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## Industrial Symbiosis: Core Elements and Implementation Approaches

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<b>Contents</b>		Page
<b>European foreword</b> .....		3
<b>Overview</b> .....		5
<b>1</b>	<b>Scope</b> .....	7
<b>2</b>	<b>Normative references</b> .....	7
<b>3</b>	<b>Terms, definitions and abbreviation</b> .....	9
<b>3.1</b>	<b>Terms and definitions</b> .....	9
<b>3.2</b>	<b>Abbreviations</b> .....	12
<b>4</b>	<b>Core Elements of Industrial Symbiosis</b> .....	13
<b>5</b>	<b>Drivers for Industrial Symbiosis</b> .....	13
<b>6</b>	<b>Approaches to Industrial Symbiosis NOTE</b> .....	15
<b>7</b>	<b>Industrial Symbiosis Implementation: Good Practice</b> .....	18
<b>7.1</b>	<b>Factors Enabling Good Practice</b> .....	18
<b>7.2</b>	<b>Actions Representing Good Practice</b> .....	19
<b>Bibliography</b> .....		20

## European foreword

This Workshop has been proposed by 4 European projects working to advance the uptake of industrial symbiosis across Europe and globally. Contribution to standardization activities has been specified as one of the means for dissemination for the projects SHAREBOX (Secure Platform for the Flexible Management of Shared Process Resources) and EPOS (Enhanced energy and resource efficiency and Performance in process industry Operations via onsite and cross-sectorial Symbiosis) of the European Commission's Horizon 2020 programme, SPIRE Sustainable Process Industries PPP. Advancing policy to stimulate industrial symbiosis is an objective of Interreg Europe projects TRIS (Transition Regions towards Industrial Symbiosis) and SYMBI (Industrial Symbiosis for a Resource Efficient Economy).

CWA Industrial Symbiosis was developed in accordance with CEN-CENELEC Guide 29 "CEN/CENELEC Workshop Agreements – The way to rapid agreement" and with the relevant provisions of CEN/CENELEC Internal Regulations – Part 2. It was agreed on 2018-10-22 in a Workshop by representatives of interested parties, approved and supported by CEN following a public call for participation made on 2018-01-24. It does not necessarily reflect the views of all stakeholders that might have an interest in its subject matter.

The final text of CWA Industrial Symbiosis was submitted to CEN for publication on 2018-11-12. It was developed and approved by:

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 University of Ghent  
 CEPI - Confederation of European Paper Industries  
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## CWA 17354 (E)

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## Overview

The 2018 Amendment to the Waste Framework Directive (2008/98/EC) passed into law calls for member states to promote sustainable use of resources and industrial symbiosis. As industrial symbiosis is further integrated into the policies, reports and recommendations of the European Commission across multiple DGs and various member states at the national, regional and local scale, the variety of terminologies used in these documents can be confusing and sometimes misleading to those wishing to implement industrial symbiosis. Such confusion dilutes the effectiveness of the approach to deliver resource efficiency, greenhouse gas reduction and economic benefits.

Resource efficiency through industrial symbiosis offers economic opportunities for European industry. This CEN Workshop Agreement (CWA) is intended to help organisations, governments and individuals consider and implement industrial symbiosis. To support the effective adoption of industrial symbiosis by the public and private sector and to advance toward mainstream adoption, this CWA provides a consensus on the core elements of industrial symbiosis to enable its identification and on good practice approaches to industrial symbiosis implementation across Europe and beyond. These common elements and approaches can form the basis for policy, recommendations and widespread implementation.

Specifically, this CWA sets out the following:

1. Core elements of industrial symbiosis;
2. Drivers for industrial symbiosis;
3. Approaches to industrial symbiosis;
4. Industrial symbiosis implementation: good practice.

Industrial symbiosis is the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer. Core elements of industrial symbiosis are the aspects that enable its identification. Elements considered core to industrial symbiosis are:

- Returning underutilised resources (often called waste) to productive use;
- Information about opportunities (e.g., data on other organisations' resources, or new technologies) is required to be able to advance a synergy;
- Business conditions incentivising industrial symbiosis, which may be through market conditions or through policies and regulations; and

Four common approaches to industrial symbiosis (that are not mutually exclusive) vary depending on where the onus for identifying and advancing opportunities lies:

1. Self-organised: a bottom-up approach resulting from direct interaction among industrial actors, without external coordination. Expertise resides within the organisations with resources and opportunities; organisations identify, assess and advance opportunities themselves.
2. Facilitated: wherein a third-party intermediary coordinates the activity, working with organisations to identify opportunities and help bring them to fruition. Facilitators (sometimes referred to as practitioners) work with the companies to identify, assess and advance opportunities; often the onus is on the facilitators to progress opportunities. Facilitator business models vary from commercial brokers to public investment networks and any combination thereof.
3. ICT-supported: industrial symbiosis activity is supported by an ICT system to capture and manage data on resource availability and potential synergies. The onus lies with the software users, be they companies, other organisations or facilitators.

4. Strategic or planned: a top-down approach where networks are formed following a central plan or vision that includes attracting new businesses to regeneration sites or purpose-built developments. The onus lies with the central body (often public sector) implementing the plan or vision.

Good practice implementation in any approach requires the following steps:

1. Fully characterising the resources available: thinking broadly about resources (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials); and reassessing waste for value as a resource.
2. Identifying and assessing opportunities to return underutilised resources to productive use: statistically, most (not all) reuse opportunities are outside one's own sector, so cross-sector knowledge may be required.

Matching the available resource with the appropriate opportunity, addressing technical, economic, and legal requirements. Intermediate transformation steps may also be required.

## 1 Scope

Industrial symbiosis is the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer. It presents a systems approach to a more sustainable and integrated industrial economy that identifies business opportunities to improve resource utilisation and productivity. The objectives of this CEN Workshop Agreement (CWA) are to support the mainstream adoption of good practice approaches proven through implementation by advancing the mutual understanding of actors (public, private, third sector, and community) currently using the term industrial symbiosis in different ways. This CWA is intended to help the above actors consider and implement industrial symbiosis.

## 2 Normative references

The following **standards-related references** are central to this document:

- BS 8001: 2017 “Guidelines to a Circular Economy” and references therein  
<https://www.bsigroup.com/en-GB/standards/benefits-of-using-standards/becoming-more-sustainable-with-standards/BS8001-Circular-Economy/>
- IWA 27: 2017 “Guiding principle and framework for the sharing economy”  
<https://www.iso.org/standard/72643.html>

The following **related references (reports, policies)** are central to this document:

There are multiple directives that mention industrial symbiosis and its relationship to resource efficiency within the European Union, although few are specific to industrial symbiosis as a focus; rather, industrial symbiosis is included as support to their primary aims. Some of the most relevant documents are listed below:

- Official Journal of the European Union, Legislation L150, Volume 61, 14<sup>th</sup> June 2018 amendments to: Directive 1999/31/EC Landfill of Waste; Directive 2008/98/EC on Waste; and Directive 94/62/EC Packaging and Packaging of Waste.  
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AL%3A2018%3A150%3ATOC>
- DG GROW, Cooperation fostering industrial symbiosis: market potential, good practice and policy actions (2018)  
[http://publications.europa.eu/publication/manifestation\\_identifier/PUB\\_ET0517150ENN](http://publications.europa.eu/publication/manifestation_identifier/PUB_ET0517150ENN)
- European Environment Agency: Circular Economy in Europe (2016)  
<https://www.eea.europa.eu/publications/circular-economy-in-europe>
- European Resource Efficiency Platform: Short-term recommendations (2014)  
[http://ec.europa.eu/environment/resource\\_efficiency/documents/erep\\_manifesto\\_and\\_policy\\_recommendations\\_31-03-2014.pdf](http://ec.europa.eu/environment/resource_efficiency/documents/erep_manifesto_and_policy_recommendations_31-03-2014.pdf)
- European Commission Communication: GREEN ACTION PLAN FOR SMEs, Enabling SMEs to turn environmental challenges into business opportunities (2014)  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0440&from=EN>
- European Commission Communication: A Stronger European Industry for Growth and Economic Recovery, Industrial Policy Communication Update (2012) recommendation  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0582&from=EN>

- DG Regions: Connecting Smart and Sustainable Growth through Smart Specialisation (2012)  
[http://ec.europa.eu/regional\\_policy/en/information/publications/guides/2012/connecting-smart-and-sustainable-growth-through-smart-specialisation-a-practical-guide-for-erdf-managing-authorities](http://ec.europa.eu/regional_policy/en/information/publications/guides/2012/connecting-smart-and-sustainable-growth-through-smart-specialisation-a-practical-guide-for-erdf-managing-authorities)
- European Commission: Roadmap to a Resource Efficient Europe (2011)  
<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0571&from=EN>
- DG Enterprise: Sustainable Industry: Going for Growth & Resource Efficiency (2011)  
<https://ec.europa.eu/docsroom/documents/5188/attachments/1/translations/en/renditions/pdf>
- ETAP 10<sup>th</sup> Eco-Innovation Forum (2011)  
[http://ec.europa.eu/environment/archives/ecoinnovation2011/1st\\_forum/](http://ec.europa.eu/environment/archives/ecoinnovation2011/1st_forum/)
- European Waste Framework Directive 'Being Wise with Waste' – Best Practice (2009)  
<http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf>

A review of how the term 'industrial symbiosis' is used in the European institutions' documentation (legislative and beyond) has produced the following examples:

- **Council of the European Union:** Since 2013, there have been many references but only 2 occasions whereby there is an attempt to describe the term: one as a '*new business model*', and one as a '*user-driven innovation business model*'.
- **European Parliament:** There have been many references to industrial symbiosis since 2013. It is referred to as '*turning one industry's by-product into another industry's raw material.*' From the European Parliamentary Research Service, '*Industrial symbiosis engages different organisations in a network to foster eco-innovation and long-term culture change. It provides mutually profitable transactions for novel sourcing of required inputs, value-added destinations for non-product outputs, and improved business and technical processes*' citing Lombardi and Laybourn (2012a).<sup>1</sup>
- **European Commission** – Findings are divided into the various Directorate-Generals:
  - **DG Environment:** There are several mentions of the term industrial symbiosis. Referring to NISP®, a facilitated industrial symbiosis activity: "*It is a business opportunity programme that develops mutually profitable links between traditionally separate companies from all industrial sectors and of all sizes so that previously unused or discarded resources such as energy, water and/or materials from one company can be recovered, reprocessed and re-used by other companies in the industrial member network.*" Further links to global agendas are made here: "*...with respect to industrial symbiosis, knowledge transfer and the shift towards a circular and green economy, particular attention should be given to resource efficient, environmentally-sound performance of businesses, including the value chains, and on the harmonisation of the methodology for measuring their ecological footprint.*"
  - **DG Grow:** also cites Lombardi and Laybourn (2012a)<sup>2</sup> in its 2018 report<sup>3</sup> to encourage broader uptake of industrial symbiosis for economic benefit.

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<sup>1</sup> Lombardi DR and P Laybourn (2012a) Redefining Industrial Symbiosis: Crossing Academic-practitioner Boundaries. *Journal of Industrial Ecology* 12(1): 28-37

<sup>2</sup> *Ibid*

<sup>3</sup> Domenech et al. (2018). Cooperation fostering Industrial Symbiosis, Report prepared for DG Grow. Available at: <https://publications.europa.eu/en/publication-detail/-/publication/174996c9-3947-11e8-b5fe-01aa75ed71a1/language-en>



- **DG Regio:** There is an indirect definition in one of its publications, *'The Industrial Symbiosis Network helps to identify opportunities to recover and reprocess waste products from one industry that can then be re-used by other businesses. This, in turn, reduces the amount of waste going to land fill, cuts carbon emissions and creates greener jobs. In essence, it is a brokerage initiative to increase business opportunities and contribute to the sustainable growth of the region.'*
- **DG Research** describes industrial symbiosis in the text of the H2020 2014 call on waste: *'Industrial symbiosis, whereby different actors derive mutual benefit from sharing utilities and waste materials, requires large-scale systemic innovation with the aim of turning waste from one industry into useful feedstock for another one.'*
- **DG Secretary General** was responsible for coordinating the policy work that went into the circular economy package. Industrial symbiosis is communicated as: *'turning one industry's by-product into another industry's raw material'*. On a separate occasion industrial symbiosis is referred to as *'an innovative industrial process'*.

### 3 Terms, definitions and abbreviation

#### 3.1 Terms and definitions

##### 3.1.1

##### **alternative fuel**

any fuel with a potential for long-term non-renewable fuel substitution

REFERENCE: Adapted from Communication from the Commission of 24 January 2013 entitled 'Clean Power for Transport: A European alternative fuels strategy', available at <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A52013PC0017>.

##### 3.1.2

##### **by-product**

substance or object, resulting from a production process, the primary aim of which is not the production of that item fulfilling the following points:

- (a) further use of the substance or object is certain;
- (b) the substance or object can be used directly without any further processing other than normal industrial practice;
- (c) the substance or object is produced as an integral part of a production process;
- (d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

REFERENCE: Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives  
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098>

##### 3.1.3

##### **cascading use**

in general, means a sequence of use phases with declining product value. Cascading allows the use of resources (materials and water) to be extended. For instance, using biomass as a production material first, then recycling it (several times) before finally recovering the energy content from the resulting waste at the end of its lifecycle. Such cascading systems may provide general advantages for climate change mitigation and ease land use pressure