Interreg Europe – Policy Learning Platform – Environment and Resource Efficiency

Policy brief

Industrial symbiosis

This policy brief provides information on how industrial symbiosis is supported by EU policy framework and on the potential actions regions and cities can take to support the establishment of sustainable industrial networks that are based on exchanges of resources.

1. Background

Since the early days of industrialisation industrial economy has been following a linear model of resource consumption that follows a take-make-dispose pattern.[1] Industrial symbiosis is an approach which closes the loop in the material and energy flows contributing to a circular economy model. Industrial symbiosis represents a shift from the traditional industrial model in which wastes are considered the norm, to integrated systems in which everything has its use.

Industrial symbiosis is part of the industrial ecology concept, that uses the natural ecosystem as an analogy for human industrial activity. The principal objective of industrial ecology is to restructure the industrial system by optimising resource use, closing material loops and minimising emissions, promoting de-materialisation and reducing and eliminating the dependence on non-renewable energy sources.[2] While industrial ecology is principally concerned with the flow of materials and energy through systems at different scales, from products to factories and up to national and global levels; industrial symbiosis focuses on these flows through industrial networks in local and regional economies.[3]

In a broad sense, industrial symbiosis is defined as the synergistic exchange of waste, by-products, water and energy between individual companies in a locality, region or even in a virtual community. Key to industrial symbiosis is collaboration between companies and the synergistic possibilities offered by geographical proximity. Industrial symbiosis engages traditionally separate industries in a collective approach to competitive advantage involving physical exchanges of materials, energy, water and/or by-products.[4]

At least three different entities must be involved in exchanging at least two different resources for the framework to be considered industrial symbiosis.[5]

A distinction is made between three types of industrial symbiosis configuration:

- among firms co-located in a defined eco-industrial park
- among local firms that are not co-located, and
- among firms organised “virtually” across a broader region[6]

---

[1] Ellen MacArthur Foundation, Towards the Circular Economy 1: Economic and Business Rationale for an Accelerated Transition; January 2012, Cowes, Isle of Wight, 2012

[2] In line with the definition of Erkman and Ramaswamy (2001)

[3] Chertow, M., Industrial symbiosis. The Encyclopedia of Earth, 2008

[4] Chertow, M., Industrial symbiosis: Literature and Taxonomy. Annual Review of Energy and the Environment 25, 2000

[5] Chertow, M., “Uncovering” Industrial Symbiosis. Journal of Industrial Ecology 11(1), 2007

[6] Chertow, M., Industrial symbiosis: Literature and Taxonomy. Annual Review of Energy and the Environment 25, 2000

2. EU policy framework

At the European level, the potential contribution of industrial symbiosis to sustainable production and EU industry competitiveness was recognised in the Resource Efficient Europe flagship initiative of the Europe 2020 Strategy. The Roadmap to a Resource Efficient Europe[7], which is part of the Resource Efficiency Flagship initiative, points out[8] that improving the reuse of raw materials through greater 'industrial symbiosis' could save EUR 1.4 billion a year across the EU and generate EUR 1.6 billion in sales. With the aim to boost efficient production, the roadmap stipulates that Member States should help companies work together to make the best use of the waste and by-products they produce e.g. by exploiting industrial symbiosis.

The 2012 Communication of the European Commission titled, 'A stronger European industry for growth and economic recovery'[9] predicted that the factories of tomorrow will apply highly energy- and material-efficient processes, and increasingly adopt sustainable business models such as industrial symbiosis to recover materials, heat and energy. It is assumed that these technologies represent a significant business opportunity, with a global market that is expected to double in size to over EUR 750 billion by 2020.

The Circular Economy Action Plan[10] of the EU urges to promote innovative industrial processes including industrial symbiosis. In its revised proposals on waste, the Commission is proposing to clarify rules on by-products to facilitate industrial symbiosis and help create a level-playing field across the EU.

The EU is supporting such developments through its research and innovation programme Horizon 2020. In the 2014-2015 the Programme launched calls in two focus areas: 'Leadership in enabling and industrial technologies' and 'Climate action, environment, resource efficiency and raw materials'. In the Work Programme 2016-2017 the new focus area – 'Cross-cutting activities' – may fund industrial symbiosis actions in priority area 'Industry 2020 in the Circular Economy'.

3. Cases from European regions

- ***Kalundborg symbiosis, Denmark***

The first full realisation of industrial symbiosis was the case of Kalundborg in Denmark. The Kalundborg Symbiosis came into being as a result of private conversations between a few enterprise managers from the Kalundborg region in the '60s and '70s. The primary partners in Kalundborg – an oil refinery, power station, gypsum board facility, pharmaceutical plant, and the City of Kalundborg exchange a variety of residues that become feedstock in other processes, and share ground water, surface water and waste water, steam and electricity. Over the years more and more businesses were connected to the scheme, and in 1989 the term 'industrial symbiosis' was used to describe the collaboration for the first time.[11]

Some of the material exchanges found in Kalundborg: sludge from the biotechnological company is used as fertiliser in nearby farms; a cement company uses the power plant's desulphurised fly ash; the refinery's desulphurisation operation produces sulphur, which is used as a raw material in the sulphuric acid production plant; and the surplus yeast from the biotechnological company is used by farmers as pig feed.[12]

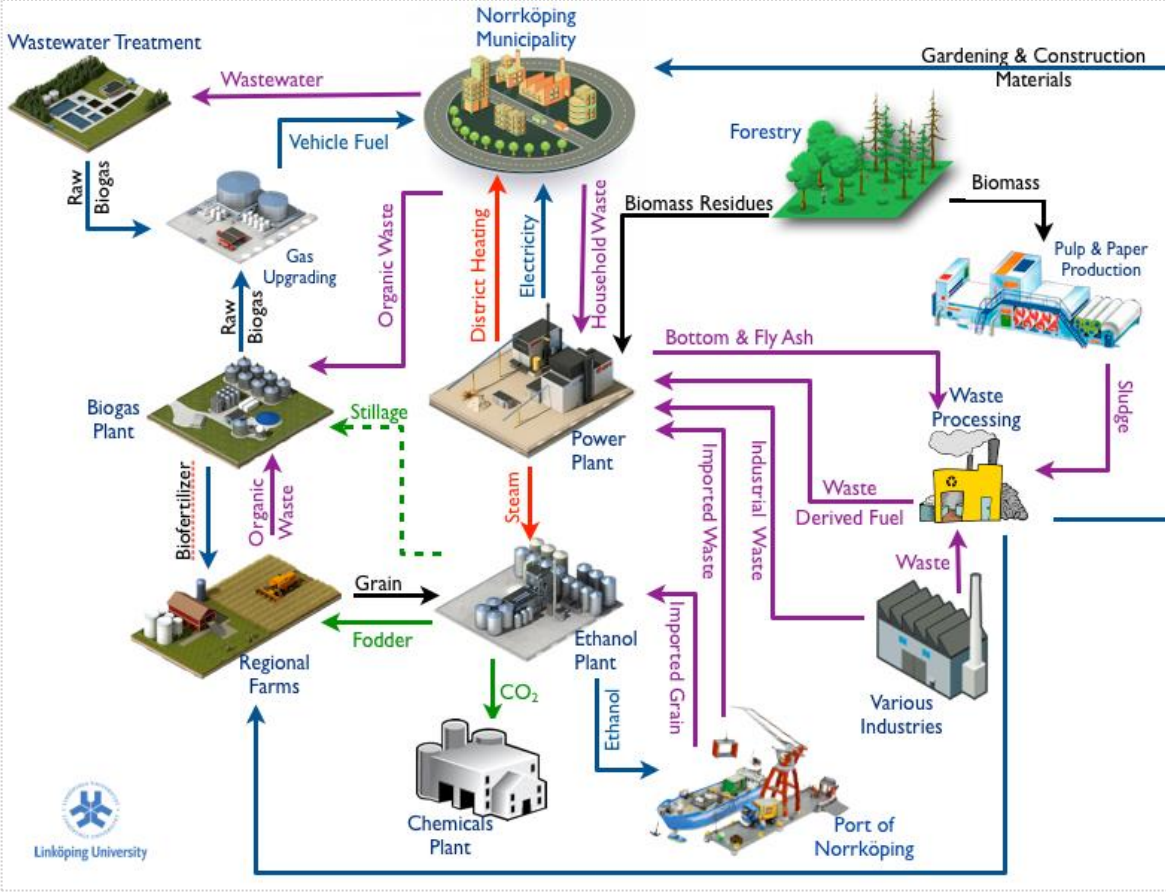
---

[7] EC, Roadmap to a Resource Efficient Europe, 2011
[8] COWI, The Economic Benefits of Resource Efficiency Policy, 2011
[9] EC, A Stronger European Industry for Growth and Economic Recovery, 2012
[10] EC, Closing the loop - An EU action plan for the Circular Economy, 2015
[11] Chertow, M., Industrial symbiosis. The Encyclopedia of Earth, 2008
[12] Baas, L., Cleaner Production and Industrial Ecology; Dynamic Aspects of the Introduction and Dissemination of New Concepts in Industrial Practice, 2005

- ***Norrköping industrial symbiosis network, Sweden***[13]

The combined heat and power plant (CHP), serving the local district heating system in Norrköping, Sweden, has a central role in the operation of the industrial symbiosis network of the town. The municipality of Norrköping was a key player in modifying E.ON's CHP plant enabling the utilisation of alternative fuel sources. Currently, the municipality provides the CHP plant with household waste as fuel, and the municipality is a key customer for the heat, electricity and cooling produced by this plant. The plant is dominantly fuelled with forestry residues from the region, domestic and industrial waste sourced from Norrköping, from other Swedish municipalities, and other European countries. The plant provides district heating, electricity, some district cooling, and industrial steam.

Within the industrial network, among others, steam, household waste, stillage (a by-product of bio-ethanol production), bio-fertiliser and digestate from biogas production are exchanged among the municipality, the CHP plant, a bio-ethanol producer, a biogas plant and local farmers. The various material and energy flows are indicated in the picture below.



Source: Industrial symbiosis in Sweden; http://www.industriellekologi.se/symbiosis/index.html

The dedicated and strategic actions of the municipality have been a key driver in developing the industrial network. These actions included the establishment of a district heating system,

[13] http://www.industriellekologi.se/symbiosis/norrkoping.html

development of a CHP plant, and supporting the use waste and biomass as fuels. The business development department of the municipality has been instrumental for Agroetanol's decision to locate their plant in in the area, to take advantage of the available steam. The role of the ipality has also been essential in the development of a biogas market in transportation.

- ***Wooden waste pallets used to produce wood shavings, NISP, UK[14]***

The C2CN INTERREG IV C project identified a specific good practice for industrial symbiosis through the National Industrial Symbiosis Programme (NISP), a business opportunity program run in the UK. A cheese producer, AJ & RG Barber was looking for a reuse solution for its wooden waste pallets through one of the synergy workshops of NISP. After a number of negotiations NISP identified a company from its network, Mendip Woodshavings that was able to make use of the waste and blend it with other material ready for reuse. Mendip Woodshavings, that already provided Barber with various farm products such as animal bedding, was able to collect the used cheese boxes on its return journeys. Through this arrangement Barber saved the cost of both transportation and landfill gate fees, and could free up a substantial area of the site which had previously been used for storage.

- ***Industrial Symbiosis Platform in Sicily, Italy***

In May 2011, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) launched a 3-year project to build an Industrial Symbiosis Platform in Sicilia Region. The platform acts as tool in the service of businesses and particularly SMEs. The main objective of the platform is to provide help in launching industrial symbiosis through a georeferenced information system support. The activities also involved a consultation in Sicily with stakeholders, with particular reference to Confindustria Sicilia and the Sicilian Regional Agency for Waste.[15] As a result of the meetings organised under the project more than 80 SME were linked giving rise to more than 690 potential matches. The matches were mainly related to plastics and plastic products, metals and metal products, municipal wastewater treatment sludge, and construction and demolition waste.[16]

4. The way forward: potential actions on regional and local level

There are range of actions through which regions and cities can directly and indirectly support and promote industrial symbiosis:

- ***Application of economic and regulatory instruments***

Several economic and regulatory instruments introduced by regional and local authorities can drive industrial symbiosis indirectly, through favouring higher and penalising lower waste hierarchy options. Examples include relatively high landfill and incineration taxes, pay-as-you-throw schemes, local landfill bans of various waste streams (e.g. on organic waste), targeted economic incentives.

- ***Development of cooperation platforms***

The establishment of cooperation platforms can bridge the co-operation and coordination deficit between the suppliers of the production residuals, the potential clients of these residuals and the providers of know-

[14] http://www.interreg4c.eu/good-practices/practice-details/index-practice=374-national-industrial-symbiosis-programme-nisp&.html

[15] Cutaia, L., et al. The Project for the Implementation of the Industrial Symbiosis Platform in Sicily: The Progress After the First Year of Operation, 2014

[16] Cutaia, L., et al. The experience of the first industrial symbiosis platform in Italy, 2015

how and technology. Such platforms may help provide potential markets with minimum required scale and scope of industrial symbiosis arrangements, as well as knowledge. The services provided by cooperation platforms can include offering support in 'material scans' and matchmaking for SMEs; providing industrial symbiosis-related technical trainings on the valorisation of material streams; and providing support in securing funding mechanisms.

- ***Establishment of eco-industrial parks***

Regional and local authorities can also take initiative to bring together relevant actors and establish eco-industrial parks with an overall aim to promote industrial symbiosis.

- ***Identification and invitation of potential investors***

The authorities can undertake a targeted research for potential investors that could make use of a certain by-product available in the area.

- ***Generation of market demand***

As consumers, local authorities can generate market demand for certain material and energy flows (e.g. biogas that is used in transportation).

Interreg Europe programme also supports efforts in this area. Two Interreg Europe projects, TRIS and SYMBI, specifically focus on the environmental and economic benefits that industrial symbiosis brings. While in SYMBI there is an emphasis on green public procurement and innovative programmes, TRIS puts focuses on aspects regarding policy and regulation, networks and tools to improve the capacity of SMEs.

Sources of further information:

- Baas, L., 2005. Cleaner Production and Industrial Ecology; Dynamic Aspects of the Introduction and Dissemination of New Concepts in Industrial Practice. Eburon Academic Publishers. Delft.
- Chertow, M. 2008. Industrial symbiosis. The Encyclopedia of Earth.
- Chertow, M. 2007. "Uncovering" Industrial Symbiosis. Journal of Industrial Ecology 11(1)
- Chertow, M. 2000. Industrial symbiosis: Literature and Taxonomy. Annual Review of Energy and the Environment 25
- COWI. 2011. The Economic Benefits of Resource Efficiency Policy. August 2011
- Cutaia, L., et al. 2015. The experience of the first industrial symbiosis platform in Italy. Environmental Engineering and Management Journal. Vol.14, No. 7, 1521-1533. June 2015
- Cutaia, L., et al. 2014. The Project for the Implementation of the Industrial Symbiosis Platform in Sicily: The Progress After the First Year of Operation, February 2014
- EC. 2015. Closing the loop - An EU action plan for the Circular Economy. COM(2015) 614 final. Brussels, 2.12.2015
- EC. 2012. A Stronger European Industry for Growth and Economic Recovery. Industrial Policy Communication Update. COM(2012) 582 final. Brussels, 10.10.2012
- EC. 2011. Roadmap to a Resource Efficient Europe. COM(2011) 571 final. Brussels, 20.9.2011.
- Ellen MacArthur Foundation, Towards the Circular Economy 1: Economic and Business Rationale for an Accelerated Transition; Cowes, Isle of Wight, January 2012
- Erkman, S., Francis, C., Ramaswamy, R. 2001. Industrial Ecology: An Agenda for the Long-term Evolution of the Industrial System "Cahier de propositions" of the Industrial Ecology Workshop (First draft for discussion, based on contributions by Suren Erkman, Colin Francis, Ramesh

Ramaswamy). Geneva, 27 August 2001. Institute for Communication and Analysis of Science and Technology (ICAST).

- ESPON, Interact, Interreg Europe and URBACT. Pathways to a circular economy in regions and cities. Policy brief. 2016
- http://www.industriellekologi.se/symbiosis/norrkoping.html
- http://www.interreg4c.eu/good-practices/practice-details/index-practice=374-national-industrial-symbiosis-programme-nisp&.html

#sustainable, #environment, #resources, #policyresponses, #regionalauthorities , #localauthorities, #policylearning

15 February 2017

Interreg Europe

Environment and Resource Efficiency Policy Learning Platform

Thematic expert: **Tamas Kallay**

t.kallay@policylearning.eu

Thematic Expert: **Peter Szuppinger**

p.szuppinger@policylearning.eu

www.interregeurope.eu