



PART D

**SYNERGY
TECHNICAL
IMPLEMENTATION**

SCALING EUROPEAN RESOURCES WITH INDUSTRIAL SYMBIOSIS

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GUIDELINES FOR INDUSTRIAL SYMBIOSIS IMPLEMENTATION

- A - Introduction to industrial symbiosis (video)
- B - Intervening factors
- C - Overview of strategies for IS projects implementation
- D - Synergy technical implementation
- E - Sectoral outlook
- F - Strategic recommendations

This document is part of a series of guidelines, that aim to assist industry players in their implementation of industrial symbiosis.

The full series is available for download at:

www.scalerproject.eu

PART D - SYNERGY TECHNICAL IMPLEMENTATION

Technical recommendations and good practices

This document presents a dedicated overview on how to technically implement a synergy. The report compiles information from the SCALER project's main outcomes regarding the operational implementation of synergies. It provides technical recommendations and good practices for each of the proposed dedicated phases of synergy implementation.

The document also compiles information regarding the set of tools and methods available to industrial symbiosis practitioners.

Tools and methods

SPECIFIC TOOLS DEDICATED TO EACH STAGE

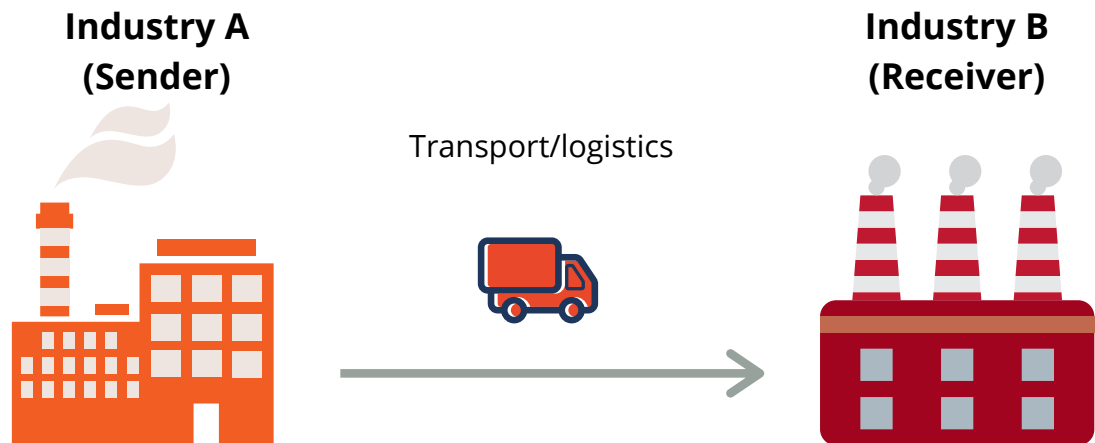
Tools play an important role in supporting the implementation of industrial symbiosis. In each of the proposed phases there are specific tools that can be used to help with the implementation process. This document makes reference to some existing tools.

GENERAL OVERVIEW OF TOOLS

At the end of this document (ANNEX I) a general overview of the specified tools is presented according to their role and purpose.

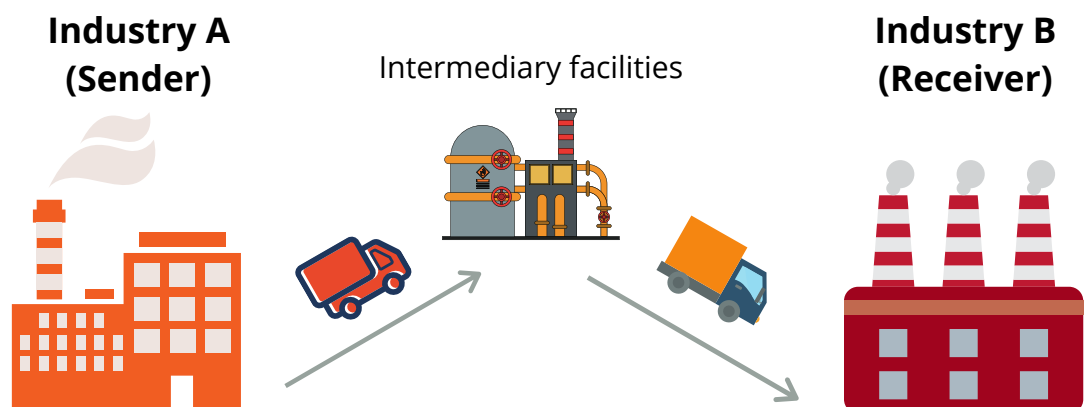
TECHNICAL OVERVIEW OF A SYNERGY

DIRECT SYNERGY TYPE



Direct synergies correspond to cases where the waste stream is directly used, or with the support of light technology (e.g. crusher, packaging, transport, storage, collection/distribution), as a substitute for a raw material in the receiving industry.

INDIRECT SYNERGY TYPE



Indirect synergies are considered when the waste stream requires a modification or a treatment (e.g. extraction, separation, purification, cleaning or transformation) before use, as a substitute for a raw material in the receiving industry. The modification or treatment can be done either by a directly involved stakeholder or a third party.

SYNERGY TECHNICAL IMPLEMENTATION STAGES

0

IDENTIFY YOUR COMPANY POTENTIAL

1

FIND SOLUTIONS FOR WASTE

2

ASSESSMENT OF THE SYNERGY

3

IMPLEMENTATION AND FOLLOW-UP

4

DOCUMENTATION AND REPORTING

STAGE 0. IDENTIFY COMPANY POTENTIAL

MAPPING INPUTS AND OUTPUTS

APPLY SYSTEM AND PROCESS LEVEL MAPPING

Think broadly in terms of resources, including waste flows, by-products, energy, water, logistics, capacity, expertise, equipment and materials.

Material Flow Analysis tools (MFA) can help with mapping materials and waste streams, supporting the identification of possible resources for synergies.

FULLY CHARACTERISE THE RESOURCES

THE IMPORTANCE OF MEASURING DATA

Although not mandatory, technologies like the Internet of Things and big data can support in collecting data.

An estimation of the data can be used when real data is not feasible or difficult to obtain. Compare them with industry-related data on material quantities.

ANALYSE THE POSSIBLE RE-USE OF RESOURCES WITHIN YOUR COMPANY

REUSE INTERNALLY

1. Analyse productive processes and operations
2. Analyse raw materials and process inputs
3. Analyse outputs and wastes
4. Check waste compatibility for possible substitutions of a raw material

STAGE 0. IDENTIFY COMPANY POTENTIAL

THE VALUE OPPORTUNITY OF WASTE

THE UNCAPTURED VALUE OF BUSINESS

Envision waste as a resource rather than something that has no value, or even a negative value.

The University of Cambridge has developed tools such as the Cambridge Value Mapping and Sustainable Value proposition Builder tools, to help identify and design new business value propositions related to uncaptured value.

UNDERSTANDING THE MARKET VALUE OF WASTE

POSITION YOURSELF ON THE MARKET

Consult waste market platforms to help identify if your waste is already being used in industrial symbiosis transactions. Platforms often exist and function on a regional basis.

Do your company's waste streams already have a value in the market?

Are there any companies interested in receiving your waste?



STAGE 1. IDENTIFY SOLUTIONS (OR SYNERGIES) FOR WASTE

The goal of this stage is to raise awareness of alternative sources to raw materials, and find internal/external users for waste outputs.

Search

- Antecedents of waste utilisation/synergy implementation
- The web for relevant firms and data
- Industrial symbiosis databases of case studies and synergy exchanges

Gain

- Cross-sectoral knowledge - technical documents can help identify new solutions for waste!

Create

- Awareness and gather interest
- Collaborations to find solutions for waste, either by attending conferences, workshop or working groups on the topic

Consult

- Facilitators (national governmental agencies, associations, academia and research institutes, consultants) that can help you find suitable partners and use for your waste

Think

- Outside the box!

You may find it easier to start with businesses you already have a relationship with, but look to expand your scope!



Horticulture

Bioethanol production

Topsoil

Soil conditioning

Animal feed

Aggregates

British Sugar in the UK specialises in the valorisation of its by-products. Today the sugar factory produces more than 10 different by-products, adding additional revenue to the core business activity.

British sugar has become a reference on industrial sustainability and resource efficiency, producing less than 200g of waste per tonne of sugar produced.

STAGE 1. IDENTIFY SOLUTIONS (OR SYNERGIES) FOR WASTE

USE OF INDUSTRIAL SYMBIOSIS SUPPORT TOOLS IN THE IDENTIFICATION OF SYNERGIES

MATCHMAKING SYSTEMS

Industrial symbiosis is supported by ICT systems that capture and manage data on resource availability and potential synergies. These tools have been mostly used to help identify solutions for waste.

One big group of tools is the so-called matchmaking process, i.e. linking one waste/by-product to an industry that can receive it. These type of tools are often used for mapping and identifying potential receivers in a specific location. Of all the matchmaking tools, ICT platforms hold the most potential given their full set of capabilities, that go from mapping to matching, and even assessing the potential of a synergy.

RELATIONSHIP MIMICKING

Other key tools include databases and knowledge repositories which help with mimicking established industrial symbiosis opportunities.

These tools contain data regarding the entities performing the exchange, as well as on the by-products themselves. Other information could also be available, for example geographical and technical. Databases involving a specific region can also improve the symbiosis dynamics in said area.

For more information on the tools designed for the identification of symbiotic opportunities, please refer to Annex 1 of this document.

STAGE 2. SYNERGY ASSESSMENT

A symbiotic cooperation will only thrive when there are clear advantages for all parties. Therefore, it is necessary to assess the synergy potential by analysing it from a technical standpoint but also evaluating it at **environmental, social and economic levels**. These assessments provide estimations on the shared benefits and overall impact of the synergy.

The **legal aspect** is also crucial to the implementation of synergies, which should be in accordance with legal frameworks and policies. A positive assessment of a synergy is an important cue to raise awareness of regulators on the potential of a given exchange, and thus reinforce **policy changes**.

Technical assessment

The SCALER project performed a technical assessment on 100 identified synergies with the most potential in Europe. For the technical analysis, we considered variables such as:

- Waste streams and inputs quantitative and qualitative data
- Modes and means of transportation
- Use of technology, and need for treatment operations
- Matching waste/raw material quality requirements and quality considerations
- Infrastructure such as warehouse space, other exchange logistics

The major output from this work was the assessment of the compatibility of the resource being exchanged between companies and the identification of the technologies and treatments associated to each synergy.

The results from this technical assessment analysis on the 100 synergies were compiled, and are available in our "Synergies Outlook" available at www.scalerproject.eu

STAGE 2. SYNERGY ASSESSMENT

Environmental assessment

The LCA methodology helps model the environmental impacts (climate change, use of resources, etc.) for single or multiple synergies between companies in comparison with a reference scenario, i.e the scenario in which the exchanges are not taking place.

This means considering the fate of the resource of interest (landfill, incineration, other disposal methods) if not used in the synergy, and also the raw materials that would have been used instead.

This methodology is heavily reliant on data. The scope of the synergy LCA study should be adjusted to the amount of available data. A screening LCA method could prove useful for an initial impact assessment of synergies when data is limited.

One of the main conclusions regarding the impact of the synergies refers to the transport of the waste streams between facilities - a main factor for the execution of synergies.

SCALER carried out an LCA assessment of the previously mentioned 100 synergies - all results can be found in our report "Synergies environmental assessment" available here: www.scalerproject.eu/resources/reports



STAGE 2. SYNERGY ASSESSMENT

Socio-economic assessment

SCALER METHODOLOGY

The SCALER methodology supports the quantification of social and economic impacts of a synergy. The socio-economic assessment considered in the SCALER project looked at pure economic values created or destroyed by a synergy project. Several typologies of economic values were evaluated: new revenues, costs avoided, additional costs and foregone income.

- **New revenues** correspond to the hidden economic value intrinsic to a waste stream, and considers it as a new revenue source.
- **Costs avoided** correspond to the costs avoided by implementing the synergy, such as CO2 tax reduction or waste management costs.
- **Additional costs** correspond to new costs driven by the implementation of the synergy, such as elements related to machinery investment or transport.
- The **foregone income** economic value was not considered in the scope of this economic analysis.

The following variables were used as an entry-point for the assessment:

- Waste stream volume
- Final valuable volume (volume of the element of interest for the synergy) in the waste stream
- Waste stream price in the baseline scenario
- Substituted resource equivalent price

To access the full description of the methodology used for the socio-economic assessment, download the report at www.scalerproject.eu/resources/reports

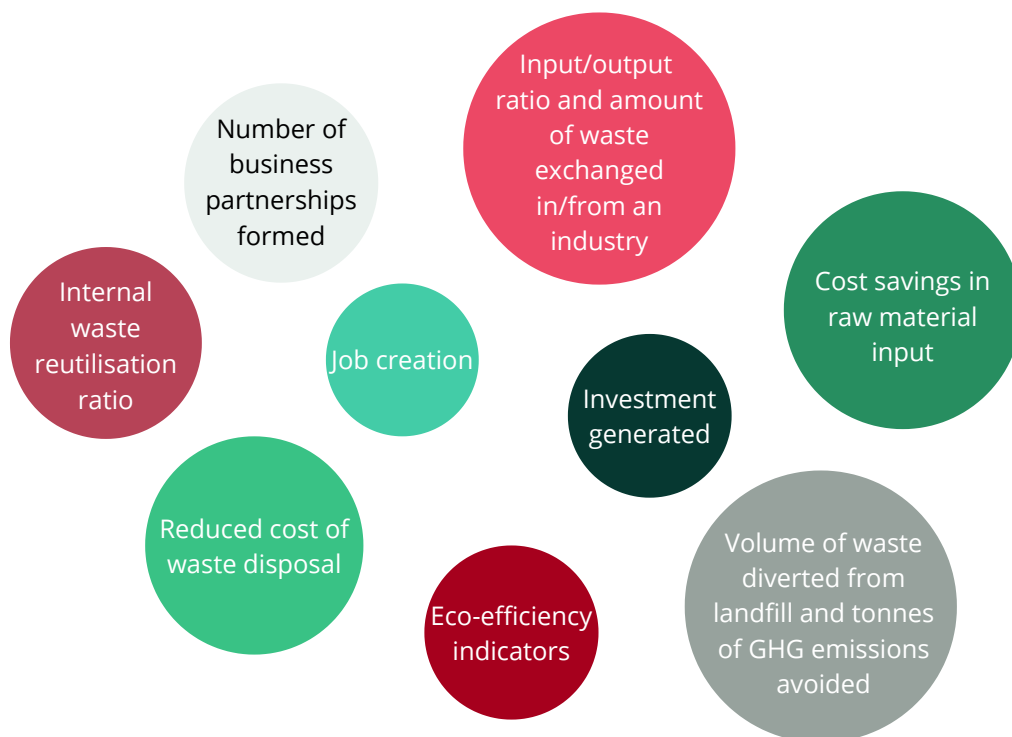
Several assessment methodologies are available, such as cost-benefit types of analysis, that consider gains and investments of the symbiosis. Alternatively, the use of Life-Cycle Costing and/or combined Life-Cycle Social Assessment methodologies also exist.

STAGE 3. IMPLEMENTATION AND FOLLOW UP

MONITOR AND KEEP TRACK OF ACTIVITY

KEY PERFORMANCE INDICATORS

Industrial symbiosis is based on the exchange and collaboration between or among companies. Several indicators could be used to track and assess the performance of these exchanges. The following could be used to monitor industrial symbiosis from the perspective of a single company.



Other performance indicators are used in the context of a network of synergies, or for management of eco-industrial parks, such as:

- Industrial Symbiosis Indicator tool(1), which enables firms to manage processes by detecting variations in simple metrics and KPIs.
- Industrial Symbiosis Indicator using an ecosystem approach(2).

1. Felicio, M., Amaral, D., Esposto, K., & Durany, X. G. (2016). Industrial symbiosis indicators to manage eco industrial parks as dynamic systems. *Journal of cleaner production* , 118, pp. 54-64.

2. Fraccascia, L., Albino, V., Giannocaro, I. (2017) New Performance Indicators for Industrial Symbiosis: an Ecosystem Approach. Conference: 1st Symbiosis User Network Conference

DOCUMENTATION AND REPORTS

DOCUMENT AND REPORT

WHY?

Documentation can help keep track of the history of industrial symbiosis activities within a company and support with the dissemination and replication of best practices.

KNOWLEDGE SHARING TOOLS

Industrial symbiosis databases and knowledge repositories constitute an important means for the dissemination of implemented synergies, case studies and best practices. This in turn helps with the replication and mimicking of synergies by other companies.



The SCALER 100 synergies and technical database contains information regarding 100 potential synergies and their technical assessment, including technology and economic and environmental data.



The circulator is a self-service tool and open platform for knowledge sharing that allows users to select cases based on key aspects around circular business models and industrial symbiosis.



MAESTRI offers a library of industrial symbiosis case studies and linked exchanges that contains information related to existing cases. One section presents the description of the case studies, while the exchanges database describes all the exchange resources used.



The industrial symbiosis DATA repository is an open platform for collecting and supplying structured information on industrial symbiosis, containing existing cases of symbiotic implementations.

CONCLUSIVE THOUGHTS

1

There are a great number of tools to support the implementation of synergies, ranging from the identification of solutions for waste, to managerial tools and performance evaluation of activities.

2

Implementing synergies requires commitment from the entire organisation. The operational phase requires a great deal of communication and trust between parties.

3

Mapping your organisation's inputs and outputs facilitates the pre-assessment of synergistic opportunities and makes the implementation process easier.

4

Assessing synergies will allow you to estimate benefits and impacts. It could also create leverage as a driving-force for policy-makers to identify key aspects in relation to circular and sustainable strategies and policies.

5

Keeping track of your industrial symbiosis activity will allow you to better manage the symbiotic process, estimate the actual benefits and generate better transparency of results.

ANNEX I

INDUSTRIAL SYMBIOSIS SUPPORT TOOLS

Multiple tools are available to help actors, from EIP managers to facilitators, policy makers, or single companies willing to participate in industrial symbiosis. The entire tool arsenal could be comprised of platforms, modelling tools, methodologies and frameworks.

Some of the tools have more than one purpose, mainly digital platforms which often mapping of potential hotspots for symbiosis, but also link waste-to-resource exchanges and incorporate synergy assessment methods.

The following table summarises some of the available tools that can support initiatives. The table contains references to some of the tools presented in the SCALER report "Pathways to increase industrial symbiosis" available at www.scalerproject.eu/resources/reports

Purpose	Description	Tool/Method
Open online waste market	Digital marketplaces that allow users to submit waste to be transacted as resources	Materials Marketplace(1) MOR(2)
Synergy identification systems	Matchmaking systems or platforms to help firms connect and establish symbiotic exchanges	Synergie 4.0 platform and database, Symbiosys, iNex, Looplocal tool, Sharebox
Synergy assessment	Group of tools that support the assessment of the impacts and benefits of an exchange	LCA, LCC, S-LCA, Cost Benefit Analysis, SWOT analysis
Value identification	Identify waste value and potential new business models	Cambridge value tools; MAESTRI toolkit
IS knowledge repositories and databases	Knowledge repositories and databases containing information regarding existing case studies and implemented synergies	SCALER database; MAESTRI Library of case studies and linked exchanges, ROI online (3), IS Data, Circulator tool
Process modelling, simulation and optimisation	Plan developments or optimise behaviours at different levels: mapping and location, network planning, policy determination, social, trust and knowledge diffusion	Material Flow Analysis, Enterprise Input-Output method, Agent based modelling, EIP or network planning tools
IS monitoring tools	Monitoring of IS activity, and providing analysis to assess synergy performance	IS Indicator Tool (see p. 11), Eco-efficiency computation

1. <https://go.materialsmarketplace.org>

2. <http://www.moronline.pt/>

3. http://www.roionline.org/case_study.php/

MORE SCALER GUIDES



Quick Guides – Helping industries increase efficiency through resource sharing

These guides offer quick insights into how businesses can start industrial resource synergies with other companies to minimise their waste and create more value from their production.

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Synergies Outlook – List of 100 potential synergies to increase industrial resource sharing

This repository provides a list of 100 promising synergies that could be implemented in the European process industry, helping companies identify potential waste exchange with other firms.

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