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Report on the exploitation of the tool to additional supply chain

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Project information

Project Title	Improving Cold Chain Energy Efficiency
Project Acronym	ICCEE
Project Number	847040
Project dates	September 2019 – August 2022
Abstract	<p>The ICCEE (Improving Cold Chain Energy Efficiency) project will facilitate Small and Medium Enterprises (SMEs) in the cold chains of the food and beverage sector to undertake energy efficiency measures (EEMs) after carrying out supply chain energy audits. The focus on the cold chains of the sector is due to the significant energy requirements (refrigerated transport, processing and storage) with large potentials for savings. The implementation of the holistic approach, shifting from the single company perspective to the chain assessment, lead to increased opportunities for EEMs. To enable the update of EEMs, ICCEE will a) implement and apply an analytical energy efficiency tool to support and facilitate decision-making at different company organisational levels and b) launch a capacity building program towards staff and relevant stakeholders and a community dedicated to support a change in energy culture of the sector. The feasibility of EEMs will be evaluated by considering economic, environmental and social impacts encompassing their entire life cycle and the entire supply chain. Non-energy benefits and behavioural aspects will also be addressed and recommendations on financing schemes for SMEs will be assessed. The first part of the trainings will reach 300 companies through 20 national workshops thanks to the collaboration of associations in the consortium.</p> <p>32 companies will be trained for the use of the tool in 4 EU workshops. At a final step, ICCEE will launch e-learning courses, which will be available also beyond the project's lifetime reaching at least additional 64 companies. ICCEE will introduce primary energy savings (118 GWh/year), increase invested capital in sustainable energy (64 million €), and reduce GHG emissions (40,376 tonCO₂/year). Capacity building activities allow to increase stakeholders' knowledge and enhance their energy culture (2000 people). Outcomes from ICCEE will also support policymakers in defining tailored policies for the sector.</p>

Rev.	Written by	Date	Checked by	Date
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About

The project Improving Cold Chain Energy Efficiency (ICCEE) will accelerate turning energy efficiency opportunities of small and medium sized enterprises (SMEs) of the sector into actual investments and create a clear understanding of the opportunities offered by improving energy efficiency for companies' staff.

The specific objectives of ICCEE are:

- 1) Implement and apply an analytical energy efficiency tool to support and facilitate the decision-making processes of the companies in the supply chains in assessing their current energy performance of the supply chain,
- 2) Identify the energy saving potential of companies and support investments in viable energy efficiency improvement measures,
- 3) Create a capacity building programme and a community dedicated to support the change in the energy culture of organizations improving their energy performance through direct training and the development of an e-module.

ICCEE will make it easier for SMEs in the cold chains of the food and beverage sector to undertake energy efficiency measures (EEMs) after carrying out supply chain energy audits.

Focus on the cold chains was decided due to the significant energy requirements (refrigerated transport, processing and storage) of the sector, with large potential for savings. The cold supply chain is among the most energy-intensive systems within the food and beverage sector whilst there is limited understanding of its large energy efficiency potential and the economic advantages that can be obtained from energy saving measures.

The implementation of a holistic approach, shifting from the single company perspective to the chain assessment, leads to increased opportunities for EEMs.

ICCEE is coordinated by the University of Brescia with 12 partners: IEECP, FIRE (Federazione Italiana per l'uso razionale dell'energia), Adelphi Research Gemeinnützige, ATEE (Association Technique Energie Environnement), Fraunhofer, Riga Technical University, ESCAN, SPES GEIE, ECSLA, Chamber of Korinthia, University of Stuttgart, and Romalimenta.



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Project partners





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Introduction

A prerequisite in order to realize transfer of project results and products into their professional domains is to ensure that potential end-users are informed about the project and its developments. This is part of the actions the project plans to bring visibility for target end-users and stakeholders.

To increase the impact of the project it was considered important to disseminate the tools developed within the project also to other supply chains of the food and beverage sector that were not directly considered among the pilot ones.

The aim of this activity is also to build a partnership with the industrial associations and other relevant organizations that are already active in similar venues to act as a platform for best practice and knowledge sharing from the learnings of the project that can be carried forward even after the end of the project.

To reach such result, was developed a questionnaire that the partners involved in this task have submitted to the companies identified at national level. The aim of the questionnaire is detecting the degree of understanding of the tool, the potential improvement actions that can be carried out on the tool to facilitate or to allow its use in specific sectors and on the usefulness of its use. The results of the surveys carried out are reported in this deliverable.

1. Description of companies

As part of the activities carried out, 25 companies all around Europe were got in touch with; in some cases on site visits were organized in order to understand the various aspects of the production process. Partners developed a survey with the aim of analyzing additional supply chains with respect to those considered during the workshops. The group of stakeholders analyzed gives an overview of the food and beverage sector since the interviewed companies carry out different activities and output different products such as:

- Dairy
- Meat
- Fish
- Food Retail
- Pastry/Ice cream
- Fruit and Vegetables
- Wine
- Refrigeration technologies production

The numbers relating to the companies analyzed by partner and by sector are shown below.

Partner	Companies involved
Anaptyxiaki Epimelitiriou Korinthias	2
Associat Technique Energie Environment (ATEE)	2
Federatia Patronala Romana Din Industria Alimentara-Romalimenta	11
Federazione Italiana per l'Uso Razionale dell'Energia (FIRE)	6
Spread European Safety Geie (SPES)	2
Università degli Studi di Brescia	2

Table 1 - Number of companies involved by ICCEE partners

Sectors	Companies involved
Dairy	4
Distribution	1
Fish	1
Fruit and vegetables	8
Meat	12
Pastry/Ice Cream	2
Technology	1

Table 2 - Number of companies involved for each sector

As shown in above tables, meat and fruit/vegetables are the most analyzed sectors while Romania and Italy are the countries in which there were more interviews and visits.

In most cases it was possible to get in touch with people belonging to the highest levels of organizations; meetings with CEOs, presidents, managers and production cycle experts made it possible to achieve a high detail level. It should be noted that companies operating in food and beverage sector are often characterized by complex production processes that operate with a multiplicity of raw materials which are subjected to different sub-processes to return varied final products.

In this context, it becomes crucial to interface with people having a top view of the activities and who is not only expert in one segment of the process but who has sufficient knowledge of all the different sequences. Furthermore, the study involved different actors operating on the same food product carrying out different activities: for example in the case of meat, the study concerned raw materials suppliers, producers, trade associations and retailers. Another aspect to consider in order to fully understand the complexity of the sector analyzed concerns the fact that the companies that were got in touch with / visited output products intended for human nutrition, therefore they are subjected to controls to ensure compliance to laws and regulation and keeping of quality standards.

These obligations for companies are a priority that is above energy efficiency and reducing consumption, contrary to what could occur in other sectors in which energy saving does not risk impacting the quality of the final products.

It should also be noted that in the food and beverage sector many processes have remained linked to traditional habits that are difficult to overturn even if from an energy point of view they can be organized in a different way to obtain the same results while consuming less. In many cases the cold supply chain is not managed to optimize consumption but to ensure compliance with long-established processes that distinguish the final product on the market, even for purely commercial reasons and to protect the brand.

This aspect is particularly important for products protected by geographical indications like protected geographical indication (PGI) and protected designation of origin (PDO) like cheese, wine or ham which must maintain a high quality level to ensure that they are recognizable and appreciated all around the world, therefore in production process experience, recognized know-how and tradition come before energy saving opportunities.

2. Survey results presentation

During meetings with the identified stakeholders, FIRE presented the benefits of using ICCEE tools and involved people from companies to extrapolate opinions and comments. To facilitate the collection of feedback, FIRE developed an interview and a questionnaire in which companies are invited to express themselves on the following points:

- **If they consider the tool(s) useful for their organization**
- **If they find the tool(s) easy to understand**
- **If they think that inputs required are easily available**
- **If they think there is a need for specific training for the staff involved in using the tool(s)**
- **In their opinion what functions could be involved in using the tool(s)**
- **In their opinion if staff involved in using tool(s) needs specific training and at what level**
- **If they retain necessary to tailor the tool(s) for their specific cold chain and how**
- **Suggestions to improve tool(s)**
- **Specific adaptations to make the tool more useful**
- **Availability to join IIN platform**

The results of the survey reveal a varied situation depending on the reference sector and the country of origin.

The Italian partners (FIRE and University of Brescia) carried out 9 on site visits to the companies during which they involved people from the organizations in the compilation of the tools.

During these visits, FIRE and UNIBS carried out the following activities:

- **Inspection of the production plant with data and photos collection;**
- **Interviews with operators and production managers;**
- **Presentation of the ICCEE project, its tools and its aims;**
- **Compilation of the tool with the support of the production process experts;**

This operation made it possible to extrapolate data from the production lines and show the results of the tool directly to stakeholders facilitating the understanding of the usefulness of the tool itself.

As shown in Table 3 Table 4, most of the companies involved showed their interest and satisfaction and found tools useful or very useful for their organization and easy to understand.

Do you think the tool(s) presented is useful for your company?	Answers (%)
Not at all	0
Somewhat	4
Moderately	20
Very much	36
Completely	40

Table 3 – Answers about tool usefulness

Most stakeholders believe that the tool is “*useful for achieving a global understanding of the production site energy consumption*”. Companies have stated that the tool can be useful as “*a first step towards making processes more efficient*” and “*towards a change in the management of the cold supply chain*”. For many companies the usefulness of the tool is linked to its “*ease of use*” which does not require extensive training.

Do you find the tool(s) easy to understand?	Answers (%)
Not at all	0
Somewhat	8
Moderately	32
Very much	52
Completely	8

Table 4 - Answers about tool understandability

Almost all the companies involved highlighted the need to customize tools to make them capable of effectively representing their production cycle.

This aspect shows how the usefulness of the tool for stakeholders increases the more that the tool is able to adapt to the specificities that each production includes.

Clearly this evolution towards customization must be combined with the need to have a tool that is as flexible and generic as possible in order to be able to adapt to very different realities.

The questionnaire has been structured in such a way as to provide companies with the possibility of returning information on which internal function is most involved in the use of the tool.

Specifically, the stakeholders had to indicate which of the following functions in their opinion could be involved in the use of the tool and what level of training for the staff of each function was necessary:

- **Direction**
- **Management**

- **Production**
- **Maintenance**
- **Purchase**
- **Other**

It is possible to analyze the results of this survey aggregating data by:

- **sector to which the companies belong**
- **country of origin**

Following diagrams show which cold chain stage(s) are covered by the interviewed enterprises. The Cold chain stages considered are:

- **Raw material (Farming, fishing, growing, milking, etc.)**
- **Transformation**
- **Market**
- **Distribution center**
- **Retailer**
- **Single drop transport**
- **Multi drop transport**

The following figures (Figure 1 to Figure 7) shows the stage coverage by sector.

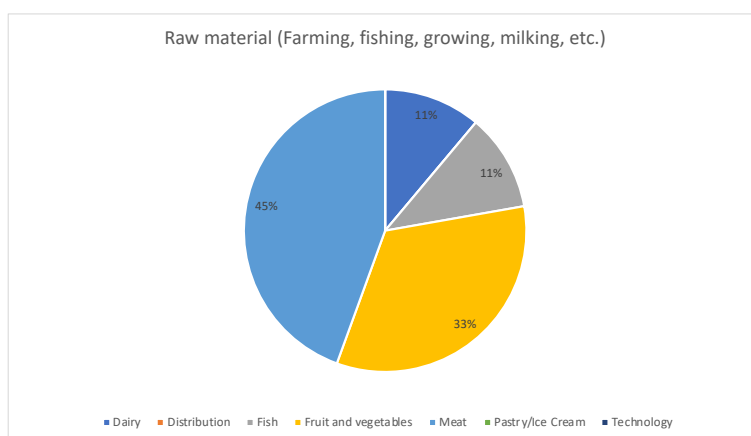


Figure 1 - Percentages of answers about raw material for each sector

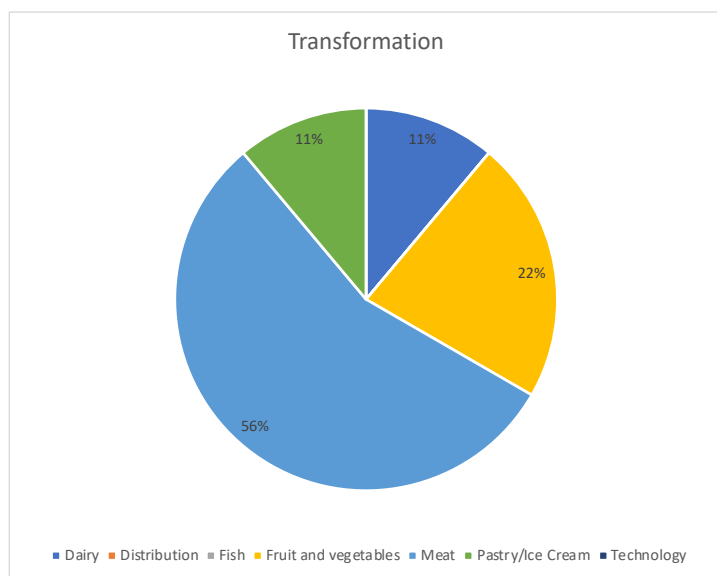


Figure 2 - Percentages of answers about transformation for each sector

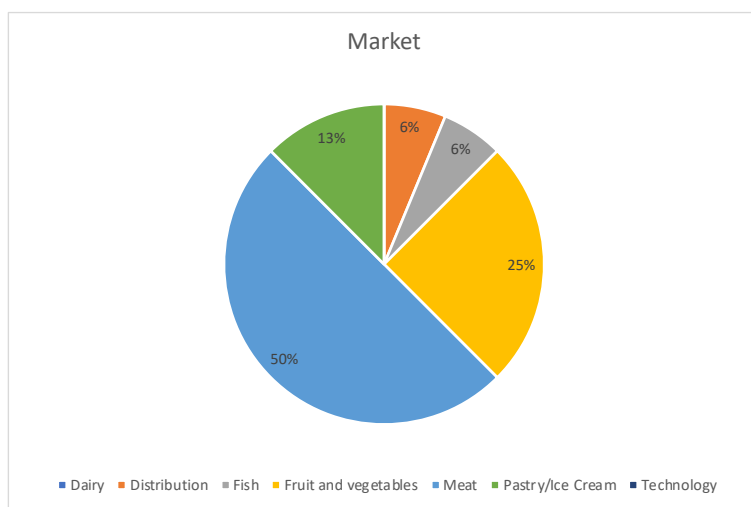


Figure 3 - Percentages of answers about market for each sector

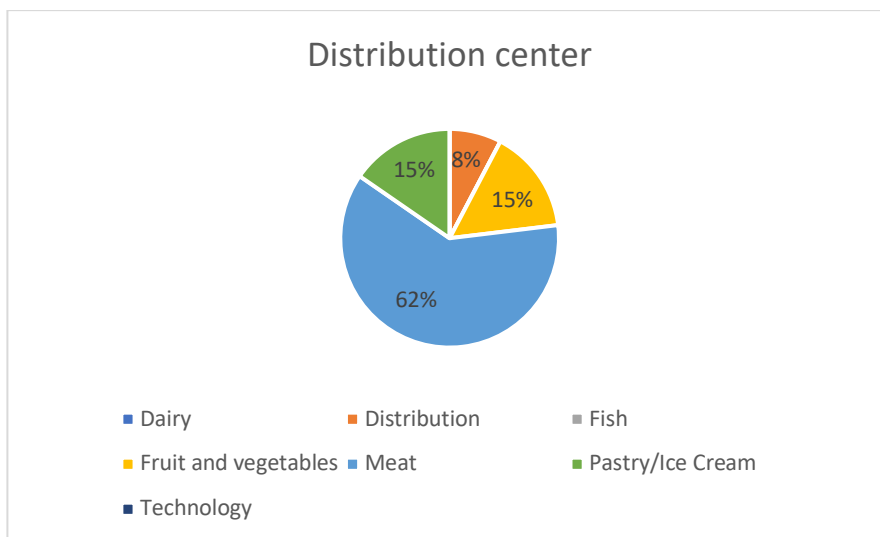


Figure 4 - Percentages of answers about distribution center for each sector

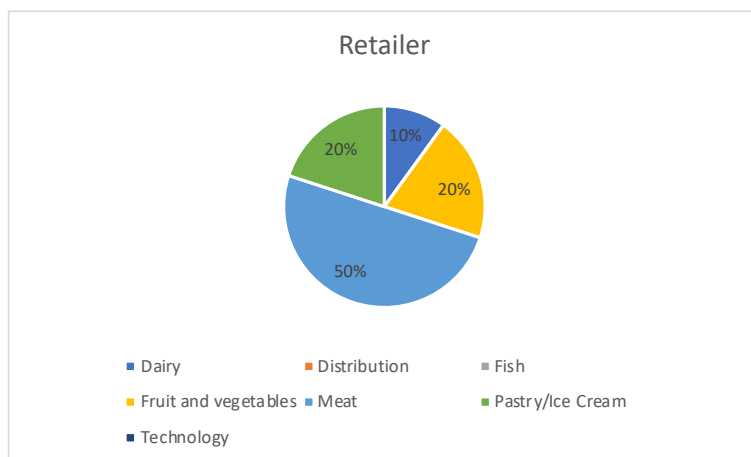


Figure 5 - Percentages of answers about retailer for each sector

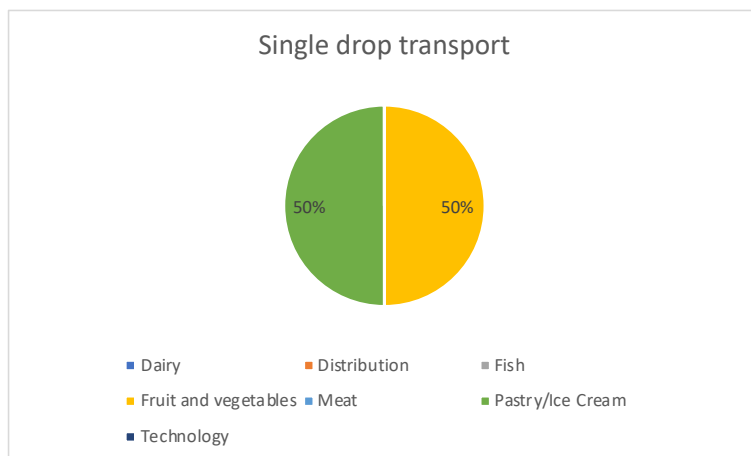


Figure 6 - Percentages of answers about single drop transport for each sector

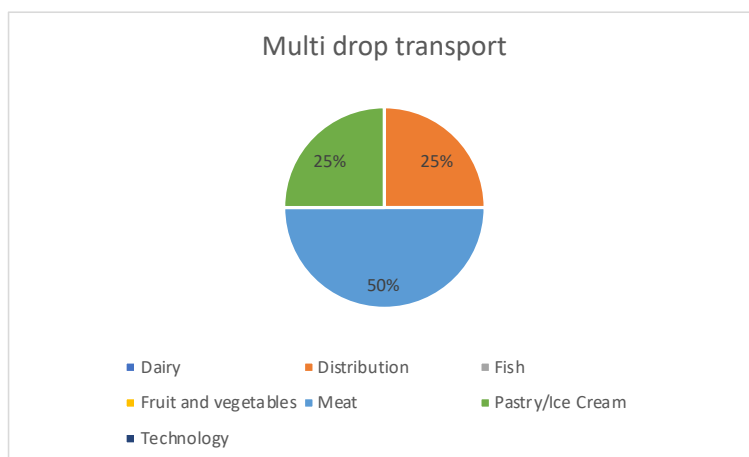


Figure 7 - Percentages of answers about multi drop transport for each sector

Above diagrams shows that Pastry/Ice Cream and Dairy are sectors with the highest stage coverage because companies belonging to these sectors have a complex cold supply chain that begins in the processing of raw materials and includes all intermediate transports. In these sectors, in fact, it is very common to have internal transport within the organization that has cold stores located in different sites. Transport from one site to another must necessarily take place with refrigerated trucks in order not to compromise the quality of the products.

The following figures (Figure 8 Figure 1to Figure 14) shows the stage coverage by country.

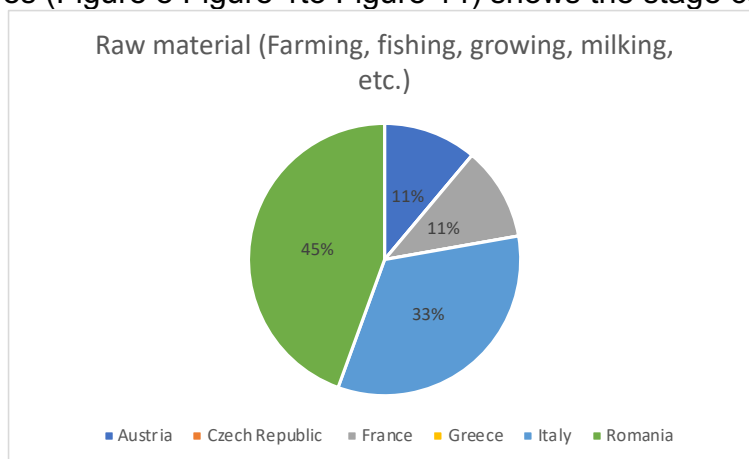


Figure 8 - Percentages of answers about raw material cycles for each country

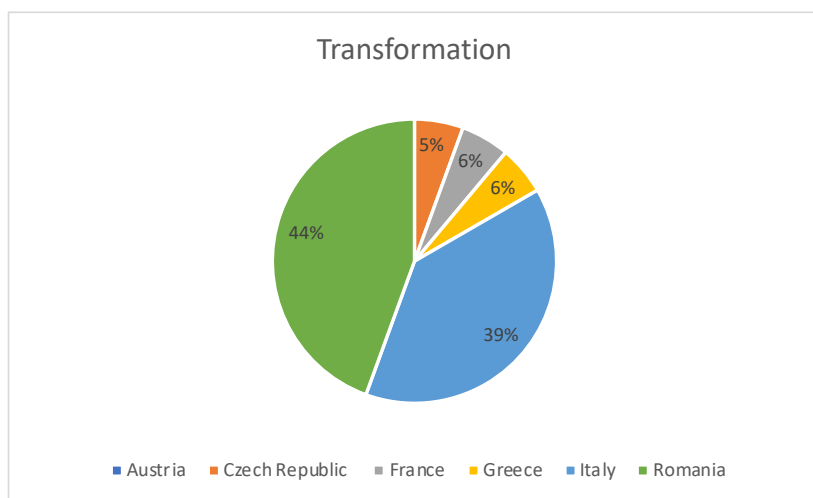


Figure 9 - Percentages of answers about transformation for each country

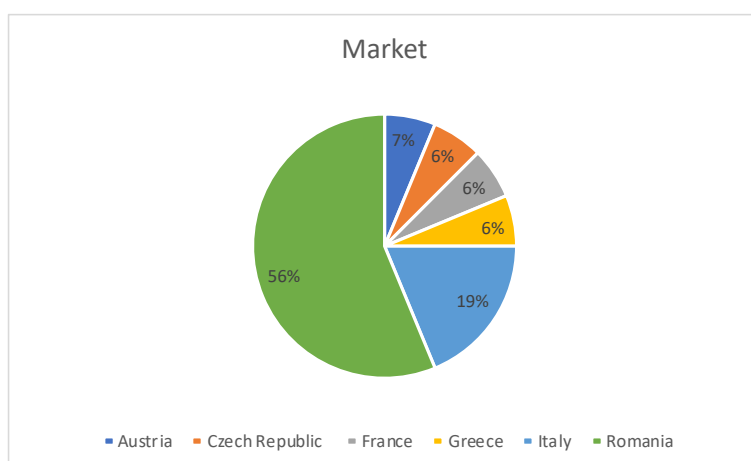


Figure 10 - Percentages of answers about market for each country

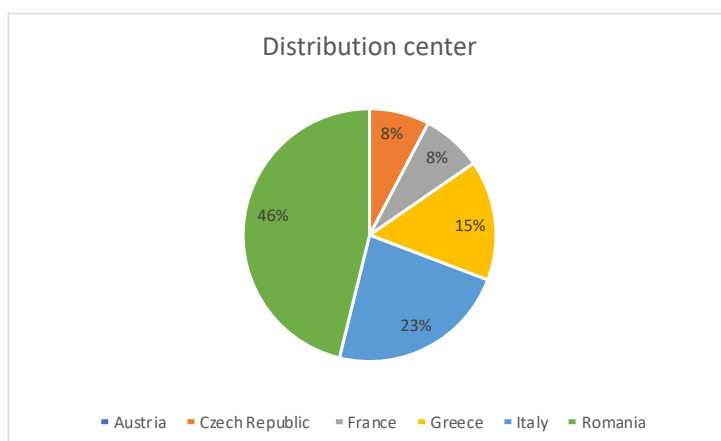


Figure 11 - Percentages of answers about distribution center for each country

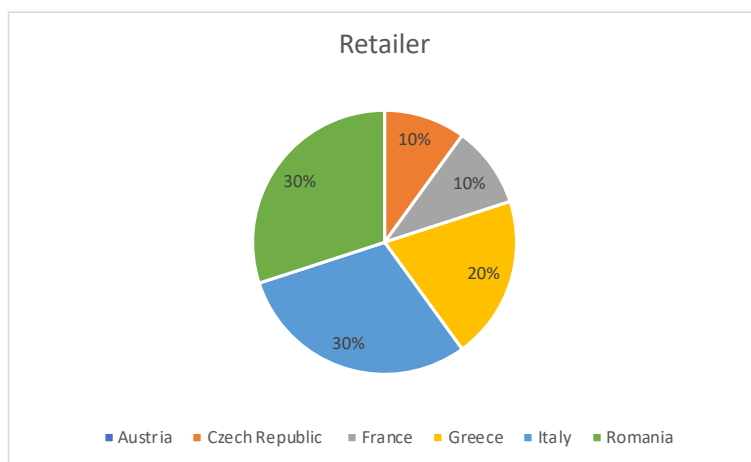


Figure 12 - Percentages of answers about retailer for each country

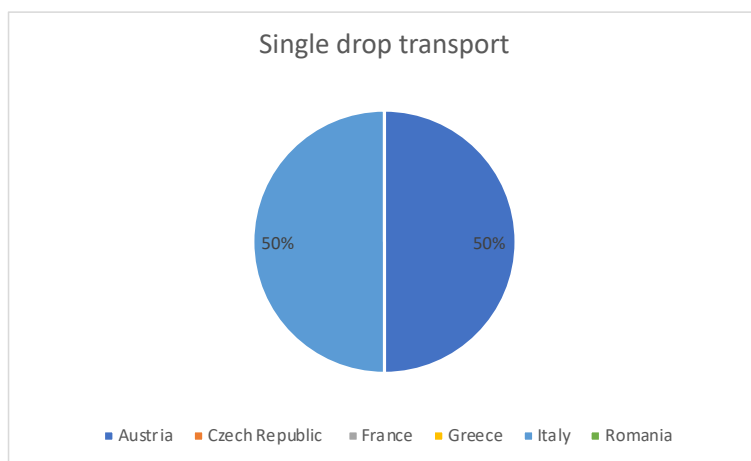


Figure 13 - Percentages of answers about single drop transport for each country

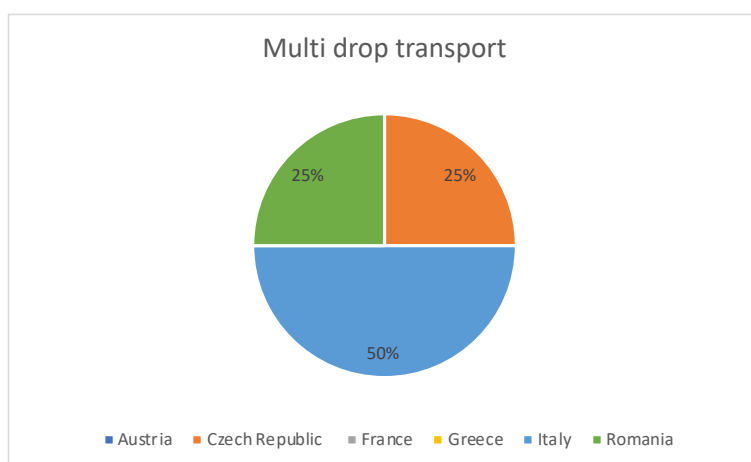


Figure 14 - Percentages of answers about multi drop transport for each country

The survey made it possible to analyze which are, according to the companies, the internal functions to be involved in using the tool. In particular, companies were asked to indicate which of the following functions could be involved in using the tool:

- **Direction**
- **Management**
- **Production**
- **Maintenance**
- **Purchase**
- **Other**

The results are reported in the following tables aggregated by sector and country.

Sector	Direction	Management	Production	Maintenance	Purchase	Other
Dairy	14%	15%	13%	10%	13%	8%
Distribution	5%	5%	4%	5%	6%	8%
Fish	5%	5%	4%	5%	6%	8%
Fruit and vegetables	18%	15%	26%	15%	6%	17%
Meat	45%	45%	43%	55%	56%	50%
Pastry/Ice Cream	9%	10%	4%	5%	6%	8%
Technology	5%	5%	4%	5%	6%	0%

Table 5 - Answers about which function could be involved in using the tool for each sector

Country	Direction	Management	Production	Maintenance	Purchase	Other
Austria	0%	5%	5%	5%	0%	8%
Czech Republic	5%	0%	5%	5%	7%	0%
France	0%	5%	5%	5%	7%	0%
Greece	10%	0%	9%	0%	0%	0%
Italy	33%	32%	27%	26%	13%	8%
Romania	52%	58%	50%	58%	73%	83%

Table 6 - Answers about which function could be involved in using the tool for each country

Questionnaire asked companies to indicate for each tool need for specific training for the staff involved in using the tool(s) with a number 1 to 5 (where 1 Not at all, 2 Somewhat, 3 Moderately, 4 Very much and 5 Completely), choosing between Direction, Management, Production, Maintenance, Purchase and Other.

The results are reported in the following tables aggregated by sector and country showing the average score calculated on all functions (for CSC tool).

Sector	Average score
Dairy	3,2
Distribution	4,3
Fish	4,0
Fruit and vegetables	2,1
Meat	3,4
Pastry/Ice Cream	2,5
Technology	2,5

Figure 15 - Average score obtained for each sector

Country	Average score
Austria	1,5
Czech Republic	3,3
France	1,7
Greece	2,1
Italy	2,0
Romania	4,2

Figure 16 - Average score obtained for each country

All companies involved confirmed their availability to join the IIN platform and share information and data and asked for the the link to the platform website.

3. Ways to improve tools

During interviews to companies with contact people many opportunities to improve tools emerged. The first suggestion is about to modify tool in order to consider more than a final product. Most of companies got in touch with have many different products as output of their production process so it would be useful to add multiple choices; for example, CSC tool should allow a comparison between different products curves so it would be possible getting information about what output is the more susceptible to quality losses. This revision would make possible a complete overview upon the entire cold supply chain, avoiding information losses due to selection of a single representative product.

Another useful evolution would be allowing a comparison between different scenarios to explore tool potential and show situation before and after implementation (for instance adding a graph representing both data directly from the tool and also data from input cells that can be filled pasting the output data from another scenario).

Interviews and visits to productions sites made evident CSC tool limits in representing the complexity that characterizes an industrial process. CSC tool may evolve adding the different production steps, linked or not to cold or hot treatments in order to attribute the real energy consumptions of the production (and not only the cold storage of raw material and final product, that in some cases is only a fraction of the transformation consumption). This evolution would be useful for that companies in which a product undergoes different sub-processes at different temperatures and each sub-process is characterized by different operating times and eventually seasoning (in the actual configuration of the tool a turnaround for some of these cases is to use all the steps of the cold chain to describe just the cold process inside the enterprise). This is a critical aspect especially for that companies in which production process is very brief and energy intensive while conservation and/or seasoning time is longer and characterized by less energy consumption. In general this feature would be useful to the production processes where the energy consumption of the production process is relevant compared to the cold storage of raw material and final product.

Food and beverage sector is distinguished by a large variety of products so tools should be richer and include much more choices for raw material products and final products; with this upgrade, tool would become more specific and detailed. The tool should be able to reproduce situations in which one raw material is used to output many different products (for example a company uses milk to produce yogurt, cheese, butter and pasteurized bottled milk) or many different types of each product (a company uses grape to produce different kinds of wine) and situations in which many different raw materials are used to produce a

single product (ice cream production requires milk, chocolate, fruit and others to produce even just one type of ice cream).

Companies operating in F&B sector are in the middle between raw material suppliers and end users; they often receive agricultural raw material (e.g. fruits, vegetables, milk or flour) from suppliers around the world. In many cases, these raw materials are stored in refrigerated warehouses before the shipping to the producers and energy consumption in this initial phase is usually unknown to the producer. At the same time, a producer is not always aware about energy consumption for cold in following steps such as transports and retailers. This lack of knowledge pushes to users to fill with some estimated data. At the end the user may not trust the results due to this estimated data. A feature that will allow the users to declare if the data is measured or estimated and then highlight the results affected by the estimates, could be useful. It would help the users to understand which results are more reliable and which data are more relevant.

Companies are interested to understand how quality losses are linked to cold supply chain management. CSC tool could be enriched with summarized information (with links to deepen if interested) on how food nutritional qualities fall during conservation at different temperatures. Moreover, companies are interested to understand how these quality losses can affect their business so adding also information and/or case studies would be appreciated.

Other improving suggestions are about format; some companies suggest to integrate all tools in one app in order to make data entry easier. For other stakeholders, availability of KPIs inside tools could facilitate estimating the potential costs and benefits from energy efficiency improvements. Some companies suggest that would be very useful having tools able also to monitor the evolution of parameters as dashboard. This would allow an overall evaluation of their performances.

To summarize, the main points for tools improvement that emerged from the discussion with the stakeholders involved are:

- Modification of tool in order to consider more than a final product;
- Comparison between different scenarios in order to explore tool potential and show situation before and after energy efficiency measures implementation
- Addition of different production steps in order to attribute production real energy consumptions
- Enrichment of the choices available in the default menu
- Implementation of a feature to declare if the data is measured or estimated
- Addition of summarized information about quality losses and its effects on business
- Enrichment of the tool with further parameters to transform it into a dashboard

Conclusion / Summary / Policy recommendations

From the above data and considerations, it is possible to conclude that the tools presented to the companies aroused enthusiasm and interest from all stakeholders (in the cases when there has been the occasion to talk with more figures from the same company during the visit). In a socio-economic context in which energy consumption and the related costs to be incurred are a significant concern for all organizations, it has become clear that companies are particularly open to the adoption of tools to achieve a better understanding of their energy performances in order to identify opportunities for efficiency and therefore for savings.

It seems appropriate to point out that the food and beverage sector is characterized by particular and specific conditions that strongly distinguish it from other industrial sectors and thus its cold supply chain. The companies involved, in most cases SMEs, underlined the need for agile, easy-to-use tools developed specifically for food production.

The strength of the ICCEE tools is certainly their ease of understanding and use which makes them usable by people belonging to different functions in the organization (from management to maintenance).

The way in which the tools output the results is considered easy to read by all those who use the tool and was widely appreciated.

In future developments, the suggestions for improvement illustrated in chapter 3, could make the tools even more useful and powerful allies to support organizations in evaluating the improvement potentials along the cold supply chain.

This is particularly true for SMEs, small and often undersized to be able to afford and manage monitoring tools and often lacking capacity to control their production process.

In these contexts, ICCEE tools can accelerate a transition towards more efficient processes and modernize production techniques often linked to the tradition and past experience of operators.

This transition, however, will not be possible if it is not accompanied by a different approach by both operators and managers who must become more aware of the importance of monitoring consumption and more open to adapt working methods to evolving context.

As explained in the document, these changes in the food and beverage sector are often slowed down by regulations of protected products (e.g. PGI and PDO) or by habits established and consolidated over time. Therefore a dedicated training aimed at all levels of the organization becomes essential to facilitate the penetration and adoption of ICCEE tools.

To summarize, the main conclusions that can be drawn after interviews with stakeholders are:

- All companies are available to adopt any useful tool for understanding their energy consumption as long as it is easy to use
- The tools must be as customizable as possible to adapt to the complexity of the food and beverage sector
- In SMEs, ICCEE tools can become a push towards energy efficiency by overcoming the resistance due to lack of knowledge and traditional practices
- The adoption of the tools must be accompanied by a training activity to change the approach and established habits, taking into account the limitations due to the regulation

Annexes: Questionnaire Format

T 5.3 FEEDBACK FORM ON TOOLBOX EXPLOITATION TO ADDITIONAL COLD CHAINS

1. Company data

- ☐ **Company/body ...**
- ☐ **Sector ...**
- ☐ **Cold chain stage(s) covered (multiple choice)**
 - 1. Farming, fishing, growing, milking, etc.**
 - 2. Transformation**
 - 3. Market**
 - 4. Distribution center**
 - 5. Retailer**
 - 6. Single drop transport (please specify from which to which stage)**
 - 7. Multi drop transport**
 - 8. Other, please specify**
- ☐ **Country ...**
- ☐ **First name and Last name contact person ...**
 - 1. Position ...**
 - 2. E-mail address ...**

2. Which tool(s) has/have been presented/tested? (multiple answers possible)

- 1. Cold supply chain tool (CSC)**
- 2. Life cycle assessment too (LCA)**
- 3. Life cycle costing tool (LCC)**
- 4. Benchmarking non-energy benefits (BEN)**
- 5. Non-energy benefit evaluator (NEB)**
- 6. Multi-criteria analysis tool (MCDA)**

3. Do you think the tool(s) presented is useful for your company?

- ☐ **Not at all**
- ☐ **Somewhat**
- ☐ **Moderately**
- ☐ **Very much**
- ☐ **Completely**

4. Do you find the tool(s) easy to understand?

- ☐ **Not at all**
- ☐ **Somewhat**

- ☐ Moderately
- ☐ Very much
- ☐ Completely

5. Do you think that the inputs to be included in the tool(s) are easily available?

- ☐ Not at all
- ☐ Somewhat
- ☐ Moderately
- ☐ Very much

6. Do you think there is a need for specific training for the staff involved in using the tool(s)?

- ☐ Not at all
- ☐ Somewhat
- ☐ Moderately
- ☐ Very much
- ☐ Completely

7. Which company functions could be involved in using the tool(s)?

<ul style="list-style-type: none"> • Tool → • Company function • ↓ 	Cold supply chain tool (CSC)	Life cycle assessment tool (LCA)	Life cycle costing tool (LCC)	Benchmarking non-energy benefits (BEN)	Non-energy benefit evaluator (NEB)	Multi-criteria analysis tool (MCDA)
• Direction	•	•	•	•	•	•
• Management	•	•	•	•	•	•
• Production	•	•	•	•	•	•
• Maintenance	•	•	•	•	•	•
• Purchase	•	•	•	•	•	•

<ul style="list-style-type: none"> • Other, specif y • 	•	•	•	•	•	•
<ul style="list-style-type: none"> • Other, specif y • 	•	•	•	•	•	•

8. Need for specific training for the staff involved in using the tool(s)?

- Indicate for each case a number 1 to 5, where 1 Not at all, 2 Somewhat, 3 Moderately, 4 Very much and 5 Completely

<ul style="list-style-type: none"> • Tool → • Company function • ↓ 	Cold supply chain tool (CSC)	Life cycle assessment tool (LCA)	Life cycle costing tool (LCC)	Benchmarking non-energy benefits (BEN)	Non-energy benefit evaluator (NEB)	Multi-criteria analysis tool (MCDA)
• Direction	•	•	•	•	•	•
• Management	•	•	•	•	•	•
• Production	•	•	•	•	•	•
• Maintenance	•	•	•	•	•	•
• Purchase	•	•	•	•	•	•
• Other, specif y	•	•	•	•	•	•

•						
• Other, specif y •	•	•	•	•	•	•

9. Do you retain necessary to tailor the tool(s) for specific cold chains

- ☐ Yes
- ☐ No

If yes, please explain your answer:

10. Do you have any suggestion to improve the tool?

11. Are there specific adaption or features to make the tool more useful for your company?



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12. One of the results of ICCEE project is the IIN platform, would you like to join the platform with the information about your company?

- ☐ **Yes**
- ☐ **No**
- ☐ **Other, please specify**

(Check if support to join the IIN could be of help)