Multiple benefits of energy efficiency

D 4.3

Training Tools

Catherine Cooremans, University of Lausanne

Document number: Version 1.0

Publishing date: 28 February 2019

Project deliverable: D4.3

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 785131. This document only reflects the authors' views and EASME is not responsible for any use that may be made of the information is contains.

Project partners

Fraunhofer ISI

BPIE

FIRE
FEDERAZIONE ITALIANA PER L'USO RAZIONALE DELL'ENERGIA

Environmental *Change* Institute
eci
UNIVERSITY OF OXFORD

BORGOC

NATIONAL TECHNICAL UNIVERSITY OF ATHENS

ECEEE
european council for an energy efficient economy

UNIL | Université de Lausanne

KAPE

Hes·so
Haute Ecole Spécialisée de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences and Arts Western Switzerland

Graz ENERGYAgency

Utrecht University

Lucerne University of Applied Sciences and Arts
HOCHSCHULE LUZERN
FH Zentralschweiz

IREES
Institute for Resource Efficiency and Energy Strategies

ISR - University of Coimbra

www.mbenefits.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 785131. This document only reflects the authors' views and EASME is not responsible for any use that may be made of the information is contains.

Table of Contents

Figures

Introduction

The goal of the European project M-Benefits[1] is to improve the business case of energy-efficiency measures (EEMs) advised by energy experts[2] to companies, in order to improve their implementation rate. This can be achieved by including not only the energy benefits but also the non-energy benefits of EEMs in the analyses (made for instance by energy audits).

The "Toolkit M-Benefits" (hereafter *toolkit* or *toolbox*) is the first deliverable from Work Package 4 "Toolkit Development".

The Toolkit of WP4 includes three main tools:

- Evaluation Tools (WP4.1): analytical tools enabling professionals to include Multiple Benefits (i.e. energy benefits and non-energy benefits) in their project evaluations and proposals.
- Communication Tools (WP4.2): enabling professionals to present benefits of energy efficiency projects to a company Investment Selection Committee, or to any other stakeholder, in a way that is attractive to decision-makers.
- Training Tools (WP4.3): course material to be used to train professionals (mainly energy experts) to apply the Evaluation and Communication tools. These educational tools will be used in workshops, webinars and online courses.

The analytical tools which compose the methodology aim to enable energy-efficiency experts to identify, categorize, evaluate and quantify (when possible) *ex-ante* the Multiple Benefits (MBs) of energy-efficiency projects. The evaluation tools are available in the form of an Excel document that integrates MBs categorization and the various analyses to be made, including a financial assessment tool to evaluate energy and non-energy benefits of energy-efficiency projects in financial terms. The M-benefits assessment methodology builds up on existing energy audits and improves the financial evaluation by including financial assessment of non-energy benefits. This represents a major innovation of this project for enhancing the business case of energy-efficiency investments.

M-Benefits Toolkit Overview

The M-Benefits methodology to identify and assess the Multiple Benefits (i.e. the energy and non-energy benefits) of energy-efficiency measures or projects at company level is an assessment process compiling which takes place in **five analytical steps**. Each step is concluded by a **milestone** (i.e. the results produced by each step, which are important for the compiled assessment of multiple benefits inside companies).

- Step 1 - Business model & decision-making context
  → Kick-off meeting
- Step 2 - Energy & operational analysis
  → Energy-efficiency measures (EEMs) identified
- Step 3 – Value-Cost-Risk analysis
  → EEMs categorized and valued in strategic & monetary terms
- Step 4 - Financial analysis (NPV-IRR-PB)
  → EEMs evaluated in financial terms

[1] www.mbenefits.eu
[2] Whether working internally in companies, or externally as ESCOs or Engineering consulting companies.

- Step 5 - Synthesis & conclusions

  → Presentation of the project to the Investment Selection Committee

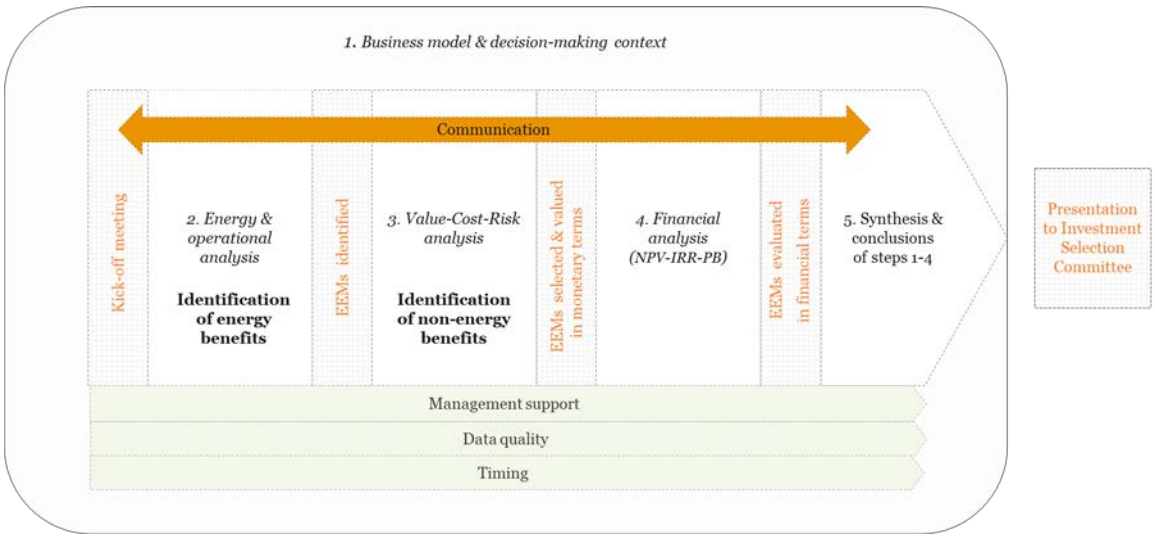


Figure 1. Figure 1 – Methodology (Toolkit) to identify, categorize, evaluate and quantify the Multiple Benefits of energy-efficiency projects

The key concepts available to both energy managers at companies and energy consultants (1. key resources to the analytical and decision-making process; 2. analytical steps & 3. milestones) composing the methodology are described in the next sections.

The M-benefits methodology especially on 2 and 3 overlaps the current energy audits activities in most of the EU Countries performed by energy consultants or energy managers and it builds upon these results for the case study analyses. The identification of multiple benefits at the level of energy measures and energy services are analyzed in the step number 3. The Value-Cost-Risk analysis for the different multiple benefits aims to quantify and monetize various important multiple benefits, which effect is financially evaluated in step number 4.

The tool for all steps and in particular for step 3 includes an assessment and inspirational guide for energy managers and engineers in order to categorize, identify and quantify positive and negative effects at different strategic levels of the companies. Key resources such as communication, management support, data quality and timing play a very important role for the approval of the energy-efficiency measures by the companies' different departments.The Multiple Benefits Methodology is summarized in Figure 1. The key concepts (1. key resources to the analytical and decision-making process; 2. analytical steps & 3. milestones) composing the methodology are described in the next sections.

The following documents compose the **Multiple Benefits TOOLKIT**:

WP4.1	EVALUATION TOOLKIT	
	Summary of M-Benefits methodology	PPT
	User Manual on Evaluation	Pdf
	Resources (generic check-lists - questionnaires)	Excel
	Case Study Analyses (results)	Excel
	Monitoring & Control tool (ex-post MBs checking)	Excel
WP4.2	COMMUNICATION TOOLS	
	Tips and Solutions for an Effective Communication	Pdf
WP4.3	TRAINING MATERIALS	
	User Manual on Evaluation (same as WP4.1)	Pdf
	Course material (for teaching the main concepts and tools underlying MB Toolkit in training sessions (WP5)	PPT Excel
WP4.4	SERIOUS GAME	
	Software platform	

Figure 2. Table 1 – Multiple Benefits Toolkit Documents

WP4.1 – Monitoring & Control tool. The objective of this tool is to track progress initially within the pilots but also later on with respect to compile information of the EEMs that have been implemented. The goal of monitoring & control is to check the reality of the Multiple Benefits but also the Evaluation Toolbox itself after EEMs have been implemented (i.e. regarding the quantification of MBs, their monetary and financial evaluations, MBs achieveds in implemented projects. Influence of the MBs Toolbox on investment decision-making). The corresponding Monitoring & Tool Excel sheet will be included in the RESOURCES & CASE STUDY ANALYSES Excel documents later on, during the Pilot project phase, in collaboration with WP6.

WP4.4 - Serious Game M-Benefits was developed as part of the Multiple Benefits project Toolbox. The serious game is described in the following documents:
https://dms-prext.fraunhofer.de/livelink/livelink.exe?func=ll&objaction=overview&objid=22845920
https://dms-prext.fraunhofer.de/livelink/livelink.exe?func=ll&objaction=overview&objid=22845198

MULTIPLE BENEFITS TOOLBOX EXCEL DOCUMENTS						
	Type of analysis	Analytical tool	Excel RESOURCES (generic)	Excel sheet nr.	Excel CASE STUDY ANALYSES	Excel sheet nr.
Step 1	Analysis of the company	Business model canvas	https://www.strategyzer.com/canvas/business-model-canvas	1.1	Synthesis of business model analysis	1.1
		Decision-making model	Decision-making questionnaire	1.2	Level of energy management; top management support; positive and negative drivers of ee investment; building portfolio	1.2
Step 2	Energy-operational analysis	Energy audit	https://www.iso.org/standard/60088.html		Summary of energy audit results: baseline of energy consumption in pre-defined boundary; energy indicators; potential for energy consumption reduction.	2
		Process mapping		2.1	Process mapping + Energy services + Energy Efficiency Measures (EEMs) mapping	2
Step 3	Strategic analysis (Value-Cost-Risk)	Value-Cost-Risk model	Check-List Non-Energy Benefits (NEBs) General + NEBs per energy service	3.1	Identified NEBs for each EEM	3.1
			Indicators & data definition/collection) Departments sources of data	3.2	Idenfied indicators and data for each EEM. Qualitative, quantitative, monetary values (when relevant) for each EEM.	3.2
Step 4	Financial analysis	Finance valuation methods	Pre-formated spreadsheet (Excel)	4	VAN-IRR-PB for each EEM or for grouped EEMs	4
		VAN-IRR-PB				
Step 5	Synthesis & conclusions		Template (PPT)	5		5

Figure 3. Table 2 – Multiple Benefits Methodology and Excel documents – Summary

As described in Table 2, two Excel documents are supplied by the toolkit to complete the analytical steps:

- The **RESOURCE document** provides, when appropriate or possible, questionnaires or generic lists to streamline the analysis and/or gives inspiration to the analyst.
- The **CASE STUDY ANALYSIS document** is intended to collect the results of the analyses.

One or two sheets of both Excel documents are dedicated to each analytical step, as shown by Table 2.

TOOLKIT Description – EVALUATION

The goal of the analytical process is to develop a pitch capable to convince the top management of a company to approve the EEMs investment project presented by the energy manager/team. Approvement is supposed to formally occur, as it is often the case in companies, during a meeting of the Investment selection committee, at the end of the analysis process.

Four resources are crucial for building up the pitch and,ultimately, for having the project approved by the Investment Selection Committee: **1. Communication; 2. Management support; 3. Data quality; 4. Timing**.

We will first describe these key resources (first section) and then the 5 steps of the Multiple Benefits methodology (2nd section) and, finally, the analysis milestones (3rd section).

Key resources to the analytical and decision-making process

1. Communication

Six interrelated spheres of culture influence the worldview, behaviors and decisions of decision-makers and of all other actors in the organisation, whether individuals and groups: the national, regional, professional, functional, business sector and corporate spheres of culture[3].

Each sphere creates particular mental schemes within people minds, but also involves different approaches: engineers, financial people or sales & marketing people apply different concepts, use different methods and tools, look at different issues with different lenses and speak different languages.

Because of these differences, communication between professionals is often a challenge. However, in order to create interest, understanding and, ultimately commitment (see Figure 2) within companies on energy issues, communication is indispensable.

As shown in Figure 1, communication is transversal to the whole analytical process, in two ways:

- **It connects the different steps of the analysis**, flowing forwards and backwards: information is collected and analysed at each step of the process but sometimes it is necessary to go backwards to check some pieces of information or to collect additional information.
- **It bridges different groups of people** around the energy-efficiency measures identified by the energy experts: people from operations, finance, marketing & sales, strategy, quality, environment, health & safety, etc. are solicited to give advice and information on technical, operational or financial aspects of the project.

Communication is a vital resource throughout the analytical process, not only because it is **a key tool to obtain information**, but also because it gives energy experts, throughout their contacts with people from other departments, the opportunity to **create support** within the company for the energy-efficiency project being developed.

Some useful tools for an effective Communication are described in another document (Name of the document: Tips and Solutions for an Effective Communication, Pdf).

[3] Schneider and Barsoux, 2003:47.

2. Management support

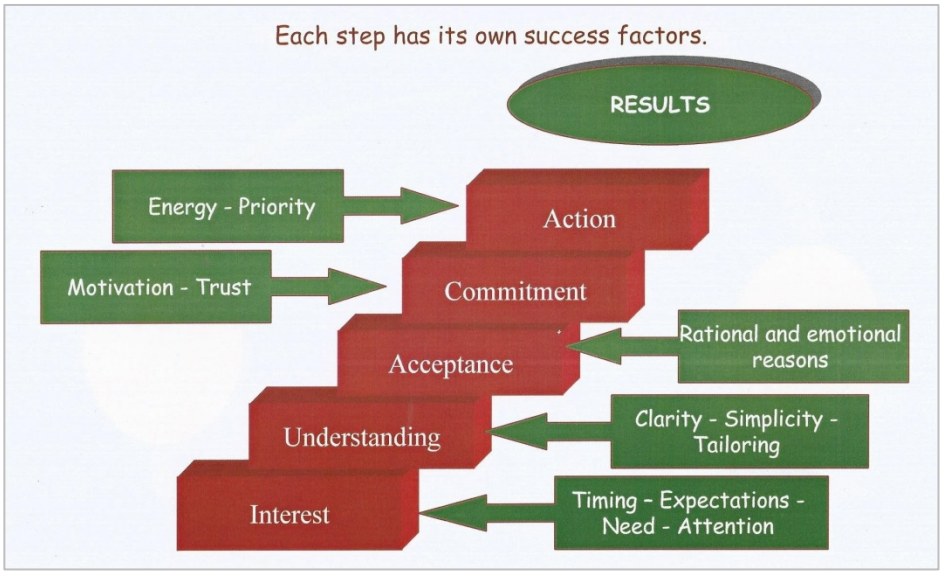


Figure 4. Figure 2 – The impact ladder of good communication. Source: Klaus, R. (2001), Heinz Goldmann Foundation.

As shown by Figure 2, getting support for an idea or a project takes time. Support grows gradually in different stages, which form a **communication ladder**: interest, understanding, acceptance, commitment and, only finally, action.

In the investment decision-making process, commitment is taken by the Investment Selection Committee when making a positive decision[4] about an investment project. The time allocated to present a project before the Committee is very short: most often it does not exceed 20-30 minutes, usually too short a time to generate commitment if a project is unknown by the Committee's members. Therefore, interest, understanding and acceptance must be obtained beforehand, well before the Committee meeting.

Each step of the impact ladder of communication has its own **success factors**. As described in Figure 2, timing, expectations, need and attention are necessary factors to get interest from the audience. These factors are interrelated: you will get attention if you meet the expectations and needs of your interlocuteur(s), with the right timing. This also means you need to have the right communication.

The first opportunity to communicate about the future project and to create contacts and channels of communication is offered by the Kick-off meeting, at the very beginning of the process. This is why it is extremely important to carefully organize this meeting, and to obtain the participation of as many functional managers as possible. From this starting point, communication must continue to flow during the whole investment process, until the Investment Selection Committee meeting, its conclusive step, to generate support and obtain data, another vital resource for the investment project.

[4] A decision can be defined as "a specific commitment to action ... usually a commitment of resources " Mintzberg, Raisinghani et Theoret (1976, p. 246).

3. Data quality

> "For data and information, better care is mostly about quality. Organizations must correctly create or otherwise obtain the data and information they really need, correctly, the first time. Thy must make it easy for their people to find, access, and understand them, so people trust and use them with confidence and power. Finally, organizations must take reasonable steps to protect their data and information from being stolen or used in anippropriate ways.
>
> Relatively few organizations could credibly claim to meet these criteria today...The result is that data and information are essentially unmanaged assets... most organizations have a lot of work to do to make their data and information fit for use."
>
> Redman, T. C. (2008:4, 5, 9)

"Data quality refers to **the condition of a set of values of qualitative or quantitative variables**. There are many definitions of data quality but data is generally considered high quality if it is "fit for [its] intended uses in operations, decision making and planning. Alternatively, data is deemed of high quality if it **correctly represents the real-world** construct to which it refers"[5].

"The **quality of data** is determined by factors such as: accuracy, or correctness; completeness, which determines if data is missing or unusable; reliability; relevance; conformity, or adherence to a standard format; consistency, or lack of conflict with other data values; and duplication, or repeated records.

Lack of trust by business managers in data quality is commonly cited among chief impediments to decision-making"[6]. The same can be said about the lack of consideration of non-energy benefits in the analysis of energy-efficiency investment projects: the lack of (quality) data is generally cited as the major obstacle.

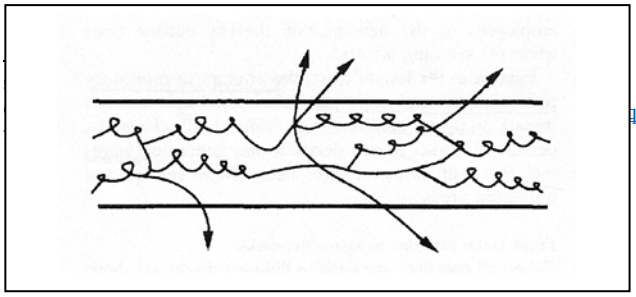
However the data necessary to qualify and value the potential non-energy benefits of an energy-efficiency project often exist in companies: we *just* have to make the effort to find the **data owner**, **the source of the data.** It is a time-consuming effort but it is worthwhile since it may considerably improve the chances for an energy-efficiency project to be decided and implemented. Moreover the time needed to collect data will decrease in the future thanks to the Multiple Benefits pilot projects and case studies.

It must also be emphasized that an investment project always takes place in the future and future is uncertain. Therefore putting quantitative or monetary figures on an investment project is often a difficult task for any type of investment, not only for energy-efficiency investments.

Finally it must be noted that data collection has an important side effect: **it gives the opportunity to create contacts** with powerful functions or departments in a company (strategy, operations, finance, marketing & sales, etc.) and, therefore, to build up internal support for the energy-efficiency project being developed.

4. Timing

Most often, we tend to see projects requiring investment as though they were independent from other investment proposals or issues. But projects are not isolated in companies. As illustrated by Figure 3, **decision-making is "a complex network of issues involving a whole host of linkages**, more or less tightly coupled. Periodically decisions emerge from this network, or at least actions, driven by insights as well as various affective factors in addition to the cerebral rationalities of the actors"[7].



quality

Figure 5. Figure 3 – Organizational Decision Making as Interwoven, Driven by Linkages (Langley, Mintzberg, Pitcher, Posada et Macary, 1995:275).

There are different types of linkages between decisions. **Sequencial linkages** connect different decisions concerning the same issue stream[8]. Decisions can also be linked laterally, i.e. across different issue streams. There are two forms of **lateral linkages**: "pooled linkages"[9] characterize situations in which different decision-making issues share the same available resources, such as the time and energy of powerful decision-makers or financial resources. In the case of "contextual linkages", concurrent decision processes within the same organization are interrelated simply because they bathe withing the same organizational context, involving the same people... the same strategies and the same organizational culture[10]. Because of these links, allocating resources to a decision-making issue affects the amount of resources that remain available to others. In summary, decision-making is influenced by the intensity and type of the relationship between decisions and by the type of organization in which it is embedded.

Issues do or do not generate organizational decisions[11]. In Figure 3, decisions are illustrated by arrows coming out of issue streams. But Figure 3 not only shows that topics are connected to each other within the organization, it also shows that some issues do not come out of the flows (thus becoming decisions): they remain at the state of **non-decision** (i.e. no decision is made). Non-decision, which should not be confused with negative decision, is often the result of energy audits.

These considerations regarding the links between decisional issue streams highlight the **importance of timing in decision-making**: sometimes issues come too late or too early in relation to others; sometimes the organizational landscape is invaded by one dominant issue (such as digitalization 4.0; or a crisis situation). Sometimes procedures impose timing: for instance, if a company has defined 10 years as the interval between two building renovations, an energy audit after, say, three years, will more than likely be a waste of time and money.

Analytical steps and milestones

This chapter describes the **five analytical steps** composing the Multiple Benefits Methodology.

The first analysis (Business model & decision-making context) is made at company's level, while Energy & operational, Strategic and Financial analyses are made at the level of the energy-efficiency project. The last step is a conclusive one, summarizing all the aspects analysed in steps 1-4.

[8] "Or between various levels of decision activities associated with the same broad issue" (Idem: 271).
[9] Langley et al. (1995 :272).
[10] Idem:273.
[11] Idem:276.

Step 1 – Analysis of the company: business model & decision-making drivers

- **Goal of step 1:** to improve knowledge of the company where the energy-efficiency project will be developed.
- **Why:** know your customers to conceive a project customized to their interests and needs.
- **Tools for the analysis:**
  - ✓ **The business model canvas:** describes a business model in 9 basic building blocks.
  - ✓ **The decision-making model:** describes in 4 categories the drivers of companies' investment decision-making.

The global level analysis of the business model and of the decision-making drivers is intended at understanding the global stage where the energy-efficiency project will have to take its space and convince top management.

Business Model Canvas

The Strategizer's Business Model Canvas (Figure 2) describes a business model in 9 basic building blocks: customers segments; value propositions; channels (to reach customers); customer relationships; revenue streams generated; key resources and key activities required to create value; the key partners; the cost structure of the business model[12].

[12]Please have a look at this website where a video (2.2 minutes) summarize the Business Model Canvas https://www.strategyzer.com/canvas/business-model-canvas

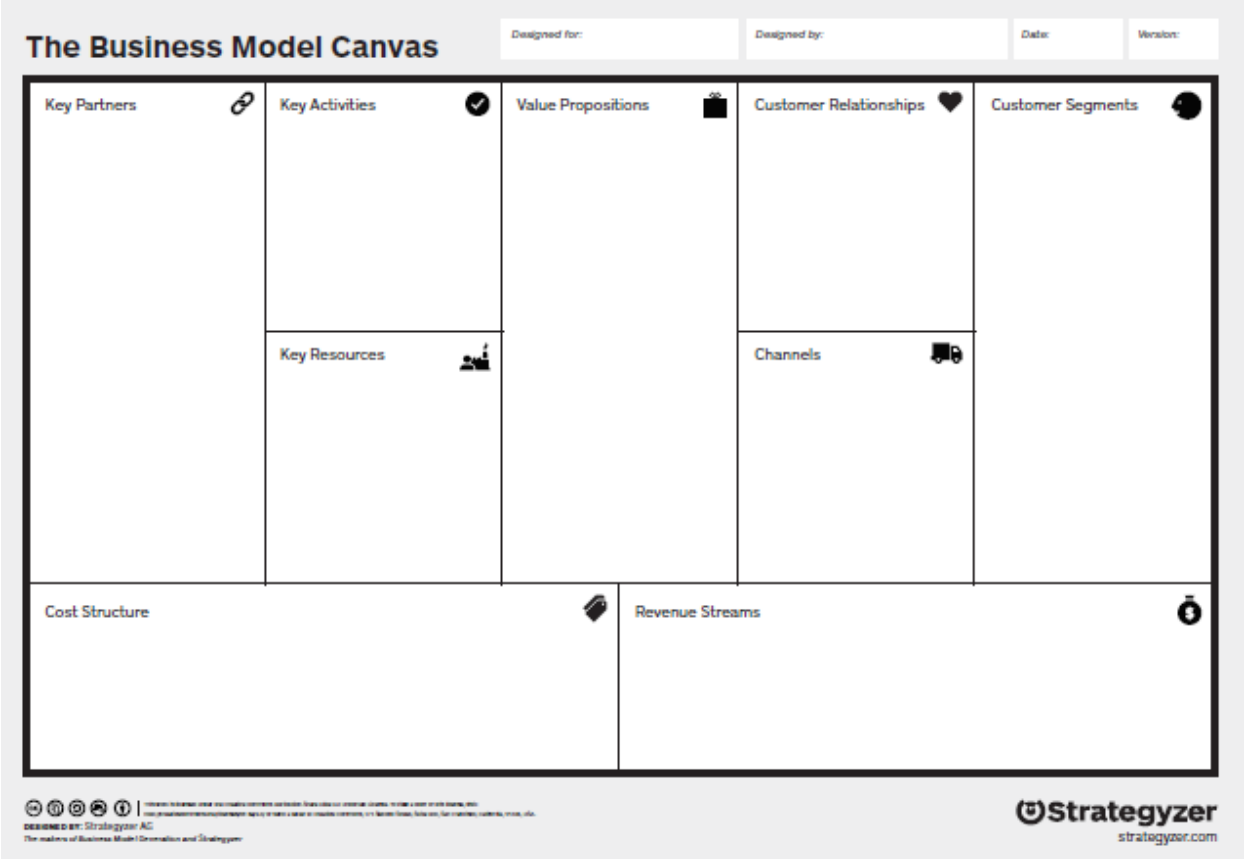


Figure 6. Figure 4 – The Business Model Canvas – Source: Osterwalder A., Pigneur, Y., 2009

Six of the nine blocks are especially important to the Multiple Benefits analysis, which aims to identify how energy issues and energy services contribute to a business model:

- **Customer segments** "are the groups of people and/or organizations a company or organization aims to reach and create value for with a dedicated Value Proposition"[13].
- **Value propositions** "are based on a bundle of products and services that create value for a Customer Segment"[14]. Value is intended here as a value of use, which consists of all the benefits that the customer derives from the use of the products or services of a company.
- **Activities**. Activities are the most important actions or functions that a company must perform in order for its business model to work: for example, buying raw materials or producing[15].
- **Resources**. Resources consist of the most important assets that are needed for the business model to work, so the company can create, produce and deliver its value proposition(s), maintain relationships with its customers and generate revenues.
- **Cost structure "**describes all costs incurred to operate a business model"[16].
- **Revenue streams** result from a Value Proposition successfully offered to a Customer Segment. It is how an organization captures value with a price that customers are willing to pay[17].

[13] Business Model Canvas (2015:24). Why and how organizations around the worl adopt it. A field report from Strategizer. https://assets.strategyzer.com/assets/resources/business-model-report-2015.pdf
[14] Idem.
[15] NB: The activities analysed here should not be confused with the "activity" of a company (the products or services that a company produces in a certain sector).
[16] Idem.
[17] Idem.

Tips, questions & answers for energy experts applying M-Benefits methodology:

- Go to the company's analysed website, an easy mine of information.
- Identify the most important customer segments and the corresponding company's value propositions, as well as key activities and resources.
- Is the company is value-driven or cost-driven?
- What are the key resources and activities?
- What are the risks threatening the business model?

Resources: Business Model Canvas – doc EXCEL RESOURCES – sheet 1.1

Decision-making model

The decision-making model (described in Figure 3) completes the business model canvas to understand how and why organisations (for-profit companies and public administrations) make investment decisions.

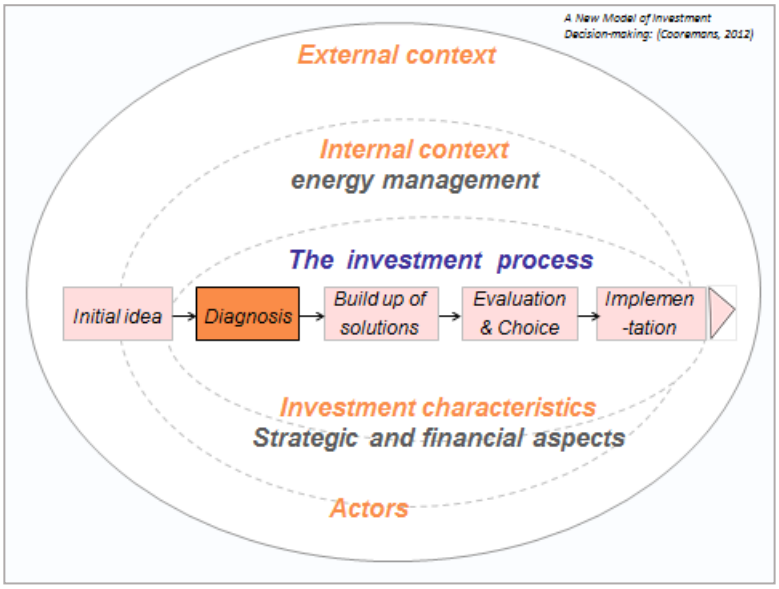


Figure 7. Figure 5 – The investment decision-making model. Source: Cooremans, 2012

According to the model, investment decision-making must be considered as a process influenced by four drivers, described in the following paragraphs:

- **Process**. The decision-making process comprises three phases: identification (diagnosis), development (build-up of solutions), and selection (evaluation of the different solutions and choices). In this process[18], the most important phase is not "Evaluation and choice", where the decision is formally made. It is the diagnostic phase, which is crucial in two ways: firstly, it translates—or not—an initial idea into a decision event (which means the real start of a project in a company); secondly, it influences the project development (a project perceived as important will receive human and financial resources to be evaluated in more details) and thus, ultimately, the decision made (i.e. the choice phase, where the decision can be positive, negative, or a no-decision).
- **Organizational and external contexts**. Organizational context comprises structure (flow chart) management systems, strategy, and culture. The external context is

[18] Defined as a dynamic chain of actions and events.

referring to the organization's environment, of which main components are competition moves, demand, social evolutions, regulation, the general economy, and technological progress.

- **Actors involved**. In any company, some people have more power than others. A "dominant coalition", composed of a "core triad of heavyweight functions", closely associated with core business: production (or its equivalent in services companies), marketing & sales, and finance. Together with general management, this coalition imposes its choices upon investment decision-making (because powerful people impose their choices).
- **Investment characteristics**. In any company, there is a competition between investment projects for the limited financial and human (the support of powerful managers) resources. Characteristics of investment projects do influence the outcome of this competition. The main characteristics are: the importance of the investment to the company and the level of change(s) it would entail; complexity of the project; uncertainty regarding project results,; the number of actors involved and the type of stimuli evoking them (threat or opportunity, level of urgency); the available solutions (ad hoc or ready-made, internal or external). Investments can also be categorized according to their functional object (production increase, product innovation, etc.) or according to their strategic character, or strategicity.

Tips, questions & answers for energy experts applying M-Benefits methodology:

- Go to the website or ask people you know inside the company. Try to get the flow chart.
- What could be the key persons influencing the decision-making process of your project? How can you get their support: which arguments would favour or block their support to your project?
- What is the company strategy (and/or vision)?
- Are energy efficiency or energy conservation parts of the company's culture?
- How would you evaluate the external context of the company: is competition high? Are techological innovation, legislation or customer tastes moving fast?
- **Submit the decision-making questionnaire (Excel RESOURCES - sheet 1.2) to the company's management.**
- **Indicate the company's answers to the Business Model Canvas and the Decision-Making Questionnaire in doc EXCEL CASE STUDY ANALYSIS – sheets 1.1. and 1.2.**

Step 2 – Energy & operational analysis

- **Goal of step 2:** identify EEMs capable, at the same time, to secure or improve the company's processes and to decrease its relative energy consumption, in a predefined boundary.
- **Why:** contribution to process and OE is a key positive investment decision-making driver; energy consumption is not appealing to the top management of (most) companies.
- **Tools for the analysis:**
  - ✓ **Energy audit:** describes how energy carriers are converted, distributed and used and the monitoring & control system; analyses the current energy consumption and the reduction potential; defines a baseline to which compare future progress and the energy performance indicators.
  - ✓ **Process map:** describes the various steps of a process related to the production of goods or services.
  - ✓ **Energy services & process map:** describes which energy services feed the process and what are their constraints and risks.

Energy analysis

The energy analysis, intended at identifying potential EEMs, often takes the form of an **energy audit**[19] which is performed on an industrial or commercial facility site, according to a pre-defined boundary or scope of analysis[20]. An energy audit carries out a diagnosis of site energy uses and establishes a catalogue of EEMs that are technically feasible and economically profitable, accompanied by recommendations. Aiming at the realization of energy savings, this approach must provide the audited company with the necessary decision-making basis regarding the actions to be taken to improve energy efficiency.

In order to provide this decision-making basis, the energy auditor firstly defines a site's consumption profile by evaluating the consumption of primary (e.g. natural gas, fuel oil, renewables, etc.), secondary (electricity) and tertiary energy carriers (or utilities; i.e. vapor, compressed air, water) by machines and equipment. In a second step the energy auditor looks at the means to reduce the energy consumption of machines and equipment.

This conventional energy approach (the "KWh approach") is illustrated by Figure 4. Based on this approach, energy specialists identify potential EEMs and prioritize them in energy and financial terms. One striking aspect of this approach, as shown in Figure 4, is the fact that site's production activities are not considered in the analysis.

[19] An energy audit can be formally defined as "a systematic procedure that obtains an adequate knowledge of the existing energy consumption profile of the site; identifies and scales the cost-effective energy saving opportunities; reports the findings" (Väisänen 2003:3).
https://www.iso.org/standard/60088.html

[20] I.e.a site with several buildings; a single building; a production process; a technical system such as a cooling network; etc.

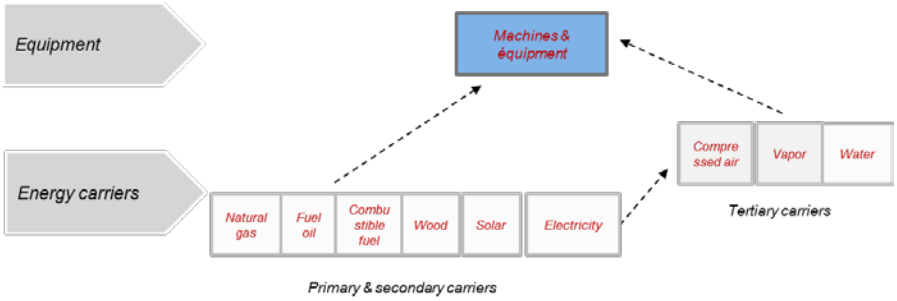


Figure 8. Figure 6 – The energy audit scope and goal of analysis.

But, to attract a company's top management interest, EEMs must also be prioritized taking into account process and strategic considerations. This involves doing an operational analysis in order to identify the EEMs contributing the most to the process quality, reliability and flexibility.

Process mapping

A **process** can be defined as "a sequence of operations connected to each other, producing (or reproducing) results"[21] or as "a tool allowing different actors to cooperate on a common objective: to deliver to the customer a product or a service"[22]. The process **customer** can be an internal customer (for instance the next process in the value chain) or the final buyer or user of the product or service.

"Process analysis enables the study and improvement of product and information circuits between units in a dual perspective of customer satisfaction and reduction of internal costs"[23] . The most common and useful tool to analyse a process is the **process mapping**. Process mapping consists of identifying all steps (and/or substeps) forming the process, and representing them in a chart. A process map is a helpful tool not only to represent a process but also to gain a critical perspective on it. A good process map must have carefully defined **boundaries** (the process supplier and process customer). An illustration of process mapping is given by Figure 5:

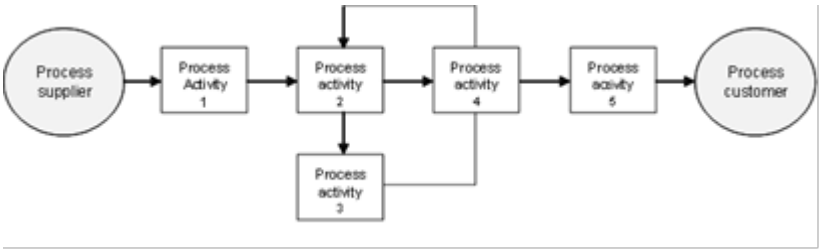


Figure 9. Figure 7 – Process mapping (George, et al., 2005:40)
Figure 10.
The process map must be provided by operations people, or built-up in collaboration between operations and energy people.

Once the process is mapped, it is necessary to analyse the sources of its operational effectiveness, or excellence. "Operational effectiveness (OE) means performing similar activities better than rivals perform them. Operational effectiveness includes but is not limited to efficiency. It refers to any number of practices that allow a company to better utilize its inputs by, for example, reducing defects in products or developing better products

[21] Livian 2000:93.
[22] Caseau 2011:20.
[23] Collignon 1997:2786.

faster. In contrast, strategic positioning means performing different activities from rivals' or performing similar activities in different ways"[24].

Another definition of **operational excellence** is "an operation where each and every employee can see the flow of value to the customer, and fix that flow before it breaks down"... It is "about understanding that Operations is a strategic part of the business that can have an impact on market share, break into new markets, adapt to changing markets, keep the business ahead of the competition, and return sustained shareholder value"[25].

More concretely operational excellence can also be described as "the search for perfection within the framework of the defined characteristics; it's about "doing well the first time", aiming at zero-defect, zero-delay, zero-stock, zero-paper, zero-returns[26]".

Operational excellence is composed of **four broad interrelated dimensions**: safety (of staff); quality (of products and processes); costs (borne to produce a company's value proposition-s); time-to-market. Examples of indicators for these four dimensions include:

- **Safety**: number of accidents per year; number of days of absence per year; perception of safety by the staff (annual survey); percentage of employees trained in good practices.
- **Quality**: downtime per day; percentage of products which conform to specifications; percentage of raw material losses; throughput (quantity produced by unit of time). These quality indicators illustrate the fact that the concept of quality not only includes product quality but also the quality of the production process, evaluated by its ability to provide products that meet quality requirements, as well as by its reliability (measured by the percentage of operation without failure) and flexibility (process ability to respond very quickly to changes in demand).
- **Cost**: costs of raw materials per month/year; costs of raw materials losses per month/year; cost of energy, gas, water per month/year; cost of additional hour of line operators.
- **Time-to-market**: preparation time per day; production time per day; machine downtime per day; number of delivery problems per year; number of new products developed per year.

Some parameters are critical for the process; these are the **CTQ (critical-to-quality) parameters**. A CTQ parameter is defined as any characteristic of a product, process, or service that satisfies a key customer requirement or a key process requirement. This implies that, if this parameter is not respected, the customer will not be satisfied or the process will not be accomplished properly. The CTQ parameter must be measurable to have operational utility. Speed, accuracy, timeliness, costs, are examples of product or process characteristics that can be measured and used as CTQ parameters.

Indicators of operational excellence can be improved by EEMs. They are included in the Value-Cost-Risks analysis (see Step 3)

Bridging energy and process analyses: energy services

Companies focus on process, not on energy consumption. However, energy services are vital to companies' processes and value creation, since they are often key in insuring process quality and security.

Energy services include:

- **Lighting**
- **Ventilation**

[24] Porter (1996:62).
[25] (Duggan 2012:28-27).
[26] (Collignon 1997:2784). We have freely translated from the original: "la recherche de la perfection dans le cadre des caractéristiques définies; il s'agit de "faire bien du premier coup", de viser le zéro-défaut, zéro-délai, zéro-stock, zéro-papier, zéro-retour".

- **Air conditioning**
- **Cooling & refrigeration**
- **Heating**
- **Hot water**
- **Automated processing of information & communication**
- **Motive power (engines)**

These services make the link between operational excellence and energy consumption (the conventional kWh approach). They enable to bridge energy and operational analyses: **energy services are the common ground where process people and energy people can meet and collaborate.** However energy services are the blind spot between energy and process analyses, because process people are not competent to evaluate the quality and security of the energy services feeding the value chain, and energy specialists focus on machines and energy carriers.

Therefore the conventional energy approach must be enlarged and reversed: instead of focusing on machines, equipment and energy carriers (as described in Figure 6), it must first understand process and which energy services, and how, contribute to it.

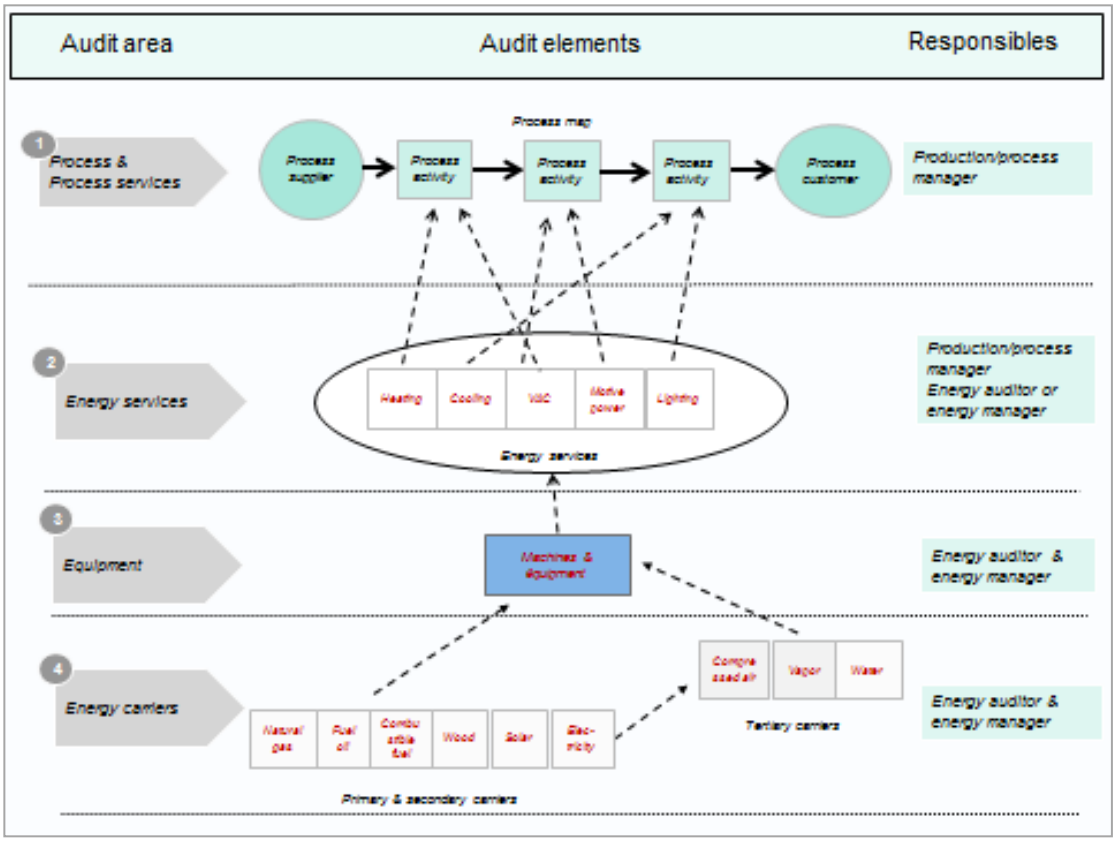


Figure 11. Figure 8 – Process-energy approach: joining energy and operations experts and interests

This new “operational-energy approach” has to follow the following steps:

1) Understand process.

2) Identify the key energy services feeding the process analysed, together with their related risks and constraints, and look for ways to improve their quality and reliability.

3) Analyse which machines and equipment produce these energy services.

4) Identify ways to reduce their consumption.

Such an analysis, which goes well beyond the impact of an energy-efficiency project on energy consumption, requires multidisciplinary competences, because process people are not competent in energy services, and energy people are not competent in process. Energy auditors, energy managers and operational staff and management in charge of the process have to join their skills and experiences. **M-Benefits brings together process people and energy people**

We can illustrate this integrated analysis using the example of aluminum foil production. Figure 9 represents the value chain process of aluminum foil production. The first step of the process is casting, which involves pouring liquid aluminum into a mold, and then cooling and solidifying it as an ingot. During the second process step, the pusher furnace reheats and homogenizes the ingots, preparing them for the third step, hot rolling. During hot mill, foil is produced from the aluminum sheet stock by rolling it between heavy rollers. In step four, cold mill, aluminum foils are further milled to the desired thickness. Even though this deformation process is called “cold” rolling, the strip is heated up to approximately 100°C during each pass and large quantities of coolant have to be poured over the rolls to maintain thermal equilibrium. Finally, in step 5, heat treatment of aluminum foil coils is applied for degreasing and final annealing of foil “wounds”.

Figure 12. Figure 9 – Aluminum foil production process map

Table 3 lists which energy services are necessary to each step of the production process. The first column on the left lists the energy carriers. The second column on the left lists the main energy services necessary for industrial processes. Each subsequent column to the right is dedicated to each substep of the aluminum foil process. Figure 10 shows the same information differently, using process mapping.

ENERGY CARRIERS Primary / secondary / tertiary	ENERGY SERVICES	VALUE CHAIN ACTIVITIES OF ALUMINUM FOIL PRODUCTION				
		Casting	Pusher furnace	Hot mill	Cold mill	Thermal treatment
Combustible fuel (diesel fuel for worklift)	Air conditioning	x	x	x	x	x
Natural gas	Ventilation	x	x	x	x	x
Low-voltage electricity	Communication (automation - electronic regulation)	x	x	x	x	x
Medium-voltage electricity	Heat - low temperature	--	--	--	--	--
High-voltage electricity	Heat - medium temperature	--	x	--	--	x
Compressed air	Heat - High temperature	x	--	--	--	--
Water	Lighting	x	x	x	x	x
	Motive power - fixed (propulsion, electric drive system)	--	--	x	x	--
	Motive power - mobile	x	x	x	x	x
	Refrigeration - positive cold	x	x	x	x	x
	Refrigeration - negative cold	--	--	--	--	--

Figure 13. Table 3 – Energy-operational services in the aluminum foil industry

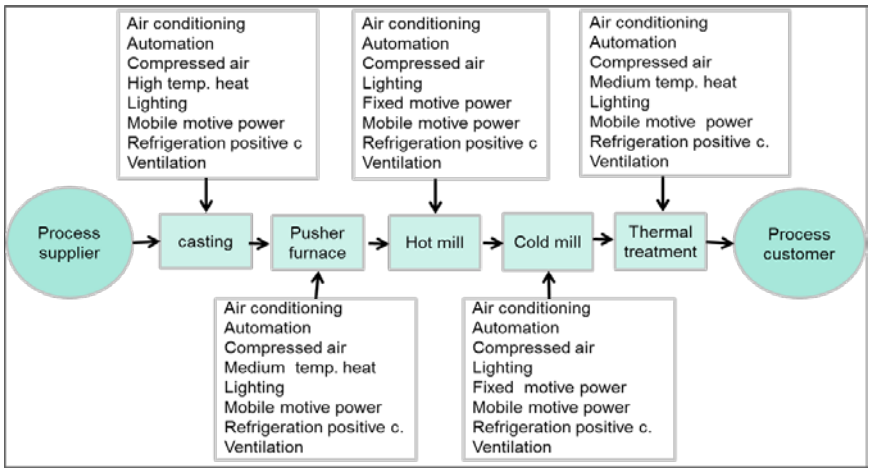


Figure 14. Figure 10 – Aluminum foil process mapping including energy services contribution

When linking energy and operational aspects, several elements must be included in the analysis. On the operational side, the most important **questions** to be answered for each process considered are the following: what are the goals of the process (defined to meet the expectations of the process customer)? What are the process key factors of success (production conditions)? What are the risks attached to the process? For instance, in the example of Novelis, the aluminium foil company: concerning lighting, a minimum of 300 lux is necessary in the production area of the factory and a minimum of 200 lux in the storage area; for high-to-medium temperature heat, minimum and maximum levels are necessary to ensure product quality; for compressed air, a certain level of humidity is required for quality reasons. (3) What is the value contribution of each energy service to each substep?

Tips, questions & answers for energy experts applying M-Benefits methodology:

- Energy people: make the conventional energy analysis (energy audit)
- Process people: describe the process map, its goals (who is the process client, what are their needs or expectations), the sources of operational excellence, the key factors of success and the relevant risks.
- Process people and energy people: make the energy services analysis along the following steps:
  - ✓ Identify the key energy services feeding the process (or each process) analysed, together with their related risks and constraints.
  - ✓ Look for ways to improve energy services quality and reliability.
  - ✓ Analyse which machines and equipment produce these energy services.
  - ✓ Identify EEMs that can contribute to the quality and reliability of energy services and reduce the energy consumption of machines and equipment *at the same time*.
- **Indicate in Excel CASE STUDY ANALYSIS, sheet 2.2, the results of your analysis: process, energy-services and EEMs mapping**.

Step 3 – Strategic (Value-Cost-Risk) analysis

- **Goal of step 3 -** for each EEM: 1) **determine** the non-energy benefits of each EEM identified during Step 3; 2) **categorize** them in strategic terms, i.e. analyse their contribution to risk reduction, value proposition increase and cost reduction; 3) **select** the EEMs which best contribute to operational excellence, energy consumption reduction and competitive advantage; 4) **define** relevant data and indicators; 5) **collect** data (in various company's departments; 6) **value** EEMs selected in monetary terms.
- **Why:** contribution of an investment to core business and competitive advantage is a key decision-making driver; energy consumption is not appealing to the top management of (most) companies.
- **Tools for the analysis:**
  - ✓ **Risk-Value-Cost model:** a framework to categorize each EEM identified (in step 2) according to its contribution to risk decrease, value proposition increase and cost decrease for the company.
  - ✓ **Indicators & data definition/collection model:** a framework to define relevant indicators and data for each EEM.
- **Resources:**
  - ✓ **CHECK-LIST MBs, general + for each energy service and major corresponding EEMs – doc EXCEL RESOURCES – sheets 3.1.1-3.1.9.**
  - ✓ **Quantifying and Valuing MBs – doc EXCEL RESOURCES – sheet 3.2.**

Step 3 is important since it will select the EEMs to be included in the energy-efficiency investment project (if there is more than one EEMs and if a choice between them must be done). Building on Step 2, which has identified potential EEMs and evaluated them in energy and operational terms, Step 3 is dedicated to assess the contribution of EEMs to the strategic direction of the company.

This contribution is important to obtain top management support and have the energy-efficiency project decided and implemented. The strategic character of an investment (or its *strategicity*) is more influential than profitability in companies' investment decision-making.

But a company does not always have a clear strategy; or its strategy is changing; or it is not communicated. So, how to assess the strategic character of an investment, i.e. the contribution of an investment to a company's strategy if the strategy is not known?

To circumvent this problem, we consider an investment as "strategic if it contributes to create, maintain or develop a sustainable competitive advantage"[27]. Competitive advantage has three interrelated constituents: costs, value, and risks. Based on this definition, the more an investment contributes to a company's risk reduction, value proposition increase and cost reduction, the more strategic it is.

[27] Cooremans, 2011

Figure 11 represents the three dimensions of competitive advantage.

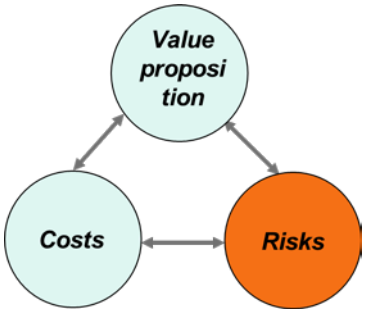


Figure 15. Figure 11 – The three dimensions of competitive advantage[28].

- **Value proposition(s)[29].** Value is intended here as a value of use, which consists of all the benefits that the customer derives from the use of the products or services of a company[30]. Thus the value at the source of competitive advantage is not a monetary value; it's a value of use.

  Value is what sets a company apart. The value proposition is channeled to target customers, identified as those who will appreciate a particular set of benefits.

  If a value proposition is convincing, more customers want the products and services or they want more of the products and services or, they are ready to pay a higher price for these. Therefore increased value translates in additional income.

- **Cost** refers to the costs bourne to conceive and produce the value proposition. EEMs can reduce many costs in a company, well beyond the energy costs.

- **Risk.** Energy-efficiency investments very often entail a reduction of important risks. Let's mention non-exhaustively: risks of staff accident or illness; risks of production or quality problems; commercial, environmental, legal risks; energy and carbon price risk. These positive impacts have been observed in many cases.

  A reduction of risk exposure often translates in value proposition increase and cost decrease: for instance a better controlled pasteurization process will reduce canned vegetables quality problems and losses of raw materials. More consistent quality positively contributes to the value proposition and turnover, while reduction of raw material losses translates in cost reduction.

  Investments in energysaving technologies have potential negative risks for companies: technical risks related to technologies reliability, resources risks (change of suppliers or information systems), human errors risks (lack of skills in the use or maintenance of new equipments), and risks of production or information processes dysfunctions in case of replacement of existing equipment. Another risk of energy-efficiency investments is related to the uncertainty of their outcome, as energy savings and financial savings resulting from these investments are uncertain. **However, although they are mentioned in the litereature, these risks are rarely mentioned by companies as a barrier to energy-efficiency investments**[31].

An example of Value-Cost-Risk analysis is given in Figure 9, based on the information given by Kannan and Boie (2002): an energy audit analyses a bakery process lines in the production unit to determine "which amounts of energy were consumed during a reference period and how this energy was used" (Kannan and Boie 2002:948). The audit recommends several energy-saving measures: replacement of the bake ovens, lighting improvement, hot water usage, insulation of pipes, and recalibration of thermostat. These measures could save about 6.5 percent of the total energy bill. The audit does not mention any non-energy

[28] Source: Cooremans, 2011.
[29] There is one value proposition for each customer segment. Therefore a company serving only one customer segment will have only one value proposition.
[30] See Step 1.1
[31] See Cooremans, 2012.

benefits but, based on the description given by Kannan and Boie (2002), we can hypothesize the following NEBs of the energy-saving measures described: increased product quality and reliability (due to a better heating quality of the new ovens), increased throughput[32] and productivity (thanks to a shorter preheating time of the ovens) and increased workplace comfort and safety (due to better oven and pipe insulation). Increased comfort encourages higher employee productivity and loyalty. Increased work safety reduces the risk of accidents, which in turn may reduce insurance premiums. CO2 emissions are reduced as well, together with possible legal and commercial risk. If adopted, energy performance measures would thus significantly contribute to the three dimensions of the bakery's competitive advantage: increased value (better product quality and reliability), reduced costs (higher productivity of ovens and employees, reduced product loss, reduced insurance premiums and maintenance cost), and reduced risks (increased workplace safety). Better product quality and reliability may be a source of higher sales.

Figure 12 shows the contribution of MBs to the bakery's competitive advantage. It also shows how the three dimensions of competitive advantage are linked. For instance, reduction of the accident risk leads to a cost reduction, a better product quality leads not only to additional sales but also to lower product loss.

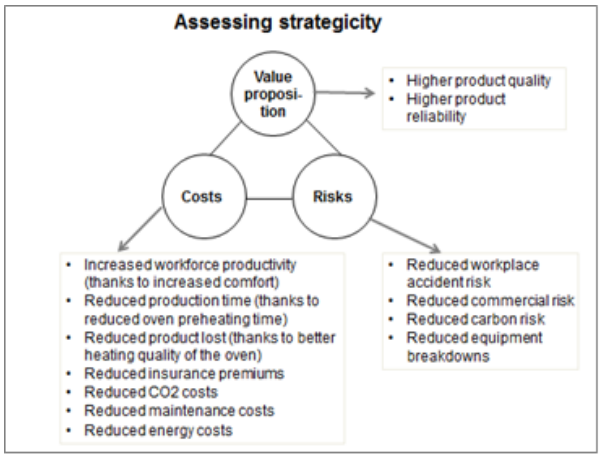


Figure 12 – Multiple benefits of EEMs in a bakery and their contribution to competitive advantage

Strategicity analysis is a good basis to start a financial assessment, because its three components can have impacts on investment profitability: risk reduction translates into additional turnover or reduced costs; improved value proposition would translate into additional turnover to improve long-term profitability together with cost reduction.

To get ready for the financial analysis, it is necessary to go deeper into the strategic analysis, by identifying, for each benefit identified: what indicator, can be chosen to evaluate the non-energy impacts of an energy-efficiency measure; what is the type of data (qualitative or quantitative) and its source in the company (i.e. the responsible department or person). This sub-step of the analysis is very important since it enables to put figures on the various benefits identified for each measure.

As already emphasized[33]that monetary figures have to be hypothesized as it is the case for any investment project, since, by definition, an investment project takes place in the future and future is uncertain. Putting monetary figures on an investment projects is often a difficult task for any type of investment, not only for energy-efficiency investments. However, relevant figures and information most often exist and hypotheses can be reasonable and solid.

Resources: the **M-BENEFITS CHECK-LIST** Excel spreadsheet help you identify the benefits of each EEM identified during Step 2 and categorize in Value-Cost-Risk terms. The

[32] Throughput is the quantity produced by unit of time.
[33] See the section Data quality, p. 8.

Check-List also gives you suggestions of indicators which can be used to measure the benefits and value them in monetary terms, as well as a list of generic companies' department sources of data. In the **DATA** spreadsheet you can indicate the data collected.

Tips, questions & answers for energy experts applying M-Benefits methodology:

- Energy and process people work in collaboration in Step 3.
- Make the strategic analysis along the following steps:
  - ✓ Identify the multiple benefits associated to each EEM.
  - ✓ Determine their contribution to Operational Excellence
  - ✓ Determine their contribution to Value Proposition increase, Cost decrease and Risk decrease.
  - ✓ Determine the corresponding indicators and where, in the company, the quantitative information is available.
- **Indicate in EXCEL CASE STUDY ANALYSIS, sheets 3.1 and 3.2 the results of your analysis for each EEM: multiple benefits and their corresponding data, when possible withmonetary figures.**

Step 4 – Financial analysis

- **Goal of step 4**: 1) **evaluate** the financial flows of the EEMs selected; 2) **calculate** their profitability (Net Present Value, NPV, and Internal Rate of Return, IRR) and Payback.
- **Why:** although profitability is secondary in companies' choices (as opposed to strategicity), it must be calculated and communicated, as well as the Payback.
- **Tools for the analysis:**
  - ✓ Standard Finance theory evaluation tools.
- **Resources: Financial assessment spreadsheet – doc EXCEL RESOURCES – sheet 4.**

Step 3 - Strategic analysis has selected the EEMs to be included in the energy-efficiency project and has valued them, when possible, in monetary terms (i.e. in € or other currencies). They now have to be evaluated in financial terms. Concretely this means collecting all EEMs monetary values evaluated during Step 3 and translate them in a financial calculation.

Financial calculation consists of two steps: 1) collecting all monetary values and include them in the financial spreadsheet to evaluate the investment flows; 2) calculating the profitability (Net Present Value, NPV; Internal Rate of Return, IRR) of the investment flows as well as the payback[34]

Put figures collected during Step 3 in doc EXCEL CASE STUDY ANALYSIS, sheet 4, financial assessment spreadsheet (NPV, IRR and Payback will be automatically calculated by Excel).

[34]The payback does not indicate a profitability but the time frame necessary to get the initial investment spending (Capex) back, which means to realize an operation with no gain.

Step 5 – Synthesis and conclusions

Steps 5 consists of summarizing the analytical results of Step 1-4 in a mode appealing to the technical functions (i.e the energy benefits of the EEMs selected) but also to any business management language: production & operations; strategy; finance.To facilitate the presentation of the results and of a convincing business case, a **resource**, the presentationTEMPLATE, is proposed by the toolkit.

Milestones

As described in the previous section, the Multiple Benefits methodology includes five steps.

Each step concludes on a milestone, which is necessary to start the next step. We summarize again below the Analytical Steps and their corresponding Milestones:

- **Step 1: company's analysis - Business model & decision-making context**

→ **Milestone 1: kick-off meeting**

The kick-off meeting brings together the top management of the company (if possible, the CEO together with the operations, marketing and sales, strategy and finance managers) and the energy people. The kick-off meeting gives the opportunity to the energy people to get in contact with the company's managers, to make the energy-efficiency project visible to them, to describe its goals and probable advantages. The meeting represents an early opportunity to create support within the company and to open a channel of communication with managers, which will be important, for all the duration of the project, to obtain the necessary information and data regarding the non-energy benefits of EEMs.

- **Step 2: Energy & operational analysis**

→ **Milestone 2: EEMs are identified,**

based on collaboration between energy people and operations people to integrate process, energy services and EEMs mapping.

- **Step 3 – Strategic (Value-Cost-Risk) analysis**

→ **Milestone 3: EEMs categorized and valued in operational, strategic & monetary terms.**

Since financial and organisational resources are limited, not all the EEMs identified deserve to be included in an energy-efficiency project (or maybe they can be the subject of another future investment project). The EEMs identified at the end of Step 2 are analysed to assess their contribution to Operational Excellence and Strategic direction.Based on the results of these analyses the more attractive EEMs are selected.

- **Step 4 – Financial analysis (NPV-IRR-PB)**

→ **Milestone 4: EEMs evaluated in financial terms.**

The EEMs selected at the end of Step 3 are included in a financial spreadsheet to evaluate the investment flows and profitability, as well as the pay-back.

- **Step 5 – Synthesis & conclusions**

→ **Milestone 5: Presentation of the project to the Investment Selection Committee.**

Conclusion

The Toolkit described in this document to identify, categorize and evaluate the Multiple Benefits of energy-efficiency measures, is already fully applicable.

Although the result of a long and in-depth work, involving many discussions and inputs, this is an evolving document: it will be expanded and modified in the future, based on the feedback received from our users, energy experts and practitioners, companies, from eleven European countries. We look forward to their contributions!

References

Ballé, M., Beauvallet, G. (2013). Le management Lean. Pearson France.

Barney, J., 1991. Firm resources and sustained competitive advantage. J. of Management, 17(1), 99-120.

Business Model Canvas (2015). Why and how organizations around the worl adopt it. A field report from Strategizer. https://assets.strategyzer.com/assets/resources/business-model-report-2015.pdf

Caseau, Y. (2011). Processus et entreprise 2.0. Innover par la collaboration et le *lean* management. Dunod, Paris.

Cooremans, C., 2015. Competitiveness of energy-efficiency: a conceptual framework. In Proceedings of the 2015 Summer Study, 123-131. European Council for an Energy Efficient Economy.

Cooremans, C., 2012. Investment in energy-efficiency: do the characteristics of investments matter? Energy Efficiency 5, 497-518.

Cooremans, C., 2011. Make it strategic! Financial investment logic is not enough, Energy Efficiency 4(4), 473-492.

George, M.L., Rowlands, D., Price, M., Maxey, J., 2005. Lean Six Sigma Pocket Tool Box, Mc Graw-Hill, New-York.

Kottler P. 1999. Kotler on marketing. How to create, win and dominate markets. Free Press: New York.

Langley, A., Mintzberg, H., Pitcher, P., Posada, E., & Saint-Macary, J. 1995. Opening up decision making: The view from the black stool. Organization Science, 6(3): 260-279.

Livian, Y.-F. (2000). Introduction à l'analyse des organisations (2ème éd.). Economica, Paris.

Mintzberg, H., Raisinghani, D., & Theoret, A. 1976. The structure of 'unstructured' decision processes. Administrative Science Quarterly, 21(2): 246- 275.

Osterwalder A., Pigneur, Y. (2011). Business Model Nouvelle Génération. Pearson, Paris.

Porter, M.E., 1985. Competitive advantage, Free Press, New York.

Redman, T.C., 2008. Data Driven: Profiting from Your Most Important Business Asset, Harvard Business Press, Boston (MA).

Shaffie, S. et Shahbazi, S. (2012). Lean Six Sigma. The McGraw-Hill 36-Hour Course. McGraw-Hill, New-York.

Schneider, S. C., & Barsoux J.-L. 2003. Managing across cultures (2nd ed.). Prentice Hall, London.

Multiple benefits of energy efficiency

M-BENEFITS Toolkit

to identify, categorize, evaluate and quantify the MBs of energy-efficiency projects

Course material & summary of the User Manual

Multiple benefits of energy efficiency

To successfully evaluate the multiple benefits of energy-efficiency projects, M-Benefits methodology **needs**:

4 key resources

- Communication
- Top management support
- Data quality
- Timing

Key resources to the analytical process:

1. Communication

between energy experts and professionals of other functions inside companies in order to:

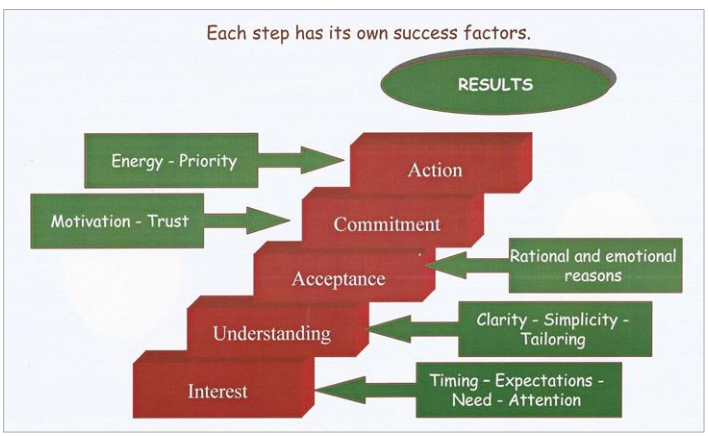
- connect the 5 steps of the analysis
- bridge different groups of people and professional cultures
- create opportunities to develop internal support for EEMs

Multiple benefits of energy efficiency
Project Level Analysis – Cross-cutting resources

Key resources to the analytical process:

2. Management support:

- Linked to strategic character of a project.
- Interest is not the same in every department.
- Support needs time and communication to grow



The impact ladder of good communication. Source: Klaus, R. (2001), Heinz Goldmann Foundation.

Key resources to the analytical process:

3. Data quality:

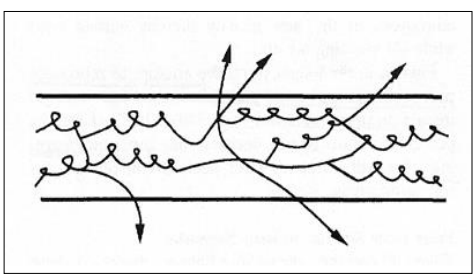
- Concerns qualitative or quantitative variables
- Data quality is defined by: accuracy; completeness; reliability; relevance; conformity (adherence to a standard format); consistency (lack of conflict with other data values).
- Data are (most often) available: you just need to find their owner (source).
- Collecting data gives energy experts opportunities to exchange with other professionals in companies, to exchange and gain trust, to create internal contacts and support.

Multiple benefits of energy efficiency
Project Level Analysis – Cross-cutting resources

Key resources to the analytical process:

4. Timing:

- Projects or decisions are not isolated in companies, issues are linked.
- Projects are in competition one to each other.
- Allocating resources to an issue may affect the amount of resources available to others.
- Issues may come too late or too early in relation to others, or one issue dominates (ex. Digitalization).
- Companies' procedures may impose timing (ex. renovation periodicity).



Organizational decision-making driven by Linkages (Source: Langley et al., 1995:275).

Multiple benefits of energy efficiency

The M-Benefits methodology in summary – 2

To evaluate the multiple benefits of energy-efficiency projects,
M-Benefits methodology includes:

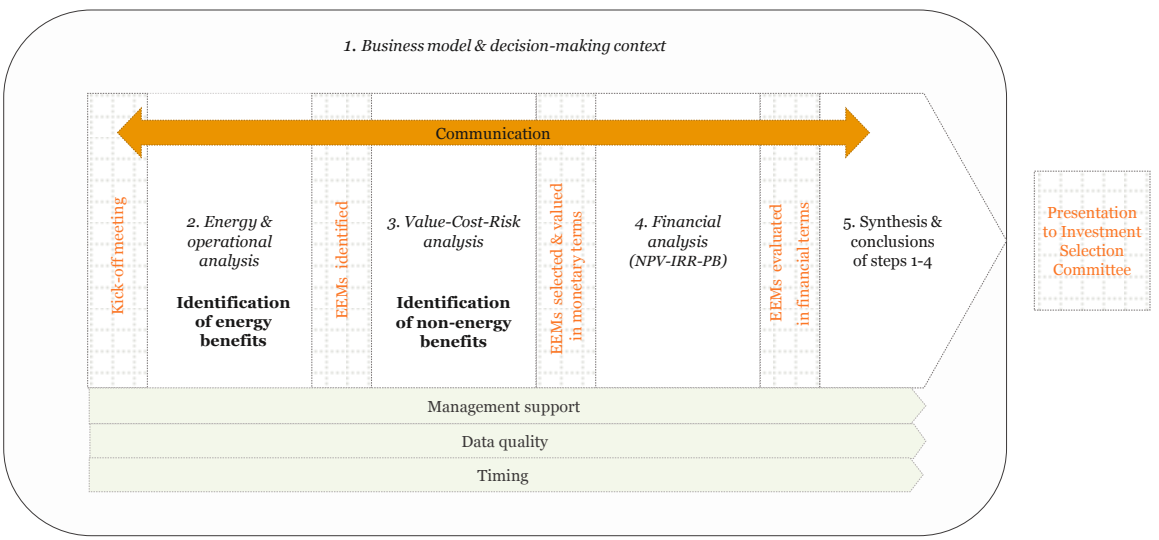
5 successive analytical steps & milestones:

- STEP 1 – Business model & decision-making context
  → M1 - Kick-off meeting
- STEP 2 – Energy & operational analysis
  → M2 - Energy-efficiency measures (EEMs) identified
- STEP 3 – Value-Cost-Risk analysis
  → M3 - EEMs categorized and valued in strategic & monetary terms
- STEP 4 – Financial analysis (NPV-IRR-PB)
  → M4 - EEMs evaluated in financial terms
- STEP 5 – Synthesis & conclusions
  → M5 - Presentation of the project to the Investment Selection Committee

7

Multiple benefits of energy efficiency

The M-Benefits road map



8

Step 1 – Company analysis

- Goal of step 1: improve knowledge of the company.
- Why: know your customers to conceive a project customized to their interests and needs.
- Tools for the analysis:
  - ✓ The business model canvas: describes a business model in 9 basic building blocks.
  - ✓ The decision-making model: describes in 4 categories the drivers of companies' investment decision-making.

9

Step 1.1 – Business model analysis

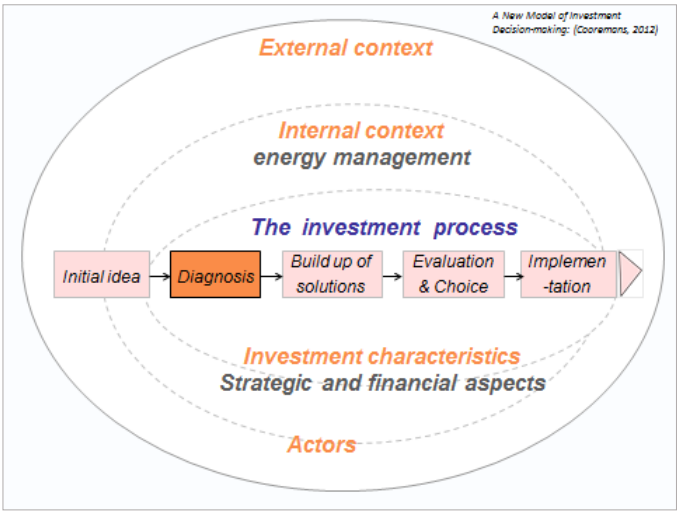
- 5 out of the 9 Canvas blocks to be analysed:
  - ✓ Value proposition
  - ✓ Key resources
  - ✓ Key activities
  - ✓ Cost structure
  - ✓ Revenues structure
- Data needed from the company (or from its website).
- Confidential details not to be addressed!
- Focus: concentrate on the important issues but do not make a detailed strategy analysis.

10

Step 1.2 - Decision-making drivers

4 types of factors influencing investment decision-making to be analysed:

- External context
- Internal context
- Actors involved
- Investment characteristics



11

Multiple benefits of energy efficiency
Step 1.2 - Company Level Analysis

Step 1.2 – Decision-making drivers

Tips, questions & answers for energy experts applying M-Benefits methodology:

- Go to the website or ask people you know inside the company. Try to get the flow chart.
- What could be the key persons influencing the decision-making process of your project? How can you get their support?
- What is the company strategy (and/or vision)?
- How would you evaluate the external context of the company: is competition high? Are technological innovation, legislation or customer tastes moving fast?

Submit the decision-making questionnaire (doc Excel RESOURCES - sheet 1) to the company's management.

Indicate the company's answers to the questionnaire in doc EXCEL CASE STUDY ANALYSIS – sheet 1.

12

Milestone 1:

Kick-off meeting:

- Gathers (when possible) top management (CEO, production, marketing & sales, finance) and energy experts (energy manager and energy auditor) to discuss the scope and goals of the project and its probable advantages.
- Gives the opportunity to the energy experts to get in contact with the company's managers, to make the energy-efficiency project visible to them, and to develop support.

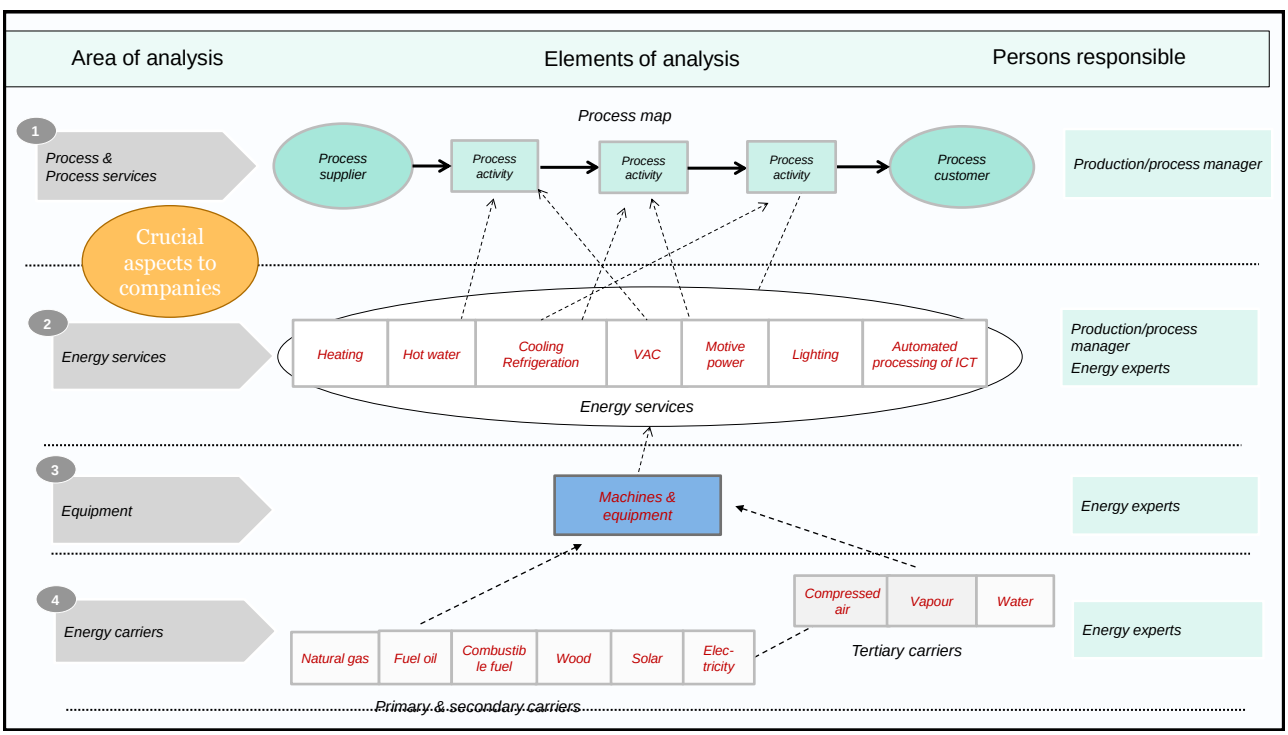
Step 2 – Energy and operational analysis

- Goal of step 2: identify EEMs capable to secure or improve the company's processes and to decrease its relative energy consumption, in a clearly predefined boundary (i.e. industrial installation; building; process, etc.).
- Why: contribution to process and operational excellence is key to investment decision-making; energy consumption reduction is not appealing to the top management of (most) companies.
- Tools for the analysis:
  - ✓ Energy audit
  - ✓ Process map: describes the various steps of a process
  - ✓ Energy services & process map: describes energy services contributing to process and what are their constraints and risks.

Step 2

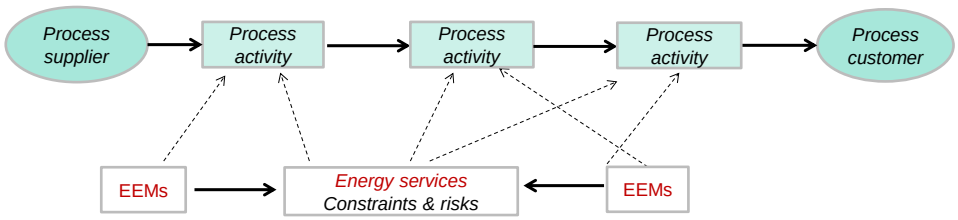
ENERGY-OPERATIONAL ANALYSIS (in the pre-defined boundary):

- Energy analysis (audit): energy carriers and consumption; baseline and indicators
- Process analysis:
  - ✓ Process = a sequence of operations connected to each other, producing (or reproducing) results.
  - ✓ process mapping + identifying key elements of operational excellence (safety – quality – cost – time-to-market)
- Energy services: contribution to operational excellence



ENERGY-OPERATIONAL ANALYSIS
(in pre-defined boundary):

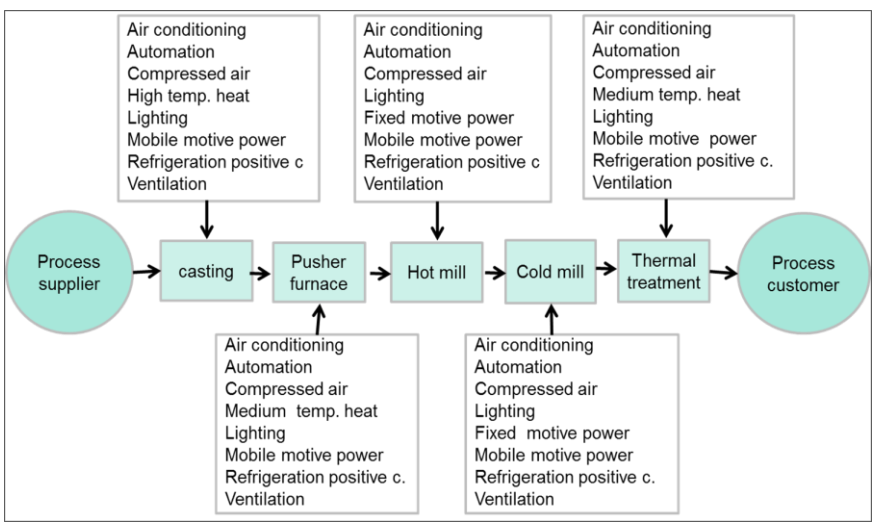
- Location of each EEM identified on the process(es) investigated
- Location of the EEMs identified in process(es) steps and substeps
- Analysis of EEMs contribution to energy services quality and reliability and therefore to process quality and reliability



Energy services contributing to process are the common ground where process people and energy people can meet for a fruitful collaboration!

17

Example: Aluminium foil production process map and energy services



18

Milestone 2:

Relevant energy-efficiency measures (EEMs) are identified

Step 3

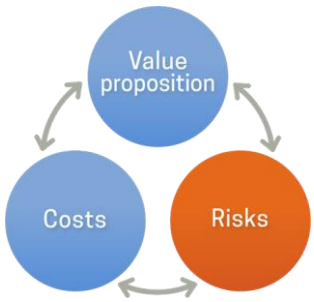
- Goal of step 3 - for each EEM: 1) Determine the non-energy benefits of each EEM identified during Step 3. 2) Categorize them in strategic terms, i.e. analyse their contribution to risk reduction, value proposition increase and cost reduction. 3) Select the EEMs which best contribute to operational excellence, energy consumption reduction and competitive advantage. 4) Define relevant data and indicators. 5) Collect data (in various company's departments. 6) Value EEMs selected in monetary terms.
- Why: contribution of an investment to core business and competitive advantage is a key decision-making driver; energy consumption is not appealing to the top management of (most) companies.
- Tools for the analysis:
  - ✓ Risk-Value-Cost model
  - ✓ Indicators & data definition/collection model

Resources: CHECK-LIST MBs, general + for each energy service and major corresponding EEMs

Step 3

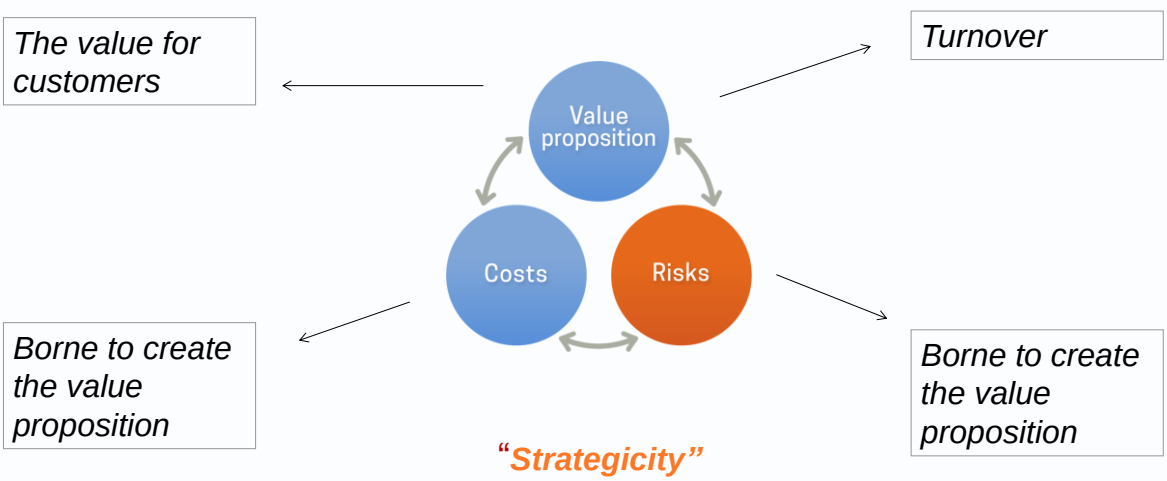
VALUE-COST-RISK (STRATEGIC) ANALYSIS
for each EEM:

- **Identification of the non-energy benefits**
- MBs Check-List in DOC Excel RESOURCE
- Analysis of benefits contribution to :
  - Risk reduction
  - Value proposition increase
  - Cost reduction
- Definition of relevant data and indicators enabling to **value multiple benefits**
- Data collection (in the various company's departments identified as sources of the data)



21

The 3 dimensions of competitive advantage



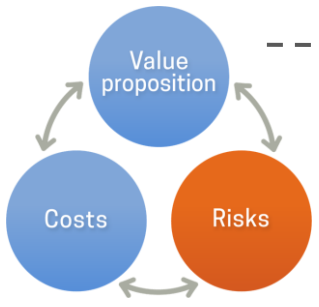
"Strategicity"

Multiple benefits of energy efficiency

Step 3 - Project Level Analysis

EXAMPLE OF VALUE-COST-RISK ANALYSIS

(Oven replacement in industrial bakery)



- Higher product quality
- Higher product reliability

- Reduced workplace accident risk
- Reduced commercial risk
- Reduced carbon risk
- Reduced equipment breakdown

- Increased workforce productivity (thanks to increased comfort)
- Reduced production time (thanks to reduced oven preheating time
- Reduced production loss (better oven heat quality)
- Reduced CO2 costs
- Reduced maintenance costs
- Reduced energy costs

23

Multiple benefits of energy efficiency

Milestones

Milestone 3:

Energy-efficiency measures (EEMs) selected and valued in monetary terms including energy benefits and non-energy benefits

24

Step 4

FINANCIAL ANALYSIS

for each EEM (or group of EEMs):

- Evaluation of investment flows.
- Selection criteria: discount rate and investment duration.
- Financial results: Net Present Value (NPV) – Internal Rate of Return (IRR) – Payback time.

Milestone 4:

Energy-efficiency measures (EEMs) valued in financial terms

Step 5

SYNTHESIS & CONCLUSIONS

Description of :

- The EEMs selected in the energy-efficiency project.
- Energy-operational, strategic and financial impacts (positive and negative) of their implementation
- Customized to the various interests and schemes of companies departments

Milestone 5:

Presentation of the energy-efficiency project to the Investment Selection Committee