Chapter 74

Planning and territorial management in power transmission lines - critical analysis of impacts

https://doi.org/10.56238/devopinterscie-074

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ABSTRACT
The study for the implementation of large engineering works demands constant planning, management, and decision-making to deal with the multitude of problems that may arise during the implementation of a given enterprise. Due to the constant growth and development of cities, the execution of new infrastructure works has been necessary and recurrent in the region, causing some questions and uncertainties on the part of the owners of areas intercepted by power transmission lines, in short, due to the depreciation of the market value of the property. In this sense, this research critically analyzes the impact caused by the right of way of power transmission lines on servant properties in the North of the State of Santa Catarina and highlights the importance of using the multipurpose technical register and integrated and shared spatial information as subsidies to carry out the planning works and carrying out effective management of the territory.

Keywords: Territorial Planning, Socioeconomic impact, Use of the soil, Information sharing.

1 INTRODUCTION

An administrative easement in real estate is a possession by the government or public service concessionaire for the installation of some public utility work. In the case of the insertion of a Transmission Line (LT) and/or Distribution Line (LD) of energy, the burden caused on the servant properties are routinely discussed, and without a unanimous definition of its real impact on the value, remaining area, and use of the land of the property.

Energy LT and LD planning do without complex and dynamic information, as they are linear undertakings that generally impact, in the same route, a wide variety of contexts, both static and dynamic. These variables are described in the five Technical-Economic and Socio-environmental Feasibility reports provided by the Energy Research Company (EPE): Details of Technical Characteristics; Socio-environmental Assessment; Sharing with Existing Facilities and; Land Cost Estimates. These documents aim to help define the best route, minimize costs and impacts, and reduce variations between bidding scopes and executed budgets (EPE, 2021).

> "It is believed that the systematic knowledge of the land structure is fundamental for the knowledge of the territory, its occupation and its use, and the georeferencing of the properties is the propitious tool for the collection of such information, since it allows the constitution of a base cartographic, precise and accurate, which can be used in the most diverse spatial analyses, aimed at the needs of

> public and private institutions" (TALASKA et al., 2011).Acredita-se que o conhecimento sistemático da estrutura fundiária é fundamental para o conhecimento do território, da sua ocupação e de seu uso, e o georreferenciamento dos imóveis é a ferramenta propícia para a coleta de tais informações, pois possibilita a constituição de uma base cartográfica, precisa e acurrada, que pode ser utilizada nas mais diversas análises espaciais, voltadas às necessidades de instituições públicas e privadas" (TALASKA *et al*., 2011).

In general, there is a lot of production of geographic data in large companies, but most of this data is restricted to the bodies that produce them. In this sense, it is extremely important to share the National Spatial Data Infrastructures (INDE) with other open data infrastructures, as this integration streamlines the process of planning and managing the territory, increases the credibility and accuracy of the information, reduces costs and impacts in large engineering works, as is the case of preliminary analyzes of easement in properties already affected by TL and LD, as the easement, in this case, could be shared and impact less on a given property.

Due to the constant growth and development of cities, especially in the North of Santa Catarina, the execution of new infrastructure works has been necessary and recurrent in the region, causing some questions and uncertainties on the part of the owners of areas intercepted by power lines, in short, due to the depreciation of the property's market value.

In this sense, this research aims to critically analyze the impact caused by an energy TL on servant properties, using the North of the State of Santa Catarina as a case study. The specific objectives are to highlight the Geographic Information Systems (GIS) and the Multipurpose Technical Register (CTM) in a shared and integrated way as a way to subsidize and carry out the planning of the works and the effective management of the territory. Such integration and sharing aim to maximize the use of the interfered area and its remainder, mainly in areas already affected by other easements.

2 THEORETICAL REFERENCE

In this chapter, the main concepts of the research will be presented to subsidize the conceptual understanding of the same. Firstly, it will be presented how to carry out energy LT planning and, in the sequence, it will be exposed how the GIS, the CTM, and the sharing and integration of geographic information can be essential in the implantation of a future TL.

2.1 ENERGY LT PLANNING

According to the electricity sector regulations, all new transmission installations to be integrated into the basic network must be recommended by expansion planning studies carried out within the scope of the Transmission Study Groups (GET) coordinated by EPE. When it comes to bidding, the planning process requires the preparation of detailed documents, called R1 to R5, for a better characterization of each project with a view to instruction in the bidding process carried out by the National Electric Energy Agency (ANEEL) (EPE, 2022).

The following items describe the scope of each of these reports:

• The R1 report demonstrates the technical, economic, and socio-environmental viability of the new facility;

• The R2 report presents the technical details of the reference alternative;

• The R3 report presents the route guideline for the TL and location of Substations (SE), as well as the associated socio-environmental analysis;

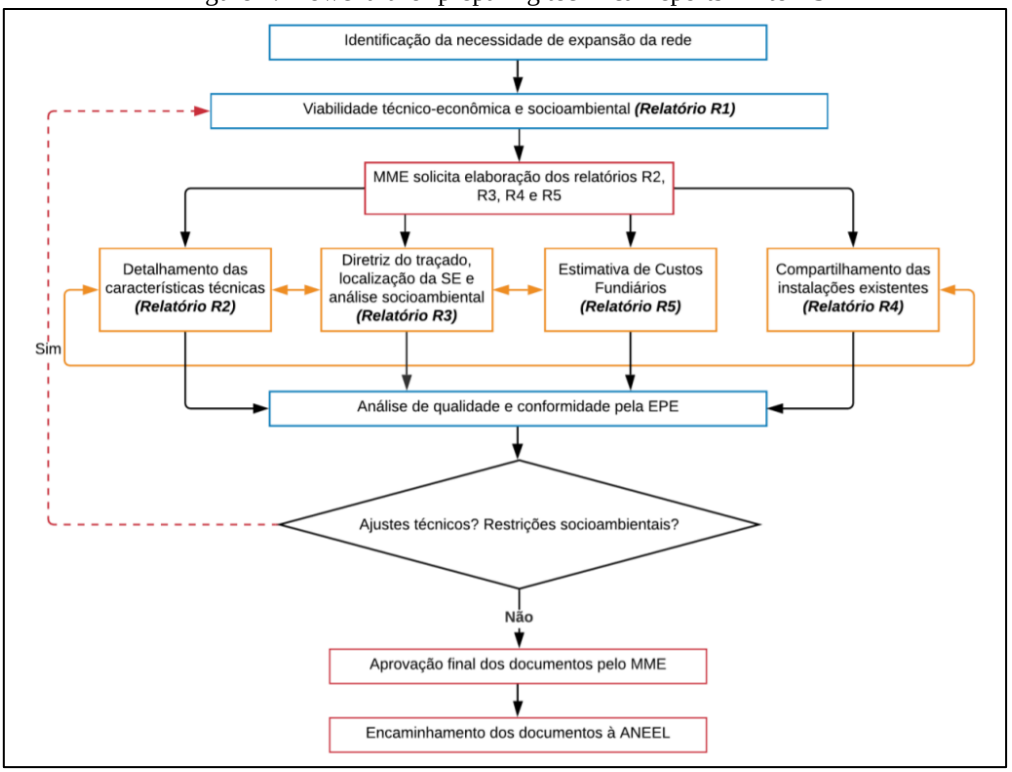
• The R4 report defines the requirements of the surrounding system, to ensure adequate sharing between the existing facilities and the new work;

• The R5 report presents the estimate of land costs related to the region where the new installation will be implemented.

The diagram shown in Figure 1 illustrates how each report is related, and Figure 2 presents Brazil's energy matrices for the reference year 2021, where it can be seen that energy production through hydroelectric plants is the main energy source with 62 .56% of national production, which, according to the National Electric System Operator (ONS), (2022) requires 169,914 kilometers of LT for this energy to be transmitted to the different regions of the country.

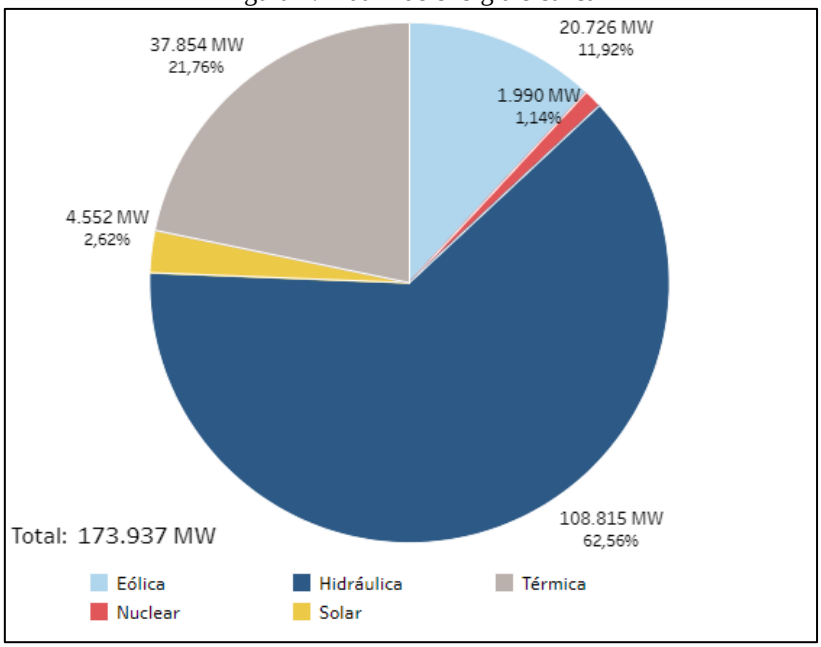
The perspective of the ONS is that in 2026 the total LT of energy will reach 201,942 kilometers. Currently, there is a forecast that in the North region of Santa Catarina, there will be approximately 700 kilometers of LT of energy that should be executed in the coming years.

Figure 1. Flowchart for preparing technical reports R1 to R5



Source: EPE (2022).

Figura 2. Matriz de energia elétrica



Source: ONS (2022).

2.2 USE OF GIS AND CTM IN LT WORKS

GIS has largely met corporate needs, supporting robust architectures associated with other infrastructure and/or corporate software. These systems have provided bases to build a multipurpose integration to collect, organize, analyze, visualize, manage, and disseminate geospatial information. These GIS solutions are developed to meet diverse needs and make geospatial information available to users of different audiences, whether public, private, individual, or collective.

> "The current GIS proposal is to promote broad access to geographic information, common infrastructure for building and developing GIS applications, common data management systems, and significant savings for organizations that develop and use GIS" (LONGLEY et al., 2001).

The evolution of GIS has enabled its increasing use as a tool to aid spatial analysis, making it possible to assess geographic scenarios quickly and, consequently, make decision-making more agile both at the government and business levels.

According to Schmidt et al., (2002) "there is a great development of new techniques for the study of data observed throughout a geographic region" and "the CTM ranges from the measurements, which represent the entire cartographic part, to the socioeconomic evaluation of the population" (LOCH; ERBA, 2007).

> "In Brazil, contrary to what happens in some other countries, there is no specific legislation that deals with the urban cadastre, therefore, the "technical cadastres" or "real estate cadastres" are carried out without any kind of standardization of procedures. in its execution. Thus, for example, there are few registers in which measurements of property boundaries are carried out. Normally, technical registers or real estate registers consist of a list (list) of properties in an area with information related to them, however, devoid of data of a reliable metric/geodesic nature and, therefore, constitute real estate censuses" (BRANDÃO; SANTOS FILHO, 2008).

One of the first initiatives to integrate and share geospatial data is related to the National Territorial Information Management System (SINTER), a public management tool that integrates information from different sources on real estate: cadastral, economic, tax, registry, geospatial and thematic. In turn, the Rural Environmental Registry (CAR) includes semantic, legal, and geographic data: areas of social interest, public utility, permanent preservation, restricted use, and legal reserves (MINISTÉRIO DA AGRICULTURA, AGROPECUÁRIA E ABASTECIMENTO BRASILEIRO (MAPA), 2022).

Despite the CAR, in practice, divergences are verified in the information provided or, the absence of consistent and technical information, which causes overlaps or voids in areas.

> "It is believed that the systematic integration of land structure data and information is fundamental for the knowledge of the territory, its occupation, and its use, with georeferencing being the propitious tool for the collection and integration of information" (TALASKA et al., 2011).

Geographical information and associated technologies, such as GIS, have been increasingly used in the most diverse areas of knowledge, which go beyond regional analysis. Spatial analysis is a tool that makes it possible to manipulate spatial data in different ways and extract additional knowledge in response (ROCHA, 2004) and contributes to support decision-making and the consequent intervention in space in different areas.

The structuring of cadastral information and the cartographic base, through GIS and CTM, so that it is effectively used, as a tool in the management of the territory by different bodies, contributes to the search for solutions that minimize the diversity of urban problems and rural areas linked to the planning and execution of energy LT works.

GIS also enables companies and managers to visualize their problems spatially, bringing benefits such as improved efficiency, decision-making, planning, communication, and collaboration and, at the same time, generating transparency (PARR et al., 2012).

Energy LT, as they are works of public utility, have a Declaration of Public Utility (DUP), which aims to facilitate the release of land and allow the construction of projects that make use of administrative easement (ANEEL, 2022), which is an institute law that maintains the right of use and possession to the owner of the land area affected by the work, but imposes restrictions on its use, upon payment of compensation by the agent. In the case of air LT tickets, the owner is not allowed to build or plant tall trees.

In this way, spatial analyzes are the key to solving problems in the management of LT works, especially if entrepreneurs can synthesize and display spatial data in different ways, as well as combine multiple themes to spatially analyze a given area and take the best decision to minimize the impacts caused on the affected properties.

3 MATERIALS AND METHODS

First, this research defined the area where the case study would be carried out as a procedure. Two TL and two SE of energy were defined, all located in the Municipality of Guaramirim, North of the State of Santa Catarina. Are they:

- LT 525 kv Curitiba – Blumenau;
- Subestação Joinville Sul (JSU=CBA-BLU);
- LT 525 kv Curitiba Leste – Blumenau;
- Subestação Joinville Sul (JSU=CTL-BLU).

In a second procedure, to achieve the proposed objectives, the use of the following materials was defined:

• Geographic information on the location and size of the aforementioned LT and SE, made available by ANEEL (2019), in authoritative resolutions,

• Full content certificates of the servant properties (enrollments) that were obtained through a search in the Real Estate Registry, as they are public information;

• Property limits in shapefile type files made available by the National Rural Environmental Registry System (SICAR);

• Satellite images obtained from Google Earth;

• ArcGIS software to aid in spatial analysis of the overlap between existing and future LT and property polygons.

The third procedure was based on the critical analysis of the specific situation, regarding the impacts caused by the insertion of new TL, in properties that have already been affected by other TL.

4 RESULTS AND ANALYSIS

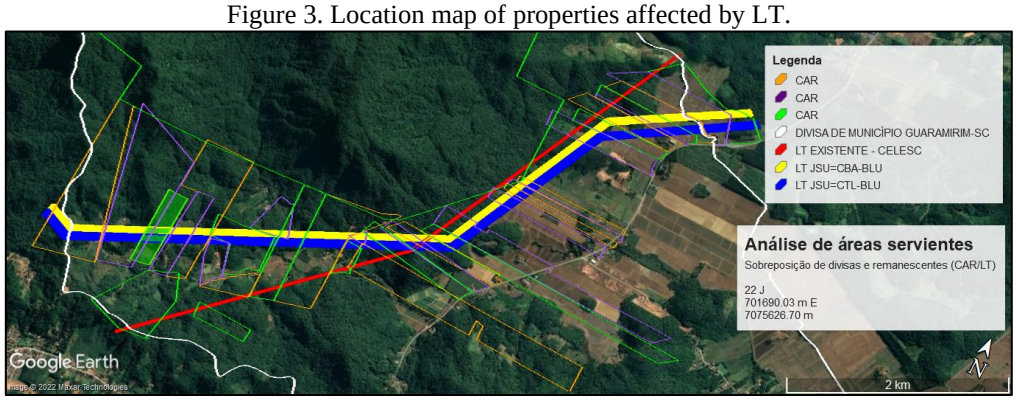
By superimposing the areas related to properties and existing and future TL, it was possible to analyze, where, at first, the prediction of insertion of new TL in properties that had already been intercepted by other TL, under the responsibility of CELESC, was perceived.

In Figure 3, it is possible to verify the existence of CELESC's TL (existing) in red, the property boundaries (in purple, orange, and green), according to SICAR, and also the future TL that will be implemented in yellow, and blue. Through the analysis it can be noticed a successive overlapping of currencies and remainders between the currencies provided by SICAR, in addition to a lack of information on some properties, makes the use of such information very inaccurate.

Another analysis carried out was about the positioning of the energy lines that, although they run parallel in most of their routes, do not share the same easement, causing remnants between them. Figure 4 exemplifies the situation of the property, already intercepted by energy TL and which will also be affected by new TL, where the red band refers to CELESC's LT (already recorded in registration) and the yellow

and blue bands refer to future LT easements that will be built. The blank line refers to the perimeter of the property according to SICAR.

Figure 3. Location map of properties affected by LT.



Source: Google Earth (2022), SICAR (2022) e Certidão de Inteiro Teor dos Imóveis Servientes (2022).

Visually through color slicing, in Figure 4, the impact caused on the property can be seen, with allocations in arable and cultivated areas, where the lack of use of sharing and/or integration of spatial and cadastral information in GIS is evident. This problem is caused by numerous factors, the most common being the non-use of cartographic bases shared by different companies in the sector, linked to their lack of interest in making adjustments to the layout, which is mainly due to bureaucratic issues and also to techniques related to the future structures of the work. For the affected owner, the socioeconomic impact caused can be irreversible.

It is believed that these impacts could be reduced if legal measures were adopted, such as the sharing and integration of information when the allocation is of public utility, not only of geographic information but of easements, which would reduce or even eliminate unfeasible remnants among the strokes. Another possible solution would be to correct the line layout and position it in different parts of the property, for areas with lower value and/or commercial/productive potential, for example.

Figure 4. The property was hit by LT.

Source: Google Earth (2022), SICAR (2022) e Certidão de Inteiro Teor dos Imóveis Servientes (2022).

5 CONCLUSION

It is concluded that the objectives were met, as the allocation of LT in properties in the study area was critically analyzed and the lack of integration and sharing of spatial information was highlighted.

It is also concluded that the culture of non-sharing and non-integration of data from different administrative easements, the positioning of TL on properties without prior knowledge of what is recorded in them, the overlapping and divergences of real estate currencies, entail serious socioeconomic impacts, affected properties, burdening the owner and resulting in non-compliance with the social function of the properties.

To solve this problem, it is proposed the integration and sharing of information through GIS and CTM, between the bodies and entrepreneurs of public utility works, since this proposal of integration and data sharing is already a reality in other organizational spheres in Brazil and the world.

It is believed that a modern and balanced energy infrastructure is fundamental for the development of any nation, as an adequate supply of energy facilitates the sustainable development of the economy and significant social advances. In this way, the planning of works of public utility must always dispense with information coming from GIS and CTM, as only in this way can there be a guarantee of precision and organization in the sharing and integration of geospatial data.

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