D4.5 – Energy, economic and social assessment

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Terms, definitions and abbreviated terms

Acronym	Definition	Acronym	Definition
M	Month	**LCI**	Life Cycle Inventory
WP	Work package	**LCIA**	Life Cycle Impact Assessment
LCA	Life Cycle Assessment	**AoP**	Area of Protection
ISO	International Standards Organisation	**EE**	Energy Efficiency
Zero-E	Zero Emissions Engineering	**FU**	Functional Unit
kWh	kilo Watts hour	**KPIs**	Key performance indicator
CO2	Carbon Diaxoide	**PM2.5**	Fine particle matter
PP	Payback Period	**NPV**	Net Present Value
MAC	Marginal Abatement Cost	**IRR**	Internal Rate of Return

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1 Executive Summary

This document “D4.5 – Energy Economic and Social Assessment” of contract no.894404 has been led by ZERO-E and provides various assessments of project pilot activities. SUPER-HEERO project aimed to develop pilots to understand the possible impacts and benefits, according to the grant agreement, energy and CO2 emissions savings will be evaluated during and at the end of the project. This report contains information regarding environmental impacts of project pilots.

From 8 supermarkets chosen to be pilots at the beginning, 3 made interventions suggested by SUPER-HEERO and 2 of them followed up the SUPER-HEERO financial scheme. In total, 10 LCAs were carried out; the 8 supermarkets chosen at the beginning plus 2 considering the implementations to compare the impacts before and after the implementation. Survey data and data related to campaign statistics from the project pilots / investors has been utilized for the social assessment.

In the conclusion section, it explains why the results of impacts are equivalent to the percentage of reduction in energy. As well as actions to consider when doing a LCA to supermarkets focused on energy.

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2 Introduction

This report aims at providing the main information related to Task 4.4 Assessment of environmental, social and energy impacts. This deliverable develops different approaches to measure the impacts of the energy consumption in the supermarkets that are part of the demo sites of the project.

For the Assessment of environmental, social and energy impacts, as pointed in D4.4. the methods to be used are LCA (Life Cycle Analysis) and complementary LCIA (Life cycle Impacts Assessment).

This assessment will measure the energy consumption of five different categories that were detected during the monitoring and energy audits process and were identified as the main loads of the energy system in supermarkets.

Based on those categories, the energy efficiency measures presented by Super Heero in D2.2 and the actual implemented measures in the supermarkets, this assessment compares the impacts from the collected information with the impacts of the implemented measures and will translate the results to CO2 and Fine particle matter formation PM2.5 as the most relevant impacts that energy consumption has on the environment.

2.1. Structure of the Document

This report contains the following sections:

- Chapter 1 Executive summary of the report;
- Chapter 2 Introduction;
- Chapter 3 Methodology of the LCA;
- Chapter 4 is the main part of this report where the LCA Assessment is developed;
- Chapter 5 Conclusions
- Chapter 6 references

3 Life cycle assessment methodology

3.1 Methodology introduction

Life Cycle Assessment (LCA) is a powerful tool to evaluate the environmental performance of products, goods and/or services, considering their impact as wide and thorough as possible. It can consider the full life cycle, from the extraction of resources and processing of

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raw materials, through production and usage, ending up to the end-of-life scenario. Moreover, it supplies an effective instrument for decision-making on critical issues arising from the assessment, such as product development, policy making or strategic planning.

The methodology is structured by the International Standards Organisation (ISO) and focused on the evaluation of the environmental burden of the studied process or product, according to different parameters such as waste produced, contaminants emitted, and energy/materials consumed. To reach these objectives, information on inputs and outputs of the entire process needs to be gathered and processed. Furthermore, LCA is also preventing the shift of environmental burdens between life cycle stages, geographical locations, and environmental impacts.

According to ISO 14040, the methodology will be performed by:

- Stating the goals of the analysis and defining the scope of the study, including a description of the system under study and a definition of the geographical and temporal boundaries.
- Compiling an inventory spreadsheet of relevant inputs and outputs within a suitable system boundaries and functional unit previously defined.
- Evaluating the potential environmental impacts associated with those inventory data by a dedicated software assessment.
- Interpreting the results of impact assessment phase and thoroughly check the quality of the data in a close relation with the objectives of the study.

The standardised LCA framework encompasses four phases, with strong connections between each other, as shown in Figure 1:

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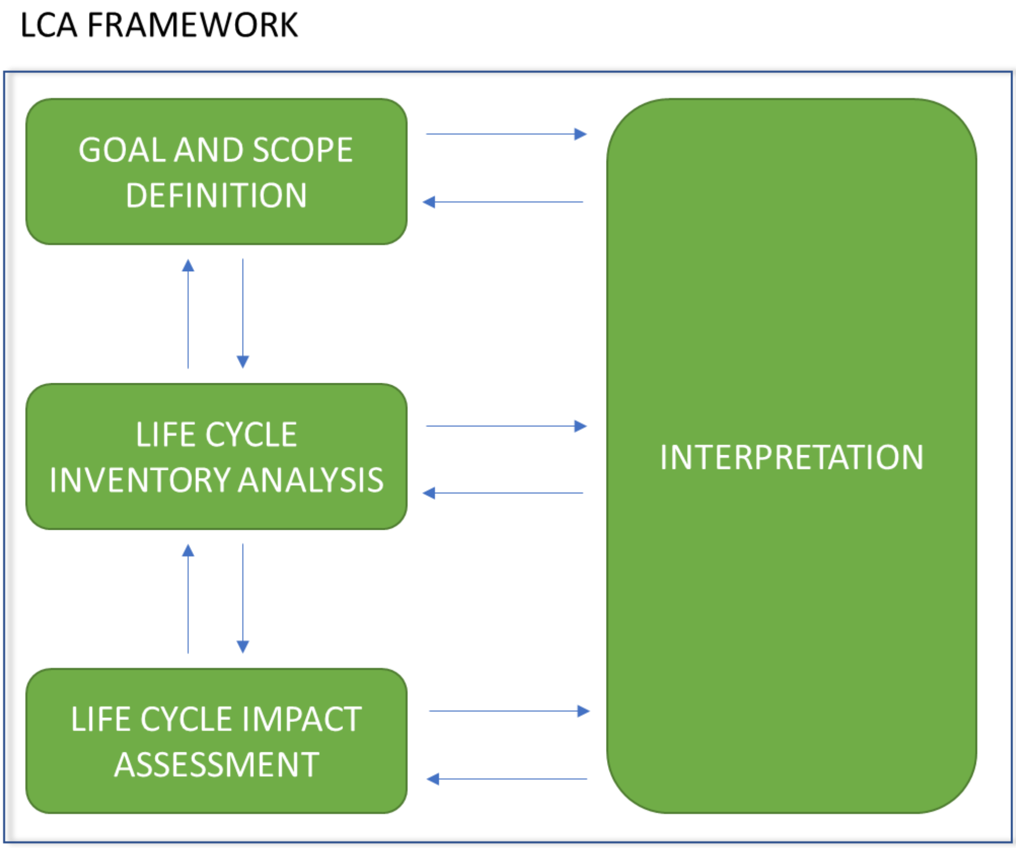

Figure 1. Stages of the Life Cycle Assessment

Hereby, individual stages of the framework proposed are described:

Goal and scope definition

The purpose, scope and main hypothesis considered for the study are defined in this stage. The scope and goal of the assessment must be clearly stated and defined with the set of decisions that will be undertaken, based on the results obtained; in parallel, it must be ensured that the extent, depth, and detail of the study are compatible and consistent to address the stated goal. The definition of the system implies the identification of the system from a technical point of view, its boundaries (conceptual, geographical, and temporal), quality of data to work with, the main hypothesis and assumptions and, eventually, barriers and actions to overcome.

A key topic at this stage is the definition of the **functional unit**. This is the "unit of the product or service whose environmental impacts will be assessed and/or compared", this amount will be determined by the LCA evaluator according to its interpretation of the project. An

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appropriate selection of a functional unit is crucial in the study because different amounts can lead to different results for the same system design.

Additionally, **system boundaries** outline the unit processes, location, and its limits and, lastly, timeframe of the technology, which will be included in the system for the study. It is essential to distinctly limit tracking energy and material uses of upstream processes because it might lead to inconsistencies and alteration. This action is partially based on choices that should be detailed and justified to provide assurance in the analysis.

As shown in Figure 2 for system boundaries, several options are available, and it is strongly dependent on the data availability and their accuracy. The "Cradle-to-cradle" assessment is the widest and most complete study, examining not only the entire life cycle but also how the end-of-life scenario will engage the residues from our system to a resource either within the same system or not. When this transition is not considered, the study is known as "cradle-to-grave" and, in case of some stages are neglected, either at the initial or final stages of the lifetime, the assessment has either "cradle-to-grate" or "cradle-to-cradle" boundaries.

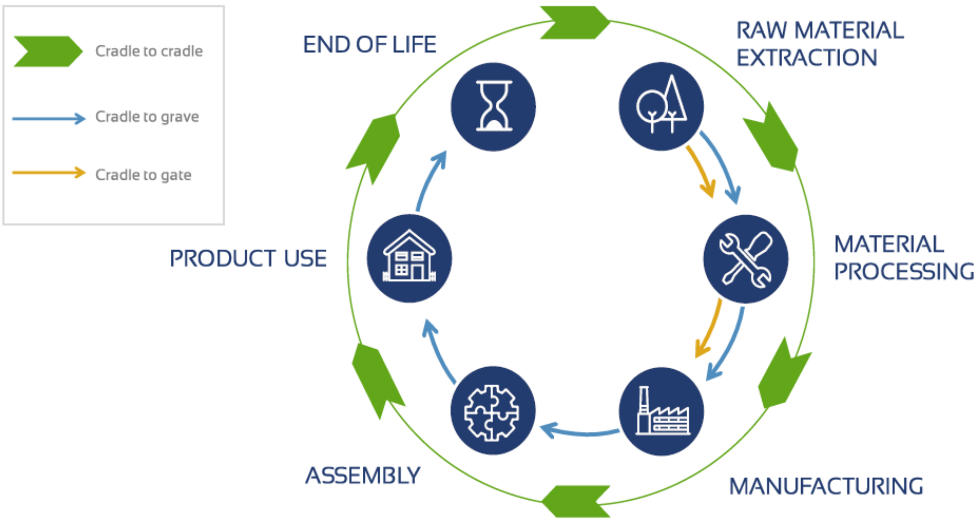

Figure 2. System boundaries definition (ISO14040)

Lastly, at this step, the **impact categories** considered in the impact assessment are established, such as climate change; their selection will be highly based on the system under study and the most meaningful parameters worth considering.

Inventory analysis (Life Cycle Inventory, LCI)

This phase consists of a full process of data collection, to quantify and measure any input and output within the Technosphere, defined in system boundaries and relation to the natural environment. In this stage, all emissions released to the environment (air, water and soil) and

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resources consumption (energy and materials) along the life stages and referred to the functional unit will be gathered.

Usually, this is the longest and most intensive stage of LCA because the partners in the consortium, employing a spreadsheet properly and timely provided by ZER0-E, must fill it with the data required for the assessment.

It is important to highlight that a regular communication between ZER0-E and the partners of the consortium, especially the ones working with that technology development of the project, should be precisely set up to avoid delays in the analysis and misunderstanding and discrepancy with the data collection.

Hence, the spreadsheet with the need data to be compiled, needs to be clear and easy to explain, and contains measurements and/or estimation, identification of relevant and non-relevant elements, mass and energy balances and system boundaries allocation (if it is required).

Impact assessment (Life Cycle Impact Assessment, LCIA)

During this stage, LCI results are translated into environmental impacts categories and expressed at either midpoint or endpoint levels by applying an impact assessment method. It is the procedure to identify and characterise the potential effects produced in the environment from the system analysed. One of the state-of-the-art software will be used for this purpose.

These results will be assigned to the impact categories and potential environmental impacts will be calculated. An *impact category* is defined as a "class representing environmental issues of concern to which life cycle inventory analysis results may be assigned"[1]. When referring to impact categories, it must be clarified if either midpoint or endpoint categories are being used. Figure 1.3 shows how the impact pathway usually life cycle evaluators follow. Starting from data collection of energy and emissions, categories at the midpoint level require indicators, according to the method taken as a model. Some examples are Global warming potential, Ecotoxicity, Ozone depletion, among others.

[1] EC, 2013, Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. OJ L124, 04.05.2013, pp. 1-210.

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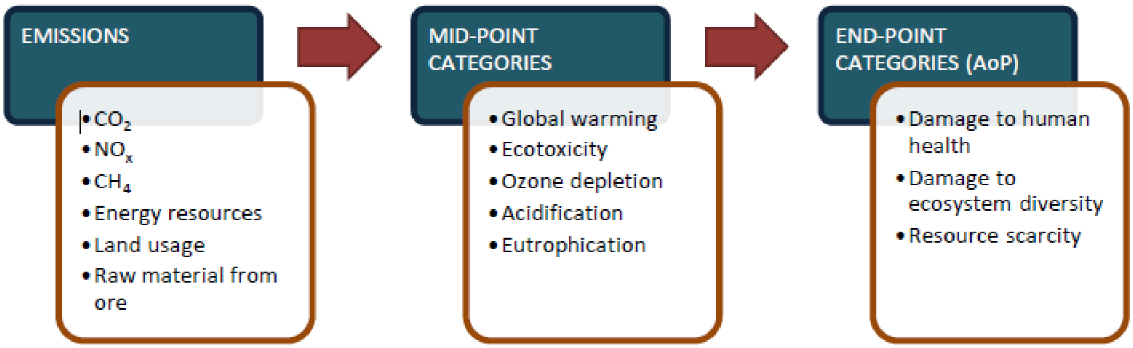

Figure 3.Scheme of steps of the environmental mechanism

Eventually, endpoints are described by Area of Protection (AoP), it allows easy understanding because they are close to what matters to society and allowances cross-comparison on a scientific basis within the same AoP. On the other hand, end-point categories lack accuracy because many parameters are grouped and classified which leads to inaccuracies and uncertainties, as expressed in Bare et al. Consequently, the impact categories will be expressed at the mid-point level.

Throughout the project, the categories may vary from the ones mentioned in the Goal and Scope definition; if this is the case they will be changed as soon as the Deliverable is released.

Life Cycle Impact Assessment consists of the following steps:

- **Selection of impact category**, there are three; first, the **Ecosystem Impact** involves climate change, acid rain, eutrophication, land use change, solid waste, toxicity. Secondly, **Human Impacts** which involves ozone depletion, smog, particulate matter, carcinogens and toxicity. Finally, **Resource Depletion**, that contains fossil fuels, freshwater, soil, forest, grassland and minerals.
- **Classification**, assign LCI results to different impact category.
- **Characterization**, calculate the impact.
- **Normalization** (optional), grouping and assign a weight to the impacts.

[1]

Interpretation

To conclude the assessment, the findings obtained throughout the initial three stages are presented synthetically, showing the critical sources of impacts the eco-friendliest stages and the consistency according to all the aspects defined during the goal and scope stage, ensuring that there is information as complete as possible.

These steps are following this presented order, however, in this study is going to be compared to cases. Supermarkets before the intervention (orange information) and supermarkets after

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the intervention (green information). And the intervention will be different in each supermarket and the results will depend on the development of several factors in the project.

4 Application of environmental assessment to SUPER HEERO project

4.1 SUPER HEERO objective

As is reported in the Grant Agreement:

While it's widely accepted that energy efficiency investments are not only necessary from an environmental point of view but also, in most cases, convenient in terms of expected return and payback times, ***it's still difficult to attract private finance that can boost the energy transition process on a large scale in the retail sector*** *and supermarkets is just a good example of it. By* ***supermarket, we refer to*** *the self-service shop offering a wide variety of food, beverages and household products. It is larger and has a wider selection than earlier grocery stores but is smaller and more limited in the range of merchandise than a hypermarket or big-box market.* ***In particular, SUPER-HEERO project refers to small/medium scale supermarkets, for which securing financial investments it is more complicated****. Of the total operating costs of a supermarket, which include purchasing merchandise, employee salaries, and more,* ***energy can account for between 10% and 15%,*** *which is huge for a business that operate on tight margins* ***(on the order of 1%)1,****2. Given the thin profit margins of supermarkets, any monetization from energy savings is extremely significant for the business.3 In particular****, refrigeration and lighting account for over 50%*** *of total energy use in the average supermarket, making these systems the best places to start looking for energy efficiency opportunities.* ***By developing an innovative collaborative and scalable financial scheme the SUPER-HEERO Project aims at providing an instrument for small/medium scale supermarkets to access the much-needed funds*** *that allows implementation of energy efficiency strategies (i.e. energy retrofits, cost-effective solutions, performance-based partnerships, etc.) and thus* ***unlocking the potential of energy savings over 40%*** *4, which in turn would materialize in economic, social and environmental gains.*

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Figure 4. SUPER-HEERO scheme

4.2 Goal and scope definition

For SUPER-HEERO the LCA will identify the environmental impact of the energy consumption in supermarkets, therefore with the information it is able corroborate which technologies and equipment can be implemented in the supermarkets to reduce the energy consumption. It is considering just the energy that is consumed inside the building. Hereby it is possible to calculate the impact of the energy consumed in CO_2 equivalent. In resume:

- Goal: calculate CO_2 equivalent emitted by the energy consumed inside a supermarket
- Scope: energy consumed inside the supermarket building

This study will assess 8 supermarkets referred as (A, B, C, D, E, F, G, H). Each supermarket has a different location and installation characteristics. This will helped recognize the similarities in energy consumption regardless the differences between them.

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	Name	Location
A	Dia Almansa	Spain
B	Dia Arriaga	Spain
C	Coviran 1	Spain
D	Despar	Italy
E	Podva 1	Italy
F	Naturasí 1	Italy
G	Podva 3	Italy
H	Podva 4	Italy
I	Coviran 2	Spain
J	Naturasí 2	Italy

Table 1. List of Supermarkets and Location.

As pointed in D2.2. the Key areas of energy efficiency in supermarkets are overall energy management; energy supply; heating, ventilation, air conditioning; lighting; product refrigeration; other areas. In this report will focus on heating, ventilation, air conditioning; lighting; product refrigeration; special equipment and other areas

4.3 Functional Unit

Since the flow to analyse is energy consumption, the functional unit (FU) will be **kWh (kilo Watts hour).** With this unit is possible to measure the energy, as well, it will allow to evaluate the KPIs regarding the ecological impact; for example, $\frac{tons\ CO_2}{kWh}$ and make comparisons of the consumption before and after the implementation.

4.4 System boundaries

The system boundaries can be classified as follows: cradle-to-grave, cradle-to-gate, cradle-to-cradle, and gate-to-gate (as shown in figure 5). The approach of the system boundaries is

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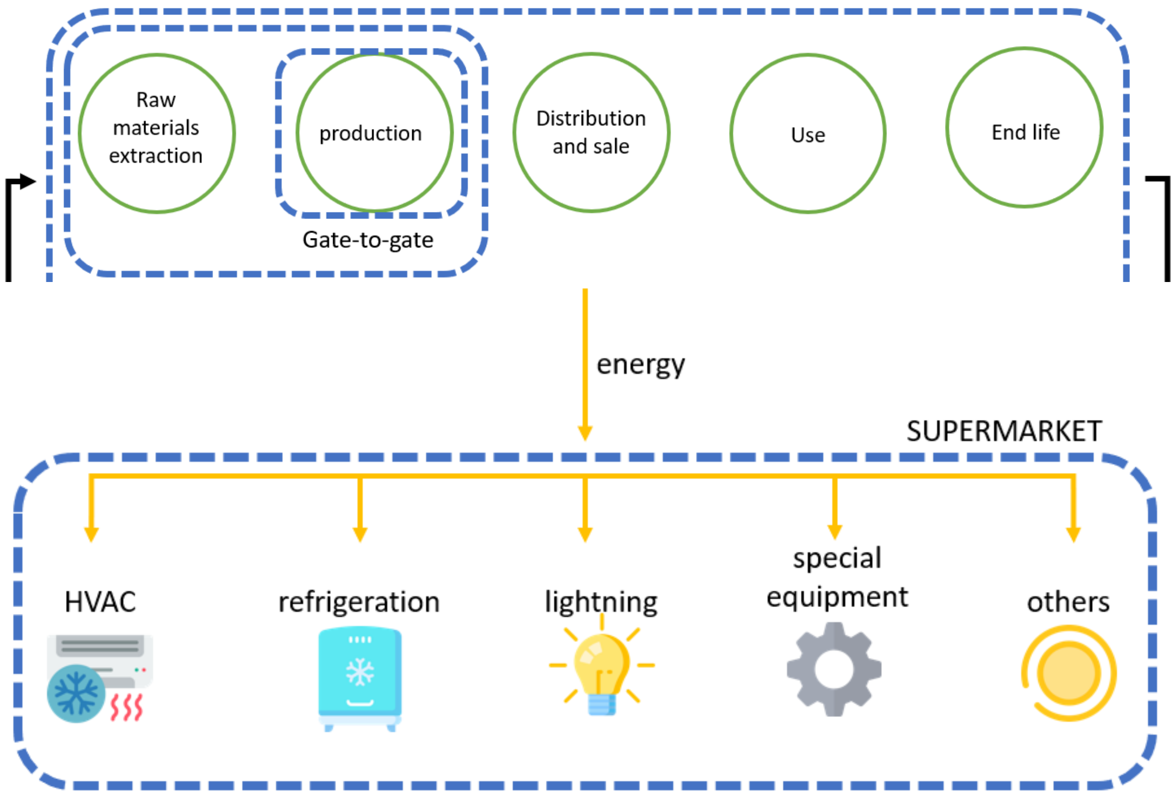
delimited by the scope of the study, in general, beginning from the extraction of the raw material until the end-of-life strategies adopted for the system analysed.

Figure 5 System boundaries in a LCA ISO 14040[1]



The conclusion from the image is that even if the system boundary gate-to-gate is in the production phase of the good, considering that one of the main objectives of Super Heero is energy efficiency in the supermarkets, this assessment is focused on the energy consumption of the equipment used for the supermarkets to function correctly. So, in this case the system boundary gate-to-gate is used, since what it being measure is energy required to have a functional supermarket. As mentioned before, the energy consumed is going to be classified in HVAC, refrigeration, lightning, special equipment, and others. This classification allows to have the same variables to analyse in the different supermarkets.

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4.5 Inventory analysis

Through the monitoring and audit phase of the project, the technical partners (RINA, CREARA, R2M) installed monitoring systems in the demo supermarkets and collected data regarding energy consumption of its different systems.

The analysis is focused on the supermarket's energy consumption in a year, the consumption will be divided in the five categories mentioned before.

1. Refrigeration (frezzers and fridges)
2. Lightning
3. HVAC
4. Special equipment (ovens, pumps, grills, etc)
5. Others

To collect this information, a spreadsheet containing all the required data was shared with the partners and the supermarkets. In this spread sheet not only lie information of the monitoring time of Super Heero, but also historical data for over a year of energy consumption from each site.

Four of the eight demo sites, didn´t gave any information due to access permission, therefore for sites E, F, G and H, the data has been estimated to complete the LCA. The supermarkets have the following percentage of energy consumption in the categories mentioned.

Category	A	B	C	D	E	F	G	H
Refrigeration	16.4%	8.9%	50%	51.5%	46.5%	47.2%	45.5%	45%
Lightning	14.3%	16%	13.3%	26.5%	26.6%	25.5%	24.3%	26.9%
HVAC	46.6%	57.3%	12.7%	11.8%	23.3%	22.3%	24.1%	23.5%
Special equipment	10.7%	10.2%	19.6%	7%	2.2%	2.5%	2.4%	2.9%
Others	12.2%	7.6%	7.6%	3.1%	1.4%	2.6%	3.7%	1.7%

Table 2. Supermarkets and percentage of energy consumption.

From Table 1 it can be concluded that in supermarkets refrigeration is the area where it is consumed the most energy above the others. This statement is going to be in all supermarkets due to the principal product to sell in supermarkets are food, and to keep it fresh it is necessary fridges and freezers.

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Following it is the HVAC and lighting. A supermarket has flows of people coming in and out. As long as the supermarket is open, the building must ensure a comfortable place to work and shop; HVAC and lighting are basics to make the building a comfortable place by providing the correct temperature, ventilation and clarity.

In the next figure it is shown the average of percentage consumption in the 8 supermarkets.

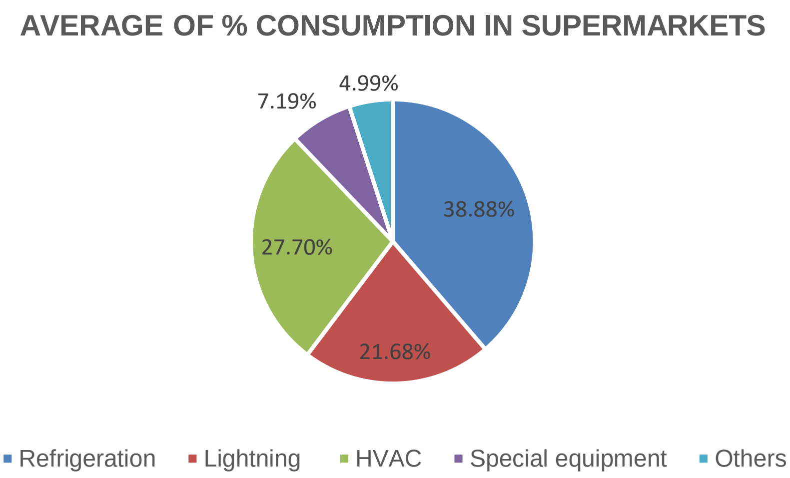

Figure 6. Average of energy consumption in supermarkets.

To measure the impact of the supermarkets in the different categories, the following Table 2 and Table 3 show the energy consumption of each supermarket in KWh for the selected areas:

Category	A	B	C
Refrigeration	192.013,4	206.100,6	42,733,7
Lightning	67.866,8	32.012,1	168.243,1
HVAC	59.176,5	57.549,92	44.752,6
Special equipment	44.278,9	36.688,0	65.951,2
Others	50.486,2	27.336,2	14.805,3
TOTAL	**413.822**	**359.687**	**336486,2**

Table 3. Supermarkets and energy consumption in KWh.

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Category	D	E	F	G	H
Refrigeration	174.352,9	37.253,6	16.882,2	14.487,7	19.019,96
Lightning	758.235,6	74.347,4	35.813	27.352,3	36.421,2
HVAC	389.460,8	42.529,9	19.348,1	14.604	21.771,784
Special equipment	103.388,9	3.517,5	1.896,88	1.442,7	2.347,144
Others	46.257,9	2.238,4	1.934,81	2.228,2	1.375,912
TOTAL	**1.471.696,3**	**159.887**	**75.875**	**60.115**	**80.936**

Table 4. Supermarkets and energy consumption in KWh.

As the supermarkets for this study are from Spain and Italy, the datasets of the energy inputs of the study are the following:

Country	Name	Category
Spain	Electricity, medium voltage {ES} market for	Consequential system
Italy	Electricity, medium voltage {IT} market for	Consequential system

Table 5. LCA energy inputs.

4.6 LCIA

For the calculations of the impacts, it was used SimaPro software, which has a database of inputs, in this case the energy country mix, (Electricity, medium voltage {ES} market for, Consequential system and Electricity, medium voltage {IT} market for, Consequential system).

The database includes the Factor equivalent of the impact indicator for each input. In this case each country considers the consumption mix of a product in a given geography, connecting suppliers with consumers of the same product in the same geographical area. And includes direct emissions to air (SF6 from the insulation gas in the high voltage level switchgear are allocated to the electricity demand on medium voltage) and electricity losses during transmission.

SimaPro is going to be used for the pilots to compare the supermarkets before and after the implementation. Giving the next results in Table 5.

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IMPACT CATEGORY	UNIT	A	B	C	D	E	F	G	H
Global warming	**kg CO2eq**	**179000**	**15557.64**	**14600**	**309155.6**	**33587.06**	**15938.87**	**64346.83**	**17002.02**
Stratospheric Ozone Depletion (SOD)	kg CFC11 eq	0.0661	0.057391	0.0537	0.236979	0.025746	0.012218	0.049324	0.013033
Ionizing radiation	kBq Co-60 eq	382	331.4886	310	538.4167	58.49428	27.75869	112.0646	29.61024
Ozone formation, Human health	kg NOx eq	88.1	76.52215	71.6	546.5381	59.3766	28.1774	113.755	30.05688
Fine particle matter formation	**kg PM2.5 eq**	**37.8**	**32.82772**	**30.7**	**53.8604**	**5.851463**	**2.776835**	**11.21036**	**2.962055**
Ozone formation terrestrial ecosystem	kg NOx eq	90.6	78.72556	73.6	563.4191	61.21058	29.04772	117.2686	30.98525
Terrestrial acidification	kg SO2 eq	92.9	80.66706	75.5	516.2197	56.08277	26.6143	107.4446	28.38952
Fresh water eutrophication	kg P eq	9.12	7.924813	7.41	32.17371	3.495394	1.658753	6.696552	1.769394
Marine eutrophication	kg N eq	0.516	0.448444	0.42	1.732544	0.188226	0.089323	0.360607	0.095281
Terrestrial ecotoxicity	kg 1,4-DCB	491000	426514.4	399000	788571.5	85671.43	40655.71	164131.2	43367.52
Fresh water ecotoxicity	kg 1,4-DCB	12100	10477.89	9800	42203.85	4585.081	2175.868	8784.198	2321.002
Marine ecotoxicity	kg 1,4-DCB	14100000	12281229	11500000	10111.87	1098.567	521.3291	2104.658	556.1027
Human Carcinogenic toxicity	kg 1,4-DCB	142000	123646.5	116000	75.28116	8.178642	3.881206	15.66882	4.14009
Human non-carcinogenic toxicity	kg 1,4-DCB	8710000	7564865	7080000	8084.867	878.3504	416.8246	1682.763	444.6275
Land use	m2a crop eq	22800	19800.57	18500	120676.7	13110.47	6221.624	25117.32	6636.617

Mineral resourse scarcity	kg Cu eq	198	172.0476	161	144.7184	15.72239	7.461122	30.1213	7.958793
Fossil resource scarcity	kg oil eq	5160	4478.215	4190	92965.09	10099.85	4792.922	19349.51	5112.619
Water consumption	m3	229	199.1779	186	1836.398	199.5086	94.67759	382.223	100.9928

Table 6. Impact result ReCiPe Midpoint LCA for each supermarket.

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Regarding the goals of the project and the impacts to assess, this study is mainly focused on environment and human impacts, from which Global warming represented in Kg CO2eq and fine particle matter formation represented in Kg PM2.5 eq are part are relevant part.

In the next tables are presented the results of the selected system categories.

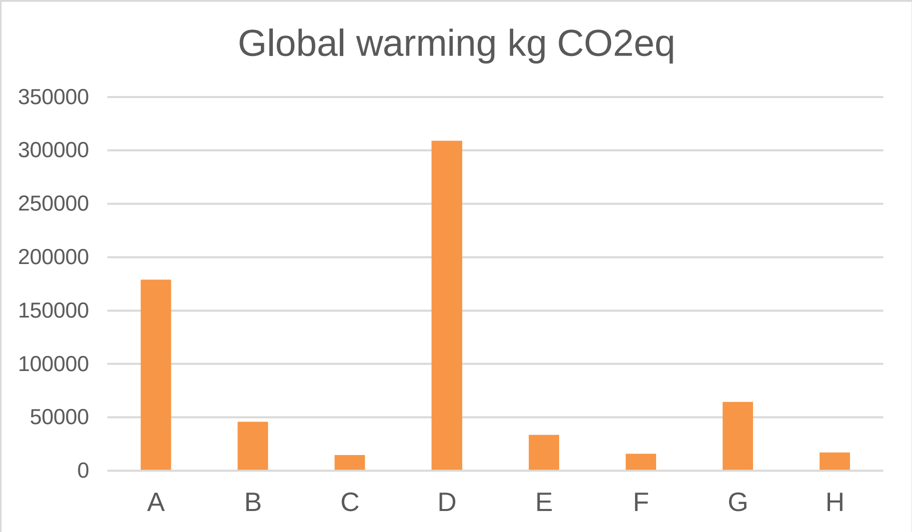

Figure 7. kg CO2 equivalent emissions of each supermarket.

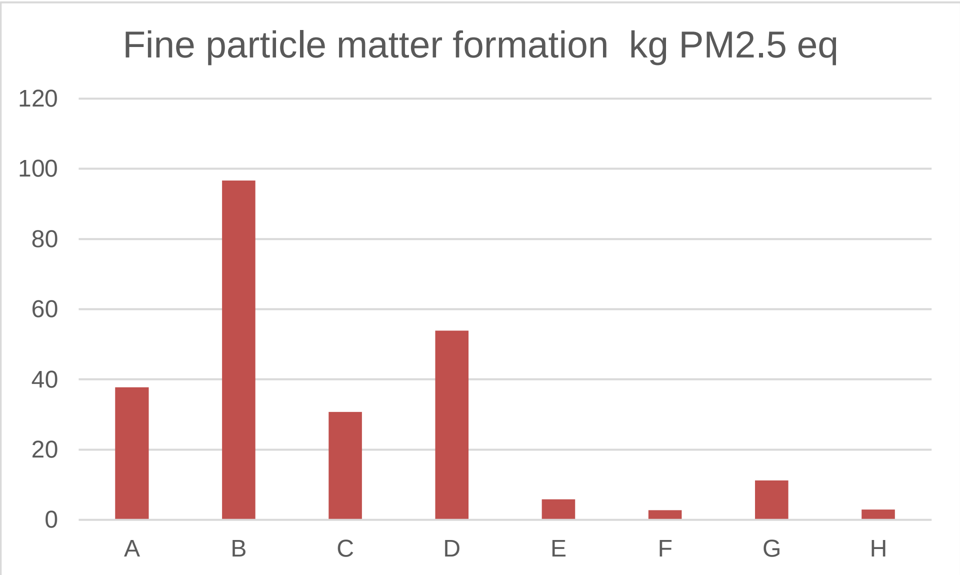

Figure 8. kg PM2.5 equivalent emissions of each supermarket.

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As shown in the tables, supermarkets A and D, present the higher CO2 emissions number, with 175 t and 300t each, meanwhile in Fine particles (PM2.5) formation the higher value is for super market D with 90kg.

This can highlight the supermarkets that need deeper and urgent interventions, but even knowing this data just a few supermarkets decided to go to next step of Super Heero and make the implementation developed for the project.

Supermarket F decided to be part of the next step and took in consideration the financial scheme and the implementation of technology. And supermarket B implemented some of the recommendations done after the auditory by SUPER-HEERO, but did all the implementations by themselves. In points 4.7 and 4.8 there is detailed information about the impact after the implementations.

4.7 Results Italian pilot (supermarket F)

4.7.1 Technology implemented and cost

Key aspects to better understand this demo site are, based on estimations made at the project development time:

- One store location
- 23,80 kWp PV system at 41,500 €
- 27 MWh of annual production at an estimated value of 8,100 € of production
- Seven-year system leasing with handover at year 8
- Joint financing by the crowd, brand and proponent
- 20-year financial benefit of 107,925 € and 159 t CO2 emissions avoided.

The technology implemented for this supermarket is **solar panels**, model TSM-DE09R.08W425 from the technology provider TRINA. There are 56 modules with an angle of 5°, with a power of installation of 23,80kWp. The Inverter is a model 3PH 24000TL-V3-3PH24000TL-V3. And the cost of this implementation is 40.000 €.

Since is not possible to monitor the consumption of the supermarket after the installation, and considering the climate conditions of the area and the technical sheet of the solar panel shared by the provider it was agreed by the coordinator (R2M) to assume an efficiency of 80% of the system installed. This is because even though in a year it is supposed to supply all the year energy demand. By month there are variations where in summer the energy supply by the

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solar panels will be higher than the demand but in winter the demand would be higher than the production.

4.7.2 LCIA with the technology implemented

Since is not possible to monitor the consumption of the supermarket after the installation, and considering the area available in the roof to install the panels and its technical sheet, the PV system installed will supply 35% of the energy demand in this demo sites and the consumption from the country mix grid will be of 65% of the total of energy consumed. Since the implementation are solar panels, it was considered for the calculations that each section (refrigeration, lightning, HVAC, Special equipment, and others) is going to reduce the consumption mentioned before. In the point 4.7.3 it is shown the comparison between impacts.

	Consumption (kWh) in Supermarket F	
	Before Implementation	**After Implementation**
Refrigeration	16.882,2	7.162,6
Lightning	35.813	3.869,625
HVAC	19.348,1	3.376,438
Special equipment	1.896,88	379,375
Others	1.934,81	386,96
TOTAL	**75.875**	**15.175**

Table 7. Comparison kWh Supermarket F.

4.7.3 Impacts Italian pilot

After putting the historical consumption of this supermarket in SimaPro software, as detailed in section 4.6, it is estimated to have the following impact:

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IMPACT CATEGORIES	UNIT	F	SUPERMARKET F AFTER IMPLEMENTATION
Terrestrial ecotoxicity	kg 1,4-DCB	40655.71	8131.14
Global warming	**kg CO2 eq**	**15938.87**	**3187.77**
Land use	m2a crop eq	6221.62	1244.32
Fossil resource scarcity	kg oil eq	4792.92	958.58
Freshwater ecotoxicity	kg 1,4-DCB	2175.87	435.17
Marine ecotoxicity	kg 1,4-DCB	521.33	104.27
Human non-carcinogenic toxicity	kg 1,4-DCB	416.82	83.36
Water consumption	m3	94.68	18.94
Ozone formation, Terrestrial ecosystems	kg NOx eq	29.05	5.81
Ozone formation, Human health	kg NOx eq	28.18	5.64
Ionizing radiation	kBq Co-60 eq	27.76	5.55
Terrestrial acidification	kg SO2 eq	26.61	5.32
Mineral resource scarcity	kg Cu eq	7.46	1.49
Human carcinogenic toxicity	kg 1,4-DCB	3.88	0.78
Fine particulate matter formation	kg PM2.5 eq	2.78	0.56
Freshwater eutrophication	kg P eq	1.66	0.33
Marine eutrophication	kg N eq	0.09	0.02
Stratospheric ozone depletion	kg CFC11 eq	0.01	0.00

Table 8. Impacts before and after the implementation, supermarket F.

This table is clear, since it shows that after the implementation of the PV panels, the reduction was significant, even after estimating only a supply of 35% from the PV system.

In the next figure, the reduction in emissions of CO2 equivalent, is very clear.

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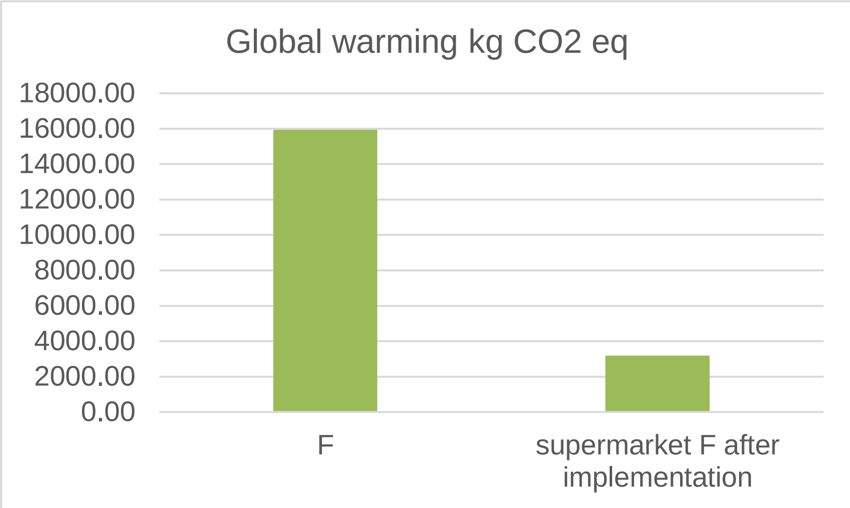

Figure 9. CO2 eq before and after, supermarket F, calculated with SIMAPRO software.

In the indicator, there is a considerable reduction, before the implementation the impact is almost 16 tons of CO2 eq, after the implementation the impact reduces to 3,1 tons con CO2 eq. It is important to highlight that the reduction was about 80% of emissions, which can compare to the emissions of 3 cars in a year.

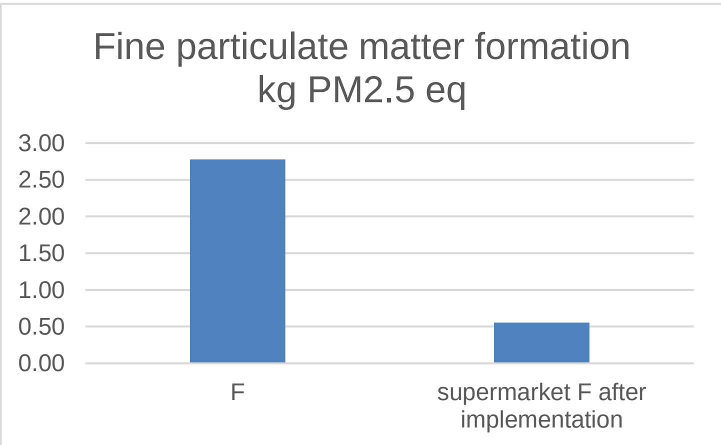

Figure 10. PM2.5 eq before and after, supermarket F.

The Fine Particle Mater Formation indicator shows the reduction, from 2,7 kg PM2.5eq to 0,5 lg PM2.5eq. This is a great reduction, as commonly known Fine particles (PM2.5) pose big

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health risk, since they can affect a person's lungs and heart. (Epa.gov) Reducing the emission of this particles allows better quality of life of people.

4.8 Results Spanish pilot (supermarket B)

4.8.1 Technology implemented and cost

In this case the information after the implementation was shared by the supermarket. Also is important to highlight this supermarket made the installation of equipment by themselves; therefor there is no information regarding costs.

The measures implemented were the following:

- Consumption monitoring system
- Temperature adjustment in HVAC
- Sectorization equipment in climatization
- Door installation in open fridges

After the implementation the supermarket mentioned there was a decrease of consumption of more than 50%, for the next point we are going to assume a decrease of 50% in energy consumption in each month.

4.8.2 LCIA with the technology implemented.

As the same case in supermarket F the decrease of consumption was applied to each sector, this means that the impact would be the half of the impact before the implementation.

	Consumption (kWh) in Supermarket B	
	Before Implementation	**After Implementation**
Refrigeration	206.100,651	103.050,3255
Lightning	32.012,143	16.006,0715
HVAC	57.549,92	28.774,96
Special equipment	36.688,074	18.344,037

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Others	27.336,212	13.668,106
TOTAL	**359.687**	**179.843,5**

Table 9. Comparison kWh supermarket B.

4.8.3 Impacts in Spanish pilot

After putting the estimated consumption as input into the SimaPro software, as detailed in section 4.6, it is estimated to have the following impact:

IMPACT CATEGORY	UNIT	B	SUPERMARKET B AFTER IMPLEMENTATION
Global warming	**kg CO2 eq**	**15557.64**	**7778.82**
Stratospheric ozone depletion	kg CFC11 eq	0.057391	0.03
Ionizing radiation	kBq Co-60 eq	331.4886	165.74
Ozone formation, Human health	kg NOx eq	76.52215	38.26
Fine particulate matter formation	**kg PM2.5 eq**	**32.82772**	**16.41**
Ozone formation, Terrestrial ecosystems	kg NOx eq	78.72556	39.36
Terrestrial acidification	kg SO2 eq	80.66706	40.33
Freshwater eutrophication	kg P eq	7.924813	3.96
Marine eutrophication	kg N eq	0.448444	0.22
Terrestrial ecotoxicity	kg 1,4-DCB	426514.4	213257.20
Freshwater ecotoxicity	kg 1,4-DCB	10477.89	5238.95
Marine ecotoxicity	kg 1,4-DCB	12281229	6140614.82
Human carcinogenic toxicity	kg 1,4-DCB	123646.5	61823.27
Human non-carcinogenic toxicity	kg 1,4-DCB	7564865	3782432.68
Land use	m2a crop eq	19800.57	9900.29
Mineral resource scarcity	kg Cu eq	172.0476	86.02
Fossil resource scarcity	kg oil eq	4478.215	2239.11
Water consumption	m3	199.1779	99.59

Table 10. Impacts before and after implementation, supermarket B.

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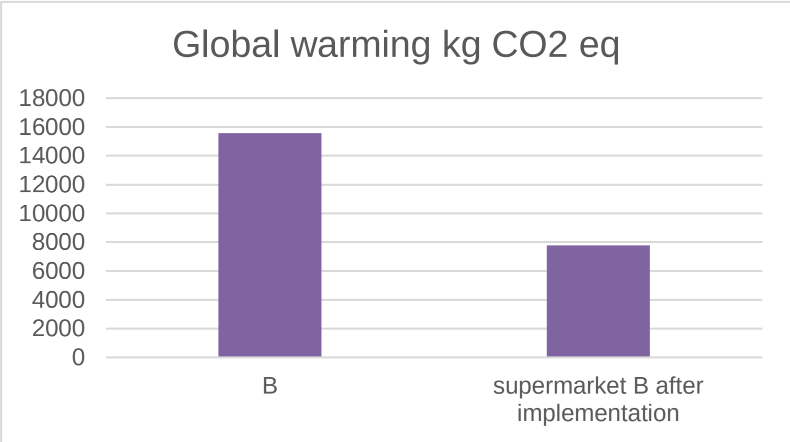

Figure 11. CO2 eq before and after, supermarket B.

In the indicator there is an important reduction, before the implementation the impact is almost 16 tons of CO_2 eq, after the implementation the impact reduces to 7,9 tons con CO_2 eq. It is important to highlight that the reduction was about 50% of emissions, wich can compare to the emissions of (2.8) almost 3 cars in a year.

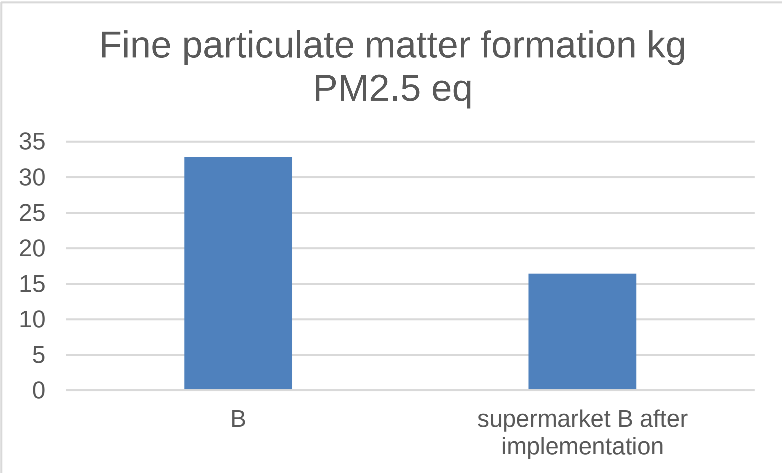

Figure 12. PM2.5 eq before and after, supermarket B.

In the last two figures it is possible to interpretate that both indicators had a reduction of 50%, the CO_2 eq went to 15.5 tons to 7.7 tons of CO_2 eq and the Fine Particle Matter formation from 32kg to 16kg.

It is important to say, that if well supermarket B only got 50% of reduction in C02 emissions, the reduction of Fine Particles is a big number, and it is great for human's health.

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5. Economic impact assessment of demo sites

5.1. METHODOLOGY

5.1.1. Introduction

This assessment is based in profitability indicators, that were made gathering and using estimation data coming from the Super Heero implementation projects.

Following a list of the gathered information:

- Design and installation cost
- Equipment cost
- Energy consumption cost for each site
- Energy consumption savings
- Energy consumption before de implementation

The analysis was made using the following financial concepts and variables:

- Internal rate of return
- Payback period
- Return of the investment
- CO2 impact (cost per ton saved)

5.1.2. Methodology

The methodologies selected for this assessment are Benefit-cost Analysis (BCA) and economic impact analysis (EIA), and financial impact analysis (FIA), Since they are the most common methods, from the ones generated by the Science of economics in terms of evaluating proposed project investments in monetary terms.

The first one measures the economic efficiency of spending in terms of whether the total benefits of a project, program or policy exceeds total costs when compared on a consistent money-denominated basis. The second one measures the pattern and extent to which a project, program or policy leads to changes in the development of the economy of a specified area, as measured in terms of income and employment effects on elements of the economy (industries, households, projects, etc.). Finally, the third one measures the economic feasibility of investing to develop and then continue operation of infrastructure, service or technology, as measured in terms of revenues, expenditures, net cash flow and return on investment over time (Weisbrod. G, 2016).

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Based on the chosen methodologies the analysis of the measures implemented in the demo sites was performed with the financial impact analysis (FIA) approach, that considers the financial variables defined in three dimensions presented in the following table:

Time dimension			
Tool	**Treatment of time effects**	**Outcome Metric**	**Interpretation of view**
FIA	Nominal $ (Future year values are increased by inflation growth over time)	Annual Cash Flow and Return on investment (ROI) by year over the project lifetime	Feasibility of financing (in terms of expenditures required and revenues achieved over time)
Spatial dimension			
Tool	**Treatment of Spatial effects**	**Outcomes Covered**	**Excluded effects**
FIA	Specific Projects, Facilities or Services	Revenues generated and expenditures made at specified facilities or projects	Revenues and expenditures outside of specified facilities.
Elements of the Economy (and society)			
Tool	**Treatment on Elements of Society**	**Outcomes Covered**	**Excluded effects**
	Owner, investor and/or Operator Finances	Net Cash Flow (revenue - expenditure) for facility or project owners and operators	Non-paying uses, plus cash flow for others (not owners or operators of specified facilities)

Table 11. FIA Tool base on three dimensions.

As for the LCA, to collect the information needed in this assessment, a spreadsheet containing all the required data was shared with the partners and the supermarkets. In this spread sheet not only lie information of the monitoring time of Super Heero, but also historical data for over a year of energy consumption from each site, in kWh but also in cost.

After having the data, it was necessary to analyse it and calculate the profitability indicator of the implemented measures in each demo site and besides.

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For this assessment, the following concepts were developed and are applied to SUPER HEERO demo sites:

$$Net\ Present\ value\ (NPV) = \frac{Total\ project\ costs - Total\ project\ savings}{(1 + discount\ rate)^{project\ lifetime}}$$

$$Internal\ rate\ of\ return\ (IRR) = 0 = \frac{Total\ project\ costs - Total\ project\ savings}{(1 + internal\ rate\ of\ return)^{project\ lifetime}}$$

$$Payback\ period = \frac{(Total\ installation\ cost)(€)}{(\text{Electricity savings per year})\ (\frac{€}{year})}$$

$$Return\ of\ investment\ (ROI) = \frac{(Electricity\ savings) - (Total\ installation\ cost)(€)}{(Total\ installation\ cost)(€)}$$

$$Marginal\ abatement\ Cost\ (MAC) = \frac{(-)Net\ present\ value\ (€)}{(Total\ CO2\ emissions\ saved\ (t\ CO2\ e)}$$

To better understand the last indicators is important to clarify some definitions:

The Net Present Value (NPV) represents the total value of the project by summing all its costs and savings and adjusted for the time value of money. Where costs exceed the savings, the NPV will be a negative value representing a net cost to the investor/owner. Conversely, where the savings exceed the costs, the NPV will be a positive number evidencing that the project will pay for itself (GREENSENSE, August 2014).

The Marginal Abatement Cost (MAC) is the cost per unit of GHG or CO2 emissions abated throughout the lifetime of the project. To calculate the marginal abatement cost, it is necessary to multiply the NPV by –1. This is to show that projects with negative marginal abatement cost (that is a negative cost of abatement) are economically viable in that they save the investor/owner money. Conversely, a positive marginal abatement cost has a true cost per tonne of CO2e abated and is associated with a negative NPV (GREENSENSE, August 2014).

Finally, if both the net present value and the marginal cost of the technologies are positive, the internal rate of return is greater than the discount rate or the opportunity rate, and the

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return on investment is positive, the project as a whole will be financially feasible from the point of owner view.

5.2. Supermarket F (Padova)

5.2.1. Installation

As mentioned in the LCIA, this demo site has the following specifics:

- One store location
- 23.8 kWp PV system at 40,000 €
- 26.18 MWh of annual production at an estimated value of 6,600 € of production
- Seven-year system leasing with handover at year 8
- Joint financing by the crowd, brand and proponent
- 20-year financial benefit of 107,925 € and 159 t CO2 emissions avoided.

The technology implemented for this demo site was:

SUPER MARKET	TECHNOLOGY TYPE	PROVIDER	MODEL	RATED CAPACITY
F	PV Modules	TRINA	**TSM-DE09R.08W425**	23.80 kWp (80%efficiency)

Table 12. Technology implemented in SUPERMARKET F.

The information of the savings depends only of simulation process presented by the technology providers and the project coordinator, due to Super Heero ended just when the installation was done and it was not more time to collect real data of the functioning of the instalment.

5.2.2. Summary of collected data

As mentioned in the LCA section, the energy consumption data was collected through monitoring systems and audits installed by Super Heero, in addition to that historical billing and consumption information for one year, was delivered by the supermarket to better understand the kind of installation to make in it. And, a simulation was made to assess the installation area and business plan to carry out this implementation.

The resulted data is in the following table:

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TECHNOLOGY TYPE	TOTAL INVESTMENT
PV Modules **TSM-DE09R.08W425** by TRINA	41,500 €

Table 13. Total investment.

SUPER MARKET F	Electricity cost (€/year)	Electricity consumption (kWh)	Electricity production (kWh)	Electricity cost savings (€/year)
Before	30,420 €	75,875	0	0
After implementation	30,420 €	75,875	26,200	6,676 €

Table 14. Electricity savings at Supermarket F.

Maintenance was not considered, since the inversion includes it.

5.2.3. Results and discussion

Taking the data above, the financial indicators obtained were:

TECHNOLOGY TYPE	TOTAL INVESTMENT
Electricity savings	6,676 €/year
Payback Period (PP)	6.2 years
Net Present Value (NPV)	19,281.2 €
Marginal Abatement Cost (MAC)	-74.73 €/t CO_2e
Internal Rate of Return (IRR)	46%
CO_2 emission factor (NG)	0.389 t CO_2e/MWh
CO_2 savings (Total emissions saved)	159 t CO_2e

Table 15. Financial indicators at Supermarket F.

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The results indicate that the EE measure implemented in this supermarket is feasible, since the electricity production from the PV system (consumption savings from the mix grid) is more, compared to the initial investment cost (NVP > 0, MAC < 0 and PP <20 years)

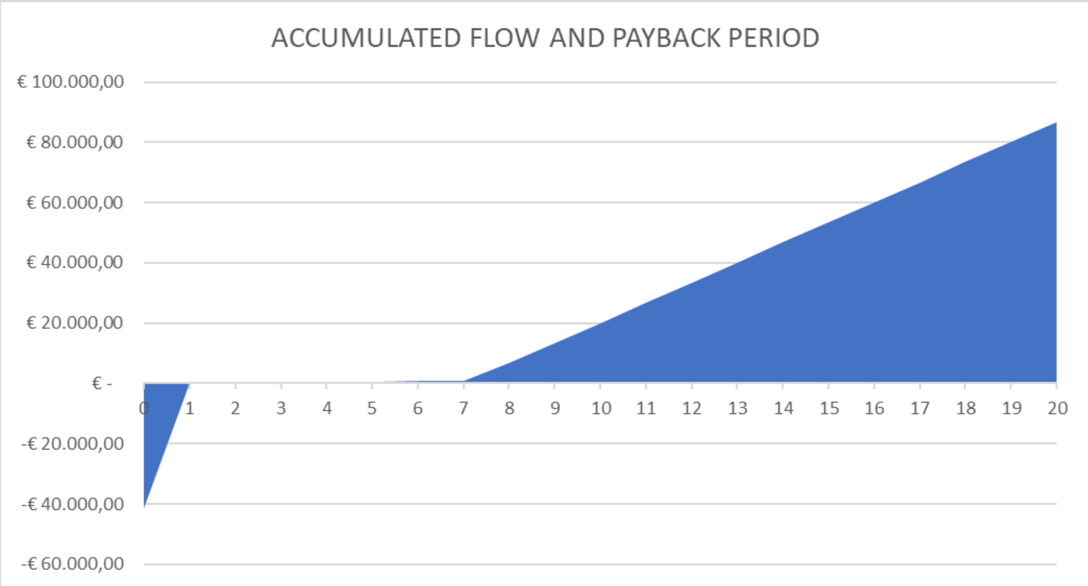

Figure 13. Accumulated flow and payback period at Supermarket F.

To obtain these results, it necessary to clarify the next conditions:

- The total investment cost is equal to the installation cost of the PV System.
- The savings area calculated through simulation process done by the technology provider
- The project lifetime is 20 years, that is near to the life time of the solar panels.
- he discounts rate is often applied to investment decisions to allow for diminishing value of money over time. In this case, a 3% discount rate was assumed.

5.3. SUPERMARKET J

SUMMARY

Supermarket J, is a demo site that entered the project in May, this is an update to include it in the project, since it is prove of the success of the installation in Supermarket F. This assessment is based on the information delivered by the supermarket and during the development of the options of implementation.

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5.3.1. Installation

- One store location
- 82.88 kWp PV system at 95,638 € (for this analysis just the 21% of the investment corresponding to the bran owner will be assessed in accumulated flow and payback period) 20,000 €
- 91.4 MWh of annual production at an estimated value of 22,846 € of production
- Seven-year system leasing with handover at year 8
- Joint financing by the crowd, brand and proponent
- 30-year financial benefit of 456,679 € and 809 tCO2 emissions avoided.

SUPER MARKET	TECHNOLOGY TYPE	PROVIDER	MODEL	RATED CAPACITY
J	PV Modules	TRINA	**TSM-DE09R.08W425**	82.88 kWp

Table 16. Technology implemented in SUPERMARKET J.

The information of the savings depends only of simulation process presented by the technology providers and the project coordinator done using the calculator tool of the EC (https://re.jrc.ec.europa.eu/pvg_tools/en/). Due to Super Heero ended just when the installation was done and it was not more time to collect real data of the functioning of the instalment.

5.3.2. Summary of collected data

As mentioned in the summary, the data was collected to assess the capacity of the installation, in addition to that historical billing and consumption information for one year, that was delivered by the supermarket to better understand the kind of installation to make in it. And, a simulation was made to assess the installation area and business plan to carry out this implementation.

The resulted data is in the following table:

TECHNOLOGY TYPE	TOTAL INVESTMENT	BRAND OWNER INVESTMEN
PV Modules **TSM-DE09R.08W425** by TRINA	95,638 €	20,000 €

Table 17. Total investment.

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SUPER MARKET J	Electricity cost (€/year)	Electricity consumption (kWh)	Electricity production (kWh)	Electricity cost savings (€/year)
Before	80,000 €	200,000	0	0
After implementation	30,420 €	200,000	91,400	22,846 €

Table 18. Electricity savings at Supermarket J.

Maintenance was not considered, since the inversion includes it.

5.3.3. Results and discussion

Taking the data above, the financial indicators obtained were:

TECHNOLOGY TYPE	TOTAL INVESTMENT
Electricity savings	22,846 €/year
Payback Period (PP)	4.2 years
Net Present Value (NPV)	29,989.17 €
Marginal Abatement Cost (MAC)	-116.24 €/t CO2e
Internal Rate of Return (IRR)	119%
CO2 emission factor (NG)	0.389 t CO2e/MWh
CO2 savings (Total emissions saved)	809 t CO2e

Table 19. Financial indicators at Supermarket J.

The results indicate that the EE measure implemented in this supermarket is feasible, since the electricity production from the PV system (consumption savings from the mix grid) is more, compared to the initial investment cost (NVP > 0, MAC < 0 and PP <20 years)

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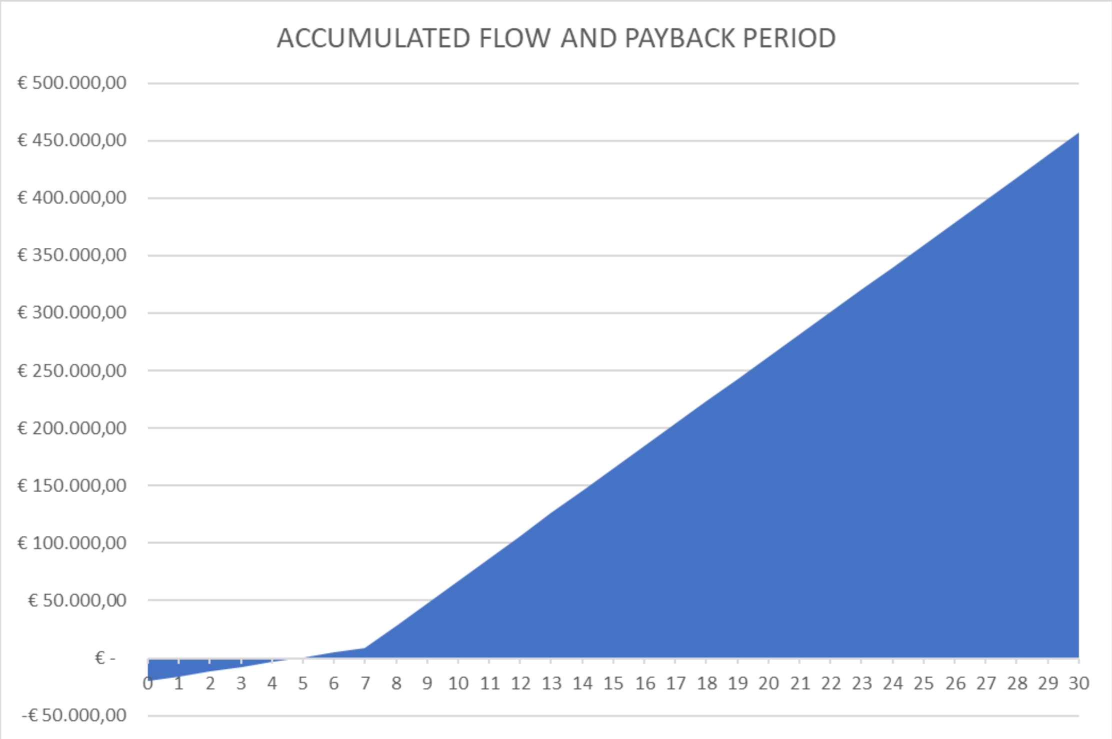

Figure 14. Accumulated flow and payback period at Supermarket J.

It is important to clarify that, even though the total inversion is 95,638 €, Figure 14 shows the accumulated flow and payback period of the inversion made by the brand that was 21% (20,000 €).

It was contemplated a mixed financial plan, as follows:

INVESTOR	INVESTMENT	%
Owner	20,000 €	21
System Operator	15,638 €	16
Super Heero Crowd	60,000 €	63
Total	95,638 €	100

Table 20. Inversion percentage SUPERMARKET J.

This information is contained in the Crowd funding project for the campaign and the contract signed among all the parts.

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The assessment was made over the Total investment.

To obtain these results, it necessary to clarify the next conditions:

- The total investment cost is equal to the installation cost of the PV System.
- The savings area calculated through simulation process done by the technology provider.
- The project lifetime is 30 years, decided by all the interested parts.
- The discounts rate is often applied to investment decisions to allow for diminishing value of money over time. In this case, a 3% discount rate was assumed.
- The CO2 emission factor (NG) was taken from https://www.nowtricity.com/country/italy/2022

6. Social Assessment

6.1. Methodology

A social impact assessment is the process of analysing, managing and monitoring the intended and unintended social consequences (good and bad) of projects or measures and the social change processes invoked by those interventions[2]. Aspects of social impact most closely related to Super-Heero include[2]:

- People's way of life, how they live, work, play and interact with one another
- their culture, that is their shared beliefs, customs, values and language or dialect
- their community its cohesion, stability, character, services and facilities
- their environment, the quality of the air and water people use; the availability and quality of the food they eat
- their health and wellbeing where health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity
- their personal and property rights
- their fears and aspirations for their future and the future of their children.

The methodology applied in the project was to be aware of these factors, to design the processes and campaigns with them in mind and to capture data, conversations, sentiment and change processes whenever possible. Observations and assessment are reported in the following sections surrounding the developed innovative financing scheme and the two implemented pilots. Customer feedback data from exit surveys is reported in the sister report D4.4. Data related to select campaign statistics is reported it in this document.

[2] https://www.iaia.org/wiki-details.php

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6.2. Social Impact Assessment of the Super Heero approach

Impacts assessed in the development and implementation of the approach, in carrying out workshops and webinars and in engaging with supermarket stakeholders are as follows.

- After COVID, supermarkets realize that they have a role in the social fabric of societies and communities. Sustainability actions with community engagement resonates well all actors involved. At workshops, people generally appreciate the idea of Super-Heero, recognize that it is innovative and want to see it succeed.
- Crowdlending invokes several change processes. For supermarkets, it becomes a new tool that avoids going to the bank which can be associated with negative sentiments (controls, long timeframes, paperwork, getting upsold, etc). For investors, they benefit economically, choose what they want to invest within and have the opportunity to directly contribute to a better environment.
- Community engagement and the opportunity to make an energy intervention an experience resonated with all actors (brand management, energy manager, franchise owners, suppliers, local government and campaign participants). Once people understood the approach, people typically began to advocate it. Cohesion between the brand and pilot franchise owner was notably positive. Cohesion and support by the brand marketing and advertising team for the second pilot project was also upbeat and encouraging.
- It is possible to invoke negative feelings or emotions associated with a campaign not going well. Ener2Crowd who sees a high volume of projects across years can predict when campaigns are likely to be quickly supported or when they may take more time given cycles during the year or the cash flows within the E2C ecosystem. A project campaign not resonating may not mean the campaign mangers are not doing a good job but that the timing or other factors are just coming at the wrong time. This may have been one factor that affected our two campaigns (April vs. June) where June is a little slower.
- It is possible also to do damage between a brand and franchise owners if things do not go well. We had a potential pilot in Italy that was to leverage a regional funding incentive for innovative measures. This was supported by the brand and Super Heero. However, the availability of funding closed nearly immediately after the portal opened and the franchise owner who had to invest time and some money for the application documents (accountant) was very upset about that.
- Rewards programs utilized at the two pilots were directly linked to social impacts. These were very well received and helped people understand some of the ideas / objectives of the approach overall. The reward program included:
    - Tree planting
    - Free tickets to a city open gardens day
    - In-store coupons
    - A free recharge at store EV columns
    - A bonus for signing up as a first time investor and
    - A bonus for referring a friend

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Related to the tickets to the open gardens day, one participant wrote in the exit survey "I have already responded to the survey but wanted to express my gratitude for the tickets to Anime Verdi. These are gardens in my home city which I had never experienced and it was really nice. Thank you."

- We did create some disappointment in the first campaign where shop indicated their intent to invest but did not understand that once open at the national level that the campaign might close quickly. In our second campaign, we made sure to repeat this message many times starting from the initial meetings.

6.3. Social Impact Assessment: Pilot 1, Padova

In promoting and communicating the pilot campaigns, it was co-designed to show the building, intervention, companies involved, and the involved municipality for a sense of transparency, information sharing and communty involvement.

Figure 15 Super Heero Padova

Figure 16 shows the table of anonymous investor data. With respect to social impacts, we note the following. In total, 35 investors contributed to the 40k euro campaign (approximately 1k per investor). The smallest investment was the minimum (100 euro) and the largest investment was the maximum (5000 euro). These limits were co-designed with the supermarket to give access to everyone (lower value) and to prevent any one large investor from saturating a large portion of the campaign (effectively blocking participation of the community). From our exit survey (29 responses out of 35), 6 were women and 23 were men (20% women). From Ener2Crowd we are informed that in their ecosystem there are fewer women but that women typically invest more. Local investors (Provincia and Region) had

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access to the campaign first. They made up 13 of the 35 investors (37%) and contributed 20.3k euro of the 40k euro raised (50%) suggesting higher commitment locally. 5 new investors (not already in the E2C ecosystem) were triggered and two new cardholder were triggered. 16 of the 35 investors were brand cardholders (45%). Looking to the regions, northern Italy participated much greater than southern Italy.

Investitori Via Parini Naturasi Aprile 2023				
Numero Investitore	Importo Investito	Tasso d'Interesse	Provenienza	
1	150.00 €	5.00	Campania / Casapulla	
2	150.00 €	6.00	Campania / Santa Maria la Fossa	
3	3,000.00 €	5.00	Emilia-Romagna / Castelfranco Emilia	NUOVO INVESTITORE
4	1,000.00 €	5.00	Emilia-Romagna / Ostellato	
5	100.00 €	6.00	Friuli-Venezia Giulia / Moimacco	
6	100.00 €	6.00	Lazio / Frosinone	
7	500.00 €	5.00	Lazio / Sacrofano	
8	2,500.00 €	6.00	Liguria / Pietra Ligure	
9	450.00 €	5.00	Lombardia / Castano Primo	
10	500.00 €	5.00	Lombardia / Gussago	
11	100.00 €	5.00	Lombardia / Mantova	
12	200.00 €	5.00	Lombardia / Milano	
13	100.00 €	6.00	Lombardia / Paderno Dugnano	
14	1,042.60 €	6.00	Lombardia / Pavia	
15	100.00 €	6.00	Piemonte / Ovada	
16	1,500.00 €	5.00	Piemonte / Settimo Torinese	
17	1,349.52 €	5.00	Piemonte / Settimo Torinese	
18	1,500.00 €	6.00	Piemonte / Torino	NUOVO INVESTITORE
19	100.00 €	5.00	Puglia / Massafra	
20	200.00 €	5.00	Sicilia / Caltanissetta	
21	5,000.00 €	6.00	Toscana / Cascina	
22	100.00 €	5.00	Toscana / Montopoli in Val d'Arno	
23	499.00 €	6.00	Veneto / Mestrino	NUOVO INVESTITORE
24	4,500.00 €	7.00	Veneto / Noventa Padovana	NUOVO INVESTITORE
25	1,533.57 €	6.00	Veneto / Noventa Padovana	
26	4,000.00 €	6.00	Veneto / Padova	NUOVO INVESTITORE
27	250.00 €	6.00	Veneto / Pieve di Soligo	
28	1,000.00 €	5.00	Veneto / Riese Pio X	
29	400.00 €	5.00	Veneto / San Dona' di Piave	
30	5,000.00 €	5.00	Veneto / Treviso	
31	1,100.00 €	6.00	Veneto / Trichiana	
32	1,231.00 €	5.00	Veneto / Venezia	
33	200.00 €	6.00	Veneto / Verona	
34	100.00 €	5.00	Veneto / Verona	
35	500.00 €	5.00	Veneto / Volpago del Montello	

TOTALE	**40,055.69 €**			
Number of Investors	35		Regional Investors	13
Mean interest rate	5.49		Regional Investors	20313 euro
Weighted interest rate	5.68		New Investors	5
New cardholders triggered	2		New Investors	13499 euro

Figure 16. Investment data Padova

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Figure 17 shows the age demographics of the participating investors. The largest number of investors fall in the ranges from 40-60 years old.

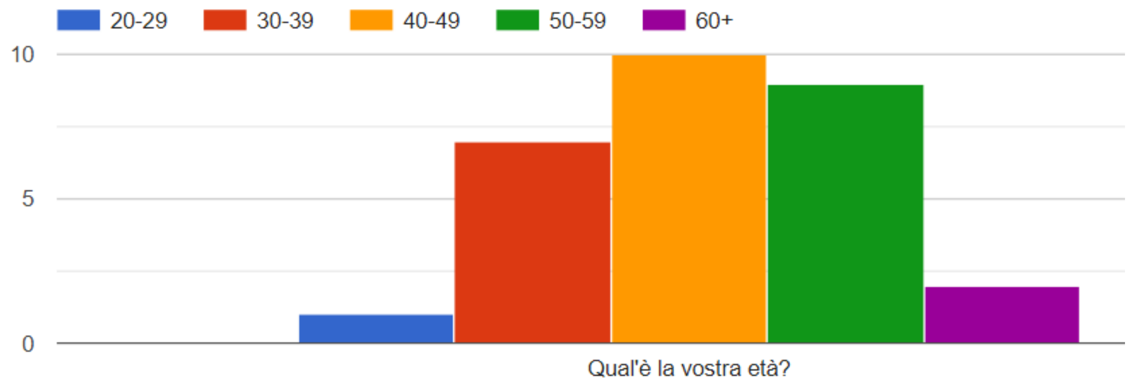

Figure 17. Age demographics Padova

The data is interesting. However, the dataset is small (35 participants) and likely skewed by persons directly involved in the Super-Heero project who contributed to the campaign. This particular campaign was small (40k euro). That was driven by the type of intervention implemented (PV installation on a small roof for a modern store where other interventions were not necessary).

6.4. Social Impact Assessment: Pilot 2, Pordenone

Similar imagery was utilized for the second Super-Heero pilot at Pordenone.

Figure 18. Super-Heero Pordenone

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Figure 20 shows the anonymous investor data table. This campaign was slightly larger (60k euro) enabling more community participation. The same investment minimum (100 euro) and maximum (5000 euro) were utilized and once again both of these investment values were present. In total, 64 investors participated in the campaign with once again an average sized investment of approximately 1k euro. 11 of the 64 investors where women (17%) and the average age was 45. Demographics for the age distribution are shown in Figure 19. The distribution of this second campaign had the largest participation from 30-49 years old but no participation from investors in their 20s.

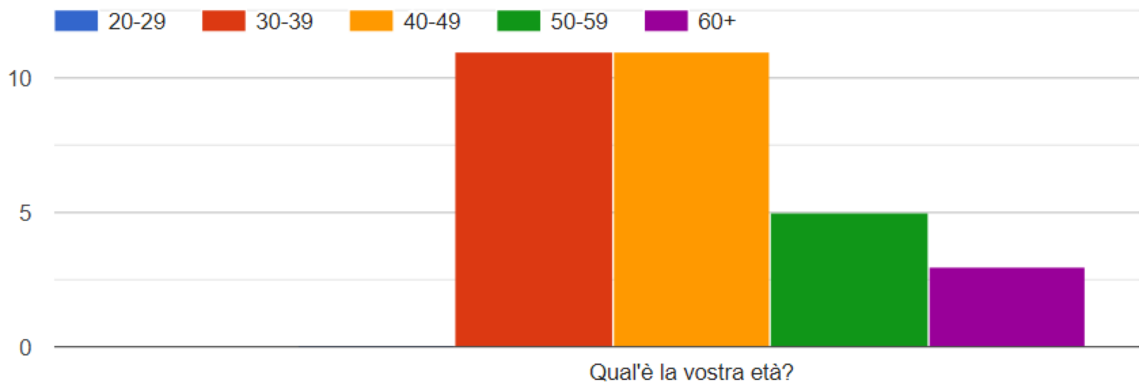

Figure 19. Age demographics Pordeone

In total, 22 of 64 investors (34%) were cardholders of the involved supermarket contributing 34.2k (57%) of the funds raised once again indicating greater commitment / trust of cardholders vs. non-cardholders.

Local participation in this campaign was lower than in the first campaign. 8 of the 64 investors (12.5%) were from the province or region raising 7.1k euro (11%). The first campaign did benefit from a longer effort in shaping the campaign and the region of the first campaign does have more existing investors in the Ener2Crowd ecosystem. We did however anticipate a better result because our processes were improved. It is known and shared by Ener2Crowd that attracting new investors does take considerable time, advocacy and effort. This result affirms that in our approach. The campaign did attract 4 new investors and two persons benefitted from the “referral” bonus signing up two of those 4 new investors. One participant benefitted from the free EV charge offered nationally at any SiRicarica EV column.

Again, the dataset is small (64 participants) which once again relates to a modest sized campaign (60k euro). It is interesting however to have two datasets enabling comparison between them and affirmation of trends seen. Investor feedback results are detailed in the accompanying D4.4.

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Investitori Naturasi Pordenone Giugno 2023						
Numero Investitore	Importo Investito	Tasso d'Interesse	Provenienza		ETA'	GENERE
1	350.00 €	5.00	Campania / Napoli		48	M
2	100.00 €	6.00	Campania / San Vitaliano		40	M
3	500.00 €	5.00	Emilia-Romagna / Albinea		55	M
4	200.00 €	5.00	Emilia-Romagna / Bertinoro		42	M
5	500.00 €	5.00	Emilia-Romagna / Bologna		37	M
6	100.00 €	6.00	Emilia-Romagna / Bologna		55	M
7	150.00 €	5.00	Emilia-Romagna / Cento		51	M
8	1,000.00 €	6.00	Emilia-Romagna / Forlì		65	M
9	2,000.00 €	5.00	Emilia-Romagna / Gatteo		66	M
10	150.00 €	5.00	Emilia-Romagna / Imola		27	M
11	5,000.00 €	6.50	Emilia-Romagna / Parma	NUOVO INVESTITORE	53	M
12	1,000.00 €	5.50	Emilia-Romagna / Poggio Renatico	NUOVO INVESTITORE	70	M
13	585.00 €	6.00	Emilia-Romagna / Ravenna		36	F
14	100.00 €	6.00	Friuli-Venezia Giulia / Moimacco		34	M
15	200.00 €	6.00	Friuli-Venezia Giulia / Trieste		49	M
16	100.00 €	5.00	Lazio / Roma		31	M
17	5,000.00 €	6.50	Lazio / Roma	CODICE AMICO	40	M
18	300.00 €	6.00	Lazio / Roma		42	M
19	5,000.00 €	6.50	Lazio / Roma	NUOVO INVESTITORE	44	F
20	5,000.00 €	5.00	Liguria / Genova		39	M
21	2,314.54 €	6.00	Liguria / Pieve Ligure		56	M
22	100.00 €	5.00	Lombardia / Bergamo		35	M
23	1,000.00 €	6.00	Lombardia / Bergamo		34	M
24	100.00 €	5.00	Lombardia / Cologno al Serio		39	M
25	156.11 €	6.00	Lombardia / Como		42	M
26	413.54 €	5.00	Lombardia / Concorezzo		41	F
27	1,000.00 €	5.00	Lombardia / Lodi		31	M
28	100.00 €	5.00	Lombardia / Lodi		44	M
29	100.00 €	5.00	Lombardia / Mantova		42	M
30	1,100.00 €	5.00	Lombardia / Milano		61	F
31	800.00 €	6.00	Lombardia / Milano		57	M
32	100.00 €	5.00	Lombardia / Milano		45	M
33	750.00 €	5.00	Lombardia / Milano		35	M
34	5,000.00 €	6.00	Lombardia / Ornago		63	F
35	350.00 €	5.00	Lombardia / Palazzo Pignano		35	M
36	333.00 €	6.00	Lombardia / Pavia		66	F
37	2,000.00 €	6.00	Lombardia / Pavia		51	M
38	200.00 €	5.00	Lombardia / Suello		41	F
39	250.00 €	5.00	Lombardia / Suello		43	M
40	300.00 €	5.00	Lombardia / Ternate		43	M
41	500.00 €	5.00	Piemonte / Borgofranco d'Ivrea		54	M
42	100.00 €	5.00	Piemonte / Costigliole d'Asti		43	M
43	100.00 €	6.00	Piemonte / Ovada		64	M
44	679.89 €	5.00	Piemonte / Settimo Torinese		37	F
45	1,000.00 €	5.00	Piemonte / Settimo Torinese		61	M
46	550.21 €	5.00	Piemonte / Settimo Torinese		37	F
47	500.00 €	6.00	Piemonte / Torino		55	F
48	400.00 €	5.00	Puglia / Alberobello		65	M
49	100.00 €	5.00	Puglia / Cerignola		44	M
50	4,000.00 €	6.00	Puglia / Corato		43	M
51	100.00 €	5.00	Puglia / Molfetta		42	M
52	500.00 €	5.00	Sardegna / Cagliari		36	M
53	100.00 €	5.00	Sicilia / Catania		27	M
54	100.00 €	5.00	Toscana / Livorno		40	M
55	100.00 €	5.00	Toscana / Ponsacco		35	M
56	500.00 €	5.00	Toscana / Pontedera		33	M
57	152.51 €	5.00	Toscana / Rufina		36	M
58	300.00 €	5.00	Trentino-Alto Adige / Dro		41	M
59	499.00 €	7.50	Veneto / Padova	NUOVO INVESTITORE	34	M
60	200.00 €	5.00	Veneto / Pianiga		49	M
61	150.00 €	6.00	Veneto / Pieve di Soligo		50	M
62	200.00 €	5.00	Veneto / San Dona' di Piave		41	M
63	5,000.00 €	5.00	Veneto / Treviso		47	M
64	750.00 €	5.00	Veneto / Volpago del Montello		55	F

TOTALE 60,383.80 €

Number of Investors	64	Cardholders Naturasi	22
Mean Interest Rate	5.40	Cardholders Naturasi	34237 euro
Weighted Interest Rate	5.7	Regional Investors	8
Average Age	45	Regional Investors	7100 euro
Number Male	53	New Investors	4
Number Female	11	New Investors	11499 euro
% Women	17%		

Figure 20. Investor data Pordenone

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7. Conclusion

Pilot activities came late in the project for a series of reasons (covid, energy crisis). A full set of results (campaign, installation, monitoring) is available on one Italian supermarket with the application of renewable energy (solar panels) as technology implemented. In Spain, two supermarkets in Spain implemented actions that were recommended by SUPERHEERO project, and they shared their decrease in energy consumption to estimate an impact of the interventions. At the end of the project, and with the success of the first implementation, another supermarket from the same brand in Italy decided to enter the project and install PV System on the roof. At the time of this writing that project is entering the installation phase and now another three supermarkets from that brand (#3 - #5 in Italy) are being developed.

Because the interventions in supermarkets were at the end of the project, real time energy consumption monitoring is not effectively available and therefore the estimated impacts are equal to the estimation of energy consumed. It is important to note that there should be monitoring in each section of consumption to understand how different implementations, such as the once introduced by supermarket B affect the consumption.

Even though the supermarkets were stablished in two different countries, the impacts in CO2eq were almost the same. This could mean that future interventions no matter where the supermarket is can be replicated and be sure of the reduction in CO2eq, yet in order to confirm this there should be more studies.

Another important point to highlight is that there could be two types of interventions:

- Implementation of renewable energy (supermarket F), which will decrease the impact but the energy consumption in the supermarket will be the same.
- Increase efficiency (supermarket B), to focus in reduce energy waste using the energy that is needed, by reducing the consumption the impact will reduce.

No matter which type of intervention the supermarket chooses, both can significantly reduce the negative impact from energy consumption.

Considering the Economical assessment, the results obtained by the simulation and business plan proposed for the evaluated demo sites, at installing solar panels, the efficiency obtained ranges between 35% to 45%, the pay back period is great since it is lower than 10 years and the financial benefit will be received for over 20 years, making this implanted measures a benefit not only in terms of emissions reduction for the environment and community, but great for the investors and crowd in terms of money.

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The financial results present a viable scenario for the development, application and scalability of changing to Renewable energies, and potentialize even more the rest of the EE measures presented by super Heero, since with an overall approach efficiency can be magnified and even more reduction of energy consumption can be achieved, resulting on less emission to the environment and more profitability for the parts.

The social impact assessment detailed the methodology, assessments observed across the project and specific results attained at each pilot. Notably, the innovative financial scheme does invoke change in processes between brands and francise owners and also between supermarkets and their clientele. Reward programs and interest rates directly provide economic benefit to the participants and the approach / rewards program provides cohesion and linkages to communities while doing good for the environment which points toward a better future.

Overall, the approach and types of energy efficiency measures implemented are promising for the tertiary sector with the implementation of the correct financial mechanisms and the involvement and interest of the crowd, technology providers and facility or brand owner.

8. References

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