	
	Acceptability	Moderate	

## WASTE HANDLING TECHNOLOGIES

### *Technology 3: Shredding*

A shredder facilitates size reduction and helps in waste handling. While shredders can be used in the management of MSW, e.g. organic solid wastes and wood (which tend to be softer), it should be applied only for appropriate C&D wastes – particularly wood and other vegetative matter.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

## OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	High	All shredders that are able to work on CDW and MSW are heavy and bulky, thus are immobile.
	Mobility	Low	
	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	High	This technology can be integrated easily into the process flow.
	Extent of usage of local parts and components	Moderate	Will need parts imported from overseas for the sake of compatibility.
	Availability of local skills and capacities	Moderate	<b>As claimed by the manufacturer</b>
	Track record of performance and reliability	High	
	Other technical factors:	Moderate	
	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a</li> </ul>	High	There is a limit to the shredding capacity, thus operational scale-up will need to take this into consideration.

	<p>stable manner in various situations)</p> <ul style="list-style-type: none"> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>Moderate</p> <p>High</p> <p>Low</p>	<p>Cutters and gears wear and tear.</p> <p>With proper maintenance, lifespan is expected to be high.</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p> <p>High</p> <p>High</p>	
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>Moderate</p> <p>High</p> <p>High</p>	<p>The exact space requirements will depend on the kind and capacity of shredder.</p> <p>Will require a permanent work site.</p>

## FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	
Long-term factors	Operation and	Moderate	

	maintenance costs		
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### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	While it creates jobs on its own, it could effect job availability of downstream processes (recycling, composting, etc.)
	Acceptability	Moderate	

## TECHNOLOGIES FOR BIOLOGICAL TREATMENT OF ORGANIC WASTES

Two biologically-centered technologies used in the treatment and value addition of organic wastes are (Agamuthu, 2001):

- a. Composting - Is the degradation of organic solid wastes into gases (carbon dioxide, CO<sub>2</sub>) and physical residue (compost) that increase soil fertility. Composting is carried out by microorganisms, ants and worms in the presence of oxygen. As the degradation process goes on, a reduction in the volume of the wastes occurs and the temperature increases, resulting in death of dangerous microorganisms in the wastes (Hargreaves *et al.*, 2007). The final product is economical and could be commercialized for profit.

Composting is common option in Europe Union member countries, as the EU Landfill Directive has pushed legislation to favor solid waste treatment that prevents environmental degradation, due to disposal of solid wastes in landfills. In China, compost finds use as landfill cover and as a nutrient and elemental supplement to agricultural and horticultural soils (Wei *et al.*, 2000).

- b. Biogasification – Is technically known as anaerobic digestion. It is the process where, in the absence of oxygen, organic wastes are degraded into gases (CO<sub>2</sub> and methane, CH<sub>4</sub>) and a digestate (or digested feedstock/sludge/slurry), which can be used to increase soil fertility (Rao *et al.*, 2000). Methane can be directed to houses in the area and can be used for cooking. Anaerobic digestion is also a popular waste treatment option in Europe (Agamuthu, 2001).

### ORGANIC WASTE TECHNOLOGIES

#### *Technology 1: Composting – Heap/Windrow Method*

Composting is the biological degradation of organic solid wastes into gases (carbon dioxide, CO<sub>2</sub>) and physical residue (compost) that can be used as a fertilizer.

#### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental	Meeting	Yes	

Policies	environmental policy objectives		
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### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Low	
	Mobility	High	Composting can be done in-situ, close to the organic waste site
	Compatibility with local natural conditions (topographical, climate etc.)	High	The local temperature encourages composting and microbial growth.
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	High	Only the principles of large-scale composting should be introduced. The technology will be developed locally.
	Availability of local skills and capacities	High	Composting has been done in Aceh or Indonesia before.
	Track record of performance and reliability	Moderate	Success significantly depends on the local weather and environment. Sudden changes may affect performance.
	Other technical factors: <ul style="list-style-type: none"> <li>Adaptability to future situations (potential for scale-up/expansion,</li> </ul>	High	There is no limit to how much organic waste that can be composted.

	upgrading, etc.) <ul style="list-style-type: none"> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	Moderate  Moderate  High  Low	Composting should be done within a strict temperature range to ensure a safe and complete product.  Compost will need monitoring and manual turning to ensure uniform heat dissipation and aeration.
Environment, health and safety	Risk level for: <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	Low Low  Low Low Moderate	Will release bad smell if the ideal temperature range is not met, or if the compost heap is too wet or becomes devoid of oxygen,
Installation	Requirements for installation: <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul>	High          Low          High	The compost heaps will require a large area, with a roof.

	Other requirements such as support structures, covered building etc.		
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	Moderate	
Long-term factors	Operation and maintenance costs	Low	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	
	Acceptability	High	

## ORGANIC WASTE TECHNOLOGIES

### *Technology 2: Biogasification (Anaerobic Digestion)*

Here, oxygen is removed in the solid waste treatment tank and organic solid wastes are degraded into gases and a digestate, which can be used as a liquid fertilizer for soil.

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Low	

	Mobility	Low	Ideally, the organic wastes should be brought to a different site for the process to occur.
	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	Moderate	To fully utilize the methane, a gas piping system will be required.
	Availability of local skills and capacities	Moderate	
	Track record of performance and reliability	Moderate	
	Other technical factors:		
	<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> </ul>	High	There is no limit to how much organic waste that can be digested.
	<ul style="list-style-type: none"> <li>• Process stability (perform in a stable manner in various situations)</li> </ul>	Moderate	
	<ul style="list-style-type: none"> <li>• Ease of maintenance</li> </ul>	Moderate	
	<ul style="list-style-type: none"> <li>• Expected technology lifespan</li> </ul>	High	
		Low	

	<ul style="list-style-type: none"> <li>• Calibration requirements, if any</li> </ul>		
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Low</p> <p>Low</p> <p>Low</p> <p>Moderate</p>	Personnel must be careful around the digesting area/pit
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> <p>Other requirements such as support structures, covered building etc.</p>	<p>High</p> <p>Moderate</p> <p>High</p>	

### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	
Long-term factors	Operation and maintenance costs	Moderate	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural	Income generation	Moderate	

aspects	and job creation potential  Acceptability	High	If methane can be generated at sufficient quantities consistently, it will become a cheap source of energy for cooking.
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## OTHER TECHNOLOGIES

There are several technologies that can also be used in the management of MSW and CDW.

Disposal in landfills is a common final solution as landfills are able to handle all materials in the waste stream (Agamuthu, 2001). Natural microbial and chemical degradation in landfills facilitate the breakdown of waste. However, disposal in landfills has the most significant environmental impact (Tam & Tam, 2006). There are several types of landfills, the most common being sanitary landfills and open dumps (United Nations Environment Programme, 2004). A sanitary landfill would be the best option for waste disposal available to a developing nation as the technology is flexible and simple (United Nations Environment Programme, 2005). Wastes are transported to the sanitary landfill and layers of soil are placed over the wastes. It is important that the wastes be completely sorted so all recyclable material is salvaged before final disposal.

Waste reduction is also another technology in the management of solid wastes. It concerns itself with analyzing the process that generates waste, applying several principles in waste reduction and reducing wastes without affecting the product output. Waste reduction is the epitome of sound waste management. It involves life cycle analysis of the process in question, education of all stake holders on the importance of waste minimization and discipline/diligence on the part of the process operators. Waste reduction is supported by an ICT infrastructure which forms part of its technology (computers/laptops, modeling software, the internet, electronic references, electronic readers/meters and gauges, mobile laboratory equipment and cell phones for communication).

## OTHER TECHNOLOGIES

### *Technology 1: Sanitary Landfill*

Disposal in landfills is a common final solution in solid waste management as landfills will hold and allow all materials in the waste stream to naturally degrade. Some wastes degrade at a very slow rate and can function as persistent environmental pollutants. The most common types of landfills are the sanitary landfills and open dumps. While not a viable long-term solution to waste disposal, landfills facilitate waste separation and recycling, with the action of waste-pickers.

## STRATEGIC FACTORS

Issue	Factor	Decision	Notes
Compliance	Compliance with local laws	Yes	<b>Specific local laws may vary</b>
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Low	
	Mobility	Low	Wastes should be transported for final disposal
	Compatibility with local natural conditions (topographical, climate etc.)	High	Humidity and tropical temperature facilitates breakdown of wastes
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	High	
	Availability of local skills and capacities	Moderate / High	A landfill is simple to maintain
	Track record of performance and reliability	Moderate	Irresponsible dumping and lack of maintenance can have adverse environmental effects
	Compatibility with existing situations	High	
	Other technical factors: <ul style="list-style-type: none"> <li>Adaptability to future situations (potential for</li> </ul>	Moderate	Expansion of a sanitary landfill requires more land and possibly lining

	<p>scale-up/expansion, upgrading, etc.)</p> <ul style="list-style-type: none"> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>High</p> <p>Low / moderate</p> <p>High</p> <p>Low</p>	<p>of the earth used</p> <p>Provided periodic maintenance is conducted and wastes are not arbitrarily dumped</p> <p>Landfill is a simple technology</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Moderate</p> <p>Low</p> <p>Moderate / High</p> <p>Low</p> <p>Moderate / High</p>	<p>The public should not be allowed in a landfill unnecessarily</p> <p>Municipal solid waste or hazardous wastes could leach into soil or nearby water sources. Potential emission of certain gas also exists</p> <p>Potentially from the emission of hydrogen sulphide, methane, etc.</p>
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components</li> </ul>	<p>High</p> <p>High</p>	<p>Landfills operations should be large to be worthwhile</p> <p>Bulldozers to transport soil and lorries will need large space.</p>

	when not in use Other requirements such as support structures, covered building etc.	Low	Provided periodic maintenance is conducted and wastes are not arbitrarily dumped
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	High	
Long-term factors	Operation and maintenance costs	Low	

### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Moderate	Onsite waste sorting to recover recyclables is possible, before layers of soil are placed over the wastes
	Acceptability	Moderate	Could meet opposition due to odours and aesthetics

## OTHER TECHNOLOGIES

### *Technology 2: Waste Minimization*

Waste reduction is a waste management strategy that aims to prevent wastes from being produced as much as possible. It involves life cycle analysis of the process in question, education of all stakeholders on the importance of waste minimization and discipline/diligence on the part of the process operators. It is supported by an ICT infrastructure which forms part of its technology (computers/laptops, modeling software, the internet, electronic references, electronic readers/meters and gauges, mobile laboratory equipment and cell phones for communication).

### STRATEGIC FACTORS

Issue	Factor	Decision	Notes
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Compliance	Compliance with local laws	Yes	
Environmental Policies	Meeting environmental policy objectives	Yes	

### OPERATIONAL FACTORS

Issue	Factor	Decision	Notes
Technical Suitability	Energy/resource consumption	Low	
	Mobility	High	Waste minimization technology and its principles can be applied to many processes and projects
	Compatibility with local natural conditions (topographical, climate etc.)	High	
	Compatibility with existing situations	High	
	Extent of usage of local parts and components	High	Local experts can innovate and incorporate local products, laws or culture into waste minimization principles
	Availability of local skills and capacities	High	Training and local capacity development can play an important future role
	Track record of performance and reliability	High	As the technology is adaptable and tailored for specific processes, performance and reliability is assured
	Compatibility with existing situations	High	
Other technical			

	<p>factors:</p> <ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	<p>High</p> <p>Moderate</p> <p>High</p> <p>High</p> <p>Moderate</p>	<p>Reliability under extreme processing conditions should be thoroughly assessed</p> <p>A process or construction project with waste minimization technology will require some calibration</p>
Environment, health and safety	<p>Risk level for:</p> <ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	<p>Low</p> <p>Low</p> <p>Low</p> <p>Low</p> <p>Low</p>	<p>Waste minimization will benefit all stake holders, the surrounding human community and the environment</p>
Installation	<p>Requirements for installation:</p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in</li> </ul>	<p>Low / Moderate</p> <p>Low / Moderate</p>	<p>Might involve installation of new/additional monitoring equipment</p>

	use Other requirements such as support structures, covered building etc.	Low	
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### FINANCIAL FACTORS

Issue	Factor	Decision	Notes
Economic / financial factors	Capital investment	Moderate	Consultancy fees and trial runs of the process may incur extra costs
Long-term factors	Operation and maintenance costs	Low	

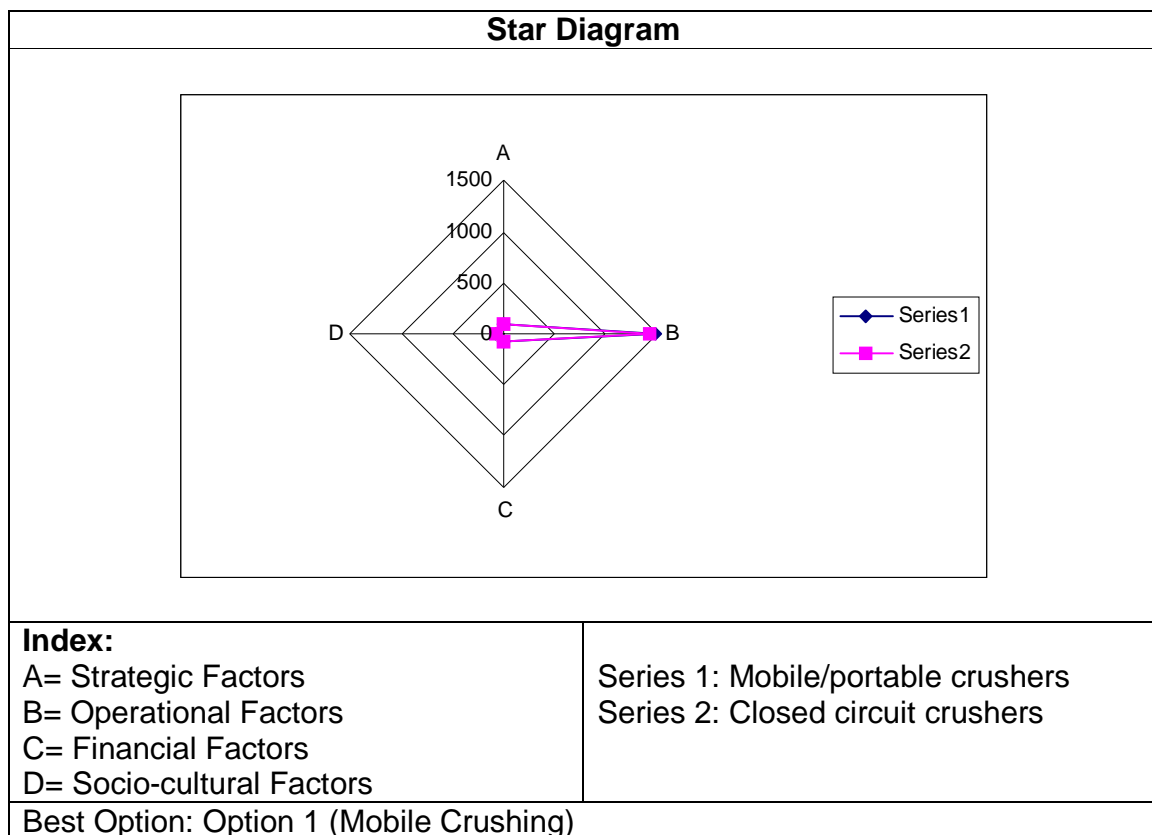
### CUTURAL FACTORS

Issue	Factor	Decision	Notes
Socio-cultural aspects	Income generation and job creation potential	Low	“Lean and mean” processing operations may reduce jobs in the operation in questions  May meet some consternation among practitioners of existing technology or those whose jobs are affected, but should meet acceptance of the public
	Acceptability	Moderate	

## CONCLUSION - IDENTIFICATION OF TECHNOLOGIES

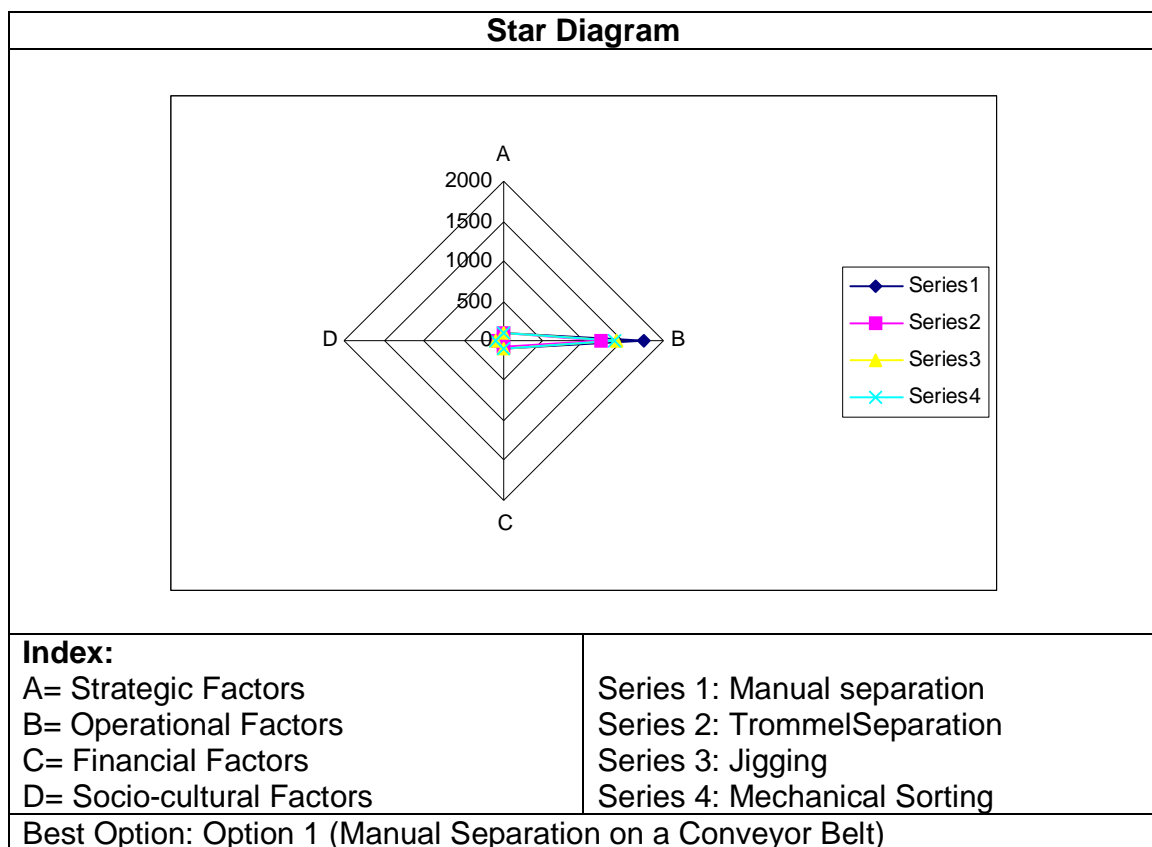
### SIZE REDUCTION TECHNOLOGIES

Assessment Criteria	Score and Rank Option 1: <i>Mobile/Portable Crushers</i>	Score and Rank Option 2: <i>Closed circuit Crushing</i>
Strategic Factors		
Total Score	100	100
Rank	<b>equal</b>	<b>equal</b>
Operational Factors		
Total Score	1488	1420
Rank	<b>1</b>	<b>2</b>
Financial Factors		
Total Score	77	77
Rank	<b>equal</b>	<b>equal</b>
Socio-cultural Factors		
Total Score	70	70
Rank	<b>equal</b>	<b>equal</b>
<b>Total Score</b>	<b>1735</b>	<b>1667</b>



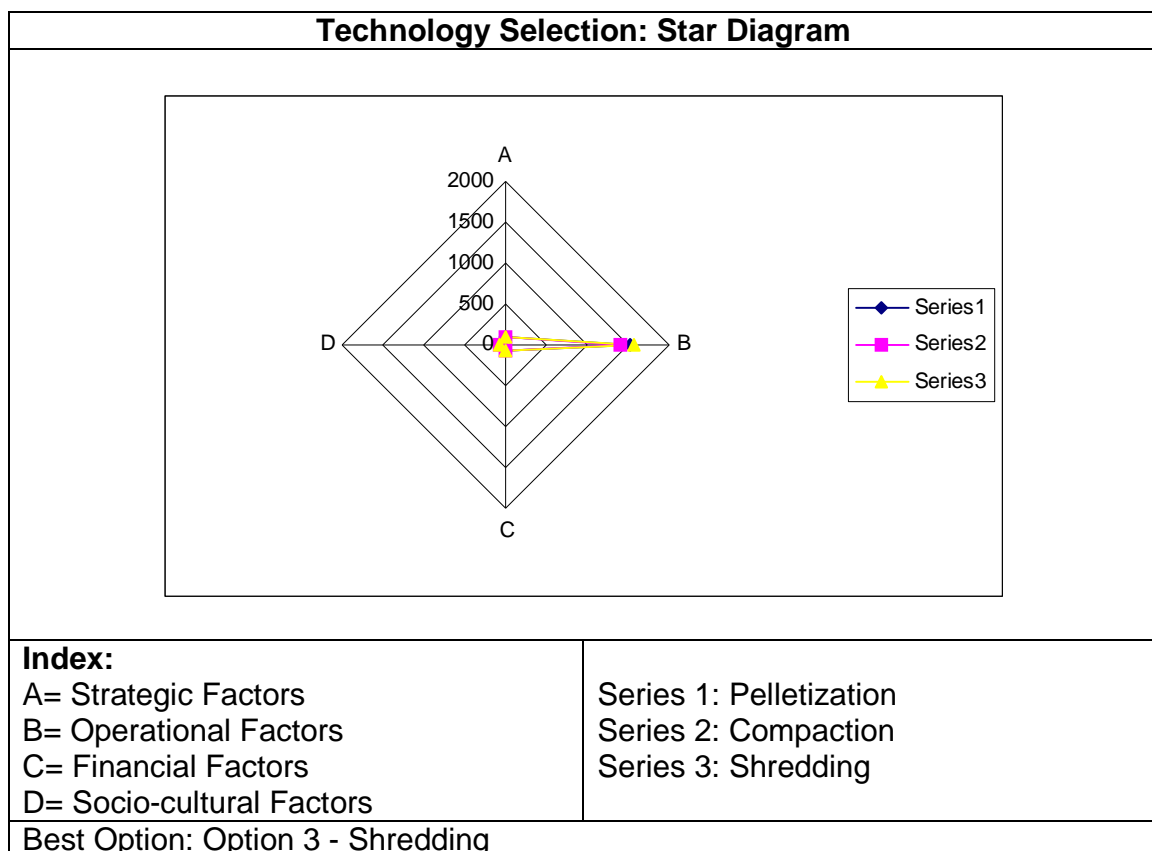
## SORTING TECHNOLOGIES

Assessment Criteria	Score and Rank Option 1: <i>Manual separation</i>	Score and Rank Option 2: <i>Trommel Separation</i>	Score and Rank Option 3: <i>Jigging</i>	Score and Rank Option 4: <i>Mechanical Sortin</i>
Strategic Factors Total Score Rank	100 <b>equal</b>	100 <b>equal</b>	100 <b>equal</b>	100 <b>equal</b>
Operational Factors Total Score Rank	1746 <b>1</b>	1226 <b>4</b>	1416 <b>2</b>	1386 <b>3</b>
Financial Factors Total Score Rank	98 <b>equal</b>	77 <b>2</b>	98 <b>equal</b>	98 <b>equal</b>
Socio-cultural Factors Total Score Rank	85 <b>2</b>	70 <b>3</b>	100 <b>equal</b>	100 <b>equal</b>
Total Score	2029	1473	1714	1684



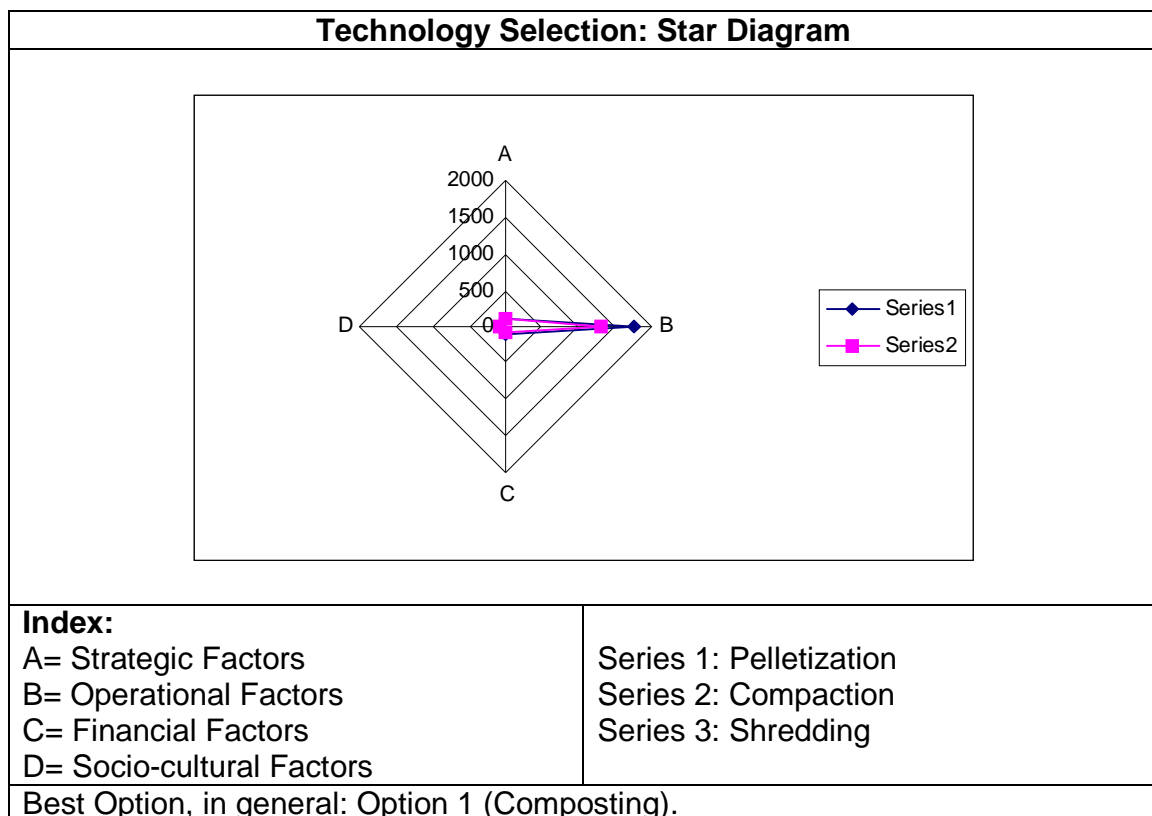
## WASTE HANDLING TECHNOLOGIES

Assessment Criteria	Score and Rank Option 1: <i>Pelletization</i>	Score and Rank Option 2: <i>Compaction</i>	Score and Rank Option 3: <i>Shredding</i>
Strategic Factors Total Score Rank	100 <b>equal</b>	100 <b>equal</b>	100 <b>equal</b>
Operational Factors Total Score Rank	1532 <b>2</b>	1400 <b>3</b>	1544 <b>1</b>
Financial Factors Total Score Rank	77 <b>equal</b>	77 <b>equal</b>	77 <b>equal</b>
Socio-cultural Factors Total Score Rank	55 <b>3</b>	70 <b>2</b>	80 <b>1</b>
Total Score	1764	1647	1801



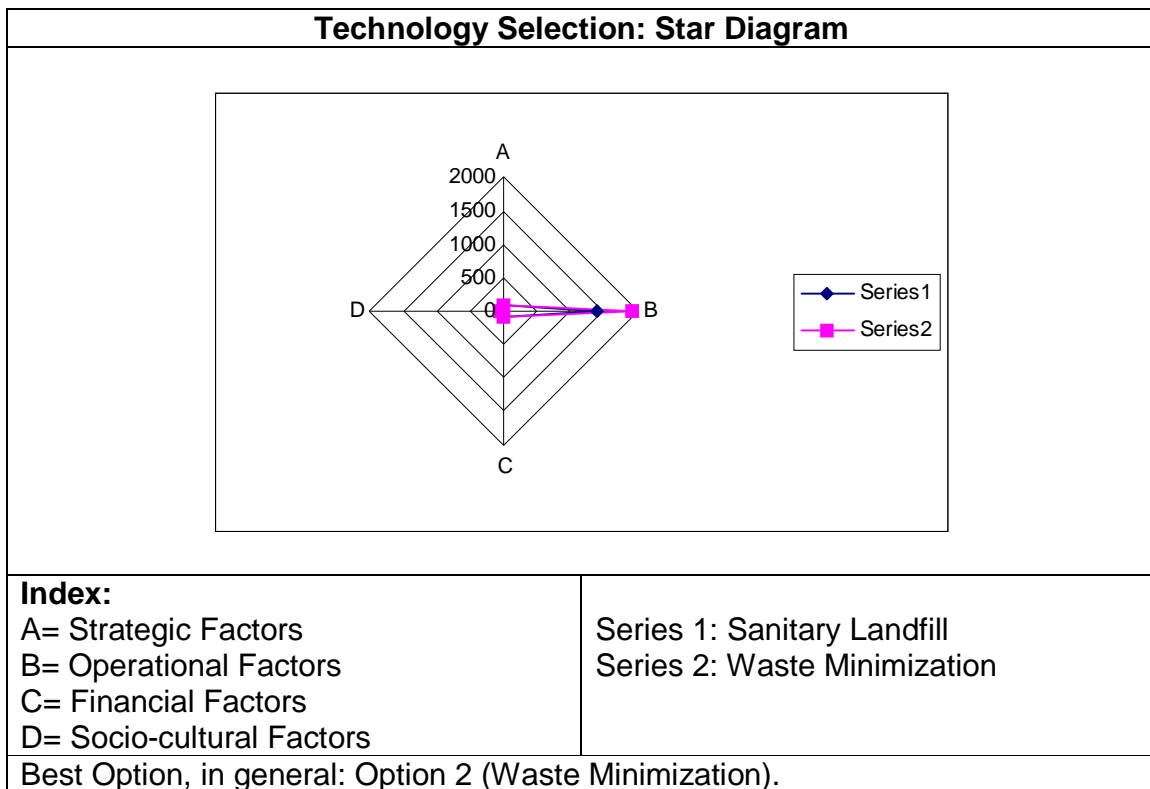
## TECHNOLOGIES FOR BIOLOGICAL TREATMENT OF ORGANIC WASTES

Assessment Criteria	Score and Rank Option 1: <i>Composting</i>	Score and Rank Option 2: <i>Biogasification</i>
Strategic Factors Total Score Rank	100 <b>equal</b>	100 <b>equal</b>
Operational Factors Total Score Rank	1772 <b>1</b>	1310 <b>2</b>
Financial Factors Total Score Rank	119 <b>1</b>	77 <b>2</b>
Socio-cultural Factors Total Score Rank	85 <b>1</b>	80 <b>2</b>
<b>Total Score</b>	<b>2076</b>	<b>1567</b>



## OTHER TECHNOLOGIES

Assessment Criteria	Score and Rank Option 1: <i>Sanitary Landfill</i>	Score and Rank Option 2: <i>Waste Minimization</i>
Strategic Factors Total Score Rank	100 <b>equal</b>	100 <b>equal</b>
Operational Factors Total Score Rank	1404 <b>2</b>	1914 <b>1</b>
Financial Factors Total Score Rank	98 <b>1</b>	77 <b>2</b>
Socio-cultural Factors Total Score Rank	70 <b>1</b>	55 <b>2</b>
<b>Total Score</b>	<b>1672</b>	<b>2146</b>



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## APPENDIX (CALCULATIONS)

Tables A1 – A13 show the score calculations, with explanation of scores and weights in Annex 1.

**Table A1. Size Reduction Technology 1: Mobile/Portable Crushers**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	7	10	70	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	4	10	40	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	10	10	100	
Compatibility with existing situations	4	10	40	
Other technical factors: <ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> <li>• Process stability</li> </ul>	10	10	100	

(perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	7	10	70	
• Expected technology lifespan	4	10	40	<b>930</b>
• Calibration requirements, if any				
Risk level for:				
• Workers	7	10	70	
• Local community	7	10	70	
• Environment	7	10	70	
• Noise	4	10	40	
• Odours	7	10	70	
• Airborne particles	7	10	70	<b>390</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	10	8	80	
• Storage of technology components when not in use	7	8	56	
Other requirements such as support structures, covered building etc.	4	8	32	<b>168</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	
Acceptability	7	5	35	<b>70</b>

**FINAL SCORE:**

**1735**

**Table A2. Size Reduction Technology 2: Closed Circuit Crushing**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	4	10	40	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	4	10	40	
Availability of local skills and capacities	4	10	40	
Track record of performance and reliability	10	10	100	
Compatibility with existing situations	10	10	100	
Other technical factors: • Adaptability to future	7	10	70	

situations (potential for scale-up/expansion, upgrading, etc.)	10	10	100	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	7	10	70	
• Expected technology lifespan	4	10	40	<b>910</b>
• Calibration requirements, if any				
Risk level for:				
• Workers	7	10	70	
• Local community	7	10	70	
• Environment				
• Noise	7	10	70	
• Odours	4	10	40	
• Airborne particles	7	10	70	
	7	10	70	<b>390</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	4	8	32	
• Storage of technology components when not in use	7	8	56	
Other requirements such as support structures, covered building etc.	4	8	32	<b>120</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	

Acceptability	7	5	35	<b>70</b>
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**FINAL SCORE:**

**1667**

SIZE REDUCTION TECHNOLOGY	FINAL SCORE
Mobile/Portable Crushers	<b>1735</b>
Closed Circuit Crushing	<b>1667</b>

**Table A3. Sorting Technology 1: Manual Separation on a Conveyor Belt**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	10	10	100	
Mobility	10	10	100	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	10	10	100	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	10	10	100	
Compatibility with existing				

situations	10	10	100	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	70	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	10	10	100	
• Calibration requirements, if any				<b>1210</b>
Risk level for:				
• Workers	4	10	40	
• Local community	10	10	100	
• Environment	10	10	100	
• Noise	10	10	100	
• Odours	10	10	100	<b>440</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	4	8	32	
• Storage of technology components when not in use	4	8	32	
Other requirements such as support structures, covered building etc.	4	8	32	<b>96</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	49	
Operation and maintenance costs	7	7	49	<b>98</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total</b>	<b>Grand</b>

			<b>Score</b>	<b>Total</b>
Income generation and job creation potential	10	5	50	
Acceptability	7	5	35	<b>85</b>

**FINAL SCORE:**

**2029**

**Table A4. Sorting Technology 2: Separation using a Trommel**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	7	10	70	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	7	10	70	
Extent of usage of local parts and components	4	10	40	
Availability of local skills and capacities	4	10	40	
Track record of performance and reliability	10	10	100	
Other technical factors:				
<ul style="list-style-type: none"> <li>• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> </ul>	10	10	100	
<ul style="list-style-type: none"> <li>• Process stability (perform in a stable</li> </ul>				

manner in various situations)	7	10	70	
• Ease of maintenance	7	10	70	
• Expected technology lifespan	7	10	70	
• Calibration requirements, if any				<b>870</b>
Risk level for:				
• Workers	4	10	40	
• Local community	4	10	40	
• Environment	4	10	40	
• Noise	7	10	70	
• Odours	7	10	70	<b>260</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	4	8	32	
• Storage of technology components when not in use	4	8	32	
Other requirements such as support structures, covered building etc.	4	8	32	<b>96</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	
Acceptability	7	5	35	<b>70</b>
<b>FINAL SCORE:</b>				<b>1473</b>

**Table A5. Sorting Technology 3: Jigging**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
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Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	7	10	70	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	7	10	70	
Extent of usage of local parts and components	10	10	100	
Availability of local skills and capacities	10	10	100	
Track record of performance and reliability	7	10	70	
Compatibility with existing situations	7	10	70	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	7	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	7	10	70	
• Calibration requirements, if any				<b>1000</b>
Risk level for:				

<ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	7 4 7 7 7	10 10 10 10 10	70 40 70 70 70	<b>320</b>
Requirements for installation: <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul> Other requirements such as support structures, covered building etc.	4  4  4	8  8  8	32  32  32	<b>96</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	49	
Operation and maintenance costs	7	7	49	<b>98</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	10	5	50	
Acceptability	10	5	50	<b>100</b>

**FINAL SCORE:**

**1714**

**Table A6. Sorting Technology 4: Mechanical Sorting Process**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	10	10	100	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	7	10	70	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	7	10	70	
Compatibility with existing situations	10	10	100	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	7	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	7	10	70	
• Expected technology lifespan	4	10	40	
• Calibration				<b>1000</b>

requirements, if any				
Risk level for:				
• Workers	7	10	70	
• Local community	7	10	70	
• Environment	4	10	40	
• Noise	7	10	70	
• Odours	4	10	40	<b>290</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	4	8	32	
• Storage of technology components when not in use	4	8	32	
Other requirements such as support structures, covered building etc.	4	8	32	
				<b>96</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	49	
Operation and maintenance costs	7	7	49	<b>98</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	10	5	50	
Acceptability	10	5	50	<b>100</b>

**FINAL SCORE:**

**1684**

WASTE SORTING TECHNOLOGY	FINAL SCORE
Manual Separation on a Conveyor Belt	<b>2029</b>
Separation using a Trommel	<b>1473</b>
Jigging	<b>1714</b>
Mechanical Sorting Process	<b>1684</b>

**Table A7. Waste Handling Technologies 1: Pelletization**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	7	10	70	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	4	10	40	
Availability of local skills and capacities	10	10	100	
Track record of performance and reliability	7	10	70	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	7	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	7	10	70	
• Calibration requirements, if any				
Risk level for:				<b>900</b>

<ul style="list-style-type: none"> <li>Workers</li> <li>Local community</li> <li>Environment</li> <li>Noise</li> <li>Odours</li> </ul>	10 10 10 7 7	10 10 10 10 10	100 100 100 70 70	<b>440</b>
Requirements for installation: <ul style="list-style-type: none"> <li>Amount of space required for installing and operating the technology</li> <li>Storage of technology components when not in use</li> </ul> Other requirements such as support structures, covered building etc.	10 7 7	8 8 8	80 56 56	<b>192</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	4	5	20	
Acceptability	7	5	35	<b>55</b>

**FINAL SCORE:**

**1764**

**Table A8. Waste Handling Technologies 2: Compaction**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	4	10	40	

Mobility	7	10	70	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	7	10	70	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	100	10	100	
Other technical factors:	7	10	70	
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	10	10	100	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	4	10	40	
• Calibration requirements, if any				<b>930</b>
Risk level for:				
• Workers	7	10	70	
• Local community	10	10	100	
• Environment	10	10	100	
• Noise	4	10	40	
• Odours	4	10	40	<b>350</b>
Requirements for installation:				
• Amount of space required for	7	8	56	

installing and operating the technology				
<ul style="list-style-type: none"> <li>Storage of technology components when not in use</li> </ul>	4	8	32	
Other requirements such as support structures, covered building etc.	4	8	32	<b>120</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	
Acceptability	7	5	35	<b>70</b>

**FINAL SCORE:**

**1647**

**Table A9. Waste Handling Technologies 3: Shredding**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	5	10	50	
Mobility	6	10	60	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
	10	10	100	

Compatibility with existing situations				
Extent of usage of local parts and components	8	10	80	
Availability of local skills and capacities	9	10	90	
Track record of performance and reliability	10	10	100	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	10	10	100	
• Process stability (perform in a stable manner in various situations)	10	10	100	
• Ease of maintenance	9	10	90	
• Expected technology lifespan	10	10	100	
• Calibration requirements, if any	10	10	100	<b>1070</b>
Risk level for:				
• Workers	8	10	80	
• Local community	8	10	80	
• Environment	8	10	80	
• Noise	4	10	40	
• Odours	5	10	50	<b>330</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	8	8	64	
• Storage of technology components when not in use	5	8	40	
Other requirements such	5	8	40	

as support structures, covered building etc.				<b>144</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	8	5	40	
Acceptability	8	5	40	<b>80</b>

**FINAL SCORE:**

**1617**

WASTE HANDLING TECHNOLOGY	FINAL SCORE
Pelletization	<b>1764</b>
Compaction	<b>1647</b>
<b>Shredding</b>	<b>1801</b>

**Table A10. Technologies for Biological Treatment of Organic Wastes 1: Composting**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	10	10	100	
Mobility	10	10	100	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing	10	10	100	

situations	10	10	100	
Extent of usage of local parts and components	10	10	100	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	10	10	100	
Other technical factors:				
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	7	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	10	10	100	
• Calibration requirements, if any				
				<b>1110</b>
Risk level for:				
• Workers	10	10	100	
• Local community	10	10	100	
• Environment	10	10	100	
• Noise	10	10	100	
• Odours	7	10	70	
				<b>470</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	10	8	80	
• Storage of technology components when not in use	4	8	32	
Other requirements such as support structures,	10	8	80	
				<b>192</b>

covered building etc.				
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	49	
Operation and maintenance costs	10	7	70	<b>119</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	
Acceptability	10	5	50	<b>85</b>

**FINAL SCORE:**

**2076**

**Table A11. Technologies for Biological Treatment of Organic Wastes 1: Biogasification**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	10	10	100	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	7	10	70	
Availability of local skills and capacities	7	10	70	

Track record of performance and reliability	7	10	70	
Other technical factors:	10	10	100	
• Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)	7	10	70	
• Process stability (perform in a stable manner in various situations)	7	10	70	
• Ease of maintenance	10	10	100	
• Expected technology lifespan	4	10	40	<b>930</b>
• Calibration requirements, if any				
Risk level for:				
• Workers	7	10	70	
• Local community	4	10	40	
• Environment	4	10	40	
• Noise	4	10	40	
• Odours	7	10	70	<b>260</b>
Requirements for installation:				
• Amount of space required for installing and operating the technology	4	8	32	
• Storage of technology components when not in use	7	8	56	
Other requirements such as support structures, covered building etc.	4	8	32	<b>120</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	7	7	49	<b>77</b>

<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	
Acceptability	10	5	50	<b>80</b>

**FINAL SCORE:**

**1567**

SIZE REDUCTION TECHNOLOGY	FINAL SCORE
Composting	<b>2076</b>
Biogasification	<b>1567</b>

**Table A12. Other Technologies 1: Sanitary Landfill**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	4	10	40	
Mobility	4	10	40	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	10	10	100	
Availability of local skills and capacities	7	10	70	
Track record of performance and reliability	7	10	70	
Compatibility with existing situations	10	10	100	
Compatibility with existing situations	7	10	70	

Other technical factors:				
<ul style="list-style-type: none"> <li>Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> </ul>	10	10	100	
<ul style="list-style-type: none"> <li>Process stability (perform in a stable manner in various situations)</li> </ul>	4	10	40	
	10	10	100	
<ul style="list-style-type: none"> <li>Ease of maintenance</li> </ul>	4	10	40	
<ul style="list-style-type: none"> <li>Expected technology lifespan</li> </ul>				
<ul style="list-style-type: none"> <li>Calibration requirements, if any</li> </ul>				
				<b>970</b>
Risk level for:				
<ul style="list-style-type: none"> <li>Workers</li> </ul>	7	10	70	
<ul style="list-style-type: none"> <li>Local community</li> </ul>	4	10	40	
<ul style="list-style-type: none"> <li>Environment</li> </ul>	7	10	70	
<ul style="list-style-type: none"> <li>Noise</li> </ul>	4	10	40	
<ul style="list-style-type: none"> <li>Odours</li> </ul>	7	10	70	
				<b>290</b>
Requirements for installation:				
<ul style="list-style-type: none"> <li>Amount of space required for installing and operating the technology</li> </ul>	4	8	32	
<ul style="list-style-type: none"> <li>Storage of technology components when not in use</li> </ul>	4	8	32	
Other requirements such as support structures, covered building etc.	10	8	80	
				<b>144</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	4	7	28	
Operation and maintenance costs	10	7	70	<b>98</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	7	5	35	

Acceptability	7	5	35	<b>70</b>
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**FINAL SCORE:**

**1672**

**Table A13. Other Technology 2: Waste Reduction**

**STRATEGIC FACTORS**

<b>Strategic Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Compliance	10	5	50	
Environmental Policies	10	5	50	<b>100</b>
<b>Operational Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Energy/resource consumption	10	10	100	
Mobility	10	10	100	
Compatibility with local natural conditions (topographical, climate etc.)	10	10	100	
Compatibility with existing situations	10	10	100	
Extent of usage of local parts and components	10	10	100	
Availability of local skills and capacities	10	10	100	
Track record of performance and reliability	10	10	100	
Compatibility with existing situations	10	10	100	
Other technical factors: <ul style="list-style-type: none"> <li>Adaptability to future situations (potential for scale-up/expansion, upgrading, etc.)</li> </ul>	10	10	100	

<ul style="list-style-type: none"> <li>• Process stability (perform in a stable manner in various situations)</li> <li>• Ease of maintenance</li> <li>• Expected technology lifespan</li> <li>• Calibration requirements, if any</li> </ul>	10 10	10 10	100 100	<b>1270</b>
Risk level for:				
<ul style="list-style-type: none"> <li>• Workers</li> <li>• Local community</li> <li>• Environment</li> <li>• Noise</li> <li>• Odours</li> </ul>	10 10 10 10 10	10 10 10 10 10	100 100 00 100 100	
Requirements for installation:				
<ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> </ul>	7 7	8 8	56 56	
Other requirements such as support structures, covered building etc.	4	8	32	<b>144</b>
<b>Financial Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Capital investment	7	7	49	
Operation and maintenance costs	4	7	28	<b>77</b>
<b>Cultural Factors</b>	<b>Score</b>	<b>Weight</b>	<b>Total Score</b>	<b>Grand Total</b>
Income generation and job creation potential	4	5	20	
Acceptability	7	5	35	<b>55</b>

**FINAL SCORE:**

**2146**

OTHER TECHNOLOGY	FINAL SCORE
Sanitary Landfill	<b>1672</b>
Waste Minimization	<b>2146</b>

## ANNEX 1

<b>1</b>	<i>Technology Identification and Selection</i>
<b>Strategic factors</b>	

The key objective of the set of factors related to strategic assessment is to ensure compatibility and conformity of the technology options with governmental policies and programmes related to environmental and sustainability, waste management, technology and related issues<sup>2</sup>.

It specifically looks at the compliance of the technology with relevant laws and legislation related to environment and sustainability, waste management and disaster preparedness. The assessment is broad-based, at the macro level, and provides descriptive explanation of the issues involved.

For the assessment, descriptions and data values as applicable for each factor, and reasons for each factor's rank (low, medium or high) need to be mentioned.

Issue	Factor	Explanation
Compliance	<i>Compliance with local and national environmental laws, legislation, regulations etc., including multilateral environmental agreements (MEAs) if applicable.</i>	<p>YES/NO</p> <p>The technology options should be compliant with local environmental legislation and rules/regulations.</p> <p>Information from technology fact sheets, technology vendors and expert opinion if necessary is used for decisions on this factor.</p>
Environmental policies	<i>Meeting environmental policy objectives such as 3Rs, disaster preparedness and management planning etc.</i>	<p>YES/NO</p> <p>The technology options should meet stated government policies and objectives on related issues: environment, disasters, health et al.</p> <p>Information from</p>

<sup>2</sup> For example, the new National Waste Management Law of the Government of Indonesia, that will come into effect in late 2007.

		technology fact sheets, expert opinions and information from vendors is used for decisions on this factor.
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<b>2</b>	<i>Technology Identification and Selection</i>
	<b>Operational factors</b>

Operational factors are based on a thorough technical analysis of the technology options that includes its potential environmental impacts.

The operational factors included for assessment include its technical suitability, environment/health/safety and installation issues. The assessment is specific to the issues/factors outlined below and is evaluated based on a ranked scoring for each item.

For the assessment, descriptions and data values for each factor, and reasons for each factor's rank (low, medium or high) need to be mentioned.

Issue	Factor	Explanation
Technical suitability	<p><i>Energy/resource consumption:</i></p> <ul style="list-style-type: none"> <li>• <i>Fuel</i></li> <li>• <i>Electricity</i></li> <li>• <i>Steam</i></li> <li>• <i>Water</i></li> <li>• <i>Other resources</i></li> </ul>	<p>LOW/MEDIUM/HIGH (<u>Note</u>: Low consumption = high score)</p> <p>Quantity per hour</p> <p>The technology's need for various resources is assessed here.</p> <p>Information from vendors, technology fact sheets and expert opinions can be used to take decisions on this factor.</p>

	<i>Mobility</i>	<p>LOW/MEDIUM/HIGH</p> <p>Depending on the location of the disaster or need for C&amp;D waste processing, the technologies will have to be mobile, transported as self-mobile equipment, or on trucks.</p> <p>Information from vendors, technology fact sheets and expert opinions can be used to take decisions on this factor.</p>
	<i>Compatibility with local natural conditions (topographical, climate etc.)</i>	<p>LOW/MEDIUM/HIGH</p> <p>For the optimal performance of the technology, it is necessary to check compatibility with local natural conditions and climate (including contamination, topographical suitability etc.)</p> <p>Information from technology fact sheets, expert opinions and information from vendors is used to take decisions on this factor.</p>
	<i>Extent of usage of local parts and components</i>	<p>LOW/MEDIUM/HIGH</p> <p>Preference should be given to use of local parts and components for both cost as well as social reasons</p> <p>Information from vendors and technology fact sheets is used to take decisions on this factor.</p>

	<i>Availability of local skills and capacities</i>	<p>LOW/MEDIUM/HIGH</p> <p>Preference is to be given to the availability of local skills and capacities for operation and management of the technology option. Information from vendors and technology fact sheets is used to take decisions on this factor.</p>
	<i>Track record of performance and reliability</i>	<p>LOW/MEDIUM/HIGH</p> <p>Track records of the technology and the vendor need to be checked to facilitate endorsement.</p> <p>Technology fact sheets, market intelligence, site visits to similar installations can help in deciding on this aspect.</p>
	<i>Compatibility with existing situations</i>	<p>LOW/MEDIUM/HIGH</p> <p>It is essential that the new system is compatible with the existing infrastructure (roads, electricity supply etc.) and technology systems as well as the local government's waste management systems.</p> <p>Expert opinions supplemented by the technology fact sheets and vendor information is used to take decisions on this factor.</p>
	<p><i>Other technical factors:</i></p> <ul style="list-style-type: none"> <li>• <i>Adaptability to future situations (potential for scale-up/expansion,</i></li> </ul>	<p>LOW/MEDIUM/HIGH</p> <p>Vendor information, technology fact sheets,</p>

	<p><i>upgrading, etc.)</i></p> <ul style="list-style-type: none"> <li>• <i>Process stability (perform in a stable manner in various situations)</i></li> <li>• <i>Ease of maintenance</i></li> <li>• <i>Expected technology lifespan</i></li> <li>• <i>Calibration requirements, if any</i></li> <li>•</li> </ul>	<p>expert opinions and case studies can be used to take decisions on this factor.</p>
<p>Environment, health and safety</p>	<p><i>Risk level for:</i></p> <ul style="list-style-type: none"> <li>• <i>Workers</i></li> <li>• <i>Local community</i></li> <li>• <i>Environment</i></li> <li>• <i>Noise</i></li> <li>• <i>Odours</i></li> </ul>	<p>LOW/MEDIUM/HIGH (<u>Note</u>: Low risk = high score)</p> <p>The technology's potential environmental, health and safety risks to the workers, communities as well as to the environment need to be assessed.</p> <p>Information from expert opinions and technology fact sheets, supplemented by risk assessment exercises where needed, can be used to take decisions on this factor.</p>
<p>Installation</p>	<p><i>Requirements for installation:</i></p> <ul style="list-style-type: none"> <li>• Amount of space required for installing and operating the technology</li> <li>• Storage of technology components when not in use</li> <li>• Other requirements such as support structures, covered building etc.</li> </ul>	<p>LOW/MEDIUM/HIGH (<u>Note</u>: Low need = high score)</p> <p>Depending on the technology, its installation requirements may vary.</p> <p>Information from expert opinions and technology fact sheets, case studies, and vendor information can be used to take decisions on this factor.</p>

### 3 Financial factors

Financial factors are based on the capital investment incurred in procuring, installing, operating and maintaining the technology. While detailed costs may be difficult to obtain at this stage, estimates can be used for this purpose.

Estimates for operation and maintenance of technologies are also used to assess viability. Additional factors related to the potential of jobs created or incomes generated are also taken into consideration.

For the assessment, descriptions and data values for each factor, and reasons for each factor's rank (low, medium or high) need to be mentioned.

Issue	Factor	Explanation
Economic / financial factors	<i>Capital investment</i>	<p>LOW/MEDIUM/HIGH (<u>Note</u>: Low investment = high score)</p> <p>This is a standard cost-benefit analysis that also looks into returns on investment.</p> <p>Vendor information and queries with vendors can be used to take decisions on this factor.</p>
Long-term factors	<i>Operation and maintenance costs</i>	<p>LOW/MEDIUM/HIGH (<u>Note</u>: Low cost = high score)</p>

### 4 Socio-cultural factors

Socio-cultural factors cover issues related to the local community where the technology will be installed, and includes issues such as job creation and income

generation potential, acceptability of the technology by the community, and other related issues.

For the assessment, descriptions and data values (if applicable) for each factor, and reasons for each factor's rank (low, medium or high) need to be mentioned.

Issue	Factor	Explanation
Socio-cultural aspects	<i>Income generation and job creation potential</i>	<p>LOW/MEDIUM/HIGH</p> <p>A key aspect of a technology is its ability to generate income and create jobs for the local community – (a) in operating and maintaining the technology, and (b) in using the technology's outputs for further processing and product development.</p> <p>Information from expert opinions and technology fact sheets, case studies, and vendor information can be used to take decisions on this factor.</p>
	<i>Acceptability</i>	<p>LOW/MEDIUM/HIGH</p> <p>Overall potential attitudes, views and impressions of the local community are determined here. Examples include:</p> <ul style="list-style-type: none"> <li>• Impacts/affects on daily life, if any</li> <li>• Impacts/affects on community areas</li> <li>• Community perceptions on health, safety, noise odour etc.</li> <li>• Trust in information provided</li> </ul> <p>Information is gathered from interviews with local political leaders, community leaders (Bupatis) and expert opinions.</p>

The technology identification and selection process consists of reviewing technology systems that deal with construction and demolition wastes. These technology systems are then subjected to an assessment by applying the four sets of sustainability factors indicated above to obtain a short list of technology options.

Therefore, the technology catalogue are ranked as indicated in the 'explanation' column – yes/no or low/medium/high, and a score is accordingly assigned to each of the factors

- YES=10; NO=3
- LOW=10; MEDIUM=7; HIGH=4.

*IMPORTANT: As indicated in the explanation column, the score values may have to be reversed in some cases – LOW=4; MEDIUM=7; HIGH=10.*

Based on the criticality of the technology's performance in the project area, the following weights have been assigned, taking into account the projects objectives and needs:

Assessment Factors	Criteria	Weight	
<b>Strategic factors</b>			
	Compliance	5	Total 10
	Environmental policies	5	
<b>Operational factors</b>			
	Technical suitability	10	Total 28
	Environment, health and safety	10	
	Installation	8	
<b>Financial factors</b>			
	Economic / financial factors	7	Total 14
	Long-term factors	7	
<b>Socio-cultural factors</b>			
	Socio-cultural aspects	5	Total 5

For each of the five technology systems that need to be assessed, two or three options are assessed and total scores calculated and indicated as in the table below:

Technology System:  
Option no.

<b>Assessment criteria</b>	<b>Score</b>	<b>Weight</b>	<b>Total score</b> <i>(score x weight)</i>
Strategic factors			
Operational factors			
Financial factors			
Socio-cultural factors			

The three options for each technology system are then ranked according to the total scores and presented as in the table below:

1. Technology System:

<b>Assessment criteria</b>	<b>Total score and Rank</b>		
	<b>Option 1</b>	<b>Option 2</b>	<b>Option 3</b>
Strategic factors	Total Score: Rank:	Total Score: Rank:	Total Score: Rank:
Operational factors	Total Score: Rank:	Total Score: Rank:	Total Score: Rank:
Financial factors	Total Score: Rank:	Total Score: Rank:	Total Score: Rank:
Socio-cultural factors	Total Score: Rank:	Total Score: Rank:	Total Score: Rank:

*Best option:*

Based on the information provided in the three options for each technology system, and the respective best option, the project partners will take a decision on the technology system and initiate the drawing of detailed specifications and procurement.