Industrial Symbiosis

This good practice is relevant to European Green Capital Award indicators:

What is Industrial Symbiosis?

Industrial symbiosis is the process by which wastes or by-products of an industry or industrial process become the raw materials for another. Application of this concept allows materials to be used in a more sustainable way and contributes to the creation of a circular economy.

The transition to such an economy is the goal of the European Commission's Circular Economy Action Plan as it will result in the increase of Europe's economic competitiveness, sustainability, resource efficiency and resource security. It also contributes to the reduction of greenhouse gas (GHG) emissions.

Industrial symbiosis creates an interconnected network which strives to mimic the functioning of ecological systems, within which energy and materials cycle continually with no waste products produced. This process serves to reduce the environmental footprint of the industries involved. Virgin raw materials are required to a lesser degree, and the need for landfill waste disposal is reduced. It also allows value to be created from materials that would otherwise be discarded and so the materials remain economically valuable for longer than in traditional industrial systems.

Examples of industrial symbiosis are wide ranging and include the use of waste heat from one industry to warm greenhouses for food production, the recovery of car tyre shavings for use in construction materials, and the use of sludge from fish farms as agricultural fertiliser.

Industrial symbiosis has been applied for waste management and valorisation in Lahti, Finland, and Pécs, Hungary.

Kujala Waste Centre, Lahti, Finland

Aims and Methodology

Päijät-Häme Waste Management Ltd (PHJ) has employed the principles of industrial symbiosis in the city of Lahti to optimise waste processing, treatment, and recycling. Their Kujala Waste Centre project has co-located various waste related businesses on a single site extending over 70 hectares to allow the outputs from one to be easily transferred to another for reuse or further processing.

The original site which oversaw the intake and sorting of waste was completed in 2001. Since then, further businesses have been added and the site now contains 20 interconnected operational units to store, handle, recover, transfer and dispose of waste.

Implementation of Industrial Symbiosis at Kujala

Waste is sorted and as much of the material as possible is recycled. The majority of recyclable waste is refined and used in the production of new material which can be utilised in industry. Organic material is used for biogas generation and in the composting plant. Raw biogas is produced from bio-waste, garden waste, and waste water sludge. This is then upgraded at the facility to produce high quality biogas which is transferred to the natural gas network. The remaining material is composted for use in agriculture and growing media.

Gas produced from waste which is deposited in landfill is reclaimed and most is pumped to a heating station where it is used to generate steam used in soft drinks manufacture.

Remaining landfill gas is used to generate energy at the Kujala site. Leachate from the landfills and dirty water from other waste management processes and facilities is treated at Lahti Aqua Ltd’s Ali-Juhakkala waste water treatment facility.

Contaminated soil is stabilised and compacted into a non-toxic form at the Kujala site. It is utilised in embankments or as preliminary landfill cover.

Cities at a Glance

Statistics sourced from EGCA 2019 Applications.

Gross Domestic Product: €/capita:
Lahti: €29,913  Pécs: €6,843

Population:
Lahti: 119,263  Pécs: 156,049

Municipal waste generated (kg/capita):
Lahti: 486  Pécs: 452

Proportion of waste sent to landfill:
Lahti: 7%  Pécs: 29%

Percentage of organic waste collected separately:
Lahti: 16%  Pécs: 37%

Percentage of recycled household waste:
Lahti: 38%  Pécs: 27%

Want to know more?

For further information on Lahti and Pécs’ projects please see:
• Mecsek-Dráva Waste Management Project - Non Technical Summary
• PHJ - Industrial Symbiosis at Kujala Waste Centre

Useful References

• EU Circular Economy Package
• EU Cohesion Fund

Find out more about the European Green Capital Award, and its sister competition, the European Green Leaf Award on our website:
ec.europa.eu/europeangreencapital/

Figure 1: Kujala Waste Centre Flow-Chart. Designed by Anna Polkutie, Esa Ekholm and Hanna Bergman, supported by Lahti region Development (LADEC). Source: City of Lahti, 2017.

Future Plans

PHJ’s 2020 strategy indicates that the primary goal is to increase the value added so that waste can be turned into saleable products and materials. PHJ has set a goal of achieving a 50% recycling rate of all municipal waste. PHJ also aims to increase the amount of bio-waste which is collected separately from general waste in a cost effective way.

In collaboration with the City of Lahti, PHJ is investigating sustainable solutions to optimise the potential of surplus land and brownfield sites. PHJ is also working towards powering the operations of the Kujala Waste Centre with on-site renewable energy generation. This goal has led to the installation of solar panels onto roofs in Kujala. The next planned step is to utilise the closed landfill surface as a solar park.
The Pécs-Kökény Waste Management Centre was developed as part of Hungary’s Mecsek-Dráva Waste Management Project. This project was developed to solve the waste challenges of 313 municipalities and is supported by the European Union. The project required close cooperation across municipalities and a dynamic project team which included input from planning and waste management experts.

The project collaborated with the EU Technical Assistance Programme and secured funding from the EU Cohesion Fund. It also utilised municipal funds and ensured state backing. The key objectives of the project are to achieve compliance with the Waste Framework Directive (2008/98/EC), and the Landfill Directive (1999/31/EC), improve resource efficiency with regard to mixed residual waste and minimise diversion of waste to landfill, promote waste to energy conversion of non-recyclable material and minimise operational cost of waste management and therefore reduce public waste tariffs.

Implementation of Industrial Symbiosis at Pécs-Kökény
Recyclable materials are reclaimed and used to generate raw materials for re-sale. Passing through a mechanical-biological treatment plant, material suitable for fuel generation is separated and utilised as energy. Organic matter within the waste is also removed and is transferred to a composting facility to create a useful product.

Future Plans
Pécs has plans to extend the present manually operated sorting system in the materials recovery facility, and install a pre-sorting machine line to automatically pre-sort the waste. This will improve efficiency and will restrict hand sorting to fine sorting.

Further separation of bio-stabilised waste will be carried out to remove the 20-80 mm fraction which can be recovered for energy generation. To reduce waste sent to landfill, the amount entering landfill will be restricted to that which is below 20 mm fraction.

Key Statistics: Pécs-Kökény Waste Management Centre
- Waste processed per year: 100,000 tonnes
- Population served: 426,022
- Amount invested: £25 million
- Net operating cost: £2.8 million, £28/tonne of waste processed
- Source of net operating costs financing: Waste management fees paid by users, and income from sales of raw materials

Challenges and Learnings
Challenges in implementing industrial symbiosis include managing close cooperation between governing bodies, stakeholders and the general public, and achieving public acceptance. Presenting plans and illustrating the social, environmental and economic benefits of a scheme clearly can help to overcome this issue. Good waste management strategies may take time and persistence to develop, and there is a need for good waste sorting efficiency at household and consumer level to ensure cost efficiency.

For the Kujala Waste Centre, obtaining environmental and construction permits, and reducing the volume of waste produced in the region were key challenges. Obtaining data on the sources and processing of industrial, agricultural and construction wastes was also challenging. Guidance, support and regulatory compliance and enforcement can help to overcome these barriers. The Pécs-Kökény Waste Management Centre found that the selection of technically and economically appropriate technologies required strong guidance and management from planning through to construction. The City of Pécs recommends that professional events and exhibitions are held to inform the project and source expertise. Engaging in knowledge transfer and participatory stakeholder engagement are recognised as key processes which cities should prioritise if they adopt industrial symbiosis.

Key Benefits
Some key benefits of industrial symbiosis are outlined below:

<table>
<thead>
<tr>
<th>Impact Reduction</th>
<th>Economic Value</th>
<th>Climate and Air</th>
<th>Knowledge and Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>•Reduction of environmental impact of waste through recovery, reuse and recycling.</td>
<td>•Creation of economic value from waste material.</td>
<td>•Reduction of GHG emissions from waste transport and raw material extraction.</td>
<td>•Extension of knowledge and practical know-how of how waste management can be transformed into a sustainable and growth oriented business.</td>
</tr>
<tr>
<td>•Biostabilisation reduces the environmental impacts and risks associated with wastes that are sent to landfill.</td>
<td></td>
<td>•Reduction of reliance on fossil fuels and decrease of emissions of NOx, SOx, CO2.</td>
<td></td>
</tr>
</tbody>
</table>