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Investment models for industrial symbiosis

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1. Strategic Implementation Learnings

Challenges and barriers of industrial symbiosis financing

Industrial symbiosis projects face certain common challenges because of organizational, market, policy, perceptual and financial factors.

Organizational

- Dependency between firms
- Complexity of coordination
- Lack of internal assessment tools
- Misalignment with core business
- Investment cycle patterns
- Information asymmetry

Market/Policy

- Uncertainty
- Not being eligible for programs because of sectoral definitions
- Unclear or slow permit processes
- Lack of specialized financing support

Perceptual

- Financiers limited knowledge of industrial symbiosis
- Perceived high risks

Financial

- High up-front costs
- Long payback periods
- Unusual investment cases

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Financing stages

All industrial symbiosis projects are not homogenous and the most appropriate funding sources can differ based on the stage of development.

Pre-industrial symbiosis

- Characterized by testing, pilots and R&D
- Dominated by public funding (innovation grants, subsidies, tax credits, EU Horizon projects, etc.)
- Collaboration with universities and research institutes are key
- Partnerships such as Public-Private-Partnerships and Incumbent-Startup-partnerships can pool resources and drive up-scaling

Development stage

- Financing depends on risk level and investment size
- Retained earnings are most common source of financing, followed by government grants and loans
- Large-scale infrastructure often requires external financing and public involvement

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Risk mitigation strategies

Since industrial symbiosis projects usually are associated with an elevated perceived risk, risk mitigation strategies should be used to lower that perceived risk.

- Conduct pilot projects and upscaled proofs of concept
- Sign long term contracts & commitments (supply/purchase agreements) - if high level of dependence between actors
- Sign off-take agreements
- Use mixed funding sources
- Use Special Purpose Vehicles (SPVs) or Joint Ventures (JVs) to manage multi-actor financing
- Collaborate with large, credible partners for legitimacy
- Demonstrate track record and competency
- Make use of policy instruments (subsidies, guarantees, tax breaks, long-term commitments), but prepare for their removal
- Align with EU Taxonomy

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Role of institutions

Financial institutions are important in the financing of industrial symbiosis projects, but they have a wide variety of perspectives and roles.

Commercial banks

- Risk-averse
- Require guarantees/public backing

European financial institutions (EIB, NIB, EBRD)

- Fund large-scale, high-risk projects aligned with EU policy
- Provide technical support and favorable loan conditions

Local/regional banks

- Better at judging stability due to local ties
- May leverage larger banks

Public institutions

- Provide continuity but risk project gaps when grants expire

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Sustainability & policy alignment

For industrial symbiosis developers, sustainability and policy alignment unlocks funding opportunities and builds stakeholder trust.

- Industrial symbiosis projects can benefit from green/sustainable finance schemes
- EU taxonomy increasingly sets required sustainability indicators
- Subsidies are seen as bonuses, financiers prefer profitability without them
- Policies with long time horizons are crucial for stability

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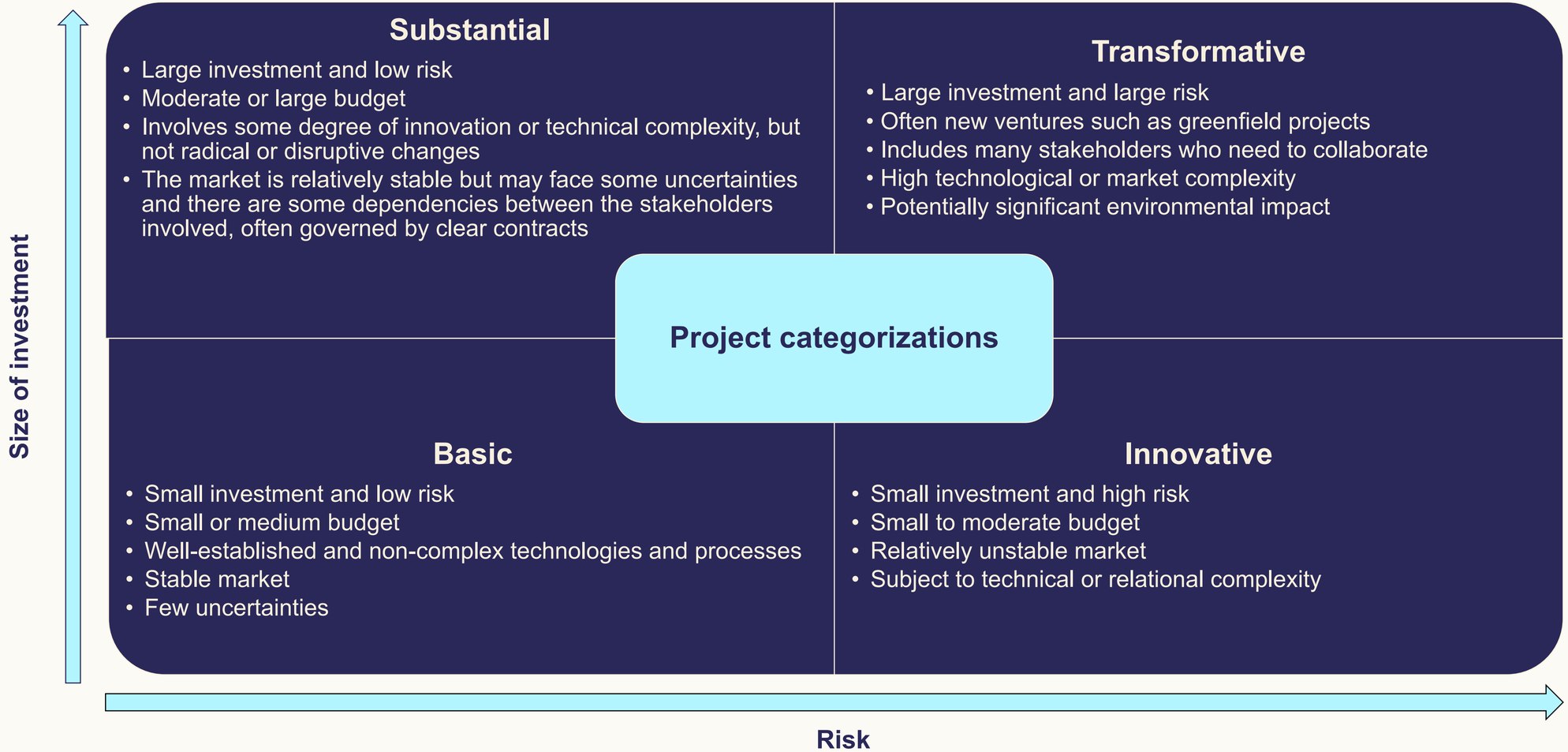
2. Models and Frameworks for Industrial Symbiosis Financing

Industrial symbiosis project categorization

CORALIS is an EU funded project exploring industrial symbiosis solutions, addressing technological, managerial and economical factors. As part of a three-step process for improving funding conditions for industrial symbiosis developers, they propose a categorization of industrial symbiosis projects, summarized below.



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CORALIS three-step process

1

Identify relevant funding sources

Depending on the categorization, different sources of funding are recommended.

Basic industrial symbiosis projects
Retained earnings is a common funding option for many industrial symbiosis projects. Other internal sources of funding have also been mentioned, such as financing from the mother company. Government grants are sometimes sought for such projects, but only if the benefits outweigh the transaction costs of obtaining the government funding.

Substantial industrial symbiosis projects
Retained earnings might not be enough and thus external funding is sought. The primarily source of funding. beyond retained earnings is loans from banks. If classified as environmentally friendly, it can potentially attract some grants from the government.

Innovative industrial symbiosis projects
Due to the high risk and low cost, it is hard for companies to access external funding including both debt and equity. Government grants are prioritized, but there are also possibilities through local angel investors.

Transformational industrial symbiosis projects
Internal funds are often not available, usually financing through debt, equity or a combination of both is needed. Government grants or subsidies are also often needed.

2

Identify relevant recommendations

Each industrial symbiosis project has its own unique characteristics, so it is ultimately up to the industrial symbiosis project developers to decide on the most relevant recommendations. Factors which industrial symbiosis developers should consider are:

Techno-physical
- Land acquisition
- Engineering and construction
- Innovation and technology
- Transport and logistics
- Supply and operations

Financial
- Demand and market
- Time-to-market
- Investment costs
- Future cash flows

Relational
- Collaboration
- Partners
- Communication and relationship management

Political
- Regulatory compliance
- Policy landscape

Sustainability related
- Prepare for financiers´ specific requirements and internal goals
- Align with EU taxonomy
- Use experts for evaluations

3

Implement relevant recommendations

This stage entails reading the recommendations, tailoring them to the specific conditions of the industrial symbiosis project at hand and then implementing them. industrial symbiosis project managers should also be aware of the possible development of new innovative funding sources in the near or distant future.

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Industrial symbiosis business models

Successful industrial symbiosis implementation depends on effective business models that decide the in- and outflows of resources to realize economic and environmental benefits. Below are some examples, based on real industrial symbiosis cases.

Pay for resources

Firms in the symbiosis pay each other for the resources that circulate. Which way the transaction flows depends on which value the waste stream has. For example, Lantmännen Agroetanol buys waste steam from Eon and pays for a biogas facility to handle some low value waste flows from their ethanol production.

Pay for resources and facilitation

Firms pay for resources and facilitation is included in the price. One example is Industry Park of Sweden, run by anchor firm Kemira. Firms who rent a place in the industry park get access to heat at a lower price and Kemira bring the different renters together based on their input and output needs.

Yearly fee

Firms pay a yearly fee to participate in the industrial symbiosis, e.g. Kalundsborg Symbiosis. By a cooperative association that the participating actors run, facilitation and development of the symbiosis is financed.

Pay for the connecting technology

One or more actors purchase a technical solution that becomes a link that creates prerequisites for collaborations in symbiosis form between the actors. Link firms Ekobalans and The Waste Transformers have this business model.

Link firm becomes part of the symbiosis

Another possibility is that a link company becomes a part of the symbiosis establishment. How the payment structure looks depends on factors such as what type of technical solution the link firm contributes with and what value the waste flows that are handled have.

Co-ownership

One possibility is that an output firm goes together with a link firm or an input firm and co-owns a processing stage. One company is the co-owned firm which Lantmännen Agroetanol and Linde formed for CO2 extraction from waste flows in ethanol production.

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Investment evaluation models

When incorporating circular economy principles into the production process and reflected in investments, it is important to assess the profitability of projects. In practical terms, five common methods are used to evaluate investment projects.

1

Payback period
The expected number of years required for the cash inflows generated by a capital investment to fully recoup the amount of that investment.

2

Net present value (NPV)
The difference between the present value of cash inflows and the present value of cash outflows over a period.

3

Profitability index
The present value of anticipated future cash flows divided by the initial investment made in the project.

4

Internal Rate of Return (IRR)
The discount rate at which the net present value (NPV) of all cash flows becomes zero in a discounted cash flow analysis.

5

Modified IRR
Considers the reinvestment of positive cash flows at the firm's cost of capital and the financing of initial outlays at the firm's financing cost.

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EU frameworks

Awareness of EU policy frameworks is important for industrial symbiosis projects to ensure compliance, access funding, align with sustainability targets, and strengthen competitiveness by anticipating regulatory trends.

Sustainable Finance Action Plan (SFAP)

- Reorients capital flows toward sustainable investments
- Mainstreams sustainability in risk management
- Foster transparency & long-termism

EU Taxonomy of sustainable activities

- Effort to consolidate environmental and sustainability related priorities
- Defines which activities are considered sustainable
    - Creates indicators used by sustainable funds, e.g. Article 9 funds
- Guides investors, firms and policymakers

Circular Economy Action Plan (CEAP)

- Promotes industrial symbiosis across member states
- Prioritizes the food sector among other sectors

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