



How to create incentives for industrial symbiosis

while preventing and mitigating implementation risks

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Abstract

The objective of this deliverable is to reveal and analyse the incentives that support the implementation of industrial symbiosis on a large scale. This report aims to extend the results of the best practices of industrial symbiosis presented in Deliverable 2.1 "Lessons learnt and best practices for enhancing industrial symbiosis in the process industry", Deliverable 2.2 "The role of intermediaries and enabling technologies for industrial symbiosis initiation and implementation" and Task 5.1 Stakeholders consultation and engagement of the SCALER project.

In addition, both the risks addressed to the implementation of these Incentives and the group of actions that might mitigate these risks have been identified.

Abbreviations

CS	Case study
D	Deliverable
EU	European Union
IS	Industrial Symbiosis
MEBC	Midlands Environmental Business Company
T	Task
WP	Work package
WRAP	The Waste and Resource Action Program
EBC	Environmental Business Communications
NISP	National Industrial Symbiosis Program

Glossary

Incentives: Something that encourages a firm to implement IS synergies.

Enablers: Something or someone that makes it possible the implementation of synergies.

Government: Political administration of a country.

Incentive Assessment: Procedure used to determine the value, scope, focus, importance of a certain group and incentive.

Implementation Risk: The possibility that a factor may interfere in the implementation of an initiative or project.

Internal Factor: Interior factors of the company or institution that may affect or impact the ability of the application of a certain incentive.

External Factor: Outer actor or external forces that can impact the ability of the application of a certain incentive.

Mitigation Action: Action that help to eradicate or reduce the frequency, magnitude, or severity of impact risk.

State: Country.

Introduction

The main objective of this study is to reveal the incentives that promote the implementation of industrial symbiosis on a large scale. In order to accomplish this objective our research was based on T2.2, T2.3 and T5.1. These incentives have been identified in the areas that can be considered critical, such as financial, social, technological, information-related and policy-related and others.

In a second phase of our study, the secondary objective was not only to analyse these incentives but also to understand the risks that could be associated with their implementation and, in a deeper context, how to mitigate them. With this purpose, a risk assessment and an empirical analysis for obtaining possible mitigation actions was developed.

This report is the main output of the T2.3 "Incentives Assessment" that is part of the WP2 of the SCALER project. This project seeks to boost the application of IS in the process industry by considering non-technical and technical best practices, enabling technologies, key intermediary and facilitating tools and methods.

1. Research Strategy

1.1 Task definition

Basing on the best practices, enabling technologies and intermediaries identified in T2.2 and T2.3 as well as on stakeholder consultation (T5.1), it was possible to derive potential incentives that could support large-scale IS initiatives both at regional and national levels, and considering the different contextual applications of symbiosis.

These incentives shall take into consideration the different realities across European regions concerning, for instance, geographical factors, regional infrastructures and the local diversity of economic activities, that will be assessed in several relevant domains (financial, economic, social, technological, information-related and policy-related and others).

The output of this task will be a set of incentive measures to promote large-scale IS initiatives, assuring the effectiveness and viability of future projects developed in the several contexts, thus preventing and mitigating implementation risks (D2.3).

The identification of barriers and challenges from T2.2 provided the input to this task in relation to the identification and assessment of actions for preventing and mitigating implementation risks. The Methodological Approach proposed is shown in Figure 1.

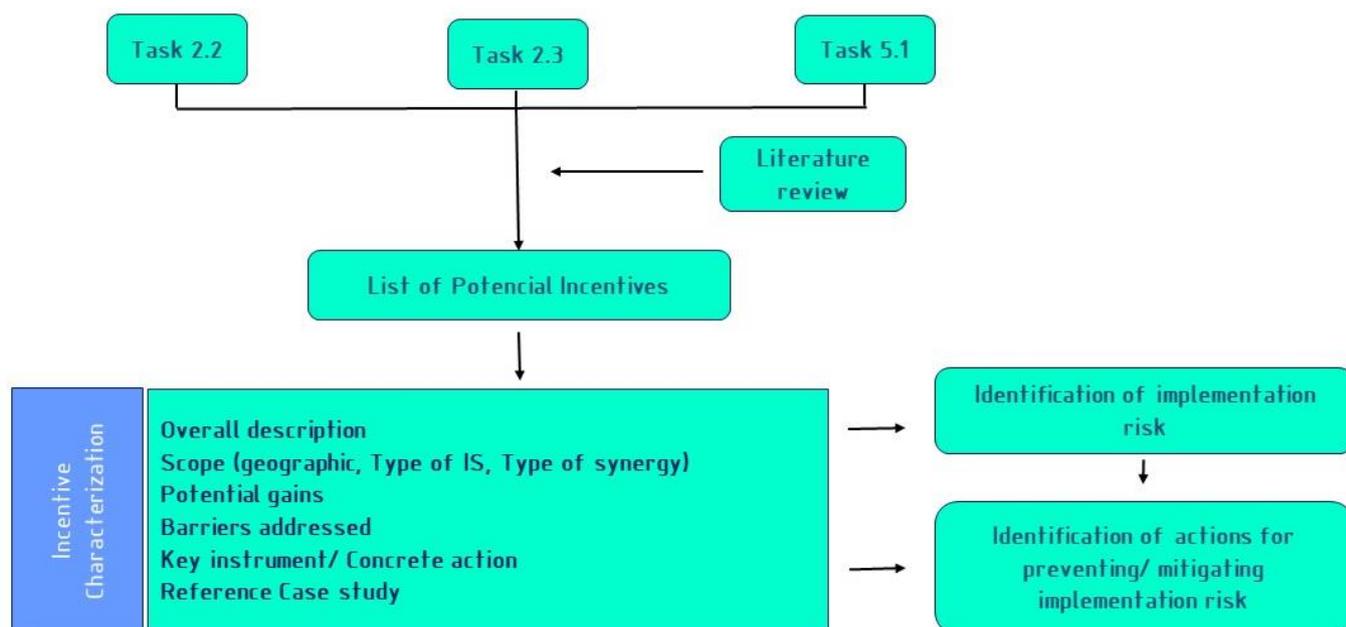


Figure 1 - Methodological Approach

1.2 Literature Review

For the development of the incentive assessment, a literature review was carried out to uncover the main findings. It is meaningful to acknowledge the research that UCAM developed in D2.1 of the most relevant publications in this area, identifying 85 key publications to obtain the results of the case studies. Therefore, our work was also based on the reading of these key publications.

Nevertheless, considering that the incentives assessment has a very practical approach other publications were also considered, such as technical reports of EU

countries, official documents of the EU, statistics, case studies and others. These documents were not considered with a publication year specific criteria, but purely considered for their content and main findings.

1.3 General Structure of Incentives of IS

The incentives assessment seeks to identify the initiatives that supported, in concrete cases, the promotion and implementation of large-scale industrial symbiosis. The next analysis is based predominantly on the results of tasks T.2.2 and T2.3, but also considering the results of the stakeholder consultation T5.1.

The incentives identified in this task were divided into seven groups in order to facilitate understanding. Figure 2 presents the Incentive Assessment Vision.

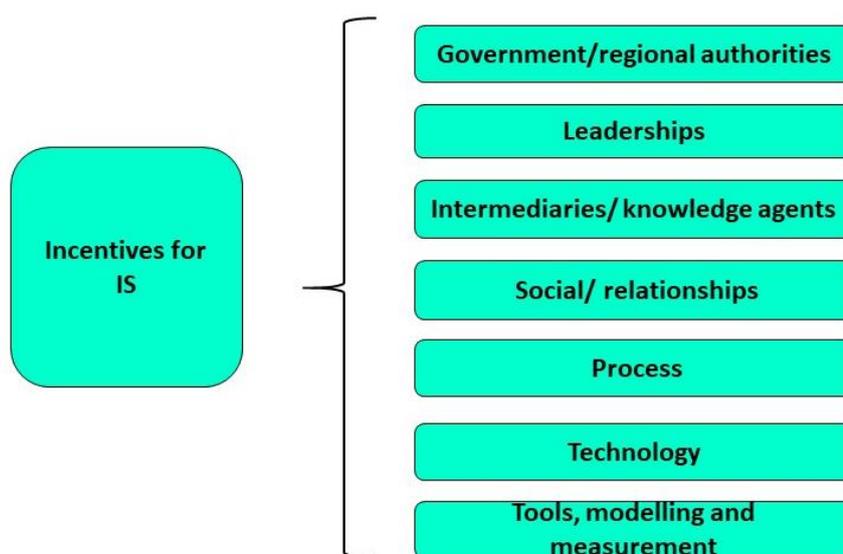


Figure 2 - Incentives Assessment Vision

1.4 Risk Identification approach

Once identified the incentives that support the implementation of the IS on a large scale in the various areas mentioned in the general structure (1.3), the next step was to derive the potential risks that are associated with the implementation process of these incentives, hence, providing an identification of the risk factors. The risk factors are defined as issues or problems related to the internal and external conditions of the system. This identification is completely based on an empirical approach, supported by experiences of some implementation cases, stakeholder consultations and external observation. Figure 3. shows the risk identification approach.

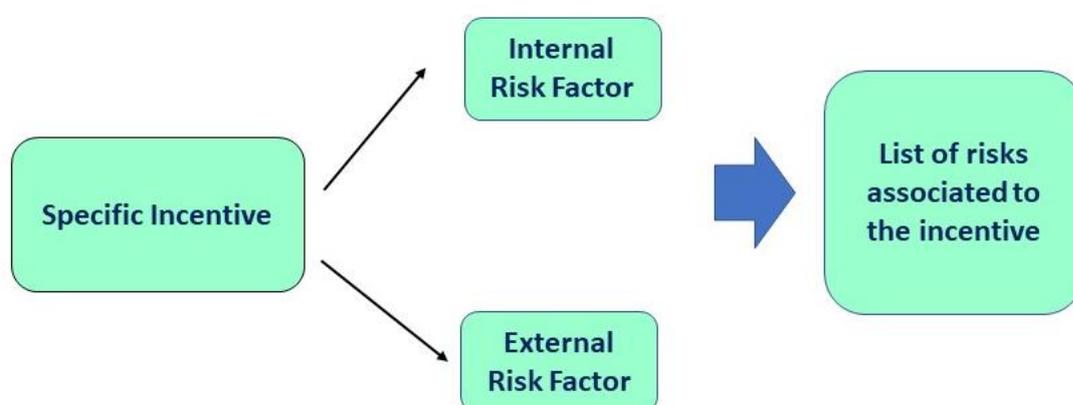


Figure 3 - Risk Identification approach

1.5 Incentives findings from Survey

The enquiry developed in D2.1 included a question to try to understand, from the point of view of the industrial actors, which are the most important incentives for the development of symbiotic initiatives.

Among the most interesting results to this question (Figure 4), was the fact that industrialists consider that the critical incentives for developing and implementing resource synergies are of economic nature (economical gains), ability of willing partners, and unblocking policies.

It should be noted that according to the response obtained from our respondents, the main financial incentive is not the co-financing of utilities or IS programs. On the contrary, industrial actors prefer to join or participate in a synergy because there is some guarantee that this synergy has a clear economic profit.

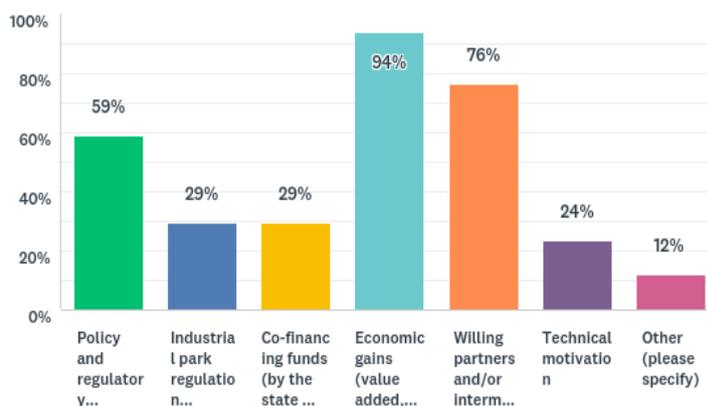


Figure 4 - Graphical representation of the survey incentive question

2. Industrial Symbiosis Incentives

2.1 Government/regional authorities

A financial incentive is defined as an economic tool that helps to tackle economic barriers and support the planning and implementation of eco-innovation (Massard, 2014). These incentives are financial benefits offered to enterprises, government and organizations to encourage behaviour or actions which otherwise would not take place, further motivating actions which otherwise might not occur without the financial benefit. The financial incentives are closely related with the government and local authorities, because the management of the investment plans are developed by these entities.

The government and regional authorities have the influence to intervene in IS initiatives at different levels and create a greater impact, thus becoming critical agents when it comes to promoting incentives. Several authors affirm that the intervention of these authorities is more effective in the financial and political areas (FOEN, 2014).

On the other hand, a political incentive is defined as an action or initiative that can modify the current political conditions by overcoming the barriers addressed (Richard C., 2011).

Different types of instruments were found in the review of the literature identified in the previous deliverable (D2.1). Nevertheless, the main objective of this deliverable will be to show those concrete examples that helped the implementation of the industrial symbiosis and that are also supported by real cases of implementation.

2.1.1 Co-funding investment program

In several cases of industrial symbiosis implementation, it has been proved that financial support in specific areas, such as, infrastructure, public services and services can be a differentiating factor. Financial incentives, economic tools and access to finance, all help to tackle economic barriers and support the planning and implementation of IS (Massard et al., 2014).

In a previous deliverable (D2.1) it was clearly identified that there are best practices on the implementation of IS that generate environmental and economic benefits, create acknowledgement in companies and society about IS (namely the Case Studies 7, 9, 10). Nevertheless, without the full support and appropriate interventions of the governments, the promotion of instruments to remove regulatory barriers and definition of new facilitation IS programs along with the implementation of industrial symbiosis could become a long and uphill road.

Even in cases where technically feasible synergies are presented, the economic barriers might block their concretization based on the costs involved in the development of the IS project compared to other forms of waste disposal, including treatment and/or landfilling.

Currently, in some countries of the European Union (from an economic perspective), it is still more viable to use typical methods of waste treatment. Prices of landfill disposal in the EU are considerably low and landfilling remains a convenient and cost-effective solution. Moreover, despite the fact that in the last years this rate has had a tendency to increase (Gate Fees Report 11th edition, 2018), it is also necessary to reinforce the actual policies to encourage the transfer to a more environmentally friendly waste treatment method.

In addition to the limitations and barriers presented, the IS initiatives must face other strong constraints, such as, the uncertainty of the future policy (waste, environmental) and the limitations in the credit of the companies to develop the initiatives by themselves (Baumgarten and Nilsson, 2014).

In this context it is understandable that the development and promotion of an integrated co-funding investment (particularly in infrastructure, utilities and services) becomes a critical factor for the success of those initiatives.

2.1.2 Premium Tariff Energy

In the industry sector, the consumption of energy is always a key point of major concern. According to the "Energy Outlook 2017 in Europe", consumption in the industrial energy sector has been slightly decreasing, nevertheless it will be necessary for the different governments to continue promoting policies and instruments that helps to reduce energy consumption in the industrial sector; The incorporation of renewable energy systems is one of the most recognized.

There are several experiences that show that rewarding companies that pursue the incorporation of renewable energies, generates considerable profits as well as significant awareness in the industrial community (I. Johnsen, 2015).

The Finnish government program is a clear example of success. Since 2011, Finland has maintained a feed-in tariffs regime in the form of a price guarantee to support the introduction and increasing production of renewable energy (Memorandum of Sitra, 2018). Electricity generators from wind, biogas and biomass receive variable premium feed-in tariff on top of the wholesale electricity price for a period of 12 years.

The Promotion of the Premium Rate that rewards companies that have incorporated renewable energy systems is a concrete and applicable incentive, clearly implying an absolute commitment from part of the government, the energy agencies and the ministers supporting and encouraging this initiative.

2.1.3 Common Waste Fund

There are several authors who have identified and typified that social/economic factors can limit the propagation of symbiotic synergies. Among some of the most important ones that can be highlighted are the lack of knowledge of the waste value (Cohen, 2000), the lack of awareness (Bacudio, 2016. Table 2. p 6), the lack of

understanding of the economic viability of participating in IS initiatives (Raabe, 2017) and the low price of waste (Van Beers, Corder, Bossilkov, Evan Berkel, 2007).

Regarding this kind of initiatives, the platforms are a fundamental part of the development, considering that they are the meeting point where industrial actors forgather to make numerous waste negotiations. Among the governments that have promoted this type of initiatives, is the Portuguese case with the MOR (Organized Waste Market). The MOR includes several electronic platforms of negotiation, which is object of recognition by the Portuguese Agency for the Environment (APA).

The creation and promotion of platforms that support a common waste fund in national/regional approach can be considered as promoting the diversification of strategies to value waste and is an incentive for the proliferation of synergies.

2.1.4 Bio Fuels Tariff

As previously mentioned, energy consumption is a major concern in the industrial sector in the European Union (International Energy Outlook, 2017). Nevertheless, the introduction of renewable energy sources is currently not enough to meet the high demands of the sector; therefore, it is necessary to carefully observe the fuels that are being currently consumed and what are the alternatives to replace them with fuels that generate less environmental impact.

Among the most viable options of biofuels utilization, there are currently several plans and policy programs that promote their consumption (EU Biofuels Annual 2018, EU 28) which have a great success in European countries, especially in the transport sector.

There are many Member States in the European Union that have been concerned to encourage the consumption of biofuels with the purpose of reducing the consumption of fossil fuels. It is mandatory that these policy measures must be supported through plans of action that guarantee the implementation of these measures. Among the various cases Spain can be mentioned as an example (promoted by Decreto Real 459/2011).

The incorporation of biofuels cannot be limited to the transport sector, and therefore it will be necessary to continue promoting legal frameworks that help these fuels to be incorporated in industrial activities. It is essential that this framework, apart from legal aspects, incorporate tools that work as mobilizers

(preferably that have been successful in previous cases), such as the promotion of a special tariff that benefits those companies that introduce them in their industrial activities.

2.1.5 Landfill Tax incentivisation

Several authors defend that the incentives for industrial symbiosis with the greatest impacts are the financial ones. In fact, the IS literature has generally emphasised in its discourse, the *“cost-based”* approach as a main driver (Domenech, 2011) specifically for those that are cross-cutting by involving the political and the financial area, overcoming the barriers in an easier way.

Finland introduced several economic instruments to support the transition towards more ecological industries and environmentally friendly processes (I. Johnsen, 2015). Certainly, one of the most successful instruments has been landfill gate fees. The Finish strategy was quite simple, it consisted in encouraging the recycling and other waste disposal methods while decreasing its price per ton treated.

Another approach in this same incentive, refers to the fact that constant increases in landfill tariffs (due to policy or market reasons) motivates companies to look for alternative waste treatment methods. The Waste and Resource Action Program (WRAP) of UK shows in its Gate Fees Report (Gate Fees Report 11th edition, 2018) that in Wales the gate fee increased from £26 to £32 just in the last period [2016-2017].

In this sense, it can be considered that an incentive for the implementation of industrial symbiosis is the promotion of a waste tax and landfill tax policy, in any of the two presented approaches (increasing the landfill gate or decreasing the tariffs of alternative methods).

In this sense, it can be considered that the promotion of waste tax and landfill tax policies are incentives on the implementation of industrial symbiosis, whether by increasing the landfill gate or by decreasing the tariffs of alternative methods.

2.1.6 Policy/ regulatory framework of waste management

The literature constantly refers that political factors tend to be great enablers for the development of synergies in industry. Even though, there are many barriers that can be overcome with the implementation of policy framework, from social barriers to more complex ones such as the lack of financing.

According to the results shown by the survey carried out in Deliverable 2.1 (previously referenced) from the perspective of our respondents, the implementation of policies and regulatory instruments emerges as the third most important incentive. Even in the case studies, it was possible to identify how the lack of regulation and knowledge can become major barriers (CS18, CS19).

The lack of uniform policy regarding waste, the uncertainty to the approach taken by new regulations in this area and the lack of knowledge of the symbiotic business model are some of the factors that dominate the implementation of the industrial symbiosis in the European context.

It is completely understandable that to encourage this paradigm, the promotion of a consolidated waste policy by the governments becomes a defining factor. This waste policy should refer to a clear definition in the waste management policy that allows and promotes the incorporation of business models such as the industrial symbiosis.

This policy should be consolidated with three main approaches (SCALER D2.1, 2018);

1. The standardization of IS methodology and terminology.
2. The focus on investment and support for these models; Specifically, in critical areas like infrastructure, utilities and services, this support should have a lasting character.
3. The clear definition of the target to be reached; these objectives must be directly linked to the need of each industry

2.1.7 Environmental and Energy Taxes

In the same line of reasoning of the landfill tax incentives, several governments have decided to promote other environmental and energy taxes, which in many cases are promoted even in the same legal framework (I. Johnsen, 2015). As previously mentioned, there are transversal incentives that combine the political area with the financial area.

Several instruments can be adopted in this area. They can be separated into two main large groups; those that penalize environmental pollution or excessive and inefficient use of resources, and those that promote the use of alternative methods with less impact on the environment (environmentally friendly processes).

Certainly, these two large groups are divided into sub-categories such as fuels, waste treatment processes, emissions, etc.

One of the most recognized instruments of the first referred group was the Norwegian CO₂ tax (A. Bruvoll and H. Dalen, 2006) and the Sweden Tax on natural gravel (I. Johnsen, 2015). On the other hand, referring to the second abovementioned group, the Finland Reduced taxation for biofuels and, in a larger perspective, the tax exemption for biofuels of Sweden are the most Influential cases of environmentally friendly methods incentivisation.

In this sense, one of the most effective approaches to create awareness (on the side of the governments) in the consumption of materials and levels of environmental pollution is to promote instruments, such as, the two previously mentioned. To conclude, it will be necessary to create and promote environmental and energy taxes that encourages companies to improve their waste management having in mind non-conventional alternatives such as circular synergies and programs of industrial symbiosis.

2.1.8 Improving the Energy Efficiency and Resource Efficiency

Energy efficiency and resource efficiency are two transversal areas that are closely related to the circular economy; this concept focuses on maximizing the circularity of resources and energy within production systems, based on the fact that natural resources are scarce, and that waste at the end of its life may retain some value (Ghisellini, 2016). In general, initiatives that seek to promote energy and resource efficiency work as facilitators for the circular economy and its business models.

Several Member States of the European Union have come to promote energetic and resource efficiency plans. As an example, there is the POSEUR program in Portugal, initiative promoted by the Portuguese government that emerges as an Operational Program Sustainability and Efficiency in the Use of Resources (POSEUR, 2015). In other hand, there are States that have developed greater scope and more ambitious plans than those that simply goes through the implementation of circular models supporting the resource and energy efficiency. Among these plans the NISP of the UK can be mentioned (International Synergies, 2015).

It is imperative to continue promoting this type of programs, focused on these two multidisciplinary areas, which are heavily relied upon the support of the governments.

2.1.9 Strategies for a circular economy and green growth

The government plays a critical role in the intervention as a driver of green growth and circular economy. In this context, there are many social, political and economic barriers for which companies have not joined these initiatives. Having the support of the government creates an environment of support and credibility that attracts companies. (I. Johnsen, pp 17-19, 2015).

The role of the state cannot be limited to the financing and the transition of policies, it must also be involved in the actions and strategies that encourage industrial actors and communities to join those initiatives.

There are different types of strategies and development plans of governments to support green growth. Among the leading strategies, the "Waste and Resource Action Program (WRAP)" of UK and the European Commission "Circular Economy Package" can be highlighted (Circular economy package, 2016).

In this sense, some of the initiatives that have emerged supported by the EU, such as the "Green Public Procurement (GPP)", can be also highlighted. This initiative promotes processes whereby public authorities seek to procure products and services with a reduced environmental impact throughout their life-cycle when compared to goods, services and works with the same primary function that would otherwise be procured (EU, Buying Green!, 2016).

It is understandable that the promotion and reinforcement of this type of strategies has a crucial role as an incentive in the implementation of the industrial symbiosis. It will be also necessary to support the initiatives that may arise from these strategies (such as the Green Public Procurement) that will eventually come to support the transition at various levels.

2.2 Leaderships

2.2.1 Target definition

It has been proven that the companies are able to generate profit in the field of Industrial Symbiosis and, in fact, this is one of the reasons that motivate them to join IS initiatives. Nevertheless, in order to organize development to achieve greater benefit (economic, social, environmental), it will be necessary to implement methodologies that support the clear definition of objectives in IS initiatives. With

this purpose, the industrial management systems such as Lean thinking and Lean Green function as facilitators.

Of course, barriers such as lack of environmental awareness by the staff and lack of budget by the company to invest in this initiative (fund constraints) are some of the most predominant according to Cherrafi and Elfezazi (2017).

It is understandable that the promotion of an environment where a clear target definition by the companies exists in areas that can take advantage of resources and improve the processes. Ultimately, this will help the transition to a more sustainable Industry.

2.2.2 Self-organizational and coordination approach

The lack of coordination arises as a common factor in the failed cases of industrial symbiosis implementation. This lack of coordination is clearly closely related to other social and information-related barriers, such as lack of motivation, lack of knowledge about the opportunities for symbiosis development and resistance to new concepts (I. Johnsen, pp.17, 2015).

Being the lack of coordination a barrier closely related to the internal characteristics of the companies and the relationships between the different actors involved in the initiative, it is difficult to promote an incentive to completely eradicate this problem, however it is possible to promote guidance that help to overcome these difficulties.

In this sense, we can have two main different approaches to support and overcome the problems associated with the lack of coordination in emerging synergies:

1. Incorporation of external intermediaries that fulfil the role of coordinator financially and regulatory supporting firms at the initiation of synergies or projects (Sun et al., 2017a).
2. Companies adopt a self-organizational approach, where the objectives, processes and targets are internally defined.

2.3 Intermediaries/ knowledge agents

2.3.1 Anchor company involvement

Anchor companies are companies which with its significant corporate presence in the global or international context represents a point of trust. These companies can endorse and support the initiatives and attract more firms to join them. In some practical cases it has been clearly proven that the involvement of an anchor company has been a critical factor for the success of an initiative. Among these cases the Qijiang Industrial Symbiosis (Li, 2017) can be mentioned.

As previously referred, the promotion of participation of some companies in initiatives of IS is a critical factor that can help to overcome some social barriers and provide more support to those initiatives. In a wider context, it can be considered that a clear incentive is the promotion of the participation of anchor companies in the creation and support of projects. Companies with those backgrounds and skills provide credibility and visibility and encourage IS activities.

2.3.2 Local bridges

The participation of knowledge agents in the development of symbiotic synergies has proved to be in several cases a differentiating factor in the success of the initiative (CS 4). The universities, research organisations and specialist consultancies have played a vital part in enabling synergies to be established through the provision of highly specialised knowledge and the involvement of researchers. Even though, these agents rarely enter into contact by themselves, perhaps because of the difference in their activities and other social barriers.

A general problem associated with external intermediaries (people) is that companies are generally not open to share their information with unknown agents. There are several social barriers that stand out. Among them, perhaps the most outstanding, is the lack of trust. It is at this exact point that intermediaries can have a significant role as they can build the bridge and foster relationships between industrial sites, research centres and universities unifying those two sectors.

In many cases companies prefer to use networking platforms that are duly associated with state agencies or ministries, preferably framed in projects or state action plans where they can contact knowledge agents.

A possible incentive for bridging process is to establish a network of contacts that provides the connection between universities, research centres, the industrial actors and local authorities, bridging and surpassing the address barriers.

2.3.3 State intervention as a driver

The intervention of the state continuously emerges as a critical incentive for the materialization of IS synergy and projects. The literature refers that the presence of incentives always stands out as a common factor in successful cases and fomenting the importance of the state intervening in favour of the transference of conventional models to circular models. Costa and Ferrão identified how the Chamusca Municipality Government (CMG) commitment was a differentiating factor as it made possible having a direct interaction with agencies, knowledge agents, industrial actor and other government representatives (Costa and Ferrão, 2010).

This incentive can be considered as a transversal instrument since the intervention of the state cannot be limited simply in a specific field (financial support). In incentive 2.1 it was highlighted, and clearly demonstrable, that the state has greater impact promoting and improving policies that cover some type of financing. Nevertheless, their participation in other areas such as the social component, technology is simply crucial (in incentive 2.4 this issue will be addressed on a larger scale).

2.4 Social/ relationships

2.4.1. Networking and clustering

The communication between different actors is essential in symbiotic relationships, as it is understood that many of the symbiotic initiatives do not materialize due to lack of knowledge and other social barriers. As it was referred in the incentive 2.3.2, In some cases the relationships between universities/research centres (or other knowledge agent) and industrial actors were a defining factor for the success of the initiatives, once these agents bring new knowledge and perspectives to practical cases.

But it cannot be let that the networking depends absolutely on the proactivity of some actors. As previously mentioned, one of the most difficult barriers to

overcome are the social ones, and these two actors generally have considerable social barriers to overcome before materializing some type of exchange (lack of environment trust, resistance to new concepts, lack of motivation).

For this reason, it is considered that a differentiating element to facilitate networking and clustering between different actors could be the creation of networks that support the implementation of IS. This network is essential to promote the networking/clustering and join the social and corporate interconnection with multidisciplinary knowledge base.

2.4.2 Social responsibility

Rashid (2014) defined the environmental social responsibility as a concept where companies integrate environmental concerns in their business operations and the interaction with stakeholders, without compromising economic performance (Nik and Nor, 2014).

The involvement and commitment on the part of firms, community and society is crucial for the success of these initiatives. Regarding social responsibility, there are two types of actions that have been identified as beneficial for disseminating:

1. Companies disseminate the benefits of industrial symbiosis by sharing their experiences (in a corporate social responsibility approach) to motivate other companies to join synergies and symbiotic initiatives, and strengthening the company's green profile.
2. Municipalities (Local authorities) and government agencies that promote dissemination programs which stimulate awareness in society.

In the previous deliverable some of these initiatives were identified in the case studies. In e.g., the CS 10, the Midlands Environmental Business Company (MEBC) has the Environmental Business Communications (EBC) department dedicated to the promotion and engagement, building confidence and capacity in IS through communications and workshops.

As a social incentive, closely related to the governmental entities intervention (Incentive 2.3.1), programs approached in the social responsibility of communities and firms must be promoted by the local authorities with the aim of enlarging the involvement of these actors.

2.4.3 Short mental distance environment

The short mental distance was described by Chertow and Ashton (2009) as "mental distance between firm managers to perceive opportunities for collaboration and material reuse/exchange". But it is not only the short mental distance that guarantees the success of a synergy. Other factors studied and recognized by Weslyne S. (2012) such as, openness of communications, trusty communication, are also responsible for the success of synergies.

In any symbiotic initiative it will be necessary to create an environment of trust and reciprocity between the involved companies. The short mental distance assures convergence of goals and visions and facilitating communication and at the same time supports trust between firms.

It is considered that an incentive is the promotion of mechanisms that generate and create an environment that allows social embeddedness and allows the openness of communication, trust and reciprocity between the firms.

2.4.4 Human drivers

Regarding the social aspect in the implementation of industrial symbiosis, it has been bought in some practical cases that social inertia seems to be a common factor in cases of industrial symbiosis. In CS 3 and CS 9, social inertia was identified for various reasons associated with social barriers (loss of leadership players, lack of motivation).

Among the drivers identified by Baumgarten and Nilsson (2014), one that was differentiating was the incorporation of highly trained human drivers, compromised and enthusiastic by the concept of IS.

On this subject, the incorporation of human drivers, with high leadership capacity in the coordination of the synergies that promotes the implementation of IS, could be considered as an incentive. The leadership of the initiative or project should be taken by people with highly credible managing. In this sense, the board of the company has a critical role in delegating the most qualified people to this function.

2.5 Process

2.5.1 Role of intermediaries as promoter

The participation of intermediaries has proven to be a critical factor in the development of synergies as identified in the previous deliverable. Specifically, in CS4, the NISP and Business Council for Sustainable Development-United Kingdom (BCSD-UK) primary role was to identify, connect and coordinate firms and stakeholders within the Humber region Industrial Symbiosis Program (HISP) (D2.1 SCALER Report, 2018).

Mirata (2004, p.980) supports that Intermediaries can participate in different levels: identifying synergies and opportunities; helping to identify the technological needs for these synergies; assisting policy development with better guidance.

The intermediaries can be served as coordinator or facilitator of the initiatives, bringing as main benefit efficient problem management, strategic targeting of resources, dissemination support and exploitation innovation/ technologies (Laybourn, 2013).

One of the most effective strategies to organize the implementation of Industrial Symbiosis is to define practical guidelines to the implementation. This theme will be further elaborated in WP4 where implementation guidelines will be created. The main objective is to define an overall strategy and recommendations in ready-to-use practical guidelines for implementation, putting together information on best practices and incentives (WP2) as well as the results from quantitative assessment of IS (WP3).

2.6 Technology

2.6.1 Transition to Industry 4.0

In the paradigm of a new industry, the tendency to transfer to I4.0 emerges as a clear opportunity for the establishment of information and communication technologies with digital manufacturing technologies (Kang et al., 2016). These new concepts function naturally as facilitators of sustainability concepts, such as, Industrial Symbiosis and Eco-efficiency.

Kang identified that in overall the core technologies of Industry 4.0 are (Kang, 2016):

Cyber-physical systems: Enables automation, monitoring, and control of processes and objects in real time (Wang, 2015) as an example, the controllers and sensor systems (Wang, 2015; Yu,2015).

Cloud manufacturing: Virtual portals which create a shared network of manufacturing resources and capabilities offered as services (Yu, 2015) e.g., SaaS (Software as a service), IaaS (Infrastructure as a Service), PaaS (Platform as a service), (Zhang, 2010).

Internet of Things (IoT): A computational system which collects and exchanges data acquired from electronic devices (Kang, 2016) e.g., the radio-frequency identification (RFID) technology tags, sensors, barcodes, smart phones (Da Xu, 2014; Atzori, 2010).

It is understandable that the transition to this new industry concept is an incentive for digitalization, which of course will allow the control/monitoring of processes in a more efficient way and supporting the introduction of concepts such as Industrial Symbiosis.

2.7 Tools, modelling and measurement

2.7.1 Shared databases of waste (uniformized)

The shared databases serve as a mobilizing tool for sustainable development. The premise of this really new concept is quite simple, companies can publish what waste they can make available and in some cases what waste they could take in.

In some practical cases it has been demonstrated how these waste databases have helped to join synergistic initiatives. Among the success cases, can be mentioned:

SYNERGie®4.0: Resource Mapping and Synergies online tool applied in international context (9 countries) to record resources/make matches developed by International Synergies. (D2.2 Tab. Enabling technologies for IS).

SymbiOPorto: Platform for the Promotion of synergies in the Metropolitan Area of Porto, aims to promote industrial symbiosis among companies in the region through the implementation of a platform that includes a waste database of companies.

Perhaps the biggest problem with this type of initiative is that the industrialists are crowded with different platforms. The number of platforms is greater than the

response capacity, data management and data availability. For this reason, there are many industrial actors who have left these initiatives even if they confirm their participation.

In addition to this reason there are other social barriers by which companies do not want to share their information on this type of databases. In D2.1 some of the considerations that are crucial in this regard, e.g. the lack of a trust environment and the partner's inertia by the firms were addressed.

In this sense, it can be considered that these instruments work as great facilitators for knowledge and waste mapping, promoting the interaction between firms and emerging symbiotic synergies. It will be necessary to continue encouraging this type of platforms. As previously mentioned, the ideal case would be a transverse and uniform platform at the national level that acts at various industrial levels (duly supported by the government).

3. Industrial Symbiosis implementation risk

3.1 Risk identification methodology

The following step to the incentives identification was to derive the possible risks associated with their implementation process. The identified risk factors presented are defined as issues or problems related to the internal and external conditions of the system. This identification was completely based on an empirical process approach, supported only by experiences of some implementation cases, contact with stakeholders and external observation actions.

3.2 Implementation Risk by Incentive

3.2.1 Co-funding investment Programs

Implementation Risks:

- Low receptivity of firms as result of the lack of trust of earlier industrial symbiosis initiatives.

- Resistance to the incorporation of new concepts, methodological approaches and mind-set changes concerning Industrial Symbiosis.
- Firms resistance to actions/projects that necessarily modify their operations in different levels (Social inertia by the leaders of the companies).
- High bureaucratic requirements of the programs and lack of standardized environmental policies to support their implementation.
- High dependence on state funds availability for Industrial Symbiosis programs' implementation.

3.2.2 Common Waste Fund

Implementation Risk:

- Low receptivity of companies and legal authorities due to the unfamiliarity with waste fund topics.
- Unawareness of the possible uses of available wastes (Lack of knowledge) by companies.
- Insufficient IT skills and data management capacity in companies
- Implementation delays of the programs due to high bureaucratic processes and lack of support by associated environmental policies.
- Limited diversity in the waste supply chains due to high homogeneity of the industrial sectors actually involved in IS processes.
- Vulnerability of supply chains associated to discontinuous available material flows.
- Unsuitable waste quality standards to receiving sectors demand.
- Unexpected waste prices variation in contrast with more stable market materials availability (virgin raw material).
- Geographical and logistic issues. Long distances and means of transportation can affect the feasibility of synergies.

3.2.3 Premium Tariff Energy

Implementation Risks:

- Modifications and investments at energy operational levels can limit companies' receptivity.
- Unaffordable initial investment costs for renewable energy implementation actions even when including state support (partially or fully subsidized) or non-state support actions.
- Insufficient company internal capacity for technology management.

- Sustainability of tariff incentive and state funding.

3.2.4 Bio fuels Tariff

Implementation Risks:

- Complexity of technology adaptation requirements for biofuels implementation.
- Diversity of industrial sectors and their specific requirements for biofuels technology implementation.
- Sustainability of tariff incentive and support state funding over time.
- Low firm receptivity due to uncertainties associated to financing state dependence.

3.2.5 Policy/ regulatory framework of waste management

Implementation Risks:

- Diversity of national realities and policies concerning waste status and valorisation options.
- Bureaucratic complexity and associated time delays between new policy adaptation and implementation actions (loss of momentum).
- Firms scepticism to face new environmental challenges and social barriers (resistance to change).
- Scepticisms and lack of receptivity from important actors in the energy sector (energy agencies, private service companies, etc.).

3.2.6 Environmental and Energy Taxes

Implementation Risks:

- Promotion of alternative tax models.

- Complexity on tax model benefits calculation, measurement and control at company level.
- Scepticisms and lack of receptivity from important actors in the energy sector (energy agencies, private service companies, etc.).

3.2.7 Improving the Energy Efficiency and Resource Efficiency

Implementation Risk:

- Inexistence of national legal frameworks and policies that allow the promotion of energy and resource efficiency.
- Internal capacity of the firm to face new technological challenges.
- Resistance to the incorporation of new concepts, methodological approaches and mind-set changes concerning energy and resource efficiency.
- Lack of funding to support the costs associated with the promotion of this type of programs.
- High bureaucratic requirements that could delay programs' implementation (loss of momentum).

3.2.8 Strategies for a circular economy and green growth

Implementation Risks:

- Lack of green culture in the company could affect the acceptance of this type of programs.
- Lack of funding to support the costs associated with the promotion of this type of programs.
- Inexistence of governmental presence as a dynamic mobilizer agent.
- The lack of resources to sustain the procurement demand process at local level.

- Large delays and logistical problems due to high bureaucratic levels in the public procurement process.

3.2.9 Local bridges

Implementation Risks:

- Low receptivity of this type of initiatives by the firms, due to lack of knowledge and resistance to new concepts.
- Uncertainty in the continuity of these programs due to the lack of support from the local authorities in this type of initiatives.
- Lack of trust between institutions (universities and research centres) and firms, since they are two sectors with different perspectives and approaches.
- Lack of actors working as coordinators and facilitators preventing coordination and loss of momentum problems.
- Lack of funding to support and maintain this type of platform.
- High bureaucratic processes and the lack of connection between the companies involved in the synergy could induce the loss of momentum.

3.2.10 Human drivers

Implementation Risks:

- Loss of key players in IS initiatives due to high turnover culture of some firms.
- Inability to manage the responsibilities of a synergy.
- Overworked personnel generate demotivation in them.
- Low autonomy levels of the key players to advance with the development initiatives can generate loss of momentum.
- Lack of information transfer between IS projects and initiatives in course (after the loss of key players), leaving the initiatives in a vulnerable position and with an uncertain continuity.

3.2.11 Networking and clustering

Implementation Risks:

- Low receptivity by the business community, usually associated with the lack of trust in potential partners (lack of trust environment).
- Lack of interest from the leaders of the companies, as companies heavily encased in "business as usual" present strong resistance to new concepts.
- Lack of funding to support the costs associated with the promotion of these networks.
- Lack of support from the local authorities in this type of initiative, generating some uncertainty in the continuity of these programs.

3.2.12 Social responsibility

Implementation Risks:

- Low receptivity from companies with a slight interest in developing a green profile and social responsibility initiatives.
- Lack of support from the local authorities in this type of initiative, generating some uncertainty in the continuity of these programs.
- Lack of receptivity on the part of the community, social inertia associated with lack of motivation and resistance to new concepts.
- Lack of financial support for the promotion of this type of programs, generally produced by the lack of state funds can create uncertainty in the continuity of the execution.

3.2.13 Anchor company involvement

Implementation Risks:

- Low receptivity by the anchor company. These companies are normally part of a larger and international group, having limited decision autonomy.

- Lack of interest by the anchor companies. Usually they have a fairly defined business approach, with no capability or resources for this type of initiative.
- Conflict of interests between firms, generated by natural competition between companies.
- Lack of funds for this type of programs.

3.2.14 Short mental distance environment

Implementation Risks:

- Lack of receptivity by the companies, associated to lack of trust with the possible synergy partners.
- The lack of knowledge and demotivation might also influence the firm's managers, making them unable to identify synergies and possible collaborations.

3.2.15 Target definition

Implementation Risks:

- Lack of receptivity by the companies, strongly adapted to the business scheme orientation and with objectives normally aligned with the "business as usual".
- Low receptivity and trust among collaborators, due to the resistance to change at the entrepreneurial level in diverse scales and levels.
- Mistrust of the industrial sector considering that environmental concerns such as climate change, resource and water scarcity, are not often integrated into long-term business strategy.

3.2.16 Self-organizational and coordination approach

Implementation Risks:

- Lack of receptivity by the firms to the incorporation of external intermediaries due to lack of trust.

- Inability to define a self-organizational approach due to the high degree of complexity that could involve target, objective and measurement definition.
- Lack of motivation among company employees, who do not fully support this type of initiative either by social inertia or resistance to new concepts.
- Loss of key player in IS initiatives due to high turnover or organizational culture.

3.2.17 Transition to Industry 4.0

Implementation Risks:

- Lack of receptivity by the industries associated to required high investment costs.
- Lack of receptivity by the industries associated to misunderstanding of direct benefits and high complexity in the calculation of the return of investment.
- In companies lacking interest to join projects that will modify their operations in some levels, the lack of stakeholder support also emerges as an important factor.
- Lack of interest and resistance to change by companies' workers. IT skills are usually required, which leads to large adaptation processes.
- Technical problems associated with lack of drive and support management, caused by lack of capability of data management.

3.2.18 Shared databases of waste (uniformized)

Implementation Risks:

- Inexistence of legal framework at the national or European level that obliges companies to participate in the implementation of waste shared databases. Without this legal framework the lack of receptivity by the firms emerges.

- Lack of proper management of shared waste databases, mainly caused by lack of time due to being overburden with industrial activities and lack of IT skills.
- The lack of continuity of this program after its implementation. The shared waste databases require heavy investment and maintenance; state funds may not be enough to guarantee the continuity of the program.
- Incapacity of internal management due to complexities of system technology, lack of trained personnel for the management of systems, etc.).
- Lack of knowledge in waste characterization. High level of complexity of materials' classification issues (waste/sub product) can arise as problems that limit the supply of technical data to the database.

3.2.19 Role of intermediaries as promoter

Implementation Risks:

- Lack of receptivity of the firms to receive intermediaries, generally caused by social barriers and lack of confidence. Other factors such as industrial confidentiality can strongly influence.
- Lack of interest of company directors' board and engineers, generally caused by the fact that they cannot clearly understand the benefits (mostly economical) that can be brought by joining synergies.

4. Actions to mitigate implementation risk

4.1 National Level

- Governments have to be aware to support and encourage policies and legal frameworks that support the transition to a more sustainable industry, aligned with a clear European legislation (standardized).
- Governments must have greater involvement and presence in Industrial Symbiosis initiatives and programs, the role of the state cannot limit itself as a financial entity but should also be incorporated as a promoter.
- Governments must allocate national funds for IS incentives, which must necessarily have a character of continuity to overcome the barriers associated with uncertainty.

4.2 Regional/Local Government/City Level

- Local authorities must be strongly committed to the dissemination of IS and its benefits, through greater participation and involvement in the promotion of the Circular Economy and its business models, through conferences, workshops, action groups, or regional communication plans.
- Local authorities must also be completely engaged, actively participating in IS programs and initiatives in progress, since it is fundamental that the industrial sector feels their support in all stages of an IS project (assessment, Implementation, operation, monitoring).
- It will be necessary to encourage awareness of society to the importance of a more sustainable development, not just in an industrial perspective. Once local authorities are more concerned with knowledge transfer in these topics, it will be easier to make a transition having the full support from local informed communities.

4.3 Intermediaries

- In order to concretize projects and initiatives, the intermediaries should reinforce the dissemination of good practices, anchors companies' experiences, circular economy and other topics that help creating awareness in the industrial sector.
- The lack of trust is a constant problem and must be overcome. In this sense, the negotiation process should be reinforced with development agreement, agreement of timing (with stakeholders) thus generating a trust environment.
- The creation of guidelines by the intermediaries is also a fundamental tool. This instrument is a practical tool that guides and allows the identification of different aspects, such as, general structure, partners, and resources.
- The intermediaries must generate mechanisms that allow to measure which benefits involve the incorporation of symbiotic synergy.

4.4 Knowledge Agencies

- Knowledge Agencies should actively participate in clustering and networking initiatives to help overcome the social barriers associated with the different approaches of the two sectors.
- Knowledge Agencies (universities and research centres) should be closer to the industry, developing applied research linked with real industry needs and practical problems.

4.5 Firm Level

- A constant training of personnel in topics such as the circular economy, their business models, green thinking and green growth should be implemented. These actions have the main objective of overcoming social barriers.

- The firms should implement constant investment in technological areas, such as purchase of utilities, improvement of IT skills and training among personnel.
- The firms should actively participate in initiatives such as clustering/networking and really engage with partners and initiatives that may arise.
- It will be necessary to cultivate the trust environment in the initiatives where firms are involved, promoting open mindedness to receive anchor companies, knowledge agencies, local authorities' representatives and other intermediaries.
- In companies with a high turnover culture, the effects of key players' losses should be analysed. The transfer of knowledge will be fundamental to mitigate the risk associated to the loss of key players.

5. Conclusions and recommendations

The main objective of the incentives assessment was to reveal the incentives that support the implementation of industrial symbiosis on a large scale, through an extensive bibliographic review, the analysis of the 25 case studies from the previous deliverables D2.1 and D2.2 and the results of stakeholder consultation (expert enquiry). These incentives were divided into seven areas that have been considered of high importance.

Sequentially, in order to assure a sustainable implementation of IS synergies, the goal was also to understand which are the possible implementation risks associated with the identified incentives and the respective preventive/mitigation actions. For this purpose, an empirical methodology was followed based on the identification of (internal and/or external) intervening factors.

Identifying the most important or relevant incentives is not an easy task, mainly because there is an infinity of intervening factors that could change the relevance in practical cases. This means that what can be determinant for a specific synergy, might not make sense or be irrelevant for another.

Nevertheless, in the addressed case studies, as well as in several other cases revealed in the literature, it was observed how the financial incentives prevail in the

podium as the most relevant. Regarding financial incentives, it should be stressed that it specifically refers to those that in one way or another, end up securing a profit from the synergy implementation and not the co-funding programmes and actions made available by the national and or European entities. This conclusion was also supported on the stakeholder responses of the expert enquiry developed in deliverable 2.1.

Many times the benefits of this transition are not directly financial benefits such as increased operational efficiency and resource efficiency, although they eventually become as such. In companies that have a "business as usual" concept, it is really difficult to create an environment of trust and reciprocity since they do not believe in the concept, mainly because they do not understand how they could estimate the return of the investment.

From our perspective, the most complicated incentives to overcome are mainly those directly related to the policies to be adopted in the field of Industrial Symbiosis, mainly because in the European context the fate of the new directives in this matter is uncertain.

Another critical factor is associated with the social barriers, the awareness of citizens/communities as well as the "business as usual" mind-set of many organizations. At this point, the role of the government and local authorities is a critical factor. As previously mentioned in the mitigation actions, dissemination, involvement and commitment are considered key elements for success.

This deliverable is the output of the two previous deliverables (D2.1 and D2.2) and will serve as support material for the creation of the D2.4 - "Pathways to increase industrial symbiosis implementation, including tools & methods capable of being fully used by stakeholders".

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Annexes

Incentive name	Overall description	Concrete action to develop/Key instrument	Key instrument of referent	Potential benefits (Gains)	Type of Strategy	Address barriers
Co-funding Investment Programs	States must promote national and regional funding funds that create a stream of monetary support so that entities can implement IS plans and projects	Establish an promote an integrated co-funding (revenue participation) in infrastructural utilities and services	European Level: H2020 National, & Portugal: RD2020 Regional, & Asturias 2020, Interreg, NI	Public financial contributions	Valorization	Low cost for the waste, in most of cases the co-funding becomes a critical factor
Common Waste Fund	Create a common waste fund in national/ regional approach, promote the diversification of strategies to value waste	Establish a common waste fund	Mercado Organizado de Residuos (Porcupi)	*Ensure the fluctuations between the supply/ cost of the waste *Mapping the industrial symbiosis networks and cluster (platform include)	Valorization	The problematic of weakness and unstable demands factor / low cost for waste
Premium Tariff Energy	Special tariff that rewards companies that have incorporated renewable energy systems (discount rate)	Promotion of Premium Tariff Energy	Finish Government Programme 2015 (SITRA/Ajponen 2014)	Reduce the cost of Energy	Mutualisation/ Sharing	Issues with the existing energy utility regulation
Bio fuels Tariff	Promotion of the incorporation of biofuels for industrial activities	Companies include a quote of biofuels in the companies / promote a system that gives a better tariff to the companies that incorporating these fuels	Finish Government Programme 2015 (SITRA/Ajponen 2014)	Reduce the cost of bio fuels	Mutualisation/ Sharing	Tax incentivization and role of government subsidies
Landfill Tax incentivization	Encouraging recycling and other waste disposal methods by setting lower fees per tonne of waste so disposed than the equivalent landfill gate fees Other approach in these series, its increase the landfill gate fees. The companies will create alternative methods to treat the waste.	Promotion of a waste tax and landfill tax policy	Finish Government Programme 2015 (SITRA/Ajponen 2014)	Reduce the cost of waste treatment / emerging IS network	Mutualisation/ Sharing	The increasing price of landfill treatment by ton / highest feed in recycling and other waste disposal methods (it does not apply in all countries*)
Policy/ regulatory framework of waste management	Clear definition by the states in the waste management policy that allows and promotes the incorporation of business models such as the industrial symbiosis	Promotion by the states of a consolidate waste policy		Consolidation of a system that allows the development of industrial symbiosis	Mutualisation/ Sharing	Struggles by the firms in acquiring permits for industrial development/
Environmental and Energy Taxes	Various tax measures in favor of the energy transition e.g. Minimum or reduced taxation for biofuels	Create a programme of Environmental and Energy Taxes	Finish Government Programme 2015 (SITRA/Ajponen 2014)	Reduce the cost of Energy	Mutualisation/ Sharing	Existing environmental regulations
Improving the Energy Efficiency and Resource Efficiency	Programme approached in the improvement of the EE and RE	Promote national and regional program that promote and support the improvement in EE and RE	POSEUR Portugal 2020	Improve the Energy Efficiency in process	Mutualisation/ Sharing	Existing environmental regulations
Strategies for a circular economy and green growth	Promotion of policy in circular economy, green growth aiming reach a good balance between environmental performance, cost considerations, market availability and ease of verification	Implement a green criteria policy in public procedures	Green public Procurement (GPP) or green purchasing	Facilitate the inclusion of green requirements in public tender documents	Mutualisation/ Sharing	Intervention in form not public financial contributions and investment

Incentive name	Overall description	Concrete action to develop/key instrument	Potential benefits (Gains)	Type of IS	Type of Synergy	Address barriers
Local bridges	Intermediaries that can build the bridge and foster relationships between the firm and research centres and universities	Establish a network of contact that provides the connection between the universities, a center of research, the industrial sites and local authorities. Bridging and surpassing the address barriers. Institutes, The universities, research organisations and specialist consultants have played a vital part in enabling synergies to be established through the provision of highly specialised knowledge and the involvement of researchers	Implementation of universities and research centers in the provision of IS, transfer of knowledge	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of intermediary / coordinator to undertake information gathering, identify synergy/feasibility. Lack of communication and dialogue between companies
Human drivers	Human drivers with high level of leadership that will support the building of environmental using	The leadership of the initiative or project must be taken by people with highly credible managing, in this sense, the board of the company has a critical role in delegating the most qualified people to this function.	Incorporate most qualified people in the initiative	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of intermediary / coordinator to undertake information gathering, identify synergy/feasibility
Networking and clustering	The creation of network IS that support the implementation, joining the social and corporate interconnections with multidisciplinary base of knowledge	Establish a network of Networking and clustering of IS initiatives	Greater support on a large scale from the government entities / greater credibility in the initiative to develop / Local benefit, Attracting of complementary business to these sites / Increasing local economic development (retaining and creation of jobs)	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of intermediary / coordinator to undertake information gathering, identify synergy/feasibility. Lack of communication and dialogue between companies
Social responsibility	Crucial role of the involvement of the local authority and local community is crucial to the implementation of IS	Programmes approached in the social responsibility of community and firms promoted by the local authorities with the aim of enhancing the involvement of these actors	Promote the involvement of anchor companies with the objective of creating backup projects, companies with backgrounds as high-ranking managers, who provide both credibility and visibility, encouraging IS activities	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of trust environment. Lack of companies willing to engage in this type of initiative
Anchor company involvement	The anchor companies are companies with its significant corporate presence in the global or international context, these companies endorse and support. Commonly committed to building strategic relationships with key companies and industries actions to develop the project and initiatives	Promotion of the involvement of anchor companies in IS initiatives	Promote an environment of trust among those involved / Improve communication made easier the exchange of information	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of intermediary / coordinator to undertake information gathering, identify synergy/feasibility
Short mental distance environment	It will be necessary to have an environment of trust and reciprocity between the firms involved. The short mental distance assures convergence of goals and visions and facilitates communication	Promote mechanisms that generate/ create an environment that allows social embeddedness and allows the openness communication, trust and reciprocity between the firms	Promote an environment of trust among those involved / Improve communication made easier the exchange of information	Facilitated IS	Valorization and mutualisation/ Sharing	Lack of trust environment. Lack of companies willing to engage in this type of initiative
Human drivers	Internal and external elements of the companies that implement IS are crucial to the success of the IS. Intra IS their participation will be a critical factor for the success of the IS	N/A	N/A	Self-organised IS	Valorization	Lack of intermediary / coordinator to undertake information gathering, identify synergy/feasibility
Target definition	Clear definition by the companies in which areas can take advantage of resources and improve the process	Implement methodologies that support the clear definition of objectives in IS initiatives. Industrial management systems such as Lean thinking	Organic development to achieve greater benefit (economic, social, environmental)	Self-organised IS	Valorization	Lack of qualification or knowledge by the staff. Lack of budget on the part of the company to invest in this initiative
Self-organizational and coordination approach	Highly trained and motivated staff for the implementation of Industrial Symbiosis initiatives, capable of being autonomous in the management of the IS implementation plan	N/A	N/A	Self-organised IS	Valorization	Improper management (Lack of communication, coordination and integration) / Lack of highly trained staff with highly credible managing skills