Modeling Firms' Energy-Efficiency Investment Drivers in Commercial Buildings

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ABSTRACT

What are the drivers of corporate energy-efficiency investments? No satisfactory answer has been given to this question. Energy economics has been bogged down in a debate on the possible existence of cost-efficient energy savings, while behavioral research has mainly studied the human and social aspects of residential energy use. Flagrant disinterest of management sciences towards energy reflects the indifference of firms.

The goal of this paper is to propose a new theoretical framework capable of explaining the drivers of firms' energy-efficiency investments. In this regard, we first analyze the relationship between energy and firms, using relevant business science concepts. This analysis leads to reassessing the energy-efficiency barriers conceptual framework: two meta-barriers explain the lack of corporate interest towards energy, and determine all the barriers previously identified by the energy literature. These meta-barriers are: the (supposedly) non-strategic character of energy for many companies, and a kind of 'fairy energy' culture in which energy is consumed as a limitless commodity from an unknown, uncontrollable and almost magical source.

The third part of the paper proposes the processual/contextual perspective to analyze the drivers of corporate energy-efficiency investments. This perspective considers the investment decision as a step in a dynamic process, and takes into account the influences of the organization and its business environment on this process. Finally, the paper provides a new theoretical model for analyzing corporate energy-efficiency investment decisions. In conclusion, we sketch an empirical research project to test the model's hypotheses and briefly discuss its possible findings.

Introduction

What are the drivers of corporate energy-efficiency investments? No satisfactory or comprehensive answer has been given to this question until now.

The energy economics literature has been very busy debating the related question of why profitable energy-saving investments are not undertaken by businesses, and discussing the market, organizational and institutional barriers responsible for this situation. The possible existence of cost-efficient energy savings challenges neo-classical economics theory by contesting, *ipso facto*, certain founding assumptions (market efficiency, goals of the firm, rationality of economic actors). Through successive extensions of the neo-classical orthodox model (Sorrel 2004) (agency theory, transaction costs economics, behavioral economics), economists have adapted their theoretical framework in order to take into account - and better describe - the complexity of the firm. However, economists still conclude that the assumption of the firm's optimal behavior regarding energy-efficiency investments remains valid: within the framework of admitted market failures (mainly imperfect information), barriers in fact reveal a behavior 'indeed optimal from the point of view of energy users' (Jaffe & Stavins 1994, 805). Imperfect information and bounded rationality augment the level of uncertainty and therefore the

investment risk, which, added to its irreversibility, explains and justifies the high rate of return required by investors. In addition, certain hidden costs render the investment less profitable than it appears. Finally, the high level of risk and low cost-effectiveness lead to a negative decision and block access to capital. For economists, the cost-effective energy saving potential is not real: energy-saving investment would be energy-efficient but economically inefficient. This analysis is not satisfactory for three reasons: first, the rate of return for certain projects is such that none of the explanations provided can explain why potential investors reject them; second, the first step to reducing the energy gap is a simple adjustment of existing equipment, which is achievable at a negligible monetary cost; finally, it does not explain the differences in behavior between similar firms operating in the same industry. Moreover, the energy-economics literature hasn't explored important questions already discussed for several years by finance research: how can investments be categorized, and how does the investment type influence the decision-making process and the final decision? What are the criteria used by companies to decide if an expense will be considered as an investment or as a general expense, and what are the consequences of this choice? Finally, since the beginning of the 'market barriers debate' twenty-five years ago, the corporate world has changed. In particular, strong trends are relevant to the relationship between energy and companies: the transformation of corporate control (due to the rising power of shareholders and financial markets), corporate refocusing (concentration on core business) and the reduction of structures.

Psycho-social research has investigated the behavioral and social aspects of energy use and the psychological barriers to an efficient use of energy, focusing on residential energy use by individuals and communities. Little attention has been given to organizational behavior regarding energy use or to individuals' and groups' behavior within organizations.

On the part of management sciences, disinterest towards energy is flagrant. Energy efficiency and energy-saving investments are non-issues, whether in the manuals or the reviews (a quick test: a search for articles answering to 'energy efficiency', 'energy management' or 'energy conservation' written over the last twenty years in such publications as Harvard Business Review or Strategic Management Journal gives only a few results).

This brief survey of several perspectives -or absence of perspectives- on energy-efficiency investments shows the necessity of a new theoretical framework capable of explaining the drivers of firms' energy-efficiency investments by integrating the multiple and dynamic dimensions –human and organizational, financial and strategic– of corporate behavior.

The goal of the present paper is to propose such a framework. In this regard, we first analyze the relationship between energy and firms, using relevant business science concepts: the components of an organization, the value chain concept and the resources as considered by management accounting. This analysis leads to reassessing the energy-efficiency barriers conceptual framework: two meta-barriers are discussed which explain the lack of corporate interest towards energy and determine all the barriers previously identified by the energy literature. These meta-barriers are the non-strategic and cultural characters of energy in firm.

The third section of the paper describes a theoretical perspective which seems suitable to analyze the drivers of corporate energy-efficiency investments: the processual/contextual perspective, which considers the investment decision as part of a dynamic process and takes into account the influences of the organization and its business environment on this process. Finally, the paper provides a new theoretical model for analyzing corporate energy-efficiency investment decisions as well as rethinking the relationship between energy and firms. In conclusion, we

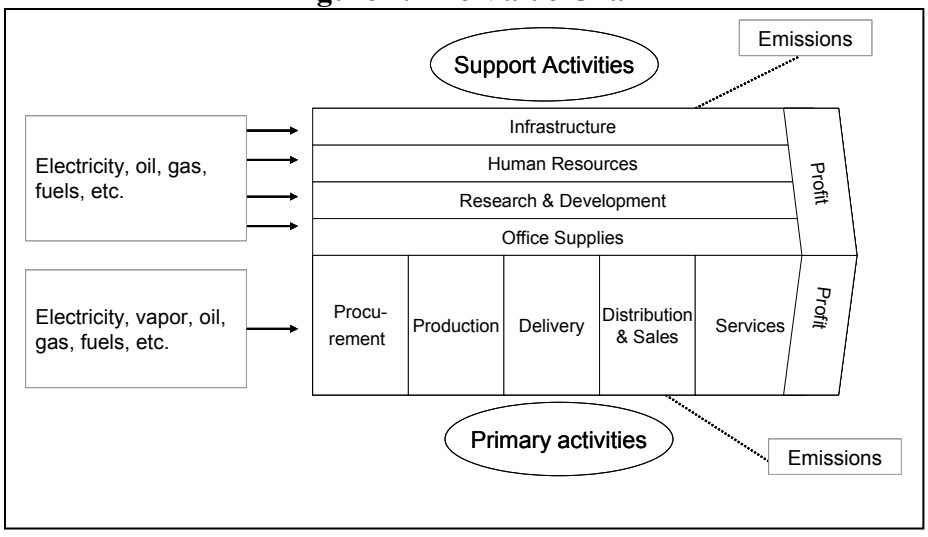
sketch an empirical research project to test the model's hypotheses and briefly discuss the consequences of its possible findings for public programs for energy and climate policies.

Energy and Firms

The disinterest of business science research reflects the indifference of firms towards energy efficiency and energy, shown by several studies (de Groot, Verhoef & Nijkamp 2001; Weber 2000). Why such a lack of interest? To explore this question, we will use three concepts to briefly analyze the nature, role and importance of energy to firms: the components of an organization, the value chain concept and the resources as considered by management accounting.

- **Energy and Organization Theory.** According to the organization theory, an organization is composed of four principal components (Livian 2005, 50): the structure, the human component, the management system and the physical component, which includes two elements: distribution in space (localization, materials and energy processes), and material (technical equipment, buildings). Energy is a part of the physical component of an organization, even if it is most often invisible.
- **Energy and Value Chain.** The value chain analysis (Porter 1987) describes the different steps that enable a firm to obtain a competitive advantage vis-à-vis its competitors in proposing an attractive offer to its clients. These different steps comprise the primary activities of the firm, meaning its core business. Support activities traverse the entire value chain and support – as their name indicates – primary activities.

Figure 1. The Value Chain



Analysis of the value chain shows how energy is diffused and dispersed throughout the firm. Primary activities as well as support activities consume energy resources, but in various proportions depending on the industry: for energy-intensive firms, the cost of energy is important in primary activities – where consumption is generally, but not always, monitored – but is low in support activities, where it is ignored. For non-energy-intensive firms – most of the services sector – the cost of energy is

negligible both in primary *and* support activities. This analysis explains why, among the IEA sectors of final energy consumption (buildings, transport, industry), commercial buildings comprise the sub-sector with the highest energy-saving potential: in all industries (with the obvious exception of the real-estate and building industries for which it is their core business), these buildings are part of the support activities (as infrastructure) and their cost is negligible in proportion to other operating expenses.

- **Energy and Management Accounting.** Management accounting considers three large categories of resources: raw materials and other supplies, human resources and long-term assets (which are not entirely consumed during their first use but gradually, over time). For firms whose core business is energy production, energy entering the value chain is a raw material, whereas energy that feeds support activities is an indirect resource. For other firms, energy is a resource of indirect use which enables the functioning of long-term assets. Expenses incurred by energy consumption shall be considered as auxiliary expenses, as they are only one element in the long-term assets operating cost.

A Physical Resource, but Invisible, Indirect, Diffuse

These analyses allow us to understand the primary handicaps which determine the way energy is being considered by firms: energy is part of the organization's physical component which is least valued by management, as opposed to non-material resources like information (Hammer 2003; Teece et al.1997). In addition, energy's indirect character and its peculiarities render it mostly invisible, and we know that an invisible element is the most easily forgotten (Stern 1992). Energy often contributes to activities which are considered secondary, and which are often outsourced. The diffuse nature of energy makes it difficult for it to be taken into account by the general management system (i.e. if there is not an energy management).

Analysis of the value chain demonstrates, if necessary, how energy is the veritable nervous system of a firm, more so than the information system, which is generally presented as such. Why is a resource seemingly so critical[1] not actively managed by firms?

Energy for (Most) Firms: a Non-Strategic Issue

Strategy means to define the long-term activities and goals of an organization according to its internal resources and to external factors, in order to build a durable competitive advantage. To reinforce or develop a competitive advantage means to do better and/or to be less expensive than the competitors. In other words, competitive advantage is the relationship between the perceived value – meaning the value attributed to a product by the client – and the costs of production for the firm. Risk is the third dimension of the competitive advantage: for example, a firm cannot choose a new, less expensive, supplier if the source is not reliable.

The resource-based view analyzes resources – or combinations of resources – in terms of their contribution to the firm's competitive advantage. Competitive advantage allows a firm to differentiate itself from the competition, to create value and to survive in the long term. According to the resource-based view, a resource only allows the development of long-term competitive advantage under conditions of specificity (belonging to a particular firm) and non-transferability (difficulty in duplication). These conditions are generally met not at the level of

[1] 'Critical' is this context means indispensable to an organization's functioning (Pfeffer and Salancik 1978)

one single resource, but at the level of combinations of resources which will form an organizational capability. Energy, in its various forms, does not normally possess these characteristics of specificity and non-transferability. However, energy can become a specific resource difficult to duplicate, and can even constitute a veritable organizational capability for a firm in two cases: production for a firm's own use, and energy management. In these two cases, the direct and indirect strategic benefits are numerous for the firm.

Most firms regard energy as a cost only and not as a potential source of risk and value. This implies that, where its cost is low - or invisible - energy will be neglected. Actually, firms have a commodity view (Eyre 1997; Stern and Aronson 1984) as opposed to a resource view (in the strategic meaning) of energy. Firms do not consider energy as a strategic resource because they consider energy's contribution to their competitive advantage to be negligible. This is the reason for the lack of interest shown by firms in regard to energy and to any investment in energy efficiency. The non-strategic nature of energy for firms is the first meta-barrier which underlies the other barriers identified by research and practitioners.

Energy Culture

The fact that firms do not consider energy as a strategic resource cannot be explained solely by the objective reasons discussed above. A more general framework underlies the dominant commodity view of energy: energy culture.

One famous definition of culture, in the management field, is Hofstede's description (2005) of culture as a mental program, the 'software of the mind' which will (only partially, as individual personality also plays a role) determine a person's behavior. This is because culture is founded upon basic assumptions which take things for granted, neither challenged nor questioned (Schneider & Barsoux 1999, 22). These assumptions give rise to different beliefs and values[2]. Values and beliefs in turn influence attitude[3] -people's idea, convictions or tastes- and behavior -what people are doing. What is important is not the behavior itself, but the meaning of the behavior, as the same behavior can have different meanings and different behaviors can have the same meaning.

Human and social dimensions of energy use have been extensively studied by behavioral research (Lutzenhiser, 1993; Stern, 1992; Stern and Aronson, 1984). Values, beliefs and attitudes have been analyzed as well as energy-use patterns and energy users' behaviors. But not enough attention has been given to the cultural dimension of energy use and to the basic assumptions on which this dimension is founded.

What is the occidental energy culture? It is one of a highly centralized, monopolistic (once a state monopoly and now, at least in Western Europe, a business monopoly or oligopoly) and remote system, producing energy far away from its place of consumption and delivering it sometimes over hundreds of kilometers. This system has been in place for almost two hundred years now, and has slowly built up what could be called a "fairy energy" culture. This term is borrowed from an old-fashioned expression, common in Western Europe a few decades ago - 'Fairy Electricity'- to illustrate the common and unconscious assumption that energy is coming

[2] 'Beliefs are statements of fact, about the way things *are*. Values are preferred states about the way things *should be*, about ideals' (Schneider & Barsoux 1999, 27).

[3] 'Attitude is representing a person's idea, convictions, or liking with regard to a specific object or idea. … Attitude represents a predisposition to respond to an object, not actual behavior toward the object … Attitude is a latent variable that produces consistency in behavior, either verbal or physical' (Churchill & Jacobucci 2002, 366-367).

from an unknown, almost magical, source and can be consumed as a limitless commodity. This is especially true with electricity. Electricity is unconsciously regarded as readily-available and as free as the air we breathe. Electricity is taken for granted. Where does it come from? From the wall…

One basic assumption of a 'fairy energy' culture is the association between energy and freedom, between energy and the 'good life': 'energy confers goods and services, upward social mobility, and 'the good life'. Shortages of energy are seen to portend national weakness, economic stagnation, and an end to 'the good life'.' (Stern & Aronson 1984, 46). Energy is the symbol of the 'ever-increasing' way of life.

Another basic 'fairy energy' culture assumption is that energy is out of consumers' control (regarding production *and* consumption). This is important, as the assumption of control is connected to the desirability of taking action (Schneider & Barsoux 1999, 33). When people feel they don't have control over an issue, they are more likely not to take action. They become fatalists. A fatalistic customer doesn't switch to another supplier or energy source. And, of course, he doesn't even think of producing his own energy.

Thus, freedom is only apparent as 'the biggest business in the world'[4] has shifted control from individuals and local communities to large-scale corporate organizations. In this system, the final consumer is generally fatalistic and thus passive (and prisoner). Energy-producers maintain the illusions of freedom and uncontrollability - and the passivity of their consumers (individuals and organizations) - in order to protect their industry against any competition detrimental to their profits. Publicity campaigns of European electricity producers brilliantly illustrate this strategy. The publicity shown in Image 1 below is extracted from the campaign of winter, 2004 'You have energy' of Electrabel, the Belgian energy-producer.

Image 1. Electrabel Advertising Campaign

Source : Electrabel. www.electrabel.be

The influence of the energy system's characteristics on energy-efficiency decisions has been underlined by Eyre (1997). Rational use of energy, based on reason, cannot compete with

[4] *'If you had to name the world's largest industry, which would you pick? No, not the information technology or telecommunications, nor defence or car manufacturing. Lee Raymond, the chairman of ExxonMobil, has the answer: 'Energy is the biggest business in the world …'.'* The Economist, Feb. 8th 2001

the magic of fairy energy. Consumers' fatalism towards energy leads to their passivity and disinterest in energy management and energy (self-) production.

A 'fairy energy' culture, as kept alive by the energy industry, constitutes the second meta-barrier, more important than the non-strategic character of energy for firms (first meta-barrier). Moreover, the debate regarding the evolution towards a more sustainable energy system is more a debate between centralization vs. decentralization –decentralization means a loss of control for traditional energy-producers– than, as it is usually envisioned, a debate between fossil and renewable sources of energy.

Buildings

Buildings are a long-term asset. Therefore, an energy-efficiency investment can increase the building's financial value. Apart from that, a large part of what has been said about energy applies to commercial buildings: they are a part of the physical component of the firm and as such discredited by the firm's management. With the exception of companies operating in the building industry, firms consider their commercial buildings as part of their support activities, seen as less and less important (which explains the growing success of outsourcing to facility management). Furthermore, buildings are not considered as strategic because of a general lack of knowledge about them, as well as about the indirect benefits of their comfort and security. Their contribution to competitive advantage is, therefore, similarly envisioned only in the cost dimension, to the exclusion of the value and risk dimensions.

But the strategic dimension of buildings for their business users can -and must be- underlined: a building is the vehicle that brings a company to its stakeholders (communications and image) and brings energy to a company (in the case of a conventional energy system). It can alternatively be an energy producer (in the case of a decentralized system) which further increases its importance.

Reassessing the Barriers to Energy-Efficiency Investments

Building on the previous discussion of the non-strategic and cultural dimensions of energy for a firm, we can now propose a reorganization of the concept of barriers around four categories. The first two categories are those identified and discussed until now by the literature on energy efficiency:

'Base' barrier: concerns information and cognitive problems - that is, lack of knowledge of energy-efficiency measures and their technical and financial aspects. Although this is an important barrier, it is not sufficient to explain a firm's negative decisions regarding energy-efficiency investments.

'Symptom' barriers: so designated because they express signs of strategic and cultural problems. Symptom barriers comprise the numerous barriers to energy-efficiency investments that have been identified and discussed by energy economics research. An example of a symptom barrier is capital access, which is often mentioned as a major barrier: in fact difficult access to capital is the result of the lack of strategic qualities that firms attribute to energy-efficiency projects.

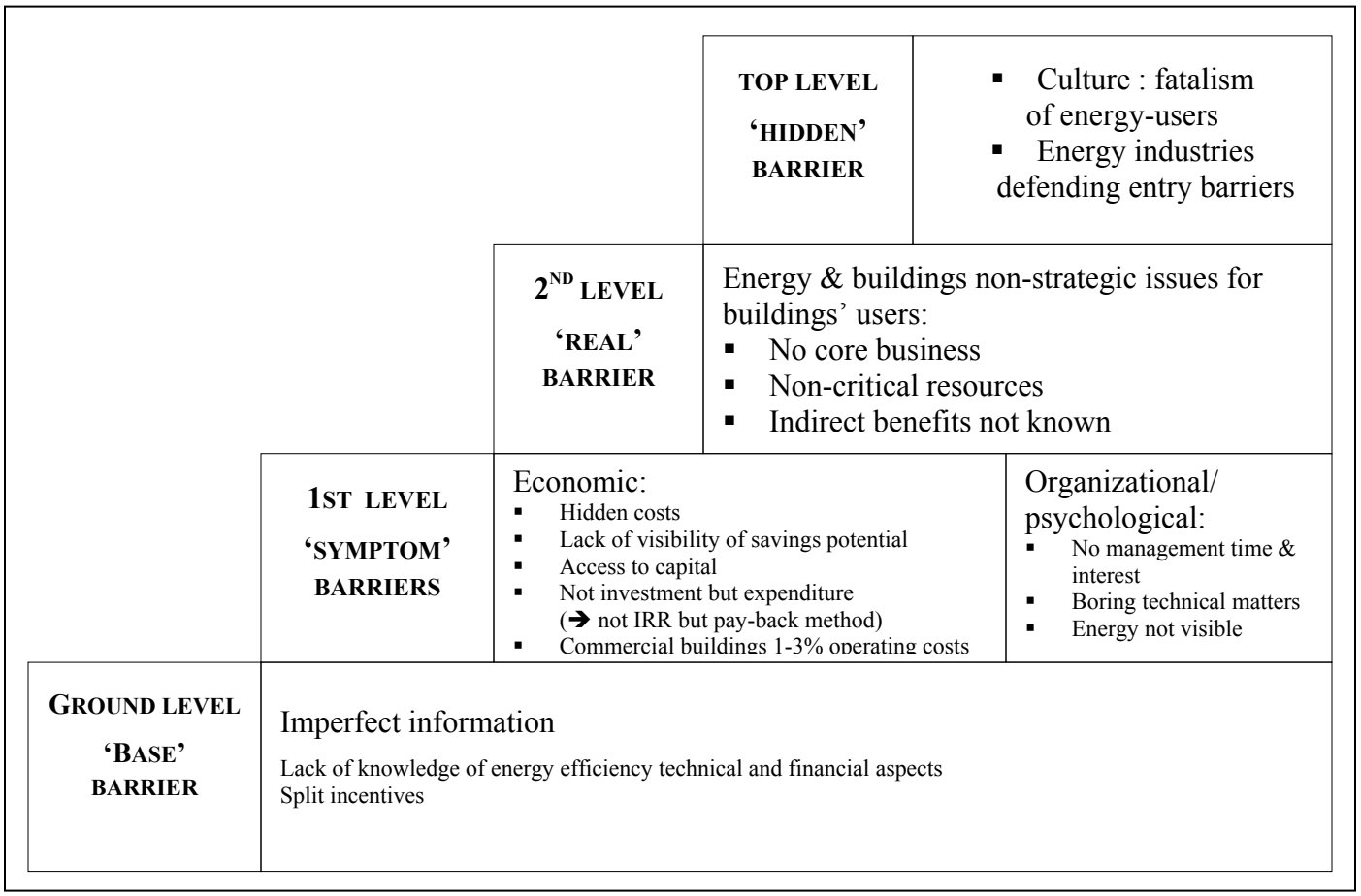
The two upper levels constitute meta-barriers, a framework in which the other barriers can be described (Eyre 1997), but which also determines energy use, routines and decisions/non-decisions within firms:

'Real' barrier: concerns the non-strategic character of energy for user-companies, which consider energy neither as a part of their core business, nor as a contributor to their competitive advantage, nor as a critical resource, for the risks to the security of energy supply are ignored. In addition, the indirect benefits of energy management are poorly understood.

'Hidden' barrier: the most important barrier of all, "hidden" because it subconsciously influences the behavior of decision-makers. A 'fairy energy' culture barrier, founded on the unconscious assumption that energy is coming from an unknown, uncontrollable and almost magical source, and can be consumed as a limitless commodity. A centralized energy system is delivering energy to fatalist and passive consumers, under the control of the energy industry defending its profitability against any form of competition.

Figure 2 represents the conceptual scale of barriers to energy efficiency in buildings.

Figure 2. The Energy-Efficiency Barriers



Consequences of the Real and Hidden Barriers

The consequences of meta-barriers on how energy is considered within firms are considerable: energy is not visible in any of the controlling system dimensions (with the exception of the primary activities of energy-intensive industries): goals, information/communication, monitoring, and rewards. One cannot manage what is not measured.

Another paramount consequence of the supposedly non-strategic character of energy is the way an energy-saving project is treated by the corporate accounting and controlling systems: when energy efficiency is the main reason for the action under consideration, the expenditure will often be treated as a general expense and *not* as an investment. A general expense is written in a firm's income statement and reduces its operating profit. When the expense can be compensated by future income –which is normally the case with energy-efficiency expenses- the payback required is very short (ideally less than a year in order not to impact on profit). On the contrary, an investment is written as an asset on the balance sheet. It involves a different method of calculation (Net Present Value or Internal Rate of Return) and a longer payback. This has generally not been noticed by the economics literature on energy-efficiency investments: in many cases, the subject studied itself doesn't exist as there is … no investment. When the energy-efficiency project is considered as an investment, it will be in competition with other investments, which will probably 'win the race' if they are related more closely to a firm's core business.

A few years ago, corporate non-strategic view on energy did not seem groundless: security and reliability of energy supply were guaranteed, and indirect benefits of energy management were unknown. Today, the situation is rapidly changing, but people and organizations are not adapting their behavior, or very slowly. The meta-barriers framework explains why change is so slow in times of growing insecurity of energy supply, rising prices and global warming. It also indicates the way to change energy-users' behavior: by acting upon the basic, unchallenged assumptions underlying the fairy energy culture: freedom and uncontrollability.

The Process and Context of Energy-Efficiency Investment Decisions

However, not all firms behave in the same way. Some of them consider energy as a strategic resource and do manage energy. Meta-barriers to the efficient use of energy do not have an equal influence on all companies. Why? What are the drivers of a firm's energy behavior? Research has demonstrated that, contrary to the assertions of neo-classical theory, characteristics of firms do indeed matter (DeCanio, 1993, 1998; DeCanio & Watkins 1998). Similarly, Lutzenhiser et al. (2002) have identified different behaviors across similar organizations. The reasons are complex, deriving from a firm's history and culture. Extensions or alterations of the neo-classical economics model are not sufficient to explain - let alone predict - corporate behavior regarding energy in general and energy-efficiency investments in particular. A new theoretical model is needed.

Energy-savings investments have not been studied by business sciences, but investment has traditionally been an important topic for finance. However, traditional neo-classical finance is more prescriptive than descriptive, more interested in evaluation methods than in the reasons explaining why, in the real world, certain investment decisions are made and others not. Neo-classical finance is contested because of the fact that practices observed don't correspond to its prescriptions. As revealed by a certain number of empirical studies (Charreaux 2001, 20, mentions three studies), the evaluation process seems to play a relatively minor role in investment decision-making. Therefore, similarly to neo-classical economics, neo-classical finance has enlarged its perspective: organizational finance has been investigating the factors driving firms' investment decisions, trying to understand the influence of organizational characteristics on these decisions.

Decision-making research applied to the fields of change management, innovation and investment, has shown that the formal decision is the result of a chain of events in which the first steps and the actors involved are especially important (Desreumaux & Romelaer 2001).

A useful theoretical framework, consistent with these developments, is the processual/contextual approach, a label which refers not to a theory but to 'a range of processual perspectives on various aspects of organizational functioning', which has in particular dominated the debate on organizational change since the 1990's. This approach 'claims that it is necessary to understand how the substance, context and process of organizational change interact to generate the observed outcomes' (Buchanan & Huczynski 2004, 627). This means putting the phenomenon studied in a double perspective: a dynamic perspective where a firm's history and the processual flow of events are taken into consideration, and a contextual perspective which considers the organizational process within its internal context (the organization) and external context (the organization's environment). The organizational context comprises individuals and groups, linked by interest and power relationships, and organizational characteristics. Desreumaux and Romelaer (2001) consider two levels of internal context in which the first level influences the second one (for example, the size of a company influences its structure).

Applying the processual/contextual approach to investment decision-making entails the following steps: first, it is necessary to consider the inception of the investment idea and the whole investment decision-making process (ending with the formal decision-making). This also means considering where in the organization the investment idea is emerging, who are the actors or groups of actors involved, what is the history of the company regarding similar investments, etc. Second, the various contextual factors influencing the investment decision-making process must be identified and analyzed. Third, the investment substance must be analyzed. This refers to the investment type (for instance, tactical or breakthrough, replacement or new type material, modular or non modular, etc.), and to its technico-economics characteristics.

The diagram below represents the processual/contextual approach as applied to corporate investment process.

A processual/contextual approach to the investment decision-making process has two main strengths: it recognizes the complexity of investment decision-making, drawing attention to the many factors interacting at different levels in and around the organization, and to its temporal, dynamic, dimension. And it is a rather general analytical framework which can integrate many different concepts and previous research findings. However, this approach may lead to over-complexity and a careful analysis is necessary to identify the main factors acting on the process.

A Two-Step Energy-Efficiency Investment Drivers Model

Combining processual/contextual and meta-barriers frameworks to analyze corporate energy-efficient investments drivers, we can now propose the following model (portrayed in Figure 4) representing the main factors influencing the corporate decision-making process in energy-efficient investments.

Figure 3. The Process and Context of Investment Decision-Making

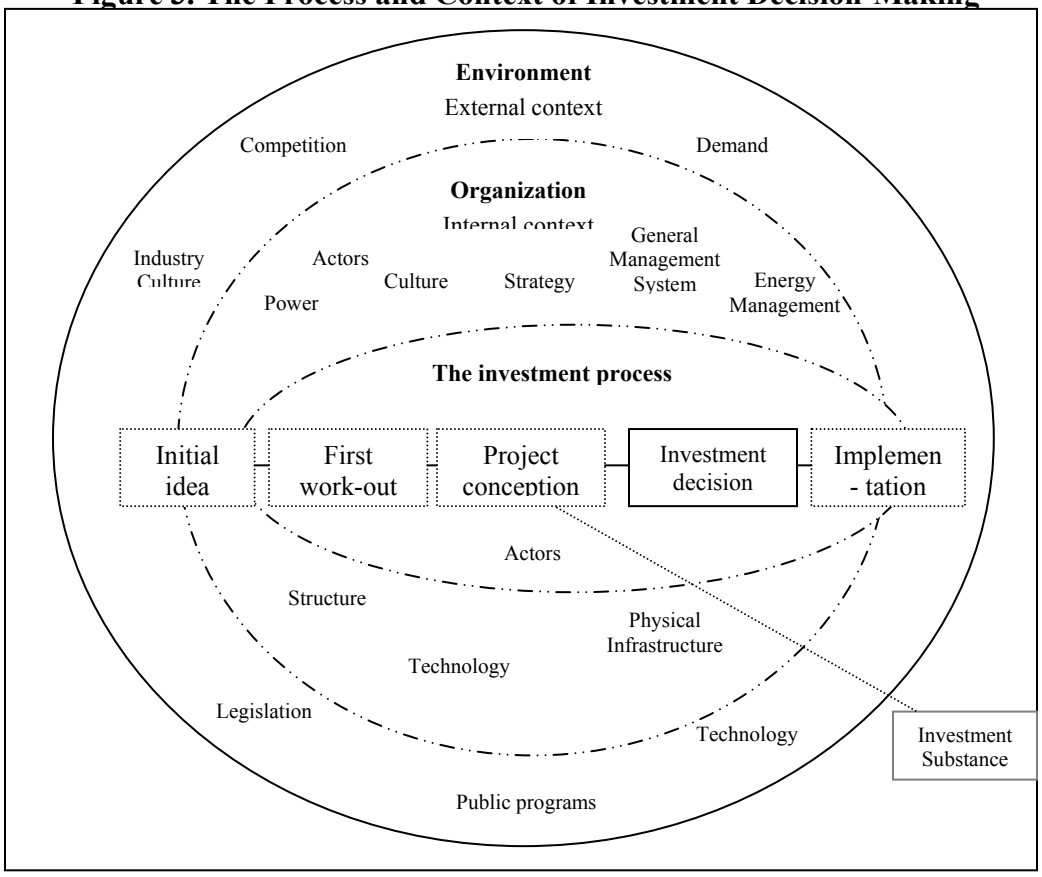
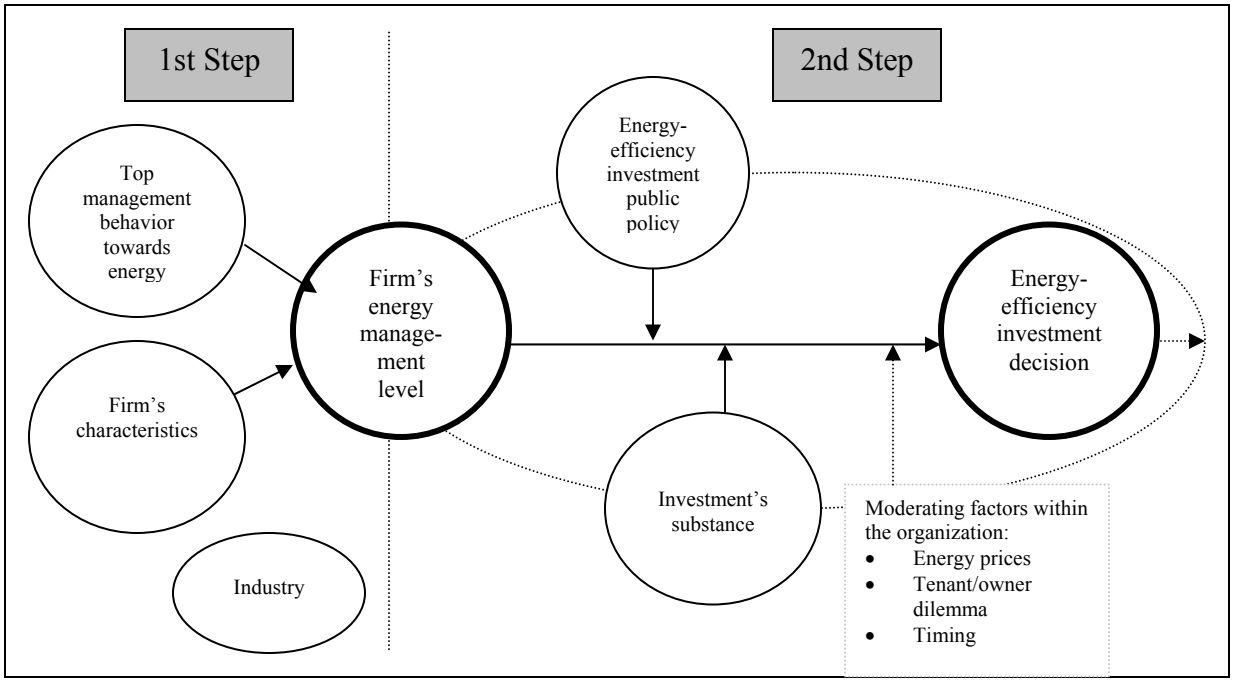


Figure 4. Energy-Efficiency Investment Drivers: 2-Step Model



Step 1 of the Model

According to the processual/contextual perspective, an investment decision must be analyzed as a step in a dynamic process, itself influenced by its internal and external contexts. Therefore, we can assume that barriers to energy efficiency should not be sought at the level of investment decision itself, but in the broader context of the 'energy status' in a firm, meaning the importance attached to energy by a firm and, therefore its visibility within the management system. Our hypothesis is that energy status determines the way energy efficiency is considered by the firm and, therefore, influences the investment process and decision-making. Energy management is a good indicator of energy status. The important question of the model's first step is to understand which are the drivers of the firm's energy management level (dependent variable).

Internal context factors are the most important in this regard: the firm's energy management level is mainly influenced by cultural characteristics of the firm itself and of its upper-management. Culture plays a paramount role; or more precisely, several 'spheres of culture' (Schneider & Barsoux 1999, 47) - national and regional, industry and company, professional and functional - interact to influence business practice and individual behavior within firms.

A firm's culture is influenced by the industry in which it operates. We hypothesize that four dimensions of the firm's culture (industry, nationality, change culture and environmental culture) do influence the firm's energy management level. The role of another internal context factor, the control of the company, must be analyzed as well: a public company would be more short-termist and less inclined to energy-efficiency investments.

Spheres of culture also interact with the general 'fairy energy' culture, determining the way individuals consider energy and leading to different behaviors regarding energy in the workplace. Among firm's individuals, the upper-management is especially important because of its general influence on the organization (Hambrick 1984; Hennicke et al. 1998). Top management's cultural characteristics (professional and functional) determine their basic assumptions, beliefs and attitude towards energy: for instance, we hypothesize that finance managers are less inclined to energy-efficiency measures than managers with an engineer background.

Step 2 of the Model

The second step of the model is specifically related to the investment process and to the final investment decision (dependant variable). The primary relationship to be tested here is the influence of the firm's energy management level. We hypothesize that firms with active energy management will invest more in energy-efficient technologies.

At this stage, external context factors and the investment substance combine with the firm's energy management level to influence the investment decision-making process and the final decision. Technico-economic and strategic characteristics of the investment (investment's substance) and energy and climate public programs influence the final decision. Some contextual variables have a moderating effect on the investment process: timing (anticipation of legal norms and reinvestment cycle), split incentives and energy prices.

Conclusions and Next Steps

This paper has presented an analysis of the drivers of firms' behavior regarding energy-efficiency investments, pointing to the necessity of a broader, twofold perspective. This means considering the investment decision as a (minor) step of the whole investment process (processual dimension) and inserting the investment process within the contexts of the organization and of the organization's environment (contextual dimension). This processual/contextual perspective must include the strategic and cultural meta-barriers underlying firms' behavior, which were discussed in the second section of the paper.

Based on this conceptual framework, we have built a model describing the factors driving corporate energy-efficiency investments. The model's hypotheses have yet to be empirically tested. This will be done soon in a cross-sectional study relying on a sample of about one hundred and fifty firms, counting among them Geneva's (Switzerland) major energy consumers. These firms are participating in an important Demand-Side Management Program organized jointly by the Geneva Energy Office Planning and the local Utility, SIG.[5] However, even if the model's hypotheses were rejected following the results of the empirical study, the processual/contextual framework proposed here would remain a right theoretical approach. The model would have to be adapted and new hypotheses would have to be formulated and further tested.

The final aim of our analysis and of the coming research is to integrate firms' predicted behavior into public programs for energy and climate policies. If empirical results confirm the link between energy management and energy-efficiency investment, then public programs should focus on companies with a high level of energy management, with complementary programs focusing on benchmarking communication to embark on low level energy-management companies. Measures should also be taken upstream in companies of the second category to convince them to adopt a more active energy management. Generally, public programs should devote more attention to the first stages of the investment process, and to the actors and interests involved.

Finally our analysis leads to the necessity of broadening the corporate perspective on energy and buildings: that is, switching from a technico-economic approach to a strategic approach. Ultimately, the issue to be further analyzed is the contribution of strategic energy management to firms' performance.

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[5]. The empirical study is starting right now (May 2006) with the questionnaire testing. We hope to be able to give the first research results at the occasion of the ACEEE Summer Study.

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