

Output factsheet: Software tool N.1

Version 1

Project index number and acronym	CE946 REEF 2W
Lead partner	ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development
Output number and title	O.T1.1 Tools for measurement of EE&RES improvements and urban compatibility assessment for the new plants
Responsible partner (PP name and number)	PP06 Universität für Bodenkultur Wien
Project website	https://www.interreg-central.eu/Content.Node/REEF-2W.html
Delivery date	03.2018

Summary description of the key features of the tool (developed and/or implemented)

The scope of software tool N.1 is to provide a first evaluation on the benefits of applying innovative technological processes at WWTPs concerning waste and wastewater treatment. Together with software tool N.2 it is merged into one Excel. However, key features of software tool N.1 include energy efficiency (EE) evaluations and potential implementation of renewable energy sources (RES). Software tool N.1 evaluates:

- the wastewater treatment process (essential parameters include sludge composition, and other substrates regarding the share of C, H, O, N, Ash, Volatile Matter and Fixed Carbon)
- the energy efficiency (EE) at the WWTP (essential parameters include daily wastewater flow, COD concentration, digestion tower temperature, air temperature, electric energy consumption etc.)
- the potential of applying renewable energy sources (RES) like solar power (including parameters like surface area and electrical/thermal efficiency), hydro power (usable height and turbine efficiency) and energy from biogas at the WWTP (e.g. share that is fed into the grid)

On top of these assessments, economic (including e.g. prices for electricity, natural gas and heat or energy subsidies for RES, biomethane and heat) and ecological evaluations (Life Cycle Analysis with respect to acetic acid, methanol, ferric chloride, sludge use, offgas treatment etc.) are carried out and merged in one single Excel, together with software tool N.2. In the “report” section of the tool a detailed comparison of input and output parameters is presented. Thus, the user can compare different scenarios and derive potential strategic decisions for the utility under consideration.

NUTS region(s) where the tool has been developed and/or implemented (relevant NUTS level)

The tool has been developed and/or implemented in NUTS level 0 including:

- Austria
- Germany
- Italy
- Czech Republic and
- Croatia.

Expected impact and benefits of the tool for the concerned territories and target groups

Using software tool N.1 enables WWTP operators and decision-makers on the municipal level to specifically evaluate the wastewater treatment process. Based on the detailed evaluations the overall energy efficiency (EE) of the utility is evaluated and can consequently be improved. Renewable Energy Sources (RES) like solar power, hydro power or energy from biogas are included in the calculations and allows users to assess benefits of RES applications. On top of that economic evaluations are carried out, on which many decisions of potential users are based upon. The included Life Cycle Assessment offers users a first glimpse on the ecological consequences of their decisions. Concerned territories can benefit from the tool applications, as it shows potentials to provide surplus energy to the settlements close to the WWTP (also see software tool N.2).

Sustainability of the tool and its transferability to other territories and stakeholders

Software tool N.1 can be used for a first step to assess EE and RES potentials on a WWTP. The holistic approach of the tool - due to the Integrated Sustainability Assessment (ISA) and its strategic character - make it easily transferable and applicable in multiple countries. Besides national values (Austria, Croatia, Czech Republic, Germany, Italy) also European values are included and used for the calculations. Main target group of the tool are WWTP operators. However, the goal is that also decision makers on the municipal level can use the tool to initiate strategic planning activities on how to integrate WWTPs into energy concepts etc. Sustainability is fully given, since the ISA approach, on which the tool is based on, integrates multiple levels of sustainability (also see D.T1.5.1 and D.T1.5.4).

Lessons learned from the development/implementation process of the tool and added value of transnational cooperation

Software tool N.1 is currently still at an early stage of development. However, first feedback was collected and the overall approach of the REEF 2W project, including the Integrated Sustainability Assessment, were generally well received. Concerning the tool development, the single parts of the tool (tool N.1 and tool N.2) have to be connected more consequently in order to gain more realistic results that can accordingly be used for deriving planning decisions in practice. The specially deployed tool developer workshops during the project proved to be essential in order to develop a tool that is applicable across Central Europe and incorporates aspects across different disciplines.

References to relevant deliverables and web-links If applicable, pictures or images to be provided as annex

DT.1.4.3

See Annex 1

Annex 1: Home Screen and Front Screen of the REEF 2W Excel-Tool



Annex2: Data-input WWTP Description

WWTP Description ✕

Name of WWTP/Operator

Address of WWTP

Country

Contact person

Year of commissioning of the last expansion stage

Treatment capacity PE (*)

Connected population PE (*)

(*) Equivalent Population

Annex 3: Data-input Substrates

Substrate to select	Tons (*) [t a.s./year]	Total Solid (%)	C (%)	H (%)	O (%)	N (%)	Ask (%)	Volatile Matter (%)	Fixed Carbon (%)	Income Price [€/ton]
Primary Sludge <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Secondary Sludge <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Other substrates										
OFMSW (**) <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Digestate (***) <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Food industry waste <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Animal Blood <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Animal Fat <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Other <input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

(*) As received.
 (**) Organic Fraction of Municipal Solid Waste.
 (***) If you start to observe the combination among Anaerobic Digestion and Composting, Gasification and HTC, at point 2 of this tool, you have to enter digester's data. If you have the data on the tool, enter it, otherwise type zero and it will be calculated by the process of anaerobic digestion. The same applies to other data.

Annex 4: Data-input Energy Efficiency and Renewable Energy Sources

WWTP Properties_Energy Efficiency

Daily average of wastewater flow [m³/d]

Daily average of COD inflow concentration [mg/l]

Digestion tower temperature [°C] (30-60 °C)

Ambient air temperature [°C]

Total heated surface area [m²]

Building heat demand [kWh/(y*m²)]
(depending on the age of the building) (50-150 kWh/(y*m²))

Electric energy consumption [kWh/d]

WWTP Properties_Renewable Energy Sources

Solar power

Hydro power

Energy from biogas (*)

(*) If you want to include the biogas upgrading you need to choose the amount of biogas to fed into the grid or into the CHP.

Annex 5: Data-input Economic parameters

Economic Values ✕

Electricity Total price - partner estimate [€/kWh]

Price of natural gas [€/kWh]

Price of heat [€/GJ]

CNG price for cars [€/kg o Nm3]

Energy subsidies (RES) [€/kWh]

Subsidy for biometan [€/Nm3]

Subsidy for heat [€/GJ]

Disposal price sludge [€/t]

Annex 6: Data input Life Cycle Assessment

Chemicals ✕

	Status quo	Future situation
Acetic acid [kg/y]	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
Methanol [kg/y]	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
Ferric chloride [kg/y]	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
Polyaluminiumchlorid [kg/y]	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
Polymer [kg/y]	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>

Output factsheet: Software tool N.2

Version 1

Project index number and acronym	CE946 REEF 2W
Lead partner	ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development
Output number and title	O.T1.1 Tools for measurement of EE&RES improvements and urban compatibility assessment for the new plants
Responsible partner (PP name and number)	PP 06 Universität für Bodenkultur Wien
Project website	https://www.interreg-central.eu/Content.Node/REEF-2W.html
Delivery date	03.2018

Summary description of the key features of the tool (developed and/or implemented)

The scope of software tool N.2 is to provide a first evaluation on the benefits of providing surplus energy to the WWTP surroundings. Together with software tool N.1 it is merged into one Excel. Split into different sections software tool N.2 includes evaluations regarding

- the thermal energy demand in the WWTP surroundings by evaluating spatial structures (e.g. village centres, small and medium sized town centres, settlements consisting of multi-store buildings, industrial/commerce areas and agricultural sites)
- the grid lengths of a potential district heating network to supply areas close to the WWTP
- future energy supply scenarios including variations in the number of connected heat consumers, potential spatial densifications and energy savings as well as renewable energy provision in the WWTP surroundings

The potential energy demand in the WWTP surroundings are compared to the potential energy provision of the WWTP. On top of these assessments, economic (including e.g. prices for electricity, natural gas and heat or energy subsidies for RES, biomethane and heat) and ecological evaluations (Life Cycle Analysis with respect to acetic acid, methanol, ferric chloride, sludge use, offgas treatment etc.) are carried out and merged in one single Excel, together with software tool N.1. In the “report” section of the tool a detailed comparison of input and output parameters is carried out. Thus, the user can compare different scenarios and derive potential strategical decisions for the utility under consideration.

NUTS region(s) where the tool has been developed and/or implemented (relevant NUTS level)

The tool has been developed and/or implemented in NUTS level 0 including:

- Austria
- Germany
- Italy
- Czech Republic and
- Croatia.

Expected impact and benefits of the tool for the concerned territories and target groups

Using software tool N.2 enables WWTP operators and decision-makers on the municipal level to derive strategic decisions concerning potential energy consumers in the surroundings of the WWTP. In that sense WWTPs are regional energy cells having the potential to offer surplus energy (e.g. thermal energy, gas and electricity). The potential energy demand in the WWTP surroundings, that is calculated with software tool N.2, are compared to the surplus energy provision of the WWTP (see software tool N.1). The tool offers an integrated assessment, additionally including scenario calculations. Users gain information about the thermal energy demand, potential grid lengths (e.g. for district heating networks) and can also apply scenario calculations. Especially the integrated approach in combination with software tool N.1 offers multiple benefits for target groups and concerned territories in Central Europe. On top of that economic evaluations are carried out, on which many decisions of potential users are based upon. The included Life Cycle Assessment offers users a first glimpse on the ecological consequences of their decisions.

Sustainability of the tool and its transferability to other territories and stakeholders

Software tool N.2 can be used for a first step to gain information about the spatial context of the territory in question and for further spatial and energy planning (also referring to integrated spatial and energy planning). The holistic approach of the tool - due to the Integrated Sustainability Assessment (ISA) and its strategic character - make it easily transferable and applicable in multiple countries. Besides national values (Austria, Croatia, Czech Republic, Germany, Italy) also European values are included and used for the calculations. Main target group of the tool are WWTP operators. However, the goal is that also decision makers on the municipal level can use the tool to initiate strategic planning activities on how to integrate WWTPs into energy concepts etc. Sustainability is fully given, since the ISA approach, on which the tool is based on, integrates multiple levels of sustainability (also see D.T1.5.1 and D.T1.5.4).

Lessons learned from the development/implementation process of the tool and added value of transnational cooperation

Software tool N.2 is currently still at an early stage of development. However, first feedback was collected and the overall approach of the REEF 2W project, including the Integrated Sustainability Assessment, were generally well received. Concerning the tool development, the single parts of the tool (tool N.1 and tool N.2) have to be connected more consequently in order to gain more realistic results that can accordingly be used for deriving planning decisions in practice. The specially deployed tool developer workshops during the project proved to be essential in order to develop a tool that is applicable across Central Europe and incorporates aspects across different disciplines.

References to relevant deliverables and web-links If applicable, pictures or images to be provided as annex

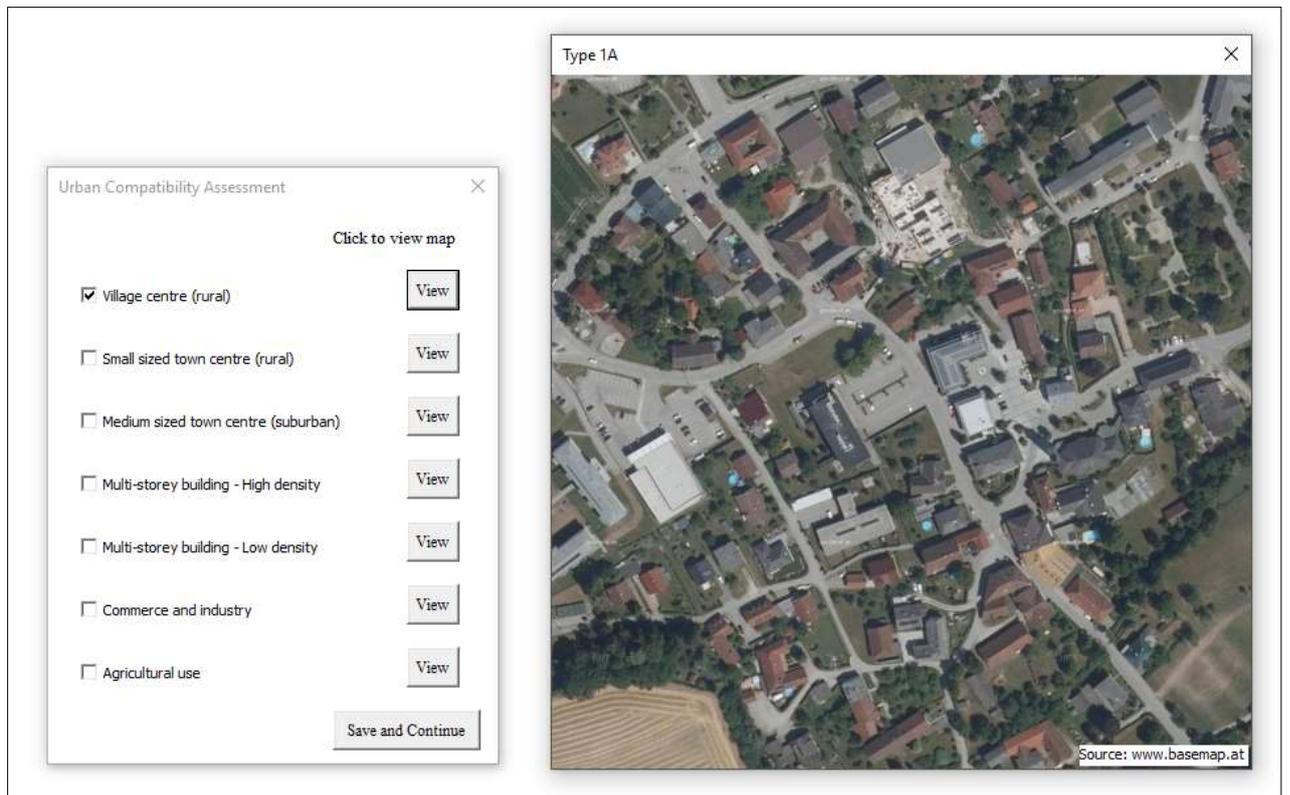
DT.1.4.3

See Annex 1

Annex 1: Home Screen and Front Screen of the REEF 2W Excel-Tool



Annex2: : Overview settlement types



Annex 3: Data-input Urban compatibility Assessment

	Village centre (rural)	Small sized town centre (rural)	Median sized town centre (suburban)	Multi-storey building - High density	Multi-storey building - Low density	Commerce and industry	Agricultural use
Status quo							
Gross development area [ha]							
Specific thermal energy demand [MWh/(ha*y)]							
Heat demand [MWh/y]							
Settlement specific grid length (internal) [m/ha]							
Grid length (external) [m]							
Future situation							
Degree of connection (%)							
Degree of densification (%)							
Degree of energy savings (%)							
Share of solar thermal energy provision (%)							

Annex 5: Data-input Economic parameters

	<input type="text"/>
Electricity Total price - partner estimate [€/kWh]	<input type="text"/>
Price of natural gas [€/kWh]	<input type="text"/>
Price of heat [€/GJ]	<input type="text"/>
CNG price for cars [€/kg o Nm3]	<input type="text"/>
Energy subsidies (RES) [€/kWh]	<input type="text"/>
Subsidy for biomethan [€/Nm3]	<input type="text"/>
Subsidy for heat [€/GJ]	<input type="text"/>
Disposal price sludge [€/t]	<input type="text"/>

Annex 6: Data input Life Cycle Assessment

Chemicals ✕

	Status quo	Future situation
Acetic acid [kg/y]	[input field]	[input field]
Methanol [kg/y]	[input field]	[input field]
Ferric chloride [kg/y]	[input field]	[input field]
Polyaluminiumchlorid [kg/y]	[input field]	[input field]
Polymer [kg/y]	[input field]	[input field]

Annex 7: Report section of the tool - Input parameters

Results

EMEP Regional Energy Emissions

Chemical name	EMEP 2010	EMEP 2020	EMEP 2030
Acetic acid	1.20	1.20	1.20
Methanol	1.20	1.20	1.20
Ferric chloride	1.20	1.20	1.20
Polyaluminiumchlorid	1.20	1.20	1.20
Polymer	1.20	1.20	1.20

EMEP Regional Air Quality Emissions

Chemical name	EMEP 2010	EMEP 2020	EMEP 2030
Acetic acid	1.20	1.20	1.20
Methanol	1.20	1.20	1.20
Ferric chloride	1.20	1.20	1.20
Polyaluminiumchlorid	1.20	1.20	1.20
Polymer	1.20	1.20	1.20

Inventory Parameters

Parameter	Value
Acetic acid	1.20
Methanol	1.20
Ferric chloride	1.20
Polyaluminiumchlorid	1.20
Polymer	1.20

Energy Parameters

Parameter	Value
Electricity	1.20
Gas	1.20
Oil	1.20
Coal	1.20

Material Parameters

Parameter	Value
Acetic acid	1.20
Methanol	1.20
Ferric chloride	1.20
Polyaluminiumchlorid	1.20
Polymer	1.20

Life Cycle Assessment, Multi-Parameter

Parameter	Status quo	Future situation
Acetic acid	1.20	1.20
Methanol	1.20	1.20
Ferric chloride	1.20	1.20
Polyaluminiumchlorid	1.20	1.20
Polymer	1.20	1.20

