On Corporate Sustainability Reporting

Case of Electric Utilities

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Dissertation submitted to the Faculty of Engineering of University of Porto

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Sustainable Energy Systems

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Porto 2013

To my sons, light of my life

Acknowledgements

The work of this thesis, developed over the past four years, was a endurance path full of challenges and exciting discoveries. The arrival to a good end was only possible with the valuable support of all who have followed this journey and to whom I wish to express my most sincere gratitude.

First and foremost, to my supervisor, Professor Oliveira Fernandes, my gratitude for the trust, the tireless support, the valuable guidance and the wise inspiration.

To Professor Isabel Soares, my co-advisor, I will never thank enough the serene dedication, the inspired suggestions, the always constructive support and the sincere friendship.

I am sincerely grateful to Professor Vitorino Martins for the availability and friendliness and by the carefully guidance into the intricacies of the econometrics and statistics tools. His support has been crucial for this investigation.

I also thank to the entire team of teachers in the Program, with a special thank to Professor António Martins for his contagious enthusiasm, encouragement and inquisitive irreverence on the issues under study.

To my colleagues Ana Neves, Carlos Sousa, Filipa Carlos Gustavo Sousa, Manuel Rocha, Maria Kapsalaki, Miguel Silva and Pedro Silva, who closer shared this challenge, my thanks for the friendship and for the stimulating discussions on issues of sustainability and energy.

To my parents, Isabel and Francisco, my gratitude for the always attentive support and care and for their solid, unifying and peaceful presence at the core of our large family.

To my brothers, my sister, theirs families and friends, thanks for believing in me and for our lively and heated debates, which certainly contributed to apprehend other postures and positions.

To my sons, Afonso e Rodrigo, source of my inspiration and perseverance, thank you for the comprehension and love.

To my husband Orlando, my deepest gratitude for the patience, the availability and the unconditional support, for the calm and lucid presence in all moments, for the companionship on my wanderings, even in the roughest roads and in the stormy tides.

Thank you all

Abstract

This thesis presents a proposal to address the environmental, social, economic and financial information, generically reported by European utilities for electricity production and concentrate that information on a limited set of indicators, capable of widespread application. These indicators represent the activities and contributions of these companies in terms of internal and external sustainability.

A current challenge for companies is the measurement of social, environmental and economic performance which, in corporate scenario, is being considered fundamental for business success. Besides, corporations are recognized as sized actors of environmental disturbance, either by direct action as by indirect action through the induction of social and economic effects.

European electricity utilities were chosen as the object of the present study, both because having a large impact on social, economic and environmental issues and because integrated in a regulatory and market specific context.

Although several frameworks are available for reporting on Sustainability and on Corporate Social Responsibility (CSR), they still appear incomplete mainly due both to a lack of maturity in the concepts and to the shortage of operational disclosure tools. In general, indicators commonly presented by companies to monitor their economic, environmental and social performance, exhibit a great diversity of metrics, calculation formulas and basic concepts even within the same sector. Monitoring the evolution of the global behavior of each company is still hampered by the use of a very broad set of indicators, some of them with a qualitative character, which in most cases do not relativize the differences according to the company size and production capacity. For these reasons, company's individual performances and achievements are hardly compared.

Consequently, the focus of the work presented in this thesis is on the application of multivariate techniques, in order to condensate a large amount of data into a set of electricity industry representative indicators, with the minimum loss of information.

The use of Principal Components Analysis technique allowed to identify, from a large set of relativized indicators, those with a stronger explanatory power, which act as representatives of all the other.

The principal components identified, showed to be aligned with the conceptual foundation of the corporate contribution for sustainability, adopted in this thesis. The methodology, which presents a quite innovative character when applied to sustainability indicators, proved to be adequate and provided valuable outputs.

Keywords: Corporate reporting, sustainability, corporate social responsibility, European electricity industry, factor analysis, principal components analysis, industry performance indicators.

Resumo

A presente tese apresenta uma proposta para tratar a informação ambiental, social, económica e financeira, genericamente reportada pelas empresas europeias produtoras de electricidade e concentrá-la num conjunto limitado de indicadores, susceptíveis de utilização generalizada. Estes indicadores representam as actividades desenvolvidas e os contributos destas empresas quer em termos da sustentabilidade interna, quer externa.

Um desafio corrente para as empresas é a medida do seu desempenho económico, financeiro, ambiental e social, que no cenário corporativo é crescentemente assumido como fundamental para o sucesso dos negócios. Por outro lado, as corporações são reconhecidas como agentes dimensionados de perturbação ambiental, quer por acção directa, quer indirecta, através dos efeitos que induz ao nível económico e social.

As *utilities* europeias de produção de energia eléctrica foram escolhidas como objecto do presente estudo, quer por apresentarem uma influência significativa que decorre das suas actividades, em termos sociais, económicos e ambientais, quer por integrarem um contexto específico em termos regulatórios e de mercado.

Embora diversas linhas de orientação estejam disponíveis para estruturar o reporte da sustentabilidade e da responsabilidade social corporativa (CSR), carecem ainda de complitude e representatividade, principalmente devido à imaturidade dos conceitos e à escassez de ferramentas operacionais para apresentação da informação. Em geral, os indicadores comummente apresentados pelas empresas para monitorizar a sua performance económica, ambiental e social, exibem uma grande diversidade de métricas, fórmulas de cálculo e conceitos básicos, mesmo entre as empresas de um único sector de actividade.

A monitorização do comportamento global corporativo baseia-se ainda na utilização de vastos conjuntos de indicadores, alguns com carácter qualitativo, que em geral não relativizam as diferenças associadas à dimensão ou capacidade produtiva. Por estas razões, o desempenho e as realizações de cada empresa, são dificilmente comparáveis com os das suas congéneres.

Consequentemente, o trabalho apresentado nesta tese centra-se na utilização de técnicas multivariáveis, com o objectivo de condensar um vasto conjunto de dados, num conjunto de indicadores representativos do desempenho da indústria de produção de electricidade, com uma perda mínima de informação. O uso da técnica Análise de Componentes Principais permitiu identificar as variáveis com maior poder explicativo, que actuam como representantes de todas as outras.

Os componentes principais identificados, demonstraram estar alinhados com a fundamentação conceptual da contribuição corporativa para a sustentabilidade, adoptada nesta tese. A metodologia, que apresenta um carácter inovador pela aplicação aos indicadores de sustentabilidade, provou ser adequada às questões de investigação e proporcionou relevantes resultados.

Palavras-chave: Reporte corporativo, sustentabilidade, responsabilidade social corporativa, indústria europeia de electricidade, análise factorial, análise de componentes principais, indicadores de performance para o sector.

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Abbreviations and acronyms

General

CFP	Corporate Financial Performance
CEO	Chief Executive Officer
CO_2	Carbon dioxide.
CSR	Corporate Social Responsibility
CSRR	Corporate Social Responsibility Report
EC	European Comission
EGS	Environmental, Social and Corporate Governance
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIC	Gross inland consumption
GNP	Gross National Product
IEA	International Energy Agency
EVD	Economic value distributed
IFRS	International Financial Reporting Standards.
KPI	Key Performance Indicators
NO_x	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreement
SKPI	Sustainability Key Performance Indicators
SO_2	Sulphur dioxide
SR	Sustainability Report
TSO	Transmission System Operators

From Methodology

SFA	Stochastic frontier analysis
OLS	Ordinary least squares
FA	Factor analysis
DEA	Data envelopment analysis
PC	Principal component
PCA	Principal component analysis
CFA	Common factors analysis

1. Introduction

Generically sustainability describes the characteristic of a process that can be maintained indefinitely at a certain level. The concept as the intrinsic meaning of preserve, resist and endure. It is a rather new concept that firstly acquired particular visibility under the environmental perspective.

After the industrial revolution, the increasing consumption of natural resources was followed by the corresponding generation of waste, in such quantity and with such characteristics that could not be entirely processed by ecosystems. The depletion of resources has been accompanied by the awareness of its scarcity. The pollutant emissions were soon associated with issues of loss of quality of life. Due to human intervention the functions of ecosystems have been affected and accordingly the environmental balance changed (Arrow et al. 1995; Schumacher 1973; Singh et al. 2009). For some, the sustainability of earth and consequently of humankind was compromised (Schnaiberg 1980; Brown et al 2010; Schumacher 1973).

Although the concept of sustainability is widely used, it is likely to be interpreted in different ways. Accuracy still lacks in its definition. Most interpretations of sustainability take as their starting point the consensus reached by the World Commission on Environment and Development (WCED) in 1987 (Brundtland Report) and, since then, the concept was subject of several interpretations in some cases with mutually exclusive meaning depending on the context, the user or the goals to achieve (Redclift 2005).

The fully operationalization of the sustainability concept as taken a long way until the 2004 Johannesburg Conference, when it was assumed as having a three-fold expression: environmental, social and economic.

Is this perspective, the demand for long-term equilibrium implies the development of consistent management of resources over time, not simply through the use of resources at a rate, which could be maintained without diminishing the levels for future generations, but meeting the environmental, social and economic impacts in short and long term.

Given the aforementioned problems, the concept suggests a reminder for the inter-generational equity of opportunities and resources. The options taken in the present will affect the future generations opportunities and welfare, as also it conditions the range of available options. The capacity of ecosystems perform their functions and the level of resources to bequeath to future generations will affect their own ability to survive (Weinberg, Pellow and Schnaiberg 1996; Gray and Milne 2002).

Social and environmental issues have intertwined impacts that transcend national boundaries. Most of environmental issues are reflected in the overall level, regardless of their geographical origin (Egri and Ralston, 2008). The globalization of trade has raised several questions referring regional disparities, namely those related to environmental performance, human rights, working conditions, resource exploitation or business ethics (Logsdon and Wood, 2002; Williams and Aguilera, 2006).

Human activities appear to be the main driver for much of the present imbalance, once they have environmental, economic and social implications and in the reverse way, human activities are also increasingly conditioned by this disequilibrium. Global problems, such as climate change, are now well known and are increasingly understood as threats to human kind survival.

Yet, neither public nor private agents act at one dimension and in isolation. The corporate sector integrates complex organisms (companies) whose activity implies large social, environmental and economic impacts, in some cases at a worldwide scale.

Following Porter and Kramer (2011), business is commonly perceived as building its profit at the expense of the exploitation of common resources. The legitimacy of business is increasingly questioned, as they are given responsibility for much of the environmental and social problems resulting from its activities.

Corporations, from their side, are certainly part of the commitment to promote the sustainable development. They are asked to recognize sustainability as a concept to be applied to the development of their own activities and long-term strategies, while assuming greater responsibility toward society and environment. The fact that they are organized structures may favor the process of change towards a more sustainable behavior, if in the presence of the right conditions and motivation.

The concept of sustainability applied to business may be faced from two interconnected and interdependent perspectives . An inner vision, which refers to the company's ability to survive on a long-term and an broader vision, which refers to the company's contribution for the sustainability of the planet.

If on one hand, the internal sustainability depends on the understanding of the present, on the apprehension of the emerging trends and on the development of appropriate strategies, on other hand it conditions and it is largely constrained by external context.

The aforementioned, results into a systemic, interactive and holistic vision, whereby companies integrate a grid of relationships that they influence as economic agents, but in turn they are conditioned by the context in which they move.

This represents an increasing awareness of the dual role of companies as resource consumers and polluters, but also as key elements in the construction of collective welfare and therefore essential agents for the sustainability of the planet.

The energy sector is fundamental for sustainability. The sector's contribution both for the depletion of natural resources, for the pollutant emissions and for the creation of social well-being is undeniable (Azapagic and Perdan 2000; Azapagic 2003).

The challenges that the sector is presently facing are closely related to environmental, economic and social issues. Strategic investment decisions, relevant to ensure industry competiveness and social welfare, are being made with increasing attention on aspects such as global warming or renewable energy sources.

A new energy paradigm is being designed and promoted. It is based on the use of renewable energy, the flexibility of distribution networks, the integration of individual producers, the investment in energy efficiency, the promotion of research and the application of technological developments.

However, although having recorded significant improvements in the efficiency of resource use and in promoting the use of renewable sources, the sector is still heavily dependent on raw materials of fossil origin, largely from external sources.

A worldwide increasing in electricity demand is a trend perfectly defined for the next decade that will be countered with new investment and hopefully with increased efficiency, either in production and in use.

Electricity production requires high investments and is responsive to long-term risks. These risks arise from the expected useful lifetime of production units, which is sensible to changing factors, as the access to scarce raw materials or the emerging constrains, namely those relating to water, waste or air emissions.

As generation units, for example, are expected to operate for several decades, energy industry managers have to foresee operational long-term horizon while having to deal with rapidly changing incentives and restrictions.

The electricity industry in Europe plays a central role in European sustainability scenario.

European electricity production is still largely based on fossil fuels and on nuclear generation, which implies long-run impacts mainly associated with green gas emissions and waste management. The impact on the environment, health and safety from nuclear power plants have led some European countries to define policies leading to the decommissioning of its nuclear sites.

Moreover, most European countries have followed a liberalization agenda in the sector. This situation, coupled with further deregulation, demands the setting of benchmarks to assess potentials for international efficiency improvement among electricity market agents.

The standpoint of the consumer is that electricity is, by own nature, a uniform product. Seemingly the price is the only differentiation factor. However, the growing information and consumer awareness about environmental and social issues, may sustain decision-making based on sustainability performance of the electricity generator. Intrinsic differentiation can be built from the weighting of different primary energy sources in the production mix, the externalities not assumed or the relations with the community and employees. In a foreseeable future, those and other issues may become constraining for the consumer's decision when selecting the generator of electricity.

Consumers, investors, managers and regulators are looking for credible, reliable, relevant, usable and comparable data, to use for the decision making, the definition of strategies, the evaluation of performance or benchmarking (Edvardsen and Førsund 2003), (Jamasb and Pollitt 2003).

From the above, can be concluded that a strong business model for electricity, requires a real concern about the ability to survive the very long term, while assuming and dealing with the responsibilities arising from the activities performed. Success over time depends also on addressing stakeholder’s needs and expectations as much as to secure confidence in the company.

As larger resource users and world impacters (on economic, social and environmental dimensions), electricity industries play a main role on leading the way for maintain and improve world’s sustainability.

Long term survival, stakeholders engagement, confidence, contribution and corporate responsibility, align the concept of sustainability that is being developed in this study.

2. Research Questions

Sustainability is being increasingly assumed as a responsibility for public and for private corporate entities. The corporate sector comprises complex organisms whose activity implies large social, environmental and economic impacts, in some cases at a worldwide scale. As economic agents, they are an important part of the sustainable development process.

Therefore corporations are no longer asked simply to act as good citizens by complying with the mandatory rules and regulations. Instead, they are asked to recognize sustainability as a concept to be applied while developing their own activities and long-term strategies. This means a compromise usually materialized in several corporate documents, from which Sustainability Reports (SR´s) and Corporate Social Responsibility Report (CSRR) are assuming an increasing importance both at corporate level and business overall concerns.

The objective of those reports is to assess and disclose to stakeholders and the community in general, the standard of sustainable performance that the organization achieved including environmental, social and economic information in the context of the defined long-term strategies, goals and compromises. But, the same way an accounting report doesn't guarantee by itself a good financial situation, a SR does not guarantee that good practices represent the main stream within a corporation.

On one hand, Sustainability Reports seem to contain many hard-to-verify or incomplete statements. A close survey of the available models of disclosure and reporting proved to be unreliable: the term "sustainability reporting" is being used in a partial way, once it refers only to deliberately exposed issues. In these cases, it subverts the aim and misleads the readers (Gray 1997; 2001; Kolk 2004; Meehan et al. 2006; Adams 2004; 2007; 2008; Adams and Evans 2004; Larrinaga-Gonzalez and Bebbington 2001; Bebbington et. al. 2007; Owen et al. 2000, Hess and Dunfee 2007, Martins et al 2007, Doane 2005; Arnold 2008; Hubbard 2009[a)]; Rahman and Post 2011).

On the other hand it is still not clear that the market recognizes and values the companies that are keen to become more sustainable, or even that the market distinguishes the efforts made by those companies (Alniacik et al 2010; Eccles and Krzus 2010; Weber 2008; Soppe 2009, Doane 2005, Arnold 2008). Moreover, some actions taken in the framework of corporate strategies for sustainability don't have directly to do with the intrinsic obligations of the company (e.g. the distribution of milk for African children should not be seen as a compensation for unfair labor practices or environmental pollution). In fact, reports may present only the positive

aspect of the overall behavior of the company, deliberately leaving certain practices that relate directly to the core activity of the organization in the dark (Adams and Evans 2004; Gray 2001; Owen et al. 2000; Meehan et al. 2006; Cooper and Owen 2007; Hubbard 2009[a]; Rahman and Post 2011). Frequently, the questions resulting from the way business is conducted, which directly affect communities, are not properly addressed (Doane 2005). Depending on the SR addressee's, internal sustainability issues are exposed (those referring to the ability to survive), but not the issues related to the contribution of business for global sustainability.

Yet, SR and CSRR are elaborated following international guidelines to assure standardization of form and contents. Business have available a panoply of tools and methods to assess, manage and report their sustainable performance, depending on the aim, the context and even the corporate own culture. However, several frameworks, codes of conduct or management standards, in some cases, overlap or present different focus. That makes difficult to discern and to make a proper judgment of what is being actually reported. There is a mosaic of approaches and methods that can lead to different results and therefore can induce to distortions on the evaluation and pursuit of corporate sustainability.

The apparent completeness of the current 'templates' may sometimes, if not always, hide the essentials, namely the indicators and the criteria to select and rank those that must be taken into consideration. This is not only a difficulty that results from the diversity of activities and sensitivities of actors from different regions of the Globe. The question is essentially related with the eventual hierarchy of sustainable values and the way to balance them (Gasparatos et al. 2008; Adams 2008; Arnold 2008; Hubbard 2009[b)]). Probably, the mix and the weighting of those criteria may differ from region to region. However, the issue of how to establish a proper framework to do that is still far from being fully accomplished.

Some authors reinforce the suspicions that remain on credibility of reports, mainly due to the interests of management and their influence over the reporting process, which undermines accountability and transparency before stakeholder groups (Adams and Evans 2004; Gray 2001; Owen et al. 2000).

The business adoption of CSR was mostly implemented in those areas offering economic gains in prejudice of other, in part, because adequate conceptual resources, to help managers integrate other aspects of CSR into their corporate strategies and operations, are still missing (Meehan et al. 2006).

Given the concerns about the content of the report and the assurance practices, other authors believe that this is a time for a theoretical thinking and an empirical examination focusing in particular on how to enhance accountability and transparency to stakeholder groups (O'Dwyer and Owen 2005; Adams 2008, Kolk 2004, Hess and Dunfee 2007).

The definition of a methodology to identify industry specific issues to report is leading to legitimate decision-making and ultimately to improve the overall level of industry performance (O'Dwyer and Owen 2005; Adams 2008, Kolk 2004; Bebbington et al. 2007; Ilinitch et al. 1998; Hubbard 2009[a]; Arnold 2008; Azapagic 2003; Lydenberg et al. 2010). Other authors, such Lee and Saen (2012), reinforced that companies find hard to measure and integrate in a systematic way the issues of sustainability, which is due to the insufficiency of tools to support operational integration. They urged the definition of a framework for sustainability focused on corporative practices and on operational performance assessment.

European countries have shown a long-term concern with environmental and social issues, namely those related with global warming, emissions of CO_2 and other greenhouse gases. However, they have not been accompanied by appropriate studies at the European level. Because the recent interest in CSR in Europe, there are few studies at the continental level (Azapagic 2003; Falck and Heblich, 2007; Delbard 2008, Ziegler et al. 2011).

Meanwhile, on the peculiar case of electric utilities there are few academic papers that address the key issues of CSR reporting. Public Utilities by their own nature and scope are intended to be accountable to various stakeholders. Because of providing a public service and for presenting large-scale impacts, electricity producing companies have accrued responsibility for reporting to their stakeholders. Therefore, disclosed information is subject to careful scrutiny and analysis. Electric utilities are a good example of having to deal with challenges emerging on a global scale.

Yet, most of these companies have been carefully preparing non-financial reports for the early years, they move between vast borders, enabling them to decide what to report or not. Even from the same industry, reports still miss from homogeneity of information along time and between peers. The lack of comparability makes it difficult to identify best practices and the markup the best results.

That raises the following question:

- How can relevant data be structured to contribute to the effective promotion of corporate sustainability?

Other questions are consequently raised:

- What must constitute the core of a SR? What must be identified as critical to be measured and reported in a commonly understood language?
- What are the reasons for the lack of comparability between reports?

The generic ambition of the present research is to contribute to assure accountability, to improve transparency, provide comparability and increase completeness on reporting, in order to enable benchmarking and effectively boosting Sustainable Development. It is intended that SR can express the real values and principles of each corporation and reveal its own contribution for sustainability.

A monitoring system based on comparable, relevant and representative indicators for industry critical issues, it is assumed as an important contribution to achieve this goal. The present work intends to test a methodology to signal key issues in terms of corporative sustainability and to identify a small set of indicators, obtained, as far as possible, free from bias and subjectivity of values, representing material contributions from European electricity producers to sustainability.

In order to address these issues, the following objectives are defined for this thesis:

1. Understand the state of sustainability reporting for European electricity producers. The furtherance of this objective requires the following activities:
   - Characterize the context of the energy producers in Europe
   - Identify the information reported and signal the causes for the failures of comparability among companies and among sectors

2. Propose a limited set of indicators relative, comparable and representative of the sustainability issues relevant for the electricity industry.
   The furtherance of this objective requires the following activities:
   - Propose and identify relevant indicators for the electricity production sector
   - Identify and apply methods of data reduction
   - Evaluate the results achieved
   - Relativize the performance of the sample relating to the indicators obtained

The structure of the document is organized in 6 chapters and annexes distributed as following:

Chapter 1 is an introductory chapter referring to the background material related with the research topic.

Chapter 2 (present chapter) exposes the problem statement, the research motivation, and the research questions. Research contribution is briefly formulated and a summary of the significant expected findings introduced.

Chapter 3 presents the review of the literature. As the study spreads over very differentiated areas relating to environmental, social and economic issues, a survey over the evolution of relevant concepts is performed. The importance for businesses of interrelations between the concepts of ethics, accountability, and sustainability, according to different authors, is further examined and discussed. Relates the framework of corporate sustainability with the difficulties in reporting and the objectives of the thesis.

In Chapter 4 the methodology selected is substantiated accordingly to the research question and objectives to attain. The mode of application on the sample selection, definition of industry critical areas and definition of indicators to collected is then described. The multivariate techniques to be applied are characterized and justified.

Chapter 5 refers to method implementation, starting with a brief review of European energy scenario and sample characterization.

Relevant indicators are ascertained through a initial collection of reported indicators, definition of industry relevant issues to debug the initially chosen indicators. For the four dimensions of corporate sustainability, relevant theoretical concepts are then proposed. A set of relative indicators is constructed taking into account both the pertinent industry issues and the proposed concepts. Descriptive statistics are calculated for relative indicators to assess the coherence of obtained results.

Principal Components Analysis is applied to relative indicators with the aim to identify the variables with high explanatory power, to detect components which explain the sustainability behavior of companies and to reduce data. Additional data reduction methods are used to understand general conduct and to relativize the performance of the sample among themselves.

Chapter 6 covers both presentation and analysis of results for PCA and additional data reduction methods .

Chapter 7 conclusions are presented as also some avenues for future work.

3. Survey of the Literature

"Yet in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs . . . Painful choices have to be made."

WCED 1987, Our Common Future

3.1. The early grounds of sustainable development

Sustainable development integrates economic, social and environmental issues into a holistic and dynamic perspective, essential for the redefinition of a new path for the evolution of mankind.

However, apart from the latest natural sciences contributions, the concept early roots are based on ethics and on economic thought, which are indissociable from social issues. The allocation of scarce resources for the satisfaction of human needs is the core of economic theory (Rossetti 1991) and it represents a pivotal concern of man's existence.

In fact, the economy cannot be dissociated from issues of sustainable development. The use and allocation of scarce resources for the satisfaction of human needs is the primary cause that has been conditioning the environmental and social issues since the beginning of humanity. But, never before human activity had such a great impact as we are witnessing now.

In any case, there is a growing recognition that achieving sustainability rests almost entirely on getting the economy right (UNEP 2011).

A short survey over the evolution of some economic concepts will be presented next. It is intended to contribute for a better understanding the innovative character of sustainable development concept and it's own meaning for earth management and for Humanity.

As civilization has progressed and society evolved, new needs and wants required increased resources for own gratification (Marshall 1890; Schumacher 1973). In turn, the human needs and desires grow more than proportionally to the expansion and improvement of the productive resources (Schumacher 1973, Rossetti 1991).

Economic growth is commonly understood as the quantitative increase in an economic variable (Solow 1956, 1957; Case and Fair 1999; Romer 1990, Rossetti 1991). Under a pure economic perspective, the concept refers to the increase of major economic aggregates, namely the national income, the stock of capital, the employment and the consumption. When growth occurs in a balanced way all the aggregates evolve in the same direction and the same percentage rate.

Basically the concept concerns to the productive capacity of an economy and the resulting increase in national income. The measurement of growth is achieved by means of monetary accounting and at national scale is commonly expressed through GDP (Gross Domestic Product) or GNP (Gross National Product).

The classical economic theory assumes that production of goods and services, expressed in monetary terms, can be explained as a function of capital and labor.

First economists, such as Adam Smith (1723-1790), Malthus (1766-1834) and Ricardo (1772-1823) were all pessimistic about the prospects of a sustained long-term economic growth. Basically, their major concern was the scarcity of natural resources (namely, land). The *labour theory of value* launched by the first economists was also partly adopted by Karl Marx.

For those authors was natural to consider only capital and labor as major inputs. Economic activities were mostly related to agriculture and livestock and the sun was the main source of energy (Smith 1789; Marshall 1890). However, from the industrial revolution, the use of machinery required to resort to other sources, primarily coal, then oil and more recently electrical power and natural gas (Ayres and Warr 2005, 2006, 2009).

The neoclassical economic thought, which started to be developed by 1870, abandoned the labor theory of value. Instead, the commodity's price started to be seen as a measure of its own scarcity, not the cost of the incorporated labor. Thus, this allowed a simultaneous analysis of both side of a market: supply as the amount of a commodity that was available and demand as the amount required. Notwithstanding, the introduction of *marginal analysis* as a new methodology also meant that the long-term growth patterns were almost abandoned until 1950. The neoclassical model notion of growth was associated with increased stocks of capital goods. Since people can be more productive given more capital, increasing capital relative to labor creates economic growth,

Solow (1956, 1957) introduced the concept of "technological progress", which was an unexplained exogenous variable, as major driver of growth. He established the primacy of technological progress as main propellant for the sustained increases of output per worker.

At the end of the 1980s, Paul Romer (1990) developed a new growth theory, which allowed for the endogeneity of technological change. Economic agents can affect the pace of technological change, namely through research and development and technology is closely connected with "knowledge" (Meireles et al. 2010). The human capital was framed not only as working hours but also as workers skills and knowledge. In this perspective human capital has

increasing rates of return and growth does not slows as capital accumulates. Following this line, those countries investing in human capital and technological change may assure constant growth rates.

More recently, Ayres and Warr (2002) turned their attention to the energy issues, defending that "*economies appear to evolve* over *a long term trajectory driven by technological progress, in which the factors of production maintain a fairly stable relationship to each other. Long term economic growth reflects the underlying dynamics of technological progress*." These authors assume that the main cause for the economic growth since the nineteen-century was the availability of cheap energy and available work. Using a mathematical model, they defended that the efficiency of electrical generation was a good proxy for technological progress, which explains the parcel of economic growth that is not due to capital or labor. At present, economic activities depend on the availability of energy supplies both in primary forms and as vectors. Thus they argued that energy services, or more specifically useful work, is the key to a quantifiable endogenous theory of economic growth and the limits of thermodynamic conversion efficiencies may act as limits to growth (Ayres and Warr 2002).

In general it is accepted that economic growth relies on the use of resources (capital, work and land) to provide wealth, through the production and supply of goods and services. The creation of wealth generated by the use of production factors, should result in the creation of more jobs, improvement of live quality, namely better education and healthcare services.

Theories of economic growth have been relating the growth rate of an economy with the increasing in living standards and welfare of local population. Nevertheless, the scientific community, ONG´s and citizens, have subjected them to severe criticism.

Meadows et all, published in 1972 the reference and controversial book "The Limits to Growth" modeling the interactions between exponential growth with finite resources. They concluded that maintaining the pace of growth, as it was known was compromised over the long term.

By other hand, the relationship between inequality and economic growth has raised considerable attention among economists since the late 1980s. A considerable strand of the literature addresses the causation from growth to inequality, while another research line focus on the reverse effect of inequality on growth (Neves and Silva 2010).

Ayres and Warr (2008, 2009) argued that economic growth is not a historical inevitability. Once that resource consumption is a cause of growth it is not possible to maintain economic growth at the pace of the last 200 years, at the risk of imposing heavy costs to society and endanger the survival of the species (Ayres and Warr 2003; Schumacher 1973).

The pressure on natural resources has been increasing continuously over the last two centuries either as sources of raw materials, either as a way of processing the waste.

However the carrying capacity of ecosystems and the depletion of resources only recently began to be considered in setting policy and economic directions (Arrow and all 1995; Meadows et al. 1972; Schumacher 1973).

Arrow and all (1995) warned against the generally accepted assumption that economic growth is somehow beneficial to the environment. The assumption that an automatic adjustment mechanism would lead to the common good guided the definition of the main economic policies during the 70´s and 80´s. The "invisible hand", assumed by Samuelson (1964, 2001), was touchstone of the liberal economic theory, advocating the continued growth coupled with economic liberalization. The economy-widepolicies, particularly with regard to globalization of trade have been undertaken assuming that the common good would be achieved through the normal functioning of markets. The proliferation of these policies took place giving little attention to the chorus of protests, warning to environmental quality, carrying capacity or environmental resilience (Arrow and all. 1995).

Although widely used to defend the non-intervention on free market functioning, the "invisible hand" is considered by Kennedy (2009) as a concept introduced on economic theory empty with any scientific explanatory value.

Kennedy (2009) adverted that modern economists have taken an "*isolated metaphor, used rarely by Adam Smith*" to erroneously justify the perfection of the functioning of commercial markets, by arguing that the defense of individual interests leads inevitably and unintentionally to public benefit. If economic agents do not meet the consequences of their actions when pursuing their own interests, they can harm the common good, by inducing both social and environmental damage.

Adam Smith (1789) himself warned to the danger of "*human behaviours in situations where markets operate less than competitively in aggregate, can and do result in sub-optimal outcomes, such as from the imposition of monopolies, protectionism, and conspiracies to restrict supplies"*. To these questions can be added more contemporary others such as pollution, indifference to spillover externalities and tragedies of the commons (Kennedy 2009). The general equilibrium point in perfectly competitive conditions does not exist outside the constructs of the mathematical theory (Kennedy 2009).

The efficient allocation of resources driven by the "invisible hand" requires that market prices incorporate "true social costs", or externalities. Otherwise, the free market's operation contributes to accentuate the disparity in wealth distribution and aggravate the depletion of resources.

Marshall (1890) was the first author to refer the idea of externality (social cost) which was lately developed by Pigou (1932). Externalities are assumed as costs imposed or benefits conferred on others that are not taken into account by the person taking the action.

A manufacture polluting a river during its operational activities, imposes a cost to all the communities affected by this pollution, also affecting the ecosystems' functions. When firms internalize these costs of operation (negative externalities) overall welfare could be raised. Although, the allocation of production external costs arguably raises the costs of products and compromises economic growth (Schaltegger and Wagner 2006).

Coase (1960) proposed a new economic view on environmental problems. He defended that the governmental intervention, through taxes and subsidies as proposed by Pigou, was dispensable if the people affected by the externality and the people creating it could get together and bargain.

Traditionally it is assumed on neoclassical environmental economics, that the purpose of environmental regulation is to correct a market failure, once that production costs are not entirely undertaken by their generators. The correction goes through the internalization of costs of the negative externality, which imposes additional costs on companies (Schaltegger and Wagner 2006).

Reinhardt et al (2008) agreed that if firms voluntarily internalize externalities, it possibly may result in a more efficient allocation of resources. However, there is no reason to suppose that firms may necessarily achieve new efficiency levels through the reduction of externality-producing activities (Reinhardt et al 2008).

Economists, such as Kenneth Arrow, have shown that competitive firms and competitive markets do not necessarily produce the optimal amount of innovation and growth within an economy (Arrow 1962; Kamien and Schwartz 1982; UNEP 2011).

Mishan (1967) warned that the benefits of economic growth could be misleading if they were not discounting the inherent negative impacts such as raised pollution, increased crime or depletion of resources. He related economic growth with social discontent once the first generates social and environmental costs that were not generally taken into consideration. Their approach was later recovered by green movements and by the degrowth promotion movements. Mishan (1967) also defended and exemplified with specific situations that economic growth does not necessarily involves improving the quality of life.

Richard Douthwaite, (1999) argued that strategies used by governments to raise national income often increase poverty and unemployment, once each increase in national income may consume more resources than those created on a sustainable basis. For citizens, in this situation, the balance is negative.

Serge Latouche (2003, 2004), an advocate of the degrowth movement, noted that "*If you try to measure the reduction in the rate of growth by taking into account damages caused to the environment and its consequences on our natural and cultural patrimony, you will generally obtain a result of zero or even negative growth.*"

Even the main indicators of economic performance, such as growth in Gross Domestic Product (GDP) are not adjusted to account for pollution, resource depletion, declining ecosystem

services, and the geographical and social distributional consequences of natural capital loss (UNEP 2011).

Nowadays, humankind as to deal with the reducing availability of fossil energy sources, the over-exploitation of natural resources, the declining of environmental quality, the loss of ecosystems services, as also the decreasing of flora and fauna diversity, situation which contrasts with a highly consumer life-style, on developed and developing countries (Arrow et al. 1995).

Since the 30s several types of renewable resource management theories have been developed. The aim was to assure welfare as also the preservation of non-renewable resources, since then, increasingly regarded as capital (Singh et al. 2009). Natural capital has distinctive features from other forms of capital namely man-made capital, human capital and social capital (Gasparatos et al. 2008). If misused, it may depreciate, as any capital asset, often irreversibly (Dasgupta 2008) and it is non-substitutable with other forms of capital (Daly, 1989, Costanza and Daly 1992). Presently ecosystems are one type of natural capital that is especially at risk (Dasgupta 2008).

However, economic sciences have been unable to assess properly the natural resources.

Only recently, the economic analysis has enjoyed the contact and input from other disciplines, which explain the well being of humanity also through the natural and social environment.

Schumpeter (1934) was an earliest voice to suggest a holistic approach to the study of economic phenomena. He maintained a critical perspective towards the analysis of the social matter, once he considered that the social process is in reality an indivisible whole. However, economic analysis is commonly held to be partial or biased. From the historical course, the investigator artificially selects the economic facts. These is an abstraction of reality, once one fact is never exclusively economic and other aspects, perhaps more relevant in this classification, are overlooked

Schumacher (1973) later resumed the valuation of other sciences contribution's for economic thought. He defended a holistic approach containing ethical, ecological, social and metaphysical components, which he considered were missing from the statistical models.

Consequences of economic activities and growth models pursuit are under debate. The discussion on the relation between economic growth and environmental quality, and on the link between economic activity and the carrying capacity and resilience of the environment (Arrow and all. 1995) is more present than ever before.

It is obviously an impossibility to pursue an infinite economic growth within a finite environment (Schumacher 1973).

The concept of economic development is presently based on the sustained increase in the standard of living in a nation's population (such as health, education) along with the increase of GDP per capita. This means, the general improving of the living conditions of a population, namely through access to health, education and sanitation services. Other aspects of economic welfare have been recently regarded as relevant faces general human development, such as leisure time, environmental quality, freedom, or social justice.

Economic development is a concept halfway between economic growth and sustainable development. In fact, the increase in per capita income alone, linked to economic growth, is no guarantee of improved living conditions of populations.

Schumpeter (1934) was one of the earliest economists to address economic development questions. During 1912 he published the “Theory of Economic Development” which laid the basis for the economic growth theory. Following Schumpeter (1934) growth causes are mainly nonecoconomic and they can be found on in the institutional structure of society, namely on cultural and sociological environment.

In this context, economic development is constructed through alternate phases of economic growth and depressions. While growth corresponds to prosperity stages of the cycle, resulting from the introduction of new technologies and products in the economy, depressions are assumed as auto correcting phases, removing non-efficient or poorly managed firms from the market. Entrepreneurs activities were driving forces of sustainable development though the introduction of innovative products and new technology into the economy, as also through the development of new forms of organization.

Schumpeter (1934) believed that the creation and destruction of existing structures and the replacement for new ones, was responsible for the continuous progress and for the improvement of the standard of living of people. He left the foremost ideas of a dynamic approach and a holistic vision of economic development.

For some economists that means that per capita welfare should not be declining over time (Pezzey 1989). This idea has two main implications. First, well-being depends on the total stock of capital, including natural capital, available on the economic system, which determines the availability of opportunities for the construction of welfare. Second, “*that economic development today must ensure that future generations are left no worse than the present ones”* (Pearce et al. 1989)

The IEDC 2011 (International Economic Development Council) defines the concept of economic development as: “*a program, group of policies, or activity that seeks to improve the economic well-being and quality of life for a community, by creating and/or retaining jobs that facilitate growth and provide a stable tax base*”.

Such implies that, along with the accumulation of physical capital (through GDP), is promoted the accumulation of human capital (namely through the enhancement of professional qualification of citizens). However, the accumulation both human and physical capital raises concerns about the excessive resource depletion and degradation of natural capital.

Much of the interest in sustainable development is increasingly aligned with the concern of irreversible depleting of the world's stock of natural wealth, which can deeply impact the well being of the current and future generations (UNEP 2011). The concept is associated with the ability to make options, which is materialized on deciding the paths of human welfare, choosing between the use and the accumulation of natural capital stock.

In this sense, economic development strategies and policies have to take account of natural capital employed. The valuation of resulting depreciation on natural assets, namely on the goods and services that ecosystems provide, have to be considered as costs of development policies (UNEP 2011, Pearce et al. 1989; Pearce and Barbier 2000). The sacrifice of environmental quality affects both present and future generations and compromises the achievement of sustainable economic development.

The concept of sustainable development naturally evolves the previous concerns.

In the early days, before the pioneer deliberations of Brundtland Commission the concept of "Sustainable Development" was subject to conflicting interpretations. While for some (Redclift 2005, Pearce et al. 1989), its was rooted in mainstream ideas of increasing growth and consumption at the expense of natural capital and it was, by nature, incompatible with the concept of sustainability, for others, sustainability concerned to a scale of economic activity that allowed the maintenance of ecological life support systems. In fact, was called for some as Herman Dary as an oxymoron, once it was considered the words "sustainable" and "development" have opposite meanings (Redclift 2005).

The debate still remains, once meeting the needs of the current population, demands a serious economic growth (Holliday et al. 2002). In this case, sustainable development is based on the assumption of a balanced increase of resources and it has the underlying process of economic growth. Those in favor of sustainable development argue that continued economic growth is possible if consumption of energy and resources is reduced. Both European Union (EU) and OCDE (Organisation for Economic Co-operation and Development) proposed the objective of decoupling economic growth from resource use and environmental degradation, assuming either a positive GDP growth rate associated with a zero growth rate of the environmental variable (absolute decoupling), or a growth rate of the environmental variable lower than the rate of GDP growth (relative decoupling) (OCDE 2001). In both cases, is questionable if it is possible to obtain long-term improvements alongside with the maintenance of a durable decoupling between economic growth and environmental degradation (Mauerhofer 2008).

Decoupling resource consumption from an expected increasing in life quality of the world's population is a challenge of our days. The preservation of ecosystem services, the conservation and management natural resource and the social equity and cohesion, are objectives whose pursuit requires an holistic view, based on shared objectives and on local actions.

The integration of social, economic and environmental goals, is key for the success of sustainable development process, once each goal may also support all the others. Good social conditions require strong economies, which partly rely on environmental resources and environmental conditions are inseparable from quality of life.

This involves recognizing that there are potential conflicts among aims. Finding new solutions and equilibriums goes through the challenging of traditional ideas, the search for alternative solutions, the development of innovative ways, the use of creativity and the citizens involvement with the construction of the present and the design of the future.

Sustainable development commonly understood as entailing '*the integration of economic, social and environmental objectives, to produce development that is socially desirable, economically viable and ecologically sustainable*' (Hens and Devuyst 1996).

From an economic perspective can be said that sustainable development is about social justice. The debate about what constitutes a fair and just distribution of wealth, rights, and opportunities is nothing new. The discussion about distributional issues within a generation has been enlarged to the questions about the distributional issues between present and future generations, with a particular focus on environmental questions. The achievement of equilibrium between economic, environmental and social folds will demand for types of partnership and a political agenda never before witnessed in human history (Holliday et al. 2002).

The construction of a sustainable development is based on cycles of continuous improvement, yet firmly rooted on the wisdom and best-proven practices of the past.

Sustainable development is understood in the course of this work as a long-term process with a global scope. It is based on local action, incremental changes and the cycling construction of short-term balances within the framework of a long run vision.

3.2. The Business Case for Sustainable Development[1]

In a world where the relevant issues in the areas of economy, environment and society tend to be globalized, the role of corporations is under scrutiny. Among the negative attributes of globalization is the erosion of confidence among society and institutions, before the awareness of inappropriate behaviors from the leaders of the major business (Rake and Grayson 2009).

The concept Sustainable Development refers to a global trend and demands a holistic approach that extends over time. A challenging aspect of sustainable development is that as it cannot by achieved by a nation in isolation and it requires the involvement of different economic agents (Holliday et al. 2002). The various actors of social relations are asked to commit themselves to the continuous construction of sustainable development (Soppe 2009). Business, civil society and government are the three pillars of society. Helping create a world in which what is good for the planet is good for business is a challenge in which enterprises play an important role.

In the following sections are addressed both the questions of ethics as the basis for corporative responsibility and the business contribution to sustainability. It is also presented the evolution of the concept of CSR and surveyed the problematic surrounding the reporting of sustainability.

The period after the summit of the Rio was seen a turning point in the relation between corporate business and environment. Thereafter it was assumed by some major economic players that environmental issues needed to be taken into account and internalized as central concern of corporate governance (Redclift 2005).

Some business leaders realized that the concept of global sustainability had a great potential for application at business level. They perceived the existence of parallel between the issues involved in sustaining a planet with those involved in sustaining a corporation (Holliday et al. 2002). *Both require balancing acts between managing for the long term and managing for the short term.* If managers fail in their management strategies, firms can fail and they may become extinct (Holliday et al. 2002). Both depend on the grid of relationships that ensure resource availability and performance of daily activities necessary for survival. As in the natural word the ability to survive depends from the ability to grasp the changes underway and to react appropriately. Still within the sustainable development thinking, many corporate leaders found new strategies to growth and thus meet the expectations of stakeholders.

[1] *"Business must both find its roles in and for a sustainable future, and also advocate these roles to the public, governments, consumers, investors and NGOs. To be trusted, business must walk its talk." WBCSD Annual Review 2008*

As sustainable development is about changes in resource exploitation, investments, technological development, and institutions, business cannot remain indifferent to these issues given that concern them directly.

Changing times require attention and intervention so that new balances between the factors described above remain business-friendly. A vision of sustainable development as an opportunity rather than a charge, can lead to exploitation of competitive advantages. Sharp CEOs are concerned in guiding their companies toward sustainability, but also try to orient society toward sustainability (Holliday et al. 2002).

Companies have a high potential of contribution for sustainability, because while economic agents they play various roles, acting as customers, suppliers, distributors, investors, educators, among others. As economic players, they are an important part of the sustainability construction process.

As a matter of fact, companies can operate as a motor for more sustainable practices among stakeholders (Vives 2008; Heal 2004; Engen and DiPiazza 2005). Business has an opportunity and a responsibility to show that it can help lead society along a sustainable path of progress, either by its own example or as key provider of solutions for *global issues*. The regulation gap between the institutional reaction and social needs can be completed expeditiously through the intervention of the companies. Business by acting decisively and quickly is able to precede the slow decision-making in sovereign states with respect to environment and society crucial issues (Falck and Heblich, 2007).

This way, business goals are inseparable from the values of societies and environments within they are operating. Today's actions must be considered as a determinant for the future, bearing in mind the fast growing of the global dimension of environmental and social issues, will accompany the general evolution of markets and of economic issues.

Samuel A. DiPiazza[2] make aware of the urgent need of thinking sustainability, suggesting that the exploitation of the planet's resources without a coherent plan to replenish it can lead to a global crises. He compares the actual financial crises elapsing from *people borrowing beyond their means* with a natural crises emerging from borrowing the planet beyond its supply capacity. As in financial markets, if nothing is done, that can lead to a collapse of natural capital.

[2] *(Global CEO, PricewaterhouseCoopers) in WBCSD Annual Review 2008*

3.2.1. Business Ethics as base for CSR

The moral conscience is an essential characteristic of human specie and it is assuming prominence since recent financial scandals and not so recent environmental disasters.

Decision-making in the business sphere as in the personal sphere is constrained by a set of principles, which in turn are conditioned by specific cultural, religious and social contexts. Thus the exercise of corporate responsibilities is closely dependent on the ethical principles assumed by an organization and its managers.

The distinction between ethics and moral is the fact that morality relates to the actual practices of the men as members of a given society. Morality is based on the principles behind a given community, embodied in rules, guidelines or standards of conduct and action, defined within various and specific constraints, while ethics concerns the critical reflection about day-to-day practices.

For business ethics can be understood the branch of ethics that examines the dilemmas, decisions and judgments in the context of business. As examples of frequent quandary, may be listed the practice of corporate social responsibility, the limits of decent competition or the conflict of interests among stakeholders.

As business ethics, can also be understood "*the study and evaluation of decision making by businesses according to moral concepts and judgments*" (Columbia Encyclopedia)".

Now, more than ever, ethical dilemmas are affecting the way of doing business. The depletion of natural resources, pollution of water, soil and air, the increasing attention of citizens and consumers to the environmental and social issues require a serious consideration about ethics on business. The ethical principles of the company and managers will, ultimately, determine how the company interacts with stakeholders and how it assumes its responsibilities.

However, ethical conflicts frequently arise from the concurrence of interest between stakeholders. The balance is not always easy to achieve (Roe 2005).

Reinhardt et al (2008) remember that the academic debate over the legality of sacrificing profits in the public interest appears to have begun in 1932 with opposing articles from Dodd (1932) and Berle (1931, 1932)[3]and that issue anticipated the economic debate in decades. The debate is still present and the original ideas of their authors are still subject to reinterpretation. Bratton and Wachter, (2008) offered a new reading of these fundamental and actual texts of corporate law, which have recently reached the 75th anniversary.

[3]Berle's 1931 article, "*Corporate Powers as Powers in Trust"* and Dodd's 1932 response, *"For Whom Are Corporate Managers Trustees?"*

The economic controversy began more recently, in 1970, with Milton Friedman's article, "The Social Responsibility of Business Is to Increase Its Profits," published in the New York Times Magazine.

According to the shareholder primacy theory, shareholders have priority over all other stakeholders. *That means that in a free-enterprise, private-property system, a corporate executive is an employee of the owners of the business. He has direct responsibility to his employers. That responsibility is to conduct the business in accordance with their desires, which generally will be to make as much money as possible while conforming to the basic rules of the society, both those embodied in law and those embodied in ethical custom* (Friedman, 1970).

Friedman argued that the company's objective is to generate profit. In such case the ethics of companies would be strongly conditioned by the interests of shareholders. In this line, even when CSR activities are authorized, it is underlined to its acceptance that they come upon the interests of shareholders, or at least do not conflict.

The debate coated greater emphasis on Anglo-Saxon countries were until recently was almost unquestionable the non-legality of sacrificing profits in benefit of environmental and social issues, definition originally offered by Elhauge (2005). Primarily former British possessions (ex: USA and Australia) share many legal features. Corporations in these countries have similar board structures, face similar legal requirements, and even share some legal precedents. In such countries, CSR as been discouraged, but permitted. (Reinhardt 2008). Corporate managers can be legally charged for penalize the interests of shareholders, if engaged in socially beneficial activities, even in the best interests of the corporation, but ignoring the collective interests of shareholders (Corfield 1998), (Borok 2003), (Roe 2005); (Lynch-Fannon 2007), (Reinhardt 2008).

However European countries and Japan, easily undertake the CSR concept once the responsibilities before stakeholders, particularly towards employees, since long have been accepted and valued as part of organizational culture.

Particularly after the end of the First World War, some entrepreneurs and thinkers such as Rathenau, have been proposing that each company should consider alongside with the interests of shareholders, the convergence of employees', consumer and the collective interest in developing the national economy. These interests required a set of verifications and balances to achieve an ethically acceptable equilibrium between them.

Within cultural traditions of social democracy or firm loyalty to employees, most European countries have legal systems that place a greater emphasis on stakeholder participation and differ largely from the system in the United States (Roe 2000; Williams and Aguilera 2006).

Curiously, the concept has generated more enthusiasm and controversy among Anglo-Saxon countries that adopted liberal models of which left a regulatory gap that was filled with the concept of CSR.

Continental EU countries initially showed little interest on the concept once they were already dealing with a more restrictive regulatory framework for environmental and social issues, which was raised in a specific cultural context. Only recently the globalization of business resulted in the loss of national legislation influence in the sphere of companies' activity. The miss of national linkages led to greater interest in the concept (Falck and Heblich, 2007). While prevailing the pillars of the basic order of society (law and social conventions), conditioning companies to comply with the demands of society, there is no need for CSR.

For the last years, the European and Japanese companies have been attaching special attention to the structuring mechanisms of corporate responsibility, as well as to the respective verification by external parties. U.S. companies are caught between the desires to socially and environmentally go beyond what is legally required and the legal consequences that might result from such behavior (Smith, 2004), if confronted with the will of the shareholders (Roe 1993, 1994, Gilson and Roe, 1999).

Corporations in Europe and Asia are also more likely to have a few large shareholders, who may take social responsibilities seriously, particularly those towards employees (Roe 1993, 1994, 2000; Gilson and Roe, 1999). This contrasts with the pattern of highly dispersed share ownership in the United States (Reinhardt, 2008). Europeans have also sought to incorporate CSR into their investment climate, both at the institutional and individual level (Sutton 2004, Kolk 2008).

By his side, Japan moved from a feudal production system to one of the most modern economies worldwide recognized, during the last century. The development of the productive structure was based on the old strict rules of conduct and the value of responsibility between the parties that characterized the feudal organization, in which accountability is critical for the maintaining of the productive system (Reinhardt, 2008, Roe, 2000; Roe, 2005; Gilson and Roe, 1999).

Friedman and followers from the Chicago School of Economics consider only the use of monetary resources for the business as worthy of protection and remuneration. This approach assumes "a priori" that companies with ethical behavior have always loss of income and they require sacrifice of profits from their shareholders. That is not necessarily true once the company may minimize the risk and it may increase its own value through investments in environmental and social actions.

According to others, companies should assume their own social responsibilities such as generating employment, responding for its environmental impacts, paying taxes and serving the consumers, once they use other assets besides money, such as knowledge, labor, materials, land, air and water, which usually are not properly valued.

The stakeholder's theory (Freeman 1984) alerted for the importance of companies relationships with external groups (stakeholders), once, it defended, that he impact of externalities on these groups was critical for the forthcoming success of the organization.

The use of non-financial assets is considered highly relevant for business success and it is a mainly responsibility from company and managers to respond for their use[4].

The debate continues active and CSR received considerable attention from both scholars and the public, especially in the environmental protection area (Reinhardt et al. 2008).

Presently, ethical issues in business have become more complicated because of the global and diversified nature of many large corporations. Multinational corporations operate in countries with different expectations about social or environmental responsibilities and dealing with different limits for criminal behavior. The company can decide whether to adhere to general ethical principles or to adjust to the local rules in order to maximize profits (Logsdon and Wood, 2002; Williams and Aguilera, 2006).

The limits imposed by law sometimes do not meet the ethical limits of a company. The latter may be beyond the law, if the company is ethically well developed and act beyond what is required to.

Business ethical limits may fall below the law when the company took certain action only under the legal obligation. In this context, Reidenbach and Robin (1991), were interested in different expressions of business ethical behavior. Using human development models, this authors proposed the following classification for companies' moral stages (Figure 3-1). This approach falls on a pyramid model that provides a framework for understanding the evolving nature of the firm's economic, legal, ethical and philanthropic performance. Lower stages are in the bottom of the pyramid and higher ones are near the top. It is important to note that a multi-

[4] It is worth while noticing that Kenneth Mason, Quaker Oats President declared in 1979 the Business Week, about Friedman's profits-are-everything that his philosophy was:

"*a dreary and demeaning view of the role of business and business leaders in our society." "Making a profit is no more the purpose of a corporation than getting enough to eat is the purpose of life. Getting enough to eat is a requirement of life; life's purpose, one would hope, is somewhat broader and more challenging. Likewise with business and profit."*

"The moral imperative all of us share in this world is that of getting the best return we can on whatever assets we are privileged to employ. What American business leaders too often forget is that this means all the assets employed - not just the financial assets but also the brains employed, the labor employed, the materials employed, and the land, air, and water employed."

divisional organization may occupy several stages at the same time, and companies may also regress from higher to lower levels.

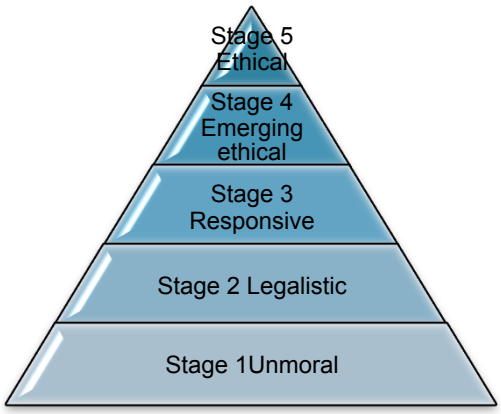

Figure 3-1 Classification of company moral stage

Stage 1 Unmoral. There is no concern with ethical decisions. Limits to business action are defined for a cost –benefit analyses for the short term.

Stage 2 Legalistic. There is a higher concern with ethical decisions than in the previous stage. Limits to business action are defined also for legal constraints. Managers are concerned with law enforcement to not incur in fines or penalties

Stage 3 Responsive. Managers understand the value of not acting solely on legal basis; which is coupled with a growing sense of balance between profits and ethics.

Management begins to test and learn from more responsive actions. A responsive company's ethics code would reflect a concern for other stakeholders, but additional ethics support vehicles, are less likely to be found.

Stage 4 Emerging Ethical. Managers have an active concern for ethical outcomes. They are focused on achieving the right thing in the right way. Ethical perception has focus but may still lack organization and long term planning. Ethical values in such companies are part of the culture are and they shared across the organization, often supported on codes of ethics and core values.

Stage 5 Ethical Companies. This stage represents what the researchers call the ethics organization. Selected core values are used to strike a suitable ethical balance in business operations.

The above raises the question if whether ethical or socially responsible companies undertake profits or are really less profitable than unethical businesses. Similarly, is questionable whether corporate managers should assume corporate responsibilities not only toward shareholders' short-term returns but also towards good governance of the long-term interests of society. On the other hand, applying the concept of ethics in business globally poses serious difficulties. Regardless of the principles of ethics in business are defined, operationalizing these principles in practice has been a challenge for most transnational corporations and even for smaller and more local enterprises (Werhane 2000, 2010; Vives 2008).

All the available sets of standards for business ethics (ex: United Nations Global Compact, (OECD) Guidelines for Multinational Enterprises, Global Economic Ethic, International Organization for Standardization's ISO 26000 and others) articulate voluntary guidelines both for responsible behavior and for what is unacceptable practice. Some of these guidelines and frameworks overlap in intent and content (Gordon 2001). Since these standards are derived from the best Western thinking in theoretical and religious ethics, they represent an enormous breakthrough for the fields of business ethics and corporate responsibility However, multinational enterprises (MNEs) operating in non-Western cultural or religious settings would have difficulties operating under these guidelines, then, where other kinds of principles take precedence. Werhane (2010) exemplifies the difficulties and dilemmas in *assuming corporate social responsibilities in different ethical contexts.*

Michael Hoffman and Robert McNulty (2009) call for a *"declaration on the universal rights and duties of business*" in reply to the lack of universal principles governing the rights and obligations of business behavior. A strong international statement is critical to increasing the equity in markets and promoting a fair competition in business worldwide (Hoffman and McNulty 2009).

Moral and cultural differences must be considered in future research on business ethics and CSR truly global guidelines, while preserving the intent of current standards (Werhane 2010).

Whether CSR is a materialization of business ethics, it may be questioned in what extent can CSR serve as a vehicle to embody a new ethics in business.

3.2.2. Corporate Social Responsibility (CSR) in business scenario

The concept of CSR has been debated on academic and business circles, although there is no consensus on its definition (Argandona and Hoivik 2009). Waddock (2004) compiled a list of the terminology and the ideas in use, to illustrate this quandary. As stated by Sethi (1975) "*the phrase corporate social responsibility has been used in so many different contexts that it has lost all meaning. Devoid of internal structure and content, it has come to mean all things to all people*".

Corporate social responsibility (CSR) is also known as corporate responsibility, corporate citizenship, responsible business, sustainable responsible business (SRB), or corporate social performance (Wood 1991).

Corporate Social Responsibility (CSR) has various interpretations and applications in enterprises throughout the world. It is a subject that has been developed since the decade of 30 from the 20th century for Merrick Dodd, from the Harvard Law School. While Berle (1932) defended that the main responsibility of a company is towards shareholders, Dodd (1932) argued that a company meets a social service with a profitable basis. His justification rests on the fact that companies were allowed to operate in anticipation of the fulfilling of a service to the community and not just because they generate profits for shareholders (Dodd 1932, Caroll 1991). Historically, business organizations were created as economic entities designed to provide goods and services to societal members. The profit motive was established as the primary incentive for entrepreneurship (Caroll 1991). This provided the intellectual support to defend the existence of a corporate social responsibility.

One of the most influential definitions, proposed by Carrol (1979), states: "*The social responsibility of business encompasses the economic, legal, ethical and discretionary expectations that society has of organizations at a given point of time".* Later Schwartz and Carrol (2003) fit this definition and proposed a three-dimensional model, which considered the legal, economic and ethical responsibilities.

Carroll's (1991) "pyramid of corporate social responsibility" is perhaps the most famous example for the evolution of corporate responsibility. This model presents a graphical representation for the hierarchy of corporate responsibilities that move from economic and legal through more socially oriented ones of ethical and philanthropic responsibilities.

The bird of the modern activist movements during the 1950s and 1960s in the United States drew attention to the businesses and business practices and advocated a broader notion of CSR (Cochran 2007, Caroll 1991). The turbulent years of 80´s following a series of hostile takeovers wake the concept that is growing since then.

In the early days the concept was associated with philanthropic activities undertaken by the organization or by managers and it was later extended to include institutions and enterprises (Falck and Heblich 2007; Vives 2008; Cochran 2007). Forehand philanthropic activities were performed usually on behalf of individuals who generally accumulated the roles of owner and manager of the organization. In this situation there are no conflicts of interest since the cost of the social commitment was taken personally (Falck and Heblich 2007, Cochran 2007).

However, the separation between the ownership and the management raised the question of the legitimacy of corporate charity activities that did not imply direct benefits for the company (Cochran 2007, Porter and Kramer 2002).

Perhaps because the concept of CSR has evolved from philanthropy, many continue to look at if they are synonyms (Vives 2008, Meehan et al. 2006) and for many CSR continues to be considered as a way to exercise philanthropy, targeting efforts to a needy group or to a charitable organization selected by the corporation's managers. (Meehan et al. 2006)

Moreover the widespread use of the acronym led to the conviction that the CSR was a standard, universal and well-defined concept (Vives 2008, Argandona and Hoivik 2009).

The expression social responsibility has triggered controversy in academia and business environment, largely due to poor communication on different concerns and distinctive interpretations of the concept (Doane 2005, Vives 2008, Argandona and Hoivik 2009).

Hegdiger (2010), for his side, acknowledges that although there is no single and accepted CSR definition in the scientific literature, the many versions available incorporate simultaneously business, ethical and social dimensions.

However, Meehan et al. (2006), based on the analyses of theoretical nature of CSR approaches, advocated that those last fail to provide the kind of practical tools that managers need to embed a CR orientation in their organizations.

Even the terms "social" and "responsibility" are also often misunderstood. While for some the term social refers to strict social issues, such as health, education, employment or security, for others the concepts knocks a broader context that includes both natural and social environment in the scope of action of the corporation (Vives 2008). Responsibility can represent either accountability or a sense of duty towards society (Vives 2008, Kuhndt 2004, Lynes 2008).

Given the above the concept of CSR ranges between a radical view that the corporation is free to pursue profit maximization, regardless of its impact on society, and another equally radical view that the corporation must resolve society's problems and assume responsibility for government failures (Vives 2008, Lyon 2008).

The WBCSD defined Corporate Social Responsibility (CSR) in which is included the environmental concerns, as "*the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life*" (WBCSD 2002).

Different views have different implications. The present work adopts the CSR definition of European Commission (COM 2001), as "*a concept whereby companies decide voluntary to contribute to a better society and a cleaner environment*", through the integrating of "*social and environmental concerns in their business operations and their interaction with stakeholders*".

In this perspective, the company is assumed as a legal "person" responsible for the impacts of its own activities on the society and on the environment, which are taken into consideration on operational activities and on strategic decisions of the organization (Figure 3-2). Ethical principles frame the definition of the basic strategically lines, guiding corporate actions through several interrelated time horizons.

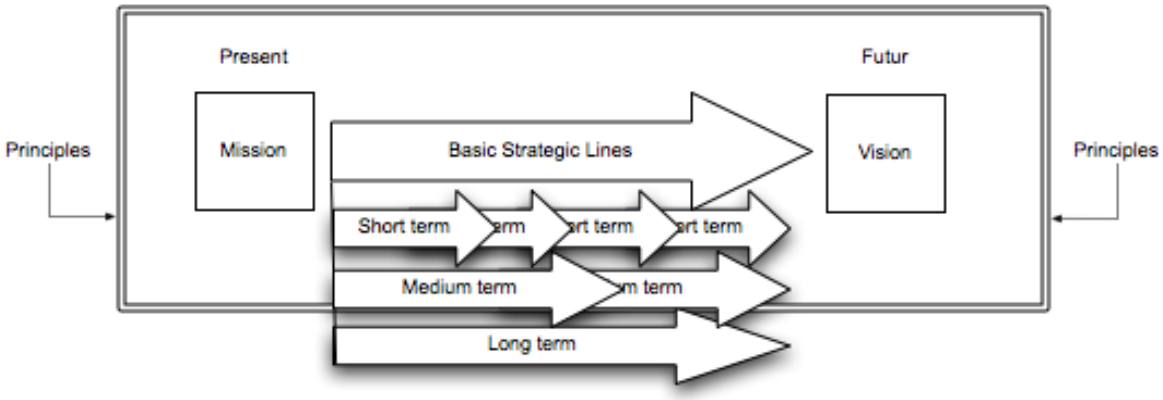

Figure 3-2 Strategic corporate framework

This definition reinforces the relevance of business for a better society and leaves open space for companies to contribute, through their actions and voluntarily will, for this aim.

A company has responsibility before stakeholders rather than shareholders. Stakeholders refer to anyone who is influenced, either directly or indirectly, by the actions of the firm. According to the stakeholder theory, the business entity should be used as a vehicle for coordinating stakeholder interests, instead of maximizing shareholder (owner) profit.

The integration of stakeholder concerns requires a holistic view of the business. Until recently companies were viewed as mere units of processing resources, according to a particular organization and by using a set of technologies. Presently, companies are conceptualized as members of a network of multilateral relations, which affect and are affected by each other, interactively.

For example, the manufacture of a product may be affected by customers' requirements, consumer expectations, working conditions, health and safety of employees, the social and environmental conditions in the area of implementation of the plant, as well as the applicable laws and regulations. All these conditions affect the company in a greater or lesser degree throughout the supply chain, both for upstream and downstream directions.

That way, from focusing on the internal dynamics, greater interest and attention is being put in the external dynamics, of those complex organisms that are companies.

On this perspective Corporate Responsibility (CR) is more than the sum – at least the integration – of its social and environmental components; it is about integrating social and environmental concerns into business strategy and operations and the promotion of a vision of business accountability to a wide range of stakeholders, besides shareholders and investors (Porter and Kramer 2006; Godfrey and Hatch 2007).

The concept reinforces the link between the firm and the context in which it interacts (Doane 2005). The old paradigm based on individualism, competition and isolation, is definitively outdated (Marshak and Grant 2008; Porter and Kramer 2011; Kytle and Ruggie 2005).

Consequently, the commitment with stakeholders requires transparent and accountable provision of information to the interested parties that are sustaining the organization. Customers, suppliers, employees, consumers or investors are pivotal for the operation of any company.

The practice of CSR in the business scenario has been connoted with the performance of multiple functions in particular: correction of externalities, acceleration of processes of change, more efficient use and better distribution of resources (Heal 2004; Vives 2008, Falck and Heblich 2010). CSR has been seen as a broad-spectrum prescription for solving the environmental and social problems that affect business, from labor standards to CO_2 emissions (Doane 2005).

For some, the CSR is viewed and defended through the lens of the market, once that incentives for investment and rewards for ethical business behavior are supposedly evaluated trough the increase of business opportunities and the rise of competitiveness.

For other, CSR evolved to respond to the market failures and it is taken to reduce externalized costs or to avoid distributional conflicts (Heal 2004).

Although society valuates fairness as well as efficiency, the presumption that markets are efficient does not imply that they are simultaneously fair. They cannot necessarily assure matching the best social or environmental solution (Heal 2004; Vives 2008).

External costs or externalities arise from the production or distribution of goods or services and are determined as the difference between private and social costs. Private costs are those assumed by firms or individuals while social costs are those assumed by society as a whole, and include the sum of private costs with externalities.

In some sectors of the economy, such as tech sector, private and social costs are aligned and debates are unusual, once externalities are almost inexistent. In these cases, corporate social responsibility has little role to play. However, in situations where *"distributional disagreements*" and differentials between private and social costs appear, CSR may act as the invisible hand to produce a social advantage, in addition to increasing the company's profits and protecting against loss of reputation (Heal 2004; Vives 2008).

External costs express market failures and economic inefficiencies at the local, state, national, and even international level. Global market failures in the absence of global integrated legal framework, mainly those relating to external costs, are hardly internalized (Falck and Heblich 2010, Heal 2004, Hediger 2010).

Falck and Heblich (2010) assume that the basic social order is constituted both by a legal framework and social conventions, which reflect the ruling principles and dominant views. The history has sown that new ideas have to slowly integrate this order before be widely accepted. CSR can contribute to faster this process through the proposal of new ways of action and behavior that exceed their own implicit and explicit obligations.

CSR can be distinguished from market social responsibility, with the first conditioned by legal and regulatory framework of the second (Vives 2008; Reinhardt et al. 2008).

A socially responsible strategy can help to minimize problems of income distribution or allocation of resources especially in contexts where there are more conflicts. While acknowledging that companies should take responsibility for impacts resulting from its activities (Vives 2008) does not claim that they are to be responsible for solving society's problems, which are the responsibility of different authorities.

However, since Bowen (1953) published his seminal "*Social Responsibilities of the Businessman*" until recently, business managers have preferred the Chicago School's short economic guidance, focused on profit generation, than a wider subscription of social responsibilities (Meehan et al. 2006).

In the current strongly interactive business environment, fostered by the Internet, key stakeholders have easy access to critical information about the companies. The reputation and social environmental influences their attitudes towards the company and serves not only as an instrument of public relations but as a powerful tool that can create mutual advantages for both business and community (Alniacik 2010; Doane 2005).

A reflection on the loss of credibility and trust in business has substantiated two decades ago the belief that CSR was important. Presently the same reflections between what should be done and the effective business practices raise the question of sustainable enterprises (Rake and Grayson 2009).

Hediger (2010) recognizes an attempt to relate CRS and CS (corporate sustainability) with the global challenge of sustainable development, in some cases giving the same meaning to both concepts. Using capital theoretical and welfare economic approaches he proved that, from the standpoint of sustainable development, CSR and CS are distinct but interrelated concepts. Following this author, CS refers mainly to the maintaining of capital and corporate value; insofar CSR refers to the management of firm resources and the contribution to stakeholder's welfare.

Garriga and Melé (2004) expound that Corporate Social Responsibility (CSR) field presents not only a landscape of theories but also a proliferation of approaches, which are controversial, complex and unclear. These authors defend that each CSR theory is focused in four main dimensions, which are related to: the fulfillment of objectives to achieve long term profits; the use of business power in a responsible way; the integration of social demands and ethical values; the contribution to a good society by doing what is ethically correct. The development of a new theory to better understand the relationship between business and society is needed. It should integrate the mentioned four dimensions and contribute to overcome each dimension's limitations. This would require both an accurate knowledge of reality and a sound ethical foundation (Garriga and Melé, 2004).

Thus, can be assumed that, sustainable businesses are those that work their ability to survive in the long run. Recent history has proven that are not the most profitable companies who succeed, but those that are responsive and better suited to the requirements, both for the market and for the entire context of its activity.

A sustainable business is based on a set of strategies and socially responsible actions in a specific spatial and temporal context. However, due to the constant evolution of the issues surrounding the business activities and strategies, CSR has to evolve permanently to meet changing social and environmental requirements. The corporate sustainability is achieved through the interactive exercise and evolution of corporate social responsibility (*Figure* 3-3).

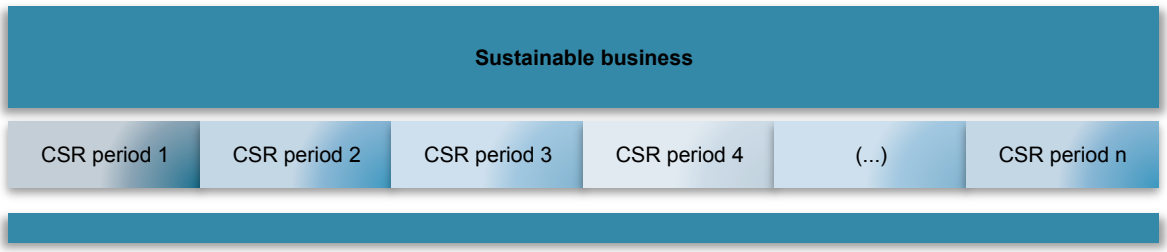

Figure 3-3 Relation between Corporate Sustainability and CSR

Sustainability itself is assumed as an *holistic* concept that is based on the idea that the whole is greater than the sum of the parts (Soppe 2009) and that it concerns more to movement between states rather than the achievement of a single position (Gray 2010).

So, the aim of social responsibility is to contribute to sustainable development (ISO/DIS 26000) and the concept of CSR precedes the concept of sustainability (Rake and Grayson 2009). Corporate responsibility refers to actions and effects in the short term, while the second also refers to a strategic vision in the long term. The construction a sustainable business relies in the assumption of corporate responsibility.

Considering the present state of the world, the compromise with corporate responsibility is not possible without the compromise with corporate sustainability (Rake and Grayson 2009). Yet the effect is bilateral, once the practices of today should be framed both by the present constrains and by the vision of the future.

3.2.3. Reporting on Sustainability

The reporting of non-financial issues assumes a variety of denomination namely Sustainability Report (SR), Corporate Social Responsibility report (CSRR), Social and Environmental report (SE), Environmental, Social and Governance Report (ESG). Whilst the differences that may exist on contents and format, on this work, was adopted the denomination SR. In the following developments the concept of SR generically refers to a broad range of non-financial corporate issues.

However, corporate responsibility behavior needs to go along with a proper reporting system. Reporting practices based on accountability and transparency can contribute to reinforce public trust, respond to consumer's expectations, follow employee's hopes, retain best talents and manage reputational risks, among others. (Alniacik et al. 2010)

Social responsibility in business arose initially associated with movements of philanthropic character.

Later this effort has gone towards improving the competitive context of organizations, through the involvement in social causes in order to motivate employees and improve the image of companies to the outside.

Corporate social responsibility offers two levels of action. One turned into the organization, referring the commitment of employees with certain behaviors, which is materialized in codes of conduct and ethical codes. Other, with a broader influence, referring the social interactions with employees, clients, suppliers and communities, which is expressed in social reporting.

Codes of conduct, ethical codes, or guidelines for behavior serve as example of the first level and it concerned to the organization commitment with an ethical behavior, which extends to employees (O'Dwyer and Madden 2006)

The early several definitions of conduct codes present them as "stand alone documents" separated from the operational documents. However initially focusing in US companies, they spread along the world and they constitute the early efforts on inspiring the ethical consciousness on business (O'Dwyer and Madden 2006).

The second level of action was initially materialized in social, health and environment reporting, but it took off when corporate environmental responsibility has increasingly become a topic of concern.

The first, so-called, reports of sustainability emerged in the last decade of twentieth century and resulted, in general, from adapted environmental or safety and health reports, which began to appear as independent reports during the 80´s. However, only from 1999, SR began to exhibit a wide viewer and include environmental, social, economic and even financial issues (Kolk 2004).

In the early days there were no accepted standards for corporate non-financial reports, which meant that there were wide variations in both the content and the format of the reports produced. This prevented the realization of temporal analysis or the mere comparison of results between companies and limited the use of SR as an effective tool to support management.

Presently, although clear differences between countries and sectors, there is a clear trend for the disclosure of non-financial information in all sectors of activity (Kolk 2004).

Bebbington et al. (2007) use the term “corporate social responsibility (CSR) reporting”, to reinforce the link between the reporting activities and organizational and operational functions relating to social corporate responsibility. A representative report implies a dynamic change of information with several levels of an organization with implications “*on strategic planning, governance, stakeholder engagement, risk management, decision making, data collection and management systems, performance measurement, performance management, public relations and communications”.* (Adams 2008). *The* CSR reporting makes sense only when interpreted in light of the company's CSR and its own dynamics of operation.

Recently, the increasing awareness of stakeholders led to the development of frameworks in order to meet their expectations, improve the quality of reporting and increase transparency.

3.2.3.1. Expectations on corporate reporting

Non-financial reports are an important management tool, allowing a better systematization of information usually disperses and the accomplishment of internal diagnosis. The reporting may also be used to improve the management of internal information and to assess the systems of performance monitoring. It is part of a mechanism for monitoring, analysis and accountability of the performance of an organization.

The sustainability or CSR reports emerge as a way to operationalize sustainability in business, once it involves the creation of a practical tool to measure the quality changes in the performance of companies in terms of sustainability in a credible, transparent and consistent way.

In this context, those reports appear as an integrator element of each organization activities, framed by their own values and principles and reflecting its real contribution for sustainability.

Many studies defend that companies concerned with sustainable issues, in average, achieve better shareholder returns than other companies laboring on the same sector. Some researchers have shown that a social corporate responsible behavior can improve business health (Engen and Di Piazza, 2005). When the interests of stakeholders are taken into account on management decisions, positive effects can be expressed, for example, on long-term reputation, work relationships, access to credit, product perception, as also on customer loyalty and supplier preference. A proper position before stakeholder expectations helps to create appropriate conditions to ensure survival. Corporate value increases, once that raising value is directly associated to higher capacity of survival on the long run. Sustainable companies represent higher value for stakeholders and they tend to cooperate to preserve those organizations. The process is interactive and can generate a virtuous spiral of sustainable development.

Positive and negative information on corporate social responsibility influences purchase, employment and investment intentions of various stakeholders (Alniacik et al. 2010; Rake and Grayson 2009).

By other hand, reporting allows some parts of the financial community to gear up their use of non-financial, extra-financial and sustainability disclosures to better understand performance of companies. However, most investors do not use the mainstream SR because they were not trained to decode it. Unlike financial reports, SR does not present numbers, trends or metrics that allow comparison between companies or temporal analyses. The information provided is usually scattered by extensive reports and rarely refers the problems and difficulties that organizations have to deal with.

The credibility of the report is rooted on an honest assessment of business behavior. As an example, most of the companies involved on recent accounting and ethical scandals published their corporate responsibility report (BP, Enron, WorldCom, Ahold and Parmalat) (Kolk 2008; Kolk and Pinkse, 2009). Many of these scandals are connected with internal stakeholders ethical issues such as managers and employees irregular behavior and it usually fall within the corporate governance debate (Kolk and Pinkse, 2009). Yet, the disparity between related behavior and effective actions involving greenwash, bribery and corruption, may lead the public opinion and the stakeholders to discredit SR and this reports may lose ground as a serious means of communication between companies and stakeholders, unless accountability, transparency and responsibility growth on.

As recent financial scandals affected negatively the reputation of listed companies, SR reporting may well contribute to a wider assessment of corporate performance and help to minimize conflicts with stakeholders (Becchetti et. al 2009). Social responsibility is key for corporate strategy, working towards greater transparency and disclosure on global company performance.

However, following Porter and Kramer (2011), corporate responsibility has a dark side once the most companies embrace disclosure practices more they are accused for insufficient accuracy and for creating problems in society. A narrow and outdated approach concerning value creation is mainly responsible for the focus on financial performance, which is reflected in short-term success.

Companies concerned with short-term financial flows, may forget broader perspectives of value creation. They can depreciate the interactions both with society, environment and economy; witch may heavily constrain their ability to survive in the long run.

Porter and Kramer (2011) define value as benefits relating to costs. Although this view of value is usually lagged from environmental and social issues, they propose a new approach of value creation based on corporate practices, which increase competitiveness in business while simultaneously enhance economic and social improvements. This broader perspective of value, expectedly will contribute to long-term success and for increasing corporate sustainability.

The short-term perspective widespread in financial markets defines the way investors and corporate managers operate and the way they are rewarded. In the wake of scandals as those surrounding the downfall of companies such as Enron and WorldCom, expectedly other measures could assume leadership and to be recognized as key measures in assessing the financial performance of companies, those who favor long-term safety and yield of assets (Zadek and Merme 2003).

So, signals and lessons collected from current Sustainability Reports point to the need of a better understanding of the links between the evolving sustainability agenda and wider market opportunities. Nevertheless, recent years have witnessed an increase in the number of companies reporting publicly on various aspects of their environmental and social performance, most companies are still missing an important opportunity to communicate with their stakeholders and other institutions. Civil society insists that sustainability practices to be credible should be developed, implemented and evaluated with the involvement of relevant stakeholders (COM 2006 136).

Investors stress that, besides sustainability reports it is still needed to improve disclosure and transparency of company practices, and consumers still demand more complete and transparent information to guide their purchase choices (COM 2006 136).

To comprehend the extent of the unsustainability of current business is a necessity for individuals, organizations and societies. Various fields and extensions require models, metrics and tools appropriate, so can be defined the strategies and measures that boosts sustainability

As business activities have multiple impacts, the report presented to the stakeholders will need to present a multifaceted and inclusive structure.

SR´s built based on information of enhanced quality and subject to transparency and completeness principles assume a higher credibility and significance before corporate stakeholders and other parties. If this information reflects all the corporation activities interconnected, it can provide a genuine and holistic image about its performance.

3.2.3.2. Critical issues on corporate reporting

Some authors are quite skeptics about corporate sustainability and even more about sustainability reporting. First of all because they assume that is difficult if not impossible to define what is a sustainable organization and therefore it is impossible for an organization to report on its own sustainability (Gray and Milne 2002; Bebbington and Gray 2001; Bebbington et al. 2007).

Second because they consider that sustainability should be assessed collectively and cumulatively, given the economic activity related to a resource basis available at a certain time (O'Dwyer and Owen, 2005).

Current sustainability reports include evenly quantitative and qualitative information on financial, economic, social, environmental and ethical performance, for a group or company. O'Dwyer and Owen, 2005, consider that this type or report, "do little more than report on aspects of a companies' economic, environmental and social impacts (the so-called 'triple bottom line[6]')" and reveals a misunderstanding about the concept of sustainability.

In this perspective and also because these reports are mostly focused on the activities of companies with low or no participation of external stakeholders, they defend that those commonly referred as SR should be called at best as Triple Bottom Line Reports (O'Dwyer and Owen 2005).

Many reports simply state the company's policies and intentions toward social and environmental issues, but provide no data (Kolk 2003).

Other authors criticize the fact of most reports are included, so far, in the strategy of the company's public relations. As Adams (2008) recognizes much of the research on the field of Sustainability reporting has been motivated by the knowledge that CSR reports do not demonstrate accountability. Also because companies use CSR reporting "*as a public relations exercise to manage impressions to improve their reputation interpreting CSR as a way to serve shareholder wealth"*.

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[6] The concept of Triple Bottom Line is frequently associated with CSR, coined by John Elkington in 1998, has an accounting connotation that falls short of the broader scope of CSR. The Triple Bottom line (TBL) means expanding the traditional reporting framework to take into account environmental and social performance in addition to financial performance. Bottom line, also known as net income or profit, is an accounting term and refers to the income that a firm has after subtracting costs and expenses from the total revenue. In some countries profit is the usual term
Net income is informally called the bottom line because it is typically found on the last line of a company's income statement. A related term is top line, meaning revenue, which forms the first line of the account statement.

Double bottom line, a business term used in socially responsible enterprise and investment for companies that seek a second bottom line look to measure their performance in terms of positive social impact.

Triple bottom line is a business term used in measuring organizational success in economic, environmental and social subjects.

Larger multinationals, from Nike, to British Petroleum have introduced CSR programmes as a way to defend their reputations in the face of single-issue campaigns from civil society. (Doane 2005).

This opinion is shared by other authors based on critics complaining that Sustainability Reports were merely “greenwashing public relations tools”, with no outstanding contribution to accountability (Hess and Dunfee 2007; Owens 2006; Adams and Frost 2006).

Moreover, the fact that firms uses a wide variety of other outlets to provide information to stakeholders. In addition to social reports, this type of activity is much harder to compile, so information concerning the scope of corporate responses through the media to social critics is limited (Hess and Dunfee 2007)

With respect to the amount of disclosured information, there is growing support that the following factors are associated with greater disclosure of environmental information through corporate communications: firm size, membership in an industry which is facing significant environmental issues, financial performance, media exposure, and being subject to regulatory proceedings (Berthelot et al 2003; Adams 2002)

Traditional accounting research has been criticized by academics in the field of social and environmental accounting, allegedly for its narrow approach, its service to capitalism and its failure to consider the social and environmental impact of organizations and their impact on a broader group of stakeholders than simply shareholders (Adams, 2008). Disclosure of business information has to be extended to new themes, highlighting key concepts as accountability, responsibility and transparency, all of which are fundamental to corporate responsibility (Figure 3-4).

Figure 3-4 Desirable Characteristics for Sustainability Report

However, the desirable characteristics for are not fully achieved. The regulation of each country, the stakeholders involved and the recipients of the report affect the quality of disclosure. Is still in the hands of each organization to decide what is relevant or material to report.

Materiality is an important issue that determines which is the information that should be reported and applies both to financial and non-financial information (Eccles and Krzus, 2010). National and international authorities have developed several conceptual frameworks for financial information, e.g. IASB(International Accounting Standards Board). Relating to non-financial information AccountAbility´s AA1000 Assurance Standard provides some materiality criteria applicable to corporate sustainability report.

In both cases (financial and non-financial), there is still is no clear consensus about what it is material.

The accountability theory (Gray et al. 1997) is frequently referred in the context for social reporting, as accountability with regard to material impacts to key stakeholder groups. However as a desired attribute of sustainability reporting, accountability is unlikely to be achieved in the absence of: robust stakeholder engagement; widely accepted reporting guidelines; assurance guidelines (similar to those in place for financial audits); legislation; and, penalties for non-compliance (Adams 2008). Researchers are challenged to look for a better understanding the links between CSR performance and CSR reporting. Knowing better this links will provide opportunities to improve change towards greater accountability and performance, which can lead to improve the social and environmental performance of organizations (Adams 2008).

The big defiance is to develop a methodology, for universal application, to do the correct viable accounting of the sustainable performance of each corporate. As Adams and Larrinaga-Gonzalez (2007, p. 334) noted:

> *(...)"There is a lack of research on: how and why they (the companies) fail to be accountable for some aspects of their sustainability performance (Adams, 2004); and, the specificity of settings that gives rise to this situation (Larrinaga – Gonzalez and Bebbington, 2001). One of these research avenues might be to engage with organizations to examine the processes of ethical, social and environmental (or sustainability accounting and accountability[7] and the manner in which these processes, the data collected and subsequent reporting impact on performance)".*

In this sense, a SR could be taken not only as an instrument of information, but also as an instrument of assessment of change and organizational improvement, providing relevant contributions to promote sustainability at a corporate level and at global scale.

[7]Accountability is often used synonymously with such concepts as responsibility, answerability, enforcement, liability, and other terms associated with the expectation of account-giving.

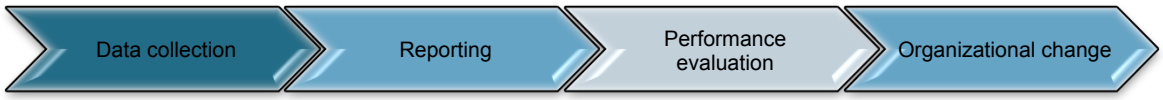

Figure 3-5 *Reporting and improving corporate sustainability performance step-by-step*

Yet, two main reasons prevent the unraveling process from occurring, which included the ability of firms to selectively disclose and stakeholders' lack of knowledge with respect to what information a corporation has or could acquire. The incentives for firms "*to engage in selective disclosure*" are relevant. They can be tempted to present the information most favorable and hiding or smothering the other while stakeholders have significant research costs to assess the complitude, relevance and deepness of information presented (Hess and Dunfee 2007). Both problems can be lessened with a standardized format, since all firms must disclose the same information. In addition, the standard format sets out what information firms should be able to disclose

This contribution is important, once current reports are still missing relevant information besides suffering from lack of briefness.

Regarding this matter, Stoney and Winstanley (2001) point out that it is quite fallacious to imagine that ''…*stakeholding can change the corporate balance of power without the support of wider societal reform'' and that it is equally fallacious to imagine that accountability to stakeholders can be established by reporting reform alone*".

On other hand, Adams and Whelan (2009) argued that, companies may have their reputation affected by environmental or social events, but they keep their legitimacy for continue to work. Social and environmental aspects do not threaten organization legitimacy in the same serious way that failure to comply with financial standards and norms of behavior do. Firms can dismiss social and environmental disclosure norms without consequences (Adams and Whelan 2009).

To ensure equity, the performance of each organization is expectedly relativized, depending on the circumstances and the context in which their activities fall. However, the report must be rigorous and precise. If all dimensions from sustainable performance were accountable, they can be expressed in objective terms following indicators, criteria and assessment tools, verifiable by third parties.

Gray (1992) was the first to propose forging a practicable link between sustainability and accounting, though an “account of sustainability” (Bebbington and Gray 2001). This accounting would be based on a sustainable cost calculation (SCC), which attempts to measure the additional costs borne from the organization effort to be sustainable. This could be a rather restrictive/biased perspective, is not guaranteed to be sustainable involves more costs.

The creation of a transparent platform of communication between stakeholders and companies represents a masterpiece on corporate social responsibility achievement. For both company and stakeholders, it will highlight the relationship between financial and non-financial performance, as also externalities imposed to stakeholders (Eccles and Krzus 2010).

3.2.3.3. Emerging Trends

There is an increasing trend to integrate non-financial reports with other forms of social and financial reporting, aggregating them into a single corporate report (Krajnc and Glavic, 2005; Eccles and Crzus, 2010).

The disclosure of corporate information in an integrated and coordinated way is needed to provide stakeholders with a holistic view of corporate sustainability (Eccles and Crzus, 2010).

This holistic view is doubtless extremely important in the perception of the company's corporate responsibility.

European financial and non-financial entities are getting involved in developing a global framework for report integration. The European Federation of Financial Analysts Societies (EFFAS), jointly with European Sustainable Investment Forum (EUROSIF), the European Laboratory for Valuing non-financial performance, the Prince's Charities "Accounting for Sustainability" Project, the Railpen Investments and the World intellectual Capital Initiative (WICI), published in March 2010, the "European Combined Reporting Alliance" position paper. This paper expresses the results of a teamwork and think-tank and it strongly encourages the concept of *"integrated report*", which is considered key for supporting decisions on investment settling, commercial loaning and rating.

Other initiatives such as the International Integrated Reporting Committee (IIRC), which integrates the *International Accounting Standards Board* (IASB), the Financial Accounting Standards Board Financial Accounting (FASB (US-GAAP)), the Prince's *Accounting for Sustainability* Project, the Global Report Initiative (GRI), the Fédération des Experts Comptables Européens (FEE), EFFAS and other members both from financial and non-financial reporting domains, are jointly addressing the challenge of creating an integrated reporting framework.

The European Commission, together with Principles for Responsible Investment (PRI), EFFAS and the International Corporate Governance Network (ICGN), is leading a new programme to improve investor's ability to integrate ESG information into investment analyses and decision-making.

Currently, some authors suggest that the use of assessment methodologies for the intellectual capital can be extrapolated to the evaluation of non-financial assets, mainly those relevant for the assessment of sustainability performance.

The development of new categories of intangible assets is expected and new methods will arise to report the essence of culture and the values of companies. Polo and Vazquez (2008) proposed the integration of the social report with the intellectual capital report, because they consider some matters, contents and goals are common to both documents. Given the observed similarities and the greater flexibility and scope of the intellectual capital report, they believe that the integration of the two types of report can simplify the presentation of non-financial information and make it accessible to a greater number of stakeholders.

Producing a single report allows executives to understand how not all corporate responsibility practices have the same value and to dedicate more energy and resources to that which will increase the firm's sustainability. The integrated development of corporate citizenship and intellectual capital monitoring could enhance the benefits of corporate responsibility practices and create a competitive edge. (Pedrini 2007)

Since it is impossible to manage that which cannot be measured, the need for a map of the various forms of capital used in the company, as well as of their corporate responsibility practices, has thus been identified as a first step toward good management.

3.2.4. CSR through financial market lens

The idea that the economic performance of a company was linked to environmental and social performance, with few exceptions, only recently has received generalized acceptance by the academic community (Sharfman and Fernando 2008).

Those first approaches to positive relationship between environmental and economic performance, were mostly based on a resource-based view. In this perspective, it is assumed that a greater economic effectiveness results from a greater efficiency in resource management, including environmental resources. For example, the implementation of measures to reduce waste can pass through both the reuse of materials, or the introduction of more effective procedures / technologies. Such attitude involves the use of fewer resources and consequently implies less operational costs for the company, impacting the broad improvement of the organization effectiveness (Sharfman and Fernando 2008).

The broader relationship between corporate financial performance (CFP) and sustainability performance has been the subject of scientific studies, which can be framed by two lines of research in opposite directions. Those who analyze the reaction of financial markets to the company's internal strategies, mainly through the measurement of market returns, while others address the impact of financial markets on the performance of sustainability (Ziegler and Schroder 2010; Sharfman and Fernando 2008, Lydenberg 2009; Arnold 2008).

In the following sections are initially displayed the approaches that justifies the global performance of a company as a result of its financial performance and its ability to finance. Then are presented the approaches that justify the opposite, i.e. the good financial health is the result of good environmental, social and economic performance. A third group refers to the methods used to justify the existence of mutual effect between performance of sustainability and financial performance.

3.2.4.1. CSRP versus Financial performance

The financial effects of the corporate social and environmental performance (CSRP) follow various strands of research, which include portfolio analyses, event studies and long-term micro econometric studies (Ziegler and Schroder 2010). Such analyses are mostly intended to ascertain whether it is worth investing in socially and environmentally responsible behavior, i.e., to determine whether financial markets reward those behaviors.

This line of research fits the instrumental stakeholder theory, which suggests a positive relationship between Corporate Social and Environmental Performance (CSRP) and Corporate Financial Performance (CFP) (Orlitzky et al. 2003). According to this theory, the satisfaction of various stakeholder groups concurs for better organizational financial performance.

Silveira (2006) studied the impact of corporate standards ethics, corporate governance, social responsibility, sustainability and transparency in the volatility of Latin American banks. The methodology involved multiple linear regressions sectional (cross-section) using as dependent variable the volatility of stock returns and as explanatory variables the corporate standards (ethics, corporate governance, social responsibility, sustainability and transparency). Control variables, were included in the regressions to ensure the robustness of results. The study revealed that the set of corporate standards has a negative relationship with the volatility of return on bank shares in Latin America.

Ioanniou and Serafeim (2010) explored the link between CSR strategy and corporate financial performance, exploring the mechanisms via which crucial CSR information gets evaluated and reached public equity markets. They quantified the impact of CSR strategies on sell-side analysts recommendations.

Ziegler et al. (2011) studied the relationship between information disclosure by energy companies and the performance of their shares and found that it is more positive for this sector due to greater exposure and scrutiny.

A great deal of other academic research has been conducted to identify the possible relationship between corporate social performance and financial performance (Alniacik e al. 2010). Obtained results were inconclusive. Margolis and Walsh (2007) analyzed 80 studies relating CSR activities with financial performance. They found that 53% of these studies documented a positive relationship, 24% found no significant effect, 5% showed a negative effect, and 19% produced mixed results.

Although theoretical and empirical research often points to a positive relation between CSR and business competitiveness, the current literature is often missing the way to measure the CSR impact on business performance (Weber 2008).

Other empirical approaches apply event studies. An event study is a tool widely used in finance to investigate the reaction of the stock market to a specific type of news or events (Capelle-Blancard and Couderc, 2008). It consists in an econometric research methodology, which aggregates mathematical economics, statistics and theory and it is commonly applied to investigate financial markets statistically relevant response to certain past or announced events, namely Information on environmental or social corporate activities.

Gupta and Goldar (2005) conduct an event study to examine the impact of environmental performance of large Indian companies on their stock prices.

They applied the Ordinary Least Squares (OLS) as estimation method for the market model. This model assumes a linear relationship between the return of any security and the return of the market. They defined a standardized one-shot event by firm, so that the selected event could be associated with a statistically significant variation in the market value. Dasgupta et al. (2001) performed a similar analysis for Latin America countries, but consider multiple bad (and good) events for various firms.

The traditional method for event study starts from the definition of the categories of events, fact that conditions the subsequent improvements in results. Capelle-Blancard and Couderc (2008) reversed the methodology, looking for causes from the effects already detected (ex: knowing an abnormal return, it is intended to identify the cause). They considered time-varying beta estimates they used a GARCH process to model the volatility. The authors held several investigations to assess the relative importance of different types of news in driving significant price changes in the defense industry. They concluded that most of the key drivers are the same as in other industries but he identified some special features, mainly related with geopolitical events that had relevance on the market value of defense industry firms.

Assuming that chemical disasters are a major risk that influences firm's revenues but also generates external impacts affecting the health and the environment, Capelle-Blancard and Laguna (2010) examined the stock market reaction to industrial disasters. For the period 1990–2005 they did a collection of 64 explosions in petrochemical industry. Using the dataset, they performed two-phased econometric analyses. First, using an event-study methodology they assessed the average market value losses supported by shareholders. Secondly, they tried to identify the factors behind the fall in the value of the shares of each firm. They found that stock market reacts immediately to chemical disasters, with serious falls on stock prices within two days following the accident. A multivariate analysis suggested that losses in the first days were seriously related to the severity of the accident.

Although short-horizon methods for event studies are quite reliable, long-horizon methods, despite continuous improvements, still struggle with some limitations (Kothari and Warner 2006). Some authors still consider that the event study has a short-term character, preferring the use of long-term econometric approaches at *the firm level* (Ziegler and Schroder 2010).

Lo and Sheu (2010) applied the Blinder-Oaxaca decomposition to explain why the market value of sustainable leaders is higher, on average, than on other firms. Using a sample of U.S. S&P 500 companies from 1999 – 2002, they explained the determinants of sustainable and non-sustainable differences on firms' valuation. The results obtained suggested that less than 40% of the difference between sustainable and non-sustainable value was explained by firm's specific characteristics, such as operation, financial performance, industry and growth. Each one of these categories was represent by three or four variables. More than 40% of the

difference was not explained by commonly used financial valuation criteria, which leaves room for other factors to influence investors. Lo and Sheu (2010) concluded that sustainability matters for investment decision-making. Sustainability information is perceived and valued by investors and it counts as an intangible asset. However, their results suggested both the need for development of other evaluation techniques and the use of different variables. An holistic monitoring system of corporate performance demands the understanding of the drivers valued by investors, which go beyond the publicly-recognized criteria and evaluating variables commonly-used in both academics and real financial markets (Lo and Sheu 2010)

Gupta and Goldar (2005) found a positive correlation between abnormal returns of firm stock prices and the level of is own environmental performance, that lead to the conclusion that financial markets could play an important role on present and future environmental management. They conducted an event study to examine the impact of environmental rating of large pulp and paper, auto, and chlorine alkali firms on their stock prices. They found that the announcement of weak environmental performance lead to negative abnormal returns while a good performance lead to positive abnormal returns.

The disclosure of new information on the environmental and social performance, when affecting investor's expectations about company's profit, may constrain the purchase options, impacting on the share price (Gupta and Goldar 2005).

Orlitzky et al. (2003) performed meta-analyses over published studies to assess the relationship between CSP and CFP. They concluded the existence of a positive and mutual link between CSP and CFP, affecting each other through a virtuous cycle: top-performing companies with better financial behavior can more easily support and afford CSP activities. In turn, CSP also helps them become a bit more successful. Corporate social responsibility is rewarding in many ways and this analysis helps to reject some notions developed by neo-classical economists whereby CSP is necessarily inconsistent with shareholder wealth maximization.

However, in light of results, the authors warn to the need of a field join endeavor to improve the reliability of CSP and CFP measures (Orlitzky et al. 2003).

In reverse direction some studies are mainly focused on the corporate sustainability effects on the financial performance and are generally consistent with the slack resource theory, *which suggests that better financial performance leads to the availability of slack resources that provide the opportunity for firms to invest in environmental and social activities* (Waddock and Graves 1997; Ullmann 1985). That means that companies with a good financial performance *"have less difficulties to pay attention to stakeholder groups and to obey moral standards or can invest in new capital, which inevitably (even when not intended) leads to a better sustainability performance (e.g., Telle, 2006). Indeed, the study of Waddock and Graves (1997) shows that corporate sustainability performance is positively affected by different indicators of corporate*

financial performance such as return on sales, return on equity, and return on assets." Therefore, companies with better financial health have greater ease in investing resources on issues related to corporate sustainability.

In this line, Sharfman and Fernando (2008) studied the impact of the cost of capital, as external effect influencing the environmental performance of companies. They assumed that the overall cost of capital of a firm is given by the weighted average of the cost of debt and equity capital. This approach applies only to large companies publicly traded in capital markets. They used a Capital Asset Pricing Model (CAPM), usually applied to determine a theoretically appropriate required rate of return of an asset, to estimate de cost of equity capital.

Huang (2010) examined the effects of economic volatility on global sustainability using a dynamic panel data model. Panel data refers to multi-dimensional data and it may contain observations on multiple phenomena along several time periods for firms or individuals. Huang (2010) concluded that output volatility and financial market volatility exert strong negative impacts on sustainable development. Those impacts are aggravated in higher energy intensity countries and lower trade share countries.

Ziegler and Schroder (2010) examined empirically the determinants of the inclusion of worldwide and European firms in sustainability indices respectively Dow Jones Sustainability World Index and Dow Jones Stoxx Sustainability Index, which claim to integrate the corporate leaders in terms of sustainability. The inclusion of firms in sustainability stocks indexes can be seen as a good indicator for corporate sustainability performance, once it is expected that selected firms present a sustainable behavior exceeding those of their competitors. However, Ziegler and Schroder (2010) argue that once sustainability performance is not standardized, the selection of measures may err for a certain amount of subjectivity. For such reason, they question the reliability of the use as an indicator of corporate sustainability integration of a particular company in a sustainability index. For their research, they used flexible panel *probit* data models which present the advantage of reducing the occurrence of spurious relationships and because they allow the inclusion of unobserved heterogeneity (Ziegler and Schroder 2010). Spurious correlations may occur thanks to unobserved firm characteristics. For example good management can affect both corporate sustainability and economic performance. Unobserved heterogeneity results from *time invariant firm-specific random effects (ex: firm strategy constant over time) and to an autoregressive structure in the stochastic components (ex: single decision about wages)* (Ziegler and Schroder 2010).

The panel data model applied for Ziegler and Schroder (2010) includes unobserved heterogeneity and lagged explanatory variables, to avoid endogeneity problems that can lead to biased or inconsistent estimates.

The probit models have the advantage of greater simplicity in estimation than other models with an autoregressive structure, which are more complex

3.2.4.2. *Bilateral effects and Conclusions*

Orlitzky et al. (2003) defended that is a limited vision to consider a unilateral causal link between Corporate Social and Environmental Performance (CSRP) and Corporate Financial Performance (CFP). The authors believed that both instrumental stakeholder theory and slack resources descriptions are accurate, further the two constructs have a relationship of mutual causality. To prove that they proposed three sets of temporal associations: (a) prior Corporate Social Performance affects Corporate Financial Performance; (b) prior Corporate Financial Performance affecting subsequent Corporate Social Performance; and (c) contemporaneous (cross-sectional) associations.

To conduct their investigation these authors made use of a meta-analytic review of primary quantitative studies of the CSP–CFP relationship. Psychometric meta-analysis is a sophisticated research-integration technique that quantifies the effects of theoretical and methodological deficiencies in a given line of inquiry (Orlitzky et al. 2003). The method of meta-analysis is based on a theory of data, which includes the comprehension of both several kind of errors (on sample, on measurement and on data).

Meta-analysis is a technique usefully applied in many substantive areas where multiple individual studies give rise to inconclusive or conflicting results (Orlitzky et al. 2003), such as in the studies conducted to investigate the relationship between CSP and CFP. The results of Orlitzky et al. work show that there is a positive association between CSP and CFP (positive, simultaneous and bidirectional) across industries and across study contexts.

Falck e Heblich (2010) studied how to interrelate the shareholder and stakeholder approach with strategic CSR. For such, they focus on the identification and classification of social trends and on the corresponding strategic CSR actions. Using a multi-stage process to identify the best CSR response to stakeholders and society expectations.

In short, for some, corporate sustainability performance is an investable concept, since it may bring mutual benefits both for companies and investors. It is natural that companies with no environmental or social concerns incurred in direct or indirect losses with wealth, credibility and image, which usually lead to loss of value in financial markets, on the long run. From a financial point of view, sustainability is part of a strategic corporate context and has to do with the decisions of management and the creation of long-term value (Soppe 2009, Doane 2005).

For other, as Lydenberg[9] (2009), corporate responsibility is linked to social responsible investing. He argues that financial markets were taken by short-term thinking, mainly concerned on achieving short-term profits, having disturbing consequences, such as poor asset allocation and increased volatility in financial markets. He suggests that the concept of sustainability and the practice of responsible investing may help focusing financial markets on the long run.

It is expected that the short-term investors do not nurture great interest in the corporate sustainability reporting of companies. Their transactions in capital markets are designed to aim an immediate return and they generally have a speculative character. Long-term investors, with a horizon of 5 to 10 years (e.g. pension funds), tend to enhance corporate sustainability and safe value creation over time.

The current practices on finance have been following, since the 70´s, the Modern Portfolio Theory (MPT), which is for some (Lydenberg 2009; Mason 2009) the paradigm that underlies the current crisis. Lydenberg (2009) criticizes the assumption that the MPT portfolio management techniques do not affect the level of market risk and returns. With this in mind the responsibilities of investors fall beyond the level of the portfolio, since their decisions affect the market and society. They defend the development of a new theory of investment, once that the MPT does not meet the economic reward of social and environmental risk. The SR could link up with this work, particularly as related to methods of accounting for assets (Lydenberg 2009).

The definition of the criteria for success of investment, to guide investors beyond the profitability of their own portfolios, is urgent. Under the umbrella of responsible investment, the merit of an investment is measured both by the benefits brought to society and to the markets.

Responsible investing must attend to environmental and social damages, which occur in the path of achieving profit and that should be paid through the deviation of productive resources (Lydenberg 2009).

Amaeshi (2009) noticed that a current complain from investment professionals was the lack of quantified and standardized information, which complicates the analysis and commits comparisons with other companies. Most of the corporate material, typically communicated in prose style, was of limited use for investment professionals. The information, he continues, should be quantified and properly explained.

Financial markets, seems to appear, extremely important agents in promoting corporate responsibility, which is materialized in a mutual relationship, as previously described. Therefore, it is important to know whether the market recognizes the sustainability efforts of companies, once it affects the resource allocation.

[9] Article from S. Lydenberg included in the book: Bettignies, Henri-Claude; Lépineux, François, 2009. “Finance for a Better World - The Shift Toward Sustainability”, Palgrave Macmillan

The financial area has undoubtedly a very significant impact in promoting corporate sustainability (through the granting of credit and interest rates, as well as the appreciation of the shares) and is affected by this in a virtuous circle.

Markets operate on the basis of collective intelligence using data from disperse sources. For the present research is relevant to capture the issues that affect the market, but also those that concern sustainability but are hidden behind local regulations or are kept way from public eyes.

The fact that financial markets are sensitive to news about companies paves the way for a greater focus on the information provided and therefore greater control on environmental and social issues.

3.3. Monitoring and measuring sustainability

The overall assessment of sustainability traditionally felt under two basic lines, the use of physical indicators or the use of economic approaches. In both cases, the attempts to understand the complex issues of sustainability have proved to be incomplete in the approach and in the results (Böhringer and Jochem, 2006; Gasparatos et al. 2008).

Although a lot a research has been developed in the area of sustainable development, namely on tools and concepts, the definition and implementation of metrics is crucial for the monitoring and measuring of progress toward sustainability (Krajnc and Glavic, 2005; Singh et al. 2009).

Various efforts have been performed either by academia or by international organizations to measure sustainability (Krajnc and Glavic, 2005). Most of them focus mainly on one dimension of sustainability. Very few take into account simultaneously the environmental, economic and social aspects (Singh et al 2009; Gasparatos et al. 2008; Böhringer and Jochem, 2006).

Sustainability indicators aim to provide information of the environment and socio-economic activities and about the interplay between them (Böhringer and Jochem, 2006). Indicators translate sustainability issues into quantifiable measures with the ultimate aim of helping address the key sustainability concerns (Azapagic, 2004). Gasparatos et al. (2008) reinforces that indicators have been widely used to measure, to understand and to take actions in the most diverse fields. He goes further suggesting that it is not surprisingly that indicators are subject of great interest in the research on sustainability assessment.

Several frameworks suggest the use of numerous sustainability indicators, which are generally measured in very different units. However a large number of performance measures, although useful for measuring the different dimensions of sustainability, it hampers to make business decisions, to compare companies or to establish benchmarks. (Krajnc and Glavic 2005).

Singh (2009), Böhringer and Jochem (2006) also defended that indicators of sustainable development should be negotiated with appropriate communities of interest, so that indicators could be selected within a coherent framework. This way, the involvement of stakeholders could ensure the integration of specific parameters on the evaluation process, either initially or over time as an interactive process.

A significant advantage of indicators over all other approaches is that they present an increased accuracy in evaluating and quantifying the different sustainability issues under consideration and they do not necessarily need to be translated to other metrics such as money (Gasparatos et al. 2008). Its plasticity and adherence to the diverse issues of sustainability may play as an advantage for the worldwide development and use.

However, the question about measuring the sustainability, in a holistic, meaningful and unambiguous way remains present. (Böhringer and Jochem 2006)

3.3.1. Assessment of Corporate Performance

While the economic and financial information currently presented is key to evaluate the corporate financial health, using recognized standard tools and benchmarking information, the available mechanisms to elaborate and assess SR are not in an equivalent stage of development and overall recognition and acceptance.

With the appearance of corporate responsibility the urgency has arisen to find a system of measurement and valuation, which could allow managers and stakeholders to understand the company's level of achievement in fulfilling stakeholder expectations.

The need of measurement instruments for CSR that could support its implementation on the corporate context is being studied by academy for the last decades. Nevertheless researchers and scholars have views from the concept of CSR, a wide range of proposals has emerged from their work. Although some proposed generic measures and indicators require much effort for processing, often reveal themselves misfits from business objectives (Rahman and Post 2011).

Strong and objective measures are a recognized need for the reporting of corporate responsibility, in order to differentiate those companies with an effective good environmental and social performance, from others that hide their poor performances behind undisclosed information or unverifiable pretensions of social and environmental commitment (Clarkson et al. 2008).

Rahman and Post (2011) performed a review of different environmental CSR conceptualizations and they conclude that valid, reliable, and transparent environmental CSR measurement instruments were needed. They developed and proposed an instrument which aggregated three relevant corporate dimensions (governance, credibility and environmental performance), composed by a set of 22 items.

Böhringer and Jochem (2006) conducted an extensive literature research on the criteria for selecting appropriate indicators of sustainability. From authors such Pezzey, Ramachandran, Stehling, Radke and Esty, they concluded that the requirements should comprise the representation of holistic fields within the concept of sustainability and that meaningful indicators should be representative of the processes undertaken by the organization or industry under study. Correlated indicators should be avoided. Data collected should be reliable, accessible and enable the achievement of comparisons over time.

By his side, Ilinitch et al. (1998) defended that performance-based metrics of CSR may be of particular importance in conducting comparisons between companies. As allowing the collection of reliable, consistent and accurate information, those metrics should be made available to stakeholders to adequately support decision making.

Some empirical studies consider indicators for only one dimension on sustainability performance and in some cases only one indicator, which provides a short view of the complexity of interrelations of corporate sustainability.

However Ziegler et al. (2011) applied broader indicators for corporate sustainability performance, including both an environmental and a social dimension.

Relevant indicators should allow both easy interpretation and hassle use by stakeholders, enabling them with a clear perception of corporate performance in terms of sustainability. It is expected that CSR measures treat industries and companies uprightly and that the benefits obtained with the use of indicators outweigh the costs of their own collection and processing (Ilinitch et al. 1998).

CSR metrics are also expected to incorporate the best assets of existing measures; rely on publicly available data; ensure transparency in the use of such data (Rahman and Post 2011).

The normalization, aggregation, and weighting of the chosen variables, according to Böhringer and Jochem (2006), should be the subject of special attention, particularly when used for the construction of SD composite measures. Nevertheless, the authors alert to the value judgments, which is implicit in the conduct of any of these actions.

Yet still prevailing differing interpretations of the CSR concept, it is widely accepted among academics, that only a coherent CSR measurement instrument with acceptable validity, reliability, and transparency may provide a sound platform to move forward the state of knowledge (Rahman and Post 2011).

3.3.2. Benchmarking and sustainability indexes

The positioning of company's CSR performance in relation to the respective sector has been performed using several techniques. Benchmarking and indexes are some of the most usual.

3.3.2.1. Benchmarking

A standard definition of benchmarking is a comparison of some measure of current performance against a measure of reference performance (Edvardsen and Førsund 2003). The comparison allows highlighting those variables closest to the reference values as well as the most remote and therefore likely to improve (Jamasb and Pollitt 2003).

Jamasb and Pollitt (2003) applied broadly used benchmarking techniques to an international sample of electricity distribution utilities. These techniques *measure relative efficiency of firms in relation to a sample's efficient frontier* (Jamasb and Pollitt 2003). The results obtained from the enforcement of data envelopment analysis (DEA), corrected ordinary least squares (COLS)[11], and stochastic frontier analysis (SFA), were compared with each other in order to ascertain the main issues in international benchmarking. The first technique falls in the category of programming (non-parametric) approaches, while COLS and SFA are statistical (parametric) techniques.

In previous benchmarking analyses, physical units were not adopted or, at most, assumed as proxy of operating and capital costs. The authors assumed the use of physical quantities as measures of the potential for efficiency improvements in resources use. These improvements are measured by the reduction in physical units of the utilities inputs (Jamasb and Pollitt 2003).

It should be taken into account that this study was conducted from the perspective of the regulator, so more suited to the issues of quality and cost of supply. From the perspective of corporate sustainability, more holistic by nature, it will make all the sense to consider the issues of efficiency in resource use and consequently the definition of physical measures.

[11] The OLS (Ordinary last squares) method attributed to Carl Friederich Gauss, present some attractive statistical properties. The method provides a unique estimation of the parameters that allow minimizing the sum of the square of the errors between the sample regression towards the population regression. By other words the parameters that allow constructing a regression line as close as possible the population regression line.

Edvardsen and Førsund (2003) used DEA to obtain a comprehensive benchmarking as opposed to partial key ratios. They established a frontier production function for utilities, and then calculate efficiency scores relative to the frontier using a sample of large electricity distribution utilities from Denmark, Finland, Norway, Sweden and The Netherlands.

Lee and Saen (2012) applied de DEA to Korean electric industry to understand the measurement of corporate sustainability measurement. They proposed a new model to measure corporate sustainability performance, employing a combined approach of dual-role and cross-efficiency factors.

The use of several benchmarking techniques allowed concluding that standardization of data was critical for international benchmarking and it required common procedures and templates for data collection, consistency of patterns over time and deadlines for processing data. International companies raised additional issues on ensuring comparability of data, usually compelling the use of a least common denominator strategy (Jamasb and Pollitt 2003).

The authors stressed the need to identify a set of minimum requirements for inputs, outputs and as also variables for data collection.

Research results indicated that the selection both of benchmarking techniques and variables, linked to model specifications, might affect results, for instance efficiency scores or rankings of firms (Jamasb and Pollitt 2003).

However, presently the GRI (2006) framework and EU guidelines are pushing for a standardization trend on benchmarking practices and it is expectable a convergence of benchmarking practices among different countries (Jamasb and Pollitt 2003).

3.3.2.2. Rankings and Indices

The last twenty years were fruitful on the development of several toolboxes of quantitative methods to assess sustainability (Krajnc and Glavic, 2005), which frequently raise rankings and indices. Indices represent the aggregation of various measures for a complex phenomenon. In composite indices are generally combined measures of ends and means (Singh et al. 2009). Secondly, they aggregate and relate various criteria and issues in order to ease decision-making (Krajnc and Glavic, 2005).

Different indicators aggregate in sustainability index can enable quick and efficient assessment of sustainability of company as well as benchmarking of companies within a particular sector (Krajnc and Glavic, 2005).

Composite indices and rating systems seek to introduce greater objectivity in the evaluation of sustainability, mainly trough a multi-dimension approach. However, the systems used to obtain those indexes and ratings still suffer from subjectivity on its own construction *(*Singh et al. 2009). The composite index is influenced to a great extent by the choice of the indicators and the criteria underlined (Gasparatos, El-Haram and Horner 2008; Böhringer and Jochem, 2006).

For example, the firm size measured by sales is a relevant determinant for the inclusion in sustainability indexes, such as Dow Jones Sustainability Indexes, FTSE 4 GOOD. For these indices, must be said that every year a large group of companies included in more general indices are not subject to any evaluation for inclusion in the indices of sustainability, independently of its environmental and / or social performance (Ziegler and Schroder 2010). This means that companies that comprise the studied indices are not necessarily those with the best performance in three sustainability dimensions (environment, society and economy).

Doane (2005) strengthens that indexes frequently include those companies that best manage risk and reputation even if creating very significant adverse impacts into the environment and in society. These “best of the baddies” are frequently aligned with those companies that really contribute to a better society.

Besides, some of the available indices and metrics depend on the data that is not easily available. Their application requires the resolution of problems related to measurement, weighting and indicator selection. Due to these constraints most of them are little used by policy makers (Böhringer and Jochem, 2006).

These authors recognized that although sustainability indices should bring forward the characteristics of transparency and briefness, in most cases they fail meeting basic scientific requirements fundamental for indices formation: normalization, weighting, and aggregation. The normalization and weighting of indicators may be compromised by the use of subjective criteria or for lack of assessment of critical assumptions. Regarding the aggregation of indicators, the authors warn for the scarce utility for scientific rules, that if applied could guarantee consistency, and meaningfulness of composite indices. Hence, sustainability indices currently employed in policy practice indicators are often useless or give wrong information for policy decisions. (Böhringer and Jochem, 2006)

Krajnc and Glavic (2005) reinforced that methods for the aggregation of indicators are either not sufficiently well established, under development, or not available with respect to all the sustainability aspects. They proposed a mathematical model for the determination of the composite sustainability index that could enable feasible comparisons between companies regarding sustainability performance within a specific sector. They suggested the use of GRI (2006) indicators as a starting point portfolio.

3.4. State of the Art

A complex phenomenon like sustainability cannot be measured and expressed through single indicators. At first because sustainability as to deal with activities from such diverse areas as the environment, the society and the economy. The interrelationships between them depend on the general and particular factors, which determine the dynamics of each system. Regions, urban areas and corporations have a different perspective of sustainability, in virtue of different characteristics, activities, stakeholders and interrelations.

On a globalized world business is challenged to face sustainability issues and to be responsible for the way it conducts itself in all activities. However, current times are marked for crises. The financial, economic, environmental and social crises are affecting the way of doing business worldwide. Water shortage, climate change, loss of biodiversity, poverty, pollution, resource depletion, are only some interacting faces from a large-scale problem of sustainability.

Employees, consumers and society are increasingly valuing companies with social and environmental concerns, tending to grow its ability to survive in the long run. On the other hand, companies with no environmental or social concerns may incur in direct or indirect losses regarding credibility and image, which usually, on the long run, lead to loss of credibility and markets.

So far, the company's value was calculated according to their financial performance. But after the crisis of 2008/09, the value of the company depends strongly on their ability to survive, which implies a new paradigm.

An inquiry through a manifold of sources, including newspapers, sustainability or corporate reports, stakeholder’s feedbacks, would be critical to provide an accurate picture of corporate contribution for sustainability. However, this reveals a time consuming and complex task.

The pressure to deliver results in environmental and social areas has led companies to seek new ways to collect and communicate this information, namely through the reporting of corporate non-financial performance.

The development of guidelines has come to systematize the reporting of business performance and provide a better understanding of achievements in the field of environment and society. Nevertheless, almost one third of the proposed indicators have qualitative character (Kolk 2004).

In general, standards for sustainability reporting are still missing. The submission of information relating to sustainability and corporate performance suffers from the lack of standardization and comparability (Krajnc and Glavic 2005; Kolk 2004; Gasparatos and al 2008). Key questions regarding frameworks, measurement and empirical methods have not yet been settled.

Dozens of frameworks for assessing corporate sustainability performance have been proposed, using a large amount of indicators. However, the heterogeneity of measures hinders the analyses over time and the comparisons between companies (Krajnc and Glavic 2005). By other hand, it is important to realize to what extent the indicators will be used, since their collection requires effort and resource use.

It is a fact that the assessment of such a complex concept as sustainability demands the use of several indicators (Krajnc and Glavic 2005; Kolk 2004; Gasparatos and al 2008), chosen and analyzed under certain criteria to better describe such intricate systems. Accordingly, the choice of tools and indicators must be carried out in accordance with the context and settings to show (Gasparatos and al 2008).

Yet, current methods to define the relevance of disclosured matters are often based on subjective judgments for each category of analyses. Paraphrasing Lyndenberg, (2010) “the process is an art more than a science”.

The development of new communication approaches in conjunction with attempts to incorporate sustainability measures into strategic performance measurement systems, such as the balanced scorecard (BSC), are being performed by companies.

Although, attempts to add multiple nonfinancial measures into company’s strategic measures have long been under way, the inclusion of sustainability measures is recent. Few empirical studies have investigated whether the last are incorporated and used corporate strategic decision-making and in which way sustainability measures help business managers. (Weber 2008)

Several initiatives were engineered to report on sustainability issues but their application reveals difficulties concerning the determination of crucial data to report. The relevance for the core operation of the business and for the key stakeholders in the corporation should guide this selection (Lydenberg et all 2010). As the basis of reporting is crucial the clearance of main issues affecting present and future generations that companies have to disclosure.

In this sphere, the core of the sustainability reporting is constituted for relevant sector-specific key performance indicators. Business indicators should be focused on sector key sustainable issues and integrated with financial and economic indicators (Lydenberg et all 2010)

Leadership is a driver for CSR and also for dynamic organizational change (Rake and Grayson, 2009). Although authors recognize that companies learned to collect, measure and monitor the evidence and develop the business case, they failed to hardwire consistently on mind and culture of all the staff, partners and supply chain.

The involvement of stakeholders on the sustainability assessment, should integrate a transparent and trustworthy process (Gasparatos et al 2008).

From the literature review, can be noticed that companies and stakeholders still deal with several difficulties at the level of sustainability reporting.

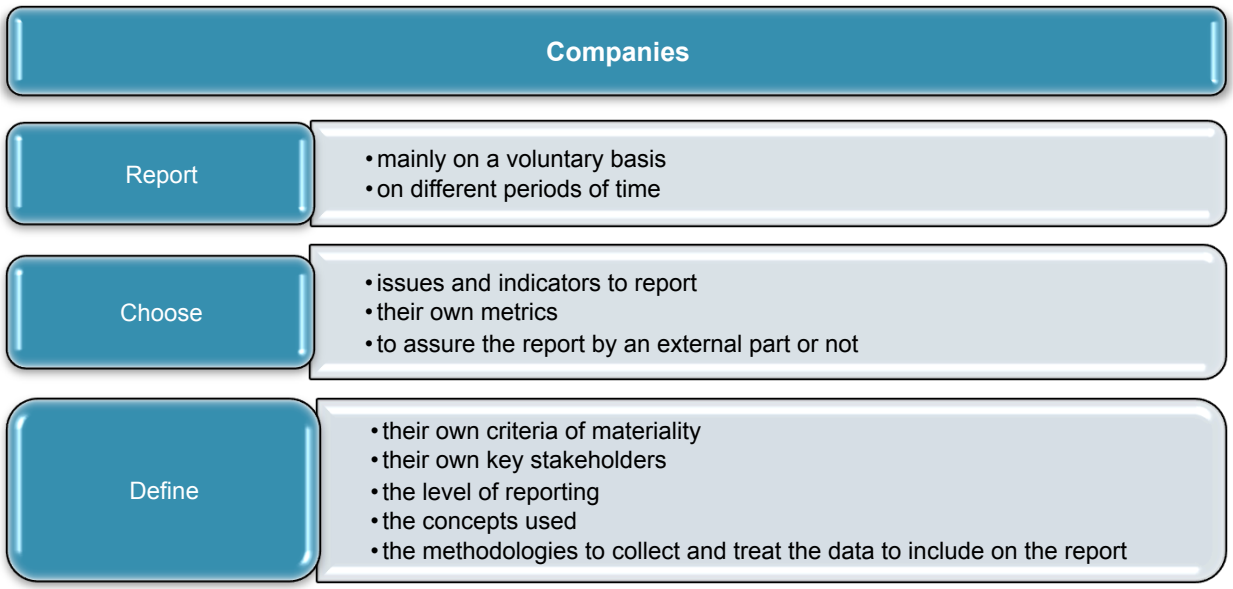

Figure 3-7 State of sustainability reporting - companies

Reports usually results on:

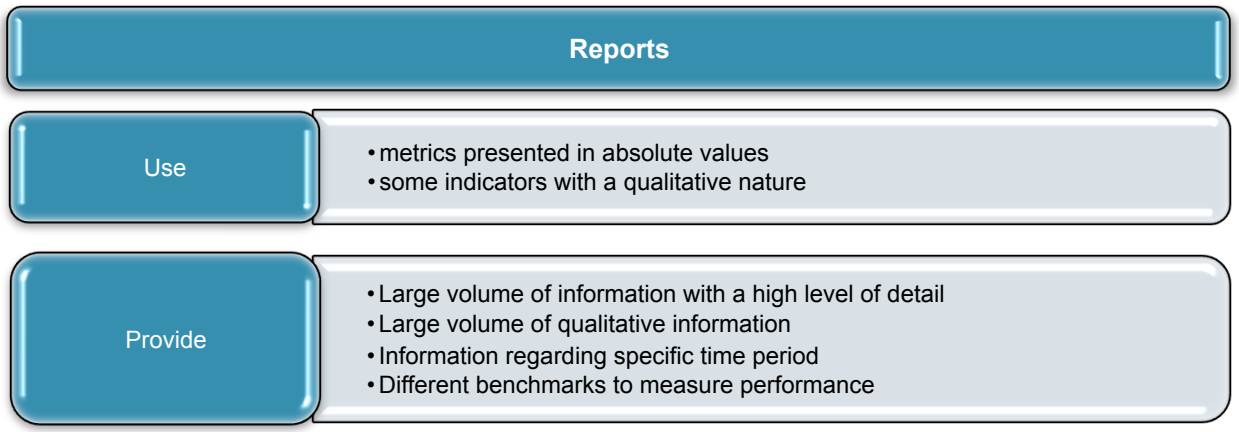

Figure 3-8 State of sustainability reporting - reports

From the previous, stakeholders have to deal with:

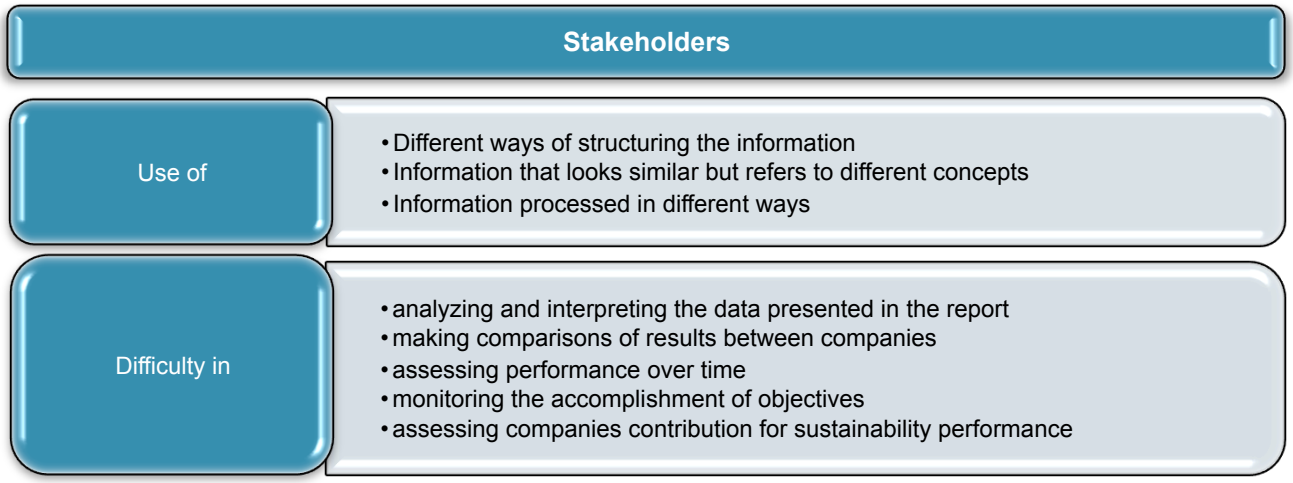

Figure 3-9 State of sustainability reporting - stakeholders

The main limitations on a representative and meaningful report are aggregated in three main groups (Figure 3-10).

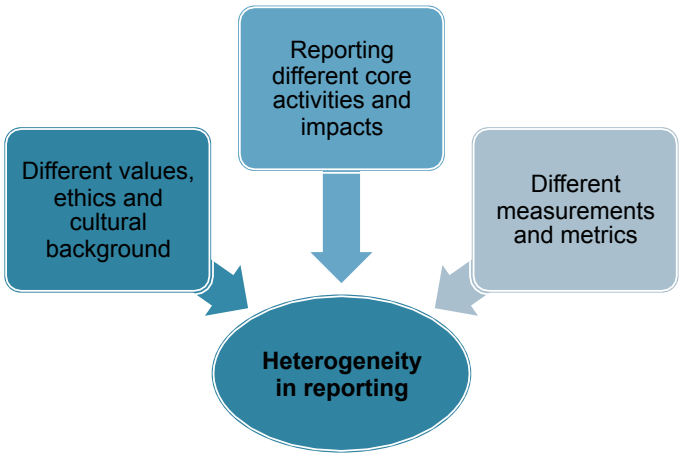

Figure 3-10 Limitations on sustainability reporting

The speech above reflects the diversity of conditions and frameworks applicable to companies that result into a defragmented set of instruments for corporate information, which often do not reflect its overall performance.

From the previous, can be also concluded that corporate disclosure of non-financial information of European companies is poor and unregulated. Even non-financial information, whose disclosure is mandatory in European countries, is not homogeneous, depending on the legal framework of each country.

In European countries corporations have already the obligation to report on environmental and social issues that materiality affects the firm performance, such as green gas emissions or social report.

Nevertheless, non-financial disclosure is mainly regulated at a voluntary level and it does not reveal the consistency needed for making comparisons both between companies and over time.

Since lacking a framework as those used for disclosure financial information topics and aspects covered by non-financial reports are weak when used to compare different companies. Its use for stakeholder's decision-making is quite limited.

The increasing interest in non-financial information demands relevance, timeliness, comparability and consistency of the data.

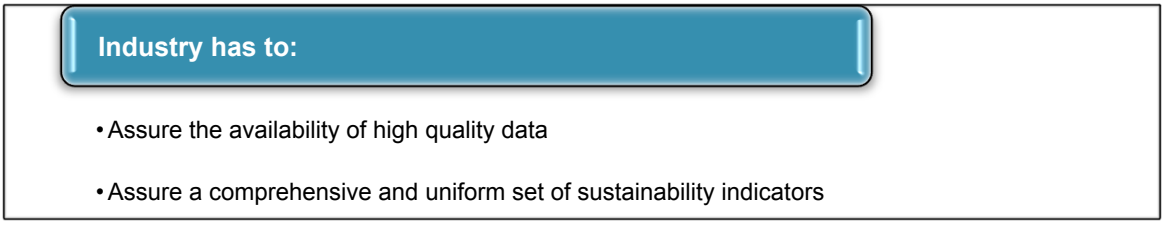

Figure 3-11 State of sustainability reporting - needs

The development of key performance indicators (KPI´s) for corporate social responsibility emerges as a need for allowing benchmarking between companies and the analyses of the performance evolution during the time for each of them.

The core interest areas are assumed as all the activities arising from the objectives and the *"raison d'être"* of the company, as also the impacts that arise from those activities.

The relation between activities and impacts is characterized by a mutual influence. As activities affect impacts, the last ones can also influence the development of activities by imposing constraints and new targets.

As expressed in *Figure* 3-12, KPI used for monitor activities and impacts, contributes to identify relevant issues that should be considered core issues, within the domain of corporate sustainability performance.

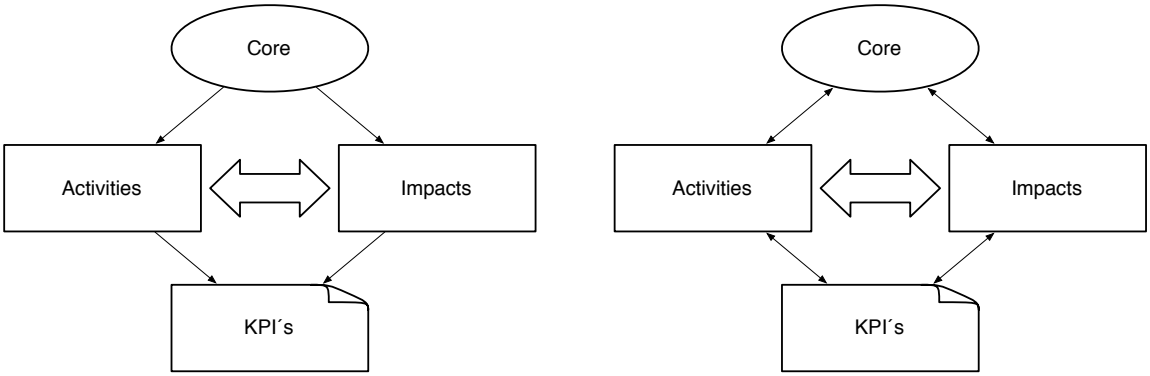

Figure 3-12 Network of interrelationships for KPI´s

Considering as example a power plant, for electricity generation, with gaseous emissions. The characteristics and the volume of those emissions, can affect the activities. A legal setting or community intervention can frame the imposition of changes on production processes or installation of equipment for environmental protection.

Thus both, activities and impacts, should be considered on KPI´s setting.

By other hand the monitoring output can induce the need to improve the activities and impacts, as result of the redefinition of goals or benchmarking activities.

Specific performance indicators are justified, once different industries have to deal with different activities, processes and impacts.

On the other hand, several groups of stakeholders have different expectations and uses for non-financial disclosure.

The above considerations raise the following questions:

- What must constitute the core of a SR? What must be identified as critical to be measured and reported in a commonly understood language?
- How can this report be structured to contribute to the effective promotion of corporate sustainability, increasing these firms ability to survive in the long term?
- How to identify performance indicators that allow to measure, beyond the past performance, the adequacy to the critical trends that constrain the path of corporate actions? Which are the indicators reflecting the long-term sustainability issues for and from business?

The objective of the present research is to contribute to increased conciseness, transparency and representativeness of the RS. For that purpose the main contribution of this work is the identification of a relevant set of Sustainability Key Performance Indicators (SKPI´s) for the energy sector, usable for several stakeholder groups.

It is also expected to provide better understanding on the relation between corporate sustainability and financial markets.

From the previous, we assume that corporate contribution for sustainability has to meet the economic, environmental and economic dimensions, but also a financial dimension. In this study, the economic dimension is connoted with the company's use of resources, in order to meet its needs and carrying out its activities. Economic dimension is concerned with operational and management aspects, while the financial dimension is labeled with the issues of access to financial markets and the valuation of the company for shareholders and investors.

The literature has shown a clear multilateral relationship between all the mentioned dimensions, while highlighting the role that balanced interactions may play in building and enhancing long term companies survival.

The vision of corporate sustainability applied in the present work meets four basic lines: the financial recognition in the short and long term, the economic efficiency, the social improvement and the environmental neutrality. Neutrality is understood as the internalization of the environmental and social externalities and the compensation for the negative impacts.

Building a sustainable business respects the assumption of corporate responsibility in the short term, while meeting the definition of strategic guidelines for the future.

The same way is here argued that sustainability indicators should be constructed from the short term KPI CSR indicators (Figure 3-13). An integrated view over time coupled with a holistic attitude in the short term, will allow the identification of sustainability indicators relevant for a particular sector or industry.

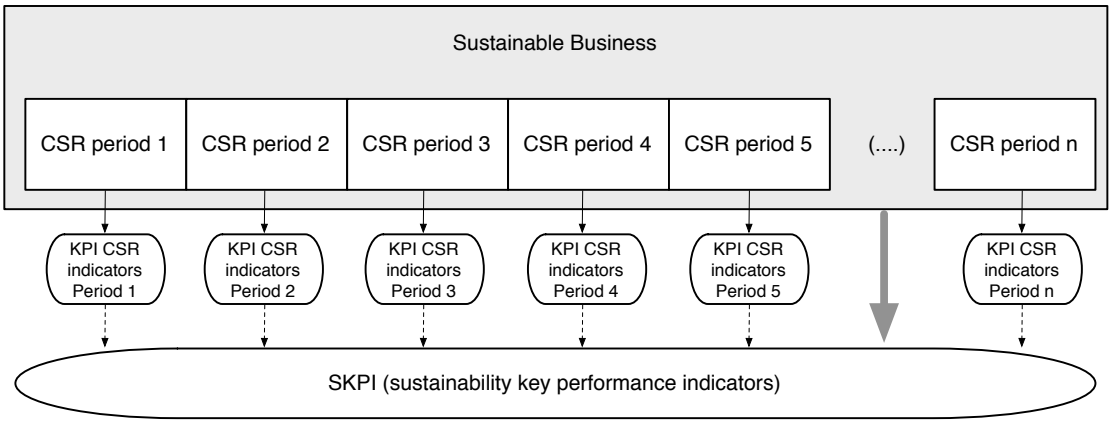

Figure 3-13 Conceptual source of SKPI

4. Methodology

4.1. Introduction

The purpose of this research is to identify a limited and representative set of key sustainability performance indicators (SKPI) from the vast series used in company's reports (sustainability reports (SR) and other forms of non-financial reports). It is expected that it may contribute for greater rigor, relevance and comparability of these reports and to understand the actual and potential contributions for the promotion of sustainable development at corporate level.

This issue leads to the question of measuring and communicating corporate contribution for sustainability (corporate sustainability) in a transparent, meaningful and comparable way. In this perspective, the current SR inefficiency seems to result mainly from failures on the disclosure of relevant information, but also from the market small capacity to recognize the corporate sustainable behavior.

Stakeholders apprehension of corporate sustainability is based on disperse analysis and methodologies developed by several agents, which may provide conflicting or biased results. Moreover, the information provided by corporations fails from uniformity of criteria in regard both to the collection of data and to the submission of results. A real understanding of the performance for sustainability requires standardize, comparable, transparent, verifiable and quantifiable information. The indicators used to illustrate the performance of companies, often lack consistency, relevance and representativeness. So, the perceived importance of corporate contribution for sustainability is leading the current work.

The authors (Revilla et all. 2003) found that the improvement quality of data provided by companies should be based on common supports for information gathering, adapted to the firm's practices of data collecting and processing. A good relationship with industry, taking into account their information requirements and the aims of the report, also contributes to the delivery of high quality data. They also discovered that companies were interested in accessing specific statistical data, that contribute to track its own position relating to their competitors in the market.

In this field, several frameworks have been proposing a wide range of pertinent indicators. Yet, a very large collection of indicators hampers the analysis of information, difficult the performance understanding and hinders the comparison between companies.

The use of a not very extensive set of representative indicators of sustainability performance is relevant to understand and to relativize the performance of each company regarding the industry.

Given that each sector has specific characteristics that influence the definition of relevant indicators, this research focuses on the production and commercialization of electric energy (Ziegler et al. 2011).

To handle this problem it was decided to use a Factor Analysis technique (FA), since it allows the identification of the most representative indicators from a vast available set and it provides the summarization of the information in smaller groups of components.

As far the survey of literature allowed to conclude, the use of factor analysis is quite innovative in addressing the corporate sustainability issues, especially in the case of non-dichotomous variables use.

In the present study the technique will be applied to non-dichotomous variables, collected from European companies in the energy sector. The analysis was performed upon a database constructed by the author using: publicly available data from company reports and websites, industry reports and other open access sources.

The author assumes that the indicators presented in GRI (2006) framework are conceptually well suited to the reality of the studied sector. Yet, they still present some disadvantages such as: qualitative nature, difficulty in collection, high number, lack of uniformity both in collection, processing and presentation, as well as uniformity in the definition of metrics. The definition of SKPI will contribute to the clear the set and reports easier reading.

Most available studies suggest a set of indicators, from selection methodologies designed by the authors. Nevertheless, it is arguable that these methods may present problems of subjectivity, both in defining the selection criteria and in the allocation of scores, which may reflect research personal positions towards the case under consideration and therefore limiting the results.

This work aims to circumvent this subjectivity embedded in research through the investigator intervention. In this line, the indicators incorporated into AF analysis were those presenting the minimum observations required for inclusion.

The present chapter refers, besides the current introduction, a brief survey of the literature on analytical practices, the methodological proposal for data collection, sample determination and indicators selection, as also the presentation and justification of selected multivariate methods.

4.2. Literature review over applicable methods

Several authors have been addressing the questions of the adequacy and representation of KPI. Literature has shown that the analysis of corporate performance is being skewed and it favors a certain angle of vision, which is detriment for the rest. Economic and financial performance takes major role in academic research.

The analyses of corporate sustainability can be performed on a basis of “best in class approach” using the most sustainable corporation of each sector, or “industry based approach” using information from the entire sector of activity or from a representative sample.

Krajnc and Glavic (2005) proposed a model to reduce the number of corporate sustainability indicators, aggregating them into a composite sustainable development index. The procedure of calculating the index is divided into the following parts: selecting, grouping, weighting, judging, normalizing indicators, calculating sub-indices and combining them into the index. They illustrated the proposed model with a case study, designed to compare the sustainability performance of two companies from the same sector.

Zhou et al. (2006) performed a comparative study between three of the most common techniques of aggregation (linear, geometric and weighted). The results showed that the geometric aggregation technique provided the lowest loss of information.

Rahman e Post (2011) applied a hierarchical factor analysis to dichotomous variables to identify those measures of environmental and social corporate responsibility “*exclusively valid, reliable, and transparent*”. The hierarchical factor analysis consisted, in a two steps procedure, beginning with a factor analyses of the dichotomous variables to create sub-factors, followed in a second stage, with factor analyses of the scores of the sub-factors. The result was a CSR measure, which included 22 indicators grouped into 3 categories *“Governance Data (5 items),* Credibility Data (11 items), and Environmental Performance Indicators (6 items)”. Within each obtained category, the items were to test for internal consistency and reliability using a Cronbach alpha test.

A hierarchical factor analysis it is best suited to dichotomous variables than a single factor analysis. As in this study, most of the items were dichotomous variables; simple factor analysis of dichotomous variables tends to yield many and often misleading factors. Confirmatory factor analysis was later used to assess the validity of the three scales (Rahman and Post 2011).

GRI framework was used as reference for the structuring of indicators (Rahman and Post 2011; Clarkson et al. 2008).

Chen (2011) applied a structural equation modeling complemented with confirmatory factor analysis (CFA) to construct a CSR model responding to four basic components (accountability, transparency, competitiveness, responsibility), which represented first order factors including 22 indicators.

Most authors have sought for a corporate sustainability measure which makes simultaneously the diagnosis of a situation, the definition of objectives while allowing to assess the evolution of performance (Lee and Saen 2012).

It may be asking too much for a single measure, noting that the contribution for sustainability is done in an incremental way, both from small steps and from the demand of new balances. This way, in the present study, it is mostly valued the agility and flexibility on the indicators selection, as well as the adequacy of its scope and metrics.

4.3. Sample selection

The energy sector has been traditionally notorious for economic, environmental and social impacts that may result from the exploration of primary energy sources, transporting, processing and the generation of new energy vectors. The nature, extent and magnitude of these impacts, has left energy companies under scrutiny by stakeholders and by the media. Besides, the energy sector has to manage rapid economic and environmental changes and especially it has to deal with specific climate change challenges. The electricity industry is particularly exposed to expected changes, threats, opportunities and constraints. For all these reasons it was chosen as particular subject of this research.

During last decades the energy sector as been affected by liberalization, structural changes and concentration processes. A context of market liberalization expectedly encouraged the internationalization of companies and the presence in other markets was naturally reinforced. The companies from energy sector are characterized by spatial dispersion both in the production and marketing of their products and services. The dispersion of generation facilities usually drifts from indigenous natural conditions and from political economic conditions. The availability or ease of access to primary sources of energy (for example coal, gas, water or wind) can be considered as natural condition.

To diversify the risk and ensure a balanced international portfolio in terms of markets, fuel, contract type and technology, each company has, in rule, its gross power capacity spread over several states and supported by various technologies. The worldwide installation and operation of generation units as well the functioning of the markets, it is supported on several regulatory frameworks and on a local political-economic contexts.

In Europe the bulk of electricity generation, transport and distribution is largely provided by public and private utilities. The impact of their presence in the European territory is enormous.

Utilities provide essential services to the community, related with a large population main need, such as water supply, sanitation, electricity or transports. Besides the service provision, utilities may also provide infrastructure access, namely the high voltage electricity network, ensuring the maintenance and expansion of the grid. For those reasons and depending on the characteristics of the service provided as also the costs for installing and maintaining the infrastructures, they enjoy from a special operation regime.

In fact, due the extent to which their activities affect the public interest, they usually work under close regulatory framework and they are subject to public control. To prevent distortions on competition and abuse of dominant position by major energy groups, EU has defined unbundling requirements for energy companies.

The various segments of the value chain (production, trading, transmission and distribution) ought to be operated by independent entities (Soares and Sarmento 2010). Independence is assessed through the accounting, information, organizational, and legal structures of market agents.

From the previous, the focus of the present study is European large electric utilities, once as larger corporations they produce greater social, economic and environmental impacts in the course of their activities. Buy other hand larger companies commonly provide a wide amount of information resulting both from their activity's monitoring and from mandatory disclosure.

The present study is mainly focused on European Union (EU) member countries, once they fall under the umbrella of global policies and goals for energy and under a common energy regulatory framework. Besides, European Union presents specific characteristics that make it distinguished in global terms, such as the characteristics and coherence of the territory, the energy sector restructure and the integration of electricity and gas markets.

Yet, some companies based in other European countries but outside the EU, may be included in the study (e.g. The Norwegian companies). This is due to the fact that they are subject to national legislation aligned with the EU regulation and the scope of its activities with EU member states fall necessarily under the guidance of the Union rules.

The first step on conducting this research is to define the sample of energy firms. In order to have a representative set and avoid selection bias, it will be made a collection of the European companies from energy sector, including public utilities and electricity producers. The kind of ownership is not considered for the sample selection, which may integrate both public and private entities, but also investor owned and cooperatives.

The selection criteria are:

- Companies with headquarters in Europe, in order to limit the study to those firms with greater role in European territory
- Companies with core business related to electricity production, although they may distribute their activities for a variable range of business areas (e.g., electricity production, distribution and transportation of gas and / or electricity, oil and gas exploration and production, sanitation and water supply, environmental services and others).
- Availability of non-financial information, disclosured in published corporate reports (sustainability, citizenship, corporate responsibility or annual reports), or posted on the companies websites.

To ensure the coherence and reliability of the data the following exclusion criteria were applied.

- Non availability of non-financial information
- Less than half of the total revenue generated by electricity related activities.

4.4. Data collection

The production of high quality data demands rich, accurate and non-biased supportive raw data (Revilla et all. 2003). In this perspective, the collection of high quality data was a constant concern when selecting the sources.

European power companies often integrate an economic group that ensures the economic value chain. Depending on the size and strategy adopted, a group may develop diverse activities such as the extraction of raw materials, production of electricity and heat from a variety of fonts, supply of electricity and natural gas, among other services to consumers and to companies.

Although the economic group usually integrates various firms and it develops activities in non-European countries, the data collected refers to the economic group and not to single companies, for the following reasons:

- Because the scope of published information generally refers to the group, although some partial information, for specific reasons, may regard a territorial unit or a business area.
- To prevent cases in which companies relocate externalities for production units outside Europe, in order to achieve better performance indicators for a specific region.
- To prevent companies from using less rigorous requirements for define and evaluate the performance on the operational units integrated in less developed countries or benefiting from the framework of more permissive regulations. All the impacts of the activity of the group are considered in an integrated manner.

Wherever possible, the collection of absolute indicators (example: total emissions of CO_2, total generation) is privileged over presented ratios. Thus, to overcome different formulations between firms, the calculation of relative indicators is carried from the absolute indicators previously collected.

4.5. Selection of indicators

Key performance indicators are main instruments for monitoring the performance of an organization on key issues. The selection of those indicators implies a beforehand knowledge about the most important issues for the organization as also for the industry.

It is also important to notice that reported sustainability key performance indicators (SKPI) are the visible tip of the iceberg. They present the result of a set of actions purposely defined to deal with a particular critical issue. The complementary metrics and the strategies defined to achieve behavior improvements are not directly exposed in most reports, although fundamental pieces for SKPI construction.

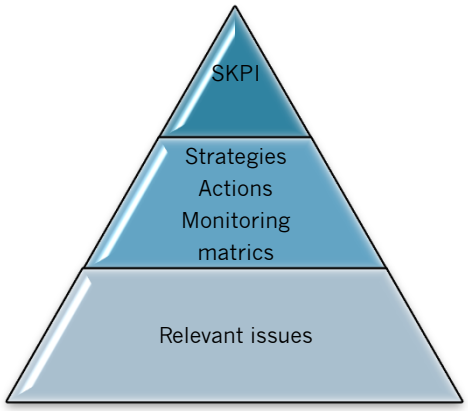

Figure 4-1 Context of SKPI

Indicators are selected according to the objectives to pursue. It is important to know, at first, the aspects to control and value in the energy sector, and after define a set of indicators that may contribute to the achievement of those objectives (e.g. reduce CO_2 emissions or increase the renewable energies shares on the total generation).

The relevance of indicators for sustainability is rooted on the characteristics of the industry. After knowing the depth and relevance of their real generated impacts, the really relevant issues arising from their activities as economic agents are defined, without neglecting the social and environmental externalities. If selected indicators relate to issues controllable by companies, they can lead to real improvements in business performance.

For example, SOx emissions are both dependent on the type of fuel or the process of purification of gases. Improving the performance goes through technological innovation for fuel use or for gas cleaning, or even through the replacement by other fuels with lower environmental impacts.

It is important to know what companies are actually doing to improve their performance in these critical areas. This performance improvement has to be seen over time and among peers.

Raw data is collected using GRI (2006) framework and aggregated in absolute indicators. Using the GRI (2006) framework as reference and using publicly available information, are collected as much indicators as possible.

In the present work they are aggregated in four main categories: environment, social, economic and financial. Those who meet the minimum number of observations are used to estimate relative indicators.

Expected characteristics of relative indicators:

- Realistic and relevant (theoretical justification) for relevant issues
- Transparent (theoretical justification) on the collection and treatment of data
- Relative (as far as possible, indicators selected are made relative, for example according to the productive capacity, the turnover or the number of employees, in order to allow for comparisons between companies. Only occasionally, in very concrete and duly justified situations, indicators are used in absolute value.
- Independent (using statistical tools to determine the correlation between indicators)
- Relevant on the short and long term
- Easy to get (data) and calculated
- Representing the interests of various stakeholders (using the directions of the GRI and industry)
- Smallest number (a giant list of indicators is not applicable)

The use of many indicators in great detail does not allow a global view of business performance because it induces the dispersion of the analysis and hinders the interpretation.

4.6. Factor analyses

Currently there has been a growing availability of data referring the most diverse subjects. However, increasing information demands powerful tools for ordering, processing and interpreting, in order to create useful knowledge for decision making.

Multivariate statistical techniques go beyond simple statistics, allowing the simultaneous analysis of multiple measurements on individuals or objects of the research. Its main character lies in the multiple statistical variables under study, which are assumed to be random and interrelated in such way that their individual effects can only be interpreted jointly (Hair et al 2009 (b)).

Multivariate techniques are applied either from two to thousands variables. Factor analysis (FA) technique fits into the larger context of multivariate statistical techniques, which have been increasingly used for the study of complex, multidimensional relationships among variables (Hair 2009). It allows the management and organization of hundreds or thousands of variables. It plays a leading role among multivariate techniques, providing summarization and data reduction, paving the way for the application of other techniques.

FA technique is particularly suited for the purpose of this thesis once the last involves the use of a large number of variables relating to environmental, economic, social and financial issues. A very vast set of variables, although providing large information usually ends up presenting a difficult and complex interpretation by users. However, some variables are naturally associated presenting similar behaviors. For example, it is expected that increases in production's capacity are accompanied by a revenue variation in the same direction. The overlapping of some variables is much likely to occur among a large set of variables, than between few variables, which may remain distinctive and different.

This way, a large number of variables that expresses a particular reality, can be replaced by a smaller group, which maximizes the explanation of the entire data set.

Having this objective in mind, FA is applied in this study. From the vast set of information provided by the sample companies, it aims to identify the variables most representative of corporate contribution for sustainability.

From a wide range of reported indicators, FA technique allow to extract those most representative, as also to rank the factors most relevant to the sustainability analysis (each factor integrates multiple indicators).

The analysis also allows eliminating indicators that measure the same things and those who have less relevance, with a minimum loss of information for the user.

4.6.1. FA presentation

Factor analysis techniques allow to understand the structure and interrelationships of a wide number of variables addressed in multivariate techniques, in order to determine underlying patterns, that may support the condensation of large amount of information into a smaller set of factors or components (Hair 2009). It has been widely used in business related research.

The technique identifies the correlation between variables and it comprises the most highly correlated in groups, called factors.

A factor, in the present sense, is a linear combination of the original variables, highly intercorrelated, constructed in line with underlying relationships (structure) between them. Each factor is assumed to represent a specific dimension within the data. It may also express a concept that is not adequately represented by a single measure.

Each dimension has a meaning as a collective whole, if in presence of a conceptual basis for understanding the relationship between variables.

However, FA results (factors) are dependent on the quality and consistency of input data. The use of an indiscriminate set of variables without any conceptual coherence is likely to generate poor results.

A primary requirement for the selection of variables is that correlation value can be calculated between all of them. Such is not difficult when dealing with metric variables. However, if some no metric variable has to be included in the analysis, it should be converted into a dummy variable (coded 0 or 1).

Literature suggests a minimum of 50 observations, subjected to the rule of at least 10 observations for each variable (Hair 2009).

The issues related to the design of AF, such as sample size, selection of the variables to consider and conceptual grounds are very important to understand the structure of the data. The structure revealed in the analysis depends on the researcher's early decisions on these matters. FA primary concerns focus more on the character and composition of the variables included in the analysis than on their statistical qualities. It is assumed that an underlying structure does exist among variables.

This technique does not apply any concepts of explained variables or explanatory variables, as it happens in dependence techniques. All variables without distinction are used to maximize the understanding of the global variable set and not to estimate a dependent variable.

The application of FA provides two major outcomes, which are data summarization and data reduction. Data summarization deals with structure of data and the underlying dimensions that allow reducing the data to a set of factors expressing concepts. Factors are estimated as also the contribution of each variable for the factor (loading). Data reduction goes further and it derives a factor score for each dimension, allowing the creation of a composite measure or the selection of a small set of variables to replace the larger original one (Hair 2009).

4.6.2. Designing FA

Whether used to summarize or to reduce, the technique requires a thoughtful selection of the variables to use, accordingly to the results expected. An FA always produces factors that reflect the conceptual foundations that underlie the selection of variables to be used.

Using an wholesale set of variables, with lean conceptual coherence, will probably produce poor outcomes, once the technique can not determine whether the data is suitable, but just to determine the correlation among variables.

The previous judgment of variables is also important to achieve the completeness of the factor. For example, a variable that refers to air emissions from a company with processes that consume large amounts of fossil fuels may be relevant to the definition of a factor that expresses the local environmental impact of this unit.

The literature suggests the definition of key variables that may reflect closely the hypothesis proposed for the underlying factors (Hair 2009). The design issues are very important to understand the structure of data. The structure revealed in the analysis strongly depends on the decisions of the researcher namely those relating to variables selection and sample size.

The nature and composition of the variables included is as important as their statistical qualities and the investigator has the responsibility to ensure that the observable patterns are conceptually valid and suitable to the study.

In addition to the conceptual requirements for FA, generic design requirements are as follow (Hair 2009):

- Use of metric variables (although it can be used a small group of dummy variables)
- At least 4 variables per factor expected
- At least five observations per variable (hopefully 10)
- Some degree of multicollinearity among variables is desirable, once representative factors demand variables intercorrelated.

4.6.3. Principal component analysis (PCA) versus Common factors analysis (CFA)

Factor analysis may be implemented via two different methods, which are Principal Component Analysis (PCA) and Common Factors Analysis (CFA) (Hair 2009).

Both PCA and CFA intend to reduce the dimensionality of a set of data (extracting factors), but the two techniques take different approaches to achieve this result (Hair 2009, Jolliffe 2002).

The literature and some software packages propose several e sometimes confusing designations for both methods. The present study used the definitions proposed by Hair (2009) including:

- In PCA it is assumed that all variability in an item should be used in the analysis. Factors are based on the total variance[13] (common, unique and error variance).
  The method is primarily used to summarize most of the original information (correlated variables) into a minimum number of factors (principal components), which account for the maximum portion of total variance of the original set of variables.
  The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.
- In CFA it is used only the common variability of an item with the other items. Factors are based on the common variance, which excludes specific variance and error variance. The method is mostly applied to identify underlying dimensions reflecting the communalities among variables.

As a variable is more correlated with other variables, their common variance increases. In FA variables are grouped in factors based in their shared variance.

The selection of one method or another is based on knowledge of the characteristics of relationships between variables and the objectives to achieve with FA.

In most cases, these two methods usually yield very similar results, mainly if the number of variables exceeds 30 or the communalities exceed 0,6 for most variables (Hair 2009, Gorsuch 1983). However, principal components analysis is often preferred as a method for data reduction, while principal factors analysis is often preferred when the goal of the analysis is to detect structure. CFA, having more restrictive assumptions and excluding part of variance, presents itself as less suitable for this research.

[13] Variance is a value (i.e. the square of the standard deviation) that represents the total amount of dispersion of values for a single variable about is mean (Hair 2009).

5. Method Implementation

5.1. Overview

In the following sections the criteria for sample selection is explained and the selection of companies displayed. A set of generic relevant issues for the industry is presented. These issues are decomposed in themes applying the recognized framework Global Reporting Initiative (GRI). For each theme several indicators are proposed. Hereafter the criteria for selection of indicators is defined and applied, which lead to the first list of indicators to be used in this work. Finally, the data needed for indicators is collected and treated so that they can be implemented the established multivariate techniques.

The methodology is applied accordingly to section 4 Methodology and to Figure 5-1 Methodology.

The present chapter begins with a brief description from the European energy context, and proceeds with the sample selection. From the universe of energy companies, the sample is selected according to the criteria established in section 5.2. The exclusion factor is the inexistence of non-financial public data, voluntary disclosed by the company.

A short characterization of the main findings within the sample is then performed, to provide a better understanding of European electric utilities.

Thereafter, based on reports and frameworks, is performed an analyses of the most critical issues for the sector. This analysis, conducted at European level, allowed the identification of a vast set of indicators that could reflect the environmental, social, economic and environmental behavior of electric companies.

This large number of indicators, defined to reflect the critical issues for the sector, was later reduced to a selected set, influenced by the data availability for most of the sample.

Although, there is some systematized information available for national and local level, at corporate level is noted a great lack of data. The sources consulted for the collection of data were mainly, the financial and non-financial reports disclosured by companies. The quality control of information disclosed is, in most cases, assured by national authorities to which these data must be reported.

Based on available indicators, which are mostly expressed in absolute values, a set of relevant relative indicators is then proposed.

Some descriptive statistics are performed over this selection, in order to assess, from an operational standpoint, the interest of the relative indicators for the objectives of the research.

Multivariate statistical techniques, Factor Analysis (FA), were then applied to the information collected, to identify the most relevant indicators, as also the similarity between the sample individuals.

The information obtained was then presented and discussed.

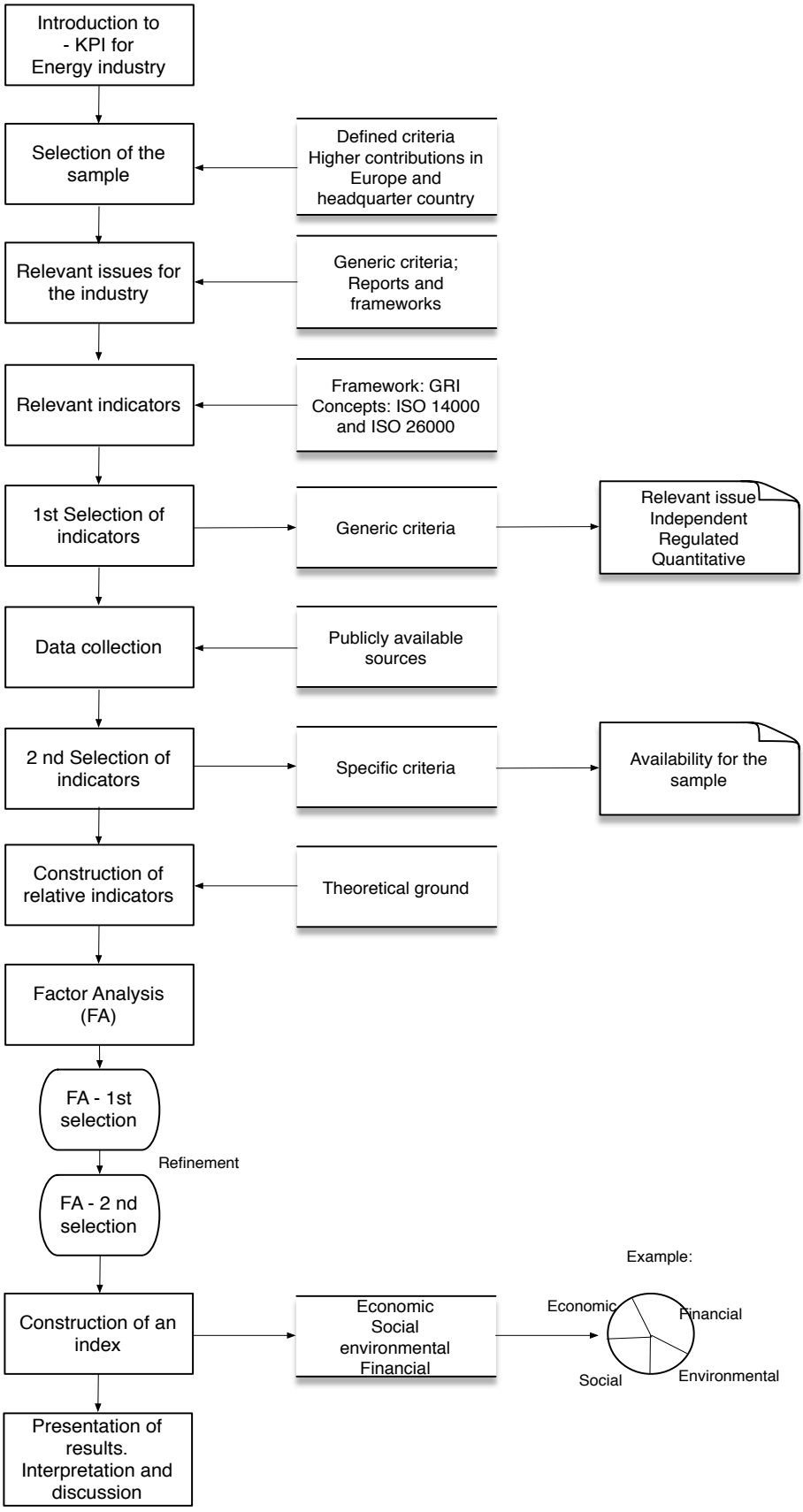

Figure 5-1 Methodology

5.2. Sample

This section refers to a brief characterization of the European energy sector, the process description of sample selection and a characterization of the same.

5.2.1. European Energy Scenario

During the twentieth century, electricity companies grew in national markets. Authentic giants, electric companies strongly dominated their home markets and usually integrated the entirely electricity and gas value chain (Soares and Sarmento 2010).

Aware of the risks inherent to the situation, the European Union institutions proposed a sector restructuring which relied on three main concepts: liberalization, integration and unbundling. As result of European directives and national legislation, the profile of most European utilities has fully changed.

Liberalization process was assumed as main contribute to the rejuvenation of energy sector, once market participants would get better prepared to adapt to rapid economic and environmental changes in the energy sector and, mainly, to meet the specific climate change challenges (COM (2009) 115 final).

As a result, on 2007, almost EU Member States had their electricity and gas market 100% open to competition, with exception made to Bulgaria, Cyprus and Estonia (SEC (2009) 287).

However, the weight of the largest generator in its home country is highly variable. The ten largest producers in twenty tree Member States still control more than 70% of national production capacity. In countries like France, Estonia, Cyprus and Malta, a single agent is responsible for more than 75% of the total electricity generation in the market.

A prerequisite for integrate European electricity and gas markets is that national markets were properly connected and that those interconnections were efficiently used. The resulting increase in border trade, helped to moderate the market power and, as markets become more competitive, to benefit consumers with competitive prices and services (COM (2009) 115 final). Presently, European energy markets are increasingly integrated and energy networks diversified but integrated.

On the world stage, the EU represents approximately 15% of primary energy consumption, being exceeded only by the USA and China. This way, EU represents one of the most important players on the energy markets worldwide (DG TREN 2010).

The analyses of Gross Inland Consumption (2007)[14] (Table 5.1), shows a strong demand for oil and gas, however still presenting a strong value on solid fuels (hard coal and lignite). EU-27 still setting presents a strong presence of fossil fuels, which dominate energy mix representing 78% from gross inland consumption. Low-carbon energy sources (nuclear and renewable) represent 22% from gross inland consumption, relating to 2007 data.

Table 5.1 Gross Inland Consumption

		Fuel Shares in % (2007)						
In Mtoe	All Products	Solids	Oil	Gas	Nuclear	Hydro	Biomass	Other
EU-27 **	**100,0**	**18,3**	**36,4**	**23,9**	**13,4**	**1,5**	**5,4**	**1,1**

Source: *OECD;* ***** Source:*** *Eurostat, May 2009*

The power generation represents 71,3% from the use of solid fuels and 31,9% from gas natural use, both on EU-27. From all the fuels used in EU, about 53% are imported (Eurostat 2009).

The current EU energy scenario is characterized by a strong external dependency, with an energy system heavily dependent on primary sources (Eurostat 2009). Consequently, the prices of gas and electricity on EU markets are highly sensitive to oil prices developments in international markets, for two main reasons. First, the oil price is used as a reference for long term price agreements on gas supply. Second, a large proportion of power production technologies still rely on natural gas and petroleum as raw material.

This means a strong dependence on resources not endogenous, non-renewable, with strong impact in terms of emission of greenhouse gases.

Before the situation described, the use of an entire range of mixed power generation technologies is crucial to ensure security of supply and to reach equilibrium among renewable energy sources (RES), which may present an intermittent character and flexible back-up capacity (Eurelectric 2010).

Although the electricity industry is investing significantly in RES (renewable energy sources), the installed production capacity for wind, geothermal and hydro, reached 25% of total installed capacity, in 2007. Most investments in RES are supported by electricity industry, which is taking the challenger to diversify and encourage renewable based electricity production (Eurelectric 2010).

[14] Gross inland consumption is the quantity of energy consumed within the borders of a country. It is calculated using the following formula: primary production + recovered products + imports + stock changes - exports - bunkers (i.e. quantities supplied to sea-going ships) (DG TREN 2010)

The European generation mix is characterized by a large share of nuclear (27,8%) (see *Table* 5.2) and by a rapidly increasing share of natural gas (up 10 percentage points from 1998 to 2008) (Eurostat, 2009).

Table 5.2 Gross Electricity Generation, 2007

(in TWh)

	Total	Conventional Thermal (CT):					Nuclear	Pumped Storage	Renewables *
		Total CT	- Coal	- Oil	- Gas	- Other Power Stations			
EU27	3 362	1 867	988	112	760	6	935	34	526
Share	100,0%		29,4%	3,3%	22,6%	0,2%	27,8%	1,0%	15,6%
EU25	3 257	1 804	941	111	746	6	913	33	507
Share	100,0%		28,9%	3,4%	22,9%	0,2%	28,0%	1,0%	15,6%

Source: *Eurostat, May 2009*

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage. Municipal Solid Waste, Wood waste, Biogas included.

The position of nuclear generation is the opposite of the one registered for renewables. Even though the installed capacity of nuclear power accounts for only 17% of total installed capacity, is responsible for producing almost 28% of electricity for consumption within the EU (Eurostat, 2009).

Non-hydro renewables registed increasing growth rates between 1998 and 2008. In 1998 represented 1,9% of total output, and in 2008 the share of non-hydro renewables in total output reached 6,7%. Strong policies supported this increase.

Wind as also biomass dominates non-hydro renewable generation with 49% each (Eurostat, 2009).

Besides, electricity use has been steadily increasing in the world, both for private and business use, providing *lighting, heating and cooling, specific industrial uses, entertainment, information technologies, and mobility* (OECD/IEA 2011). Electricity use plays a major role in economic and social terms. In turn, the industry sector has been witnessing the replacement of other energy sources, namely oil and coal, for electricity, which becames the main source of energy in industry (IEA 2009).

However, electricity generation remains largely based on fossil fuels. As CO_2 is admittedly, the primary cause of human-induced climate change, electricity generation is in the frontline of major contributors. CO_2 emissions represent almost 84% of all GHG in European landscape, in 2007.

Electricity and heating sector was responsible, in 2007, for 40% on CO_2 emissions fro IEA countries (IEA[15] Scoreboard 2009)

Electricity sector is also responsible for relevant SO_2 and NO_x emissions. The two last contribute to acidification of ecosystems and to negative health effects. Following Eurelectric (2010), when compared to 1980, electricity sector emissions of SO_2 have been reduced by 80%, while NOx emissions reduced by 60% (Eurelectric 2010).

Yet, there still is plenty of room to reduce electricity related emissions in EU both CO_2 emissions and other gases. Following IEA, the "decarbonization" of electricity and end-use efficiency are key lines to explore on the strategy to tackle climate change.

Improvements in energy efficiency have been playing an important role in European energy context, both in energy savings and avoided CO_2 emissions (IEA 2007).

Generation electricity efficiency is commonly perceived as more electricity production from less fuel consumption, mainly due to technological innovations. From the technological changes that most contributed to efficiency increase, some are highlighted such as the combined-cycle gas turbines; the decrease in the use of oil-fired plants and the significant increase of more efficient natural gas-fired plants; a increasing number of combined heat and power (CHP) plants (IEA Scoreboard 2008).

The immediate consequence of the increasing efficiency is the reduction on the consumption of raw materials, reducing the demand pressure on primary energy sources for the same level of output.

Increases in efficiency are associated with an increased ratio output / input and generally involve the reduction of any kind of loss or waste associated with the process. Beyond production efficiency, the concept can also be refer to the efficiency in final energy use, for example at the end consumer, to efficiency in electricity transport or to environmental efficiency, usually associated with waste reduction and minimization of environmental impacts.

Of the above, the production and use of energy assumes a core position on sustainability context and are relevant issues to consider on the debate for the construction of a sustainable future.

[15] IEA member countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States

5.2.2. Context of the European Electricity Sector

The European electricity sector has shown great dynamism in particular the level of performance of mergers and acquisitions as well as a remarkable ability to adapt to increasing economic, social and environmental demands.

The current crisis being experienced in the EU has been reflecting both in the politics of energy and on the activity of agents that operate at the level of production, marketing or distribution of energy. In this scenario the economic objectives of creating an integrated energy market (for electricity and gas); reducing the carbon footprint associated with the production of electricity; increasing energy efficiency; promoting energy independence and providing affordability of electricity, may lack from one well-defined political support, which may provide security to investors and businesses to perform a correct implementation.

Yet, the electricity developments in Europe from 2010 to 2012, at operational level, are characterized for an increase in installed capacity (from 863. 385 MW to 928.852 MW), based in the reinforcement of renewable sources and on the decrease of both nuclear and hydro pumped technologies (Eurelectric 2013).

However EU still remains quite dependent from fossil fuels for electricity production. In 2011 51% of electricity generation was fossil fuel fired (Eurelectric website, 2012 statistics).

Thus the EU has a been rising its energy dependency on fossil fuels exporting countries, showing however a growing replacement of oil by natural gas.

Worldwide, other apparently abundant energy sources have been discovered in recent years. The exploitation of new sources of conventional and unconventional fossil fuels, namely shale gas and oil shale, has launched new players in the raw materials markets, changing the trade flows of primary energy and reorganizing the energy landscape.

For the recent years, the economic European scenario for electric utilities has been characterized for by some steadiness in trends. Electricity producers are dealing with decreasing demand, decreasing spreads for generation and orientation of production subsidies for renewables on the detriment of fossil fired generation (Eurelectric 2013). In fact, the increasing of the renewables share has contributed to lower the wholesale price of electricity, reducing the margins of thermal. The prices on consumers are maintained due to renewable production subsidies.

The crises in the capital markets displaced private funds from perifery to central european countries (Eurelectric 2013). That may reflect on dificult financing and credit acess from economic agents, namely from electricity players.

Besides the perception of the level of risk on the electric industry has changed. Having to deal with increasing regulatory risk, high debts and narrow operating margins, electric utilities have to handle with increasing difficulties in financing themselves in the markets.

The european regulatory framework demand for long term investments relating to the decomission of the most pollution power plants, the targets for renewable sources or the goals defined for gaseous emissions. That means that electricity industry is a very capital intensive sector needing to maintain, increase or modernize its production capacity, investing in some cases in new technologies or markets.

However, electricity companies have maintained the level of investment in tangible assets, and reduced the financial investment (Eurelectric 2013). In a fragile financing context, most of the investment needs are covered with corporate debt.

Abreast of the incentives for decentralized production at the household level, it was noticed during the last years of the twentieth century and the first decade of the present century emerging alternatives to centralized power generation and distribution.

The European electrical sector has undergone a period of mergers and acquisitions, mainly between 2000 and 2012, with the consolidation of large enterprise groups with the main objective of companies to expand their acting performances and to get economies of scale in various segments, ie, generation, transmission and distribution. The EU regulatory frameworks for the electricity sector, which stimulates the operational efficiency as also new generation and transmission projects, increasingly complex, contributed to the consolidation of these negotiations, especially among domestic companies.

Therefore, by 2010, several trends have been designed for European energy sector:

- Liberalization and integration of markets for electricity and gas
- Concentration of private capital in mega clusters with a large diversification of activities.
- Vertical integration - Targeting of activities in different areas of business in different companies, although they may belong to the same group (production, distribution and marketing). There has been enhancing the productive capacity of most companies and the articulation of various business areas in the same group.
- Privatization of national groups.

Some reforming countries have sold their public companies or admitted new entrants in nacional energy markets. These actions were supported by the view that increasing diversity in ownership could contribute to facilitate competition, provide comparability of performance and boost regulation (Jamasb and Pollit 2005).

Privatization can also provide significant immediate revenue for the government and reduce its future liabilities. On the other hand they lose a strategic asset and a source of revenue.

Although privatization is not a necessary requirement for market liberalization, is also questionable if it is a needed condition for achieving better performance.

Some companies still maintain a share of public ownership above 80%, such as Eesti (Estonia), EDF (France), Electricity Supply Board (Ireland), Eneco (Netherlands), Stratkraft (Norway), Vattenfall (Sweden).

Relating to concentration movements most countries allowed and in some cases encouraged the fusion of independent companies on national giants. As example:

- In 2000, Eneco merged with six regional energy companies into ENECO Energy
- Essent was born in 1999, from the merger between PNEM/Mega and EDON which were themselves the result of various mergers.
- In 2009 Essent (until then a public owned company) became part of the RWE Group.
- In 2006 DONG Energy was formed as a result of the merger of six Danish energy companies for exploitation, production and distribution of oil and gas
- In 2001 Hafslund acquired the power retailer Oslo Energi, in 2002, became the sole owner of Tindra Energi. In 2003, Oslo Energi and Tindra were merged to form Hafslund Power Sales. Regarding power distribution in the greater Oslo area, a merger of Hafslund and Viken Energinett was initiated in 2001 and finalized in March 2002
- In 2004 EVN acquired a majority shareholding in two Bulgarian electricity distribution companies in Plovdiv and Stara Stagora. In 2006, EVN acquired the Macedonian national electricity distribution company, which has operated under the name EVN Macedonia since 2008.
- EON came into existence in 2000 through the merger of energy companies VEBA and VIAG. In 2002 the UK, Powergen was taken over itself. In 2003 E.ON entered the gas market through the acquisition of Ruhrgas (now E.ON Ruhrgas). E.ON Ruhrgas is represented in more than 20 countries in Europe. E.ON also acquired Sydkraft in Sweden and OGK-4 in Russia.

However, from 2010 onwards it becomes noticeable:

- Some stabilization of concentration movements, which were succeeded by sales on segments of production, or business areas, for reasons of logistics, cost minimization or geographic concentration (ex: 2012 Scottish and Southern Energy aquired the entire share capital of Irish company Endesa Ireland Ltd (“Endesa Ireland”), owned by Endesa (0.02%) and Endesa Generación SA (99.98%). In 2011, Cêntrica sold Oxxio to ENECO)

- Companies or groups with strong public participation saw its participation enhanced. It is noted that in some cases this participation is not directly performed though public entities, but held through investment companies, which are majority owned by public companies.
- Increased participation of citizens in the management (ex: Dong - increased public share between 2010 and 2012. About 11% of the capital is in the hands of the SEAS-NVE which is Denmark's largest consumer-owned energy company. The core business is delivery of energy and communication services to customers in Denmark.)
- Increased mobility of customers between electricity suppliers. Market entering new retailers, that have no connection to production assets, have been assuming a growing importance in terms of marketing.
- Tendency for the developments in the energy sector concern on the organizational level beyond raw materials, extraction and production processes. Gas and electricity companies are increasingly working together to achieve greater efficiency.

A considerable number of mergers and acquisitions as contributed to restructure and reshaping the European electricity and gas sector. The main strategy of companies consisted in concentrating its assets in electricity and gas, and focusing on a vertical integration (generation, transmission and distribution) while continuing to control firms in other sectors (Castro et all 2008).

However, since energy markets were deregulated, the European Union “has not given emphasis to putting mechanisms in place to control moves towards concentration” (Castro et all 2008). Legislation and institutions did not follow the pace on market power concentration.

Recently, “from the foregoing examination it can be seen that the authorities are more cautious and more aware of companies’ market power and its consequences for social welfare” (Castro et all 2008).

This situation is particularly dramatic in the current crisis scenario in which urge decision making and the definition of concerted strategies at EU level.

5.2.3. Sample selection

The population subject to the study is composed by the European utilities engaged mainly in electricity production, but also in other activities such as gas and electricity transport; gas, electricity and heat distribution; oil and gas exploration and production; sales and wholesales of gas and electricity.

The first selection aggregated the companies with higher representation at national level. An attempt was made to get a heterogeneous sample in terms of size, structure of shareholders, business areas and territorial coverage, which was representative of the diversity of European energy business community. Companies without the non-financial information published were excluded.

Other exclusions were due to factors such as poor quantified data on non-financial published reports or the recent company integration within a group. In this last case, information on the company is usually reported in the group-consolidated report.

However, some companies recently integrated within an economic group still present independent non-financial reports referring to their own activities. In these specific cases, companies were included in the sample. The companies founded in this position are:

* Electrabel is a subsidiary of GDF Suez since 2009. Electrabel operates at the Benelux countries. It publishes an integrated report, applied only to Belgium, providing great availability of figures referring to electricity and natural gas activities.

* EnBW Energie Baden-Wurttemberg AG (EnBW) is a subsidiary of EDF group in 45%. EnBW integrates several companies benefiting from a vertical integration for gas and electricity. EnBW is a ENTSO E member once it provides electricity transmission at regional level. Some EnBW data appears in the report of the group EDF. In 2011 EnBW released an integrated report. There are indications of a possible share sale of EnBW by EDF.

* Endesa is participated by ENEL group in more than 90%. Endesa published a separate sustainability report for the year 2010. The sustainability issues are also mentioned in the 2010 Annual Report concerning the activities of electricity and gas.

* International Power PLC, which integrates the activities of electricity and gas, was acquired in 70% by GDF Suez Group.

* Nuon was participated in 50% from the group Vattenfall, in 2009. Vattenfall´s participation should increase to 100% over the next five years. Nuon published an independent CSR report from 2002 to 2009, referring the activities of electricity, gas, and heat. The CSR Report for 2006 and 2007 are not available in English. Due to the constraints associated with unbundling, Nuon separated the transportation segment in 2009, handed over to the company Alliander.

Transmission System Operators (TSOs) were also excluded. They are main intervenient in electricity trading, once are responsible for the wholesale transmission of electricity at high voltage networks. Although they usually hold a regional or national monopoly, they behave independently from generation and supply interests. According to non-discriminatory and clear rules, they allow electricity market players such as power companies, traders, suppliers, distributors and customers, to access the high voltage electricity grid (www.entsoe.eu/). The European Network of Transmission System Operators for Electricity (ENTSOE) includes 41 members. Most companies are operating natural monopolies, under tight regulation, with a national or regional scope. A preliminary analysis on their non-financial reporting has shown that presented information was manly bending over network operation data. Other non-financial information was hardly accessible. For these reasons and because the impacts of electricity transmission have a narrower extent when compared with power generation, these companies were excluded from the sample.

Table 5.3 Generation utilities

Name	Headquarter	Installed generation capacity (MW)	Share of renewables in electricity generation	Revenue (10^6 Euros)	Employees	Share of Public Ownership
Acciona	Spain	7 587	97,26%	6 263	31 687	0,00%
BKW FMB Energy Ltd.	Switzerland	2 532	37,24%	2 586	2 914	52.54%
Centrica	UK	4 672	1,50%	25 114	34 969	0,00%
CEZ GROUP	Czech Republic	15 018	3,68%	7 954	32 627	69,78%
Dansk Olie og Naturgas A/S	Denmark	6 654	19,80%	7 331	5 874	75,00%
Drax	UK	4 000	0,00%	1 887	1 150	0,00%
Edison	Italia	12 586	0,00%	9 685	3 939	0,00%
Eesti	Estonia	n.a.	0,00%	796	2 608	100,00%
Electrabel	Belgium	11 233	3,13%	n.a.	7 213	0,00%
EDP Energias de Portugal SA	Portugal	21 990	64,43%	14 171	12 096	25,00%
Electricite de France SA	France	140 100	1,65%	65 200	158 842	84,48%
Electricity Supply Board	Ireland	5 600	0,00%	2 740	6 980	95,00%
EnBW Energie Baden-Wür AG	Germany	15 489	10,50%	17 509	20 952	46,55%
Endesa SA	Spain	40 141	35,48%	31 177	24 732	0,00%
Eneco	Netherlands	2 200	44,00%	4 922	6 545	100,00%
Enel Societa per Azioni	Italy	97 281	31,74%	73 377	78 313	31,20%
EON AG	Germany	68 475	10,00%	92 863	85 105	(*)
ESSENT	Netherlands	4 048	12,10%	6 120	5 872	0,00%
EVN	Austria	1 787	39,02%	2 752	8 536	51,00%
Fortum Corporation	Finland	14 113	41,28%	6 296	10 585	50,76%
Gas Natural Fenosa SA	Spain	17 305	17,79%	19 919	18 778	0,00%
Hafslund	Norway	NA	100,00%	2 018	1 123	53,73%
Iberdrola SA	Spain	44 991	30,12%	32 926	29 641	0,00%
International Power PLC	UK	70 196	0,00%	3 745	3 520	0,15%
NUON	Netherlands	3 645	8,44%	5 458	2 750	51,00%
Rwe AG	Germany	52 214	3,95%	47 741	70 856	(**) 5,1%
Scottish Southern Energy PLC	UK	11 330	15,71%	25 097	20 177	0,00%
Statkraft	Norway	16 010	88,50%	3 680	3 301	100,00%
Vattenfall AB	Sweden	39 923	22,72%	23 725	40 363	100,00%
Verbund AG	Austria	8 638	81,88%	3 308	3 096	51,00%

(Data referring to 31 December 2010) **Legend:** NA - data not available

(*) Information disclosured did not revealed the direct involvement of public entities ; (**) Treasury shares

In the current European setting it is difficult to identify energy sector companies engaged in a single key activity, once they generally present a vertical integration of business, which in many cases include those from extraction of resources to product delivery to the customer, through processing, distribution and provision of support services.

Alongside with vertical integration has been registered a strong trend towards a horizontal integration in the sector via the creation of partnerships and / or acquisition within the same market / sector, both seeking an increase in size (market share) and taking advantage of possible savings of scale.

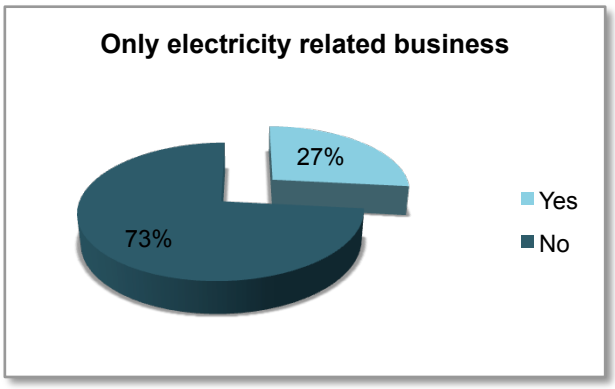

Figure 5-2 Business diversification

Only 27% of the sample is devoted exclusively to activities related to production, trading or distribution of electricity, eventually associated with the production and distribution of heat (Figure 5-2).

The remaining 73% comprise in general businesses of marketing, transportation and distribution of natural gas, and on a smaller scale the extraction of fossil fuels, the environmental services, the construction and engineering activities, as also, water supply, wastewater treatment and waste management services. Occasionally sample companies may integrated telecommunications services (e.g., EVN, Hafslund and Scottish and Southern Energy).

About 40% (see Figure 5-3) of the sampled companies develop their activities in other continents beyond Europe, with a notorious participation in Latin American countries, especially by companies based in Italy, Spain and Portugal, which play a key role in the expansion of intercontinental energy businesses. Companies based in the countries of northern and central Europe show a greater tendency for internationalization within Europe, expanding its business into neighboring countries. There is still a non-negligible investment in electricity production in the U.S., particularly in the renewable sector, which also receives some contribution from the UK companies besides the southern Europe companies.

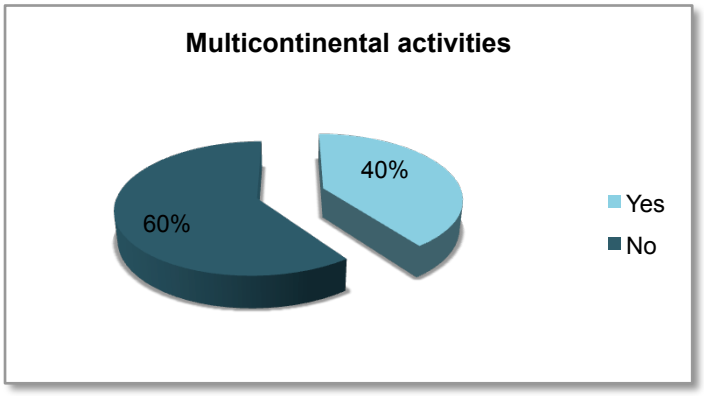

Figure 5-3 Geographical dispersion

The selected sample comprises companies with diverse legal forms and ownership. The share of public shareholding is still relevant in the broader sample (Figure 5-4). By public ownership is perceived the participation in company's capital of the state or other public entities such as central, regional or local public authorities. Relating to 2010, about 20% of companies show a public participation of more than 80% and 47% of the sample presents a public contribution higher than 50%. These holdings are concentrated in Northern and Central Europe, on the ground that the energy business is considered a strategic investment and a structuring asset for the country, and it should be safeguarded from foreign interests. The countries from Southern Europe and the United Kingdom, have been withdrawing public participation in the capital of their energy firms, leaving the energy business increasingly handed over to the private initiative under the supervision of regulatory authorities.

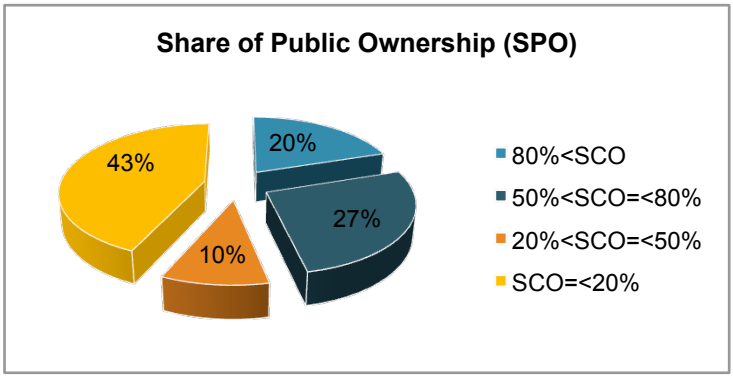

Figure 5-4 Share of public ownership (2010)

Energy companies play a very important role in society since, besides the products and services they provide, they are also responsible for creating a large number of jobs. In 2010, 50% of the sampled companies responded individually for more than 10,000 jobs each. A single company is responsible for over 100,000 jobs. About 27% of the sample is responsible for ensuring between 10,000 and 50,000 jobs. These numbers reveal a particular responsibility from the industry towards society (Figure 5-5).

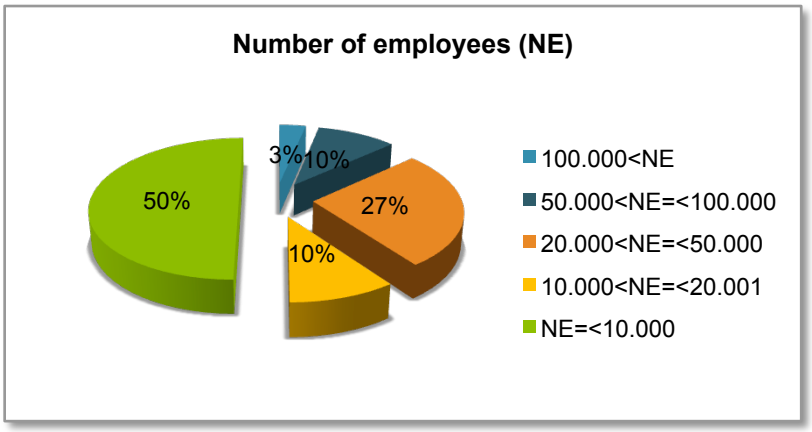

Figure 5-5 Number of Employees (2010)

As previously mentioned, the production of electricity has an important impact on the level of emission of greenhouse gases and on the consumption of natural resources. The use of renewable energy sources has been promoted as a bid to help minimize these effects and to reduce the negative contribution of electricity production in environmental terms.

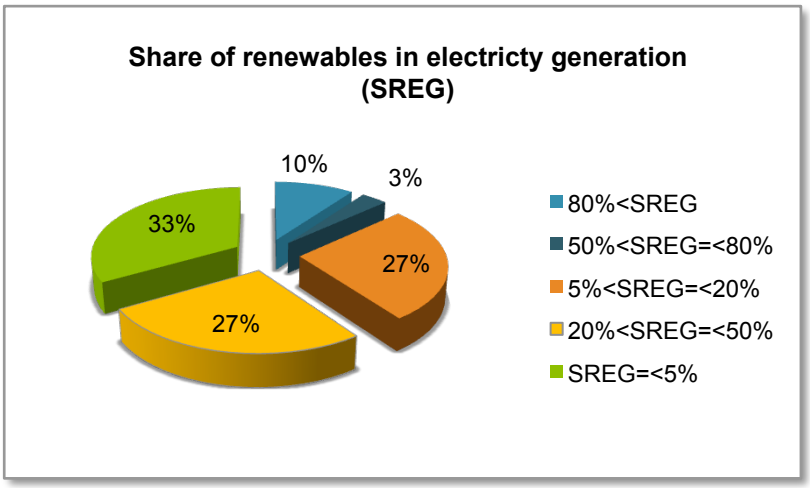

Figure 5-6 Share of renewables in electricity generation (2010)

However, beyond all the efforts made at EU level to promote the renewable energies, in 2010, 33% of the sampled companies still produce less than 5% of its electricity using renewable energy sources (Figure 5-6).

The sample comprises the largest and most representative producers of electricity in Europe and 60% of them still use less than 20% of renewable sources in electricity production. Only 10% of the sampled companies produce over 80% of its electricity from renewable sources.

In late 2010, about 70% of the sampled companies presented an installed capacity under 20.000 MW, from which more than half with less than 10,000 MW. The analysis of *Table* 5.3 allows to detect that companies having above 30% shares of renewables in their energy mix are 55% of companies with installed capacity less than 20,000 MW and from these 66% with an installed capacity less than 10,000 MW.

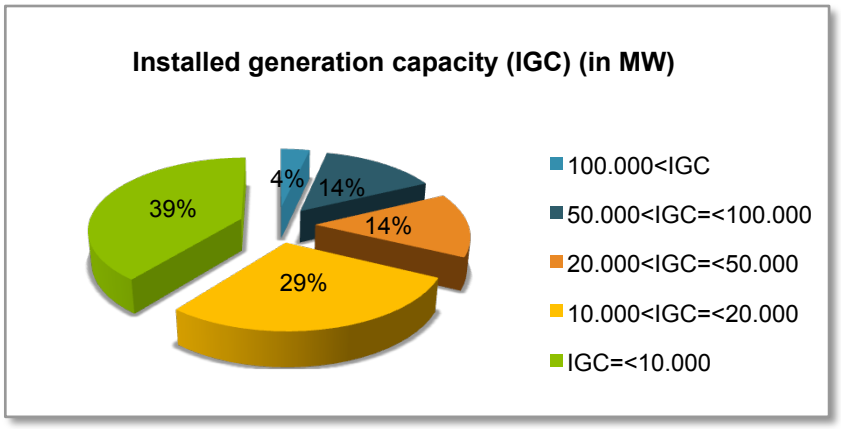

Figure 5-7 Installed generation capacity (2010)

The production with the use of renewable sources is more valued in smaller companies. However, the same table reveals that all larger companies with shares of renewable higher than 30%, are concentrated in southern Europe. Portugal, Spain and Italy lead the investment in renewable sources in terms of large-scale production, which might indicate a closer alignment of corporate strategies with the global environmental concerns.

The integration of a company into a CSR or sustainability index necessarily entails an external evaluation. Non-financial reports usually refers the registration of the company on sustainability or corporate responsibility indexes (usually DJSI (Dow Jones Sustainability Index) or FTSE4Good Sustainability). This variable can also work as a proxy for the integration of sustainability funds. In fact, companies presented into a index are usually called to compose CSR or sustainability funds.

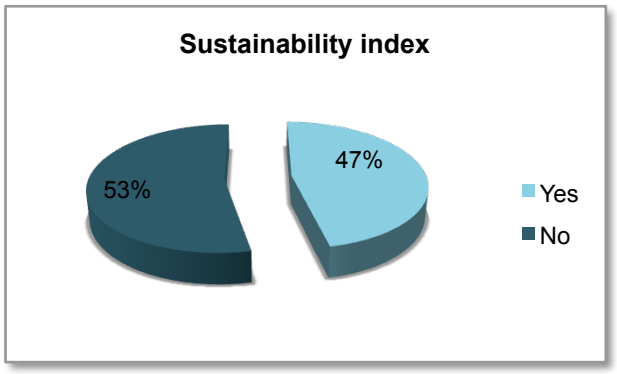

Figure 5-8 Sustainability index

Regarding the recognition of performance in terms of sustainability (Figure 5-8), 47% of companies are listed on indexes of sustainability or CSR (mainly from FTSE4Good or Dow Jones). Firms in Northern Europe frequently comprised in the index Infogrok, which as a very generalist character (not specifically relaying to sustainability issues) and includes approximately 40,000 companies. Infrogrok was not considered in the analysis.

The reporting of non-financial information is being increasingly integrated into firm's annual reports. In 2010, 53% of sampled companies achieve some sort of financial and non-financial report integration (Figure 5-9). Interestingly, in addition to the disclosure of integrated information, many companies continue to publish separate books with non-financial information, which indicates a visible concern to adjust the reporting profile to different stakeholders needs and expectations.

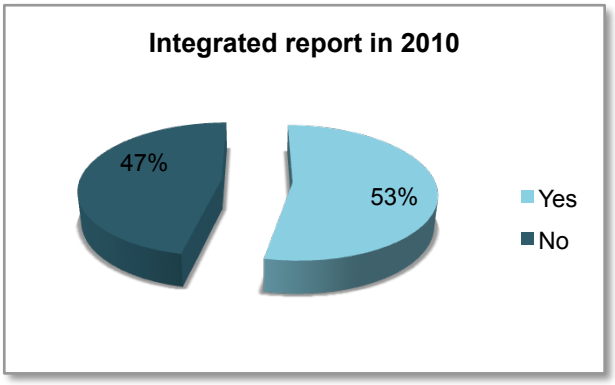

Figure 5-9 Report integration

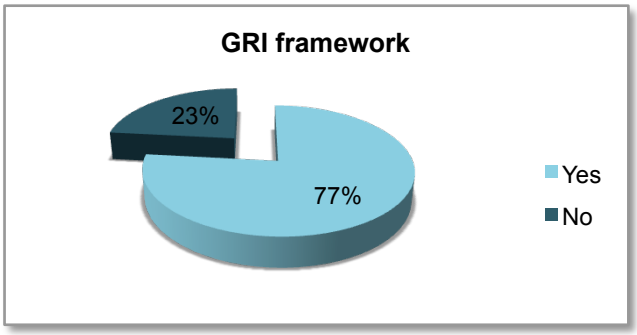

Figure 5-10 GRI use

The GRI (2006) is the framework mostly used to normalize the information for non-financial report. 77% of the sample uses the GRI to structure and collect information to be reported. Although not all companies choose to register their reports on the GRI organization.

5.3. Relevant indicators

Currently a wide range of frameworks provides guidelines for the presentation of non - financial information of companies, which can manifest itself in various forms (financial reports, annual sustainability of corporate responsibility, citizenship, governance, among others). Simultaneously, national law and European regulation require the annual submission of specific information of enterprises, namely those relating to tax, employment, occupational safety and some environmental issues.

All this information provides the calculation of a wide range of indicators, within a scenario seemingly defragmented and raises the following questions:

- To what extent these indicators reflect the company's real contribution for sustainability?
- To what extent a broad set of indicators scatters attention, evading the issues most relevant?
- To what extent the indicators overlap, presenting similar information?
- To what extent the legislative and cultural framework conditions companies disclosured information leading to the privilege of some indicators at the expense of other?

In this context, it is important to define a restricted set of representative indicators, universal, readily available, transparent and relevant for stakeholders understanding of the contribution of a company for sustainability.

Yet, none of the metrics and tools previously presented seems to be capable of assessing the progress towards sustainability in a holistic manner.

However, the concepts of corporate responsibility (CR) and sustainability still suffer from lack of coherence, consistency and widespread acceptance (Hediger 2010). In relation to those concepts adopted in this thesis, should be clarified that the interpretations adopted are as follows:

- CSR is associated with the assumption of responsibilities arising taken in the sphere of action of a company before its various stakeholders (customers, suppliers, shareholders, employees, consumers, public authorities and others).
- The concept of sustainability when applied to business is viewed from two perspectives interconnected and interdependent.

- An internal perspective, referring to the company's ability to survive in the long term.
- An external perspective, referring to company's contribution to the sustainability of the planet.
- If on one hand, the internal sustainability depends on understanding the present, on the apprehension of the trends that are emerging for the future and on defining the appropriate strategies, by other hand, internal sustainability conditions and is largely conditioned by the external context. Both perspectives are necessarily intertwined

In this context, the growing concern for CSR and sustainability in business is due to:

- Acceptance of a systemic and interactive view, whereby companies integrate a web of relationships that they, as economic agents, influence but they are inversely conditioned by the context in which they move.
- Perception of the dual role of the companies, on one hand as consumers of resources and generators of pollution, but on the other, as key elements for the construction of collective welfare and therefore essential agents for the sustainability of the planet.
- Perception of a crisis not only financial, but also social and environmental, resulting in climate change, population growth and resource scarcity (energy, natural resources, water, land access).

Given the above, the present work assumes that (see Figure 5-11):

- Each company interactions and activities fall necessarily within one of the following dimensions: environmental, social, economic and financial.
- Corporate sustainability is not only taken in consideration as the survivability of a company in the long run, but particularly from the perspective of business contribution for the sustainability of the planet.

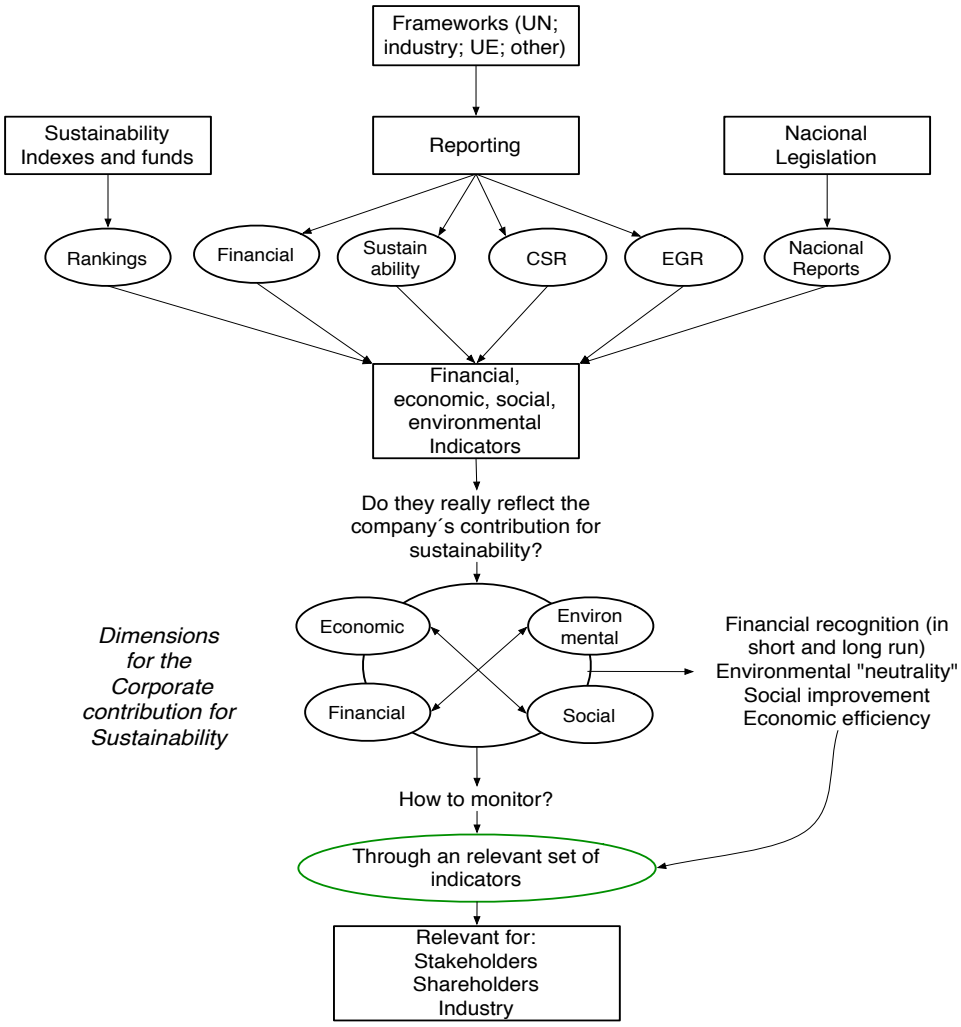

Figure 5-11 Dimensions of corporate contribution for sustainability

The selection of indicators, for the present work, took place in several stages:

1. Survey on the available frameworks and first indicators collection (described in subsection 5.3.1)
2. Raw data collection (described in subsections 5.3.2 and 5.3.3)
3. Review of industry relevant issues (described in subsection 5.3.4)
4. Selection of absolute indicators (described in subsection 5.3.5)
5. Relativized indicators proposal (described in subsection 5.3.7)

5.3.1. Initial indicator collection

First was carried out a compilation of energy industry related indicators referred in several sources (GRI, EFFAS and industry specific frameworks).

From the previous collection non-quantitative indicators were eliminated as well as similar indicators or those relating to the same subjects.

A review over the published non-financial reports from our sample of energy companies was performed to identify matters effectively reported.

A survey over available databases evidenced that, in most cases, besides expensive, they showed a limited number of indicators, with less diversity and scope than what would be desirable for the research. The majority had poor transparency regarding sources and methods for data collection. In some situations limited disclosured information is intended to avoid conflicts of interest in relation to the services provided by the database provider (Rahman and Post 2011).

Thus, for the databases available on the market do not prove to be adequate to the objectives of the research it was decided to build a database for exclusive use in this work. The definition of the supporting structure for the data attended to:

- the type of data to collect
- the functionality on handling and review
- the easiness on integration with tools for implementing the methodology defined.

Regarding the data type Gujarati (1988) presents three types of data that can be employed in quantitative analysis:

- Time series data, where it is studied the behavior of a variable over time,
- Cross-sectional data, when analyzing the behavior of data collected on sample units at a given point in time
- Panel data, when checking jointly the behavior of data individual units (cross-sectional data) over time (time series data). Data is observed over two dimensions (typically, time and cross-sections). Panel data may also refer to multi-dimensional data if containing observations on multiple phenomena observed over multiple time periods. It is termed as multi-dimensional when the phenomenon is observed over three or more dimensions (ex: individuals, variables, time).

According to Hsiao (1986), panel data models offer significant advantages over sectional or time series models, once the former allow to control the heterogeneity of individuals analyzed though the inclusion of variables not explicitly measured. Considering the individual specific characteristics, the panel data model, avoids biased results that can come from the non-inclusion of those variables.

Panel data models provide a greater amount of information, greater variability in the data, less multicollinearity among variables, more degrees of freedom and greater efficiency in the estimation (Hsiao 1986).

In the present case for the firms of the sample, for the period of analyses, the variables were classified also as:

- Continuous quantitative variables (e.g. emissions, revenues).
- Qualitative nominal variables (or dichotomous variables).

5.3.2. Raw data collection

Raw data collection was based on publicly available information, mostly collected on company websites. Non-financial data was mostly collected in Corporate Responsibility Reports, Sustainability and Environmental Reports. Financial data was collected on Annual, Accounts and Financial Reports.

Whenever possible and since having the data available in more than one form of report, it was duly verified, in order to avoid disparities between the various sources. In the same way, information available on websites was confronted with reported data.

In the presence of different values, priority was always given to the most recently published information, which in many cases was correcting data from previous years. This situation was due to changes in data collection systems, but mainly, it was a consequence of undertaken processes of mergers and acquisitions. In general the alteration in the composition of assets, especially in the case of productive assets, involves amendments in all main categories of indicators (economic, environmental and social).

The collection period covered the years 2005 to 2010 as a way to ensure consistency and integrity of information.

The historical share prices was usually downloaded from company website or from YahooFinance. The stock exchange referred on company website for its shareholders was used as reference for our analyses. It generally corresponds to the stock exchange for the country where the company locates its headquarters. When there is more than one stock exchange in the country, it was selected the one with the highest transaction volume of the shares.

The selected variables are expressed both in monetary values and physical units.

As several variables are expressed in national currencies, it was used an average of the exchange rate for year 2010 to convert those values into a single monetary unit, the euro (Table 5.4).

Table 5.4 Average exchange rate

Danish Krone	1 DKK = 0,1341 EUR
Pound Sterling	1 GBP = 1,12 EUR
Swedish Krona	1 SEK = 0,11 EUR
Norwegian Krone	1 NOK = 0,1275 EUR
Swiss Franc	1 CHF = 0,8113 EUR
Czech Koruna	1 CZK = 0,04 EUR

Source: *Bank of Portugal (2011)*

5.3.3. Data collection challenges

The present research deals with non experimental data which may present accuracy problems. The most common are:

- errors of measurement
- observational errors
- lack of certain data for part of the sample (problem of nonresponse)
- differences on data collection methods among sample
- high aggregation of data (low information on sample individuals)
- confidential data

Dealing with different sustainability reports from the energy companies has shown that indeed standards for measurement are essential, and most of the above referred errors frequently occurred. In fact:

- different companies have different criteria to identify sensitive or confidential issues, which naturally are kept out report.
- disclosured information varies over time, even for the same company.
- errors on the measurement of previous data are presented and rectified in latest reports.

Although, in general, most of the sample companies use the GRI framework to structure reports, to collect the data and establish comparisons among reports is extremely difficult because:

* The use of different units for measurement. (ton, metric ton, t). In some cases, for example, the primary energy consumption is expressed in tons and others in Tj. The variable "Primary energy consumption" for instance, is expressed in different units of measure (toe, TJ, KWh, ton) which require performing conversions inter and intra company. Additionally it may happen that the same company use different units of measurement, for example, for different fuels.

* The application of different scales for unit conversion depending on geographical origin of the countries. For example for the conversion of billions in other units in some countries is used a short scale (Anglo-Saxon) and in others a long scale (Denmark, Finland, France, Portugal, Spain, Sweden and other countries).

* The use of different methodologies, framed by specific regulation and national accounting systems, to estimate the values to consider in the various reported categories. For instance, “in France, the “frequency rate” does not include travel-related injuries. Outside France, the latter may be taken into account when the local legislation considers injuries to be work-related. The number of fatal injuries includes injuries at work and travel-related injuries involving employees. It does not take into account fatal injuries involving subcontractors” (EDF 2010).

Another example, in calculation of total waste, some companies included it in the gypsum and ashes (EDP) item, whilst others consider them as by-products (EDF).

* The use of different concepts to express similar situations, as for example, EBIT or operating profit. To compare companies is necessary to clarify the concepts used in each particular context.

* The calculation of the values for the different categories integrates different items from company to company. Often, when comparing the reported ratios with the ratios calculated from absolute values, from the same source, different values are obtained. This suggests the use of different calculation formulas for both sides.

* The development of several specific reports (e.g. for environment, biodiversity, social issues), unlike what might be expected, difficult the access to the information and makes harder to perform comparisons between companies. The evaluation of performance becomes complex since the information is dispersed in various documents.

* In the same document is frequently noted a lack of consistency in data presentation, which may alternate between the corporate group, the group sections or the group companies. For example, the economic and financial information is usually presented as consolidated for the business group, while environmental information may refer only to a geographical area of intervention (see the document "Sustainable indicators EDF 2010", where presented emissions relate only to France).

* A major breakdown of indicators by geographical area that is not accompanied by corresponding aggregate indicators, also difficult the understanding of the overall performance of the company

* It is relevant to notice that recent sustainability reports are presenting less information than those from previous years. The analysis of sustainability reports over time have also shown that the diversity of the indicators presented and the topics discussed is also being lower, with a tendency to cluster around key themes that will become more common through companies in the sector. Yet, the disparities among the information disclosured for different companies is still too large.

To overcome these difficulties are proposed the following requirements:

- Consolidate information from the different companies of the groups
- Define and standardize data
- Define and standardize metrics
- Setting and standardize units for measurement
- Definition of concepts for global use
- Definition of formulas for calculating the indicators
- Definition of items to consider in the calculation of indicators
- Definition of information to consider in each section

In the present research, the obtained data was structured as pooled data type, which combines elements both from time series and cross-section data, referring to different variables. Several cross-sectional units (companies), were surveyed at periodic intervals (once a year at end of December) and for the period of time between 2005 and 2010.

5.3.4. Industry relevant issues

Beyond the important issues relevant to the sector, it should be noted a whole range of crosscutting issues which influence the assessment of business performance and are referenced in EU regulatory framework as also in national laws. In this field fall issues such as: labor relations, social equity, interaction with local communities and preservation of natural resources, among others.

From the previous developments, relevant issues for electricity sector were aggregated into the following four dimensions:

Dimension 1 - Environment

CO_2 Emissions and other GHG emissions – The production of electricity using fossil fuels is a major contributor to global warming, from those with origin in human activities. (OECD/IEA 2011).

Renewable energy sources - The use of renewable energies has been assumed as an important solution in fighting climate change and as an alternative to the use of fossil fuels.

Water use – Most electricity production processes imply an intense use of water. Both in thermal generation, using fossil fuels, or nuclear power generation, water is used in large amounts, primarily for cooling. On other hand, the seawater is used (captured and rejected) for regasification of Liquefied Natural Gas. The construction of salt caverns for storage of natural gas also generates large quantities of salt water. In all cases the treated water that has to be properly routed to the appropriate destination, at the risk of affecting the characteristics of the receiver. Hydropower generation, when associated with the dam, affects the availability of water upstream and downstream, and impacts on the conservation of biodiversity. In some cases, the dam construction affects local historical patrimony as also the cultural preservation and it invalidates other economic uses of the soil.

At EU level groundwater is protected as strategic reserve and its use is discouraged in favor of surface water.

Biodiversity - Biodiversity is mostly affected by the activities of electricity transport and distribution but also by hydropower, which has a huge impact on aquatic and riparian ecosystems, either by the flooded areas and by amendments to the level of flow, either by creating obstacles to the movement of species aquatic (migration along the course of a river to

carry out certain species spawns). The thermal generation impacts on biodiversity, through the rejection of cooling water, which can change the parameters of the aquatic surrounding areas and compromise the survival of local ecosystems.

Residuals - The largest share of waste generated on energy production mainly consists on various kinds of ash, slag and gypsum. These materials are generated on the desulphurization process. Under European legislation they can be treated as by-products and incorporated into other industrial processes.

Nuclear waste - Although generated in much lower amounts, by their dangerousness and temporal extent of their activities, it represent a critical issue in the panorama of electric generation

Dimension 2 - Social

Energy companies play a key role in social terms both for the volume of direct and indirect employment generated and by the geographical dispersion of the activity, confronting different communities and cultures. The services rendered and the goods traded are central for the development of society and for the welfare of millions of citizens. the impact on communities, the importance of service and relevance of traded goods. The major issues integrated in the social aspect are as follows:

Employment conditions and professional development
Health and safety
Community support
Corruption and bribery

Dimension 3 - Operational / Economic

The importance that energy plays in economic development, arises some questions related to: the need to optimize the use of scarce resources (primary energy sources such as fossil fuels or biomass), the appropriation of resources by energy companies and competition for the soil use with other activities (e.g. dams). Stakeholders of energy companies have different interests. It is important to understand the operating conditions in terms of efficiency and how the value added by energy related activities is distributed by stakeholders. The major issues integrated in the economic /operational aspect are as follows:

Installed capacity
Distributed vale added
Generation and end-use efficiency

Dimension 4 - Financial

This last category has not been openly seen in more conventional forms of presentation of corporate responsibility, which generally refer only to economic, environmental and social matters. It was introduced because it was considered relevant for the long-term survival of the sample. Financial issues play a key role in the concerns of business and are crucial to the pursuit of social and environmental objectives.

Long-term profitability
Ability to meet the long run commitments
Sustained increase in the company value

5.3.5. Selected indicators

Indicators reported for a small number of companies (less than 33%) were eliminated, given their low representativeness in terms of the sample. Indicators with less than 50 observations were eliminated given their low representativeness in terms of the issue.

The definitions of Basic Economic and Financial indicators (Table 5.5) are based on International Financial Reporting Standards (IFRS), once the sample firms have an international dimension and as a consequence they use the IFRS as accounting standard.

Table 5.5 Basic Economic and Financial indicators

Economic and Financial			
Symbol	**Name**	**Unit**	**Description**
EBITDA	EBITDA	(10^6 euros)	Earnings before interest, taxes, depreciation and amortization (or gross operational profit)
EBIT	EBIT	(10^6 euros)	Earnings before interest and taxes (or operational profit)
N_PFT	Net profit	(10^6 euros)	Gross profit minus operating expenses and interest (or net profit)
CAPEX	Capital expenditure	(10^6 euros)	Investments for capital maintaining or expansion
T_ASS	Total assets	(10^6 euros)	Economic resources tangible or intangible controlled by the corporation and expressed in monetary value
N_ASS	Net Assets	(10^6 euros)	Residual value left for company owners after deduction all liabilities from all assets. means the same as Shareholders' equity. It usually means the same as Shareholders' equity
N_DBT	Net debt	(10^6 euros)	Liabilities and debts minus cash and other similar liquid assets
T_EQT	Total Equity	(10^6 euros)	Ownership in company assets after all debts associated with those assets are paid off
T_LBL	Total Liabilities	(10^6 euros)	Obligation of an entity arising from past transactions or events
DEV_D	Direct economic value distributed	(10^6 euros)	Used GRI (2006) definition [16]
T_RVN	Total revenues	(10^6 euros)	Total income that a company receive during a fiscal year from its normal activity (or turnover)
ST_IDX	Sustainability index	Dummy	1- Yes; 0 - No
T_DBTR	Total debt ratio	%	(Long Term Debt + Short Term Debt) / Capital Employed

[16] GRI definition for Direct Economic Value Distributed

Direct economic value generated	
a) Revenues	Net sales plus revenues from financial investments and sales of assets
Economic value distributed	
b) Operating costs	Payments to suppliers, non-strategic investments, royalties, and facilitation payments
c) Employee wages and benefits	Total monetary outflows for employees (current payments, not future commitments)
d) Payments to providers of capital	All financial payments made to the providers of the organization's capital.
e) Payments to government	Gross taxes
f) Community investments	Voluntary contributions and investment of funds in the broader community (includes donations)
Economic value retained	
Economic value generated less Economic value distributed	Investments, equity release, other

The EBITDA gives indication on the operational profitability of a company. By removing the payment of interest, taxes, depreciation and amortization, on profit calculation, the effect of different factors on the company's profitability is nullified, allowing comparisons to be made. Among others, the effects that influence earnings may include, for example, the different structures of assets, debt, or taxation, which in the case of EBITDA are not considered (Haltman 1986).

The difference between EBITDA and EBIT regards depreciation of capital. Amortizations and depreciations reflects the investment that a company makes in economic terms in tangible and intangible assets (possibly in environmental and social assets). The calculation of amortizations and depreciations as depending on subjective decisions relating to assets useful life, depreciation methods or residual values, can also induce distortions on the net income. For these reasons, EBITDA removes subjective judgments that can obscure how the company is really performing. It is widely used to compare financial performance among companies, namely those with different capital structures, fiscal framework or depreciation policies.

Net profit is the is the most refined form of profit since it considers all expenses necessary to the corporate business, or else, it is the obtained profit after interest, taxes, depreciation and amortization are deducted. Net profit provides a implicit picture of the management decisions and it reflects a clear vision about the expenses that the company has to bear to keep running (Nabais 1997).

Although EBITDA individually taken, provides a incomplete picture, once it does not address several relevant expense items. If on one hand the EBITDA reflects the ability to generate earnings, the net profit represents the ultimate results, after the payment of the liabilities from the company's operation.

The capital expenditures (CAPEX) refers the expenses incurred to maintain, replace or expand the company asset base, representing business improvements. The CAPEX reflects the effort in the maintenance and expansion of business capacity. It complements the information provided for EBIT, once it is subject to the accounting for depreciation and amortization over the asset expected life (Nabais 1997).

Thus, the indicators previously presented are assumed to complement each other and they are jointly used to understand business financial performance.

There were also collected the indicators considered in IFRS as main elements of a company financial position which are:

"Asset: *An asset is a resource controlled by the enterprise as a result of past events from which future economic benefits are expected to flow to the enterprise.*

Liability: *A liability is a present obligation of the enterprise arising from the past events, the settlement of which is expected to result in an outflow from the enterprise' resources, i.e., assets.*

Equity: *Equity is the residual interest in the assets of the enterprise after deducting all the liabilities under the Historical Cost Accounting model. Equity is also known as owner's equity. Under the units of constant purchasing power model equity is the constant real value of shareholders´ equity." (IAS 1 article 10)*

Following the same source it was collected "total revenues" as the elements of an income statement that measure the financial performance, which is understood as:

Revenues: *increases in economic benefit during an accounting period in the form of inflows or enhancements of assets, or decrease of liabilities that result in increases in equity. However, it does not include the contributions made by the equity participants, i.e., proprietor, partners and shareholders (IAS 1 article 10).*

Some companies report the distribution of the value generated in the exercise, by stakeholders (employees, shareholders, lenders, community, state and in some cases suppliers), registering however considerable differences in the methodology applied in the calculation of the amounts attributable to each of stakeholders. in this case we used the terminology and calculation method set forth in the GRI (2006) framework (see footnote 16).

In addition to the indicators referred into the consulted frameworks, a new indicator have been proposed by the author to incorporate the previous selection. As far as is known it is an unprecedented fact in the assessment of corporate sustainability. Additional indicator is annualized volatility. Volatility refers to the variability of returns of an asset over a given period, and is commonly used to quantify the risk of holding that asset during that period. In this particular situation volatility of corporate shares is used to evaluate the market recognition of corporate sustainable behavior, once it is quite stable in crisis situations and provides greater stability over time. By itself, volatility is a fundamental element for the risk management in financial markets. It is expected that companies having more concerns about sustainability would present lower volatility on their stock prices.

The analysis of the volatility of share prices of a sample of companies within the energy sector (electricity producers) was chosen as an indicator of market recognition for the conduct of business. This information is important for investors who could be able to design their investment strategies taking in account the use of these companies as a way to balance their investment portfolios.

Volatility was calculated using the following formula:

$$Y_t = \ln (P_t / P_{t-1})$$

Y_t = Instant return on time t

P_t = Share closing price on time t

Annualized values were obtained based on the calculation of the standard deviation on daily returns.

The analysis of companies' volatility focuses on the period from 1 January 2004 to 31 December 2010. The data set consists on daily closing price from energy companies shares, listed on the stock market in which the company's headquarters is registered. The stock prices were extracted from several sources: sample company's websites, stock exchange websites and financial websites linked to Stock Exchange websites.

About 1800 observations were obtained for each company. This data presents a non-experimental nature, once occurs entirely out of the control of the researcher.

The indicators with minimum number of observations collected for the environmental, social and operational matters are presented below (Table 5.6, Table 5.7 and Table 5.8). Unlike the economic and financial indicators, the meaning of the following indicators is easily apprehendable and not undertaken any detailed explanation.

Table 5.6 Basic operational indicators

Operational			
Symbol	**Name**	**Unit**	**Description**
EL_CAP	Electricity capacity	MW	Installed capacity for electricity generation (maximum power)
PEC_CN	Primary energy consumption	Tj	Fossil fuels used on electricity generation
EL_GENT	Total annual production	GWh	Gross electricity generation
EL_SELF	Electricity for self-consumption	GWh	Electricity used in production and administrative services
NEL_GENT	Net electricity produced	GWh	Total annual production less electricity for self-consumption
NEL_GENRE	Net electricity generation from renewable sources	GWh	Includes hydro, wind, biomass (not for combustion), geothermal and tidal sources
NEL_GENNU	Net electricity production from nuclear	GWh	Includes only nuclear sources for electricity generation
NEL_GENTH	Net electricity production from thermal	GWh	Includes conventional, co-generation, combined cycle and other combustion processes (including biomass and waste)
EL_LOSS	Electricity losses	%	Transmission and distribution losses
G_EXT	Gas extension	Km	Network extension (for gas distribution)
EL_EXT	Electricity extension	Km	Network extension (for electricity distribution)
ELD_SAL	Electricity sales distribution	GWh	Electricity for large consumers
ELS_SAL	Electricity sales supply	GWh	Electricity sales for residential clients and small consumers
ELT_SAL	Total electricity sales	GWh	Electricity sales for all clients
EL_COS	Electricity costumers	n.º	Number of costumers for electricity sales supply
G_TRN	Gas transport	GWh	Amount of gas transported
G_SALD	Gas sales distribution	GWh	Amount of gas distributed
G_SALS	Gas sales supply	GWh	Amount of gas supplied
G_SALT	Gas sales total	GWh	Total amount of gas Sales (distribution and supply)
G_COS	Gas Costumers	n.º	Number of gas costumers
H_GEN	Heat generation	GWh	Economically values heat on district heat and process heat
BYPRO	By products (gypsum and ashes)	t	Generated products available for introduction in other productive processes.
BYPRO_REC	Recovered by products ashes and slag	t	Byproducts effectively incorporated into other economic processes

Table 5.7 Basic environmental indicators

Environmental			
Symbol	**Name**	**Unit**	**Description**
WA_COO	Water for cooling	(10^3 m^3)	Total of water used for cooling
WA_WITH	Water withdrawal	(10^3 m^3)	Total of water captured from various sources (rivers, sea, underground) used for company processes
WA_DSCH	Water discharged	(10^3 m^3)	Total water discharged
CO_T	CO_2 total	Kt	Total CO_2 emissions (for the group)
CO_TH	CO_2 thermal	Kt	CO_2 emissions from company thermal facilities
SO_T	SO_2 total	Kt	Total of SO_2 emissions from company facilities
NOX_T	NO_x total	Kt	Total of NO_x emissions from company facilities
PART_T	Particles	Kt	Total of particle emissions from company facilities
WST_T	Total waste (t)	t	Total waste generated from company facilities (hazardous plus non-hazardous waste)
WST_NZ	Non-hazardous waste	t	Total non-hazardous waste generated from company facilities
WST_NZREC	Recovered non-hazardous waste	t	Total non-hazardous waste generated from company facilities not disposed in landfill
WST_Z	Hazardous waste (t)	t	Total hazardous waste generated from company facilities
WST_ZREC	Recovered Hazardous waste	t	Total hazardous waste generated from company facilities not disposed in landfill
WST_NU	Nuclear waste from low and intermediate level waste	Dummy	Total nuclear waste generated from company facilities (1- Yes; 0 – No)
ENV_EXP	Environmental expenditure	(10^6 euros)	Environmental current costs plus environmental investment
ENV_CST	Environmental current cost	(10^6 euros)	Environmental costs incurred by the company for the year

From all possible social indicators those generally more affordable are disclosured in social balance reports, which in some countries have a mandatory character.

Table 5.8 Basic social indicators

Social			
Symbol	**Name**	**Unit**	**Description**
EVD_EMP	Economic value distributed to the employees	(10^6 euros)	Economic value distributed to the employees including wages, salaries and other benefits paid to employees
EVD_TAX	Economic value distributed to taxes	(10^6 euros)	Economic value distributed to the state and local authorities. Includes income taxes, license fees, property taxes and others
EVD_COM	Economic value distributed to the communities	(10^6 euros)	Economic value distributed to the communities, supporting sport, cultural, social, philanthropic activities. Contributions to community
EVD_OWN	Economic value distributed to owners	(10^6 euros)	Economic value distributed to the owners, including dividends, group contributions and minority interests
EVD_LEN	Economic value distributed to lenders	(10^6 euros)	Economic value distributed to the lenders
EVD_SUP	Economic value distributed to suppliers	(10^6 euros)	Economic value distributed to the suppliers and other operating costs
EMP_T	Employees total	n.º	Total number of employees at the end of the year
EMP_FTE	FTE	n.º	Full-Time Equivalent converted to full-time positions
EMP_FAT	Nº of work-related fatalities	n.º	Number of fatalities occurred in labor context
EMP_TRG	Nº hours of training	n.º	Total hours of training
EMP_ACC	On duty accidents	n.º	On duty accidents, excluding contractors
EMP_LDA	N.º of days lost due to accidents	n.º	N.º of work days lost due to accidents

The selected indicators are expressed in different units and scales. The performance of comparisons among them, requires their standardization or the relativization.

In the present case, the relativization of the indicators revealed itself as a adequate way to address the complexity arising from the lack of a common scale of measurement.

Moreover relativization allow to create new measures, more adequate to concepts and dimensions to explore.

Relative indicators are developed in the following chapters (see item 5.3.7).

5.3.6. Material concepts for the defined dimensions

Confronted with the vagueness of the concept of corporate contribution for sustainability, it is considered in this work is that this contribution is manifested in four key dimensions. Each dimension is expressed in several material concepts (see Figure 5-12) The contribution of each company or corporation for sustainability is assessed in terms of:

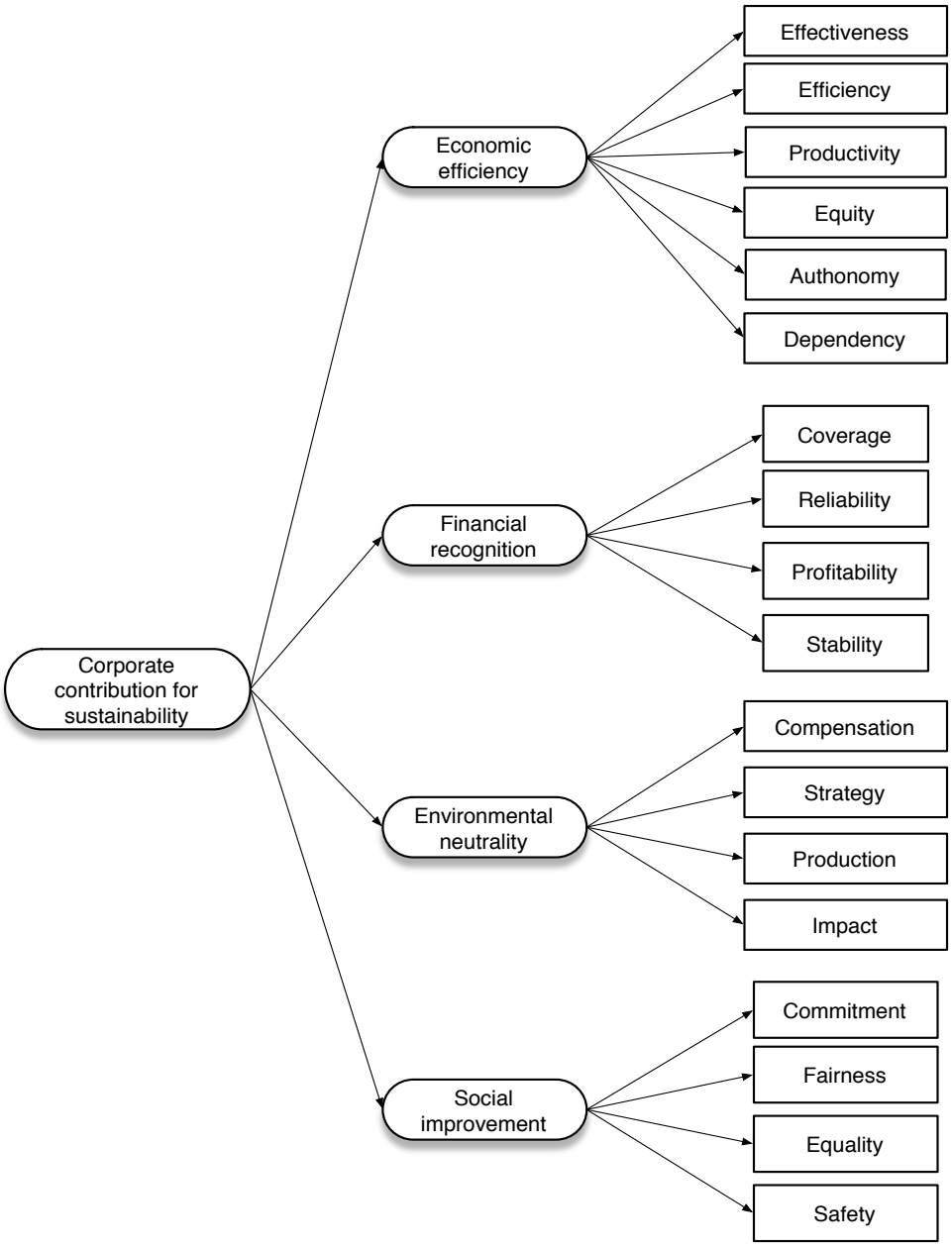

Figure 5-12 Material concepts for the corporate contribution for sustainability

Several authors have been trying to characterize the sustainability dimensions. The present research proposes that corporate contribution for sustainability demands for economic efficiency, financial recognition, environmental neutrality and social improvement.

Samuelson (1964), defines **economics "***as the study of how a person or society meets its unlimited needs and wants through the effective allocation of resources*". For Lionel Robbins (2007) "*economics is a science that deals with the study of human behavior as a relationship between ends and scarce means which have alternative uses*".

Based on the above definitions, focusing on issue of the use of scarce resources to achieve a particular goal, we assume that the main concept characterizing the economic dimension is efficiency. Efficiency refers to the relationship between the results and the resources used and it has implicit an underlying arbitrio in choosing resources, means and objectives.

Effectiveness, productivity, equity, autonomy and dependency are assume as material concepts of the economic dimension. Effectiveness measures the relationship between the results and the desired goals and it assumes greater importance when articulated with efficiency.

Productivity measures the quantity produced (production) against the resources used (inputs), allowing to quantify efficiency.

Equity is also a powerful concept for the economic dimension. As companies are important consumers of resources to provide products and services and employment providers, they have a large responsibility in building social well being. The way companies distribute the value generated in their business by various stakeholders and the way they remunerate the use of different capital sources (e.g. intellectual, environmental, social), is critical for understanding the corporate contribution to the economic, social and environmental sustainability.

Autonomy and dependency are mainly associated with external factors out of the company control, such as suppliers and costumers.

Accordingly to the literature, the financial credibility is important to provide the resources that allow a good environmental and social behavior. On the other hand, a company that controls and minimizes its environmental and social impacts, presents fewer risks and have greater ease in financing. Presently, the valuation of a company in financial markets increasingly reflects not only shareholders expectations, but also other stakeholder's valuation. Thus the dimension most relevant financial folder is associated with the concept of recognition, which in turn is linked to the sub dimensions of coverage, reliability, profitability and stability.

Financial recognition is firstly characterized by coverage and reliability, both referring to the capacity to assume the financial commitments with equity. Profitability is relevant as an expression of the ability to capitalize companies' assets. Stability refers to ability to manage changes, deal with shocks and control the risks. The proposed variables were designed to address these dimensions and concepts.

Industry is recognized as a main source of environmental degradation through pollution and resource depletion. However they may also contribute decisively for a sustainable world, both from its own operational options and for the impact on other economic agents. The conservation of energy and natural resources is a basic question when inquired the role of business on environment issues. From the relationship of companies and environment, ideally would be expected that the negative effects world be minimized, compensated and neutralized by appropriate measures. Neutrality is assumed as the main material concept characterizing the environmental dimension of sustainability.

Environmental issues in corporate scenario frequently incorporates a strategic perspective that refers decision-making, both to take action in the present and to intervene in the future. From the selection of technologies to research funding, there is a strategy which implicitly will be reflected on production level, impacts and compensation measures.

The social dimension of corporate contribution to sustainability is based in the main concept of improvement. As main users of human resources, primarily through labor force and intellectual capital, corporations exert a broader social influence extending to families, to other businesses and to communities. The provision of goods and services for consumption and the intervention in supply chains impact the level of public health, consumer habits and quality of life. The working conditions affect health and safety, social stability, professional development and ultimately family relationships. The demand for raw materials determines the local productive activities and in some cases, the world geopolitics (e.g. fossil fuels, food commodities).

Corporate social dimension is closed linked to the commitment with stakeholders. Safety both in workplace and in products and services, is also assumed as an important concept to achieve social improvement. Fairness and equality refers to cross principles applied in relationships with the various interested parties.

In the specific case of electric utilities, as large employers, wider suppliers, large scale consumers of raw materials, having strong impacts on social, economic and environmental issues, they assume undeniable corporate responsibilities and they play a major role on the contribution for sustainability.

The material concepts previous defined, as well as the characterization of the dimensions of corporate contribution for sustainability followed in this work, provide guidance to interpret the proposed indicators and the results obtained.

Relative indicators reported by the sample companies, where directly used whenever proved the consistency in calculation methods. These indicators are marked with “(*) Reported relative indicator”

5.3.7. Proposed relativized indicators

The selection of variables to use, was performed bearing in mind the concern that all variables were independent and metric. Thus, dummy variables and those presenting a explanatory relationship among them, were excluded .

The indicators presented in Table 5.9 were proposed taking into account the material concepts that represent the financial dimension of corporate contribution for sustainability which are mainly materialized in market recognition.

Table 5.9 Relative financial indicators

Symbol	Unit	Formulation	Name	Dimension
FINANCIAL				Recognition
IEBIT	ratio	iebit=ebit/t_ass	Weight of EBIT on the total assets	profitability, effectiveness
IEBITDA	ratio	i_ebitda=ebitda/t_ass	Weight of EBITDA on the total assets	profitability, effectiveness
IDBT	ratio	i_dbt=n_dbt/t_ass	Weight of net debt on the total assets	coverage, reliability
IT_LBL_EQT	ratio	it_lbl_eqt=t_lbl/t_eqt	Weight of total liabilities on the total equities	coverage, reliability
DV_YLD*	Euro	dv_yld=dividend per share/price per share	Dividend Yield	profitability reliability
E_PS*	Euro	e_ps=income to equity shareholders / nº. of common shares outstanding	Earning per share	profitability reliability
ROA*	ratio	roa=net income / t_ass	Return on assets	profitability effectiveness
ROE*	ratio	roe=income to equity shareholders / average shareholder equity	Return on equity	profitability, effectiveness
ROI*	ratio	roi=operational results/t_assets	Return on investment	profitability effectiveness
ROR*	ratio	ror=net income / t_rvn	Return on revenue	profitability coverage
VOL	ratio	(see formula)	Annualized volatility	reliability stability

(*) Reported relative indicator

In the use of IEBIT and IEBITDA, both EBITDA and EBIT are related to total assets, which allows to identify the impact of different structural factors on the profit generation.

The use of both weight of net debt on the total assets (IDBT) and weight of total liabilities on the total equities (IT_LBL_EQT) is justified because the indicators complement each other providing information about the level of debt coverage and financial autonomy.

The ratio IT_LBL_EQT compares the amount of financing provided by creditors as opposed to funding from shareholders, providing information on the creditworthiness of the company in the long run. It is also an indicator of long-term risk because the higher the indebtedness and the longer the period of repayment of the debt, the greater is the risk of the company. It is also an indicator of long-term risk because of indebtedness and the longer the period amortization of debt, the greater is the risk of the company.

Dividend yield (DV_YLD) is an indicator designed to measure the profitability of a company dividends relative to its share price. It measures the profitability of a company dividends relative to its share price. This index has the benefit of being able to compare the profitability of dividends between companies. It also reflects the company policies relating the profit distribution.

The earnings per share (EPS) refers to the value that company effectively distributes to its shareholders and it reflects the company's policies regarding the value generated.

ROA (return on assets) measures the ability to manage the company's assets to generate results. The information provided complements the data obtained by IEBITDA and IEBIT, as it considers different levels on profit calculation.

The ROR (return on revenue) is useful in comparing the profitability of a company from year to year. Intrinsically, the difference between net income and revenue is expenses, such that an increasing ROR implies less expense for higher net income.

ROI (return on investment) is widely used to evaluate the performance of an investment and to effect comparisons between different investments.

ROE (return on equity) refers to effectiveness on shareholders equity management. It can be alternatively calculated by multiplying profit margin for asset turnover and for financial leverage. This form of calculation, defragments the indicator, into three checks of the financial performance, which refer respectively to: the pricing strategy and ability to control operating costs, the management of assets to generate revenue and the weight of equity in the asset.

Volatility (VOL) is a measure of information flowing (Ross 1989). The increasing integration of financial markets worldwide has generated an increasing interest in seeking to understand how information propagates across these markets and how investors perceive these information and set their investment decisions.

The level of volatility in financial markets affects the investment decisions from company side by one hand and by the other the willingness to grant credit from the banking side (Morales and Andreosso-O'Callaghan 2008). Therefore changes in the level of volatility of returns of actions involve changes at the level of financial stability.

That raises the question if companies that have lower volatility compared to the average of the respective sectors are considered by investors more reliable to respond to shock waves. It can also be questioned if these companies with lower volatility have the high standards of social care and environmental behavior and they assume genuine concerns about its own sustainability performance.

Assuming the concern with the use of scarce resources to maximize social welfare, we propose the variables from Table 5.10. They refer to resource use (financial, water, fuels) in the production process and corresponding outputs (electricity, heat, by-products, revenues, economic value distributed).

Table 5.10 Relative economic indicators

Symbol	Unit	Formulation	Name	Dimension
ECONOMIC				effectiveness and efficiency
IPEC_CN	Tj/GWh	ipec_cn= pec_cn/el_gent	Primary energy consumption per unit of electricity generated	efficiency
ISELF_T	%	iself_t=el_self/el_gent	Share of produced electricity used for self-consumption	efficiency
IWA	10^3 m^3 / GWh	iwa=wa_coo/el_gent	Cooling water used per unit of electricity generated	efficiency
IBYPRO	%	ibypro=bypro_rec/bypro	Share of recovered by-products (gypsum and ash)	effectiveness
IH_GENTH	%	ih_genth=h_gen/nel_genth	Weight of heat generation on the total electricity generation	effectiveness efficiency
IPDTV	GWh/ employee	ipdtv=el_gent/emp_t	Electricity generation per employee	productivity
IGENT_SAL	%	igent_sal=el_gent/elt_sal	Weight of electricity generation on the total electricity sales	authonomy
ISAL_ELCOS	GWh/ costumer	isal_elcos=elt_sal/el_cos	Electricity sales per costumer	dependency
IRVN_EMP	10^6 €/ employee	irvn_emp=t_rvn/emp_t	Revenue per employee	productivity
IT_RVN	%	it_rvn=t_rvn/t_ass	Weight of total revenues on the total assets	effectiveness
ICAPEX	%	icapex=capex/t_ass	Weight of capital expenditures on the total assets	effectiveness
IEVD_EMP	%	ievd_emp=evd_emp/dev_d	Weight of wages, salaries and benefits on the EVD[17]	equity
IEVD_LEN	%	ievd_len=evd_len/dev_d	Weight of payments to lenders on the EVD	equity
IEVD_OWN	%	ievd_own=evd_own/dev_d	Weight of payments to owners on the EVD	equity
IEVD_TAX	%	ievd_tax=evd_tax/dev_d	Weight of taxes (income and others) on the EVD	equity

(*) Reported relative indicator

The first three variables are input indicators. It is intended that the assessment of primary energy used per unit of electricity produced (IPEC_CN), the share of produced electricity used for self-consumption (ISELF_T) and cooling water per unit of electricity produced (IWA) enables to evaluate the extent to which the sample companies employ their input resources. These variables refer to the concept of efficiency in resource use for electricity production.

The share of recovered by-products (IBYPRO), the weight of heat generation on electricity generation (IH_GENTH) and the electricity generation per employee (IPDTV), are output indicators, referring to the concepts of efficiency, effectiveness and productivity. They allow to understand the way companies use they resources to maximize outputs and the way they achieve proposed goals.

[17] Economic Value Distributed (EVD)

Variable IH_GENTH refers to the amount of heat sold in the market and points to the recovery of heat that is generated in thermal processes for electricity production. The use of heat, often underrated, represents an additional increase in efficiency of thermal generation.

IBYPRO refers to the ability of the electricity companies value its sub-products that have application in other economic activities as raw materials.

IGENT_SAL and ISAL_ELCOS are indicators of commercial autonomy/independence against its customers and suppliers, also reflecting the acceptance of company's products and services.

IGENT_SAL indicates the percentage of electricity sold produced by the company, which reflects the dependence compared to other producers and suppliers of electricity.

ISAL_ELCOS regards electricity sold per customer and hence the dependence of the company towards its client portfolio. The greater the number of customers served, lower the risk of the company being affected by the transfer customers to other operators in the market and higher and its weight and influence in the market.

The use of IT_RVN (assets turnover) refers to the ability to generate revenue with the company assets. Companies in the sector of energy production generally have low values for assets turnover, since the characteristics of this activity to require the completion of high investments in assets.

The variables ICAPEX (weight of capital expenditures on the total assets) and IRVN_EMP (revenue per employee), are indicators of productivity and effectiveness and they express the way companies use and monetizes their physical assets and human capital.

EVD are indicators of equity, reflecting the imbalances on the distribution of the economic value generated in business by the various stakeholders.

Material and energy flows are the basis of environmental indicators, expressing both resource use and emissions. The proposed indicators expresses these two situations. They also attend to a new paradigm based on renewable energy, efficiency in production and consumption and the dematerialization of inputs.

Environmental indicators are divided in four main groups, characterized by the associated concepts.

Table 5.11 Relative environmental indicators

Symbol	Unit	Formulation	Name	Dimension
ENVIRONMENTAL				neutrality
IEXPENV_REV	%	iexpenv_rev=env_exp/t_rvn	Weight of environmental expenditure on revenues	compensation, strategy
IGENTH_T	%	igenth_t=nel_genth/nel_gent	Share of thermal souces production in electricity production	production, strategy
IGENNU_T	%	igennu_t=nel_gennu/nel_gent	Share of nuclear souces in electricity production	production, strategy
IGENRE_T	%	igenre_t=nel_genre/nel_gent	Share of renewables souces in electricity production	production, strategy
IGENRENU_T	%	igenrenu_t=(nel_genre+nel_gennu)/nel_gent	Share of CO^2 free electricity production	production, strategy
ICO_TEQ	Kg/kWh	ico_teq=co_teq/el_gent	CO^2 equivalent relative emissions from electricity generation	impact, air emissions
ICO_TH	Kg/kWh	ico_th=co_th/el_gent	CO^2 relative emissions from electricity generation	impact, air emissions
INOX_T	g/kWh	inox_t=nox_t/el_gent	Particles relative emissions from electricity generation	impact, air emissions
IPART_T	g/kWh	ipart_t=part_t/el_gent	NO_x relative emissions from electricity generation	impact, air emissions
ISO_T	g/kWh	iso_t=so_t/el_gent	SO_2 relative emissions from electricity generation	impact, air emissions
IWST_REC_NZ	%	iwst_rec_nz=wst_nzrec/wst_nz	Share of recovered non hazardous waste	impact, solid emissions
IWST_ZREC	%	iwst_zrec=wst_zrec/wst_z	Share of recovered hazardours waste	impact, solid emissions
IWST_Z	%	iwst_z=wst_z/wst_t	Share of hazardous waste on total waste	impact, solid emissions

The weight of environmental expenditure on revenues (IEXPENV_REV) refers both to the strategy of prevention and minimization of impacts and to the compensation actions for any environmental damage. The costs and environmental investment are relativized in terms of total revenues.

The share of thermal, nuclear, renewables and CO^2 free (nuclear and renewables) in electricity production, represented respectively by IGENTH_T; IGENNU_T; IGENRE_T, IGENRENU_T, is associated with the production and strategy concepts. These variables reflect decisions regarding production technologies and guidelines outlined for future.

The remaining indicators refer to the concept of impact, namely those associated to gaseous and solid emissions.

Although the social influence of business it is larger than the sphere of employee issues, the usable in this research is mainly confined to labor relations (IEMP). In fact only 15% of proposed indicators refer to other issues of social improvement. It was assume that this dimension would be driven by safety in workspace, by the commitment with employees, by equality in treatment, regardless of gender, race or color and by fairness in income distribution for the governmental institutions and for communities.

Table 5.12 Relative social indicators

Symbol	Unit		Name	Dimension
SOCIAL				Responsibility
IEMP_ACC	‰	iemp_acc=1000*emp_acc/emp_t	Average accidents per one hundred employees	Safety
IEMP_FAT	‰	iemp_fat=1000*emp_fat/emp_t	Average fatalities per one hundred employees	Safety
IEMP_FTC	%	iemp_ftc=emp_ftc/emp_t	Share of employees with full-time contract	commitment, company
IEMP_PC	%	iemp_pc=emp_pc/emp_t	Share of employees with permanent contract	commitment, company
IEMP_TRG	hours	iemp_trg=emp_trg/emp_t	Hours of training per employee	commitment, company
IEMP_ABS*	%	iemp_abs=number of absent days /the number of available workdays	Absenteeism rate	commitment, employees
IEMP_SEN*	years	iemp_sen=sum of years of employees permanence in the company/emp_t	Average seniority (permanence in the company)	commitment, company, employees
IEMP_TURN*	%	iemp_turn=number of employee leaves/ average number of employees	Share of employees replaced within the company, excluding retirements (staff turnover)	commitment, company
IEMP_WOMT	%	iemp_womt=emp_womt/emp_t	Share of women in total workforce	equality
IEMP_WONM	%	iemp_wonm=emp_wonm/emp_t	Share of women in management	equality
IEMP_WOMB	%	iemp_womb=emp_womb/emp_t	Share of women in the board	equality
ITAX	%	itax=evd_tax/t_rvn	Weight of tax on revenues	fairness
IWAGE	%	iwage=evd_emp/evd_own	Weight of wages, salaries and benefits on payments to the owners	fairness

(*) Reported relative indicator

The variables IEMP_FTC (Share of employees with full-time contract), IEMP_PC (share of employees with permanent contract) and IEMP_TRG (hours of training per employee), express the company's commitment to employees is reflected on the flexibility of work schedules, stability of employment contracts and training.

The investment, both in human resources and in the creating appropriate labor conditions for employees and candidates, results is better health and safety and talent retention. It is represented by the variables: average number of accidents involving company staff (IEMP_ACC); average work related fatalities in company staff (IEMP_FAT), absenteeism rate (IEMP_ABS), period of median stay in the company (IEMP_SEN).

Staff turnover (IEMP_TURN) refers to the percentage of employees yearly leaving the company. High staff turnover and low seniority may mean that investments in human capital are not properly monetized, as well as that social commitment is reducing in terms of job maintenance. Yet small and consistent turnover can benefit some businesses, high turnover rates may signify that management style needs adjustments, once new hires presents associated challenges and costs for the company.

The variables (IEMP_WOM) relate to the weight of women at different hierarchical levels (T - total, M - management and B - management board). Although the sector analysis shows traditionally a strong preponderance of men, since 2004 it has been a growing weight of women namely at the level of management positions. This indicator presents a high visibility in the sample companies possibly due to European legislation concerning gender equality.

The weight of tax on revenues (ITAX) and the weight of wages, salaries and benefits on payments to the owners (IWAGE) are intended to represent the fairness concept on social improvement. The variables indicate the companies contribution for society through taxes, as also the distribution of incomes between financial and human capital.

5.4. Descriptive statistics

In FA it is assumed that the character and composition of the selected variables is more relevant than their statistical qualities. Therefore, it was considered relevant to a correct perception of the character of the variables the performance of a brief analysis of the descriptive statistics for the variables selected for the year 2010. This statistical analysis aims to assess the consistency of the variables in relation to the theoretical framework. An overview will allow to detect whether the proposed set of indicators is interesting in a operational standpoint. This reflection tests the alignment of the results with the objectives of the research and it provides ground for further work.

A brief interpretation of the mean, median, standard deviation, skewness and kurtosis, will contextualize the sample and ascertain the adequacy of the obtained variables to the context of the industry.

The normal distribution is often referred, once it is widely used as a model for the statistical study of complex phenomena both in natural as in social sciences. A variable with a normal distribution presents a symmetrical distribution around the mean and under certain conditions the average of a large number of random variables with different probability distributions tends to a normal distribution. Although normally distributed variables provide stronger solutions, is not relevant when a descriptive result is intended.

The standard deviation is broadly used to describe how concentrated the distribution is around its mean for a random variable. High standard deviation indicates that values are disperse over a large set of values, whereas low standard deviation means that the values obtained for the sample are closely located near the media. In this perspective, standard deviation may serve as a measure of uncertainty.

Since we deal with data expressed in different units and different scales, and because the averages of several variables are different, we use a measure of relative dispersion to compare the variability of different data sets. In this case, we used the coefficient of variation (CV) being a measure of general use. The smaller the CV, greater data accuracy.

$$CV = \frac{S}{\overline{X}}$$

$$S = Standard\ deviation$$

$$\overline{X} = Media$$

Equation 1 Coefficient of variation

Skewness measures the asymmetry of a probability distribution. If zero, the distribution is equitable in relation to media. If less than zero (negative asymmetry), shows a left tail and if greater than zero (positive asymmetry), presents a tail to the right.

Kurtosis is a measure of dispersion which characterizes the flatness of the curve of a distribution function. If zero, the flattening is equal to the normal distribution (mesokurtic). If less than zero, flattening is greater than the normal distribution (platikurtic) and if greater than zero, the flattening is smaller than the normal distribution (leptokurtic).

Jarque-Bera is a test of goodness of fit used in statistics, i.e., if the data exhibit a skew and kurtosis compatible with the normal distribution.

Table 5.13 gives descriptive statistics for financial variables. Attending to the theoretical framework it is intended that these variables reflect the coverage, reliability, profitability and stability for each company. The statistics may present the main trends in sample.

Table 5.13 Descriptive statistics for financial variables

Variable	Obser-vations	Media	Median	Maximum	Minimum	Standard deviation	CV	Skewness	Kurtosis
DV_YLD	17	0,16	0,054	1,97	0,01	0,4668	2,92	4,1128	16,9404
E_PS	25	1,77	1,270	6,20	0,00	1,7670	1,00	1,5597	1,6260
IEBIT	29	0,06	0,062	0,14	0,01	0,0307	0,49	0,5599	0,2254
IEBITDA	29	0,11	0,096	0,25	0,06	0,0416	0,39	1,8642	4,4094
IDBT	14	0,28	0,289	0,76	0,00	0,1806	0,64	1,1645	3,2978
IT_LBL_EQT	29	1,98	1,582	5,52	0,53	1,3070	0,66	1,2917	1,0588
ROA	20	0,04	0,037	0,10	-0,01	0,0283	0,71	0,3884	-0,1213
ROE	23	0,13	0,129	0,26	-0,04	0,0742	0,57	-0,2551	-0,1634
ROI	21	0,20	0,062	2,64	0,02	0,5614	2,87	4,5482	20,7782
ROR	19	0,10	0,102	0,35	0,01	0,0851	0,81	1,7225	3,3708
VOL	21	0,01	0,014	0,02	0,01	0,0022	0,15	0,6331	-0,1040

The distance between the media and the median gives information about the asymmetry of the sample, i.e. the difference between the sample average value and the value which divides the number of the sample observations into two equal parts. Given the median, half the population will have values lower or equal to the median and half the population will have values greater or equal to the median.

The greater the distance, the greater the asymmetry of the distribution. For this set of variables, in most cases, the media nearly coincides with the median, indicating a fairly even distribution of observations around the media. In some cases, media far exceeds the average, as for variables DV_YLD, ROI, which might indicate a higher dispersion of values on the right side of the median, that triggers the media value.

In these cases, can be expected a higher concentration of variable's lower values and a higher dispersion of variable's higher values. The analysis of the standard deviation and skewness reinforces this interpretation.

All of the variables are positively skewed, excepted for Return on Equity (ROE). A graphical representation of the distribution function, would present a curve with a longer tail on the right side than in the left side. That means that the mass of the distribution is concentrated in the left side of the curve but some very high values are located at the right side. The sample thus presents the tendency to concentrate the data about the media, with a slight distortion on the curves to the left, with long tails on the right resulting from few very high values. The negative skewness is rare in the social sciences.

Most variables are found to be leptokurtic (i.e., fat tails), except ROE, ROA (return on assets) and volatility (VOL), which are slightly platykurtic.

The skewness and kurtosis coefficients indicate that the variables dividend yield (DV_YLD) and return on investment (ROI) are leptokurtic and positively skewed regarding the normal distribution. In both cases the values for skewness are high (4.1128 and 4.5482 respectively), indicating the probability of occurrence of extreme high values. The right side of curve presesents a long tail, which is not compatible with a normal distribution curve.

The values for Kurtosis are much above zero, which indicates that the probability distribution curve for these variables present a flatening lower than the normal distribution. It is relatively easy to obtain some scarce values for these variables that deviate from the average for a distance of several multiples of the standard deviation.

In fact, return on investment (ROI) and Dividend Yeld (DV_YLD) present the largest standard deviation among all financial variables, which is consistent with the general impression that observations are largely spread around the media.

The Jarque- Bera test also rejects the hypothesis that dividend yield (DV_YLD) and return on investment (ROI) are normally distributed in both cases.

The remaining financial variables most often display a distribution consistent with the normal distribution.

The environmental variables included in Table 5.14 reflect both the company's actual impacts on the environment and the production strategies that influence these impacts.

Table 5.14 Descriptive statistics for environmental variables

Variable	Obser-vations	Media	Median	Maximum	Minimum	Standard deviation	CV	Skewness	Kurtosis
IGENTH_T	28	0,40	0,453	0,92	0,00	0,3090	0,77	-0,0258	-1,3692
IGENNU_T	28	0,17	0,037	0,66	0,00	0,2133	1,26	0,9658	-0,4037
IGENRE_T	28	0,30	0,188	1,00	0,00	0,3134	1,05	1,1566	0,2627
IGENRENU_T	28	0,47	0,469	1,00	0,00	0,3150	0,67	0,2077	-1,0079
IEXPENV_RVN	29	0,01	0,000	0,08	0,00	0,0196	1,95	2,3661	5,5347
ICO_TEQ	24	0,34	0,307	0,73	0,04	0,1758	0,52	0,3444	-0,4367
ICO_TH	25	0,41	0,417	0,76	0,11	0,2038	0,50	-0,1938	-0,9600
ISO_T	21	0,64	0,270	7,00	0,02	1,5057	2,36	4,1620	18,0595
INOX_T	21	0,48	0,361	1,52	0,05	0,3545	0,73	1,5221	2,6467
IPART_T	12	0,06	0,018	0,52	0,00	0,1458	2,41	3,3784	11,5580
IWST_ZREC	19	0,25	0,000	0,97	0,00	0,3660	1,47	1,0864	-0,4157
IWST_Z	22	0,14	0,061	0,90	0,00	0,2259	1,63	2,5420	6,5493
IWST_REC_NZ	20	0,45	0,596	0,98	0,00	0,4086	0,91	-0,0831	-1,9306

From table Table 5.14 is noted a concentration of values around the mean for observations involving the production of electricity simultaneously from renewable sources and nuclear (IGENRENU_T). This suggests the consistency of corporate strategies, that rely on the simultaneous use of these technologies as a way to circumvent the dependence on fossil fuels. However, the CV above 1 both for the the weight of production of renewable in the total production of electricity (IGENRE_T) and the weight of the nuclear on total production of electricity (IGENNU_T), indicates a greater dispersion of observations. It is also noticed a slight positive skewness for both variables, which means that some companies present extreme values on their shares of nuclear production or renewable production .

The skewness for the generation variables (IGENRE_T, IGENNU_T) is reinforced by the observation that the mean values are much higher than the median. As the media is highly influenced by extreme values, in this case it far exceeds the value that divides the observations for these variables into two equal parts (median). That means that more than 50% of the sample had values below the media and some few companies in the sample have values much higher than the media.

For the variable representing the carbon free electricity (IGENRENU_T), the media equals the median, which means that although individual companies resort to different energy mixes, they tend to converge when dealing with the sum of nuclear and renewables.

The cases for production process from burning fossil fuels (IGENTH_T) and generation from non-fossil fonts (IGENRENU_T) have similar statistics. The distribution of observations is substantially symmetrical and the same are concentrated around the average, which means that the variability of data is low and there are no outliers positively or negatively distorting the curve.

Both variables present negative values for the kurtosis, which indicate a curve flatter than a normal distribution and with a wider peak. The probability for extreme values is lower than probability for a normal distribution and the values are wider spread around the mean.

Gaseous emissions when compared with electricity production, show a lower dispersion in terms of CO2 (represented by ICO_TH and ICO_TEQ). The distribution is consistent with a normal distribution, with no significant skewness or flattening. Albeit variables present large differences between maximum and minimum values, which may be due to the use of different production technologies, the values are distributed evenly around the mean and the median. This means that companies with higher emissions are offset in reverse way by companies with lower emissions. The existence of mechanisms for monitoring and controlling the CO2 reduction, presenting a mandatory character in most European countries, may contribute to this behavior of the observations.

Regarding the remaining variables representing the emissions per kWh produced (ISO_T, INOX_T, IPART_T), they show a large data dispersion around the average. The various companies in the sample present emission levels of greenhouse gases very different depending both on the technology used and the legal framework. A strong positive skew, with long tails to the right is easly identified, which means that while most of the observations are below the media, some few companies exhibit extremely high values.

The values for Kurtosis indicate a distribution sharper than the normal, with values concentrated around the mean and thicker tails. This means high probability for the occurrence of extreme values.

The residues, both referring generation (IWST_Z) and treatment (IWST_REC_NZ and IWST_ZREC), exhibit large standard deviations. The weight of hazardous waste in total waste generated (IWST_Z), presents a high dispersion (CV = 1.63) with positive bias, which means that over 50% of the sample companies generate a quantity of hazardous waste below the mean, but there is a strong probability of occurrence of outliers with very high values. That means that he majority of companies in the sample produces relatively few hazardous waste in relation to total waste, but some individuals may produce exceptionally high quantities. This may result either from differences in the technology used, as well as from different classifications of the dangerousness of the materials generated.

For the recycling of hazardous waste (IWST_REC_NZ and IWST_ZREC), the previously described behavior remains, but with lower skewness and lower probability of occurrence of extreme values. This may mean that, although companies have large differences in the generation of hazardous waste, such differences tend to fade regarding the handling and routing of these residues. The trend for an harmonized legislation at the European level has contributed to an increasing homogenization of good practices for waste management.

Regarding the recycled non-hazardous waste (IWST_REC_NZ) the dispersion is lower than the one presented for the hazardous waste. Observations tend to concentrate on the right side of media, meaning that more than 50% of the sample companies recycle a percentage of its waste higher than media. A tendency for the occurrence of extreme low values is also noted, i.e., very few companies carrying waste recycling far below the mean.

The environmental expenditures (investment + costs) on revenues, given by IEXPENV_RVN, register a huge disparity in the observation's behavior, for the selected sample. The variable in general assumes extremely low values, which indicate a low weight of these expenses in total revenues. Over 50% of companies have values below the media, but may be noted a tendency for extreme values, with few firms embarking on relatively high environmental expenditures.

The economic variables presented in the Table 5.15, are related primarily to effectiveness and eficiency on resources use and the equitable distribution of the economic value created. The issues of autonomy on other electricity suppliers, or dependence on customers, are also covered.

Table 5.15 Descriptive statistics for economic variables

Variable	Obser-vations	Media	Median	Maximum	Minimum	Standart deviation	CV	Skewness	Kurtosis
IT_RVN	29	0,49	0,437	1,24	0,19	0,2449	0,50	1,7167	3,4487
IPDTV	30	5,76	3,667	24,65	0,39	6,1042	1,06	2,2317	4,5788
IRVN_EMP	29	0,93	0,937	2,46	0,11	0,5034	0,54	0,8575	1,9095
ICAPEX	25	0,04	0,056	0,12	-0,12	0,0579	1,31	-1,3754	1,7628
IPEC_CN	13	5,14	5,500	9,04	0,26	2,6808	0,52	-0,5174	-0,3680
IH_GENTH	10	1,09	0,324	7,68	0,17	2,3234	2,14	3,1251	9,8235
IWA	18	0,17	0,002	1,356	0,000	0,328	1,39	1,7413	2,5344
IBYPRO	9	0,79	0,660	2,72	0,25	0,7639	0,97	2,4334	6,4579
ISELF_T	16	0,03	0,019	0,11	0,00	0,0351	1,13	1,1258	0,2850
IGENT_SAL	25	0,78	0,698	2,76	0,16	0,5292	0,67	2,2393	7,4346
ISAL_ELCOS	14	0,03	0,018	0,12	0,00	0,0329	1,08	2,0902	4,4002
IEVD_TAX	26	0,15	0,154	0,35	0,03	0,0894	0,59	0,4036	-0,6252
IEVD_EMP	27	0,40	0,342	1,00	0,02	0,3024	0,76	0,6132	-0,8447
IEVD_LEN	16	0,13	0,109	0,34	0,02	0,0920	0,69	1,1540	0,6497
IEVD_OWN	21	0,26	0,235	1,00	0,03	0,2316	0,89	1,8012	4,1453

The weight of revenues on assets (IT_RVN) presents a balanced distribution around media, with low CV values but with the tendency to assume values extremely highs. This means that the return on assets suffers from scarce variability in the sample, although some few companies are able to generate more revenue per unit of assets.

The electricity produced per employee (IPDTV) is lower than the media, which amounts to 5,76 GWh per year and per employee. In fact, 50% of the sample stands below 3,7 GWh. This reflects not only different capitalization of human resources, but different structures of functioning relating to administrative and operational support services. The internationalization strategies, expanding for Latin America or Africa also implies both hiring relatively more employees and the starting-up adjustments of the new production units.

However, the revenue generated per employee (IRVN_EMP) presents a distribution concentrated, balanced and symmetric with respect to the media, as also a lower propensity for extreme values than variable IPDTV. This means that although employees are not directly engaged in the production of electricity, they contribute in other ways to generate revenue. The sector is characterized by a wide disparity of activity in addition to the production of electricity, such as transport and supply of electricity and gas, environmental services, extraction of fossil fuels, among others.

The weight of capital expenditures on total assets (ICAPEX) presents a high dispersion over the sample, with some extreme low values, meaning that the capital expenditure by unit of assets is highly variable over the sample. Some companies are performing expansion investments, over new geographical sites or on new technologies, while other don't.

The primary energy consumed for unit of produced electricity (IPEC_CN) presents a low CV, meaning that most companies have similar ratios. Higher energy consumption is associated to a greater share of thermal power generation.

The use of water per unit of electricity produced (IWA) refers to cooling activities on thermal power plants. The european regulation includes rigid guidelines regarding the use of water and the preservation of the strategic reserves (groundwater). The water use dependes both on the tecnological needs but also on the availability of usable water and on national legislation. The sample presents a high variation on the water use for cooling. Although more than 50% of the sample is below the media, some extreme high values contribute for a positive bias. These values vary inversely to the share of renewables in electricity generation.

The waste of thermal energy generated through the co-generation process constitutes an inefficient use of resources. The variable "weight of heat for sale on total electricity generated" (IH_GENTH) refers only to companies with co-generation processes and it seems to present a great variability among the sample, with the caveat that many companies do not report this information.

The commercialization of thermal energy implies the existence of suitable distribution networks, generally unavailable in the countries of southern Europe and partially available in central Europe. This variable indicates the efficiency on the use the energy potential for fuels employed in co-generation. It may partialy indicate the sucess of the coordination of energy efficiency strategies, for thermal energy use.

Ashes and gypsum are byproducts generated by co-generation processes that are capable of commercial value and usable by other economic activities. The variable IBYPRO, refers to the share of ashes and gypsum valued in other economic activities. Although its production depends on the share of thermal, it presents an high variability on the sample, meaning different attitudes towards by-products valuation and different technological options for electricity production.

The conditions of independence opposed to suppliers and customers are reflected in the variables electricity sales per costumer (ISAL_ELCOS) and weight of electricity generation on overall electricity sales (IGENT_SAL). The relationship between production and sales reflects the company's market strategy, the conditions for market access and the utilization of its own production capacity. In extreme cases, may be find a situation in which the company sells less than its production to the final customer, as part of its output is forwarded to other producers under supply contracts and the opposite situation, in which the company sells more than its production, because it acquires electricity from other producers.

Observations for both variables are found fairly evenly around the media and extreme high values may occur. For IGENT_SAL thses values refer to companies producing a larger share of the electricity sold to consumers and thus more autonomous with respect to electricity suppliers. Extreme high values for ISAL_ELCOS may also refer to those companies with larger customer portfolios, which form a solid base for marketing the products.

The Economic Value Distributed (IEVD) by employees, owners, lenders and public authorities present similar behaviour. In short, firms do cluster around a single ‘average’ level of Economic Value Distribution although there is some possibility of extreme high values.

The social variables presented in the Table 5.16, are related primarily to the commitment between employers and employees, the safety and health in workplace and on equality between genders. The issues relating to a fair distribution on revenues among workers, owners and public authorities are also covered.

Table 5.16 Descriptive statistics for social variables

Variable	Obser-vations	Media	Median	Maximum	Minimum	Standard deviation	CV	Skewness	Kurtosis
IEMP_ABS	17	0,047	0,04	0,10	0,02	0,0200	0,43	1,4043	1,7857
IEMP_ACC	20	0,156	0,06	1,29	0,00	0,3048	2,01	3,4172	12,1623
IEMP_FTC	12	0,910	0,93	0,98	0,74	0,0756	0,08	-1,2404	0,9762
IEMP_PC	15	0,931	0,96	1,00	0,73	0,0770	0,08	-1,9053	2,9849
IEMP_SEN	12	15,84	15,715	19,60	8,50	3,0473	0,19	-1,1513	2,1149
IEMP_TRG	11	34,46	34,700	54,62	7,64	12,3633	0,36	-0,7289	1,4718
IEMP_TURN	17	0,067	0,06	0,13	0,02	0,0393	0,58	0,2730	-1,3847
IEMP_WOMB	20	0,205	0,19	0,50	0,04	0,1314	0,82	0,8190	0,1628
IEMP_WOMT	27	0,252	0,25	0,34	0,18	0,0495	0,20	0,2974	-0,7236
IEMP_WONM	16	0,192	0,20	0,33	0,10	0,0671	0,45	-0,3296	0,4490
IEMP_FAT	21	0,003	0,00	0,02	0,00	0,0060	2,73	4,0355	17,1781
ITAX	25	0,054	0,04	0,23	0,01	0,0486	0,90	2,5376	7,3423
IWAGE	20	1,729	1,46	6,39	0,23	1,4932	0,86	1,9188	4,3823

In social issues, the topics relating to accidents (IEMP_ACC) and fatalities (IEMP_FAT) are those with larger CV, indicating greater dispersion of data around the media, a positive skewness and a high propensity for the occurrence of high outliers. These values may be due to occasional events (accidents) or to different forms of accounting, for example considering (or not) the accidents occurred in subcontracted companies. In European countries, the employment legislation defines rigid security and safety requirements, which strongly determine working conditions. This way, most of the sample companies display values below the media.

The indicators concerning to employment relationship, as full-time contracts (IEMP_FTC) and permanents contracts (IEMP_PC) have similar statistics, with very low coefficients of variation (CV), suggesting small standard deviations and a large concentration of values around the media. That means that the industry offer similar conditions of hiring to its employees.

It is noted a slight negative skewness, which indicates the occurrence of some extreme values on the left side of the curve, meaning that some companies may have lower rates for permanents contracts and for full-time work contracts. In some cases, these situations fall into strategies for flexible working and family support. Since electricity generation is an industry that demands a high investment in employee training, once it requires high levels of expertise, it is justified that at least 73% of employees work under permanent contracts (IEMP_PC minimum value equals 72,9%).

The number of training hours per employee (IEMP_TRG) has a similar behavior but with greater dispersion of observations. The average number of training hours per employee ranges between 7.6 and 54.6, which indicates a large variability in the strategies for employee training on the different sample companies, as well as different regulatory frameworks and corporate obligations concerning these matters.

The loyalty and commitment of employees to the company is expressed through absenteeism rate (IEMP_ABS), seniority (IEMP_SEN) and turnover (IEMP_TURN). This variables exhibit a similar behavior among themselves, with low CV and a slight skewness. Some companies tend to produce extreme high values for seniority, resulting from policies of retaining talent, investment in human resources and establishment of ties of loyalty between employees and company. The average time spent in each company is 16 years, although a temporal analysis reveals that the opening of new production and commercialization facilities, especially in Latin America, have made lower the average, by hiring new employees.

Women have a presence with little variation in the personnel structure of the electricity industry. At the general level, the share of women in total workforce (IEMP_WONT) represents about 25% of industry workers, with a minimum variability throughout the sample. At the management level less data is available. A few firms present extreme low values, but over 50% of the sample companies have over 19% of its management positions held by women (IEMP_WONM). At the level of top management, the presence women on the boards (IEMP_WOMB) amounts to about 17% of the seats. The temporal analysis of the collected data (2004 - 2010) reveals that this presence has been increasing significantly in recent years, in some cases by force of law, once some countries made mandatory a minimum share of 25% of women in top management. Among the variables concerning to women in industry, the last one presentes the greater CV, indicating a larger dispersion of observation around the media. However, more than 50% of observations are concentrated well below the media, meaning that in most cases the proportion of women in the top management is very low. In fact, apart from some extreme high values which make the average raise, about 50% of companies exihbit less than 14.36% of the board positions occupied by women. There shall be noted that the percentage of women in top management positions is lower than the overall percentage of women in the company, while the share of women in medium management is openly superior to average percentage of women in the sector

The weight of taxes paid on income (ITAX) is highly variable. More than 50% of the sample presents lower than the media values. Some extreme high values, that make the average climb, are recorded, as also the concentration of observations on the left of the mean, associated to a positive skewness. These results depend on the fiscal framework of each company, as well as the expenses incurred during the financial year.

Similarly, company´s transfers for wages represent about 170% of the payments made to the owners (IWAGE). The behavior of variable (IWAGE) is quite similar to the behaviour of variable ITAX. These transfers may amount to 640% of payments to shareholders, but tend to focus on lower values on the left side of the media. It is also noted a tendency for the occurrence of occasional the extreme high values.

5.5. Factor analysis

In the present research FA is used within a exploratory perspective, for searching a structure among a set of variables. There is not any constraints or preconceived thoughts defined a priori, relating to an expected structure, number of components, or any hypothesis to test.

As previously referred, factor analysis (FA) can provide a process either for data reduction or for structure identification of a set of variables (Hair 2009). Data summarization allow the identification of underlying dimensions, that after proper interpretation, provide the description of the original data through a limited number of concepts. Data reduction takes this process further by deriving a factor score for each identified dimension (factor).

FA present some features particularly interesting for the present study namely:

- it doesn't assume the existence of any function a priori
- It is available to deal with the complexity that comes from several scales.

The procedures of FA are based on the initial computation of a table of interrelationships between variables (correlation matrix).

The correlation matrix is then transformed by estimating a factor "model" for a matrix of factors. This array contains the "factor loadings" for each variable of each derived factor.

The weight of each variable factor is then interpreted in order to identify the "underlying structure" of the variables.

Although, the underlying statistical assumptions such as normality, homoscedascity and linearity may affect the FA because they condition and eventually reduce, the derived correlations among variables (Hair 2009).

The concept of correlation is basic in this analysis, once it represent the measure of the relation between two or more variables. The correlation coefficient, which measure the strength of the association among variables, vary between -1, meaning a perfect negative correlation and +1, meaning a perfect positive correlation. All the variables are assumed to be independent and random. They are treated symmetrically, once the results may be interpreted in opposite directions.

When dealing with FA is desirable the existence of a relevant degree of multicollinearity, to assure the production of representative factors.

Multicollinearity broadly means that variables are intercorrelated through the existence of one or several linear relationship among them. Multicollinearity is perfect if the variable can be derived through a linear combination of other variables with stochastic error term equal zero.

The imperfect multicollinearity means that one variable may be partly explained through a linear combination of other variables and a stochastic error term different from zero (Gujarati 1988).

As can be seen in the above diagrams (Figure 5-13) the degree of multicollinearity is given by the shaded area of the circles representing variables. The group from the left as a lower collinearity than the one from the right side.

Figure 5-13 Low and high collinearity

5.5.1. Implementing Principal Components Analysis

The objective in FA is to explain the covariance or correlations among the variables. This way PCA is used to reduce the data into a smaller number of components and CFA is used to understand what constructs underlie the data. PCA is widely a descriptive procedure.

The technique implementation passes through several phases: Intercorrelation testing, selection of variables, interpretation of components and finally construction of an aggregated PCA.

Thus, to perform a Principal Components Analysis was used the software EVIEWS. The main steps suggested are the following:

- Estimate the correlation matrix
- Extract a complete components solution (the number of components extracted equals the number of variables)
- Determine the number of components to retain, attending to the variance accounted and to variable's communalities
- Select a rotation method and perform the component rotation
- Identify relevant variable's scores
- Interpret the components

- Apply the components solution, namely on the theoretical understanding of the data reduction meaning and through the statistical use the in other analyses

Some design conditions are required for FA, such as number of observations, interrelation among variables, sample size, type of variables, properly aligned with the conceptual framework.

Hair (2009) suggests a least of ten observations per variable. All the selected indicators present a ratio of a minimum of ten observations, which fall within the acceptable limits required for FA design.

Given the objective of identifying interrelated sets of variables, some degree of multicollinearity is required. To test if variables are sufficiently intercorrelated to include in the analysis three methods may be applied (Hair 2009):

- A visual inspection to assess if a substantial number of correlations is statistically significant (higher than 0,3)
- The Bartlett test of sphericity
- Measure of sampling adequacy

Attending statistical characteristics of variables, the FA should not be applied when:

- correlations are low, variables are not sufficiently correlated to produce representative factors
- correlations are equal, which means that there is no structure for the group of variables

To test the intercorrelation it was used a visual inspection assuming that:

- As significant the correlations over 0,245.
- The share of significant correlations on the total correlations equal or over 0,2 for each set of variables.

The results obtained were:

- Social variables: 37% of correlations are representative
- Environmental variables: 20% of correlations are representative
- Economic variables: 23% of correlations are representative
- Financial variables: 39% of correlations are representative

After the intercorrelation testing (which may involve the elimination of variables), HAIR (2009) suggests examining "communalities" of each variable to identify those with lower values. Lower communalities mean that little variance of a variable was extracted by the factor solution.

Extraction is the process of forming PCs as linear combinations of the measured variables, reproducing variable's variance. The obtained solution is unique. For each set of variables PCA provides a sole solution.

Applying the latent root criterion to retain the factors with eigenvalues greater than one, it was obtained (Table 5.17):

- Social variables: 5 factors (principal components) which explain 0,8346 of variance
- Environmental variables: 4 factors (principal components) which explain 0,8106 of variance
- Economic variables: 6 factors (principal components) which explain 0,7785 of variance
- Financial variables: 4 factors (principal components) which explain 0,7393 of variance

Table 5.17 Eigenvalues

Variables	PC*	Value	Proportion	Cumulative value	Cumulative proportion
Social	1	3,791006	0,291600	3,791006	0,2916
	2	2,561959	0,197100	6,352965	0,4887
	3	1,777928	0,136800	8,130893	0,6255
	4	1,402364	0,107900	9,533257	0,7333
	5	1,316174	0,101200	10,84943	0,8346
Financial	1	3,953762	0,3594	3,953762	0,3594
	2	1,784267	0,1622	5,738029	0,5216
	3	1,341770	0,1220	7,079798	0,6436
	4	1,052449	0,0957	8,132248	0,7393
Environmental	1	3,864303	0,2973	3,864303	0,2973
	2	2,832365	0,2179	6,696668	0,5151
	3	2,047535	0,1575	8,744203	0,6726
	4	1,793564	0,1380	10,53777	0,8106
Economic	1	2,675371	0,1784	2,675371	0,1784
	2	2,152382	0,1435	4,827753	0,3219
	3	1,938548	0,1292	6,766301	0,4511
	4	1,876329	0,1251	8,642631	0,5762
	5	1,638040	0,1092	10,28067	0,6854
	6	1,397340	0,0932	11,67801	0,7785

PC* - Principal component

The eigenvalues are used to select the number of components to retain as they represent the amount of variance accounted by a factor. If an individual factor accounts for the variance of one variable it is assumed a eigenvalue of one. This way each variable contributes with the value of one for the total eigenvalue. Components with eigenvalue less than one are considered insignificant and excluded.

For each set of variables, the first component explains the larger amount of variance and the other components are extracted by decreasing order of importance (factor two and followers explains successively lesser variance).

In PCA, the components are calculated as linear combinations of the original variables. The goal is to account for as much of the total variance in the variables as possible with the fewest components.

The factor loadings represent the degree of association of each variable with the factor (in the present case the principal component). Variables with higher loadings are more representative of the component than variables with lower loadings.

Although it is desirable to have a high level of correlation between variables of a PC (principal component), the correlation among the obtained PC´s is zero, because one dimension is expressed only by a certain combination of those variables. Each component by default is uncorrelated with the previous.

Although some literature (Hair 2009, Jolliffe 2002) advises conducting a rotation to extreme loadings and to identify the variables with the highest weight in the component, this is not done in this study. Once because it implies the voluntary loss of information, but also due to subjectivity in selecting the rotation method and the choice of a solution. Besides the rotation aims to distribute the variance of the major factors for the remaining in order to obtain a pattern more simplified and easy to interpret. Withal, component rotation is particularly relevant in cases in which the reduction of data is not the sole purpose of PCA. Software packages also provide limited options to selected adequate methods for component rotation.

In the present case, bearing in mind the objective of data reduction, it was assumed that unrotated component solution provided an adequate interpretation of variables under study.

The work continues with the selection of variables. As practical criteria for significance we resort to Hair (2009) proposal for loading assessment:

- Factor loading between (+/-)0,30 and (+/-)0,40 meet the minimum level for structure interpretation.
- Factor loading higher than (+/-)0,50 are considered significant
- Factor loading higher than (+/-)0,70 are considered indicators of a clearly defined structure and an optimal aim in PCA analysis

However, the acceptable level of significance for the loading reduces, as the number of variables to analyze increases (Hair 2009). For our proposal, it was established the selection of variables with a minimum load higher than (+/-)0.35. These variables represent the larger variance from all the component variables and they heavily contribute to perform the interpretation of components. The variables with the highest loading in a component are larger influencers in shaping the label for the same.

As the later extracted components account for lesser variance, progressive higher loadings are requested for assuring significance.

The obtained PC´s are interpreted for each dimension of sustainability, to understand the significance of data reduction.

If there are multiple variables with the same weights, are usually selected the one that is more reliable or that is more appropriate for theoretical analysis (even if they present a slightly lower weight than other variables) (Hair 2009).

The interpretation of the factors will be sufficient if the aim of analysis is to understand the interrelationships among the variables. If the goal is the use of variables in other techniques that require the reduction of their number then CPA results may be subject to additional uses beyond component interpretation. Subsequent data reduction forms may be used (Hair 2009):

- Select and use surrogate variables from the factor
- Replace the original set of variables consisting of summated scales or factor scores

5.5.2. Additional data reduction methods

The methods for data reducing that can be combined with the PCA are the following:

* Surrogate variables - For each principal component (PC) the variables with the highest value are selected to integrate a aggregated PCA. The new PCA is subsequently interpreted and results are compared with those previously obtained in the disaggregated analysis

* Summated scales – Results from the combination of several variables loading highly in a component which are combined in the same measure.

* Factor scores – is a composite measures which is computed based in the all the loadings of all the variables in the component. Each variable contribution for the score is based on the weight of its loading.

From these methods, were also created several lists both individually and aggregating the various dimensions of corporate sustainability, as a complement to PCA.

The lists allow to evaluate each company on the basis of identified perspectives and interpretation of the components, locating each company in the obtained sets of solutions.

The several steps relating to the applicatition of PCA and additional data reduction tools are expressed in Figure 5-14.

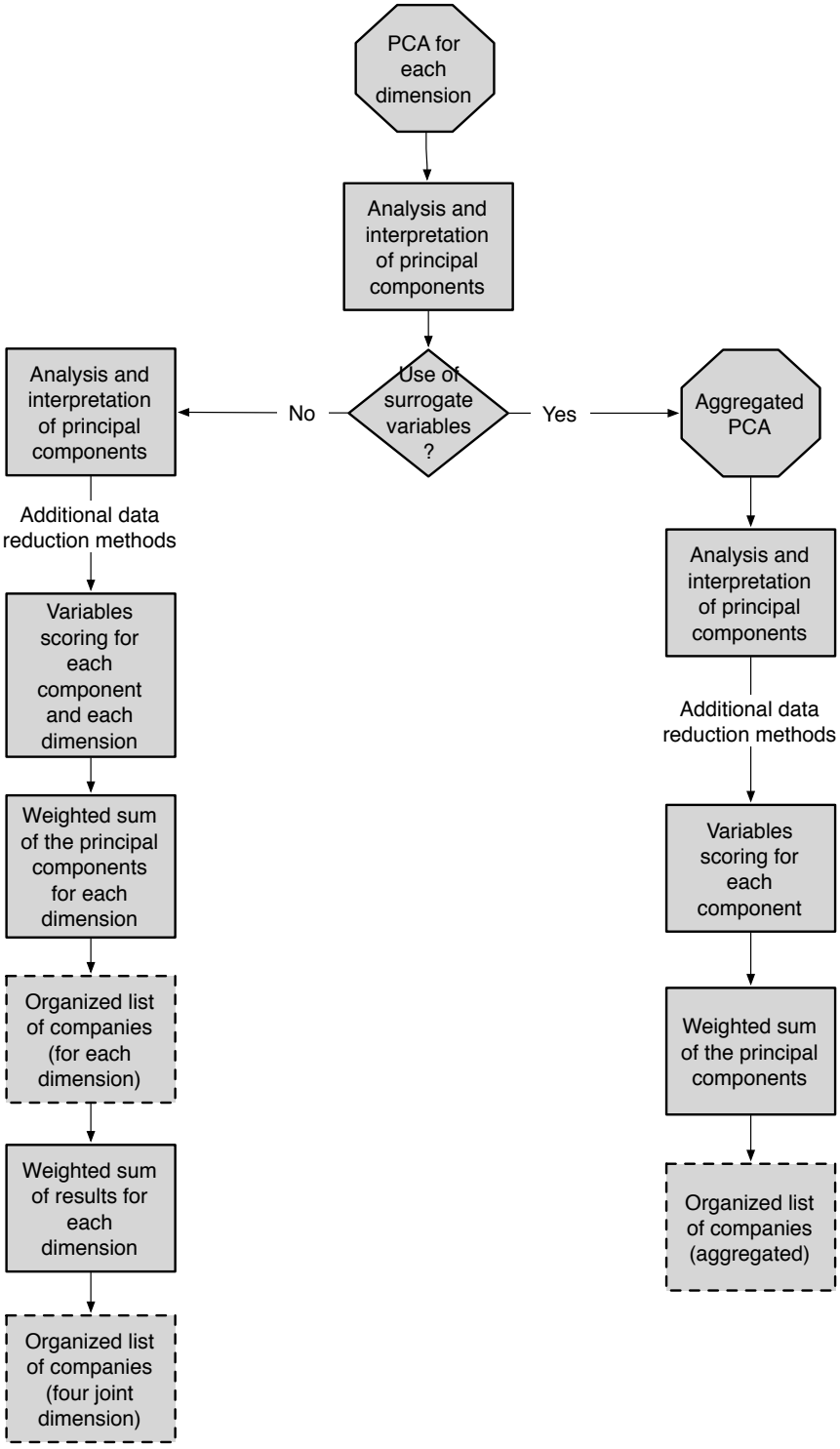

Figure 5-14 Sequence for PCA and additional reduction tools

6. Presentation of Results

6.1. Principal Components Analyses (PCA)

The presentation of results relates primarily to the individual interpretation of selected components for each one of the dimensions of corporate contribution to sustainability (environmental, social, economic and financial). Thereafter the collective characterization of the component enables to understand each dimension through the concepts identified for the components.

The same procedure is performed for a mixed set of variables, those presenting higher loadings in the PCA for individual dimensions.

Subsequently is carried out the presentation of several structured lists constructed with the results obtained in both PCA (individual and aggregated dimensions), which relativizes the behavior of each sample company in the four dimensions proposed.

6.1.1. PCA for individual dimensions

Attending to the objectives of FA, as presented in 4.6.3, is was decided that the method to extract the factors is PCA (Principal Components Analysis). Once it is based on the total variance, it is considered most suited for the purpose of this research.

Individual variables are grouped and analyzed as a collective expression of a concept. The selected components reflect those variables more homogeneous across the sample.

Positive or negative signs mean that variables are positively or negatively related within a component but they have no meaning if perspectived on an analysis among components.

In an desirable structure each variable has a high loading on just one factor. Some variables that are loading highly in more than one factor are maintained in this analysis, because all the variable are relevant for the theoretical framework and because the goal of PCA is data reduction.

For social indicators in Table 6.1, the principal component PC1 explains about 29% of the total variance for the original set of variables and 35% of the variance explained by the solution of the five principal components. The following components explain successively lower amounts of the residual variance.

Knowing that the technique extracts as many components as variables considered, in the case of social indicators it would be possible to extract 13 components. However, the use of the eigenvalue criteria allowed to select the first five principal components (PC´s), which apprehend 83,46% of the total variance. The contribution for the explanation of total variance assumes a decreasing importance from component one (PC1) to component five (PC 5).

The "proportion of total variance" given in the table refers to the proportion of the total variance that is explained by each one of the principal components, which isum, n this case, reaches the value of 83.46%. The "corrected proportion" refers to the weight of each component in the variance explained by the sum of principal components (e.g. PC1 explains 29,16% from the variance of 83,46%, which gives 34,94%).

After signal the variables with a loading above 35%, we identified the investigated variables with higher weight in each component.

Table 6.1 Principal Component Analysis (PCA) for social indicators

Variable	PC1	PC2	PC3	PC4	PC5	
IEMP_ABS	-0,047369	-0,133604	0,174939	0,057930	0,738848	
IEMP_ACC	-0,193375	0,371412	-0,451646	0,206549	-0,015907	
IEMP_FTC	0,464692	-0,146493	0,297068	0,066184	-0,003379	
IEMP_PC	0,464557	-0,114754	0,226856	0,147853	-0,066541	
IEMP_SEN	0,351480	-0,206607	-0,337809	0,159632	0,209068	
IEMP_TRG	0,248666	0,481574	-0,052267	0,355860	-0,094145	
IEMP_TURN	-0,180157	-0,105132	0,299558	0,520551	0,144272	
IEMP_WOMB	0,043686	0,505113	0,168746	-0,167609	0,297280	
IEMP_WOMT	-0,241147	0,212659	0,342033	0,480689	-0,103930	
IEMP_WONM	0,175158	0,278708	-0,149331	-0,022954	0,475829	
IEMP_FAT	0,158741	-0,117058	-0,425560	0,172957	0,074805	
ITAX	0,155732	0,322130	0,264139	-0,439815	-0,053363	
IWAGE	-0,413024	-0,168554	0,022035	-0,147024	0,204916	
Proportion (of total variance)	**0,291600**	**0,197100**	**0,136800**	**0,107900**	**0,101200**	**0,834600**
Corrected proportion	**0,349389**	**0,236161**	**0,163911**	**0,129283**	**0,121256**	**1,000000**

In component 1 (PC1) variables with the highest weight are: share of employees with full-time contract (IEMP_FTC), share of employees with permanent contract (IEMP_PC) and weight of wages, salaries and benefits on payments to the owners (IWAGE).

In the first component, issues assuming greater relevance are those relating both to the employment conditions and contracting and to the share of labor income distribution in respect of income from capital. With less weight, it also assumes some relevance the average permanence in the company (IEMP_SEN), which is coupled with the stability of labor contracts.

In component 2 (PC2) variables with the highest weight are: share of women in administration board (IEMP_WOMB), and hours of training per employee (IEMP_TRG).

In the second component (PC2) issues assuming greater relevance are those relating both to individual valuation of employees through training (IEMP_TRG) and women in top management positions (IEMP_WOMB). It will be expected that greater investment in education is accompanied by an increase in seniority, since the company will want to capitalize the investments made in the development of its human resources.

In component 3 (PC3) variables with the highest weight are: average accidents per 1000 employees (IEMP_ACC) and average fatalities per 1000 employees (IEMP_FAT).

In the third component (PC3) issues assuming greater relevance are those relating both to security and health safety at workplace.

In component 4 (PC4) variables with the highest weight are: staff turnover (IEMP_TURN), share of woman in total workforce (IEMP_WOMT) and weight of taxes in revenues (ITAX).

In the forth component (PC4) issues assuming greater relevance are those relating both to the rotation of employees (IEMP_TURN) and the percentage of women in the total employees of the company (IEMP_WOMT), ranging in the same direction. This results are eventually be linked to strategies for career development and family support. Women tend to more easily find new jobs that enable them to maximize the balance between work and family. The values obtained for the percentage of women in the total workforce, varies in inverse proportion to the taxes paid. This may be due to several factors such as the practice of lower wages for women, which also represent a smaller tax base. On the other hand, women are absent more often in the workplace, to provide support for family or for issues of motherhood, which implies less social contributions. Thus, it may warrant a change in the opposite direction of total taxes paid (ITAX), associated with the total percentage of women in the company. The electricity generation sector has demonstrated over the past six years, a tendency to reduce its headcount. Increased female labor may generate more revenue, but with less social charges.

The component also reflects the interest of the organization in the retention of skilled labor and talent.

In component 5 (PC5) variables with the highest weight are: employee absenteeism rate (IEMP_ABS) and share of women in management (IEMP_WONM).

In the fifth component (PC5) issues assuming greater relevance are those relating both to the motivation and commitment of employees with employment, precarity on employment and health in the company. The absenteeism rate refers to unplanned absences of workers. It presents in general lower values associated to precarious employment. In the present case it is directly related to the proportion of women in middle management.

Considering the descriptions and interpretation previously performed, it is proposed the following naming for the social principal components (Table 6.2):

Table 6.2 Social components summary

Principal component	Component proposed name	Share of explained variance	Related concepts
PC1	Labor contracts	35%	Commitment; fairness
PC2	Professional development	24%	Commitment; equality
PC3	Security and occupational safety	16%	Safety
PC4	Retention of human capital	13%	Fairness; commitment
PC5	Health and motivation	12%	Commitment; equality

From all components, there is an valuation of the issues related to the stability of labor contracts and the proportional distribution of the factors of production (capital and labor) remuneration, which explains almost 35% of variance. The professional development of the individual and the fairness in leadership positions, represents almost 24% of the explained variance. The sum of the two first components account for approximately 59% of the total variance of social issues. The remainder relates to others themes such safety and health at workplace, job stability, career development and motivation.

Women in business has taken an interesting role when related to staff turnover, absenteeism, seniority and health at work, appearing with three high loadings on five components.

The identified components relate basically to employment issues, given that this was the only social area with enough information through the sample to be considered in the analysis. Other social issues also relevant to the sector were not included due to insufficient workable data. For this reason it was not included in the analysis relevant matters, namely those regarding the wage differences in different geographical areas, ratio of basic salary of men to women, local hiring, integration of local senior managers, union conflicts, contributions to communities, wages compared to local minimum wage at significant locations of operation, people displacement resulting from creation or expansion of production facilities, contribution to political parties and politics, policy positions.

The intersection of the highest loading variables on each component, therefore with greater explanatory power, with the concepts associated with social dimension of sustainability, shows that all concepts are represented in the obtained solution (Table 6.2).

This indicates that the conceptual foundation of each dimension is properly represented in the results.

The technique extracts as many components as variables considered and in the case of financial indicators it would be possible to extract 11 components. However, the use of the eigenvalue criteria allowed to select the first four PC´s, which apprehend 74% of the total variance. The contribution for the explanation of total variance assumes a decreasing importance from component one (PC1) to component four (PC 4).

For financial variables in Table 6.3, the principal component PC1 explains about 36% of all the variance for the original set of variables and 49% of the variance explained by the solution of the four principal components. The following components explain successively lower amounts of the residual variance.

As previously, after signal the variables with a loading above 35%, we identified the investigated variables with higher score in each component.

Table 6.3 Principal Component Analysis (PCA) for financial indicators

Variable	PC1	PC2	PC3	PC4	
DV_YLD	0,104055	0,047782	0,460426	0,521596	
E_PS	-0,022930	-0,153716	-0,454015	0,601025	
IEBIT	0,318156	-0,465089	0,211888	-0,112725	
IEBITDA	0,326580	-0,463464	0,071086	-0,123937	
IDBT	-0,005324	0,206430	0,601325	-0,206721	
IT_LBL_EQT	-0,086072	0,071273	-0,216304	-0,279466	
ROA	0,518207	-0,024538	-0,043558	0,009318	
ROE	0,325750	0,493832	-0,095708	-0,070607	
ROI	0,402074	0,481925	-0,130173	0,024646	
ROR	0,486326	-0,085263	-0,106423	0,060073	
VOL	-0,022472	0,106277	0,290209	0,456636	
Proportion (of total variance)	**0,359400**	**0,162200**	**0,122000**	**0,095700**	**0,739300**
Corrected proportion	**0,486136**	**0,219397**	**0,165021**	**0,129447**	**1,000000**

In component 1 (PC1) variables with the highest weight are: return on assets (ROA), return on investment (ROI), return on revenue (ROR).

In the first component (PC1) issues assuming greater relevance are those relating both to business profitability, mainly return on assets, but also the profitability of investments, revenues and equity. PC1 provides information about the employment of the assets and indirectly allows assessing whether the investment in assets is appropriate to the needs of the company and whether is being properly monetized.

In component 2 (PC2) variables with the highest weight are: weigh of EBIT on total assets (IEBIT), weigh of EBITDA on total assets (IEBITDA), return on equities (ROE), return on investment (ROI).

In the second component (PC2) issues assuming greater relevance are those relating both to return on assets and equity

PC2 information allows to evaluate if financing structure is balanced between what is invested and how equities are paid. It will be expected that the return on assets varies in reverse that the return on equity.

In this situation is more valued the fact profitable application of the generated return than its distribution among shareholders. A good financing structure maximizes the return on equity.

In component 3 (PC3) variables with the highest weight are: earnings per share (E_PS), weight of net debt on the total assets (IDBT), dividend yield (DV_YLD).

In the third component (PC3) issues assuming greater relevance are those relating to the relationship between return on equity versus weight of debt capital. In PC3, the ratio of debt burdens in total assets varies in inverse proportion of earnings per share, and in the same sense that the dividend yield. This component refers to the financial structure seen from the side of the debt in relation to assets. A very unbalanced structure may indicate excessive debt. Selected variables give indications about financial confidence in the company and coverage.

In component 4 (PC4) variables with the highest weight are: earnings per share (E_PS), dividend yield (DV_YLD) and annualized volatility (VOL).

In the forth component (PC4) issues assuming greater relevance are those relating both to return on equities versus volatility. Earnings per share (E_PS) and the dividends per share vary in the same direction as volatility.

By distributing the dividends the company lowers their funding capacity and consequently becomes more dependent on external borrowing. The EPS gives an overview of the ability to generate results for each title of ownership (action).

The component reflects the market value of the company which is influenced by the risk.

Only the variable “weigh liabilities on equities” (IT_LBL_EQT) shows no high score on any component. It was not considered in the component interpretation because it presents a limited explanatory power of the variance.

Considering the descriptions and interpretation previously performed, it is proposed the following naming for the financial principal components (Table 6.4):

Table 6.4 Financial components summary

Principal component	Component proposed name	Share of explained variance	Related concepts
PC1	Returns on assets	48%	Profitability
PC2	Balance in the financing structure	22%	Effectiveness, coverage, reliability
PC3	Financial coverage	17%	Profitability, reliability
PC4	Reliance	13%	Profitability, reliability, stability

From all components, there is an valuation of the issues related to the returns on assets, which explains almost 48% of variance. The demand for a balanced financing structure, represents almost 22% of the explained variance. The sum of the two first components account for approximately 60% of the total variance of financial issues. That means that two first components are characterized for issues related both to proper use of assets and to the creation of a financing structure that enables an adequate return the capital. The remainder components relate to others themes such as financial coverage and reliance.

The joint vision of the four principal components basically refers to the issues connected to return on capital, such as indebtness, return on assets (reflecting the company's management with respect to its productive capacity), results generation and the balance of financial structure. The volatility appears as a sign of instability and risk associated to business strategy and profitability.

Other financial issues also relevant to the sector were not included due to insufficient workable data. For example, can be referred in this situation, some pertinent matters to the electricity industry, such as the financial assistance received from government.

The intersection of the highest loading variables on each component, therefore with greater explanatory power, with the concepts associated with financial dimension of corporate contribution for sustainability, shows that all concepts are represented in the obtained solution (Table 6.4).

This indicates that the conceptual foundation of each dimension is properly represented in the results.

In the case of environmental indicators could be extracted 13 possible components. However, the use of the eigenvalue criteria allowed to select the first four PC´s, which apprehend 81% of the total variance. The contribution for the explanation of total variance assumes a decreasing importance from component one (PC1) to component four (PC 4).

For environmental variables in Table 6.5, the principal component PC1 explains about 30% of all the variance for the original set of variables and 37% of the variance explained by the solution of the four principal components. The following components explain successively lower amounts of the residual variance.

As previously, after signal the variables with a score above 35%, we identified the investigated variables with higher weight in each component.

Table 6.5 Principal Component Analysis (PCA) for environmental indicators

Variable	PC1	PC2	PC3	PC4	
IEXPENV_RVN	0,080602	-0,058676	0,536090	0,256541	
IGENNU_T	-0,178032	-0,053694	0,431875	-0,236145	
IGENRE_T	-0,251426	0,401488	-0,274671	0,225782	
IGENRENU_T	-0,397648	0,354087	0,043605	-0,001312	
IWST_REC_NZ	-0,317179	-0,127024	0,126759	0,242954	
ICO_TEQ	0,254598	-0,300943	-0,205307	0,264481	
ICO_TH	-0,009158	0,035758	-0,542528	0,223726	
ISO_T	0,373536	0,396999	0,108425	0,019317	
INOX_T	0,348679	0,399944	0,111517	0,089253	
IPART_T	0,369000	0,376072	0,066866	0,021929	
IWST_ZREC	-0,086061	-0,012488	0,249739	0,724909	
IWST_Z	-0,155089	0,164389	0,071631	-0,328721	
IGENTH_T	0,382409	-0,336082	-0,005204	-0,077727	
Proportion (of total variance)	**0,297300**	**0,217900**	**0,157500**	**0,138000**	**0,810700**
Corrected proportion	**0,366720**	**0,268780**	**0,194277**	**0,170223**	**1,000000**

In component 1 (PC1) variables with the highest weight are: share of CO_2 free electricity production from renewables and nuclear (IGENRENU_T), share of electricity from thermal production (IGENTH_T), relative SO_2 emissions from electricity generation (ISO_T), relative particle emissions from electricity generation (IPART_T).

In the first component (PC1) issues assuming greater relevance are those relating both to generation sources and gaseous emissions. SO_2, NO_x and particle emissions vary in the same

direction that the thermal generation, but as would be expected, in the opposite direction that electricity production from renewable sources and nuclear (CO_2 free generation). An intensive use of thermal technologies is accompanied by an increase in gaseous emissions while the use of nuclear and renewable technology is linked to a decrease of gaseous emissions

This component combines the use of different technologies with atmospheric pollution associated with combustion processes, starting from particles, SO_2 and NO_x.

In component 2 (PC2) variables with the highest weight are: share of renewables sources in electricity production (IGENRE_T), relative NO_x emission from electricity generation (INOX_T), relative SO_2 emissions from electricity generation (ISO_T), relative particle emissions from electricity generation (IPART_T).

In the second component (PC2) issues assuming greater relevance are those relating both to production technologies and gaseous emissions. The PC2 has a structure similar to PC1, but some loadings present inverse mathematical signs. That means that PC2 is harvesting other issues and eventually some contradictions which have not been explained by PC1. Is also noticed a strengthening on the position of renewables, which still varies in the opposite direction to thermal production.

However, in contrast to what happened in PC1, in this case, gaseous emissions are increasing when the use of renewables increases and reduced by the increasing use of thermal production.

SO_2 emissions are associated to combustion processes of fossil fuels, in which occur the oxidation of sulfur present in the fuel. The higher the sulfur content, the greater the amount of SO_2 formed contributing namely to the formation of acidic rain. NO_x are emitted from combustion at high temperatures.

The interpretation of the second component refers, firstly, to the complementarily between production technologies: from renewable sources and from thermal generation. It may also indicate changes in the thermal generation productive mix. Higher thermal generation associated with the gaseous emissions reduction, may be due both to fuel substitution (eg coal for natural gas) or increased production efficiency

In component 3 (PC3) variables with the highest weight are: CO_2 relative emissions from electricity generation from thermal sources (ICO_TH), weight of environmental expenditure on revenues (IEXPENV_RVN) and share of nuclear in electricity production (IGENNU_T).

In the third component (PC3) issues assuming greater relevance are those relating both to environmental investments and CO_2 emissions. Environmental expenditures are negatively associated to CO_2 emissions from thermal generation, which may indicate a financial effort put on those environmental issues subject to greater exposure, regulation and control.

Nuclear generation has been assumed for the late 20th century as an interesting contributor to ensure adequate electricity supplies while controlling the CO_2 emissions increasing.

In component 4 (PC4) variables with the highest weight is the share of recovered hazardous waste (IWST_ZREC). In the this component (PC4) issues assuming greater relevance are those relating to the recovery and recycling of hazardous waste.

Considering the descriptions and interpretation previously performed, it is proposed the following naming for the environmental principal components (Table 6.6):

Table 6.6 Environmental components summary

Principal component	Component proposed name	Share of explained variance	Related concepts
PC1	Technologies and air pollution	37%	Production, strategy, impact on air
PC2	Productive structure adjustment	27%	Production, strategy, impact on air
PC3	Environmental expenditures	19%	Compensation, strategy, impact on air
PC4	Hazardous waste	17%	Impact solid emissions

From all components, there is an valuation of the issues related to the air pollution and production mix, which explains almost 37% of corrected variance.

The productive structure issues represents almost 27% of the explained variance. The sum of the two first components account for approximately 64% of the total variance of environmental issues. The remainder relates to others themes such as environmental expenditures (costs and nature of investment) and treatment of hazardous waste.

Air emissions take an interesting role when related to production structure and environmental investments, appearing with two high loadings on four components.

All PC's from environmental dimension register an inverse relationship between the production of electricity using renewable energy sauces and the production resulting from the use of fossil sources.

The identified components relate basically to production issues, given that this was the only environmental area with enough information through the sample to be considered in the analysis. Other environmental issues also relevant to the sector were not included due to insufficient workable data. For example, can be referred in this situation, some pertinent matters to the electricity industry, such as the impact on biodiversity, the nuclear waste production, the

contamination of water, the impact of dams and reservoirs on ecosystems and the flooding of agricultural land, water sources significantly affected by withdrawal of water, habitats protected or restored, total water discharge by quality and destination, monetary value of significant fines for non- compliance with environmental laws and regulations.

The intersection of the highest loading variables on environmental component, therefore with greater explanatory power, with the concepts associated with each dimension of sustainability, shows that all concepts are represented in the obtained solution (Table 6.6).

This indicates that the conceptual foundation of each dimension is properly represented in the results.

In the case of economic indicators could be extracted 15 possible components. The use of the eigenvalue criteria allowed to select the first six PC´s, which apprehend 78% of the total variance. The contribution for the explanation of total variance assumes a decreasing importance from component one (PC1) to component six (PC 6).

For economic variables in Table 6.7, the principal component PC1 explains about 18% of all the variance for the original set of variables and 23% of the variance explained by the solution of the six principal components. The following components explain successively lower amounts of the residual variance.

As previously, after signal the variables with a loading above 35%, we identified the investigated variables with higher weight each component.

Table 6.7 Principal Component Analysis (PCA) for economic indicators

Variable	PC1	PC2	PC3	PC4	PC5	PC6	
IT_RVN	-0,221070	-0,216369	-0,401619	0,019459	0,283615	0,397800	
ICAPEX	0,058502	-0,034764	0,043592	-0,299543	0,215709	0,233684	
IPEC_CN	-0,202241	0,070976	-0,297382	0,173520	0,294828	-0,329827	
IPDTV	-0,176197	0,237134	0,113678	0,449820	-0,160478	-0,099222	
IWA	0,072015	0,224946	0,044014	-0,148229	0,621431	-0,063197	
IH_GENTH	0,078440	0,605835	-0,207644	-0,285086	-0,265194	0,020087	
ISAL_ELCOS	-0,346051	0,487464	0,067682	0,021955	0,142154	0,363307	
IGENT_SAL	0,194209	0,131126	0,198777	0,474156	0,078127	-0,210189	
IEVD_EMP	0,418139	-0,026043	0,165711	0,224950	-0,029473	0,245152	
IEVD_LEN	0,270949	-0,094055	-0,143741	0,187648	-0,055777	0,487821	
IEVD_OWN	0,304693	0,244096	-0,019119	-0,003724	0,401365	-0,146893	
IEVD_TAX	0,477387	0,243208	-0,007375	0,193080	0,012471	0,097317	
ISELF_T	-0,032166	0,188172	0,490842	-0,267809	-0,134590	0,188840	
IBYPRO	-0,187049	-0,192718	0,583119	0,077690	0,305075	0,111096	
IRVN_EMP	-0,387715	0,132088	-0,129621	0,384748	0,033544	0,332908	
Proportion (of total variance)	**0,178400**	**0,143500**	**0,129200**	**0,125100**	**0,109200**	**0,093200**	**0,778600**
Corrected proportion	**0,229129**	**0,184305**	**0,165939**	**0,160673**	**0,140252**	**0,119702**	**1,000000**

In component 1 (PC1) variables with the highest weight are: weight of taxes (income and others) on economic value distributed (IEVD_TAX), revenue per employee (IRVN_EMP), electricity sales per costumer (ISAL_ELCOS).

In the first component (PC1) issues assuming greater relevance are those relating both to distribution of the economic value distributed between taxes and wages. Revenues per employee also play a significant role in the component. Together these variables account for a more active social policy, with benefits for labor.

In component 2 (PC2) variables with the highest weight are: weight of heat generation on the total electricity generation (IH_GENTH), electricity sales per costumer (ISAL_ELCOS).

In the second component (PC2) issues assuming greater relevance are those relating both to efficiency in resource use and market power. The marketing ability of thermal energy is directly related to the dimension of customer portfolio and the respective volume of electricity demanded. The component reflects the importance of structural conditions and market responsiveness for heat trading ability.

In component 3 (PC3) variables with the highest weight are: share of recovered by-products (IBYPRO), share of produced electricity used for self-consumption (ISELF_T), weight of total revenues on total assets (IT_RVN).

In the third component (PC3) issues assuming greater relevance are those relating both to efficiency in resource use (self consumption and byproducts). Lower consumption both of electricity and lime implies lower costs and corresponds to higher income per asset.

The by-products refer to lime and gypsum generated in the production process. The consumption of lime is associated with the use of systems purification and desulphurization of flue gas, mainly in the processes coal users. Lime use in gas desulfurization processes represents an environmental cost for the company, reason why the revenues are lower when byproducts are higher.

The component reflects the profitability of assets linked to the efficient use of material and technological resources.

In component 4 (PC4) variables with the highest weight are: weight of electricity generation on the total electricity sales (IGENT_SAL), electricity generation per employee (IPDTV), revenue per employee (IRVN_EMP).

In the forth component (PC4) issues assuming greater relevance are those relating both to return of labor, labor productivity and the ability to increase sales. The three variables evolve in the same direction.

The electricity sector has been presenting the tendency to reduce the number of employees, while capitalizing its human resources and increasing revenues, situation reflect on PC4.

In component 5 (PC5) variables with the highest weight are: cooling water used for electricity generation (IWA), economic value distributed to the owners (IEVD_OWN).

In the fifth component (PC5) issues assuming greater relevance are those relating both to water use and economic value distributed to the owners, because frequently plants with high profitability and very low marginal costs are those using more water for cooling (e.g. Nuclear and thermal power plants). The chosen technology has associated a certain intensity of natural resource use. The return on assets and on invested capital, also depends on the cost internalization for using those resources.

This way, the component reflects the impact of technological options on natural resource use and on the return of equities.

In component 6 (PC6) variables with the highest weight are: economic value distributed to the lenders (IEVD_LEN), weight of total revenues on total assets (IT_RVN), electricity sales per costumer (ISAL_ELCOS).

In the sixth component (PC6) issues assuming greater relevance are those relating both to obtained loans, return on assets and sales enforcement. The highest returns on assets depends respectively from: production per employee; funding capacity in the markets and extent of the market. Returns on assets varies inversely with the consumption of fossil fuels per unit of output. The component reflects an appropriate balance between the assets, the financing structure and the size of the markets.

Considering the descriptions and interpretation previously performed, it is proposed the following naming for the economic principal components (Table 6.8):

Table 6.8 Economic components summary

Principal component	Component proposed name	Share of explained variance	Related concepts
PC1	Social distribution of economic value distributed	23%	Equity, productivity
PC2	Ability for heat trade	18%	Effectiveness, efficiency, dependency
PC3	Efficiency on productive process	17%	Effectiveness, efficiency
PC4	Labor productivity	16%	Productivity, autonomy
PC5	Profitability of technological options	14%	Efficiency, equity
PC6	Ground for financial liabilities	12%	Effectiveness, dependency, equity

From all components, there is an valuation of the issues related to the social distribution of economic value (among stakeholders), which explains almost 23% of variance. The efficiency issues of thermal processes are presented in two different views. On PC2 efficiency is envisaged through market valuation of heat as a commercial product. On PC3 efficiency stems from fuel use and technological solutions. Efficiency issues represents respectively for both PC, almost 18% and 17% of the explained variance, which totals to 35% of the explained variance for the economic dimension. The sum of the three first components account for approximately 58% of the total variance of economic issues.

The remainder relates to others themes such labor productivity, market, earnings linked to technological options, externalities and the ability to ensure loan compliance.

The identified components relate basically those relevant issues with enough information through the sample to be considered in the analysis.

Other economic matters also relevant to the electricity production sector were not included due to insufficient workable data. For example, can be referred in this situation, some pertinent matters to the electricity industry, such as the proportion of spending on locally-based suppliers or the energy saved due to conservation and efficiency improvements.

The intersection of the highest loading variables on each component, therefore with greater explanatory power, with the concepts associated with economic dimension of sustainability, shows that all concepts are represented in the obtained solution (Table 6.8).

This indicates that the conceptual foundation of economic dimension is properly represented in the results.

Knowing that the obtained Principal Components (PC´s) summarize the behavior of the sample, the PCA for the individual dimensions of the corporate contribution for sustainability, may be synthesized as:

- Social issues are characterized for matters of recruitment and employment
- Environmental issues characterized by pollution and production sources
- Economic issues are characterized by the distribution of the value created
- Financial issues are characterized by return on assets and equity

From the initial 52 variables used in former PCA, those 19 with higher loadings (Table 6.9) were then mixed on a joint set of variables, representing the four dimensions of corporate contribution for sustainability.

Table 6.9 Summary of aggregated variables from PCA1

Variables	Description	Variables	Description
IWA	Cooling water used per unit of electricity generated	E_PS	Earnings per share
IH_GENTH	Weight of heat generation on the total electricity generation	IDBT	Weight of net debt on the total assets
IGENT_SAL	Weight of electricity generation on the total electricity sales	ROA	Return on assets
IEVD_LEN	Weight of payments to lenders on the Economic Value Distributed	ROE	Return on equity
IEVD_TAX	Weight of taxes (income and others) on the Economic Value Distributed	IEMP_ABS	Employee absenteeism rate
IBYPRO	Share of recovered by-products (gypsum and ash)	IEMP_ACC	Average accidents per one hundred employees
IGENRE_T	Share of renewable sources in electricity production	IEMP_FTC	Share of employees with full-time contract
IGENRENU_T	Share of CO2 free electricity production	IEMP_WOMB	Share of women in the management board
ICO_TH	CO2 relative emissions from electricity generation (Kg per kWh)	IEMP_TURN	Share of employees replaced within the company, excluding retirements
IWST_ZREC	Share of recovered hazardous waste	------ ------	------ ------

The variables with the highest loading on the previous results (Table 6.1, Table 6.3, Table 6.5 and Table 6.7) are hereafter used to construct Table 6.10, which brings together the four sustainability dimensions.

6.1.2. PCA for aggregated dimensions

Using variables from Table 6.9 the PCA was then applied for the second time (PCA2). In the case of mixed set of variables, representing the four dimensions of corporate contribution for sustainability, could be extracted 19 possible components. The use of the eigenvalue allowed to select the first seven Principal Components (PC´s), which apprehend 83% of the total variance. The contribution for the explanation of total variance assumes a decreasing importance from component one (PC1) to component seven (PC 7).

For aggregated variables in Table 6.10, the principal component PC1 explains about 21% of all the variance for the original set of variables and 25% of the variance explained by the solution of the seven principal components. The following components explain successively lower amounts of the residual variance.

Table 6.10 Principal Component Analysis (PCA) for aggregated indicators

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	
IWA	-0,295865	0,354307	-0,104866	-0,215608	0,103184	-0,038489	0,361657	Econ
IH_GENTH	-0,126872	-0,324914	0,453500	-0,294518	0,045683	-0,144196	0,193011	Econ
IGENT_SAL	-0,073257	0,110542	0,215481	0,362014	0,208333	0,080756	-0,041984	Econ
IEVD_LEN	-0,248748	-0,117262	-0,067649	0,229041	-0,163599	-0,103377	0,491131	Econ
IEVD_TAX	-0,253883	-0,107099	0,206514	0,259951	0,007433	0,079893	-0,030853	Econ
IBYPRO	0,099482	0,004441	-0,439389	0,307673	0,306264	-0,083183	0,356834	Econ
IGENRE_T	0,276099	0,204758	0,330411	0,062170	-0,003132	-0,211200	0,140402	Environ
IGENRENU_T	0,235950	0,094323	0,436251	0,259552	0,143329	-0,132825	0,171635	Environ
ICO_TH	0,306249	0,110704	-0,161537	-0,022131	-0,250504	0,182302	0,022926	Environ
IWST_ZREC	-0,013248	0,400759	0,253548	-0,298454	-0,164994	0,205972	-0,011791	Environ
E_PS	-0,109028	0,162367	-0,028712	-0,039816	0,140024	-0,399368	-0,468929	Financ
IDBT	0,423486	0,108044	-0,092375	-0,153910	-0,235780	0,009293	-0,115440	Financ
ROA	0,060087	-0,020483	0,017121	-0,159847	0,640255	0,140792	-0,010016	Financ
ROE	0,146037	0,016828	-0,026150	-0,214110	0,437892	0,428839	-0,286949	Financ
IEMP_ABS	-0,122885	-0,283774	0,200828	-0,044786	-0,132539	0,481334	-0,014010	Social
IEMP_ACC	-0,257146	0,364911	-0,109476	-0,101049	-0,073909	0,174247	0,010579	Social
IEMP_FTC	-0,387496	-0,368354	-0,089898	-0,018249	-0,040914	0,060572	0,015334	Social
IEMP_TURN	-0,284979	-0,288687	-0,179569	-0,089375	-0,056332	0,060733	0,028900	Social
IEMP_WOMB	-0,012238	0,190525	0,061447	0,492969	-0,089258	0,420238	0,034721	Social
Proportion (total variance)	**0,205000**	**0,150800**	**0,134400**	**0,119400**	**0,093100**	**0,071300**	**0,054800**	**0,8288**
Corrected proportion	**0,247346**	**0,181950**	**0,162162**	**0,144064**	**0,112331**	**0,086028**	**0,066120**	**1,0000**

As previously, after signaling the variables with a loading above 35%, the variables with higher weight in each component were identified.

In component 1 (PC1) variables with the highest loadings are: weight of net debt on total assets (IDBT) and share of employees with full-time contract (IEMP_FTC).

In the first component (PC1) issues assuming greater relevance are those relating both to debt to assets, type of labor contracts and labor stability.

The increase in debt relative to assets implies greater accountability to lenders which often leads both to precarization of labor contracts and to use of part-time work as a way to reduce staff costs.

CO_2 emissions from thermal also present higher loadings which may indicate that this situation is linked to those heavy technologies which demand larger investments.

PC1 reflects the equilibrium between the commitments assumed toward lenders and employees.

In component 2 (PC2) variables with the highest loadings are: (IWST_ZREC), average accidents per 1000 employees (IEMP_ACC), share of employees with full-time contract (IEMP_FTC) and cooling water used for electricity generation (IWA),

In the second component (PC2) issues assuming greater relevance are those relating both to occupational and environmental safety and staff retention.

The precarious nature of employment contracts affects the individual's professional training and potentiates the occurrence of accidents. The company concerns with the proper routing of hazardous waste and water consumption reflects some accountability with the impacts of its own activities and with the fulfillment of its legal obligations.

PC2 reflects the concern with labor and environmental safety.

In component 3 (PC3) variables with the highest loading are: weight of heat generation on the total electricity generation (IH_GENTH), share of recovered by-products (IBYPRO), share of CO_2 free electricity production (IGENRENU_T).

In the third component (PC3) issues assuming greater relevance are those relating both to production efficiency on: using renewable sources, valuing heat production and marketing byproducts. It relates the electricity production sources with the technology used for electricity production.

PC3 reflects the efficiency on resource use from CO_2 free technologies

In component 4 (PC4) variables with the highest loading are: share of women in administration board (IEMP_WOMB), weight of electricity generation on the total electricity sales (IGENT_SAL).

In the forth component (PC4) issues assuming greater relevance are those relating both to the share of woman in board with electricity sales.

PC4 reflects the influence of women occupying senior positions on commercial management.

In component 5 (PC5) variables with the highest loading are: return on assets (ROA), return on equity (ROE).

In the fifth component (PC5) issues assuming greater relevance are those relating both to return on assets and equity.

PC5 reflects the balance between assets and the financing structure of the company.

In component 6 (PC6) variables with the highest loading are: (IEMP_ABS), share of women in administration board (IEMP_WOMB), return on equity (ROE) and earnings per share (E_PS).

In the sixth component (PC6), issues assuming greater relevance are those relating both to motivation of employees, return on equity and women in management board. The absenteeism rate has been appearing associated with the percentage of women in the labor force. However, the participation of women in top management contributes to higher returns on equity, albeit, in the present case, with lower ability to generate revenue for each title of ownership.

PC6 reflects the commitment of senior management.

In component 7 (PC7) variables with the highest loading are: weight of payments to lenders on economic value distributed (IEVD_LEN), earnings per share (E_PS) and cooling water used for electricity generation (IWA).

In the seventh component (PC7) issues assuming greater relevance are those relating both to weight of debt in the company's profitability, efficiency on water use and earning per share. Water use appears once again associated with loans obtained and earnings from ownership. Usually water use is higher on those technologies which demand larger investments on facilities, personnel and equipment (thermal or nuclear facilities). These units incur in high costs both for startup and for infrastructure maintenance, usually demanding large amounts of borrowed capital. Before increased liabilities, earnings per share may decrease. The trade-off of returns on equity and debt is, in this component, linked to the technology chosen for electricity production.

PC7 reflects the influence of the production technology on capital remuneration .

Considering the descriptions and interpretations previously performed, it is proposed the following naming for the components (Table 6.11):

Table 6.11 Aggregated components summary

Principal component	Component proposed name	Share of explained variance	Related concepts
PC1	Commitment to lenders and employees	25%	Coverage, reliability, commitment
PC2	Environmental and labor safety	18%	Impact, safety, commitment
PC3	Efficiency on resource use from CO_2 free technologies	16%	Efficiency, effectiveness, production strategy
PC4	Impact of women on commercial management	14%	Autonomy, equality
PC5	Return on assets and equity	11%	Profitability, effectiveness
PC6	Commitment of women in senior management	9%	Profitability, effectiveness, reliability, commitment, equality
PC7	Distribution of value between shares and debt	7%	Profitability, reliability, equity, efficiency, effectiveness

From all components, there is an valuation of the issues related to the commitment with lenders and employees, which explains almost 25% of variance. Environmental and labor safety, represents almost 18% of the explained variance, while efficiency on resource use from CO2 free technologies explains 16% of variance. The sum of the three first components account for approximately 59% of the total variance of the aggregated issues. The remainder relates to others themes such return on assets and equity, senior management commitment and distribution of value between shares and debt.

The components obtained for the PCA on aggregate dimensions (Table 6.10) are aligned with the results of the PCA on individual dimensions performed in subtitle 6.1.1. The variables are organized similarly to obtain components whose interpretations are consistent with those previously obtained. This suggests the methodological robustness and consistency in the results.

Knowing that the obtained Principal Components (PC´s) summarize the behavior of the sample, the PCA for the aggregate dimensions of the corporate contribution for sustainability, may be synthesized in the previous seven perspectives, which jointly characterizes the sector of electricity production. Accordingly, environmental, social, economic and financial issues are mainly represented through: the distribution of economic value, environmental and labor safety (which includes pollution and work contracting), efficiency on production processes and resource use, market and commercial management, return on equity and debt capital.

The identified components highlight the most relevant issues derived from the information collected in the sample used in this analysis. However, other sustainability issues also relevant for the sector were not included due to insufficient workable data.

The intersection of the highest loading variables on each component, therefore with greater explanatory power, with the concepts associated with each dimension of sustainability, shows that all concepts are represented in the obtained solution (Table 6.11). This indicates that the conceptual foundation of each dimension is properly represented in the results.

Besides the obtained components, the method identified the most relevant indicators, i.e. those with higher loadings in the component, to be used as the most representative for the industry under study (Table 6.12).

Table 6.12 Summary of aggregated variables from PCA2

Variables	Description	Variables	Description
IH_GENTH	Weight of heat generation on the total electricity generation	IDBT	Weight of net debt on the total assets
IEVD_LEN	Weight of payments to lenders on the Economic Value Distributed	ROA	Return on assets
IWST_ZREC	Share of recovered hazardous waste	IEMP_ABS	Employee absenteeism rate
------ ------	------ ------	IEMP_WOMB	Share of women in the management board

6.2. Results for additional data reduction methods

The use of different forms of data reduction allows us to identify patterns, detect levels of convergence and ultimately validate the results.

The methodology employed provided two types of results that make sense if mutually consistent and that need of adequate interpretation in the light of the situation as examined at sector under analysis. The results consist on:

1 - the variables identified by the application of multivariate techniques as the most representative of the analyzed set.

2 - the main components of which consist of linear combinations of variables used, which represent an underlying reality

In this case, each variable is weighted in the component and each component have different weights on total solution.

The construction of the lists given below, was based on the use of scores, that is, the multiplication of loadings obtained for each variable and for each component, by the correspondent observation of each variable for each company.

The results obtained for each principal component were then multiplied by the proportion of corrected variance and then summated for each dimension. This allowed to obtain, for each company, a representative value for each dimension (Table 6.13, columns for “social”, “financial”, “environmental” and “economic”).

As can be seen by Table 6.13 companies have different valuations in the four dimensions considered, standing out positively or negatively in one or another dimension. These companies are compared in relation to a median enterprise, which is constructed from the median values of each variable. The use of the median is intended to compensate the lack of data on some variables and the company median works as a reference for making comparisons.

From the aggregation of results for each dimension, it has built an organized list which represents the contribution of each company in the sample for sustainability (Table 6.13 column “Four join dimensions”).

For the results of PCA, obtained from the most representative variables (Table 6.10) it was obtained a list of companies according to their contribution to sustainability (Table 6.13 column “aggregated”). Results are very similar to those previously obtained and in fact, companies assume similar positions, with little variation when comparing the two rankings “four join dimensions” and “aggregated”. This suggests a consistency of results between the two

methods used (aggregation of dimensions and variables most representative). In the second case, however, it can be sugested a certain loss of information regarding those variables with a lower weight, which were excluded from the Principal Component Analysis.

Table 6.13 Resume of data reduction results

	PCA 1					PCA 2
Company	13 social variables	11 financial variables	13 environmental variables	15 economic variables	Four joint dimensions (52 initial variables)	Aggregated (19 selected variables)
Company 1	5	27	8	33	21	22
Company 2	19	12	5	26	18	18
Company 3	10	20	17	21	19	29
Company 4	32	8	26	25	29	21
Company 5	29	26	30	32	31	19
Company 6	22	29	21	23	24	17
Company 7	4	2	24	29	12	27
Company 8	14	14	13	30	20	12
Company 9	31	17	33	24	33	33
Company 10	18	33	7	22	22	14
Company 11	16	28	19	28	23	31
Company 12	11	15	31	31	25	24
Company 13	25	7	9	27	15	4
Company 14	17	21	4	16	11	5
Company 15	30	30	27	11	27	25
Company 16	3	4	14	18	7	16
Company 17	9	6	15	7	2	10
Company 18	27	31	29	13	28	28
Company 19	6	18	20	3	5	7
Company 20	21	16	10	6	8	11
Company 21	12	22	23	2	6	6
Company 22	24	19	2	20	26	20
Company 23	13	9	11	12	13	15
Company 24	33	23	28	17	30	26
Company 25	1	1	1	1	1	1
Company 26	2	13	16	4	3	3
Company 27	20	32	32	19	32	30
Company 28	8	25	22	5	9	32
Company 29	15	3	18	8	4	13
Company 30	26	24	25	9	14	23
Company 31	7	5	3	14	16	9
Company 32	28	11	12	10	10	2
Company 33	23	10	6	15	17	8

The combination of the two types of results (main components and variables) here used to construct the previous list, can assume various structures (using different number of variables or even all of the variables considered). The use of different structures may affect the position of each company in the ranking.

The summary for reduction methods, presented in page 167 and following, is largely sensitive to form how the variables are considered in the construction of the index (for example if they are expressed in the same units of measurement or if weighing the positive and negative contributions for sustainability).

As shown by the analysis previously presented, the results reflect the set of variables considered and thus the assessment of the sustainability of each one of the companies was carried out taking into account the variables considered.

The methodology can reduce the number of indicators to be used to those more representative of the company's sustainability, creating differente structures. The analysis of "Table 6.13 Resume of data reduction results" registers some consistency between information provided by different structures.

However, it is important to note that the results always reflect the data used and for that reason it is crucial the use of raw data as complete and accurate as possible. If certain variable presents a particularly good performance in one or another area, that performance is relativized in components. Of course, if the variable has a greater explanatory power, it can contribute to a better position in the list. On the other hand, if a variable presents extreme values for one or more elements of the sample, that variable has the potential to contribute to greater variations in the company's position depending on the structure selected.

The exercice also showed that the position of a company on the ranking was frequently influenced both by the introduction of new variables and for the total amount of data available for the company.

In fact, companies do not report evenly on the four dimensions of sustainability, once a company can present much information for one dimension and very little information for another dimension. For this reasons, companies present different performances on each one of the proposed dimensions, assuming different positions in organized lists depending on the structure selected.

From the above, may be concluded that the methodology applied is solid, although, in this exercise, results are limited by the amount of data. It is important to reinforce that understanding the business contribution for sustainability has to be supported on a minimum set of indicators that encompass, as much as possible, the complexity of the concepts involved.

6.3. Final remarks

The present research was based on non experimental data, gathered from the companies in the sample. Although collected with great care and rigor, it is recognized that it still lack of higher quality. Errors may occur from the measurement of the variables, both due to problems mentioned in subchapter 5.3.3 and due to the fact that there is many missing data for the selected sample. Thus, some care is needed in the analysis and application of the obtained results.

Besides, as previously noted, some areas relevant for the industry of electricity are rarely reported. The analysis is thus limited by the unavailability of data, which are not uniformly presented by the sample. It is advisable a stronger homogenization of concepts and metrics to enhance greater soundness of the analysis and to allow more reliable results. In the presence of information gaps, the partial answers obtained may register selectivity bias and thereby they do not represent exactly the general sample.

Moreover, another problem encountered is that the use of indicators composed by two or more variables, implies the potentiating of the lack of information (if the value for one variable is missing the indicator can not be calculated).

This way, the use of indicators in some cases similar and complementary is intended to overcome the missing data and to cover the industry critical issues as broadly as possible .

Regarding the performed Principal Components Analysis there is a loss of information in three ways:

- The information contained on components that are not considered in the analysis, those beyond the eigenvalue. Excluded components can be more discriminating in regard to the sample and present less homogeneous information.

- The information excluded by the use of surrogates variables. As only one variable is selected to represent a complex result (component), there is always a risk of over-simplifying the complexity of the components previously calculated.

- Moreover, some concepts of corporate contribution for sustainability are exclusively associated with few variables. If none of them is assumed as surrogate variable the concept does not appear at the aggregated level analysis.

One of the criticisms (Hair 2009; Gorsuch 1983; Hunter 2004) to PCA is that it is very difficult to make a comparison of the results and apply these results to other situations. Given the database used, the composition of the sample and the purpose of investigation, resulted a sample of limited size. Since the sample was small it was not possible to create smaller groups to perform comparative results, it was decided to perform a comparison with the Common Factor Analysis (CFA). Although CFA is conceptually different from PCA, in practice, if in the absence of major data problems, both techniques provide similar results.

Thus, a CFA analysis with orthogonal rotation was carried out (see Annex D). The results obtained were very similar to those obtained with CPA, especially in regard to the first components. The two techniques provided nearly coincident outputs, fact that contributes to ensure the soundness of the results.

Although the application of both techniques CFA and CPA lead to similar results, the CFA presents greater instability in calculation methods and variables assume lower loading which result from the account of only the shared variance.

To end this section, it can be concluded that apart from these limitations, the methodology revealed a set of relevant information to the knowledge of the electricity production sector in Europe and the corresponding contribution to sustainability.

It is also expected that a clear disclosure of corporate sustainability performance may provide a better understanding about corporate externalities and the respective actions undertaken for internationalization of costs, as also the resulting successes or failures.

Transparency, relevance and widespread access to company's reported performance is, in the manner prescribed, an unprecedented achievement in human history. It implies undeniable changes on social organization level, once it allows a larger and more complex network of interconnections between a plurality of stakeholders whose interests, until recently and in many circumstances, were not taken into consideration. The author believes that the increasing disclosure of environmental, social and economic issues and the arising incentive to dialogue, may be faced, in this context, as a quiet revolution.

7. Conclusions

The present chapter summarizes the results of the research that was exposed and discussed in previous chapters. Hereafter the main findings are presented, as also the correspondent applications and recommendations. To finalize some suggestions are made for further investigations.

Our main goal was to contribute to identify key performance indicators to assess European electricity sector contribution for sustainability.

Even for the same industry, sustainability reports still lack of uniformity on the information disclosured both between peers and along time. The lack of comparability makes difficult to identify best practices and markup the top results. In the case of European companies for electricity generation, these issues are especially sensitive once these industries are highly responsible for generating environmental, social and economic impacts and they are heavy influencers in sustainability building. Presently, in the particular case of public utilities, they face increased responsibilities in reporting towards their stakeholders. Moreover, there are few academic studies that address the key issues of CSR and sustainability reporting for electricity industry at European level.

A monitoring system based on comparable, relevant and representative indicators for industry critical issues was assumed to be an important contribution to achieve this goal.

For the proposed research questions, the main achievements obtained are the following:

1. What are the reasons for the lack of comparability between reports?

The main causes for the lack of comparability between reports are dependent particularly from:

- Differences in the concepts, metrics and measurement units
- Different applied frameworks, which consequently identify as relevant diverse critical issues .

- Different prevailing legal frameworks at national level, largely influence critical issues to report. The same corporation operating in several countries may have to deal with different regulations.
- Multiple scopes of reporting (e.g. production facility, local, national, continental or intercontinental boundaries)
- Combination of various business areas in the same report (e.g. extraction of fossil fuels, electricity production, electricity and gas distribution, environmental services) that involve different contributions to sustainability.
- Indicators expressed in absolute terms that do not reflect the differences in size and production capacity.

To overcome these issues, it was decided to:

i. Define uniform concepts and metrics to support the collection of data for the sample companies.

ii. Build a database according to clearly defined criteria, with the aim to provide a solid foundation to achieve international comparison of the performance of companies.

iii. Use of relative indicators. A large part of the literature employs absolute indicators, which make difficult to accomplish comparisons between companies with very different scales and may induce distortions in the results. The relativization of indicators enables to control several problems that could arise during data analysis. In this study, relativized indicators were used according to the dimension (size and production capacity) of business units. It was intended they could provide an adequate benchmarking for the companies under study regardless their differences.

iv. Propose a panel of mixed physical and monetary indicators covering the environmental, social, economic and financial issues for corporate sustainability on electric utilities. This selection was limited by the availability of data for the sample.

Many other critical issues for the industry were not considered for the lack of a minimum number of observations required to implement the Factor Analysis (FA) technique, or because they simply were not reported by a representative group of companies (e.g. nuclear waste, liquid water use, impacts on biodiversity, links to local communities).

As new data is being collected and made available, expectedly in the near future, the methodology developed may be applied to sweep the extended set of indicators and to select the most relevant new ones.

2. ***What must constitute the core of a SR? What must be identified as critical to be measured and reported in a commonly understood language?***

To answer this question it was necessary to identify a small set of indicators, obtained, as far as possible, free from bias and subjectivity of values, representing material contributions to sustainability from European electricity producers.

Principal Components Analysis (PCA) was proposed to meet these requirements and it was the methodology used to signal key indicators in terms of corporative sustainability. It has reduced an extensive amount of information to a limited set of variables. It also showed consistent with the dimensions considered in the analysis and with the concepts proposed for each of them.

The methodology proved effective in selecting a group of indicators, sufficiently small but representative of corporate contribution for sustainability, covering the most relevant issues to the sector. The ascertained indicators represent a summary that allow an assessment of sustainability performance between companies and in the long run .

3. ***How can relevant data be structured to contribute to the effective promotion of corporate sustainability?***

The applied methodology proposes a set of indicators that is not intended to replace the indicators arriving from different frameworks that are currently being reported. The present work is assumed as a critical reflection to present innovative alternatives to the present reporting.

The set of ascertained indicators is representative of corporate sustainability, given the basic information that we managed to collect. The definition of homogeneous methodologies for data collection and its effective implementation among companies, may allow the integration of new data and indicators, enabling a more accurate perspective for the corporate sustainability performance.

After the application of the methodology, the dimensions of corporate sustainability were characterized in terms of the established indicators. In the case of the European electricity production, these dimensions are highlighted comprehensively by:

- Return on assets, equity and debt capital (economic and financial dimensions).
- Efficiency of production technologies (economic and environmental dimensions)
- Efficient use of resources (economic and financial dimensions)

- Equity in the distribution of economic value generated by the stakeholders (economic and social dimensions)
- Working conditions, relating to the contract of employment and health and safety (social dimension)
- Contribution of women on production and management (economic and social dimensions)
- Pollution (environmental dimension)

Contributions for the knowledge in the field that are extracted from this thesis are the following:

1. Identification of industry key issues, regardless of hierarchies of values and cultural conditioning, which are often hidden in the panoplies of frameworks and templates available to perform the assessment of corporate sustainability

2. Minimization of the subjectivity on selection criteria arising for example from personal convictions or individual values. The identification of key indicators, reflecting the major questions to evaluate the corporate contribution for sustainability, is based on variance.

3. Contribution to identify a proper framework to define indicators of general application for companies engaged in production of electricity, independently of the management interests and individual sensitivities.

4. The methodology fulfilled the purpose of reducing the data while minimizing the subjectivity in the reduction process and is presented as a effective technique in reducing more extensive information as additional data is collected.

5. The result of research complements the frameworks currently available with an innovative set of indicators

6. The developed set of indicators, may reflect the overall value of the company (long-term value for all stakeholders), regardless of book value and market value. Selected indicators complement the traditional methods for assessing the value of a company, which depend on many factors (especially in the case of non-listed companies).

7. The present work contributes to the creation of a vehicle of transmission of effective information on sustainability, generalizable to all organizations.

However, this analysis has two constraints to consider when interpreting and reproduction the results to other businesses and industries.

i. The analysis is purely exploratory. Although this may be an advantage, since it allows to adjust the indicators to be used to the material issues of each sector or industry, hardly the results are replicable in other sectors.

ii. The results obtained for Principal Components Analysis reflect only those issues for which it was possible to collect information. Other material issues were not integrated due to the lack of workable data.

iii. The positions presented in the lists for additional reduction methods, do not meet all the material issues for the sector. For example, if nuclear waste were considered in the analysis, companies with nuclear generation would probably see its positions lowered in the environmental ranking.

Relating to the available literature, some novelties arise from this study:

i. The methodology features an innovative value in relation to the practice of research since the Factor Analysis (FA) has little use on CSR and corporate sustainability issues. The technique selected (PCA) counts with broad application to marketing and management research questions. Beyond the novelty of the application to issues of sustainability and CSR, the method proved to be suitable for data reduction of the studied companies, generating consistent and useful results and responding appropriately to the objectives of the study.

ii. This methodology enables to grasp the character of change and evolution inherent to the concept of sustainability as it allows the periodic evaluation and updating of indicators

iii. An added value of this work is the construction of a unique database for European electric utilities, according to well-defined criteria, which brings together social, economic, financial and environmental information.

iv. The use of indicators depending on the size and productive capacity is another important and innovative contribution of this research, once most frameworks suggested variables expressed in absolute terms.

v. The definition of material concepts associated with sustainability dimensions is also an innovative feature.

These concepts provide a guide for the interpretation of the indicators and for the clarification of their meaning. Concepts are also used to assess if the indicator implies a positive or negative impact in terms of sustainability

Some possible developments and further topics of research that have arisen from the present thesis. Some paths to explore:

i. Apply the methodology to other geographical areas beyond Europe to study possible differences (e.g. arising from other legal, regulatory and cultural frameworks)

ii. Apply the methodology to other activity sectors beyond the production of electricity, since the indicators presented in the thesis were drawn to this particular case.

iii. Develop new metrics and concepts to standardize data collection

iv. Develop databases freely accessible and usable in scientific research (data about companies are either not available, too expensive or private).

v. In possession of expanded standardized data, covering new key areas in electricity production industry, remake the analysis to identify new indicators.

vi. Investigate whether there are differences between the performance of companies mainly public or private, to ascertain whether the type of company property affects the decisions and strategies regarding the corporate contribution for sustainability

vii. Explore the issues of volatility (in the case of listed companies) associated with internal issues of sustainability and the corporate contribution to sustainability. That raises the question if companies, having lower volatility compared to the average of the respective sectors, are considered by investors more reliable to respond to shock waves. It can also be questioned if these companies with lower volatilities have high standard of care with social and environmental behavior and genuine concerns about its own sustainability performance.

viii. Explore the relation between sustainability performance from electric utilities, expressed through the obtained indicators and their position in the financial markets. Investigate whether the market tends to recognize the corporate sustainable behavior and if companies having higher sustainability concerns present also a better performance than the average of their sector of activity.

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Annexes

Annex A. Collected Indicators

Annex B. List of Reports Consulted

Annex C. Descriptive Statistics - 2004-2010

Annex D. Results for CFA

Annex E. Full Results for PCA

Annex A

Collected indicators

A. Collected indicators

Legend for indicators characterization	
1	Dimension
2	Efficiency
3	Profitability
4	Autonomy
5	Growth
6	Recognition
7	Environment
8	Society / community
9	Employment
10	Water
11	Air
12	Residuals

Economic and Financial														
Symbol	**Description**	**Unit**	1	2	3	4	5	6	7	8	9	10	11	12
EBITDA	EBITDA	(10^6 euros)	x		x									
EBIT	EBIT	(10^6 euros)	x		x									
N_PFT	Net profit or net income	(10^6 euros)		x	x									
O_PFT	Operating profit	(10^6 euros)												
CAPEX	Capital expenditure	(10^6 euros)				x	x							
T_ASS	Total assets	(10^6 euros)	x											
N_ASS	Net Assets	(10^6 euros)												
N_DBT	Net debt	(10^6 euros)			x	x								
T_EQT	Total Equity	(10^6 euros)	x		x	x								
T_LBL	Total Liabilities	(10^6 euros)	x											
DEV_D	Direct economic value distributed	(10^6 euros)			x					x				
DEV_RET	Direct economic value retained	(10^6 euros)			x									
T_SAL	Total Sales	(10^6 euros)	x											
G_SAL	Gas sales	(10^6 euros)	x											
H_SAL	Heat sales	(10^6 euros)	x											
EL_SAL	Electricity sales	(10^6 euros)	x											
T_RVN	Total revenues (or turnover)	(10^6 euros)	x											
ST_IDX	Sustainability Index	Dummy						x						
T_DBTR	Total debt ratio	absolute			x	x								

Operational														
Symbol	**Description**	**Unit**	1	2	3	4	5	6	7	8	9	10	11	12
EL_CAP	Installed capacity for generation (maximum power)	MW	x			x								
PEC_CN	Primary energy consumption (Tj)	Tj	x	x										
EL_GENT	Total annual production (gross electricity generation)	GWh	x											
EL_SELF	Energy for self-consumption	GWh		x										
NEL_GENT	Net electricity produced	GWh	x	x										
NEL_GENRE	Net electricity generation from renewable sources	GWh	x	x		x		x						
NEL_GENNU	Net electricity production from nuclear	GWh	x	x										
NEL_GENTH	Net electricity production from thermal	GWh	x	x										
EL_LOSS	Transmission and distribution losses	%		x										
G_EXT	Network extension (for gas distribution)	Km	x											
EL_EXT	Network extension (for electricity distribution)	Km	x											
ELD_SAL	Electricity sales distribution	GWh	x											
ELS_SAL	Electricity sales supply	GWh	x											
ELT_SAL	Total Electricity Sales	GWh	x											
EL_COS	Costumers for electricity sales supply	n.º	x											
G_TRN	Gas transport	GWh	x											
G_SALD	Gas sales distribution	GWh	x											
G_SALS	Gas sales supply	GWh	x											
G_SALT	Gas sales total	GWh	x											
G_COS	Gas Costumers	n.º	x											
H_GEN	District heat and process heat	GWh		x										
BYPRO	By products (gypsum and ashes)	t		x										
BYPRO_REC	Recovered ashes and slag	t		x										

Environmental														
Symbol	**Description**	**Unit**	1	2	3	4	5	6	7	8	9	10	11	12
WA_COO	Total of water used (cooling)	(10^3 m3)	x					x	x			x		
WA_WITH	Withdrawal	(10^3 m3)	x	x					x			x		
WA_DSCH	Total water discharged	(10^3 m3)	x	x					x			x		
WA_N	Net water	(10^3 m3)		x					x			x		
CO_TEQ	Total CO2 eq. emissions (for the group)	Kt	x						x				x	
CO_T	Total CO2 emissions (for the group)	Kt	x					x	x				x	
CO_TH	CO2 emissions from thermal facilities	Kt	x					x	x				x	
SO_T	Total SO2 emissions	Kt	x					x	x				x	
NOX_T	Total NOx emissions	Kt	x					x	x				x	
PART_T	Particles	Kt	x					x	x				x	
WST_T	Total waste (t)	t							x					x
WST_NZ	Non-hazardous waste	t							x					x
WST_NZREC	Recovered non-hazardous waste	t							x					x
WST_Z	Hazardous waste (t)	t							x					x
WST_ZREC	Recovered Hazardous waste	t							x					x
WST_NU	Nuclear waste Low and intermediate level waste	Dummy						x						x
ENV_INV	Environmental Investment	(10^6 euros)							x					
ENV_EXP	Environmental expenditure (current expenditure + Investment)	(10^6 euros)							x					
ENV_CST	Environmental current cost	(10^6 euros)							x					

Social														
Symbol	**Description**	**Unit**	1	2	3	4	5	6	7	8	9	10	11	12
EVD_EMP	Wages, salaries and benefits (Paid to employees)	(10^6 euros)								x	x			
EVD_TAX	Taxes (income and others)	(10^6 euros)								x				
EVD_COM	Contributions to community	(10^6 euros)								x				
EVD_OWN	Owners	(10^6 euros)								x				
EVD_LEN	Lenders	(10^6 euros)								x				
EVD_SUP	Suppliers	(10^6 euros)								x				
EMP_T	Employees (end of year)	n.º	x							x	x			
EMP_FTE	FTE = Full-Time Equivalent: Converted to full-time positions	n.º	x							x	x			
EMP_FAT	Nº of work-related fatalities	n.º		x						x	x			
EMP_TRG	Nº hours of training	n.º		x						x	x			
EMP_ACC	On duty accidents	n.º		x						x	x			
EMP_LDA	N.º of days lost due to accidents	n.º		x						x	x			

Annex B

List of Reports Consulted

B. List of Reports Consulted

Acciona 2005 Sustainability report
Acciona 2006 Consolidate financial statements
Acciona 2006 Sustainability report
Acciona 2007 Annual report
Acciona 2008 Sustainability report
Acciona 2008 Annual report
Acciona 2009 Sustainability report
Acciona 2010 Sustainability report
Acciona 2010 Annual report
Acciona 2010 Consolidate financial statements and director's report

BKW 2005 Annual report
BKW 2005 Financial report
BKW 2006 Annual report
BKW 2008 Sustainability report
BKW 2010 Annual report
BKW 2010 Financial report
BKW 2010 Facts and figures
BKW 2010 Sustainability report

Centrica 2005 Corporate responsibility report
Centrica 2006 Corporate responsibility report
Centrica 2007 Corporate responsibility report
Centrica 2010 Corporate responsibility report
Centrica 2010 Corporate responsibility report – basis of reporting
Centrica 2010 Annual report

CEZ Group 2005 Annual report
CEZ Group 2006 Annual report
CEZ Group 2007 Annual report
CEZ Group 2007 Corporate responsibility report
CEZ Group 2008 Annual report
CEZ Group 2009 Annual report
CEZ Group 2009/08 Corporate responsibility report
CEZ Group 2010 Annual report

DONG 2005 Annual report
DONG 2005 Quality, Safety & Environment Report
DONG 2006 Annual report
DONG 2006 Corporate responsibility report
DONG 2010 Annual report

DRAX 2006 Annual report
DRAX 2008 Annual report
DRAX 2008 Environmental report v8
DRAX 2009 Annual report
DRAX 2009 Environmental report
DRAX 2010 Annual report
DRAX 2011 Annual report
DRAX 2011 Environmental report

E.ON 2005 Annual report
E.ON 2005 Corporate responsibility report
E.ON 2006 Annual report
E.ON 2007 Annual report
E.ON 2007 Corporate responsibility report
E.ON 2007 Strategy and key figures
E.ON 2008 Financial report
E.ON 2008 Corporate responsibility report

E.ON 2009 Company report
E.ON 2009 Financial report
E.ON 2009 Corporate responsibility report
E.ON 2010 Annual report
E.ON 2010 Corporate responsibility report
E.ON 2010 Indicators ESG DVFA/EFFAS

EDF 2005 Annual report – Sustainable development indicators
EDF 2006 Financial report
EDF 2006 Sustainable development report - indicators
EDF 2007 Financial report
EDF 2007 Sustainable development report - indicators
EDF 2008 Sustainable development indicators
EDF 2009 Financial report
EDF 2009 Sustainable development indicators
EDF 2010 Activity and sustainable development report
EDF 2010 At a glance
EDF 2010 Financial report
EDF 2010 Sustainable development indicators

EDISON 2006 Sustainability report
EDISON 2007 Sustainability report
EDISON 2008 Consolidate financial statements
EDISON 2008 Sustainability report
EDISON 2009 Code of ethics
EDISON 2009 Sustainability report
EDISON 2010 Annual report
EDISON 2010 Sustainability report

EDP 2005 Annual report – Financial notebook
EDP 2005 Annual report – Sustainability notebook
EDP 2006 Annual report – Financial notebook
EDP 2006 Annual report – Sustainability notebook
EDP 2006 Annual report – Corporate governance
EDP 2007 Annual report – Sustainability notebook
EDP 2008 Annual report – Corporate governance and sustainability
EDP 2009 Annual report
EDP 2009 Biodiversity report
EDP 2009 Carbon disclosure project
EDP 2009 Social report
EDP 2009 Water disclosure project
EDP 2010 Annual report

EESTI 2004 - 05 Environmental report
EESTI 2005 - 06 Annual report
EESTI 2005 - 06 Environmental report
EESTI 2009 -10 Environmental report
EESTI 2010 Annual report

ELECTRABEL 2006 Activities report
ELECTRABEL 2007 Activities report
ELECTRABEL 2008 Activities report
ELECTRABEL 2009 Activities and sustainable development report
ELECTRABEL 2010 Activities and sustainable development report

EnBW 2004 Annual report
EnBW 2006 Annual report – Company report
EnBW 2006 Annual report – Sustainability report
EnBW 2006 Annual report – Financial report
EnBW 2007 – 08 Sustainability report
EnBW 2008 – 09 Sustainability report
EnBW 2010 Annual report
EnBW 2011 Annual report

ENDESA 2005 Sustainability report
ENDESA 2006 Annual report
ENDESA 2006 Annual report – operations review
ENDESA 2007 Sustainability report
ENDESA 2008 Sustainability report
ENDESA 2009 Annual report
ENDESA 2009 Annual corporate governance
ENDESA 2009 Sustainability report
ENDESA 2010 Annual report
ENDESA 2010 Sustainability report

ENECO 2007 Annual report
ENECO 2009 Annual report

ENEL 2007 Sustainability report
ENEL 2008 Sustainability report
ENEL 2009 Sustainability report
ENEL 2010 Annual report v2
ENEL 2010 Sustainability report

ESB 2007 Annual report
ESB 2008 Annual report
ESB 2009 Annual report
ESB 2009 Sustainability report
ESB 2010 Annual report
ESB 2010 Sustainability report

ESSENT 2006 Annual report
ESSENT 2006 Corporate social responsibility report
ESSENT 2007 Corporate social responsibility report
ESSENT 2008 Annual report
ESSENT 2009 Corporate social responsibility report
ESSENT 2009 Financial statements
ESSENT 2010 Corporate social responsibility report - summary
ESSENT 2010 Financial statements
ESSENT 2011 Corporate responsibility report

EVN 2004 – 05 Sustainability report
EVN 2005 – 06 Sustainability report
EVN 2005 – 06 Annual report
EVN 2008 – 09 Sustainability report
EVN 2009 – 10 Full report
EVN 2010 – 11 Full report

FORTUM 2005 Annual report - Financials
FORTUM 2005 Annual report
FORTUM 2006 Annual report - Financials
FORTUM 2006 Annual report – review of operations
FORTUM 2007 Annual report – review of operations
FORTUM 2008 Annual report
FORTUM 2009 Annual report
FORTUM 2010 Annual report
FORTUM 2010 Sustainability report

GN FENOSA 2005 Corporate responsibility report
GN FENOSA 2006 Corporate responsibility report
GN FENOSA 2008 Corporate responsibility report
GN FENOSA 2009 Corporate responsibility report
GN FENOSA 2010 Report on Biodiversity and Ecological Footprint
GN FENOSA 2010 Report on Carbon Footprint
GN FENOSA 2010 Corporate responsibility report
GN FENOSA 2010 Annual report

HAFSLUND 2005 Annual report
HAFSLUND 2006 Annual report
HAFSLUND 2010 Annual report
HAFSLUND 2010 Business areas

IBERDROLA 2005 Legal information
IBERDROLA 2005 Sustainability report
IBERDROLA 2007 Environmental management Strategy and focus
IBERDROLA 2007 Biodiversity Report
IBERDROLA 2007 Sustainability report
IBERDROLA 2008 Sustainability report
IBERDROLA 2009 Sustainability report
IBERDROLA 2010 Annual report
IBERDROLA 2010 Sustainability report
IBERDROLA 2010 Consolidated Financial Statements

IP PLC 2004 Annual report
IP PLC 2005 Annual report
IP PLC 2007 Annual report
IP PLC 2008 Annual report
IP PLC 2010 Annual report

NUON 2005 Sustainability report
NUON 2006 Annual report
NUON 2007 Annual report
NUON 2008 Annual report
NUON 2008 Corporate social responsibility report
NUON 2009 Annual report
NUON 2009 Corporate social responsibility report
NUON 2010 Annual report

RWE 2005 Annual report
RWE 2005 Corporate responsibility report
RWE 2006 Corporate responsibility report
RWE 2010 Corporate responsibility report

SSE 2006 Annual report
SSE 2010 Annual report
SSE 2011 Annual report

STATKRAFT 2006 Annual report and Sustainability report
STATKRAFT 2008 Annual report and Sustainability report
STATKRAFT 2010 Annual report and Sustainability report

VATTENFALL 2004 Annual report
VATTENFALL 2005 Annual report
VATTENFALL 2005 Corporate social responsibility report
VATTENFALL 2007 Corporate social responsibility report
VATTENFALL 2008 Annual report
VATTENFALL 2009 Corporate social responsibility report
VATTENFALL 2010 Annual report
VATTENFALL 2010 Corporate social responsibility report

VERBUND 2004 Sustainability report
VERBUND 2005 Annual report
VERBUND 2005 Sustainability report
VERBUND 2007 Annual report
VERBUND 2007 Sustainability report
VERBUND 2008 Sustainability report
VERBUND 2009 Sustainability report
VERBUND 2010 Annual report
VERBUND 2010 Sustainability report

Annex C

Descriptive Statistics (2004-2010)

C. Descriptive Statistics (2004-2010)

	VOL	ROR	ROI	ROE	ROA	IT_LBL_EQT	IDBT	IEBITDA	IEBIT	E_PS	DV_YLD
Mean	0.018148	0.136081	0.328623	0.324086	0.052131	2.381322	0.267383	0.114211	0.076814	2.602187	0.200363
Median	0.015976	0.105663	0.072199	0.155285	0.047672	1.754588	0.233197	0.102119	0.066555	1.360000	0.043348
Maximum	0.076028	1.612709	8.300000	10.05000	0.433875	9.303850	0.781511	0.671520	0.386454	21.84000	4.210000
Minimum	0.007284	-1.318198	-0.628732	-0.078066	-0.430732	0.288376	-0.053379	-0.448380	0.009190	-1.671133	0.005000
Std. Dev.	0.008696	0.228955	1.283270	1.032316	0.067668	1.802719	0.162611	0.079962	0.054945	3.548351	0.625773
Skewness	2.624510	0.957859	5.329579	7.458755	-0.752909	1.595905	1.087624	0.715409	3.157171	3.022284	4.447486
Kurtosis	16.12650	32. 19911	30.43270	62.64676	31.95349	5.228898	4.524381	28.28430	16.42345	14.08400	23.73953
Jarque-Bera	1124.196	4281.289	4727.848	24571.74	4448.026	114.9302	20.87235	5023.854	1723.804	1042.688	2249.182
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000029	0.000000	0.000000	0.000000	0.000000
Sum	2.450029	16.32966	43.04963	50.55734	6.620657	433.4007	18.98417	21.47161	14.44100	408.5433	21.23851
Sum Sq. Dev.	0.010133	6.238004	214.0815	165.1797	0.576943	588.2128	1.850958	1.195657	0.564552	1964.164	41.11713
Observations	135	120	131	156	127	182	71	188	188	157	106

	IRVN_EMP	IBYPRO	ISELF_T	IEVD_TAX	IEVD_OWN	IEVD_LEN	IEVD_EMP	IGENT_SAL	ISAL_ELCOS	IH_GENTH	IWA	IPDTV	IPEC_CN	ICAPEX	IT_RVN
Mean	0.814539	0.840494	0.035823	0.153520	0.280488	0.152813	0.402160	1.143105	0.046475	1.275536	31.16305	5.800785	5.385031	0.041728	0.493700
Median	0.749337	0.892929	0.031098	0.131868	0.212619	0.109026	0.327811	0.735750	0.016645	0.320720	15.21390	3.653494	5.787610	0.051305	0.407295
Maximum	3.398852	2.718114	0.136252	1.000000	1.000000	1.000000	8.472077	19.05556	1.448399	19.23077	221.9979	25.83497	13.83772	0.234413	1.480549
Minimum	0.041367	0.251302	-0.096038	-0.023976	0.032656	0.018097	0.022493	0.163309	0.004363	0.092593	0.011718	0.188988	0.003200	-0.181671	0.111077
Std. Dev.	0.519243	0.345173	0.035742	0.122671	0.244100	0.147379	0.729883	2.199000	0.178896	3.518408	46.69385	5.896094	2.801499	0.062577	0.262356
Skewness	1.760122	3.002099	-0.078586	2.747939	1.616705	3.031675	9.560153	6.139182	7.486066	4.211378	2.229772	1.885912	0.020076	-0.754136	1.679748
Kurtosis	8.028168	19.24325	4.681840	18.52902	5.216083	16.03897	106.0211	43.74460	58.95220	20.13960	7.890964	5.741840	3.514432	4.433348	5.667370
Jarque-Bera	287.2687	612.2830	8.440975	1492.454	74.90906	706.4945	65416.19	10261.66	9225.737	820.5949	151.5063	154.9284	0.698912	28.68209	143.3750
Probability	0.000000	0.000000	0.014691	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.705072	0.000001	0.000000
Sum	149.0607	41.18423	2.543412	20.26462	32.81714	12.53069	57.50882	155.4623	3.067325	68.87895	2586.533	991.9343	339.2569	6.634723	92.32196
Sum Sq. Dev.	49.06956	5.718921	0.089423	1.971305	6.911851	1.759375	75.64750	652.8059	2.080242	656.0975	178785.9	5909.868	486.6006	0.618706	12.80247
Observations	183	49	71	132	117	82	143	136	66	54	83	171	63	159	187

	IGENTH_T	IWST_Z	IWST_ZREC	IPART_T	INOX_T	ISO_T	ICO_TH	ICO_TEQ	IWST_REC_NZ	IGENRENU_T	IGENRE_T	IGENNU_T	IEXPENV_RVN
Mean	0.546088	0.189131	0.591309	1.188028	9.241830	2.620360	437.5302	383.8483	0.676954	0.511399	0.300570	0.180033	0.020817
Median	0.564083	0.095346	0.676183	0.032000	0.437500	0.340000	468.0000	413.0000	0.736558	0.458785	0.194798	0.124390	0.013750
Maximum	1.000000	1.665818	0.965066	34.00000	396.0000	101.0000	907.1764	866.0000	0.999896	1.004683	1.004683	0.660351	0.082001
Minimum	0.000227	0.001537	0.001000	0.001100	0.043419	0.015000	12.50000	0.000000	0.009730	0.003300	0.001306	0.000000	0.001331
Std. Dev.	0.289077	0.268531	0.269733	5.460407	53.60814	12.22974	244.1568	205.3799	0.282352	0.299564	0.310440	0.206048	0.020031
Skewness	-0.339625	3.045220	-0.686814	4.845906	6.111849	6.497723	-0.145628	0.108521	-1.151429	0.262531	1.207504	0.761601	1.239920
Kurtosis	2.144048	14.02328	2.723015	25.75635	39.21888	46.24527	1.916724	2.284536	3.531677	1.927904	3.195624	2.205519	3.841639
Jarque-Bera	6.268677	568.3386	2.209023	1758.875	6940.825	9770.377	6.973170	3.144358	11.17167	7.600424	36.44623	16.72427	18.00216
probability	0.043529	0.000000	0.331373	0.000000	0.000000	0.000000	0.030605	0.207592	0.003751	0.022366	0.000000	0.000234	0.000123
Sum	68.80707	16.26531	15.96534	81.97393	1053.569	301.3414	58191.51	51819.53	32.49377	65.45906	44.78489	24.48454	1.311450
Sum Sq. Dev.	10.44572	6.129236	1.891660	2027.491	324743.1	17050.60	7868856.	5652241.	3.746973	11.39680	14.26322	5.731533	0.024876
observations	126	86	27	69	114	115	133	135	48	128	149	136	63

	IWAGE	ITAX	IEMP_FAT	IEMP_WONM	IEMP_WOMT	IEMP_WOMB	IEMP_TURN	IEMP_TRG	IEMP_SEN	IEMP_PC	IEMP_FTC	IEMP_ACC	IEMP_ABS
Mean	1.715150	0.054144	0.128110	16.25369	24.37383	25.53695	6.706422	34.61068	15.86750	89.53210	91.40751	11.04747	4.810667
Median	1.212124	0.041783	0.038308	16.35000	24.97109	9.000000	5.843807	36.25933	15.25000	95.20000	93.00000	7.057210	4.000000
Maximum	7.253555	0.301111	2.066799	38.00000	35.00000	1357.895	18.50000	83.59830	30.00000	100.0000	100.0000	128.6957	11.00000
Minimum	0.112731	-0.002936	0.000000	0.000000	12.40000	0.000000	0.780000	7.638779	6.470000	47.47000	74.03234	0.107291	1.940000
Std. Dev.	1.613999	0.049471	0.252438	9.029699	5.174534	135.9383	4.060964	15.13925	3.658820	12.30044	6.642801	15.81308	2.181775
Skewness	1.721120	2.839038	4.977573	0.157793	-0.052695	9.653681	0.529314	0.755860	0.571345	-1.856049	-1.036415	5.192830	1.179535
Kurtosis	5.545381	12.18074	35.85072	2.720052	2.369680	95.12652	2.573655	4.535779	5.827415	5.692561	3.347537	36.50433	3.373361
Jarque-Bera	84.00321	631.1856	5056.763	0.622878	2.178191	36547.79	4.450082	9.287828	23.25005	65.71735	8.650758	4614.008	21.39228
Probability	0.000000	0.000000	0.000000	0.732392	0.336521	0.000000	0.108063	0.009620	0.000009	0.000000	0.013229	0.000000	0.000023
Sum	188.6665	7.038702	13.19529	1365.310	3119.851	2528.158	549.9266	1661.312	952.0500	6714.907	4296.153	994.2727	432.9600
Sum Sq. Dev.	283.9441	0.315718	6.499938	6767.443	3400.527	1810964.	1335.806	10772.25	789.8309	11196.26	2029.833	22254.75	423.6528
Observations	110	130	103	84	128	99	82	48	60	75	47	90	90

Annex D

Results for CFA

D. *Results for CFA*

Economic variables

Rotation Method: Orthogonal Varimax						
Factor: Untitled						
Date: 06/05/12 Time: 16:03						
Initial loadings: Unrotated						
Convergence achieved after 33 iterations						
Rotated loadings: L * inv(T)'						
	F1	F2	F3	F4	F5	F6
IT_RVN	0.031523	-0.230338	-0.294971	0.208514	0.072712	-0.645025
ICAPEX	-0.021799	0.044780	0.109562	-0.107444	0.124509	-0.216720
IPEC_CN	-0.242516	-0.101285	-0.319645	0.229823	0.280846	0.110949
IPDTV	0.065948	-0.048891	-0.070280	0.422634	-0.130791	0.623047
IWA	0.037590	0.061492	0.114435	0.027686	0.846411	-0.090181
IH_GENTH	0.058570	1.079364	-0.133178	0.073859	0.052124	0.035165
ISAL_ELCOS	-0.111051	0.454614	0.357745	0.858357	0.208891	-0.037739
IGENT_SAL	0.431673	-0.154293	0.002633	0.043187	0.115246	0.450546
IEVD_EMP	0.741482	-0.087833	0.106207	-0.147909	-0.078907	-0.064153
IEVD_LEN	0.458023	-0.077678	-0.137601	0.017170	-0.161753	-0.275619
IEVD_OWN	0.328239	0.101474	-0.085291	-0.139755	0.548516	0.083721
IEVD_TAX	0.871312	0.196406	-0.127066	-0.119973	0.154542	0.088240
ISELF_T	0.003190	0.317918	0.659983	-0.064561	-0.115514	0.065852
IBYPRO	-0.076034	-0.527107	0.875671	0.139751	0.131612	0.058098
IRVN_EMP	-0.091442	-0.168849	-0.143859	0.930936	-0.150801	0.053162
Rotated factor correlation: T'T						
	F1	F2	F3	F4	F5	F6
F1	1.000000					
F2	-3.47E-17	1.000000				
F3	8.33E-17	3.50E-16	1.000000			
F4	2.08E-16	-7.63E-17	-7.91E-16	1.000000		
F5	-8.33E-17	-2.84E-16	-6.25E-16	4.86E-16	1.000000	
F6	-5.55E-17	8.33E-17	-2.22E-16	-8.33E-17	1.11E-16	1.000000

Initial factor rotation matrix: T_0						
	F1	F2	F3	F4	F5	F6
F1	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
F2	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000
F3	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
F4	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
F5	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
F6	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
Factor rotation matrix: T						
	F1	F2	F3	F4	F5	F6
F1	0.674066	0.117608	-0.222366	-0.684572	0.092884	-0.071345
F2	0.148936	0.871897	-0.148112	0.359878	0.217924	0.136654
F3	0.340866	-0.058669	0.834198	0.056470	0.268011	0.330852
F4	0.550774	-0.413445	-0.376068	0.557307	-0.063665	0.263895
F5	-0.020452	-0.200239	-0.088847	0.138256	0.832862	-0.488690
F6	0.321704	0.107193	0.288806	0.262591	-0.417539	-0.747204
Loading rotation matrix: inv(T)'						
	F1	F2	F3	F4	F5	F6
F1	0.674066	0.117608	-0.222366	-0.684572	0.092884	-0.071345
F2	0.148936	0.871897	-0.148112	0.359878	0.217924	0.136654
F3	0.340866	-0.058669	0.834198	0.056470	0.268011	0.330852
F4	0.550774	-0.413445	-0.376068	0.557307	-0.063665	0.263895
F5	-0.020452	-0.200239	-0.088847	0.138256	0.832862	-0.488690
F6	0.321704	0.107193	0.288806	0.262591	-0.417539	-0.747204
Initial rotation objective:	5.155334					
Final rotation objective:	3.092020					

Environmental variables

Rotation Method: Orthogonal Varimax				
Factor: Untitled				
Date: 06/05/12 Time: 16:09				
Initial loadings: Unrotated				
Convergence achieved after 143 iterations				
Rotated loadings: L * inv(T)'				
	F1	F2	F3	F4
IEXPENV_RVN	0.144375	-0.335666	0.539615	0.375461
IGENNU_T	-0.204588	-0.146900	-0.000760	0.586145
IGENRE_T	0.049918	0.998697	0.112794	-0.204802
IGENRENU_T	-0.157860	0.814279	0.033764	0.403608
IWST_REC_NZ	-0.468886	0.207106	0.364289	0.169489
ICO_TEQ	0.004537	-0.548434	0.160766	-0.651081
ICO_TH	-0.056546	0.207345	-0.067029	-0.669190
ISO_T	1.015679	-0.044457	-0.043929	0.007519
INOX_T	0.985150	0.010840	0.061001	-0.009470
IPART_T	0.962114	-0.009013	-0.035197	-0.044291
IWST_ZREC	-0.031251	0.105446	1.074011	-0.048358
IWST_Z	-0.045439	0.241843	-0.213523	0.292740
Rotated factor correlation: T'T				
	F1	F2	F3	F4
F1	1.000000			
F2	1.21E-17	1.000000		
F3	-2.78E-17	1.11E-16	1.000000	
F4	1.39E-17	3.05E-16	1.67E-16	1.000000
Initial factor rotation matrix: T_0				
	F1	F2	F3	F4
F1	1.000000	0.000000	0.000000	0.000000
F2	0.000000	1.000000	0.000000	0.000000
F3	0.000000	0.000000	1.000000	0.000000
F4	0.000000	0.000000	0.000000	1.000000

Factor rotation matrix: T				
	F1	F2	F3	F4
F1	0.946316	-0.260444	-0.080352	-0.173778
F2	0.296338	0.920637	-0.037687	0.251377
F3	0.123212	-0.132915	0.863332	0.470968
F4	-0.038581	0.258708	0.496771	-0.827527
Loading rotation matrix: inv(T)'				
	F1	F2	F3	F4
F1	0.946316	-0.260444	-0.080352	-0.173778
F2	0.296338	0.920637	-0.037687	0.251377
F3	0.123212	-0.132915	0.863332	0.470968
F4	-0.038581	0.258708	0.496771	-0.827527
Initial rotation objective:	3.686190			
Final rotation objective:	2.286522			

Financial variables

Rotation Method: Orthogonal Varimax				
Factor: Untitled				
Date: 06/05/12 Time: 15:56				
Initial loadings: Unrotated				
Convergence achieved after 18 iterations				
Rotated loadings: L * inv(T)'				
	F1	F2	F3	F4
DV_YLD	0.073319	0.074541	0.976361	0.035428
E_PS	-0.003387	-0.066303	0.006658	-0.379757
IEBIT	0.925092	-0.035712	0.062835	0.136545
IEBITDA	0.810068	0.046255	0.004306	-0.079849
IDBT	-0.050719	0.040519	0.168743	0.574146
IT_LBL_EQT	-0.122554	-0.048146	-0.106513	-0.001338
ROA	0.753818	0.715251	0.061073	-0.037016
ROE	0.027916	0.847726	-0.003673	0.165082
ROI	0.078977	1.054449	0.060201	-0.021025
ROR	0.742367	0.627919	0.056529	-0.249915
VOL	-0.063482	0.001322	0.116789	0.071057
Rotated factor correlation: T'T				
	F1	F2	F3	F4
F1	1.000000			
F2	1.71E-16	1.000000		
F3	3.47E-17	-2.35E-16	1.000000	
F4	2.78E-17	4.16E-17	1.11E-16	1.000000
Initial factor rotation matrix: T_0				
	F1	F2	F3	F4
F1	1.000000	0.000000	0.000000	0.000000
F2	0.000000	1.000000	0.000000	0.000000
F3	0.000000	0.000000	1.000000	0.000000
F4	0.000000	0.000000	0.000000	1.000000

Factor rotation matrix: T				
	F1	F2	F3	F4
F1	0.690157	0.714566	0.107737	-0.038370
F2	-0.712704	0.692040	0.015998	0.113482
F3	-0.028511	-0.099779	0.949678	0.295537
F4	0.122165	-0.022819	-0.293680	0.947791
Loading rotation matrix: inv(T)'				
	F1	F2	F3	F4
F1	0.690157	0.714566	0.107737	-0.038370
F2	-0.712704	0.692040	0.015998	0.113482
F3	-0.028511	-0.099779	0.949678	0.295537
F4	0.122165	-0.022819	-0.293680	0.947791
Initial rotation objective:	3.078122			
Final rotation objective:	2.202279			

Social variables

Rotation Method: Orthogonal Varimax					
Factor: Untitled					
Date: 06/05/12 Time: 16:14					
Initial loadings: Unrotated					
Convergence achieved after 18 iterations					
Rotated loadings: L * inv(T)'					
	F1	F2	F3	F4	F5
IEMP_ABS	0.116148	0.104482	0.196410	0.115636	-0.314134
IEMP_ACC	-0.971145	0.083956	0.082947	0.055239	0.308914
IEMP_FTC	0.871207	-0.020802	0.223857	-0.113190	0.449958
IEMP_PC	0.805575	0.022883	0.331324	-0.032618	0.466957
IEMP_SEN	0.214792	-0.081549	0.938715	-0.315235	0.184260
IEMP_TRG	-0.131137	0.467111	0.219491	0.258260	0.843655
IEMP_TURN	0.034632	-0.122147	0.023548	0.528076	-0.224204
IEMP_WOMB	-0.076239	1.027538	-0.067510	0.067127	0.092345
IEMP_WOMT	-0.120812	0.078622	-0.303396	0.957347	0.021404
IEMP_WONM	-0.026969	0.374646	0.159822	-0.124906	0.234249
IEMP_FAT	-0.006954	-0.114619	0.405234	-0.142351	0.094835
ITAX	0.200866	0.531881	-0.353802	-0.245426	0.235201
IWAGE	-0.276480	0.034574	-0.038011	0.212385	-0.922746
Rotated factor correlation: T'T					
	F1	F2	F3	F4	F5
F1	1.000000				
F2	9.71E-17	1.000000			
F3	-8.33E-17	-4.44E-16	1.000000		
F4	2.15E-16	1.67E-16	5.55E-17	1.000000	
F5	-1.70E-16	2.22E-16	4.44E-16	-1.67E-16	1.000000
Initial factor rotation matrix: T_0					
	F1	F2	F3	F4	F5
F1	1.000000	0.000000	0.000000	0.000000	0.000000
F2	0.000000	1.000000	0.000000	0.000000	0.000000
F3	0.000000	0.000000	1.000000	0.000000	0.000000
F4	0.000000	0.000000	0.000000	1.000000	0.000000
F5	0.000000	0.000000	0.000000	0.000000	1.000000

Factor rotation matrix: T					
	F1	F2	F3	F4	F5
F1	0.627440	0.096335	0.385837	-0.310671	0.593002
F2	-0.406527	0.688623	-0.178841	0.197492	0.538096
F3	0.655008	0.221285	-0.517546	0.484792	-0.138274
F4	-0.088450	-0.506722	0.240697	0.721002	0.397026
F5	0.064769	0.459111	0.702393	0.331078	-0.426676
Loading rotation matrix: inv(T)'					
	F1	F2	F3	F4	F5
F1	0.627440	0.096335	0.385837	-0.310671	0.593002
F2	-0.406527	0.688623	-0.178841	0.197492	0.538096
F3	0.655008	0.221285	-0.517546	0.484792	-0.138274
F4	-0.088450	-0.506722	0.240697	0.721002	0.397026
F5	0.064769	0.459111	0.702393	0.331078	-0.426676
Initial rotation objective:	6.083184				
Final rotation objective:	3.686695				

Annex E

Full Results for PCA

E. Full Results for PCA

Economic variables

Principal Components Analysis						
Date: 06/18/12 Time: 15:24						
Sample: 2004 2010						
Included observations: 210						
Pairwise samples (pairwise missing deletion)						
Computed using: Ordinary correlations						
Extracting 6 of 15 possible components						
Minimum eigenvalue: 1						
Eigenvalues: (Sum = 15	Average = 1)					
				Cumulative	Cumulative	
Number	Value	Difference	Proportion	Value	Proportion	
1	2.675371	0.522989	0.1784	2.675371	0.1784	
2	2.152382	0.213834	0.1435	4.827753	0.3219	
3	1.938548	0.062219	0.1292	6.766301	0.4511	
4	1.876329	0.238289	0.1251	8.642631	0.5762	
5	1.638040	0.240700	0.1092	10.28067	0.6854	
6	1.397340	0.398479	0.0932	11.67801	0.7785	
Eigenvectors (loadings):						
Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
IT_RVN	-0.022107	-0.216369	-0.401619	0.019459	0.283615	0.397800
ICAPEX	0.058502	-0.034764	0.043592	-0.299543	0.215709	0.233684
IPEC_CN	-0.202241	0.070976	-0.297382	0.173520	0.294828	-0.329827
IPDTV	-0.176197	0.237134	0.113678	0.449820	-0.160478	-0.099222
IWA	0.072015	0.224946	0.044014	-0.148229	0.621431	-0.063197
IH_GENTH	0.078440	0.605835	-0.207644	-0.285086	-0.265194	0.020087
ISAL_ELCOS	-0.346051	0.487464	0.067682	0.021955	0.142154	0.363307
IGENT_SAL	0.194209	0.131126	0.198777	0.474156	0.078127	-0.210189
IEVD_EMP	0.418139	-0.026043	0.165711	0.224950	-0.029473	0.245152
IEVD_LEN	0.270949	-0.094055	-0.143741	0.187648	-0.055777	0.487821
IEVD_OWN	0.304693	0.244096	-0.019119	-0.003724	0.401365	-0.146893
IEVD_TAX	0.477387	0.243208	-0.007375	0.193080	0.012471	0.097317
ISELF_T	-0.032166	0.188172	0.490842	-0.267809	-0.134590	0.188840
IBYPRO	-0.187049	-0.192718	0.583119	0.077690	0.305075	0.111096
IRVN_EMP	-0.387715	0.132088	-0.129621	0.384748	0.033544	0.332908

	IRVN_EMP	IBYPRO	ISELF_T	IEVD_TAX	IEVD_OWN	IEVD_LEN	IEVD_EMP	IGENT_SAL	ISAL_ELCOS	IH_GENTH	IWA	IPDTV	IPEC_CN	ICAPEX	IT_RVN
IT_RVN															1.000000
ICAPEX														1.000000	0.112409
IPEC_CN													1.000000	-0.092370	0.225966
IPDTV												1.000000	0.057415	-0.094102	-0.314007
IWA											1.000000	-0.189293	0.171336	0.194943	-0.020479
IH_GENTH										1.000000	-0.005460	-0.081920	0.001347	-0.088528	-0.227199
ISAL_ELCOS									1.000000	0.703431	0.331623	0.278379	0.132551	0.015655	0.052220
IGENT_SAL								1.000000	-0.036573	-0.074553	0.015434	0.317012	0.228544	-0.170290	-0.221975
IEVD_EMP							1.000000	0.378950	-0.160394	-0.141856	0.034807	-0.129299	-0.286645	-0.022573	-0.016171
IEVD_LEN						1.000000	0.320140	0.163516	-0.175302	-0.042478	-0.119236	-0.118421	-0.222408	0.057088	0.271385
IEVD_OWN					1.000000	0.102759	0.046810	0.199462	-0.153680	0.246273	0.508344	0.012777	-0.032576	0.089551	0.005482
IEVD_TAX				1.000000	0.488886	0.287278	0.650649	0.338093	-0.151025	0.308640	0.116138	0.085072	-0.179089	-0.016668	-0.009067
ISELF_T			1.000000	-0.033801	-0.082597	-0.088939	0.043513	-0.012402	0.199424	0.333620	0.001412	0.005960	-0.273695	0.198211	-0.316862
IBYPRO		1.000000	0.450057	-0.239224	-0.005291	-0.173935	-0.024377	0.149355	0.374822	-0.810039	0.073478	-0.036327	-0.129609	-0.053588	-0.110957
IRVN_EMP	1.000000	-0.003235	-0.128302	-0.217057	-0.177254	0.070818	-0.220501	-0.070128	0.685070	-0.215021	-0.112177	0.503343	0.223828	-0.174419	0.174929

Environmental variables

Principal Components Analysis					
Date: 06/18/12 Time: 15:51					
Sample: 2004 2010					
Included observations: 210					
Pairwise samples (pairwise missing deletion)					
Computed using: Ordinary correlations					
Extracting 4 of 13 possible components					
Minimum eigenvalue: 1					
Eigenvalues: (Sum = 13	Average = 1)				
				Cumulative	Cumulative
Number	Value	Difference	Proportion	Value	Proportion
1	3.864303	1.031938	0.2973	3.864303	0.2973
2	2.832365	0.784831	0.2179	6.696668	0.5151
3	2.047535	0.253971	0.1575	8.744203	0.6726
4	1.793564	0.822553	0.1380	10.53777	0.8106
Eigenvectors (loadings):					
Variable	PC 1	PC 2	PC 3	PC 4	
IEXPENV_RVN	0.080602	-0.058676	0.536090	0.256541	
IGENNU_T	-0.178032	-0.053694	0.431875	-0.236145	
IGENRE_T	-0.251426	0.401488	-0.274671	0.225782	
IGENRENU_T	-0.397648	0.354087	0.043605	-0.001312	
IWST_REC_NZ	-0.317179	-0.127024	0.126759	0.242954	
ICO_TEQ	0.254598	-0.300943	-0.205307	0.264481	
ICO_TH	-0.009158	0.035758	-0.542528	0.223726	
ISO_T	0.373536	0.396999	0.108425	0.019317	
INOX_T	0.348679	0.399944	0.111517	0.089253	
IPART_T	0.369000	0.376072	0.066866	0.021929	
IWST_ZREC	-0.086061	-0.012488	0.249739	0.724909	
IWST_Z	-0.155089	0.164389	0.071631	-0.328721	
IGENTH_T	0.382409	-0.336082	-0.005204	-0.077727	

IGENTH_T	IWST_Z	IWST_ZREC	IPART_T	INOX_T	ISO_T	ICO_TH	ICO_TEQ	IWST_REC_NZ	IGENRENU_T	IGENRE_T	IGENNU_T	IEXPENV_RVN	
												1,00000	IEXPENV_RVN
											1,00000	0,18970	IGENNU_T
										1,00000	-0,38710	-0,35116	IGENRE_T
									1,00000	0,77007	0,29013	-0,09007	IGENRENU_T
								1,00000	0,27151	0,09347	0,28738	-0,19169	IWST_REC_NZ
							1,00000	-0,18477	-0,67910	-0,41534	-0,22757	0,05972	ICO_TEQ
						1,00000	0,41839	-0,09632	-0,00270	0,29558	-0,37864	-0,40117	ICO_TH
					1,00000	-0,02004	0,04557	-0,54017	-0,15086	0,03099	-0,17583	0,25292	ISO_T
				1,00000	0,98992	-0,03728	0,02572	-0,40166	-0,13201	0,03661	-0,16228	0,10409	INOX_T
			1,00000	0,99692	0,99710	-0,07002	0,00541	-0,38992	-0,24024	-0,01292	-0,19619	-0,09235	IPART_T
		1,00000	0,02230	0,05723	-0,13964	0,01220	0,14546	0,61035	0,10071	0,28802	-0,06551	0,66326	IWST_ZREC
	1,00000	-0,35696	0,00117	-0,06778	-0,07815	-0,04900	-0,34664	0,14912	0,30264	0,21031	0,10716	0,11259	IWST_Z
1,00000	-0,27253	-0,19320	0,22753	0,10628	0,11947	-0,22322	0,48494	-0,26908	-0,99587	-0,72860	-0,40775	0,10122	IGENTH_T

Financial variables

Principal Components Analysis					
Date: 06/18/12 Time: 15:33					
Sample: 2004 2010					
Included observations: 210					
Pairwise samples (pairwise missing deletion)					
Computed using: Ordinary correlations					
Extracting 4 of 11 possible components					
Minimum eigenvalue: 1					
Eigenvalues: (Sum = 11	Average = 1)				
				Cumulative	Cumulative
Number	Value	Difference	Proportion	Value	Proportion
1	3.953762	2.169495	0.3594	3.953762	0.3594
2	1.784267	0.442497	0.1622	5.738029	0.5216
3	1.341770	0.289320	0.1220	7.079798	0.6436
4	1.052449	0.059156	0.0957	8.132248	0.7393
Eigenvectors (loadings):					
Variable	PC 1	PC 2	PC 3	PC 4	
DV_YLD	0.104055	0.047782	0.460426	0.521596	
E_PS	-0.022930	-0.153716	-0.454015	0.601025	
IEBIT	0.318156	-0.465089	0.211888	-0.112725	
IEBITDA	0.326580	-0.463464	0.071086	-0.123937	
IDBT	-0.005324	0.206430	0.601325	-0.206721	
IT_LBL_EQT	-0.086072	0.071273	-0.216304	-0.279466	
ROA	0.518207	-0.024538	-0.043558	0.009318	
ROE	0.325750	0.493832	-0.095708	-0.070607	
ROI	0.402074	0.481925	-0.130173	0.024646	
ROR	0.486326	-0.085263	-0.106423	0.060073	
VOL	-0.022472	0.106277	0.290209	0.456636	

Ordinary correlations:

	DV_YLD	E_PS	IEBIT	IEBITDA	IDBT	IT_LBL_EQT	ROA	ROE	ROI	ROR	VOL
DV_YLD	1.000000										
E_PS	-0.005946	1.000000									
IEBIT	0.132482	-0.083536	1.000000								
IEBITDA	0.070971	-0.045974	0.642956	1.000000							
IDBT	0.185154	-0.214942	0.028968	-0.087452	1.000000						
IT_LBL_EQT	-0.116861	0.035414	-0.089901	-0.114581	-0.021951	1.000000					
ROA	0.162915	0.075446	0.725974	0.737751	0.006835	-0.156333	1.000000				
ROE	0.072697	-0.097396	0.025311	0.039038	0.136853	0.013355	0.640166	1.000000			
ROI	0.143975	-0.161085	-0.038937	0.035574	0.015860	-0.096033	0.921249	0.888883	1.000000		
ROR	0.142645	0.067170	0.693388	0.678663	-0.155562	-0.122709	0.924479	0.502258	0.811871	1.000000	
VOL	0.113383	-0.049647	-0.021741	-0.086006	0.058280	0.018127	-0.069817	-0.003098	0.010684	-0.019625	1.000000

Social variables

Principal Components Analysis					
Date: 06/18/12 Time: 15:36					
Sample: 2004 2010					
Included observations: 210					
Pairwise samples (pairwise missing deletion)					
Computed using: Ordinary correlations					
Extracting 5 of 13 possible components					
Minimum eigenvalue: 1					
Eigenvalues: (Sum = 13	Average = 1)				
				Cumulative	Cumulative
Number	Value	Difference	Proportion	Value	Proportion
1	3.791006	1.229047	0.2916	3.791006	0.2916
2	2.561959	0.784031	0.1971	6.352965	0.4887
3	1.777928	0.375564	0.1368	8.130893	0.6255
4	1.402364	0.086190	0.1079	9.533257	0.7333
5	1.316174	0.347458	0.1012	10.84943	0.8346
Eigenvectors (loadings):					
Variable	PC 1	PC 2	PC 3	PC 4	PC 5
IEMP_ABS	-0.047369	-0.133604	0.174939	0.057930	0.738848
IEMP_ACC	-0.193375	0.371412	-0.451646	0.206549	-0.015907
IEMP_FTC	0.464692	-0.146493	0.297068	0.066184	-0.003379
IEMP_PC	0.464557	-0.114754	0.226856	0.147853	-0.066541
IEMP_SEN	0.351480	-0.206607	-0.337809	0.159632	0.209068
IEMP_TRG	0.248666	0.481574	-0.052267	0.355860	-0.094145
IEMP_TURN	-0.180157	-0.105132	0.299558	0.520551	0.144272
IEMP_WOMB	0.043686	0.505113	0.168746	-0.167609	0.297280
IEMP_WOMT	-0.241147	0.212659	0.342033	0.480689	-0.103930
IEMP_WONM	0.175158	0.278708	-0.149331	-0.022954	0.475829
IEMP_FAT	0.158741	-0.117058	-0.425560	0.172957	0.074805
ITAX	0.155732	0.322130	0.264139	-0.439815	-0.053363
IWAGE	-0.413024	-0.168554	0.022035	-0.147024	0.204916

Ordinary correlations:

	IEMP_ABS	IEMP_ACC	IEMP_FTC	IEMP_PC	IEMP_SEN	IEMP_TRG	IEMP_TURN	IEMP_WOMB	IEMP_WOMT	IEMP_WONM	IEMP_FAT	ITAX	IWAGE
IEMP_ABS	1.000000												
IEMP_ACC	-0.039499	1.000000											
IEMP_FTC	0.159141	-0.753716	1.000000										
IEMP_PC	-0.025896	-0.693704	0.884181	1.000000									
IEMP_SEN	0.117913	-0.052582	0.551208	0.619360	1.000000								
IEMP_TRG	-0.287878	0.547437	0.414368	0.380321	0.233685	1.000000							
IEMP_TURN	0.231170	-0.012368	-0.078244	-0.112065	-0.142954	-0.180716	1.000000						
IEMP_WOMB	0.067343	0.161259	-0.157983	0.034272	-0.135759	0.615641	-0.107184	1.000000					
IEMP_WOMT	0.017497	0.091291	-0.341724	-0.204835	-0.663967	0.300657	0.508580	0.172612	1.000000				
IEMP_WONM	0.166974	0.044444	0.078180	0.051731	0.095351	0.358352	-0.186018	0.448236	-0.120622	1.000000			
IEMP_FAT	-0.168803	-0.056986	0.022157	0.197924	0.540768	0.057936	-0.108239	-0.220566	-0.159827	0.274040	1.000000		
ITAX	-0.142636	-0.085163	0.281083	0.151814	-0.209587	0.245262	-0.216161	0.618807	-0.109375	0.143626	-0.097971	1.000000	
IWAGE	0.263762	-0.098170	-0.727875	-0.733297	-0.301631	-0.575688	0.241882	0.022107	0.228518	-0.422096	-0.087558	-0.292967	1.000000

Aggregated variables

Principal
Date: 06/18/12 Time: 16:35
Sample: 2004 2010
Included observations: 210
Pairwise samples (pairwise missing deletion)
Computed using: Ordinary correlations
Extracting 7 of 19 possible components
Minimum eigenvalue: 1

Eigenvalues: (Sum = 19 Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	3.895322	1.029376	0.2050	3.895322	0.2050
2	2.865946	0.312175	0.1508	6.761268	0.3559
3	2.553771	0.285022	0.1344	9.315039	0.4903
4	2.268749	0.500247	0.1194	11.58379	0.6097
5	1.768502	0.414458	0.0931	13.35229	0.7028
6	1.354044	0.312278	0.0713	14.70633	0.7740
7	1.041766	0.068053	0.0548	15.74810	0.8288

Eigenvectors (loadings):

Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
IWA	-0.295865	0.354307	-0.104866	-0.215608	0.103184	-0.038489	0.361657
IH_GENTH	-0.126872	-0.324914	0.453500	-0.294518	0.045683	-0.144196	0.193011
IGENT_SAL	-0.073257	0.110542	0.215481	0.362014	0.208333	0.080756	-0.041984
IEVD_LEN	-0.248748	-0.117262	-0.067649	0.229041	-0.163599	-0.103377	-0.491131
IEVD_TAX	-0.253883	-0.107099	0.206514	0.259951	0.007433	0.079893	-0.030853
IBYPRO	0.099482	0.004441	-0.439389	0.307673	0.306264	-0.083183	0.356834
IGENRE_T	0.276099	0.204758	0.330411	0.062170	-0.003132	-0.211200	0.140402
IGENRENU_T	0.235950	0.094323	0.436251	0.259552	0.143329	-0.132825	0.171635
ICO_TH	0.306249	0.110704	-0.161537	-0.022131	-0.250504	0.182302	0.022926
IWST_ZREC	-0.013248	0.400759	0.253548	-0.298454	-0.164994	0.205972	-0.011791
E_PS	-0.109028	0.162367	-0.028712	-0.039816	0.140024	-0.399368	-0.468929
IDBT	0.423486	0.108044	-0.092375	-0.153910	-0.235780	0.009293	-0.115440
ROA	0.060087	-0.020483	0.017121	-0.159847	0.640255	0.140792	-0.100161
ROE	0.146037	0.016828	-0.026150	-0.214110	0.437892	0.428839	-0.286949
IEMP_ABS	-0.122885	-0.283774	0.200828	-0.044786	-0.132539	0.481334	-0.014010
IEMP_ACC	-0.257146	0.364911	-0.109476	-0.101049	-0.073909	0.174247	0.010579
IEMP_FTC	0.387496	-0.368354	-0.089898	-0.018249	-0.040914	0.060572	0.015334
IEMP_TURN	-0.284979	-0.288687	-0.179569	-0.089375	-0.056332	0.060733	0.288997
IEMP_WOMB	-0.012238	0.190525	0.061447	0.492969	-0.089258	0.420238	0.034721

Ordinary correlations:

	IWA	IH_GENTH	IGENT_SAL	IEVD_LEN	IEVD_TAX	IBYPRO	IGENRE_T	IGENRENU_T	ICO_TH
IWA	1.000000								
IH_GENTH	-0.005460	1.000000							
IGENT_SAL	0.015434	-0.074553	1.000000						
IEVD_LEN	-0.119236	-0.042478	0.163516	1.000000					
IEVD_TAX	0.116138	0.308640	0.338093	0.287278	1.000000				
IBYPRO	0.073478	-0.810039	0.149355	-0.173935	-0.239224	1.000000			
IGENRE_T	-0.146968	0.113785	0.208381	-0.184039	-0.143261	-0.052070	1.000000		
IGENRENU_T	-0.381950	0.359155	0.276349	-0.296079	0.016808	-0.011995	0.770066	1.000000	
ICO_TH	-0.056343	-0.330463	-0.237314	-0.194403	-0.296267	0.156896	0.295577	-0.002697	1.000000
IWST_ZREC	0.486549	-0.025878	0.098678	-0.421015	-0.212401	-0.657948	0.288019	0.100706	0.012198
E_PS	0.206542	-0.155755	0.010165	0.057153	0.063864	-0.024076	-0.118990	-0.029456	-0.128967
IDBT	-0.377728	-0.482606	-0.232490	-0.380129	-0.411348	-0.155772	0.422544	0.142255	0.683410
ROA	0.087970	0.182963	0.048926	-0.251135	-0.060151	0.119024	0.020315	0.039044	-0.141347
ROE	-0.081622	-0.093448	-0.033697	-0.175995	-0.197539	0.029601	-0.003007	0.064378	0.148273
IEMP_ABS	-0.299116	0.481160	0.091792	0.031805	0.201680	-0.300800	-0.199742	-0.197232	-0.089784
IEMP_ACC	0.690406	-0.211025	-0.039678	0.197045	0.007574	-0.027630	-0.092090	-0.349453	-0.114931
IEMP_FTC	-0.800365	0.130820	-0.268877	-0.333119	-0.260955	0.307016	0.071369	0.061196	0.376175
IEMP_TURN	0.246750	0.368668	-0.198189	0.320601	0.252862	0.126467	-0.601117	-0.528347	-0.314789
IEMP_WOMB	-0.088256	-0.649415	0.307543	0.081560	0.366587	0.061090	-0.029344	0.512091	0.162053

IEMP_WOMB	IEMP_TURN	IEMP_FTC	IEMP_ACC	IEMP_ABS	ROE	ROA	IDBT	E_PS	IWST_ZREC
									1.000000
								1.000000	0.171597
							1.000000	-0.214942	0.258278
						1.000000	0.006835	0.075446	-0.131197
					1.000000	0.640166	0.136853	-0.097396	0.139363
				1.000000	0.039669	-0.112119	-0.432211	-0.194957	0.052639
			1.000000	-0.039499	0.024550	-0.117139	-0.166429	0.082305	0.347734
		1.000000	-0.753716	0.159141	0.226331	0.022552	0.675918	-0.259699	-0.420273
	1.000000	-0.078244	-0.012368	0.231170	-0.154485	-0.077121	-0.324616	-0.131789	-0.232862
1.000000	-0.107184	-0.157983	0.161259	0.067343	-0.161417	-0.095397	-0.192229	-0.148542	0.116971