



REVAMP User Guide

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Introduction

Resource Value Mapping (REVAMP) is a decision support tool for rapidly estimating the resource recovery potential from organic waste streams, based on a material flow analysis approach. The present version of REVAMP includes three waste streams: faecal sludge, sewage sludge and the organic fraction of municipal solid waste; and four resource recovery technologies: anaerobic digestion, drying and densification to generate solid fuels, black soldier fly processing to generate animal feed and fertilizer, and composting ¹. The tool allows to estimate the potential amount of recovered product, its energy and nutrients contents and the potential revenue that could be obtained when sold.

How to access REVAMP

An online version of the tool is available at the website <u>https://revamp.earth</u>. The tool can be accessed by clicking "REVAMP TOOL" – on the menu at the top of the home page (See Figure 1).



Figure 1. Access to REVAMP Tool from home page

Navigating REVAMP

The REVAMP Tool page offers four tabs for input data: Waste Streams, Waste Quality, Treatment Processes and Prices. You access each of these tabs by clicking on the buttons under Step 1 and Step 2, presented in the blue frame in Figure 2, located on the REVAMP tool page.

¹ A brief description of the included waste streams and recovery technologies is presented in the Glossary.

Step 1: ⁰	St	Step 2: ¹ Step 3: ¹			
waste streams waste qua	lity treatment processes	prices cal	culate value		
Vaste streams					
nter your waste streams here and det	ermine the percentage of each waste stre	eam to be used for	each resource optio		
Faecal sludge	Sewage sludge	Organic m	unicipal solid waste		
1000	1000	1000			
Amount available per day (m3/day)	Amount available per day (tonnes/day)	Amount availba	le per day (m3/day)		
Select what % of waste to what option	Select what % of waste to what option	Select what % c	f waste to what option		
Select what % of waste to what option Anaerobic digestion	Select what % of waste to what option Anaerobic digestion	Select what % of Anaerobic dige	f waste to what option		
Select what % of waste to what option Anaerobic digestion 12	Select what % of waste to what option Anaerobic digestion 0	Select what % of Anaerobic dige	f waste to what option		
Select what % of waste to what option Anaerobic digestion 12 Solid fuel	Select what % of waste to what option Anaerobic digestion 0 Solid fuel	Select what % of Anaerobic dige	f waste to what option		

Figure 2. Input Data tabs in REVAMP Tool

The Waste Streams tab collects data about the amount of waste streams that is available in your city/town and what percentage of each waste stream should be treated by each resource recovery option. In the example presented in Figure 3, 1000 tonnes of sewage sludge are generated per day 0% is expected to be treated by anaerobic digestion, 25% by solid fuel production, 23% by Black Soldier Fly and 12% by composting. In this example the total is 60%, meaning that 40% of the sewage sludge generated is not treated by one of the treatment processes included in the tool.

Vaste streams		
nter your waste streams here and determine the percenta	age of each waste stream to be used for each resource option.	
Faecal sludge	Sewage sludge	Organic municipal solid waste
1000	1000	1000
Amount available per day (m3/day)	Amount available per day (tonnes/day)	Amount availbale per day (m3/day)
Select what % of waste to what option	Select what % of waste to what option	Select what % of waste to what option
Anaerobic digestion	Anaerobic digestion	Anaerobic digestion
12	0	45
Solid fuel	Solid fuel	Solid fuel
56	25	13
Black soldier fly process	Black soldier fly process	Black soldier fly process
23	23	13
Compost	Compost	Compost
9	12	29
Total	Total	Total
100	60	100

Figure 3. Waste Stream tab in REVAMP Tool

Waste Quality tab accepts data on the physical and chemical characteristics of the waste streams that influences the resource recovery potential such as total solids (TS), nutrients content and

calorific value. Some parameters, like total nitrogen in Figure 4, appear twice in the Waste Quality tab, differentiating when the main phase of the waste stream is liquid (e.g. mg N/L) or solid (e.g. mg N/kgTS). In these cases, filling up one of the fields is enough to estimate nutrients recovery.

Waste quality					
Waste quality has default data on the physical and chemical characteristic of waste streams. You are free to change these.					
show references +					
	Units	Faecal sludge	Sewage sludge	Solid waste	
Total solids, TS	%	3.0	5.0	28.9	
Total solids, TS	mg/L	30000.0	0.0	0.0	
Volatile solids, VS	% TS	57.0	65.0	74.0	
Total nitrogen, TN	mg N/L	3310.0	0.0	0.0	
Total nitrogen, TN	mg N/kg TS	0.0	2500.0	18.9	
Total phosphorus, TP	mg P/L	390.0	0.0	0.0	
Total phosphorus, TP	mg P/Kg TS	0.0	16000.0	2.7	
Total potassium, TK	mg K/L	120.0	0.0	0.0	
Total potassium, TK	mg K/kg TS	0.0	4000.0	19.5	
Calorific value, CV	MJ/Kg TS	16.2	16.0	17.3	
Biomethane potential	NM ³ CH ₄ /tonne VS	304.0	304.0	445.0	

Figure 4. Waste Quality tab in REVAMP Tool

Near the top of the Waste Quality tab, the "Show Reference" button is located. This button allows the user to include comments about the source, methods and/or conditions related to each parameter value, as shown in Figure 5.

Waste quality Waste quality has default data on the physical and chemical show references +	characteristic of waste stream	s. You are free to change these	2.	
	Units	Faecal sludge	Sewage sludge	Solid waste
Total solids, TS	%	3.0	5.0	28.9
	Comments			
Total solids, TS	mg/L	30000.0	0.0	0.0
	Comments			
Volatile solids, VS	% TS	57.0	65.0	74.0
	Comments			
Total nitrogen, TN	mg N/L	3310.0	0.0	0.0
	Comments			

Figure 5. Show References in Waste Quality tab

The Treatment Processes tab receives data on the performance of each treatment processes when waste streams are physically and chemically transformed through them (See Figure 6). This tab also includes the "Show Reference" button that allows to add comments related to the values.

Treatment processes				
show references +				
	Units	Faecal sludge	Sewage sludge	Solid waste
Anaerobic digestion				
Volatile solids degradation rate, $\ensuremath{VS}_{\ensuremath{D}}$	%	100.0	70.0	60.0
Dry mass reduction rate for anaerobic digestion (AD) residue, $\ensuremath{DMR_{AD}}$	% of initial TS	67.5	67.5	67.5
Black soldier fly process				
Biomass conversion rate for black soldier fly (BSF) larvae, BCR	96	10.0	10.0	11.8
Dry mass reduction rate for BSF residue, DMR_{BSF}	% of initial TS	51.85	51.85	70.0
Total nitrogen (TN) reduction in BSF residue, TNR_{BSF}	% of initial TN	40.0	40.0	40.0
Total phosphorus (TP) reduction in BSF residue, $\ensuremath{TPR}_{\ensuremath{BSF}}$	% of initial TP	65.5	65.5	65.5
Total potassium (TK) reduction rate in BSF residue, $\ensuremath{TKR}\xspace_{\ensuremath{BSF}\xspace}$	% of initial TK	55.0	55.0	55.0
Composting				
Dry mass reduction in compost, DMR _c	% of initial mass	19.4	19.4	19.4
Total nitrogen (TN) reduction during composting, \ensuremath{TNR}_c	% of initial TN	34.3	34.3	50.0
Total phosphorus (TP) reduction during composting, $\ensuremath{TPR}_{\ensuremath{C}}$	% of initial TP	1.77	1.77	1.77
Total potassium (TK) reduction during composting, TKR_C	% of initial TK	12.63	12.63	12.63

Figure 6. Treatment Processes tab in REVAMP Tool

The Prices tab contains data on the potential prices at which recovered products can be sold on the local market. Instead of the "Show References" button, the Prices tab includes the "References" column where comments can be added (See Figure 7).

Prices

Update the prices available in your local market.

Product	Potential price	Units	References
Biogas	0.33	US\$/N m ³	
Solid fuel	300.00	US\$/ton	
Black soldier fly larvae	200.00	US\$/ton	
Compost	5.00	US\$/ton	

Figure 7. Prices tab in REVAMP Tool

Introducing data

When opened for the first time, data fields are filled with random values. If you have data available for some or all the various parameters in your city/town, please fill that data in and replace the default values. Otherwise, you can load data about a project previously uploaded by someone else. This can be done by clicking on the "import case study" button located in the left side of the REVAMP tool page (See blue line in Figure 8).

Resource Value Mapping (REVAMP) is a decision support tool for rapidly estimating the resource recovery potential from organic waste streams including sewage sludge, faecal sludge, and other organic solid waste.					
😍 imp	<u>ort case study</u>		<u>ort your data</u>	pen	<u>user guide</u>
Step 1: ®			Step 2: •	Step 3: •	
waste streams	waste quality	treatment processes	prices	calculate value	

Figure 8. Load and processes buttons in REVAMP Tool

It is possible to load data from a project previously saved, clicking on the "import your data" button (see Figure 8). This data should have been saved in a personal account (accessed by introducing email and password) or by uploading a xml file containing the project data (See Figure 9).

	×	
import case	Import saved data Import XML	open user guide
	Please provide an e-mail. You will need it along with a password that will be e-mailed to that address to retrieve this save project later by using the "load your data" feature. If you have previously stored projects; please select an existing file from the list to save over - or provide a new project name to create a new file.	
Step 1: ⁰	Please provide the e-mail used to save your work	
waste streams waste	Password	lue
Waste streams	Los your assessed?	
Enter your waste streams here and detern	submit	is municipal solid wasta

Figure 9. Importing saved data and xml files

Results Visualization

Once the required data has been filled, the results reflecting the recovery potential can be obtained by clicking in the "Calculate value" button, last one on the right side of the steps (See Figure 8).

The recovery potentials are presented in two tabs (See figure 10). The "charts" tab includes column charts showing the potential energy, nutrients and revenue that can be recovered from each of the three organic waste streams.

The "results" tab presents the detailed numeric information used to build the column charts but organized in tables; there is one table per each recovery technology, including the three organic waste streams.



Figure 100. Results tabs in REVAMP Tool

Saving a Project

A project can be saved at any stage of input data or analysing results by clicking on the "save project" button located on the bottom right side of the REVAMP tool page (black dotted line in Figure 11).

Prices

Update the prices available in your local market.

Product	Potential price	Units	References
Biogas	0.33	US\$/N m ³	
Solid fuel	300.00	US\$/ton	
Black soldier fly larvae	200.00	US\$/ton	
Compost	5.00	US\$/ton	

save project

Figure 11. Saving a project in REVAMP Tool

When saving a project, you should specify the name of the project and your email (see Figure 12). You will receive an email with a password that would allow you to access your project in the future.

Price	s	
Update	a the prices available in your local market	
Prod	×	
Bioga	Please register an account or login to store your project with us so you can continue to work on it later.	
	Project name	
Solid		
	Email address	
Black		
		//
Comj	l'm not a robot	
	submit	roject
		project

Figure 12. Saving a project in REVAMP Tool

Exporting a project to xml file

Any of the projects that appears in the project list can be exported as an xml file by clicking the "Download as xml" button, under the results tab (see black line dotted in Figure 10). The xml file contains the project data.

Glossary

Faecal Sludge: Faecal sludge comes from onsite sanitation technologies, i.e., it has not been transported through a sewer. It results from the collection and storage/treatment of excreta or blackwater, with or without greywater. Faecal sludge includes both sludge from pit latrines and that from septic tanks.

Sewage sludge: Sewage sludge (also referred to as wastewater sludge) is sludge that originates from sewer-based wastewater collection and (semi-) centralized treatment processes.

Organic Municipal Solid Waste: This is the organic part of the urban solid waste and it includes items like food waste, market waste and crop residues

Anaerobic Digestion: This is a process which generates biogas, which has about 60% methane content. Biogas can be used for lighting, cooking and also for generating electricity and heat. The process of anaerobic digestion also generates a residue which can be used as soil conditioner or fertilizer in a farm to recover nutrients like nitrogen, phosphorus and potassium.

Solid Fuel: Excreta and organic waste streams have a high calorific value and can be turned into a solid dry fuel for combustion in briquette or powder form. This can be used either for cooking in households and institutional kitchens as well as for industrial applications like kilns and boilers.

Black soldier fly larvae: Organic waste streams can be treated using fly larvae composting, for example with the Black Soldier Fly, to produce valuable larvae and a residue. The larvae of the black soldier fly are 40% protein and 30% fat and can therefore make a protein-rich animal feed. The residue from the fly larvae composting contains nutrients and can be applied to a garden as soil conditioner or fertilizer.

Composting: This is a process whereby a waste stream is composted to make soil conditioner or fertilizer for applying on farms. The compost generated is often rich in nutrients and also rich in organic matter content