BEST PRACTICES – INDUSTRIAL SYMBIOSIS
FACTSHEET

Improving Cold Chain Energy Efficiency in food and beverage sector

'Resource recovery towards circular economy'

Italy
Fruit & vegetables

TRL 5

Industrial symbiosis: by-products exchanges

By-products exchanges allow the recovery of resources (e.g., mass and energy) from waste streams including food production plants and other players in the geographical proximity. These synergies can improve the overall sustainability of such processes from both economic and environmental points of view.
Resource recovery represents a key pillar in the transition from a linear to a circular economy.

Savings
0.68 – 1.6 M€/year

Main NEBs (other benefits)
Reduced greenhouse gases emissions
Improved productivity
Lower dependence on fossil fuels

Description

Among the different transactions characterizing the Industrial Symbiosis (IS) there is the by-products exchanges which refer to business-to-business relationships that mimic symbiotic interactions between organisms, where surplus resources generated by an industrial process are captured and redirected as 'new' input into other processes providing mutual benefits instead of being thrown away.

What is the improvement focus?

The main principles of industrial symbiosis include ensuring economic and environmental advantages for the involved companies and society and ensuring the least distance between companies that are implementing the by-product exchange in order to exploit the synergistic potentials offered by geographic proximity [1,2]. As the nature makes a complete and continuous recycle of every material, Resource recovery in industrial symbiosis networks represents a key pillar in the transition towards closed-loop solutions and circular economies for which everything is recycled or re-used and nothing destroyed, i.e. no waste and pollution are produced.
In the domain of food and beverage industry, different synergies can be found for the valorisation of by-products [3]: e.g., separation of valuable material from industrial food waste, utilization of food waste as a substrate/reactant in creating valuable compounds through fermentation, energy recovery form

waste food or excess heat from nearby industries.

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Benefits

IS represents a great opportunity to optimize the efficiency and the utilization of the resources and, at the same time, to improve environmental, economic and social performances leading to huge competitive advantages [2,4,5]. This is mainly due to the fact that the global benefits introduced with the industrial symbiosis network are greater than the sum of the single benefits that the actors could individually generate [6]. Moreover, a broader vision of industrial symbiosis considering an increasing collaboration between private companies and regional or national authorities, through public-private partnerships, allows to gain greater benefits also for public organizations [7]: (1) improved performance of the public service facilities; (2) reduced and stabilized cost for providing services such as heat, cooling and electricity to public service facilities (e.g. hospitals, offices and schools) leading to greater cost-efficiency and (3) reduced environmental impact.

Horticulture case study

In this case study, we consider the industrial symbiosis potential between an energy-intensive factory that make use of forging processes, and a nearby greenhouse installation [8]. The considered industrial process is particularly suitable for the application of carbon capture and utilization (CCU) through horticulture enrichment. Firstly, the properties of the process exhausts (such as the level of contaminants, and the temperature) match the requirements of the CO_2 horticulture enrichment. Secondly, the close proximity to an existing greenhouse installation allows the direct transportation of CO_2 through pipelines. The symbiotic potential among the industrial installation and the horticulture process could be exploited by using the waste heat and CO2 emissions of the forging process for, respectively, the heating of the greenhouse, and the supply of CO2 to the horticulture enrichment process.

If we consider only the synergy focusing on the use of CO_2 enrichment as CCU method for the reduction of industrial emissions, it is possible to reach economic savings, and to reduce the environmental impact with respect to a scenario without CO_2 enrichment and to a scenario with CO_2 enrichment provided by a traditional system (i.e., heaters burning natural gas).
The results highlight three different economic savings: the increase of revenues deriving from the CO_2 enrichment process, the savings due to avoided natural gas consumptions (used in traditional CO_2 enrichment methods), and savings due to the reduction of CO_2 emissions in the industrial installation.
In the considered case study, the implementation of the industrial symbiosis network would lead to economic benefits between 0.68 and 1.6 M€/year, assuming 2 production cycles per year, which corresponds to the typical cultivation schedules for the selected crops (i.e., tomatoes, cucumbers, and strawberries).
At the same time, the exchange of CO_2 among the forging process and the greenhouse installation would allow to recover from 1,500 to 2,000 tons of CO_2 per cycle, which represent from 16 % to 21 % of the overall carbon dioxide emissions of the considered industrial installation.

Opportunities and barriers to implementation

Opportunities	*Barriers*
Reduced greenhouse gases emissions	Investment cost
Improved productivity	Requires more R&D
Lower dependence on fossil fuels (i.e., natural gas)	
Economic savings	

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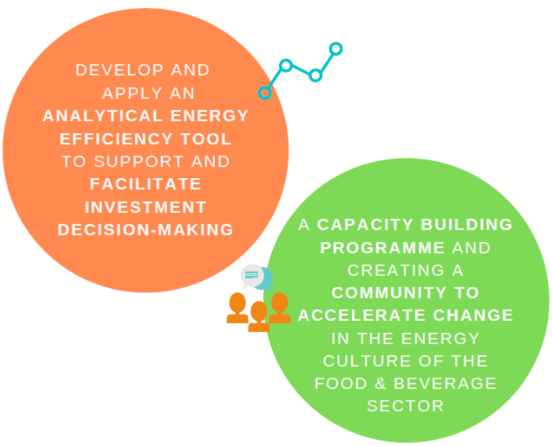
About ICCEE

The project ICCEE, www.iccee.eu, funded by the EU programme Horizon 2020, aims at improving energy efficiency in the cold chain of the food & beverage sector and making it easier for the sector to:

- undertake energy efficiency measures across the entire supply chain and
- accelerate the implementation of energy audit results.

ICCEE follows a holistic approach that moves from a single company perspective to the assessment of the entire cold supply chain. Existing financing schemes for SMEs will be assessed: the optimal ones will support the implementation of energy efficiency measures. ICCEE objectives build on 2 pillars:



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