



# PROPOSAL SUBTASK

## Subtask #3

### **“Energy- and carbon-oriented Industrial Symbiosis” in Task XXI “Decarbonizing industrial processes in a circular economy framework”**

Coordinated by

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## 1. Background

Task XXI aims to investigate the topic of circular carbon from an industry perspective, i.e., to describe industrial energy systems in the context of a sustainable, fossil-free economy, striving to meet the targets of both concepts by developing a resource efficient and circular economy and a sustainable energy system.

Resource efficiency, by way of circular transitions such as industrial symbiosis, and development of a fossil-free economy will inevitably play an important role in a sustainable economy. Both future systems, i.e., the circular economy and the fossil-free economy, are rarely considered together in science and discourse, although they interact or often contradict each other.

Carbon is a key element in both systems. For industrial production, carbon in its various forms (hydrocarbons) plays an essential role as a raw material that is difficult to replace. The use of energy cannot enter a closed loop due to the laws of thermodynamics, and hence the efficient use of this resource should be a priority focus. But for carbon circulation is pivotal in order to greenhouse gas emissions. Carbon should be circulated both in the energy and in the product sector, striving for a Carbon Cycle or a Circular Carbon economy. There is a strong connection between energy efficiency and circular carbon since the circulation of carbon molecules requires energy inputs, and it is thus important to understand the effects of circulation so that the solutions are aligned with sustainable/fossil free development.

One goal of the work conducted within the first year of IETS Task XXI was to identify white spots to be included in subsequent new/updated subtasks. At the end of 2021, it became obvious that the activities carried out are, on the one hand, broad and attract many participants/groups, but are, on the other hand, too broad to allow for concrete joint elaboration and exchange from projects. In order to narrow down the activities with regard to contents and methods, also at the risk of losing groups involved in Task XXI in 2021, the Task management contacted all groups/participants asking for their interests and projects they can associate with potential activities. They were also free to propose own activities. In the following, only activities that received interest from at least 3 participants/groups are mentioned. The potential subsequent subtasks and activities are:

- Subtask: Circular Carbon<sup>1</sup>
  - Activity: LCA and Energy System modelling
  - Activity: Integration of carbon capture in industry
  - Activity: Networking with other IETS Tasks and other TCPs' Tasks (e.g., ETSAP)

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<sup>1</sup> Please note that during the preparation phase of the subtask circular carbon proposal, due to further inputs and refining, the activity names have changed compared to the December 2021 headlines.



- Subtask: Industrial Symbiosis
  - Activity: Definition and delimitation
  - Activity: Good practice examples and new development in knowledge
  - Activity: Business Models
  - Activity: Networking with other IETS Tasks and other TCPs' Tasks (e.g., IETS Task XI)

## 2. Objectives and Scope

Industrial symbiosis is an approach aiming to make industrial processes more efficient and circular through collaborations across organizational and sectorial boundaries. With this subtask, industrial symbiosis is to receive a central place in the range of activities of the IETS. Due to the focus of the IETS, energy and greenhouse gas emissions are central, which explains the integration under the umbrella of a joint task with Circular Carbon.

### 2.1 Objectives

Industrial symbiosis supports the climate neutrality of industry through reuse of former industrial waste streams and thus energy savings in production, as well as through cooperation in avoiding emissions. Recycling or reusing end-use products shall not be in the focus of this subtask. Please also note that Industrial symbiosis in the area of heat is assigned to IETS Task XV “Excess Heat”, if this heat is not directly related to the energies and resources considered here.

The following four Activities are proposed for this Subtask.

- Activity A: Definition and delimitation: Industrial symbiosis has been found to have received a variety of definitions. Among them there are also well-established ones. Nevertheless, in the analyzes of the IETS Task XXI in 2021, it was not possible to clearly differentiate them from other, usual business activities of industrial companies just by using the definitions. The aim of this activity is to discuss industrial symbiosis as a concept, to classify the definitions, and to determine a working definition (limiting for the reasons given above) for this subtask.
- Activity B: Good practice examples and new development in knowledge: Industrial symbiosis is a concept for which practical examples are available, but there is also a lot of currently ongoing development in terms of aligning assessments and facilitation with sustainable development. Examples of practical work from existing symbiosis networks that fit the scope of this subtask, e.g., in terms of facilitation processes, assessments, technical solutions, will be identified, summarized and discussed. Current new development in research will also be identified, summarized and discussed, e.g. in terms of how relevant research can be turned into good practice. The activity will lead to an evaluation and knowledge buildup in terms of what is and should be/will be



good practice for developing and operating sustainability oriented industrial symbiosis networks within the frameworks of IETS Task XXI.

- Activity C: Business Models: The architecture, engineering, construction and facility management of industrial symbiosis are known to be risk-averse and highly sensitive to capital cost. The key to overcoming these barriers is access to compelling evidence of the business case for adoption, and evidence of existing business models that tangibly demonstrate how the industrial symbiosis can be implemented and risks managed. The task will review and explore the barriers and incentives of the adoption and implantation of industrial symbiosis, and existing business models of industrial symbiosis.
- Activity D: Networking: This is a broad topic and its scope overlaps with part of the work done in many other IETS Tasks as well as other IEA TCPs. It is therefore important to develop channels of communication that allow for not only exchange of information but also to explore possibilities for carrying out joint actions (for instance workshops) that would be of mutual benefit. This activity aims to establish collaboration between the proposed Subtask and other Tasks in IETS as well as with the fitting TCPs. The first step will be to identify joint activities that can be conducted with minimal extra efforts from the parties. This could include participating in each other workshops. As a second step, it will be explored the possibility to carry out a joint activity, for instance, a joint workshop or a shared activity in subsequent subtasks.

In general, all activities and subtasks shall seek to identify new/updated subsequent activities/subtasks.

## 2.2 Scope

Generally speaking, all IETS Tasks should be based on energy efficiency and/or GHG mitigation. If other resources than energy can contribute to that, an extension of the scope is legitimate, but the energy and GHG benefits must always be highlighted. In order to comply with this regulation, the system boundaries of the four activities are limited to energy and greenhouse gases.

Delimitation of Industrial Symbiosis: The main focus in this subtask will be on industrial symbiosis for reducing primary energy use whilst also reducing greenhouse gas emissions in alignment with sustainable development. Energy efficiency is strongly connected to e.g., water efficiency through the Energy-Water nexus, i.e., reducing water use in an industry can substantially reduce energy demand and vice versa. Also, other material waste streams can be strongly connected to the energy demand, e.g., the use of waste streams in production will affect the performance of the production system in positive or negative direction, requiring a change in energy demand. In this subtask, however, the main focus will be on **direct** primary energy reduction within the industrial symbiosis context. In terms of sustainability the main focus will be on greenhouse gas emission reduction from a holistic perspective, but effects on other



perspectives on sustainability will be discussed in order to understand/highlight potential contradictions in terms of benefits.

### **3. Organization of work**

The work of the subtask will be subdivided into four activities. In the following, the activities' proposed leaders, objectives, preliminary methods (to be detailed in early activity work) and targeted deliverables are mentioned.

After approval of the subtask, the subtask leader should send out a template for inquiring about the projects of the subtask participants. The template collects the general project description, information on the priorities the project sets and a proposal for assignment to the activities, and clarifies to what extent the project goes beyond the current state of knowledge. In cooperation with the participants, the subtask leader may carry out additional literature research.

#### **3.1 Activity A: Definition and delimitation**

Activity leader: Energieinstitut an der Johannes Kepler Universität Linz

Aim of the activity:

- Subactivity A1: Discuss how to ideally delimitate Industrial Symbiosis in this subtask. Is Industrial Symbiosis for purpose in order to also achieve sustainability goals, or is it also allowed to happen accidentally?
- Subactivity A2: Discuss the various appearances Industrial Symbiosis can have, clarify the need of Industrial Symbiosis to follow sustainability goals, delimitate how it distinguishes from normal business activities.

Preliminary methods: Preparation of results derived in subtask 1, discuss the content of definitions of Industrial Symbiosis versus its stated intentions and its classification in the branches of science.

Deliverable: Joint elaboration of a workable delimitation for the use in the subtask, contribution to the final subtask report.

#### **3.2 Activity B: Good practice examples and new development in knowledge**

Activity leader: RISE Research Institutes of Sweden AB

Aim of the activity: Collection and evaluation of energy- and carbon-related good practice examples from existing industrial symbiosis sites around Europe. Collect, assess and discuss new developments in research from expert organizations (i.e. academia and institutes etc) around Europe. Create a portfolio of existing and new types of good practices for developing energy efficient and low climate impact industrial symbiosis sites that can serve as motivation/support for new developments.

Preliminary methods: Jointly discuss the definition of good practice in terms of industrial symbiosis. Included in the definition should be a categorization of type of symbiosis, a definition of the different phases in developing and operating symbiosis networks. Good practices will then be elaborated with two perspectives:



- Practical focus, i.e., focusing on existing symbiosis networks and how they operate and develop: Based on the definition, examples of good practice with regard to different aspects of developing and operation a symbiosis network will be collected. This can be aspects like facilitation, technical solutions, business models, agreements, assessments digital tools used etc.
- New development focus: Based on the definition, examples of new developments in methods and tools from expert organizations will be collected. This can be digital tools, system-based assessments, economic models.

The collection of good practices will be discussed by the involved actors in this activity, with the aim of finding ways to package and disseminate the knowledge collected to a broader audience.

Within the activity different ways to allow other IETS Tasks, especially IETS Task XI, and other Tasks of TCPs, to contribute to the collection will also be defined and included.

Deliverable: Report “Good practice and new development in knowledge for developing energy- and carbon-related industrial symbioses in alignment with sustainable development”.

### **3.3 Activity C: Business Models**

Activity leader: SDU Center for Energy Informatics

Aim of the activity: This activity will create new knowledge with the combination of literature review, use cases and data input from involved partners. This activity will share knowledge with best practices & lessons learned via exchange with stakeholders within the international network. The activity’s outcomes will enhance the adoption of the industrial symbiosis concept to achieve the goals of GHG Emissions Reduction.

Preliminary methods:

- Literature Review: Review barriers and incentives and existing business models
- Qualitative and quantitative data collection: E.g., interviews and questionnaires; Get input from related partners regarding strategies and other related information
- Multi-case analysis: Review and analysis of selected cases to investigate the potential of business model innovation.

Deliverable: Report “barriers, potentials and business models for industrial symbiosis implementation”.

### **3.4 Activity D: Networking**

Activity leader: RISE Research Institutes of Sweden AB

Aim of the activity: leverage synergies with other IETS Tasks and other TCPs’ Tasks. Based on the work and networking done in 2021, a close communication with IETS Task XI (Subtask preparation “Circular Bioeconomy and Biomass-Oriented Industrial Symbiosis”) is appropriate. Moreover, IETS Task XV (Activity preparation on “Industrial Symbiosis for Waste Heat”) will be contacted in order to establish communication. Other Tasks such as IETS Task XX on Industry Transition Roadmaps, and Task XVIII on digitalization will also be contacted, among others.



Preliminary methods: Identify and define IETS Tasks and other TCPs’ Tasks that are thematically interlinked. Initiate communication with Task leaders and Subtask leaders in these tasks, and discuss ways of collaboration. Organize workshops or other types of knowledge exchange activities in order to leverage the work done in each task.

Deliverable: Protocols and implications of networking activities [non-public], which is communicated to the IETS Task XXI leader and/or the IETS ExCo and an overview is integrated in the [public] Final subtask report.

## 4. Deliverables

The main deliverables in the Subtask will be the

- Final subtask report.

The Subtask leader is responsible for report creation and the framework text. The activity leaders contribute with subchapters on aims, methods, results and conclusions (or other, if appropriate) of the activity.

More specifically, the deliverables mentioned in section 3 are derived for the activities.

- Definition and delimitation: Joint elaboration of a workable delimitation for the use in the subtask, contribution to the final subtask report.
- Good practice examples: collection and evaluation of good practice examples, summary to be included in the final report.
- Business Models: Report “barriers, potentials and business models for industrial symbiosis implementation”.
- Networking: Summary of interactions, conclusions and recommendations, to be included in the final report.

## 5. Program Subtask Plan

The time schedule and the amount of work performed in the Subtask will be the following:

	22/Q3	22/Q4	23/Q1	23/Q2	23/Q3	23/Q4	24/Q1	24/Q2	24/Q3	24/Q4
Act. A	x	x	S1	x	x	x	S2			
Act. B	x	x	x	x	x	x	x	x	x	x
Act. C	x	x	x	x	x	x	x	x	x	x
Act. D	x	x	x	x	x	x	x	x	x	x



## **6. Dissemination**

### **6.1 Dissemination**

The results from the Subtask will be disseminated through the following activities:

- Final subtask report, presented to IETS executive committee and prepared for publication on the IETS homepage. The activity leaders contribute with subchapters on aims, methods, results and conclusions of the activity.
- Presentation at scientific conferences and, in parallel, as conference articles.
- Presentation at not-yet-specified workshops of other IETS Tasks, other TCPs, other TCPs' Tasks, related research projects, or similar, when available or requested.
- If applicable, dissemination of innovative results through scientific papers

### **6.2 Intellectual property rights**

All main results from the Subtask, including outcomes from workshops, shall be open. Parties participating in the Subtask, however, may decide if a small part of a report shall be confidential. Any uploaded / shared material shall mention the original author. Unless otherwise stated and agreed, the author agrees that the material may be used and copied without restriction.

## **7. Duration of Subtask**

This Subtask shall enter into force on July 1st, 2022, and shall remain in force for a period of 2.5 years until December 31th, 2024.

## **8. Resources**

The Subtask manager and, if applicable, the activity leaders will be the following:

Subtask manager:	RISE Research Institutes of Sweden AB
Activity A leader:	Energieinstitut an der Johannes Kepler Universität Linz
Activity B leader:	RISE Research Institutes of Sweden AB
Activity C leader:	SDU Center for Energy Informatics
Activity D leader:	RISE Research Institutes of Sweden AB

## **9. Obligations and Responsibilities of the Participants**

Participants to the Subtask commit themselves:





- to contribute actively to the Task with the results from at least one project, already ongoing or recently finished in their group or country. The project(s) will count in the person-month contribution.
- to provide their activities on their own costs but may actively strive for the corresponding funding of personnel and travel costs.
- to actively contribute to the work with the synthesis report.

Each participating country shall contribute with an amount of work corresponding to at least one person-month per year plus one international travel during the Subtask duration. This includes responsibilities for contributing to the synthesis report. In accordance to the practice in the TCP IETS, projects/results that are already financed by the groups/countries and are brought into the Subtask will count towards the person-month contribution.

## **10. Participants**

Participants confirmed to commit immediately after subtask approval:

- Sweden
- Austria
- Denmark

Other participants (IETS members) are not confirmed but can also join immediately after the approval of the subtask proposal.

## **11. Subtask management**

### **11.1 Subtask management effort**

The workload for managing the Subtask, in addition to the Subtask manager's own contribution as a participant, will be at least one person-months per year.

### **11.2 Subtask host country and funding**

The costs for Subtask Management will be borne by the countries hosting the Subtask managers. The Subtask Manager will be proposed and funded by Sweden.

### **11.3 Subtask management obligations**

The Subtask Manager shall:

- organize meetings (telephone meetings, webinars or face-to-face meetings) and workshops in accordance with the description in the Subtask proposal,
- coordinate the work within the Subtask (including dissemination actions),
- be responsible for a synthesis report of the work in the Subtask,
- with help of the other participants and the IETS executive committee and secretariat, identify new participants for the Subtask.



Contact details

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