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**Ministry of Housing
and Urban Affairs**
Government of India



USER GUIDE FOR **Solid Waste - Appropriate Technologies (SW- APT)**

An Aid for Decision Making in Processing
and Disposal Technologies

CENTRAL PUBLIC HEALTH AND ENVIRONMENTAL ENGINEERING ORGANISATION

Brief introduction:

The “Solid Waste – Appropriate Technologies (SW-APT)” tool is an aid to decision making for processing and disposal technologies. The tool is based on excel and will support the decision makers, politicians, technical staff, urban planners from urban local bodies and states to find the most suitable and sustainable solutions for municipal solid waste management for their cities.

The purpose of this tool is to give a qualitative indication of technical options that exist for scientifically managing Municipal Solid Waste as per the Solid Waste Management Rules 2016 and its subsequent amendments and the Municipal Solid Waste Management Manual, 2016 of CPHEEO. The tool provides a scientific means to evaluate decisions of different waste treatment options in India including the relative impact of these systems on technical, economic, environmental, climate and social aspects.

Factors influencing the decision:

There are many factors that need to be considered while designing and selecting the appropriate waste management technology and system for a particular city or state. Several factors influence the decision for selection of an appropriate technology, as listed below:

- Quantum of waste - influenced by the population, per capita waste generation, population growth rate, waste generation growth rate, planning horizon etc.
- Characteristics of waste - including moisture content, calorific value etc.
- Technical factors - Appropriateness of adopted technology to waste mix in terms of capacity, calorific value, moisture content, water and grid availability etc.
- Availability of land - extent and locational suitability of land
- Environmental factors - including greenhouse gas (GHG) emissions
- Geological, hydrogeological conditions – appropriateness of land for the sanitary landfill
- Social factors - Employment opportunities and minimum wages, public perception
- Legal factors - applicable key legislation or approvals needed for final setting up and operating of processing

facilities or landfills.

- Project costs – Cost of land, plant and machineries
- Operation and maintenance cost - including wages, fuel, water and electricity etc.
- Product market - Volumes, selling price, distance, market opportunities

The SWAPT tool compares the chosen technology options among themselves in terms of environmental benefits and costs. The technological options analysed in the tool are combination of options as given below-

- Compost
- Compost + RDF
- Compost+ Waste to Energy
- Biomethanation
- Biomethanation+ RDF
- Biomethanaiton+ Waste to Energy
- Compost + Biomethanation+ RDF
- Compost + Biomethanaiton+ Waste to Energy

All combinations of technologies have been considered with Material recycling facilities (MRF) and Sanitary landfills (SLF) as an intrinsic part.

The SW-APT Tool provides a report for each of the above listed project options as well as a comparative table with

all technologies. The reports include requirements for infrastructure, raw material and manpower. The economic aspects of the report include project costs, revenues, payback time, net present value, and cost-benefit ratio. The environmental benefits include details on the greenhouse gas (GHG) emissions associated with the full project life-cycle.

The above technologies have also been compared for technical and economic viability of the project and the report states when a technology needs to be reconsidered for the city and which requisite conditions are not met.

The SW-APT Tool is only meant as an aid to decision making and should be used along with other standards and methods to fully evaluate the appropriate waste management option or system.

Using the SW-APT

To use the tool, **Excel's Macros must be enabled.** This can be done by choosing the option when the file is opened, or by clicking Options at the top of the screen (in Excel 2007, 2010) and choosing Enable, or by using Excel's security settings.

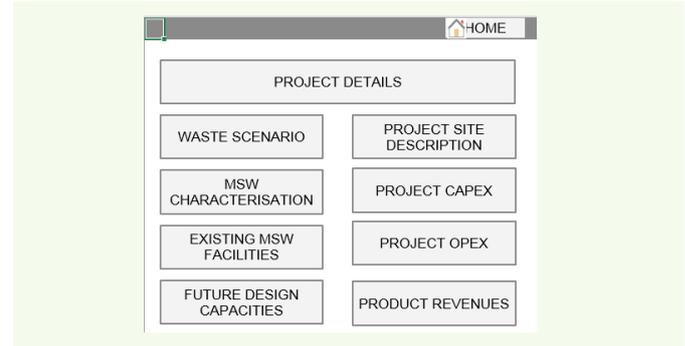
Steps for using the SWAPT Tool:

OPENING VIEW



When the tool opens, the following page is visible. This page has 7 functions buttons. The main functions buttons are Input fields, General reports and Detailed Reports. Support function buttons are About SW-APT, Quit, Reset and Help.

INPUT FIELDS



Project details: Click on the 'Project Location' button and enter the appropriate information as prompted by the tool or use the default values as indicated if no better data exist. The projected population as on the Base year under consideration is displayed. The user shall input the current population data if it exists. In addition, details of land available and the proposed project plan period should be entered as prompted by the tool.

Selecting the State and Name of City displays the values of the population in the past decade as per Census of India 2011 and 2001. The projected population as on the Base year

is displayed based on the computed population growth rate. In case the actual population is known, it may be entered by the User. Where, the city displays a negative growth rate, or when 2001 data doesn't exist, the projected population is assumed to be constant over the decade.



Waste Scenarios: Click on the 'Waste Scenario' button and enter the details as displayed on the screen. Reference may be made to primary waste quantification surveys, CPCB reports, CPHEEO manuals, approved DPRs etc. The actual growth based on the actual population figure is displayed along with the decadal growth rate based on 2011-2001 data. The user may return to first sheet to modify the base year population if necessary.



MSW Characterisation: Click on 'MSW Characterisation' button and enter the details of Moisture, LHV of RDF fraction separately, % of fossil, enter the details of % of recyclables fractions, biodegradables, inerts and RDF fraction (should have LHV > 1500 kcal/kg). Total has to be 100%. Reference may be made to primary waste quantification surveys, CPCB reports, MSWM Manual by CPHEEO, approved DPRs etc. The suggested values are from NEERI for the considered population class.



Existing MSW Facilities: Click on "Existing MSW facilities" and enter details of existing aerobic composting, bimethanation and Vermicomposting plants. Details of Material recovery plant for Paper, plastic, Metal, glass, rags etc may be entered here.



Future Design Capacities: Click on "Future Design Capacities" and enter details of efficiency of material recovery, and the plant size proposed for future. The suggested values are presented alongside based on NEERI studies.



Project Site Description: Click on the 'Project Site Description' and key in location name, geographical coordinates, and distance from key infrastructure, monuments and natural geographical and geological features. The depth of water table below ground and the proposed height of Sanitary landfill has to be entered. The siting criteria is checked against parameters specified by MoEFCC and available in MSWM Manual, 2016.



Capex: Click the 'Capex' button (for capital expenditure) and enter the details of the cost of commonly used and available technologies. The Tool presents the approximate market costs considered in

the Planning Commission report on Waste to Energy. Where ever costs were not available, the rates are derived from open source DPRs for SWM projects prepared under Swachh Bharat Mission and experience of the developer.



Opex: Click the ‘Opex’ button (for operation expenditure) and enter the costs of resource inputs like electricity, water, diesel, technical resources, skilled and unskilled labour etc.

Suggested values are based on current market costs.

Product Revenues: Click the ‘Product revenues’ button to



enter selling price of Compost, recyclables, RDF, electricity etc. The expected tipping fee may also be entered. The market prices prevailing in the market are also suggested as reference.



Default Values: This section displays the defaults or suggested values used in the SWAPT tool.

GENERAL REPORTS

Clicking on the ‘General Reports’ button will display the following:

1. **Input data:** It displays the consolidated data input in the earlier sections along with the suggested data for easy comparison. The user may then review and modify the input if necessary

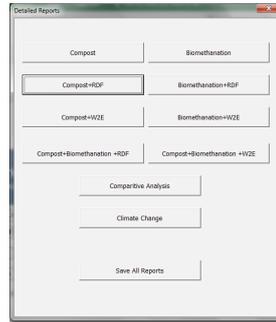
2. **Prefeasibility Report:** The SW-APT tool provides as output, the complete project prefeasibility with inputs and analysed data. It presents the comparison of chosen combination of technologies along with their technical feasibility only. The financial analysis is NOT presented here. This is needed to be printed as a common and initial section for all the specific technologies selected.

3. **Technology description:** This presents the description of all the technologies available and recommended in the SWM Rules, 2016 and the MSWM Manual 2016.



DETAILED REPORTS

Clicking on the “Detailed Reports” button presents the user with the following options. The user can obtain further technical details as well as financial analysis for a quick appraisal of selected technologies. This follows the globally accepted Integrated waste management hierarchy as suggested in the SWM Rules, 2016 and the MSWM Manual 2016.



All chosen combinations have the Material Recovery Facilities (MRFs) and Sanitary landfills (SLFs) as an integral component, in waste management.

- Compost
- Compost + RDF
- Compost+ Waste to Energy
- Biomethanation
- Biomethanation + RDF
- Biomethanation + Waste to Energy
- Compost + Biomethanation+ RDF
- Compost + Biomethanation+ Waste to Energy

Comparative Analysis: The report generated presents all the key data about various technology combinations in an Integrated SWM facility.

Climate change: This section presents the GHG calculations and bar-charts for various options along with base line status quo options of open dumping and burning. This is for academic purposes only.

Print report: The print button is present on the top right and may be used to print individual reports.

Save reports: This button prints all the reports in a single click. All the reports are found in the SWAPTOUTPUT folder that the user previously created in the User's Desktop. Kindly note that previous version of reports would be over written.

Limitations of SW-APT Tool:

The Tool is designed to red flag key decision elements that influence the selection. It should not be used as a supplement or replacement of sound engineering advice. Any issue flagged should be rechecked to ensure compatibility with ground issues: Like all software, the emphasis is on good and reliable data to obtain better results.

The SW-APT tool begins from the processing facility and includes disposal. Collection and transportation are not considered in the Tool. The pre-feasibility analysis report gives a techno-economics of the project for a given fee and the input costs. It can be used to carry out a “What if” analysis to check out the sensitivity of the project for varied capacities, SLF heights, different location, project cost, product cost, labour rates and tipping fee.



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