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An Investor ORIENTED TAXONOMY FOR ENERGY SYMBIOSIS

This document has been prepared within the Horizon 2020 INCUBUS Project entitled 'An Industrial Symbiosis Incubator for Maximizing Waste Heat/Cold Valorization in Industrial Parks and Districts'

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1. EXECUTIVE SUMMARY

The European Green Deal is one of the priorities of the European Commission and strives to make Europe the first climate-neutral continent. The Fit for 55 package proved that Europe works seriously to implement this ambition. In addition, the challenges that our continent currently faces on security of energy supply and on affordability of energy prices are showing us that the only viable solutions for a decarbonized, secure and affordable future lies on sustainable and energy efficient solutions, and on a system that swifts even faster towards renewable technologies. This is reflected in the new legislation package on RePOWER EU that was presented by the European Commission on May 18th 2022.

Accelerating investments into sustainable energy and energy symbiosis is crucial to ensure a climate-neutral Europe in the long-term and to prepare our cities and regions for the current and future impacts of climate change.

Despite huge opportunities for both ecological and economic benefit, very few energy symbiosis projects have been realised in Europe so far. One of the repeatedly mentioned barriers in the literature is the challenge of financing such projects, not because they are not profitable, but because they are too complex and unfamiliar for most lenders to properly assess risk and profitability. Further, a lack of seed funding for early-stage feasibility work means few projects even make it to the "investment ready" stage, compounding the challenge of de-risking, standardising and streamlining this kind of investment opportunities.

From INCUBIS we already prepared a document to provide practical information and guidance on financing and de-risking energy symbiosis projects (D2.3) to support project promoters, developers, facilitators and other stakeholders that anticipate potential challenges in securing financing for their energy symbiosis projects. The document is designed to support all European energy symbiosis projects, regardless of their context, design, size or stage of development.

In this document aims to **build capacity in investors**, and in the business community at large, to be able to **identify and properly evaluate symbiosis investment opportunities**. To do so, we have updated and adapted existing guidelines for valuating and assessing the risks of energy projects, to take into account the specifics of energy symbiosis.

This deliverable includes: i) investor-oriented taxonomy of energy symbiosis projects define specific concepts and classify projects based on investment and financial risk criteria, ii) opportunity definition, iii) main specific barriers and risks of energy symbiosis investments identified by key stakeholder, iv) set of tools and guidelines.

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1.1 INTRODUCTION

Securing funding and investment for the development of energy symbiosis projects is widely recognised as a major barrier to the recovery and utilisation of industrial waste heat and cold[1]. However, to meet European Green Deal 2050 targets of net zero carbon, these types of energy efficiency projects must be realised. Symbiosis is widely seen as one of the key solutions to meeting environmental targets, as set out in the SPIRE 2050 vision[2] and SET Plan[3], as well as contributing to the competitiveness and resilience of EU industry.

Specific challenges relating to energy symbiosis project investment include:

- Difficulty assessing technical risk
- Risk of premature termination of heat supply or demand
- Long payback periods
- Lack of standardised contracts and legal frameworks, leading to high transaction costs

Along with these challenges, there is also the difficulty in ensuring that projects are properly financed every step of the way through their lifecycle, from incubation and development through to construction and operation. For example, a lack of seed funding for early-stage development activities is also believed to be one of the issues preventing "investment ready" projects reaching large institutional investors.

Section 4 of Deliverable 1.2 of the INCUBIS project presents a literature review that explores these issues in greater depth. The reader is encouraged to review this chapter before moving onto this document.

In contrast to D1.2 and D2.3, which focus on the case where developers of energy symbiosis projects finance their projects, deliverable 5.2 is intended to be a more practical guideline for investors to finance energy symbiosis, with an energy symbiosis (ES) adapted method and tools to valuate projects and analyse the risk of investments as well as an ES taxonomy based on investment criteria.

The main effort behind the work package has been based on analysing different existing guidelines, protocols, and EU best practices to adapt them to ES projects, and to collect information from stakeholders, in particular investors, to analyse the barriers they face and help them overcome them.

The deliverable also discusses the different factors to consider when investing in ES (market, opportunity, legislation, public investment, risks, barriers, etc).

1.1 EU trends supporting Energy Symbiosis projects

Energy transitions towards sustainable, efficient, and decarbonized models are a major challenge. Consequently, increasing energy symbiosis has become a key component of energy policies around the world.

In recent years, numerous European Union (EU) funded R&D projects have been developed to promote Circular Economy, achieve Energy Efficiency (EE) and European Energy Transition. However, scaling up energy symbiosis in line with their potential to meet energy security and climate objectives requires significantly larger investments than currently forecasted. While the bulk of the investment will need to come from the private sector, public capital providers have an important role in mobilizing private sources.

[1] https://www.reuseheat.eu/wp-content/uploads/2019/03/D2.1-Market-and-stakeholder-analysis.pdf
[2] https://www.spire2030.eu/sites/default/files/users/user85/Vision_Document_V5_Pages_Online_0.pdf
[3] https://ec.europa.eu/energy/topics/technology-and-innovation/strategic-energy-technology-plan_en

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The public sector is essential in the initial phase of financing the energy transition, through subsidies, guarantees, feed-in tariffs, capacity payments and others. However, the private capital markets, banks and other private investors are ultimately responsible for sustaining the development of the energy transition in the medium and long-term. The current level of investment in the energy transition to a decarbonised economy is not sufficient to meet the Paris Agreement target.

This document is a guideline to encourage and promote industrial symbiosis investments for new investors who have low experience in the energy sector. This report analyses the determinants of investment decisions in the case of private investors and the role played by different financial parameters in the process. First, it presents the market and legislative parameters, and the opportunity of investing in energy symbiosis. Finally, some barriers were identified through investor surveys carried out.

1.2 EU Taxonomy and sustainable finance

The EU Taxonomy was introduced for the first time in 2018 from the EU's Action Plan on Financing Sustainable Growth as a key action categorised in the strategic topic "reorienting capital flows towards a more sustainable economy". It is defined as a common classification system for sustainable economic activities, being an indispensable, detailed, and clear tool to support investors, companies, policymakers, issuers, and project promoters to foster the transition to a low-carbon, resilient and resource-efficient/circular economy in the cities and organisations. Hence, the EU Taxonomy can be set by European Cities and Regions as a framework to assess their current position and track progress in terms of climate and sustainable investment towards climate action.

An economic activity that can be a project or investment should meet the technical screening criteria:

1. **Be taxonomy eligible:** the activity must be taxonomy eligible to contribute to environmental objectives. In other words, the activity needs to fit a NACE macro-sector category identified as being most relevant to environmental objectives and complying with the technical screening criteria, established by the Commission through delegated acts, is mandatory.
2. **Demonstrate taxonomy alignment**: the activity must demonstrate taxonomy alignment, which needs to make a substantially contribute to environmental objectives.
3. **Do No Significant Harm (DNSH):** the activity needs to show it doesn't significant harm to any of the other five environmental objectives as defined in the Taxonomy Regulation.
4. **Comply with minimum safeguards:** minimum social and governance safeguards are also set out in the Taxonomy Regulation.

Sustainable finance refers to the process of taking environmental, social and governance (ESG) considerations into account when making investment decisions in the financial sector, leading to more long-term investments in sustainable economic activities and projects[4].

The Platform on sustainable finance is continuing the work on developing criteria for the remaining four objectives of the Taxonomy Regulation: water, circular economy, pollution, and biodiversity, alongside work on Taxonomy usability and extension to social criteria and significantly harmful and low impact activities. The EC will regularly review the technical screening criteria and, where appropriate, amend the delegated acts adopted in accordance with the Regulation (EU) 2020/852 in line with policies, scientific and technological developments. This guideline has been developed based on the current EU Taxonomy of 2020.[5] When the new taxonomy is published, INCUBIS will analyse it and update this guideline if necessary.

[4] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance_en
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852

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2. TECHNICAL, ECONOMIC, LEGAL PARAMETERS

Most decisions in the financial ecosystem are based on exhaustive and comprehensive research, to achieve the highest return on investment and minimize losses. This world may seem complex for investors unaccustomed to valuing and investing in energy efficiency projects. However, this guideline provides compiled information on key market variables to help improve investment strategies and understand the financial returns they can offer and the specific risks.

The main criteria can be grouped under three different headings: technical, economic, and legal parameters.

2.1 Technical parameters

The technological options and solutions in the energy sector are very wide-ranging, so the technical criteria is highly dependent on the technology that is implemented. Therefore, when investing in a project, the following must be taken into account: identification of the technology type and its availability on the market; its level of technological development (TRL); the guarantee of the equipment and the baseline, i.e. the loss situation in terms of energy consumption and the estimated electricity production or generation.

In addition, environmental technical analysis must be carried out to ensure the sustainability of the project.

2.2 Economic parameters

All investors make their investment decisions by comparing the values of certain criteria (e.g., IRR, Sharpe ratios) calculated for the various investments of interest. A widely used measure in investment comparison, Brealey, Myers, and Marcus (2019), is the Weighted Average Cost of Capital (WACC) which is used as a discount rate for the expected cash flows of the project. The advantage of using WACC is that it takes the company's capital structure into account that is, how much it leans on debt financing vs. equity. WACC is a common way to determine the required rate of return (RRR) because it expresses, in a single number, the return that both bondholders and shareholders demand to provide the company with capital (Eq. 1)

$$WACC = \left(\frac{E}{V}\ x\ Re\right) + \left(\frac{D}{V}\ x\ Rd\ x\ (1 - Tc)\right) \qquad \textit{Equation 1}$$

Where:

- E = Market value of the firm's equity
- D = Market value of the firm's debt
- *V = E+D*
- *Re* = Cost of equity
- *Rd* = Cost of debt
- *Tc* = Corporate tax rate

Therefore, the key points in choosing the best method of financing are the cost of capital, i.e. which option offers the cheapest source of financing, the lowest WACC and which option offers the best debt maturity.

On the other hand, there is a parameter for calculating the costs of each generation plant, levelised cost of energy (LCOE) in €/kWh. This can be interpreted as the selling price of electricity that would recover all costs, including the cost of capital, but excluding transmission, distribution and marketing costs. The LCOE is therefore the basic benchmark for comparing different energy production technologies, in terms of their cost.

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$$LCOE = \frac{I_o \sum_{t=1}^{n} \frac{A}{(1+r)^t}}{\sum_{t=1}^{N} \frac{E}{(1+r)^t}}$$ *Equation 2*

Where:

- I_o = Investment (€), including financial costs
- A_t = Annual total cost (€/year), composed of fixed and variable cost required for the operation of the plant, including the cost of fuel, maintenance, taxes, repairs and insurance payments.

In addition, the economic and financial analysis should include the profitability of the project; the capital requirements and the financial capacity to provide the required economic resources; an estimate of the income produced by energy sales; operating costs; funds generated; main profitability and liquidity ratios and their sensitivity to the variation of certain variables, such as the price of energy. To do this, the following key indicators are considered:

- Compound Annual Growth Rate (CAGR): Percentage term indicating the annual growth of an investment process. This means the rate of return on an investment over a given period is greater than one year. This rate of return is applicable to both fixed-income and equity investments.
- Total Available Market (TAM): Total market demand for a product or service. It is a great tool for investors as it allows them to estimate the maximum possible revenue a startup could generate in each market and its potential scalability.
- Serviceable Available Market (SAM): Sub-market formed from the various geographical, regulatory, or pricing/quality market differences within a TAM. It represents the proportion of the market you are potentially able to capture with your current product/service, business model, and sales and distribution channels.
- Serviceable Obtainable Market (SOM): Sub-sector of the market niche (SAM) that you are realistically able to target given the limitations of resources, presence of competition, and level of market awareness.

To calculate these key factors a top-down estimate looks at larger, macro-economic trends within a market to narrow down and determines what percentage a company could capture. there are two options for making your estimation. To do so, founders rely on outside market reports from industry analysts to make their estimations, which include customer trends, demographic data, GDP evolution, trade balance, prices of raw materials, surveys, industrial activity, energy consumption… Afterwards, it is essential to analyse the international market, national economies, national market sub-sector and all potential competitors.

2.3 Legal parameters

In legal terms, the feasibility study of an energy project analyses that the project is legally executable, and it complies with all permits, licences, and authorisations. For each country the legal parameters are different, for this reason, it is important to evaluate the legislation limitation of a country before investing.

3. EUROPEAN LEGISLATION

The industrial sector is one of the largest energy users in EU[6]. For this reason, the European Commission introduced regulations to reduce emissions, improve Energy Efficiency (EE), and encourage Energy Symbiosis[7]. In the last few decades, several EU policies and regulations have been established to respond

[6] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_statistics_-_an_overview
[7] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32012L0027

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to these issues and paved the way to introduce the European Green Deal[8]. Due to the slow implementation of EE actions by EU member states to meet the 2020 target, a new directive was proposed in 2011, and the Energy Efficiency Directive (EED) (2012/27/EU) was adopted in 2012 to revoke the previous Energy Services Directive, and included: legal obligations for establishing energy-saving schemes in EU member states; provisions on the setting of EE targets. Today, EU member states in the National Energy Efficiency Action Plans (NEEAP) must quantify the national measures to implement significant EE improvements and energy savings in all sectors and in all stages of the energy chain[9].

There are several directives, communications, and funded programs that highlight the importance of Energy Symbiosis and Energy Efficiency investment:

- Decision No 1386/2013/EU of the European Parliament and the Council calls for an increase in private sector funding for environmental and climate-related expenditure, by putting in place incentives and methodologies that stimulate companies to measure the environmental costs of their business and profits derived from using environmental services[10].
- Article 3 of the Treaty on European Union aims to establish an internal market that works for the sustainable development of Europe, based, among other things, on balanced economic growth and a high level of protection and the improvement of the quality of the environment[11].
- Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11th December 2018 on the Governance of the Energy Union and Climate Action[12].
- Regulation (EU) 2020/852 of The European Parliament and of The Council, of 18th June 2020, on the establishment of a framework to facilitate sustainable investment[13].
- Commission Implementing Regulation (EU) 2020/1294 of the European Parliament and of the Council of 15th September 2020 on the renewable energy financing mechanism[14].
- The communication entitled "Roadmap to a Resource Efficient Europe" aims at ensuring the sustainable management of resources based on economic growth[15].
- The communication "Closing the loop—An EU action plan for the Circular Economy" underlines the importance of IS by the cooperation with EU member states' promotion[16].
- The Directive 2018/851 on waste aims at improving the efficiency of waste management and encourages EU member states to implement Industrial Symbiosis[17].

These regulations and communications set out the necessary legislative foundation for reliable, inclusive, cost-efficient, transparent and predictable governance of the Energy Union and Climate Action (governance mechanism), which ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change, through complementary, coherent and ambitious efforts by the Union and its Member States, while limiting administrative complexity. In addition, Directive (EU) 2018/2001 of the European Parliament and of the Council introduced a new, binding, renewable energy target for the Union for 2030 of at least 32 % of

[8] https://ec.europa.eu/info/publications/communication-european-green-deal_en
[9] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/national-action-plans-and-annual-progress-reports_en
[10] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D1386&rid=2
[11] https://lexparency.org/eu/TEU/ART_3/
[12] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1999&from=ES
[13] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32020R0852
[14] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R 1294&from=ES
[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0571
[16] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614
[17] https://eur-lex.europa.eu/eli/dir/2018/851/oj

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gross final energy consumption[18]. Furthermore, the European Green Deal, which aims to reduce emissions by at least 55% by 2030, must be met[19], and the Circular Economy Plan.

However, in these EU legislations, there is no direct link or negotiation between contributing and hosting countries. The advantages for contributing countries are:

- They can finance renewable energy projects elsewhere that are potentially more cost-effective than renewable energy produced on their territory would be.
- In addition, there is compliance with the European Green Deal, which aims to reduce emissions by at least 55% by 2030 compared to 1990 levels.

For host countries:

- They can receive additional local investment in renewable energy projects without a burden on the national budget.
- They can enjoy the benefits in terms of local employment, lower greenhouse gas emissions, improved air quality, modernisation of the energy system and reduced dependency on imports.

Furthermore, there are resource-specific regulations to be considered:

- To boost the energy performance of buildings, the EU has established a legislative framework that includes the Energy Performance of Buildings Directive 2010/31/EU and Directive (EU) 2018/2002 of the European Parliament and of the Council of 11 December on energy efficiency.
- EU Strategy on Heating and Cooling COM (2016) is the first EU initiative addressing the energy used for heating and cooling in buildings and industry, which accounts for 50% of the EU's annual energy consumption. This strategy aims to decrease energy leakage from buildings, maximise efficiency, boost the share of RE, and reuse energy waste from industry.

According to Article 16 from Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020[20], an economic activity shall qualify as contributing substantially to one or more of that six environmental objectives (Figure 1) by directly enabling other activities to make a substantial contribution to one or more of those objectives, implying that such economic activity:

- Does not lead to a lock-in of assets that undermine long-term environmental goals, considering the economic lifetime of those assets.
- Has a substantial positive environmental impact, on the basis of life-cycle considerations.

[18] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources.
[19] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[20] European Parliament and of the Council, "Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088," vol. 63, no. L 198/13, 22 June 2020.

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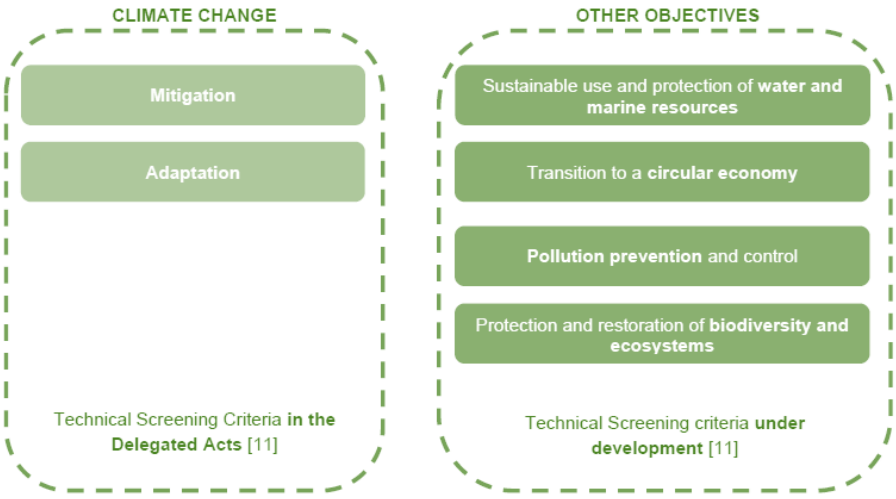

Figure 1. EU's Taxonomy environmental objectives.

4. OPPORTUNITY IDENTIFICATION

A spate of disturbing geo-political events and the growing frequency of adverse climate events have unequivocally proven the need to accelerate the energy transition. These events have also added weight to the viability and impetus to transition toward renewable sources of energy.

At a government level, climate change and decarbonization objectives are driving states and investors to consider increasing their portfolio allocations to climate and energy transition assets.

In 2021, global investments in the energy transition industry totalled $755 billion (BloombergNEF, BNEF) [21] and it covers investments in sectors such as energy symbiosis, energy storage, electrified transport, electrified heat, nuclear, hydrogen and sustainable materials.

Key main factors[22] that are showing the growth of the energy symbiosis sector and the big opportunity to invest in there:

- **Energy investments are projected to rise of about 8% in 2022 (US$2.4 trn).** Investments are increasing in all parts of the energy sector, but the boost in recent years has come from the power sector, mainly in renewable and grids, and from increased spending on end-use efficiency, and energy symbiosis.
- **Global clean energy spending finally ramps up.** Since 2020 the rate has risen to 12%, well short of what is required to hit international climate goals, but nonetheless an important step in the right direction. The highest clean energy investment levels in 2021 were in China ($380bn), the European Union ($260bn) and United States ($215bn).
- **Regional variations expose new energy divides.** The rise in energy investment has been concentrated in advanced economies and China. This would, most likely, further increase the energy inequality.
- **Investment focus on immediate projects.** In a situation where commodity prices are high and supplies are scarce, the focus of investment is squarely on projects that can be delivered as soon as possible.

[21] https://eic.eismea.eu/community/stories/2022-investment-trends-green-energy
[22] https://energydigital.com/top10/top-10-energy-investment-trends-in-2022

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Methane abatement and flaring reductions fall into this category. Major investments in renewable gases have been made to substitute the use of methane, such as hydrogen, biofuels, green methane etc...

- **Sustainable finance concentrated in advanced economies.** Financial conditions for clean energy businesses have been volatile in recent years, but many listed energy-related businesses started 2022 with relatively strong balance sheets. A measure of liquidity, profitability and equity market valuations all improved or stayed steady compared with the year before the pandemic.
  This positive signal for energy investment was far from universal, however, with acute financial strains still visible among many (often state-owned) energy companies in emerging and developing economies.
- **Clean Energy investment rising-but not fast enough.** Investment to bring more clean and affordable energy into the system is rising, but not yet quickly enough to forge a path out of today's crisis or to bring emissions down to net zero by mid-century, a critical but formidable challenge that the world needs to overcome if it is to have any chance of limiting global warming to 1.5ºC.
- **Renewables in the power driving seat.** Renewables are set to remain the number one power sector category for investment in 2022, after a record year in 2021 when more than $40bn was spent for the first time ever.
  Despite numerous issues affecting the sector, including inflationary pressures, tighter financing conditions and supply chain bottlenecks, there is a solid pipeline of projects that stem from more ambitious climate goals and robust policy support.

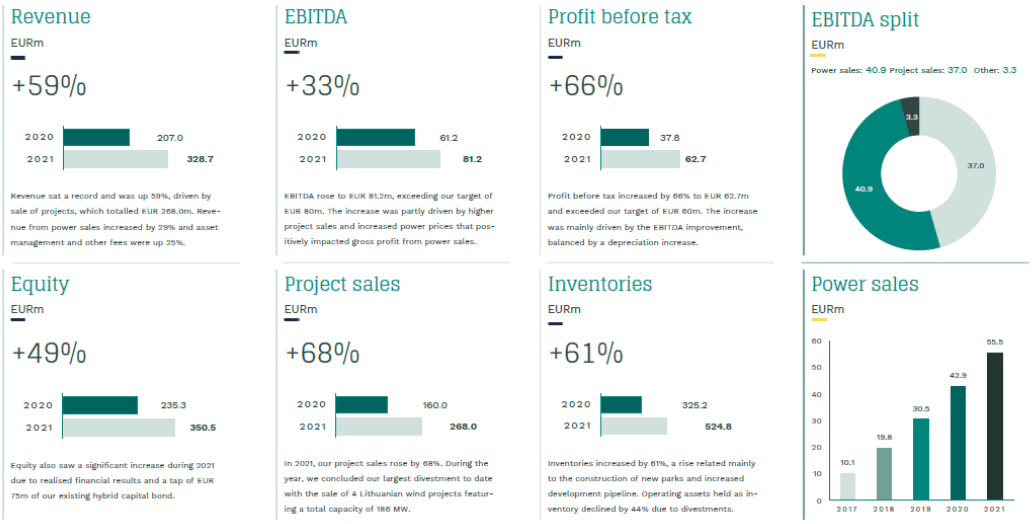

Figure 2. Financial high annual report of 2021.[23]

From the graphs listed above it is clear how advantageous is to invest in the energy sector nowadays. This trend is helped by the energy transition policies that are driving investments in the energy symbiosis sector. Furthermore, energy independence it's a key topic at the European level due to the large dependence on gas for many European countries. Therefore, it is essential to provide investment in energy symbiosis projects to accelerate the transition to a more sustainable future for the sector.

Nowadays, energy efficiency has become one of the main arguments for the energy transition, and many energy symbiosis projects have risen from this topic. Energy Symbiosis projects consists of the exploitation of energy efficiency opportunities fund across industrial symbiosis sites and sectors. In the following graph, are depicted some of the possible energy symbiosis combinations that would enable a

[23] https://europeanenergy.com/wp-content/uploads/2022/03/annualreport2021.pdf

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higher energy efficiency within the energy sector.

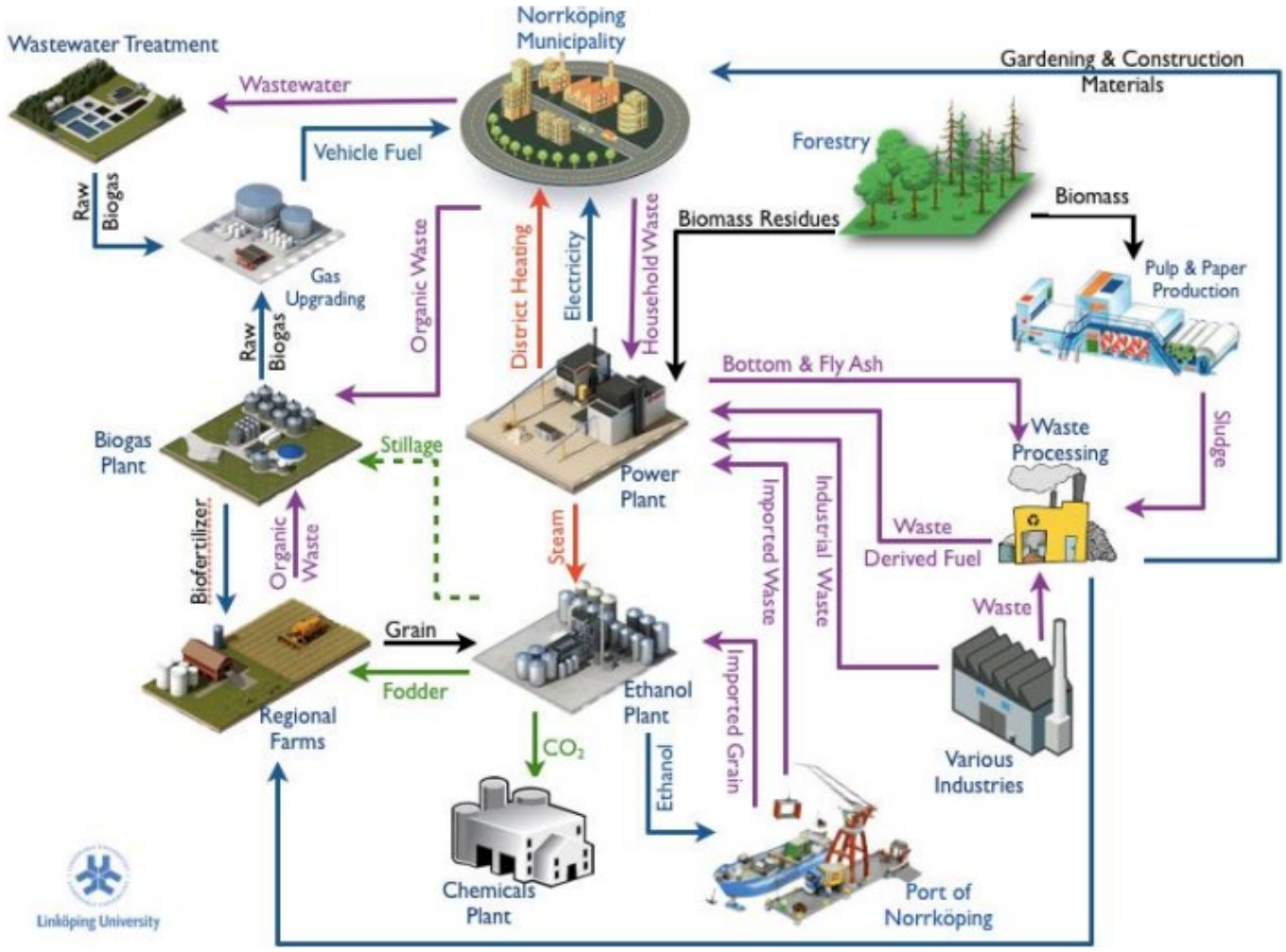

Figure 3. Renewables capital investment by energy type (wind and solar) compared to (oil and gas (O&G)) investment.

As depicted in the graph there is plenty of opportunities and here are listed some real examples such as:

- the raw biogas that is possible to extract after Anaerobic Digestion from a Wastewater Treatment plant it can be used for instance in gas upgrading processes;
- the use of CO2 captured from industrial processes and reused to produce biomethane, through the methanation process or utilized in chemical plants;
- the waste heat/cold from a factory or different types of industries can be re-used for instance to improve the heat efficiency in households or for other sectorial purposes.

In general, there is plenty of possible synergies to improve energy efficiency overall the entire energy sector, industries are plenty of waste or sub-products that can be reused for other energy purposes improving the energy efficiency for different energy systems. Therefore, the waste for a company could be a valuable product for another company or for other types of applications or even other sectors.

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4.1 Recommendations to investors

To prevent a situation in which investors are misled, investment recommendations must meet a number of transparency requirements. These recommendations resulted from PRI report.[24]

Table 1. Recommendations to investors resulted from PRI report.

Recommendations for sustainable investment	
Establish a framework	• Ensure adequate resources are set aside and management is aware of this regulatory requirement; • Integrate the taxonomy into the investment strategy; • Manage expectations.
Develop a process	• Start early. Allocate time and expertise for detailed analysis; • Quantify findings as far as possible; • Start small. Test one sector, product, region or city; • Apply a step-by-step approach; • Take a bottom-up approach.
Identify challenges	• Strictly adhere to thresholds wherever possible; • Carefully consider reliability levels for different sources of data; • Verify with companies when in doubt; • Provide context for results.
Find solutions	• Engage on data; • Share with partners; • Work with data providers; • Support innovation and improvement from data providers; • Investigate validation and external assurance.

Table 2. Risk assessment and funding categories for several types of circular bioeconomy projects.

Project type	Cash-flow characteristics	Risk assessment	Funding and financial categories				
			Alternatives	Equity	Grants	Guarantees	Debt
Research & Development	Pre-revenue	Very high	●	●	●	●	
Start-up	Pre-profit	Very high		●	●	●	
Scale-up	Pre-profit to profit	High		●			●
Growth	Profit	Medium		●			●
Mature	Profit	Low					●
Advisory	N/A	N/A			●		●

4.3 Opportunity structuring

In energy symbiosis projects there are different actors that plays key roles at different levels: from national governments to local authorities (e.g., municipalities), industrial chambers, business associations, industrial park operators and cluster managers, Regional Development Agencies, intermediaries (e.g. consultancies specialized in facilitating IS) and sometimes one of the companies that has a key role in the symbiotic network (i.e. major provider or consumer of by-products).

[24] Principles for Responsible Investment, "Testing the Taxonomy: insights from the PRI Taxonomy Practitioners Group," 2020.

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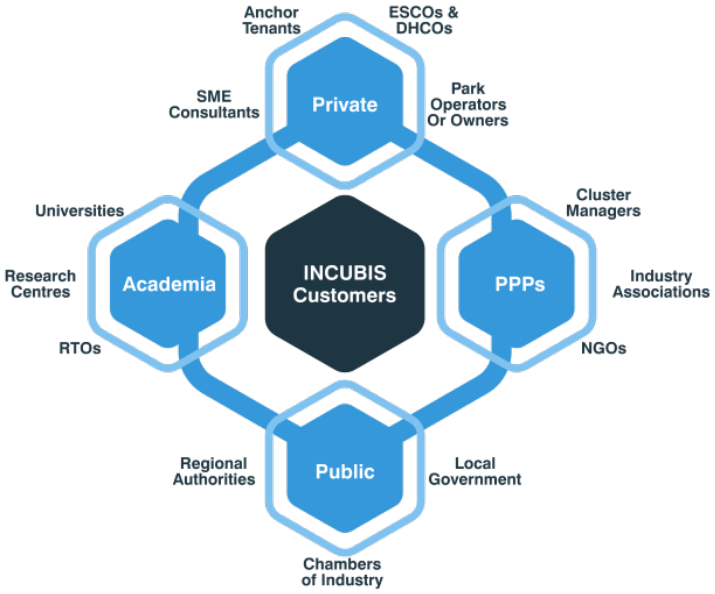
Motivation of the target audience for implementing Symbiosis

- **Expanding service portfolio and increasing profit** (e.g. ESCO and IPO)
- **Minimizing vacant land rate** (municipalities and IPOs)
- **Improving and extending services down the synergy lifecycle** (IS facilitators)
- **Decreasing costs and increasing revenue** (anchor tenants)
- **Environmental and Social benefits** (municipalities)
- **CSR benefits** (IPOs, Anchor Tenants, ESCOs)



Please refer to D2.3 section 6 and D6.2 to read more about Investor-oriented Business Models and Contracts for Energy Symbiosis.

5. RISKS

Making an investment decision requires considering several important factors, including your financial objectives, risk tolerance, and budgeting abilities. It's critical to make the right choices today because they could have a big impact on your financial future. Although ES investment trends are mostly positive, there are persistent barriers that prevent the private sector from accessing many of the existing investment opportunities.

1) Market Risk:

The payback periods and the profitability of investments in energy efficiency projects are calculated based on estimated future energy prices. In general, changes in currency and interest rates, regional or global economic instability, and economic and market conditions are some of the factors.

- Interest Risk: Investors are plagued by interest risk, which appears as fluctuating interest value over the course of the investment horizon. The uncertainties surrounding the capital an investor is likely to access at the end of the investment horizon are largely to blame.
  So, the cost of the debt instrument will change if the interest rate does. For instance, the price of bonds declines when interest rates do, which causes the value of bonds to decline as well.
- Inflation and Currency Risk: The risk of foreign exchange fluctuations, domestic inflation, convertibility rules and lower returns for international investors stemming from the depreciation of the local currency (in which project cash flows are denominated) relative to the reporting currency of the project developer.
- Volatility Risk: Equity-based funds typically make investments in the stock of corporations that are listed on stock exchanges. The value of these funds depends on how well businesses perform, which is frequently impacted by the predominant microeconomic factors. These variables include shifting governmental directives, SEBI rules, and the state of the economy.

2) Counterpart Risk:

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Liquidity risk is one of the most crucial factors influencing investment decisions. The ease with which an asset (such as equity shares, debentures, etc…) can be exchanged for money on the stock market is referred to as liquidity.

In the case of energy symbiosis, this risk is called "Counterpart risk" because the investment is financed and commissioned in the beginning, and then it is just a matter of the counterpart - the neighbour consuming the heat - paying for the energy bills. Because the heat cannot travel far, if your neighbour - the counterpart - shuts down his shop, you cannot repay the investment.

Liquidity risk thus represents the risks involved in such trades since the successful conversion of stock into money depends on several factors, including a company's book value, and the bid-ask spreads for its shares on the market.

- Funding Liquidity Risk: Such risks are related to a company's intrinsic values, which reflect its capacity to pay off short-term debt with operating cash flows. Failure to pay current obligations (defaulting on loans) can damage an organization's reputation in the market, which can cause a sharp decline in the share price as investors lose faith in the organization's credibility and potential for success.
- Market Liquidity Risk: Such liquidity risks address the systematic risk element connected to market investments and resulting from stock market volatility. Because corresponding changes in share prices have an impact on the trading patterns of particular securities listed on stock exchanges, market forces are a significant factor in determining such trading liquidity risk.

A high market liquidity risk means that it might be difficult to sell the specified securities, which would lead to low demand for them. There are several causes for this decreased demand, including:

- Highly volatile stocks are readily susceptible to price fluctuations.
- Ongoing economic crisis/recession.
- A discredited reputation of a company due to certain events.
- Global economic scenario.

3) Credit Risk:

In Mutual funds' investments, credit risk frequently arises from a circumstance in which the issuer of the scheme fails to pay the promised interest. Typically, fund managers include investment-grade securities with strong credit ratings in debt funds. The fund manager does, however, include lower credit-rated securities to increase the rate of returns.

4) Uniformity factor:

A good Mutual Fund is one that consistently outperforms its benchmark over the long term, as a very investor is aware. The excess return is referred to as the fund's "alpha" when it exceeds the benchmark. Most importantly, it's the hard-earned money you're investing in a mutual fund with. The fund should surpass its benchmark and generate a higher alpha, as you should anticipate. It may be the first parameter you use.

Furthermore, fund performance is important. It should be considered for a suitable amount of time. This is done to make sure the investments have experienced several market cycles.

This would make it possible to get a steady return over time. This is one of the most important factors that any investor takes into account while making an investment decision.

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5) Technical Risk:

These are the studies and technical characteristics of each project and each particular technology, i.e. possible overestimate in energy efficiency. This will have a negative impact on revenue streams or costs. Another risk is technical failures of equipment or an overestimation of the lifetime of the plant in question.

6) Policy / regulatory Risk:

To promote investment and encourage the development of renewable technologies, governments have used mechanisms to support renewable projects and those that promote energy efficiency – support policies that result in tariffs, quotas, tax credits, or other incentives / disincentives. However, political or social changes can bring modifications in policies, or even in the regulatory framework of the sector. These changes may affect issues such as feed-in tariffs for energy purchases, subsidies or rebates for energy efficiency in buildings, the tax treatment of investments in renewables or energy efficiency, etc.

Regarding renewable energy remunerative mechanisms, there are different types of financial-fiscal instruments can be distinguished:

- Direct investment: Governments can invest directly in the creation of renewable energy generation. A common example is the use of public green investment banks.
- Feed in Tariff (FIT) and Feed in Premium (FIP): are instruments in which the relevant administration sets minimum feed-in tariffs in kWh for electricity produced from renewable sources, the amounts of which vary according to the characteristics of the different green technologies. The prices are set over a long period of time, thus ensuring a return on investment.
    - FITs pay a fixed amount per kWh to the Renewable Energy Sources (RES) plant operator. As the plant operator does not sell the electricity produced on the market, the FIT is the only revenue stream for the RES plant.
    - FIP: the RES plant operator receives a fixed support payment in addition to the remuneration earned from the sale of the produced electricity on the market.
- Green certificates (GC): These are tradable green certificates that renewable energy producers obtain for their production. Renewable energy sources included are solar, wind, geothermal, (small) hydro, biomass, biodiesel, hydrogen fuel cells, and landfill methane capture.

Table 3. Retribution EU system, modified from EWEA, RES-Legal (2016).

Country	Mechanism
Germany	FIP
Spain	Reasonable profit
UK	GC
France	FIP
Italy	GC
Sweden	GC
Poland	GC
Portugal	FIT
Denmark	FIT
Netherlands	FIP
Romania	GC
Ireland	FIT
Austria	FIT
Belgium	GC
Greece	FIT
Finland	FIP
Bulgaria	FIT

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- **Competitive auctions for power purchase agreements (PPA):** The government organises an auction to award tenders to produce a certain share of renewable energy supply. The remuneration of the winning tender is usually above the standard market level. The justification for these auctions is based on defining the levels of support for renewables in a competitive and market-based approach. In addition, they act as a mechanism to control the expansion of renewables and their cost by setting a budget, capacity or generation cap. These auctions consist of an orderly competitive process financed by the European Regional Development Funds (ERDF) in which renewable power to be installed is awarded to the highest bidder.
  PPAs are a type of long-term, pre-fixed-price power purchase and sale instrument that favours the production and consumption of energy, whether physical or virtual. It is an agreement to buy or sell electricity over a long term (typically more than 10 years) and for a fixed price. It is therefore a forward instrument that allows the risks of both parties to the agreement to be covered. The producer or developer of renewable projects with financing needs uses the agreement to secure revenues and thus reduce project risk, facilitating third-party financing. In turn, the trading company signing the utility PPA buys the electricity at a fixed price, avoiding the volatility of wholesale electricity market prices.
- **Production tax credits and tax relief:** These mechanisms are employed in 40 countries and include investment or production tax credits. In addition, 100 countries reduce taxes (e.g., VAT) on renewable energy production, REN21 (2019). The evidence on the impact of these measures on the amount of renewable energy produced is mixed, as no effects are detected in the case of photovoltaic, but there are positive effects in the case of wind energy. An additional problem with these instruments is the uncertainty about their permanence, as they are subject to greater dependence on policy changes than other regulatory measures.
- **Guarantees and sureties:** Evidence suggests that such instruments reduce the risk for private investors, which favours the deployment of investment in renewables, especially for novel technologies and emerging economies. Nonetheless, if the guarantees are lax, there may appear to be negative effects due to overinvestment in lower-quality projects.
- **Carbon tax:** The initial evidence available suggests that the introduction of carbon taxes has a positive and significant impact on investment in renewable generation, as it makes renewable projects more economically attractive than those based on fossil fuels.
- **Emission Trading Systems (ETS):** This instrument is intended to encourage carbon emitters to internalize the costs of emissions and to encourage emission reductions. Policymakers set an emission limit (decreasing over time) and issue emission allowances. Emission allowances are auctioned or allocated for free and can then be traded. Companies with high marginal abatement costs must buy permits from companies with low costs or reduce their level of emissions. Although it may be a theoretically attractive instrument if implemented globally, the empirical evidence of the impact of ETSs on investment in renewables is inconclusive,
  In Europe, halfway through the first phase of the EU-ETS (2005-2007) the carbon price dropped to almost zero and remained so for the rest of the period. According to the OECD (2017), carbon prices need to range between €40 and €80/tCO_2 by 2020 for the Paris Agreement targets to have a chance of being achieved. However, currently, prices are below €40/tCO_2 for 93% of emissions and are below €80/tCO2 for 95% of emissions. In Europe, the price has never exceeded 32 EUR/tCO_2 since 2005.
- **Guarantees of Origin (GO):** these certify the production of one megawatt-hour (MWh) of electricity. These certificates are regulated by Directive 2009/28/EC, EU (2009), which states that the GO is an electronic document whose sole function is to prove to third parties that a certain amount of energy has been produced from renewable sources. Once issued, if the electricity producer is not subsidised, the GO can be traded. In the certificate market, the renewable energy producer who has obtained the GOs can earn additional revenue by selling them. Buyers of GOs, usually energy traders, use them to comply with regulatory requirements on the trading of renewable energy. GOs are certified by a government agency. The GO includes information on the technology used

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in production, and the location, type and capacity of the installation, in order to avoid double counting of certificates.

- Green bonds: A fixed-income financial asset, which offers a coupon for a certain period of time and which should be used to finance or refinance, in part or in full, climate change mitigation and environmental projects. Investment in renewable energies is the most common use of the proceeds, but there are other purposes such as investment in low-carbon buildings, investments in energy efficiency carbon buildings, investments in energy efficiency, low-carbon transport or sustainable management. These bonds are often linked to energy transition assets and backed by the balance sheet of the issuer (e.g. certified low-carbon buildings). There is no clear concept of the standards that a bond must meet to be called green. It is the issuer itself that labels it as a "green bond". This could slow down the growth of such instruments, due to the uncertainty, this creates for investors.
- Green investment banks (GIBS): This institution plays an important role in project finance, but their primary function is to act as facilitators and underwriters of private sector investment decisions. In this sense, while GIBs can invest directly in renewable generation assets or low-carbon infrastructure, their most important role is the provision of hedging instruments and transaction facilitators. GIBs help mitigate barriers to financing and, by leveraging public resources, use financial mechanisms that reduce risk and facilitate transactions in order to attract private investment. In addition, GIBs have been instrumental in overcoming barriers to investment in energy transition assets by expanding financing possibilities for smaller investments, through pooling and aggregation. In doing so, they succeed in reducing transaction costs and investment risk through their various credit enhancement actions. As a result, the risk of energy transition investments is reduced for private sector investors, increasing the likelihood of repayment of their investments, and leading to improved investment attractiveness.
  Thus, GIBs can provide confidence to private investors by acting as transaction leaders and co-investors in green projects. International experience suggests that GIBs can help significantly reduce barriers to private investment in LCR infrastructure needed for countries to mitigate climate change.
  The advantages and disadvantages of the most important financial instruments are set out below (Table 4).

Table 4. Pros and cons of financial parameters for renewable energy.

Instrument	Pros	Cons
Green Investment banks	1. Reduced risk for equity investors due to reduced credit risk. 2. Diversification of the risk of each project by being included in the GIB's portfolio. 3. Reduction of transaction costs through scale economies. 4. By acting as promoters and facilitators in the project, increases the confidence of other investors.	1. Limited capitalisation is done only through funds public and, therefore, the impact is limited.
Green bonds	1. Liquid assets traded on an organised market. 2. Transparent prices. 3. Reduced information asymmetry (rating agencies). 4. Corporative reputation.	1. Multiple accreditations (including accreditation by the issuer). 2.No independent verification of the status of the funds. 3. Lack of a clear definition of what a green bond is.

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Power Purchase Agreements	1.Ensures the stability of investments by bringing viability to renewable projects and reducing risk. 2. Increases the possibilities of project financing. 3. Price risk coverage and the fulfilment of sustainability objectives.	1. Ensures the stability of investment stability by bringing viability to renewable projects and reducing risk. 2. Increases the possibilities of project financing. project. 3. Hedging the price risk of price risk hedging together with the fulfilment of sustainability objectives.
GO	1. Stimulates the development of renewable projects by generating additional income for the energy producer	1. There is no organised national or European market. 2. Current negotiations bilateral. 3. Low volume in the market.

6. MAIN BARRIERS IDENTIFIED FROM INVESTORS' INTERVIEWS

Compared to investments in fossil fuel power generation, investments in energy symbiosis require heavy upfront investments, but have low operation and maintenance costs. This means that the investment risk is higher than in the conventional case and to compensate for this risk, investors require a higher return, which implies a higher cost of capital. This is compounded by the relatively small scale of many projects (energy efficiency and modernisation projects), as well as the lack of standardisation, liquidity, and transferability of financial instruments. All these factors act as impediments to investor participation.

Main barriers to scaling up Energy Efficiency Finance:

- Lack of demand.
- Connecting the public and private sector.
- Fragmented sector-alignment of actors.
- Lack of unified ecosystem of industry players: no agreed set of best practices, standard materials and processes, and regular exchange of information across the energy efficiency financing value chain.
- Incomplete and fragmented support: initiatives supporting the development, processing, and analysis of project finance exist, but are splintered, inefficient and temporary.
- Lack of continuous access to well-maintained, standardized materials: EU funded projects and other initiatives are typically specialised, and once they finish, knowledge often becomes dispersed or dormant.
- Lack of access to training on standardized material: even if materials are well-maintained, project developers may not have the internal knowledge or capacity to access training to learn how to apply these materials.
- Know Your Customer (KYC).
- Trust and knowledge.
- Manpower.
- ESG demands.
- Ownership transparency.

Key to overcome these barriers:

- KYC – making the project understandable for the financier.
- Social marketing (energy awareness) and 360 personalised assistances (technical, administrative, and financial advice).
- One-stop-shop + people-centric approach + qualified local professionals.

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- Engage private sector: provide mature leads, assist and reduce administrative tasks, provide user feedback.
- Engage the community using effective triggers: health, sustainability, explain all benefits, not only economic, use plain communication, making energy visible, building a trusting environment together with the local authorities, local energy communities, etc.

Summary of main barriers that investors in energy efficiency face (from investors interviews):

- Counterpart risk. Is the probability that the other party in an investment, credit, or trading transaction may not fulfil its part of the deal and may default on the contractual obligations.
- CO_2 reductions. The key requirement is to make a sustainability impact, typically in the form of CO_2 savings/reductions: it is a complicated process to demonstrate the decrease in CO_2 emissions thanks to the new technology.
- Long amortisation periods and uncertainty of revenue stream: Considering renewable energies other than solar and wind, there is still a lot of research and development to be done in order to pay back the investment in a short period.
- High cost of capital expenditure (CAPEX): Within renewables, there are different types of technologies, the more mature ones and those that are still under development, have a lower TRL and involve much higher capital costs. Biogas, biomethane, hydrogen, geothermal energy and wave and tidal power are examples of premature technology.
- Securing of input material and off-takers: due to the energy transition, the renewable energy market needs to be completed. This causes a lower number of potential buyers and lower furniture of materials needed to produce renewable energy infrastructures.
- Legal barriers: this can be a hard topic to overcome since each country has its own legislation, therefore, the investor would need to verify for each country in which is investing which are the legal terms.
- Space barriers: land occupation it can be a possible barrier, due to local legislation and soil occupation limits.
- Rising critical minerals impact clean energy technologies. This surge in critical mineral prices has been a major factor in reversing, at least temporarily, the trajectory of declining costs for some clean energy technologies.
  The share of cathode material costs (including lithium, nickel, cobalt and manganese) in the costs of an EV battery has risen from 5% in the mid-2010s to more than 20% today, at a time when some 300 new gigafactories are in planning and construction.
- Energy fluctuation: broadly known renewable energies have a fluctuating nature, meaning that there is no security of supply.
- Clean Energy investment rising-but not fast enough: Investment to bring more clean and affordable energy into the system is rising, but not yet quickly enough to forge a path out of today's crisis or to bring emissions down to net zero by mid-century, a critical but formidable challenge that the world needs to overcome if it is to have any chance of limiting global warming to 1.5ºC.
- Around 30GW of new coal-fired plants were approved in 2021: Although China has pledged to stop building coal-fired plants abroad, there is still significant new capacity coming onto the domestic market, with more than 20GW approved for development in both 2020 and 2021, and more than 15GW approved so far in H1 2022.
  Investment in oil, gas, coal and low-carbon fuel supply is the only area that, in aggregate, remains below the levels seen prior to the pandemic in 2019.
  This is despite sky-high fuel prices that are generating an unprecedented windfall for suppliers: net income for the world's oil and gas producers is set to double in 2022 to an unprecedented $4trn.

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- **Lack of a unified ecosystem of industry players:** No agreed set of best practices, standard materials and processes, and regular exchange of information across the energy efficiency financing value chain.
- **Incomplete and fragmented support**: A critical and largely invisible barrier. Initiatives supporting the development, processing, and analysis of projects for finance exist, but are splintered, inefficient and temporary.
- **Lack of continuous access to well-maintained, standardized materials:** EU funded projects and other initiatives are typically specialized, and once they finish, knowledge and collateral often becomes dispersed or dormant.
- **Lack of access to training on standardized materials:** Even if material are well-maintained, project developers may not have the internal knowledge or capacity, or access to training to lear how, to apply these materials.

7. TOOLS AND GUIDELINES

The aim of this section is to support the reader to know the most relevant tools in order to successfully achieve energy symbiosis investments. Having carried out an extensive literature review into this area, the decision was taken to summarize and signpost existing resources, rather than synthesizing this material into a single written document/chapter. This decision came from the realisation of two facts. Firstly, the complexity of this topic and volume of material required to address it is very large, therefore a single document would unlikely serve users well. Secondly, the quality of existing resources, along with their applicability for energy symbiosis, is high; significant

7.1 INCUBIS digital platform

The INCUBIS platform will include all existing and new resources, including guidelines, tools, best practices, training, etc. to create a place for all energy symbiosis facilitators and public authorities to find the information in a one-stop-shop.

Intending to provide support to facilitation teams and service delivery to ES projects, the **INCUBIS digital platform** has integrated different modules to help ES facilitators deliver services and assess the progress of the project and their facilitation action interventions. The INCUBIS Digital Platform follows the paradigm of the "Virtual Incubators" delivering Knowledge Intensive Business Services online through the integration of suitable ICT tools and modules to support and enable the provision of Energy Symbiosis Facilitation Services in the 4 case study regions.

The INCUBIS Digital Platform provides a working environment assisting the energy symbiosis facilitator along each stage of energy symbiosis project lifecycle building capacity at individual, organizational, regional and European levels to lift key systemic barriers. In concrete terms, The INCUBIS Digital Platform enables: i) to train stakeholders on methods and tools (Density map, Waste Heat Potential Map, Ranking of best potential ESI partners), ii) to facilitate delivering energy symbiosis projects (Synergies matchmaking and Project management tool), iii) to present standards and best available techniques (Webinars, Training, Mentoring, Best practices) and iv) to build capacity of investors by proposing an investor-oriented taxonomy of energy symbiosis (Investments and Funding portal).

7.2 I3CP

Industrial and Infrastructure Investor Confidence Project (I3CP) is an international programme to standardise the development of energy efficiency projects in order to reduce performance risk, reduce due diligence costs and enable aggregation of standardized projects. The project has developed a number of frameworks for developing and evaluating projects, along with a network of third-party auditors

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that can certify projects as being investment ready, providing investors with a much-needed technical support and confidence to invest.

7.3 PROPEL

The PROPEL project have designed and market tested a suite of collateral for the energy efficiency sector. The PROPEL Capacity Building Programme provides a steady flow of training materials and educational activities on our collateral designed to ease contracting, risk assessment, financing and client sales, allowing market players to speed up the closing and financing of larger numbers of energy efficiency project deals. Through the Capacity-Building Programme in PROPEL (CBP), energy efficiency stakeholders have now the opportunity to actively engage, obtain access to these materials and receive expert support and insights for increasing their deal flow.

7.4 SEFA

SEFA will continue to develop and maintain the standardised materials from PROPEL, acting as the centre of competence, and offering trainings on their use.

The Sustainable Energy Finance Association (SEFA) is an industry group that represents the clean energy ecosystem in Europe. Our aim is to advance the uptake and scale of sustainable energy projects, such as energy efficiency, distributed renewables, storage and electrification of transport.

We enable members to seamlessly deploy sustainable energy projects by providing all critical collateral and clear pathways to successful deal closure. Our ecosystem is representative of the whole value chain providing a voice at the table for all players within the sector.

SEFA aims to scale the sustainable energy sector in Europe by connecting and enabling key actors to accelerate project uptake and boost market growth, by providing a set of training materials that is made available through the Capacity Building Programme:

- The Standardised EEaaS contract offers a securitizable, off-balance sheet structure, that was co-developed with and reviewed by our network of funds and banks.
- The Hybrid Business Model approach combines standardized and flexible contractual elements, from performance-driven and service-driven contract models.
- Risk assessment protocol: The Risk Assessment Protocol represents a key tool to ensure the bankability of your projects and to gain the investors' trust
- ESG assessment template: Analyzing ESG risks provides crucial non-financial information that allows financiers to make better investment decisions in addition to purely financial data
- KYC tool: Compliance with KYC regulations helps ascertain credibility and deters money laundering and other run-of-the-mill fraud schemes

7.5 WASTE HEAT

The waste heat toolbox includes tools (WH Toolbox) and guides on investment decision making (including waste heat energy calculator), funding opportunities for each region, relevant business models, permits related to infrastructure projects for each region, relevant policy guides and link and good practice inventory for participating countries. The toolbox is available on waste heat platform.

7.6 HOOP

Developed 3 Investment Package Manuals:

- EU Taxonomy applied to circular bio-based activities

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- European investment package on circular bioeconomy for European Member States, Regions, and Cities.
- National and regional investment package on circular bioeconomy for European Regions and Cities.

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