DEESME

National schemes for energy efficiency in SMEs

Deliverable 3.1

Multiple benefits approach of energy audit

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About

Improving energy efficiency is increasingly understood as the most cost-effective way to reduce energy-related greenhouse gas emissions, improve economic competitiveness and increase energy security. In the European Union, several pieces of legislation aimed at guiding states and companies, regardless of their size, on ways to improve their energy efficiency: one of them is the Energy Efficiency Directive, establishing a common framework of measures and requirements with the goal to remove market barriers and promote a more efficient use of energy in supply and demand. Article 8 of the Directive offers ways to achieve this, requiring Member States to promote and facilitate the implementation of energy audits and energy management systems. The audits are compulsory for large companies and recommended for small and medium enterprises (SMEs). National authorities should encourage both to implement the resulting recommendations.

Member States have all chosen different approaches to transpose the requirements into national laws and to support companies (trainings, websites, helplines and funding support schemes). SMEs have less workforce, technical and financial capacity to perform energy audits, and therefore rarely do so: making them aware of the multiple benefits that can derive from improving their energy efficiency and accompany them in the energy transition, with knowledge and funding from both the public and private sectors, is key. That is what DEESME, a Horizon 2020-funded project (September 2020 – September 2023), aims at.

DEESME enables companies, especially SMEs to manage the energy transition by taking profit of multiple benefits from energy management and audit approaches and provides national authorities with guidelines and recommendations to empower their schemes under article 8, using the multiple benefits' approach.

The project identifies and shares good practices from national schemes, EU projects, and other initiatives with national authorities and support them in developing more effective schemes dealing with energy audits and energy management systems. It assists SMEs to develop and test the technical DEESME solutions by organizing information and training initiatives, realising energy audits, and implementing energy management systems starting from international standard and adding the multiple benefits energy efficiency approach.

The project is built on a consortium of academics, research organizations, consultancies and government offices from Belgium, Bulgaria, Germany, Italy, the Netherlands and Poland, namely: IEECP (NL, coordinator), FIRE (IT), SOGESCA (IT), Fraunhofer ISI (DE), CLEOPA (DE), SEDA (BG), ECQ (BG), KAPE (PL), EEIP (BE).

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Executive Summary / Foreword / Summary of findings

This deliverable presents the DEESME approach for multiple benefits that seeks to expand the interest for energy efficiency beyond the traditional financial and technical concerns, such as measures of reduced energy consumption or lower greenhouse gas emissions, and relate it to the strategic priorities and managerial objectives of business companies. The aim is to change the perception of energy audits as regulatory obligations, expand their scope beyond the direct benefits of energy efficiency and relate energy efficiency measures to the underlying business model and the attainment of the general business objectives. The DEESME approach for multiple benefits serves particularly the requirements of SMEs for sustainable business models, as it relates energy management decisions to the advancement of the business objectives.

In order to introduce the multiple business and non-energy benefits that can derive complementarily from the development of energy efficiency policies and measures we employ the business modelling analytical framework. The business model serves as a diagnostic tool for the description and understanding of the 'business logic', the current business situation, practices and objectives and provides the basis for the multiple benefits analysis that spans energy auditing beyond energy efficiency and relates it to the attainment of the general business objectives. Hence, the proposed DEESME multiple benefits approach combines business model analysis with energy efficiency in order to achieve a dual objective: not only to relate the energy efficiency decisions with the attainment of the general business objectives, but to introduce concepts of energy efficiency and sustainability in the business modelling analysis as well.

The DEESME methodology incudes four stages: a) it begins with the *business model analysis* that demonstrates the underlying business logic and the business priorities for the creation of value and the improvement of business efficiency; b) it continues with the *energy efficiency analysis* that reveals the opportunities for energy efficiency and reduced energy emissions; c) it culminates with *the multiple benefits analysis* that recognizes and evaluates business benefits that expand the scope of energy management and relate energy efficiency decisions to business development; d) it concludes with the *business model sustainability advancement* that searches for opportunities for business model innovation and improvement through the advancement of business sustainability.

The approach can be seen as a life cycle that promotes energy efficiency in the first place and contributes to the advancement of business sustainability, as it begins with business model analysis as a diagnostic tool and ends with the review of the business logic through the prism of energy efficiency measures for the development of business model innovation and improvement. This way, the DEESME multiple benefits approach suggests that energy efficiency can bring several benefits that go beyond energy and cost savings and can be related to the business model innovation and improvement.

Keywords: energy audit, energy management system, multiple benefits, business model, business logic, business model canvas, carbon footprint, cost analysis.

1. Introduction

The DEESME project aims to promote the EU Energy Efficiency Directive (EED) by supporting companies and particularly SMEs in the implementation of energy saving measures in order to take advantage of low-carbon technologies, improve materials/resources efficiency and develop renewable energy schemes. To this end the project takes the following approaches:

- It seeks to remove barriers for SMEs in implementing energy saving measures and low carbon technologies, which are mostly related to lack of awareness, difficulty to access financing, doubts around actual saving potential and the lack of technical human resources.
- It seeks to promote a "multiple benefits" mindset that expands the scope of energy savings, relates energy management to business management and looks for additional business benefits that promote business development and improvement.

It is a fact that the companies and particularly the SMEs are not fully aware of the multiple benefits of carrying out energy efficiency initiatives (IEA, 2014). DEESME aims to spread the concept of multiple benefits, which has already been shaped in the literature and in the MBenefits H2020 European project, and support SMEs in becoming aware of the multiple benefits that derive from energy audits and energy management systems, such as reduced operating and maintenance cost, increased equipment life-time, increased capital and labour productivity, improved working environment (e.g. air quality, temperature control, reduced noise, improved lighting), improved staff morale, increased sales and customer loyalty and satisfaction, improved corporate reputation, tax concessions, etc.

The proposed multiple benefits approach will motivate SMEs to see energy management from a new perspective that connects energy efficiency to business development and improvement. It aspires to change the perception of energy audits as regulatory obligations performed through bureaucratic procedures – that are met quite often at the expense of the company and without any real business benefit for the company. This new perspective will enable business managers to see the managerial implications of energy management and how it can support business efficiency and improvement. The role of the energy auditor/ consultant is broadened to include also guiding companies to the identification of the business benefits that can go along with energy efficiency measures. The next tasks of WP3 include the development of training material and activities for the mobilization of energy auditor/ consultant and business managers to adopt the DEESME approach for multiple benefits as a part of the implementation of energy auditing and energy management systems.

This deliverable proposes the multiple benefits approach. In section 2 it presents the background of the multiple benefits approach, specifies the aims and the requirements and explicates the proposed methodology. Each stage of the proposed methodology is explained in details in a separate section. The document ends with the conclusions.

2. Background, aim and methodology

2.1. Background

Business managers tend to focus on business priorities and the attainment of the core business objectives and they have a low priority for energy management, as they do not understand it or it is not in direct line with core business objectives (UNEP, 2017). If they cannot perceive the business benefit of such projects, they tend to neglect them or to see only the social benefits (at their expense). This attitude is even more frequent in SMEs, as they have restricted managerial and organizational resources and competencies. Hence, a key factor for the adoption of energy and environment management projects by business companies and especially by SMEs is the change of this attitude.

In the literature we can find various barriers to energy efficiency investments. Banks et al. (2012) stress the fact that the link to strategic value is not apparent to the business managers. Andrews and Johnson (2016) concluded after a review of the literature that most of the barriers are neither technical nor economic but behavioural. For instance, they highlight the lack of integrated design and whole system thinking, the lack of data, difficulty of quantification of energy efficiency measures, lack of training, appraisals that do not include energy efficiency, lack of incentives, variation/inconsistency in observed results, etc. In sum, while 'barriers' to energy efficiency investment can be identified, there appears to be a more profound level at which the energy efficiency gap needs to be understood. This is related to the fact that energy efficiency is not visible, salient or important to investment decision-makers in firms (Killip et al., 2019).

Conventionally, the most common approach for the evaluation of energy efficiency projects is the financial analysis that regards these projects as investments that should bring a positive return. Such an analysis is based on a cost-benefit comparison and uses as a criterion usually the payback period or the NPV. However, this approach tends to focus on the cost and revenues that will be produced by the energy efficiency project in itself and to disregards or underestimate the other, multiple benefits that come with such a decision. In addition, the evaluation of energy efficiency projects simply as investment opportunities means that energy efficiency decisions can be postponed, even if they have a positive financial profile, because, for instance, they do not fit to business/ strategic objectives, or because there are other investment alternatives with higher yield. Therefore, it is important to connect the decision for energy efficiency projects to the business models and the strategic objectives.

Russell (2009) suggests keeping the financial investment logic in the evaluation of energy and environment management projects, but expand the scope of the domains in which their benefits are reported. One way to achieve it is by quantifying and monetizing the non-energy benefits that can accompany these projects. Another approach is to go beyond the financial analysis, to begin by the business priorities and to see the way that the environment management projects fit into the business priorities. This alternative approach is adopted in The MBenefits project: "Instead of taking energy efficiency as the starting point these studies seek to understand the priorities of investment decision-makers and to propose means by which energy efficiency can be integrated into their decisions".

The multiple benefits approach for the evaluation of energy efficiency projects suggests that that energy efficiency has many environmental, social and economic benefits (IEA, 2014). This approach seeks to expand the perspective of energy efficiency beyond the traditional measures of reduced energy demand or lower greenhouse gas emissions. It has been applied mostly in the evaluation and adoption of energy efficiency measures at national or regional level, but is has been applied in general terms also in the context of business enterprises.

According to the MBenefits project, additional/ multiple business benefits can include increased process and product reliability, reduced operation and maintenance costs, increased productivity (capital and labour), increased equipment life-time, avoided equipment costs, improved working environment (e.g. air quality, temperature control, reduced noise, improved lighting), happier and healthier employees, increased staff morale/satisfaction, enhanced corporate image and reputation, increased sales, increased profitability, tax concessions, etc.. These benefits will vary between organizations: for some companies, increasing manufacturing production reliability could be key, whereas for others, having more comfortable buildings and more productive staff is of primary interest.

From a strategic point of view, Cooremans (2011, 2012) suggests that the contribution of an investment to a company's competitiveness is related to the following factors: a) the value proposition, b) the efficiency, and c) the reduced risk. Based on this, she has developed a categorization of energy-efficiency investments according to their contribution to the three dimensions of competitive advantage (Cooremans, 2015). This approach requires the energy auditor to start by understanding what is important to the firm, whether or not that includes energy or energy efficiency, in order to understand the strategic priorities and decision-making culture of the firm. At a next stage the energy auditor should look for ways in which energy efficiency investments can be aligned with the strategic priorities and the business goals. The basic requirement of this procedure is to explore how energy efficiency can serve a firm's real priorities, not to try and persuade the firm that energy efficiency is -or should be- a strategic goal in itself. Since they contribute to competitive advantage, non-energy benefits appear as a promising way to match firm's real priorities. Similarly, Russell (2015) promotes the need to align energy efficiency or energy use with business goals and priorities. He suggests that multiple benefits findings and figures should be effectively translated and communicated so that the information becomes integral to business decision-making.

2.2. Aim

DEESME suggests approaching energy efficiency investments from a strategic perspective, rather than from the conventional technical or financial perspective, and emphasizes the multiple business and non-energy benefits that can derive complementarily from the development of energy management systems measures.

The aim is to:

- change the perception of energy audits as regulatory obligations,
- expand the scope of energy audits beyond the direct benefits of taking measures for energy efficiency, and
- relate energy efficiency to the underlying business model and the attainment of the general business objectives.

The recognition of the multiple benefits that go along with energy efficiency is based on the analysis of the business model. The business model is a general description of the business logic that provides answer to the most basic question: how can the business create and capture value?

The DEESME approach for multiple benefits wishes to integrate business model analysis with energy auditing and the development of energy management systems in order to achieve a dual objective:

- expand the scope of energy decisions and initiatives beyond energy efficiency and relate them to the attainment of the general business objectives, and

- introduce concepts of energy efficiency in business model analysis.

In the proposed DEESME multiple benefits approach, we will emphasize on three areas:

a) How can energy efficiency support create value and improve the value proposition for the customers and the society?

b) How can energy efficiency improve the efficiency of the business model, as a result of improved cost control and revenues management?

c) How can energy efficiency support improve or innovate the business model, especially with respect to advancing the sustainability of the business model?

2.3. Methodology

Energy audits and energy management systems are considered as tools and mechanisms that can be related to multiple other business benefits and opportunities for business model improvement and innovation. In DEESME the recognition of the multiple benefits that go along with energy efficiency is based on the analysis of the business model.

A concise definition of business models is provided by Osterwalder and Pigneur (2010), who describe business models as conceptual tools for value creation: "a business model refers to the rationale of how an organization creates, delivers, and captures value". The business model refers to a systematic description of the business decisions and practices with respect to the customers, the value proposition, the value chain for the production of the business offering and the value proposition and the profit mechanism for the capturing of business value (Gassmann, Frankenberger and Csik, 2014).

The business model can be considered as a master plan that describes the way in which a company creates value in order to meet its business objectives. In order to put the business model into effect a company needs to carry various processes and activities. These processes and activities, in conjunction with the related resources and capabilities and their coordination along the company's value chain, will deliver the business value.

The business-model analysis provides the baseline for the DEESME multiple benefits approach. It serves as a diagnostic tool for the description and understanding of the current business situation, practices and objectives and provides the basis for the multiple benefits analysis that spans energy analysis beyond energy efficiency to relate it to the attainment of the general business objectives. The business model analysis concludes also the DEESME multiple benefits approach by seeking the improvement or the innovation of the business model through the lens of the energy efficiency analysis and the multiple benefits identification that have been preceded.

The methodology includes four stages:

1. it begins with the **business model analysis** that demonstrates the underlying business logic and the business priorities for the creation of value and the improvement of business efficiency;
2. it continues with the **energy analysis** that reveals the opportunities for energy efficiency and reduced emissions;
3. it culminates with the **multiple benefits analysis** that recognizes and evaluates business benefits that expand the scope of energy management and relate energy efficiency decisions to business development;

4. it concludes with the **business model sustainability advancement** that searches for opportunities for business model innovation and improvement through the development of energy efficiency.

The methodology of the DEESME multiple benefits approach is depicted in figure 1.

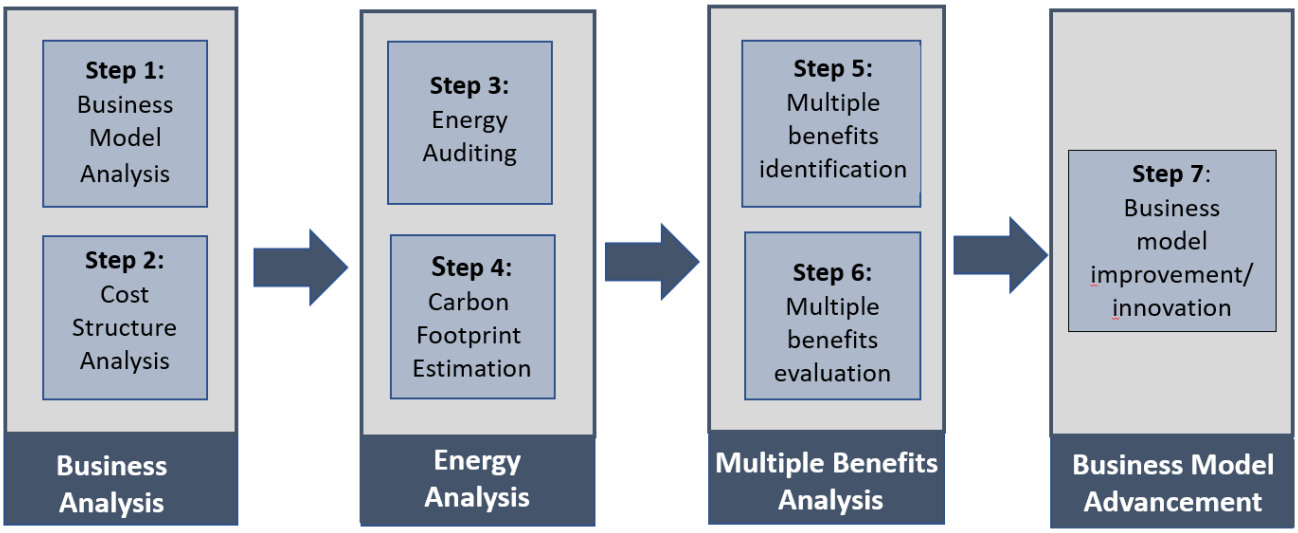

Figure 1: Methodology for the DEESME multiple benefits approach

The proposed methodology can be seen as a life cycle (figure 2) that begins and ends with the business model analysis – as a diagnostic and as a strategic tool, respectively. Each iteration of the cycle leads to improved levels of energy efficiency and business model sustainability through improvement and innovation.

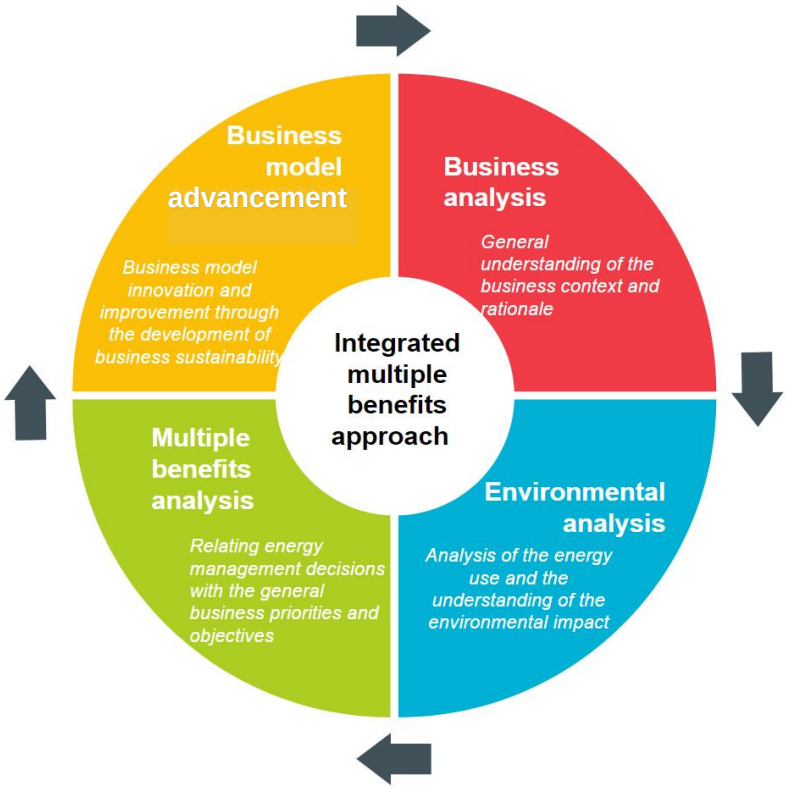

Figure 2: The DEESME multiple benefits approach as a life cycle

The analytical procedure is guided by the energy auditor/ consultant who has been trained in the DEESME multiple benefits approach. The procedure should be performed in close collaboration with a team of managers of the company because it goes beyond the technical and managerial requirements of the energy audit and wishes to connect the energy auditing results with the managerial and strategic decisions of the company. The team of managers that have an important role in the DEESME multiple benefits analysis include:

- a business strategy manager (members of the company's strategic team),
- an operations/ production manager, and
- a financial/ accounting manager.

In DEESME we will provide a tool in the form of a spreadsheet file that will guide the implementation of the integrated multiple benefits approach; each step of the procedure will be developed in a separate section of the spreadsheet file.

2.3.1. Stage 1: Business analysis

Description: In order to introduce energy efficiency decisions in the wider business context we must understand the overall business rationale and the business priorities and objectives. The business analysis provides the starting point for the implementation of the DEESME approach for multiple benefits. In this stage the energy auditor/ consultant will acquire a better view for the company and will develop a common understanding with the management team of the company about the business requirements and the way that energy efficiency decisions can fit in the business rationale and support the strategic priorities and objectives of the company.

Objective: The general understanding of the business context and rationale.

Implementation: The business analysis takes place in two steps:

- **Step 1: Business model analysis**. The business model analysis is a method to define and communicate easily and quickly a business idea or concept. It will be used to provide the overall description of the business and contribute to a better understanding of its objectives and operations. We employ the Business Model Canvas method (Osterwalder and Pigneur, 2010), which is one of the most popular approaches in business modelling and has received wide acceptance both in academic research and in business practice. It consists of a one-page document which collects the fundamental elements of a business in a structured way. It provides a general description of the underlying business logic with regard to the value creation, the customer, the business procedures, partnerships and the cost structure.
- **Step 2: Cost structure analysis**. The cost structure analysis enables the energy auditor identify the cost centres, review cost behaviour and examine all types of cost that are necessary in the business operations. A cost centre is an area of business activity, process or plant that can be metered effectively and where there is opportunity to manage and reduce energy consumption. Cost structure analysis is critical for the improvement of business efficiency and particularly it can explain how energy efficiency measures can contribute to the business objectives. Hence, it will help to better understanding the cost structure of the business model and identifying opportunities for improved resource efficiency.

2.3.2. Stage 2: Energy analysis

Description: The energy analysis is a core part of the integrated multiple benefits approach that seeks to introduce energy efficiency improvements that promote the business rationale and support the strategic priorities and objectives. In this respect, the main technical standards for energy auditing and energy management (e.g., EN 16247 and EN ISO 50001) can serve as business management tools for the identification of business opportunities for improved efficiency and value creation. Notice that energy auditing and the energy management system are examined in depth in other tasks and deliverables of WP3.

Objective: The analysis of the energy use and the understanding of the carbon footprint impact.

Implementation: The business analysis takes place in two steps:

- **Step 3: Energy Auditing**. According to EN-16247, an energy audit is a systematic inspection and analysis of energy use and energy consumption of a site, building, system or organization with the objective of identifying energy flows and the potential of energy efficiency improvements and reporting them. Therefore, energy audits lead companies to identify and implement energy saving and efficiency measures adapted to the organization's needs while making energy use more

cost effectively and environmentally friendly. In this step the auditors/ energy consultants are guided in the procedure of energy auditing.

- **Step 4: Carbon footprint calculation**. The carbon footprint enables the evaluation of the greenhouse gas emissions caused by the business operations of the company. It captures the mix of energy sources used in producing, delivering and using a product/service, as well as non-energy related GHG emissions. This analysis will support companies to estimate the carbon footprint of their major operations/ products and will provide guidelines on how to improve it. The auditors/ energy consultants will be guided in the procedure of identifying and analysing the business operations and calculating their carbon footprint. Three core standards around carbon footprint analysis are the GHG Protocol, ISO/TS 14067, and PAS 2050. The GHG Protocol is the most common international tool used by business leaders and governments to comprehend, quantify and control GHG emissions.

2.3.3. Stage 3: Multiple benefits analysis

Description: The multiple benefits analysis follows the energy analysis aiming at expanding its scope beyond energy savings. It highlights the various non-energy benefits, i.e. the business and strategic benefits that are related to the energy efficiency measures and decisions that were identified through the energy audits and energy management systems. Hence, it connects energy management decisions and business management priorities and objectives and sensitizes managers, especially in SMEs, on energy efficiency decisions by demonstrating their relationship with the general business priorities and objectives.

Objective: Relate energy efficiency benefits with the general business priorities and objectives.

Implementation: The multiple benefits analysis takes place in two steps:

- **Step 5: Multiple benefits identification.** The identification of multiple benefits is based on the business model concept, developed in step 1, in order to corroborate the relationship between energy efficiency benefits and the wider business benefits. With regard to the Business Model Canvas, there are the following categories of benefits that can be related to the energy efficiency measures: Value Proposition, Activities, Resources, Customers (including Channels and Relationships), and Partners.
- **Step 6: Multiple benefits evaluation.** The companies will evaluate the impact of the multiple benefits identified previously in their operation and their business model in order to decide how they can take advantage of these multiple benefits to improve their business model. The evaluation is qualitative in nature and it is based on the special knowledge, the experience and the insights of the energy auditor/ consultant and the business managers that participate in the procedure. The evaluation will determine the significance of the identified benefits, the type of impact/ contribution in the business model and the exploitation proposal.

2.3.4. Stage 4: Business Model Sustainability Advancement

Description: The company will review the business model that was initially drafted in stage 1 through the lens of multiple benefits approach in order to identify opportunities for the advancement of business model sustainability. The outcome outlines the opportunities that can derive from the adoption of energy efficiency measures and the development of sustainable business practices and ideas. Therefore, it can

provide the outset for a next cycle of the DEESME multiple benefits approach that could bring about improved understanding of the multiple benefits and improved decisions regarding energy efficiency measures and business model sustainability.

Objective: The advancement of business model sustainability through business model innovation and improvement.

Implementation: After the evaluation of the multiple benefits, the energy auditor/ consultant and the management team review the initial business model to find opportunities for the advancement of the business model sustainability. There are two major ways of business model sustainability advancement: a) business model innovation, which refers to the innovation of the business model with regard to its core elements and their relationships, and b) business model improvement, which refers to the improvement of the efficiency of the existing business model.

3. Business analysis

3.1. Business Model Analysis

A company analysis is needed to frame the corporate business model and the investment context, tailoring the audit and the energy efficiency measures to the customer's needs. In order to highlight the investment priorities and the basis of the value proposition, a powerful tool that can be used is the business model canvas, which visually represents the main characteristics of each dimension of the company's business model:

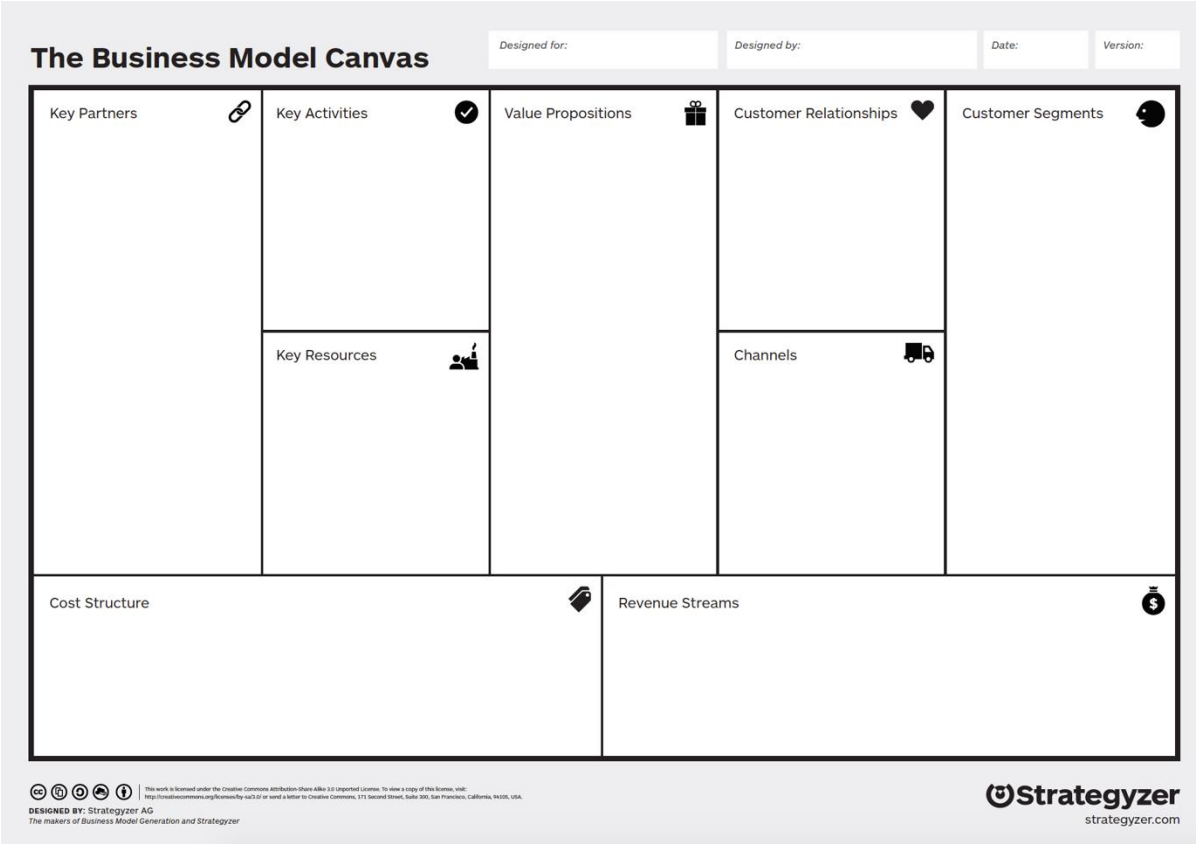

Figure 3: The Business Model Canvas pattern

The Business Model Canvas allows to visually represent the way in which a company creates, distributes and captures value for its customers. It consists of nine key blocks:

- *Key partners*: it defines the network of suppliers and partners necessary for the functioning of the corporate business model;
- *Key activities*: it describes the strategic activities that must be carried out to create and support value propositions, reach customers, maintain relationships with them and generate revenues (eg purchase of raw materials, production ...);
- *Key resources*: it refers to the strategic assets that a company must have in order to create the value proposition and support its business model;

- *Value proposition*: it is the package of products and services that represents a value (benefits that the customer has from the use of the product or service provided by the company) for a specific customer segment;
- *Customer segments*: it describes the major customer segments served by the company and their needs/ requirements;
- *Customer relationships*: it refers to the type of relationship that the company establishes with the different customer segments;
- *Channels*: it describes how the company reaches a certain customer segment to present and provide it with its value proposition;
- *Revenue streams*: it describes the revenue streams that the company obtains from the sale of products / services to a specific Customer Segment. How the company acquires value from the price the customer is willing to pay;
- *Cost structure*: it defines the costs that the company will have to incur to make its business model operational.

Filling the business model canvas enables to acquire or increase knowledge of the organization, having in mind that the effort must be tailored to the customer's needs.

Output of this task are the main features of the company business model and a first view of the opportunities and barriers to energy efficiency interventions to be identified and analysed in the energy audit and in the multiple benefits analysis.

3.2. Cost Structure Analysis

The cost structure analysis identifiers the cost centres, reviews cost behaviour and examines all types of cost necessary to complete production processes. A cost centre is an area of business activity, process or plant that can be metered effectively and where there is opportunity to manage and reduce energy consumption. Next, we provide some general guidelines for the calculation of the consumption in cost centres.

Ideally, for each cost centre it should be possible to:

- Identify it by geographical and/or functional point of view
- measure energy consumption (directly or indirectly)
- clearly identify one (or more) input(s) and one (or more) output(s).
- calculate one or more energy indicators

Below subdivision in cost centres comes from the "energetic structure" normally used for energy audits in Italy. Similar approaches are prescribed in other countries. Auditors/consultants should evaluate which of the below mentioned elements is applicable to the operations of the company-subject of the audit, as well as tailor the procedure accordingly.

- Process A (it should be repeated for each major process)
    - Process unit 1
    - Process unit 2, etc.

    - Productive line 1
    - Productive line 2, etc.
- Utilities (auxiliary services)
    - Cold production (chillers, dry-coolers, …)
    - Boilers
    - Air compressors
    - Heat recovery
    - Power plant
    - Cogeneration plant
    - Renewable energy (PV, solar systems, …)
    - Fans & blowers
    - Pumps
    - AHUs
    - Product handling
    - Additional elements can be added
- General services
    - Lighting
    - Offices conditioning
    - Ventilation
    - IT equipment
    - Additional services can be added
- Vehicles (intended for personnel)
    - The types of vehicles should be added

4. Energy analysis

4.1. The energy audit

According to EN 16247, an energy audit is a systematic inspection and analysis of energy use of a site, building, system or organization with the objective of identifying and reporting the energy flows and the potential of energy efficiency improvements. The energy audit determines how to improve energy efficiency, reduce energy consumption and bring additional environmental benefits.

The EN 16247-1 standard specifies the requirements, a common methodology, obligations within the energy auditing process and the deliverables of the auditing process. Besides the general requirements common to all energy audits, there are specific parts for energy audits in buildings (EN 16247-2), in processes (EN 16247-3) and in transport (EN 16247-4). The standard recognizes that there are differences in approach to energy auditing in terms of scope, aims and thoroughness, but seeks to harmonize common aspects of energy auditing in order to bring more clarity and transparency to the market for energy auditing services. It applies to all types of facilities and organizations, and to all forms and uses of energy. It can provide the basis for implementing an energy management system according to the international standard ISO 50001.

Several benefits of energy audits can expand beyond the improved energy efficiency and can include the following:

- they identify opportunities for energy savings and therefore can reduce the energy cost, which improves profitability and enhances competitiveness;
- they identify opportunities for improvements in business processes and therefore improve productivity;
- they can help organizations to reduce the environmental impact of their activities and therefore to fulfil obligations with respect to emissions control;
- they can improve employee satisfaction and the reputation of the company to customers and the community.

4.1.1. Principles and general requirements

Energy auditing aims to assess the current status of energy use in a company by determining the energy input, energy use and energy flows. It includes a thorough examination of production operations and facilities, while it can be expanded to include also company's transportation and the energy consumption profile of the buildings. The particular requirements can differ from the one sector to the other or from the one company to the other. For this, we stay in this section with the description of the general principles.

The total energy consumption is defined as the amount of energy used and consumed over the relevant period. All sources of energy are to be taken into account (electricity, combustible fuels and fuel-equivalent by-products, heating, non-combustible renewable sources of energy, etc.) and all sites, processes, facilities and transportation of the company (including sales premises, administrative premises, storage rooms or similar spaces) in which the company uses or consumes energy systematically.

The energy audit must be sufficiently proportionate and representative, so as to provide a reliable overview of total energy efficiency and reliably derive the most important possible improvements. The

criterion of proportionality and representativeness suggests that in the case of numerous similar sites, on-site visits to one site can be seen as 'representative' for the others. Notice that different countries use different approaches for the implementation of the energy audit (e.g. the share of the areas/ activities that have to be included in the audit) and the energy auditor/ consultants should be aware of and follow these particular requirements.

The energy data should refer to both energy consumption and load profiles and they must be appropriate, complete, representative, traceable, useful, and verifiable. In addition, energy data must be continually or periodically measured in order to be always up-to-date.

The reference period for the energy audit refers to 12 consecutive months and it should be the same for all sources of energy. If data for certain portions of the reference period are missing, estimations can be used to close possible gaps.

The company sets qualified/accredited person in charge or contracts an external energy auditor for the performance of the energy audit. The standard provides some general requirements for the energy auditor. In brief, the energy auditor shall:

- Be suitably qualified and experienced for the type of work and the agreed scope, aim and thoroughness.
- Treat as confidential all information provided by the organization during the energy audit.
- Act in an objective manner.
- Disclose any conflict of interests within the company in a transparent way.

4.1.2. The energy auditing procedure

This section presents briefly the phases performed in an energy audit process, according to the European standard DIN EN 16247-1/ Energy Audits – Part 1: General Requirements.

1. **Introductory contact**: the energy auditor must set the framework of the auditing procedure, by setting the goals, needs, scope and expectations of the energy audit, as well as the criteria that will be used to measure energy efficiency, timescale to complete the energy audit and degree of thoroughness.
2. **Kick-off meeting**: the energy auditor determines the required data and the requirements for measurements and makes concrete agreements and arrangements about the practical performance of the energy audit in order to establish and ensure the cooperation. During the kick-off meeting the company nominates a representative who will be the contact person and responsible for assisting the energy audit.
3. **Data collection**: the energy auditor must, in cooperation with the organization, collect information and data related to the energy used by sites, systems, processes and equipment. Sources of information can include additionally the past data and previous analysis in the company regarding energy efficiency, energy tariffs, specification documents and manuals (for design, installation, operation and maintenance), economic data and the specifications of the energy management system.
4. **Field work**: the energy auditor must inspect the sites, systems, processes and equipment in order to assess the energy use real conditions. Operating routines and user behaviour and their

influence on energy consumption and efficiency have to be assessed. This is the basis for the first recommendations for improvement.

5. **Analysis**: the energy auditor assesses the existing energy performance situation of the audited object, identifies energy efficiency improvement opportunities and recommends approaches to improve the organization's energy efficiency. These energy saving actions should be ranked upon the agreed criteria.
6. **Report**: the energy auditor's report should be transparent, conclusive and comprehensible and must ensure that the energy audit requirements agreed with the organization have been met. It comprises a summary, general background information, the documentation of the energy audit and a list of options for improving energy efficiency, with:
    - Relevant measures made during the energy audit.
    - Assumptions made for calculating savings.
    - Recommendations and plans for implementation.
    - Information about available grants and allowances.
    - Appropriate profitability analysis.
    - Recommendations for measurement and verification procedures for an estimation of savings after the recommended measures are implemented.
    - Possible interactions with other proposed recommendations.
7. **Final meeting:** in the final meeting, the energy auditor presents the results of the energy audit and his/her conclusions in a way that facilitates decision making for the organization.

4.2. Carbon Footprint estimation

The carbon footprint analysis evaluates the GHG emissions caused by the company in its operations. It captures the mix of energy sources used in producing, delivering and using a product/service, as well as non-energy related GHG emissions. There are two main reasons why calculating a carbon footprint of a product/service can be useful:

- It enables to identify cost savings across the supply chain.
- It helps to identify opportunities to reduce environmental impact through reductions in material use, water, waste and energy.

4.2.1. Carbon footprint methodology

There are different protocols for calculating a carbon footprint of a product/service. The most popular ate the following ones:

- ISO 14044 (LCA)
- PAS 2050
- ISO/TS 14067 (organizations) - ISO/TS 14067 (products)
- GHG Protocol

Table 1: Carbon footprint protocols

Methodology	ISO 14044 Environmental Management - LifeCycle Assessment	PAS 2050	GHG Protocol	ISO/TS 14067
Main goal	Life Cycle Inventory Analysis & Life cycle Assessment	To provide a uniform specifications for GHG emissions of goods and services	To quantify the GHG inventories of products, also including requirements for public reporting	To standardize the quantification process and the communication of GHG emissions
Developed by	ISO	BSI	World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD)	ISO
Last release	2021	2011	2011	
Outcome	Quantification of relevant emissions and resources consumed associated with any products	Provides a "consistent method for assessment"	Enables organizations to "account for and publicly report GHG inventories of products".	
Principle		Based on 14044	Based on 14044	
Life cycle stage included		Cradle-to-grave Cradle-to-gate	Cradle-to-grave Cradle-to-gate	Cradle-to-grave Cradle-to-gate Gate-to-gate
Cut off criteria		At least 95% of the complete product life cycle	100%	No criteria
Product related evaluation		'Supplementary requirements' (SRs) that include sector guidance/rules /Product Category Rules.	The Product Standard refers to 'product rules' to enable comparisons.	
Biogenic carbon		biogenic emissions and removals to be included in the assessment, except for food	biogenic emissions and removals to be included in the assessment	If calculated, not to be included in results
Time period for assessment		100 y	To be specified by company, but if unknown use 100 y	100 y
Capital goods		To be excluded	To be excluded	The GHG emissions derived from the production of capital goods can be voluntarily

				included in the calculation
Stored carbon		To be assessed	To be assessed	If calculated, not to be included in results
Land use change		Direct land use change is included	Direct land use change is included (requires separate reporting for transparency)	Direct land-use change shall be separately documented; indirect land-use change should be considered
Soil carbon change		Non included, but allowed in certain circumstances.		
System boundary		the default is to exclude processes that are not typically relevant to a product's life cycle; if non-attributable processes are included it must be disclosed	the default is to exclude processes that are not typically relevant to a product's life cycle; if non-attributable processes are included it must be disclosed	allows the assessment of full or partial life cycle stages
Electricity		more specific on how specific data sources shall be addressed e.g. for energy supply systems / stand-alone sources / electricity and heat from large energy transmission systems/ renewable energy factors	does not provide specific guidance but the general data collection rules are generally consistent	
Allocation		the hierarchy is supplementary requirements (SRs) and then economic allocation	the hierarchy within the Product Standard is physical allocation and then economic allocation.	
Waste		Not considered in allocation	Not considered in allocation	
RE-use Recycle		Included	Included	Included
Data quality requirements		As ISO 14044	As ISO 14044	As ISO 14044
Uncertainty		Considered only as guidance	Qualitative statement required	
Website		http://aggie-horticulture.tamu.edu/faculty/hall/publications/PAS2050_Guide.pdf	https://ghgprotocol.org/	

GHG Protocol seems to be the methodology that has the most benefits:

- Widely used
- Website full of (free) information
- Calculation tools available
- Applies to entire companies or only one product
- Different standards available:
  - Corporate
  - Corporate value chain
  - Product
  - Mitigation project

4.2.2. What to include

Emissions that can be included are the following ones:

- Fuel/Energy purchased
- Fugitive emissions (e.g. refrigerant)
- Raw materials
- On-site combustions
- Process emissions
- Transportation (inbound & outbound)
- Business travels
- Employee commuting
- Waste
- Water

The company can choose the scope of the carbon footprint analysis taking into account the following requirements for each option:

- **Scope 1**: Direct GHG emissions. Direct GHG emissions physically occur from sources that are operated by the project/process. For example, emissions produced by the combustion of fossil fuels, by industrial processes and by fugitive emissions, such as refrigerants or methane leakage.
- **Scope 2**: Indirect GHG emissions. Scope 2 accounts for indirect GHG emissions associated with energy consumption (electricity, heating, cooling and steam) consumed but not produced by the project. These are included because the project has direct control over energy consumption, for example by improving it with energy efficiency measures or switching to consume electricity from renewable sources.

- **Scope 3**: Other indirect GHG emissions. Scope 3 emissions are all other indirect emissions that can be considered a consequence of the activities of the project (e.g. emissions from the production or extraction of raw material or feedstock and vehicle emissions from the use of road infrastructure, including emissions from the electricity consumption of trains and electric vehicles).

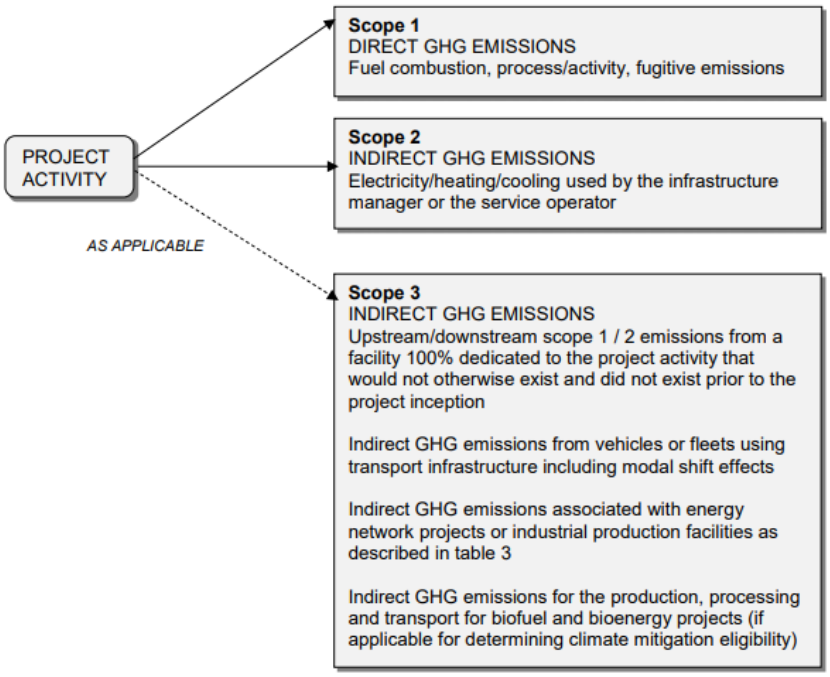

Figure 4. The scope of the carbon footprint analysis

4.2.3. Phases to follow

1. **Project scope:** Choose the project scope (see above)
2. **System boundaries**

Choose the system boundaries, including the organization & process boundaries, according to the requirements described in the following table.

Table 2. System boundaries for carbon footprint estimation

PROJECT TYPE	FOOTPRINT BOUNDARY CLARIFICATION
ALL PROJECTS, (OTHER THAN FOR THOSE EXCEPTIONS SPECIFIED BELOW)	INCLUSION: scope 1 and 2 emissions for a typical year of operation. EXCLUSION: scope 1 and 2 emissions associated with the commissioning, construction and decommissioning of the project. EXCLUSION: scope 3 emissions. INCLUSION: scope 3 emissions from 100% dedicated sources upstream or downstream that would not otherwise exist and a number of specific cases below. An example of the first case would be a power plant that exists solely to supply the project (upstream) or a waste disposal site that is for the exclusive use of the project (downstream) that would not otherwise exist.
TRANSPORT MOBILE ASSETS AND INFRASTRUCTURE	INCLUSION: scope 3 emissions from vehicles travelling on the financed physical infrastructure links, or fleets departing from, or arriving at a transport node, are included in the absolute and the relative emissions calculations. GHG relative emissions are calculated based on the displacement of passengers from one type of transport to another (modal shift effects), shifts in travel patterns (one road to another or from one time of day to another) and the induced increase in passengers and freight traffic. If the project includes the replacement of rolling stock, the savings in emissions from this intervention should also be taken into account.
ENERGY NETWORK PROJECTS	INCLUSION: scope 3 emissions from outside the boundary defined by the physical limits of the project are included in the relative emissions calculation where they are considered significant. For example, a district heating network project typically has a boundary that includes the losses of the heat network and any sources of heat generation under the control of the operator. If the project results in fuel switching (individual heating to district heating) or results in a change of the operational regime of a heat plant outside the control of the project operator, significant GHG emissions from these sources are included.
INDUSTRIAL PRODUCTION FACILITIES	INCLUSION: scope 3 emissions from outside the boundary defined by the physical limits of the project are included in the relative emissions calculation where they are considered significant. For example, the installation of a combined heat and power plant that provides waste heat to a residential area can lead to large GHG savings outside of the project boundary. If an industrial project leads to large energy or GHG emissions outside of the direct project, these should be included. EXCLUSION: The scope 3 emissions upstream and downstream of the industrial production is generally not considered (see exception above under "All Projects" covering 100% dedicated upstream and downstream sources). For example, the use of steel to make wind turbines or glass to double glaze windows would not be considered part of the absolute or relative emissions calculation.
ALL REHABILITATION / REFURBISHMENT PROJECTS	CLARIFICATION: The boundary for absolute emissions calculations for projects that rehabilitate or refurbish existing facilities corresponds to the boundary of the rehabilitation or refurbishment project and not the GHG emissions for the whole facility. If however the GHG emissions of the facility are significantly modified because of the project, the relative emissions calculation shall use a boundary that includes the entire facility.

3. **Determination of the reference period**
4. **Collection of data – assessment data quality**
    - identification of GHG sources;
    - selection of the quantification methodology;
    - selection and collection of activity data relating to GHGs.
5. **Identification and calculation of GHG inventory**
    - selection or development of GHG emission factors (sources: https://www.ipcc-nggip.iges.or.jp/EFDB/main.php; https://www.eea.europa.eu/publications/emep-eea-guidebook-2019);
    - calculation of GHG emissions;

- calculation of the GHG inventory (example of source: https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf).

6. **Selection of impact categories and indicators**
7. **Impact assessment**
8. **Verification (consistency, completeness, sensitivity check)**

5. Multiple benefits analysis

The multiple benefits analysis follows the energy analysis aiming at expanding its scope beyond energy efficiency benefits and measures and relating it with the general business priorities and objectives. The multiple business benefits can be related directly to the energy efficiency benefits and measures (for instance, improved lighting can increase productivity and also employee satisfaction, the adoption of energy efficiency regulations can remove financial penalties, bring tax benefits and investment opportunities, etc.), but they can also be related indirectly (for instance, improved air quality can also bring increase productivity and employee satisfaction, sustainable business practices and 'green' products and services can bring improved reputation, increased sales and customer loyalty).

The multiple benefits analysis supplements the energy analysis in order to:

- highlight the various energy and non-energy benefits that are related to the energy efficiency measures and decisions;
- link energy management decisions and business management priorities and objectives;
- sensitize managers, especially of SMEs, on energy efficiency decisions by demonstrating their relationship with the general business priorities and objectives.

The multiple benefits analysis in the DEESME builds on the analogous approach developed in MBenefits H2020 European project (https://www.mbenefits.eu). Yet, in the DEESME we base our methodology on the business model concept in order to corroborate the relationship between energy efficiency benefits and the multiple business benefits, introduce energy efficiency decisions in the business logic and demonstrate how energy efficiency measures can contribute to the execution and the advancement of the business model.

With regard to the Business Model Canvas, we propose the following types of multiple business benefits that can be related to the energy efficiency management:

- **Value Proposition**: multiple benefits are related to improved product/ service efficiency, new products (especially 'green products') and innovations.
- **Activities**: multiple benefits are related to productivity, utilization, maintenance, emissions/ carbon footprint, quality, and accidents/ risks.
- **Resources**: multiple benefits are related to energy consumption, raw materials/ water/ consumables consumption, waste, recycling, employees (satisfaction, health and security, skills, training).
- **Customers** (including Channels and Relationships): multiple benefits are related to 'green customers' share/ 'green sales', new customers, customer satisfaction, customer loyalty.
- **Partners**: multiple benefits are related to supply chain relationships (e.g., Green Public Procurement contracts, strategic agreements based on the adoption of ISO standards), litigation risks, regulatory compliance (adoption of social and environmental policies), and stakeholder relationships.

The multiple benefits are expressed quite often as increased revenues or increased efficiency with respect to another block of the Business Model Canvas. However, the multiple benefits are not directly related to (derive from) the Revenues and the Cost Structure building blocks.

5.1. Multiple benefits identification

In this section we provide a basic set of the types of multiple benefits that can supplement and enhance the energy analysis. The proposed types of multiple benefits cover all the domains of the Business Model Canvas. For each type of multiple benefit, we provide a description, a basic indicator, alternative/ additional indicators, the calculation method and a short discussion about the intent and the limitations of the benefit.

The list of multiple benefits cannot be exhaustive and 'complete', because the requirements of each individual company are different, according to the characteristics of the sector/ subsector in which it operates and the particular business logic and objectives. The multiple benefits and the indicators used for their estimation can be myriad in practice.

The energy auditor/ consultant, together with the managers of the company who participate in the multiple benefits analysis, will decide for the multiple benefits will be used in order to address the needs and the objectives of each company. In other words, they can tailor the proposed in DEESME multiple benefits analysis method to their particular needs and objectives by adding new, leaving out or modifying the proposed types of multiple benefits and indicators. Therefore, the energy auditor/ consultant and the company's managers will decide for the following:

- The types of the multiple benefits that are relevant and important for the company.
- The indicators they will use (for instance, the basic indicator we suggest, or any of the alternative indicators we suggest, or any other indicator (or set of indicators) they believe serves better their needs (or can be calculated from the available data).
- Additional multiple benefits and/ or indicators that they believe are necessary in order to describe and understand the multiple business benefits and their impact on the business success.

Table 3. List of Multiple Benefits

DOMAIN	BENEFIT TYPE	INDICATOR
Value Proposition	1. Improved product/ service efficiency	Energy cost per unit of product/ service
	2. Introduction of new products/ services	Nº of new 'green' products/ services
	3. Development or innovations	Total R&D expenses for 'energy efficiency' initiatives
Activities	4. Increased productivity	Value of output items/ Value of input items
	5. Increased utilization	Capacity utilization
	6. Improved maintenance	Maintenance Unit Cost
	7. Reduced carbon footprint	Total GHG emissions per year
	8. Improved quality	Right First Time
	9. Improved Safety	Incidence Rate
Resources	10. reduced energy consumption	Total energy consumption per year
	11. Improved raw materials consumption	Quantity of raw materials purchased
	12. Increased recycling	Percentage of total waste that is recycled
	13. Reduced waste	Waste reduction rate
	14. Increased employee satisfaction	Employee Satisfaction Index
Customers	15. Acquisition of 'green' customers	'Green' customers share
	16. Acquisition of new customers	New customers share
	17. Increased customer satisfaction	Satisfied customers share
	18. Increased customer loyalty	Loyal customers rate
Partners	19. Improved supply chain relationships	Total nº of suppliers with ISO certification for energy or environmental management
	20. Improved stakeholder relationships	Total nº of stakeholders involved in decision making
	21. Reduced litigation risks	Total amount of expenses and fines related to environmental law violations
	22. Increased regulatory compliance	Nº of EU and national energy policies adopted

5.1.1. Value Proposition

1. Product/ Service Efficiency

- **Description**: it refers to the business efficiency in providing product/ service to the market. It is relevant to the value proposition because the efficiency of delivering products/ services is quitter often a source of value for the customer and also a source of competitive advantage for the company.
- **Basic indicator:** Energy Cost Per Unit. It refers to the total cost of energy spent over a period of time divided by the number of units produced in that time frame. It relates directly the energy consumption to all the functions of the business model. Calculation method: Energy Cost Per Unit = Total Energy Cost / Number of Units Produced.
- **Limitations:** there can be certain limitations in the calculation of the total business output (number of units produced) in certain industrial sectors that are characterized by continuous output and certain service sectors. The accounting department must have developed solutions that handle this issue.
- **Potential improvement:** the development of additional metrics for the correlation of energy efficiency, as well as other environmental measures, and the business functions, such as the estimation of energy consumption as a ration of the business output.
- **Additional/ Alternative indicators:**
    a) Unit cost. It is a basic accounting measure that refers to the total expenditure (includes all of the fixed and variable cost) incurred to produce, store, and sell one unit of a particular product or service. The unit costs are a quick way to check if a company is producing a product efficiently.
    b) Return on Assets (ROA). It is a basic accounting metric that measures the efficiency in the use of the business assets. Calculation method: Net income / Avg. total assets.

2. New Products/ Services

- **Description**: it refers to new product/ service development by the company in a year. New product/ service development includes also their introduction to the marketplace. The main benefit of new product/ service development is that new products/ services have the potential to provide increased value to the customer.
- **Basic indicator:** New 'green' products/ services: it refers to the number of new 'green' products (i.e., environmentally friendly, in total or in some parts, with regard to the resources/ materials or the processes used) introduced in the market in the period of a year. For example, the development of a new product/ service that consumes less energy in its production procedures or during its use by the customer can be seen as a 'green' product/ service.
- **Limitations:** the definition of new products can be quite ambiguous sometimes, as some people refer to totally new products/ services and others to the development of variations and improvements to existing products/ services. The managers should decide for the definition of 'new product/ service' they will use in their metrics; it is important to be consistent in the definition they will choose.

- **Potential improvement:** development of concrete methods to measure different aspects on new product/ service development and analysis of their impact on value creation and energy savings.
- **Additional/ Alternative indicators:** other particular benefits and relevant indicators that can be used for the measurement of new products are the following ones:
    a) nº of new products/ services (in general) introduced in the market in the period of a year. It can be used especially when a company does not produce 'green' products/ services; or it can be used complementarily to the basic metric ('green' products/ services) to provide a complete view on the business performance.
    b) New Product Introduction Rate: it refers to the effectiveness of the new product development process, calculated as the amount of time it takes to design, develop and roll out a new product. It can be estimated for regular or for 'green' products/ services.

3. Innovations

- **Description**: it refers to the exploitation of new ideas for the development of more efficient and effective processes or new products and services. Innovation brings new business opportunities, enables the development of new business models and provides the basis for the development of competitive advantage in the market. Innovation is also an enabler for the transition towards efficient, sustainable and secure energy systems.
- **Basic indicator:** Total R&D expenses for the implementation of 'energy efficiency' initiatives in a year.
- **Limitations:** the concept of innovations is quite ambiguous, as it does not determine any standards about the degree of 'innovativeness' of the processes, products or services. Therefore, the managers should decide what is important for them to measure and define accordingly the concepts and indicators used for the measurement of innovation.
- **Potential improvement:** development of concrete methods to measure different aspects on innovation processes and outcomes and analysis of their impacts on value creation and energy savings.
- **Additional/ Alternative indicators:** there are several alternative indicators that can be used to measure the degree of innovation of a business, such as:
    a) Total R&D expenses. It refers to all the R&D activities of the company.
    b) Total R&D expenses for 'green initiatives'. It aims to focus on R&D initiatives that have a positive impact to the environment.
    c) The production of intellectual property (e.g., number of patents).
    d) Innovation rate. There are two basic metrics for the measurement of the innovation rate: 1. revenue share of innovation / total turnover * 100, and 2. nº of innovations / nº of total products * 100.

5.1.2. Activities

4. Productivity

- **Description**: it is a measure of the efficiency of a company's production process/ operations; productivity is defined as the ratio between the output volume and the volume of inputs (how efficiently production inputs are being used to produce a given level of output). Productivity is a general measurement that can be tailored to the particular attributes of different companies and in different sectors.
- **Basic indicator:** Value of output items/ Value of input items (value of output items can be calculated as amount of output items * price; value of input items can be calculated as amount of input items * cost).
- **Limitations:** productivity is quite a broad term and cannot include precisely all the aspects of input and output; hence, particular measures should be defined (see below in the alternatives indicators) that focus on some parts of the company's production process/ operations. There are several challenges in measuring productivity, especially in measuring output and input (especially the intangible ones, or in the service sector) and calculating their money value, etc. The accounting and the production/ operations departments must have developed solutions that handle these issues.
- **Potential improvement:** problems in both the accuracy of the data and in the methodologies applied can generate measurement errors. Improvements must be done in data quality and methodology. Additionally, it is important to understand the underlying factors affecting productivity growth.
- **Additional/ Alternative indicators:** productivity is a core measurement in any business. Particular indicators that can be used for the measurement of productivity are the following ones:

  a) Workforce productivity: It refers to the amount of goods and services that a group of workers produce in a given amount of time. It is calculated as the total output / total number of employees.
  b) Reduced production cycle: It refers to all activities related to the conversion of raw materials into finished goods, thus, it is the average time between process completions. It refers to the duration of production time and it is calculated by subtracting the process start time from the process end time.
  c) Increased production yields: It refers to a measure of production performance. It is calculated by measuring the number of finished products, known as outputs, against the inputs (time, materials and energy) needed to create them in a certain period of time (it depends on the kind of processes and products and can be a day/ week/ month/ year).
  d) Increased productivity of machinery: It refers to a machine's proficiency in converting the raw inputs into a finished product. It is calculated as the total number of products produced / total of machines used in a certain period of time.
  e) A composite indicator refers to the improved equipment performance and it is calculated with the Overall Equipment Effectiveness that measures the overall assets level of productivity. The OEE formula is calculated by multiplying Availability X Performance X Quality, and it is represented as a percentage.

     *Availability: divide the total run time of an asset by the total planned production time of an asset.

     *Performance: divide the actual system throughput by its maximum possible throughput.

*Quality: divide the number of usable units produced by the total units started.

5. Utilization

- **Description**: capacity utilization refers to how much of the production capacity is being utilized; it is the amount of output as a proportion of the total possible output. Utilization is a typical measure for manufacturing companies; however, it can also be applied to services (e.g., the amount of time that point of service are used to serve customers).
- **Basic indicator:** actual utilization / total productive capacity.
- **Limitations:** There are several challenges in measuring both utilization and productive capacity, such as what is included in the measurement (workforce, machinery, equipment, etc.) and how utilization and capacity are determined and measured.
- **Potential improvement:** problems in both the accuracy of the data and in the methodologies applied can generate measurement errors. Improvements must be done in data quality and methodology. Additionally, it is important to understand the underlying factors affecting productivity growth.
- **Additional/ Alternative indicators:** there are particular indicators for the measurement of utilization, such as:
  a) Asset Utilization: it is calculated by dividing the actual output by maximum capacity and multiplying the result by 100.
  b) Workforce Utilization: it is calculated by dividing the actual output by maximum workforce capacity and multiplying the result by 100.

6. Maintenance cost

- **Description**: it refers to the expenses for the upkeep and repair of machinery and components throughout the business operation. The measure is useful also for tracking machinery's effectiveness over time.
- **Basic indicator:** there are several measurements for maintenance cost. A composite and insightful indicator is the Maintenance Unit Cost, which is calculated as: total maintenance costs / standard units produced. The metric is flexible and can be applied to one asset, a collection of assets, or a plant as a whole.
- **Limitations:** there are some limitations that have to do with the measurement of the maintenance cost, especially when numerous and disparate items of equipment are included. For instance, the average cost of ongoing maintenance can differ from one asset to another (how much regular maintenance does it need, how it handles wear and tear, what is the cost of spare parts, etc.). The production/ operations department must have developed solutions that handle this issue.
- **Potential improvement:** maintenance should be seen in the wider scope of business operations. It is important to review the total MRO cost (maintenance, repair and operations) in order to increase of the operations effectiveness.
- **Additional/ Alternative indicators:** there are particular benefits and relevant indicators related to maintenance:

a) A simple indicator refers to the estimation of the Maintenance Cost per Machine (over a period of time).
b) Malfunction Rates refers to the number of malfunctions or the number of breakdowns of machinery and equipment in a certain period of time.
c) Longer Equipment Life (due to reduced wear and tear) refers to the reduction of equipment costs due to the fact that they have a longer lifespan and it is calculated as the cost of equipment minus delayed spending for replacement. The useful life of an asset is calculated by dividing the cost of the asset by the estimated number of years in its life. The longer the useful life, the lower the equipment costs.

7. Carbon footprint

- **Description**: it is the amount of carbon dioxide released into the atmosphere as a result of the activities of a company. This generally applicable indicator from WRI includes the amount of GHG emissions to air from fuel combustion, process reactions and treatment processes. It includes CO2, CH4, N2O, HFCs, PFCs and SF6, and are given in metric tons of CO2-equivalents. A method for the calculation of carbon footprint is presented in section 4 of this deliverable (step 4 of the proposed methodology).
- **Basic indicator:** it is calculated by summing the emissions resulting from the business operations for the manufacturing of a product or the performance of a service. The usual metric for carbon footprint is the number of tons of carbon dioxide emitted per year.
- **Limitations:** Calculation based on yearly split of energy carriers and their respective emission factors.
- **Potential improvement:** Refinement of the method considering the order (sequence) in which the energy carrier contributes to energy savings.
- **Additional/ Alternative indicators:**

a) Reduced dust emissions.
b) Reduced NOx / SOx emissions (each can be calculated separately).
c) Water footprint is a measure of the total level of freshwater consumption for the direct or indirect operation of the business. There are particular methods for the calculation of the water footprint.

8. Quality

- **Description**: quality describes broadly the capability of the product/ service to meet certain standards (e.g., technical standards, or user's requirements). Improving the quality is paramount to all businesses. The producers tend to measure the conformance quality, or the degree to which the product/service was produced correctly (without faults), according to the requirements of technical standards. The consumers, on the other hand, may focus on the specification quality of a product/service, or how it compares to the similar offering of the competitors.
- **Basic indicator:** there are several indicators that can be used for the measurement of quality. The company can decide for the indicator (set of indicators) that fit better to its needs. We suggest here an indicator that can be used as a basis for the measurement of quality is the 'Right First Time' that measures how many products are produced correctly from the first time (without the needs for modification or rework). In its reverse form, it portrays another popular quality metric,

the 'Percentage of Defectives', which is calculated as the total number of defectives to the total output.

- **Limitations:** quality is subjective and what constitutes an acceptable level of quality varies. Additionally, not all aspects of quality are tangible and it is always evolving, for instance because of improved technology, better materials, or new manufacturing techniques. Notice that, from the customer's point of view, quality is a perceptual, conditional and subjective attribute of the total performance of the product/ service and, hence, it may be understood differently by different people.
- **Potential improvement:** companies can be supported in the effort for improved quality by the development of a quality management system, that provides particular principles, procedures and metrics for the management of quality.
- **Additional/ Alternative indicators:** there are different approaches on quality and numerous metrics for the measurement of quality. We single out two additional examples:
    a) Overdue Corrective Action Rate: it tells how good a company is in completing improvement actions and in preventing recurring mistakes. For the calculation of this metric, divide the number of overdue improvement actions by the number of open improvement actions.
    b) Customer Service Costs: it provides the customer's perspective in quality and is calculated by multiplying the number of product recalls * the cost of product recall.

9. Health and safety incidents

- **Description**: it refers to incidents such as injuries, diseases and other dangerous occurrences at the workplace. Improving the organization's health and safety culture and performance means that the organization places a high priority on preventing injuries, minimizing risks, solving occupational health and safety issues, investing in control measures, engaging the entire workforce in health and safety, being transparent and open about health and safety and leading and striving for continual improvement in health and safety performance.
- **Basic indicator:** there are several metrics for health and safety incidents. A basic metric is the Incidence Rate, calculated as the number of health and safety incidents that occur over a standard period of time. A variation of this metric is the number of incident events that occur over a standard period of time by a standard number of people (usually 100).
- **Limitations:** health and safety is a wide area that can include several and sometimes disparate measures. Hence, the development of a composite metric is difficult and the companies must use particular metric, that fit better their attributes and requirements.
- **Potential improvement:** Improvements must be done in data quality and methodology in the measurement of health and safety incidents. Additionally, it is important to understand the underlying factors affecting health and safety and their impact on reputation, productivity and employee morale.
- **Additional/ Alternative indicators:** there are particular benefits and relevant indicators related to health and safety:
    a) Lost Time Injury Frequency Rate: it refers to the number of lost time injuries which occur per million hours worked.

b) Employee Comfort: comfort at work is seen as a three-dimensional concept, each dimension corresponding to a different level of analysis, namely physical, evaluative, and psychological. Each dimension will be illustrated through research investigating (i) the physical factors of the work environment, (ii) satisfaction with the work environment, and (iii) attachment to the workplace and to the affective ties of employees to their workplace.
c) Reduced Absenteeism: absenteeism is the term used for chronic or habitual workplace absence, often unplanned and unannounced. It is calculated by the number of unexcused absences in a given period of time divided by the total period and multiplied by 100. Illness, family leave or personal leave are legitimate absences and they don't become absenteeism unless they become extended or repeated without a supporting cause.
d) Production Days Lost through Sickness Absence. It is the percentage of total work days lost by sickness absence.

5.1.3. Resources

10. Energy consumption

- **Description**: the total sum of energy consumed for a certain activity in a given period of time. It can include all types of energy source, such as electricity, district heat, fossil fuels, other fuel-based energy (e.g., biomass, waste fuel) and non-fuel-based energy (e.g., solar, wind). The measurement of energy consumption is covered by the energy audit, presented in section 4 of this deliverable (step 3 of the proposed methodology).
- **Basic indicator:** Total Energy Consumption per Year, which results from the sum total of the energy bills.
- **Limitations:** limitations can be related to the collection of reliable data and on the collection of detailed data per type of energy source.
- **Potential improvement:** the development of energy management systems, which is the topic of next tasks and deliverables in WP3, can provide answers to the accurate measuring of energy consumption.
- **Additional/ Alternative indicators:** Total Energy Consumption per Department/ Business Unit. It is alternative of the basic indicator for energy consumption.

11. Raw material consumption

- **Description**: raw material consumption measures the total amount of raw materials required to produce the final products or deliver the services of an organization. In this category we should also add the use of consumables and other types of materials used in the business operation.
- **Basic indicator:** a simple indicator is the quantity of raw materials purchased. There are more composite indexes for the measurement of raw materials that can tailor to the attributes and the requirements of each company.
- **Limitations:** a particular challenge and limitation is the numerous types of raw materials that can be used in certain companies.
- **Potential improvement:** the production/ operations department and the warehouse can provide insights for the correct measurement of raw materials consumption.

- **Additional/ Alternative indicators:** There are more composite indexes for the measurement of raw materials that can tailor to the attributes and the requirements of each company.

12. Recycling

- **Description**: recycling is the process of converting waste materials into new materials and objects. The recovery of energy from waste materials is often included in this concept.
- **Basic indicator:** percentage of total waste that is recycled (divide the amount of total waste that is recycled into the total waste generated * 100)
- **Limitations:** there are difficulties in separating amd therefore measuring the waste.
- **Potential improvement:** the development of approaches and methodologies that move beyond recycling and include other aspects of the cyclical economy.
- **Additional/ Alternative indicators:** there can be several particular benefits related to recycling. For instance, the Product Recycling Rate measures the proportion of the products a company sells that is recycled or reused. It is calculated as: amount of products recycled or reused/ total amount of products sold * 100.

13. Waste

- **Description**: waste can be solid, liquid, or gaseous and each type has different methods of disposal and management. Waste management is the activities and actions required to manage waste from its inception to its disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process. The process of waste management involves treating solid and liquid waste. During the treatment, it also offers a variety of solutions for recycling items that aren't categorized as trash.
- **Basic indicator:** Waste Reduction Rate is a measure of the level to which a company is able to reduce the waste it is generating as part of its operations. It is calculated as: Wasted raw material (in this period a) / Wasted raw material (in the last period b) X 100
- **Limitations:** the different types of waste, the variety of waste management processes and different requirements in waste management pose great challenges in the development of effective measures of waste.
- **Potential improvement:** waste management systems provide particular principles, procedures and metrics for waste management.
- **Additional/ Alternative indicators:** there can be several particular benefits related to waste management:
    a) Reduced Waste Heat: Reduce the amount of unused heat given to the surrounding environment (in the form of thermal energy) when performing mechanical and thermal processes.
    b) Reduced Product Waste: Reduce the amount of unusable or unwanted substance or material produced during or as a result of a process.
    c) Reduced Hazardous/ Non-hazardous Waste: a hazardous waste is a waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment. Hazardous waste is generated from many sources, ranging from industrial

manufacturing process wastes to batteries and may come in many forms, including liquids, solid gases, and sludges.

14. Employee satisfaction

- **Description**: it is the extent to which employees are content with their jobs and work environment. Factors that influence employee satisfaction include compensation, workload, perceptions of management, flexibility, teamwork, other benefits, etc.
- **Basic indicator:** Employee Satisfaction Index (ESI) includes three questions: a) how satisfied are you with your current workplace? B) how well does your current workplace meet your expectations? and c) how close is your current workplace to the ideal one? The employees answer the questions on a scale from 1 to 10 (1 is the lowest rating and 10 is the highest rating). ESI is calculated as [((question mean value ÷ 3) – 1) ÷9]*100.
- **Limitations:** measuring levels of job satisfaction can be difficult because of the subjectivity of the concept. Different people think of job satisfaction in different ways and give more or less weight to different factors in describing themselves as being satisfied or dissatisfied at work.
- **Potential improvement:** Employee satisfaction is usually measured with employee satisfaction surveys, that can include questions about management expectations, co-worker relationships, stress levels, career progression, etc. SMEs can form a basic questionnaire that contains a limited number of the most important questions about customer satisfaction and apply a 5-point Likert scale (1= not at all … 5=Very much). The survey should be repeated after a standard period of time (usually every semester or yearly). Human Resource Management can support in the topic of employee satisfaction. In many cases the HRM departments run such surveys regularly and have this data available.
- **Additional/ Alternative indicators:** There are several indicators for measuring employee satisfaction.
    a) Employee retention/loyalty: it refers to the ability of an organization to retain its employees and it is calculated by the average number of years that employees work at the company or by the retention rate, which is the percentage of employees a company retains over a given period of time.
    b) Employee recruitment: it refers to the process of attracting the best candidates for a certain position at a company and it can be estimated with the number of new employees per year

5.1.4. Customers

15. Acquisition of 'green' customers

- **Description**: it refers to the share of the customers who prefer 'green' consumption options, customers who are aware of the necessity for the protection of the environment and they purposefully purchase 'green' products/services.
- **Basic indicator:** 'Green' customers share, calculated as the percentage of 'green customers' divided by total number of customers x 100. The number of 'green customers' can derive from customer survey or any other form of customer feedback, or from the analysis of the sales records (how many customers buy 'green' products/ services).

- **Limitations:** not all sectors and subsectors have this type of customer. In addition, the 'green' buying behaviour of the customers should be consistent and long-term or permanent in order to be considered as 'green customers'.
- **Potential improvement:** the marketing department can provide information and support in the identification of 'green customers', as well as the analysis of their buying behaviour. It is a challenge to relate the growth of 'green' customers with the adoption of energy green policies, ESG policies and the business reputation.
- **Additional/ Alternative indicators:** there can be additional benefits and metric related to 'green customers':
    a) Green Products/Services Share can be defined as the percentage of 'green' products/ services in the total product/service portfolio; it can be calculated as the number of 'green' products/ services divided by the total number of products/services.
    b) According to the characteristics of the company and its customer base, additional metrics could refer to particular cases of 'green' products/ services, such as the percentage of recyclable or cyclical products, the percentage of energy-saving products/ services, etc.

16. Acquisition of new customers

- **Description**: it refers to the number the customers who have purchased from a company and used the product/ service for the first time. New customers can also be switching from a competitor brand.
- **Basic indicator:** new customers share, calculated as the percentage of new customers in a reported period in relation to the total number of customers.
- **Limitations:** there are difficulties in identifying new customers, as well as in defining new customers (for instance, a customer who hasn't bought for a long period is a new customer or not?).
- **Potential improvement:** Marketing can serve to the measurement and the better interpretation of metric about new customers. It is a challenge to relate the number of new customers with the adoption of energy green policies, ESG policies and the business reputation.
- **Additional/ Alternative indicators:** there can be particular metrics related to new customers, such as:
    a) Customer Acquisition Rate: it is calculated by dividing the number of customers acquired over a period of time by the length of the same period.
    b) Customer Acquisition Cost: it is calculated by dividing all the costs spent on acquiring more customers (marketing expenses) by the number of customers acquired in the period the money was spent.
    c) Customer Conversion Rate: it is the percentage of potential customers who take a specific desired action. For instance, in e-commerce it refers to the percentage of website visitors that perform a specific desired action on the website or landing page.
    d) Number of Referrals: it is the number of new customers who register after the recommendation of existing customers. In this way, a business can track not just new conversions but also customers who are satisfied enough to tell others about it.

17. Customer satisfaction

- **Description**: it is defined as a measurement that determines how satisfied customers are with a company's products/ services, procedures and capabilities. Customer satisfaction information, including surveys and ratings, can help a company determine how to best improve or change its products/ services and its operations.
- **Basic indicator:** satisfied customers share, calculated as the percentage of total customers surveyed who have declared they are satisfied with the products/ services or procedures of the company. This information can derive from customer surveys or any other form of customer feedback.
- **Limitations:** companies must perform customer surveys or develop other forms of customer feedback in order to collect this information. In addition, customer satisfaction is a subjective and composite measurement that is determined by a variety of factors.
- **Potential improvement:** the marketing department has a strong interest on customer satisfaction and can support in the calculation of the relevant metrics. The different aspects of customer satisfaction must be taken into account in order to measure it successfully. It is a challenge to relate customer satisfaction with ESG policies and the business reputation.
- **Additional/ Alternative indicators:** there are several additional metrics for measuring customer satisfaction, such as:
    a) Customer Satisfaction Score: it is the most basic indicator to measure global customer satisfaction. It is based on the answers to the question: "Overall, how satisfied are you with X?". CSAT is calculated by dividing the total of positive responses (very and somewhat satisfied) by the total number of responses, multiplied by 100. But it only measures the emotional dimension of satisfaction and does not indicate something about the future behaviour of the customer.
    b) Net Promoter Score (for customer satisfaction): it measures the affective and behavioural dimensions of customer satisfaction by evaluating the likelihood of customers to recommend a brand or its products/services. It is based upon the answers to the question: "On a scale of 0 to 10, what is the probability that you would recommend X brand to your friends or colleagues?" The NPS is obtained by subtracting the percentage of detractors (customers who respond 0 to 6) from the percentage of promoters (who respond 9 or 10).

18. Customer loyalty

- **Description**: it is a measure of a customer's likelihood to do repeat business with a company or brand. It is the result of customer satisfaction, positive customer experiences, and the overall value of the goods or services a customer receives from a business.
- **Basic indicator:** it can be measured with the Loyal Customer Rate, which is the number of customers who purchased more than a certain number of times (in depends on the sector) divided into the number of unique customers in the same period. The Loyal Customer Rate is calculated as: nº of customers who purchased + X times / nº of unique customers, where X is the required number of purchases for loyal customer in the particular sector/ subsector.
- **Limitations:** customer loyalty is an abstract term that is different from the one company to the other or the one sector to the other (e.g., in B2B and B2C). The indicator should be defined

according to the characteristics of the sector and in a par with the metrics used by the other companies in the sector.

- **Potential improvement:** one should consider more than one indicator calculation for customer loyalty depending on the business activity.
- **Additional/ Alternative indicators:** there are several alternative metrics for measuring customer loyalty, such as:
    a) Lifetime value (LTV): it refers to the total amount of money customers spend on a company's brands from their first to their latest purchase. Based on this metric, companies can recognize their 'good customers', that is the customers that make the higher turnover over time. This metric can be obtained from the sales systems used by the companies.
    b) Churn rate: it refers to number of customers who cancel or disengage from an order. It is calculated as a percentage of the cancelations or disengagement from an order over the total number of orders.
    c) Lost customers: it refers to the number of customers who have quitted the company over a certain period (a year). It is calculated as the percentage of customers lost/ quitted over the total number of customers in a certain period.

5.1.5. Partners

19. Supply chain relationships

- **Description**: the supply chain is a network between a company and its suppliers and partners that is formed for the production and distribution of products/ services to the customer. It includes different activities, people, entities, information and resources and is aimed to reduce costs, speed up the production cycle and help the company remain competitive in the market. Entities involved in the supply chain may include producers, vendors, warehouses, transportation companies, distribution centres, and retailers.
- **Basic indicator:** Total number of suppliers with ISO certification for energy or environmental management - or a similar and relevant instrument of accreditation.
- **Limitations:** nothing.
- **Potential improvement:** models and approaches describing the operations of supply chains can be valuable in the effort to improve the measurements for the quality of relationships with the suppliers. The Supply Chain Council has developed the Supply Chain Operations Reference (SCOR) model which is used to evaluate an organization's supply chain. It's based on a static model that defines the supply structure along with supply chain metrics and scorecards used to evaluate performance and identify areas for improvement.
- **Additional/ Alternative indicators:** Supplier Environmental Sustainability Index is an indicator that measures the environmental performance of suppliers. It usually is a multi-item measure including elements such as energy consumption, carbon emissions, waste levels, and water usage, among others.

20. Stakeholder relationships

- **Description**: stakeholders are individuals, groups and other entities affected by the operation of a business and also affecting the operation of a business through their reactions. Maintaining strong relationships with the core stakeholders is key to the long-term development and success of a business company. Common business stakeholders include customers, communities, employees, owners, suppliers and partners, government agencies and regulators.
- **Basic indicator:** total number of stakeholders involved, directly and/ or indirectly, in business decisions making.
- **Limitations:** while the issue of stakeholder management received increased attention in the recent years, there are not specific indicators for the measurement of the quality of stakeholder relations.
- **Potential improvement:** there is quite high research interest recently in stakeholder management and the involvement of stakeholders in decision making. The development of metrics and stakeholder management methods will support the evaluation of stakeholders' relationships.
- **Additional/ Alternative indicators:** there can be additional indicators for the measurement of the stakeholder relations, such as the total number of stakeholders involved in volunteering projects and other CSR (Corporate Social Responsibility) activities.

21. Litigation risks

- **Description**: it is the risk for a company to suffer legal procedures as a result of its actions/ inaction, products, services or another event.
- **Basic indicator:** Expenses and fines related to environmental law violations.
- **Limitations:** Legal risk is one of the most difficult kinds of risks for organizations to measure and manage. However, with the help of the ISO 31000 definition of risk, legal uncertainties can be expressed and then be measured together with their potential effects. In this way better management can be achieved.
- **Potential improvement:** Companies generally use some kind of litigation risk analysis to identify the areas that have high litigation risk - and thereby take appropriate measures to limit or eliminate those risks. The companies must identify, define and classify all kinds of legal risks in order to develop an effective risk management strategy.
- **Additional/ Alternative indicators:** there can be additional indicators for the measurement of litigation risks, such as the expenses and fines related to any law violation (e.g., anti-competitive behaviour, etc.).

22. Regulatory compliance

- **Description**: Regulatory compliance is an organization's adherence to regulations, guidelines and specifications relevant to its business processes. For example, the adoption of the principles and measures of the Energy Efficiency Directive or the Renewable Energy Directive of EU is a metric of the regulatory compliance.

- **Basic indicator:** Number of EU and national energy policies adopted - in total and over the past year.
- **Limitations:** nothing
- **Potential improvement:** the companies must create an effective regulatory corporate compliance program and review it regularly. They must also conduct a compliance audit and regulatory compliance training.
- **Additional/ Alternative indicators:** there can be several particular indicators of regulatory compliance, many of which have a sectoral character.

5.2. Multiple benefits evaluation

After the identification and estimation of the relevant multiple benefits, the companies will evaluate their impact on their operation and their business model in order to decide how they can take advantage of them. The evaluation of the multiple benefits is qualitative in nature. The energy auditor/ consultant, together with the supportive management team, will decide for:

- **The significance** of the benefits. For each relevant benefit, they will decide if it has "major", "minor" or "none" significance for the company (benefits that seem to have marginal or no significance can be omitted from further analysis).
- **The type of impact/ contribution in the business model**. The impact/ contribution can be evaluated as "high" or "low". We consider two basic conditions of impact/ contribution: a) *impact/ contribution to the value creation*, which has a strategic character and can lead to business model innovation, and b) *impact/ contribution to the business efficiency*, which has an operational character and can lead to business model improvement.
- **The exploitation proposal/ plan**. The energy auditor/ consultant and the supportive management team will decide how the company can take advantage of the multiple benefits that have the greatest significance and impact on the business model. They will outline the exploitation proposal, or the alternatives that exist. A detailed action plan will be necessary for the proposals that will receive the priority of the management team.

It is obvious that the role of the business managers becomes central in this step because the results of the multiple benefits analysis are employed for the development of ideas, plans and course of actions for the business improvement and development.

A rule of thumb that can serve to the prioritization of the different opportunities for advancing the identified multiple benefits is the combination between the degree of significance and the level of the impact. Hence, emphasis should be put on the combination of "major" significance and "high" impact. On the contrary, benefits of "minor" significance and "low" impact can be seen as marginal and can be underrated – left for later.

The structure of the evaluation tool and a fictional example for a service company is provided in Table 4. For such a company, the most important benefits are the development of New Products/ Services, Innovation, Quality and Employee Satisfaction because they have "major" significance and "high" impact for both value creation and efficiency. These are the areas/ benefits that appear to be the most promising ones for the advancement of the company. Benefits that have "major" significance and "high" impact for only value creation or efficiency (e.g., Safety, 'Green' Customers, Customer Satisfaction, and Customer Loyalty) should be the next priority of the company. Overall, the opportunities for such a

company seem to be related to business model innovation, because most of significant benefits are related to value creation. Since 'Green' Customers are a priority for the company, there are opportunities for the development of more sustainable business model, especially with concern to the offerings to and the relationships with the customer.

Table 4. Multiple Benefits Evaluation

BENEFIT	SIGNIFICANCE	IMPACT		EXPLOIT. PROPOSAL
		Value Creation	Efficiency	
1. New Products/ Services	Major	High	High	
2. Innovations	Major	High	High	
3. Market value	Minor	Low	Low	
4. Productivity	Minor	Low	High	
5. Utilization	None	--	--	--
5. Maintenance	None	--	--	--
6. Carbon footprint	Minor	Low	High	
7. Quality	Major	High	High	
9. Safety	Major	Low	High	
10. Energy consumption	Minor	Low	High	
11. Raw material consumption	None	--	--	--
12. Recycling	Minor	Low	High	
13. Waste	None	--	--	--
14. Employee satisfaction	High	High	High	
15. 'Green customers' share	Major	High	Low	
16. New customers	Minor	High	Low	
17. Customer satisfaction	Major	High	Low	
18. Customer loyalty	Major	High	Low	
19. Supply chain relationships	Minor	High	Low	
20. Stakeholder relationships	Minor	High	Low	
21. Litigation risks	Minor	Low	Low	
22. Regulatory compliance	High	Low	High	

6. Business Model Sustainability Advancement

The last stage of the DEESME multiple benefits approach the energy auditor/ consultant and the management team will review the business model, which was outlined in the initial stage of the multiple benefits approach, through the prism of the results that have been produced during the process in stages 2 (energy analysis) and 3 (identification and evaluation of the multiple benefits) and the knowledge that have been gained in order to find opportunities for the advancement of the business model sustainability. The purpose of this stage is to find ways to strengthen and advance the business model.

In the DEESME multiple benefits approach business model sustainability is relevant the principles of sustainability that view on the effect of the business activities on the environment, with the intention not only to avoid harming it but also to have a positive impact and pursue mutual benefits. The principles of sustainability describe a broader context for business decisions and operations, while energy management emphasizes on energy efficiency policies and measures. The concept of sustainability today extends even beyond the impact on the environment and includes also the business impact on the communities and the society. Hence, sustainability seeks for opportunities that combine the economic, the social and the environmental development and calls for business actions that respect the environment and promote the society. This perspective is relevant to the DEESME approach for multiple benefits that emphasizes on the non-energy benefits that can derive from the energy efficiency initiatives and considers energy efficiency decisions in the wider context of the business management and strategy.

There are two major ways of business model sustainability advancement:

- **Through business model innovation**: it refers to the innovation of the business model with regard to its core elements and their relationships. Taking into account the evaluation of the multiple benefits in the previous stage, opportunities for business model innovation can derive from the advancement of the benefits that have major significance and high positive impact on the opportunities for value creation.
- **Through business model improvement**: it refers to the improvement of the efficiency of the existing business model. Opportunities for business model improvement can derive from the benefits that have major significance and high positive impact on the efficiency of the business operations.

In this stage the business model analysis is repeated, but the questions are answered having in mind not the current business context, but the opportunities that can derive from the adoption of energy efficiency measures and the development of sustainable business practices and ideas. Therefore, the key questions in each core element of the Business Model Canvas for the advancement of business sustainability are the following:

- Value Proposition
    - *How can we better respond to customers' lookout for energy savings/ sustainability?*
    - *What are the opportunities for 'green' solutions in our market?*
- Customer Segments
    - *What are the social and market trends with regard to energy efficiency/ sustainability?*
    - *What are the needs of each customer/ customer segment related to energy savings, resource efficiency and sustainability?*

- Channels
    - *How can we use low impact distribution and communication channels?*
- Relationships
    - *How can we cultivate the values of energy savings and sustainability with customers?*
- Key activities
    - *How can we improve the energy efficiency of the key activities?*
    - *How can we develop 'green' and sustainable practices (e.g., recycling) in the performance of the key activities?*
- Key resources
    - *How can we achieve energy and resource savings?*
    - *What alternative and sustainable resources exist?*
- Key partners
    - *Can we choose partners with compelling sustainability certifications and social reports?*
    - *How can we collaborate with stakeholders for the advancement of business model sustainability?*
- Revenues
    - *How can we develop innovative financial models for the successful monetization of 'green' opportunities?*
    - *How can we meet business profitability and sustainable development?*
    - *How can we promote the fair distribution of benefits and profits to all constituents?*
- Cost structure
    - *How can we exploit energy efficient/ sustainable alternatives in order to deduce cost?*
    - *How can we exploit energy efficient/ sustainable alternatives in order to reduce risks?*

Figure 5 provides a general template for the analysis and the advancement of business model sustainability.

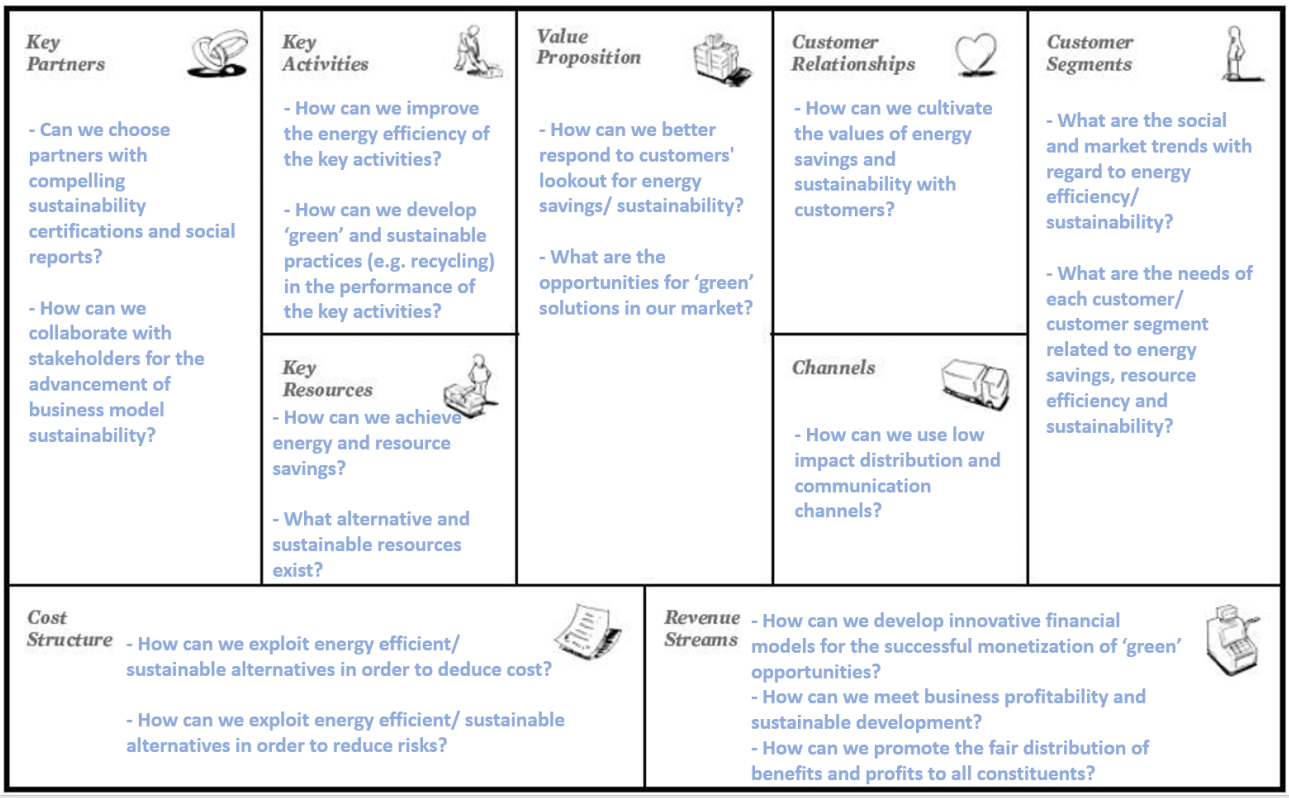

Figure 5. The template for the advancement of business model sustainability

7. Conclusions

Companies and especially SMEs tend to disregard the implementation of energy efficiency measures because they cannot discern the direct business benefit they will gain from them. This report presented the integrated multiple benefits approach that expands the scope of energy audits and energy management systems beyond the traditional financial and technical concerns and seeks to relate identified measures with the multiple business and non-energy benefits that can come along energy efficiency. The approach is based on the concept of the business model that is used both as a diagnostic tool and as a business design tool for the advancement of business sustainability. Hence, the DEESME multiple benefits approach not only relates energy decisions and initiatives with the attainment of the general business objectives, but also introduce concepts of energy efficiency and sustainability in business model analysis.

Next to the methodology, DEESME provides also a tool in the form of a spreadsheet file that will guide and provide structure to the proposed multiple benefits approach. Each step of the procedure will be developed in a separate sheet of the spreadsheet file.

The next tasks of WP3 include the development of training material and activities for the mobilization of energy auditor/ consultant and business managers to adopt the multiple benefits approach as a part of the implementation of energy auditing and energy management systems.

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