

# Investment in energy efficiency: Do the characteristics of investments matter?

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## Abstract

*“Investment in energy efficiency: do the characteristics of firms matter?”* In their famous 1998 paper, DeCanio and Watkins raised the question and answered it affirmatively, contradicting the mainstream view of investment decision-making. Our paper addresses a parallel question: *“Investment in energy-efficiency: do the characteristics of investments matter?”*

To answer this question, we first describe our new investment decision-making model, applicable to all investment types. We then discuss our research results, based on questionnaires submitted to finance managers of thirty-five Geneva-based major electricity consumers (more than 1 GWh per year) in various commercial and industrial sectors. We show how characteristics other than profitability play an important role in investment choices: 90 % of firms use categories to classify investments. The investment category subsequently influences profitability evaluation, profitability requirement and, ultimately, the decision made. For half of the firms in our study, energy-efficiency investments did not exist as a category. However, wide diversity regarding investment behavior is observed between firms.

Our findings lead to a different explanation of the energy-efficiency gap and open the way for a new approach to promoting energy-efficiency investments, which is briefly discussed in the conclusion.

## Introduction

According to mainstream neo-classical economics, investment decisions are strictly based on investment profitability. Energy-efficiency investments are not decided upon by profit-seeking firms because of their low real profitability, or because information problems prevent price indications from reaching decision-makers, or force organizations to define sub-optimal routines. To date, however, energy-efficiency investment literature has not investigated enough the important issues of investment characteristics and of their influence on decision-making.

Characteristics of investments—and in particular their more or less strategic character—matter: this is the stance of the paper. Our model of investment decision-making, rooted in an extensive exploration of organizational decision-making literature explains why and how these factors play a role. Based on this model, a survey was conducted in Geneva, Switzerland, from 2006–2007, to confirm the importance of strategic considerations in general investment decision-making, to assess the strategic (un)importance of energy-efficiency investments for businesses, and to check for possible differences in treatment between investment categories. The goal of the paper is to describe and discuss our findings and their implications for researchers, practitioners, and policy-makers.

To address this goal, the paper is organized into three parts. The first part describes our theoretical framework, the second part describes the research methodology and our measurement tool of the strategic character of an investment, and the third part discusses our research results, which follow two themes: 1) general corporate investment behavior and influence of investment category on investment choices; 2) energy-efficiency investments: how they are perceived strategically

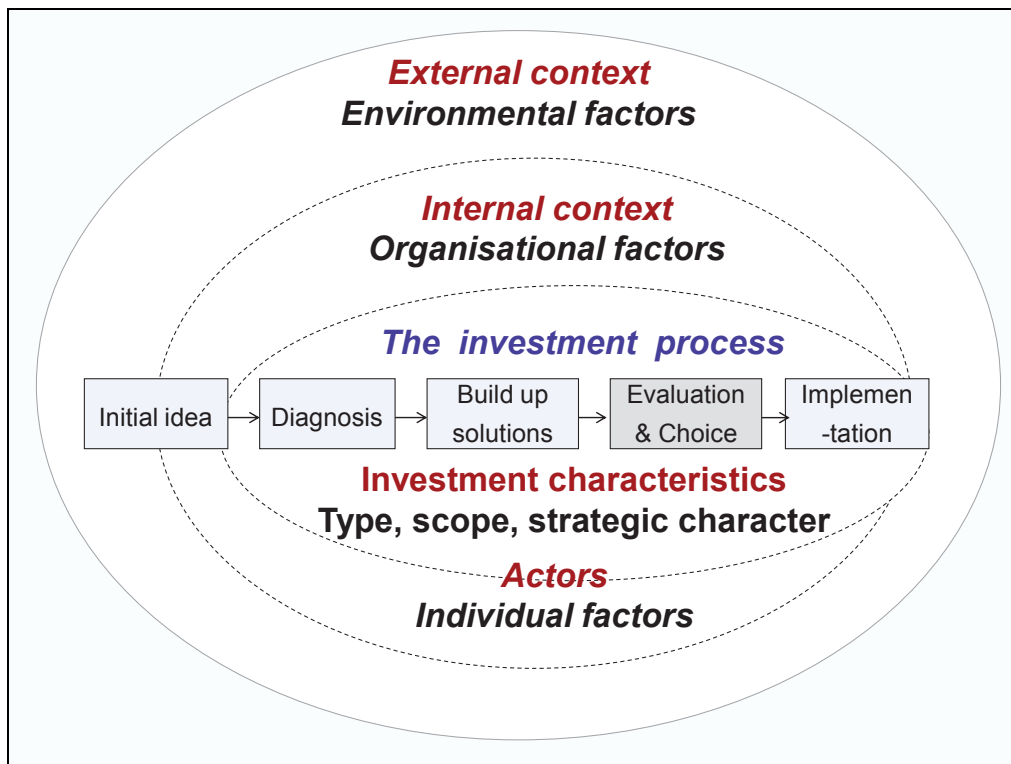


Figure 1 – A new model of investment decision-making.

and how companies behave regarding this particular investment category. The conclusion will briefly discuss the limits and implications of our findings in the field of energy-efficiency.

### A new model of investment decision-making

Based on a thorough literature review and a theoretical exploration of the academic field of decision-making, we can propose a new model of investment decision-making. I have drawn the diagram in Figure 1 to represent this model.

According to the model, and as shown in Figure 1, decision-making has to be considered not as a point in time but as a process influenced by organizational and external contexts, by the actors involved and by the characteristics of the decision to be made. Among investment characteristics, contribution to competitive advantage—in other words—strategic interest, is a key factor influencing decision-making, a factor which is even more important than its financial interest (the paper focuses on this issue). But strategic character is not given, it is interpreted by actors (individuals and groups) and by organizations, due to the action of several filters. Let us describe in more detail these four types of drivers influencing investment decision-making.

**Decision-making: a process inserted in two contexts.** A decision is a step in a decision-making process, defined as a dynamic chain of actions and events. When it can be identified (it is not always possible to trace decisions retroactively), a decision cannot be considered as a single element or as a point in time.<sup>1</sup> The decision-making process comprises three

phases: identification (diagnosis), development (build-up 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 in two ways: firstly, it translates—or not—an initial idea into a decisional event; secondly it influences the subsequent phases of development (information search and selection, elaboration of the solutions or possible options) and choice. Contrary to what is represented in the diagram (for the sake of clarity), the decision-making process is rarely smooth and linear. It is cyclical and uneven, with feedback loops, pauses, and dead-ends. Organizational context (comprising structure, strategy and culture) and external context (the organization's environment) influence all of the decision-making process phases. Main external context components are competition moves, demand, social evolutions, regulation, the general economy and technological progress. However, an organization's environment is not given; rather, it is interpreted and "built" by actors' vision and by organizational filters (corporate culture, routines, control systems). As described by Lyles (1987, p. 266), with reference to Weick (1979), "organizations will invent the environment to which they will respond by deciding which aspects of the environment are important or unimportant".

**Decision-making: a process influenced by actors' power.** The actors involved (groups and individuals) influence the course of the decision-making process and its result (which can be a negative, positive, or no-decision). Decision-making is political because organizations are political systems, *i.e.* they are collectives of people with competing interests (Eisenhardt

1. "Instead of a decision appearing at a point in time, decision-making follows a general trajectory of gradual convergence on the image of some final action. Instead of conceiving decision making as a series of steps (or cycling imposed

on a linear sequence ...), it comes to be seen in a more integrative way as the construction of an issue." (Langley et al., 1995, p. 266.)

and Zbaracki, 1992). In any organization, a dominant coalition (Prahalad and Bettis, 1986), or a “key collection of individuals” composing top management, has a significant influence on the way a firm is managed. According to Miller, *et al.* (1996, p. 301) the dominant coalition is a “core triad of heavyweight functions”: production (or its equivalent in services companies), marketing and sales, and finance (these functions are closely associated with core business). Together with general management, this coalition imposes its choices upon the organization because, “simply put, decisions follow the desires and subsequent choices of the most powerful people” (Eisenhardt and Zbaracki, 1992, p. 23).

**Decision-making: a process influenced by investment characteristics.** Any decision-making process is inserted in an “interwoven streams of issues network” (Langley *et al.*, 1995); in every organization, there is a competition between issues for financial and human (the time and energy of powerful managers) resources. Concurrent decision processes within the same organization may be interrelated because they share the same resources, but also simply because “they bathe within the same organizational context, involving the same people, the same structural design, the same strategies, and the same organizational culture and traditions” (Langley *et al.*, 1995, p. 273).

Characteristics of decisional issues play an important role in this competition. With regard to investment projects, these characteristics comprise three dimensions: analytical characteristics, investment scope, and strategic nature.

The strategic nature of an investment project is an important decision-making driver, even more important than profitability. It depends on the scope of the investment and on its contribution to core business, and thus to an organization’s competitive advantage. We define *an investment as strategic if it contributes to create, maintain or develop a sustainable competitive advantage* (Cooremans, forthcoming). This definition implies that an investment, or an investment decision, is not simply strategic or non-strategic. Investments may have different strategic importance and strategic decision-making is a continuum, where decisions can be non-strategic, weakly strategic, strongly strategic or totally strategic. The more strategic a decision is, the more it contributes to competitive advantage, the more important it is to a firm’s performance or even survival, and the more complex and uncertain it will be.

In organizational finance and decision-making literature, several empirical works have demonstrated the importance of strategic factors in decision-making and the link between investment decisions and a company’s strategic goals (Alkaraan and Northcott, 2007, 2006; Burcher and Lee, 2000; Butler, *et al.*, 1991; Carr and Tomkins, 1996; Chen, 1995; De Bodt and Bouquin, 2001; Maritan, 2001; Putterill, *et al.*, 1996; Segelod, 1997; Van Cauwenbergh, *et al.*, 1996). Similarly, in the “alternative” literature on energy-efficiency investments, the (absence of a) link between energy-efficiency investments and a company’s core business is often mentioned as a (negative) factor which plays an important role in the decision-making surrounding investments (de Groot, *et al.*, 2001; Harris, *et al.*, 2000; Parker, *et al.*, 2000; Sæle *et al.*, 2005; Sandberg and Söderström, 2003; Sardanou, 2007; Sorrell, 2000; Velthuisen, 1993; Weber, 2000; Weber 1997). This stream of literature, however, lacks the theoretical grounds to explain its findings.

Based on the theoretical framework described above, we can explain why strategic nature is an important driver of investment decision-making as follows: a decision-making process only starts if the new decisional event, the “initial idea” (Desreumaux and Romelaer, 2001) is interpreted, in the diagnostic phase, as a stimulus important enough to trigger action (Mintzberg, Raisinghani, Theoret, 1976); however, crossing the action threshold is not enough to ensure a positive decision because of the organizational competition existing between interwoven streams of issues (as per the Langley *et al.*, 1995 framework mentioned above). An investment project categorized as non-strategic will most probably lose the competition and will be excluded from the decisional stream, to end up as a no-decision; a category little studied (Bachrach and Baratz, 1962). However, the highly strategic nature of an investment may also complicate and slow down the decision-making process because of the uncertainty, complexity, and novelty it implies. The more new and complex a decision and its consequences, the more unstructured the decisions to be made, the higher the number of actors involved, the longer, more sporadic, cycling and politicized the decision-making process. In summary, the strategic nature of an investment project is an important and necessary condition, but not automatically sufficient to entail a positive decision.

**Yet “strategic issues do not appear in prepackaged form” (Dutton and Jackson, 1987, pp. 77). Data and decisional events are interpreted by actors and by organizational systems.** Investments are not (only) strategic for objective reasons. They are interpreted as such by decision-makers and organizations. At the beginning of the decision-making process, strategic issue diagnosis assesses and categorizes new data and events, which are interpreted—“infused with meaning” (Dutton, 1987)—at the individual and organizational levels. During this process, some issues become “decision events” (Dutton *et al.*, 1983), which are more or less strategic. But during the issue diagnosis process, information is distorted by the use of heuristics—rules of thumb, shortcuts, routines, which decision-makers use to simplify complex problems—and by cognitive biases, these “hidden decision’s traps” (Hammond, Keeney, Raiffa, 2001) common to all individuals. The influence of heuristics and cognitive biases always distorts information in the same way: managers unconsciously search for information supporting views, beliefs, or hypotheses that they have long cherished (Makridakis, in Mintzberg *et al.*, 2005, p. 168). Moreover managers’ personal pre-existing knowledge systems act as filters of organizational events. “Executives’ experiences, values, and personalities affect their field of vision (the directions they look and listen), selective perception (what they actually see and hear), and interpretation (how they attach meaning to what they see and hear)” (Hambrick, 2007, p. 337). The organizational context influences how decision-makers understand and interpret issues, through three major organizational filters: strategy, structure, and culture. Structure includes management systems and routines which frame and control actors’ behavior within the organization. The meaning attributed to the same event, and the type of reaction to this event, will therefore be different from one organization to another.

## Methodology

### DATA COLLECTION

The research was undertaken in collaboration with the University of Geneva Business School (HEC) and the Geneva Energy Office (ScanE), and is based on interviews and questionnaires submitted to major electricity consumers of the Geneva canton (sites consuming more than 1GWh of electricity per year), participating in a peak demand-side management program. Thirty-five companies supervising sixty-one buildings or industrial sites participated in the survey, nineteen of which are active in the secondary sector (metalworking, clock- and watch-making, chemical and pharmaceutical industries) and the rest of which are active in the tertiary sector (chain stores, parking lots, shopping malls, conference/exhibition centers).

Data collection consisted of a two-step survey: 1. On the occasion of a semi-directive interview with the company manager responsible for energy issues (usually the facility or technical manager), a questionnaire is filled in; 2. A subsequent questionnaire was completed by a top finance manager. Some questions were identical to those of the first questionnaire in order to check for different views on the same issues between managers in charge of energy and finance managers. Only eighteen “finance questionnaires” have been collected (eleven secondary sector and seven tertiary sector companies; fourteen of these companies are medium to big, with more than 250 employees). Although the sample size is small, data collected give interesting indications on businesses’ general investment behavior and on energy-efficiency investment behavior. They also enable a comparison with the De Bodt and Bouquin (2001) survey (forty-four usable questionnaires, out of the thousand sent out by mail), from which most of the questions regarding general investment behavior were taken.

### STRATEGIC NATURE CONCEPT MEASUREMENT

According to the definition adopted in the theoretical framework described above, a decision is strategic if it contributes to create, maintain, or develop a sustainable competitive advantage. On one hand this definition implies that a decision is not simply strategic or non-strategic, but more or less strategic or non-strategic. On the other hand, this definition implies that the main constituent of the “strategic character of an investment” is this investment’s impact on a firm’s competitiveness. What are the indicators which allow measurement of competitive advantage generated by a strategic decision?

According to Michael Porter, “competitive advantage grows fundamentally out of value a firm is able to create for its buyers that exceeds the firm’s cost of creating it” (Porter, 1985, p. 3). Value is what buyers are willing to pay for what a firm provides them and is measured by total revenue. Two theoretical approaches have defined the means to build superior value at a lower cost: the “activities approach” and the “strategic resources approach”. The first approach is centered on the concept of activities which are “the basic units of competitive advantage”. The second theoretical approach is based on the concept of strategic resources which, according to the Resource Based View (RBV) (on strategy), are the founding elements of competitive advantage. These two approaches agree on a bi-dimensional concept of competitive advantage. These

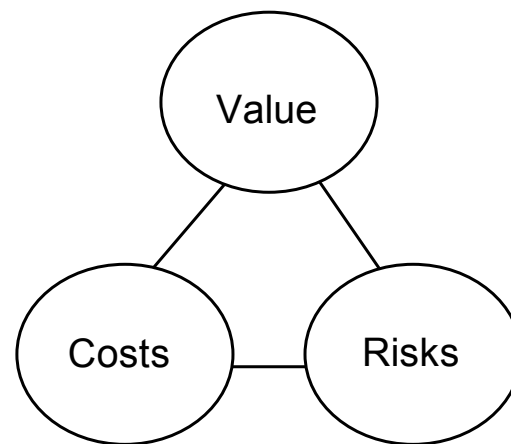


Figure 2 – The three dimensions of competitive advantage.

two dimensions are, on one hand, value (which a firm is able to create for its buyers) and on the other hand, cost (of creating this value). The two approaches to competitive advantage only differ in the means of developing superior value and reducing costs: choice of activities for one, and resources development for the other.

However, an analysis of several theoretical frameworks—strategic risk, resource dependence (Pfeffer and Salancik, 1978), and RBV—has led me to propose taking risk as a third dimension of competitive advantage, supplementing the value and costs dimensions (Cooremans, forthcoming). Therefore, I suggest enlarging the definition of competitive advantage by saying that *competitive advantage is a three-dimensional concept, formed of three interrelated constituents: costs, value, and risks*. I have designed Figure 2 to very simply illustrate the three dimensions of competitive advantage.

According to the definition above, the more an investment decision contributes to competitive advantage, the more strategic it is. Thus, to measure strategic character (or “strategic-ity”) of an investment, one has to measure its contribution to competitive advantage in each dimension; value, costs, and risk. To estimate the strategic character of energy-efficiency investment to the companies of the sample, we asked managers to estimate the impact of the adoption of energy-efficient technologies on their company, in terms of risks, costs, and value. The question in Figure 3 was submitted to energy and finance managers.

Respondents were asked to give a value from 1 to 5<sup>2</sup> to each of the constituents: “risks”, “costs”, and “value”, analyzed by question W 2\_5 / F 2\_5<sup>3</sup>. By aggregating the answers, a scale of interval was built, allowing measurement of the strategic dimension of an energy-efficiency investment, which is thus spread out from a minimum of 0 to a maximum of 15.

2. Figures of the scale correspond to: 1 = completely unimportant; 2 = not important; 3 = moderately important; 4 = important; 5 = very important.

3. Variables labeled “W” indicate energy managers’ answers, variables labeled “F” indicate finance managers’ answers.



**W 2\_5 / F 2\_5 Do you think that the adoption of energy-efficient technologies is important [for your company] for the following reasons?**

**Classify in ascending order (1 = the least important – 5 = the most important)**

- W / F 2\_5\_3 Risks reduction \_\_\_\_\_

Please precise which ones \_\_\_\_\_

- W / F 2\_5\_4 Costs reduction \_\_\_\_\_

Please precise which ones \_\_\_\_\_

- W / F 2\_5\_5 Products value increase \_\_\_\_\_

Please precise which ones \_\_\_\_\_

Figure 3 – Question W 2\_5 / F 2\_5.

## Results and discussion

### GENERAL INVESTMENT BEHAVIOR

Results concerning the relative importance of the financial and strategic logic in investment choices and businesses’ general investment behavior will be discussed in this section. In this respect, the most important conclusions are the following: profitability plays an important but not decisive role in investment decision-making, due to the influence of other factors; the diagnostic phase is crucial; there is competition between investment projects; the projects which are considered as more strategic are chosen. These various points, which solidly confirm the validity of the theoretical framework described above, will be discussed in the following pages, as well as another aspect highlighted by the research: unorthodox practices of businesses in investment choices.

According to the mainstream approach on investment decision-making, an investment is decided according to its profitability. Three capital budgeting tools proposed by capital investment theory are most often used to assess an investment’s profitability:<sup>4</sup> payback period, Net Present Value (NPV), and Internal Rate of Return (IRR) methods. These methods specify the modalities fixing the discount rate and take into account the risk attached to an investment project.

Our research results confirm that investment profitability plays an important role in decision-making, as shown by various questionnaire responses: profitability analysis is mandatory for an investment project, irrespective of its category, for an overwhelming majority of companies (87 % of positive answers in our sample). Three-quarters of the financial managers disagree with the assertion that “*financial evaluation of the investments has, after all, a small influence on the final decision*”. Profitability calculations are considered as “decisive” in

the choices made by a quarter of the respondents (28 %) and as “important” by 50 % of the respondents.

However, the influence of profitability on investment decision-making is far from being exclusive. As admitted by the quasi-totality of financial managers who responded (fifteen out of seventeen), the “*profitability of an investment is not sufficient to entail a positive decision*”. A majority of financial managers (ten positive answers out of seventeen respondents) confirm, on the other hand, that “*a project can be realized even if it is not profitable*”. These results are similar to those of previous research, in particular that of De Bodt and Bouquin (2001).

The influence of profitability on investment decision-making is even secondary, as demonstrated by our research, because of the influence of the following factors: 1) the importance of power in organizations and on the decisions made is, once more, confirmed. Existence of a “champion” supporting an investment project seems crucial, in many companies, for its adoption. Power relationships between company departments influence the investment process. 2) Investment amount and category determine the procedure, the analytical and capital budgeting tools used, profitability requirements, the different steps a project has to follow and, apparently, resort to external financing. 3) Strategic investments, *i.e.* investments increasing competitive advantage in performing core business, have more chance to be selected.

A formal procedure of investment control exists in a large majority of companies (approximately four out of five). Investment amount influences this procedure in the majority of the companies questioned (76 % of the answers<sup>5</sup>), as well as the stages that the investment project proposal has to follow (88 % of the answers<sup>6</sup>).

Investment categorization plays a crucial role in this formal procedure. Almost all companies classify investment projects according to a pre-existing typology. The category chosen

4. Investment profitability measures the relationship between the capital invested and the income which ensues from the investment. For a nice description of capital budgeting methods, I suggest the following reading “Finance for Managers.” pp. 140–170. *Harvard Business Essential*. Harvard Business School Press, Boston, MA (2003).

5. 13 yes, 4 no, and 1 non-answer to question F 9\_11 **Does the procedure depend on the investment amount?** O Yes O No.

6. 15 positive answers out of 17 and 1 non-answer to question F 9\_19\_1 **Do the stages that a project has to follow depend on the investment amount?** O Yes O No.

**Table 1 – Influence of investment category.**

Influence of investment category on:	Nr. positive answers	% of the total
Type of analysis (question F 9_10)	11	61 %
Capital budgeting tool used (question F 9_14)	11	61 %
Investment steps (question F 9_19_2) (1 non-answer for each question)	8	44 %

**Table 2 – Investment categories – Question F 9\_9.**

Investment categories	Number of citations
To maintain or renew existing production capacities	14
To increase productivity of existing means of production	13
To improve production process	9
To reduce energy consumption	9
Legal conformity of equipment (pollution, etc.)	9
Equipment replacement	9
Marketing of new products	8
Research	7
Product quality improvement	7
In-house development of new products	6
Working conditions improvement (beyond legal obligations)	5
To increase productivity of support functions	5
Internal communication	1
External communication	1
Others	0

subsequently influences the type of analysis applied to an investment project (such as analyses of profitability and risk, or commercial, technical, legal, and ecological analyses) and the financial methods used to assess its profitability in 61 % of companies<sup>7</sup>. The investment category also influences the stages that a project has to follow in 44 % of companies<sup>8</sup>. Table 1 summarizes these results:

Table 2 shows investment categories chosen by financial managers as being the closest to the investment categories used in their company (by order of frequency, in a list of fifteen items proposed in question F 9\_9). “*Investments to maintain or renew existing production capacities*” is the category recognized by the largest number of companies (78 %, or 14 out of 18). It is also the first category chosen by respondents in the de Bodd and Bouquin survey, although with a lower score (41 % of the answers, or 18 companies out of 44). The second investment

category chosen (72 % of Geneva respondents, or 13 out of 18) is the category “*investments to increase productivity of existing means of production*”. Thus, the categories most frequently used by companies are categories related to core business.

Issue diagnosis is confirmed as playing an important role in the decision-making process, and therefore in investment choices. Two elements in companies’ answers confirm the importance of the diagnostic phase. First, investment projects result more often from opportunities perceived at the operational level than they result from a systematic search for a relationship with a company’s goals; this implies an open decision-making process in the beginning. Second, in the majority of cases, budgets were not defined in advance, but only after identification of investment opportunities. These results showing the importance of the issue diagnosis confirm the results of previous research, as well as the validity of this part of our decision-making model.

Categorization of investment projects by companies and its considerable influence on the decision-making process and therefore on investment choices, confirms another important aspect of our theoretical model: the existence of competition between investments. This element is also confirmed by the fact

7. 11 yes, 6 no, and 1 non-answer to question F 9\_10 **Do you apply different types of analysis to an investment project according to investment category?** O Yes O No, and to question F 9\_14 **Does the financial method used to assess profitability depend on the investment category?** O Yes O No.

8. 8 yes, 9 no, and 1 non-answer to question F 9\_19\_2 **Do the stages that a project has to follow depend on the investment category?** O Yes O No.

that the “*existence of other more important investments*” is considered as the first barrier to energy-efficiency investments by the financial managers in our survey, as well as by companies in the De Groot, Verhoef, Nijkamp (2001) survey. De Groot, Verhoef, Nijkamp do not specify what these “more important investments” are. They simply note that “the most important barrier for firms is the existence of other investment opportunities that are considered more promising or important, or ... more attractive” (De Groot *et al.*, 2001, p. 726). But they indicate elsewhere that “energy saving is just one of the criteria on which a new technology is judged and that there are other complementary benefits such as increased capacity and improved product quality that are considered along with energy saving” (*idem*, p. 723). In my own research, I did not systematically check what respondents in my survey meant by “more important investments”. However certain people in charge of energy mentioned during the interview that more important investments were “investments to obtain certifications, or investments in production” (company No. 26, steel industry), “investments in means of production” (company no. 29, steel industry), “investments in means of production or to develop new selling points” (company no. 32, watchmaker), “investments in machines” (company no. 33, watchmaker). These descriptions also correspond to the investment categories indicated as the most frequently used by companies (as described in the table on previous page). We can therefore consider that “more important investments” are those which are directly linked with a company’s core business: in other words, which are strategic investments. Therefore another central point of our theoretical framework is confirmed, which states that strategic investments<sup>9</sup> have more chance to win the organizational competition existing between investments projects. This is also confirmed by the fact that, in our research, sixteen financial managers out of seventeen agreed with the assertion, “*Above all, a project must contribute to the realization of the company’s strategic goals*” (forty companies out of forty-four in the De Bodt and Bouquin survey, 2001).

Thus, strategic character is again confirmed as being more important than profitability in investment choices, at least for companies’ financial managers. This would explain why companies do not adopt certain technological advances, even when they consider them profitable, as is the case for the companies questioned by De Groot, *et al.* (2001).<sup>10</sup> Furthermore, when an investment is perceived as important for core business, access to financial resources is not a problem. We can interpret in this way the fact that the budgetary constraints come only in eighth position as a hindering factor to energy-efficiency investments for the Dutch companies questioned by De Groot, *et al.* (with an average score of 2,8 out of 5). Moreover, this may explain why unprofitable investments may be chosen, as indicated by a majority of financial managers in our Geneva survey (see above p. 8).

Another interesting issue regarding general investment behavior is brought into evidence by our research: a lack of con-

formity of investment practices with capital investment theory prescriptions. Indeed, results show unorthodox behavior, by companies in our survey, regarding the capital budgeting methods used.<sup>11</sup> The following aspects in particular must be noted:

**Discount rate.** Only 60 % of the companies surveyed fix the discount rate by basing it on the cost of shareholders’ equity *and* the cost of loan (Weighted Average Cost of Capital, WACC). Fifteen percent of companies fix the discount rate in a fixed way. Risk is taken into account in discount rate setting in less than one company out of five.

**Time value of money.** Three-quarters of the companies surveyed use a dynamic method to assess profitability (NPV or IRR) and the simple pay-back method at the same time. Some companies, however, (at least two) use only the pay-back method, and with a long duration of five to six years.

**Risk.** Project risk analysis is compulsory for only 40 % of companies surveyed.

**Time horizon.** Strong pressure in the short term is indicated by several respondents in the interviews. As expressed in a rather emblematic way by the general manager of the Geneva subsidiary of an American company (company no. 30, coverage of ceramic surfaces with metallic powders alloys; total energy costs in Geneva = 8 % of the turnover, electricity costs = 4 % of turnover), “one year [to get back the initial investment capital], we get the money at once, two years we need to fight, three years, we never get it. ‘Waiting’ is a forbidden word in our company.”<sup>12</sup> Under these conditions, numerous opportunities for attractive investments are eliminated.

**Outside financing and leverage.** The large majority of companies in our sample are self-financed and are uninterested by a loan, even at a reduced rate of interest, thus giving up the advantages of financial leverage. The same result was also found by a survey of International Finance Corporation IFC (2006) on Russian companies’ practices regarding investments in energy efficiency: “More than 60 % of companies believe that insufficient funds is the key obstacle hampering energy efficiency projects ... However ... only every fourth company has applied for outside financing”<sup>13</sup> (IFC, 2006, p. 34). Discussing these findings, ICF notes that “It is curious that over one-third of those who did not apply for loans due to ‘sufficient funds’ also mentioned problems related to insufficient financial resources for energy efficiency” (*idem*, p. 35). IFC explains these findings by the fact that many companies do not understand the advantages of financial leverage. Based on our theoretical framework, our explanation would be that it is because these investments are not considered as strategic, so that internal financial resources are not granted and outside financing is not considered an option. For example, the person in charge of

9. As per our definition (see p. 4), an investment is strategic if it contributes to create, maintain, or develop a sustainable competitive advantage.

10. “The responses shown here concern technologies about which firms had indicated earlier in the survey that they are aware of their existence, that the technologies were considered as being profitable, but that they were still not implemented as yet” (De Groot, Verhoef, Nijkamp, 2001, p. 727).

11. A conclusion which would support the Rigby (2002) analysis which questions the quality of financial calculations made by companies: “In addition to the problem that organisations did not know how to save energy, it was also shown by market research studies carried out for BRECSU that organisations did not know how to assess the economic potential of their investments in energy efficiency. The weaknesses in the financial methodologies used by energy managers and estates departments for estimating the profitability of energy efficient criteria principally included making errors in the estimate of the inflation rate and changes to future fuel prices. The result of these errors was to render “many investment appraisal analyses meaningless” (BRECSU, 1991, page 6, quoted by Rigby, 2002, p. 15).

12. Interview of February 22, 2007.

13. “... and nearly 90 % of them were successfully granted loans” (IFC, 2006, p. 34).

energy in company no. 33 (watchmaker) mentioned that the company borrows to purchase production equipment, but that, regarding investments for operations, the rule is self-financing.

Based on our findings, we can conclude that the way a project is categorized influences the procedure and the profitability assessment method, as well as profitability requirements and financing. In the context of projects categorization and of competition between projects, and beyond questions regarding businesses' unorthodox financial practices, the strategic character of investment projects is confirmed as the primary driver of investment choices, while investment profitability appears as a generally necessary but insufficient condition. The answers of the Geneva managers hereby confirm the findings of previous studies regarding the respective influences of financial and strategic aspects of investment projects, as well as the validity of our new model of investment decision-making.

If strategic character is the main driver of investment decision-making, then how strategically are energy-efficiency investments perceived? The next section will provide answers to this question.

## ENERGY-EFFICIENCY INVESTMENTS BEHAVIOR

### Strategic character of energy-efficiency investments

Energy-efficiency investments exist as a category for almost half of the eighteen companies which responded to our questionnaire, in a similar proportion in the tertiary and secondary sectors. Indeed, the category "Investments intended to reduce energy consumption" (4<sup>th</sup> line of Table 2) was selected by 53 % of companies<sup>14</sup>, in a similar proportion for the tertiary and secondary sectors<sup>15</sup>. It is the third most frequently-mentioned category (along with the categories "Investments for production process improvement", "For machinery & equipment legal conformity", and "Replacement"). The fact that energy-efficiency investments do—or do not—exist as a category in companies has never been discussed in the energy-efficiency literature. Actually, the issue of investment categorization, in spite of its consequences on investment choices, has been almost completely left out of the general investment literature as well, probably because there has been no need to look for any special treatment applied to a category in particular.

How strategically are energy-efficiency investments considered? This is an important question since strategic character is an essential condition for an investment project to be chosen. If energy-efficiency investments are perceived as non-strategic, their chances of being chosen will be rather low.

According to our definition, the more an investment contributes to create or to strengthen a company's competitive advantage, the more strategic it is. Competitive advantage is a three-dimensional concept, composed of three interrelated constituents: costs, value, and risks. Based on the measurement tool described in the "Methodology" section, energy and finance managers were asked to rate—from 1 to 5—the contri-

bution of energy-efficiency investments to decreasing risks, decreasing costs and increasing product value in their company.

Three main conclusions emerge from our empirical research. First, energy-efficiency investments are perceived as non to moderately strategic by our respondents. Second, of the three variables which compose the strategic character of an investment, the variable "Costs" is considered most important.<sup>16</sup> Third, arithmetic hides a large variety of answers, both between companies (including companies operating in the same business sector), and within companies (between managers of the energy and finance functions). Let us further examine these three conclusions.

First, on average, energy-efficiency investments are considered "not strategic" to "moderately strategic" for the company by questionnaire respondents. Figure 3 shows how managers assess energy efficiency contribution to the three constituents of competitive advantage. Energy managers' and finance managers' results are presented on the left and right sides of the figure, respectively. The average score is 9,1 out of 15 for energy managers<sup>17</sup> and 8,6 out of 15 for finance managers<sup>18</sup>. According to the Student test, the difference between the results of energy managers and those of finance managers is not statistically significant. If we divide by 3 to reduce these figures from 15 to 5, we obtain scores of 3 out of 5 for energy managers and 2,9 out of 5 for financial managers. Based on these results and according to the measurement scale defined<sup>19</sup> (see also the Methodology section), we can conclude that energy-efficiency investments are considered as "not important" to "moderately important" by the respondent managers.

The dispersion of the answers between the two groups (energy and finance managers) for the three variables (risks, costs, and value) presents significant differences. About 50 % of the energy managers consider that adopting energy-efficient technology is in no way important to risk reduction, while the modal choice is the inverse for finance managers: nearly half of them consider the adoption of this technology as moderately important to very important to risk reduction. For finance managers as well as for energy managers, "risk" means "price risk", *i.e.* future price increase or price instability. Energy outages are perceived as a minor risk by companies, only a small minority of which are equipped with a backup system to produce electricity in case of a grid breakdown. However the answers vary considerably between companies, according to their individual experiences in terms of electricity disruptions.

The non- to moderately strategic character of energy-efficiency investments for managers in our research is confirmed by two additional results. On one hand the contribution of these investments to improving their company's competitive position is considered as not important by energy managers

14. *I.e.* nine companies out of the seventeen having answered this question; 1 no answer.

15. Three companies out of seven in the tertiary sector; five out of eleven in the secondary sector, as per answers to question F 9\_21 (**How important is considered energy efficiency in investment decisions.** Please classify in ascending order 1 = the least important – 5 = the most important).

16. Regarding the question of costs, it is interesting to note that, contrary to an idea commonly held but rarely discussed, energy costs are not automatically higher in proportion to turnover in companies of the secondary sector than in those of the tertiary sector.

17. That is the sum of the means of the results for variables W 2\_5\_3, W 2\_5\_4 and W 2\_5\_5. See the section "Strategic nature concept measurement".

18. That is the sum of the means of the results for variables F 7\_5\_3, F 7\_5\_4 and F 7\_5\_5. See the section "Strategic nature concept measurement".

19. Let us remember that figures of the scale correspond to: **1 = completely unimportant; 2 = not important; 3 = moderately important; 4 = important; 5 = very important.**



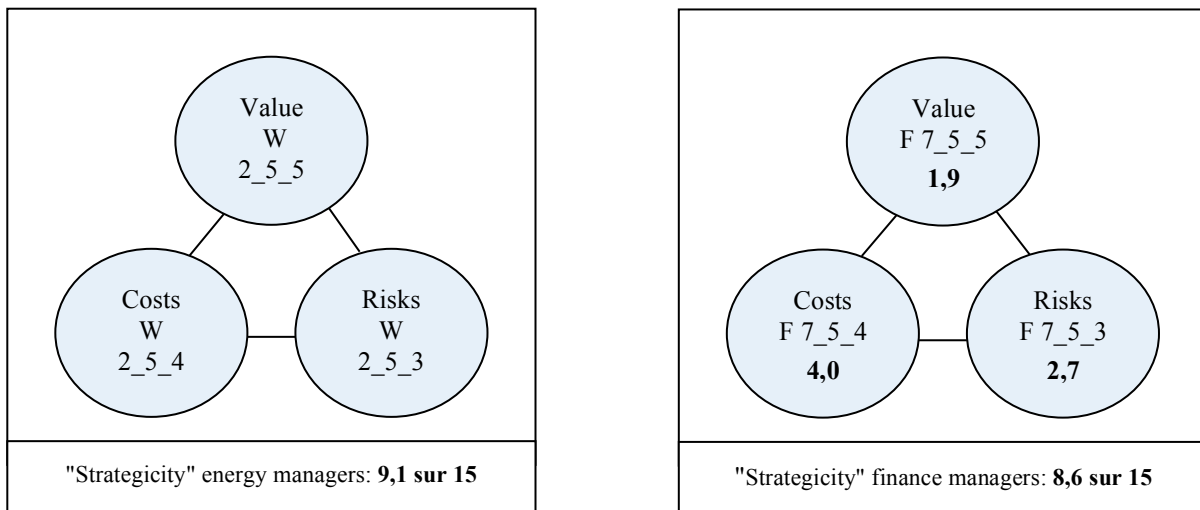


Figure 4 – Strategic character of energy-efficiency investments for energy and finance managers.

(average of the answers of 2,2 for question W 2\_5\_7<sup>20</sup>; 35 answers) as well as for finance managers (average of 2,1 for question W 7\_5\_7; 15 answers). On the other hand, the importance of these investments for the corporate image<sup>21</sup> (corporate image is a strategic resource in strategic management literature) is estimated as moderately important by energy managers (average of the answers is 3,1 for question W 2\_5\_8; 35 answers), and as of rather low importance by finance managers (with an average of 2,6 for question F 7\_5\_8; 15 answers).

The second striking conclusion is the fact that, out of the three dimensions which compose the strategic character of an investment, it is the constituent “Costs” which is considered as the most important. This is the case for all respondents (energy and finance managers) and for all industries. “Costs reduction” entailed by energy-efficiency investments is rated generally higher than 4 (out of a maximum of 5) and often close to 5, while the dimensions “risks reduction” and “increase of products value” almost always obtain a score lower than 3 out of 5. The importance of “costs reduction” for managers (both energy and finance) is confirmed by our analysis of the factors fostering energy-efficiency investments: energy costs reduction is always rated as the most stimulating factor. In this instance, our results are similar to those obtained by the De Groot, *et al.* (2001) survey (*i.e.* 3,9 out of 5 on average) of Dutch companies.

The prospect of energy costs reduction is, however, not as stimulating as one might believe; indeed, in the Dutch study, the fact that energy costs are not important enough was the third factor blocking the adoption of energy-efficient technology (with an average score of 3,4 out of 5). This answer is especially interesting because companies questioned by De Groot, *et al.* (2001) were active in energy-intensive industries (chemi-

cal, basic metals, metals, machinery, food, paper, horticulture, construction materials, and textiles) and had energy costs amounting to a rather high percentage of their turnover (approximately 10 %). In Geneva, finance managers rated the barrier “energy costs are not important enough” as more important than their colleagues in charge of energy (but the average of the answers is rather low, at 2,2 out of 5 for finance managers against 1,4 out of 5 for energy managers). If energy costs are considered not important by managers, the perspective of an energy costs reduction is not a very powerful factor in motivating them toward investing in energy-efficient technology.

Thus, energy costs reduction is a stimulating factor, but not always sufficient to entail positive decisions regarding energy-efficiency investments. Again the importance of the strategic character of an investment is confirmed, as these results show that energy costs must not be interpreted according to a financial approach but according to a strategic approach. For certain companies confronted with competition for prices and low costs, such as the machinery or metals industries, low costs are a strategic necessity of competitiveness and thus, of survival. This is the situation faced by companies nos. 23 and 25 in our sample, as illustrated by a statement from the energy manager of company no. 25 (machinery industry): “we constantly fight to make as well [in terms of quality] as the Japanese, at lower costs”. However, for most companies, the cost dimension is not a priority in energy-efficiency investments decision-making. For these companies, energy costs are considered a somewhat necessary evil.

The third important conclusion of our findings regarding the strategic character of energy-efficiency investments is the variety of interpretations, which is observed. Variance of the answers between managers of the same groups is extremely high: they ranged from 4 to 13 (out of a maximum of 15) for energy managers and from 5 to 13 (out of 15) for finance managers. Energy-efficiency investments are perceived as more important in strategic terms by energy managers of the tertiary sector (with an average of 9,9 out of 15) than by those of the secondary sector (with an average of 8,4 out of 15). According to the Student test, this deviation is slightly significant in statistical terms (between 5 % and 10 %). Results are similar for finance man-

20. W 2\_5\_7 / F 7\_5\_7. Do you think that adoption of energy efficient technologies is important for your company, for the following reasons? Benchmarking (Competition pressure) \_\_\_\_\_

Please classify in ascending order (1 = the least important – 5 = the most important).

21. W 2\_5\_8 / F 7\_5\_8 Do you think that adoption of energy-efficient technologies is important for your company for the following reasons? Corporate image towards clients \_\_\_\_\_

Please classify in ascending order (1 = the least important – 5 = the most important)

agers, with a mean of 9,5 out of 15 (tertiary sector) and of 8,1 out of 15 (secondary sector), but in this case, deviation is not significant, according to the Student test. Generally speaking, investments in energy efficiency obtain a higher score in the three dimensions of competitive advantage (“risks”, “costs”, and “value”) with managers of the tertiary sector than with those of the secondary sector. Variance between companies, even within the same industry, is also very high.

Yet, as a general finding of our empirical research, we can state that energy-efficiency investments are considered at best, on average, as moderately important by respondent managers.

### Energy-efficiency investment behavior

According to our theoretical framework, non-strategic investments lose the competition for human and financial resources which exists within each company. Therefore, the low strategic character of energy-efficiency investments should have negative consequences. Is this conclusion confirmed by our findings? This will be discussed in this section.

Our results show that energy-efficiency investments exist, as a category, for over a little half of the eighteen companies which responded to our questionnaire on investment control behavior. Our results also confirm previous research findings (De Bodt and Bouquin, 2001) showing that investment category influences the selection methods and criteria which companies apply to a project, as well as the stages it has to follow. These observations entail two lines of questioning: 1) when this investment category exists in a company, is any particular treatment applied to it, in terms of selection methods and criteria of selection? and 2) when this category of investment does not exist, how is energy efficiency taken into account in decisions concerning other investment categories? The results presented in the table on the next page begin to answer these questions.

Questions F\_9\_16<sup>22</sup> and F\_10\_6,<sup>23</sup> in particular, aimed at highlighting differences in the treatment between general investments and energy-efficiency investments. Question F\_9\_16 investigates the time horizon used by companies to assess investment profitability (several answers possible). As shown in table no. 3 on the next page, a fixed duration is applied by two companies only. Among companies which responded to this question, 72 % declare taking the life span of equipment as the forecasting horizon for their profitability assessment (13 answers out of 18), and almost 40 % mention the strategic horizon of the project as the time horizon for their profitability assessment (7 answers out of 18 to question F\_9\_16). Energy-consuming installations such as HCV<sup>24</sup> have a life span of fifteen to twenty years. According to the answers to question F\_9\_16, investment duration for energy-efficiency equipment should therefore be fifteen to twenty years, and yet profitability horizons for energy-efficiency investments indicated by the

eighteen companies which responded to question F\_10\_6 (5 no-answers) are much shorter: two years (2 companies), three to five years (4 companies), and ten years (2 companies). Three-quarters of the thirteen companies which answered question F\_10\_6 applied a duration equal to or shorter than five years for energy-efficiency investments. Therefore, companies' practices regarding energy-efficiency investments seem to be contradictory to their answers regarding general investments.

This observation raises the question: are the practices contradictory to the answers for all investment categories, or do we have here proof of a different and unfavorable treatment applied against energy-efficiency investments? The beginning of an answer could be given, although in an anecdotic way, by the energy manager of company no. 31 (Swiss company, electronics industry), who, during the interview, mentioned a duration of three years for investments in energy efficiency but a duration of ten years for “production tool” investments. Therefore, companies would allow longer durations for investments in the production tool. This could explain why the overriding majority of companies indicates the life span of equipment or the strategic duration of the project as the duration for their investments, while for energy-efficiency investments, the investment duration is often much shorter than the equipment life span. Additionally, this would be further proof of the key role played by strategic character in investment choices. More research is needed to address this important question.

Another issue is the importance of energy-efficiency investments with regard to total investment. This issue was addressed by question F\_10\_2 of the investment questionnaire. Answers vary widely, with percentages ranging from 1 % to 20 %. Regrettably, only seven companies answered this question. Further research is needed to analyze the relationship between the percentage of investment in energy efficiency with regard to the total investment on one hand, and the importance of energy costs for companies on the other.

Finally, how is energy efficiency taken into account in other investment decisions? This was addressed by question F\_9\_20<sup>25</sup>. Twelve companies out of eighteen responded positively to this question, and six negatively. The proportion of positive answers is slightly higher in firms of the secondary sector (8 out of 11) than in firms of the tertiary sector (4 out of 7).

### Conclusion

Investment categorization exists in an overwhelming majority of companies. Categorization strongly influences investment control procedure, profitability assessment methods, profitability requirements, investment financing and, ultimately, investment choices. In the context of project categorization and of competition between projects, the strategic character of investment projects is confirmed as the primary driver of investment choices, while investment profitability appears as a generally necessary but insufficient condition. For half of the companies surveyed, energy-efficiency investments do not even exist as a category. When they exist, they are perceived, at best, as moderately strategic by companies. This seems to entail

22. 9.16 Time horizon for profitability assessment is primarily determined by: (Please mark adequate compartments)

- fixed duration identical for all projects?
- Lifespan of equipments?
- Reasonable time horizon for forecasting ?
- Strategic dimension of project
- Other ? Please precise : \_\_\_\_\_

23. Question F 10.6. For the profitability study (if realized), which was the time horizon of the energy-efficiency project (in number of years)? \_\_\_\_\_ years

24. Heating, Cooling, Ventilation

25. Question F\_9\_20: “In case of an investment in production, office or communication equipment, is energy consumption of the equipment taken into account as a decision criteria?”

an unfavorable categorization, which would explain why many energy-efficiency projects, although highly profitable, remain unchosen. These findings confirm or explain results of previous empirical research as well as an essential aspect of the new theoretical framework proposed in this paper.

Our sample is too small to fully generalize the results described and analyzed in the paper. This conclusion is obvious, especially with regard to the diversity observed in companies' investment (general and energy-efficiency) behaviors. This diversity is expressed in all the aspects analyzed by our research: investment control procedures (methods of analysis and of profitability assessment, fixation of the discount rate, investment duration), energy-efficiency investment behavior, and perceptions of energy-efficiency investments' strategic character. This diversity is noticeable even between companies active in the same business sector and which present the same characteristics, a finding (not discussed in the paper) which is significantly explained by the influence of corporate culture. Still, our results are coherent with the new model of decision-making that we propose, which is based on decades of decision-making research.

More research is needed to explain the diversity observed in firms' investment behavior as well as to better understand the modalities and consequences of project categorization in investment choices. The influence of investments' strategic character on investment duration, discount rate applied, and financing, especially, has to be further investigated.

However, a clear implication of our findings is the following: in order to successfully champion energy-efficiency investments, all energy-efficiency actors—scholars, practitioners, and public programmers—need to highlight, when possible, the strategic character of energy-efficiency investments or, in other words, the impact of energy-efficiency investments on firms' competitive advantage in performing their core business.

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