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Simbiosis Industrial: Su relación con la economía circular y sus beneficios económicos, sociales y medios ambientales

IRIS TECHNOLOGY GROUP

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Contents

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Part 1 – Introduction to Industrial Symbiosis and status quo

Policy background

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The Business of Circular Economy

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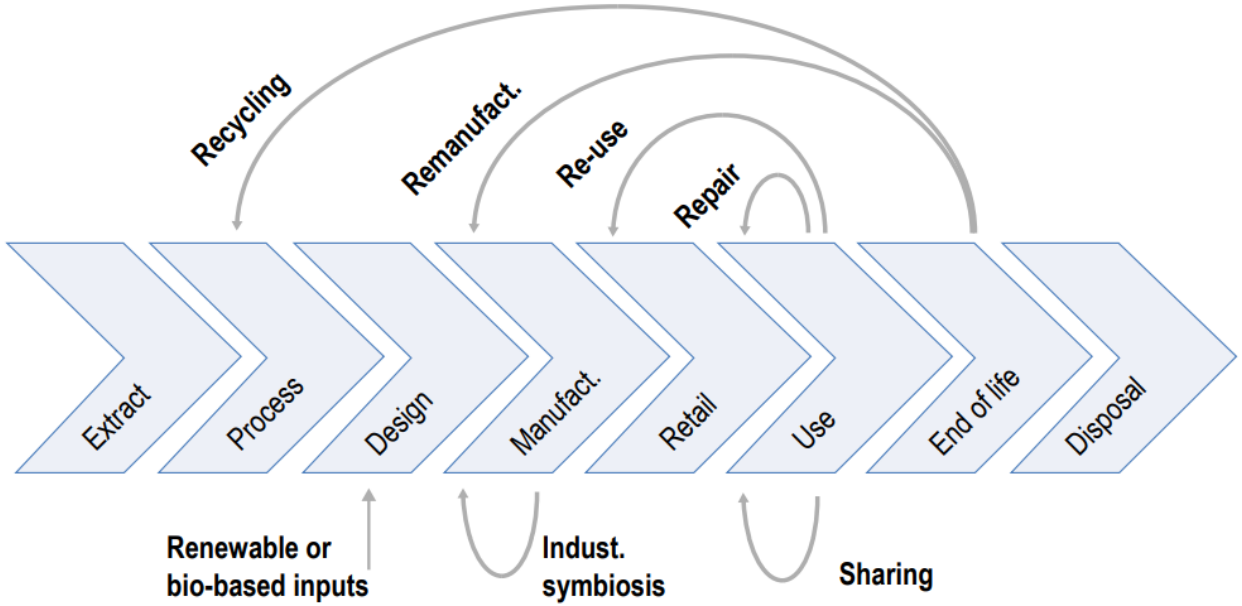
- **Commercial Opportunity**: $4.5 Trillion by 2030 (Accenture, 2015)
- **Business Threat**: 40% of S&P500 may go out of business by 2030 (SAP, 2016)
- **Competitive Advantage**: Early adopters will outperform competition (SAP, 2016)

Circular Economy Core Strategies (OECD, 2019):

1. Close supply chains (recycle, reuse, remanufacture, repair)
2. Sell your waste (Industrial Symbiosis)
3. Share your resources (e.g. utilities, facilities, etc.)
4. Increase resource and energy efficiency through renewable sources
5. Extend product/asset useful life (inspection & maintenance)



Industrial Symbiosis: The Basics

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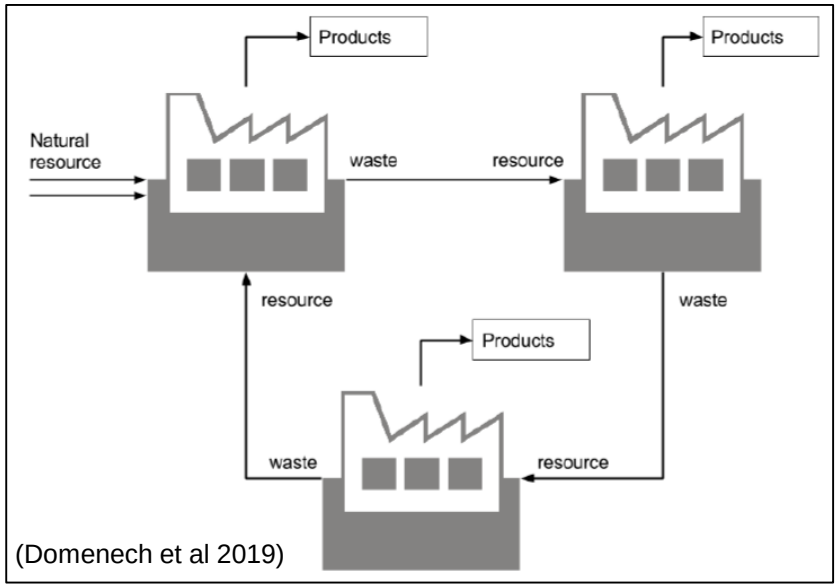
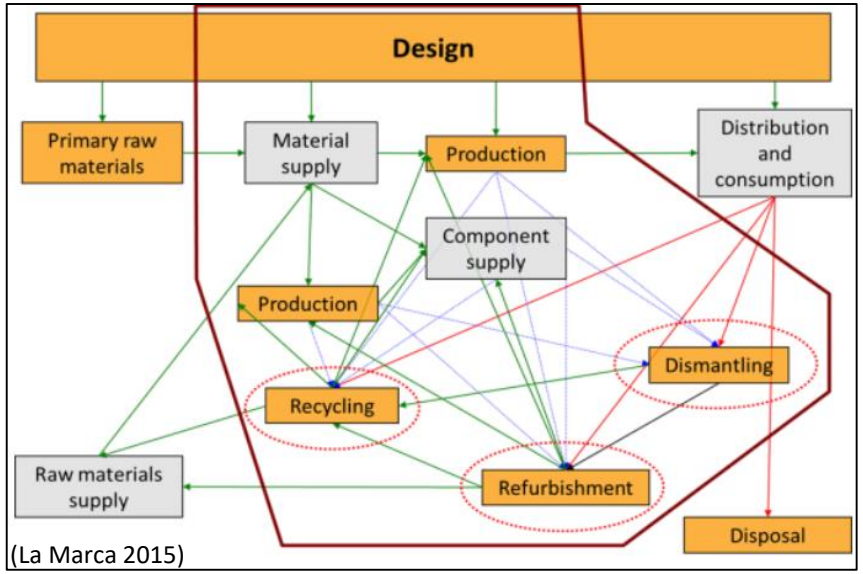
TENTATIVE DEFINITION: A ***B2B commercial strategy*** *according to which industries seek to engage in business with each other using their* ***non-products and other excess resources.***



(Domenech et al 2019)

KEY TERMS AND CONCEPTS:

1. **Synergy**: The sharing of a single byproduct/waste/resource between industries
2. **Symbiotic Network (ISN)**: A group of industries engaging systematically in synergies
3. **Eco-industrial park**: A special case of ISN where all sites are co-located in the same industrial área
4. **Facilitator:** A 3rd party that intermediates between companies and stakeholders to help identify and materialize IS opportunities.
5. **Key Enabling Technologies:** Key technologies that enable IS to happen by addressing technical aspects (i.e. resource conversion, storage and transport) or business aspects (i.e. opportunity identification, evaluation and matchmaking)



(La Marca 2015)

Types of Industrial Symbiosis

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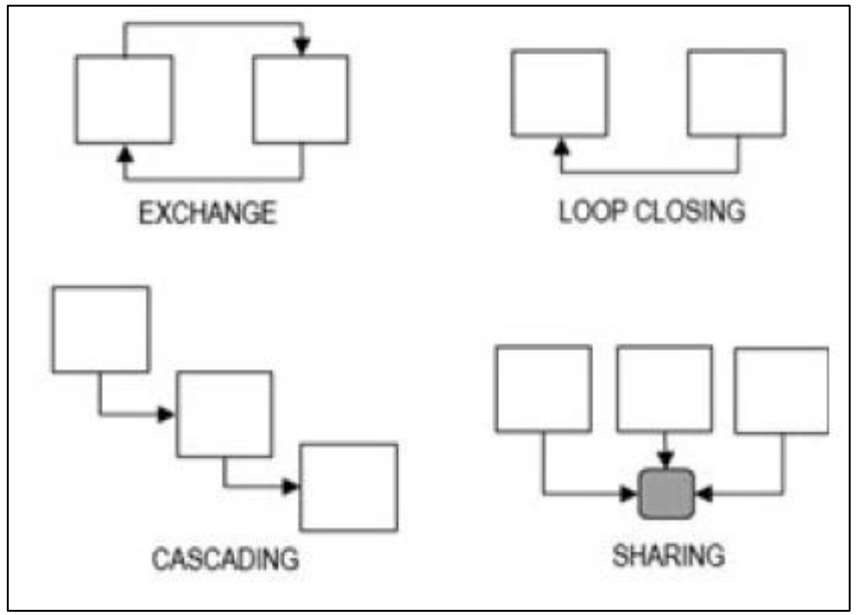
TYPES OF SYMBIOSIS

Waste/byproduct synergies - the commercial exchange of waste materials between two or more parties for use as raw materials.

Utility/infrastructure sharing - the pooled use and management of resources such as energy, water, and wastewater.

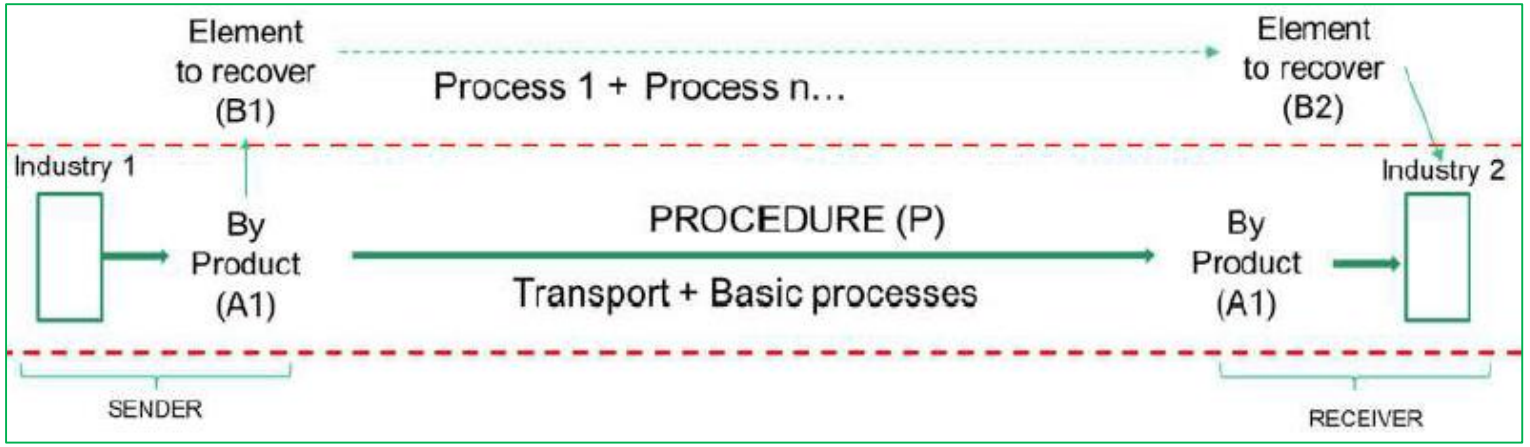
Joint provision of services - the pooled use and management of resources for ancillary activities (e.g. transportation, catering, etc.).



TYPES OF WASTE SYNERGIES:

Direct synergies where waste streams of one industry are directly used by another, with little processing (mainly packaging and logistics).

Indirect synergies where waste streams require significant treatment (e.g. extraction, separation, purification) before they can be used.



Types of Symbiotic Networks

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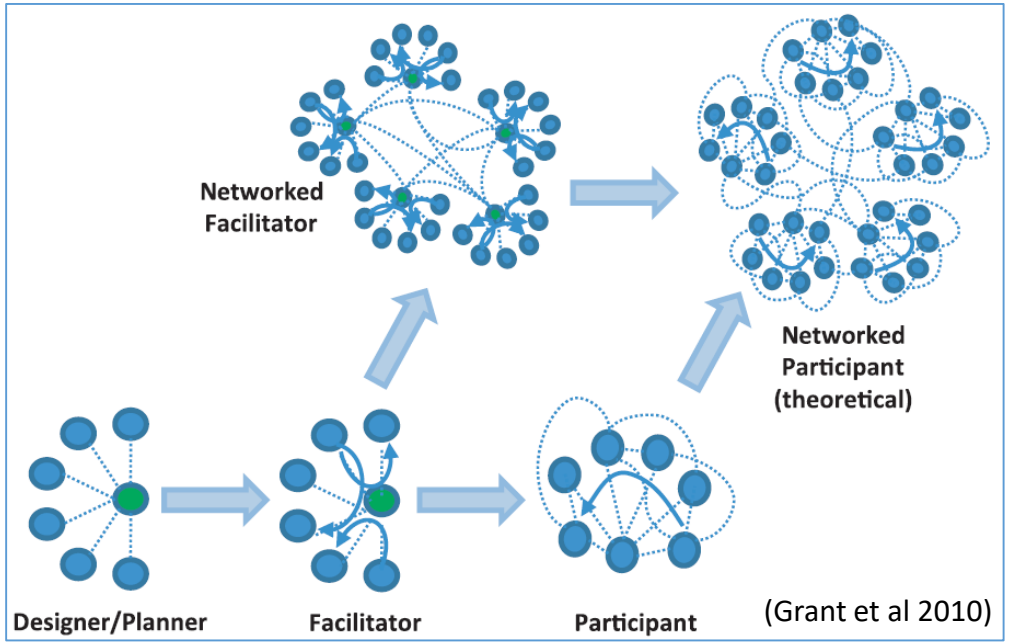
TYPES OF SYMBIOTIC NETWORKS:

1. **Self-organized networks** are formed without conscious strategic planning and without awareness of the overall network structure
2. **Planned networks** is a top-down approach where a governmental body dictates the type of synergies, industries and the network structure.
3. **Facilitated networks**: The uncovering and/or nurturing of symbiotic practices between companies from third parties



(Grant et al 2010)

SYMBIOSIS PROJECT LIFECYCLE STAGES

IDENTIFICATION	ASSESMENT	BARRIER REMOVAL	IMPLEMENTATION	FOLLOW UP
» IT-enabled » Facilitated Workshops » Input-output Mapping	» Technical feasibility » Technoeconomic study » Regulatory screening » Cost-Benefit analysis » ROI Analysis » Environmental Assessment » Socioeconomic Assessment	» Access to funding » Lobbying authorities » Provision of technical expertise » Business (contractual) advise » Stakeholder coordination » Project Management » Training & capacity building » Permitting	» Permit acquisition » Project execution - Engineering - Procurement - Construction	» Auditing » Monitoring » Evaluation » Maintenance » Improvement » Dissemination » Replication

Geographic scope of Symbiosis

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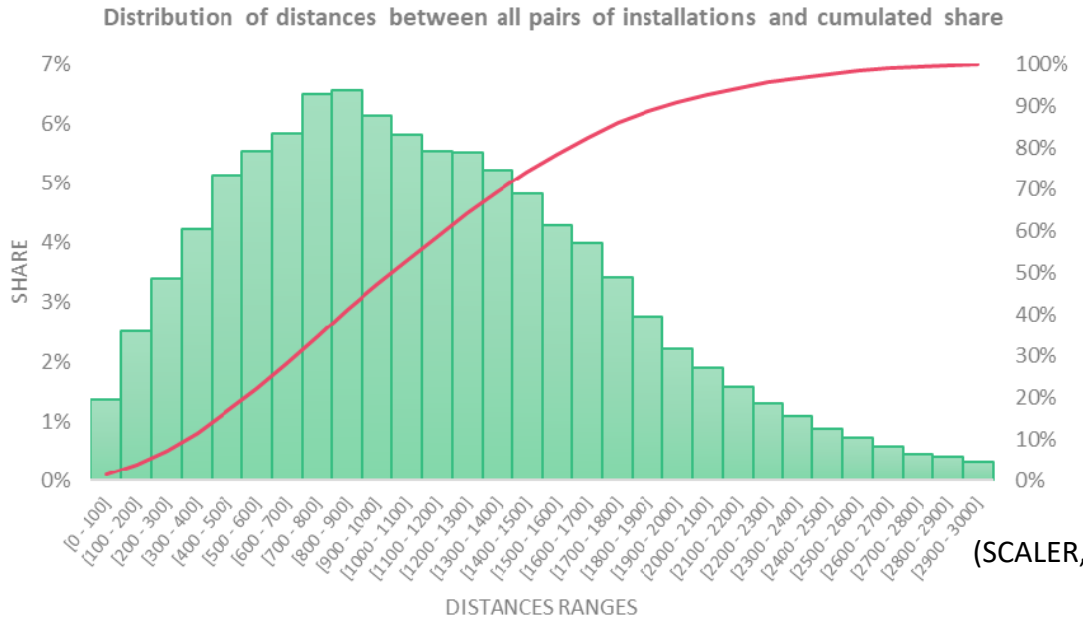
Different types of resources suggest different geographical scopes depending on:

a) The type of waste stream and its physical and chemical characteristics;

b) The value of the waste stream and

c) The geographical distribution of resource recovery facilities.



(SCALER, 2020

Approx. 75% of synergies take place in a 120km radius but they can reach up to 3000km

Local scope: Steam and waste heat exchanges (due to heat losses)

Regional scope: Bulky low value waste, such as construction and demolition (C&D) waste and common metals such as steel and aluminium

International scope: low volume high value resources, such as cobalt and other valuable and scarce metals and minerals

Local	Regional	National / International
Energy CHP Steam Heat C&D waste Green / Food waste	Fly ash Metal and metal products Some mineral waste oil	Fly ash Critical materials (rare earths, critical metals) RDF (negative cost)

(Domenech et al 2019)

Industrial Density & Eco-Industrial Parks

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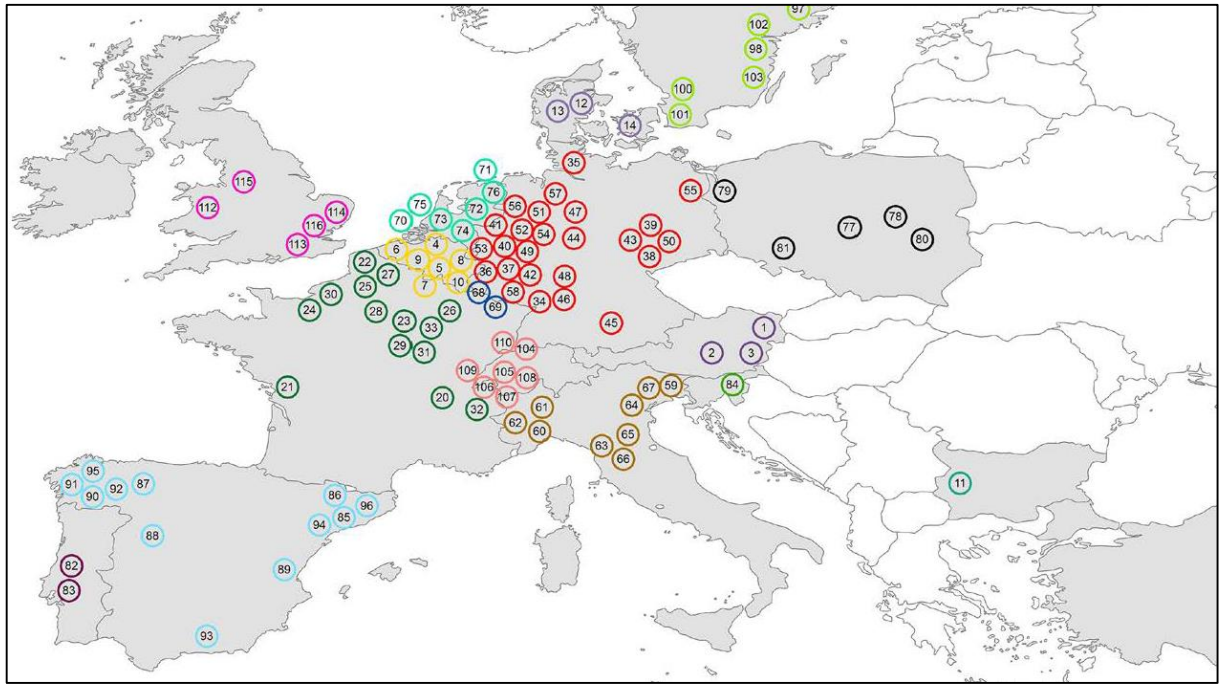
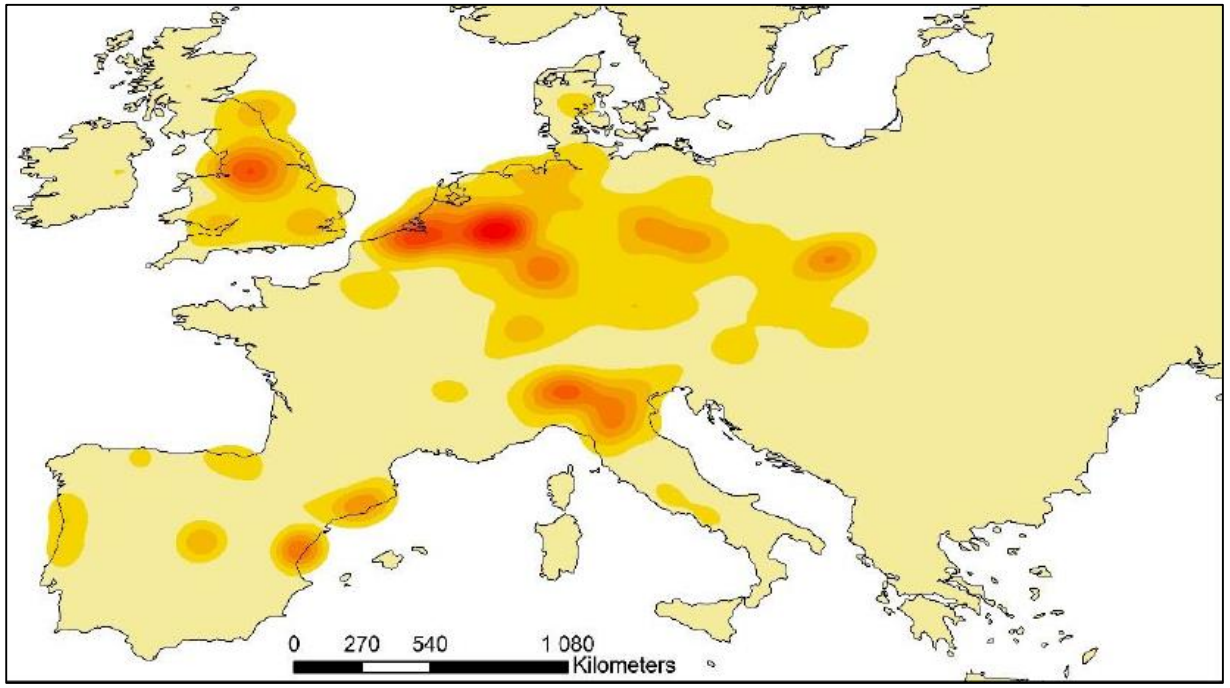


(Eco-Innovera, 2014)



(World Bank Group, 2016)

Waste management	109	51%
Energy efficiency	106	50%
Industrial symbiosis	95	45%
Resource efficiency	75	35%
Renewable enegry	74	35%
Water management	70	33%

Example: Linkoping Industrial Symbiosis

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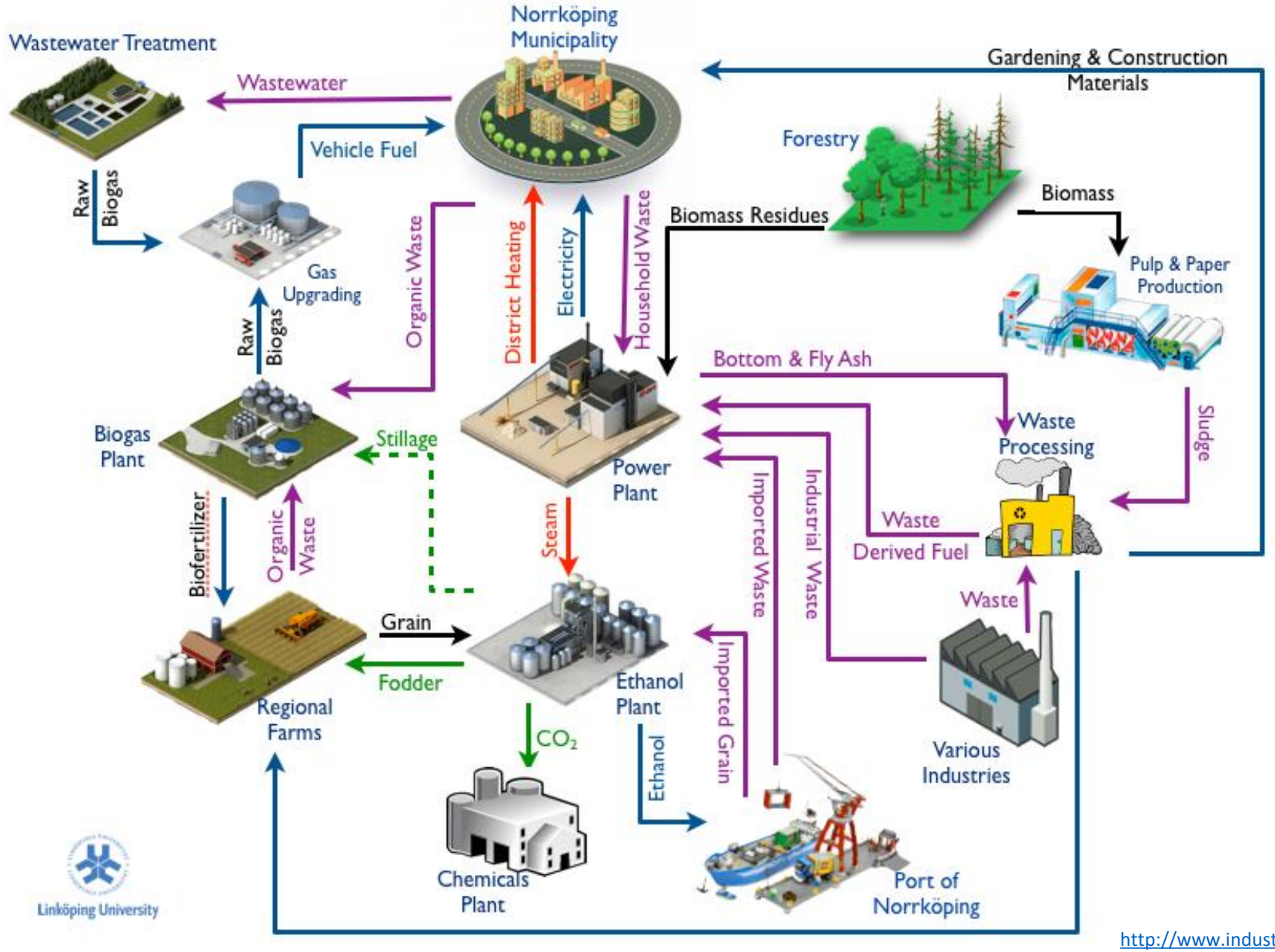

http://www.industriellekologi.se/symbiosis/norrkoping.html

Historical development

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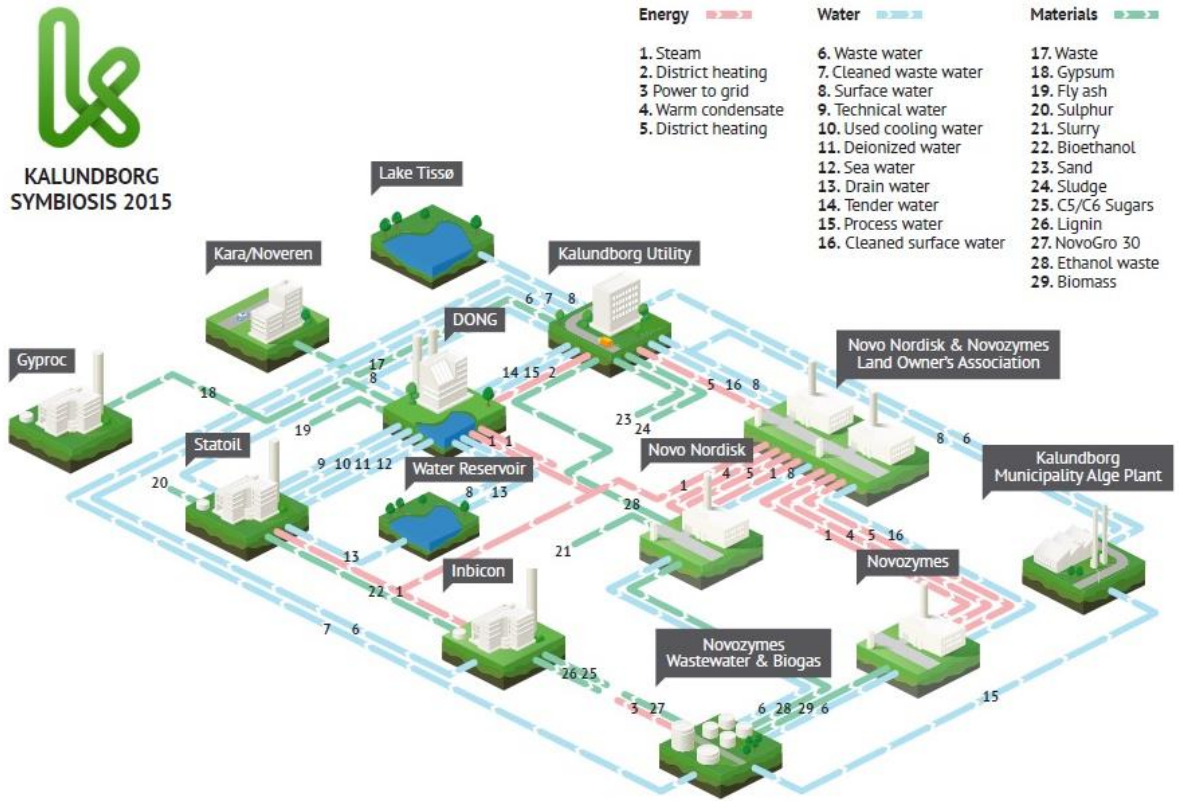
A little bit of history: 1989 – A key year for Industrial Symbiosis

- **Frosch & Gallopoulos of General Motors** publish an artilce where they define the ***Industrial Ecosystem****: "In such a system… the effluents of one process… serve as the raw material for another process…"*
- The label "industrial symbiosis" is applied to **Kalundborg** by Inge Christensen, a pharmacist, and her husband, Valdemar Christensen, the Kalundborg power plant manager, to describe what was happening in the industrial ecosystem

Case study: Denmark - Kalundborg (2015)

- 29 exchanges of water, energy and other by-products between 10 sites
- 3 million cubic metres of water saved
- 150,000 tons of yeast replaces 70% of soy protein in feed mix for more than 800,000 pigs
- $15 million collective annual savings across firms in the park.
- 250,000 tons per year in CO2 savings
- 30% savings in overall water consumption



Historical development

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What happened in the 90s?

- Industrial Ecology was established as a research field (1992)
- The Journal of Industrial Ecology was launched (1997)
- *Several "planned Industrial Symbiosis" attempts were made in the USA and Europe with equivocal results*
- *The concept is limited to academia with little to no impact in policies and business/industrial practices*

<u>2000 – 2010: UK National Industrial Symbiosis Programme:</u>

1. UK Government funds NISP with €100 Million to deliver nationwide facilitated symbiosis over 10 year period
2. **The programme exceeds expectations** (2005 to 2013):
    1. 12,500 members (90% SMEs)
    2. 47 million tonnes of landfill diversion
    3. 42 million tonnes of CO2 reduction
    4. 45 million tonnes of materials recovered and reused
    5. €1.3 Billion in cost-savings
    6. €1.3 Billion in additional sales
    7. 10,000 jobs generated.
3. 2013: Despite its success the programme is ceased due to budget cuts

Industrial Symbiosis: Today

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KEY FIGURES:

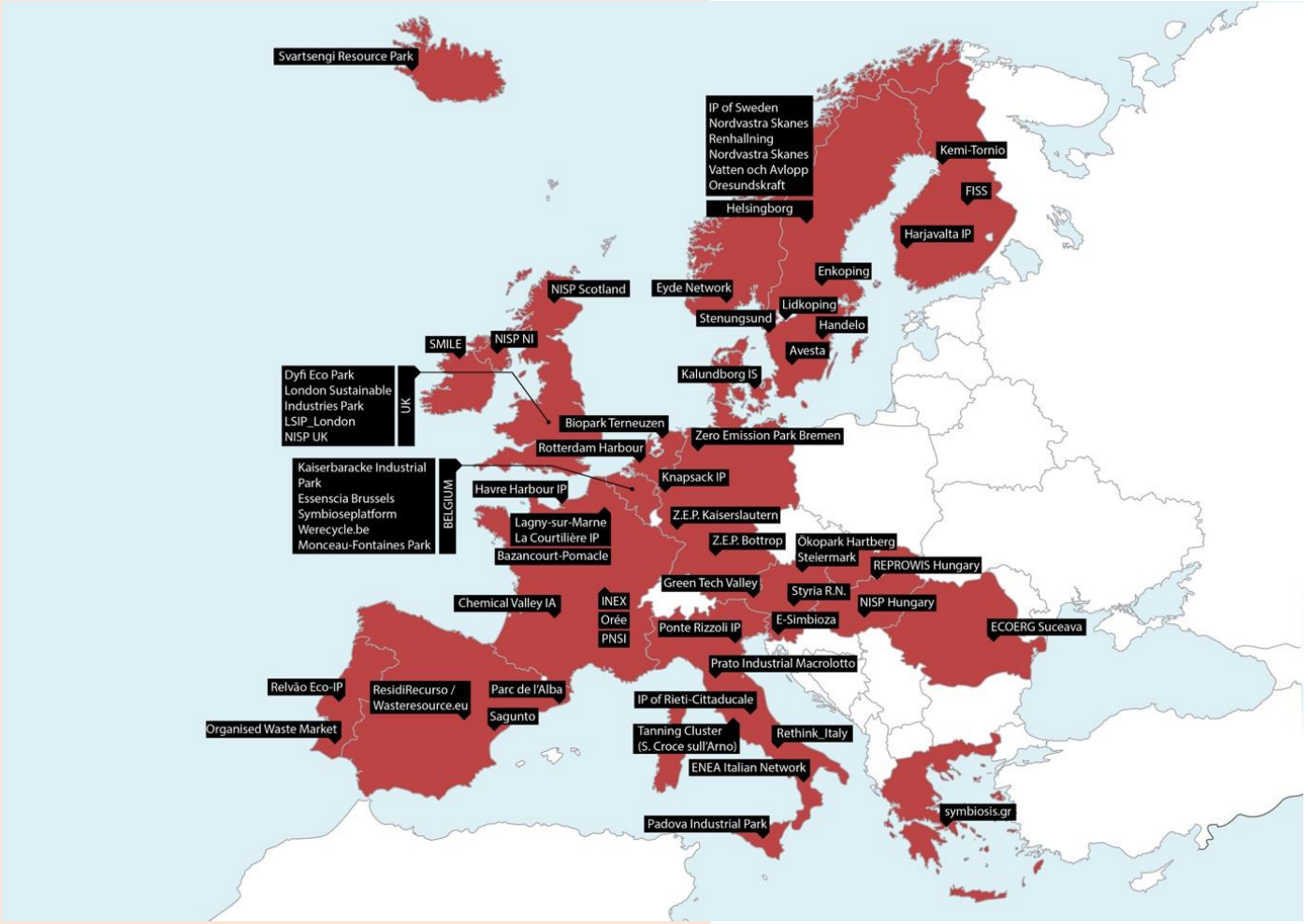
EU investment in Circular Economy (2012-2020):
> €700 Million (excl. national investments)

EU investment in Symbiosis (2014-2020):
> €200 Million (excl. national investments)

>100 projects and programmes across Europe

Nr of Eco-industrial parks in Europe (2016):
116 (DE-25, FR-14, ES-12, IT-9)

Nr of Eco-industrial parks globally (2016):
300 in 27 countries (CH-13, USA-11)



(Sommer 2019)

Benefits and Drivers

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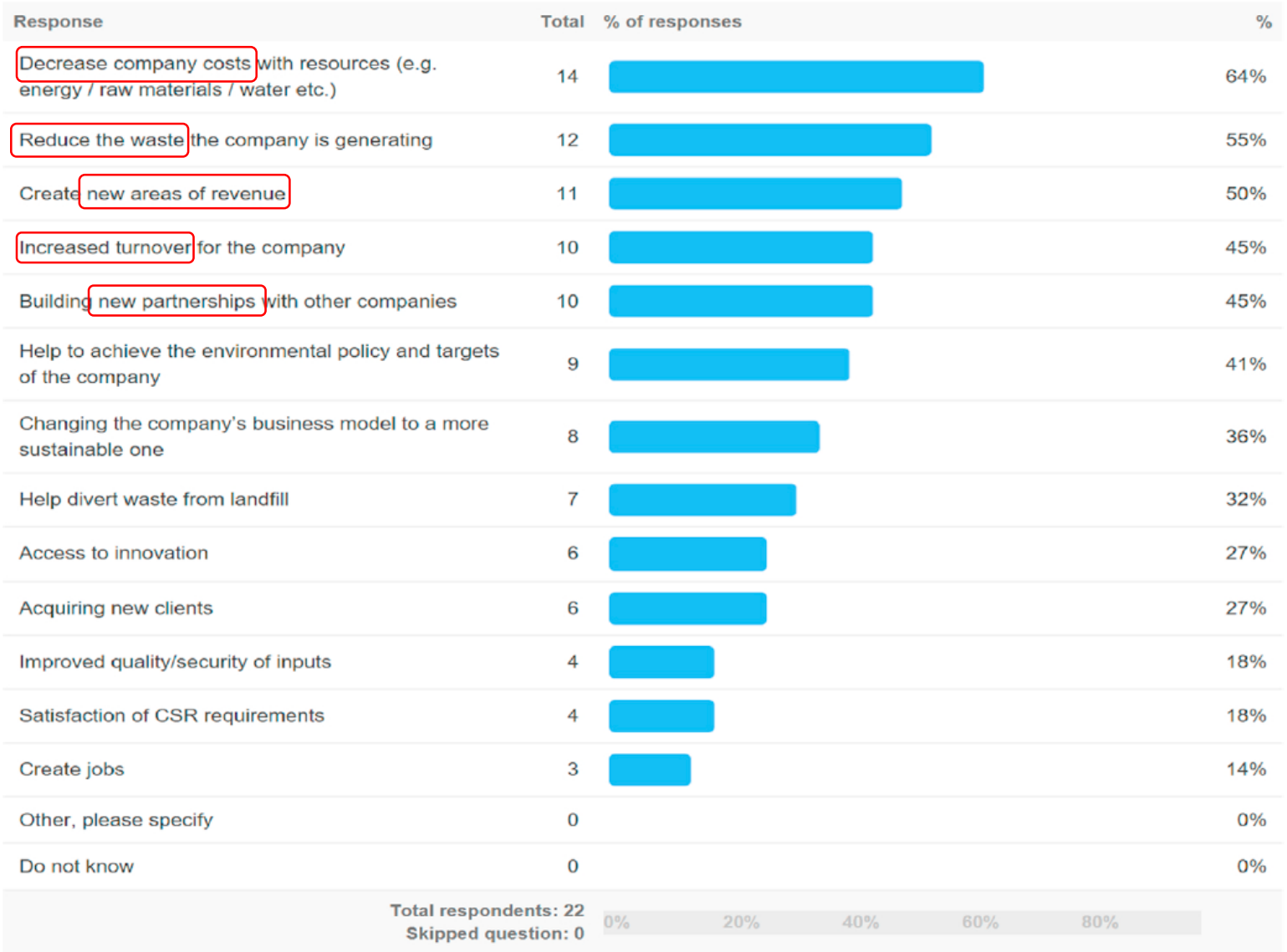
WHY:

- ***To minimize environmental impact*** (resource extraction, waste disposal, pollution)
- ***To increase value added per unit of resource*** (avoiding waste disposal costs, creating new revenues)
- **To improve supply-side resilience** (decreasing raw material costs, diversifying supply chain)
- ***To increase local economic activity per unit of resource*** (adding new Jobs and generating local investments)



Response	Total	% of responses	%
Decrease company costs with resources (e.g. energy / raw materials / water etc.)	14		64%
Reduce the waste the company is generating	12		55%
Create new areas of revenue	11		50%
Increased turnover for the company	10		45%
Building new partnerships with other companies	10		45%
Help to achieve the environmental policy and targets of the company	9		41%
Changing the company's business model to a more sustainable one	8		36%
Help divert waste from landfill	7		32%
Access to innovation	6		27%
Acquiring new clients	6		27%
Improved quality/security of inputs	4		18%
Satisfaction of CSR requirements	4		18%
Create jobs	3		14%
Other, please specify	0		0%
Do not know	0		0%
Total respondents: 22 Skipped question: 0		0% 20% 40% 60% 80%	

(Domenech et al 2019)

Potential of IS in Europe

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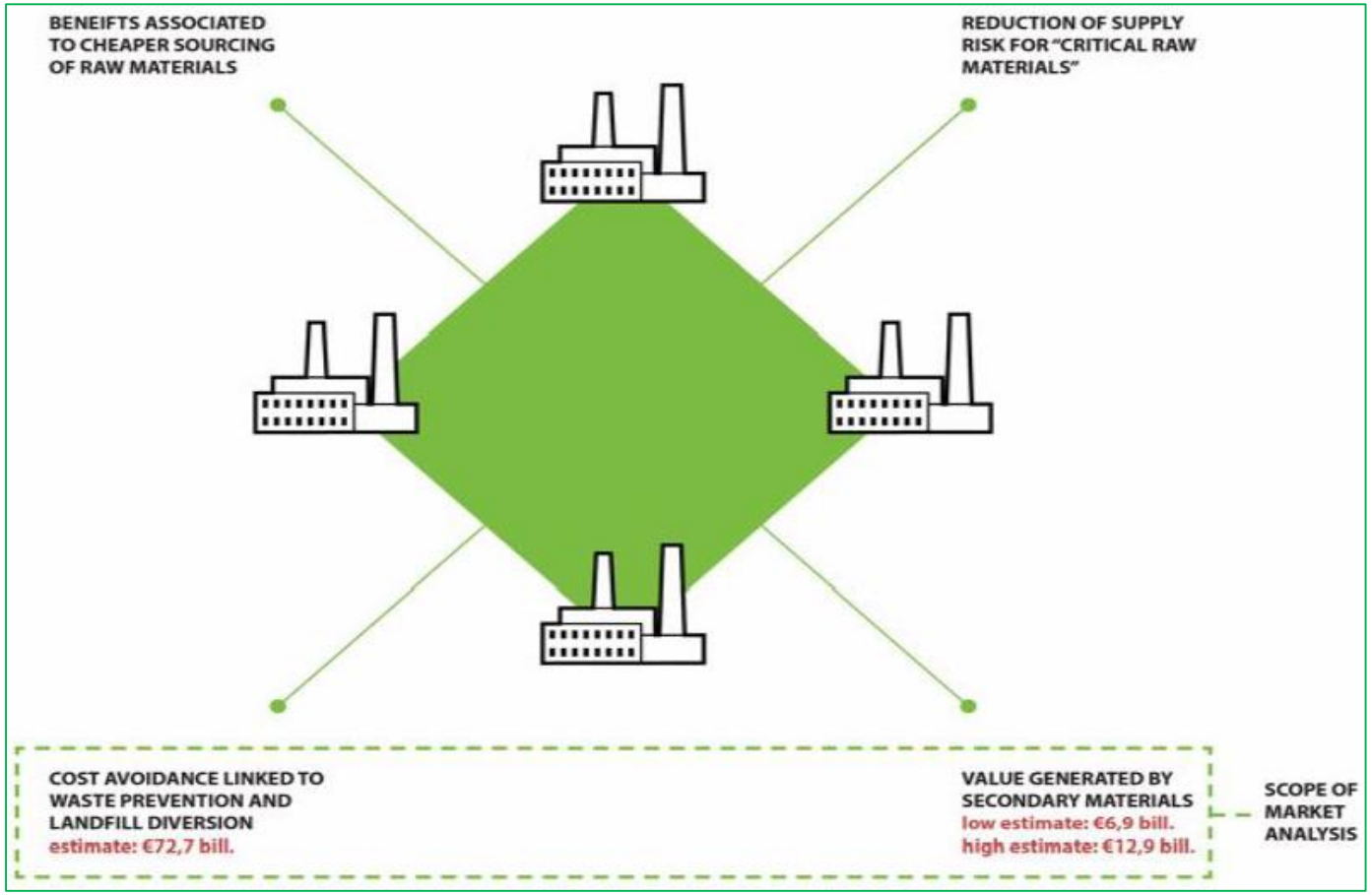
Socio-economic indicators	
VA	33 513 576 237 €
VAT	7 192 013 460 €
Labour Share (€/y)	15 416 245 069 €
Direct jobs (number)	349 805
Indirect jobs (min)	174 902
Indirect jobs (max)	1 056 410
Total investment in EU	69 857 153 732
External impacts	
Climate change (kg. CO2-eq)	-188 673 037 706
Human health (DALY)	-169 762
Ecosystem quality (PDF.m2.y)	-42 398 542 668
Use of resources (MJ)	-3 139 168 587 042
€ Climate change	15 093 843 016 €
€ DALY	12 562 422 781 €
€ Ecosystem quality	59 357 959 735 €
€ Use of resources	12 556 674 348 €
Sum of external impacts economic value (€)	99 570 899 881 €
Carbon tax evolution (€/y)	-7 546 141 073 914 €
	-
Waste tax balance	-2 239 623 012 318 €
Waste treatment costs balance (€/y)	-41 144 034 496 €



Potential savings from landfill diversion in Europe: €72.7 Billion
Potential for additional sales in Europe: €6.9 – €12.9 Billion

(SCALER project 2019)

(Domenech et al 2018)

Potential of IS: Waste streams

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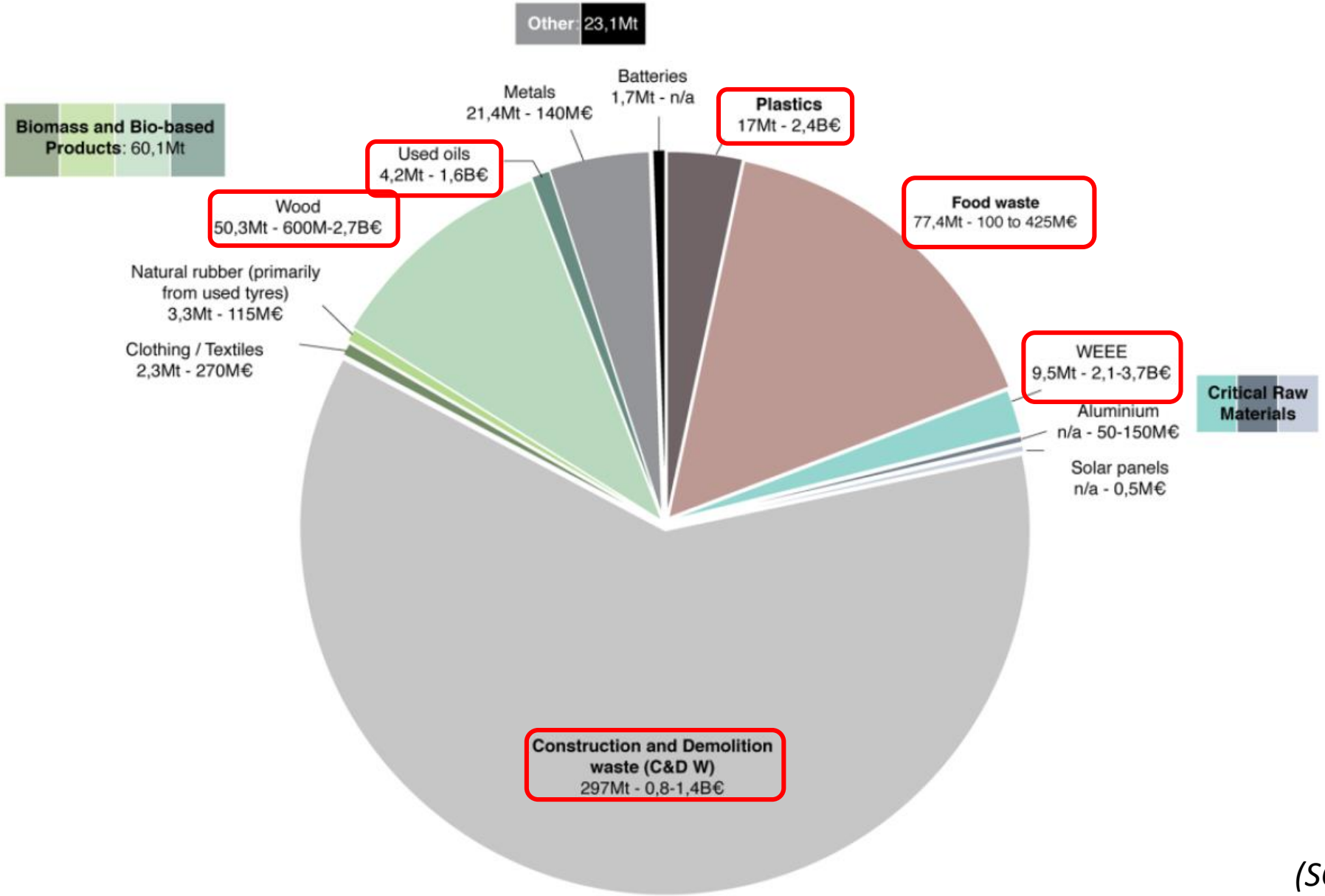

(SCALER Project, 2019)

Industrial Symbiosis Barriers

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Types of barriers for IS

Technical – Sometimes synergies are not posible due to technical reasons

Economic – IS requires investment in time and resources

Informational – Companies lack info on other companies´ byproducts or needs

Organizational – Lack of trust between companies

Regulatory – Limitations in handling material characterised as waste

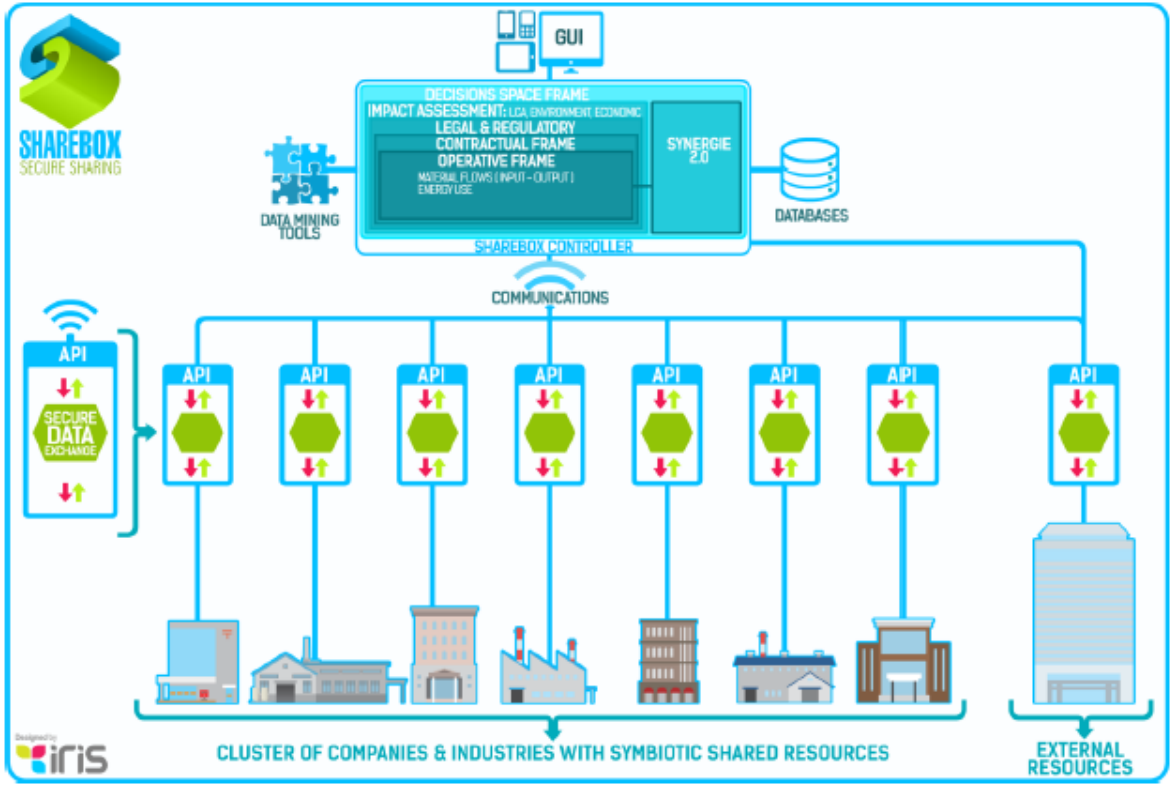
Risk & Uncertainty – IS is still considered unknown and unfamiliar to professionals

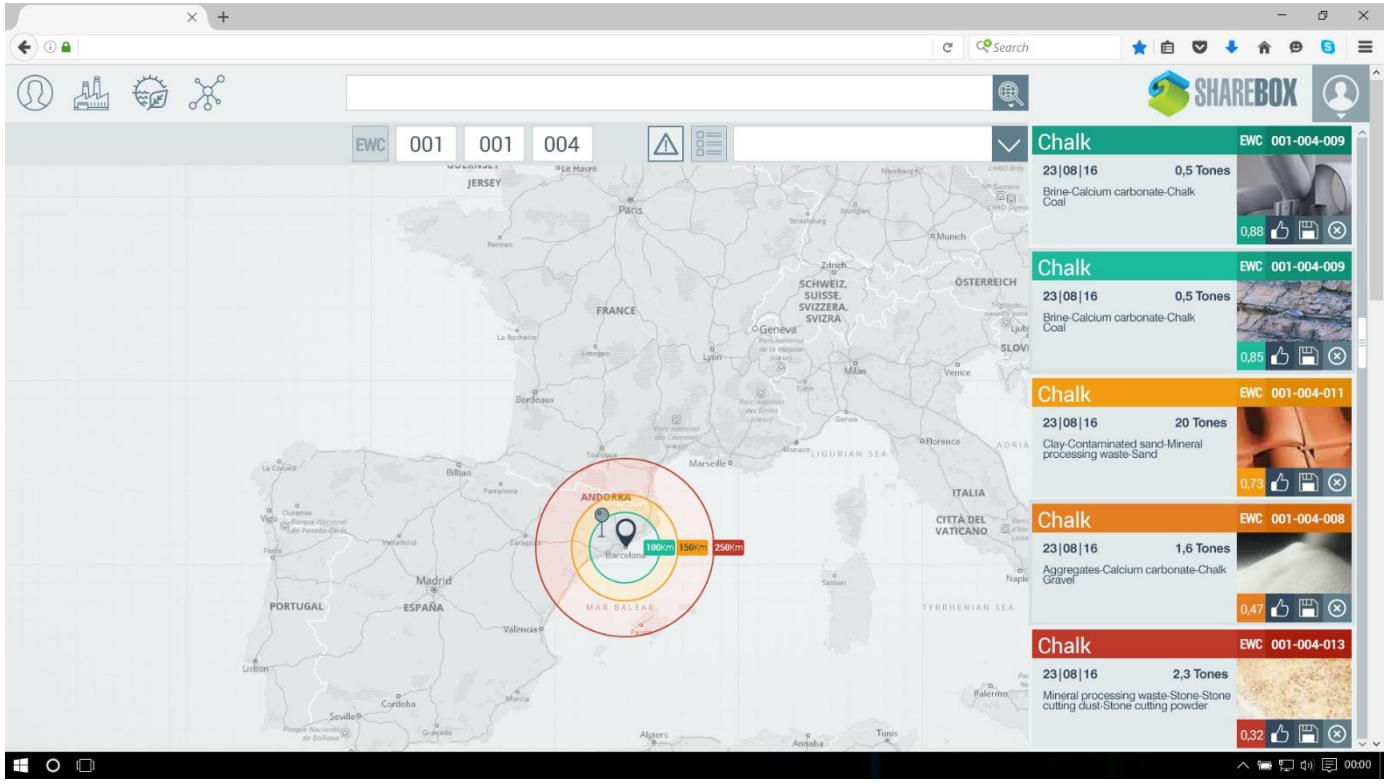
Response	Total	% of responses	%
Risk and uncertainty linked to difficulty to identify costs-benefits and return on investment ex-ante	14		64%
Lack of time	12		55%
Logistics: high transport costs and dispersed production sites	9		41%
Other, please specify	8		36%
Too high costs of the needs for the changes in procedures or processes implied by IS transactions.	8		36%
Lack of technical capacity and expertise	8		36%
Not enough information	7		32%
Transactional costs (negotiation costs)	5		23%
Upfront costs for participating in IS networks or transactions (e.g. membership fees, pay-per service fees)	4		18%
Difficulty to assign benefits among parts, once the transaction has been successfully implemented	4		18%
Storage space	4		18%
Other organisational barriers [please specify]:	2		9%
Do not know	0		0%

SHAREBOX project

This project is funded by the European Union

- **Duration:** 4 years (Sep 2015 – Aug 2019)
- **Consortium:** 16 partners (including 4 industrial clusters, 6 universities, 1 industrial association)
- **Budget:** €6 Million
- **Output:** A smart online platform for sharing byproducts and resources integrating intelligent decision support tools for managing existing synergies and AI-based identification/matchmaking of new cross-sectorial interactions





SHAREBOX project

This project is funded by the European Union

In the context of Sharebox we invited companies to facilitated workshops where potential synergies were identified, some of which were materialized.

Impact based on 26 active synergies as of December 2018:

Indicator	Impact at M48
Global Warming Potential	1.380.000 tonnes
Total material consumption	635,500 tonnes of virgin resources saved
Waste avoided	515,500 tonnes
Additional sales	€53.850.000
Cost savings	€14.120.000
Private investment generated	€4.450.000
Job creation	74 new jobs

Project leverage factor: 11€ generated for every € invested by the European Commission

INCUBIS project

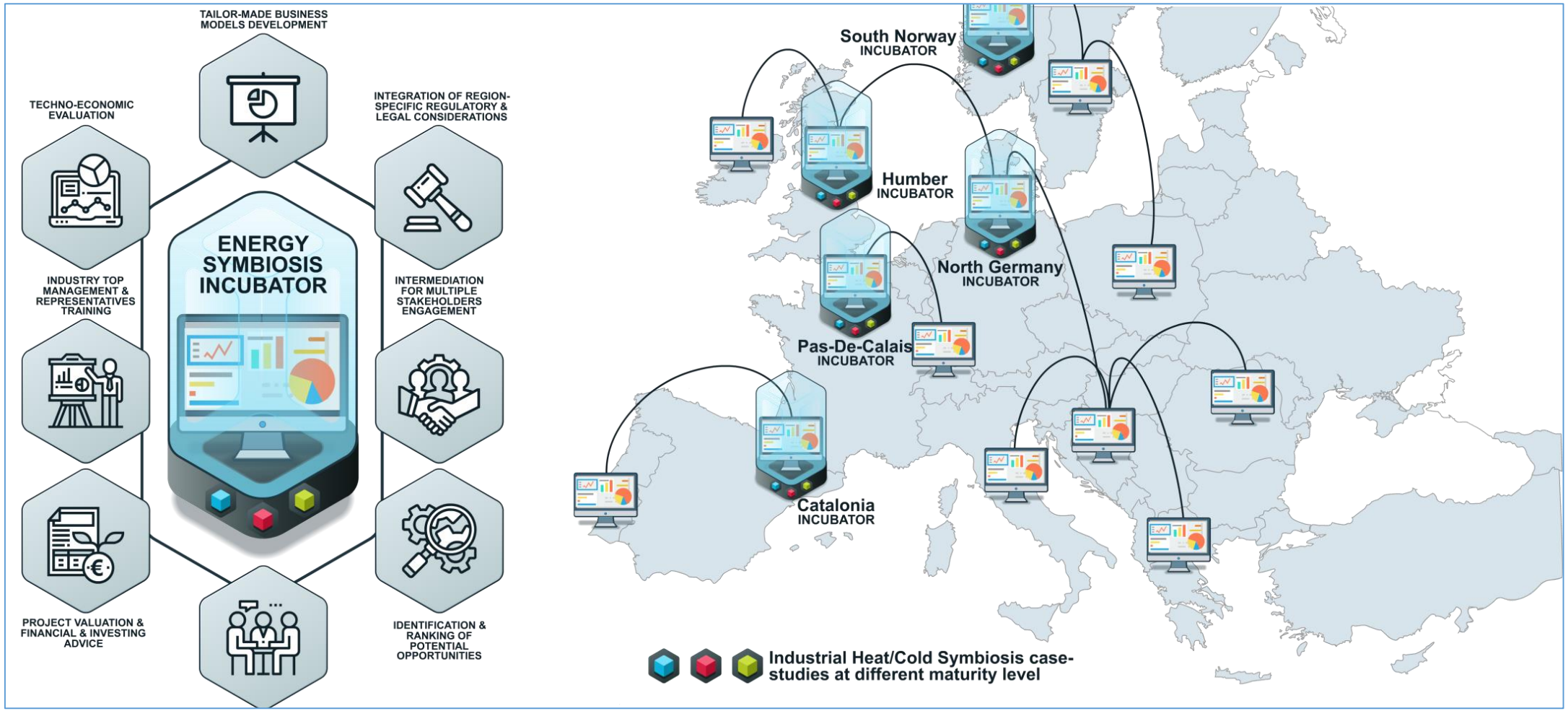
This project is funded by the European Union

Duration: 3 years (May 2020 – Apr 2023)

Consortium: 8 partners

Budget: €2 Million

Output: A network of Regional Incubators, building capacity at all levels and supporting the realization of Energy-based Symbiosis in 5 European regions.



INCUBIS project

This project is funded by the European Union

In the context of INCUBIS we will facilitate and trigger energy synergies between industries and between industries and municipalities with the following targets:

Project Performance Indicator	Quantification		Measurement unit
	during project	3 years after	
Primary energy savings triggered by the project	**> 100**	**200**	GWh/year
Investments in sustainable energy triggered by the project	**> 3**	**6**	million EUR
Benefits generated from investments[1]	**>2**	**4**	million EUR
Number of plant sites that commit to energy cooperation (EC)	**>1450**	**3000**	Number of sites
Number of ind. parks where businesses commit to EC	**> 40**	**80**	number of parks
Number of stakeholders aware of joint energy services	**>10000**	**20000**	Nr of stakeholders
Number of policies and legal frameworks created and/ or adapted to facilitate energy cooperation among businesses	**>10**	**>20**	Number of policies and frameworks
Reduction of GHG emissions triggered by the project	**>22500**	**>55000**	*tCO2-eq/year*
Reduction of air pollutants triggered by the project	**unknown**	**unknown**	*kg/year*

Project leverage factor: €5 generated for every €1 invested by the European Commission (in a 6 year horizon)

End of Part 1

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Thank you for your attention ! ! !

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