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# Itaipu Technology Park: An Eco-Innovative Niche for Renewable Energies

*Andriele De Pra Carvalho and Sieglinde Kindl da Cunha*

## Abstract

Technology parks are considered innovative environments for the development of new technologies, in a dynamic that can be explained by the micro level of multilevel analysis of the theory of sociotechnical transition, by contributing to explain the actors responsible for the process of development and dissemination of technology. The cases analyzed were composed of companies and eco-innovative projects in the renewable energy area of the Itaipu Technological Park. The methodology was based on a study of multiple cases of qualitative nature, supported by content analysis and triangulation of information. The main results showed that the ITP, with the support of its maintainer Itaipu Binacional, created an environment conducive to the development of eco-innovative companies in renewable energies, stimulating the exchange of knowledge between companies and favoring partnerships with national and international companies for technological development.

**Keywords:** Itaipu Technology Park, renewable energy, micro level, multilevel analysis, eco-innovation

## 1. Introduction

The environmental problems arising from uncontrolled growth have broadened the interest in studies that combine innovation with sustainability. Innovative technological trajectories began to seek efficient ways of environmental preservation, combined with organizational competitive advantages [1]. In this sense, linking innovation with environmental sustainability, as in the so-called eco-innovation, a concept addressed in the studies by CARRILLO-HERMOSILLA, J.; GONZALEZ, P. R.; KONNOLA, T [2], contributes to understanding the relationship between society, the economy and the environment.

This transition to sustainability or eco-innovation, according to GEELS [3] can be studied by multilevel analysis that highlights that there are different levels by which eco-innovation carries out its trajectory. The micro level, which is the level of niches and actors responsible for stimulating and beginning the eco-innovative process, the meso level, which is the dominant regime and the macro level, which accounts for changes at the global and macro level.

Because multilevel analysis, at its micro level, involves technological niches that act as a space for relationships between multiactors, being conducive to radical innovations and the interactive learning process, this article directs its focus to this level.

The micro level also contributes to the construction of social networks to support innovation, in a strategic management [4–6]. Thus, the socio-technical regime and the environment in which organizations are inserted interfere in the development of ecoinnovations at the level of technological niches. In this perspective, the context of a Technological Park stood out for the realization of this study for combining the sociotechnical regime and the development of ecoinnovations, as well as for housing companies, niches and environments with different characteristics [7].

In this context, the Itaipu Technological Park - PTI, based on the sustainability report of its maintainer, Itaipu Binacional, has become an environment conducive to the development of this study, because it is a scientific and technological pole based on a model of support for sustainable technologies and practices, which has as its theme of interest in its Strategic Planning the energy sector, an essential technology for a country and relevant for the development of renewable energy sources that consider the premises of the reduction of the environmental impact.

The discussion then focused on the transition to sustainability favored by energy eco-innovation niches developed in the Itaipu Technological Park. Thus, in this article we bring the theoretical lens of the micro level of the sociotechnical system [8, 9] in the discussion on the development of renewable energies in the Itaipu Technological Park (PTI) since this approach considers that the technological transition begins its process at the micro level. Thus, the following question arises: How does the micro level of THEPT contribute to the development of eco-innovations in renewable energies?

## **2. Methodology**

The sociotechnical approach is a medium-range theory that crosses different ontologies, because it is a multidimensional phenomenon that can be studied from various angles and by different disciplines [9]. There are different epistemological assumptions for its study, although the theory is based on particular intersections between the theory of evolution, interpretivism and constructivism and structuralism, besides combining the evolutionary view, the dynamics of systems, sociological view of innovation and the understanding that multilevel narrative always assumes the historical dimension.

The direction of this study followed the qualitative method as a research strategy, through the analysis of social aspects, which involve interpretation and that are researched in its natural environment, that is, in loco.

The first phase of the research used the case study approach [10], corresponded to the exploration phase of the empirical field to seek relevant answers to the research question. For the choice of objects of analysis, according to STAKE [10], because it is a case study and a qualitative approach, we opted for extreme cases of relevance. The PTI, because it is a park created by the Itaipu Hydroelectric Power Plant, is highlighted in the creation and dissemination of knowledge and for having projects in the area of energy, which are part of the interest and planning of the PTI, besides being an important actor in this segment for the country. Thus, the study will consider the following cases of the Park in the energy area: (i) a company incubated in pti, AP energia, which acts in improving the energy efficiency of generators, the only company incubated in this energy sector; (ii) the graduate company Esco Iguassu, which operates in the area of Energy Management, is located in the city of Foz do Iguaçu and continues to partner with Itaipu Binacional and itaipu technological park; (iii) the project that is in process to become a company, Cibiogás, which acts as an international center of renewable energy, through

Biogas; and (IV) the Hydrogen project, which seeks in this chemical component, ways to contribute to the energy matrix and energy storage.

The investigation occurred inductively, using the techniques of interview, observation and documentary analysis [10, 11], in addition to informal conversations with employees and project participants in the energy area within the PTI: AP Energia, Esco Iguassu, Projeto Hydrogen and Cibiogás.

The observation was developed in a period of forty hours in all activities carried out in the Park. The documentary research involved documents made available by the park and also information on the websites of PTI, FPTI and Itaipu Binacional.

The interviews referenced in this research were conducted with four PTI managers and the four managers of the energy niches of the PTI: AP energia, Cibiogás, Esco Iguassu and Projeto Hydrogen.

The second phase of the research was dedicated to data analysis, with the help of atlas IT software, being characterized as descriptive and analytical, for reporting practices, facts, evidence and statements in order to consolidate information that allowed the analysis of the micro level of the PTI based on the Geels Multilevel Perspective [4, 8, 12], consistent with the sociotechnical transition approach.

### **3. Development (results and discussions)**

The Itaipu Technological Park was created in 2003 by Itaipu Binacional, in the city of Foz do Iguaçu, in western Paraná, bordering Paraguay and Argentina [13, 14].

The former space that served as accommodation for itaipu binacional builders was transformed to accommodate the activities of the PTI. The physical infrastructure adapted to the reality of the PTI covers classrooms, language laboratories with computers, academic computer labs, videoconference rooms, teleroom, library, study and support rooms, sports courts, academic laboratories, auditorium, three event spaces, support room, cyber room, cinetheater, incubator and business condominium [13].

In this environment, this study was carried out that follows the context of Geels' sociotechnical theory (2014), in which the development of an eco-innovation in renewable energy begins at the micro level, which is the level of niches, in which the relationship between the actors that will stimulate the development of new technology occurs and to house companies, niches and environments with different characteristics [7].

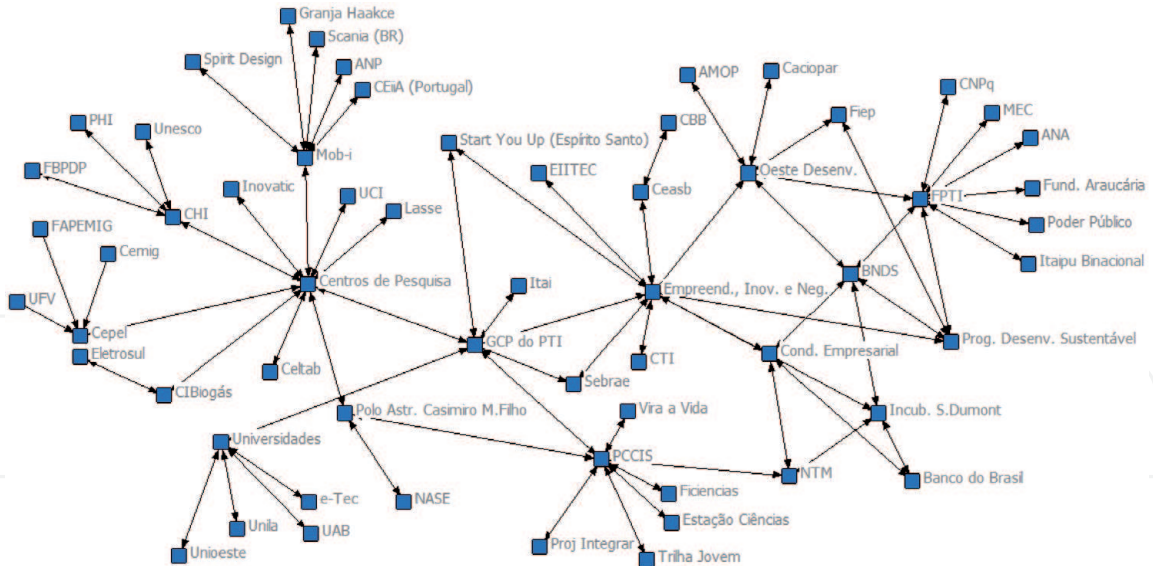
In technology parks, different interactions between actors at the micro levels can be perceived, which are fundamental to understand the dynamics of eco-innovation in renewable energy. The actors of the technological parks that make up the micro level can be represented by technology-based companies, science and technology entity, government, governing bodies, funding agency, developers, universities and research centers, information technology centers, consultancies, stakeholders, entities and local business community [7]. In practice, it is noted that these actors compose the infrastructure of the ITP, presenting a certain complexity in their relationships, some of which can be observed in **Figure 1**, which contemplate the actors of the ITP and their relationships.

These actors act as stimulators for the development of renewable energy niches, which are commented in each case analyzed in this study.

#### **3.1 The development of renewable energies in the PTI niche**

The different actors of the Park, these act in conjunction with the cases analyzed, which are the ecoinnovations in Renewable Energies. AP Energia is the





**Figure 1.**  
*Multiactors of the Itaipu Technological Park. Source: Prepared by the authors.*

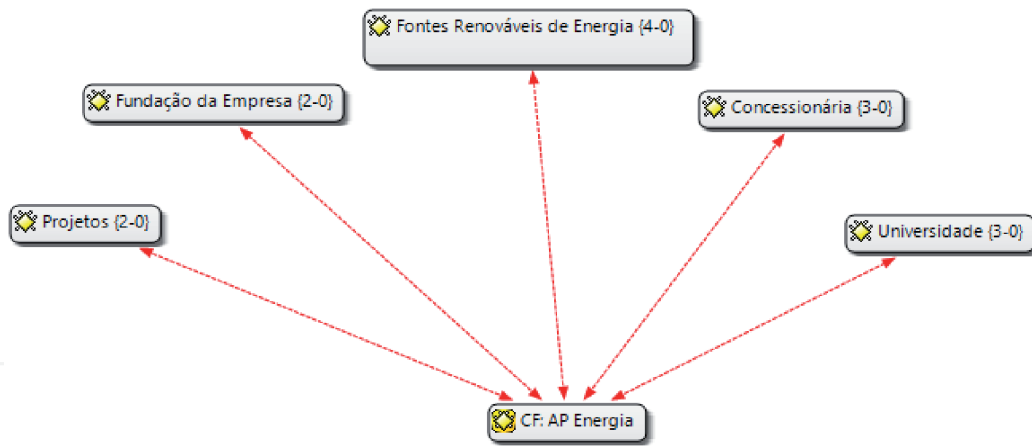
first company analyzed, whose description was based on the interview conducted with its general manager, having been complemented by data from documentary research, observation and field notes.

The first analysis sought to group the codes that related to the category “AP Energia”, through the Atlas.TI software, to interconnect the main relevant points of the company and its structure, as shown in **Figure 2**. Founded in 2014, AP Energia’s main purpose is to target segments of electricity generation from renewable sources. It serves two large segments consisting of distributed generation and medical records of industrial electrical installations. From these medical records, the company performs financial feasibility analysis, electrical studies, NR-10 medical records, quality analysis and electrical projects. However, the activities of medical records of electrical installations are complementary works to the innovative technology of the company, which represents distributed generation, which works with complete consulting for the connection of electric power generators in distribution networks. In other words, it aims to develop technologies and services for the connection of renewable energy sources, from the producer (individual) to the concessionaire.

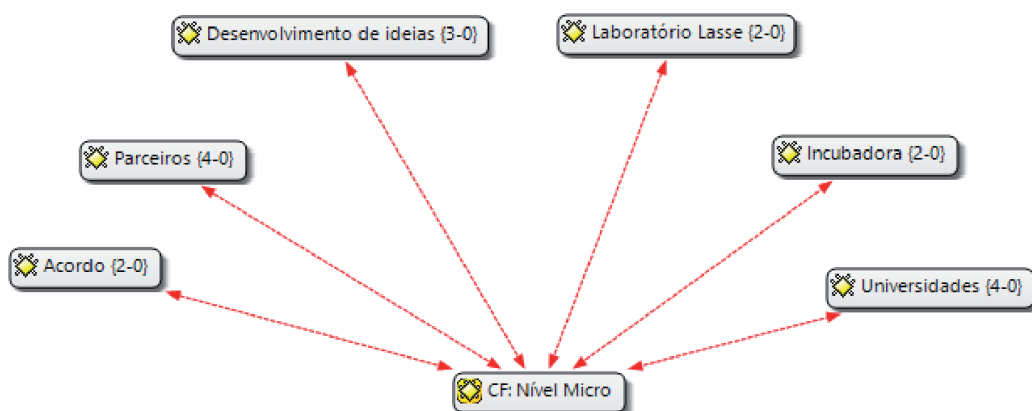
This aims at the constant improvement of its technology, seeking to be a reference in studies of electricity generation from renewable sources or not and the provision of continuous electricity services. The company’s location is in the Business Condominium within the Itaipu Technology Park. The room is small, because the company does not require large space, because it works only with software in the area. In addition, it has no employees, since much of its technology began through a graduate project, at the doctoral level, which continues to be running, as the company’s manager attests.

The company was born from the academic context and still maintains this bond today. The Park acts as a connection of the education acquired for practical application, a fact that becomes clear in the words of the manager, when it intensifies that the Park allowed to put into practice its studies and be an entrepreneur, mainly in projects aimed at improving the environment, which align the market with renewable energy sources.

All these developments and activities aimed at sustainable innovation depend on actors and existing relationships at the micro level, which covers the beginning and definition of the eco-innovation process. This category of analysis is composed of the codes shown in **Figure 3**.



**Figure 2.**  
*Category or family “AP energy”. Source: Own elaboration.*



**Figure 3.**  
*Category or family “micro level”. Source: Own elaboration.*

According to the manager of AP Energia, the actors of the Park have contributed to the development of eco-innovation. This is because sustainable innovation usually follows a process started from an idea, but which is still uncertain in its future development, so the contribution of the park's actors is fundamental. According to the clarification of the manager of AP Energia, the Santos Dumont Incubator, one of the actors of the Park, was fundamental for its development, through subsidies, consulting, training, training and contact networks. The subsidies were passed through space and physical structure to the company. The consultancies, training and training helped the management of the company, because the incubator aims to strengthen its teams for the competitive market, according to one of the incubator managers.

At this point, it remains evident that the park managers' view of directing the company to the market is recognized by the AP Energia manager as beneficial. There is a relationship of respect and hierarchy very clear, because the PTI has great national and international visibility and, as indicated by the manager of AP Energia, by loading the name of the Park along with the name of his company, facilitates the opening of new doors in the market, mainly for partnerships. The importance of the partnerships was highlighted by the manager: "As my technology depends on the investment of concessionaires, the name of PTI has contributed to open doors, agreements and negotiations with partners." It is noted how the influence of actors at the micro level is important for the dissemination of information and relationships necessary for innovation to happen through partnerships. Thus, another partner and actor considered important by the manager of AP Energy was

the Lasse laboratory, located in PTI and fundamental support for the development of the company's technology.

As the company's innovative technology is in the process of evolution, it is observed how PTI instigates research and innovation. Because it is an academic environment, where students and teachers circulate among several researchers and partners of the park of national and international reputation, in a place of interaction and learning.

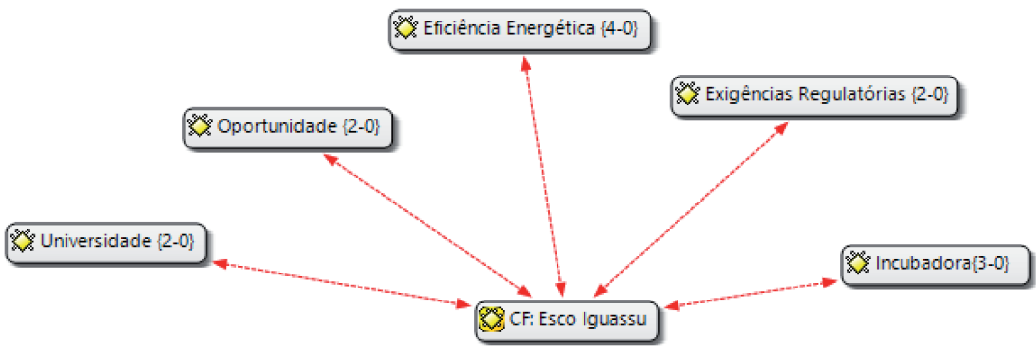
The second company analyzed, Esco Iguassu, is already graduated from the Santos Dumont Incubator of PTI and operates in the energy area. The first analysis carried out with the help of atlas ti grouped the codes directed to the category "Esco Iguassu", which addresses the main relevant points highlighted during the interview, which are highlighted in **Figure 4**.

Esco Iguassu started its incubation process at PTI in 2008 and, at the end of 2012, received its graduation, determining the end of the incubation period and the beginning of autonomy for the company. However, it remained installed in the premises of the Itaipu Technological Park. This fact demonstrates how interesting it is for the park, mainly because it also acts as a partner of the Study Center on Biogas, one of the broader projects of the PTI, as well as, because its activity is directed to the energy area, one of the three clusters that define the direction of the Santos Dumont Incubator, as indicated by its managers.

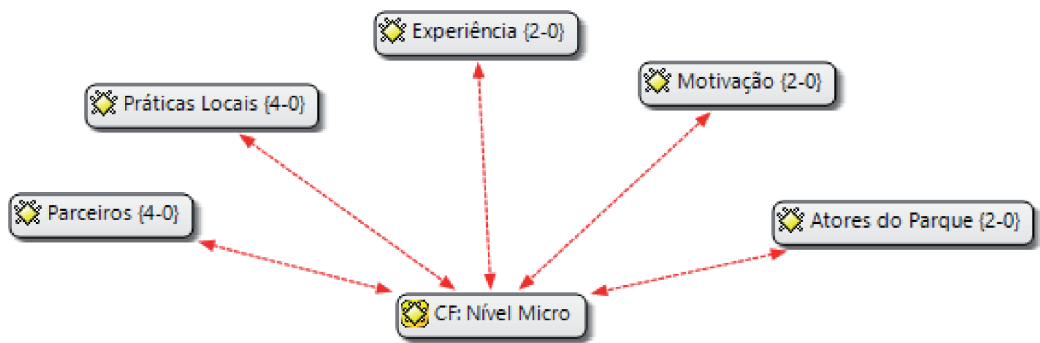
As already explained, Esco Iguassu operates in the energy area and aims to promote energy efficiency in its concession area. Therefore, it benefits from some national laws and the provision of government resources for this purpose through the Energy Efficiency Act does not. 10,295, 2011, which provides for the National Policy for Conservation and Rational Use of Energy.

According to the company's manager, the projects carried out meet the current theme with a focus on reducing energy consumption. The energy theme emerged as the main idea for the opening of the company, because its manager had been working in this area since he was graduating, within the PTI. Currently, he continues with research in the area, such as graduate student, master's level. As in the case of AP Energia, there is a strong interaction between the university and the Technological Park driving entrepreneurship.

The activity developed by Esco Iguassu demonstrates its understanding of the eco-innovative practices witnessed in the ITP, which are manifested in the actions and languages built. All these practices are influenced by the actors and dimensions of the perspective of the micro level, which can be configured as small market niches, in which the habits and routines present between individuals and the environment is conducive to new experiences and innovations. The category of the micro level family is expressed in **Figure 5**.



**Figure 4.**  
Category or family "Esco Iguassu". Source: Own elaboration.



**Figure 5.**  
Category or family “micro level”. Source: Own elaboration.

The environment of the Itaipu Technology Park is repeatedly cited by the manager of Esco Iguassu for having been fundamental to the development of his idea when he began graduation. This relationship occurs through universities, students, partners and other actors of the Park.

Among the benefits of the environment, pti also assisted the company in relation to traditional financial support, passed on to all companies in the Park, such as: rent, maintenance expenses and overheads, because according to its manager, the company never had financing or other source of exclusive resources. The environment, therefore, stimulates through its practices and not only by the transfer of financial resources.

The third case studied is the International Center for Biogas Studies- Cibiogás. In view of its scope, Cibiogás was also a case analyzed in the study conducted by MENDONÇA [15], which focused on the factors of the multilevel relationship in the process of sociotechnical transition to eco-innovation in Itaipu Binational programs. Study that will also serve as a reference for this description.

Thus, through the collected data, the first category of Analysis formulated was “CIBIOGÁS”, which grouped the codes in **Figure 6**, highlighting the notes on the characterization of the company.

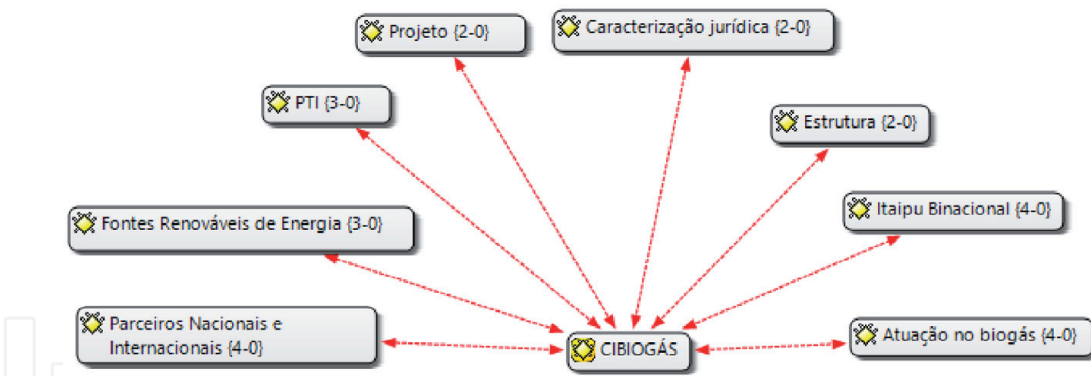
The International Center for Biogas Studies, Cibiogás, is an organization specialized in consulting, knowledge sharing and labor analysis in renewable energies, with emphasis on biogas. In addition, the entity promotes the development of projects and public policies related to the theme, with the aim of encouraging the generation of biogas in a sustainable and renewable way [16].

Cibiogás began as a prominent itaipu project, when the plant included in its organization chart the Renewable Energy Advisory. The project was based on the partnership between Onudi, Eletrobras and Itaipu, which enabled the creation of the Renewable Energy Observatory involving all of Latin America and the Caribbean, boosting the creation of the Biogas Laboratory and, later, the Center for Biogas Studies, based on a specific methodology of the University of Tera in Vienna, Austria, and structured by standards of organization of International Technology Centers [15].

At the World Energy Conference in 2011, Cibiogás was presented by itaipu’s director, the director general of Onudi, through a letter, the reasons for its application, which was well received. Subsequently, the final presentation occurred at the Center in Rio + 20 through a protocol of intention of the development of Biogas studies, which was signed by the authorities present [15].

Cibiogás was legally characterized as an international, non-governmental and non-profit organization, a specific purpose company, with autonomy to acquire movable property, real estate and participation. The Biogas Laboratory was installed next to the Itaipu Technological Park in 2011, due to the fact that





**Figure 6.**  
Category or family “CIBIOGÁS”. Source: Own elaboration.

the Park began to sign the agreements outlined by Itaipu Binacional when it began to expand its operations, through events, seminars and tests for the use of Biomethane in partnership with Scania do Brasil [16]. According to its director, the Center has grown a lot, won the ISO 9001:2008 (Quality Management System) certificate and has several partners, as well as, it is moving towards being effected as a company.

Cibiogás is a private non-economic association with seventeen associates and partners who are working together, in synergy, to consolidate Cibiogas in Paraná and Brazil, among them: Itaipu Binacional, PTI, Eletrobrás, Onudi, Onu, Eletrobrás/Cepel, Toledo Prefecture, Cooperativa Lar, Sebrae, FIEP, Seabe, Iapar, Federation of Agriculture of the State of Paraná (FAEP), Embrapa, Sebrae and United Nations Food and Agriculture Organization (FAO).

Its head office is in the ITP and has the following structure: a biogas laboratory, eleven national demonstration units and small and medium rural properties in the region and an international demonstration unit in Uruguay [16].

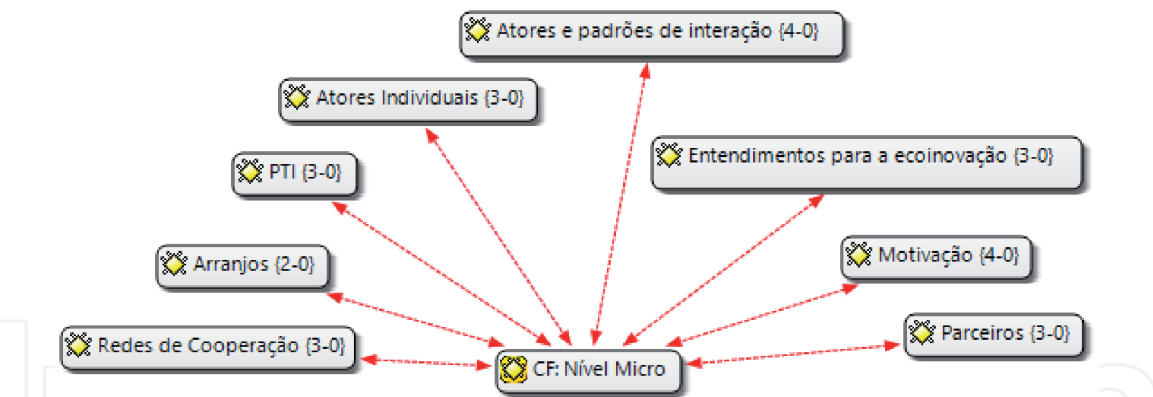
All this relationship between actors composes the variables of the category “Micro Level of Cibiogas”, reported in **Figure 7** below.

The micro level of Cibiogas is characterized by the main evidence extracted from data collection. This level identifies the main partners and actors of the Center. Among this network, Itaipu Binacional and the Itaipu Technological Park received great importance, because they are the creators and main supporters of the project. In addition to these, other actors and partners were also classified as fundamental to the Center, which have already been commented at the beginning of this analysis and identified in the Cibiogas Implementation Project [17]. These actors interact with each other and between existing technologies and opportunities, initiating a network of cooperation.

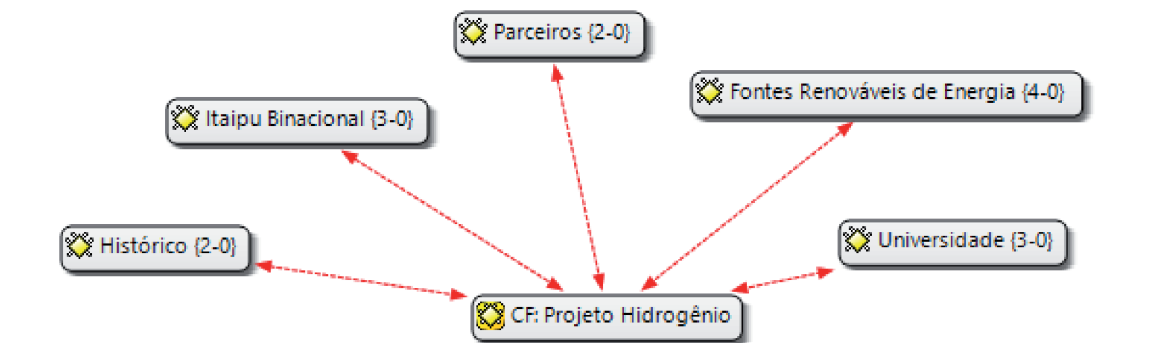
It is evident in his speeches the importance that the director of Cibiogás and his collaborators attribute to the partnerships and actors involved in the exchange of knowledge, research and experiments. An example of this partnership is universities, which state that they contribute to the nationalization of technology with studies aimed at improving the process and resolving inconsistencies with the support of academic research [15].

In addition to the participation of all these actors, the micro level also highlights the participation of the population as a collaborator for the development of innovation, especially after recognizing the importance of technology for the region and for local cooperatives.

The fourth case analyzed, the Hydrogen project, is part of the Itaipu Technological Park highlighted due to its eco-innovative potential. Thus, based on data collection, the first analysis performed with the help of Atlas.Ti, grouped the codes of the category “Hydrogen Project”, as shown in **Figure 8**.



**Figure 7.**  
Category or family “micro level”. Source: Own elaboration.



**Figure 8.**  
Category or family “hydrogen project”. Source: Own elaboration.

The project began in 2010 with specialists from Itaipu Binacional, itaipu technological park and Eletrobras, with the purpose of implementing an experimental hydrogen production plant and a research group in the area so that, from hydrogen capsules, it stores energy. That is, to analyze the viability of hydrogen production from renewable energy sources and store it in cylinders, in the form of gas, to be used in fuel cell and produce electricity. This, in turn, would be used to supply homes, industries, electric vehicles or even as a backup system, for its capacity to store energy, this being the main differential.

The stimulus to the project was given through the master’s study of engineer Antônio Carlos Fonseca, manager of the Department of Electronic and Electromechanical Engineering of itaipu’s Superintendence of Engineering, developed with Unicamp, at the National Reference Center for Hydrogen Energy. It was developed in line with Itaipu’s strategic planning and its objective: renewable energies. According to the project director, its direction was bureaucratic, but the financial support of Itaipu and Eletrobras was decisive for the start of the plant’s operation in 2011 and in 2014 it began to produce hydrogen [17].

Thus, as described by its director, the hydrogen project being consolidated will supply a national demand, as it will enable the storage of energy generated from renewable sources, such as hydroelectric plants, solar and wind power. According to Itaipu [17], the main expected benefits with the project are: to allow the evaluation of hydrogen production from hydroelectric power; provide infrastructure for hydrogen technology research; evaluate the reduction of water and energy waste in hydroelectric plants and evaluate the potential to reduce environmental impact; provide, in the technological field, research, development and innovation.

Another aspect highlighted by the project director, concerns the use of hydrogen in the form of fuel cell for engine operation, this made him seek the partnership of academics from universities installed in the PTI to develop studies in this area.

In this analysis, it is noticeable how the project is still being modeled and structured, with the contribution of several actors that make up the micro level, one of the categories of analysis, presented in **Figure 9**, with its codes grouped.

The micro level of the hydrogen project is related to the development and implementation of innovation, based on social processes, existing practices and the interaction between the multiple actors, fundamental to the new technology. An example of these individual actors is the Itaipu Hydroelectric Power Plant, which, through its strategic planning, seeks ways to encourage renewable energy sources, such as a demand of its own.

Thus, when the plant's engineer, Antônio, presented his project focused on the hydrogen plant, Itaipu began the process so that it could be put into practice. The lack of resources weighed as one of the obstacles to the beginning of the project, however, Eletrobras, another actor, stepped in and financed a part of the project, which may finally become a reality [17].

For the project director, partners are key to consolidating. Through the partners, you can direct new professionals, new financing, new opportunities and actions that further disseminate the idea of the project.

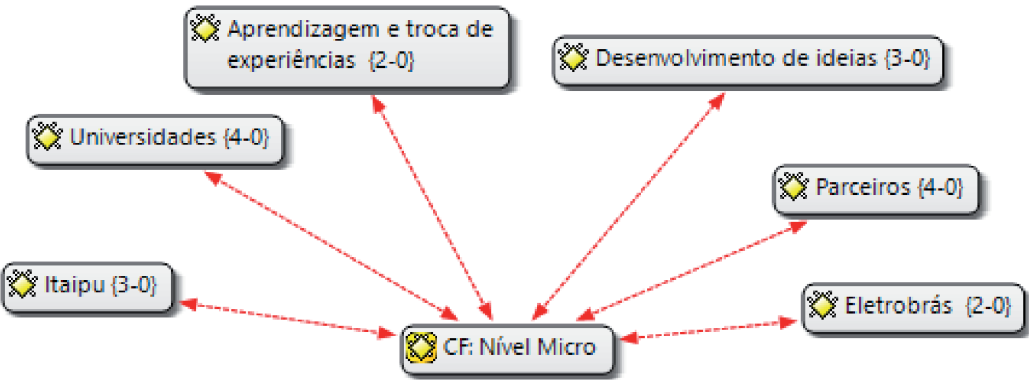
Innovation developed at the niche level is focused on learning, collective practice and the creation of cooperation networks.

The micro level, analyzed in the four cases of this research, allowed the understanding of the processes that initiate the strategy that leads to the management of the transition to a new regime [18]. In the cases analyzed, it was evident how they protect the spaces for the development of eco-innovations, which makes it a learning community allied to many actors directed to entrepreneurship, innovation and sustainability.

The technological niches in renewable energies present in the ITP demonstrate that the transformations that occur there are engaged by the collective perception of opportunities, brought through the relationship between meso and macro levels [19].

**3.2 Relationship between PTI actors-partners for sustainable energy development**

The technological niche discussed in this study, in a private environment, in this specific case, the Itaipu Technological Park, proved to be conducive to the development of partnerships between several actors, which were paramount for the exchange of knowledge and the development of ecoinnovations [6, 20]. These partnerships highlighted in the four cases analyzed, evidenced how the actors of the Park cooperate and complement each other in the activities to achieve the objectives of the ITP. In these relationships, in view of the observations made, the manifestations



**Figure 9.**  
Category or family “micro level”. Source: Own elaboration.

of the managers of the ITP, the Incubator and the companies, no competition was identified between them, only partnership and mutual collaboration.

Cooperation and mutual growth are also identified in the reports of the managers of the Santos Dumont Incubator, when they pass on that the understanding of incubated companies during the selection process is that the park environment seeks cooperation and mutual growth among the actors, mainly allied to the objectives of the PTI. In the training and consultancies passed on to companies, the exchange of experiences and partnerships are also encouraged, one of the dimensions of the micro level, according to GEELS [3] and DOLATA [21]. It should be noted that, during the descriptions of the cases, it is clear how the Itaipu Technological Park attracts many partners, something beneficial for both companies and projects.

The cases Esco Iguassu and AP Energia state that they have other formal partners that have contributed to eco-innovation, also through the PTI. These two cases recognize that the name PTI and Itaipu opened many doors and served as a rapprochement with many partners. While the Hydrogen and Cibiogas projects, because they were created by Itaipu, had many partners before they even left the paper. This fact demonstrates the incentive of the plant in the dissemination of new sources of the energy matrix, influenced by pressures of the landscape level and even the level of the regime [3, 22].

It is common to have several projects with two or more actors working in partnership and in collaboration in the search for innovations, mainly in the topics of interest to the Park: water, energy and tourism. There is a culture of sharing between projects that comprises the common use of the Park's infrastructure, which causes them to gradually form collaborative and learning networks [19].

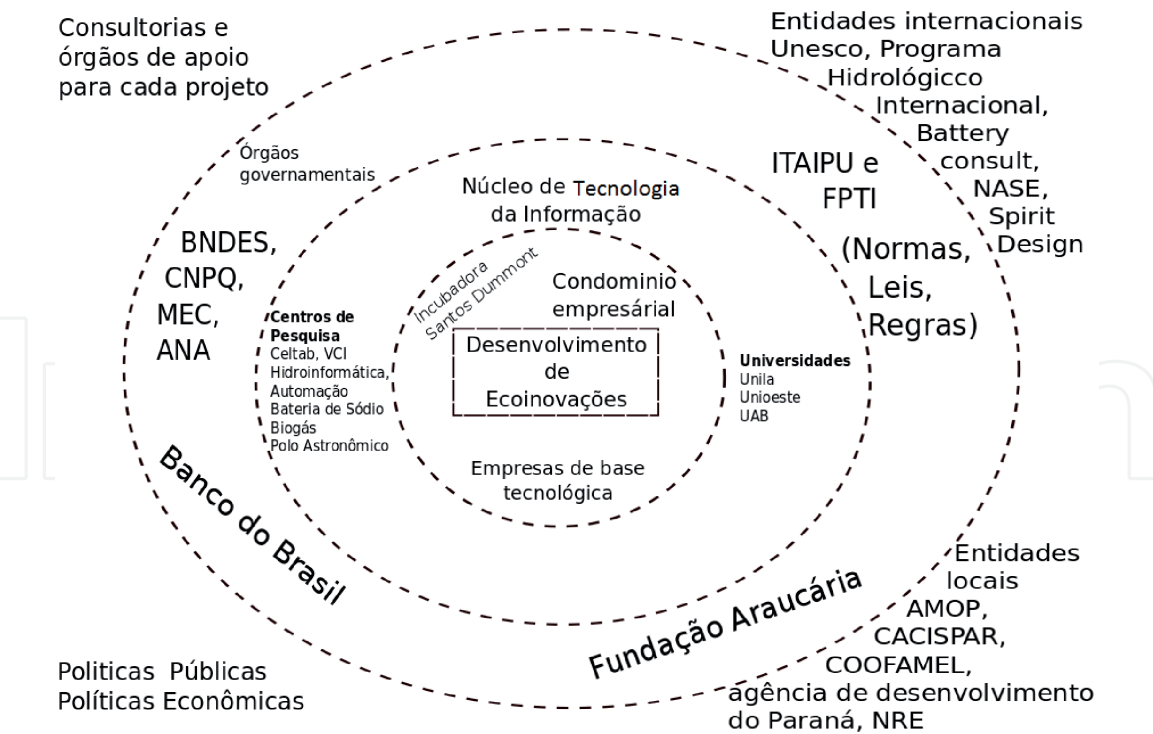
The partners interconnected with eco-innovative technologies in the energy area are composed of national and international actors. The incubated companies AP Energia and Esco Iguassu have only a partnership with national actors, who, according to their managers' report, were very important for the development of the technology. These partners were conquered mainly through the influence of the names PTI and Itaipu, which also act as partners [3, 12]. At this point, we understand the care that the PTI has for the selection of incubated companies, because it takes into account that it will follow related to its name and the name of Itaipu.

The Cibiogás and Hydrogen projects, developed and stimulated by PTI and Itaipu Binacional, in addition to national actors, also have the partnership of international actors, which demonstrates their primacy for the sociotechnical transition process. The main partners of these projects were international, for contributing to the supply of components and, in particular, to the exchange of knowledge with similar technologies developed outside the country.

When analyzing these actors, it is noted that there are related multiactors in all projects, that is, a cooperation network. In this premise, we highlight the articulation of these actors to establish a nucleus of partnerships, which are important in the development for the process of sociotechnical transition to the new regime, because, according to GEELS [3], at the micro level begins the process of dissemination of new technology. From this perspective, GEELS and KEMP [20] also emphasize that the role of multiactors, partnership networks and collaboration networks are fundamental for the dissemination of new technology, in this case, of the new energy matrix. **Figure 10** represents this network of partnerships.

Among the actors identified, the Itaipu Hydroelectric Power Plant has the greatest influence and prominence in the development of the Park, a fact proven during the collection of data from the park managers and companies and projects of the analysis cases. This reinforces the understanding of itaipu power plant's intention to expand its potential to new sources of Energy Matrix, which may shape new configurations for a new sociotechnical regime [3, 4].





**Figure 10.**  
*Pti partner multiactors. Source: Own elaboration.*

#### 4. Final considerations

In these analyses it is evident how the environment of the Park is conducive to the development of partnerships between the various actors, who cooperate with each other and complement each other, becoming paramount for the exchange of knowledge and development of ecoinnovations.

It is common to have several actors acting through partnership or collaboration in the topics of interest to the Park, among them, energy. The actors common to all cases analyzed in this study are: Itaipu Binacional, PTI, Eletrobras, Sebrae, CNPq, PTI universities, PTI academics, ANEEL and the federal government. It is noted how these actors common to all projects are national. International actors work in partnership only with specific projects such as the Hydrogen Project, the University of Ukraine and Cibiogás, whose partners are the UN, Onudi, the University of Vienna, FAO and the University of Ukraine.

As is expected Itaipu Binacional is the actor with the greatest influence of the Park, for attracting national and international partners for its projects, which in partnership with internal actors, develop ecoinnovations. At this point, the PTI infrastructure is also a highlight to attract partners and stimulate a culture of sharing, collaboration and learning, which reinforces the potential of PTI for the development of new energy sources. This potential is also identified in the internal processes of management of energy niches, which involves the relationships of these actors to develop management strategies for the sociotechnical transition to sustainability. In the cases analyzed, the involvement of the actors were important for the investment of intellectual and financial efforts in the development of technologies, in addition to the exchange of knowledge and experiences, which were paramount for the development of the energy niche.

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