

# A Roadmap for a National Industrial Symbiosis Programme for Turkey



## National Industrial Symbiosis Programme Roadmap for Turkey

### Table of Contents

1. Structure of the Report.....	4
2. Background.....	4
3. Summary Recommendation for a National Industrial Symbiosis Programme in Turkey....	5
4. Industrial Symbiosis: Context and Drivers.....	8
5. Organisational Design for Implementation: Roles & Institutions.....	11
5.1 UK’s Facilitated (NISP) Model.....	11
5.2. Korean Top-Down Model.....	14
5.3 Assessment of Facilitated Model versus Top-Down Model.....	14
6. The Recommended Model for Turkey.....	15
6.1. National Government Owner.....	16
6.2. National Coordinating Body.....	22
6.3. National Innovation Partner.....	25
6.4. Delivery Teams.....	26
6.5. Software/ICT.....	29
6.6. Programme Advisory Groups (PAGs).....	32
7. Financial Mechanisms to Deliver Sustainability.....	33
7.1 Ministry Commitment.....	33
7.2 Development Agencies (DAs).....	33
7.3 TÜBİTAK-MRC (MRC).....	33
8. Consultations.....	34
Appendix I: NISP® Job Descriptions (abbreviated).....	36
Regional Coordinator (reporting to National Coordinator).....	36
Senior Practitioner (reporting to Regional Coordinator).....	36
Practitioner (reporting to Senior Practitioner or Regional Coordinator).....	37
Administrative support (to regional delivery team).....	37
Appendix II: Synergy Activities Implemented in Eskişehir OIZ.....	38
Table II.1- Eskişehir Companies Engaged in Industrial Symbiosis, by Category.....	39
Table II.2- Eskişehir Resources Identified through Industrial Symbiosis, by Category.....	39

## List of Abbreviations

DA	Development Agency
DG	Directorate General
GHG	Greenhouse Gas
GIS	Geographic Information System
INDC	Intended Nationally Determined Contribution
ICT	Information Communication Technology
ID	Identification
IS	Industrial Symbiosis
KICOX	Korea Industrial Complex Corporation
KITECH	Korean Institute of Technology
KPI	Key Performance Indicators
MoTrade	Ministry of Trade
MoEU	Ministry of Environment and Urbanisation
MoIT	Ministry of Industry and Technology
MOTIE	Ministry of Trade, Industry and Energy
NISP®	National Industrial Symbiosis Programme
OIZ	Organised Industrial Zone
PAG	Programme Advisory Group
R&D	Research and Development
SDG	Sustainable Development Goal
SME	Small and Medium Enterprise
UNEP	United Nations Environment Programme

## 1. Structure of the Report

The project activities for development of this suggested Roadmap for a National Industrial Symbiosis Programme for Turkey commenced at the end of May 2018 with the first Project Steering Committee meeting and finishes at the end of March 2019 with an Action Plan for implementation of the Roadmap.

There are four principal outputs/activities from the project:

1. Research and assess context and data availability,
2. Develop a draft Roadmap based on best international experience,
3. Finalise Roadmap through stakeholder engagement and testing,
4. Deliver final Roadmap (this report) and an Action Plan for Implementation.

This report gratefully acknowledges the consultees who provided their invaluable experience to the team. Summary recommendations for a National Industrial Symbiosis Programme for Turkey are presented, followed by more detailed descriptions of organisational design for implementation relating to roles and responsibilities. Finally, mechanisms to secure the sustainability of the Programme are reviewed.

## 2. Background

Rapid industrialisation and urbanisation in Turkey over the last thirty years has led to challenges with waste elimination and the need to transform to a more resource efficient and greener industrial structure. In the 10th Development Plan of Turkey, environmental protection and sustainable use of resources are among the priority goals. In this regard, industrial symbiosis is defined as a strategic tool to achieve these goals in many national policy documents. Industrial symbiosis is also defined as a tool for reaching eco-efficiency and regional competitiveness objectives in regional policy documents: 19 out of 26 regional development plans throughout Turkey define industrial symbiosis as a tool towards the above-mentioned objectives. Moreover, Turkey announced industrial symbiosis will be used to mitigate its GHG emissions in its Intended Nationally Determined Contributions (INDC) within the context of U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21) held in Paris in December 2015.

In addition, industrial symbiosis is included within many national policy documents such as the Priority Transformation Programme for Enhancing Productivity in Manufacturing, SME Strategy and Action Plan (2015-2018), National Efficiency Strategy and Action Plan (2015-2018) and the National Cleaner Production/Eco-efficiency Strategy (2014-2017). However, a mechanism for facilitating industrial symbiosis is lacking at both national and regional level, due to limited local experience in this field. Some individual projects are being supported by development agencies (DAs) but since industrial symbiosis is a permanent goal both in national and international policies, a systematic framework for its widespread delivery must be established. Therefore, this project has benefitted from the UK experience including from International Synergies Limited<sup>1</sup>, Department of Environment Food and Rural Affairs (Defra), Environment Agency (EA) as

---

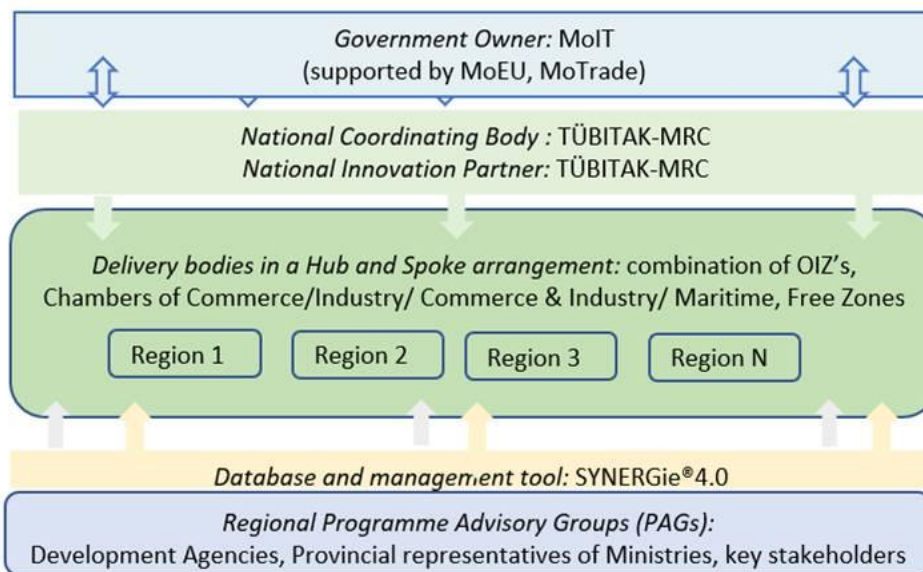
<sup>1</sup> International Synergies Ltd (ISL) created the NISP® model, delivered its activities in 3 regions, and coordinated nationally all 12 regions (across England, Scotland, Wales and Northern Ireland).

a leading country in the field to help prepare a roadmap for Turkey that defines institutional roles and support mechanisms for facilitating industrial symbiosis throughout the country.

The project for developing a National Industrial Symbiosis Roadmap is led by the Turkish Ministry of Industry and Technology (MoIT), supported by the UK Foreign and Commonwealth Office (UK Prosperity Fund) and delivered by International Synergies Limited in conjunction with the Project Steering Committee chaired by MoIT.

### 3. Summary Recommendation for a National Industrial Symbiosis Programme in Turkey

Deriving from international best practice, and informed through extensive consultation, the following figure summarises this report's recommendation for a National Industrial Symbiosis Programme in Turkey.



**Figure 1:** National Industrial Symbiosis Programme for Turkey: Organisational structure with recommended institutional owners.

- In this structure, there is a clear Government owner in the form of a Ministry which is responsible for the activity's legitimisation and is the principle beneficiary in terms of the programme supporting national aims and objectives. The Government owner provides the financial mechanism for sustainability and ensures the policy context across Ministries.

The **Government** owner is MoIT, as responsible for all industry and the bodies representing and convening industry and the programme is clearly aligned with their responsibilities. (Special

arrangements will be required to engage Free Zones, reporting to

Ministry of Trade.) Ministry of Environment and Urbanisation support (through a formal protocol) is needed as they manage waste movements and can take an active role in terms of both policy and supporting regional activity.

MoIT can allocate responsibility to the most relevant DG (or DGs) in line with their duties.

- The National Coordinating Body for implementation has primary responsibility to oversee the implementation by all delivery partners, acting as the liaison between the Government owner and the activity on the ground.

The **National Coordinating Body** should have scope to work across both the OIZs and the Chambers, since in some regions an OIZ will be the lead delivery party and in other regions it will be a Chamber. As such, neither OSBÜK nor TOBB can be tasked with this responsibility alone, as it extends beyond their mandate. One body with the appropriate experience to coordinate across both OIZs (and Free Zones) and Chambers is TÜBITAK-MRC.

- The National Innovation Partner supports industrial symbiosis delivery through technology development and technical support.

The **National Innovation Partner** is TÜBITAK-MRC, also reporting to MoIT, as this activity is clearly aligned with their current responsibilities as a National Cleaner Production Centre (NCPC).

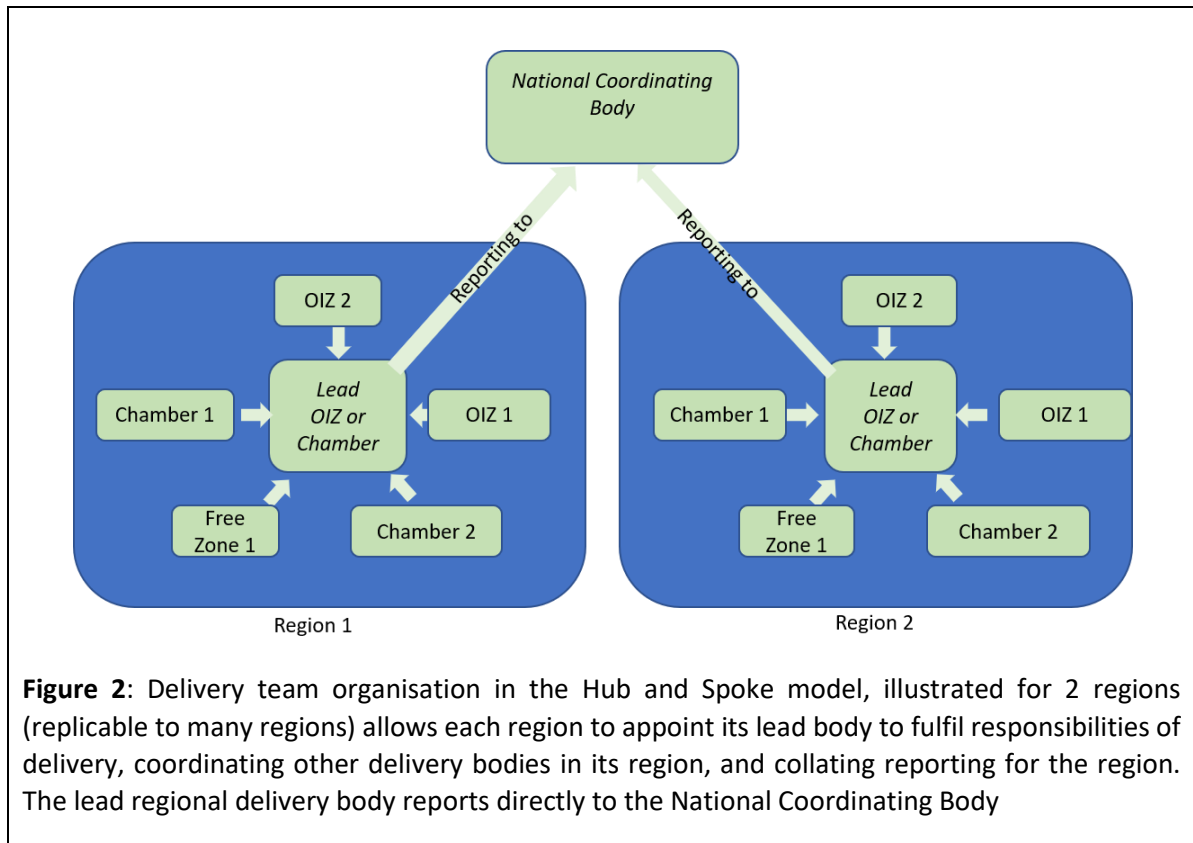
- The Delivery bodies are the facilitators (practitioners) actively engaging with the companies around the country to gather information, identify and advance opportunities through to successful completion, and then report on impacts.

The regional **Delivery bodies** will need to vary by region based on the concentration of industry and its affiliations (OIZs, Chambers, Free Zones). To allow for this variability while still enabling a coordinated approach, each region will be organised in a hub-and-spoke model. At the hub will be a lead OIZ or Chamber (or Free Zone) appointed the provincial Ministry representatives (MoIT, MoEU, MoTrade) advised by the DA. The hub will appoint a coordinator to liaise with other regional delivery bodies (OIZs, Chambers, Free Zones) and coordinate regional activity, consolidating and reporting to the national coordinator. It is recognised that culturally, particularly between OIZs, that there may be competitive factors to be overcome. Suitable personnel are likely already employed by these organisations (as in Eskişehir, where the Eskişehir OIZ and Eskişehir Chamber of Industry are actively delivering impressive industrial symbiosis facilitated projects – one of these<sup>2</sup> is detailed in the

---

<sup>2</sup> International Synergies partners with Eskişehir OIZ and Eskişehir Chamber of Industry in a Horizon-2020 funded project SHAREBOX (Grant Number 680843) to develop the next generation ICT to support industrial symbiosis. The project began with implementation of NISP® style facilitated workshop and SYNERGie® software in Eskişehir to engage

Appendix). Existing staff at the OIZs, Chambers and Free Zones with relationships with local industry are good candidates for upskilling to facilitate industrial symbiosis. Outsourcing this work to consultancies will not embed the expertise throughout these organisation – the expertise will continue to reside with the consultants.



- All partners are supported by the Information Communication Technology (ICT) that captures information, helps identify industrial symbiosis opportunities (synergies) and allows for easy impacts reporting and tracking.

*It is recommended that all partners are supported by the world-leading SYNERGie®4.0 ICT that helps identify industrial symbiosis opportunities (synergies) and captures information for easy impacts reporting and tracking. The National Coordinating Body can make a final decision on the software after full evaluation and taking factors into account such as confidentiality and licensing.*

- Finally, the Programme Advisory Group (PAG) provides the mechanism to engage critical stakeholders at a regional/local level.

businesses. Workshop support was provided by BEBKA and TTGV. Details are provided in the Appendix. For more information please visit the project website <http://sharebox-project.eu/>.

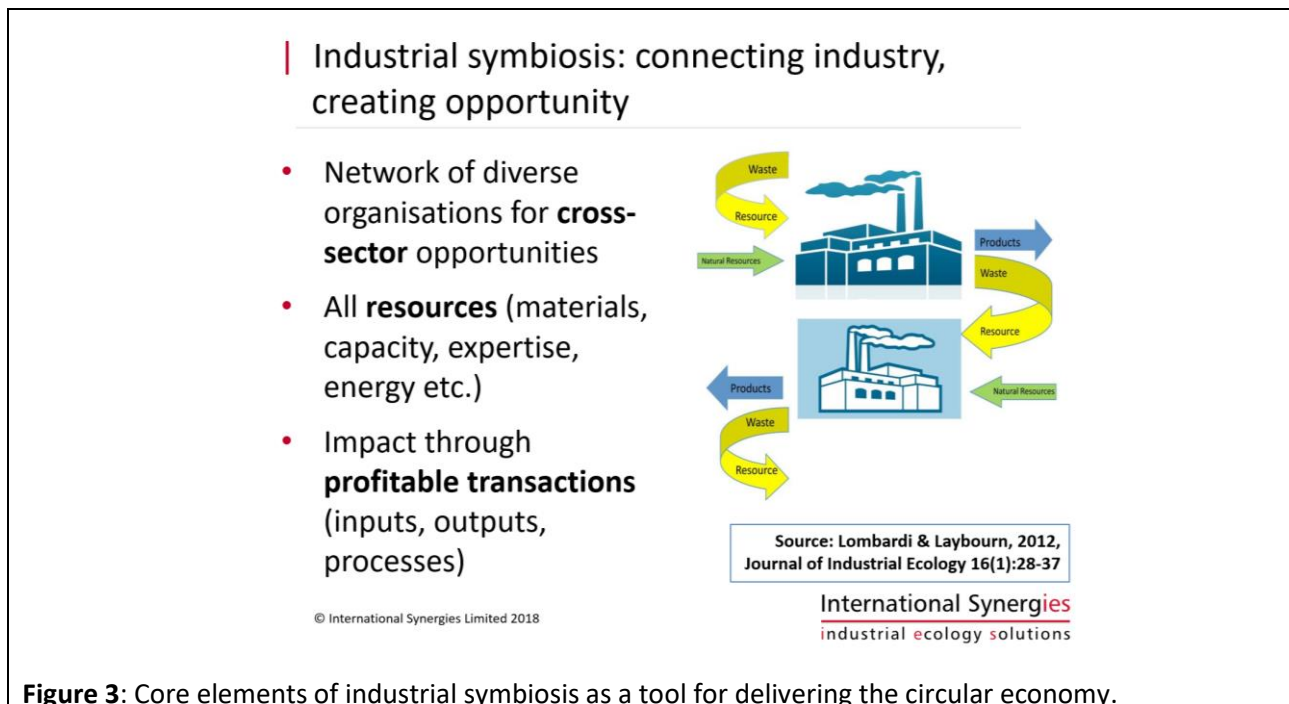
The **Regional Programme Advisory Group** ought to include the provincial representatives of all relevant Ministries to ensure alignment with each agenda (productivity, waste movements, etc). Critical stakeholders at a regional/local level such as leading businesses, the DA and sector associations.

The Ministry of Environment and Urbanisation Provincial (MoEU) representatives are particularly important to include on the regional PAG because they manage waste management plans, know the characteristics of waste and can help identify potential resource flows. MoEU approval of usage of by-products is also critical to companies being comfortable making the changes to standard procedure – in essence, giving their blessing to reuse opportunities.

The value of the Programme Advisory Groups would be greater at a regional/local level to serve as an effective engagement mechanism bringing local context to the delivery teams, rather than at the national level; however, the establishment of a National Programme Advisory Group is also possible.

#### 4. Industrial Symbiosis: Context and Drivers

According to the recent (2018) European pre-standard CEN/WS 93, industrial symbiosis “is the use by one company or sector of under-utilised 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.” Industrial symbiosis results in the reduction of waste through the reuse of waste and greater resource efficiency.



Since 2009, industrial symbiosis has been incorporated into policy reports and recommendations across the European Commission, in support of resource efficiency, climate change mitigation, eco-innovation, green



growth, entrepreneurship, industrial strategy and smart specialisation. In 2018, a report commissioned by European Commission DG Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) estimated the economic benefit available to Europe through industrial symbiosis as up to €72.7 billion through cost savings and up to an additional €12.9 billion through transactions of secondary materials.<sup>3</sup> The above financial estimates exclude other potential upsides such as finding higher value uses for materials.

Industrial symbiosis is well 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, including:

- European **Waste Framework Directive** (2009)\*
- Roadmap to **Resource Efficient** Europe – Exemplar (2011)\*
- DG Regions: Connecting **Smart and Sustainable Growth** through Smart Specialisation – Exemplar (2012)\*
- DG Enterprise: Communique on Green **Entrepreneurship** (2013)
- European Resource Efficiency Platform – **short-term recommendation** (2014)
- DG **Innovation & Research**: Short Guide to Assessing Environmental Impacts of Research and Innovation Policy (2014)\*
- **Circular Economy** Package (2015)
- European **Environment Agency**, Circular Economy in Europe (2016)\*
- DG Energy **Strategic Energy Technology** Plan (2018)
- And finally, in 2018 the amendment to the Waste Framework Directive that requires member states to “promote sustainable use of resources and **industrial symbiosis**”

\*Cites the UK’s National Industrial Symbiosis Programme (NISP®)

The facilitated industrial symbiosis model has been recommended as the most efficient means to deliver rapid impact through industrial symbiosis, according to the DG GROW report 2018<sup>4</sup>. DG GROW in its 2019 tender document for establishment of a pan-European industrial symbiosis network (Cir©Lean) further stated:

***“There is a significant exploitable industrial symbiosis potential for Europe”***

***“Overall industrial symbiosis is expected to grow significantly. Moving towards a low carbon resource efficient industry and society implies that more industrial symbiosis solutions will be required and implemented”***

In addition, the EU is investing Euros 4 million in **EU Programme: ERASMUS+ “New Skills Agenda”** Sector Skills Alliances for implementing a new strategic approach (“Blueprint”) to sectoral cooperation on skills. The main objective of the project is to develop a blueprint for a European Intensive Industries Skills Agenda and Strategy (SPIRE-SAIS) for an ongoing and short-termed implementation of new skills demands concerning **cross-sectoral industrial symbiosis** and energy efficiency.

---

<sup>3</sup> 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)

<sup>4</sup> 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)

Both the diversity and concentration of Turkish industry (including agriculture) provide the ideal conditions for industrial symbiosis. Similarly, Turkey has supportive laws and institutions albeit they are currently not aligned to effectively deliver industrial symbiosis on the ground, a situation that this Roadmap is designed to address. An example of the huge potential can be found from a single activity with limited facilitation in Eskişehir OIZ, facilitated by the OIZ and Chamber together, which has recently delivered the following impacts:

Metric	Current <b>monthly</b> impact	Project life (4-year) impact
Waste avoided (tonnes)	14,853	503,693
Carbon saved (tonnes)	17,773	474,020
Cost savings (€)	55,293	2,245,293
Virgin material saved (tonnes)	15,287	517,249

A more detailed description of the Eskişehir achievements is given in Appendix II. As this type of activity can be scaled up through a common national framework, the benefits will be enormous and, critically, they can be consistently measured and reported in aggregate. Turkey has other experience in industrial symbiosis such as the initial programme in Iskenderun Bay; however, there is currently no consistent coordination, standardisation, reporting or cross learning from such initiatives.

The advantages for Turkey to implement a national industrial symbiosis programme include:

- **A more competitive economy through enhanced productivity**
- **Enhanced inward investment opportunities**
- **Job creation and retention**
- **A business-led demand-pull on innovation**
- **Identification of export potential for Turkish cleantech/green-tech solutions**
- **An advanced tool to assist regional economic development and regeneration**
- **Climate change mitigation and contribution to Turkey's Intended Nationally Determined Contribution (INDC) agreed at COP 21 in Paris**
- **Improved waste regulation and tracking**
- **A pathway to zero waste**
- **Compliance with the European Waste Framework Directive**

In addition to the benefits accruing to individual companies' research on UK National Industrial Symbiosis Programme (NISP®) shows that (depending on the tax regime) Government investment in this type of activity has a direct rate of return to Government of up to 9:1 on their investment.<sup>5</sup>

At the 2015 G7 Alliance for Resource Efficiency Workshop on Industrial Symbiosis<sup>6</sup>, (at which the Turkish Government presented its regional policy supporting industrial symbiosis) UNEP mapped industrial symbiosis to the delivery of six **Sustainable Development Goals (SDGs)** which the National Industrial Symbiosis Programme for Turkey could make a measurable contribution to:

- Decent Work and Economic Growth (8)
- Industry Innovation and Infrastructure (9)
- Sustainable Cities (11)
- Responsible Consumption and Production (12)
- Climate Action (13)
- Partnerships (17).

## 5. Organisational Design for Implementation: Roles & Institutions

When looking to design the organisational structure of national industrial symbiosis programme for Turkey, reference has been made by International Synergies and stakeholders to 2 well-established industrial symbiosis national activities: the facilitated NISP® model in the UK, and the top-down model in the Republic of Korea.

### 5.1 UK's Facilitated (NISP®) Model

The most cited facilitated approach to industrial symbiosis in European policy is the NISP® methodology, first developed in the UK and since replicated on every continent.<sup>7</sup> The NISP® model involves facilitators (practitioners) gathering information from companies, making assessments, then identifying and facilitating synergy opportunities through to completion. NISP® started out with the involvement of 3 regions in 2002 (with funding from Regional Development Agencies) but was designed as a national programme from the outset so when the opportunity to expand came in 2005 (with national Government investment) it was easy to scale up to national coverage. The key components of the design incorporated from the beginning include:

- Central coordination with regional delivery teams
- All delivery teams had the same training even though they were from different organisations
- Shared ICT platform database, branding, website, reporting criteria (metrics)
- Annual "get-together-work-together" events for practitioners to foster shared learning and synergy replication

---

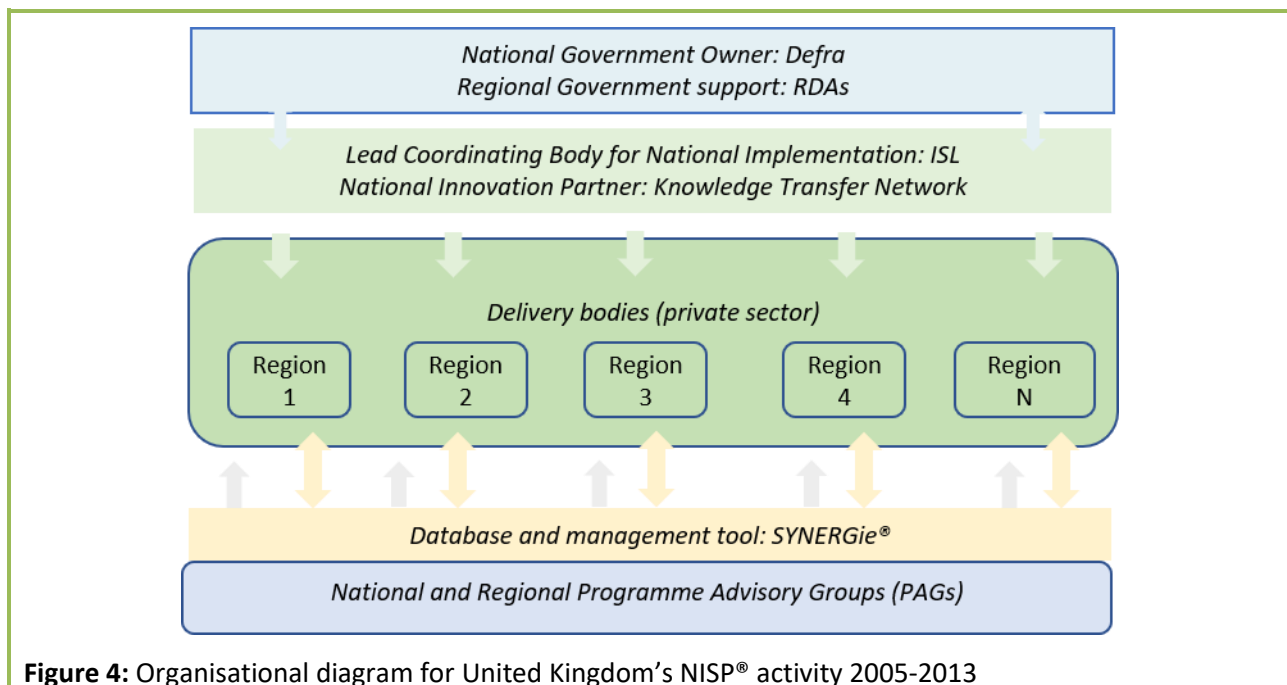
<sup>5</sup> Scott Wilson Business Consultancy and Manchester Economics. 2009. NISP Economic Evaluation Report. October.

<sup>6</sup> <https://www.international-synergies.com/projects/g7-workshop-on-industrial-symbiosis/>

<sup>7</sup> Countries adopting NISP® at a local, regional or national level include: Canada, USA, Mexico, Brazil, South Africa, Ghana, Egypt, China, Finland, Belgium, Netherlands, Italy, Spain, Germany, Sri Lanka, Peru, France, Hungary, Poland, Denmark, Israel and United Kingdom

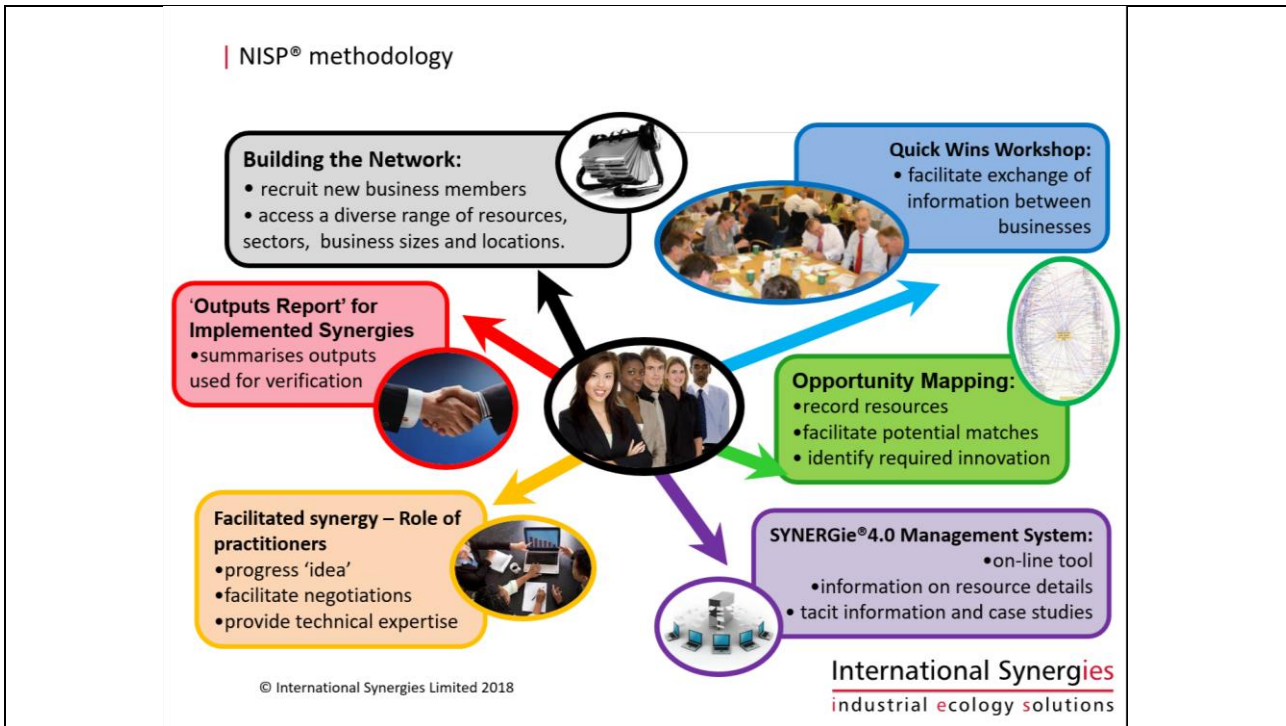
- Practitioners’ (who make up the delivery teams) primary responsibilities were to identify and advance industrial symbiosis opportunities with the companies.
- Companies are convened at workshops as well as visited individually.

When NISP® went national in 2005, it was only necessary to integrate delivery teams from the remaining regions as the infrastructure for national coordination was already in place. The roles and responsibilities of the actors in the UK delivery are mirrored in this document, Section 5, and filled by the organisations named in Figure 4, below.<sup>8</sup> The NISP® model has since been taken up at a local, regional or national level in over 20 countries since 2006. The NISP® model has typical characteristics of (relatively) low investment, high impact and rate of return, and a high level of demand led innovation.



Northern Ireland and South Africa have continuously delivered the NISP® model of industrial symbiosis since 2007 and 2013, respectively and many other programmes remain ongoing including Canada, Netherlands, Finland, Belgium, France and Israel. The following figures present both the NISP® methodology in its six stages and the impact that NISP® delivered in England over an 8-year period.

<sup>8</sup> International Synergies Ltd (ISL) created the NISP® model, delivered its activities in 3 regions, and coordinated nationally all 12 regions (across England, Scotland, Wales and Northern Ireland. The Northern Ireland programme is funded by Invest Northern Ireland (regional development agency), and has continued to date, surpassing 12 years).



**Figure 5:** NISP® methodology as developed in the UK and delivered globally.

**| NISP® delivered outcomes**

England April 2005 – March 2013

METRICS	In Year Benefits*	Lifetime Impact (Max 5 year)
Landfill diversion	9.4 million tonnes	47 million tonnes
CO <sub>2</sub> reduction	8.4 million tonnes	42 million tonnes
Virgin material savings	12 million tonnes	60 million tonnes
Hazardous waste eliminated	0.4 million tonnes	2.1 million tonnes
Water savings	15 million tonnes	72 million tonnes
Cost savings	€243 million	€1.21 billion
Additional sales	€234 million	€1.17 billion
Jobs	10,000+	
Private investment	€374 million	

€43.4 million investment - \*All outputs independently verified  
Rate of return for Govt. 9:1  
Exchange rate £1 = €1.18

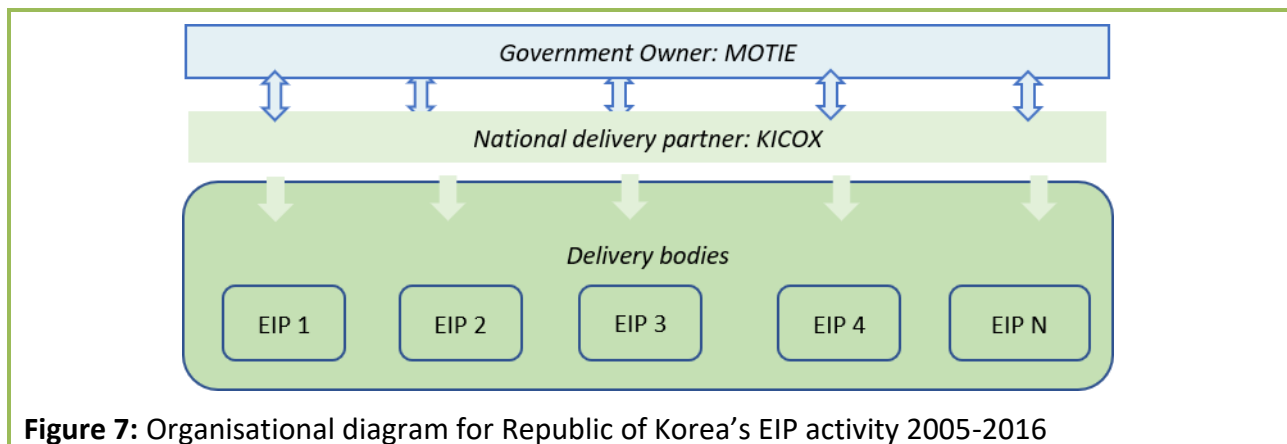
**International Synergies**  
industrial ecology solutions

**Figure 6:** NISP® England delivered outcomes, audited and verified.

## 5.2. Korean Top-Down Model

A different model for industrial symbiosis is that of the Republic of Korea where the ‘top down’ focus is on government-led implementation on industrial parks to transform them to Eco-Industrial Parks (EIPs) largely through industrial symbiosis. The responsible Government Ministry is that of Trade Industry and Energy (MOTIE) delivered by the Government-owned enterprise Korea Industrial Complex Corporation (KICOX). An advantage of this approach is that major infrastructure investments can be made (such as creating steam networks) but the EIP approach on its own has several drawbacks: engagement is with fewer companies (only 1831 companies engaged over 11 years, versus NISP®’s 15,000+ in 8 years); and the high investment required for large capital projects. Via the consultation process it was confirmed that the Republic of Korea have found this approach to industrial symbiosis unsustainable: the EIP model was abandoned in 2016 having delivered: Cost savings of €838 million, new revenues of €1,238 million and CO2 reduction of 6.48 million tonnes with 848 new employment.<sup>9</sup>

The newest phase of investment commencing 2018 has moved towards a system closer to the NISP® approach, with investment in Eco Industrial Development Centres (providing the facilitation/direction element but without funding projects) under a new body Korean Institute of Technology (KITECH) promoting regional industrial symbiosis networks connected to cities and the wider economic and social economy.



**Figure 7:** Organisational diagram for Republic of Korea’s EIP activity 2005-2016

## 5.3 Assessment of Facilitated Model versus Top-Down Model

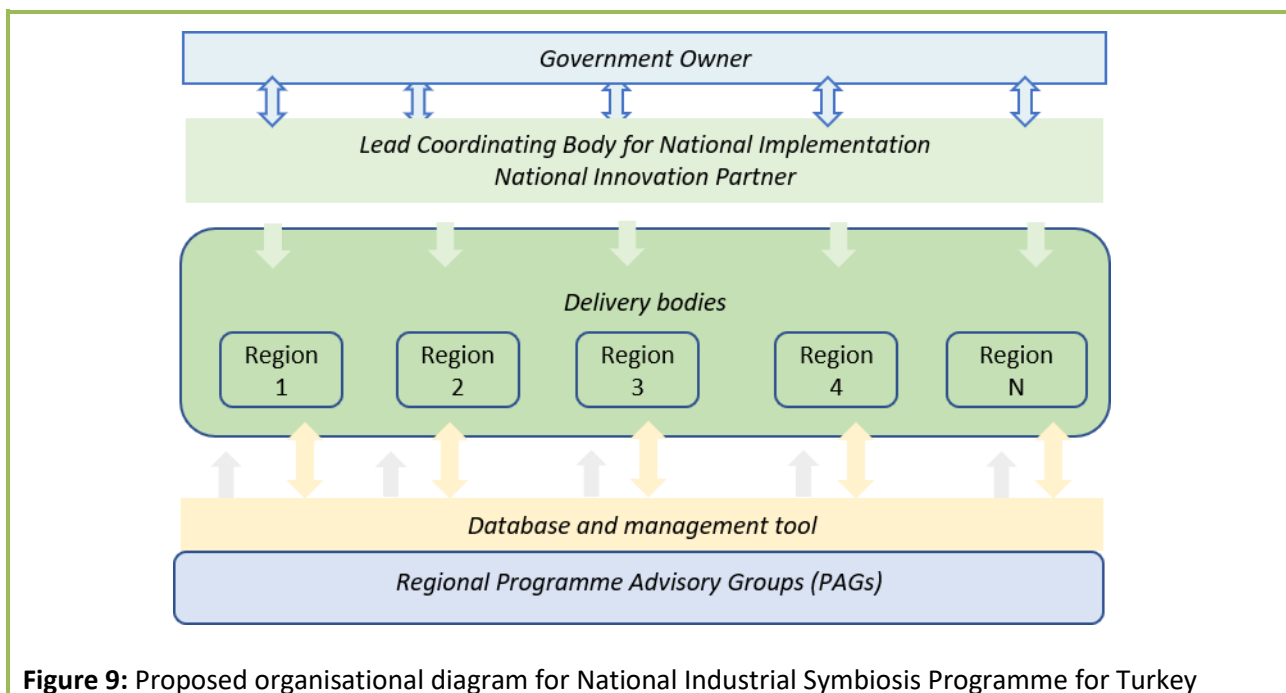
The table below helps to illustrate the difference between a NISP® approach and KICOX EIP approach. Both approaches deliver benefits however, they differ greatly in terms of numbers of companies engaged, numbers of opportunities identified and completed, and investment required. The NISP® approach (typically company led) is characterized by relatively low investment (in facilitation), high levels of company engagement and shorter payback. The KICOX EIP approach (typically infrastructure projects) is characterised by high investment, low company engagement, longer payback.

<sup>9</sup> GGGI. 2017. Greening Industrial Parks – A Case Study on South Korea’s Eco-Industrial Park Program.

	NISP® (2005 -2013), England	KICOX (2005-2016)
Companies engaged	12,000	1,831
Potential industrial symbiosis projects identified	Over 10,000	655
Projects delivered	Over 3,000	355
Investment	€43.4 million	€ 551.5 million

## 6. The Recommended Model for Turkey

Based on international experience and Turkish context, the proposed organisational structure for the Turkish National Industrial Symbiosis Programme has been defined specifying the roles required for successful delivery. The recommended structure more closely resembles the NISP® model for the reasons outlined above. This proposal was followed by a consultation with Turkish stakeholders to populate the proposed roles with the appropriate national institutions and organisations to fulfil the responsibilities associated with each role.



**Figure 9:** Proposed organisational diagram for National Industrial Symbiosis Programme for Turkey

- In this structure, there is a clear **Government owner** in the form of a Ministry which is responsible for the activity's legitimisation and is the principle beneficiary. The Government owner provides the financial mechanism for sustainability and ensures the policy context across Ministries.

- The **National Coordinating Body** for implementation has primary responsibility to oversee and deliver implementation by all delivery partners, acting as the liaison between the Government owner and the activity on the ground.
- The **National Innovation Partner** supports industrial symbiosis delivery through technology development and technical support.
- The **Delivery bodies** are the facilitators actively engaging with the companies around the country to gather information, identify and advance opportunities through to successful completion, and report on impacts.
- All partners are supported by the **ICT** that helps identify industrial symbiosis opportunities (synergies) captures information and allows for easy impacts reporting and tracking.
- Finally, the **Programme Advisory Group** provides the mechanism to engage critical stakeholders at a regional/local level.

The following sections provide more detailed descriptions for each role, together with a rationale for the recommendation of each organisation(s) for that role. This recommendation also recognises the need for flexibility in delivery at the regional/local level.

## 6.1. National Government Owner

The responsibilities of the National Government Owner of the national industrial symbiosis activity include:

1. **Ensure a supportive policy context** across government Ministries (including Industry and Technology, Environment and Urbanisation, and Trade). Turkey has an excellent foundation in this regard and no immediate policy changes are necessary to enable a successful national industrial symbiosis programme. However, legislation/regulation can always be used to make the business conditions more favourable for industrial symbiosis, particularly in the areas of landfill and carbon taxation (to make waste more expensive) together with waste legislation (making it easier for wastes to be classified as by-products and reused).
2. **Invest in industrial symbiosis activities** with new budget OR redirect budget from activities not likely to provide a comparable impact. Use influence over related delivery bodies budgets dependent on Government funding to redirect additional investment to this activity. Ultimately this type of activity ought to be 'self-sustaining' but there is a long way to go before the market conditions would make this possible. Until then, evidence demonstrates that the public sector will receive an excellent return on investment in macro-economic terms around job creation, increased tax receipts, and a more competitive economy.
3. **Appoint a lead national coordinating body**: The national Government owner should clarify, support and formalise the role of the national coordinating body, and provide financial support as required.
4. **Coordinate with and influence other national programmes, activities and strategies** to support broad investment in and support for industrial symbiosis activity (for example, liaise with the Ministry of Environment and Urbanisation to ensure the by-product permission legislation is compatible with industrial symbiosis; liaise with the Ministry of Trade regarding the waste management responsibilities of the Free Zones).
5. **Collect, collate and disseminate impact data** in terms of micro and macro-economic benefits together with impacts on environment, innovation and job creation and skills, to evidence the value-for-money of the investment and drive continuing investment in this activity.
6. **Utilise legitimising power** to drive stakeholder support for the programme



7. **Build the national programme over time** by increasing investment and encouraging expansion to engage ever-increasing numbers of companies
8. **Disseminate learnings and impacts** across Government to build broad support and engagement across Ministries: industrial symbiosis is a cross-cutting, holistic approach that positively impacts on innovation, economy, competitiveness, job creation, national finances, environment, regional economic development, inward investment, international trade, technology and knowledge transfer.
9. **Represent Turkey internationally** in this field including the G20, UN Framework Convention on Climate Change Conference of the Parties, and the European Union.

**Recommendation:**

*The **Government** owner is MoIT, as responsible for all industry and the bodies representing and convening industry and the programme is clearly aligned with their responsibilities. (Special arrangements will be required to engage Free Zones, reporting to Ministry of Trade.) Ministry of Environment and Urbanisation support (via an official protocol) is needed as they manage waste movements and can take an active role in terms of both policy and supporting regional activity.*

*MoIT can allocate responsibility to the most relevant DG (or DGs) in line with their duties.*

The **Ministry of Industry and Technology (MoIT)** is the logical owner of the industrial symbiosis activity, as they are the principal Ministry responsible for industry and the bodies interfacing with industry: OIZs and Chambers of Commerce/Industry/Commerce and Industry/Maritime Commerce, DAs, TUBITAK and KOSGEB. Further, **ARTICLE 385**, Duties and responsibilities of the Ministry of Industry and Technology, include as first and second duties:

- a) To carry out the relevant work on the **determination of industrial policies and strategies**, to prepare administrative and technical arrangements for industrial products and ensure their implementation, to register the industrial enterprises, to publish statistical information and to conduct analysis on industrial enterprises,
- b) With a view to ensure that **economy is advanced in accordance with the principles of productivity**; to carry out the relevant work the preparation of productivity policies and strategies, **to increase and enhance the productivity of industrial enterprises, to promote clean-production projects**,

The close support of, and coordination with, the **Ministry of Environment and Urbanisation (MoEU)** through an official protocol was deemed important to enhance delivery as they are responsible for legislation and manage information on permits and waste.

The duties of the MoEU General Directorate of Environmental Management are specified in **ARTICLE 8 - Decree Law 644** as relates to industrial symbiosis include (complete list in Appendix):

- c) To determine policies, strategies and relevant legislation on **clean production** and integrated pollution prevention activities.

- f) To **determine the necessary economic tools** and improve the related standards in order to perform an effective environmental management and ensure compliance with waste and chemicals in the environment.
- h) To establish objectives, policies and measures for the **management of waste** and chemicals.
- i) To determine the policies, strategies and to create legislation on **minimization of waste at sources**, classification, collection, transportation, temporary storage, recycling, disposal, reuse, treatment, converted to energy and final storage of the subject.
- j) (Amended: 8/8/2011-DL-648/5) To determine the principles related to the **waste transportation** and transportation of hazardous waste licenses and ensure that its implementation and monitoring in cooperation with related organizations; to identify the pollution status of the contaminated areas with waste and chemicals; to make the studies or allow to made studies for improving contaminated area and risks to the environment and human health.
- m) To ensure coordination with other institutions and organizations in order to establish plan, **policies and strategies for the implementation of measures related to the depletion of the ozone layer and global climate change**.

The **Ministry of Environment and Urbanisation (MoEU)** responsibilities in waste management plans for industry and the control of waste permits are as follows:

The MoEU published the National Waste Management and Action Plan (2016-2023) in December 2017, which sets goals for local authorities in all 81 provinces toward an integrated waste management system, which will require more recovery, recycling and energy production from waste, and accordingly limit the number of sanitary landfills needed. The National Waste Management and Action Plan presents general plans in the waste management sector for municipal waste as well as packaging waste, medical waste and hazardous waste. This plan, which will function as a roadmap for investments, includes information regarding the place, timeframe and the required capacity for plants to be built, and afterwards a national strategy will be developed on the reduction of the biodegradable waste to be disposed of in landfills. Regional Waste Management Plans will also be prepared taking into account the waste management system at national level. Preparation of hazardous waste management plans was completed in 2008, and these plans are being revised within the framework of the studies on the waste management plan. The waste management plans (National Waste Management and Action Plan, Solid Waste Master Plan and Local Waste Management Plan) are being prepared by the projects funded by national budget, which were launched in 2016.

As the main principle, reduction of waste at the source is the priority and recovering waste, where source reduction is not possible, is preferred in preparing legislation. Waste that cannot be recovered should be disposed of as the last option, in such a way that it will not damage the environment and human health. To achieve this goal the framework of National Recycling Strategy and Action Plan is being prepared to apply national legislation and within the scope of harmonization process with EU Environment in waste management. The plan covers all of Turkey, and the time horizon is set as 2016-2023. Within the framework of the plan, the following activities will be performed:

- Estimation of population and waste amount,
- Determination of the current situation and the main problems in waste management,
- Identification of methods of recycling, recovery, disposal by waste type,

- Contribution of stakeholder institutions and organizations in waste management, and
- Determination of the national strategic targets and the actions until 2023.

Generation of hazardous waste per capita is still much lower than the EU average: 44 kg/capita compared to 187 kg/capita for the EU-28 in 2014. It is, however, growing fast, nearly tripling over 2004-14. The bulk is chemical and combustion waste, mainly from the mining and quarrying sector. According to TurkStat data, about 7% of the waste generated in 2016 by the manufacturing industry was hazardous, of which 71% was sent to licensed waste treatment facilities. The number of hazardous waste recovery facilities increased from 185 in 2010 to 468 in 2016, comprising 44 energy recovery facilities (including three incineration plants and cement factories). Hazardous waste producers are registered and obliged to report to authorities.

There are other industry concentrations in Free Zones, which report to the **Ministry of Trade**; their support for involving companies in the Free Zones would be required. This should take the form of their explicit support for the participation of Free Zone companies in the MoIT-led programme. Free Zones are close to the EU and Middle East Markets, adjacent to the major Turkish Ports on the Mediterranean, Aegean and Black Sea, and have easy access to international airports and highways.

As the Ministry responsible for setting the relevant policies, MoIT is the clear Ministry for ownership. Within MoIT, the project has engaged with 3 DGs: Industry and Productivity, Organised Industrial Zones (OIZs), and Development Agencies.

**DG Industry and Productivity** do have the mandate, and influence over the requisite stakeholders as evidenced by the table of duties and responsibilities below.

#### **General Directorate of Industry and Productivity ARTICLE 388 –**

Duties and responsibilities of the General Directorate of Industry and Productivity include the following (complete list in the Appendix):

- a) To assist in the determination of employment policies for industrial sectors, to conduct or order the conducting of professional and occupational analyses on industrial sectors, to support technical vocational education, **to prepare programs for qualified labor force** and ensure the implementation of such programs,
- b) To follow the latest developments on **environment and climate change**, to evaluate the industrial policy formulation and assist in taking the necessary measures,
- ç) **To take the necessary measures in order to increase the competitiveness of industrial products**, to conduct sectoral analyses, to prepare evaluation reports and strategies and **ensure their implementation**, to determine the challenges regarding the industrial sectors and provide solutions, to set up sectoral committees and determine their working procedures and principles,
- ğ) To receive from relevant authorities the **data on the enterprises** about their investment, production, promotion, financial status, R&D, intellectual and industrial property rights, data on their foreign trade, employment capabilities and labor force, installed capacity, actual production, energy consumption and similar activities in accordance with procedures and principles to be set forth, to hold

the registration on industrial enterprises, to develop statistics and conduct analyses, to prepare the relevant information system over which these shall be published,

i) To provide technical assistance on productivity-related issues, to **carry out research, education and guidance activities** in this respect,

j) To support the work of enterprises on **increasing the productivity of enterprises** and to promote such activities,

k) To carry out activities for enterprises to ensure that they follow **clean production programs** and implement clean production projects,

l) **To find out issues that cause waste within the enterprises**, to carry out research on waste-preventing, productivity-increasing techniques and methods, to monitor the results thereof and to provide the enterprises with recommendations,

n) To certify the enterprises regarding **productivity**,

o) To guide real and legal persons and cooperate with them on the **establishment of productivity-related associations, institutes and training centers**,

**General Directorate of Industrial Zones** is responsible for overseeing activities related to the OIZs directly; this mandate is somewhat limited as it includes only those companies located within OIZs and their current responsibility and duties set out below (specific to OIZ planning and operational processes). Additionally, there are a great many companies and important industries that remain outside these designated zones.

#### **General Directorate of Industrial Zones ARTICLE 390 –**

Duties and responsibilities of the General Directorate of Industrial Zones are as follows:

a) To carry out the relevant work on the formulation of policies on developing and planning Organized Industrial Zones and industrial regions,

b) To determine the appropriate sites for Organized Industrial Zones, industrial sites, technology development regions, free zones and industrial sites, to carry out infrastructure work for the ones which are deemed convenient, to provide official opinion on the industrial issues of spatial strategy analyses, plans for spatial organization, 1/25.000 scale master plans, as per the relevant legislation; to carry out the duties related to the planning, establishment, construction and operation of organized industrial zones and industrial regions, as it is required by the legislation; to carry out the work on the planning, selection of site, preparation of construction plans, establishment and operation of organized industrial zones, industrial regions, to issue the decision of public utilities in organized industrial zones and to perform the expropriation for industrial regions, to audit the activities of these, to carry out the relevant work for the removal of industrial sites and industrial enterprises which are already located within the residential areas as well as the removal of industrial enterprises which are located within planned residential areas into planned industrial sites, to grant loans for expenses of transportation,

c) To monitor the implementation results of organized industrial zones and industrial regions,

ç) To organize trainings for the administration and personnel of organized industrial zones and industrial regions, to carry out activities in order to promote regional industrial sites within and outside

the country, to assist them in the provision of potential investors, to provide guidance to other countries with regard to their relevant activities,

d) to support through loans the whole of the project costs (projects necessary for the activities of Organized Industrial Zones) deemed convenient by the Ministry, the whole of the infrastructure costs of industrial sites, and up to 70% of the superstructure costs of the facilities,, to support the construction of administrative and social buildings, lands, costs on acquisition, all the infra and super structure costs including engineering and architecture, to provide interest support mechanisms on the loans to be granted to organized industrial zones by the domestic and foreign resources, to determine and audit the conditions for these support mechanisms,

e) In order to increase the competitiveness of enterprises; to provide support mechanisms, grants for the clusters consisting of companies located in a specific region, though which they cooperate with universities, public administrations and private sector, to monitor such activities and audit them,

f) To carry out other duties assigned by the Minister.

**General Directorate for Development Agencies is the responsible body for coordinating regional development agencies in Turkey.** The duties and responsibilities of this DG give it a broader, cross-cutting policy scope in terms of regional development; DG DA does not undertake activity in those specific fields (including industrial symbiosis).

**General Directorate for Development Agencies ARTICLE 394 –**

Duties and responsibilities of the Directorate General for Development Agencies are:

- a) To perform or commission research and planning studies at regional, provincial and district levels,
- b) To facilitate general coordination among development agencies and perform any other relevant works and processes,
- c) To perform works and studies required to develop policies in order to find solutions for the problems of small and medium-sized enterprises, tradesmen and artisans, as well as rural communities with the purpose of enhancing local employment and entrepreneurship, to advise institutional and legal arrangements and to lead the implementation process,
- d) To identify priority areas and needs for development, to perform necessary activities to ensure rapid development in consideration of the special needs of these areas, to facilitate the coordination in regional development projects, to advise about the topics that fall into its remit and to contact and/or negotiate with international organizations,
- e) To ensure harmonization and integration within the implementation process of the projects and activities of relevant institutions and organizations in order to facilitate regional development efforts,
- f) To fulfill all other duties assigned and/or to be assigned by the Minister.

## 6.2. National Coordinating Body

The national coordinating body for implementation has primary responsibility to oversee and deliver implementation by all delivery partners, acting as the liaison between the Government owner and the activity on the ground. The responsibilities of the national coordinating body include:

### 1. Train delivery teams

The national coordinating body provides a single point of contact to deliver approved training across the delivery teams. Ensure consistency and transfer of best practice between and amongst delivery teams. Enable efficient up-skilling of new practitioners across regions: hold introductory training sessions at a central location 2-3 times per year for all new recruits (training materials are proven and readily available).

### 2. Maintain consistent methodologies, processes and standards across the regions

The national coordinating body ensures comparable processes for replication, efficiency and rapid scale-up of new practitioners & new regions. It provides a detailed audit trail and verification of impacts and coordinates the regional strategies for implementation.

The national coordinating body provides a single point of contact to collect and disseminate regional best practice. Annual organised “get together – work together” sessions for the delivery teams further spread knowledge and foster cooperation.

### 3. Strategic target setting, monitoring and evaluation

The national coordinating body negotiates key performance indicators (KPIs) or targets with the funder/investor and uses data analysis to support delivery on strategic objectives. KPIs could include targets for waste reduction, carbon dioxide equivalent reduction, job creation, cost reduction, additional sales, water reduction and others. The national coordinating body conducts regular reviews, compiling impacts from all regions for reporting to a consistent set of KPIs and calculating value-for-money of investment. The national coordinating body also provides a single point of contact for all regions for compatible impacts reporting.

Once the key aims and objectives of the communication have been established, a strategic approach to deliver these should be outlined by the national coordinating body. During the start-up phase of the programme, and based on the programme’s specific objectives, the strategy is likely to include; establish communications infrastructure for the programme; introduce a variety of communication channels to promote the work and success of the programme; and implement a targeted public relations campaign.

### 4. Advise on recruitment of delivery teams

One of the key success factors of a national industrial symbiosis programme model is a high level of industry engagement and involvement from the outset. An effective way to achieve this is by recruiting programme team members directly from industry. It is this front-line experience and knowledge of what drives industry across a range of sectors, combined with a detailed understanding of specific industry issues, that contribute towards the success of a programme. It is worth considering recruiting team members with experience in the key industry sectors within the geographical area in which the programme will be operating. (job descriptions for national director, regional directors, senior practitioners, practitioners and administrators are included as an appendix to the Roadmap). Such staff may already exist and currently work for OIZs’ or Chambers. National coordination also ensures key skills distribution across teams (for example, not every region needs to have an automotive manufacturing expert as long as all teams across all regions know which

region already has one). The national coordinator can have an overview of the entire network skill set and can advise the regional and local organisations tasked with delivery (delivery bodies) on recruitment.

### **5. Branding & communication**

Establish clear communications aims and objectives, likely to include the following: raise awareness of the programme amongst local industry; illustrate the benefits of the industrial symbiosis approach and the programme; recruit members to the programme; provide support (guidance and material) to the programme delivery team; acknowledge programme funder/sponsor; and acknowledge stakeholder support.

Communicate aims and objectives of the programme across internal and external audiences. Develop, deliver and update consistent marketing material across all regions, which saves each region having to develop their own (and having to access the skills and budget to do so). Some bespoke material may be needed for specific regional activity, but national guidelines ensure consistency.

### **6. National stakeholder engagement**

Lead on stakeholder engagement at the national level with nationally important bodies which can support and contribute to the programme (OSBÜK, TOBB, TÜBİTAK, KOSGEB, Teknoparks and others) for efficient and high-level engagement, bringing legitimacy to the programme and leveraging national networks to add support to regional/local efforts with regional/local practitioners. Work with national government owner to recruit new regions.

### **7. Database management software and licensing**

The national coordinator will maintain the national data management system for use across all delivery regions and ensure consistent usage of database for reporting purposes. A single shared platform fosters cross-regional data sharing for rapid replication of industrial symbiosis opportunities, and enables knowledge sharing of successes across regions between delivery teams. The software platform should provide the following functionalities:

- Capture and characterise resources available for synergies
- Manage and monitor synergies and barriers
- Perform data analysis for active pipeline management and impact reporting.
- Enable internal and external reporting of impacts
- Incorporate big data from public sources to enable quick entry and opportunity identification
- Draw on a library of past successes to ease opportunity identification and replication

### **8. Raise funding/investment**

Impacts delivered through facilitated industrial symbiosis increase over time as the network and opportunities grow; that is, there are typically no diminishing rates of return. Therefore, providing an aggregated set of metrics and value-for-money performance to make the case to national and regional funders for continued programme support is important. Where necessary, allocating national support and expertise amongst regions to achieve the appropriate level of delivery in each region and supplement any regional funds (e.g. from DAs) for industrial symbiosis activity.

## 9. Policy recommendations

Understand environmental legislative issues and industrial processes relevant to achieving synergies. Identify opportunities to improve policy context based on bottom-up feedback from the regions regarding which policies/regulations present barriers to industrial symbiosis

### Recommendation:

*The **National Coordinating Body** should have scope to work across both the OIZs and the Chambers, since in some regions an OIZ will be the lead delivery party and in other regions it will be a Chamber. As such, neither OSBÜK nor TOBB can be tasked with this responsibility alone, as it extends beyond their mandate. One body appropriate experience to coordinate across OIZs (and Free Zones) and Chambers is TÜBITAK-MRC.*

OSBÜK was a candidate for National Coordinating Body due to their close relationship with all OIZs, however not all industry is located within OIZs. OSBÜK is not a government body: the role of OSBÜK is to act as intermediary for the OIZs to Government. Its management board determines its strategy and investment activity, with no external oversight. OIZ management can influence OSBÜK activity via recommendations arising from themed commissions (energy theme, environment theme, etc) populated by OIZ representatives. Recommendations from the commissions are delivered to the technical committee at OSBÜK; however, these are non-binding. OSBÜK is funded through a fee from the OIZs themselves; it does not have financial support from the Government, although there are no restrictions to OSBÜK receiving Government funding.

TOBB was a candidate for National Coordinating Body, given their access to industry. The Union of Chambers and Commodity Exchanges of Turkey (TOBB) was established under Law #5590 on the Chambers, Commodity Exchanges and Union in 1950 which was replaced by the Law #5174 in 2004. TOBB is the highest legal entity in Turkey representing the private sector and has 365 members in the form of local chambers of commerce, industry, commerce and industry, maritime commerce and commodity exchanges. TOBB has a close relationship with industry and commerce, extensive data and sectoral assemblies, and substantial regional presence through its Chambers.

TOBB's functions (that relate/could relate to industrial symbiosis) include but are not limited to:

- To lead and guide Turkish entrepreneurs.
- To submit opinions and comments to the Government in line with the requirements of the private sector.
- To ensure that the small and medium size enterprises (SMEs) which constitute the backbone of the economy, receive their equitable share.
- To prepare more than 10.000 capacity reports per annum upon request of concerned corporate entities.
- To establish the electronic infrastructure in order to standardize the services rendered by chambers and commodity exchanges and to collect data related to our members,



- To offer its members necessary information that may be useful in their commercial, economic and international activities by following developments in science and technology.
- To establish organized industrial regions and technology development centres.
- To prepare reports on country, province and sector basis.
- To establish and maintain the Sectoral Assemblies for comprehensive and accurate identification of sectoral problems, transmission of findings to the Government and their timely finalization.

Both OSBÜK and TOBB have a lot to offer and can offer substantial support in the progression of the Programme. OSBÜK represents the OIZ, but not all industry is located within an OIZ; TOBB represents all the chambers.

TÜBITAK MRC is a prime candidate for National Coordinating Body, given their technical expertise and role as National Cleaner Production Centre. TUBITAK Marmara Research Center (MRC) is one of the organizations in The Scientific and Technological Research Council of Turkey (TUBITAK) which is a leading agency for management, funding and conduct of research in Turkey. MRC aims at becoming a world leader in science and technology production with research, development and innovation capabilities of its seven institutes such as Chemical Technology, Earth and Marine Sciences, Energy, Genetic Engineering and Biotechnology, Food, Materials, and Environment and Cleaner Production. Environment and Cleaner Production Institute (ECPI) develops knowledge and technology for the benefit of society through national and international research and development activities in line with sustainable development goals (SDGs), aiming to fulfil needs in the fields of environmental management, technology and cleaner production. Since 2013, the institute has taken over the responsibility as National Cleaner Production Center for Turkey. The institute currently has 100 employees and 24 laboratories including water and wastewater, wastewater recovery technologies, solid and hazardous wastes, and energy efficiency measurement. Almost 40% of the employees are working in permanent bases. The others are supported through projects financed by ministries and private sector.

### 6.3. National Innovation Partner

The National Innovation Partner supports industrial symbiosis delivery through technology development and technical support. The responsibilities of the National Innovation Partner follow:

- Ensure a team with diverse experience,
- Ensure effective communications (technical discussion fora, partner searching systems),
- Capture innovation related outcomes either in real-time or on a quarterly reporting basis and set targets for delivery,
- Carry out an ambassadorial role for the programme within the national policy agenda surrounding innovation and technology translation,
- Develop access to or the creation of funding mechanisms for commercial research and development projects,
- Take management responsibility to ensure there are no issues around sensitive commercial activity such as intellectual property and confidentiality,
- Develop relevant strategic relationships on a national and international level,

- Co-ordinate nationally strategic innovations and collaborations for greater implementation, and
- Produce strategic reports and contributions to Government.

The innovation to support industrial symbiosis implementation includes:

- Identifying and delivering new or improved products or processes
- Investigation of opportunities to minimise waste at source
- The application of new technologies to make material amenable to higher value-added use, including:
  - new processes that remove inhibitory components, and
  - new products or processes that can use the material.

#### **Recommendation:**

*The **National Innovation Partner** is TÜBİTAK-MRC, also reporting to MoIT, as this activity is clearly aligned with their current responsibilities as a National Cleaner Production Centre (NCPC).*

TÜBİTAK-MRC is the ideal Innovation Partner to the National Coordinating Body and can combine both roles due to its strong research capabilities around innovation in materials, technologies and systems that will provide feasible solutions to the business needs identified by the delivery bodies. TÜBİTAK-MRC provides technical expertise, can perform the technical analyses to determine whether waste is hazardous and supports technology development for intermediate processing of mixed waste. TÜBİTAK-MRC is also able to engage research at universities and Teknoparks as necessary.

In the research area of cleaner production, the potential benefits of resource efficiency in five industrial sectors have been estimated. These sectors are “Manufacture of food products”, “Manufacture of textiles products”, “Manufacture of chemicals and chemical products”, “Manufacture of other non-metallic mineral products”, “Manufacture of basic metal and fabricated metal products”. As part of the project, surveys and onsite visits were carried out in **166 facilities** from mentioned five sectors. The potential has been generalized to whole Turkish Manufacturing Industry by making an estimation for the other 19 industrial sectors. In addition to this project, there are a lot of completed /ongoing projects about determination of cleaner production opportunities and applicability in diverse sectors, recovery of value-added materials from different wastewater sources and life cycle assessment.

The institute conducts R&D projects in order to develop and implement Cleaner Production (CP) technologies in the leading industries such as “food and drink”, “textile”, and “iron and steel” for cleaner production audits and circular economy in Turkey. Also, the institute organize some education regarding Cleaner Production to raise awareness of manufacturing industries, especially SMEs and provide technical support to the industries. Therefore, the institute has a significant role between public enterprises and manufacturing industry to accomplish SDGs of Turkey.

#### **6.4. Delivery Teams**

There may not be a single one-size-fits-all solution for delivery of industrial symbiosis in Turkey. The regions differ substantially in their industry make-up, concentration, and organisation; be they in OIZs, Free Zones, or represented by Chambers.

A regional Hub and Spoke model organised at a full regional scale enables the regional delivery team structure to vary. A single lead body (OIZ, Chamber, or Free Zone) will be identified through a decision-making process facilitated by the DA and provincial Ministry representatives to coordinate other local delivery teams and report the region's progress to the National Coordinating Body. This variable regional structure will require strong support from the national coordinator for uniform performance: management, training and reporting set nationally and implemented regionally via the lead regional body (Hub) can provide the common direction and a consistent message for all delivery teams (Spokes). This structure of the delivery bodies takes in significant industry that lies within OIZs, within Free Zones, or represented by Chambers to maximise opportunity for industrial symbiosis. Where there is more than one OIZ in a region/city, their collaboration must be fostered to avoid competition.

The responsibilities of the Delivery teams follow:

1. **Business engagement:** (workshops, marketing, etc): A successful programme is dependent upon having a diverse and dynamic network of members. It is therefore vital to enlist a significant quantity of 'quality' business members from a varied range of commercial and industrial sectors to the programme in the first 12 months. The recruitment and retention of business members is a continual process and should be reviewed regularly throughout the development of the programme to ensure targets are maintained as is an effective composition of business member types.

There are many methods available to recruit business members. However, in the early stages of implementation, the most effective way to engage businesses is through direct contact with businesses, such as giving presentations to groups of businesses at an event or getting involved in an event organised by another organisation or body. This allows the programme team to fully explain the aims and objectives, and most key, the businesses benefit available to participants. Although the environmental benefits and knock on effect of improved sustainability credentials are a factor in getting businesses involved in the programme, it is the commercial benefit that is most likely to drive a company's participation: the financial savings resulting from reduced costs and additional sales.

2. **Business opportunity workshops:** The synergy workshop is one of the most important elements of programme delivery. It provides an excellent way to engage directly with industry as well as being the starting point in the process of identifying potential synergies between businesses. Synergy workshops are also an effective mechanism for recruiting new business members to a programme. Workshops provide a means to engage with business members so that they remain actively involved in the programme.
3. **Collecting industry data:** Having up-to-date, accurate information on the range of resources available from business members is one of the essential components of any successful industrial symbiosis programme. It is this data that the programme team analyse in order to identify the mutually profitable links between members that will in turn generate synergy matches and ultimately create outputs (benefits). Data can be obtained during face-to-face at workshops or other events, or during a site visit. Using third party data sets is another useful channel of gathering data.
4. **Identify and progress synergies:** it should be noted that opportunities for resource reuse and synergy development are continuously identified through dialogue with business members. As such, the programme team is likely to capture a large amount of resource data in a relatively short time. Therefore, a major challenge for the programme manager and the team is to be able to effectively

manage the process of prioritising the data captured in relation to development of synergies, whilst also managing the expectations and relationships with the business members themselves.

This process of collecting data will provide the programme team with data relating to both sides of the synergy equation. That is, companies that ‘Have’ under-utilised resources to trade, those that ‘Want’ to locate resources as inputs into processes, and those that want to engage in both of these activities. Once the programme team has captured the required data from the emerging network of business network members, it can begin the process of creating matches of these resource ‘Haves’ and ‘Wants’. Synergy management: once the potential match has been identified, the facilitation and progression of the synergy towards delivering the completed outputs follows a typical project management process.

Within 6 months, the team can expect to have data on over 500 resources and over 1000 potential synergies which must be analysed, prioritised and advanced. International Synergies has developed an effective synergy management process with input from practicing programme teams from around the world. This process enables the programme team to monitor the progress of a synergy from initial identification through to completion and dissemination.

5. **Use software:** the team will have to be proficient in the database management software to be able to effectively manage the substantial data collected, and report on timeline and impact in a prompt fashion.
6. **Liaise with relevant regional bodies** (including local PAG): Instigating and recruiting an industry-led programme advisory group (PAG) in the initial stages of a programme can help to build credibility and aid recruitment amongst the wider business community. The PAG acts in a steering capacity; guiding the strategic direction of the programme to ensure that it directly addresses relevant and local industry issues in pursuit of success and impact.
7. **Coordinate with other delivery teams:** sharing of knowledge and replicable synergies across the delivery team network.
8. **Reporting** (metrics, case studies): Reporting and analysing the progress and performance of the industrial symbiosis programme is an important component of successful delivery. The reports generally fall into two distinct categories: external – for the benefit of the programme’s sponsor/funder, stakeholders, PAG and the wider membership; and internal – in order that the programme manager and team are able to monitor progress and performance against targets and objectives.

#### **Recommendation:**

*The regional **Delivery bodies** will need to vary by region based on the concentration of industry and its affiliations (OIZs, Chambers, Free Zones). To allow for this variability while still enabling a coordinated approach, each region will be organised in a hub-and-spoke model. At the hub will be a lead OIZ or Chamber (or Free Zone) appointed by the provincial Ministry representatives (MoIT, MoEU, MoTrade) in consultation with the DA. The hub will appoint a coordinator to liaise with other regional delivery bodies (OIZs, Chambers, Free Zones) and coordinate regional activity, consolidating and reporting to the national coordinator. Suitable personnel are likely already employed by these organisations (as in Eskişehir, where the OIZ and Chamber are actively delivering impressive industrial symbiosis facilitated projects). Existing staff at the OIZs, Chambers and Free Zones with relationships with local industry are good candidates for upskilling to facilitate industrial*



*symbiosis. Outsourcing this work to consultancies will not embed the expertise throughout these organisations (the expertise will continue to reside with the consultants) and consultancies may not naturally collaborate.*

## **6.5. Software/ICT**

The majority of industrial symbiosis opportunities for a given organisation lie outside its own sector; part of the challenge to delivery is accessing information about businesses in other sectors. This market failure of information in relation to resource efficiency can be addressed through mechanisms that improve information flow between actors. Under-pinning the organisational chart is a software tool to perform this function. An assessment was made to identify the best available software on the market today the results of which are presented in the table below:



Table: Comparison of Various Existing ICT Systems to support Industrial Symbiosis<sup>10</sup>

System	Data source		Data included			Matching process					Scope				Supported through facilitation
	User entry	Big data	Site/contact	Resource	GIS	User (passive) match ID	Automatic (active) match ID	Match progression (including barriers)	Outcome	Reporting	Local	Regional	National	International	
Actif	✓		✓	✓	✓	✓					✓	✓	France		
ASPIRE	✓		✓	✓	✓	✓					✓	✓			
By product exchange platform (in Catalan only)	✓		✓	✓ 41 listed		✓					✓	✓ Catalonia	Spain		
C2C	✓		✓	✓		✓					✓	✓	✓	Belgium/ Netherlands	?
iHK-recyclingbourse	✓		✓	✓		✓					✓	✓	Germany		
US Materials Marketplace	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	USA, Turkey	✓
Smile resource exchange	✓		✓	✓		✓					✓	✓	Ireland		✓
SYMBIOSIS	✓	?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Italy		
Simbiosy	✓		✓	✓		✓					✓	✓	Spain		✓
SymbioSys	✓		✓	✓	✓	✓	✓				✓	✓	Spain		✓
SYNERGie® 4.0	✓	✓	✓	Over 74,000 hosted	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓hosting data from over 20 countries	✓ over 27,000 companies

<sup>10</sup> Comparison made on the following criteria: Data source (user entry or big data); data included (site/contact, resource, GIS); matching process (passive, active, outcomes and reporting); and geographic scope (local, regional, national, international). Over 30 systems were reviewed, but only those that showed signs of being active were included in the analysis (systems with no recent activity and those that never progressed beyond beta-testing were excluded).

From the analysis SYNERGie® 4.0 is the clear market leader having been designed specifically to support facilitated industrial symbiosis tools and all organisations involved in delivery and reporting. SYNERGie®4.0 delivers resource database, project management, impact reporting and customer relationship management functionalities, and is proven in practice hosting over 74,000 resources from over 27,000 companies worldwide. Key features of SYNERGie®4.0 include:

- Integrated mapping of resources to prioritise local sourcing and reuse opportunities
- ADVISOR function guides the user to properly characterise resources for re-use and recommends opportunities based on machine learning (artificial intelligence, AI)
- Internal and supply chain Key Performance Indicator reporting aligned with stakeholder requirements (e.g. carbon – important link to INDC, waste, water, additional sales, cost savings, job creation, private sector investment etc.)
- External data set upload for pre-population of the system with local information
- Multiple user access levels differ in the user’s ability to see and edit data
- Secure multi-device app for desktop, iPad or Android tablet
- Developed over 15 years and latest version 4.0 is already being used in 6 countries.

Other programmes are being developed through Horizon 2020 as identified in the above analysis; however, no others have the long track record in practice (or have been specifically designed to support a national programme), hosting thousands of resources and having supported thousands of successful synergies around the world (including Turkey). Already in 2019 SYNERGie®4.0 has been selected for project implementation by the UK and Israeli Governments.

Existing valuable data to help populate the software resides under at least 3 Ministries: the OIZ (under MoIT) and Free Zones (Under Ministry of Trade) already have some responsibility for collecting and treating waste and wastewater, so may have good information on waste arisings and access to the (waste) resources. MoEU holds the waste permit data. Complete information on all waste flows is not required for industrial symbiosis; generic information on production processes can be obtained, and companies motivated to share data once they are convinced of the opportunity.

Turkish Free Zones Legislation **Article 37- (Amended, Official Gazette Nr. 25153 and dated 29.06.2003) dictates that** “The Committee headed by the Zone Director, composed of representatives from the Administrations of Customs and Customs Control, the Ministry of Environment and the Operator or the Zone Founder and Operator (Z.F.O.) shall decide to **remove out of the zone the wastes arising** from zone activities. The containers, packing materials, scraps, household waste residuals and wastes that are found appropriate to be removed out of the zone shall be handed over by the Operator or Z.F.O. to public or private officials responsible for cleaning services under the inspection of the Customs Administration. If these officials demand any fees, the costs shall be borne by the concerned Users.”

**TOBB** industry database and capacity reports could provide a valuable source of data on raw material used (inputs) encoded with the Prodcomm2010 coding system deriving from the NACE coding system.

The **MoEU** sectoral guidelines hold information about sector-based technologies, the wastes produced, and whether they can be reused, and known facilities in Turkey that can handle that waste. This mapping of waste to technologies to sectors can also be coded into SYNERGie®4.0.

**Recommendation:**

*It is recommended that all partners are supported by the world leading **SYNERGie®4.0 ICT** that helps identify industrial symbiosis opportunities (synergies) and captures information for easy impacts reporting and tracking. The National Coordinating Body can make a final decision on the software after evaluation and taking factors into account such as confidentiality and licensing.*

**6.6. Programme Advisory Groups (PAGs)**

The Programme Advisory Group (PAG) provides the mechanism to engage critical stakeholders at a regional or local level. The PAG is a voluntary group that should be comprised principally of business members with an active interest in developing the industrial symbiosis network within the regional/local business community. It is important that committed and enthusiastic business representatives are actively involved and have a desire to see the programme achieve its goals and indeed for their own companies to derive some direct benefit.

The role of the PAG is to:

- Provide critical guidance on their direction and strategy of the programme
- Nominate and elect a chairperson
- Help identify new members for the network
- Act as champions and advocates for the programme within the business community by supporting events, publications and engagement with stakeholders
- Support the regional delivery teams wherever possible

In addition to business members, international experience has shown that other valuable members include representatives from:

- Development Agencies (DAs – presidents, heads of department)
- Cities
- Chambers of Commerce and Industry (Chairmen)
- The regulator (provincial representatives from Ministry of Environment and Urbanization for example)
- Investment support officers (from DAs)
- Local universities (to help identify solutions)
- Sector associations

**Recommendation:**

*The **Regional Programme Advisory Group** ought to include the provincial representatives of all Ministries to ensure alignment with each agenda (productivity, waste movements, etc). Critical stakeholders at a regional/local level such as leading businesses, the DA and sector associations. The regional delivery team would be able to deliver any necessary awareness raising on industrial symbiosis to the PAG.*



*The Ministry of Environment Provincial representatives are particularly important to include on the regional PAG because they manage waste management plans, know the characteristics of waste and can help identify potential resource flows. MoEU approval of usage of by-products is also critical to companies being comfortable making the changes to standard procedure – in essence, giving their blessing to reuse opportunities.*

*The value of the Programme Advisory Groups would be greater at a regional/local level to serve as an effective engagement mechanism bringing local context to the delivery teams, rather than at the national level; however, the establishment of a National Programme Advisory Group is possible.*

## 7. Financial Mechanisms to Deliver Sustainability

The financial mechanism should be set by the government owner, allowing other funding bodies to support and complement the activity (including DAs and KOSGEB). Investment from the public sector is required for the facilitation and software to address market failures including those of information, time poverty of SMEs and the pricing of externalities such as carbon and water. Many industrial symbiosis opportunities identified through facilitation require no investment or a level of investment easily managed by companies themselves. Undoubtedly some of the identified opportunities e.g. major capital projects (such as those funded in the Korean EIP model) may need Government support. These opportunities can be assessed on a case-by-case basis to see if assistance is needed beyond the means of the companies involved.

### 7.1 Ministry Commitment

The Presidential Strategy and Budget Office (SBO) together with Ministry of Treasury and Finance (MoTF) decide on budgetary allocation of Ministries according to the Ministries' annual project portfolio as submitted to SBO and MoTF. The Ministries develop their project portfolio according to the policies set in the National Development Plan, sectoral strategies, and other policy documents that are relevant to and in line with their legislative framework. An allocation for industrial symbiosis programme in the annual public investment plan could be proposed by the government owner (MoIT) to be approved jointly by SBO and MoTF.

### 7.2 Development Agencies (DAs)

DAs are a current but inconsistent source of funding for industrial symbiosis. Many DAs have supported industrial symbiosis in their regions as a policy in their regional development plans. There are 3 funding mechanisms available to the DAs with which to support industrial symbiosis: guided projects, technical assistance and open calls. In the past some DAs have issued open calls with limited responses.

The DAs also are starting a new investment structure: 3 years in duration, with a focus on impact. These guided projects may provide a way to fund delivery teams directly (be they at the OIZ, Free Zones or Chambers) for well-defined (industrial symbiosis) implementation projects. DAs are not seen as a sustainable source of funding this activity as their priorities can change according to the ongoing problems and needs of their regions, and thus may not be able to sustain the investment in industrial symbiosis.

### 7.3 TÜBİTAK-MRC (MRC)

MRC is an independent public institution with a special budget and directly controlled by TÜBİTAK. Acting of MRC staff in any projects should be possible with an official contract. There are two options to go forward the institute's activities in any project. The first one is to transfer an approved/specific budget into MRC ECPI

in the framework of the project. The other option is an official assignment by a public institution such as Ministry of Industry and Technology.

## 8. Consultations

Throughout the consultation process, International Synergies have been assisted by the Project Steering Committee whose members included Ministry of Industry and Technology (MoIT), Ministry of Environment and Urbanisation (MoEU), Development Agencies BEBKA and IZKA, and Ekodenge. International Synergies would like to thank all the consultees, our hosts at the MoIT and the British Embassy in Ankara for their valuable contributions.

Date	Consultations
31May2018	Project steering committee – Ankara
16Oct2018	TOBB (The Union of Chambers and Commodity Exchanges of Turkey) - Ankara
16Oct2018	Ministry of Environment and Urbanisation – Ankara
17Oct2018	OSTIM (Ankara Organised Industrial Zone – Renewable Energy and Environment Technologies Cluster) – Ankara
17Oct2018	Ministry of Science and Technology – DG Industry and Productivity - Ankara
17Oct2018	TTGV Turkish Technology Development Foundation - Ankara
18Oct2018	OSBÜK – Ankara
18Oct2018	Project steering committee – Ankara
Nov2018	TÜBİTAK-MRC – email, Turkey BCSD e-mail
4Dec2018	Ekodenge skype
19,21Dec2018	OSBÜK – email, conference call
17Jan2019	Eskişehir OIZ - Eskişehir
17 Jan 2019	Eskişehir OIZ and Chamber of Industry, Eskişehir Mr. Erhan Tatar- EOIZ Manager Mr. Yavuz Ayva- EOIZ Board Member & chairman of the environmental group (Note: the environmental group is called ESART A.Ş. shareholding of the EOIZ) Suzan Eroğlu Önpeker - Çevre Yüksek Mühendisi (EOIZ) İsmail Öztürk– Eskişehir Chamber of Industry
21 Jan 2019	BEBKA – skype
22 Jan 2019	OSBÜK– Ankara Mr. Serkan ATA, Deputy Secretary General
24 Jan 2019	IZKA – organised workshop (list below)
11,12 Feb 2019	Professor Ban, Director of Chungcheong Eco-Industrial Development Center, Republic of Korea – Birmingham UK

24 Jan 2019, Local Stakeholders Workshop, İzmir - Organisations Represented:

1. Egean Region Chamber of Industry (EBSO)
2. Menemen Plastics Specialized Organized Industrial Zone
3. Manisa Organized Industrial Zone
4. Aliğa Organized Industrial Zone (ALOSBi)
5. Tire Organized Industrial Zone
6. Soma Organized Industrial Zone
7. Turgutlu Organized Industrial Zone
8. İTOB Organized Industrial Zone
9. Pancar Organized Industrial Zone
10. Bağyurdu Organized Industrial Zone
11. Higher Council of Organized Industrial Zones (OSBÜK)
12. İzmir Free Zone Founder and Operator (İZBAŞ)
13. İzmir Chamber of Commerce
14. SMEs Development (KOSGEB) İzmir Office
15. İzmir Development Agency (İZKA)
16. Bursa Eskişehir Bilecik Development Agency (BEBKA)
17. Zafer Development Agency
18. TÜBİTAK MAM
19. Ekodenge
20. Ministry of Industry and Technology
  - DG for Organized Industrial Zones
  - DG for Industry and Productivity
  - DG for Development Agencies
  - İzmir Provincial Directory
21. UK Foreign & Commonwealth Office

## Appendix I: NISP® Job Descriptions (abbreviated)

### Regional Coordinator (reporting to National Coordinator)

#### Principal Accountabilities (Regional Coordinator/Director)

- Inform the development of the goals and objectives of the Programme and identify new opportunities for the programme.
- Monitor and stay abreast of the Programme activities within the regional network, making recommendations for improvement and development where necessary.
- Confer with and represent the Programme in meetings.
- Review and evaluate programme and make recommendations for and execute agreed changes to ensure maximum effective use of resources.
- Assist in developing new business opportunities across the region.
- Assist in developing, researching, compiling and analyzing supporting data for the regional network.
- Perform complex administrative duties requiring oversight, attention to detail and analysis.
- Provide support and advice to other regions to maximise programme efficiencies.
- Develop and maintain close working relationships with local stakeholders, including the Programme Advisory Group.

### Senior Practitioner (reporting to Regional Coordinator)

#### Principal Accountabilities (Senior Practitioner, Delivery Team)

- Delivery of personal outputs and KPIs to defined business targets
  - Assist in defining project KPI
  - Setting of team objectives and targets
- Maintain a balanced network of companies to generate maximum potential for delivery of project objectives.
- Relationship management across companies in all sectors and all sizes.
- Identify business opportunities between companies, leading to financial benefit, and assist practitioner team to maximise their network opportunities.
- Prioritise and manage these opportunities to maximise delivery against project objectives
- Maintain SYNERGie® database to ensure company information is accurate and up to date for;
  - Company details
  - Company contacts
  - Resources
  - Synergies
- Deliver personal and practitioner team monthly and quarterly reports.
- Give presentations to promote the benefits of industrial symbiosis at events such as:
  - Steering meetings (PAG)
  - Events
  - Company meetings
- Lead in the delivery of workshops (as part of the project team), including;
  - Planning and recruitment

- Facilitation of tables
- Presenting
- Post workshop data input and report generation

**General**

- Carry out other duties as required by Project team management.
- Travel as necessary to deliver requirements of the role.
- Deputise for other Project team staff as and when required.

**Practitioner (reporting to Senior Practitioner or Regional Coordinator)**

**Principal Accountabilities (Practitioner on Delivery Team)**

- Delivery of personal outputs and KPIs to defined business targets
- Build a balanced network of companies to generate maximum potential for delivery of project objectives.
- Relationship management across companies in all sectors and all sizes.
- Identify business opportunities between companies, leading to financial benefit.
- Prioritise and manage these opportunities to maximise delivery against project objectives
- Maintain project database to ensure company information is accurate and up to date for;
  - Company details
  - Company contacts
  - Resources
  - Synergies
- Deliver personal monthly and quarterly reports.
- Give presentations to promote the benefits of industrial symbiosis at events such as:
  - Steering meetings (PAG)
  - Events
  - Company meetings
- Deliver workshops as part of the project team including:
  - Planning and recruitment
  - Facilitation of tables
  - Presenting
  - Post workshop data input and report generation

**General**

- Carry out other duties as required by Project team management.
- Travel as necessary to deliver requirements of the role.
- Contribute to progress reports as required.
- Deputise for other Project team staff as and when required.

**Administrative support (to regional delivery team)**

**Principal Accountabilities (Administrative support)**

General Office Duties (Optional depending on regional set up)

- Opening and distributing post

- Responsible for ordering office supplies and purchase orders
- Responsible for booking meeting rooms
- Arranging refreshments for meetings
- Arranging couriers
- Assisting with facilities maintenance; Courier services, phone lines, photocopiers and printers
- Greeting visitors

#### Admin duties for NISP team

- Collating info for Monthly, Quarterly and Annual Reports
- Typing up visit reports
- Data entry onto the SYNERGie® platform (full training will be given)
- Booking hotel accommodation
- Making travel arrangements - booking trains/flights etc.
- Admin / ad-hoc requests from team
- Distributing Publications via a distribution list
- Completing Expenses for team members
- Taking minutes - team meetings
- Assisting with the planning and organising events/conferences
- General admin duties including filing, typing, photocopying

## Appendix II: Synergy Activities Implemented in Eskişehir OIZ

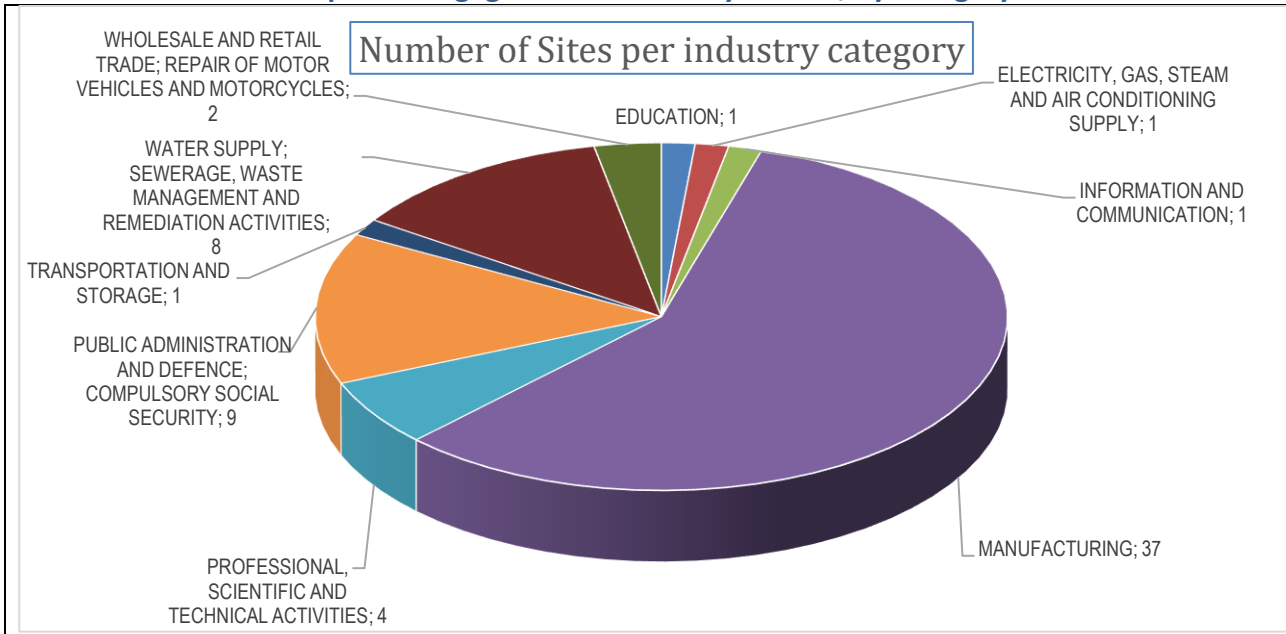
Eskişehir OIZ and Eskişehir Chamber of Industry have been delivering various industrial symbiosis projects. On one such project, International Synergies partners with Eskişehir OIZ and Eskişehir Chamber of Industry in a Horizon-2020 funded project SHAREBOX<sup>11</sup> (Grant Number 680843) to develop the next generation ICT to support industrial symbiosis. The project began with implementation of NISP® style facilitated workshop and SYNERGie® software in Eskişehir to engage businesses. Workshop support was provided by BEBKA and TTGV. Details are provided in the Appendix.

The industrial symbiosis results presented for Eskişehir are the result of activities funded by H2020 project SHAREBOX (2015-2019). Facilitation is delivered by part time staff at the Eskişehir OIZ and the Eskişehir Chamber of Industry. Workshops have been delivered in conjunction with BEBKA and TTGV as part of this 4-year programme of activity. Analyses are extracted from SYNERGie® software reporting function.

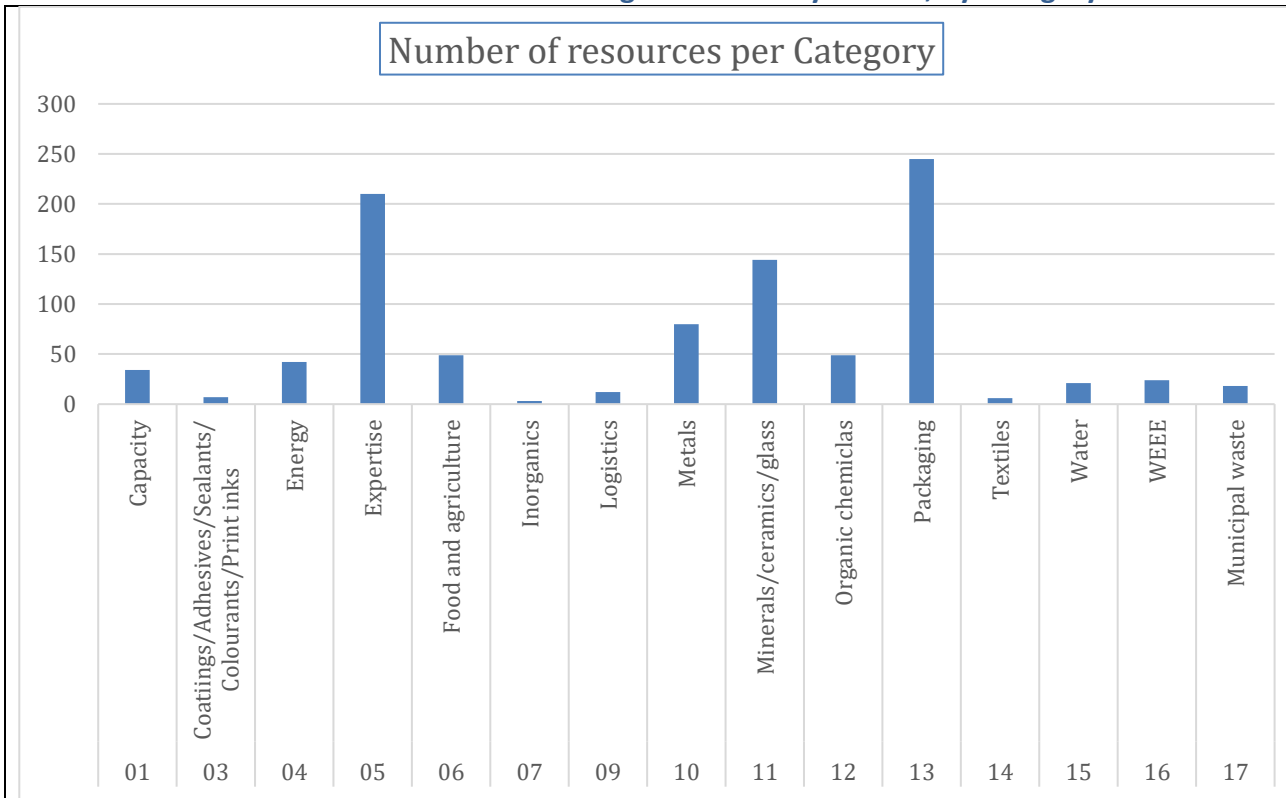
- Sixty four individual company sites have engaged: their sectoral distribution is illustrated below in Table 1. The majority (37 of 64) are from the manufacturing sector.
- Information on 944 resources was captured: their distribution across category is illustrated in Table 2. Packaging is the most reported resource.

<sup>11</sup> For more information please visit the project website <http://sharebox-project.eu/>

**Table II.1- Eskisehir Companies Engaged in Industrial Symbiosis, by Category**



**Table II.2- Eskisehir Resources Identified through Industrial Symbiosis, by Category**





**International Synergies**  
industrial ecology solutions

Should you have any enquiries regarding our report, please contact International Synergies Limited using the details below:

**Contact person:**  
**Email:**  
**Website address:**

Mr. Peter Laybourn  
[peter.laybourn@international-synergies.com](mailto:peter.laybourn@international-synergies.com)  
[www.international-synergies.com](http://www.international-synergies.com)