



# The AquaSPICE Symbiosis Enabling Platform

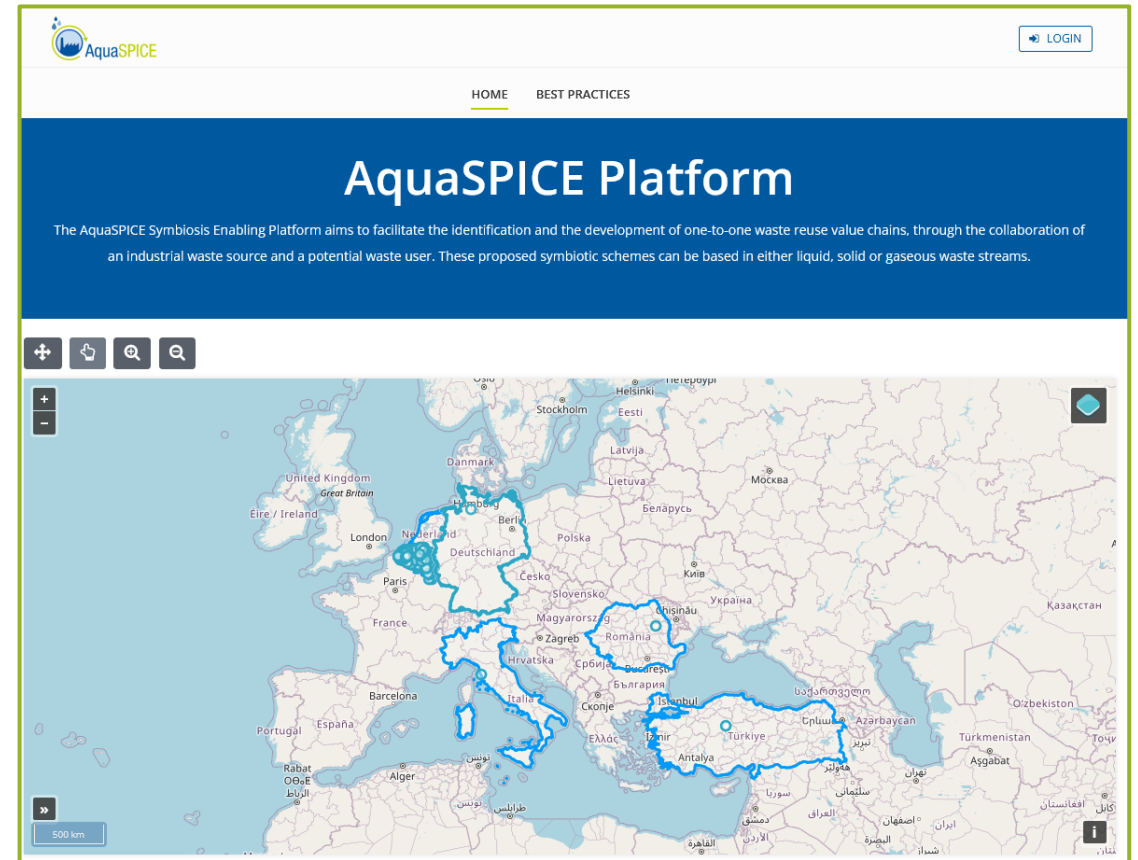
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# The AquaSPICE symbiosis enabling platform

## Aim and Objectives

- Design and develop an online platform that will facilitate the formulation of novel symbiotic business models focusing on water/wastewater reuse.
- Propose alternative solutions and assess their technical feasibility using a semantic approach based on the qualitative and quantitative characteristics of the water/wastewater streams
- Assess the economic viability of all the technically feasible symbiotic schemes.



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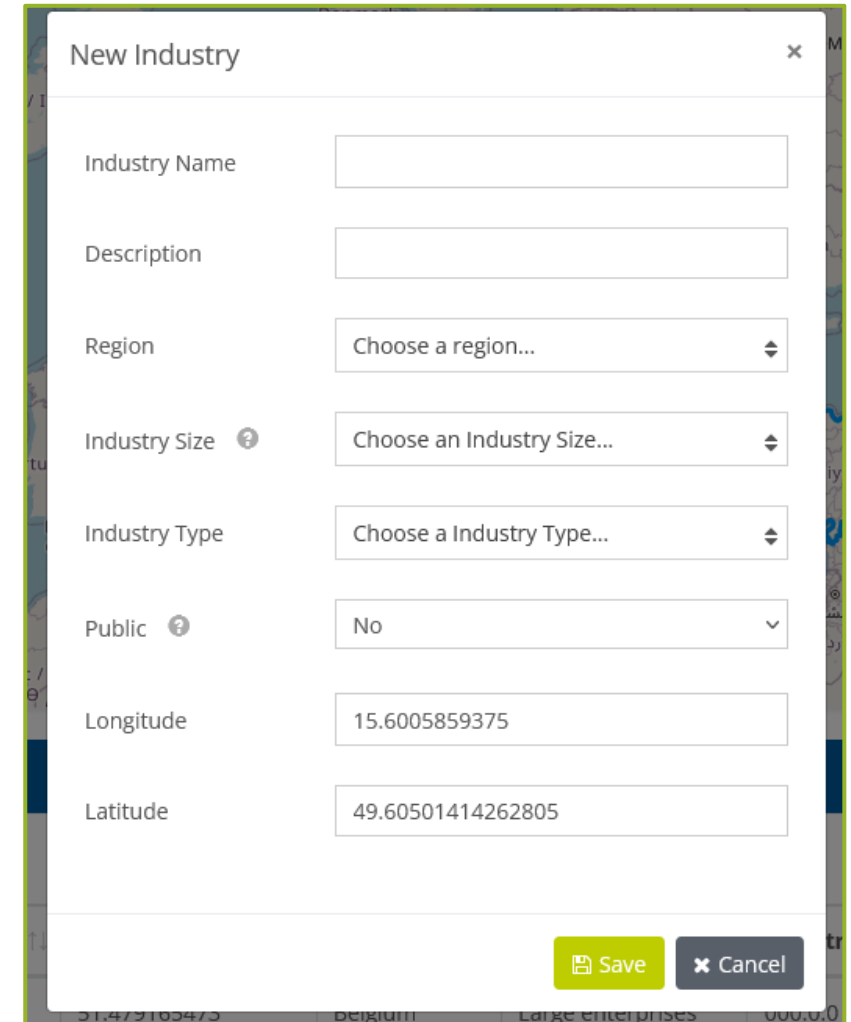
## Main Platform Characteristics

- The platform guides the user through a three-step process to perform the necessary tasks, to identify symbiotic schemes for a given region:
  - **Industry mapping and characterization**, by collecting data related to the type, location and size of the industry, as well as data for the input and waste streams.
  - **Symbiotic scheme identification** by matching industries, based on the waste stream properties and the characteristics of the input streams needed.
  - **Economic evaluation of the identified schemes** (provided that the required economic data have been also specified).
- Based on the classification reported by van Capelleveen et al. (2018), the algorithm of the AquaSPICE Symbiosis Enabling Platform can be categorised as an **Industrial Symbiosis Knowledge Repository**.
- Based on the classification proposed by Grant et al. (2010), the platform utilizes a **facilitator user interaction model**.

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## Adding/Editing an Industry

- The industry type follows the Statistical classification of economic activities in the European Community (NACE code)
  - A four-digit classification providing the framework for collecting and presenting a large range of statistical data according to the economic activity.
- The size is defined based on the number of employees and is split in four different categories:
  - Micro enterprises (<10 employees)
  - Small Firms (11-50 employees)
  - SMEs (51-250 employees)
  - Large Industries (>250 employees)



The screenshot shows a 'New Industry' form with the following fields:

- Industry Name:
- Description:
- Region:
- Industry Size:
- Industry Type:
- Public:
- Longitude:
- Latitude:

At the bottom right, there are two buttons: a green 'Save' button and a grey 'Cancel' button.

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## Adding/Editing Waste or Input Streams

- For each industrial point, all waste streams and the potentially useful, in terms of industrial symbiosis, relevant input streams are also defined.
- For each stream, either waste or input, the user should define:
  - The name/description of the waste stream
  - The discharged (for waste streams) or required (for input streams) amount
  - The time range that this amount corresponds to
  - The state (liquid, gas or solid)
- Depending on the state (solid, liquid or gas) of each stream, the user also needs to define certain characteristics that provide information about the quality and composition of the stream, to allow the potential matching.

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## Adding/Editing Waste or Input Streams

### Industrial Unit Information

Below are Name, Description, Location and more on file for your industrial unit.

<b>Name</b>		<b>Description</b>	Waste and wastewater management
<b>Longitude</b>	4.38037	<b>Industry Size</b>	Large enterprises
<b>Latitude</b>	50.8831	<b>Industry Type</b>	D35.3.0 Steam and air conditioning supply

[+ Create Waste Stream](#)

### Waste Streams

[Excel](#)


[CSV](#)

[Print](#)

[Column visibility](#) 

Show  entries

Search:

Name 	Description 	Amount 	Physical Unit 	Temporal Unit 	Waste State 	Management Cost Unit 		
Carbon Dioxide	Value for 2021	471000	Tonnes	year	Gas	euros per year		
Carbon Dioxide (CO2)	Low Purity	442000	Tonnes	year	Gas	euros per year		
Nitrogen Oxides	Value for 2021	124	Tonnes	year	Gas	euros per year		

Showing 1 to 3 of 3 entries

[Previous](#) [1](#) [Next](#)

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## Adding/Editing Waste or Input Streams

- The waste stream classification follows the European Waste Catalogue (EWC) code.
- For a liquid waste stream, the following properties can be defined:
  - pH
  - Alkalinity (mg/L)
  - TOC (mg/L)
  - COD (mg O<sub>2</sub>/L)
  - Total nitrogen (mg/L)
  - Total chlorides (mg/L)
  - Iron (mg/L)
  - Lead (mg/L)
  - Nickel (mg/L)

Gas		Liquid	
Property	Value	Property	Value
Carbon Dioxide	8	pH	7
Methane	25	Alkalinity	150
Sulfur Dioxide	40	TSS	1200
Carbon Monoxide	20	COD	0.05
Nitrogen	7	Iron	20
		Lead	15

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## Best Practices Database

- For the matching between industries, a preliminary screening is performed using a **knowledge repository**.
- The repository included information about commercially implemented symbiotic schemes, for all types of waste and the user may filter the available options to retrieve the corresponding information.

The screenshot displays the AquaSPICE Best Practices Database interface. On the left, there is a search bar containing 'Electric Power' and a 'Sort by name' button. Below the search bar is a 'Filters' section with several buttons: 'Commercial', 'D35.1.1 Production of electricity', 'Industry Sink Type', 'Waste Type', and a 'Reset' button. The main content area shows two case studies, each with a 'Commercial' tag in the top right corner.

**Coal Gangue from Coal Mine to Power Plant**

Installed in Midong Industrial Park, China / Annual amount exchanged: 785,000 tonnes  
Source: Bin Guo, Yong Geng, Thomas Sterr, Liang Dong, Yaxuan Liu (2016) "Evaluation of promoting industrial symbiosis in a chemical industrial park: A case of Midong" Journal of Cleaner Production, Volume 135, Pages 995-1008, <https://doi.org/10.1016/j.jclepro.2016.07.006>.

Industry Source Type	Industry Sink Type
B5 Mining of coal and lignite	D35.1 Electric power generation, transmission and distribution

**Waste Type**  
12.2, 12.3, 12.5 Other mineral wastes Non-hazardous

**Sawdust From Sawmill to Power Plant**

Installed in Kaiserbaracke Industrial Park (Belgium). The sawmill processes 50% of the wood for the fabrication of finished and semi-finished products. The other half part is composed of bark and sawdust.  
The Global Network for Resource Efficient and Cleaner Production (RECPnet)

Industry Source Type	Industry Sink Type
C16.1 Sawmilling and planing of wood	D35.1 Electric power generation, transmission and distribution

**Waste Type**  
7.5 Wood wastes Non-hazardous



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## Best Practices Database

- The list of Best Practices includes more than 500 symbiotic schemes collected from literature.
- For each symbiotic scheme included in the Best Practices database, the following characteristics have been collected:
  - The type of the industrial plant supplying the waste stream and of the plant receiving the waste stream, as described by their NACE code
  - The type of the waste stream exchanged between source and sink, as described by the European Waste Classification for Statistics (EWC-Stat)
  - An indication about the technology readiness level or the commercial application of the symbiotic scheme
  - A short description (in the case of a commercially developed scheme) or a scientific reference (in the case of a non-established solution).

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## Literature based technical matching

- The literature-based technical matching uses the data collected in the Best Practices Database.
- More specifically, the algorithm develops a list of the technically plausible pairings based on the list of Best Practices, using only the basic characteristics of an industrial plant, i.e. the NACE code of waste source and potential receiver in a symbiotic scheme.

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## Region-specific technical matching

- For a further screening and selection of the most appropriate symbiotic schemes, a **similarity index** has been developed (which can be implemented when relevant data are available), based on Cecelja, et al. (2015).
- This similarity index is estimated using the numerical values of either the quality parameters (for liquid waste and potential input streams) or the composition of the gaseous waste streams and potential input streams. The symbiotic schemes that are characterized by a **similarity index greater than 70%** are added to the list of potentially technically feasible symbiotic schemes.

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## Proposed Symbiotic Schemes from an Industry Point of View

- The **industrial managers** (i.e. the users who are responsible for registering an industry in the platform) or the **industrial participants** (i.e. the users who are allowed to search for possible synergies for a specific industry registered to the platform) can identify **all the potential symbiotic schemes that the industry in question can participate in**.
- From this list, they can select this/these that better fit the industry. This decision depends on the specific characteristics of the industry and is left on the individual user. The criteria for the selection can range from simply the solution with the highest return on investment/lowest payback period to more complex ones

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## Proposed Symbiotic Schemes from a Regional Point of View

- The **regional managers** (i.e. users who are responsible for managing the information concerning the industrial region where the platform has been deployed) and **regional participants** (i.e. users who are allowed to view all existing synergies between all industries registered to the platform and to search for possible synergies based on holistic/regional objectives) can access the whole list for the region and identify:
  - The waste stream that is more prominent in these symbiotic schemes
  - The type of industries that is involved the most in such symbiotic schemes.
- This information is critical for policymakers (either at a regional or at a national level), since they can base on this their decisions regarding incentives to promote industrial symbiosis.

# The AquaSPICE symbiosis enabling platform

Let's have a look at it...

- Available at <https://aquaspice.hud.ac.uk>



# Thank you

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