

Business Development package for nutrient recycling at anaerobic digester including manual and guiding materials
A product from the H2020 project SYSTEMIC



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A full list of all end products is available at www.systemicproject.eu. The SYSTEMIC project was coordinated by Oscar Schoumans (oscar.schoumans@wur.nl) and Inge Regelink (inge.regelink@wur.nl) from Wageningen Environmental Research.

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List of abbreviations

AP: Associated Plants
BDP: Business Development Package
CAPEX: Capital Expenditures
DP: Demonstration Plants
KPI: Key performance indicator
NRR: Nutrient recovery and reuse
OL: Outreach Locations
OPEX: Operational Expenditures
WP: Work Package

Preface

This deliverable was carried out and published as a part of the European demonstration project SYSTEMIC funded by the H2020 programme (project number 730400). The project SYSTEMIC focuses at five large scale biogas plants where innovative nutrient recovery processing techniques were implemented and monitored. One of the tasks within the SYSTEMIC project is to **develop a business development package (BDP) to support decision making for implementation of the innovative business cases in Europe.**

The Business Development Package (BDP) is a page on the SYSTEMIC website (see under "BDP")¹ Here project results (Deliverables from WP1, WP2, WP3 and WP4) are summarised and available as easily digestible information for biogas plant owners. It provides a step-by-step approach in the exploration of nutrient recovery and reuse (NRR) on digestate.

The main target group for the BDP are European biogas plants professionals, however policy makers, technology developers, research institutes, consultants, mineral fertiliser industry, etc. could also make use of the BDP's output.

An important part of the BDP are the 2 calculation tools:

- The NUTRICAS Tool to explore different NRR technology cascades at a biogas plant, can make simulations of mass balances of different nutrient recovery technology cascades and the associated cost estimations for implementation.
- The Key Performance Indicator (KPI) tool to evaluate a biogas plant's business performance at a glance, can make quantitative estimations of economic key performance indicators for a specific biogas plant's business case.

We would like to acknowledge the plant owners and staff of Acqua & Sole, Am-Power, BENAS-GNS, RIKA/Fridays, Groot Zevert Vergisting, Waterleau NewEnergy, Atria, and other Outreach Locations and Associated Plants who delivered information about the technologies and costs.

Also, we would like to thank the biogas plants who have been involved in testing the calculation tools' user friendliness by participating in the user tests. Finally, the team from company Moment-4 for developing the calculation tools and optimally adjusting it to the targeted user groups.

The authors

¹ www.systemicproject.eu/bdp.

To ensure the open access of the deliverables of the SYSTEMIC project, all public deliverables will be available online, even after the end of the project, via the library of Wageningen University & Research (www.wur.nl/en/Library.htm) and also via digital platform Biorefine Cluster Europe (www.biorefine.eu). The BDP will be completely available on the website of WP3 leader VCM (www.vcm-mestverwerking.be/en/faq/3921/systemic)

Summary

The business development package (BDP) is a tool to support decision making for implementation of the innovative business cases in Europe. The main target group for the BDP are European biogas plants, however policy makers, technology developers, research institutes, consultants, mineral fertiliser industry, etc. could also make use of the BDP's output.

The Business Development Package is a webpage on the SYSTEMIC website and gives a comprehensive overview of the SYSTEMIC project results relevant for biogas plants:

www.systemicproject.eu/bdp

It is structured in 6 domains and provides a step-by-step approach in the exploration of nutrient recovery and reuse on digestate:

- Technologies and mass balances
- Recovered (nutrient/fertiliser) products
- Legislation
- Business case and economic key performance indicators
- Market and business models
- Outreach and contact

1 Introduction

With the goal of distributing the gathered knowledge from the SYSTEMIC project to the target group of European biogas plants after the project, the concept of the Business Development Package (BDP) was developed. As a webpage, which would contain open-access data tailored to the target group, it could facilitate exploring and decision making for implementation of the innovative business cases with nutrient recovery from digestate (www.systemicproject.eu/bdp). The BDP was designed to provide a comprehensive overview of the project results and tools that are most relevant for biogas plants to be used in practice.

2 Methodology

To ensure its geographical distribution and use and adoption of the information in the BDP, it is designed for maximal user-friendliness and sustainability towards the target group of biogas plants. Therefore, the Business Development Package is free of charge and publicly online available from on 30th of November 2021.

Because most project deliverables are long, detailed reports in which a biogas plant owner cannot easily and quickly find his/her way, the BDP was developed in a way to summarise the SYSTEMIC project results in the form of brochures, fact sheets, video's, tools, etc.

The fact that the BDP attempts to provides the desired information in a comprehensible and fast manner, does not mean that only general information on nutrient recovery and reuse (NRR) from digestate is provided: the BDP is structured in a way that the most straightforward and basic information is found first, and that the information gets more detailed and nuanced for the more advanced or experienced biogas plant owners, who would really like to read all the details.

The BDP is structured in 6 domains (Figure 2-1) which provide a step-by-step approach in the exploration of nutrient recovery and reuse on digestate.



Figure 2-1 Domains of the Business Development Package (BDP), providing a stepwise approach to exploring nutrient recovery and reuse (NRR) technologies for a biogas plant's business case. From left to right: (1) Technologies and mass balances, (2) Business case and economical Key Performance Indicators (KPIs), (3) Legislation, (4) Recovered (nutrient/fertiliser) products, (5) Market and business models, and (7) Outreach and contact.

SYSTEMIC calculation tools

The user-friendliness is even more optimised in the SYSTEMIC calculation tools: the NUTRICAS Tool (Chapter **Fout! Verwijzingsbron niet gevonden.**) and KPI Tool (Chapter 2.2.2.1)². For example, these digital calculation tools will be available in 5+ languages (English, Dutch, Finish, Croatian, Spanish, Italian, French, Turkish) and are designed to be used by the main target group (i.e. biogas plants) without having to read any manual. Both tools provide quick suggestions for NRR technologies or optimization of the user's specific biogas plant.

In a first development stage, the **NUTRICAS Tool** was developed in Microsoft Excel™ to create mass-balances and cost estimations for each of these technology cascades (SYSTEMIC Deliverable 3.5, Verbeke et al. 2020).

² <https://systemicproject.eu/bdp/technologies-and-mass-balances> and <https://systemicproject.eu/bdp/business-case-and-kpis>

However, with the Excel version of the NUTRICAS Tool ready, it became clear that excel is limited in speed when it comes to complex calculations, like the mass balance calculations.

It was therefore decided that the Excel tool would be translated into a web application with a server-based calculation engine. A web application would also provide a greater user- and administrator-friendliness. It would also have a data storing function for the data of each user's performed mass balance calculations. This would ensure that the user can see and recall the previous mass balance calculations done with the tool. In addition it makes it possible to improve the tool and its underlying data, including product compositions, separation efficiencies and costs indications.

Economic Key Performance Indicators (KPIs) can help to understand how an organisation is performing. During the SYSTEMIC project, specific economic KPIs have been developed for biogas plants and a digital calculation tool was made for them to quickly calculate these KPIs for their current business case.

Both calculation tools are available via the BDP (www.systemicproject.eu/bdp) or the direct URL <https://systemic-nrr-webclient.herokuapp.com>.

It could be that another domain name will be applied over time, which will then be documented in the most recent version of the Official documents of the SYSTEMIC Calculation Tools (Chapter 3.2).

Both calculation tools have been designed in a flexible, modular way to be able continuously update them. A "dashboard" environment has been created to provide also the possibility for other relevant calculation tools developed in other projects, to be centralised there (Chapter 3.1). This prevents a scattered distribution of similar tools throughout the internet, prevents overlap, supports their sustainability by sharing the maintenance costs and makes the functions of multi-language and storage of the data available for all calculation tools under this dashboard of 'bio-refinery calculation tools' (Figure 3-1).

To ensure that biogas plants will be able to access the BDP after the lifetime of the SYSTEMIC project, some measures for dissemination and long term sustainability of the BDP are set up (Chapter 3).

All this contributes to a higher level of user satisfaction and higher use rate, also in the future.

2.1 Technologies and mass balances

When a biogas plant is exploring difficult technologies to recover nutrients, organic matter and water from digestate, they mostly rely on technology providers for estimations on the performance and costs of the technology. In this section the BDP provides a comprehensive description of several cost-effective technologies (www.systemicproject.eu/bdp/technologies-and-mass-balances).

2.1.1 NUTRICAS Tool

An important part of the BDP is the NUTRICAS Tool (referring to “nutrients” and “cascade”), a calculation tool for mass balance and cost-benefit estimation of technologies for nutrient recovery on digestate (Deliverable 3.5, Verbeke et al. 2020) to estimate the costs and performances for selected NRR technology combinations. It is an exploratory tool to estimate the composition of end products, costs (CAPEX, OPEX, chemical costs) for specific technology combinations for nutrient recovery from digestate.

The selection of technologies was based on the technologies that occurred most frequently in the SYSTEMIC biogas plants, the results from a survey and case studies in literature (D 3.2, Verbeke, Brienza, and van Dijk 2021).

- Liquid-solid separation techniques
 - Centrifuge (with and without polymer addition, incl. FeCl_3 , $\text{Fe}_2(\text{SO}_4)_3$ or MgCl_3)
 - Screw press (with and without polymer addition)
 - Belt press (with polymer addition)
 - Dissolved air flotation (with polymer addition)
- Nitrogen (ammonia) stripping-scrubbing
 - With CO_2 stripping, high temperature and scrubbing with H_2SO_4
 - Without CO_2 stripping, low temperature and with scrubbing with H_2SO_4
 - With CO_2 stripping, high temperature and scrubbing with gypsum (FiberPlus system, implemented at Demonstration Plant BENAS, Germany)
- Evaporation and condensation
 - With prior acidification
 - Without prior acidification (implemented at Demonstration Plant Waterleau NewEnergy, Belgium)
- Membrane filtration technologies
 - Microfiltration + reverse osmosis (GENIUS system implemented at Demo Plant Groot Zevert Vergisting, Netherlands)
 - Evaporation and condensation + reverse osmosis (implemented at Demonstration Plant Am-Power, Belgium and soon at Key Outreach Location Nurmon Bioenergia, Finland)
- Phosphorus stripping and precipitation (RePeat system, implemented at Demonstration Plant Groot Zevert Vergisting, Netherlands)
- Thermal drying
 - Fluidised bed dryer

By combining these technologies, the SYSTEMIC consortium has chosen an array of different default technology cascades are presented in the NUTRICAS Tool (see ANNEX I of D 3.2: Verbeke, Brienza, et al. 2021), based on the end products that the user would like to produce (Figure 2-2).

Please choose the end products for your digestate

The end products will filter the appropriate cascades

[sort by most common](#)

N stripped digestate

(Liquid fraction) of digestate, from where a part of the ammonia is removed

Select

Precipitated phosphate salts

Precipitated phosphorus salts in some organic matter

Select

RO Concentrate

Solution of N, P, K and other minerals or salts, possible in different compositions

Select

Solid Fraction

Solid fraction of the digestate after separation

✓ **Selected**

Select the cascade you want to use

Showing 12 cascades possible for your selected end products

AVAILABLE SOON

Separation

Separation + membrane filtration

AVAILABLE SOON

Separation + DAF + N stripping-scrubbing

Figure 2-2 Choosing end product in the NUTRICAS Tool will filter the pre-set technology cascades that are available for simulations in the NUTRICAS Tool to only show the one producing your selected end product. In this example, "solid fraction".

There is a certain limit to the degree of freedom the user has:

- The available technology cascades are fixed (Figure 2-2) and it is not possible to combine multiple cascades
- The values used for calculating the mass balances (e.g. type and amount of additive added is also fixed, Figure 2-3, separation efficiencies and recovery rates)

Mass flow

Digestate from "Digestate"

946.1296
ton/year

Please select an additive preset to apply to "Decanter Centrifuge"

No additives

No additives

0,5% cationic polymer solution

Iron Chloride (FeCl₃)

Mass flow

Digestate from "Digestate"

946.1296
ton/year

Configure selected preset or [change preset](#)

0,5% cationic polymer solution

100	l/ton
3000	€/ton polymer

Figure 2-3 Screenshot of NUTRICAS Tool: (Top) Limited list of additives to select for Decanter Centrifuge; (Bottom) Amount of additive added is fixed at a default value, only the price of the additive can be adjusted.

These two limitations were implemented to prevent that a user seeks out the boundaries of the calculation models by setting extreme values, that would produce unrealistic calculated mass balances and cost estimations. More advanced users might want more flexibility to calculate mass balances and cost estimations for their own custom-made NRR process in the tool.

This is currently not possible by users, because **the goal of the tool is to provide a way to explore the technologies, providing more or less realistic figures to get a first impression on how the technology would perform on a specific digestate composition.**

It is possible to get more freedom, when using the Excel version of the NUTRICAS Tool (see section 2.1.1.2), for example during a workshop with plant owners. But insight in the used models is required for this. It is of course also possible to update or rewrite the values and calculation models in the NUTRICAS Tool web application (see Chapter 3).

By building in these limited degrees of freedom, the tool can still be very useful for biogas plants when setting up a business plan for NRR and applying for environmental permits or even a loan. In these cases mostly a draft version of a mass balance of the future project is required.

The NUTRICAS Tool has been user-tested on its user-friendliness for EU biogas plants to be used without the requirement of a manual. To further improve its use, it will be available in the languages of the SYSTEMIC consortium English, Dutch, German and Italian and a few of the languages of the Outreach Locations and Associated Plants: Swedish, Spanish, French, Finnish, Croatian and Turkish. Any language can be added if the translation is available.

2.1.1.1 SYSTEMIC database

The **composition of the feedstocks** and **performance of the technologies** will influence the cost-effectiveness of the technology and the **characteristics of the end products**, which in turn influence their marketability. To build the NUTRICAS Tool, data on these different aspects was collected from the project consortium partners, scientific publications, other project reports, SYSTEMIC biogas plants and technology providers.

The performance or efficiency of the technology is expressed as **the recovery rate**. This is defined as the fraction of the initial amount of mass, dry matter, organic matter, nutrients / minerals (nitrogen, phosphorus, potassium) that is recovered in the end product. It describes how efficient a technology can separate, concentrate or recover certain elements from the input flow.

When a separation technology is used, the term "separation efficiency" (a.k.a. Separation Index, SI) is used for the recovery rate. The following formula is used to calculate the recovery rate:

$$Recovery\ rate\ (Et) = \frac{mass_{end\ product}(kg) \times concentration_{end\ product} \left(\frac{g}{kg} \right)}{mass_{input}(kg) \times concentration_{input} \left(\frac{g}{kg} \right)}$$

This fraction is usually expressed as a percentage, for example 10% of the mass of the initial digestate that is processed in a decanter centrifuge is found in the solid fraction.

To store and categorise the data on each technology, an Excel database ("the SYSTEMIC database") was developed. Each record in the database gives information on a specific feedstock (mix), digestate or end product and contains values (e.g. analyses values, average values, median, 10 percentiles, etc.) for the recovery rate and composition.

If the record is an end product of a NRR technology (cascade), it also contains the technology (cascade) that is required to generate this specific end product.

End product	after	of (Type c	source	Referenc	unit NH4-N	P	unit P	mass (%)	DM (%)
digestate		digestate	pig slurry OBW	Møller, H. B., Somm	g N/L - kg N/m ³		0,89 g P/L - kg P/m ³		
liquid fraction	separation-centrifuge	digestate	pig slurry OBW	Møller, H. B., Somm			0,21 g P/L - kg P/m ³		
solid fraction	separation-centrifuge	digestate	pig slurry OBW	Møller, H. B., Somm			5,9 g P/L - kg P/m ³	13,72	69

Figure 2-4 Three records in the SYSTEMIC database for the NUTRICAS Tool for NRR from digestate.

An example is shown in Figure 2-4. The figure shows three records: digestate, liquid fraction and solid fraction after separation with a centrifuge. For each product the feedstock of the digestate is stated ("source") and the composition. In this figure only phosphorus (P) content is visible. The recovery efficiency for mass and dry matter (DM) to the solid fraction of this separation technology on the digestate is also included (parameters "mass (%)" and "DM (%)").

The records in the database are not all taken or analysed according to the same method and can be presented as single value, average, median, minimum, maximum of multiple samples taken in different periods.

The data is stored in a Microsoft Excel™ datafile and put in a read-only format that can be consulted on the BDP³. Table 2-1 gives the number of records in the last version of the database from December 2020.

Table 2-1 Number of records(i.e. rows) in the database, containing data on the composition of digestate or end products or recovery rates (June 2017- December 2020)

Type of records	Number of records
Scientific literature	686
Other data (analyses, reports with analyses, other databases etc.)	744
Demo Plants	169
Outreach Locations and Associated Plants	111
Other biogas plants	48
Total records from full scale biogas plants	1758

The current NUTRICAS calculation models (online available in "NUTRICAS Tool Description"⁵) are based on this version of the SYSTEMIC database, complemented with data from the final SYSTEMIC deliverable from WP1 (D 1.5, Brienza et al. 2021, which are not included in the SYSTEMIC database).

2.1.1.2 Excel of the NUTRICAS Tool

As the mass balance estimation calculations of the NUTRICAS Tool were first designed as an Excel™ tool, a final version of that Excel file (version of 30 November 2021) is also available on the BDP⁴. This can be freely used by the more experienced user to adjust values and combine different cascades, which is not possible in the web application of the NUTRICAS Tool. Please note that there can be differences between the online web-based tool and the former excel file based tool. Overall, the online one is the final version.

2.1.1.3 NUTRICAS Tool Description

The calculation models, default values and assumptions forming the foundation of the NUTRICAS Tool, are described in "NUTRICAS Tool Description"⁵. This document also describes how and to which extent these values and models can be updated and how languages can be added and terminology can be changed. Additionally, it describes how other calculation tools can be added to "the dashboard" (Chapter

³ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > "SYSTEMIC DATABASE".

⁴ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > "Excel version of NUTRICAS Tool".

⁵ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > "THE NUTRICAS TOOL DESCRIPTION".

3.1), and under which conditions they can make use of the existing calculation models and extend them (Chapter 3.2.1 and 3.2.2).

The “NUTRICAS Tool Description” is therefore a living document which will be continuously updated (see Chapter 3.2.3). As a consequence, the “NUTRICAS Tool Description” is not shown in this report as an Annex, but the latest version is always online available on the SYSTEMIC website⁵.

Figure 2-5 shows how the SYSTEMIC database, the Excel version of the NUTRICAS Tool and eventually the “Tool description” have been stepwise building up the content of NUTRICAS Web Application. Because simulations from the users are stored in a database (Chapter 3.2.1), this aggregated data of input values of digestate compositions and additive prices can be used to further improve the calculation models of the NUTRICAS Tool (Figure 2-5, blue arrow).

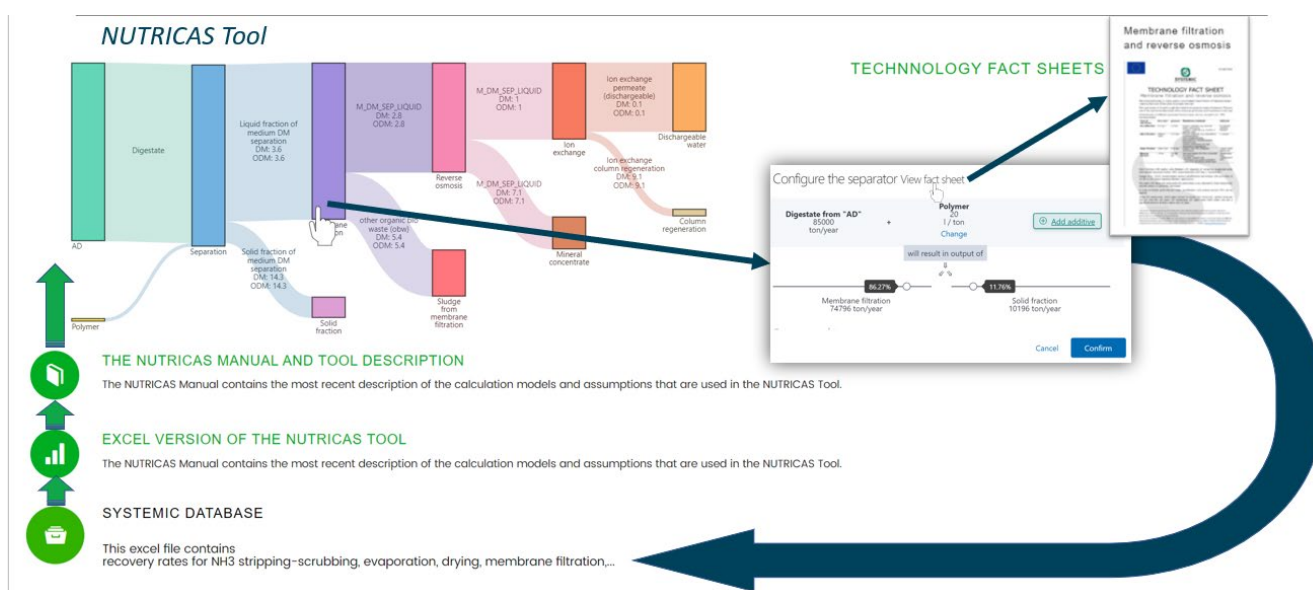


Figure 2-5 Illustration of how the SYSTEMIC project NUTRICAS Tool web application is built: the values in the SYSTEMIC database, translated to the excel version of the tool and described in the tool description. Input values from the users can be used again to enrich the SYSTEMIC database and improve the calculation models (blue arrow).

2.1.2 Process schemes of Demonstration Plants

To see some examples of different possibilities for nutrient recovery implemented in full-scale biogas plants, process schemes of the Demonstration Plants are supplied⁶.

2.1.3 Fact sheets from the Demo Plants

More in dept information on each plant can be read in the corresponding Fact sheets⁷. These include also the composition of the feedstock, digester conditions, biogas production and drivers and motivation for nutrient recovery.

A detailed look into the business cases of the Demo Plants can be found in Deliverable 2.2 Business case evaluation of five large-scale anaerobic digesters applying nutrient recovery and reuse (section 2.2.1).

⁶ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > “PROCESS SCHEMES OF THE DEMONSTRATION PLANTS”

⁷ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > “FACT SHEETS OF THE DEMONSTRATION PLANTS”

2.1.4 Webinar on the use of polymers for optimization of digestate separation

On 22 of April 2021 a free, online, technical webinar training on separation of digestate and the use of flocculants was organised in the framework of the SYSTEMIC project. The recording is available on the BDP and via Youtube⁸.

2.1.5 Biogas Plant discussions on NRR technologies

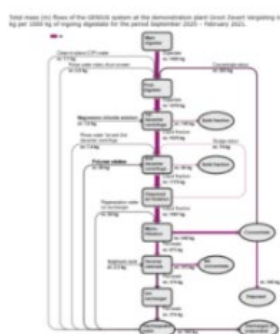
During the “Corona-year” of 2020, the SYSTEMIC biogas plants were invited to weekly online meetings, where different technologies for digestate treatment were discussed with their peers, technology providers and scientists. From these online discussions, **6 detailed reports** are made available on the BDP webpage.

2.1.6 Sankey Diagrams for mass- and nutrient balances from the Demo Plants

The Sankey diagrams from Deliverable 1.5 “Technical performance and mass- and energy balances of five large-scale anaerobic digesters applying nutrient recovery and reuse technology”, are shown directly in the BDP⁹ (Figure 2-6). The full report is also available there for further reading and more details.

SANKEY DIAGRAMS MASS- AND NUTRIENT BALANCES FROM DEMO PLANTS

Groot Zevent
Vergisting: GENIUS -
Mass



Groot Zevent
Vergisting: GENIUS -
NPK



Groot Zevent
Vergisting: RePeat -
Mass



Figure 2-6 Example of the sankey diagrams of the mass and nutrient balances of the SYSTEMIC Demo Plant Groot Zevent Vergisting (GZV) online at the BDP webpage www.systemicproject.eu/bdp.

⁸ <https://youtu.be/HrdqFzM0-M>.

⁹ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > “SANKEY DIAGRAMS MASS-AND NUTRIENT BALANCES OF THE DEMONSTRATION PLANTS”

2.1.7 Technology fact sheets

The BDP will show nine technology fact sheets¹⁰ (Figure 2-7), describing briefly the technologies that are implemented in the NUTRICAS Tool. The fact sheets can also be reached within the NUTRICAS Tool (Figure 2-5).

TECHNOLOGY FACT SHEETS

Liquid solid separation



Dissolved Air Flotation



Drying



Figure 2-7 Examples of the Technology Fact Sheets available in the NUTRICAS Tool and on the BDP website www.systemicproject.eu/bdp.

2.1.8 Report: Schemes and Scenario's for nutrient recovery

Deliverable 3.2 "Scenario's and schemes of proven techniques for digestate treatment and nutrient recovery" (Verbeke, Brienza, et al. 2021) is available on the BDP webpage for more details on the different nutrient recovery and reuse technologies. It is an elaborate report that describes different cost-efficient technologies for nutrient recovery from digestate. Per chapter a technology for NRR is described in terms of recovery rate or separation efficiency, required addition of chemicals, energy consumption, associated capital investment costs and operational costs and surface area needed.

2.2 Business case and economical key performance indicators

2.2.1 Report: Business case evaluation Demo Plants

Deliverable 2.2 "Business case evaluation of five large-scale anaerobic digesters applying nutrient recovery and reuse" (Hermann and Hermann 2020a) is provided in the BDP. It provides biogas plant owners with a unique insight into the business cases of the SYSTEMIC Demonstration Plants, in the hope that it might inspire them or give them new ideas for tackling their specific problems with digestate processing.

2.2.2 Report: SYSTEMIC's economical KPIs for biogas plants

In the context of the SYSTEMIC project, specific KPIs were developed for biogas plants that translate the technical values into commercial indicators such as cost per unit of biogas, feedstock or digestate. The

¹⁰ <https://systemicproject.eu/bdp/technologies-and-mass-balances> > "TECHNOLOGY FACT SHEETS"

KPIs are quantitative figures that reflect the performance of a biogas plant but they can be associated with targets which the organisations should set and pursue and aim at quantifying their achievement.

The KPIs focus on measuring the financial performance of a biogas plant by answering a few simple questions:

- Is the business case profitable?
- Which business activities (cost centres) are significantly contributing to the profitability of the plant?
- Which business activities are underperforming and undermining the profitability of the plant?

The methodology of development of the SYSTEMIC economic KPIs and their application to the five Demo plants and one key Outreach Locations is described in full detail in Deliverable 2.4 "Application of economic key performance indicators to five large-scale anaerobic digesters" (Hermann and Hermann 2020b), which is provided in the BDP.

2.2.2.1 KPI calculation tool

The SYSTEMIC project aims to provide biogas plant owners the tools for self-assessment of their business including assessment of the installation of NRR systems and benchmarking the own performance in comparison to others. Therefore, based on the concept of the SYSTEMIC economical KPIs, calculation was translated into a web application ("KPI calculation tool") for biogas plants to quickly calculate these KPIs for their current business case.

By means of a short list of questions, the user fills in all required information for the tool to calculate its economic KPIs. When more biogas plants have used the KPI Tool and more data is gathered, the calculated KPIs can then be compared to the KPIs of other EU biogas plants who have also used the KPI Tool (Figure 2-8). The tool can do a KPI evaluation of an existing biogas plant's business performance, but can also be used to perform simulations on how the KPIs would change when implementing certain NRR technologies, cutting specific costs or getting other revenues from end products, etc.

The aspiration of KPIs developed for SYSTEMIC biogas plants and future anaerobic digestion business cases and for investors, is having indicators that help to identify the cost centres and/or activities that perform well and those that perform below median. After having identified these activity areas, they can be tackled and strategic options for improvement can be developed. Once the strategies are implemented, the function of KPIs is to measure the achievement of objectives.



End result: KPI overview



Figure 2-8 Screenshot of an example of the calculated Key Performance Indicators (KPIs) of a biogas plant. Grey area will be implemented when more data from other biogas plants (i.e. users of the tool) is input in the KPI Tool. The KPIs can then be benchmarked against the median values, and also to biogas plants of similar size.

2.2.2.2 KPI Tool description

The KPI Tool has been user-tested on its user-friendliness for EU biogas plants to be used without the requirement of a manual.

The calculation models, default values and assumptions forming the foundation of the KPI Tool, are described in “KPI Calculation Tool Description”¹¹.

Like the NUTRICAS Tool, the KPI Tool will be available in multiple languages and the “Tool description” also describes how languages can be added and terminology can be changed.

The “KPI Tool Description” is therefore a living document which will be continuously updated (see Chapter 3.2.3) and therefore the latest version always online available on the SYSTEMIC website¹¹.

2.2.3 Practical information

Under “Practical information” at the KPI webpage¹¹ biogas plants can find a presentation given by Atria - Nurmon Bioenergia in Finland about the **production of liquefied biogas (LBG) as main revenue driver** in their biogas plant business case (“Presentation on Atria biogas plant (FI) with LBG production as main revenue – 2021”).

There is also an additional information sheet with tips and tricks on **what information to collect when applying for a loan for investment in NRR technologies as digestate processing** (“Information sheet: biogas financing from the perspective of the banking sector – 2021”).

¹¹ <https://systemicproject.eu/bdp/business-case-and-kpis> > “THE KPI CALCULATION TOOL DESCRIPTION”

2.3 Recovered (nutrient) products

Under the menu option “Recovered (nutrient) products”¹², visitors can find **five product fact sheets**. These give biogas plant owners a general idea on the composition, agronomic performance and environmental risk assessment of the application of different end products produced by NRR: ammonium nitrate solution, ammonium sulphate solution, condensed ammonium solution, mineral concentrate and liquid fraction of digestate. For an estimation of the composition of end products that could be produced from their specific digestate composition, the biogas plants are referred to the NUTRICAS Tool.

Additionally, **two product fact sheets are supplied with information specifically relevant for farmers** (“Product fact sheets for farmers”) on mineral concentrates and ammonium sulphate solution. They include information on the product composition and how the products should be applied in a practical and environmental-friendly way.

2.4 Legislation

Under “Legislation”¹³ on the BDP webpage more information can be found regarding legislative aspects relevant for NRR.

2.4.1 Contact information for advise on national legislation

To be able to supply biogas plant owners with answers on their specific questions regarding legislation concerning anaerobic digestion and application and marketing of end products from NRR processes, a list of national contact points is provided under “Legislation” on the BDP webpage.

2.4.2 Documents for policy makers

Under “Legislative” also the documents **Outcomes of the SYSTEMIC policy workshop** (2021) and an **Information sheet for policy makers** are provided, concerning suggestions from the SYSTEMIC consortium on the possible solutions to resolve the current legal bottlenecks to further facilitate the recovery of nutrients from digestate, enhancing the circular economy.

2.4.3 Report: regulations governing AD and NRR in EU member states

The complete Deliverable 2.1 “Report on regulations governing anaerobic digesters and nutrient recovery and reuse in EU member states” is provided in the BDP, since it gives an overview of the current European Policies regarding anaerobic digestion and nutrient recovery from digestate. These are followed by European Regulations that must be enforced by all Member States. Additionally, it describes the European Directives which must be adopted by Member States but not literally. Directives typically stipulate a target but leave room for selecting the strategy and pathway by the Member State. It goes further into detail for the countries with demonstration plants and outreach plants.

Since legislation is constantly changing, an update of this report done in the framework of the H2020 Nutri2Cycle project¹⁴, is also available.

¹² <https://systemicproject.eu/bdp/recovered-nutrient-products>

¹³ <https://systemicproject.eu/bdp/legislation/>

¹⁴ www.nutri2cycle.eu

2.5 Market and business models¹⁵

2.5.1 Report: Market research in Europe

Deliverable 3.4 “Market study for biobased fertilising products from digestate within a European context” (Verbeke, Hermann, et al. 2021) is integral available on the BDP.

2.5.2 Brochures and fact sheets on marketing end products

As a guideline for exploring the regional market, specific chapters are highlighted as fact sheets or brochures, which are extracts from Deliverable 3.4:

- **“Brochure on User Preferences for digestate products”** gives the conditions, requirements, specifications, preferences that different end users have for these products.
- **“Brochure: Tips and tricks for setting up a marketing strategy for digestate derived products”** gives specific tips for communication and advertising strategy of these products.

The **6 Fact sheets on Market opportunities for biorefinery products from digestate** provide a description of some current and future potential niche markets for recovered nutrient products. It includes both current and future potential niche markets and describes the barriers still to overcome before recovered nutrients can be successfully made available on these markets.

2.5.3 Business model development and application to the demonstration plants

Deliverable 2.7 “Development of business models for large-scale anaerobic digesters” (Hermann et al. 2021), is available on the BDP webpage and exhibits the opportunities and threats of certain business models (based on the evaluation of the demonstration plants) with regard to determined regulatory and commercial frameworks. It serves as a guideline for stakeholder for the preliminary, quick evaluation of projects.

2.6 Outreach and contact¹⁶

2.6.1 Summaries from Living Lab meetings

In the SYSTEMIC project we have created our own definition of a Living Lab. A Living Lab in SYSTEMIC is a real-life innovation environment where Demo Plants, Outreach Locations, Associated Plants and consortium members can learn from each other. The Living labs can also include other stakeholders like local farmers and industries, other research groups or interested projects.

Throughout the project, Living Lab meetings have been organised at physical events or online. Summaries of these meetings between this unique group of stakeholders are available on the BDP website under “Outreach and contact”.

¹⁵ <https://systemicproject.eu/bdp/market-and-business-models/>

¹⁶ <https://systemicproject.eu/bdp/outreach-and-contact/>



Living labs meeting a Groot Zevert demo plant
October 22, 2021

[Read more >](#)



Visit to SYSTEMIC demo plant Groot Zevert, the Netherlands
May 21, 2019

[Read more >](#)



The SYSTEMIC Living Lab approach for Anaerobic Digester plants
March 25, 2019

[Read more >](#)

Figure 2-9 News articles and summaries of the SYSTEMIC Living Lab meetings at the BDP website www.systemicproject.eu/bdp.

2.6.2 Report on application of BDP on Outreach Locations

In the last phase of the SYSTEMIC project, the BDP and NUTRICAS Tool have been implemented to all Outreach Locations. Deliverable 3.7 "Defining opportunities for nutrient recovery and reuse from digestate with a Business Development Package and the NUTRICAS Tool" (Verbeke, Paavola, et al. 2021) includes information on their current business case, regional market for their current digestate-derived products and bottlenecks in digestate treatment and disposal. After application of the BDP, it will be able for the biogas plants to describe different scenarios for NRR implementation and their feasibility and estimated impact on the current business case.

2.6.3 Dissemination tools for biogas plants

To help biogas plants improve the public image of anaerobic digestion and processing of digestate, some dissemination materials are provided at the BDP webpage under "Outreach and contact":

- Information sheets for farmers, citizens, policy makers;
- Plant videos;
- Educational presentations in English and Dutch.

2.6.4 Contact information

To be able to ask specific advice with regard to nutrient recovery from digestate or information on the produced deliverables, a contact form to **contact the consortium** is provided.

Even more useful is the **contact form to reach out to SYSTEMIC biogas plants** involved in the SYSTEMIC network of Demo Plants, Outreach Locations and Associated Plants (Figure 2-10).

Would you like to contact or visit one of the SYSTEMIC biogas plants?

I would like to contact SYSTEMIC biogas plant.*

Your name, biogas plant, country*

E-Mail*

Figure 2-10 Screenshot of the contact form to the SYSTEMIC biogas plants at the BDP website www.systemicproject.eu/bdp.

3 Dissemination and sustainability of the BDP and biogas plant network

The Business Development Package and The NUTRICAS Tool and KPI Calculation Tool (the latter two, further mentioned as "SYSTEMIC Calculation tools") were designed to provide information in such a way that their user-friendliness would ensure its dissemination towards the target group of European biogas plants.

However, this will not be all: the BDP will be actively advertised by the SYSTEMIC final newsletter (January 2022), twitter account and by the consortium partners on their website and via their newsletters and network, through word of mouth advertising by the SYSTEMIC biogas plants and on planned Conferences and webinars like ESNI 2022 (January 2022) and ManuREsource 2021 (May 2022).

To ensure that biogas plants will be able to access the BDP after the lifetime of the SYSTEMIC project, the BDP will be at least accessible until November 2025 on www.systemicproject.eu/bdp. Afterwards, all public deliverables from SYSTEMIC, including the BDP, will be published with a digital object identifier (DOI) number and available via the library of Wageningen University & Research (www.wur.nl/en/Library.htm), the Biorefine Cluster Europe (www.biorefine.eu).

The BDP will be completely available on the website of WP3 leader VCM (www.vcm-mestverwerking.be/en/faq/3921/systemic).

It is however inevitable that at a certain moment the content of the BDP will become outdated. But keeping this deliverable open access will certainly contribute to updates made in future projects.

The SYSTEMIC calculation tools are an exception. They have been designed in a flexible way to be easily updated or extended in the future (Section 3.1).

With regard to the network of SYSTEMIC biogas plants, the contact page and overview of all biogas plants in the network will help EU biogas plants to reach out the consortium and each other after the lifetime of the project.

The concept of Living Lab meetings with site visits will be attempted to continue once a year after the project's end. A high interest was shown by associated and outreach plants in this kind of workshops and meetings.

3.1 Openness of the SYSTEMIC calculation tools to link with other projects and technologies

3.1.1 Synergies with existing and emerging calculation tools developed in other projects

For both SYSTEMIC calculation tools (NUTRICAS Tool and KPI Tool), a common "Dashboard" was designed as the landing page after a user has been logged in to the system.

Additionally, this dashboard also has the potential to provide a centralised home for other existing and future calculation tools for digestate processing and refinery (Figure 3-1). This way, under certain conditions (section 3.2), other calculation tools related to digestate or manure processing with different concepts can also make use of already implemented powerful calculation engine, data storage ability, visibility in different languages and optimised user interface design.

This dashboard structure will prevent an oversupply of calculation tools scattered all over the internet and overlap in functions within the calculation tools. A shared dissemination and maintenance

responsibility can further improve the sustain the continuity of all the tools and their content under the umbrella of the dashboard.

Name of the dashboard is currently "SYSTEMIC tools", but when more tools are added this can be changed to something more general, like "Bio-based recovery Toolset".

The SYSTEMIC consortium has already been negotiating with other EU funded projects that were planning to construct similar tools. For example, the **EU H2020 project Nutri2Cycle**¹⁴ will also make an evaluation tool for technologies for nutrient recovery on manure and digestate. Many technologies overlap with the NUTRICAS Tool, so they will be able to work further on the established calculation models and database. They will probably also add a part about evaluating the cost-benefits for using the produced end products. The **EU Interreg project NITROMAN**¹⁷ is another project that might link their mass balance tool to the SYSTEMIC Tools' dashboard. They would include manure-processing technology cascades for nitrogen (N) stripping-scrubbing and membrane filtration from specific technology providers. To ensure that the authors and creators of each tool are granted the credit for their work, the project logo and funding source and logos of the project partners are shown under each tool (Figure 3-1).

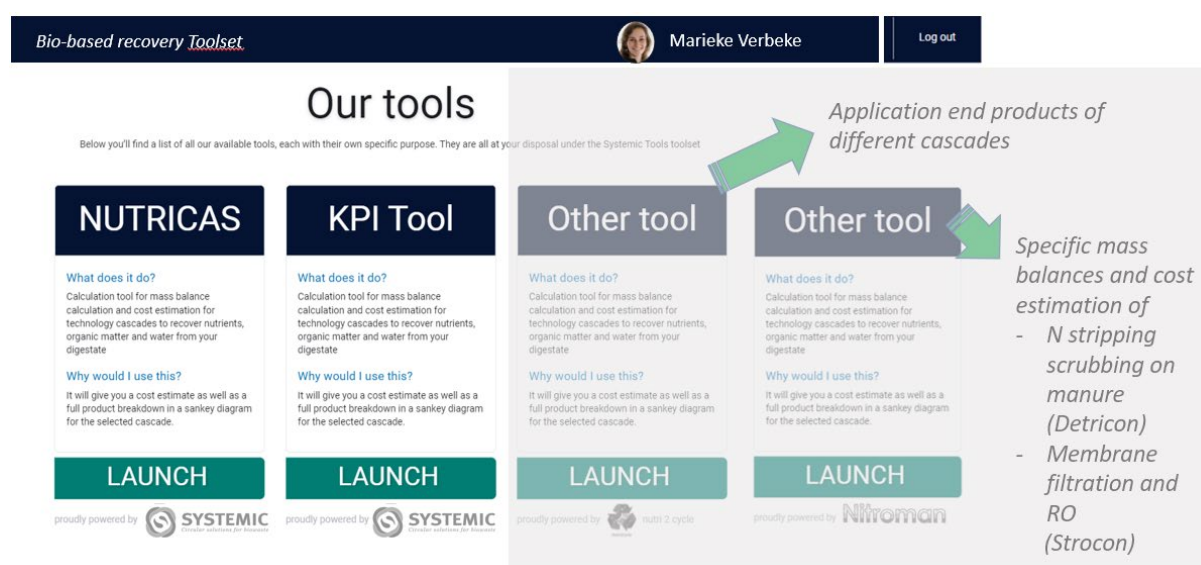


Figure 3-1 Dashboard of the Bio-based recovery Toolset (temporary name, subject to change). Grey area: tools in the pipeline of other EU projects that would possibly link to the digital environment built for the SYSTEMIC calculation tools.

3.1.2 Adding existing and emerging technologies from technology providers to NUTRICAS Tool

As described in section 2.1.1 **Fout! Verwijzingsbron niet gevonden.**, the current NUTRICAS Tool contains a number of default cascades, made up by default technologies in which the degrees of freedom for adjustment by the user is limited.

These default technologies are models and not existing technologies that can be bought at a specific technology supplier. For example, the Nitrogen (ammonia) stripping-scrubbing unit in the NUTRICAS Tool has the configuration of "pH increase by means of CO₂ stripping, working at high temperature (80°C) and scrubbing with H₂SO₄". This configuration is linked to certain cost estimations (CAPEX and OPEX) and attempts to make a realistic extrapolation when higher or lower treatment capacity is used (for more details, see "NUTRICAS Tool Description").

¹⁷ www.nitroman.be

To make more practical, real life estimations with the NUTRICAS Tool, it could be extended with data e.g. specific recovery rates, CAPEX and OPEX or even adjusted calculation models for existing technologies.

These additional technologies would no longer be default models in the NUTRICAS Tool, but contain very specific data for a specific technology developed, branded and purchasable at a specific technology provider (Figure 3-2).

Inclusion of such specific technologies in the NUTRICAS Tool, can be done on request of the tech provider, after setting up an agreement with the SYSTEMIC consortium (section 3.2.2) which describes the specific conditions. In case of collaboration neutrality of information and interest by tool holder must be guaranteed and contracted.

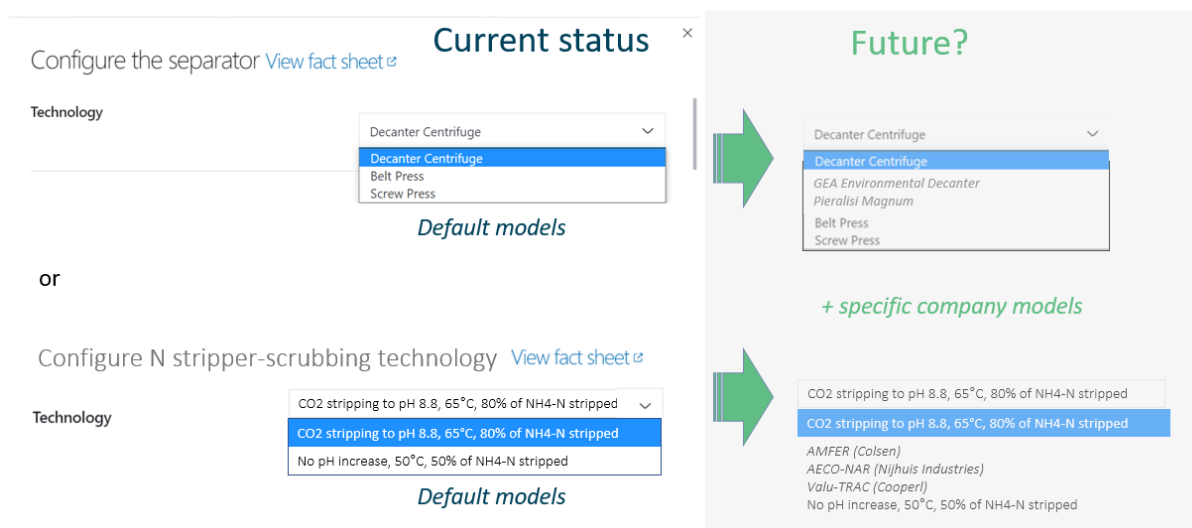


Figure 3-2 Example of the current technology options in the NUTRICAS Tool, working with default models (left), and possibility of including specific, existing technologies

3.2 Official documents for SYSTEMIC Calculation Tools

The SYSTEMIC coordinator's office (Wageningen Environmental Research, systemic@wur.nl), further mentioned as "WENR" or "the SYSTEMIC coordinator" and;

SYSTEMIC WP3 leader (Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw, info@vcm-mestverwerking.be) as, being responsible for the development of the SYSTEMIC calculation tools, further mentioned as "VCM":

- are the first contact point for requesting adaptations or changes to any of the Official documents for SYSTEMIC Calculation Tools.
- have access to the most recent version of the Privacy Policy and Partner Agreement of the SYSTEMIC calculation tools and can grant permission for access to other parties to these documents, under the following conditions:
All parties in the SYSTEMIC project (see section 3.2.1) agree with unanimity that access is granted to a third party.

The version of 30 November 2021 of the Administrative documents: Privacy Policy, business plan for the tools' maintenance and agreement between all parties contributing to the SYSTEMIC- and other tools, are found in this report.

The most recent versions are found at:

- i) <https://www.systemicproject.eu/bdp> or
- ii) the SYSTEMIC coordinator's office (systemic@wur.nl) and;
- iii) VCM (info@vcm-mestverwerking.be)

The SYSTEMIC coordinator and VCM have access to the documents and can grant permission for access of other parties to these documents, under the conditions described in the Partner agreement for SYSTEMIC calculation tools (section 3.2.2).

The NUTRICAS Tool and KPI calculation tool are mentioned further as "The SYSTEMIC Tools".

The Privacy Policy and Partner Agreement of the SYSTEMIC Calculation Tools are further mentioned as "The Official documents for SYSTEMIC Calculation Tools".

3.2.1 Privacy policy SYSTEMIC Calculation Tools

Version 30/11/2021

The most recent version of this privacy policy can be found on

https://docs.google.com/document/d/e/2PACX-1vTPvd14bsFPjNja7wsn4uF53Kd6JU0_LE6k_uz4cKkgtcjuNva_-pbU5YuPttJ9EA/pub

The NUTRICAS Tool and KPI calculation tool, further mentioned as "SYSTEMIC Calculation Tools", are developed in the framework of the H2020 project SYSTEMIC. SYSTEMIC receives funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement no. 730400.

The following organisations have the intellectual property (IP) rights of the SYSTEMIC Calculation Tools and are mentioned further as "the SYSTEMIC project" or "we":

- Project coordinator is Wageningen Environmental Research (WEnR), part of Wageningen University & Research (WUR) - NL - legal name: Stichting (Foundation) Wageningen Research.
- Proman Management GmbH - AT
- Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw (Flemish Coordination centre for Manure processing) - BE
- Department of Green Chemistry & Technology- Laboratory of Analytical Chemistry and Applied Ecochemistry of UGent - BE
- Rural Investment Support for Europe (RISE) foundation - BE

This privacy policy explains how we use the personal and aggregated data we collect from you when you use our online SYSTEMIC Calculation tools.

This privacy policy applies only to the SYSTEMIC Calculation tools and is not the same as the privacy policy of the SYSTEMIC website (<http://www.systemicproject.eu>) or the Data management and Intellectual Property agreement in the SYSTEMIC project.

What data do we collect?

The SYSTEMIC project collects the following data:

- **Personal identification information**

When using the SYSTEMIC Calculation tools, you must register yourself as a user. The date of registration and the version number of the software will be stored. The version number of the software will be updated when the software undergoes an update.

Your email address and location (country and postal code) will only be stored when you agree with this privacy statement.

- **Data collected when using the SYSTEMIC Calculation tools**

We register the date of each session and the number of simulations executed. All data that are inputted or selected (e.g. recovery rates, concentrations, etc.) when using the software are stored.

The SYSTEMIC Calculation tools do not intend to collect data about website visitors under the age of 16. Unless they have parental or guardian permission. However, we cannot check whether a visitor is older than 16. We therefore recommend that parents be involved in the online activities of their children, in order to prevent data about children from being collected without parental consent. If you are convinced that we have collected personal information about a minor without permission, please contact info@vcm-mestverwerking.be and we will delete this information.

How do we collect your data?

The SYSTEMIC project collects and process data when you:

- Register yourself as a user of the SYSTEMIC Calculation tools.
- Voluntarily input values and information when using the SYSTEMIC Calculation tools.

How will we use your data?

The SYSTEMIC project collects your data so that we can:

- Offer you opportunity to create an account in order to save and view the previous simulations that you have performed with the tool.
- Periodically send you the SYSTEMIC newsletter and other online information on the development of the software, updates, requests for additional information and user meetings. All online communication contains a possibility to opt-out concerning the account and/or online communication.

The SYSTEMIC project only uses aggregated data obtained from the actions performed by the user while doing a simulation (fields completed, boxes checked, values adapted by the user) with the NUTRICAS Tool.

Aggregated data are averages, grouping, variances, distributions, correlations, ... They are anonymised data which no longer have a link with individual personal data (i.e. login data such as e-mail, Facebook, LinkedIn, Google account) of the user.

The aggregated data are only used by the SYSTEMIC project for the following purposes:

- Optimization of the algorithm of the SYSTEMIC Calculation tools.
- Analysis and processing for publication in recognised peer-reviewed scientific publications by the SYSTEMIC project.

With your consent, by accepting this privacy statement, you allow the SYSTEMIC project to share **the aggregated data** with third parties.

Third parties are the consortium partners of the SYSTEMIC project:

- AM-Power
- Waterleau New Energy
- Groot Zevert Vergisting BV
- Acqua & Sole S.r.l.
- Rika Biofuel Developments Ltd
- GNS - Gesellschaft für Nachhaltige Stoffnutzung mbH
- A-Tuottajat Oy/A-Farmers Ltd
- ICL Fertilisers Europe C.V.
- NIJHUIS WATER TECHNOLOGY BV
- UNIVERSITA DEGLI STUDI DI MILANO
- EUROPEAN BIOGAS ASSOCIATION

or other parties, which have the official permission of the SYSTEMIC project to further expand, optimise or adapt the SYSTEMIC Calculation tools. An official agreement with such parties and the SYSTEMIC project will be added in the ANNEX of this Privacy Statement (See also section 3.2.2 of Deliverable 3.6). With your consent, by accepting this privacy statement, you also allow the SYSTEMIC project to share **your personal data** with various third parties if this is necessary to comply with any legal obligation. We conclude a processor agreement with companies that process your data on our behalf to ensure the same level of security and confidentiality of your data. The SYSTEMIC project remains responsible for these processing operations.

How do we store your data?

The SYSTEMIC project securely stores your data at the Cloud Application platform Heroku. Only a select group of authorised users has access to the personal data from registered users (stored in the Heroku Cloud Application). Access to the Heroku administrator interface is protected with a username and password and the administrator can assign a password for access to the database.

The only people with authorised admin rights will be:

- Oscar Schoumans from Wageningen Environmental Research (WEnR) part of Wageningen University & Research (WUR);
- Marieke Verbeke from Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw;

In case these authorised users with access to the personal data are replaced by someone else, this privacy policy will be updated and all registered users will be informed.

More information on the App security can be found here:

<https://devcenter.heroku.com/categories/app-security>

The SYSTEMIC project also makes use of the authentication software "Auth0" to protect your personal data.

More information on Auth0 security can be found on <https://auth0.com/docs>.

Both Auth0 and Heroku comply with the GDPR.

The SYSTEMIC project does not store your personal data longer than is strictly necessary to achieve the goals for which your data is collected. We use the following retention periods for the following personal data:

- Your login details (+ country and postal code) will be kept until you inform us to deactivate your account in the database or to stop sending online messages. This can be done by email via info@vcm-mestverwerking.be. All online communication contains a possibility to opt-out concerning the account and/or online communication.
- All data you share will also be kept until you request us to permanently delete it. This can be done by sending an email to info@vcm-mestverwerking.be

What are your data protection rights?

The SYSTEMIC project would like to make sure you are fully aware of all of your data protection rights. Every user is entitled to the following:

The right to access– You have the right to request the SYSTEMIC project for copies of your personal data.

The right to rectification– You have the right to request that the SYSTEMIC project corrects any information you believe is inaccurate. You also have the right to request the SYSTEMIC project to complete the information you believe is incomplete.

The right to erasure– You have the right to request that the SYSTEMIC project erases your personal data, under certain conditions.

The right to restrict processing– You have the right to request that the SYSTEMIC project restricts the processing of your personal data, under certain conditions.

The right to object to processing– You have the right to object to the SYSTEMIC project's processing of your personal data, under certain conditions.

The right to data portability– You have the right to request that the SYSTEMIC project transfers the data that we have collected to another organization, or directly to you, under certain conditions.

If you make a request, we have one month to respond to you. If you would like to exercise any of these rights, please contact us by email via info@vcm-mestverwerking.be

Call us at: +32 (0)50 73 77 72

Or write to us:

VCM (vzw)

Baron Ruzettelaan 1 B0.3

8310 Brugge

Belgium

To ensure that the request for access has been made by you, we ask you provide your phone number, so we can verify the request.

Cookies

Cookies are text files placed on your computer to collect standard Internet log information and visitor behaviour information. When you visit our websites, we may collect information from you automatically through cookies or similar technology.

For further information, visit <http://www.allaboutcookies.org>.

How do we use cookies?

The SYSTEMIC project uses cookies in a range of ways to improve your experience on our website.

What types of cookies do we use?

There is a number of different types of cookies, however, the NUTRICAS Tool web application uses:

- Functional and Technical – The SYSTEMIC project uses these cookies so that we recognise you on our website and remember your previously selected preferences. These could include what language you prefer and location you are in.
- Analytical – The SYSTEMIC project uses these cookies to optimise our web application. These cookies do not infringe on your privacy.

How to manage cookies

You can opt-out for cookies by changing the settings of your internet browser to not accept or store cookies. In addition, you can also delete all information previously saved via the settings of your browser. However, in a few cases, some of our web application features may not function as a result.

Privacy policies of other websites

The SYSTEMIC calculation tools contain links to other websites. Our privacy policy applies only to the NUTRICAS web application and the KPI calculation tool. Consequently, if you click on a link to another website the SYSTEMIC project is in no way responsible, we advise to check their privacy policy.

Changes to our privacy policy

We reserve the right to make changes to this statement. After a change in the privacy statement regarding personal data, all registered users will be updated by a digital message and asked again for their agreement.

For all other changes in the privacy statement, at the first following use of the software, each user will again be asked for their agreement.

This privacy statement is tailored to the use of and the possibilities on this website. Any changes and / or changes to this website may lead to changes in this privacy statement. It is therefore advisable to regularly consult this privacy statement.

How to contact us

If you have any questions about the SYSTEMIC project's privacy policy for the NUTRICAS web application, the data we hold on you, or you would like to exercise one of your data protection rights, please do not hesitate to contact us by:

Email: Info@vcm-mestverwerking.be

Phone: +32 (0)50 73 77 72

Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw

Baron Ruzettelaan 1 B0.3

8310 Brugge

Belgium

How to contact the appropriate authority

Should you wish to report a complaint or if you feel that the SYSTEMIC project has not addressed your concern in a satisfactory manner, you may contact the Information Commissioner's Office in your country or the European Data Protection Supervisor.

https://edps.europa.eu/data-protection/our-role-supervisor/complaints-wizard_en

3.2.2 Partner agreement SYSTEMIC Calculation tools

Version 30/11/2021

The most recent version of this Partner agreement is found at:

- i) the SYSTEMIC coordinator's office (Wageningen Environmental Research, systemic@wur.nl) and;
- ii) Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw, info@vcm-mestverwerking.be as SYSTEMIC WP3 leader, being responsible for the development of the SYSTEMIC calculation tools

The SYSTEMIC Calculation tools (NUTRICAS Tool and KPI calculation tool) are developed in the framework of the H2020 project SYSTEMIC. SYSTEMIC receives funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement no. 730400.

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- Proman Management GmbH - AT
- Vlaams Coördinatiecentrum Mestverwerking (VCM) vzw (Flemish Coordination centre for Manure processing) - BE
- Department of Green Chemistry & Technology- Laboratory of Analytical Chemistry and Applied Ecochemistry of University of Ghent (UGent) – BE
- Rural Investment Support for Europe (RISE) foundation - BE

Software

The SYSTEMIC Calculation tools' software (i.e. source code) is open under the conditions of the following:

- i) Open source licenses, which grant permission for anybody to use, modify, and share it for any purpose, subject to conditions of the license,
 - a. the calculation engine and server: <https://gitlab.com/vcm-vzw/systemic-nrr/systemic-nrr-engine/-/blob/master/LICENSE>
 - b. the webclient: <https://gitlab.com/vcm-vzw/systemic-nrr/estimation-client/-/blob/master/LICENSE>

This means that the source code can be used as a template or blueprint for new calculation tools or new modules can be added to it in future projects will be accessible under conditions of the current licenses.

- ii) A 'contract for communication' (Application Programming Interface), which allows access of third-party applications and systems to in a secure way.

These licenses can be changed after agreement with unanimity of WENR and VCM.

Content

The SYSTEMIC Tools were designed to be flexible and modular, anticipating the necessity to easily perform content updates i.e. calculation models, values like separation efficiency, recovery rate, CAPEX, OPEX, etc. or adding new technology cascades for digestate processing.

When one of the partners of the SYSTEMIC project wishes to include content updates to the calculation models etc. of the SYSTEMIC calculation tools, they should make a request this at the SYSTEMIC coordinator and VCM. If this request is granted the above mentioned parties can grant access to the digital environment to perform the agreed updates.

Synergies with existing and emerging digital calculation tools developed in other projects

The SYSTEMIC Tools' dashboard has the potential to provide a centralised home for other existing and future calculation tools related to bio-based solutions, digestate-, manure- or bio-waste processing and refinery.

When one of the partners of the SYSTEMIC project wishes to involve other parties to add another calculation tool to the dashboard and/or make use of the calculation models developed in SYSTEMIC, an official request needs to be sent to the SYSTEMIC coordinator and VCM.

If this request is granted, the following standard conditions will need to be implemented:

- The SYSTEMIC logo and EU flag remains visible on parts developed by within the framework of the SYSTEMIC project.
- The SYSTEMIC Tools remain open access.

An agreement is set up between the SYSTEMIC coordinator, VCM and the third party and added to this partner agreement. It will include a description of the conditions of the established cooperation:

- description of the foreseen added calculation tool, required adjustments, potential reuse or adaptation of the calculation models developed in the framework of the SYSTEMIC project, etc.;
- agreement for Intellectual Property (IP) rights;
- which data are required and delivered by whom;
- timing of the cooperation;
- the price for implementing the new calculation tool and which company (i.e. IT engineer) will do the software implementation and financial contribution to maintenance of all software of the SYSTEMIC calculation tools (see section 0);
- how possible incomes from commercialisation of all the tools on the dashboard will be divided between beneficiaries and used.

Other additional conditions of this cooperation can be agreed upon between the SYSTEMIC coordinator and VCM and the third party, and will have to be added to this partner agreement.

A description of the data governance with the newly added third parties will be added to the privacy policy.

Adding existing and emerging technologies from technology providers to the NUTRICAS Tool

Existing technologies from technology providers can be added to the NUTRICAS Tool (see section 3.1.2). For this, a technology provider has to file an official request at the SYSTEMIC coordinator and VCM.

If this request is granted, an agreement is set up between the SYSTEMIC coordinator, VCM and the technology provider and added to this partner agreement. It will include a description of the conditions of the established cooperation:

- Description of the technology, required adjustments, potential reuse or adaptation of the calculation models developed in the framework of the SYSTEMIC project, etc.
- agreement for Intellectual Property
- which data are required and delivered by whom
- timing of the cooperation
- the price for implementing the new calculation tool and which company (i.e. IT engineer) will do the software implementation
- Yearly fee for the value of advertisement of having their technology implemented in the NUTRICAS Tool and how this incomes will be divided between beneficiaries and used for maintenance of all software of the SYSTEMIC calculation tools (see section 0)

Other additional conditions of this cooperation can be agreed upon between the SYSTEMIC coordinator and VCM and the third party, and will have to be added to this partner agreement.

A description of the data governance with the newly added technology provider will be added the privacy policy.

If one of the partners of the SYSTEMIC project or third parties wishes to terminate the cooperation set in this partner agreement, they also have to file an official request at coordinators office and VCM, after which the conditions for termination will be agreed upon and described.

3.2.3 Business plan for maintenance of the SYSTEMIC Calculation tools

Version 30/11/2021

The SYSTEMIC Tools' can only be sustainable and accessible for a long period if regular software updates are done including bug fixes, technical updates (used libraries and frameworks and security updates), process automation, documentation, hosting etc. In the first year after the project (2022), these costs have already been included in the SYSTEMIC budget.

Next to that, there will be a content editor necessary to perform regular content updates like updates on technology costs e.g. CAPEX and OPEX, recovery rates or separation efficiency, translation updates, and to providing support when synergies are established with new calculation tools from other projects or technologies from technology providers are implemented.

Figure 3-3 shows the **yearly cost estimation associated maintenance for software, hosting and content maintenance/updates**. It also includes extra maintenance costs when respectively existing or new cascades or technologies would be adapted or implemented (section 3.1).

A preliminary business plan has been established to create revenues for supporting these yearly maintenance costs and keeping the SYSTEMIC Tools well updated and continuously available (Figure 3-4).

The total balance of the business plan (Figure 3-4) shows that only from year 4 after the SYSTEMIC project, the yearly maintenance costs would be outbalanced by the revenues. However, the total balance would only be positive after 10 years.

An alternative to create a positive balance from the beginning would be to have the content editors work at own expenses during the first three years after the SYSTEMIC project (Table 3-1). The content editor could be one of the SYSTEMIC partners, that would include this work into their regular daily work.

Table 3-1 Yearly total balance of the business plan for maintenance of the SYSTEMIC Calculation Tools in the first 10 years after the end of the SYSTEMIC project, excluding payment of the Content editors in the first 3 years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Yearly total (€)	1.395	474	2.837	1.792	2.162	3.579	3.994	6.285	7.401	9.611
Taxes on profit (€) 33%	460	157	936	591	714	1.181	1.318	2.074	2.442	3.172
Net profit (€)	935	318	1.901	1.200	1.449	2.398	2.676	4.211	4.959	6.440
Total balance (€)	935	1.252	3.153	4.354	5.802	8.200	10.876	15.087	20.046	26.486

The whole business plan is based on estimations and projections, and is therefore prone to changes in the future. Other financing tools and incomes could also be found along the way.

	index =1,02	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Costs	22 days per month	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year	Cost per year
General maintenance Tools version 2021											
software maintenance of the tool by IT engineer	person months per year = (1 days/22 days per month*12	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
	8000 € per person month	€ 8.000	€ 8.160	€ 8.323	€ 8.490	€ 8.659	€ 8.833	€ 9.009	€ 9.189	€ 9.373	€ 9.561
	Total	€ 4.451	€ 4.540	€ 4.631	€ 4.723	€ 4.818	€ 4.914	€ 5.012	€ 5.113	€ 5.215	
IT hosting/SAAS/...	150 € per month	Total	€ 1.890	€ 1.985	€ 2.084	€ 2.188	€ 2.297	€ 2.412	€ 2.533	€ 2.659	€ 2.792
Content maintenance by content editors	person months per year = (1 days/22 days per month*12	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
	7691,2 € per person month	€ 7.691	€ 7.845	€ 8.002	€ 8.162	€ 8.325	€ 8.492	€ 8.662	€ 8.835	€ 9.011	€ 9.192
	Total	€ 4.195	€ 4.279	€ 4.365	€ 4.452	€ 4.541	€ 4.632	€ 4.724	€ 4.819	€ 4.915	€ 5.014
Total cost for General maintenance Tools version 2021		Total	€ 4.195	€ 10.620	€ 10.889	€ 11.166	€ 11.452	€ 11.747	€ 12.051	€ 12.364	€ 12.687
Additional maintenance because of addition of new cascades/adaptation of existing technologies or cascades											
Technologies already in NUTRICAS (2021) + brand -extra software maintenance and hosting	number of new requests per year	1	5	2	1	1	1	1	1	1	1
	person months per year = (0,5 days per request/ 22 days per month*new requests)	0,14	0,18	0,20	0,23	0,25	0,27	0,30	0,32	0,34	
	Total	€ 1.113	€ 1.513	€ 1.737	€ 1.968	€ 2.208	€ 2.457	€ 2.715	€ 2.982	€ 3.259	
- extra work content editors	person months per year = (3 days per request/ 22 days per month*new requests)	0,14	0,68	0,27	0,14	0,14	0,14	0,14	0,14	0,14	
	Total	€ 1.049	€ 5.349	€ 2.182	€ 1.113	€ 1.135	€ 1.158	€ 1.181	€ 1.205	€ 1.229	€ 1.253
New technologies added + brand name -extra software maintenance and hosting	number of new requests per year	1	4	2	1	1	1	1	1	1	1
	person months per year = (0,75 days per request/ 22 days per month*new requests)	0,14	0,07	0,03	0,03	0,03	0,03	0,03	0,03	0,03	
	Total	€ -	€ 1.113	€ 567	€ 289	€ 295	€ 301	€ 307	€ 313	€ 320	€ 326
- extra work content editors	person months per year = (6 days per request/ 22 days per month*new requests)	0,27	1,09	0,55	0,27	0,27	0,27	0,27	0,27	0,27	0,27
	Total	€ 2.098	€ 8.558	€ 4.365	€ 2.226	€ 2.271	€ 2.316	€ 2.362	€ 2.409	€ 2.458	€ 2.507
Total cost for Additional maintenance		Total	€ 3.146	€ 16.133	€ 8.628	€ 5.365	€ 5.669	€ 5.983	€ 6.308	€ 6.643	€ 6.988
Total yearly costs maintenance (€)		€ 7.342	€ 26.753	€ 19.517	€ 16.531	€ 17.121	€ 17.730	€ 18.358	€ 19.007	€ 19.676	€ 20.367

Figure 3-3 Cost estimation for yearly costs associated maintenance for software, hosting and content maintenance, updates or support with extensions.

index =1,02		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
revenues		Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year	Revenues per year
Number of people using the tools per year = 1000 visitors per year in year 1+ 2% per new calculation tool added to dashboard		1020	1060	1080	1100	1100	1120	1120	1140	1140	1160
Sponsoring	# yearly sponsors	1	2	2	3	3	3	3	4	4	4
yearly sponsoring revenues = 200 € yearly sponsoring fee per sponsor + 0,05€ per user of the tools seeing the logo		Total €	251 €	462 €	463 €	668 €	668 €	669 €	669 €	874 €	874 €
Download aggregated data	number of users wanting a download = 2 % of people using the tools + 0,5 % increase per year	20	27	32	39	44	50	56	63	68	75
	Price per download	€ 2,0	€ 2,0	€ 2,1	€ 2,1	€ 2,2	€ 2,2	€ 2,3	€ 2,3	€ 2,3	€ 2,4
yearly revenues from downloads		Total €	41 €	54 €	67 €	82 €	95 €	111 €	126 €	144 €	160 €
Addition of new cascades/adaptation of existing technologies or cascades											
Technologies already in NUTRICAS (2021) + brand name	number of new requests per year	1	5	2	1	1	1	1	1	1	1
yearly contribution to general maintenance cost and hosting = 5 % of general maintenance cost per request		Total €	210 €	3.186 €	4.356 €	5.025 €	5.726 €	6.461 €	7.230 €	8.037 €	8.881 €
yearly revenues brand advertising = 200 € yearly fee per request + 0,05€ per user of the tools seeing the logo		Total €	251 €	1.518 €	2.032 €	2.295 €	2.550 €	2.816 €	3.072 €	3.341 €	3.598 €
New technologies added + brand name	number of new requests per year	1	4	2	1	1	1	1	1	1	1
yearly contribution to general maintenance cost and hosting = 5 % of general maintenance cost per request		Total €	210 €	2.655 €	3.811 €	4.467 €	5.154 €	5.873 €	6.628 €	7.419 €	8.247 €
yearly revenues brand advertising = 250 € yearly fee per new technology + 0,05€ per user of the tools seeing the logo		Total €	301 €	1.515 €	2.128 €	2.440 €	2.745 €	3.060 €	3.366 €	3.684 €	4.312 €
Integration of new calculation tools in Dashboard (by other projects)	number of new requests per year	1	2	1	1	0	1	0	1	0	1
yearly contribution to general maintenance cost and hosting as long as the project is running = 5 % of general maintenance cost		Total €	210 €	1.593 €	2.178 €	2.792 €	2.290 €	1.762 €	1.205 €	1.236 €	1.269 €
yearly revenues project brand advertising and dissemination = 500 € yearly fee per calculation tool as long as the project is running + 0,05€ per user of the tools seeing the project logo		Total €	551 €	1.053 €	554 €	555 €	55 €	556 €	56 €	557 €	57 €
total revenues (€)		€	2.024	12.036	15.589	18.323	19.283	21.309	22.353	25.292	27.077
yearly total (€)		€	-5.318	-14.716	-3.928	1.792	2.162	3.579	3.994	6.285	7.401
taxes on profit	33,00%	€	-	-	-	591	714	1.181	1.318	2.074	2.442
net profit		€	-5.318	-14.716	-3.928	1.200	1.449	2.398	2.676	4.211	4.959
total balance		€	-5.318	-20.034	-23.962	-22.761	-21.313	-18.915	-16.239	-12.028	-7.069

Figure 3-4 A preliminary business plan to create revenues in the coming 10 years to support the yearly maintenance costs and keeping the SYSTEMIC Tools well updated and continuously available. Yearly total balance (lower part) of the business plan for maintenance of the SYSTEMIC Calculation Tools in the first 10 years after the end of the SYSTEMIC project. Including payment of the Content editors in the first 3 years.

4 Expected impact

The Business Development Package will be publicly available and in combination with the developed dissemination plan of WP4 will reach out beyond the group of SYSTEMIC biogas plants. The BDP will support decision making for implementation of the innovative business cases in Europe. It will facilitate the transfer of knowledge and ongoing experiences from the demonstration plants to further outreach plants and identify opportunities for the uptake of the newly developed techniques into the business cases further expanding the principles of circular economy in the whole biogas value chain.

The expected impact of the availability of the BDP and SYSTEMIC calculation tools has been estimated, because a quantification of the impact KPIs was in most cases not possible and because they are only made public after 30th of November 2021. The impacts and contributions are described below.

First steps of the European biogas plants towards implementation of enhanced nutrient recovery technologies (TRL 7-8) by using the BDP.

and

Creating new business opportunities for the valorisation of biowaste at anaerobic digestion plants

and

Improving the competitiveness of the agro-industry by reducing the costs for disposal of manure, sludge and organic waste with 20% and costs for biogas production with 15%, and reducing CO₂ emissions from manure transport by 60-80%.

The BDP and SYSTEMIC tools are expected to be used by 1000 users in the first year after launch, of which 60% are estimated to be European Biogas Plants. Concrete implementation of the NRR technologies related to the use of D 3.6 cannot be directly quantified.

Creating new business opportunities for fertiliser industry and fertiliser retailers in trading secondary fertilisers in the European market

Domain 'Market and business models' is estimated to inspire 200 European biogas plants in the first year after launch to seek connection with the fertiliser industry and create secondary fertilisers.

Creating a leading position for European engineering companies offering sustainable nutrient recovery technologies for manure, sewage sludge and biowaste

At least 15 European technology providers are estimated to link their technologies in the NUTRICAS Tool, attracting a broad audience of estimated 200 biogas plants in the first year after the launch of the NUTRICAS Tool (Chapter 3.1.2).

Increasing the public acceptance of secondary fertilisers and feedstocks

By supplying scientifically supported and comprehensible information also for citizens (Chapter 2.6.3, "Dissemination materials for biogas plants") the public acceptance of secondary fertilisers will increase. 10% of the visitors of the BDP are estimated to be citizens.

Providing evidence-based knowledge in at least 2 policy briefs and providing Minutes from co-learning sessions (Policy workshops)

Both are available on the BDP, under domain "Legislation".

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Horizon 2020

Systemic large-scale eco-innovation to advance circular economy and mineral recovery from organic waste in Europe

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