Nordregio #01
POLICY BRIEF JAN 2019

Industrial Symbiosis in the Baltic Sea Region

Current Practices and Guidelines for New Initiatives

Industrial symbiosis (IS) is vitally important in facilitating the move towards a circular economy by helping industries and businesses cooperate in the exchange of natural resources and production infrastructures. Strong public and private sector leadership and firm links between industry and research institutes are essential for the formulation of effective IS initiatives.

This policy brief examines three good practice examples of IS from the Baltic Sea Region (BSR) and outlines practical guidelines for public authorities and business development organisations on how to develop and implement IS ecosystems. This research is based on the activities and experiences of a project, BSR Stars S3, which was financed by the EU Interreg Baltic Sea Region and focused on BSR cooperation within the bio- and circular economy.

WHAT IS INDUSTRIAL SYMBIOSIS?

The European Union increasingly emphasises IS as a key driver of the circular economy and the development of new green growth business opportunities (European Commission 2018). IS creates an industrial ecosystem in which industries and businesses share natural resources (e.g. by-products like hot energy or bio-waste) and production infrastructures for mutual economic, social and environmental gains. The key element of industrial symbiosis is promoting cross-sectoral collaboration and potential synergies between industries and firms within close geographic proximity (Chertow 2007; Jacobsen 2006; Mirata & Emtairah 2005).

INDUSTRIAL SYMBIOSIS IN THE BALTIC SEA REGION: WHAT ARE THE MAIN CHALLENGES AND BENEFITS?

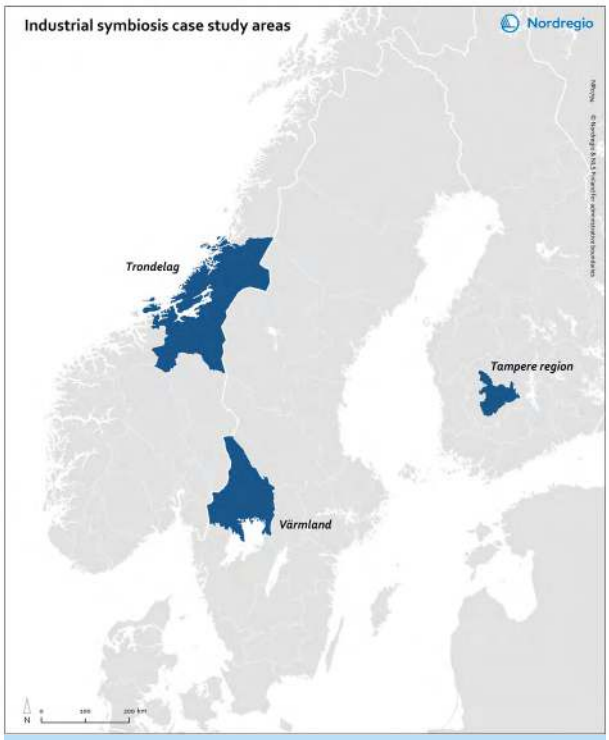
The Baltic Sea Region is a forerunner in the design and implementation of IS initiatives at regional, national and macro-regional levels. Stakeholders in the Baltic Sea Region have a long tradition of collaboration, which leaves them well placed to take advantage of the benefits of IS.

There are growing efforts to accelerate IS initiatives across the Baltic Sea Region, but they vary in both magnitude and form depending on the country. Finland and Denmark have devised national and regional policy strategies on IS (e.g. the SITRA National Roadmap for Circular Economy in Finland), while Sweden and Norway are yet to include IS extensively in policy discourse. However, there are several IS initiatives that are supported locally and regionally in Sweden and Norway.

The most decisive attempts to develop IS initiatives usually take place at the regional level, facilitated by local actors such as universities, bio- and circular economy cluster associations, green development hubs and other regional networks. There have also been attempts to promote collaboration at a transnational level, such as the development of the Nordic Industrial Symbiosis Network (see the info box on the right). These platforms serve to provide a framework for the discussion, learning and facilitation of IS best practices between key stakeholders, including public authorities, industries, businesses and universities (Johnsen et al. 2015).

Industrial symbiosis brings many benefits including cost savings, a reduction in consumption of natural resources and the elimination of waste. Challenges in its implementation remain, however, not least insufficient facilitation from public authorities, low levels of public and private investment, weak links between industry and research institutes, and the need to improve information flows to enhance stakeholder awareness of the benefits of IS collaborations (see the benefits and challenges table on page 3).

The next section showcases three examples of operational IS networks within the Baltic Sea Region at different phases of the development process: ECO3, centred in Nokia, Finland; the Paper Province cluster in Värmland Region, Sweden; and the industry agglomeration of the Trøndelag Region in Norway.



Map: Industrial symbiosis case study areas. Source: Nordregio.

ABOUT THE IS NETWORK

The Nordic Industrial Symbiosis Network is a transnational network of IS platforms that brings together industry clusters and research institutes from Finland, Sweden, Denmark and Norway to exchange experiences, learn and help promote IS initiatives in the BSR. The network currently includes Linköping University, Digipolis Kemi Technology Park, the Norwegian EYDE-Cluster for Sustainable Process Industry, Nordregio Research Institute, the Paper Province, Sotenäs Kommun and Tampere Region. More and more cities, regions and industries are interested in facilitating IS initiatives, but they do not always have the knowledge, experience or resources to get started. The Nordic Industrial Symbiosis Network aids this process by promoting transnational collaboration and the sharing of important knowledge and resources (e.g. technology and finance) that are not necessarily available in the regional or national context. The central premise of the Network is that the BSR is stronger by working together on IS activities.

These cases have been chosen based on their merit as promising independent IS initiatives to emerge from BSR Stars S3 project partner regions. The description of Nordic IS cases here complements the Nordregio 2015 policy brief that showcased Nordic IS best practice examples from Kalundborg (Denmark), Kemi-Tornio (Finland), Svartsengi Resource Park (Iceland), EYDE-Cluster (Norway) and Händelö (Sweden).

INDUSTRIAL SYMBIOSIS

BENEFITS

Reduced consumption of natural resources: The reliance of industry and business on raw materials will decrease, as resources can be reused.

Cost savings: The symbiotic use of resources, infrastructure and/or services reduces costs and in the long run increases the competitiveness and profitability of all companies involved.

Cleaner environment: IS has environmental benefits, as recycling raw materials will lead to a reduction in greenhouse gas emissions caused by current waste management practices.

New businesses and job production: The coordination and symbiotic use of industrial flows will become a breeding ground for new businesses, with the potential to accelerate the creation of new jobs and regional economic growth.

Promotes a sustainable image: Involvement in IS activities improves the sustainable image of industries and the region.

Enhances regional visibility: Developing IS initiatives can help to raise awareness in the national and international policy discourse and provides beneficial visibility opportunities, especially for more remote regions.

Source: Johnsen et al. 2015

CHALLENGES

Lack of knowledge and awareness: There is a lack of knowledge about IS business models and the potential benefits for industries and companies of collaborating on resource exchange.

Time constraints: Companies lack the time and motivation to engage in local economic networks to review the opportunities and feasibility of IS and to build the trust required for such collaboration.

Predominance of linear systems: Most industries and business are highly dependent on fossil fuels and linear manufacturing models are deeply ingrained in existing production processes.

Price of resources: High government subsidies keep the costs of raw materials extremely low, which reduces the requirement to make cost savings by switching to IS business models.

High cost of implementation: The upfront costs of restructuring internal processes to fit IS business models are are often high. However, it usually pays back after some time in material and energy savings.

Weak push from public authorities: There is often no regional infrastructure or long-term development strategy in place for facilitating IS collaboration between stakeholders.

Poor communication and information flows: There is a lack of information systems and available data on waste flows and regional IS activities, which reduces the awareness levels of stakeholders and the potential for collaborations.

Funding constraints: Insufficient public and private sector financial support for developing and implementing IS initiatives.

Geography: Long distances between potential symbiotic partners.

ECO3 PLATFORM (TAMPERE REGION, FINLAND)

WHAT IS THE ECO3 PLATFORM AND HOW DID IT EMERGE?

The ECO3 bio- and circular economy business area is an IS platform initiated in the Kolmenkulma eco-industrial park in Tampere Region (Finland), centred around the cities of Nokia and Tampere, about 180 km from Helsinki. Preliminary surveys and steps towards the IS platform were taken in 2013 and 2014, while IS and CE were also gaining increased traction in national-level policy discourse. The key initiative-takers behind financing and setting up the collaboration were the local authorities, particularly the city of Nokia, which provided the space and funding for setting up the platform, along with university experts in leading visionary roles, and in close cooperation with water and recycling facilities partly owned by the public sector.

HOW DOES THE PLATFORM FUNCTION?

While the initiative was mainly from the public sector, ECO3 is not a project-based endeavour but a for-profit enterprise set to provide participating companies with genuine economic benefits. The platform company is owned and supported by the city of Nokia but aims to generate profit by providing networking and facilitating services to existing and prospective members of the IS network.

The proximity of important infrastructure and logistical services is an important supporting factor behind the successful emergence and growth of ECO3. The cluster is also situated close to the knowledge centre made up of several universities and research facilities in and around the city of Tampere. A circular economy is named as one of the strategic smart specialisation priorities of Tampere Region, which sets the strategic framework for ECO3 operations.

ECO3 is also mentioned as a key project on the Finnish roadmap towards a circular economy devised by the Finnish National Innovation Fund, SITRA. Current ECO3 investments include new bio-gas and sewage water treatment facilities being built by 2020. These will act as platforms for new businesses to join and for new IS initiatives to grow within the ECO3 cluster.

WHICH STAKEHOLDERS ARE INVOLVED?

Today the ECO3 IS network comprises 21 partner organisations from a variety of industries, collaborating on circular resource streams in nutrients, wood and technical by-products, and efficient and sustainable energy production.

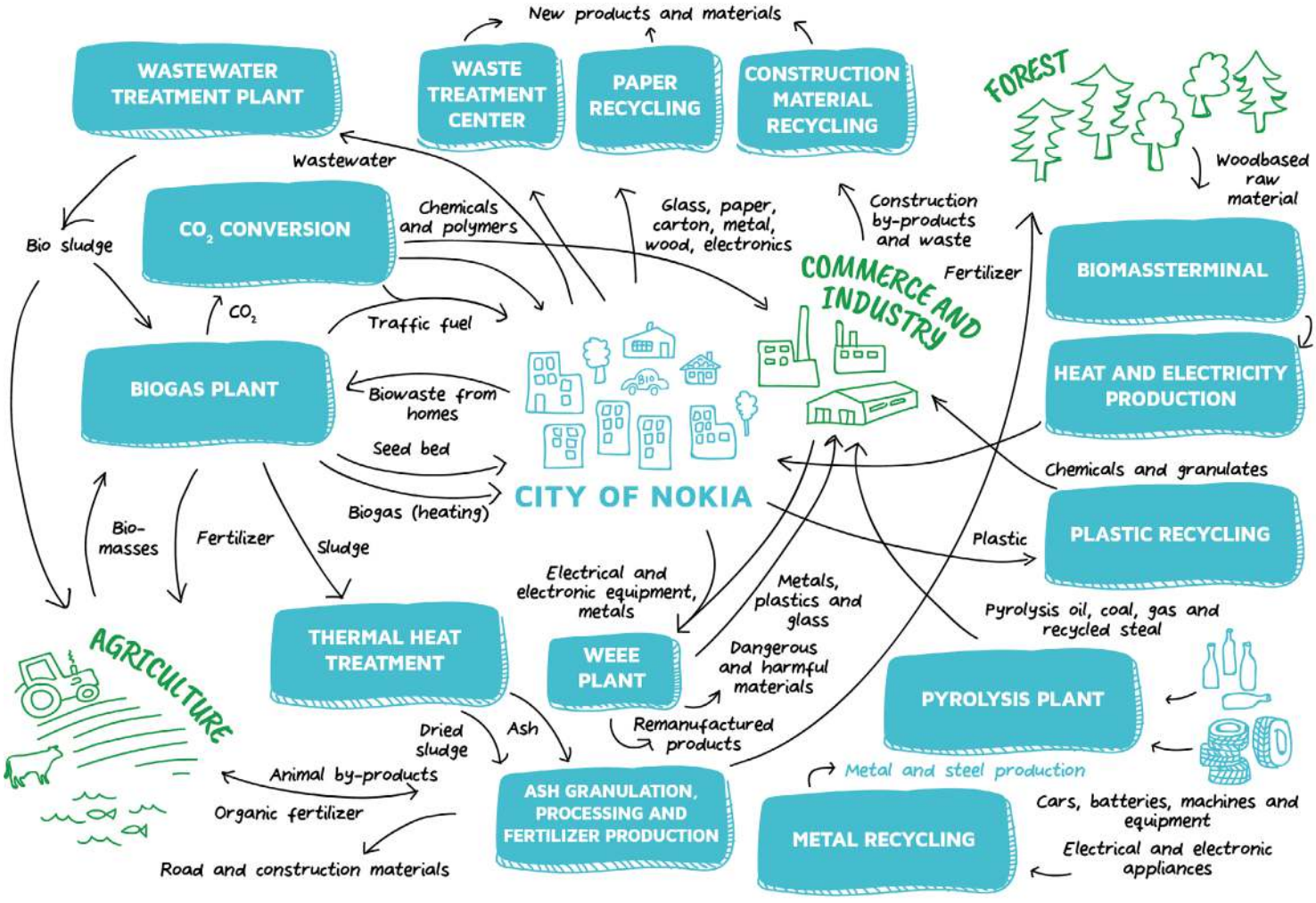
Key players in bringing actors together and setting out measures for charting and sharing by-products include Verte Ltd, a platform company owned by the city of Nokia; the city of Nokia's water company; and the Tampere Regional Solid Waste management company. The universities in Tampere have also made a crucial contribution with scientific input, anticipating and inspiring the growth of the CE model on which ECO3 is built.

WHAT ARE THE PLATFORM'S MAIN STRENGTHS AND FUTURE VISION?

ECO3 is not built around one or two big players but many smaller ones and thus grows and relies heavily on the mutual and collaborative drive of the members. There may be variations in the volume and level of commitment between companies, but the same expectation to contribute applies to both founders and newcomers. All participants gather in meetings multiple times per year to share their latest developments and discuss future ideas. Key focus

Water power plant in Tampere.

- From the preliminary steps in 2014 for an IS initiative, it took less than four years for ECO3 to reach EUR 70 million in new investments.
- The ECO3 spans a business area of 150 hectares, and currently links together 21 companies in by-product and side-stream collaborations.
- Since IS activities took off, ECO3 has directly resulted in the creation of around 100 new jobs.



Industrial symbiosis at ECO3. Source: City of Nokia (2018)

areas for the future link to digital transformations in measuring and tracking side-streams, as this may be a good opportunity to move towards even more effective use of resources. The key stakeholders are also working towards a modularisation of the platform, ideally so that the ECO3 path, with its key strategy of setting up common roadmaps, could be emulated and duplicated in other regions. To date, ECO3 has already won multiple international circular economy awards, and the cluster model has been presented to the Geneva-based United Nations Economic Commission for Europe (UNECE). The added visibility has been very beneficial for the region overall.

WHAT ARE THE MAIN CHALLENGES AND HOW CAN THEY BE OVERCOME?

Legislation inhibits CE and IS development at times, for example in outdated regulations on how to classify different types of waste. A further challenge is keeping plans and initiatives up to date with what happens in the network (i.e. maximising field knowledge). However, from the beginning ECO3 has been very strong in forecasting future scenarios and setting CE and IS roadmaps and strategies, and this will continue to be its cornerstone strategy. The contribution of universities and academics in this development has been invaluable.

THE PAPER PROVINCE (VÄRMLAND, SWEDEN)

WHAT IS THE PAPER PROVINCE AND HOW DID IT EMERGE?

The Paper Province is a forest-industry cluster in Värmland, northern Dalsland and Örebro counties in central Sweden, about 300 km to the west of Stockholm, with more than 100 member companies committed to turning industry collaboration into new ideas and bio-based solutions. Established in 1999 as a joint initiative for innovatively overcoming structural difficulties in the traditional forestry sector, in its first decade the Paper Province cluster organisation focused on various development activities. From 2007 onwards, energy issues became a main focus, for example through starting a regional energy network, supporting R&D and getting involved in energy recycling projects, and running an innovation-challenge initiative focusing on warm water. IS as a concept has been a specific focus of the Paper Province since 2015, and efforts and funding have gradually increased. Although the designated project to facilitate IS within the Paper Project was established recently, symbioses among companies in Värmland can be traced much further back – in fact, forestry facilities have cooperated and shared raw materials for over a century. The Paper Province has received wide recognition at national, Nordic and EU levels for its emergence as a bio-industry hub.

HOW DOES THE PLATFORM FUNCTION?

The Paper Province is an economic association facilitating networking and collaborative initiatives among its member organisations in several ways, closely supported by local authorities and the education sector. In the past three years, the cluster has studied the potential for and taken decisive steps towards an extensive network of IS collaboration. Public funding and research support from Karlstad University (which has been active in promoting quadruple-helix networks and has set up the Karlstad Innovation Park) and Linköping University have resulted in an overview chart of the material flows across the entire region, and a detailed side-stream survey pilot for three industrial facilities. Particularly promising potential for collaboration has been identified between pulp and paper mills and among chemical industry facilities.

WHICH STAKEHOLDERS ARE INVOLVED?

Approximately 15 forestry industry facilities comprise the most committed group in IS collaboration and planning projects. These efforts are coordinated by the cluster association and benefit from the cluster's strong existing foundations in bringing together industry facilities across the region. Detailed mapping

Symbioses among companies in Värmland can be traced much farther back – in fact, forestry facilities have cooperated and shared raw materials for over a century.

of waste streams has so far been carried out with two pulp and paper mills and one sawmill. Several other stakeholders have shown interest in expanding IS mapping and in the potential benefits of coordinating waste streams. Apart from its own, localised IS project, the Paper Province also participates in joint planning efforts to support and strengthen IS in Sweden. These strategy initiatives are mainly coordinated by Linköping University.

WHAT ARE THE PLATFORM'S MAIN STRENGTHS AND FUTURE VISION?

The proactive and clear role of the cluster association in collaboration management and matching is an essential part of utilising the potential. Furthermore, the mapping of material flows would not have come so far without engaged student research at the affiliated academic institutions. The main efforts for the next few years will include expanding the detailed mapping of waste streams and developing practical tools for supporting collaboration among the facilities that are already mapped out. Concrete showcase examples are also in the plans, in order to continue to attract new stakeholders. Further goals include strengthening local-level competence as well as working communication with higher levels of governance and cooperation. The overarching ambition is that the growth of the IS platform could gradually become more self-sustaining.

WHAT ARE THE MAIN CHALLENGES AND HOW CAN THEY BE OVERCOME?

Identifying the added commercial value of IS collaboration and communicating it convincingly to prospective participant enterprises can be challenging at times. That being said, the region already has a tradition of collaboration and trust, which makes this much easier. The Paper Province's efforts so far have predominantly been met with curiosity and eagerness to learn more about the potential of IS in Värmland.

- The Paper Province cluster spans more than 100 member companies, including both SMEs and industry giants, and a total of 12,000 employees in the region.
- Even amidst global downturns in forest-industry demand, the Paper Province consistently demonstrates growth rates three times the Swedish average.
- Among other investments and support, Vinnova, the national innovation fund, already provides the Paper Province IS initiative with funding of SEK 1 million.

Forest in Värmland, Sweden.

WHAT IS THE TRØNDELAG IS INITIATIVE AND HOW DID IT EMERGE?

Orkanger in the Norwegian Trøndelag Region is home to the Thams cluster, one of the largest industrial agglomerations in Norway. Situated about 40 km from Trondheim and 400 km from Oslo, the cluster has emerged from the foundations of industrial activity established in the area by industrialist Christian Thams in the early 1900s. In a country where raw materials and energy sources for industry have traditionally been abundant, local actors in Trøndelag have recently joined forces to make the cluster a Norwegian pioneer of CE and IS. After excursions organised by the BSR Stars project and a planning meeting with various industry representatives in April 2018, the IS initiative was recently incorporated as a recognised association in order to be eligible for better public funding opportunities and to gain membership of the Norwegian cluster programme.

HOW DOES THE PLATFORM FUNCTION?

The initiative was entirely built using local capacity; there are no designated national-level IS strategies to follow. The main coordinators are the regional authorities (Trøndelag Fylkeskommune), which actively coordinate the stakeholders involved in setting up IS support activities. Naeringshagen i Orkdalsregionen, a local business association, has operative control and maintains connections to local actors. The research institute SINTEF in Trondheim contributes academic expertise, and students and researchers from the technical university NTNU are involved in building up the project and mapping waste streams. A centre for bio-circular economy is being built in Orkanger as a future hub for IS matchmaking and as support for new innovative businesses.

WHICH STAKEHOLDERS ARE INVOLVED?

The two local electrochemical industry facilities are a cornerstone in symbiotic links, as these have energy to spare that could be channelled to salmon refining and butchering industries nearby in particular, as well as to two recently arrived larger food industry facilities and the oil technology industry. The electrochemical industry has not traditionally been linked to the region's oil industry or bio-economy, but with its short distances and growing collaborative links, the regional setting makes these new and unique symbiotic links possible and attractive.

There has been a clear shift in mindset within the region's industry in recent years, in that industrial facilities increasingly recognise their own role and responsibility to pursue green growth and CE. Without this shift in discourse, the emergence of the IS initiative would not have been possible. However, it is also crucial that the proposed IS collaboration is economically attractive. This is especially the case because many of the industry actors in Orkanger are subsidiaries of larger corporations that are headquartered elsewhere and for which local sustainability and cooperation in Trøndelag do not possess inherent value.

WHAT ARE THE PLATFORM'S MAIN STRENGTHS AND FUTURE VISION?

The research and education facilities present in the region, such as NTNU, the largest technical university in Norway, are also a great asset and their contribution so far has been very important. The cluster also has the benefit of being geographically concentrated – most of the prospective IS collaborators in Orkanger are within walking distance of each other. This means that there is potential to build trust and use resources collaboratively, even between sectors that previously had little contact with each other. In the next few years, the coordinating authorities aim to have achieved pilot projects in new, non-traditional collaborations such as these as a way of attracting even more actors to take part.

WHAT ARE THE MAIN CHALLENGES AND HOW CAN THEY BE OVERCOME?

Students and researchers working on the topic are a great asset, but because they are often not well connected to industry and regional authorities it has proven difficult to raise awareness among student networks. The regional authorities have met this challenge by financing students as summer researchers and collaborators, partly by making use of Horizon 2020 funding. Another key challenge lies in linking together actors and sectors that have not traditionally collaborated. The active facilitating role of the regional authorities is decisive in these networking efforts.

- In its early stages, the IS initiative already has 20 committed members, totalling well over 1,000 workers in the Trøndelag Region.

- Innovation Norway and Trøndelag Fylkeskommune have each funded the initiative with around NOK 2 million, and local authorities have contributed another NOK 600,000.

The research institute SINTEF in Trondheim contributes academic expertise, and students and researchers from the technical university NTNU are involved in building up the project and mapping waste streams.

BSR STARS RECOMMENDATIONS

The Interreg BSR Stars S3 project has contributed to the acceleration of the circular economy in the Baltic Sea Region by bringing stakeholders together to share information and experiences from ongoing IS initiatives at the regional, national and macro-regional level. The following IS guidelines have been drawn up based on the project activities and case study findings to help and motivate practitioners, including public authorities, industries and businesses, to develop and implement effective IS initiatives.

- Encourage an active leadership role for public authorities in motivating and facilitating collaboration through the establishment of regional IS clusters and networks, which helps to build trust among industries, business development organisations and research institutes.

- Increase efforts to include IS and circular economy activities in regional strategies by mapping areas of regional IS strengths and development potential in entrepreneurial discovery workshops with local experts.

- Provide financial incentives for industry and research institutes to engage with IS initiatives, such as tax exemptions and IS-earmarked national or EU-level public procurement funding.

- Explore private sector IS financing models, for example private for-profit platform companies (see the ECO3 case).

- Establish stronger links between local industry and research institutes to ensure that IS research, training and business models meet the needs of the private sector (see, for example, Karlstad Innovation Park in the Paper Province case).

- Encourage industry to take a leading role in coordinating the development of IS platforms by raising its awareness of the potential benefits of involvement (see, for example, the visionary role of experts from the Tampere University of Technology in the ECO3 case).

- Encourage public authorities, universities and research institutes to map regional material flows and IS stakeholders (see, for example, the role of university students in the Trøndelag case and the development of online information resources such as the ecosystem monitoring tool from Tampere Region).

- Disseminate information on IS best practices to promote learning among regional stakeholders (for example, the ECO3 platform has an updated and informative online presence).

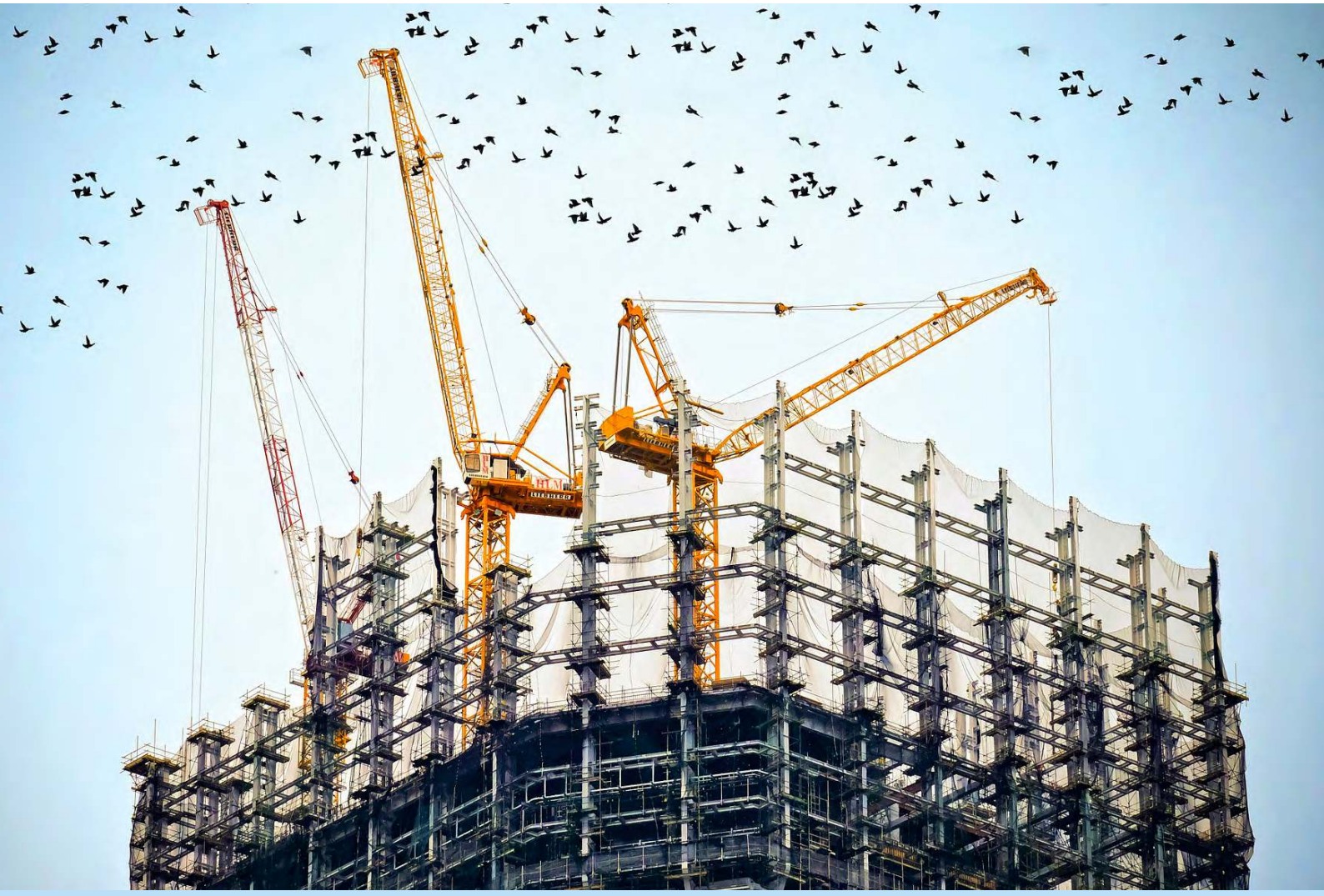
- Encourage the development of long-term regional IS visions and planning support tools through the development of strategic roadmaps and future scenario plans (see, for example, the development of roadmaps in the ECO3 case).

- Advertise regional IS initiatives to international audiences to promote the region's sustainable good practices and image to maximise the potential for transnational collaborations (see, for example, the active presence of the ECO3 platform among international institutions).

- Local public authorities to promote conditions for industrial symbiosis in urban areas, and facilitate public and private sector interest and capabilities to form industrial symbiosis in urban districts.

FUTURE DIRECTIONS: TOWARDS A MACRO-REGIONAL NETWORK

Whether achieved through formal IS policy strategies or ad hoc by regional actors, the crucial step for IS development is to identify and "uncover" emerging symbiotic networks that have the potential to expand and become integrated long-term into the regional economy. Practically, the establishment of a "BSR Network of Sustainable Regions" or the "BSR Circular Economy Investment Platform" could be considered. A Baltic Sea Region network could follow a similar structure and function as the Nordic Industrial Symbiosis Network, focusing on identifying a few themes of significance (opportunities/challenges) when attempting to propel the transition towards the bio- and circular economy at the regional and local level, including: policy design; policy implementation; monitoring and evaluations; stakeholder engagement; technology development and transfer; enabling business development services; supporting internationalisation efforts; and side-streams exchange that could be mobilised when some waste flows have no use at the regional level. The network could also work to develop fundable proposals for additional bio- and circular economy cooperation activities in the Baltic Sea Region (e.g. in the form of flagship projects). The regional network could present these proposals to the BSR Bioeconomy Council and the Nordic Council of Ministers, to be advanced in the context of the Policy Area Bioeconomy of the European Union Strategy for the Baltic Sea Region. Making these connections would benefit multi-level governance by joining local, regional, national and macro-regional sustainable development efforts, thereby realising the benefits from complementarities and synergies between efforts.



Whether achieved through formal IS policy strategies or ad-hoc by regional actors, the crucial step for IS development is to identify and 'uncover' emerging symbiotic networks that have the potential to expand and become integrated long-term into the regional economy.

References:

Chertow, M. R. (2007). "Uncovering" industrial symbiosis. Journal of Industrial Ecology, 11(1), 11–30.

European Commission (2018). Cooperation fostering industrial symbiosis: market potential, good practice and policy actions. European Commission: Brussels.

Jacobsen, N. B. (2006). Industrial symbiosis in Kalundborg, Denmark: a quantitative assessment of economic and environmental aspects. Journal of Industrial Ecology, 10(1–2), 239–255.

Johnsen, I. H., Berlina, A., Lindberg, G., Teräs, J., Smed Olsen, L., & Mikkola, N. (2015). The potential of industrial symbiosis as a key driver of green growth in Nordic regions.

Mirata, M., & Emtairah, T. (2005). Industrial symbiosis networks and the contribution to environmental innovation: the case of the
Landskrona industrial symbiosis programme. Journal of Cleaner Production, 13(10–11), 993–1002.

Nordregio (2016). Industrial symbiosis: a key driver of green growth in Nordic regions? Nordregio Policy Brief, 1 April 2016.

ABOUT THIS POLICY BRIEF

This policy brief is a part of **BSR Stars S3** (Smart specialization through cross-sectoral bio-, circular and digital ecosystems) project which seeks to enhance growth opportunities in the Baltic Sea Region, focusing on the bio-/circular and digital economy fields.
Read more: www.bsr-stars.eu/bsr-stars-s3

Aknowledgements: The authors would like to thank Johanna Alakerttula, Sakari Ermala, Torfi Jóhannesson, Murat Mirata, Magnus Persson, Marko Seppänen and Per Erik Sørås for their time and helpful inputs into the preparation of this policy brief.

Research contacts

John Moodie
Senior Research Fellow at Nordregio
john.moodie@nordregio.org

Viktor Salenius
Intern at Nordregio
viktor.salenius@nordregio.org

Johanna Leino
Development Director at the Baltic Institute of Finland
johanna.leino@tampere.fi

Photos:
Front page: Wastewater plants are often one of the key players in industrial symbiosis / Unsplash

ISSN 2001-3876
DOI: doi.org/10.30689/PB2019:1.2001-3876
www.nordregio.org

BSR STARS S3

Interreg Baltic Sea Region

EUROPEAN REGIONAL DEVELOPMENT FUND
EUROPEAN UNION

Nordregio