Energy Transition Audits towards Decarbonization

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Prepared by	Aggelos S. Bouhouras Despoina Kothona
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Document History

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0.3	20/11/2025	Aggelos S. Bouhouras Despoina Kothona	Description and analysis of regulation and policy recommendations
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List of Acronyms

Acronym	Meaning
BESS	Battery Energy Storage System
DAP	Decarbonization Action Plan
ETA	Energy Transition Audit
RES	Renewable Energy Sources
PV	Photovoltaic
LoS	Letter of Support
NDA	Non-Disclosure Agreement

Executive summary

The EnTRAINER project, co-financed by the EU's LIFE Programme, introduces an innovative approach to industrial decarbonization through the implementation of Energy Transition Audits (ETAs). Unlike conventional energy audits, which focus mainly on energy consumption and efficiency improvements, the EnTRAINER project introduces a multi-benefit analysis within the ETAs to define and prioritize the proposed measures. The ultimate goal of this approach is to deliver a comprehensive Decarbonization Action Plans (DAPs) designed specifically for energy-intensive industries. This approach integrates technological, financial, and organizational aspects to help companies develop practical pathways toward carbon neutrality. The project has been implemented across Greece, Italy, Romania, and Spain, enabling the application of the proposed methodology in diverse industrial environments under various political and economic environments.

This report, entitled "Auditing Replication Report and Satellite Followers Recommendations", aims to companies beyond the EnTRAINER project t beneficiaries, which have undergone an ETA during the project. In this aspect, it presents the lessons learned during the implementation of ETAs and the best practices identified for achieving effective decarbonization outcomes. It also examines the potential of satellite followers, i.e., companies connected to the audited "lighthouse industries", to replicate the EnTRAINER methodology and adopt similar strategies for energy efficiency and carbon reduction. The findings demonstrate that the lighthouse industries have successfully acted as role models, inspiring their suppliers, clients, and partners to engage in energy transition initiatives. Finally, based on the challenges identified during the ETA implementation, the report includes a dedicated section outlining policy and regulatory recommendations.

1. Introduction

The present deliverable, D4.2 Auditing Replication Report and Satellite Followers Recommendations, focuses on the meetings conducted for the implementation of the ETAs during the EnTRAINER project. These meetings formed the core of the ETA process, ensuring direct collaboration between the project partners, the project's auditors and the participating companies across the four countries. Through a structured approach, the meetings enabled the collection of detailed energy and production data, the identification of key challenges, and the joint development of tailored DAPs.

The implementation of ETAs followed a structured methodology, combining digital and on-site meetings with company representatives. This process included the introduction of the ETA and DAP concepts, data collection and analysis of energy consumption patterns, and the presentation of proposed energy efficiency and decarbonization measures. Through this interactive approach, the EnTRAINER teams worked closely with company owners, engineers, and energy managers to understand specific operational needs and to define feasible and cost-effective solutions.

The methodology was applied consistently across the four participating countries, with adjustments reflecting the specific characteristics of each industrial site. The first round of ETAs focused on testing and refining the methodology, while the second round consolidated the experience gained, ensuring greater efficiency and comparability of results. In each case, the process not only generated valuable technical insights but also strengthened capacity building and stakeholder engagement within the participating companies.

In addition to the audited companies, the project also targeted the replication potential of the ETA methodology by identifying and engaging satellite followers, companies within the value chains of the audited "lighthouse industries." These followers, which include suppliers, clients, and collaborating partners, were encouraged to adopt similar energy transition approaches based on the experiences and results shared by the lighthouse companies.

This deliverable is organized as follows: i) Section II presents the methodology followed for the conduction of the meetings; ii) Section 3 and Section 4 describe the meetings conducted at each audited site during the first and the second round of ETAs; iii) Section 5 presents the objectives of each audited site, as defined during the meetings; iv) Section 6 summarizes the challenges identified, with a focus on financial, policy, technical, organizational, and capacity-building aspects; v) Section 7 presents the "Lessons Learned" and the "Best Practices" derived during the implementation of the meetings; vi) Section 8 introduces the Satellite Followers of the EnTRAINER project; and vii) Section 9 summarizes the key aspects and findings of the deliverable.

2. Methodology followed for digital and on-site meetings

The meetings with the stakeholders followed a structured approach established by the project partners. After selecting the audited companies for each round, meetings were conducted with representatives from the audited sites. These meetings were held both on-site and online, taking into account the companies' workload and availability. The meetings followed a three-phase methodology (Figure 1), addressing key aspects of the energy transition process as follows:

- First phase (1 meeting): The first phase served as an introductory session, where the EnTRAINER team presented the ETA process and the concept of the DAP. Participants were familiarized with the objectives, methodology, and expected outcomes of the assessment. The session focused on understanding the company's specific needs, operational challenges, and long-term energy vision.
- Second phase (1-2 meetings): The second phase focused on data collection to understand current energy usage, key cost concerns, and any previous experience with energy efficiency measures. During this phase, the EnTRAINER team was able to identify and address not only opportunities for improving energy efficiency but also gaps in staff knowledge and experience. In addition, key concerns related to the implementation of energy efficiency measures were discussed and analyzed.
- Third phase (1 meeting): The final phase focused on the presentation and analysis of the ETA results, providing a detailed overview of the findings and proposed energy efficiency measures. The EnTRAINER team presented the measures derived from the ETA and addressed the key concerns regarding their implementation. The EnTRAINER team also provided information about the available funding programs and options for a phased implementation approach to address issues related to the high investment cost and limited economic liquidity.

The methodology described above was applied in both rounds of implementation. During the first round, the partners carefully assessed the efficiency of the approach to identify its strengths and weaknesses. After validating its effectiveness, the same process was adopted for the second round. It should be noted that, when necessary, the second phase included more than two meetings to ensure comprehensive data collection and in-depth discussion with company representatives.

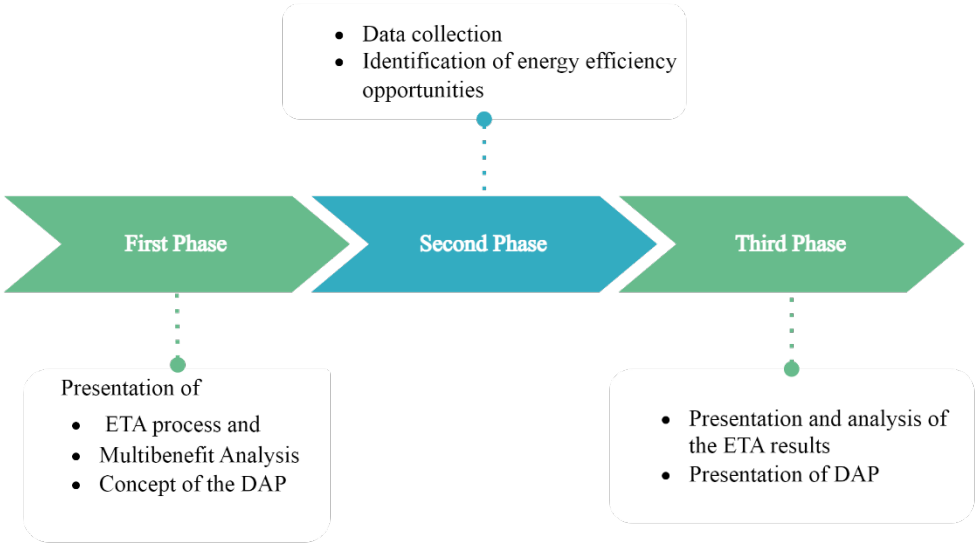

Figure 1. Methodology of virtual and on-site meetings

3. Meetings: First Round of ETAs

3.1. Greece

The first round of ETAs in Greece included five industrial and commercial sites representing diverse economic sectors, as indicated by their NACE codes. These companies were selected to reflect a broad range of energy consumption patterns and operational contexts, i.e., from manufacturing and processing industries to trade and food production. The following table provides a brief overview of the audited sites, including their main activities and sectoral classification.

Table 1. Audited sites in Greece during the 1st round

Site no.	NACE code	Short description of the main activity
Site 1	16.21	Production of artificial wood, the company's products include particleboards , veneered particleboards and fiberboards with synthetic paper (melamine) or wood leaves (veneer), and doors and kitchen counters
Site 2	24.10	Production lines for stainless steel structures
Site 3	37.00	Urban Wastewater Treatment, as well as the Reception Facility and the pretreatment of sewage water
Site 4	46.31	Fruit and vegetable trade, focused on the supply of high-quality fresh products
Site 5	10.71	Produce traditional high-quality pastry products

3.1.1. Site 1

The ETA for this industry was implemented over a period of three months. During this period there was continuous contact between the EnTRAINER team, the director of the company and a team of engineers who are responsible for monitoring the energy footprint. This ongoing interaction was essential, since the team of engineers provided all data and details required for the successful implementation of ETA.

Throughout these three months, three meetings were held at the industry's headquarters. These meetings were attended by the director of the company and the team of engineers. In the first meeting, an introduction to the ETA was provided by the EnTRAINER audit team, and initial data regarding energy consumption and production processes were collected. The second meeting involved an inspection of the industry infrastructure where additional information was gathered, and production processes and energy uses were more precisely mapped. In the third meeting, the ETA report was delivered, and the proposed actions were analyzed and discussed.

During these meetings it was emphasized that the primary need and goal of this industry is the reduction of energy costs. Therefore, a team of engineers has been responsible for monitoring the industry's energy footprint, particularly in terms of consumption in combination with the main production processes. In this context, ETA could facilitate the evaluation of the existing indicators. Moreover, it was stated that the company's goal is the adoption of a long-term Action Plan, including

the replacement of existing machines and the installation of RES. In this way, the company aims to be fully decarbonized by 2030. However, since this site has not implemented an energy audit yet, the immediate plans include conducting an ETA for its facilities. This could facilitate the development of a DAP and clarify the energy efficiency measures that should be adopted.

Throughout these discussions, the company's representatives expressed concerns about the challenges associated with investing in energy efficiency measures. The primary challenge in implementing energy upgrades is the high investment cost, compounded by the limited availability of funding programs. Additionally, the absence of a comprehensive national action plan for the decarbonization of the industrial sector poses further challenges. Specifically, the heavy bureaucracy, along with the long wait for funding agencies to pay for eligible investment costs and limited economic liquidity, greatly affects the decision-making process for investing in energy efficiency measures. However, despite these challenges, the company was committed to further exploring available funding opportunities in order to achieve its goals. Moreover, the company was determined to implement the proposed energy efficiency and decarbonization measures in alignment with its long-term sustainability goals.

3.1.2. Site 2

The ETA for this site was conducted over a period of four months, during which there was continuous collaboration between the EnTRAINER audit team and the company representatives. Moreover, engineers of the company facilitated the ETA procedure by providing all the required data and information for its implementation.

For the successful implementation of the ETA at this site, four meetings were conducted, attended by company owners, engineers, and external auditors who were interested in the EnTRAINER tools. In the first meeting the participants were introduced to the ETA procedure, with a specific focus on DAP. At the second meeting the EnTRAINER team explained the data required for the ETA and the data collection process was carried out. Apart from the digital meetings, a site inspection was conducted to assess operational inefficiencies and pinpoint high-energy-consuming machinery. In the third meeting a preliminary ETA draft was presented, detailing proposed energy efficiency actions and outlining their anticipated benefits. In the final meeting the final ETA report was delivered, providing a comprehensive analysis of all proposed actions.

In this case, the company had set an engineer responsible for keeping track on consumption and energy management procedures. However, due to workload constraints, energy efficiency improvements have not been prioritized. Therefore, a critical need identified during the meetings was the enhancement of capacity building for employees. Moreover, it became evident that, while there was an interest in investing in PV systems, there was no structured plan in place. Additionally, discussions with company representatives highlighted specific technical challenges, such as outdated heating and motion systems, inefficient power factor correction, and the need for equipment upgrades.

The companies recognized several challenges and concerns in implementing energy efficiency measures. The main challenge was the high investment cost and limited liquidity, which made immediate upgrades difficult. Additionally, there was uncertainty about the return on investment.

Despite these concerns, the ETA findings provided valuable insights, encouraging companies to commit to full decarbonization by 2030. To overcome financial barriers, the company was committed to further explore funding opportunities, in order to facilitate the implementation of the proposed measures and achieve the long-term goals.

3.1.3. Site 3

Four months required for the implementation of the ETA for this site. During this period there was a continues collaboration between the EnTRAINER audit team and engineers of the industry. For the successful implementation of the ETA at this site, four meetings were held. These meetings were attended by the industry director, while external auditors also participated to gain insights into the innovative tools developed within the project.

In the first meeting the participants were informed about the procedure of ETA, with specific focus on the DAP. In the second meeting, data collection was carried out, including details of the installed electromechanical equipment and analysis of the production process. The third meeting focused on discussing a draft version of ETA, which was developed based on the data collected. This session allowed for an exchange of views regarding the implementation of the proposed measures. Finally, in the fourth meeting, the final ETA report was presented, providing a comprehensive analysis of all proposed actions.

During these meetings, it was highlighted that there is a high necessity for energy cost reduction. The company falls within a category where energy costs represent a significant portion of the O&M expenses. Therefore, the substantial increase in energy prices over the past three years has directly influenced the company's total expenditures, profitability, and long-term viability. For this reason, the company is exploring solutions to reduce electricity bills through investments in energy efficiency measures, the installation of PV systems with BESS, or by entering into long-term Power Purchase Agreements (PPAs) for energy supply. The implementation of these measures is expected to reduce energy consumption and costs, enhance energy security, and contribute to the company's long-term plan for full decarbonization by 2050.

The representatives from the companies discussed the challenges of implementing energy upgrade investments. Specifically, the main challenge with such investments lies in the difficulty of securing funding. These companies are classified as Large Enterprises, whereas most national and EU funding programs primarily target SMEs. Although there are occasional funding opportunities for Large Enterprises, the process from initial application to final payout is often lengthy, creating a major obstacle for investment. At this point, the EnTRAINER auditor analyzed both short-term and medium-term actions that were derived after the completion of the ETA. With the immediate actions carried out from 2022 to 2024, a 4% reduction in energy consumption was achieved, while the medium-term plan anticipates an additional 10% reduction in energy consumption through further energy upgrades. Additionally, the plan included the production of electrical energy from renewable sources, as well as the cogeneration of electricity and heat from by-products. Based on these, the company incorporated all the proposed measures into the company's action plan with the aim of reducing energy consumption, lowering energy costs, enhancing energy security, and reducing greenhouse gas emissions..

3.1.4. Site 4

The ETA for this site was conducted in a period of four months. During this time, there was continuous collaboration between the EnTRAINER audit team and the company's representatives, while engineers of the company provided all the necessary data and details of the production lines. Given the nature of the business, which relies heavily on temperature-controlled storage and logistics, energy efficiency and cost reduction were key concerns.

For the ETA's implementation three meetings were scheduled with the director and engineers of the company. In the first meeting the EnTRAINER audit team presented and analyzed the ETA procedure, focusing on the DAP. During the second meeting, the data collection process was initiated including an assessment of the installed systems, electromechanical equipment, and energy flows. Finally, at the third meeting the findings of ETA were presented and discussed.

A critical need identified during the meetings was the reduction of energy costs. In this case, the decision-making is upon company owner, who lacks expertise in energy audits and optimization strategies. While there was a clear concern over high energy bills, there was a lack of structured planning on how to mitigate these costs. As a result, the company's primary goal was reducing operating costs while maintaining the highest standards of food preservation and storage efficiency.

During these meetings there was a high concern regarding the impact of energy efficiency measures. Initially, company representatives were uncertain about whether the proposed upgrades would provide significant financial benefits. However, after reviewing and analyzing the findings of ETA, they were convinced about the efficiency of the proposed measures and committed to implement the interventions. Yet, considering the high cost of implementation, the company will gradually implement the proposed measures, not only by exploring available national and EU funding opportunities but also by utilizing its own funds.

3.1.5. Site 5

The ETA for Site 5, a company specializing in the production of traditional high-quality pastry products, was conducted over a period of four months. Throughout this time, there was continuous collaboration between the EnTRAINER audit team, the company's representatives, and the company's engineers. This collaboration facilitated the assessment of energy consumption patterns and opportunities for efficiency improvements.

During this period, four meetings were scheduled. The first meeting was to inform the participants about the ETA process and its potential benefits. The second meeting aimed to collect all necessary information and data regarding energy consumption and production processes. Finally, at the third meeting, the EnTRAINER audit team presented the ETA results and discussed the implementation and potential challenges that might arise.

Given the nature of the food production sector, where production lines require high energy consumption, optimizing energy efficiency was a key priority for reducing energy costs. Although the company's owner was responsible for analyzing energy usage, a lack of technical expertise in energy efficiency measures hindered the decision-making process. As a result, despite clear concerns over high energy bills, there was a lack of structured planning on how to effectively reduce these costs.

Additionally, enhancing the capacity building of engineers was emphasized as a critical factor in achieving the company's long-term sustainability goals. This included keeping records, analyzing consumption patterns, and proposing measures to ensure compliance with long-term energy efficiency objectives.

During discussions, several concerns were raised regarding the implementation of the proposed energy efficiency measures. One of the primary challenges was the uncertainty about the actual impact of these investments. Moreover, a significant challenge related to the implementation of the proposed measures was the high cost of investments. Although the company was aware of funding opportunities, delays in accessing funding programs hindered the decision to proceed with energy upgrades. However, after the presentation of the energy efficiency measures derived from the ETA, the company was convinced about the cost reduction and the return on investment and committed to gradually implementing the proposed measures. Moreover, the company has now incorporated energy efficiency improvements into its business strategy and is actively seeking funding opportunities.

3.2. Italy

The first round of ETAs in Italy encompassed five companies from diverse industrial sectors, selected to capture a representative range of energy consumption profiles and decarbonization challenges. These sites include large and medium-sized enterprises operating in the pharmaceutical, manufacturing, agricultural, and service sectors. The following table summarizes the audited sites, outlining their NACE classification and the main activities performed at each facility.

Table 2. Audited sites in Italy during the 1st round

Site no.	NACE code	Short description of the main activity
Site 1	21.10.00	Manufacture of basic pharmaceutical products
Site 2	25.51.00*	Manufacture of domestic appliances
Site 3	01.41	Raising of dairy cattle
Site 4	96.01.10**	Industrial laundry activities
Site 5	10.39.00***	Other processing and preserving of fruit and vegetables (excluding fruit and vegetable juices)

* transcription error: the correct NACE code is 27.51.00

** the company told us that its NACE code has changed to 96.10.12

*** the company told us that its NACE code has changed to 10.32.00

3.2.1. Site 1

The company in question, which has two different production sites, was immediately interested in the project and the issues it addressed. Specifically, during the two preliminary project presentation meetings, it became clear that one of the two plants was already subject to mandatory energy audits under current legislation, while the other, being smaller, was not. Nevertheless, both plants underwent the preliminary energy audit phase. For this purpose, an online meeting was organized

with the company's representatives, two engineers responsible for monitoring the energy footprint and energy consumption, in order to collect data and preliminarily identify the solutions to be proposed for energy efficiency and decarbonization.

The analysis of the collected data made it possible to rank the companies involved in the first round of the project, and only the larger site obtained a sufficient score to proceed to the next phase of the ETA. For the presentation of the preliminary scan results, another online meeting was organized with the company representatives and other employees of the company, as this occasion also hosted the training course for employees focused on the topics of incentives and forms of financing available for energy efficiency and decarbonization.

This was followed by a site visit to the production facility to conduct the ETA. This included an inspection of the industrial infrastructure to gather more information and more accurately map the production processes and energy use. Particular attention was paid to the possibility of installing a photovoltaic system on the company's parking lot and to water consumption, which is still not adequately monitored.

The company's representatives expressed their desire for the ETA to focus on aspects that are typically overlooked in the traditional audits that the industrial site undergoes on a regular basis. For this reason, solutions were sought to electrify the production processes as much as possible, since the company already has a contract for the supply of certified electricity with a guarantee of origin, which would make it possible to achieve complete decarbonization by 2050.

The ETA, which lasted approximately six months, concluded with the presentation of the results and the delivery of the ETA report to the company. On this occasion, the representatives of the company expressed their gratitude for the results of the project and the developed DAP.

3.2.2. Site 2

The ETA that this company underwent lasted about six months, during which the company representatives showed great willingness to provide all the necessary data and information. In particular, they mentioned that the ETA would be useful for organizing energy data in a more systematic way, given the company's intention to obtain ISO 50001 certification. At the same time, they expressed concern about the high investment costs of the interventions, especially in light of limited liquidity and an economically unprofitable period. For these reasons, the focus was on interventions with relatively short payback periods that could take advantage of national incentives.

In particular, four meetings were held to implement the ETA. The first two focused on the collection of consumption data and the establishment of the company's energy structure, made possible by continuous collaboration with the company's engineering team. A training session was also held during this time, focusing on incentives and financing options in the energy sector. The third meeting involved a site visit to better understand the most energy intensive processes and identify possible improvement interventions. Finally, the final meeting was used to present the results and deliver the ETA report.

The company expressed its gratitude for the work done, which will help stimulate internal discussions and optimize its energy management system with the goal of integrating it into a comprehensive

sustainability strategy. The solutions proposed in the DAP would allow the company to achieve net-zero emissions by 2050 by replacing existing boilers for space heating with air-to-water heat pumps, expanding the photovoltaic system, and converting the company fleet to electric vehicles. In fact, with the electrification of all services, the company's carbon footprint would no longer include Scope 2 emissions, as it already purchases certified electricity with a guarantee of origin.

3.2.3. Site 3

The ETA carried out for this company proved to be one of the most stimulating in terms of interaction and collaboration with employees. In fact, there was constant communication to gather as much data as possible and to propose a decarbonization plan in line with the company's expectations. The company intended to use the results of the ETA for the preparation of the sustainability report and the definition of future investment plans. In fact, during the project, the company changed its NACE code and became one of the energy-intensive companies required to prepare an energy diagnosis. As a result, the EnTRAINER team contacted the external auditor assigned to facilitate their work by providing the data and information collected during the ETA. All this contributed to the success of the project activities for this case study.

Specifically, during the six months of the ETA, five meetings were held with the company's staff, both at the company's request and for specific needs of the EnTRAINER team. The most important of these was a visit to the production site, during which the company's technical manager showed the most energy-intensive machines and processes and highlighted the measures already taken to reduce consumption. This once again confirmed the company's focus on energy efficiency and decarbonization. In addition to the technical manager, most of the meetings were attended by the CEO, quality manager and marketing manager, ensuring that all company management were aware of the current state of the industrial site and the potential future developments as proposed in the DAP.

Once again, the main challenge was to find an alternative solution to steam generation, which is currently provided by natural gas-fired boilers, that would also be cost-effective from a cost-benefit perspective. Unfortunately, the proposed heat pump solution had a negative net present value due to the low efficiencies achievable by such machines at such high temperature differentials. Nevertheless, the company understood that the intention was to propose an intervention aimed at significantly reducing the overall carbon footprint, with an 88% reduction by 2050, thanks to the combination with other proposed solutions, such as the installation of an additional photovoltaic system and the signing of a supply contract for certified electricity.

Finally, at the last meeting to present the results of the ETA, the company's staff expressed their intention to embark on a path to implement some of the interventions proposed in the DAP.

3.2.4. Site 4

The company in question showed great interest in taking part in the project from the outset and immediately became involved. After a series of preliminary meetings aimed at gaining a better understanding of the production activity under review and the use of energy sources, a site visit was made to the plant, attended by the company's top management and the energy manager. In

particular, the energy manager expressed concern about rising energy costs and the lack of databases or industry benchmarks to compare and identify potential inefficiencies. In addition, the site visit was an opportunity to answer some of their questions about White Certificates (or Energy Efficiency Certificates, TEE), which they would like to access for the replacement of a boiler, and the possible creation of a Renewable Energy Community (CER).

Throughout the ETA, which lasted around five months, the company's representatives showed maximum cooperation, answering all questions and providing the requested data promptly. In fact, the company has implemented an energy management system in accordance with ISO 50001 and is therefore accustomed to collecting and cataloguing energy data with great precision, relying on a very extensive monitoring system. This minimized the number of meetings required to complete the ETA, which, excluding the first two introductory meetings, required only three additional discussion moments.

The DAP prepared for this company, which is subject to the energy diagnosis obligation, includes solutions aimed primarily at electrifying processes that use fossil fuels, in order to reduce its carbon footprint as much as possible. Unfortunately, as in the previous case, the proposed heat pump solution to replace the natural gas steam generators does not present economic indicators that justify the economic feasibility of the investment, even though such technologies may undergo significant improvements over the years. On the other hand, replacing some of the company's diesel vehicles with electric ones is a short to medium term solution with a good cost-benefit ratio. These measures, combined with the purchase of certified green energy, could help the company to reduce its emissions by 96% by 2050.

The company was very pleased with the results of the project, which can be combined with the solutions identified in the periodic energy diagnoses to optimize both energy efficiency and the decarbonization process. In addition, the company's energy manager has contacted other companies in the same sector and invited them to participate in the second round of ETA.

3.2.5. Site 5

The company, which operates in the fruit processing sector, has two plants in Italy, one in the north and the other in the south. Both plants underwent the first phase of the preliminary energy scan, but only the second plant went on to the subsequent ETA phase. This phase lasted about five months, during which data and information were exchanged with the company representatives in order to optimize the analysis and identify the most effective measures to be included in the DAP. A total of five meetings were held to present the project, collect energy data, visit the site and present the results. Company representatives at these meetings included the safety and environmental manager and the corporate social responsibility manager.

The plant in question is required by law to undergo an energy diagnosis every four years, as it is an energy-intensive and gas-consuming company. Over the years, measures to reduce consumption and improve overall energy efficiency, such as the installation of a photovoltaic system and the optimization of the wastewater treatment system, have been implemented in accordance with the recommendations of the energy diagnosis reports. For this reason, as in other sites, the solutions proposed in the DAP aim to electrify the production processes and purchase electricity with a

guarantee of origin in order to reduce the company's carbon footprint. In addition, the replacement of obsolete refrigeration units and the installation of an additional photovoltaic system would enable the company to achieve carbon neutrality by 2050.

The most critical aspect, as confirmed by company representatives, is the use of natural gas, which is mainly used for steam production. The company requires high temperature heat for production purposes and uses a main generator with good energy efficiency. However, according to the latest diagnosis, the replacement of one of the old auxiliary generators with a new, more efficient one is planned, although this intervention is unlikely to result in more than a 5-10% saving. However, DAP suggested replacing this generator with an electric heat pump, although this solution is not cost effective due to the low COP achievable. Nevertheless, the company expressed its interest in further exploring this issue and evaluating the intervention more carefully, especially considering the technological improvements expected in the coming years.

In conclusion, the company expressed great satisfaction with the work carried out, including the topics covered during the staff training course. For example, the company was unaware of the possibility of accessing incentives - energy efficiency certificates (TEE) - for replacing the steam generator with a more efficient machine. During the site visit, the EnTRAINER team was able to explain in detail how to access these incentives.

3.3. Romania

The first round of ETAs in Romania involved five industrial companies representing key energy-intensive sectors of the national economy. These included industries characterized by high thermal and electrical energy demands, such as ceramics, fertilizers, construction materials, paper, and metal production. The selected sites provided valuable insights into sector-specific challenges and opportunities for decarbonization. The table below presents a summary of the audited companies, including their NACE codes and main areas of activity.

Table 3. Audited sites in Romania during the 1st round

Site no.	NACE code	Short description of the main activity
Site 1	23.4.1	Manufacture of ceramic household and ornamental articles
Site 2	20.1.5	Manufacture of fertilizers and nitrogen compounds
Site 3	23.3.2	Manufacture of bricks, tiles and construction products, in baked clay
Site 4	17.1.2	Manufacture of paper and paperboard
Site 5	24.1.0	Manufacture of basic iron and steel and of ferro-alloys

3.3.1. Site 1

The first site from the list is a company that produces ceramic household and ornamental articles. They initially participated in the webinar organized to engage potential companies and were selected based on specific criteria. Communication started with a more detailed digital meeting aimed at explaining each step of the energy scan, as well as the resources needed for participation in the

project. The Non-Disclosure Agreement (NDA) and the purpose of the Letter of Support (LoS) were also explained.

After the NDA and LoS were signed by the company's representative, a responsible person was assigned from the beneficiary side, along with an auditor team from the project partner side.

A list of required data was sent to the beneficiary company, and during the data collection phase, several phone calls and discussions were held to clarify the necessary information. As much of the information was already available from the energy scan phase, the discussions were more focused on shaping the decarbonization action plan. This proved particularly challenging, as the company has high gas consumption due to the nature of its production line. The main challenge identified was the lack of available technology to replace gas-dependent equipment with alternatives operating on electricity. However, this was bridged by an alternative solution, with the possibility to reassess the availability and feasibility of technologies in the upcoming years, as part of the roadmap.

The decarbonization plan was revised based on the company's feedback and was included in its final form in the ETA.

3.3.2. Site 2

The second site was the most energy-intensive company audited in Romania. Considering this, the data collection phase was much longer compared to the other audited companies, and the elaboration of the decarbonization plan was also challenging due to a high number of consumers, many of whom rely on gas.

The communication included the participation of the members in the common webinar, the individual kick-off meeting, and regular phone calls with the responsible members.

3.3.3. Site 3

The third site's main activity is the manufacturing of bricks, tiles, and construction products from baked clay. The company has already made significant efforts to optimize energy consumption and transition away from fossil fuel-based equipment through solutions implemented over the past five years, such as a cogeneration unit, a photovoltaic system, and an energy monitoring system.

However, the company is aiming for long-term decarbonization, for which the EnTRAINER project was a good fit.

One advantage of conducting an audit at this site was the easy access to energy consumption data, as the company collects it very rigorously. Additionally, a dedicated team for energy management and environmental tasks greatly facilitated communication with the project teams.

The digital meetings included the initial kick-off meeting, preliminary discussions during the energy scan and in-house training delivery, as well as several phone calls to align the company's needs with the outputs of the ETA and the associated roadmap.

The company representatives also attended the national workshop organized by the local partner as part of the EnTRAINER project, where they shared valuable insights into the company's sustainability efforts while maintaining competitiveness.

3.3.4. Site 4

Company no. 4 manufactures paper and other cardboard-based products. The company is at an advanced stage of energy management, with a dedicated budget for energy efficiency projects and monthly monitoring of energy consumption. Through responsible energy management and clear targets, the company has demonstrated its commitment to CO_2 reduction and decarbonization, following procedures for the efficient use of equipment.

Communication with the company was maintained via email and phone calls during the data collection phase and the elaboration of the ETA. They also participated in the initial webinar organized by the local partner, as well as in the kick-off meeting following the signing of the NDA and LoS.

3.3.5. Site 5

The last company operates in the manufacturing of basic iron, steel, and ferro-alloys. The technological process is highly energy-intensive in terms of both gas and electricity consumption.

The company showed great interest in implementing measures for the gradual reduction of energy consumption, as well as the integration of renewable energy sources.

They were particularly interested in solutions that could be supported by various available financing sources. Therefore, the decarbonization plan was tailored to these needs, including a detailed description of potential funding sources.

The company participated in the initial webinar, the kick-off meeting, and the closing meeting during the energy scan phase. During the audit phase, communication continued via phone calls and emails, which facilitated data collection within a reasonable timeframe.

3.4. Spain

The first round of ETAs in Spain included five companies operating across a wide range of sectors, from food processing and manufacturing to logistics and chemical production. This selection ensured the representation of both energy-intensive and service-oriented industries, providing diverse perspectives on energy efficiency practices and decarbonization strategies. The following table summarizes the audited Spanish sites, outlining their NACE codes and the main activities carried out at each facility.

Table 4. Audited sites in Spain during the 1st round

Site no.	NACE code	Short description of the main activity
Site 1	10.89	Company specializing in the processing and packaging of honey
Site 2	32.99	Manufacturer of ice-making machines, containers and accessories
Site 3	49.41	International company dedicated to critical logistics services and supply chain process support

Site 4	46.31	Company operating in the agricultural sector, producing, exporting and marketing fruit and vegetables worldwide through its own brands
Site 5	13.20	Manufacture, sale, distribution and import of chemical products for various sectors, specifically for the automotive sector

3.4.1. Site 1

The ETA was conducted over a period of three months. During this period, close collaboration was maintained between the audit team and the representatives of the company, which included administrative staff and a group of technical engineers responsible for monitoring energy performance.

In order to successfully develop the ETA, four in-person meetings were held throughout the process. Firstly, a briefing meeting was held to present the scope of the audit, its goals and the expectations of both parties. The communication channels to be used from then on were also established. The second meeting involved an on-site visit to the company's facilities to collect data and install temporary analyzers for electricity monitoring. The third meeting took place weeks later, when the metering equipment was collected and any remaining data was gathered. Finally, the last in-person meeting was dedicated to present the results of the ETA, review the proposed measures and decarbonization roadmap and discuss their feasibility.

From the beginning, the company expressed a clear interest in reducing energy costs. Their main energy carriers are electricity and natural gas, and the latest has experienced a price increase in recent years. Dedicated internal personnel tracks energy consumption through an energy management system, and was actively engaged throughout the audit, facilitating data access.

When presenting the ETA, some challenges raised regarding the high upfront investment costs. Long bureaucratic procedures were mentioned as key obstacles, as well as the need to minimize production disruption during implementation. Nevertheless, the company reassured its intention to move forward with the proposed measures and decarbonization plan.

3.4.2. Site 2

The ETA was conducted over a period of five months. During this time, there was continuous communication between the audit team and representatives of the company, who were the ones to facilitate all the necessary data.

Five main meetings were organized. The first was a briefing session to present the audit's scope, objectives, and mutual expectations, was well as to establish the communication channels to be used moving forward. The second meeting involved an on-site visit to the company's facilities to collect data and install the energy analyzers. The third meeting took place weeks later, when the metering equipment was collected and any remaining data was gathered. At this point, there was a change in staff at the company, including the person with whom the audit team had initially made contact. Because of it, an online meeting was arranged to summarize the progress of the audit and what

would be needed from the new representatives of the company. Finally, the fifth meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

Before the ETA, the company already had a strong environmental awareness and had projects aimed at improving sustainability, so the energy efficiency measures proposed by the audit team were well received. The company had previously implemented actions related to packaging reduction or waste minimization, so the recommendations of the ETA were perceived not as isolated interventions, but as a continuation of the company's broader sustainability strategy. This openness fostered productive discussions at the fifth meeting and ensured strong engagement from them.

3.4.3. Site 3

The ETA was conducted over a period of four months. In the meantime, close communication was maintained between the audit team and logistics operators of the company, who were the ones to facilitate all the necessary data.

During this time, four in-person meetings were organized. Firstly, a briefing meeting was held to present the scope of the audit, its goals and the expectations of both parties. The communication channels to be used from then on were also established. The second meeting consisted of an on-site visit to the company's facilities to collect initial data and install energy analyzers for electricity monitoring. Weeks later, a third meeting was conducted to retrieve the metering equipment and gather any remaining information. Finally, the last in-person meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

The ETA focuses on the warehouse, which had never carried out an energy audit of this scope. In this company, energy consumption or billing was not critically analyzed by any of the operators due to a lack of technical expertise in energy efficiency. The main objective for achieving decarbonization in this industry is to reduce dependence on diesel, as it directly affects sustainability and decarbonization targets. To this end, one of the proposed measures included the replacement of the vehicle fleet for electric vehicles and a PV installation with storage, as RES.

During the meetings, the representatives discussed the feasibility of the decarbonization roadmap and recognized the positive impact that implementing the energy efficiency measures would have for the company. They recognized the changes would take time and leaned more towards a medium- or long-term implementation. Nevertheless, the proposed actions were properly aligned with their strategy.

3.4.4. Site 4

The ETA was conducted over a period of two months. During this period, regular collaboration was maintained between the audit team and the representatives of the company, which included administrative staff and a group of technical engineers responsible for monitoring energy performance.

A total of three key in-person meetings were organized. In the first meeting, the team outlined the scope of the audit, its goals and the expectations of both parties, as well as the communication channels with the audit team and the engineers. The second meeting involved an on-site visit to the

company's facilities to collect data and interview a small number of staff members to analyze their behaviour in terms of energy efficiency. Lastly, the last in-person meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

The company had staff dedicated to monitoring energy performance. During these meetings, they highlighted some of the inefficiencies and challenges that they had encountered. This was of great help, as it provided a basis for the audit and enabled it to be conducted according to the company's needs and best interests.

Finally, during the last meeting, issues like payback periods and investment costs were addressed. The company agreed with the decarbonization plan but was unsure about the timeframe in which the measures would be implemented. Nevertheless, the meeting was very productive from both sides, and the ETA reinforced their commitment to sustainability.

3.4.5. Site 5

The ETA was carried out over a span of three months. Throughout this time, a strong partnership was established between the audit team and the company's representatives in administration and management.

During this time, four in-person meetings were held throughout the audit process. Firstly, a briefing meeting was held to present the scope of the audit, its goals and the expectations of both parties. Communication procedures and responsibilities were also agreed upon. The second meeting involved an on-site visit to the company's facilities to collect data and install temporary analyzers for electricity monitoring. The third meeting took place two weeks later, when the metering equipment was collected and any remaining data was gathered. Finally, the last in-person meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

During the meetings, the company discussed some challenges of implementing energy efficiency measures. While initially they were skeptical about their real impact, particularly in terms of operational stability and return on investment, the detailed analysis provided from the audit team helped the company understand the potential benefits of the ETA. The discussions also highlighted the importance of clear implementation planning and internal communication to ensure successful execution.

4. Meetings: second round of ETAs

4.1. Greece

The second round of ETAs in Greece covered five companies representing a diverse mix of industrial sectors, including wood processing, food and beverage manufacturing, and non-metallic mineral production. These sites were selected to further expand the project's scope across different energy use profiles and operational scales. The following table provides an overview of the audited sites, detailing their NACE codes and the main activities performed at each facility.

Table 5. Audited sites in Greece during the 2nd round

Site no.	NACE code	Short description of the main activity
Site 1	16.10.23.00	Sawmilling and planning of wood
Site 2	11.05.00.00	Manufacture of beer
Site 3	23.99.19.01	Manufacture of other non-metallic mineral products n.e.c
Site 4	11.02	Manufacture of wine from grape
Site 5	10.84	Manufacture of condiments and seasonings

4.1.1. Site 1

The implementation of the ETA with the company took place over a period of four months. Throughout this time, there was constant communication between the EnTRAINER team, the company's director, and a group of engineers responsible for tracking the company's energy footprint. This continuous collaboration proved crucial, as the engineers provided all necessary data and technical details required for the effective deployment of the ETA.

During these four months, three formal meetings were organized at the company's headquarters. The director and the engineering team participated in all sessions. The first meeting focused on introducing the ETA, led by the EnTRAINER audit team, and gathering initial information concerning energy consumption and production processes. The second meeting included an on-site inspection of the company's facilities, allowing for additional data collection and a more accurate mapping of production and energy use patterns. In the third meeting, the final ETA report was presented, followed by a detailed discussion of the proposed actions and recommendations.

Throughout the meetings, it was emphasized that the industry's main objective is to reduce energy costs. Consequently, the engineering team has been tasked with monitoring the company's energy footprint, especially regarding consumption associated with core production processes. Within this framework, the ETA serves as a valuable tool for assessing existing performance indicators. Furthermore, the company expressed its long-term goal of implementing a comprehensive Action Plan, which includes the installation of a 5-MW photovoltaic system, the installation of 42 electricity meters, and the increasing equipment energy efficiency. This strategy aims to achieve full decarbonization by 2043.

During these discussions, company representatives highlighted several obstacles related to investments in energy efficiency. The main barrier identified was the high upfront cost of energy upgrades, further aggravated by the limited access to financial support programs. The absence of a comprehensive national strategy for industrial decarbonization also presents a significant challenge. Nevertheless, despite these difficulties, the company demonstrated a strong commitment to exploring potential funding opportunities and moving forward with the recommended energy efficiency and decarbonization initiatives in line with its long-term sustainability objectives.

4.1.2. Site 2

The ETA for this industry was implemented over a four-month period. Throughout this phase, there was continuous collaboration between the EnTRAINER project team, the company's director, and a

team of engineers responsible for monitoring the organization's energy footprint. This sustained interaction was essential, as the engineers provided all relevant data and technical information required for the effective implementation of the ETA.

During the implementation period, three structured meetings were conducted at the company's headquarters, attended by the company's CEO, engineers and other staff interested in the ETAs. At the first meeting, the EnTRAINER audit team introduced the ETA methodology and the DAP framework, while initial data were collected regarding the company's energy consumption and production processes. At the second meeting, an on-site inspection was carried out, enabling further data collection and a more detailed mapping of production activities and energy use patterns. At the third meeting the final ETA report was presented, and the proposed measures were analyzed and discussed with company representatives. This systematic approach ensured a comprehensive understanding of the company's energy performance and facilitated the identification of areas requiring improvement.

Through these meetings, it was highlighted that the company's primary objective is the reduction of energy costs. The engineering team has therefore been assigned the responsibility of monitoring the company's energy footprint, focusing particularly on consumption levels associated with core production processes.

Within this context, the ETA functions as a crucial tool for assessing existing energy performance indicators and identifying potential efficiency improvements. Moreover, the company expressed a clear long-term ambition to adopt a comprehensive Action Plan that includes the electricity energy storage from the PV system and the change of the production process with the adoption of Stripping Technology. The facility has already a PV System, so there will not be a need for the installation of a new PV System. The company's goal for the adoption of the long-term Action Plan targets full decarbonization by the year 2038.

Despite the company's strong commitment to sustainability, several barriers to the implementation of energy efficiency measures were identified. The high investment costs associated with energy upgrades, combined with the limited availability of financial support programs, constitute major obstacles. Additionally, the absence of a national decarbonization framework for the industrial sector creates further uncertainty. Bureaucratic delays, slow disbursement of funds from public agencies, and restricted financial liquidity significantly affect decision-making and investment planning. Although the company faces substantial challenges in financing and executing energy efficiency measures, it has demonstrated a strong willingness to explore all available funding mechanisms. Furthermore, it remains committed to implementing the proposed energy efficiency and decarbonization actions in alignment with its long-term sustainability goals. The successful completion of the ETA and the subsequent formulation of the DAP are expected to play a pivotal role in guiding the company's transition toward a more energy-efficient and carbon-neutral industrial operation.

4.1.3. Site 3

The implementation of the ETA within the industrial site was completed over a period of three months. Throughout this process, consistent communication was maintained between the

EnTRAINER project team, the company's management, and a group of engineers tasked with supervising the site's energy performance. This collaboration proved essential, as the engineers provided the necessary data and technical insights that supported the effective application of the ETA methodology.

During the implementation phase, three meetings were organized at the company's headquarters. Each meeting focused on specific objectives that contributed to the successful completion of the ETA process. This structured approach facilitated a comprehensive understanding of the company's energy profile and provided the basis for formulating targeted efficiency strategies.

During the meetings, it was clearly stated that the company's main strategic objective is the reduction of energy costs. Accordingly, a dedicated team of engineers continues to monitor the site's energy performance, particularly regarding consumption linked to major production processes. Within this framework, the ETA serves as a key instrument for assessing current performance indicators and identifying potential improvements. The company also expressed its intention to develop a long-term Action Plan aimed at modernizing production, including the installation of a 10 MW photovoltaic system, the metering and energy management software installation and the power quality improvement. This strategy aligns with the company's overarching ambition to achieve complete decarbonization by 2038.

Although the company operates within a challenging financial and regulatory environment, it remains determined to pursue its decarbonization goals. The organization continues to explore potential funding opportunities to support the implementation of the recommended energy efficiency and renewable energy measures. The successful completion of the ETA and the subsequent design of the DAP are expected to serve as fundamental steps in the company's pathway toward enhanced energy performance, sustainability, and full decarbonization.

4.1.4. Site 4

The implementation of the ETA with the company took place over a period of four months. Throughout this process, consistent communication was maintained between the EnTRAINER project team, the company's management, and a group of engineers tasked with supervising the site's maintenance. The engineers provided the necessary data and technical insights that supported the effective application of the ETA methodology.

During the implementation phase, three official meetings were organized at the company's headquarters. Each meeting focused on specific objectives that contributed to the successful completion of the ETA process. These meetings were attended by the company's CEO, financial administrator and engineers. At the first meeting the auditor clarified the ETA methodology of EnTRAINER project. A brief description of DAP was also presented, and the objectives of the company were defined. Moreover, initial guidelines about the data required for the analysis were defined and the engineers committed to collecting them. The second meeting included on-site inspection of the production lines, and the data collection process was completed. Finally, at the last meeting the auditor presented the results of the ETA and the DAP, while they discussed the available funding programs for the implementation of the measures.

During the meetings, it was clearly stated that the company's main strategic objective is the reduction of energy costs. Accordingly, a team of engineers and employees continues to monitor the site's energy performance. Within this framework, the ETA serves as a key instrument for assessing current performance indicators and identifying potential improvements. The company also expressed its intention to install a 700 KW photovoltaic system with battery for power quality improvement. This strategy aligns with the company's ambition to achieve complete decarbonization by 2032.

Although the company operates within a challenging financial and regulatory environment, it remains determined to pursue its decarbonization goals. The organization continues to explore potential funding opportunities to support the implementation of the recommended energy efficiency and renewable energy measures. The successful completion of the ETA and the subsequent design of the DAP are expected to serve as fundamental steps in the company's pathway toward enhanced energy performance, sustainability, and full decarbonization.

4.1.5. Site 5

The ETA for the company was implemented over a four-month period. Throughout this process, consistent communication was maintained between the EnTRAINER project team and the company's management since the executive manager is an engineer and already tasked with supervising the site's energy performance. The executive manager provided the necessary data and technical insights that supported the effective application of the ETA methodology.

During the implementation phase, three official meetings were organized at the company's headquarters. Each meeting focused on specific objectives that contributed to the successful completion of the ETA process. At the first meeting, EnTRAINER audit team presented the purpose and structure of the ETA and DAP and gathered preliminary data concerning energy consumption patterns and production activities. A site inspection was conducted at the second meeting to collect further information, verify operational conditions, and obtain a more detailed overview of energy flows and production processes. The finalized ETA report was delivered to the company's representatives at the third meeting, followed by an in-depth discussion and evaluation of the proposed actions and recommendations.

Through these meetings, it was highlighted that the company's primary objective is the reduction of energy costs. During the meetings, it was clearly stated that the company's main strategic objective is the reduction of energy costs. Accordingly, the executive manager continues to monitor the site's energy performance. Within this framework, the ETA serves as a key instrument for assessing current performance indicators and identifying potential improvements. The company also expressed its intention to install a 300 KW photovoltaic system for power quality improvement and replace the heating system with heat pumps. This strategy aligns with the company's ambition to achieve complete decarbonization by 2032.

Despite the company's strong commitment to sustainability, several barriers to the implementation of energy efficiency measures were identified. The high investment costs associated with energy upgrades, combined with the limited availability of financial support programs, constitute major obstacles. The organization continues to explore potential funding opportunities to support the implementation of the recommended energy efficiency and renewable energy measures. The

successful completion of the ETA and the subsequent design of the DAP are expected to serve as fundamental steps in the company's pathway toward enhanced energy performance, sustainability, and full decarbonization.

4.2. Italy

The second round of ETAs in Italy involved five companies from varied industrial sectors, encompassing manufacturing, textiles, and environmental services. The selected sites reflect both traditional production activities and service-oriented operations with significant energy demands. This diversity enabled a broader assessment of sector-specific challenges and opportunities for decarbonization. The following table summarizes the audited Italian sites, including their NACE codes and the main activities carried out at each facility.

Table 6. Audited sites in Italy during the 2nd round

Site no.	NACE code	Short description of the main activity
Site 1	15.20.10	Manufacture of footwear, other than leather parts of footwear
Site 2	17.22.00	Manufacture of household and sanitary goods and of toilet requisites
Site 3	16.23.1	Manufacture of other builders' carpentry and joinery
Site 4	96.10.1	Washing and cleaning of textile products for industrial or commercial clients
Site 5	37	Sewage collection and treatment

4.2.1. Site 1

This company was invited to participate in the project by their energy manager, who had attended the second edition of the entrainer training course for energy auditors. The company director was also responsible for another smaller company in the same sector, and it was therefore decided to subject both plants to the preliminary energy scan phase. Nevertheless, only the first company was selected for the subsequent ETA phase, as it had very high energy consumption and carbon footprint, as well as being required to carry out the mandatory energy audit for large companies.

For the purpose of the energy scan, an online meeting was organized with the company's representatives and the energy manager, in order to collect data and preliminarily identify the solutions to be proposed for energy efficiency and decarbonization.

For the presentation of the preliminary scan results, another online meeting was organized with the company representatives and other employees of the company, as this occasion also hosted the training course for employees focused on the topics of incentives and forms of financing available for energy efficiency and decarbonization.

This was followed by a site visit to the production facility to conduct the ETA. This included an inspection of the industrial infrastructure to gather more information and more accurately map the

production processes and energy use. During this meeting, it emerged that the regulation of indoor thermal and humidity comfort conditions in workspaces is highly inefficient and that the demand for electricity, heating and cooling energy remains high throughout the year. Therefore, the ETA explored solutions aimed at improving the control of indoor comfort parameters and generating the energy carriers used through trigeneration systems.

The ETA, which lasted approximately six months, concluded with the presentation of the results and the delivery of the ETA report to the company. On this occasion, the representatives of the company expressed their gratitude for the results of the project and the developed DAP.

4.2.1. Site 2

The company in question was proposed by some participants in the EnTRAINER training courses, who decided, in agreement with the EnTRAINER Italia team, to form a group and collaborate on the implementation of the ETA at the production plant. This would then serve as a case study for the completion of the last module of the training course attended by the aforementioned professionals. In this regard, two internal meetings were held to process the data, in addition to the audit at the industrial site and the meeting to present the results of the energy scan. On that occasion, training was also provided to the staff of the company involved.

The company representative was very cooperative from the outset, providing energy data and the latest version of the diagnosis that the site had undergone. In fact, the company is a large enterprise and a heavy energy consumer, therefore required by law to undergo energy diagnosis. The ETA's objective was therefore to provide solutions that differed from those identified in the diagnosis, focusing above all on finding alternatives to steam production using fossil fuel generators, with a view to achieve carbon neutrality by 2050, given that the company already purchases certified green energy and therefore has no Scope 2 emissions.

In particular, the professionals also focused on some measures aimed at improving the energy performance of the plant, such as improving the characteristics of the building envelope and heat recovery. The ETA lasted about six months and the company expressed its gratitude for the work done, which will help stimulate internal discussions and reduce their carbon footprint.

4.2.2. Site 3

This company already had a collaborative relationship with the CasaClima Team, as it had participated in the KlimaFactory Programme with the aim of improving its energy performance. Therefore, the ETA carried out for this company proved to be one of the most stimulating in terms of interaction and collaboration with employees. In fact, existing contacts made it possible to gather the necessary data extremely quickly and to evaluate measures complementary to those already identified, with the aim of reducing CO2 emissions as much as possible. The ETA lasted about five months.

In particular, four meetings were held to implement the ETA. The first one focused on the collection of consumption data and the establishment of the company's energy structure, made possible by continuous collaboration with the company's engineering team. The results of the energy scan phase were presented during the second meeting; a training session was also held during this time, focusing on incentives and financing options in the energy sector. The third meeting involved a site visit to

better understand the most energy intensive processes and identify possible improvement interventions. Finally, the final meeting was used to present the results and deliver the ETA report.

4.2.3. Site 4

The company belongs to the industrial laundry sector and is in close contact with another laundry that participated in the first round of ETA. This shows how satisfied the participating companies were with the project and how they invited other companies to participate. After a series of preliminary calls aimed at gaining a better understanding of the activity under review and the use of energy sources, a site visit was made to the plant, attended by the company's top management. In particular, the director expressed the same concerns and critical issues already highlighted by the energy manager of the laundry in the first round, which are the rising energy costs and the lack of databases or industry benchmarks to compare and identify potential inefficiencies.

The DAP prepared for this company includes solutions aimed primarily at electrifying processes that use fossil fuels, in order to reduce its carbon footprint as much as possible. Unfortunately, the proposed heat pump solution to replace the natural gas steam generators does not present economic indicators that justify the economic feasibility of the investment, even though such technologies may undergo significant improvements over the years. On the other hand, replacing some of the company's diesel vehicles with electric ones is a short to medium term solution with a good cost-benefit ratio. These measures could help the company to reduce its emissions by 2050 and the results will be used as a starting point for drafting a future sustainability report.

Throughout the ETA, which lasted around six months, the company's representatives showed maximum cooperation, answering all questions and providing the requested data. In addition to preliminary contacts and the on-site visit to the factory, an online meeting was organized to present the results of the energy scan and to train staff on energy efficiency and existing incentives. Finally, a final meeting was held to present the ETA report.

4.2.4. Site 5

The company deals with waste treatment through incinerators and wastewater treatment. In particular, they have expressed interest in participating in the project only for the part of the plant dedicated to water treatment, given that they have a very sophisticated data monitoring system but do not have the time to use it properly. In fact, the results of the ETA will be used to optimize the use of energy carriers, which are electricity and natural gas. It should be noted that the plant is characterized by biogas production, which is used by cogenerators to produce electricity, which is then consumed on site.

The ETA lasted about five months, during which data and information were exchanged with the company representatives in order to optimize the analysis and identify the most effective measures to be included in the DAP. A total of four meetings were held to present the project, collect energy data, visit the site and present the results. Company representatives at these meetings included the safety and environmental manager and the director.

Over the years, measures to reduce consumption and improve overall energy efficiency, such as a new sludge dewatering plant and a new digestor, have been implemented. The solutions analyzed in

the DAP include the installation of photovoltaic systems and the recovery of waste heat for the production of cooling energy.

4.3. Romania

The second round of ETAs in Romania included five companies operating in diverse industrial fields such as rubber manufacturing, construction materials, textiles, ceramics, and automotive components. These sectors are characterized by high energy consumption and significant potential for decarbonization through process optimization and the integration of renewable energy solutions. The following table provides an overview of the audited Romanian sites, highlighting their NACE codes and a brief description of their main activities.

Table 7. Audited sites in Romania during the 2nd round

Site no.	NACE code	Short description of the main activity
Site 1	22.19-Manufacture of other rubber products	The company manufactures drive belts.
Site 2	23.62 - Manufacture of plaster products for construction purposes	The company manufactures decorative wall cladding with stone and brick.
Site 3	13.20 - Textile weaving	The company supplies many major automobile manufacturers with airbags and airbag fabrics.
Site 4	2341 - Manufacture of ceramic household and ornamental articles	The company is a manufacturer of household ceramics.
Site 5	29.31 - Manufacture of electrical and electronic equipment for motor vehicles	The company is a manufacturer of friction-based components used in braking systems for automobiles and other means of transport, primarily for the original equipment market.

4.3.1. Site 1

The first company benefitting from an ETA in the second round is a manufacturer of drive belts. Similar to the first round, communication with the audited companies was carried out through a series of digital meetings, following a structured approach.

In the first phase, a kick-off meeting was held to present the expected outcomes of the ETA, the report format, and the proposed implementation timeline. The meeting was attended by the technical representatives from the manufacturing side, as well as the engineering manager. During this meeting, the companies' sustainability goals and their expectations regarding the ETA, especially in comparison to the traditional energy audit, were emphasized and discussed.

Compared to the first round, these kick-off meetings were more efficient, benefiting from previous experience, particularly in understanding what information companies expect to receive about the process.

The second phase focused on data collection, building upon the information already prepared for the energy scan. This step involved phone discussions with the personnel responsible to determine which data was already available, which needed to be estimated or interpolated, and to align existing strategies. For instance, *Site 1* had an intermediate emissions reduction target that was considered when drafting the decarbonization plan.

The final phase involved delivering the decarbonization plan, validating it with the responsible people, and then preparing and submitting the audit report, incorporating feedback through an iterative review process.

4.3.2. Site 2

The company no.2 from the second stage of ETA implementation is a manufacturer of decorative wall cladding with stone and brick. It was very eager to benefitting from an ETA due to their continued efforts in reducing energy costs and transitioning to renewable energy sources. This company was particularly engaged from the beginning as the CEO participated in early discussions and remained connected to the process until the finalization of the ETA. This facilitated the smooth process of engagement, data collection phase during the energy scan, as well as the active participation of the other staff, including the in-house training.

During the kickoff meeting and additional meetings required for clarifications, the need for solutions was highlighted which could electrify the company, as its dominant source is natural gas in proportion of 80%. Therefore, the ETA came as a necessary tool for the company in the decarbonization process.

4.3.3. Site 3

Site 3 is a supplier for major automobile manufacturers, producing airbags and airbag fabrics. The ETA for this company was carried out over a period of approximately three months. Similar to the other audited companies in Romania, Site 3 is highly dependent on natural gas, which represents more than 90% of its total energy consumption.

Although the company already purchases 100% of its electricity from renewable sources, the project manager expressed strong interest in investing in on-site renewable energy generation and battery storage systems to further enhance the company's energy self-sufficiency.

Communication with the company was maintained primarily through email and phone calls during both the data collection phase and the preparation of the ETA report.

4.3.4. Site 4

Site 4 is a Romanian manufacturer of household ceramics with a high natural gas consumption. The company has already taken significant steps toward decarbonization, investing in renewable energy sources as well as in efficient and innovative production equipment. Its current and future goals focus on the electrification of thermal processes and the expansion of existing photovoltaic (PV) parks.

Engagement with the company was smooth from the start, as the top management demonstrated strong determination to advance toward decarbonization and energy independence. They also clearly recognize the economic competitiveness that comes with investing in green energy and on-site energy generation.

Communication was maintained through emails and phone calls as needed. Both the energy scan and the additional ETA data collection proceeded efficiently, supported by the company's well-organized energy consumption records.

4.3.5. Site 5

Site 5 is a manufacturer of friction-based components used in braking systems for automobiles and other types of transport.

The company was actively involved throughout the three-month ETA implementation period, responding promptly to all information requests needed to complete the process. Its main energy consumption is electricity, and the initial energy scan revealed that the company's operations remain heavily dependent on carbon-intensive energy sources.

During communication, conducted through online meetings, phone calls, and emails, the company expressed strong interest in reducing energy costs through targeted energy efficiency measures and RES. They also showed openness to identifying, within the decarbonization plan, additional measures aimed at further reducing CO_2 emissions.

The existing energy audit supported the definition of priority emission-reduction actions and helped establish a roadmap for short-, medium-, and long-term objectives within the EnTRAINER framework.

4.4. Spain

The second round of ETAs in Spain involved five companies representing a diverse range of industrial activities, including plastics manufacturing, sportswear production, mechanical equipment fabrication, and metal treatment. This selection ensured the inclusion of both energy-intensive and medium-scale enterprises, allowing for a comprehensive evaluation of decarbonization opportunities across different manufacturing environments. The table below summarizes the audited Spanish sites, indicating their NACE classification and a brief description of their main activities.

Table 8. Audited sites in Spain during the 2nd round

Site no.	NACE code	Short description of the main activity
Site 1	22.22	Manufacturer of plastic containers using the extrusion blow moulding process
Site 2	46.41	Company that manufactures and distributes sports clothing and accessories
Site 3	22.23	Manufacturer of plastic containers
Site 4	28.93	Manufacturer of industrial fruit juicers and fruit cutting machines
Site 5	25.61	Manufacturing company specializing in the galvanization of large steel parts

4.4.1. Site 1

The ETA was carried out over a span of four months. Throughout this time, a strong partnership was established between the audit team and the company's representatives: the maintenance and the production manager.

With the aim of successfully conducting the audit, three in-person meetings were held, plus an online meeting. The process began with a virtual meeting to introduce the audit's scope, objectives, and the necessary data requirements. This was followed by a site visit to the company's facilities, during which relevant data was collected, and temporary analyzers were installed to monitor electricity consumption. Two weeks later, a third meeting took place to retrieve the monitoring equipment and gather any remaining data. The final in-person meeting was dedicated to presenting the results of the ETA, discussing the proposed efficiency measures, and outlining the decarbonization roadmap.

From the first contact with the company, the organization expressed their concern for energy costs. Rising electricity prices were identified as significant factors impacting production profitability, especially given the energy-intensive nature of certain processes. After discussing the company's priorities during the meetings, this concern translated into a strong interest in identifying practical and cost-effective measures to reduce consumption.

Finally, the last meeting focused mainly on the results of the ETA, the proposed actions and roadmap, but it also highlighted the funding opportunities, both national and European. The audit team presented an overview of relevant incentive schemes including tax deductions and financing lines that could support the implementation of the measures, especially for the photovoltaic installation.

4.4.2. Site 2

The ETA was conducted over a period of two months. During this period, regular collaboration was maintained between the audit team and the representatives of the company, which included administrative staff.

During this time, four in-person meetings were organized. Firstly, a briefing meeting was held to present the scope of the audit, its goals and the expectations of both parties. The communication channels to be used from then on were also established. The second meeting involved an on-site visit to the company's facilities to collect data and install the energy analyzers. The third meeting took place weeks later, when the metering equipment was collected and any remaining data was gathered. Also, some of the staff was briefly interviewed regarding their habits in terms of energy efficiency. Finally, the last in-person meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

The company had not previously conducted a thorough energy audit, and the facility, together with all the machinery, have been in operation for years. They did not have any RES installed nor dedicated personnel to monitor energy performance. Nonetheless, when presented with the results of the ETA, the representatives agreed on the need to reduce CO2 emissions. Together with the cost-effective measures that were proposed, the company showed commitment to improve their sustainability.

4.4.3. Site 3

The ETA was carried out over a span of two months. Throughout this time, close collaboration was maintained between the audit team and the representatives of the company, particularly members from the maintenance department.

A total of four in-person meetings were held throughout the audit process. Firstly, a briefing meeting was held to present the scope of the audit, its goals and mutual expectations. Communication procedures and responsibilities were also agreed upon. The second meeting involved an on-site visit to the company's facilities to collect data and install temporary analyzers for electricity monitoring. The third meeting took place two weeks later, when the metering equipment was collected and any remaining data was gathered. Finally, the last in-person meeting was held to present the results of the ETA and discuss the proposed measures and decarbonization roadmap.

The company had not previously undergone an audit of this scope. The ETA focused mainly on the extrusion and transformation areas, which showed the highest energy intensity. Measures such as optimizing compressed air use, improving insulation of injection moulding machines and integrating solar PV systems as RES were well received.

During the discussions, the company pointed out that limited metering infrastructure made it difficult for them to closely monitor their consumption profiles. They also expressed concerns about the payback periods for the PV installation. All the same, the company welcomed the findings of the ETA and showed engagement in gradually implementing the proposed actions.

4.4.4. Site 4

The ETA was conducted over a period of three months. During this period, close collaboration was maintained between the audit team and the representatives of the company: the Environment, Health and Safety Technician and the Continuous Improvement Manager.

To ensure the successful execution of the ETA, four in-person meetings were organized. The first one served as a kick-off to define the scope of the audit, its goals and the expectations of both parties. The communication channels to be used from then on were also established. The second meeting involved an on-site visit to the company's facilities to collect data and install the energy analyzers. In addition, some of the personnel was interviewed regarding their habits in terms of energy efficiency. The third meeting took place weeks later, when the metering equipment was collected and any remaining data was gathered. Finally, the last in-person meeting was dedicated to present the results of the ETA, review the proposed measures and decarbonization roadmap and discuss their feasibility.

Before the audit, the company had already shown interest in energy-related matters, particularly regarding consumption control. There is a dedicated small team that monitors energy performance, but they lack a structured approach to identify inefficiencies like an ETA does.

During the final meeting, the discussion focused on technical feasibility and the company's need for internal training. Another issue that was raised was the lack of detailed metering and monitoring systems, so implementing an Energy Management System was identified as a key measure for improving energy efficiency.

4.4.5. Site 5

The audit for this site was carried out over a period of two months. The person responsible for assisting the audit team was the head of *Environment, Health and Safety*, along with a team of technicians.

Three in-person meetings were held, plus one online meeting. The first contact defined the scope of the audit, its goals and the expectations of both parties. Communication procedures and responsibilities were also agreed upon. The second meeting involved an on-site visit to the company's facilities to collect data and install the energy analyzers. In addition, some of the personnel was interviewed regarding their habits in terms of energy efficiency. The third meeting took place weeks later, when the metering equipment was collected and any remaining data was gathered. Finally, the last meeting was dedicated to present the results of the ETA, review the proposed measures and decarbonization roadmap and discuss their feasibility.

Due to its nature as an energy-intensive company, one of the main concerns that was conveyed during the first meeting was energy costs. The main energy carriers are electricity and natural gas, and the energy efficiency measures are targeted towards reducing consumption. These actions focus particularly on optimizing the operation of high-demand equipment and reducing waste, as well as expanding their existing PV system. During the last meeting, the company showed interest in achieving cost savings without compromising production efficiency, while laying the groundwork for deeper decarbonization in the future.

5. Objectives identified during the meetings

The ETA participants included a diverse range of companies and representatives, covering different management roles and levels of technical expertise across all participating countries. In most cases, meetings were attended by company owners, general managers, and engineers, ensuring that both strategic and technical aspects were addressed. Many companies proposed energy managers or dedicated engineering teams to collaborate closely with the EnTRAINER auditors, providing data and supporting the evaluation of proposed measures. In some cases, company owners or administrative staff were directly responsible for energy-related decisions, often with limited technical background, which emphasized the importance of capacity building and training. Larger enterprises, especially in Italy and Romania, involved specialized personnel such as environmental managers, and energy efficiency coordinators, and employed more structured internal energy management systems. The active engagement of participants throughout the meetings greatly facilitated the data collection process, enhanced the understanding of the ETA methodology, and raised the company's awareness towards energy efficiency, decarbonization, and long-term sustainability goals.

During the discussion with the participants, several objectives were identified across all sites, as summarized in Table 10. More specifically:

- In **Greece**, the main objective identified across all sites was the reduction of energy costs, which remains the most pressing concern due to the recent increase in electricity and fuel prices. Companies expressed a strong interest in optimizing energy efficiency through continuous monitoring of their energy consumption and the integration of renewable energy

sources. Most industries have already assigned engineers to track energy performance, while several are planning the installation of PV systems combined with BESS as part of their future investments. In parallel, companies demonstrated a growing awareness of the need for a long-term decarbonization strategy, including the gradual replacement of outdated equipment and the employment of DAPs.

- In **Italy**, the companies showed a well-structured and strategic approach, setting ambitious goals toward carbon neutrality and complete decarbonization by 2050. Their main objectives focused on electrifying production processes, reducing dependence on fossil fuels, and improving overall energy efficiency. Many sites have already implemented or are planning to implement energy management systems in accordance with ISO 50001, which ensures systematic monitoring and continuous improvement. Companies are also exploring measures with short payback periods that benefit from national incentive schemes, while some have already installed photovoltaic systems and are considering electric vehicle fleets as part of their decarbonization pathway.
- In **Romania**, the companies participating in the EnTRAINER project shared a common objective of progressive decarbonization and enhanced energy management. Most industries aimed to reduce their reliance on natural gas and gradually transition to renewable energy sources. Several companies have already implemented energy monitoring systems, established dedicated teams for energy management, and created budgets for energy efficiency measures. The key goals included reducing overall energy consumption, improving process efficiency, and identifying financing opportunities to support large-scale investments. Many companies have already invested in renewable generation technologies and battery storage, signaling a strong commitment to aligning their operations with EU decarbonization targets while maintaining competitiveness in energy-intensive sectors.
- In **Spain**, the companies primarily aimed to reduce energy costs and improve energy efficiency, reflecting concerns over the high cost of electricity and fuel. Many of them were committed to lowering CO_2 emissions and decreasing dependence on diesel and natural gas, while also strengthening internal energy management practices. Several sites had dedicated personnel or small teams responsible for tracking energy performance through monitoring systems, though some still lacked a structured approach like that offered by the EnTRAINER's ETA. The implementation of photovoltaic installations, energy efficiency projects, and employee training programs emerged as key measures to support these goals.

Table 9. Objectives identified during the meeting and measures taken/planned.

Objective	Measures Taken / Planned
Energy cost reduction	Teams of engineers or dedicated personnel have been assigned to monitor energy performance and consumption, particularly in production processes. Companies are exploring solutions such as installing PV systems with BESS, adopting PPAs, and implementing ISO 50001 energy management systems. Other measures include replacing outdated equipment, optimizing energy-intensive processes, improving monitoring systems, and investing in staff training for better energy management.

Long-term decarbonization / carbon neutrality	Companies aim to achieve carbon neutrality by 2050 through electrification of production processes, replacing gas-dependent systems with electrical alternatives, and integrating renewable energy sources such as PV installations. Some have already invested in renewable generation, battery storage, and innovative production technologies, while others have included these actions in their DAPs and long-term sustainability strategies.
Energy efficiency improvement	Several companies have already implemented actions to enhance equipment efficiency, optimize wastewater treatment systems, and improve insulation and compressed air use. Measures include implementing energy management systems, continuous monitoring of energy consumption, and pursuing projects to enhance sustainability performance, often linked to the findings of the ETAs.
Reduction of dependence on fossil fuels (natural gas or diesel)	Companies plan to replace natural gas or diesel systems with electric alternatives, such as heat pumps, cogeneration units, or electric vehicle fleets. Some operate biogas-based cogeneration systems or plan to expand renewable self-generation capacity. Electrification of thermal processes and vehicle replacement with electric alternatives were identified as key steps toward reducing fossil fuel reliance.
Gradual reduction of energy consumption / long-term sustainability	Companies are progressively reducing energy consumption through renewable integration, optimization of production processes, and the adoption of measures supported by national and EU financing programs. They have expressed openness to identifying further CO_2 reduction actions within their decarbonization plans.
Monitoring and management of energy performance	Many companies established dedicated energy management teams responsible for tracking energy use, maintaining databases, and performing monthly energy performance monitoring. This structured approach supports data-driven decision-making, facilitates compliance with energy audits, and ensures continuous improvement toward efficiency and sustainability goals.

6. Challenges

Based on the description of the meetings, the challenges encountered during the implementation of the ETAs can be classified into three interrelated categories: financial and policy barriers, technical and operational challenges, and organizational and capacity challenges.

6.1. Financial and policy challenges

The companies consistently reported the high investment costs associated with energy-efficiency and decarbonization measures. This was also combined with limited liquidity, a key factor that constrained their ability to act. Access to funding proved difficult, especially due to bureaucratic procedures, lengthy approval processes, and delays in payment of eligible costs.

The audited team addressed all prementioned challenges by analyzing the results of ETAs with a specific focus on the economic evaluation of the measures. For all measures the economic benefits regarding the electricity cost, the payback period and the NPV were presented. Additionally, the available funding programs, the mechanisms and the national initiatives for the implementation of each measure were explicitly presented and are summarized for each country at Table 10.

Table 10. Summary of the available funding programs per country.

	Funding programs, mechanisms and initiatives	Scope
Greece	Installation of Storage Systems for Businesses	Aims to promote the integration of battery systems in PV installations. The program is open to enterprises of all sizes and sectors across Greece and provides grants either for: • the installation of battery storage systems in new PV installations, where only the storage component is subsidized, or • the addition of a battery storage system to existing operational PV plants, where again the subsidy applies exclusively to the storage system.
	I Move Electrically III	The program provides subsidies of up to €3,000 per electric vehicle (with a maximum vehicle value of €50,000), along with additional support for vehicle withdrawal and the installation of smart chargers. Businesses can also receive funding covering up to 30% of the cost for professional electric tricycles and quadricycles, and up to 20% for electric two-wheelers.
	Change Device for Businesses	Supports all measures related to: • The replacement of low-efficiency equipment with high-efficiency alternatives. • The substitution of propane burners with heat pumps. • The installation of smart meters.
	favorable loan conditions	Supports the installation of PV systems, offering coverage of up to 80% of the initial investment
Italy	Programs for renewable energy systems under Energy Release 2.0	Aims to promote the installation of new renewable energy plants and offer energy-intensive companies the opportunity to purchase electricity at reduced prices.
	Transition 5.0 tax credits	Supports the installation of: • Industry 4.0 machinery and equipment • Systems for self-generation and storage of renewable energy (excluding biomass) • Software, platforms, and systems for energy monitoring and optimization (e.g., energy dashboarding)

Romania	Modernization Fund	Supports investments in renewable energy generation (solar PV, wind, biomass), modernization of energy infrastructure, installation of BESS, and projects improving energy efficiency in industrial and district heating sectors.
	National Recovery and Resilience Plan (NRRP)	Includes: • Key Program 1 (Renewable Energy): support for new renewable installations and hybrid systems integrating storage • Key Program 7 (Energy Efficiency in Industrial Installations): funding for process electrification, heat recovery, efficient motors, boilers, and monitoring systems
	RePowerEU (Romania Chapter)	Supports for expanding renewable energy capacity, integrating distributed generation, and electrifying heating systems; measures for residential sector decarbonization and energy independence (including rooftop PV and energy communities).
Spain	Innovation Fund (EU) and IVACE Programs (Valencian Institute for Business Competitiveness)	Offers targeted support for renewable energy adoption, energy efficiency, and electric mobility. Specific initiatives include grants for renewable energy installations, electric vehicle infrastructure, and industrial energy efficiency measures in regions like Valencia.
	MOVES III (Plan de Incentivos a la Movilidad Eficiente y Sostenible)	Financial aid for the purchase of electric vehicles (cars, vans, and light trucks) and installation of public or private EV charging stations; promotes the development of electric mobility infrastructure across Spain.

Additionally, in cases where liquidity was the main challenge, the staged implementation of the proposed measure was examined. For instance, in Greece, the installation of PV systems is no longer under any funding program. However, the auditors proposed a partial installation of the system, with the ultimate goal the total proposed capacity to be installed by 2040.

Finally, in several cases, companies also focused on the absence of a coherent decarbonization strategy. However, this was resolved in early stages after explaining the role of ETA and DAP. Additionally, to address this challenge, inhouse training programs were implemented in order to increase awareness and strengthen the capacity-building. Additionally, when the ETAs were completed, the auditors explained how the proposed measures were aligned with the EU Green Deal and Fit for 55 packages.

Overall, the financial and policy challenges addressed in the meeting are briefly presented and explained in the following table.

Table 11. Financial and policy challenges identified during the meetings

Challenge	How the Challenge Was Addressed / Managed
High investment costs for implementing energy efficiency and decarbonization measures, with low short-term profitability.	• Analysis of ETAs results • Economic analysis of the proposed measures including pay-back period and NPV • Describing the available funding programs.
Limited liquidity and cash flow restricting immediate investment.	• Proposed staged implementation prioritizing low-cost measures.
Heavy bureaucracy and delays in public funding procedures.	• Shared best practices, guidance on application streamlining.
Difficulty accessing funding for Large Enterprises, as most schemes target SMEs.	• Identified alternative financing mechanisms (PPAs, etc.) • Follow-up sessions for upcoming funding programs.
Unclear policy frameworks for industrial decarbonization.	• ETAs acted as demonstration roadmaps, aligned with EU Green Deal and Fit for 55

6.2. Technical challenges

The technical challenges were mainly related to the characteristics of the production processes, the energy monitoring systems and the current technological limitations. Many industries remain heavily dependent on natural gas for steam generation, for which cost-effective electrification alternatives are still limited. Other recurring issues included outdated or inefficient equipment, fragmented or incomplete energy data, and low monitoring granularity, which hindered the precise evaluation of performance indicators. These obstacles were addressed through the on-site inspections.

Challenge	How the Challenge Was Addressed / Managed
Lack of electrification alternatives.	Installation of heat pumps was examined.
Implementation of proposed measures due to technical constraints	The companies will explore alternatives by considering the proposed measure.
Lack of data or inadequate granularity.	Temporary data gaps were addressed through on-site validation.

6.3. Organizational and capacity building challenges

Finally, the organizational and capacity barriers reflected the need for stronger internal structures to support energy transition activities. Several companies lacked dedicated energy managers or personnel trained in energy auditing and efficiency assessment. In some cases the companies set a team of engineers responsible for tracking energy consumption patterns. However, in many cases, energy management responsibilities were secondary tasks assigned to engineers already involved in daily operations, leading to data gaps and limited follow-up capacity.

A common challenge across many sites was the lack of structured energy management systems or decarbonization plans, such as internal energy strategies. This gap made it difficult to institutionalize energy efficiency and sustainability goals within the companies' governance structures. Moreover, several participants expressed limited experience with energy efficiency measures, which affected their capacity to assess investment feasibility or identify the most suitable technological solutions.

Overall, these findings emphasize that the successful implementation of ETAs depends not only on technological and financial readiness but also on the development of internal expertise and organizational capacity. The results confirm the importance of the EnTRAINER program's holistic approach, which complements technical audits (ETAs) and DAPs with targeted training and capacity-building activities. Strengthening in-house knowledge and fostering structured energy management practices are therefore essential pillars for enabling an effective and sustained energy transition.

7. Lessons Learned and Best Practices

This section is dedicated to the "Lessons Learned" and "Best Practices" of the ETAs' meetings. Regarding the "Lessons Learned", regular and structured communication throughout the ETA was a key factor for keeping companies engaged. The combination of technical discussions with financial and policy guidance on funding opportunities, incentives, and regulatory frameworks motivated companies to participate actively. Moreover, the level of engagement during meetings was closely linked to the accuracy of collected data and the effectiveness of the proposed measures. As companies became more familiar with the ETA methodology, their initial skepticism gradually turned into active collaboration and long-term commitment to energy efficiency and decarbonization objectives.

The lessons learned at each stage of ETA are presented in the following Table.

Table 12. Lessons learned during the meetings

ETA stage	Lessons learned
Introductory meeting	• Clearly defining the ETA scope, objectives, and expected benefits at the start was essential for building trust and ensuring full engagement from company representatives. • Early clarification of roles, communication channels, and data requirements prevented misunderstandings and delays later in the process. • Presenting the DAP concept early encouraged companies to align their expectations with the long-term decarbonization goals.
Data Collection & Site Inspection	• Continuous interaction between the audit team and company engineers was crucial for accurate data collection and for mapping production processes. • Site visits provided important insights into energy-intensive processes, inefficiencies, and behavioral aspects of energy use. • Companies with existing energy management systems (especially ISO 50001 certified ones) significantly streamlined this phase due to structured monitoring practices.

	• In several sites, fragmented or incomplete data (especially regarding water or gas consumption) highlighted the need for improved internal data management systems.
Intermediate meetings	• Sharing preliminary ETA findings encouraged open discussion and allowed auditors to refine proposed measures based on company-specific constraints. • These meetings often revealed hidden operational challenges (e.g., limited staff capacity, outdated systems, workload barriers) and financial concerns. • Explaining the available funding programs was important to support decision-making into implementing the proposed measures. • Constructive feedback loops between auditors and companies helped ensure that DAP recommendations were practical, cost-effective, and sector-relevant.
Final Presentation / Report Delivery Meetings	• Presenting quantified results (energy savings, payback, ROI, GHG reduction) in visual formats (charts, summaries, DAP timelines) was key to securing management commitment. • Including multiple stakeholders (CEOs, engineers, quality/environment managers) during final presentations enhanced decision-making and collective ownership of the outcomes. • The closing meetings often served as catalysts for companies to integrate ETA measures into long-term sustainability or decarbonization strategies (2030–2050).

Throughout the ETA implementation process, several best practices were identified that helped ensure the success and consistency of the audits. These practices focused on improving data quality, strengthening communication, and adapting technical and financial approaches to each company's needs. Regular collaboration with company engineers and the use of structured data templates supported accurate and comparable data collection. Linking proposed measures to available incentives and prioritizing actions with short payback periods made implementation more realistic and financially manageable. Clear presentation of results, such as energy savings and CO_2 reductions, helped build trust and encouraged companies to move forward with investments. In addition, flexibility in scheduling and continuous communication helped overcome staff or time limitations. Finally, adapting DAPs to the specific characteristics of each industrial sector proved essential for achieving practical and measurable progress toward decarbonization goals. The best practices identified during ETA implementation are summarized in Table 13, highlighting the main actions and strategies that contributed to successful outcomes.

Table 13. Best practices and key actions identified during the meetings

Best Practice Area	Description and Key Actions
Data management and quality improvement	• Establish continuous communication with company engineers.

	• Use structured data templates to ensure consistent, accurate data collection. • Conduct on-site inspections when needed and encourage companies to adopt internal energy monitoring systems (e.g., ISO 50001).
Financial planning	• Prioritize measures with short payback periods and design phased implementation plans that align with companies' financial capacities. • Link technical measures with available national funding programs.
Access to funding opportunities	• Support companies in navigating funding procedures by providing guidance on relevant schemes and co-financing options.
Adapting technology to feasibility	• When specific technologies (e.g., industrial heat pumps) are not yet viable, propose alternative or phased approaches such as partial electrification, PV with storage, or PPAs • Regularly reassess technological options as innovation advances.
Building trust through quantified results	• Present clear, data-based analyses of energy savings, payback periods, and CO_2 reductions during final meetings. • Transparent and evidence-based communication strengthens confidence and motivates companies to implement proposed measures.
Ensuring continuity despite staff or time constraints	• Address internal staff changes and workload limitations through flexible scheduling, online follow-ups, and continuous contact to maintain engagement and data flow.
Inclusive decision-making	• Involve both technical staff and management in meetings to enable faster and more informed decision-making.
Sector-specific decarbonization planning	• Tailor DAPs to sectoral needs, combining electrification, PV integration, and efficient equipment replacement

8. Satellite Followers and Replicators

The identification and engagement of satellite followers represent a key component of the EnTRAINER project, aimed at extending the impact of the ETAs beyond the companies directly involved. The so-called lighthouse industries act as exemplary cases within their respective sectors, demonstrating how energy efficiency and decarbonization measures can be effectively implemented. By sharing their results, experiences, and best practices, these companies encourage other firms within their value chains, such as suppliers, clients, and collaborators, to adopt similar approaches. This collaborative framework fosters knowledge exchange and supports the replication of successful

strategies, contributing to the broader dissemination of energy transition practices across industrial sectors.

8.1. Satellite followers description

A total of 104 satellite followers were identified during the implementation of the EnTRAINER project. Figure 2 presents the number of satellite followers identified per round of ETAs. During the first round, 58 satellite followers were recorded, while in the second round, the number reached 46. This consistent level of participation demonstrates the growing visibility of the EnTRAINER methodology and its effectiveness in engaging new stakeholders, even as the project progressed to its later stages. The results also confirm that the dissemination of ETA outcomes and DAPs successfully encouraged broader interest from external companies.

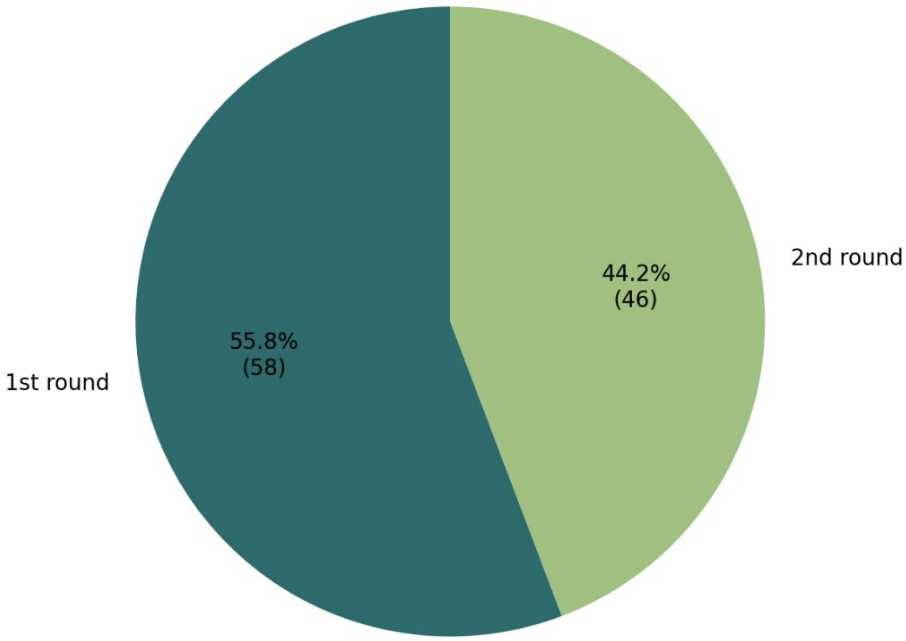

Figure 2. Number of satellite followers per round of ETAs.

Figure 3 illustrates the distribution of satellite followers per country. Italy recorded the highest number of followers (33), followed by Greece (32), Romania (21), and Spain (18). This distribution indicates particularly strong engagement from Italian and Greek industries, which have established extensive collaboration networks, while Spain and Romanian companies also demonstrated significant participation, reflecting their growing commitment to energy transition initiatives.

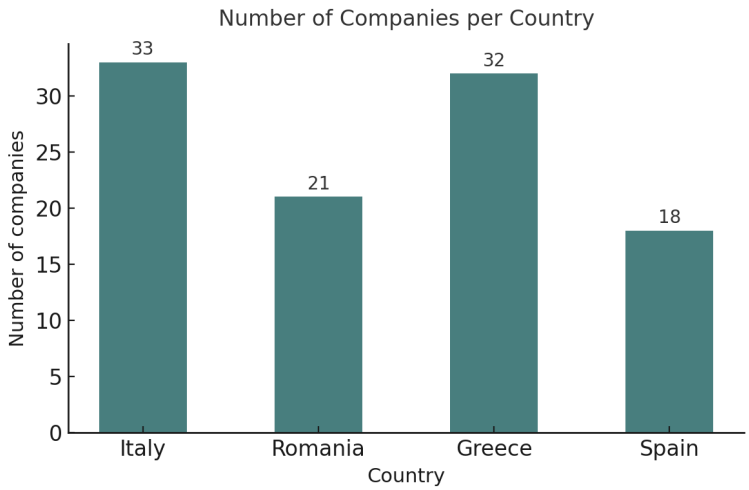

Figure 3. Number of Satellite follower per country.

Figure 4 shows the classification of satellite followers according to their relationship with the audited companies. The largest group comprises clients (33), followed by collaborative companies (19), raw material suppliers (20), and suppliers (18), while CasaClima partners (11) and companies that had previous collaborations with CasaClima (3) represent smaller yet relevant shares. This distribution highlights that the majority of satellite followers are directly connected to the audited companies through business or operational links, confirming the role of lighthouse industries as effective multipliers for promoting energy efficiency and decarbonization within their extended industrial networks.

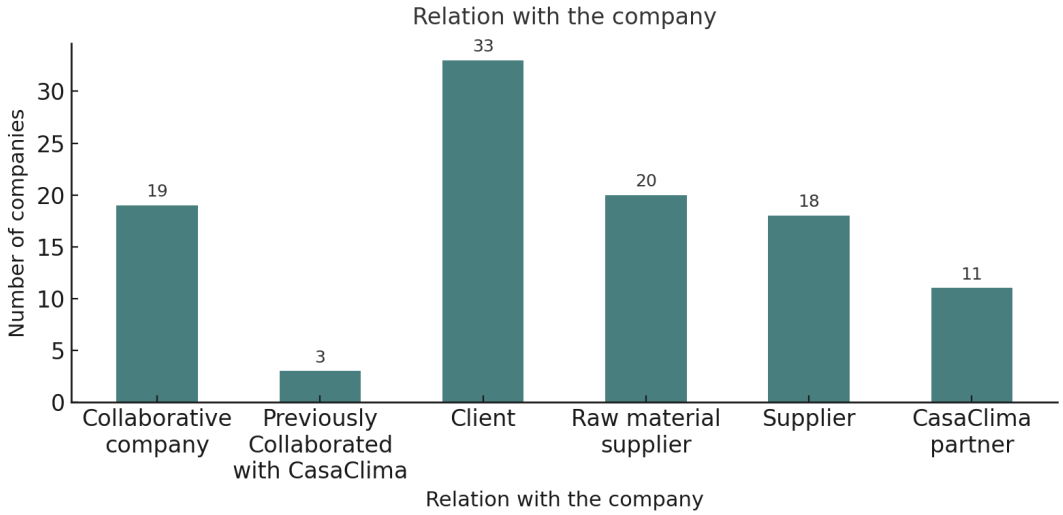

Figure 4. Number of satellite followers per relation with the audited company.

The satellite followers span a wide range of industrial activities, as reflected in their NACE codes (Table 14). The following figure illustrates the number of companies per NACE division, highlighting the diversity of industrial sectors involved in the EnTRAINER project. The highest participation is observed in the *Manufacture of non-metallic mineral products* (NACE Division 23) and *Wholesale trade* (NACE Division 46), each comprising 12 companies, reflecting the strong engagement of

construction-material and trade-related industries. Moderate representation is found in the *Manufacture of basic metals* (NACE Division 24), *Machinery and equipment* (NACE Division 28), and *Retail trade* (NACE Division 47), each hosting between five and ten companies. Several other divisions, such as *Food manufacturing* (NACE Division 10), *Beverage production* (NACE Division 11), *Chemical products* (NACE Division 20), and *Rubber and plastics* (NACE Division 22), include four to six companies. The rest of the sectors, such as *Agriculture* (NACE Division 01), *Mining and quarrying* (NACE Division 08), *Wood processing* (NACE Division 16), etc. record fewer than three companies each.

This distribution shows that the EnTRAINER methodology is relevant to many different types of industries, from high energy consuming ones to those with lower energy needs. The participation of service companies such as engineering consultancies (NACE 71.12) and environmental management firms (NACE 38.21) highlights the project's collaborative nature, bringing together experts, suppliers, and producers. Overall, the variety of NACE codes among the lighthouse industries and satellite followers confirms that energy efficiency, decarbonization, and sustainability are shared goals across sectors like manufacturing, logistics, construction, food processing, and retail. This demonstrates that the lighthouse–satellite model effectively supports joint progress toward a low-carbon economy. toward a low-carbon economy.

Table 14. Industry sectors of satellite followers.

NACE Division	Sector Description
1	Agriculture and crop production
10–11	Food and beverage manufacturing
16	Wood processing and products
20	Chemical manufacturing
22	Rubber and plastics manufacturing
23	Non-metallic mineral products (cement, ceramics, mortars)
24	Basic metals and metal products
25–29	Machinery, metal, and motor vehicle manufacturing
35–38	Utilities and waste management
41–43	Construction and installation
46–47	Wholesale and retail trade
56–59	Hospitality and catering
71	Engineering and consultancy
93	Sports and recreation
1	**Agriculture and crop production**

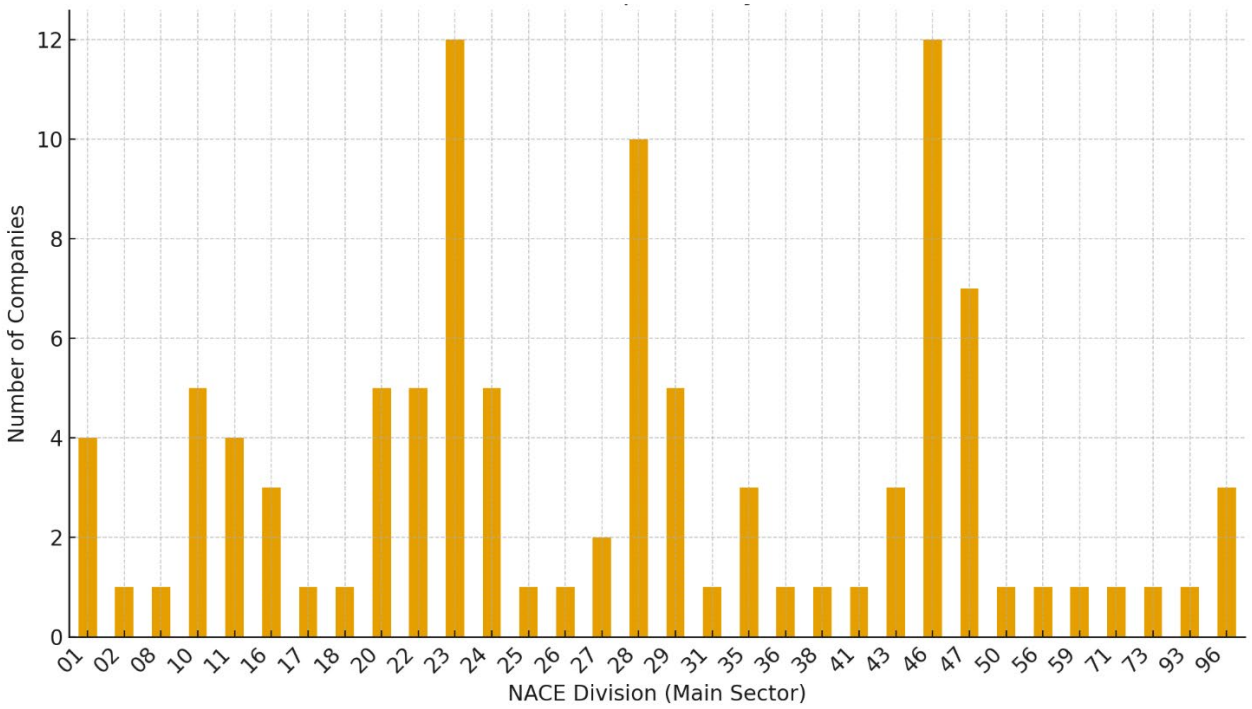

Figure 5. Number of satellite followers be sector.

8.2. Replicators

In addition to the satellite followers, the EnTRAINER project mobilized a group of 40 external auditors and engineers who expressed their interest in applying the ETA methodology within their own companies or professional activities. These individuals, referred to as replicators, emerged as key multipliers of the project. In the majority they were employees from satellite follower companies, i.e., companies connected to the lighthouse industries through supplier relationships, client links, or other business collaborations. Replicators, after being trained to the ETA approach, were motivated to adopt the developed tools and replicate the proposed methodology. Their role is critical for extending EnTRAINER's outcomes beyond the lighthouse industries, and contributing to the project's long-term sustainability.

The process for activating the replicators is illustrated in Figure 6, which presents the engagement pathway from lighthouse industries to satellite followers and finally to replicators. Lighthouse industries, during the implementation of ETAs and after their completion, played a catalytic role by promoting the ETA methodology and the EnTRAINER tools to related companies within their networks. In this way they managed to effectively stimulate the interest of potential satellite followers. Representatives of satellite follower companies often participated in meetings between EnTRAINER auditors and lighthouse industries, where they observed the ETA process in practice.

Apart from the meetings, representatives from satellite follower companies attended dedicated workshops and webinars held during the project. The workshops targeted on presenting the project results, including successful ETAs implementation stories, and the potential of the ETA and DAP methodology. These workshops were targeted at company staff, energy managers, auditors, and policymakers and served as an important communication channel for expanding the project's reach.

One of the webinars is also available on the project's webpage, providing open access to the methodology and further supporting replication efforts[1].

A significant part of the engagement and the training of the replicators were the EnTRAINER E&T courses. Employees from these companies enrolled in the EnTRAINER training programmes, including the Energy (Transition) Auditors course. Throughout this process, replicators received ongoing support from the EnTRAINER auditors. The audit teams shared examples, templates, and case studies from completed ETAs and provided methodological guidance on how to structure audits, prepare DAPs, and apply the MBA. This guidance helped replicators develop confidence and technical capacity to translate the methodology into practice.

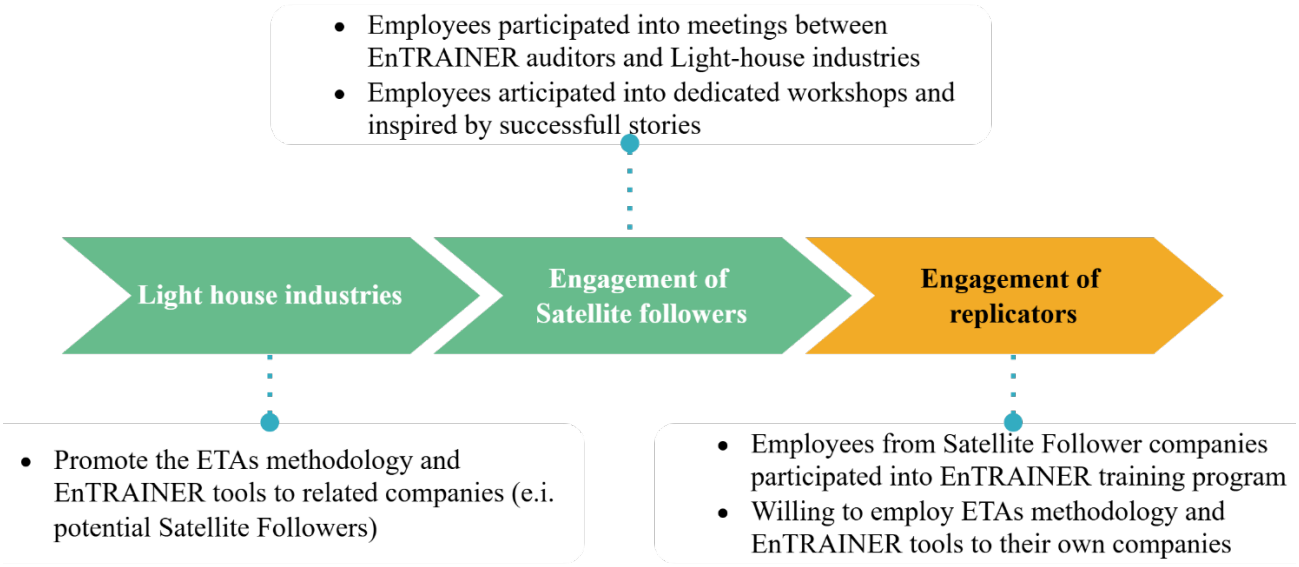

Figure 6. Engagement pathway from lighthouse industries to satellite followers and finally to replicators

During the EntTRAINER project, 40 replicators were trained (ten per country), each capable of triggering an additional ETA using the EnTRAINER methodology. Table 15 presents the lists the replicators' companies and their NACE codes. It should be noted that in case of Spain, six out of ten replicators applied the ETAs methodology and the EnTRAINER tools directly to their companies, as part of the course's case study projects. Additionally, in several large enterprises, which are required by EU legislation to conduct mandatory energy audits, trained replicators expressed their intention to integrate the DAP and MBA methodology into future audit cycles. This indicates a strong potential for long-term EnTRAINER methodology and tools to be integrated in mandatory energy auditing procedures. These outcomes aligns with the project objectives and demonstrates the effectiveness of the engagement strategy.

[1] https://entrainer-project.eu/entrainers-webinar-recording/

Table 15. Companies represented by replicators in each participating country.

No	Greece	Spain	Italy	Romania
#1	28.21 Manufacture of ovens, furnaces and furnace burners	56.10 Restaurants and mobile food service activities	23.6 Manufacture of articles of concrete, cement and plaster	47.52 Retail sale of hardware, paints and glass in specialised stores
#2	24.10 Manufacture of basic iron and steel and of ferro-alloys	59.21 Event catering activities	23.61 Manufacture of concrete products for construction purposes	41.10 Development of building projects
#3	43.22 Plumbing, heat and air conditioning installation	20.16 Manufacture of plastics in primary forms	43.21.01 Installation of lighting and photovoltaic systems on buildings	29.3.2 - Manufacture of other parts and accessories for motor vehicles
#4	46.37 Wholesale of coffee, tea, cocoa and spices	22.22 Manufacture of plastic packinggoods	10.84.00 Manufacture of condiments and seasonings	22.1.9 - Manufacture of other rubber products
#5	46.71 Wholesale of solid, liquid and gaseous fuels and related products	24.20 Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	24.54.09 Casting of other non-ferrous metals n.e.c.	01.28 Growing of spices, aromatic, drug and pharmaceutical crops
#6	50.20 Sea and coastal freight water transport	28.96 Manufacture of plastics and rubber machinery	28.25 Manufacture of non-domestic air conditioning equipment	08.12 Operation of gravel and sand pits; mining of clays and kaolin
#7	36.00 Water collection, treatment and supply	28.93 Manufacture of machinery for food, beverage and tobacco processing	46.83 Wholesale of wood, construction materials and sanitary equipment	01.11 Growing of cereals (except rice), leguminous crops and oil seeds
#8	38.21 Treatment and disposal of non-hazardous waste	29.10 Manufacture of motor vehicles	23.52.1 Manufacture of lime	35.23 Trade of gas through mains
#9	46.65 Wholesale of office furniture	20.16 Manufacture of plastics in primary forms	23.61 Manufacture of concrete products for construction purposes	46.21 Wholesale of grain, unmanufactured tobacco, seeds and animal feeds
#10	71.12 Engineering activities and related technical consultancy	46.31 Wholesale of fruit and vegetables	46.83.29 Wholesale of other construction materials	26.40 Manufacture of consumer electronics

Overall, replicators bring significant added value to the EnTRAINER project. Their involvement scales the methodology beyond the directly audited companies, supports its continuation after the end of the project, and contributes to the creation of a community of trained Energy Transition Auditors. Through their actions, the visibility and uptake of DAPs and MBA tools increase across industrial

networks, strengthening the connection between lighthouse industries and their wider ecosystems, and supporting the broader transition of European industries toward low-carbon operations.

9. Regulation and Policy Recommendations

Building on the findings, challenges, and best practices identified through the first and second rounds of ETAs, this subsection presents targeted policy and regulatory recommendations, designed to support industrial decarbonization across the participating countries. The recommendations address the systemic barriers, repeatedly highlighted by companies during the auditing process, including financial constraints, administrative burdens, technological limitations, and gaps in skills or data availability.

These recommendations are directed at public authorities, regulatory bodies, funding agencies, and industrial stakeholders and are aligned with the wider EU policy framework, including the European Green Deal, the Fit-for-55 package, and the EU Industrial Strategy. Importantly, they reflect the practical, operational realities observed across the audited sites and are therefore structured to be both feasible and high-impact, supporting companies in implementing their DAPs and accelerating the adoption of renewable and energy-efficient technologies.

Table 15 summarises the proposed policy and regulatory recommendations, linking each to the specific challenge it addresses and the wider framework it contributes to.

Table 16. Regulation and policy recommendations in respect to the identified challenges.

Challenges	Recommendation Framework	Regulation and policy recommendation
Financial challenges	Strengthening financial and incentive frameworks	• **Introduce multi-annual funding cycles** aligned with 2030 and 2050 EU climate trajectories, allowing companies to plan investments consistently with their DAPs and reducing uncertainty created by short funding windows. • **Simplify application, eligibility and reporting requirements** across national and EU programmes, including streamlined documentation and shorter reimbursement cycles.
Policy challenges	Enhancing Regulatory Clarity and Stability	• **Develop national guidelines on industrial decarbonization pathways**, offering sector-specific direction on feasible technological options, long-term transition milestones, and regulatory requirements. • **Clarify and harmonise rules on self-generation, net-metering, surplus injection and grid connection**, enabling companies to evaluate RES investments with higher confidence. • **Provide stable, long-term frameworks for Power Purchase Agreements (PPAs)** to support procurement of renewable electricity under predictable regulatory conditions.

		• **Issue guidance on renewable thermal energy and high-temperature electrification technologies**, supporting industries that rely heavily on gas and lack readily available alternatives.
Bureaucracy and access to funding programs	Accelerating Administrative and Permitting Procedures	• **Establish digital one-stop shops for permitting**, consolidating documentation requirements and reducing the number of interactions with local authorities. • **Reduce administrative requirements for small and medium-scale RES installations and energy-efficiency upgrades**, especially in non-sensitive industrial areas.
Capacity building	Supporting Capacity Building and Skills Development	• **Develop national training and certification programmes for industrial energy managers**, ensuring they have the skills required to implement and monitor DAPs effectively. • **Promote peer-learning and knowledge exchange** through sectoral associations, industrial clusters, and national training workshops. • **Strengthen capacities of local and regional authorities**, especially those responsible for permitting, grid planning, and spatial development relevant to industrial decarbonization.
Data availability	Improving Data Availability and Transparency	• **Create national industrial energy data platforms** containing anonymised consumption, production and emissions indicators to support benchmarking and decision-making. • **Introduce minimum monitoring standards for energy-intensive industries**, including sub-metering requirements, digital metering, and integration with EMS platforms. • **Encourage interoperability and data exchange** between company systems, national reporting platforms and monitoring tools used in EU programmes.
Technical constraints related to the characteristics of the equipment	Facilitating Market Uptake of Emerging and High-Impact Technologies	• **Support pilot and demonstration projects for industrial electrification technologies,** renewable thermal energy and alternative fuels, helping de-risk investments for early adopters. • **Address technical barriers** in the implementation of RES and storage in companies, due either to regulatory gaps or to lack of proper grid infrastructure, which delay significantly investments in RES, even in cases where corresponding financial support schemes exist. • **Provide regulatory clarity on hydrogen-readiness, hybrid systems, and sector coupling,** enabling companies

		to plan future investments in line with emerging EU guidance.

In addition to the challenge-specific recommendations, broader governance and cooperation actions are essential to strengthen the enabling environment for industrial decarbonization. This includes promoting the active involvement of regional and local authorities in the planning and implementation of industrial decarbonization projects to ensure alignment with local development priorities and infrastructure needs. Furthermore, supporting the creation and expansion of Renewable Energy Communities (RECs) that include industrial actors can facilitate shared investments in renewable energy generation, storage and self-consumption. Finally, fostering sectoral alliances, value-chain partnerships and cross-industry cooperation can accelerate knowledge exchange, technology uptake and coordinated action across the industrial ecosystem.

10. Conclusion

This deliverable (*D4.2* – Auditing Replication Report and Satellite Followers Recommendations), presented the methodology applied for the implementation of the Energy Transition Audits (ETAs), along with the lessons learned and best practices identified across the four participating countries (Greece, Italy, Romania, and Spain). The report summarized how the EnTRAINER methodology was applied to support industries in developing DAPs, combining technological, financial, and organizational measures to accelerate their transition toward low-carbon operations.

The methodology demonstrated that structured collaboration between auditors and companies is fundamental for achieving meaningful outcomes. Through regular communication, tailored data collection, and the integration of technical, financial, and policy guidance, participating companies were able to identify practical and cost-effective measures for improving energy performance and reducing emissions. Despite common challenges, such as limited liquidity, bureaucratic funding processes, and technological constraints, the audits revealed strong motivation among companies to pursue decarbonization, particularly when supported by clear roadmaps and available incentives.

The engagement of satellite followers proved that the EnTRAINER methodology is both scalable and replicable. Lighthouse industries acted as catalysts, inspiring suppliers, clients, and partners to adopt similar approaches and integrate energy transition principles into their own operations. This network demonstrates that the EnTRAINER model extends beyond individual audits, fostering knowledge transfer and wider adoption of sustainable practices across industrial ecosystems.

In addition, the deliverable introduced a comprehensive set of policy and regulatory recommendations aimed at addressing systemic barriers encountered during the audits. These recommendations cover issues related to financial support, regulatory clarity, administrative simplification, data availability, skills development, technological innovation, and multi-stakeholder cooperation. Additionally, they provide a strategic framework for public authorities and industrial stakeholders to accelerate the transition at both company and sector level.

In conclusion, the findings of this deliverable confirm that the EnTRAINER approach effectively combines technical innovation, financial planning, and stakeholder collaboration to drive industrial decarbonization. The next steps will focus on further promoting replication among satellite followers, disseminating the results across EU industry networks, and supporting companies in implementing their DAPs to ensure long-term impact and contribution to Europe’s 2030 and 2050 climate goals.

EnTRAINER references

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