Outcomes of IWCAIS: Positive Action for Green Growth

Summary Report from the 1st International Working Conference on Applied Industrial Symbiosis

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Executive Summary

This report sets out the findings of the first International Working Conference on Applied Industrial Symbiosis (IWCAIS), held in Birmingham, UK on 12th – 14th June, 2012.

The conference was convened by International Synergies Limited, and co-hosted by Birmingham City Council, to highlight the ability of industrial symbiosis to address current sustainability challenges - economic, environmental and social. Despite decades of experience with various industrial symbiosis models across five continents, the industrial symbiosis approach has not yet permeated mainstream business or policy.

Industrial symbiosis has been recognised by the European Commission and the Organisation for Economic Co-operation and Development (OECD) as a highly innovative way to improve resource efficiency; the goal of IWCAIS 2012 was to produce recommendations for how to best apply industrial symbiosis to achieve the sustainability goals of energy security and climate change mitigation, eco-innovation and green growth, materials security, and regional economic development.

This conference was carbon neutral through implementation of an innovative industrial symbiosis synergy with Betts Envirometal Ltd enabled through research with the University of Birmingham.
Introduction and Conference Overview

Janez Potočnik, Commissioner of the European Commission’s Directorate General Environment, opened the first International Working Conference on Applied Industrial Symbiosis (IWCAIS) by emphasising the pressing need to evolve toward a circular economy as modelled by natural systems (where everything is returned to use by various cycles)\(^1\). He further identified natural boundaries and resource scarcities as a major limit on the future growth possibilities of all economies at all stages of development. As such, resource efficiency – decoupling growth from resource use – is central to social and economic development, poverty reduction, conflict avoidance, and climate action. Industrial symbiosis (IS) is an innovative way to improve resource efficiency and a recognised part of achieving a low-carbon, circular economy, hence its inclusion in the European Commission’s Roadmap to a Resource Efficient Europe\(^2\).

“Society cannot continue to burn and consume its way to prosperity.”

Ban Ki Moon

Secretary General, Ban Ki Moon, recently observed that “society cannot continue to burn and consume its way to prosperity.” Industrial symbiosis (IS) is a systems approach to a more sustainable and integrated industrial economy which identifies business opportunities to improve resource utilisation (materials, energy, water, capacity, expertise, assets etc.). Globally, IS delivers economic and social benefits alongside environmental; to date, however, IS has not been fully integrated into mainstream business or policy, thus its potential has not yet been realised. The vision of the first IWCAIS was to identify where and how IS could be effectively applied to drive forward the challenges in each of the four interlinking theme areas – areas where an IS approach has delivered lesser known, but equally as impressive results as for resource sufficiency.

IWCAIS 2012 convened experts in the field of applied IS to work alongside experts in:

- eco-innovation & green growth,
- energy security & climate change,
- material security, and
- regional economic development.

Following three days of intense debate alongside key presentations from organisations including the UK Committee on Climate Change, the European Commission’s Directorate General Enterprise & Industry, South Korea’s Industrial Complex Corporation, and McKinsey & Company, delegates identified those aspects of each theme’s agenda where IS is relevant, and produced recommendations for how to best apply IS to achieving the theme goals. A summary of the key recommendations is presented here, by theme and across themes.

\(^1\) Commissioner Potočnik’s full address can be viewed at https://dl.dropbox.com/u/70489338/Is%20FINAL2.wmv

\(^2\) http://ec.europa.eu/environment/resource_efficiency/
Shared Learning: Global Challenges and Lessons in IS

The conference was attended by leading businesses, policy makers and industrial symbiosis experts (known as practitioners) from six continents, together representing 14 countries. As many attendees were expert in the theme areas rather than in IS specifically, practitioners from the UK, Denmark, South Korea, USA, China, and Germany shared their experiences of delivering IS, summarising both the keys and barriers to success in their various models. Many of the lessons resonated across continents and delivery models:

An extensive, diverse network of companies and organisations is critical to success, engaging businesses, government, research/academia and the community. Each group makes its own unique contribution to a successful IS network, bringing new ideas and brainstorming value, knowledge transfer for benchmarking and best practice sharing, and raised awareness to stimulate further engagement.

Businesses engage in IS when the business case for doing so is clear – current and historical economic returns have been demonstrated in many countries. The increasing attention to sustainability and materials security issues further drives business engagement, as does top management support and/or a champion within the organisation. The right IS liaison in the organisation is familiar with the organisation’s processes and cost structure, with sufficient seniority to take decisions. A consistent point of contact is preferred to facilitate communication and continuing projects.

Policy makers and regulators are critical to creating the market conditions that incentivise IS and resource efficient behaviour; policies and regulations that clarify definitions and responsibilities provide predictability and reliability for companies to plan. Currently around the world, uncoordinated policies across Government departments send inconsistent messages regarding resource management: tightly regulated disposal for health and safety may preclude resource recovery for materials security and green growth, for example. A joined-up, flexible approach focused on the desired outcome enables businesses to respond in efficient ways.

Conditions that enable new innovation and provide a broad base of technology support IS. A diverse network engaging business, research and the government has proven to foster knowledge transfer and demand-led innovation by bringing together the companies with real problems, and the researchers able to address, and sometimes resolve, them. In the UK’s NISP experience, for example, over 70% of synergies have been shown to involve some form of innovation: 50% cross-sector knowledge transfer and best practice, and 20% new research and development deriving from close links with universities.

IS practitioners play the critical role of facilitating and coordinating the contributions of the various stakeholders. Their technical expertise is valued by the other stakeholders as is their enthusiasm and commitment to support the network. Long term relationships and facilitation enable the stakeholders to develop new ways of thinking and doing business, fostering the long term culture change necessary for transformation to a new economic model.
Theme 1: Eco-Innovation and Green Growth
Recommendation: Foster Demand-Led Innovation through IS Networks

Industry has recently seen historic rising commodity prices and increased volatility, not only in materials but also in energy and water, impacting the productive economy. In the past as labour costs have risen, innovation has increased productivity. Such innovation – in technologies, markets, and behaviour – is now required to decouple growth from resource use.

Eco-innovation refers to innovation in products, services, processes, and business models that result in reduced environmental impact. According to current thinking, eco-innovation is key to achieving the transition from business as usual to a sustainable economy, and is a facilitator of the other three interlinking themes of IWCAIS 2012: energy security, materials security, and regional economic development. The OECD recently cited IS as a form of systemic eco-innovation ‘vital for future green growth’, recognising its role as a catalyst for demand-led business innovation, helping to bring novel and innovative products, processes and technologies to market. Demand-led innovation creates opportunities in critical areas such as energy technologies, environmental technologies; alternative fuels; rare earth element sand precious metals; design-for-environment and cleaner production systems.

The Challenge:

Industrial activity, responsible for wealth and job creation, faces a sustainability challenge: to decouple economic growth from adverse environmental impact. The Europe 2020 policy framework prioritizes smart, sustainable and inclusive growth – growth that fosters innovation, efficiency, and high employment. However, support for this transformation is currently lacking: clear policy signals, market signals and incentives, and information and knowledge. A new strategic vision for IS would incorporate joined-up thinking and a systemic approach to support the necessary transition.

Next Steps: Incorporate IS into Existing Networks to Foster Innovation and Demand-Led R&D.

The activities necessary to foster innovation and bring scientific research to the market are generally described in stages known as the innovation value chain:

- knowledge sourcing (education and research),
- transformation (bringing scientific research to the market as new products, services, processes, and business models), and
- exploitation (fostering entrepreneurs, facilitating business investment in innovation).

Industrial symbiosis has been demonstrated to foster activity specifically around transformation and exploitation – challenging stages that require knowledge exchange between distinct sectors (research, business, government). The IS network convenes businesses of different sectors and sizes, together with the research community. IS networks provide the communication vehicle for researchers to learn about the pressing problems being faced by businesses, and to bring their research to bear on addressing these challenges (transformation). Incubator companies are a valuable part of an IS network as they introduce new technologies as possible solutions; IS networks help entrepreneurs to connect with their potential markets and provides a network of support (exploitation). The result is demand-led innovation, rapid delivery to market and the creation of employment.
**Theme 2: Energy Security and Climate Change**

**Recommendation: Incentivise Carbon Reductions through IS Credits**

Governments and companies around the world are focused on addressing energy concerns, both by improving efficiency (of generation, distribution, and processes), and by decarbonising through fuel substitution. An additional approach to reducing carbon footprint is to cascade resources through multiple uses. This keeps materials circulating in the economy, and reduces their carbon footprint by reducing the level of activity (and investment) in extraction, refinement, transport and processing. Industrial symbiosis enables carbon reduction through many innovative pathways: efficiency improvements, novel fuel substitution, process innovation, heat recovery, avoided transport energy, and avoided virgin material extraction.

**The Challenge:**

Setting national goals to keep climate change as near to 2°C as possible requires enormous reductions in carbon dioxide, for example an 80% reduction for the UK by 2050. The proposed strategies for achieving this target focus on action across the economy, with different targets for different sectors. Industry sector emissions are seen as the hardest to reduce. Proposed short term strategies require efficiency improvements; longer term strategies (2020 and beyond) incorporate a combination of carbon capture, electrification, fuel switching and product substitution. Many of these strategies are already being implemented through industrial symbiosis.

**Next Steps:** Develop carbon accounting methodologies that accredit savings through resource efficiency

The Greenhouse Gas (GHG) Protocol Corporate Standard, used by trading schemes worldwide, specifies three scopes of emissions: Scope 1 (direct emissions from a facility’s activities), Scope 2 (emissions from purchased electricity), and Scope 3 (other indirect emissions, for example from the extraction and production of materials). The production of renewable energy and increasing energy efficiency (focusing on Scope 1 and 2, for example, as per the current UK strategy) are encouraged by a worldwide framework of incentives centered on Kyoto and various national initiatives. Arrangements based on a price for carbon emissions (whereby reducing carbon emissions generates a financial incentive) have mobilized a positive business response. Efficient use of physical resources (such as materials and water) also substantially reduces carbon emissions (Scope 3); however reductions here do not have an equivalent incentive in current accounting and trading schemes. There are penalties for disposal of resources which vary by country, but these are typically an order of magnitude smaller than incentives available in the energy arena for the same amount of carbon saving.

Current methodologies do not quantify the reduction in global warming potential resulting from avoided or reduced material usage. Accounting or trading schemes applied to the recovery of physical resources – that is, applicable at the point of return of the material to use – will provide the incentive to mobilise an extremely positive business response. The incentive structure could be financed by extended penalties on disposal (for example a landfill tax escalator, or a penalty on incineration) and/or scaling disposal penalties to reflect carbon content rather than just weight, encouraging waste separation at source. Such an incentive structure should be cognizant of the Kyoto framework by extending to Annex 1 countries only (industrialised countries and those in transition), and reflecting the price of carbon implicit in arrangements for energy.
Theme 3: Materials Security  
Recommendation: Move Materials up the Waste Hierarchy through IS Innovation

Materials security concerns ensuring a supply of those materials deemed critical to the economy. Security of supply encompasses physical availability as well as economic and political access, as export quotas and tariffs can determine a resource’s availability. Government and industry seek to manage any risk to supply of critical resources, in part through managing demand, and in part through resource recovery at end of life (thus, increasing supply). Resources that are currently under pressure may be targeted for material substitution where this can be found. Even where innovative technologies appear to be a solution, if they themselves rely on materials of limited supply, they may bring their own material security issues.

The Challenge:

McKinsey & Company’s recent ‘Resource Revolution’ work on meeting the world’s energy, materials, food and water needs calls for an integrated approach resulting from the linkages between resources: needing energy to create water, needing water to grow food and create energy, needing materials to generate energy and grow food, and so on. Costs, regulations and technological advances are central to shaping the market response and value creation. As in the Eco-Innovation and Green Growth theme, four broad areas are identified for action: adopting an integrated approach, strengthening market signals, addressing other market failures, and creating long-term resilience through business opportunities and changing mindset.

Next Steps: Make visible material flows with standard classification through regulation and policy.

The waste hierarchy (reduce, reuse, recycle, dispose) is meant to communicate the priorities for extracting the greatest value from a resource while minimising the amount of waste created and disposed. An industrial symbiosis approach has been demonstrated as an effective means to move resources up the waste hierarchy: it reduces the use of virgin materials through substitution, identifies novel reuse and recycling opportunities for existing waste and by-products (which both diverts materials from the waste stream as well as avoids virgin material use), and prevents waste generation through best practice sharing. Keeping resources circulating in the economy for longer (through reuse and recycling) reduces demand for new material, and may reduce its associated carbon footprint.

An IS approach can be used strategically to target critical materials. As the critical material content in wastes and residues is made visible (for example, platinum and palladium from automotive catalytic converters in road sweepings, and high value proteins in dairy waste), an IS network can focus attention and innovation on their recovery. To enable reuse, and move up the waste hierarchy, two steps help make the opportunities accessible:

a) Identify available materials (resources): Various data sources contain relevant information, albeit not generally in a comparable form: economic input output data, sector-specific material flow data, and energy and waste flows. National metabolism flows have been developed for some countries, although the level of aggregation may be more conducive to setting strategic priorities than to identifying specific opportunities. Ecological footprinting (public and private) is another internationally recognised tool that may be relevant.

b) Consistent policy and regulations (i.e., standardised data classification) may facilitate use of the data. Across the European Union, the European Waste
Code (EWC) classification describes the process yielding the ‘waste’ as well as the material itself. From an IS perspective, it is useful to know about the process yielding the flow as it implies certain technical specifications. However, this system is limited in its applicability as it does not provide classification for non-waste resources such as equipment, redundant stock, and furniture; nor does it address intangibles such as logistics, excess capacity and expertise.

“Industrial symbiosis can be done now...without the need for international agreements.”

Peter Laybourn
**Theme 4: Regional Economic Development**

**Recommendation: Close Local Loops through IS Planning**

A city’s organisation in relation to infrastructure, energy, production, and transport determines how it mobilises resources, and thus its sustainability. Regional economic development that draws on existing key industrial activity and resource streams (materials, energy, water, technological innovation, capacity, logistics, expertise) can lower the carbon footprint of development, while strengthening local economies, and improving material and energy security. As material security issues become more pressing, they are increasingly seen as an important driver of future economic development – for example, as industry locates to specific sites based on availability of material supply.

**The Challenge:**

Historically, regional development progressed with little attention to pollution or resource exploitation. Alongside broader sustainable development issues, recent changes derive from strengthening environmental regulations and material security concerns reflected in increasing prices. In response, eco-industrial development recommends a comprehensive and integrated framework, to enhance economic gains and environmental efficiency for both industry and the local community.

**Next Steps:** Widespread integration of IS into spatial planning systems, via regulation and policy.

Some regional and local governmental bodies are implementing best practice in IS as a means to attract and retain businesses in their region – as in Birmingham UK, where an IS approach has been integrated into the economic development plan to reinvigorate the Tyseley Environmental Enterprise District. Further, regional and local governmental bodies are using IS to attract and retain businesses in their region through incentives such as low interest loans for infrastructure development (S. Korea) or tax breaks for firms using recycled or recovered materials (China). Local and regional plans can encourage the adoption of IS by limiting access to virgin resources: in Puerto Rico, a call for proposals for a new coal-fired power plant specified the use of wastewater for cooling, required co-location with a steam user for cogeneration.
Cross-Theme Recommendations

Across the themes, a number of common recommendations arose – many suitable for immediate action.

Cross-Theme: An Integrated Approach

The importance of an integrated approach to resource management was emphasised across themes. IS programmes and resource management are generally under the domain of environment; there is currently no natural home for programmes that deliver cross-departmental objectives. The European Commission has recognised the broad applicability of IS by integrating it into policy across Directorate Generals: Enterprise & Industry, Regions, and Environment; coordination across policies would provide a more consistent direction. An Office of Resource Efficiency at the Ministerial level has been proposed by politicians and stakeholders in the UK and South Korea.

Cross-Theme: Communications Plan to Support Public Investment in IS

Commissioner Potočnik said at Green Week 2011 that “Industrial Symbiosis...should be standard procedure by 2020.” Across the world, IWCAIS participants have demonstrated that relatively small public investments produce economic, social, and environmental benefits for participants and substantial economic return for government’s investment. Despite high-level support for IS and notable success delivering on the low carbon/green growth agenda, the uptake by mainstream business and policy is still limited. Further development of the following communication elements is suggested.

Elevator Pitch:
Academic definitions of industrial symbiosis abound, and practitioners have various ways to describe IS.

A proposed abbreviated definition is:
Industrial symbiosis is a systems approach to a more sustainable and integrated industrial economy which identifies business opportunities to improve resource utilisation (materials, energy, water, capacity, expertise, assets etc).

Targeted Message:
Both the business case for individual participants of IS, and the return on investment in IS programmes for government, have been clearly documented in many countries. However, these data are not widely known. The communication of benefits must be targeted to the audience, with messages on return on investment for government versus the business case for individual synergies for businesses.

“Industrial symbiosis...should be standard procedure by 2020.”
Commissioner Potočnik

Raising Awareness:
Incorporating IS into mainstream standards (ISO for example), and building support amongst high-profile champions from the political and business arena, were identified as means to raise awareness of IS. Some form of visual communication (as per the success of the waste hierarchy as a communication tool) would be constructive, in addition to training professionals who advise and support industry such as lawyers and insurers (on risk), mainstream investors (on finance & investment), accountants (on profit/cost), and venture capitalists (on innovation).
Cross-Theme:
Roll Out Best Practice in Regulation and Policy

The uneven progress of IS in different nations highlighted the ability of certain regulations and fiscal instruments to effectively foster industrial symbiosis across the themes. The following regulatory and policy instruments were highlighted as good practice that can be rolled out in short order:

- Waste (resource policy) to drive supply and demand of “repurposed” resources: legislation at the local (Mexico City) and national (China) level is requiring companies to identify uses for their waste and by-products.

- Procurement policies to support demand for recovered materials (NB these have to be carefully crafted to avoid perverse incentives such as companies deliberately creating more scrap to re-use in order to meet recycled content).

- Fiscal instruments (taxes, trading schemes) as a driver for innovation and behavioural change.

- Waste classification, with an eye toward international standardisation to facilitate trans-boundary opportunities.

“Industrial symbiosis is one of the most promising and innovative ways of making our resource use sustainable – and in doing so, generating wide economic, social and environmental benefits.”

Commissioner Potočnik
Summary and Conclusion

IWCAIS 2012 was convened to highlight the success of industrial symbiosis in delivering on today’s sustainability challenges. Industrial symbiosis experts from five continents presented compelling evidence and success stories from across the globe. Throughout the conference we not only sought to identify key policy recommendations (above) but also to distil the success factors across different models of industrial symbiosis that make it so relevant to green growth and ultimately a more sustainable economy:

- **Industrial symbiosis is a proven driver of demand-led innovation for the transition to green growth.**
- **Industrial symbiosis networks are an effective springboard for business engagement.**
- **Industrial symbiosis networks operate at scale with great efficiency: linked programmes can communicate with each other to accelerate development, replication, and innovation.**
- **Industrial symbiosis operates trans-nationally, independent of international agreements.**
- **Industrial symbiosis ‘practitioners’ (experts) fulfil the critical role of facilitating and coordinating the contributions of various stakeholders.**

IWCAIS 2012 was timed to inform discussions at the United Nations Rio+20 Conference on Sustainable Development, and the second Global Green Growth Forum, to shape positive actions today. As reported by Commissioner Potočnik in his opening address, UN Secretary General Ban Ki Moon said that Rio +20 was a generational opportunity to hit the reset button for sustainable development. The IWCAIS 2012 findings strongly support the Commissioner’s position that “Industrial symbiosis is one of the most promising and innovative ways of making our resource use sustainable – and in doing so, generating wide economic, social and environmental benefits.”
Carbon Neutral – The Industrial Symbiosis Way...and not a tree in sight...!

The carbon offset required to make IWCAIS carbon neutral was calculated at 40 tonnes of CO$_2$. Through a new, innovative synergy involving Betts Envirometal Ltd, the University of Birmingham and International Synergies Limited industrial symbiosis network 397.7 tonnes of CO$_2$ were offset in June 2012 alone, lifetime savings estimated at 23,862 tonnes. The ongoing synergy involves the novel recovery of silver from a variety of sources.
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