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Efforts to build a culture of innovation in the Brazilian energy sector

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Abstract. Innovation and innovation management are essential topics for any organizational system nowadays. Public services, commercial and industrial corporations are pressured to study, plan and promote innovations as strategic pillars for their activities and reputation in their competitive scenario. This paper analyzes the efforts on building and improving cultural factors that can foster innovation and innovation management in a critical, competitive and technology-driven sector of electrical power production in Brazil, examining records from ANEEL, its regulatory agency. From these records, values and facts concerning Brazilian program for investment in innovation were evaluated, together with related projects data, showing results that indicated: (a) Investments were conducted in mandatory fashion, not following strategic policies; (b) Expressive amount of investments were also done in the basic and applied research, not offering fair perspectives on more qualified or value-aggregated innovations and; (c) This investment program, executed by the regulatory agency, is opportune to sponsor innovation in this important economic sector. Methodological aspects, such as indexes choice, comparisons and analysis applied in this paper can also build a basis for other studies around the same context, allowing further comparisons to other sectors – such as those in this value-aggregated chain or even with other countries, with perspectives of richer results that can provide another level of innovation investments programs comprehension.

Keywords: Culture of Innovation, Energy Sector, Brazil, ANEEL.

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1 Introduction

The importance of the knowledge and technology is undeniable for the balanced and sustainable development of the nations. This effect can be evidenced on product innovations, the more knowledge and technology are inserted to the new products and services, the higher your market value, consequently more benefits to society, through boosting the economy and improving the quality of life.

The investment in Research and Development (R&D) became a crucial factor for most sectors of the economy to prosper and exceed the challenges that concern them. In the eletrical power sector, this situation is strongly identified, considering its stong influence to the economy, environmental, politics and others key sectors for the development of nations.

The culture of innovation in Brazil was started recently, this theme gained more attention since the 90's, through the creation of support mechanisms to the productive sector in the context of policies in science, technology and innovation.

This study intends to contribute to an analysis and evaluation of the innovation policies in Brazilian eletric power sector. Therefore, the purpose is to analyze and evaluate regulatory framework in Brazil in relation with innovation efforts to create a culture of innovation at national level. The methodological procedures were based on descriptive statistics through secondary data collected from ANEEL database (submitted proposals by companies to "R&D Program ANEEL", available on the agency's website).

Although can be listed numerous benefits of the R&D Program of ANEEL, the results released until now draw attention to some aspects: Of the 2257 projects between 2008 and march 2015, only two are market production insertion. This reflects the need for projects with more applicability and greater technical and economic impact for the Brazilian electricity sector. The need for more practical application of the projects, originated new products to market, was encouraged by ANEEL when proposed changes to the program. On that occasion were created mechanisms which encouraged the development of projects with proposals for potential new products insertion into the market.

Figures relating to the projects of R&D ANEEL between 2008 and early 2015 show that program structure had no effect so far after changes. The creation of mechanisms to encourage the development of Market production insertion, by itself, was not sufficient. It is necessary to step back and see how these projects are being perceived by the companies. The mistaken view of investing in R & D to fulfill obligations imposed by the regulatory mechanism of ANEEL, could compromise the performance of this sector.

The creation and consolidation of the program proposed by ANEEL is an important step forward for the technological development of the Brazilian electricity sector, however, the role of innovation culture needs to be strengthened further in this context. Finally, some important concepts should be incorporated in this environment to ensure the successful operations of such mechanisms, for example: collaborative networks, institutional partnerships, innovation management, innovation indicators, commitment to results, innovation strategy, among others.

2 Concepts and Premisses of Innovation

Conceptualize innovation and its associated management principles are constant reviews against the common-sense understanding. These problems are caused mainly by the remarkable market events produced by some product innovations, as those emerged from information technology, automotive, aerospace and mobile communication sectors. Although supported by the background theoretical reviews, they can be considered as some ways on how innovations can modify people´s lives, including when considering us in the organizational context as members of several organizations, for example, employees of market companies.

2.1 Innovation

Although referring like new ways of production or for entrepreneurial activities, the citations by Joseph Schumpeter are considered as the first landmark for this conceptual work. In its fundamental work – Schumpeter (1934) – he announces six types of "new combinations" of entrepreneurship, in order to promote social changes. These definitions are stated in Table 1 below:

Table 1. Innovation concepts

Innovation as…	From Schumpeter (1934)
Product	"a new good" (or a new quality or functionality).
Process	"a new method of production…" (with a reference to fundamentals on a scientific definition or new ways to handle products for commercial offering).
New market	"a country…" where a manufacturer have not entered yet.
New source of supply	"of raw materials…" or semi-manufactured goods.
New organization	As the creation of a "monopolist" positioning by a competitive strategy on a new market.

Source: Authors (October, 2015).

These concepts are discussed, debated, validated and supported by many authors and organizational sources since their original edition. For example, the Oslo Manual (2005) refers to TPP – technologically-supported products and processes – or new actions or approachs to propose, define, plan and implement new product lines and related processes in organizational environments which are based on technology support and scientific applications.

From Drucker (1985), it is possible to understand a wider conception for an innovative process, reinforcing "as a process", "a new market" and "new organization" definitions, when this remarkable author studied and proposed several analyses on businesses process. In his view, these processes were oriented to support business negotiations with final customers (new market, process) and advantageous strategic positioning

(new organization), corroborating Schumpeter definitions.

Interestingly, from Utterbach (1994), it can be seen a thorough discussion around the innovation concept, in which this important author validates some of Schumpeter findings, promoting a proposition of one new view. In this work, Utterbach compares, immediately, innovation products and process lifecycles, observing how they appear in national innovation systems and can be implemented in industrial and services organizations. His work focuses on designing a model for innovation lifecycle, approaching several real cases, adjusting these to a generic context that, at the end, will serve to understand his propositions to comprehend how one innovation is firstly introduced in a market, then develops its acceptance, technological adjustments and, finally, ends its commercial, technologic and social impact, receiving progressively less changes, becoming a "commoditized" version of a product or process. He also depicts, as a result of these observations around innovation as products and processes, the understanding about new ways of organization, as a response to changes in processes and new ways of products supply, as an integration of processes to provide new products to final customers.

This market-oriented view results in an opportune conceptualization on how competitiveness provokes innovation, which eventually leads to understand how a new type of innovation – that produced by market competition – is also conceptualized.

In a practical consolidation of this first view, the works by Schumpeter and Utterbach result in six different conceptions for innovation (as we combine four of them, considering them as equal, observing the two remaining as additions), which are: (Innovation as…) (1) Product; (2) Process; (3) New organization; (4) New market; (5) New source of supply and (6) Result of competitive forces.

It is also interesting to observe that Strategy is a collateral concept which can be intensively observed in each of these definitions, and also when they are taken combined. These concepts also cannot be faced as exclusive, or, as supported by many authors as those already cited in this section, strictly demanding that one innovation is "only" from one type. It is reasonable to think that the introduction of a new product may demand a new idea to offer, or also a new way to position, promote and sell it to a new market, combining two or three conceptualizations (Drucker, 1985; Davila, Epstein & Shelton, 2006; Bés & Kotler, 2011).

There are numberless definitions for innovation, usually as contributions from academic and scientific areas such as Strategy, Marketing, Human resources management, Information technology, Computing Science, Engineering (several different fields), among many others. For the purpose of this review, those first six definitions, added by the qualifications discussed below, are sufficient to announce the following study about a system to manage innovation in organizations.

2.2 Qualifying an innovation

Additionally, many views for innovation initiatives, processes and planning, result in complementary approaches, that are affirmed as "qualifying" for the innovation concept. First, it is opportune to approach, as announced by Engen & Holen (2014), citing Tushman & Romanelli (1985), the discussion around radical and incremental innovations. Radical innovations, as it happens with the common-sense perception of

considering product as the only type of innovation, is regarded as "the innovation" whatsoever. It is a major change, a disruptive action to propose something completely new, in which will mandatorily replace the older offer – product or service – with a complete new applicative scenario. But, carefully analyzing markets, strategic positioning and marketing stories, it is easy to perceive, as studied by these authors, several cases of small changes, applied to already existing components, parts or even complete commercial solutions, that were really successful. These small but identifiable changes, which resulted eventually in new ways to use products and services, are regarded as incremental innovations.

Davila, Epstein & Shelton (2006) analyzed, in a very detailed and analytical way, how technological and business model drivers should be observed to define if an innovation can be defined as radical, semi-radical or incremental. In their model, three drivers for each dimension – technology and business model – must be evaluated to check if there was, on one hand small, on the other hand, expressive sustainable changes from the former offer, resulting in those three qualifications.

Another approach, focusing more on the process innovation itself, was previously announced by Henry Chesbrough, He defined a context of intense, interactive, cyclic and perennial cooperation of economic agents to innovate, called "Open Innovation" (Chesbrough, 2003). In this proposition, innovation planning, design and implementation is an intensive cooperative context, where signals, information, communication and knowledge flow around the value-aggregated organizational chain, integrating customers and other economic agents, as participative elements to produce the original concept for any proposed innovation. This context diverges from the "closed innovation" former view, where an organization tries to develop its new types of innovation completely by itself, generally working to offer the final conception to the market, eventually dictating how customers will receive it. In general, approaches to Chesbrough works, this "closed" fashion is related to older, strict and classical markets-oriented corporations, progressively becoming extinct by new competitive models and competitive scenarios.

2.3 Innovation Management

Taking into account those different conceptualizations for innovation, its related management is also complex and broad, becoming challenging to focus for a conceptual base detail. First, it is recommendable to understand what can be regarded as innovation management, how it can occur in real organizational arrays and, after these steps, understand how it can be defined.

Observing in the former subsection, it is possible to define innovation from six different points of view. As a product (the most usual and perceived), as a process, as the relationships with new markets and customers, as new ways to organize the final customer service (new organizational models), as how to apply new basic and modified supplies, basic materials and, finally, as results of competitive reactions. It is provocative to think, analyzing from the literature discussed before and from other sources, presented in the following, some possible contributions to manage innovation.

The principles to build such way of thinking is to merely observe how each type of those six definitions of innovation demands specific management principles,

fundamentals and actions and perceive, in an initial view, some management areas and tasks which are demanded by all those six types, in general. The following text discusses by this way, presenting its references and, in the final, a consolidation is produced.

Innovation as product requires principles of Project Management – PMBoK (2012) – specific Engineering, Design, Production Engineering – Trott (2011) -, among several other themes that define and build logic and organizational fundamentals, proposed to structure the production of "something" tangible, eventually never tested before and also functionally acceptable by customers (Christensen, 2015). It is interesting to notice that, as said before, this type of innovation is immediately perceived by customers, in general, then any other type mention previously, also showing the largest base of references discussed by researchers and practitioners for the first decades of 20th Century, just because the other forms to innovate weren´t so much noticed as strategic resources by organizations.

Innovation as process is more understood from other points of view, like those related with business process management, being better exemplified with the approach of processes that namely deal with the "flow" of strategic, production materials or even critical resources, as information or money (BPM CBoK, 2013; Hill, 2015). Modifying a process is not a completely transparent innovation for final users, frequently aiming to improve, optimize or at least change some internal organizational aspects. Although this lack of image for external agents, processes innovation in areas like Finance, Supply chain and Production management eventually produce quantitative results of impact in overall organizational performance.

New markets – in the sense of creating it or even exploiting an old one in a new approach – are usually discussed by Marketing disciplines (Kotler and Keller, 2015). Several evidences from new markets observed occurred in the last years. Emerging markets, such as those from instantaneous, impulsive and sometimes unsustainable national Economies (like from the countries of the BRICS block), demanded new forms of supply, businesses models, competitive regulations, among other actions and agreements. Marketing, Production, Human Resources, Commercial and some other professional areas were dynamically adapted to deal with these new competitive fronts. This resulted in a practical productive scenario where scientific and academic knowledge have to be produced and applied in a sudden, eventual way (Johnson, Christensen & Kagermann, 2008).

As a result from the two former types of innovation – process and market – or even as new, stand-alone innovative approach, one organization can also define a new structure to answer changing competitive external signals, as fast customer change of preferences, invasion by an external competitor or even a risk of technological replacement (Weldeken, et. al., 2014). New design for business models, an event that is still being studied and not correctly comprehended by entrepreneurs and other economic agents, is remarkably being proposed by new competitive organizations, as social media providers, sharing resource partnership promoters (as AirBnB or Uber), industrial dynamic outsourcers (as micro-factories that are now producing from beer to car parts) or by integrative platforms of services, as entertainment tickets sellers or food delivery firms (Dijk, 2015).

New ideas of treating old materials, or even integrating or exploiting these old basic

supplies in another way and also exploiting new materials, are also interesting fronts of innovation, as approached by Dangelico & Pujari (2010) and Gerstlberger, Knudsen & Stampe (2014). It is opportune both to affirm about the technological front, where technical and engineering approach are increasingly successful, and observe how the sustainability issue also provokes researchers and practitioners to understand new materials and new ways for handling of the old ones impact the environment, demanding by this way new degrees of comprehension on how innovations from this kind are valuable for humanity.

Finally, competitive forces, as those presented by Strategy authors who studied Innovation –Porter (2008), Mintzberg, Ahlstrand & Lampel (2009) and Barney (2011) – are recognized as a drive for organizational innovation. Several demands from markets, as new ways to optimize human resources management, finance, supply chain, productive arrays and other aggregated-chain components are examples of these competitive requests for innovation. Organizations competing in these new markets face the demand to change promptly their conditions to understand and propose a productive rivalry, integrating their efforts to occupy market spaces and improve the final customer perceived value.

2.4 The Integrative Context of Innovation Management

As stated in the last subsection, innovation management is a complex and unlimited context, where several management techniques and methods play a decisive role. Concluding this objective view of innovation management, is opportune to mention its integrative context referring both to the fact that it integrates these relevant disciplines of technological and managerial contributions and is, mainly, open to additional thoughts that aim to allow one organization to produce and interact with innovations.

Among the topics that can be easily identified in the literature, it is important to define Strategy as the base for innovation management composition. Strategy can be regarded as one coordinated view for one organization´s future (Porter, 2008; Mintzberg, Ahlstrand & Lampel, 2009). This coordinated view must consider innovation, in the proposed broader view conformed conceptualized before, as a strategic formulation component for one organization.

Innovation can be proposed as, for example, a new process to answer customer demands for more flexible services or even to correctly point out a new focus for launching a specific product, as a result for the availability of new technology (Ma, Jill & Ziang, 2015). Thinking this way, it is possible to affirm that even when it is considered that innovations must disrupt a company´s strategy, it is perceivable that this rupture occurs with meaning to former objectives, supported by new approaches to goal definitions processes and specifications for tactical and operational plans, i. e., it considers the rupture from a conventional, traditional strategic view (Christensen & Raynor, 2003).

Another considerable observation is that one can propose innovation as a part of the organizational strategy, but the strategic proposition, itself, can become an innovation (Ettlie & Reza, 1992). For a development of this affirmation, it is possible to understand the characteristic of strategic planning – it is one organizational process, defined by several authors as “the” organizational process” (Hammer & Stanton, 1999), as the

main integration flow for corporative decisions and implementations. The process itself, as it is possible to observe in new business models, can differentiate from a traditional, up-down, scaling process (Porter, 1998) to new interactive methods, although with the same overall guidance main objectives (Sniukas, 2015).

Another way to think is that strategy regards innovation, as conceptualized, for organizational future positioning. As strategy is unfolded in strategic-tactical plans, defining potential relationships of management areas of one organization to achieve predicted goals, it is important to understand these innovation management components. A brief observation about those areas / subjects that support the organizational strategy focus themes such as Human Resources, Marketing, Commercial, Logistics, Information systems design, Communication, Financial, Operations, Project Management, Production among others, where its specific plans must consider innovation culture and management to produce suitable scenarios that allow to propose innovations as a result of strategic thinking and planning.

Specific approaches to these areas are beyond this first-level theoretical review, although it can be oriented by some of the titles referenced until this part of the study.

3 The Energy Sector in Brazil

An important movement in the Brazilian energy sector occurred through Law 9.991/2000, established by Brazilian Electricity Regulatory Agency (ANEEL). This law provides investments in R&D by concessionary enterprises, permissionaires and authorized companies of the electric power sector. Thus, this law requires obligatory investment, of at least 1%, net revenue from companies in the sector. The initiative is known as "R&D Program of ANEEL".

It is important to note that from 2008 there were some changes in the structure of the R&D Program ANEEL, including the new classification modalit:

- Basic Research (BR)
- Applied Research (AR)
- Experimental Development (ED)
- Head Production Series (HD)
- Piooner Production Lot (HS)
- Market Production Insertion (MI)

These classifications of projects identify the stage of maturity of the businesses proposals, in addition to greater dissemination of results.

In this sense, considering that it's been more than 10 years of this investment effort in innovative projects in this sector, some studies have already realized to assess the performance of this regulatory framework as a study conducted by Institute for Applied Economic Research (Ipea) in collaboration with ANEEL. The results obtained showed strengths and points which needed to be strengthened that the programme could be more efficient.

3.1 The role and intervention of Brazilian Electricity Regulatory Agency (ANEEL)

According to Powder and Abrucio (2004), one of the results of the state reform process

in Brazil was the creation of regulatory agencies. During the first generation of reforms have created regulatory agencies related to the privatization and break of the state monopoly in the sectors of infrastructure, cases of the National Electric Energy Agency (Aneel), the National Telecommunications Agency (Anatel) and the National Petroleum Agency (ANP).

This first generation of regulatory agencies, created since 1996 in the context of privatization, breaking the state monopoly and inspired by international experience, was set up as public entities endowed with independence from the executive branch. In its creation the work of the Congress was important, as well as the recommendations of the Council of State Reform, an advisory body attached to the President, though less participation of the Ministry of Federal Administration and State Reform (Mare) (Pacheco, 2004).

The creation of ANEEL project was sent by the Federal Executive to the National Congress in late 1995, later to the first privatization in the sector, causing some problems of legitimacy, especially regarding the arbitration of disputes (Salgado, 2003).

ANEEL was created by the Law 9427, on December 26, 1996 and regulated by Decree No. 2,335, on October 6, 1997, which approved its regimental structure. The Aneel management contract had its first version adopted in 1998 and the Target Plan approved in 1999.2 The agency, set up as an independent regulatory and linked to the Mines and Energy Ministry (MME), is to regulate and inspecting the production, transmission and sale of electricity in accordance with the policies and guidelines of the federal government. Aneel has managerial and financial autonomy and competence to regulate technical issues as well as decision-making autonomy, guaranteed by fixed terms of its board, whose conformation is designed to ensure technical quality and neutrality in their decisions.

The Law No. 9991 on July 24, 2000, changed by Law No.10,438, on April 26, 2002, No. 10,848, on March 15, 2004, No.11 465, on March 28, 2007, 12.111 on December 09, 2009 and No.12.212 on January 20, 2010, concessionaires of public distribution services, transmission and generation of electricity, the licensees of public services of electricity distribution and authorized for the independent production of electricity, excluding those that generate energy exclusively from wind installations, solar, biomass, qualified cogeneration and small power plants hydropower, should apply annually a minimum percentage of their net operating income - ROL in Research and Technological Development of the Electricity Sector - R&D, according to regulations established by ANEEL.

According to this law (Article 1), concessionaires and licensees of electricity distribution are required to apply annually a minimum of 0.75% (Seventy-five hundredths percent) of their ROL in research and development of the electricity sector and 0.25% (twenty five percent) on energy efficiency - EE in the final use, and should be subject to the transition period these percentage. As for the generation companies, authorized the independent production of electricity and transmission concessionaires were required to apply annually at least 1% (one percent) of ROL in research and development of the electricity sector. By Exemption, were excluded from the obligation companies that generate power exclusively from wind installations, solar, biomass, small hydro and qualified cogeneration, observing, for the latter, the provisions of

Resolution No. 652 of 9 December 2003.

That change occurred to modify the previous rules that force generation concessionaires to invest in research and development of electric power industry annually a minimum of 0.25% (twenty-five hundredths percent) of its ROL. To the distribution concessionaires that percentage was 0.1% (one tenth percent).

The projects should be guided by innovation, for the purpose of the market and technological challenges in the electrical sector. Thus, the R&D project in this sector needs to be original and innovator.

4 Methodological Procedures and Analysis of Data

This study was conducted through the submitted proposals by companies to "R&D Program ANEEL". As such, data were collected from ANEEL database during the period 2008 to 2014.

The data considered in this study was “annual expenditures on R&D Projects” reported by energy companies for the aproval by the ANEEL in the period from 2008 to 2014, i.e. after the establishment of the priority research themes, namely: Alternative Sources of Electric Power; Thermoelectric Generation; Basin and Reservoir Management; Environment; Security; Energy Efficiency; Electrical Power Systems Planning; Operation of Power Systems; Supervision; Control and Protection Systems for Electric Energy; Quality and Reliability of Electric Energy Services; Metering, billing and control of commercial losses, and others.

The table 2 shows the number of submitted and currently projects as well as the financial amounts to be expended.

Table 2. Investments by year and projects submitted

Year	Research and Development R$	Submission	Ongoing projects
2008	44.265.986,36	33	30
2009	483.321.604,26	301	102
2010	839.291.149,32	568	293
2011	1.110.007.426,81	483	301
2012	1.772.905.013,27	505	256
2013	586.246.812,17	168	98
2014	584.301.518,42	198	155
Total	**5.420.339.510,61**	**2.256**	**1.235**

Source: ANEEL (march, 2015).

The table above shows an increase in R&D by companies from 2008 to 2012. There is a sharp drop in investment due to the loss of revenue resulting from the companies' renewal of concession agréments, during the period 2013-2014, made by the federal government.

Concerning the number of submissions and the number of ongoing projects, the power company may at any time inform the ANEEL lack of interest in carrying out projects that have already been subjected to evaluation. This lack of interest may be of any type ranging from financial problems to the technology to be developed in the project be obsolete or have been exceeded. The project number is running 54% of the submitted projects, but when analyzing the total project investment financial expenditure decreased only 20%.

The Figure 1 contains information about the percentage of R & D projects from the project scope.

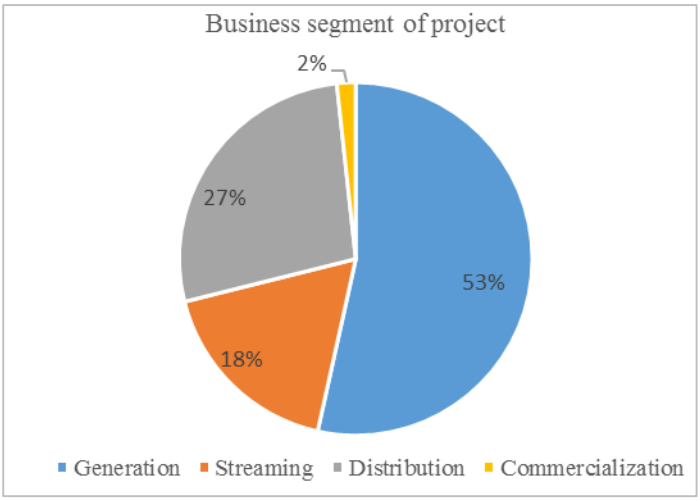

Fig. 1. Percentage by Bussiness Scope of Project (ANEEL, march 2015).

The graph shows that 53% of the Submitted projects are related to generation, 27% in distribution, 18% transmission and only two percent in energy trading area.

The Figure 2 present expenditures (R$) for projects research themes evaluated by ANEEL.

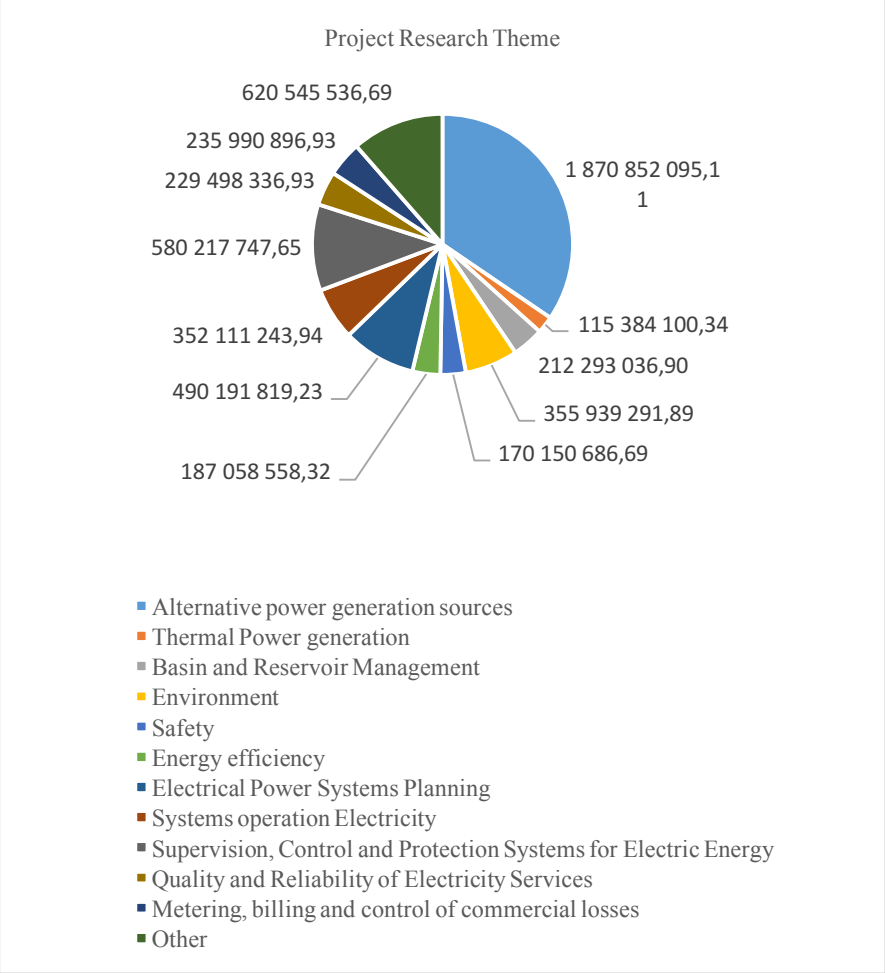

Fig. 2. Distribution of project research theme (ANEEL, march 2015).

It´s observed in the graph that the issue has the highest demand is the Sources of electricity generation alternatives with 35% of expenditure on research, followed by Supervision, Control and Protection of Electrical Power Systems with 11%, Systems Planning electricity with 9% and Environment 7%. The other theme accumulates 11%.

In phase of the Innovation Chain seen in the Figure 3, investments in research focus on applied research and experimental development.

In the analysis of expenditures by modality in the innovation chain is observed that 62% of this was allocated in Applied Research and Experimental Development 29%. These two items account for over 90% of investment in R & D fitting Basic Research 5%, Head Production Series 3%. The phases Market Production Insertion and Pioneer Production Lot account for less than 1% of the investment.

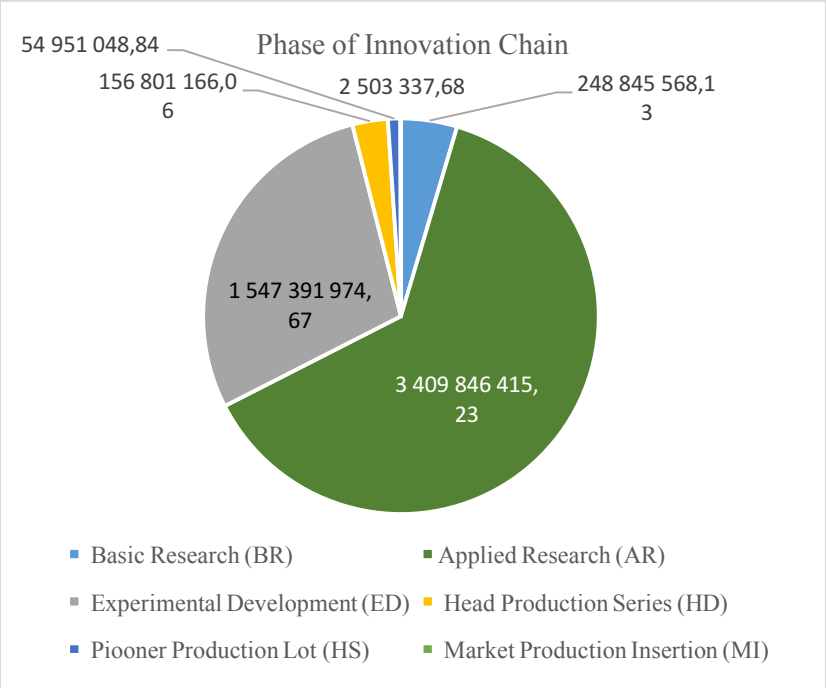

Fig. 3. Phase of Innovation Chain (ANEEL, march 2015).

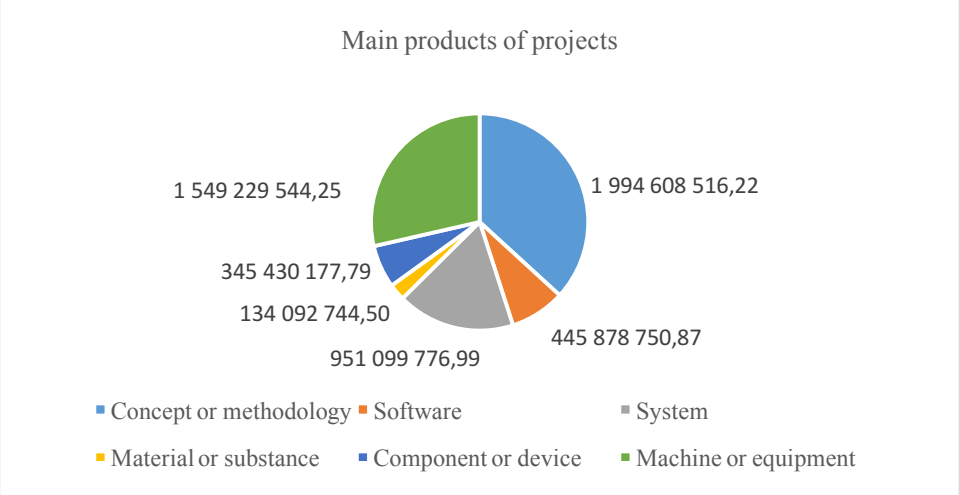

Fig. 4. Main products of projects (ANEEL, march 2015).

The expenditure related to the project's main product is closely linked results to academia, so 36% concerns to concept or methodology, followed by 28% Machinery and Equipment and 17% System. The remaining items as software component or device and material or substance amount to 19%.

The Intellectual property is divided between the power companies and the performers of the project, as conditions envisaged by Brazilian Innovation Law.

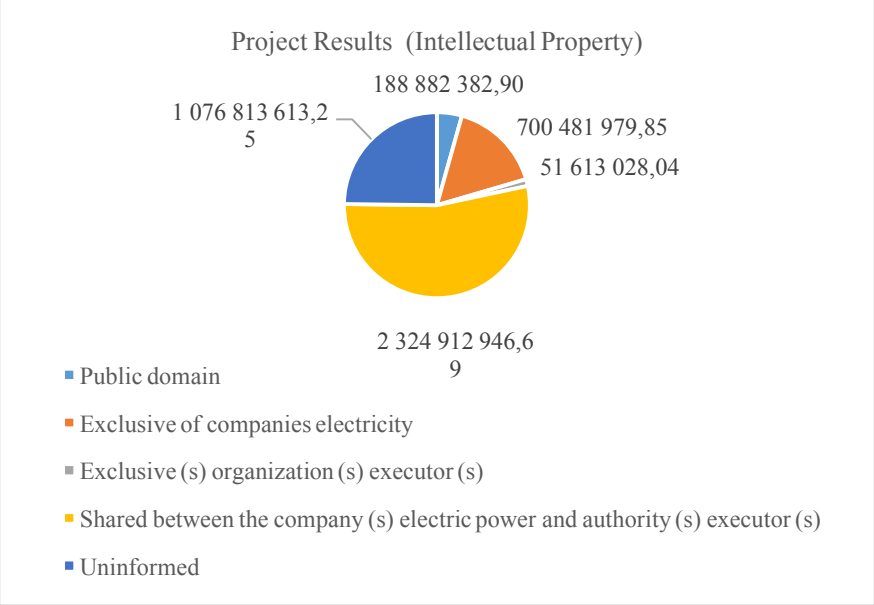

Fig. 5. Intellectual Property (ANEEL, march 2015)

In the Figure 5 it can be observed that the allocation of intellectual property of the results of projects being split between electric power companies and implementing agencies (54%), only 16% of the property is unique to electric company while in the public domain are only 4%.

Also that 25% of the ownership of intellectual property was not informed. Regarding investments can be seen in the graph below. The project submissions and the ones going to final are quite different.

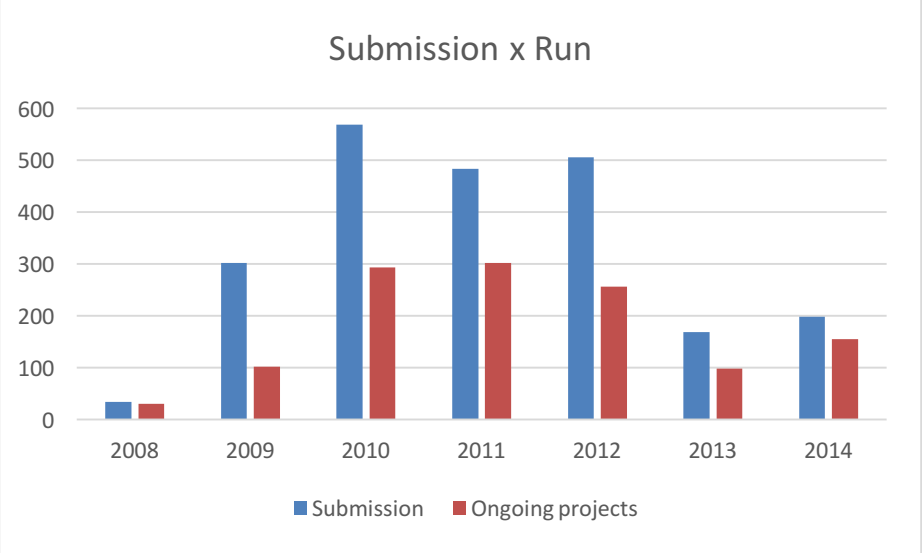

Fig. 6. Submission x ongoing projects (ANEEL, march 2015).

Analyzing the graphic (Figure 6) the rising line in R&D investments from 2008 to 2012, it can be observed that the population increased on average 0.9% per year, while per capita consumption showed an average growth of 3.8% per year in the period (EEAA, 2014).

This growth was due to the inclusion of low-income consumers under the Light for All Program (LpT). The program, over its 10 years of existence, accumulated more than 3 million power connections, representing 5% of all residential consumers in the country, and totaling about 15 million people benefited from access to electricity (EEAA, 2014).

The decline in the number of projects submitted and executed in 2013 and 2014 is due to the renewal of contracts for large dealers with the federal government, some claim loss of revenue that can be seen in the graph, since there is a requirement for investment in R & D, it can not be accumulated for more than two years.

5 Conclusion

In general, the program proposed by ANEEL brought to Brazilian eletric power sector a thousand of projects that were attended by hundreds of research institutions and qualified professionals in their developments. It is therefore important to mention that training and technological capabilities were direct benefits of R&D projects. In addition, new materials and processes have been incorporated to reduce costs, improve the quality of services, and improve the productive capacity.

The first conclusion is that 89% increase in the number of companies, now have the obligation of investment of ROL - Net operating revenue in R&D, from 49 companies in 2008 to 91 companies in 2014.

However, the billings and investments in R&D projects do not achieved the same growth rate as can be seen in the graph below, which shows the number of projects submitted and the number of projects effectively achieved.

The second conclusion is that Brazil is spending too much on basic and applied research, and the results are not progressing in the innovation chain, as the graph shows, the phases Market Production Insertion and Pioneer Production Lot, they account for less than 1% of the investment, i.e., only two and a half million have been invested in these final stages of innovation, a total of more than five billion real (R$) invested in these seven years.

Considering the relevance of the subject in an intensely strategic sector for the Brazilian economy, we encourage new future studies to examine the projects that followed the trajectory to market.

Finally, it´s worth mentioning that these efforts by ANEEL Program are essential for building a culture of innovation in the Brazilian electric sector. After the analysis performed in this study, we conclude that this challenge is associated with the global challenge in this sector, such as: strengthening the local industry competitiveness, supply chain development and development of new technologies.

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