

# Corporate sustainability: indicators definition for energy sector's organizations

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## Abstract

The concern with sustainable development has grown in several economy sectors and in the corporate environment has become a market strategy, besides a positive factor for businesses success. Therefore, this work aims is identify corporate sustainability indicators for companies in the energy sector from basis specifics theoretical and conceptual. Maked a descriptive and exploratory research, using bibliometric techniques for analysis and choice of corporate sustainability indicators in the energy sector used by companies in Brazil, considering the following aspects: source energy's type, indicator's systems and divisions by sustainability's dimension. The research results present 133 indicators distributed in the following dimensions: social (66), economic (16), environmental (38) and corporate governance (13). Such results point a few studies existence corporate sustainability's area for energy sector.

**KEYWORDS:** Corporate sustainability. Indicators. Energy sector.

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## Sustentabilidade corporativa: definição de indicadores para organizações do setor energético

### Resumo

A preocupação com o desenvolvimento sustentável tem crescido nos diversos setores da economia, e no ambiente corporativo tem se tornado uma estratégia de mercado, além de um fator positivo para o sucesso dos negócios. A partir dessa consideração, o objetivo deste artigo é identificar indicadores de sustentabilidade corporativa para empresas do setor energético a partir de base teórica e conceitual específica. Foi realizada uma pesquisa exploratória e descritiva, utilizando técnicas bibliométricas para análise e escolha dos indicadores de sustentabilidade corporativa do setor energético utilizados por empresas no Brasil a partir dos seguintes aspectos: tipo de fonte de energia, sistemas de indicadores e as divisões por dimensão da sustentabilidade. Nos resultados da pesquisa, são apresentados 133 indicadores distribuídos nas seguintes dimensões: social (66), econômica (16), ambiental (38) e governança corporativa (13). Tais resultados apontam a existência de poucos estudos na área de sustentabilidade corporativa para o setor energético.

**PALAVRAS-CHAVE:** Sustentabilidade corporativa. Indicadores. Setor energético.

## Sostenibilidad corporativa: definición de indicadores para las organizaciones del sector energético

### Resumen

La preocupación por el desarrollo sostenible se ha convertido en diversos sectores de la economía y entorno empresarial en una estrategia de mercado, además de un factor positivo para el éxito de la empresa. El propósito de este artículo es identificar los indicadores de sostenibilidad corporativa para las empresas del sector energético en una base teórica y conceptual específica. Se realizó un estudio descriptivo y exploratorio, utilizando técnicas de análisis bibliométricos y la elección de los indicadores de la sostenibilidad corporativa en el sector de la energía utilizada por las empresas en Brasil a partir de los aspectos: tipo de fuente de energía, sistemas de indicadores y divisiones por dimensión de sostenibilidad. Em los resultados de la investigación se presentaron 133 indicadores distribuidos en las dimensiones: social (66), económica (16), ambiente (38) y gobierno corporativo (13). Tales resultados apuntan a la existencia de pocos estudios en el ámbito de la sostenibilidad corporativa para el sector de la energía.

**PALABRAS CLAVE:** Sostenibilidad corporativa. Indicadores. Sector energético.

## INTRODUCTION

Energy is a fundamental component of local development and the development of economic sectors and activities, contributing in a significant manner to improving the life of the population. Within the current context of increasing demand for energy, there has arisen a need to elevate the levels of energy generation based on sustainability.

The energy issues related to sustainability have been viewed as having greater relevance since the two oil crises of 1973 and 1979 – even though energy is important to the meeting of society's needs, with emphasis on production and consumption needs, despite the implications of its generation, storage, distribution and consumption for the environment. Within this context, reflection is needed on our dependence on a preponderant source of energy for a more diversified energy matrix, as well as new forms of action being taken by sector companies, incorporating in their strategies and actions aspects, which in addition to being economic are compatible with the concepts and approaches related to sustainability.

Thus, discussions of sustainability in the business world have been widely disseminated based on changes in the energy sector, the creation of new technologies, and especially market demands related to consumer concerns about aspects of sustainability, which constitute an opportunity to meet the customer demands and also reduce costs and optimize processes. To Savitz and Weber (2007), a business is considered sustainable when it improves society's quality of life, using measures to protect the environment and improve financial results, generating profits for its shareholders. Perez (2008) shows that company concerns about sustainable development are growing, mainly in relation to the direct and indirect risks to their operations. The direct risks can come in the form of lawsuits and environmental liabilities; while the indirect risks can compromise the company's image, and as a result diminish the value of its shares and sales.

Based on the definition of a sustainable company, authors such as Savitz and Weber (2007), Perez (2008), Zsóka and Vajkai (2018), Morioka, Iritani, Ometto et al. (2018) and Stoporoli, Ramos, Quirino et al. (2019) have pointed to a growing concern with corporate sustainability and its application within the context of various economic sectors and activities. It may be noted that companies have changed their perception of the market, going from a context that is exclusively economic to a sustainable context including social and environmental dimensions as well as economic. In addition, there should be a balance between the sustainable dimensions especially for companies in the energy sector, given their importance to society and the fact that they are in a highly competitive market which requires innovation, including new techniques and challenges to improve their performance.

Based on these considerations, this study seeks to identify corporate sustainability indicators for energy sector companies based on specific theoretical and conceptual references. In methodological terms, this is an exploratory and descriptive study, which uses bibliometrics to identify, search for and analyze corporate sustainability indicators for the energy sector, based on relevant theoretical and conceptual references.

In addition to this introductory content, this text presents the theoretical fundamentals of sustainable development and corporate sustainability in the energy sector. We also

address important issues related to this subject, such as corporate sustainability indicators. Then we will address methodological procedures, presenting the results and an analysis of our study, concluding with our final considerations and the references which support this research.

## **THEORETICAL REFERENCES**

### **Sustainable development and sustainability indicator systems**

Effective concerns about development and its implications date back to the 18<sup>th</sup> century and the rise of the Industrial Revolution, characterized by mass production, increases in the levels and forms of consumption, and the unlimited utilization of natural resources, as well as the increased generation of waste without any concern for the environment.

The current model of development is based on growing production and consumption relationships with implications for the increasing degradation of natural resources, pollution, social inequality and the distribution of wealth concentrated within a miniscule portion of society. Based on this context, the concepts of sustainable development and sustainability were born, which seek to mitigate these implications based on the concept of balanced and egalitarian development.

Bellen (2004) affirms that the pressure that the anthroposphere has placed on the ecosphere has made society increase its awareness of environmental problems created by lifestyles that conflict with the natural habitat and require reflection in terms of development and sustainable development.

Sustainable development and sustainability involve current interdisciplinary themes in various areas of science, in public, private and non-governmental organizations and society as a whole. The definition of sustainability according to Sachs (1993) is related to a process of change which is necessarily multidimensional in relation to the environment given that it presents not only ecological aspects, but also is related to economic, political, cultural, social, temporal and spatial aspects.

The focus of these sustainability dimensions can vary according to the transformations of society in comparison with sustainable development. It is relevant to observe the characteristics of the company or location to be studied to pay attention to the most appropriate focus for the investigated reality, in which the dimensions and indicators should permit the measurement of the level of sustainability.

For an effective elaboration of sustainability, it is crucial to create measurement instruments such as sustainability indicators. These “tools” are constituted by one or more variables, which may be related in various ways. According to Meadows (1998), one of the problems most associated with indicators is their selection: if this is performed in an incorrect manner, this may lead to inadequate evaluations, making these indicators dangerous since decision-making may be based on them. In the measurement of sustainability and its social, economic and environmental dimensions, it is useful to evaluate the decision-making process since the obtained results may be employed to guide the development of public actions and policies.

The definition of sustainability and sustainable development addresses a variety of aspects which generate specific themes represented by distinct dimensions, reflected by the indicator systems (BELLEN, 2004).

Corporate sustainability indicator systems seek a balance between sustainability dimensions in the corporate environment, observing an evolution in the direction of a sustainable form of development. To accomplish this, they establish targets and create instruments which are fundamental steps to making the measurement of corporate sustainability possible.

There are various systems of corporate sustainability indicators employed in Brazil as indicated by Rocha (2012): the Brazilian Institute of Social and Economic Analyses model (IBASE); the Ethos model; the Corporate Sustainability Index (ISE); the Dow Jones Sustainability Index (DJSI); and the international Global Reporting Initiative model (GRI).

In addition to the cited corporate indicators, Jappur (2004) observes the need to use some methods to conduct organizations in the direction of sustainability: corporate social responsibility; corporate governance; ecoefficiency; life cycle analysis; zero emissions; certifiable management systems; and cleaner production. In this sense, the application of a method does not prohibit the use of another simultaneously, and on the contrary, depending on the case, they are associated. These sustainability methods or indicators use indicators or variables to measure sustainable development based on the construction of indices.

According to Finch (2005), the main objective of sustainability indices is the elaboration of standards to measure the financial performance of companies, given that many investors seek to apply their financial resources in ethical and socially responsible organizations. Thus, indices are disposed to create a benchmark, enabling investors to identify listed companies which use sustainable practices in their businesses. With this, companies are listed not only because of their good financial results, but also because of results based on other dimensions of sustainability.

## **The corporate sustainability of the energy sector**

The definition and the discussions related to corporate sustainability are associated with the generic concept of sustainability. Corporate social responsibility can be defined as a form of management which is defined by ethical relationships and corporate transparency with all the segments of the public that they relate to, and the establishment of corporate targets compatible with the sustainable development of society, preserving environmental and cultural resources for future generations, respecting diversity and promoting a reduction in social inequality according to the Ethos Institute.<sup>1</sup>

The term sustainability has been transformed into a subject for broad social and environmental discussions, above all in the world of business. To Savitz and Weber (2007),

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<sup>1</sup> Available at: <<http://www3.ethos.org.br/wp-content/uploads/2013/09/Gloss%C3%A1rio-Indicadores-Ethos-V2013-09-022.pdf>>. Accessed on: Sept. 16, 2020.

it is an influential and objective idea: a company is considered sustainable when it generates profits for shareholders and simultaneously protects the environment and improves the life of the society with which it interacts.

Oliveira (2008) shows that corporate social responsibility (CSR) can increase the competitiveness of companies in various ways – for example: in terms of protecting the environment, it can be an opportunity to reduce the costs of water and energy, thus saving environmental resources and reducing financial risks; in terms of human resources, it has advantages due to greater satisfaction among employees and partners leading to better productivity; a company can improve its image in the market and positively influence the behavior of consumers who are sensitive to environmental and social issues, and it is also a differential factor in the financial market for shareholders.

The theme of corporate sustainability in the energy sector is directly related to the generation, transmission and distribution of electricity – which constitutes a preponderant economic activity for sustainable development and also requires a better comprehension of the forms of action of the productive agents involved in this activity.

Given this context, the following studies have examined the subject of corporate sustainability in the organizational field of the energy sector: Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), D'Albertas, Cario, Dias et al. (2011), Salles (2012), Todeschini and Mello (2013) and Lugoboni, Paulino, Zittei et al. (2015).

Amaral (2003) proposes a study with the objective of establishing a group of indicators and proposes a report model to be used in the petroleum industry utilizing 35 sustainability indicators in the social, environmental and economic dimensions, with five pertaining to eco-efficiency based on eco-efficiency indicators and the GRI.

Camargo, Ugaya and Agudelo (2004) conducted a study to present a group of indicators to evaluate the corporate sustainability applicable to the energy generation sector, based on studies realized in three companies: one Brazilian (Petrobras), one Canadian (Hydro-Québec) and one American (Tennessee Valley Authority).

Campos (2005) proposes a group of indicators for the energy generation sector in Brazil and concludes that it has become crucial to establish a minimum number of standardized data for all companies. In turn, this group needs to be complemented by specific information for each organization and country.

Cipolat, Bard, Ludk et al. (2010) conducted a study with environmental and social indicators based on the sustainability reports of Itaipu Binacional, an electricity company that uses hydroelectric power. A comparative analysis of the indices with these actions has made possible a more explicit visualization of company activities that seek sustainability.

Grijó (2010) realized a study of the electricity sector with the objective of verifying the accounts that these companies (Companhia Energética de Minas Gerais – CEMIG; CPFL Energia; and Eletropaulo) present to their stakeholders, which indicators are disseminated, and the manner in which socio-environmental performance and the account presenting process have evolved over time. The author concludes that companies value the GRI and a group of indicators which highlight the environmental, economic and societal tripod.

D'Albertas, Cario, Dias et al. (2011) realized a study of two large companies in the energy generation and transmission segments of the state of Santa Catarina. The study's results indicated the utilization of sustainable practices in both companies. They also found an average corporate sustainability rating of 62% based on the utilized methodology, presenting a more advanced stage of sustainability.

Salles (2012) elaborates a model to evaluate the sustainability of the ethanol agroindustry based on indicators. The author adapted the free Dashboard of Sustainability (DS) app to compose the indicators and the global index of sustainable performance and communicating and monitoring the results. The author uses environmental, social and economic indicators based on a strategic agenda of sustainability showing how to measure the sustainable performance of these agroindustry companies and guide their relationships with the external world.

Todeschini and Mello (2013) conducted a study to verify whether organizations in the electricity sector which are considered sustainable achieved performance statistics that were better than other companies from the sector which are not considered sustainable during the period from 2006 to 2010, and whether the companies which were considered sustainable published information about sustainability in their 2010 annual reports. The results of this study show that the analyzed companies gave greater prominence to the positive aspects and little to the negative aspects they caused, as for example in terms of competition, defense, accessibility and situations related to legal issues.

Lugoboni, Paulino, Zittei et al. (2015) utilize documental analysis through sustainability reports based on the GRI of a dozen (12) companies in the electricity sector and reached the conclusion that the publishing of indicators has improved, possibly because of international recognition, providing greater reliability and a transformation in company information.

The nine authors cited above have made contributions to the subject of corporate sustainability in the energy sector, and based on these and other studies of fundamental theoretical content related to sustainable development, corporate sustainability, and corporate sustainability indicator systems, we have conducted a bibliometric and descriptive study of corporate sustainability in the energy sector based on an analysis of specific conceptual and theoretical studies, identifying the typology by corporate energy source, indicator systems and indicators by sustainability dimension, and with this it was possible to verify quantitatively works addressing corporate sustainability in the energy sector, based on methodological procedures defined in the following section as well as defining indicators for energy sector ventures.

## **METHODOLOGICAL PROCEDURES**

This study may be characterized as an exploratory and descriptive study, conducted through the application of bibliometric techniques for prospecting, selecting and analyzing corporate sustainability indicators for the energy sector based on a theoretical and conceptual base of specific content related to corporate sustainability in the energy sector.

The data collection was performed through searches using the databases of the Coordinating Body for the Improvement of Higher Education Personnel (Capes),<sup>2</sup> of the public domain,<sup>3</sup> of Scielo<sup>4</sup> and the Brazilian Digital Library of Theses and Dissertations.<sup>5</sup>

In the searches we used the following keywords: “company sustainability”, “corporate sustainability”, “corporate sustainability” + “energy” and “company sustainability” + “energy”. We searched the titles for these keywords based on the understanding that they contemplate the study’s subject.

After collecting the studies, we read the material to extract the data necessary to analyze the studies, considering the following three aspects: a company’s type of energy source; indicator systems; and the variables by sustainability dimension. These aspects were utilized in the bibliometric analysis in order to arrive at a definition of corporate sustainability indicators for energy sector organizations.

In terms of the selected aspects, the energy typology approach characterized the origin of the energy used, that is, hydroelectric, thermoelectric, wind or fossil fuels. In the indicator system classification phase, it identified the systems used, as well as the indicators by sustainability dimension.

Fifty-nine studies were selected of which nine met the requisites defined in the search criteria, namely a direct relationship between energy and corporate sustainability indicators for companies in the energy sector. With this, we analyzed and discussed the proposed subject in the following studies: Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), D’Albertas, Cario, Dias et al. (2011), Salles (2012), Todeschini and Mello (2013) and Lugoboni, Paulino, Zittei et al. (2015).

Finalizing this step and using a base ready for analysis utilizing bibliometric techniques, we obtained 133 indicators, divided into four dimensions: social (66), economic (16), environmental (38) and corporative governance (13). To obtain these indicators, we realized an analysis verifying the repetition and description of indicators which have the same interpretation, even if their descriptions are distinct. We also excluded some indicators which are very generic or very particular to a given energy company in the perception of the authors of this study.

## Results and discussion

This section deals with the analysis and discussion of the nine selected studies according to the criteria defined in the previous methodology section.

Initially we traced the aspects of a company’s typology, or in other words the type of energy source utilized, the indicator system applied to the studied companies, and the author’s grouping of indicators by dimensions. We have made graphs to complement our interpretation.

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<sup>2</sup> Available at: <<http://www.periodicos.capes.gov.br>>. Accessed on Sept. 16, 2020.

<sup>3</sup> Available at: <<http://www.dominiopublico.gov.br/>>. Accessed on Sept. 16, 2020.

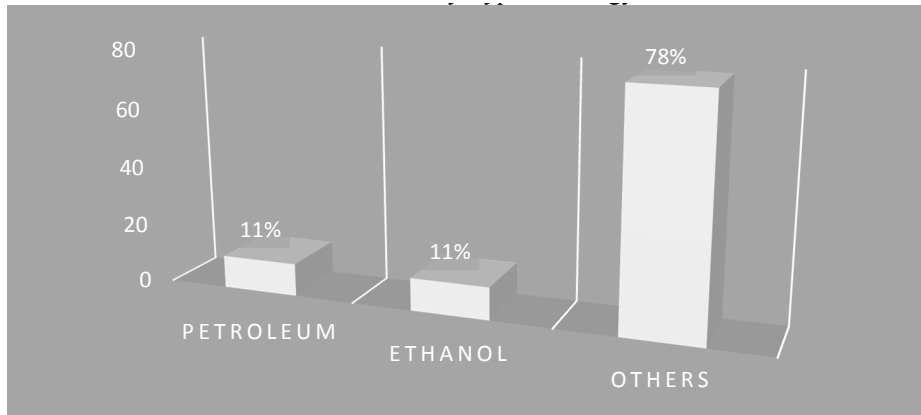
<sup>4</sup> Available at: <<http://www.scielo.org>>. Accessed on Sept. 16, 2020.

<sup>5</sup> Available at: <<http://bdtd.ibict.br/>>. Accessed on Sept. 16, 2020.



Among the nine studies selected for analysis, one study examined the petroleum industry, the second examined the ethanol agroindustry, and the remaining seven looked at the electricity sector using various sources of renewable and non-renewable energy not mentioned in the studies, as can be observed in Graph 1.

**GRAPH 1**  
**Number of Studies by Type of Energy Source**

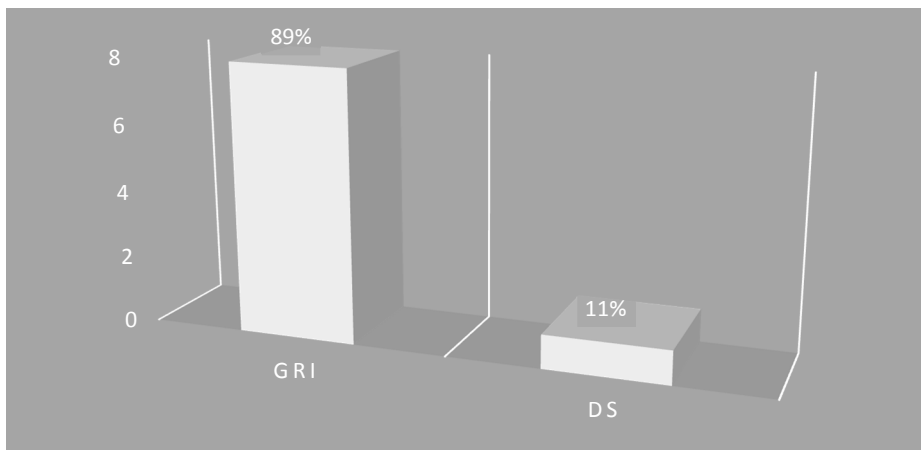


Source: Elaborated by the authors.

Graph 1 illustrates a study by Amaral (2003) of a petroleum company with 11% representation, a study by Salles (2012) of the ethanol industry also with 11% representation, as well as the other seven studies which represent 78%: Camargo, Ugya and Agudelo (2004), Campos (2005), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), D'Albertas, Cario, Dias et al. (2011), Todeschini and Mello (2013) and Lugoboni, Paulino, Zittei et al. (2015).

We observed the use of GRI indicators in eight of the nine analyzed studies, or 89% of the total, and only Salles (2012) made an adaptation of DS, 11% of the total. This may be due to the fact that the GRI model is recognized internationally. Graph 2 shows the number of studies by the indicator system used.

**GRAPH 2**  
**Number of Studies by Type of Indicator System**



Source: Elaborated by the authors.

It should be noted that the studies with indicator systems in energy companies are recent and are associated with the result of Grijó's study (2010) in concluding that the publication of sustainability reports based on the GRI indicator system is determined in law and regulations by the National Electricity Agency (ANEEL)<sup>6</sup> that energy sector companies should publish their practices in accordance with certain models. In 2007, ANEEL also determined that energy sector companies are obliged to publish their annual reports (ANEEL, 2016).

After constructing the graphs and classifying the types of companies based on their energy activity and the applied indicator systems, it was possible to prepare Box 1, which presents the number of corporate sustainability indicators in the energy sector by dimension in each study, as well as the total number of indicators by author.

**BOX 1**  
**Numbers of Indicators by Dimensions and Authors**

Authors	Number of Dimension Indicators				Total per author
	Social	Environmental	Economic	Corporate governance	
Amaral (2003)	18	10	7	0	<b>35</b>
Camargo, Ugaya and Agudelo (2004)	21	38	7	0	<b>66</b>
Campos (2005)	16	20	11	0	<b>47</b>
Cipolat, Bard, Ludk et al. (2010)	5	27	0	0	<b>32</b>
Grijó (2010)	40	30	9	0	<b>79</b>
D'Albertas, Cario, Dias et al. (2011)	7	6	4	0	<b>17</b>
Salles (2012)	14	8	9	0	<b>31</b>
Todeschini and Mello (2013)	20	18	9	21	<b>68</b>
Lugoboni, Paulino, Zittei et al. (2015)	45	31	9	0	<b>85</b>
<b>Overall total</b>	<b>186</b>	<b>188</b>	<b>65</b>	<b>21</b>	<b>460</b>

Source: Elaborated by the authors.

After analyzing the studies, there were a total of 460 indicators, with 186 of them being social, 188 environmental, 65 economic and 21 for corporate governance. However, we observed that the indicators were repeated in the studies. So, we realized a new analysis, verifying the repetition and description of indicators which have the same interpretation, even with distinct descriptions, and we also excluded some indicators which were very generic or very particular for a given energy company in the perception of the authors.

<sup>6</sup> Available at: <<http://www.aneel.gov.br>>. Accessed on Sept. 16, 2020.

After this analysis, we were able to pare down the number of indicators to 133, divided into four dimensions: social (66), economics (16), environmental (38) and corporate governance (13). Boxes 2 to 5 show the distribution of the indicators by dimension, as well as the authors who applied the respective variables. Since the eco-efficient indicators in the Amaral study (2003) were inserted in the environmental dimension, it was possible to perform this grouping and ignore this dimension in the construction and definition of corporate sustainability indicators in the energy sector, as well as the general dimension in Todeschini and Mello's study (2013) which was regrouped into the corporate governance dimension.

Box 2 presents a group of environmental dimension indicators for corporate sustainability in the energy sector. Based on the type of activity practiced in the companies, the utilization of energy exerts influence and behaves in a distinct manner, modifying the environment from the local to the global level – and based on the use of fossil fuels, hydroelectricity, or other sources of energy in these corporations, the environmental dimension indicators will be specified and defined, and can thus measure company sustainability for this dimension.

#### BOX 2

#### Environmental Dimension: Indicators for Corporate Sustainability in the Energy Sector

Order	Environmental dimension	
	Indicators	Authors
1	Materials used by weight or volume.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015), Campos (2005), Amaral (2003).
2	Percentage of recycled materials used.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
3	Direct consumption of energy.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015), Amaral (2003).
4	Indirect consumption of energy.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
5	Energy saved due to improvements in conservation and efficiency.	Camargo, Ugaya and Agudelo (2004), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
6	Percentage and total volume of recycled and reutilized water.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Todeschini e Mello (2013), Lugoboni, Paulino, Zittei et al. (2015), Amaral (2003).

*Continue*

Order	Environmental dimension	
	Indicators	Authors
7	Protected or restored habitats.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
8	Strategy and measures being implemented and future plans for the management of impacts in terms of biodiversity.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), D'Albertas, Cario, Dias et al (2011), Todeschini e Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).
9	The number of endangered species on the IUCN's Red List and on national lists of conservation habitats in areas affected by operations based on risk of extinction level.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
10	Total discharge of water by quality and destination.	Cipolat, Bard, Ludk et al. (2010) Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
11	Total of investment in, and money spent on, environmental protection.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
12	Bodies of water and habitats affected by discharges of water and drainage performed by the reporting organization.	
13	Total weight of waste, by type and disposal method.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015), Campos (2005), Cipolat, Bard, Ludk et al. (2010).
14	Emissions of substances which destroy the ozone layer.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
15	Total direct and indirect greenhouse gas emissions by weight.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015), Campos (2005), Amaral (2003).
16	Other relevant emissions of greenhouse gases by weight.	Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
17	The spilling of oil and its derivatives into the environment.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
18	Fines and penalties/lawsuits related to environmental problems.	Amaral (2003), Camargo, Ugaya e Agudelo (2004), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Todeschini and Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).
19	Efficiency of vehicle consumption (KM).	Camargo, Ugaya and Agudelo (2004).

Continue

Order	Environmental dimension	
	Indicators	Authors
20	Treatment of oil contaminated soil (\$).	
21	Solid waste sent to waste landfills.	
22	Inventory of toxic effluents.	Camargo, Ugaya and Agudelo (2004).
23	Improvements to damaged coasts – investment (\$).	
24	Annual investment in environmental programs.	
25	Total use of water.	Campos (2005), Salles (2012), Amaral (2003), Cipolat, Bard, Ludk et al. (2010), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
26	Description of main impacts caused by the consumption/generation of energy by the company.	
27	Total production of energy by source and consumed inputs.	
28	Internal consumption of energy.	Campos (2005).
29	Initiatives for the use of renewable energy.	
30	Energy produced by unit of occupied area.	
31	Description and presentation of evidence of environmental issues together with suppliers.	
32	Actions related to the improvement of the environmental performance of the supply chain.	
33	Relationship between actions and the sustainable consumption of its services.	
34	Monitoring of environmental quality of fleet logistics and management.	
35	Environmental insurance for damage caused by accidents resulting from its operations.	Todeschini and Mello (2013).
36	Recovery programs for damaged preservation areas.	
37	Legal preserves.	
38	Area of permanent preservation (APP).	

Source: Elaborated by the authors.

We may perceive that the identified environmental dimension variables cover various aspects related to damage to the environment. This damage is linked to various sources of energy presented in this study, and also demonstrates the benefits for the environment generated by the adoption of educational practices and other actions to promote ecological preservation. The following indicators appeared with greater frequency among these studies: the management of impacts on biodiversity, the impacts of product transport, the reduction of greenhouse gases, the spilling of oil and fines. The reduction of greenhouse gases and the management of impacts on biodiversity, the most common, could be related to the problem of global warming, a subject currently under great discussion – and, for this reason, strategies to mitigate this impact have been sought.

Box 3 presents the economic dimension corporate sustainability indicators for the energy sector. In turn, these indicators demonstrate the financial situation of organizations and also point out their costs, spending, investment and expenses in relation to sustainable and non-sustainable practices. In the studies of Amaral (2003) and Camargo, Ugaya and Agudelo (2004), investments in general were segregated in various specific indicators. Since Lugoboni, Paulino, Zittei et al. (2015) grouped all of them in infrastructure and service investments, and this indicator was incorporated as community development investment.

### BOX 3

#### Economic Dimension: Corporate Sustainability Indicators for the Energy Sector

Order	Economic dimension	
	Indicators	Authors
1	Salary and benefits expenses.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005).
2	Taxes and general fees.	
3	Investments in safety, the environment and health.	Amaral (2003), Camargo, Ugaya and Agudelo (2004).
4	Investments in community development.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Lugoboni, Paulino, Zittei et al. (2015).
5	Investments in research and development.	Amaral (2003), Camargo, Ugaya and Agudelo (2004).
6	Investments in national technology.	
7	Investments in renewable energy.	
8	Expenses due to sponsorship of external environmental projects.	
9	Distributions to investors.	Campos (2005).
10	Donations and spending on social programs.	
11	Spending on the environment.	
12	Received subsidies.	Campos (2005), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).

Continue

Order	Economic dimension	
	Indicators	Authors
13	Direct generated and distributed economic value.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
14	Variation in the proportion of the lowest salary compared to the local minimum wage.	
15	Policies, practices and the proportion of spending on local suppliers.	
16	Local hiring procedures and the proportion of upper management recruited from the local community.	

Source: Elaborated by the authors.

The most often repeated economic indicators among the studies were salary and tax expenses, which demonstrate the concern in the organizational environment with labor and tax burden expenses, which are quite representative and contribute significantly to reducing net results. It should also be noted that the most recent studies employ indicators which show the financial implications and other risks due to climatic change, a subject recently discussed by the United Nations Conference on Climate Change (COP 25) in Madrid.

The social dimension indicators are designed to evaluate how much organizations are concerned with societal aspects. Since we are dealing with energy companies, their role is more relevant, because energy is an essential factor in global and local development, and can have a dependence relationship with the generation of employment and income, worker training, and it also contributes to the increase in issues associated with forced labor and child labor. The social dimension corporate sustainability indicators for the energy sector are presented in Box 4.

#### BOX 4

#### Social Dimension: Corporate Sustainability Indicators for the Energy Sector

Order	Social dimension	
	Indicators	Authors
1	Food expenses.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005).
2	Decision-making processes that involve stakeholders and the results of engagement.	Cipolat, Bard, Ludk et al. (2010).
3	Management of the impacts of its operations on communities.	Cipolat, Bard, Ludk et al. (2010), Campos (2005), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
4	Participation in the elaboration of public policies and lobbies.	

Continue

Order	Social dimension	
	Indicators	Authors
5	Forced and compulsory labor.	Campos (2005), Grijó (2010), Salles (2012), Todeschini and Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).
6	Child labor.	
7	Political contributions.	
8	Existence of bribery and corruption.	
9	Preservation of health and consumer safety.	Campos (2005).
10	Job creation and turnover.	Campos (2005), Grijó (2010), D'Albertas, Cario, Dias et al. (2011), Lugoboni, Paulino, Zittei et al. (2015).
11	Social spending.	Amaral (2003), Camargo, Ugaya and Agudelo (2004).
12	Retirement spending.	
13	Employee medical and social assistance.	
14	Investments in employee education.	
15	Investment in employee cultural projects.	
16	Day care/day care assistance.	
17	Participation in the company's results.	
18	Number of women who work for the company.	
19	Percentage of leadership positions occupied by women.	
20	Contributions to society.	
21	Number of work accidents.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005).
22	Number of occupational illnesses.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
23	Professional training and development.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Campos (2005), D'Albertas, Cario, Dias et al. (2011), Todeschini and Mello (2013).
24	Number of handicapped employees.	Amaral (2003), Camargo, Ugaya and Agudelo (2004), Todeschini and Mello (2013).
25	Employee level of satisfaction.	Amaral (2003), Todeschini and Mello (2013).

Continue



Order	Social dimension	
	Indicators	Authors
26	Investment in community education.	Camargo, Ugaya and Agudelo (2004).
27	Investment in university research.	
28	Investment in social (cultural) projects in the community.	Camargo, Ugaya and Agudelo (2004), Todeschini and Mello (2013).
29	Total workers by type of employment, contract and region.	Grijó (2010), Todeschini and Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).
30	Percentage of employees represented on formal health and safety committees.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
31	Education, training, counseling, prevention and risk control programs underway to provide assistance to employees and their families and community members in terms of serious illnesses.	
32	Subjects related to health and safety covered by formal union agreements.	
33	Average number of hours of training per year, per employee, by functional category.	
34	Responsible product – evaluation of the health and safety impacts in the product and service life cycle.	D'Albertas, Cario, Dias et al. (2011), Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
35	Percentage of employees who regularly receive performance and career development analyses.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
36	Proportion of base salary among men and women by functional category.	
37	Percentage and total number of significant investment contracts which include clauses regarding human rights.	
38	Percentage of companies, contractors and critical suppliers which were submitted to human rights evaluations and the measures taken.	
39	Total number of cases of discrimination and the measures taken.	
40	Operations identified in which the right of free association and collective bargaining may be at risk.	Grijó (2010), Todeschini and Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).

Continue

Order	Social dimension	
	Indicators	Authors
41	Percentage of safety personnel trained in the policies and procedures related to aspects of human rights.	Grijó (2010), Lugoboni, Paulino, Zittei et al. (2015).
42	Total number of cases of rights violations in terms of indigenous peoples and the measures taken.	
43	Percentage of employees trained in the organization of anti-corruption policies and procedures.	
44	Total number of lawsuits due to unfair competition, oligopolistic or monopolistic practices and their results.	
45	Monetary value of significant fines and the total number of non-monetary sanctions for not complying with the law.	
46	Total number of cases of non-compliance with regulations and voluntary codes related to impacts on health and safety caused by products and services.	
47	Practices related to customer satisfaction, including the results of satisfaction surveys.	
48	Monetary value of (significant) fines for non-compliance with laws and regulations related to the use of products and services.	
49	Total number of confirmed complaints relating to violations of privacy and the loss of customer data.	
50	Adherence programs and laws, norms and voluntary codes related to marketing communication.	
51	Total number of cases of non-compliance with regulations and voluntary codes related to marketing communication.	Grijó (2010).
52	Green protocol.	
53	Certification of environmental management and social responsibility.	Salles (2012).
54	Publication of social balance.	

Continue



Order	Social dimension		
	Indicators	Authors	
55	Commitment to preventing moral and/or sexual harassment.	Todeschini and Mello (2013).	
56	Fulfilling legislation related to hiring handicapped individuals.		
57	At least 5% of the workers hired per locality need to be apprentices.		
58	Percentage represented by "complaints" out of all customer service interactions.		
59	Percentage of fundamental complaints made by consumers to consumer protection bodies which were addressed.		
60	Proportion of the highest and the lowest paid salaries.		
61	Consumers participate in the evaluation process of socio-environmental impacts.		
62	Fighting the sexual abuse of children and adolescents.		
63	Operations with significant potential or real negative impact on local communities.		Lugoboni, Paulino, Zittei et al. (2015).
64	Operations subject to review and/evaluations of their impact in terms of human rights.		
65	Number of complaints related to human rights received, addressed and resolved by formal complaint mechanisms.		
66	Prevention and mitigation measures in operations with significant potential or real negative impact on local communities.	Todeschini and Mello (2013), Lugoboni, Paulino, Zittei et al. (2015).	

Source: Elaborated by the authors.

The social indicators with the greatest frequency among the studies were forced and compulsory labor and professional training and development. Organizations have invested in intellectual capital, or in other words, professional training and development, improving their technologies and improving their customer relationships and this has aggregated value in their business context. Despite all of this, we still see instances of compulsory labor with long workdays and this may be why the compulsory labor indicator appears in most of these studies.

Finally, we have indicators for the corporate governance dimension (Box 5) of corporate sustainability in the energy sector. Todeschini and Mello (2013) emphasize that the indicators

of this dimension evaluate company property, management, auditing and supervision, the administrative board, conduct and conflicts of interest. Seven indicators were selected for this corporate governance dimension referring to fighting corruption and providing transparency.

#### BOX 5

### Corporate Governance Dimension: Corporate Sustainability Indicators for the Energy Sector

Order	Corporate governance dimension Indicators	Authors
1	Issuing of preferential shares.	Todeschini and Mello (2013).
2	Preferential shareholders have the right to vote on relevant matters.	
3	Mechanisms to publicize subjects deliberated on in assemblies.	
4	Administrative and arbitration processes and lawsuits against the company, the administrators or controller, involving unequal treatment of minority shareholders during the past five years.	
5	Prohibition of loans and guarantees in favor of the controller, administrators or other related parties.	
6	Existence of an anonymous communications channel dedicated to receiving accusations, questions and suggestions.	
7	Annual report and/or sustainability report including access for people with special needs.	
8	Educational programs about sustainability and those affected.	
9	Adherence to voluntary commitments related to sustainable development.	
10	Existence of a sustainability committee.	
11	Independent auditing report.	
12	Commitment to combat corruption which includes the internal public.	
13	Commitment to combat corruption in company partners.	

Source: Elaborated by the authors.

Todeschini and Mello (2013) show that the main information published about corporate governance dimension indicators is related to shareholder rights. However, the indicator which treats unequal treatment of minority shareholders is generally omitted, which may diminish the credibility of an organization when investors perceive this. Meanwhile, the general indicators

in this dimension show that organizations are concerned with publicizing their educational actions linked to sustainability. However, most do not publish their reports in other languages or make them accessible to people with special needs. In this manner, company information is limited and access to it may be restricted to investors, which may result in a devaluation of the company.

Boxes 2, 3, 4 and 5 were constructed based on analyses as well as the repetition and description of the variables, which resulted in a corporate sustainability checklist divided into the four presented dimensions (social, environmental, economic and corporate governance).

This study has grouped the selected variables through the use of a group of indicators, however, we suggest that in future works, specialists in this subject should validate the indicators obtained in this study by filtering the variables by a specific source, such as solar power, to evaluate the sustainability of organizations.

## CONCLUSIONS

Based on the use of the bibliometric technique it has been possible to define indicators for corporate sustainability in the energy sector based on criteria defined by national scientific articles. We have defined 133 indicators, with 66 being social, 16 economic, 38 environmental and 13 dealing with corporate governance.

It may be observed in the definition of the indicators that studies of the addressed subject based on the limitation of the used method are recent. Based on our searches, there are still few studies which use indicator systems to examine organizational sustainability, mainly in the energy sector, given that of the 59 analyzed, only 9 addressed corporate sustainability in energy companies from the period of 2003 to 2015. Thus, the average number of studies with defined variables is less than one per year.

Considering the potential for the diversification of the energy matrix in Brazil, the obtained results in this study have a broad application, to the extent that all companies with direct or indirect links to energy generation, transmission, distribution and consumption activities can use the identified indicators as a reference to analyze their levels of corporate sustainability.

This contribution of the study is more pronounced to the extent that the international energy sector is now emphasizing the need for countries to include the adoption of mechanisms to seek and practice energy sustainability in their policies and planning, both in the generation, transmission and distribution processes as well as in forms of consumption. This context presents the need for companies to practice corporate sustainability as a mechanism to seek alignment with national energy policies.

In this case, the obtained results are amplified to the extent that they can be used in various existing energy ventures – wind, hydroelectric, nuclear, thermoelectric, and solar as well as fossil fuels. In terms of ideas for future research, there is a need to perform studies of corporate sustainability for the energy sources of our country's energy matrix, as well as a validation of corporate sustainability studies based on the group of indicators constructed in this study from the point of view of specialists.

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