Investment in Energy Efficiency by Large-Scale Consumers: an innovative audit programme

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Keywords

policy instruments, audit programme, investment decision-making, strategic decision-making, energy-saving behaviours, organisation behaviour, market barriers, auditor tool

Abstract

In real life, firms do not make their investment decisions based only on investment profitability. Investment decision making is the result of a dynamic decision-making process influenced by (1) organizational and external contexts (2) actors involved, and (3) characteristics of the investment. Among investment characteristics, its strategic character is a key factor influencing decision-making. An investment is strategic if it contributes to improve a firm's value proposal, and/or reduces its costs and risks (Cooremans, 2011, 2012a).

On May 25 2011, Switzerland decided to phase out nuclear power on a step-by-step basis and to build up a sustainable energy system. Energy efficiency is a key driver of this system. Large-scale consumers[1] represent an important target for energy efficiency as they consume about 25 % of total Swiss electricity consumption.

Within this context, the Swiss canton of Vaud is about to launch an ambitious audit program aiming at decreasing energy consumption of its 600 large-scale consumers. The Canton of Vaud decided to innovate by complementing the usual technical-economic audit assessment with a new audit tool. Based on the conceptual framework described above, this new tool consists of an assessment of non-economic factors influencing energy-efficiency decision-making and of strategic aspects of energy-efficiency measures (EEMs) for audited companies. It will take the form of a questionnaire submitted to top executives of the audited companies, during a meeting, at the pre-audit stage. A reference manual will explain how to interpret the answers.

The goal of the paper is to describe the new audit program, as well as the new audit tool,[2] which will help auditors improve their evaluation and reporting, and will therefore increase the program's success.

Introduction

Improving Energy efficiency is a privileged tool of public policies aiming at reducing energy consumption. In its "Energy Perspectives for 2035/2050" (2007), the Swiss Federal Office of Energy (SFOE) gives an "absolute priority to a more efficient use of energy."

One goal of energy public policies is to reduce the energy-efficiency gap, *i.e.* the potential of profitable energy-efficiency improvement, which was estimated to be around 30 % of energy use in the tertiary sector and around 25 % of energy use in manufacturing industry (Commission of the EU, 2006). "Despite extensive attention given to energy efficiency, research states that a majority of available cost-efficient energy efficiency improvement measures are not implemented due to the existence of various barriers to energy efficiency, in particular information-related barriers" (Thollander *et al.,* 2012:659).

1. *I.e.* sites consuming more than 0.5 GWh of electrical energy and/or 5 GWh of thermal energy.

2. As the researcher having developed the conceptual framework described above, I was commissioned by the Canton of Vaud to develop the questionnaire and reference manual composing the new audit tool.

The most formalized method used to identify the energy-efficiency improvement potential is the energy audit,[3] a common tool for public programs aiming at improving energy performance. The energy audit enables identification of the potential of energy performance improvement of a building, production installation or equipment, which is expressed in terms of physical and financial energy savings. It generally follows a three-step process: 1) the pre-audit (or pre-diagnosis) lists base characteristics of the object analyzed and states its energy consumption; 2) the preliminary audit (which lasts anywhere from a few days to a few weeks) identifies the sources of energy performance improvement and their approximate cost; 3) the in-depth audit (which lasts a few months to one year) thoroughly analyses the most relevant energy-efficiency measures (EEMs).

Public programs promoting energy efficiency partially or fully subsidize audits, based on the idea that economic agents, informed by the audit of the existence of profitable potential energy savings, will implement the corresponding energy-efficiency measures. Audits are based on the neo-classical economic theory assumption stating that economic agents, in particular profit-seeking companies, behave in an economically rational way. Consequently, they will not miss an opportunity to increase their profit. A logical consequence of the importance given to information in economic choices is the idea that increasing information leads to improving the adoption rate of energy-efficient technologies.

In fact, audits reveal significant energy efficiency potentials (Fleiter *et al*., 2012). Research shows that interesting investment opportunities are identified by audits, with pay-back time under two or three years, or even under one year. It is difficult to assess the success of audits (measured in terms of the ratio between EEMs recommended and EEMs implemented, or by the percentage of energy savings). In fact, figures vary widely and are difficult to compare because of a lack of details regarding the profitability of EEMs and the criteria by which this profitability is assessed, as well as regarding characteristics of the audited companies. However one can consider the average amount of the adoption of EEMs to be around 40 to 50 %, which takes into account not only the adopted measures but also the planned measures (*i.e.* measures decided but not yet implemented)[4] (Anderson and Newell, 2004; Fleiter, *et al*., 2012; Gruber and Schleich, 2008; Gruber, *et al*., 2011; Sæle, *et al*., 2005; Schleich, 2009; Thollander, 2007). When only implemented measures are taken into account, EEM adoption figures are lower. But planned measures have to be taken cautiously. Sæle, *et al.* (2005), for example, show that half of the forty companies participating in the audit program they studied decided to implement EEMs identified by audits, whereas two years later, seven companies out of the twenty having decided to implement EEMs had not yet undertaken the decided investments. The impact of the Geneva program (NOE,[5] 2004–2011, see next section below) was estimated on the basis of the percentage of energy savings achieved,[6] with the following results: electricity savings decided and partially implemented represent 35.6 % of the identified savings. Thermal energy savings already decided and partially implemented represent 26.7 % of the identified savings (Balma and Gaumann, 2012).

Audits success could often be improved. Two broad reasons may explain why profitable energy-efficiency measures identified by audits are not implemented by organizations: the first one is the energy-efficiency barriers,[7] the second one is the quality of audits themselves.

By improving quality of audits, audit programs' cost can be decreased and their success increased. Increasing success is the goal of the innovative audit program which is about to start in the Swiss Canton of Vaud to improve the energy performance of sites which consume more than 0.5 electric GWh per year and/or more than 5 thermal GWh per year.

The aim of this paper is to describe this audit program, which will last a minimum of four years. The program is innovative in two ways: firstly because it develops a new standardized audit tool for the auditors; secondly, because it intends to overcome barriers to energy efficiency by taking them into account *ex-ante*, *i.e.* at the pre-audit stage, or the very beginning of the process.

The rest of the paper is organized in the following way: the first section describes the Geneva precursor, legal context and main characteristics of the Canton of Vaud audit program; the second section describes the conceptual framework underlying the new auditor tool; the third section describes the tool itself, which will take the form of a questionnaire on "Non-economic factors influencing EEM decision-making." The conclusion will briefly discuss the usefulness of the new methodology.

Canton de Vaud audit programme

A PRECURSOR: NOE

The first program of subsidized audits for large-scale consumers in French-speaking Switzerland is the Geneva program NOE (for New Offer of Electricity), which took place between 2004 and 2011. The objective of NOE was to reduce electricity consumption of sites consuming more than 1 GWh of electricity per year. This level of consumption concerns industrial sites and important public sites such as the canton/state hospital or the airport, as well as different types of administrative or commercial buildings (chain stores, parking lots, shopping malls, conference/exhibition centers, offices, university buildings, etc.). The program concerns businesses as well as public services, or international government organizations (UN and

3. Based on SAVE-project AUDIT II, we define an energy audit 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).

4. According to Fleiter, *et al* (2012:726), "the mean average adoption rate of all EEMs in the sample used for the regression is 40 %" to analyze the success of a German energy audit program under a fund specifically established to promote energy efficiency for SME (4,434 SMEs participated in the program). Fleiter, ***et al*** compare this rate to the one of other research by referring to the average adoption rate in Anderson and Newell (2004) which is 53 % including planned EEM. Schleich (2009) and Gruber and Schleich (2008) provide figures on the share of organizations which had adopted (or planned to adopt) at least half of the EEMs considered suitable. This share is around 35 % if only adopted EEMs are considered (Schleich 2009), and around 45 % if planned EEMs are considered as well. Thollander (2007) reports an adoption rate of 22 % and 41 %, respectively.

5. NOE for New Offer of Electricity.

6. Also taking into account the savings identified in companies having left the program along the way.

7. A barrier can be defined as "a postulated mechanism that inhibits investment in technologies that are both energy efficient and (apparently) economically efficient." (Sorrell, *et al*, 2000:11). See section on Conceptual framework, p. 6, for a more detailed description.

others). Companies (majoritarily SMEs or large companies) participating in the program were active in many different industries.

Two-hundred and fifteen applications, totalizing 25 % of the total electricity consumption of the canton, were submitted to benefit from the program. However, nearly half of the applicants abandoned the process along the way or never even really started it (they did not appoint a consultant to perform their audit). For these reasons potential beneficiaries have only partially used the available public subsidies. The hundred applications which were finally effectively treated (of which approximately one-third were industrial sites and two-thirds were tertiary buildings), represent 58 % of the total consumption of the 215 applications originally received and 15.5 % of the total electricity consumption of the Canton of Geneva.

At the end of the program, "electricity savings potential identified amount to 80.4 GWh per year, which represents 14.3 % of the total consumption of the 215 applications received. The already decided and partially implemented savings amount to 35.6 % of the savings potential and to 4 % of the total consumption of 215 applications received. Thermal energy savings (from reduced heating or warm water needs) identified amount to 16.4 % of the total consumption of the 215 applications received.[8]

LEGAL EVOLUTION IN SWITZERLAND

In principle the Swiss legal framework, whether federal or cantonal, favors voluntary commitment to energy-efficiency improvement (or CO_2 emissions reduction). According to the model, a voluntary commitment frees a company from being legally obligated to committing to energy-efficiency improvement.

Large-scale energy consumers – defined by the Swiss energy law as agents whose annual energy consumption is equal or superior to 0.5 electric GWh or 5 thermal GWh – constitute an important percentage of the global energy consumption and present important energy-saving potential. Therefore they are one of the priority targets of government energy-efficiency programs.

Buildings (whether residential, tertiary or industrial) are the physical vector of large consumers' energy consumption. According to the Swiss federal energy law, legal provisions for energy use in buildings fall under cantonal legislation.

According to the last cantonal "model"[9] of energy prescriptions (MoPEC, 2008) developed by the Conference of the Cantons Energy Directors, large consumers have the choice between two types of obligations. Firstly, the conclusion of a voluntary agreement towards the achievement of negotiated objectives, the agreement being based on the conclusions of an audit. Secondly, commitment to conducting an analysis of their energy consumption (*i.e.* an audit). Based on the audit conclusions, EEMs matching pre-defined profitability criteria have to be implemented by large consumers within a required time. Criteria defining which measures have to be implemented and the time allowed for their implementation vary from one canton to another.

CHARACTERISTICS OF CANTON DE VAUD AUDIT PROGRAM

In January 2012, the government of the Canton of Vaud approved an energy audit program for the large consumers of the canton, estimated to be around 600. The program aims at "encouraging the agents concerned to undertake actions to optimize their consumption while improving their competitiveness."[10]

The program will last at least four years, from spring 2013 to December 2016, following the usual three-step methodology: pre-audit (or pre-diagnosis), preliminary audit, and in-depth audit. The rate of financial support decreases progressively throughout the process. The audited organization is not obliged to hire the same accredited consulting company throughout the three steps.

Audits are subject to precise specifications at every stage of the evaluation, which means that pre-diagnosis professionals and auditors will have to use templates for calculations and reports. In order to do so, they will be assisted by reference documents and evaluation tools, supplied by the program administrator: checklists, a report model, a model of economic evaluation of EEMs, and a model of valuation of the non-economic aspects influencing EEMs decisions. The valuation method for the non-economic factors influencing decisions is described in more detail in the following pages.

Training, in the form of a two-day course, is also planned to allow the professionals performing pre-audits and audits to become accustomed to these tools.

An innovative auditor tool

A public audit program generally comprises twelve basic elements, which have to be judiciously defined and interconnected. As described in the Guidebook for Energy Audit Programme Developers (Vaisänen, 2003), these elements are the following: program goals, legislative framework, promotion and marketing, subsidy policy, key players, structure of administration, monitoring and evaluation, energy audit models, training of energy auditors, authorization of energy auditors, quality control, and auditor tools.

Auditor tools vary from "printed marketing material to software for calculations and published key figures for rough first estimates on the level of energy" (idem, p. 19). As noted by Thollander, *et al.* (2012), in spite of the fact that energy audits and energy audit programs are one of the most widespread instruments to overcome barriers to energy efficiency and promoting energy efficiency in businesses, there is a lack of a standardized tool to conduct the actual energy audit.

The auditor tools used or proposed until now reflect the dominant technical logic of audits. This is also the case of the European standard[11] recently adopted (in July 2012). Article 5.1.b of this new standard represents an exception to this dominantly technical approach by requiring the auditor, at the preliminary contact, to request information about several elements which are of a contextual type. These elements (listed in paragraph 1 to 6 of art. 5.1.b) are the following: energy audit context; regulatory constraints; strategic wider program;

8. All figures are official ones (Balma and Gaumann, 2012).

9. It is a "model" because each canton has to incorporate its clauses in its own legislation.

10. http://www.vd.ch/themes/environnement/energie/politique-energetique/action-100-millions/

11. EN 16247-1 Energy audits – General requirement.

management system; "changes that may have a bearing on the energy audit and its conclusions"[12] and "any existing opinions; ideas and restrictions relating to potential energy efficiency improvement measures."[13] These non-technical elements could, one way or another, affect the scope, the process, or the results of the energy audit.

The new tool which will be used by the Canton of Vaud program enlarges the traditional technical audit approach by taking into account, at the very beginning of the audit process (*i.e.* at the pre-audit stage), decisional factors which are likely to influence energy-efficiency investment (or EEMs) decision-making. One main goal is to identify strategic benefits of energy-efficiency improvement measures, which can play an important positive role in their adoption. This should improve the audit's ultimate result, *i.e.* the energy savings reached.

The new tool takes the form of a questionnaire which aims at assessing the non-economic factors hindering and fostering EEMs and the adoption of energy-efficiency investments in the audited organizations. Most of the non-technical elements of the new European audit standard listed above are included in the analysis. A reference manual explains how to interpret and use the answers.

The questionnaire will be submitted at the pre-audit stage in an in-person meeting with the organization's top executives (when possible, Chief Executive Officer, Chief Financial Officer, Production manager, etc.) and the person in charge of energy issues. This meeting will also offer a precious opportunity to enter into a direct relationship with powerful actors of the audited organization and to raise their interest on the various aspects of energy use and performance.

The underlying conceptual framework and the questionnaire are presented in the next two sections.

CONCEPTUAL FRAMEWORK: INVESTMENT DECISION-MAKING IN ORGANIZATIONS

"A barrier is a postulated mechanism that inhibits investment in technologies that are both energy efficient and (apparently) economically efficient" (Sorrell, *et al.*, 2000:11). The concept of barrier was originally proposed, almost thirty-five years ago by Blumstein, *et al.* (1980). In the following decades, a great amount of literature enriched the subject and the list of barriers lengthened over the years, whether external (market barriers) or internal (organizational or individual barriers) to an organization.

Reflecting the dominant neo-classical economics perspective on energy-efficiency investments, the most important barriers identified by the literature are lack of capital, hidden costs, and transaction costs. More recently, new typologies (Cagno, *et al.*, 2012) and a new conceptual framework (Cooremans, 2012a) were proposed in order to better take into account other factors identified as playing an important role in decisions regarding energy-efficiency investments and EEMs. Factors most frequently cited in the literature include corporate culture, power relationships, interests and skills of managers, level of energy management, and investment characteristics. The large number of factors identified as influencing energy-efficiency investment decisions *ipso facto* reduces the relative weight of economic factors on these decisions. Evaluation tools and financial factors often play a secondary role in the capital investment decision-making process, in spite of their extensive use (Cooremans, 2011).

Based on an extensive exploration of the decision-making and organizational finance literature and on my own empirical research, I have proposed a model of investment decision-making (described in more details in Cooremans, 2012a), which explains which factors play a role – and how they do so – in investment decision-making. This model takes into account most of the barriers described in the energy-efficiency literature but these are translated into a different conceptual framework. I have designed the diagram in Figure 1 to represent the model of investment decision-making in organizations.

According to the model, investment decision-making is the result of a complex decision-making process. This process is influenced by 1) organizational and external contexts; 2) actors involved; 3) characteristics of the investment and of the investment decision to be made. Among investment characteristics, its strategic character is a key factor influencing decision-making. But strategic character is not given, it is interpreted by actors[14] and by organizations, due to the action of several filters. The elements influencing investment decision-making are briefly developed in the following paragraphs.

Decision-making, a process with a crucial first phase: diagnosis

A decision must be considered not a point in time but a step in a decision-making process, defined as a dynamic chain of actions and events. The decision-making process comprises three phases: identification (diagnosis), development (build-up and development of solutions), and selection (evaluation of the different solutions and choices).

At the very beginning of the decision-making process, the diagnostic phase is crucial, firstly because it launches the decision-making process (by transforming undefined data into decisional events); secondly, because it orients the subsequent phases of development and choice. Diagnosis is influenced by organizational and individual filters. Management systems (such as, for instance, the energy management system), are elements of organizational context.

Decision-making: a process influenced by organizational and external contexts

Organizational context and external context influence all phases of the decision-making process. Organizational context comprises structure, strategy and culture of an organization; external context refers to the organization's environment. Main external context components are competition moves, the state of the general economy or of the business sector, legislation, technology developments, and social evolutions. However, an organization's environment is not given; rather, it is interpreted and assembled, or in other words "built" by actors' visions and by organizational filters (corporate culture, routines, and control systems).

12. EN 16247-1:2012 (E). Art. 5.1.b.5.

13. EN 16247-1:2012 (E). Art. 5.1.b.6.

14. In the field of organization behavior, "actors" mean individuals and groups.

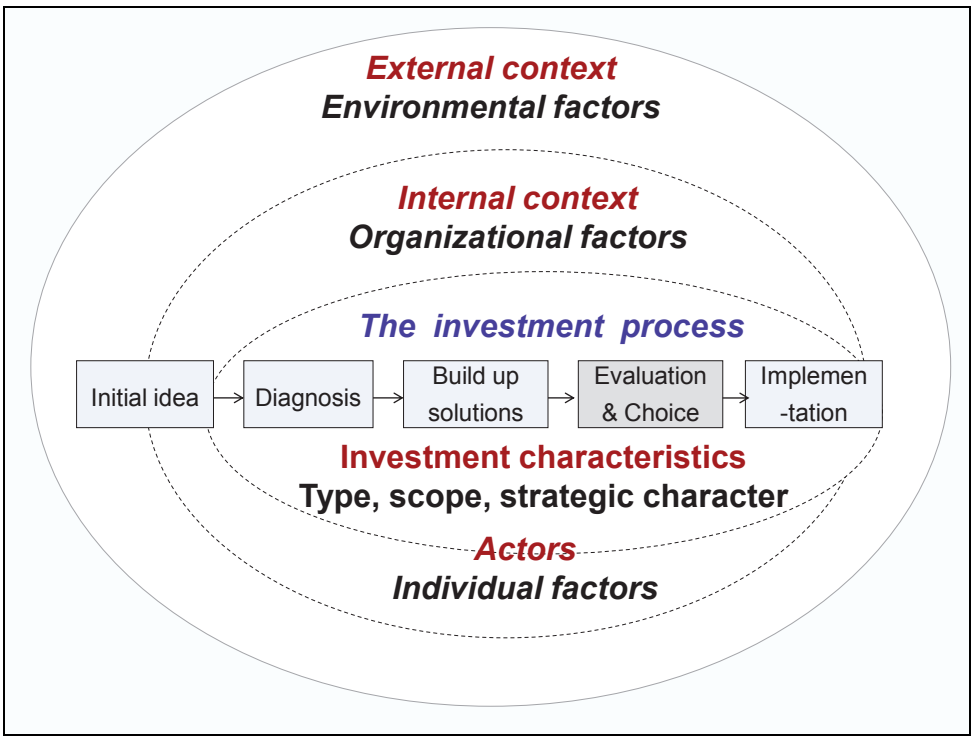

Figure 1 – A new model of investment decision-making (Cooremans, 2012a)

Organizational context influences the way managers interpret their environment by filtering information (Daft and Weick, 1984; Dutton et Jackson, 1983; Kuvaas and Kaufmann, 2004) and by creating incentives to interpret information in a certain way (Denison, *et al.;* 1996; Thomas and Daniel, 1990; Thomas *et al.*, 1994). Managers are influenced by organizational context but they also influence it themselves through their decisions.

As components of organizational context, strategy, structure and culture are powerful organizational filters. Being at the same time elements of organization structure and "artifacts of corporate culture" (Schein, 2004), management systems play an important role in attributing meaning to information during diagnosis.[15] They influence the start and, as a consequence, the process of an investment project by determining at which organizational level investment projects must be initiated, based on categorizations and financial evaluation tools, as well as budgetary autonomy.

Decision-making: a process influenced by actors' power

The actors involved influence the course of the decision-making process and its result.[16] Decision-making is political because organizations are political systems, *i.e.* they are collectives of people with competing interests. In any organization, a dominant coalition (Prahalad & Bettis, 1986), or a "key collection of individuals" made up of top management, has a significant influence on the way a firm is managed. According to Miller, Hickson & Wilson (1996: 301) the dominant coalition is composed of three heavyweight functions: production (or its equivalent in services companies), marketing and sales, and finance. Heavyweight functions are closely associated with core business. Together with the CEO, this coalition imposes its choices upon the organization.

Decision-making: a process influenced by investment characteristics

In every organization, there is some competition between issues for financial and human[17] resources (Langley, *et al.*, 1995) and investment projects compete with each other (Ross, 1986).

Characteristics of investments do influence the outcome of this organizational competition. Investment characteristics are numerous and diverse. Examples of characteristics are: investments' importance to the organization; their complexity, and the level of organizational change they entail; the number of actors involved and the 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, human resources, etc.) or according to their strategic character or nature. Research findings demonstrate that the strategic character of investment plays an important role in the competition for resources[18] and is more influential than profitability in corporate investment choices. Investment profitability appears as a generally necessary but insufficient condition.

15. These aspects have been theorized by the field of SID (Strategic Issue Diagnosis).

16. Decision-making process result is a negative, positive, or no-decision.

17. Human resources have to be understood here mainly as the time and energy of powerful managers.

18. See Cooremans (2011) for a review of two streams of literature (decision-making research and "alternative" literature on energy-efficiency investments) mentioning the role of investment strategic character on investment decision-making.

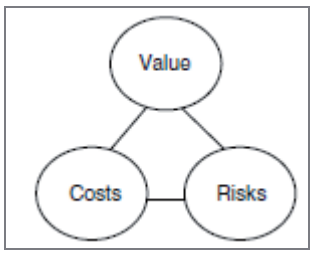

Figure 2. The three dimensions of competivive advantage (Cooremans, 2011:486).

Strategic character of an investment – or "strategicity"[19] – can be defined as the investment's contribution to a firm's competitiveness. Therefore, I will use the following definition: an investment is «strategic if it contributes to create, maintain or develop a sustainable competitive advantage» (Cooremans, 2011:483). Competitive advantage is a three-dimensional concept, formed of three interrelated constituents: value, costs and risks (idem: 486). I have designed Figure 2 to very simply illustrate the three dimensions of competitive advantage.

Two important consequences of an unfavorable diagnosis regarding strategicity are that upper management is not interested in the investment project and that, apparently,[20] more stringent selection criteria—or routines—are applied to low strategic investments. Energy-efficiency investments, when they do exist as an investment category, are generally perceived as weakly strategic by companies. This would explain why many energy-efficiency projects, although highly profitable, are not selected.

QUESTIONNAIRE ON THE "NON-ECONOMIC DRIVERS OF ENERGY-EFFICIENCY MEASURES"

The Questionnaire on the "non-economic drivers of energy-efficiency measures" is based on the conceptual framework synthesized above. It is divided into four parts, one for each of the four broad types of factors influencing EEMs and energy-efficiency investment adoption.[21]

Since the objective of the questionnaire, as an audit tool, is to help auditors' work, it contains only questions whose answers can be translated into practical conclusions, in terms of the audit investigation and reporting. Most of the questions are closed questions, i.e. questions which limit respondents with a list of answer choices from which they must choose. As is common with this type of question, answers are in the form of multiple choice, either with one answer or with check-all-that-apply, or in Likert format, where the respondent rates the situation along a scale continuum (from 1 to 4 in this case).

Nevertheless the interview is semi-directive, which means that closed questions may also develop into additional information enabling the auditor to better know an organization and its core business, and to adapt the investigation and report accordingly.

Energy management level

The first part of the questionnaire aims at assessing the level of energy management in audited companies. As described in the previous section (see previous section on "Conceptual framework"), management systems play an important role in filtering information and events, transforming them into decisional issues, and assessing the type of routines and rules to be applied. Thus, energy management system, a type of management system, can be regarded as a filter which influences organizational diagnosis regarding new energy-efficiency projects at the beginning of the decision-making process.

Energy management acts as a positive filter, as demonstrated by the higher energy performance of organizations with high level of energy management. This can probably be explained by the fact that energy management is a manifestation of the importance of energy for an organization, or of its "energy awareness."[22] Therefore, the higher the energy management system is, the higher the rate of EEMs adoption will probably be.

In order to assess the state of energy management system, we formulated nineteen questions (based on NL Agency "Energy Management Checklist"[23], on the McKane, *et al.,* 2004, framework and on ISO 50001), which compose a simplified audit of energy management in organizations. Fifteen questions out of nineteen are worth one point, and four questions are worth two points because they address some core aspects of energy management (such as a commitment to continuous improvement and the existence of energy performance indicators, or of an energy manager). The maximum score attainable is therefore twenty-two points. Our energy management questionnaire is represented in Table 1.

If, based on the answers to the questionnaire and on the score reached, energy management level appears to be low, suggestions and tools will be proposed to the audited company to improve it.

Internal (organizational) and external contexts of energy audits

Although external context has a high influence on organizations' decision-making, it is quite difficult to deduce guidelines for the auditors from answers to closed questions. For instance, no practical conclusion in terms of energy-efficiency investment could be deduced from an answer saying that "Sustainable development is a highly important issue to our customers." The same can be said of all important aspects of external context.[24] Furthermore, some of these issues are taken into consideration in the "Characteristics of investments" section of the questionnaire. Therefore only some aspects of internal context are considered in the second part of the questionnaire, which is represented in Table 2.

19. For more details on strategy, on strategic character or strategicity, on the components of strategic character, and on the methodology proposed to measure it, please refer to Cooremans (2012a:501–505; 2011:482–486).

20. More research is needed on the link between low strategicity and unfavorable treatment applied to investment.

21. The conceptual framework described in the following pages is taken from Cooremans (2012a:499–501).

22. More research is needed on the relationship between energy management and EEM's adoption.

23. http://www.senternovem.nl/mmfiles/3MJAF04.15%20-%20Energy%20Management%20Checklist%20-%20June%202004_tcm24-122945.pdf

24. Whose main components are competition moves, the state of the general economy or of the business sector, legislation, technology developments, and social evolutions.

Table 1. Evaluation of energy management level (Cooremans, 2012b).

DECISION-MAKING PROCESS			
		Score	Scale
Energy Management level	Energy intensity Which percentage do your energy consumption total costs represent in : - Percentage of your general expenses (%) - Percentage of your turnover (%)	2	2 pts if at least 1 answer
	Did your company make a commitment of a continuous reduction of its energy consumption	2	yes = 2 / no = 0
	Did your company undertake any of the following tasks in relation with energy use : - Evaluation of energy performance (benchmarking) - Definition of baseline - Definition of key performance indicators - Definition of energy policy - Setting of measurable goals regarding energy consumption reduction - Definition and setting of measures to reach the goals defined - Data collection regarding goals achievement	1 1 2 1 1 1 1	yes = 1 / no = 0 yes = 1 / no = 0 yes = 2 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0
	Which ressources have been allocated to energy-efficiency measures implementation : - Human resources (i.e. project team) - Technical resources (i.e. meters) - Electronic resources (i.e. software)	1 1 1	yes = 1 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0
	Energy manager : - Does the company have an energy manager - Does the energy manager perform other functions in your company - If yes, which one	2 0 --	yes = 2 / no = 0 yes = -1 / no = 0
	Does your company establish an internal communication on energy issues	1	yes = 1 / no = 0
	Did your company organize the following systems and procedures in relation with its energy policy: - Training system for staff - Reward system - Monitoring system of the results in goals reaching - Revising goals procedure	1 1 1 1	yes = 1 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0 yes = 1 / no = 0
	TOTAL	22	Maximum score = 22 pts

Table 2. Evaluation of internal context of energy audit.

INTERNAL CONTEXT		Score	Scale
Management systems	**Is your company certified:**		
	- ISO 9001 (quality)		yes = 1 / no = 0
	- ISO 31000 (risks)		yes = 1 / no = 0
	- ISO 50001 (energy management)		yes = 1 / no = 0
	Did the company establish an Environmental Management System (EMS)		yes = 1 / no = 0
	Please rate the influence of the following factors on energy-efficient technologies adoption: (1 = the less important - 4 = the most important)		
Organisation	Past experiences regarding EE projects		1-4
	Difficult to implement due to internal organisation		1-4

Table 3. Evaluation of actors involved in energy-efficiency and in the audit project.

ACTORS INVOLVED IN ENERGY EFFICIENCY & IN THE AUDIT PROJECT			
	PERSONS RESPONSIBLE FOR ENERGY	Score	Scale
Professional background	What is your training	--	--
Power	Who is your superior in the organization	--	--
Structure	Does your company have an energy-management team		yes = 1 no = 0
	MANAGEMENT SUPPORT		Scale
Structure	Is there a Senior manager appointed to sponsor the energy audit program or the energy mgt action program		yes = 1 no = 0

Answers regarding internal context can be interpreted in the following way:

- **Management systems**. Being ISO certified means that a company already attributes importance to certain potential consequences of energy-efficiency measures or investments (*i.e.* their potential impact in terms of quality, risk, or environment). Furthermore, it means that the audited company is used to process management and to continuous improvement. Thus management systems in this case act as positive filters regarding EEMs' decision-making.
- **Past experience**. Research has shown that a company's history and past experience influence the way a new project is treated. Information regarding negative experience is useful to frame the right arguments in favor of new projects. Specific positive experiences may be reminded to support new projects.
- **Internal organization**. Several organizational aspects may delay or complicate decision-making regarding investment projects. For instance if many people/departments are involved in project decision-making, process will be slow; complicated investment procedures or routines may also slow down or block a decision-making process (for instance an obligation to perform a legal analysis, or to depend on several hierarchical levels for a decision). A better understanding of organizational hindering factors opens paths to action.

Actors involved in energy-efficiency and in the audit project

Part 3 of the questionnaire, dedicated to investigating fostering and hindering factors related to actors, is represented in Table 3.

Answers regarding actors involved can be interpreted in the following way:

- **Professional background**. Energy use in organizations involves many different fields and skills (such as skills in electricity use, cooling, heating, ventilation, etc.) which are generally not all well mastered by a single person. Knowing the professional background of the manager in charge of energy

in an organization is important to determine which aspects of the audit could be not well understood by this person.

- **Hierarchic position**. A technical manager depending on a facility manager will have much less decisional power than, say, a production manager just below the CEO. Being aware of the importance of power in organizations and assessing energy managers' hierarchic position may lead to practical steps to increase the success of a project (such as finding ways to reach powerful managers, or arguments to convince them).
- **Energy-management team.** Is unsurprisingly required by ISO 50001 because it helps to de-compartmentalize energy use out of the technical functions and to spread energy awareness throughout an organization.
- **Senior manager support** is important to an investment project success. If this support does not exist, it must be sought.

Strategic and financial investment characteristics

The part of the questionnaire dedicated to characteristics of energy-efficiency investments and of EEMs aims at identifying financial and strategic factors which may – positively or negatively – influence energy-efficiency decision-making. This evaluation re-uses some questions from a survey made by de Groot, Verhoef and Nijkamp (2001) with 135 Dutch companies in nine energy-intensive business sectors, as well as some questions from my own research with 35 industrial and services companies in 2006–2007.

- **Strategicity**. The most important part of the questionnaire aims at assessing the strategicity of energy-efficiency measures for the audited organization. As described in the last part of the conceptual framework section, strategicity is more important than profitability to win the competition for resources between investments. "Strategicity" expresses the strategic character of an investment or, in other words, its contribution to an organization's competitive advantage in performing its core business. Strategicity is composed of three dimensions: value, costs and risks. The more an investment contributes to improving the value proposal(s) of an organization, decreasing its costs and reducing its risks, the more strategic it will be, and the more chance it will have of winning the competition. Therefore, it is crucial to better understand the possible contribution of future energy-efficiency (or renewable energy) projects to these three dimensions (an investment can contribute to one, two or all three dimensions at the same time).
- **Investment cycle**. This refers to an accounting logic. If an energy-efficiency project concerns equipment which has been purchased a short time ago, depreciated asset value must be taken into account and a replacement investment calculation has to be made.

Part 4 of the questionnaire is represented in Table 4.

- **Finance**. Internal constraints to budget must be taken into consideration when proposing a new project. Lack of capital is often presented in the energy-efficiency literature as a key barrier to energy-efficiency investments. But, according to my conceptual framework, lack of capital is a "symptom barrier", *i.e.* designated as such because it expresses "signs of deeper, invisible problems, or of mistaken interpretations. For instance, capital is not lacking but is allocated to other investments" (Cooremans, 2012a:514). Problems with external financing may be another symptom barrier: respondents' companies mention external financing as an obstacle to energy-efficiency investments when they did not actually apply for such financing (Cooremans, 2012a:508). My hypothesis, to be tested in future research, is that firms do not borrow when an investment is not a core business one. Knowing which financial support (*i.e.* fiscal arrangements, subsidies or low-interest loans) is favored by audited companies helps frame energy-efficiency investment projects based on their preferences and culture.
- **Physical resources**. Facility management is outsourced. Functions are outsourced when they are considered as non-core business. When facility management is outsourced, it often includes energy management. This probably means that energy use is not considered as strategic, an important point to remember (see paragraph on strategicity on previous page). This also means that another actor has to be taken into account when framing projects. Owner of facilities and buildings. When an audited company owns its industrial facilities or administrative/ commercial buildings, there is no split incentives (or owner-tenant) barrier. Still, it may happen that a company does not own its own facilities but is responsible for large technical systems consuming energy (heating and cooling systems, lighting, ventilation, etc.) and has defined a periodicity for their renovation.

Better knowledge regarding all aspects described in the previous paragraphs is useful for investigating possible energy-efficiency improvements in accordance with audited organizations' needs, for framing energy-efficiency investment projects, and for more convincing audit reports.

Conclusion

The auditor tool described in this paper is a new approach to better understand – and therefore *influence* – organizations' behavior regarding energy-efficiency investment decision-making. The questionnaire results could also be used to increase knowledge in the (poorly-known) field of businesses' investments..

As with any new tool, this questionnaire is perfectible. It will be tested at the beginning of the audit program with several large energy consumers in the Canton of Vaud. In any case, the new methodology proposed here implies that, in order to increase the success of the audit programs, the audit scope, process and report have to be constantly related to the results of the pre-audit questionnaire on the non-economic drivers of EEMs and energy-efficiency investment projects.

Answers to the 57 questions of the questionnaire by organizations participating in the audit program will help influence organizations' behavior regarding EEMs and energy-efficiency investment decision-making by: 1) better orienting auditors' investigations; 2) better taking into account strategic aspects of EEMs and of energy-efficiency investments; 3) better adapting investment projects and audit report to companies' interests and routines.

Table 4. Evaluation of strategic and financial aspects of EE investments and EEMs.

INVESTMENT CHARACTERISTICS			
Please rate the negative influence of the following factors on energy-efficient technologies adoption (1 = the less important - 4 = the most important)		Score	Scale
Strategicity	Other investments more important		1-4
	Energy costs are not sufficiently important		1-4
	Energy efficiency has low priority		1-4
	Current installations are sufficiently efficient		1-4
	No good overview of existing technologies		1-4
	Uncertainty regarding technologies quality		1-4
Investment cycle	New technology can only be implemented when existing technology must be replaced		1-4
Finance	Internal constraints on the budget		1-4
	Problems with external financing		1-4
	No loan possible when no core business investment		1-4
Physical resources	Facility management is outsourced		yes = 1 no = 0
Please rate the positive influence of the following factors on energy-efficient technologies adoption (1 = the less important - 4 = the most important)		Score	Scale
Strategicity	Cost reductions resulting from lower energy use		1-4
	Other costs reductions		1-4
	Lower disruption of energy supply risks		1-4
	Lower energy price risks		1-4
	Lower production riks		1-4
	Improved quality/reliability of products or of production process		1-4
	Increased staff comfort or loyalty		1-4
	Increased customers comfort / or company's image		1-4
	Stronger competitiveness		1-4
Finance	Fiscal arrangements		1-4
	Investment subsidies		1-4
	Low-interest loan		1-4
Physical resources	The company owns its facilities/building(s)		yes = 1 no = 0
	Even if tenant, influence is possible on large technical systems consuming energy		yes = 1 no = 0
	A périodicity is defined for renovation of sales area or offices		yes = 1 no = 0
	If there is a defined periodicity, what is its duration	--	years
	Howmany buildings compose the company's building stock	--	nr.

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