NLP 2035

BRAZILIAN'S NATIONAL LOGISTICS PLAN

EPL
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PÁTRIA AMADA BRASIL
GOVERNO FEDERAL

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PRESENTATION

With great pride, the Brazilian Enterprise for Planning and Logistics (EPL) presents to Brazilian and the international society the Brazilian's National Logistics Plan 2035 (NLP 2035). The materialization of this version of the NLP represents a milestone for EPL and, above all, for the integrated transport planning in Brazil.

Through joint efforts with the Ministry of Infrastructure, an unprecedented effort was made to systematize and integrate the entire transport planning cycle at the federal level. The NLP 2035 contemplates the integrated strategic planning of all modes of transport. In addition, the NLP will subsidize the preparation of Strategic Sectorial Plans, which will have robust technological and informational tools for prioritizing and implementing actions and projects with greater assertiveness.

The results of the NLP 2035 are materialized through a system of indicators that allow the comparison between scenarios, using transparent parameters, in line with the National Transportation Policy from the Ministry of Infrastructure. This way, it becomes possible for the Government and the interested society to objectively appreciate the tested scenarios.

EPL has as its mission to plan the logistic and to support the development of transportation infrastructure and the vision, expressed in its strategic map, of being a strategic partner in the planning and development of Brazilian infrastructure. The methodological innovations incorporated in the NLP 2035 have taken EPL to the state of the art in terms of transportation planning. Thus, it is with great satisfaction that I see that EPL has been fulfilling its mission and that its vision for the future becomes a reality day by day.

Finally, I reinforce the dynamic and permanent nature of the NLP, which will be updated every four years, and EPL's commitment to seek continuous improvement of its planning practices, to consolidate itself as a company that shows excellence in the development of transportation and logistics planning studies.

Arthur Luís Pinho de Lima
Chief Executive Officer of EPL

1. INTRODUCTION

Planning is an essential activity for the carrying out of public services. The public manager is responsible for developing and implementing initiatives, programs and actions that are both efficient and effective. Whether in moments of crisis, or in regular periods, or in situations of thriving economic development, there is no more assertive way to make strategic decisions, except through objective and systematized analyses. It is in this aspect that planning is inserted as a constant and essential activity and, in turn, transport planning brings a set of techniques and methods that are in constant evolution and that make it possible to increasingly expand the benefits of a management based on it.

The *National Logistics Plan – NLP*, presented here, is the materialization of this planning activity for year 2035, and gathers, in addition to the results, a series of data, information, questions and models that contribute to the development of specific analyses and for the constant use of planning in strategic decision-making on the part of the federal government, state and Federal District governments, municipalities, regulatory agencies, public and private companies inserted in the National Transport System. Therefore, the NLP is an instrument of the Brazilian State that aims to look at the current and future needs and opportunities of the transportation system.

What is the need for investments in transport infrastructure in Brazil until 2035? What is the perspective of future modal share? Are we developing a more sustainable transport network? How can transport impact the country's economic and social development, given current economic prospects? Will the future transport network provide us with more efficient travel than the current one? How can new technologies and legal changes impact national logistic? These and other questions are answered in this NLP, which for the first time since the Proclamation of the Brazilian Republic presents future scenarios integrating all modes of transport, including the freight (domestic, exportation and importation) and people (public or private), making it possible to assess different types of impact in the national territory.

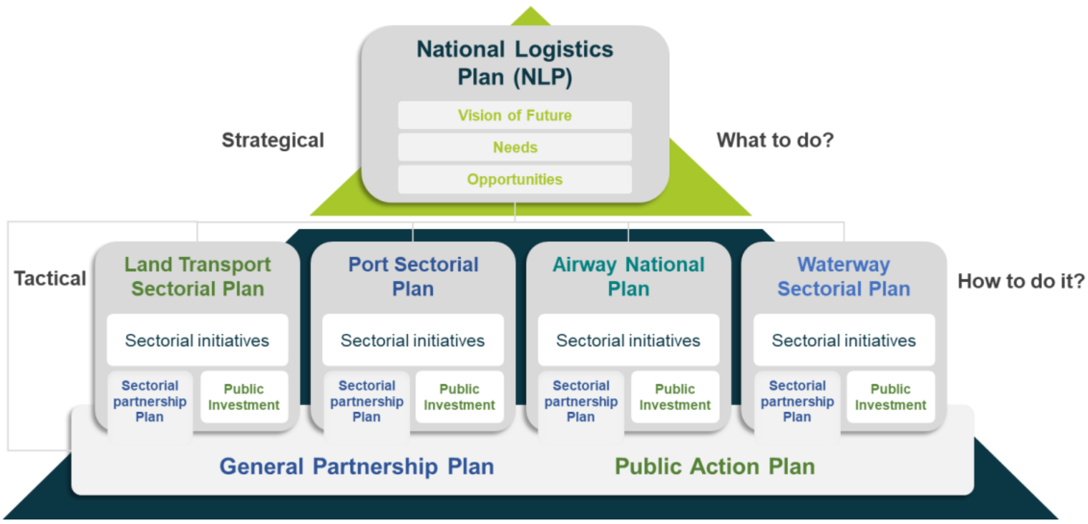
The NLP is part of the concept of *Integrated Transport Planning*, which harmonizes and integrates different instruments so that the levels of strategic, tactical, and operational decisions are conducted as a self-dependent chain, reducing the likelihood of conflicts and inconsistencies, and with a focus on the aid of initiatives, programs or actions also integrated as detailed below.

1.1. INTEGRATED TRANSPORT PLANNING

According to the Brazilian Federal Constitution (Brazil, 1988), it is up to the Union to draw up and execute national and regional plans for territorial ordering and economic and social development. Decree Nº 10.368, of May 22, 2020, confers on the Ministry of Infrastructure (MINFRA) – a body of the Direct Federal Public Administration – powers for the formulation, coordination, and supervision of national policies for railway, road, waterway, airport, and airway transports. Amid this legal framework, the Integrated Transport Planning (ITP) has as one of its main elements the NLP, whose central object is the strategic transport planning, is characterized as one of the instruments of the National Transportation Policy.

Ordinance Nº 123, of August 21, 2020 (Annex 1), from the Ministry of Infrastructure, established the Integrated Transport Planning, which includes the road transport, railway, waterway, and airway federal subsystems, as well as the road network and logistical connections between these subsystems and of these with the road systems of municipalities, states, and the Federal District. In turn, Ordinance Nº 792 of July 1, 2021 (Annex 2), from the Ministry of Infrastructure, complemented the elements of the Integrated Transport Planning by instituting the Public Action Plan.

Picture 1 summarizes the elements present in Ordinances Nº 123/2020 and Nº 792/2021 that, once institutionalized and implemented, consolidate the transport planning process at the federal level. EPL technically and operationally subsidizes the Ministry of Infrastructure in the development of Integrated Transport Planning instruments.



Picture 1: Integrated Transport Planning
Source: EPL (2021)

Each instrument of Integrated Transport Planning creates results that are used as input for following instruments, up to the consolidation through the investments in transportation infrastructure, public policies, programs and normative or regulatory actions. From the NLP, an analysis of the logistic on a national scale is expected, as well as an evaluation of the acceptance to the strategic objectives of the National Transportation Policy, even through indicators. The Plan's vision of the future allows for the identification of the main needs and opportunities for the development of the transport network.

The intermodal macro-simulations carried out in the NLP make it possible to assess and identify sets of infrastructures, territories, or even specific demand flows, which need to or may have their attributes evolved. Putting these demands in contrast with the future network and with the list of short and medium term projects already defined, it is possible to identify new needs and opportunities for the transport network planned development.

The results of these analyses, as well as the future Origin-Destination matrixes and the more strategic infrastructure layer identified in the NLP (the Strategic Layer of Analysis, explained later in this document), are input for the development of the Sectorial Plans:

- Land Transport Sectorial Plan;
- Port Sectorial Plan;
- Waterway Sectorial Plan; and
- Airway National Plan.

In the Sectorial Plans, the analyses are specific to each subsystem, which allows for a greater detailing and assessment of how the needs and opportunities identified in the NLP can be met. New needs can also be identified in these plans, for example, needs to increase the specific capacities of each element of the transport infrastructure. As main results of the Sectorial Plans, the indications of pre-feasibility of infrastructures are presented, with emphasis on those that will come to compose the Sectorial Private Partnership Plans, through Concessions, PPPs (Public-Private Partnerships) or other modalities of specific grants.

The Sectorial Private Partnership Plans create grants for the development of the General Partnership Plan; once again, intermodality is a premise for creating integrated projects that maximize the network's efficiency potential.

As a natural result, infrastructures that are not part of the General Partnership Plan will comprise a group of assets to be maintained and developed directly by the Government and, along with the strategic initiatives aimed at improving sector practices, will constitute the Public Action Plan.

By the end of this consolidation stage of the planning instruments provided for in Ordinance Nº 123, of August 21, 2020, a solid portfolio of initiatives is obtained, which guide the direct actions of the Ministry of Infrastructure, the entities linked to it, and the private initiative. The initiatives regarding infrastructure investments are then structured into specific projects[1].

1 EPL once again provides technical support to the Ministry of Infrastructure up to the implementation or effectiveness of the partnership for such projects, such as the structuring of projects for the North-South Railroad –FNS, for Port Terminals at the Vila do Conde Ports – PA, Belém – PA, Vitória – ES, Santos –SP and highways such as BR-365/364/MG/GO and BR-101/290/386/448/RS, citing only projects already finished by the Company.

1.2. BRIEF HISTORY OF TRANSPORT PLANNING IN BRAZIL

Planning a transport network in a country like Brazil is a considerable technical challenge. In addition to the continental dimension, there is a great diversity of territorial heirships that geographically can appear in segregated or overlapping ways. The national territory presents different terrains and environments, transport technologies in constant evolution, and dynamic production and consumption chains.

However, these challenges are not recent, although they remain current. The first transport plans documented in Brazil date back to the first half of the 19th century, when the inland expansion of the Brazilian territory was still not very expressive. In a country in which long-distance travels were carried out basically by navigation, the demands for transport began to show themselves in different directions of the newly instituted Empire of Brazil. In 1838, for example, advisor José Silvestre Rebello proposed a set of three royal roads with the clear intention of nationally integrating the established and emerging cities at the time (Picture 2). In 1869, military engineer Eduardo José de Moraes developed a plan focused on river navigation, seeking to exploit this resource along with the few railways already implemented (Picture 3). The concern, according to Brazil (1974), was the establishment of communication routes associated to transport routes, as well as ensuring a cost reduction on the outflow of countryside products.

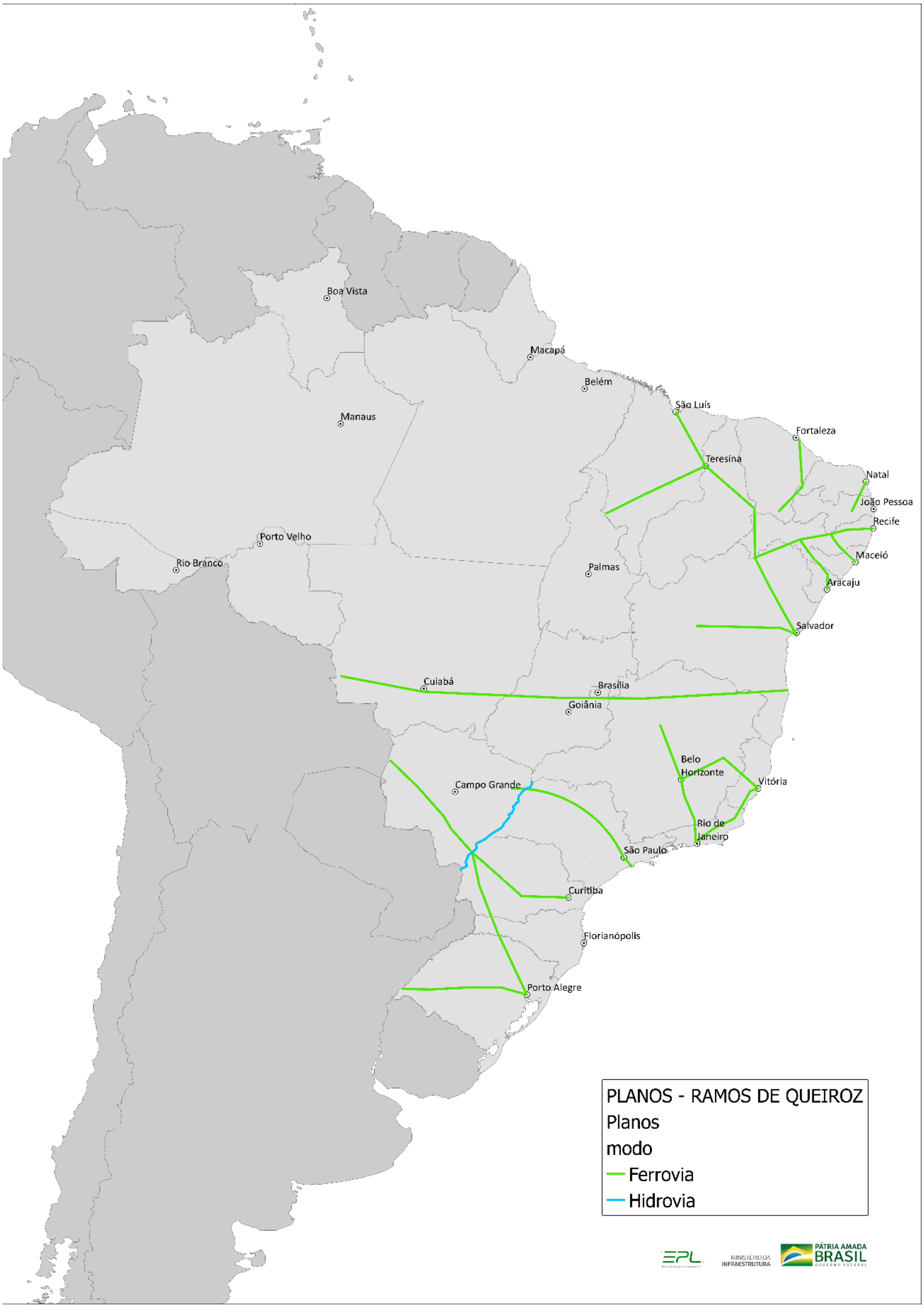
The potential of intermodality, which is one of the premises of the current integrated transport planning, was already explored in the 19th century plans. In the proposals of Engineer Ramos de Queiroz, from 1874 and 1882 (Picture 4), it can be noticed that there is an intention to connect areas of the countryside through the implementation of railways that have initial layouts similar to railways already under implementation or that had recently started operating. Among the objectives of the plan, the concern with both the freight for exportation and the transport of people stand out:

> “(...) open the hidden treasures in the heart of Brazil to the people of all nations around the globe; spread civilization throughout the countryside; save the time spent on traveling long distances, in harmony with high political and strategic interests (…)” Brazil (1974).

Picture 2: Rebello’s Plan (On Picture: Plans – REBELO/mode – Roadway)

Source: Brazil (1974), adapted

Picture 3: Moraes' Plan (On Picture: Plan – MORAES/Moraes/mode/Railway/Waterway)
Source: Brazil (1974), adapted



Picture 4: Ramos de Queiroz's Plan – 1874 (On Picture: Plans – RAMOS DE QUEIROZ/Plans/mode/Railway/Waterway)
Source: Brazil (1974), adapted

The plans developed in that century did not have the methodology or format of current plans, with diagnostic processes, problem identification and solution simulations. Data was scarce. But they reveal themselves to be provided with technical thinking that is in accordance with the time understanding, as they seek solutions to achieve defined political and strategic objectives.

Several other road plans define the institutional history of transport, from a national perspective. However, government changes, the economic situation of the Country in different decades, the time dispended in parliamentary discussions of the proposals, or even the feasibility of some plans, limited their implementation as a whole.

The plans developed between 1808 and 1890 showed, for the most part, a certain concern with intermodality, and a mutual focus on freight and people transportation, mainly due to the characteristic of the main inland transport technology at the time, rail transportation, which allowed the operation of passenger and freight cars simultaneously.

In the same line of propositions aligned mainly with the objective of *national integration*, the Roadway Plan proposed by the Minister of Agriculture, Commerce and Public Works, Rodrigo Augusto da Silva, in 1886, is presented; the 1890's Commission Federal Road Plan; and even the plans where the roadways began to appear as main solutions, such as the Catrambi Plan (1926) and the General National Road Plan, from 1934.

After the Proclamation of the Republic, significant institutional changes occurred more frequently in the transport management system, which began to segregate different planners' data and vision. At that time, roadways were seen as infrastructure that could be built promptly, in line with the development interests aimed at by the government. Soon, this transport technology became the focus of federal actions. From the 20th century onwards, several plans by mode of transport can be seen, such as the plan of the Federal Highway Commission – road transport, in 1927; the National Roadway Plan, in 1934 - contemplating railroads and waterways, but without integration of the existing roadways; the National Highways Department (DNER) Roadway Plan, in 1937; the 1956 National Railway Plan; among others. With plans separated by mode of transport or focused on specific demands, a bit of the network's systemic view of the territory was lost.

An important milestone in the history of transport planning in Brazil was the creation of the Executive Group for Transport Policy Integration – GEIPOT, in 1965, when a series of studies and diagnoses of deficiencies in the existing transport infrastructure began. This resulted in a new phase of national transport planning, with guidelines that would be incorporated by the Ministry of Transport and the Strategic Development Program (Ministry of Planning and General Coordination, 1968/1970).

The plans and programs of the second half of the 20th century that had the participation of GEIPOT maintained the planning focus on Freight transportation, trying to overcome institutional segregation and the lack of integration between the aforementioned institutions.

They are as follows: the Three-year Plan for Economic-Social Development (1963-1965); the Economic Action Plan (PAEG) (1964-1966); the Strategic Development Program (1958-1970); and the Transport Sector Development Program – PRODEST (1986), when the Group was transformed into a Brazilian Transportation Planning Company, keeping the acronym GEIPOT.

After PRODEST, there was a period in which isolated projects and initiatives rose again in the Federal Government's role, creating a gap in the country's integrated transport planning. This scenario remained untouched until 2001, with the institutional restructuring of the transportation sector, which included the creation of the National Council for the Integration of Transport Policies (CONIT) and the Federal Regulatory Agencies – National Agency of Land Transportation (ANTT) and National Water Transportation Agency (ANTAQ), in 2001, and National Civil Aviation Agency (ANAC), in 2005. Since then, the Ministry of Transport resumed discussions on the process of planning and preparing the transport policy, conjecturing the idea of policies involving an integrated logistic chain, originating the National Plan for Logistics and Transport – PNLT (2007).

The PNLT was prepared in partnership with the Ministry of Defense, through the Center of Excellence in Transport Engineering – CENTRAN. The plan aimed at the development of a strategic transport modeling, considering the main types of Freight, in addition to passengers - highlighting the need for further specific studies, due to the low reliability of projected data for medium and long-distance passenger transport flows at the time. The evaluated scenarios considered the level of spatial aggregation of the main corridors between the Brazilian microregions, as defined by the Brazilian Institute of Geography and Statistics (IBGE).

In 2009, during the revisions of the PNLT, several modeling and information treatment techniques were improved, representing a methodological advance for the development of strategic plans for logistics and transport. Still with strong focus on Freight transport, and limitations of data to federal infrastructure, the result was the proposal of an investment portfolio for the different modes of transport. It is important to highlight that regarding people transportation, the model was limited to projecting the demand of some of the subsystems, without carrying out more detailed analyses.

Subsequently, sectorial plans continued to be developed, such as the Strategic Waterway Plan - PHE (MTPAC, 2013), the National Port Logistics Plan - PNLP (SEP, 2015), and the recently published National Airway Plan - PAN 2018-2038 (Ministry of Transport, Ports and Civil Aviation (MTPAC, 2018)).

The most recent national transport planning published effort, the National Logistics Plan - NLP 2025 (EPL, 2018), developed by the Brazilian Enterprise for Planning and Logistics, (EPL) also exclusively addressed Freight transport, as well as the land and water modes. NLP 2025 itself predicted that the transport of passengers and air transport would be studied in future works; such limitations are beginning to be resolved in this NLP 2035.

The segregation of planning by mode of transport and the lack of incorporation of in-depth studies on the mobility of people in the previously developed plans resonate in the Brazilian transport network, being that the main related impacts are:

a. To the unbalancing of the matrix and to Brazil's dependence on road transport;

b. To the high transportation costs, especially when compared to other countries, due to large territorial distances and few alternatives of transportation;

c. To the creation of a planning culture that prioritizes mode of transport rather than the demand's characteristics and needs;

d. To the difficulties in intermodality for the freight and people transport, such as the lack of connections and transshipment terminals, endorsing for the absence of complementarity between the modes; and,

e. To overlapping, conflicting or disconnected public and private investments.

Currently, with the creation of the Ministry of Infrastructure (MINFRA) - resulting from the merger of the former ministry's ports portfolios (Ports Secretariat - SEP), civil aviation (Civil Aviation Secretariat - SAC), land and waterway transport (Ministry of Transport) – there is an institutional maturity that tends to evolve the vision of integrated planning in the sector. The Department of Development, Planning and Partnerships, which has, among other attributions, the integration of planning processes and the guidance and establishment of criteria for transport plans, corroborates this vision (Brazil, 2019).

This way, it was up to the Brazilian Enterprise for Planning and Logistics – linked to MINFRA – to develop new studies in this area, paying attention to the limitations pointed out in previous works and improving the methods, analyses, and results of the National Logistics Plan. Thus, this new version of the plan was created - the NLP 2035 - presented in this Executive Report.

Learning from the past, several elements and concepts were identified that are applied in current planning techniques, while seeking to overcome limitations. The NLP 2035 development effort goes far beyond data updating. The new methodology seeks to understand the entire transport system in an unprecedented way, and this implied in the use of new databases, new simulation, and evaluation models, aligned with a strategic vision that preaches intermodality and network efficiency.

1.3. REPORT STRUCTURE

Following this introductory *Chapter 1*, *Chapter 2* highlights the principles, guidelines and objectives that guided the entire conception and development of the NLP 2035. The way in which initiatives by the Government can corroborate the achievement of the outlined objectives is also presented, showing that in addition to investments and interventions in transport infrastructure, other sectorial actions can enhance positive future impacts.

Chapter 3 addresses the Plan's overview, emphasizing the methodological aspects and the main highlights and advances of the NLP 2035 – such as social participation activities, the informational bases used, the structuring of integrated and results-oriented planning.

On *Chapter 4* the 2017 Baseline Scenario is presented; that year was used to calibrate the functional model used in the NLP and the starting point for strategic analyses. Information is presented on the origin-destination matrixes of Freight and people and the infrastructure network for the year in question, in addition to the flow maps allocated according to the simulations. As a validation of the future simulation model the definition of the strategic layer of analysis and the preliminary results of the indicators for the initial year of reference are also presented.

Chapter 5 covers the stage of designing the Scenarios for year 2035, as well as the elements subject to change in each evaluated scenario: projection rates of the origin-destination matrixes of Freight and people for 2035, portfolio of simulated projects, possible legal changes and perspectives of changes arising from technological innovations.

Chapter 6 presents the main results of the Plan for each of the 2035 simulated Scenarios, and also the maps of allocated flows of Freight and people and the values of the observed indicators.

Chapter 7 brings the technical analysis of the set of future scenarios, highlighting regions and infrastructure sets that should be looked at by the Government, in addition to inferences regarding interventions that reflect positively on the indicators. This chapter highlights the main needs and opportunities for the development of the Brazilian transport network.

Finally, *Chapter 8* presents the main conclusions of the Plan, the way in which it will be updated and indicates possible advances and studies to be incorporated in the next versions of the NLP.

2. PRINCIPLES, GUIDELINES AND OBJECTIVES OF THE NLP

The principles, guidelines and objectives that guided the entire design and preparation of the NLP 2035 come from the National Transportation Policy - NTP (Ordinance Nº 235, of March 28, 2018), and Ordinance Nº 123, of August 21, 2020, which instituted the Integrated Transport Planning.

That way, the principles of the NLP 2035, as presented by the NTP, are:

a. Respect for Life;

b. Institutional Excellence;

c. Territorial planning and integration;

d. Sustainable Infrastructure;

e. Logistical Efficiency;

f. Economic, social and regional development;

g. Social and environmental responsibility; and

h. International Integration and cooperation.

Based on the NTP, the *guidelines* for the preparation of the NLP are:

a. To promote the offer of an integrated, efficient, safe and sustainable road system, with the goal of improving freight and people mobility, reducing logistical costs and increasing competitiveness;

b. To show the socioeconomic aspects of the failure to implement transportation infrastructure;

c. To incorporate attributes that make it possible to assess the modernization of management and the incorporation of innovations in the transport system

d. To improve the transport system, with the goal of strengthening economically dynamic and consolidated regions;

e. To foster the development of economically weakened or stagnant regions, based on an efficient road system;

f. To plan transport infrastructure in light of regional particularities and environmental sustainability;

g. To promote the alignment of national initiatives with the policies and planning of neighboring countries, in favor of generating free transit and sectorial interoperability;

h. To consider socio-environmental and economic aspects in transport planning;

i. To promote the continuous expansion and maintenance of the federal road system, in a technically and financially sustainable way; and

j. To align sectorial actions considering MINFRA's socio-environmental guidelines.

The *objectives* of the NLP are the same as the one of the NTP, divided into two groups. On the first, there are the objectives that concern the development of the transport network, that is, the objectives towards which the network should be oriented. Such objectives are used as the basis for the NLP scenario assessment system:

a. To provide an accessible, efficient and reliable system for people and freight mobility;

b. To ensure operational safety in all modes of transport;

c. To provide a rational and efficient road matrix;

d. To promote cooperation and international physical and operational integration;

e. To consider the regional particularities and potentials in sectorial transport planning;

f. To act as a vector for the country's socioeconomic and sustainable development;

g. To ensure adequate road infrastructure for national security and defense operations.

The second group of objectives arising from the NTP concerns the principles that must be observed during the construction and implementation of the NLP:

a. To promote intra- and inter-institutional participation, considering society, government and market, in the development of an integrated transport policy;

b. To plan logistic and transport systems from a territorial, integrated and dynamic point of view;

c. To discipline the roles of personnel in the Federal Government Transportation Sector;

d. To provide transparency to society, the market, and public agents regarding government actions in the Transport Sector; and

e. To incorporate innovation and technological development for the continuous improvement of sectorial practices.

The principles, guidelines, and objectives of the NTP accepted in the NLP 2035 support the objectives of the Integrated Transport Planning defined in art. 2 of Ordinance Nº 123/2020: *to contribute to national competitiveness, social well-being, regional development, and national integration.*

2.1. STRATEGIC INITIATIVES FOR THE DEVELOPMENT OF THE NATIONAL TRANSPORT SYSTEM

The National Transportation Policy establishes guidelines that guide the implementation of initiatives aimed at improving sectorial practices and developing the transport sector, in addition to investments in infrastructure. Among these guidelines, the following stand out:

a. To promote and improve the integration and articulation between the Transport Sector bodies, as well as between these and other related bodies, based on the systemic vision, coordination and synergy between actions;

b. To stimulate inter-institutional articulation to improve the planning and evaluation of sectorial actions aimed at socioeconomic and regional development;

c. To structure the institutional arrangement for a coherent distribution of competences within the Ministry and related institutions in favor of the development and fulfillment of sectorial actions;

d. To propose, in the intersectorial sphere, consistent and coherent legal substrates in order to provide a safe and reliable environment for the application of resources in logistics and transport systems;

e. To establish, in the intra-sectorial sphere, consistent and effective rules, in order to provide legal certainty in the planning and investments in the Transport Sector;

f. To publish reliable and integrated Transport Sector data, information and actions in a broad, regular and accessible way;

g. To continuously improve the management of transport infrastructure, operations and services;

h. To effectively regulate and supervise the transport services provided to society; and

i. To appreciate and qualify the government’s transport sector human resources through the development of strategic skills, attraction and retention of talent, and the creation of a favorable motivational environment.

The Ministry of Infrastructure and its related entities have been implementing a series of initiatives aimed at improving sectorial practices, which meet the NTP guidelines and help achieve the objectives. The impacts projected for the future transport network depend both on the actions of direct interventions in infrastructure and on these regulatory initiatives, actions, programs, or public policies.

The Integrated Transport Planning provides that the Sectorial Plans will contemplate such initiatives in more detail, but in order to guide this future elaboration, there are some theme groups that we suggest be addressed:

- **Vehicles:** it involves actions aimed at the modernization of vehicles for transporting people and Freight and their components, seeking to implement technological solutions that contribute to reducing social and environmental impacts and increasing the economic and financial sustainability of the Transport Sector;

- **Transport support equipment:** it consists of actions that have as their object the equipment that helps the operation, maintenance, or control of the transport system, highlighting the improvement of this equipment and its acceptability to the demand. Just like the actions aimed at vehicles, equipment improvement can also contribute to reducing social and environmental impacts and increasing the economic and financial sustainability of the Transport Sector;

- **Personnel**: brings together actions aimed at personnel policy with a focus on: training for the development of skills and the use of new technologies; encouraging employees, strengthening communication and integration between units; incorporating innovative and high-performance technologies and techniques, creating conditions to increase productivity; developing an organizational culture focused on results and the well-being at work, which creates a sense of belonging to the institution and integrated teamwork;

- **Government, management and operation:** consists of actions aimed at improving the public management of the transport sector, including: review, automation and reduction of bureaucracy of processes, directed towards improving the operation of transport, with a focus on safety, reducing costs and operating times, impacting the efficiency of the sector; risk management; reduction of administrative costs and government requirements; review of the political-institutional structure; greater integration within and between sectorial bodies, including integration between their systems; improvement, simplification and updating of laws, infralegal and regulatory rules; increased legal security; communication and transparency of both information and processes;

- **Information:** involves actions aimed at improving the management of information in the transport sector for the obtaining, treatment, consolidation and availability of integrated and digitalized data and information, through media that is easily accessible by the various agencies and the citizens, to enable the monitoring and knowledge of the state of transport, as well as simplifying access to public services provided by the Ministry and its affiliates**.**

Examples of these initiatives are the Information Integration Program of the Transport Sector, the Port Management Modernization Program, the Digital Transformation Program, the Civil Aviation Safety Program, the *Inov@BR* Program, and the National Plan to Reduce Traffic Deaths and Injuries – PNATRANS.

It is also noteworthy that regulatory initiatives for the restructuring of the transport sectors are essential for the effectiveness of achieving the objectives and general improvement of services. In this regard, the following can be mentioned: the Cabotage Incentive Program (Bill of Law Nº 4199/2020), known as *BR do Mar*; the Simple Flight Program to modernize general aviation rules; and the proposal of the new Legal Railway Framework.

The merging of different initiatives and broader actions can also be formatted in Public Policies linked to financial or fiscal incentive instruments. Examples of this type of initiative, but with different purposes, are the Merchant Marine Fund - FMM (Decree-Law Nº 1.801, of August 18, 1980; Decree-Law Nº 2.404, of December 23, 1987; Law Nº 10.893, of July 13, 2004) and the National Civil Aviation Fund – FNAC (Law Nº 12.462/2011), which result in effective actions for the development of transport sectors.

The Sectorial Plans described above in section 1.1 (Land Transport Sectorial Plan, Port Sectorial Plan, Waterway Sectorial Plan and Airway National Plan) will include in detail the description of these initiatives in addition to investments in infrastructure and will seek to assess the impact on sectorial objectives.

3. GENERAL VIEW

Once the guidelines, principles and objectives of the new NLP were defined by MINFRA, the Brazilian Enterprise for Planning and Logistics began the methodological conception of the Plan. To this end, we started with the analysis of its previous version – the NLP 2025 –, identifying its positive aspects and points that required improvement.

It appears that the NLP 2025 contributed as a new chapter in the country's logistical planning process and, since then, has served as a reference in the development of MINFRA's actions and programs. Most of the so-called *monitoring actions* listed in the NLP 2025 are being continued by MINFRA, among which the following stand out:

a) Public road transport works: paving of BR-163/PA (completed), duplication of BR-101/SE/AL/PE and duplication of BR-381-MG;

b) Public works for inland navigation: demolition of Lourenço's Stone;

c) Scheduled investments in existing concessions: BR-116/BA and BR-050/GO;

d) Re-bidding for existing road concessions: BR-116/RJ/SP, BR-040/MG/RJ, BR-116/RJ and BR-153/GO/TO;

e) Granted railways capacity adaptation: EFC (Carajás Railroad), EFVM (Vitória-Minas Railroad), Rumo Malha Paulista, MRS and FCA (Centro-Atlântica Railroad);

f) Road transport concession program: BR-365/364/MG/GO, RIS (South Integration Road) and BR-101/SC (auction completed), BR-364/RO;

g) Railway concession program: FNS (North-South Railroad) (already auctioned), FIOL (West-East Integration Railroad) (auction of the first segment held) and *Ferrogrão* (EF-170).

In addition, the logistical bottlenecks identified in the NLP 2025 served as a reference for qualifying new stretches for the road transport concession program.

Another relevant fact to be mentioned is about the results of the analysis of the Federal Court of Accounts (TCU) about NLP 2025, consolidated in Decision Nº 1327/2020–TCU–Plenary. On that decision, it was recommended to the Ministry of Infrastructure and the EPL that, in the process of reviewing the NLP, the following were adopted:

a) Necessary measures so that inland navigation and cabotage are contemplated, so that the NLP becomes in fact a multimodal integration plan[2];

b) Measures aimed at unifying common steps between the PNLP (National Plan of Port Logistics), the NLP and other plans in the transport sector, with a view to rationalizing public investments and greater integration between these plans.

In this sense, it was observed that although the NLP 2025 has been used as an instrument to support the planning and implementation of MINFRA policies, for its new version - the NLP 2035 - a broad review of the model used would be necessary, in order to resolve identified limitation techniques, including those pointed out by the TCU, eliminate conflicts with other sectorial transport plans of the time, developed independently, and adapt to the new concept of Integrated Transport Planning at the Federal level. In addition, the incorporation of methodological, technological, informational, and institutional innovations is essential to make the Plan stronger and more integrated and comprehensive.

The conception of the methodology for the development of the NLP 2035 was based on the analysis of different international transport planning initiatives, in addition to research and studies to survey the most current techniques and procedures for planning at the strategic level. The basic model for planning logistics in the United States, Freight Analysis Framework (FAF)[3], used by the country since the 1990s and constantly being improved, is one of the main inspirations for the NLP 2035, regarding the technical rigor and the concepts of transport modeling used. In that planning instrument, such as NLP 2035, the goal is not to result in a single set of projects, but to subsidize the development of plans and other studies with an integrated, unique, and coherent view of how the transport system works. The traditional stages of the "4-Step Model" (travel generation, travel distribution, modal share, and traffic allocation) are also still present in the NLP, however, with more current, integrated techniques, and with the use of modeling and simulation softwares of international reference. In addition, these steps are inserted in a more comprehensive methodology for assessing the impact of scenarios, adherent to the objectives for which the transport network must be developed and inserted in planning concepts brought forth by Magalhães and Yamashita

2 In this document, the term “intermodality” is used to describe the operational relationship between different types of transport. This is since, exclusively in Brazil, the definition of “multimodal of Freightes” transport is defined by Law (Law 9.611, of February 19, 1998), such as “*one that, governed by a single contract, uses two or more types of transport, from origin to destination, and is performed under the sole responsibility of a Multimodal Transport Operator [MTO]*”. Operational relationships between different modes of transport for common purposes are beneficial and aim at network efficiency, regardless of using a single contract or being executed through a MTO. However, these cannot be called like this by the legal definition. Therefore, the term intermodality seems to be more comprehensive and appropriate for the case.

3 Freight Analysis Framework (FAF) (2021). Available on:
https://ops.fhwa.dot.gov/freight/freight_analysis/faf/

(2009)[4]; which, in turn, are based on the concepts of situational (political and social) strategic planning of Matus (1993)[5]. The theoretical basis differs from others about planning, mainly because it gives more objectivity in the search for final results in detriment of procedural follow-ups.

A planner's vision, from the perspective used in this new NLP, is not limited to the identification of bottlenecks in infrastructure, but rather to the way the network can contribute to the evolution of the attributes of territory and environment in which it is inserted. In this way, transport, as a means, enhances its impacts on socioeconomic development and on meeting the original demands.

For this reason, EPL made a great effort to obtain databases that translated the real demands of transport (such as the O-D matrixes of Freightes from electronic invoices, and the O-D matrixes of people's displacement, from mobile telephony data), in detriment of the sum of demands already allocated to each subsystem. Starting to plan from the perspective of the territory of primary needs significantly changes the logic of transport planning, and, consequently, the potential contribution of its results.

Due to the range of information necessary for the development of the NLP, the technologies currently available at the EPL were used, mainly the information stored, processed, and generated in the National Observatory of Transport and Logistics - ONTL.

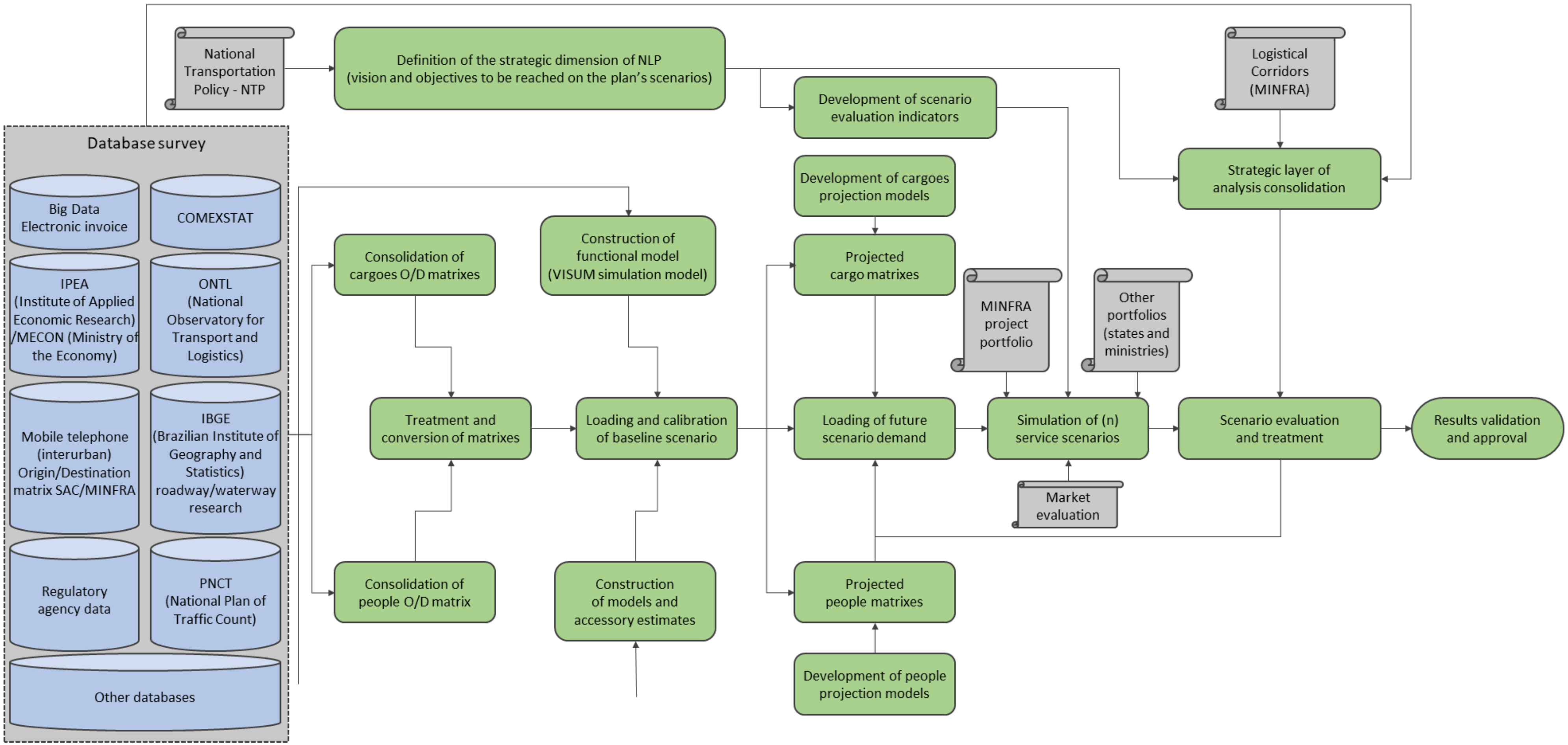
One of the methodological highlights of the development of this NLP 2035 is the identification of the Strategic Layer of Analysis, which includes the most representative logistical infrastructures from the point of view of national interest, detailed in section 4.4. The simulation of scenarios in the NLP 2035 is carried out in the widest and most detailed way possible for the level of analysis, as will be seen later, so that the results of the diagnosis and forecasts are more assertive. However, the analyses are focused on this layer, more adhering to the planning levels of the NLP.

To give the Plan a result-oriented planning character and to provide decision makers with tools for prioritizing their policies and actions, an indicator system adherent to the objectives presented in the NTP was designed, which allowed for the assessment of simulated scenarios.

Picture 5 schematically presents an overview of the NLP 2035 elaboration process.

4 MAGALHÃES, M. T. Q.; YAMASHITA, Y. Repensando o Planejamento (Rethinking the Planning Process). Discussion Texts - CEFTRU, v. 04, p. 1-30, 2009.

5 MATUS, C. Política, Planejamento e Governo (Politics, Planning and Government). IPEA – Institute of Applied Economic Research, Brasília. 1993.



Picture 5: Overview of the NLP 2035 Elaboration Process

Source: EPL (2021)

3.1. INNOVATIONS

As previously observed, the NLP 2035 proposed several innovations in relation to the stages of development of the work and methods used to prepare the Plan, among which the following stand out:

a. The systematization of the planning process, with the prior definitions of guidelines and scope arising from MINFRA, contemplating integration with the Strategic Sectorial Plans;

b. Results-oriented planning, contemplating the development of a system of indicators for the analysis of scenarios and Plan monitoring, linked to the objectives established in the NTP;

c. The systemic, strategic, integrated and intermodal vision of the national logistics infrastructure, through diagnosis, prognosis and analyses of all modes of transport responsible for intercity Freight flows and interurban people flow;

d. Informational integration with the National Observatory of Transport and Logistics – ONTL, a project under development by EPL, which is at a more advanced stage than at the time of the NLP 2025 conception, contributing strongly to obtaining a greater volume of information for knowledge industry and for the modeling of NLP;

e. The use of more comprehensive origin-destination matrixes of Freightes and people, obtained from data from electronic invoices and mobile telephony, contemplating the movement of goods within Brazil and between the country and other countries, under the perspective of Freightes' weight and value;

f. The construction of a broader and more granular simulation network, contemplating zoning at the city level, which allows for an increase of the scope and precision of the allocations in intercity infrastructures, reaching 5.589 zones, and a road transport network of more than 300 thousand kilometers of federal, state, and municipal highways. In addition, the entire railway and waterway infrastructures (inland navigation, cabotage and long-haul navigation), and port infrastructure, such as Public Ports and Private Use Terminals - TUPs, grouped into geographical units named "Port-city" (Appendix VIII presents private use terminals, ports and Freight transshipment stations grouped by Port-city);

g. Greater social participation throughout the Plan's elaboration process, including events to collect subsidies, such as Webinars, participatory meetings with sectorial personnel and Public Consultation; and

h. Objective analysis, based on indicators, considering both the traditional view of Freightes allocated by weight (Useful Ton-Kilometer – TKU), as well as the analysis of flows in value of the goods (Useful Value-Kilometer – VKU), allowing for a differentiated analysis of Brazilian transport infrastructure.

Picture 6 illustrates the most relevant innovations brought about in NLP 2035.

Picture 6: NLP 2035 Innovations
Source: EPL (2021)

4. BASELINE SCENARIO 2017

The Baseline Scenario was conceived to validate the functional simulation model of the NLP 2035. The adherence of the simulations to the real data for year 2017 represents the reliability of the Plan's estimates and future vision. This year was chosen as a reference for the purpose of calibrating the simulation model as it did not have major complications, regarding the movement of Freightes and people, such as the effects of the economic crisis observed in 2015 and 2016 or the truck drivers' strike that occurred in 2018. Year 2019, however, did not yet have its data consolidated when the work on the NLP 2035 began.

In the subsequent topics of this chapter, general information on the origin-destination matrixes of Freightes and people is presented, as well as the infrastructure network adopted, the Freightes observed in the simulation models and the main indicators of the Baseline Scenario 2017.

4.1. ORIGIN-DESTINATION MATRIXES

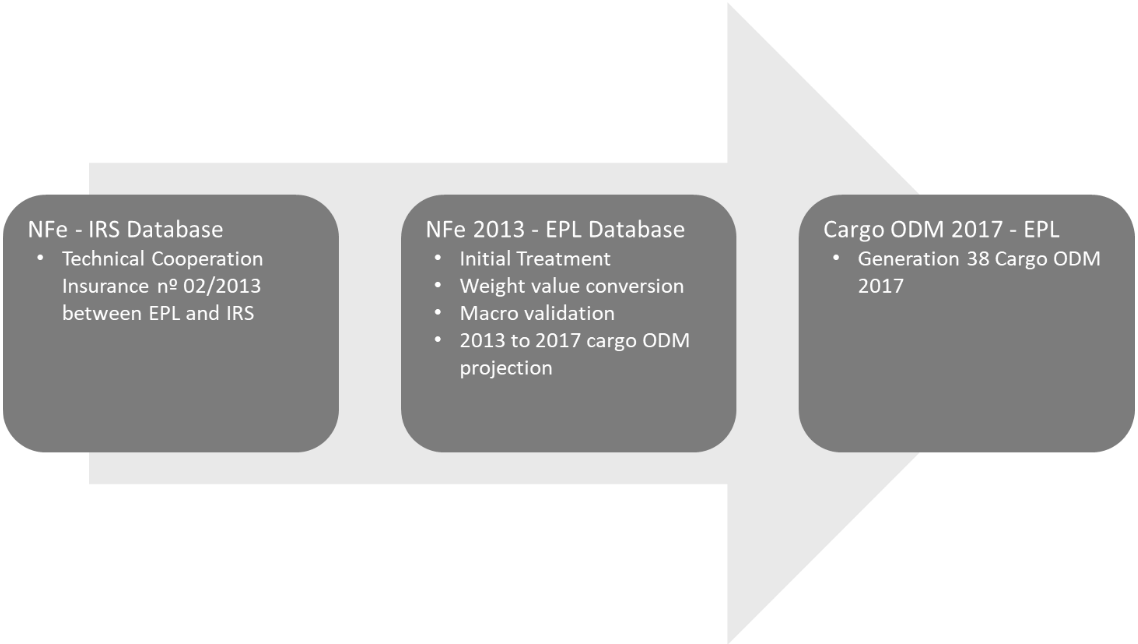
4.1.1. Origin-destination matrixes of Freightes

The Freight origin-destination matrixes (Freight ODM) show the total amount of Freight moved between two traffic zones (O/D pairs), by product group, for different demand projection scenarios and project horizons, constituting one of the main inputs needed for traffic simulations in all modes of transport. Considering that both production and demand evolve over the years, the Freightes ODM are a temporal parameter and, therefore, must be defined for each period under analysis.

The Freight ODM used in the NLP 2035 have as their main data source the Big Data of Electronic Invoices (NFe) of the Internal Revenue Service (IRS) for year 2013, available at the time, with subsequent updating with production and transport real data, such as COMEX STAT, whose data are extracted from SISCOMEX and based on the declaration of exporters and importers, the Annual Survey of Industry – PIA (IBGE) and the Municipal Agricultural Production – PAM (IBGE), among others. In this way, it was possible to bring the flow base generated through the 2013 Electronic Invoices to the baseline year - 2017, as well as to the present day, incorporating not only monetary updates, but also the production and consumption reconfigurations that occurred at that time period.

The smallest geographic selection adopted for the NLP 2035 matrixes is the municipality. For domestic Freight transport trips, the matrix is intercity, and for international trips, countries are grouped into regions of interest, as detailed in item 4.2. The use of the city domestic matrix allows for greater detailing of the simulations, and at the same time, reveals new flows not observed before, in versions of previous national plans.

Picture 7 shows the methodological sequence followed so that, from the databases of Electronic Invoices (NFe) from the Internal Revenue Service (IRS) for year 2013, the EPL 2017 Freightes ODM are obtained, which are used in the preparation of NLP 2035.



Picture 7: Methodological sequence for obtaining the 2017 Freightes ODM
Source: EPL (2021)

It is important to emphasize that the universe of Electronic Invoices (NFe) from the Internal Revenue Service – IRS was used for the first time in a strategic plan as a primary data source. The use of this data represents a paradigm shift, eliminating the need for statistical inferences from secondary data sources considered in previous transport plans. With this, it was possible to analyze the movement of goods in Brazil and between the country and abroad from the perspective of weight and value.

For the conversion of the values of the Electronic Invoice (NFe) into Freight volumes, it was assumed that the more detailed the price of a product, the smaller the conversion error. In this sense, for the refinement of prices for conversion, the methodology was applied with the following steps:

1. Verification of the representativeness of each product (Mercosur Common Nomenclature - NCM with 8 digits) in each chapter;
2. Selection of the main products (up to 65% representativeness in accumulated value in the chapter) - 487 products;
3. Differentiation by agent in the chain (producer/wholesale/retail), based on the analysis of the CNAE (National Classification of Economic Activities) of origin;

4. Differentiation by type of commercial operation (domestic/export/import).

For the calculation of prices by different agents existing in the CNAE classification of companies issuing the Invoices (classified as CNAE: Producer, Wholesale and Retail) the price margins for each of the products, calculated based on the National Accounts (available at IBGE), were used.

For export and import commercial operations, the unit prices informed by SECEX (Secretariat of Foreign Trade)/MDIC (Ministry of Development, Industry and Foreign Trade) were adopted, as a reference for converting the value informed in the NFe into Freight Volumes.

To obtain unit prices resulting from national commercial operations for the main products, EPL technicians carried out an extensive price search in national databases, and, if not found, in marketing websites of selected representative products.

The combination of the price survey for 487 main products, which represent about 60% of the entire value matrix, associated with 3 possible agents in the chain and 3 types of commercial operation, resulted in 4.383 prices for direct conversion of product values in weight. The other prices were also detailed at the NCM level, based on Export and Import values from the SECEX/MDIC bases, and for the national market, based on the relationship between national trade values and foreign trade found for the main products. Thus, the final price base for converting values to weight has 88.182 differentiated prices.

Each flow of products contained in the database was then grouped into specific matrixes, called "macro products". For this grouping, the family and chapter of each product were considered according to the Mercosur Common Nomenclature (NCM), and for products that represented more than 30% of the value traded in the chapter (SH2), a specific matrix was created.

Once grouped, the logistical analysis of the NCM's contained in each Macro product was carried out. The logistical characteristic of each NCM was verified, so that products with different transport characteristics than their Macro product were allocated to other Macro products to which they maintain greater logistical similarity or highlighted with a specific Macro product.

Another grouping carried out for simulation purposes in the NLP models refers to the "Freight Group", which brings together different matrixes with similar transport characteristics.

The Freight groups and their respective macro products were then defined from these two perspectives and are listed in Table 1.

Table 1: Relation between the Freight groups of the NLP and the 38 categories of macro products

Cargo Groups	Macro products
Solid Mineral Bulk (GSM)	- Iron Ore
Other Solid Mineral Bulk (OGSM)	- Fertilizers - Other minerals - Sub products of iron ore
Liquid Bulk (LB)	- Biodiesel - Ethanol - Natural Gas - Diesel Oil - Petrochemicals
Solid Agricultural Bulk (GSA)	- Sugars - Brans - Corn - Soybean
Containerized General Cargoes[1](CGC)	- Processed food - Beverages – Malt beers - Beverages except for malt beers - Rubber and products - Meat - Cosmetics - Pharmaceutics - Professional instruments and equipment - Dairy Products - Machine and electrical equipment - Machine and mechanical equipment - Furniture - Other Cereals and Agricultural Products - Other containerized general cargoes - Paper - Plastic and Products - Graphics industry products - Industrial chemicals - Organic chemicals
Non-Containerized General Cargoes[2] (NCGC)	- Live animals - Iron - Heavy machinery - Cast iron, iron, or steel works - Other non-containerizable general cargoes - Vehicles

1 Containerized General Cargo: general cargo that can be containerized because they have dimension and weight compatible with the capacity of a container.

2 Non-Containerized General Cargo: general cargo that cannot be containerized, as they do not have a dimension or weight compatible with the capacity of a container.

Source: EPL (2021)

Freight groups were necessary for the definitions of standard vehicles, transport and transshipment costs and capacities imputed in the transport network of the NLP simulation model. Each of the 38 macro products has a specific origin-destination matrix, whose flows resulting from their allocation in the NLP simulation models were observed separately, thus allowing a greater level of detail in the analysis of the allocated flows, when necessary. It is noteworthy, however, that the systemic analysis of scenarios through indicators occurs by the integrated analysis of the flow of Freight and people allocated to the simulation network.

It is important to highlight that the matrixes generated for the NLP 2035 relate to the transported Freight and are not to be confused with production data. The same product can appear different times in the transport matrix, as different invoices were generated. The transport matrix has a large part of intermediate flows, for example, the flows from producers to wholesalers, and another flow from a wholesaler to a retailer, referring to the same product. Intermediate flows from headquarters to branches of the same company are also present. Thus, the quantities presented should not be compared with production and consumption data without paying attention to this fact.

Subsequently, the Freightes ODM generated from the NFe were updated for the base year 2017. For this, the production values between 2013 and 2017 of the products suggested for the matrix were researched, using data found, mostly, in the IBGE surveys.

The Monthly Industrial Survey was used, through IBGE’s Automatic Recovery System (SIDRA) for the following products: mechanical machinery and equipment, vehicles, petrochemicals, electrical machinery and equipment, pharmaceuticals, beverages, industrial chemicals, organic chemicals, rubber and its derivatives, paper, furniture, products from the graphic industry and sugars.

From the same platform, using the Annual Survey of Industry (PIA) as a basis, data on meat, fertilizers, products of the photographic industry, dairy, processed foods, iron ore, heavy machinery, malt beers, clothing, other clothes, other processed foods, aluminum and its derivatives, other minerals, bran, and iron ore sub products. In the specific case of the PIA, the values were weighted by the number of respondents in the survey.

For specific products, sources such as the Brazilian Plastic Industry Association, the National Petroleum Agency, the Brazilian Foundry Association, the Brazil Steel Institute, the National Food Supply Company, and the Systematic Survey of Agricultural Production, carried out by IBGE, were also used.

Some product categories that did not have exact matches found in the searches have been replaced by some products that belong to the category or similar. As an example, the category of cast iron, iron and steel was replaced by cast iron and steel; cast iron sub products, iron and steel was replaced by rolled steel; graphic industry products were replaced by printing activities; malt beers were replaced by beers and draft beers; aluminum and its sub products were replaced by aluminum cans for packaging of various products; other minerals were replaced by calcined alumina; iron ore sub products were replaced by iron ore.

The beverages were divided into two categories, one covering all beverages produced, except beers and draft beers, and a second one including only beverages excluded from the first category.

Production data were used to calculate the annual variation from 2013 to 2017, according to the following equation:

$$Variation_t = \frac{\Delta Production_t}{Production_{t-1}}$$

So that:

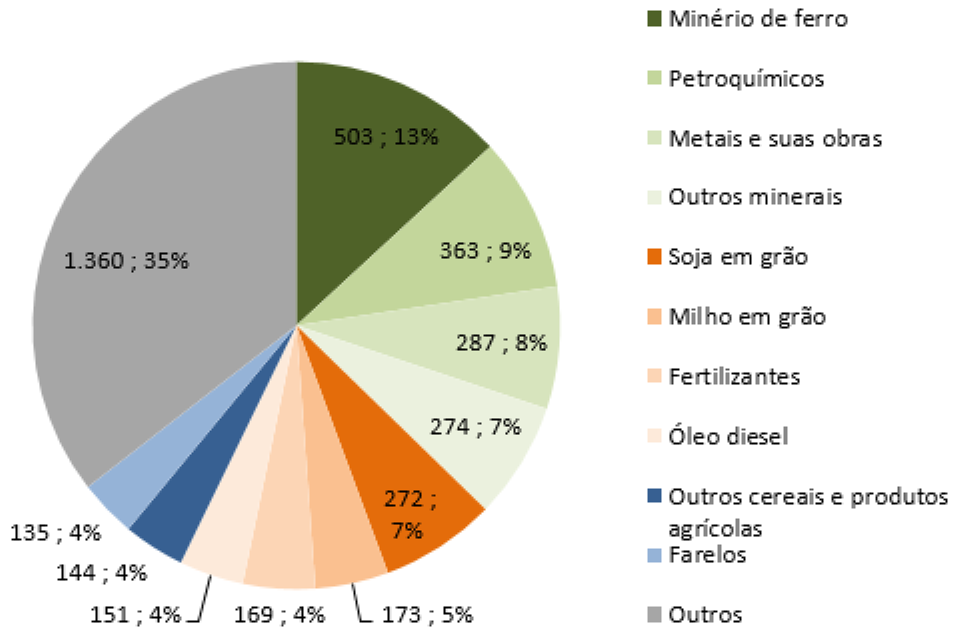
$Variation_t$ is the percent variation in production in year t in relation to year t-1.

$\Delta Production_t$ is the subtraction of production in year t from production in year t-1.

Import and export data for the country and federative units were extracted from the COMEX STAT database of the Ministry of Industry, Foreign Trade and Services. The values used will be for years 2013 and 2017, in net kilograms and divided by their respective NCMs (Mercosur Common Nomenclature).

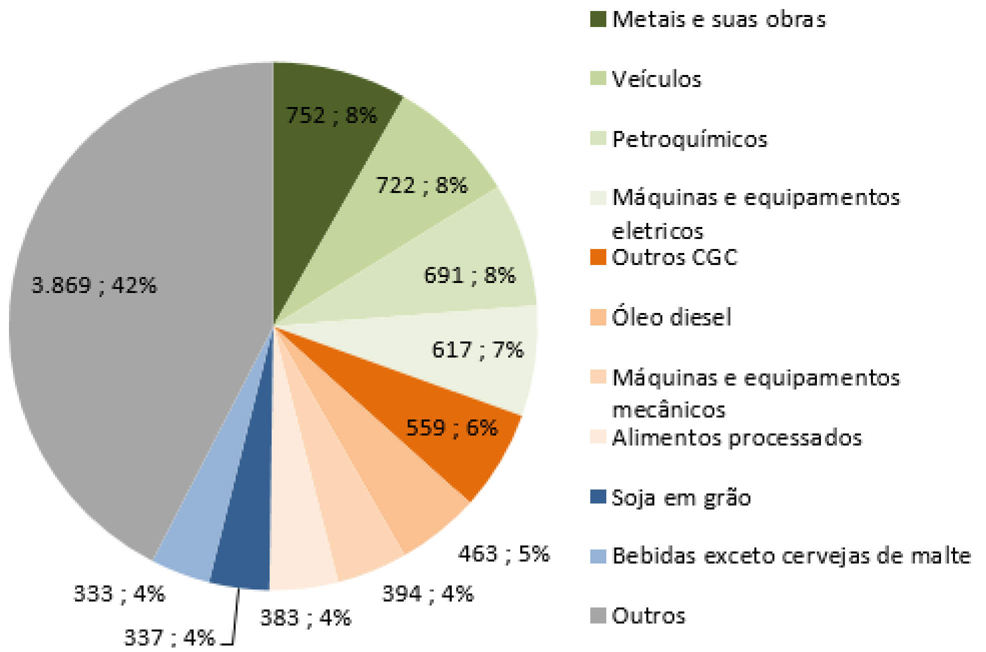
The production values of each federative unit – apart from agricultural production data – were taken from table 1849 of SIDRA (IBGE Automatic Recovery System), framing the matrix products in the most appropriate categories of the base. The data are available in a thousand *reais*, so the value for the first period (2013) was corrected by the IPCA (Broad Consumer Price Index) to match the value for the final period (2017). Agricultural production data were researched based on CONAB (National Food Supply Company), in tons.

The macro results from the 2017 Freightes ODM in weight and in value are presented, respectively, in Pictures 8 and 9 and in the maps with the desire lines of the Freight flows by weight and value in Pictures 10 and 11.



Picture 8: Macro results from the 2017 Freightes ODM by weight (million tons)
Source: EPL (2021)

(On Picture: Iron ore, petrochemicals, metals and sub products, other minerals, soybean, corn bean, fertilizers, diesel oil, other cereal and agricultural products, brans, others.)

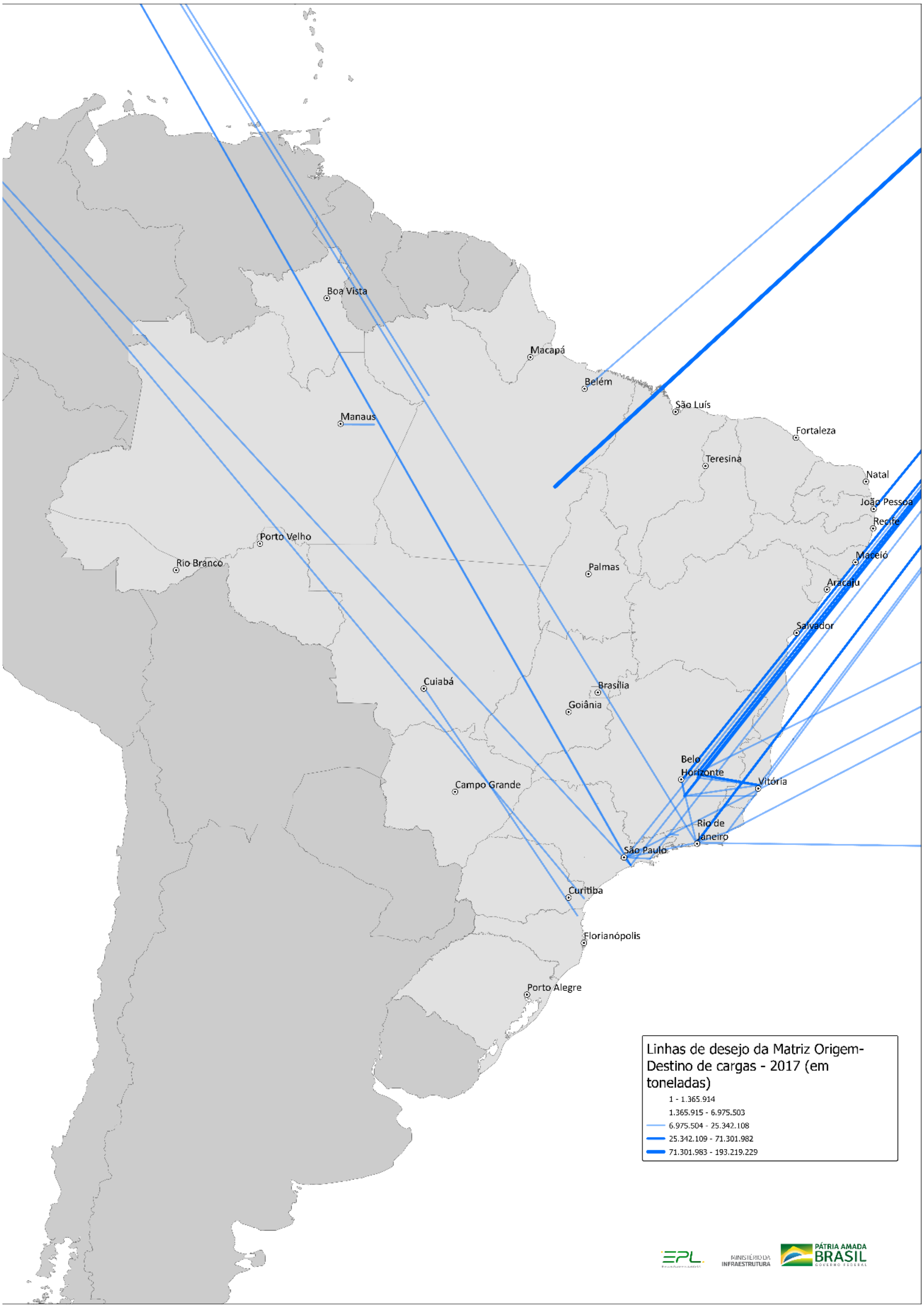


Picture 9: Macro results from the 2017 Freightes ODM by value (in R$ billions)
Source: EPL (2021)

(On Picture: Metals and sub products, vehicles, petrochemicals, machines, and electrical equipment, other CGC, diesel oil, machines, and mechanical equipment, processed foods, soybean, beverages except malt beers.)

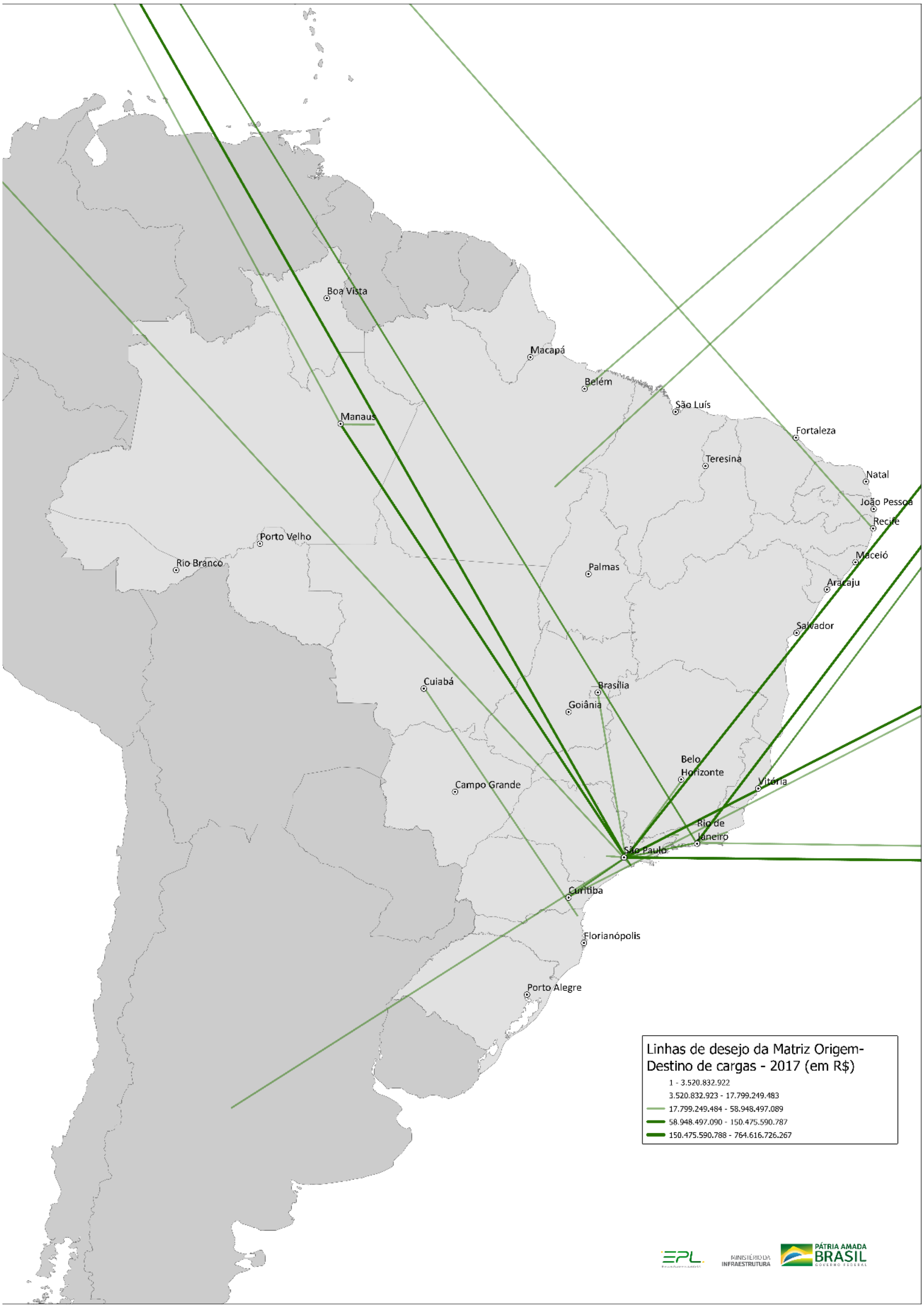
It is observed that macro products do not have the same representations in 2017 Freightes ODM in weight and in 2017 Freightes ODM in value. Only 4 macro products are among the 10 macro products with the greatest representation in the two matrixes (Petrochemical, Metal and sub products, Soybean and Diesel oil) and, even so, in different classifications. It is noteworthy that iron ore, the macro product with the highest percentage of movement in Freightes ODM in weight (13%) is not among the 10 macro products with the highest representation in Freightes ODM loads in value. On the other hand, the macro products Vehicles, Machinery, and electrical equipment, which are among the 4 macro products with the highest representation in Freightes ODM in value (each with 8% of the movement), are not among the 10 macro products with the highest representation in Freightes ODM by weight.

The spatial distribution of macro products with greater representation in the Freightes ODM in weight and in value can be seen in the desire lines of the Freight flows by weight and by value presented in Pictures 10 and 11, respectively. Classes of lesser flow intensity are omitted from the map for better visualization.



Picture 10: Desire Line Map from the 2017 Freightes ODM by Weight

Source: EPL (2021)



Picture 11: Desire Line Map from the 2017 Freightes ODM by value

Source: EPL (2021)

The desire lines of Freight flow by weight are more concentrated in Parauapebas/PA and in the Iron Quadrangle region in Minas Gerais (ore producing regions). In turn, the desire lines of the Freight flow by value have greater concentration in São Paulo, due to the location being both origin and destination of several macro products with higher added value. This configuration distinguishes the arrangement of the desire lines of Freight flows by weight and by value in the Southeast Region.

A similar situation is observed in the North Region, as Manaus/AM, which does not present high representation in the flow by weight, is highlighted in the desire lines of the flow of Freightes by value, especially due to the movement of machinery and electrical equipment produced in the Manaus Free Trade Zone to São Paulo. In the Northeast Region, while the desire line of Freight flow by weight is concentrated in João Pessoa/PB, due to the movement of the Cabedelo Port, the desire line of Freight flow by value is concentrated in Recife/PE, with greater diversification of the macro products handled.

In the South Region, there is a desire line for the flow of valued Freightes between the State of Mato Grosso and the ports of Santa Catarina/SC, due to the movement of metals and their sub products between the regions. This desire line between the Midwest and South regions is also representative in the flow of Freightes by weight, due to the export of agricultural products. In the Central-West Region, there is yet another significant desire line for the flow of Freightes by value, between the Federal District and São Paulo, resulting from the movement of vehicles, graphic industry products, electrical machinery, and equipment.

The matrix from the NFe seeks to represent the totality of goods moved between Brazilian municipalities and between them and the foreign market. The data is used for future simulation of scenarios. The simulations of future scenarios, in turn, occur in the NLP in two ways, being part of the simulated scenario in the integrated functional model in specific software, and the airway and pipeline modes of transport simulated at the same time, according to specific estimates.

For this reason, the treatment of air freight and pipeline transport matrixes required additional sources. The domestic air Freight matrix used in the NLP 2035 was developed by MINFRA in partnership with the Federal University of Santa Catarina - UFSC, based on the CT-e (electronic bill of lading). The data were processed in the format used in the NLP and added to foreign trade information from the Ministry of Industry, Foreign Trade and Services. According to the results, in 2017, the airway sector was responsible for transporting 795.027 tons.

The pipeline transport matrix, on the other hand, was built with the merging of different data sources from pipeline operators, observing the respective impacts on the NLP matrixes. The data show that the pipelines transported 115.539.200 tons in 2017.

The Freightes ODM are available in Appendix IV of this Executive Report, and the methodological procedure for processing and generating the information will be the subject of a specific publication.

4.1.2. Origin-destination matrixes of people

More and more alternatives to the traditional means of obtaining data on the movement of people for transport studies and planning are being sought after. The use of mobile telephony and GPS signal displacement data has proved to be an interesting alternative in this regard.

The population's wide access to mobile phone devices enables a robust mass of data that provides displacement information virtually 24 hours a day, every day of the year.

This large amount of information has broadened planning horizons in different areas of knowledge such as health, public safety, education, transport, etc., making it an important tool - and, certainly, that will be mandatory in the near future - for the State’s inherent planning activities.

In this regard, the EPL directed efforts in the search for data that would enable a macro strategic analysis to observe the behavior of the movement of people, having access to mobile telephony data obtained by the National Civil Aviation Secretariat of the Ministry of Infrastructure - SAC/MINFRA, respecting the legal guidelines regarding the privacy of information.

In a complementary way, the data provided were processed and expanded to represent the total movement of people on internal travels in the national territory. The people transport matrix developed considers the movement between TPU[6] (Territorial Planning Unit), which comprise sets of municipalities that seek to represent urban agglomerations and Brazilian population arrangements, in line with the object of analysis of the movement of people in the NLP 2035, which is interurban transport.

Through the crossover with other databases and the use of transport models, the modal share of the matrix was generated, between transport by car, by road bus, passenger railroad transport, waterway passenger transport and airway transport.

In addition, for purposes of integrated simulation in the functional model with Freight transport, a complementary matrix in the intercity format was also generated, with the complement of data from other sources, such as surveys and O/D matrixes of metropolitan regions and models developed exclusively for that matrix.

The main numerical results of the interurban transport and intercity transport of people matrixes can be seen in tables 2 and 3 and in the map with the flows of people desire lines in Picture 12.

6 For more information, the TPU arrangement is shown in Appendix IV of this report.

Table 2: Demand in individual people travel in 2017 matrixes

Mode	Interurban (between TPUs)	Intercity
Automobiles	1.492.218.197	7.002.037.671
Intercity Bus	439.068.664	890.236.121
City Bus	-	7.218.034.542
Railway	14.726.281	728.438.424
Waterway	6.251.031	9.329.798
Airway	76.826.091	76.779.206
Others	-	113.698.859
Total	**2.029.093.264**	**16.083.554.621**

Source: EPL (2021)

Table 3: Demand in vehicular travels and number of connections from people at 2017 matrixes

Demand	Interurban (between TPUs)	Intercity
Number of trips in passenger vehicles	717.412.595	3.366.151.734
Number of trips in intercity buses	55.303.321	98.027.546
Number of trips in city buses	-	130.643.362
Number of O/D connections	76.011	5.155.924

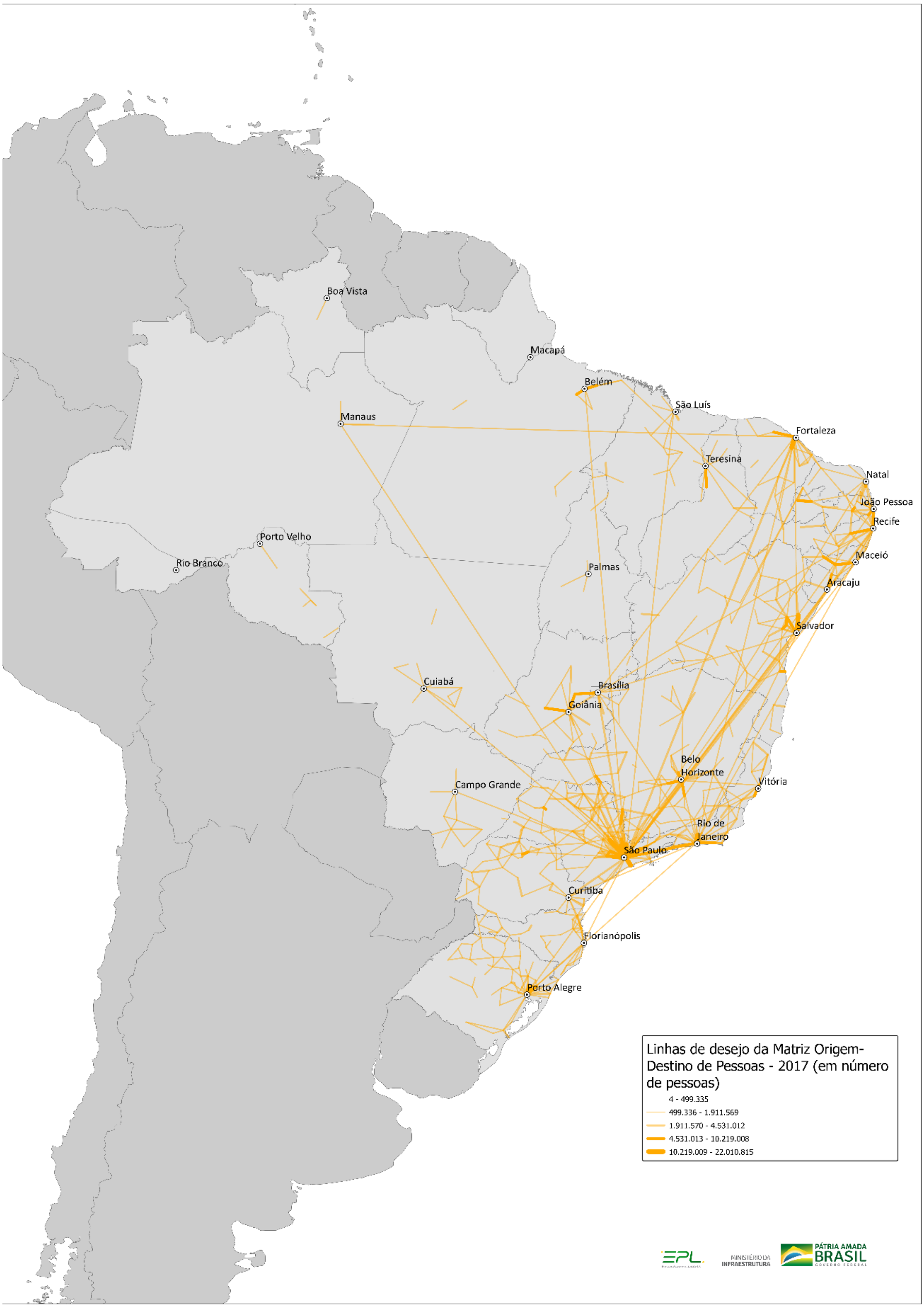
Source: EPL (2021)

Of the 2.01 billion interurban trips in Brazil in 2017, approximately 95% took place exclusively by road transport, with emphasis on people who used private cars (73.5% of the individual interurban trips made in 2017). Subsequently, approximately 21.6% of intercity trips in 2017 were carried out by road bus, 3.8% took place by air transport, 0.7% took place in rail transport and 0.3% took place by waterway.

This modal distribution of interurban people transport reflects the historical trend of offering infrastructure and services among Brazilian cities with a high concentration, and consequent greater capillarity, in the roadway mode. The other modes of transportation present in the matrix are presented as specific options in view of local or regional conditions (in the case of waterway transport) or as preferences for long-distance trips due to the displacement time (in the case of air transport). The modal division of interurban transport, however, presents different results when analyzed from the perspective of productivity (people vs. km), as will be seen later.

As can be seen in Picture 12, the main demands for interurban people transport are concentrated in connections between São Paulo/SP and nearby cities and other capitals in the country. The states of São Paulo and Rio de Janeiro present demands distributed practically throughout the entire territory. In turn, the states of the Southern Region, in addition to Minas Gerais and Goiás, have demands concentrated in parts of their respective territories. It is also observed that the connections of the capitals of the Northeast Region with the networks of cities that constitute regional poles, as well as Belo Horizonte with the North of Minas and Campo Grande with the Southwest of the State. The states of the North Region and Mato Grosso have more evident demands for interurban people travel at local or regional levels.

The People ODM are available in Appendix IV of this Executive Report, and the methodological procedure for processing and generating the information will be the subject of a specific publication.



Picture 12: Desire Line Map from 2017 People ODM/Source: EPL (2021)

4.2. INTEGRATED SIMULATION NETWORK

The simulation network considered for the NLP 2035 was completely rebuilt in relation to the version used in the previous National Logistics Plan, making it more comprehensive. It started with an internal zoning that considers the division of the country into municipalities. Thus, it was possible to characterize and predict flows that were previously discarded for being intrazonal, without having observed excessively specific characteristics, such as intramunicipal flows.

The zoning used was divided into “internal zoning” and “external zoning”. The external zoning adopted is composed of 19 international zones, being: 1 for each South American country; 1 for Central America; 1 for North America; 1 for the European continent; 1 for the Middle East; 1 for Africa; 1 for Oceania; and 1 for Asia. The international segmentations used by the zoning system can be seen in Picture 13.

Picture 13: External Zoning of the integrated simulation network
Source: EPL (2021)

The roadway network used in the internal model has 331.807 kilometers, of which 76.454 kilometers are federal roadways and the remainder state or municipal roadways.

Picture 14 shows the road network considered in the transport simulation model. It is observed that the states of São Paulo, Rio de Janeiro, Espírito Santo, and part of Minas Gerais have road coverage with high capillarity and distributed throughout their respective territories, as observed in the coastal area of the Northeast Region between Natal and Salvador. The states of the South Region, Goiás, Maranhão, Tocantins, the countryside of the Northeastern states and the mesoregions of Jequitinhonha, North, Northeast and Minas Gerais have roadway spatial coverage throughout their respective territories, but with less capillarity than São Paulo, Rio de Janeiro, and Espírito Santo.

The states of Mato Grosso do Sul and Mato Grosso show a reduction not only in capillarity but also in the spatial coverage of roads in their respective territories, especially in the mesoregions of the Pantanal, South, North and northeast of Mato Grosso. In turn, the states of Pará, Amazonas, Amapá, Roraima, Rondônia and Acre have large areas of their respective territories without roadway coverage.

This configuration of the Brazilian road network is a result, especially, of the history of investments in roadways concentrated in some regions, the territorial dimension of the municipalities (on regions where municipalities have a smaller area, there is a tendency for greater roadway coverage) and the presence of Amazon biomes and the Pantanal (in areas related to these biomes, there is a tendency towards less roadway coverage).

Picture 14: Roadway Network (base year 2017)
Source: EPL (2021)

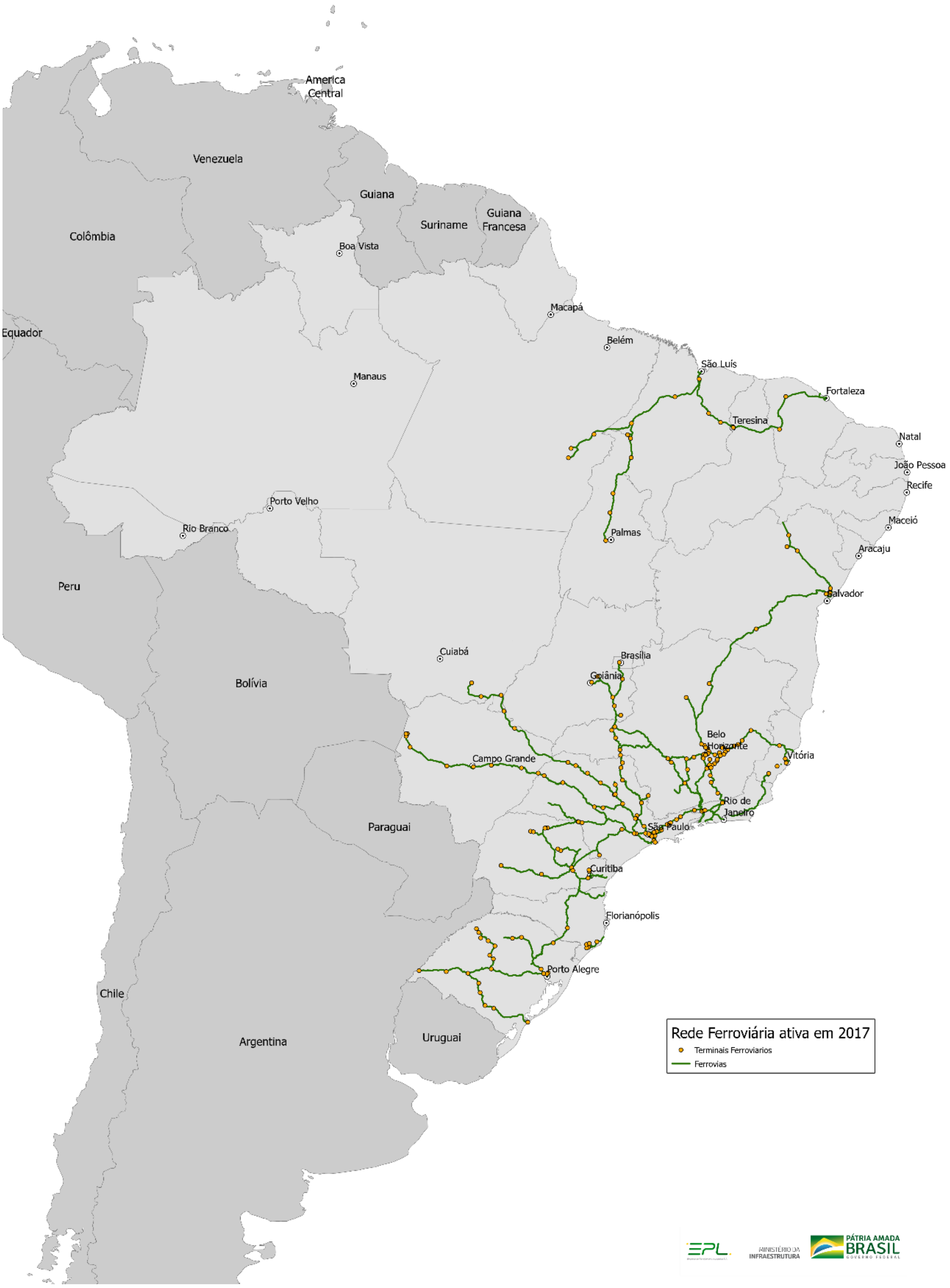
Obtained from information of the National Observatory of Transport and Logistics - ONTL of this EPL, the NLP 2035 railway network is aligned with the Monitoring System for the Inspection of Rail Transport - SAFF/ANTT (National Agency of Land Transportation), thus allowing the identification of railway sections and active terminals with Freight handling in 2017. 20.821 kilometers of railway network with Freight handling and 195 active terminals were identified.

Picture 15 shows the railway network considered in the integrated transport simulation model of the NLP. It is observed that the active railway infrastructure is divided into networks that are not fully interconnected, with greater spatial coverage in the Southeast and South regions of the country and an intense concentration of terminals in the Belo Horizonte and São Paulo Metropolitan mesoregions.

The railway network, in 2017, located in the South, Southeast, Midwest and Northeast regions is constituted by Rumo Malha Sul (in all states of the South Region), by Rumo Malha Paulista (concentrated in the State of São Paulo), Rumo Malha Oeste (in the states of São Paulo and Mato Grosso do Sul), Rumo Malha Norte (Southern Mato Grosso and East Mato Grosso do Sul mesoregions in continuity with Rumo Malha Paulista), Centro Atlântica Railway – FCA (in the states of Espírito Santo , Rio de Janeiro, Minas Gerais, Bahia, Sergipe, São Paulo, Goiás and the Federal District), MRS (in São Paulo, Minas Gerais and Rio de Janeiro) and Vitória Minas Railway – EFVM (in Minas Gerais and in Espírito Santo).

The railway network located in the North and Northeast regions is composed of the Carajás Railway – EFC, (in the Southeast of Pará, West and North of Maranhão mesoregions) by the North-South Railway – FNS, (in the West of Tocantins and South of Maranhão mesoregions) and by the Railway Transnordestina Logística – FTL, (in the mesoregions of East and North of Maranhão, Center North of Piauí, the metropolitan area of Fortaleza, Northwest, and North of Ceará).

This configuration of the Brazilian railway network reflects the historic investments for the implementation of infrastructure for the transport of products of national mining and agricultural activities.



Picture 15: Active Railway Network (base year 2017)
Source: EPL (2021)

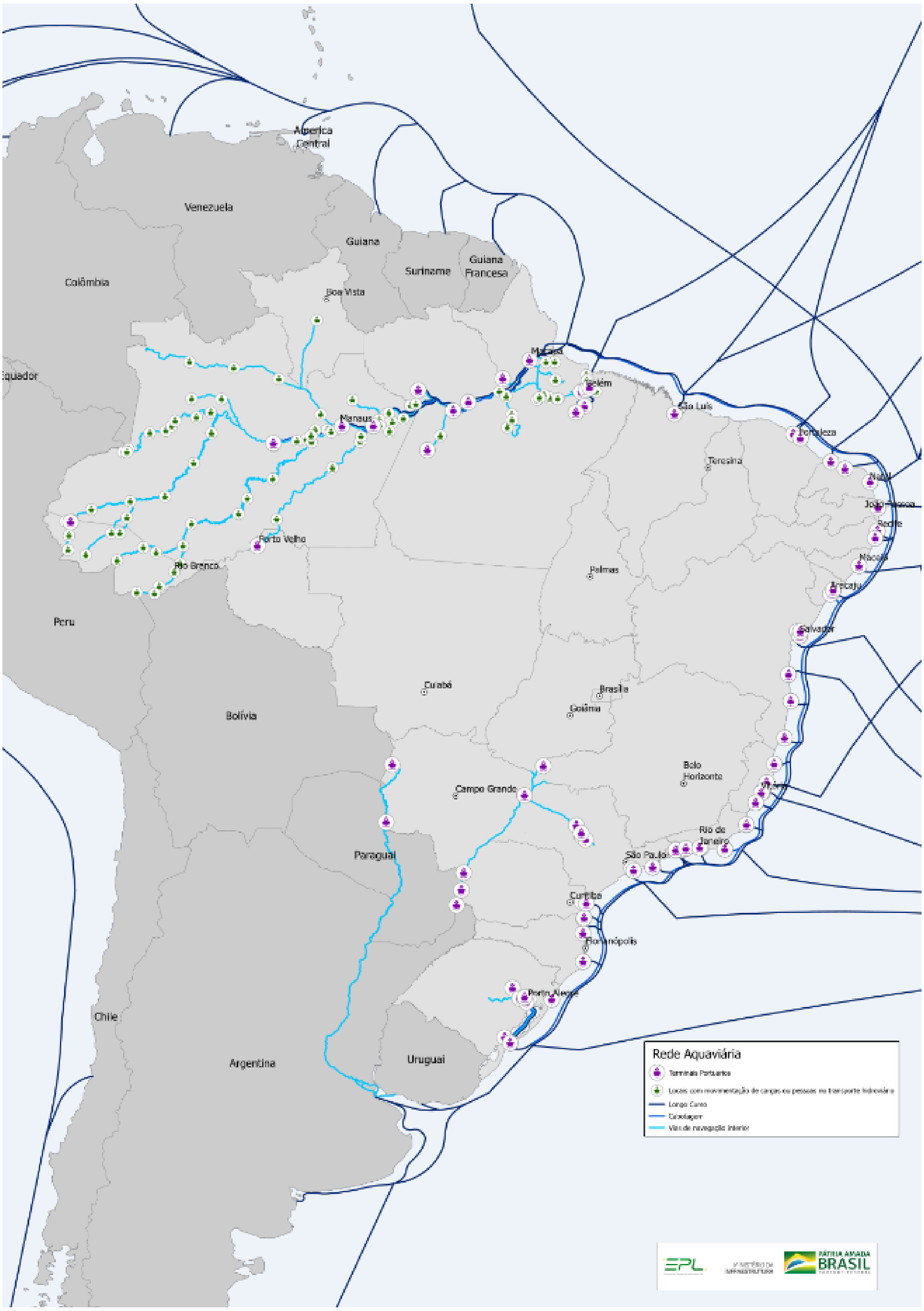
The waterway transport network used for the simulation of the NLP is composed of the transport networks of inland navigation, lake navigation, cabotage navigation and long-haul navigation.

In addition to the navigation routes, the waterway transport network is also composed of 79 port-cities and 103 locations with Freight or people handling in waterway transport, which comprise both IP4 terminals under Federal Government management and state-managed terminals on Amazonas and Pará, and cities with observed movements in the O/D matrixes, even without infrastructure characterized as “terminals”. The port-cities bring together active port facilities in the same location, including both Organized Ports and TUP (Private Use Terminals), as listed in Appendix VIII.

Picture 16 shows the waterway network considered in the transport simulation model. It is noteworthy that the Amazon River is used for inland navigation, for cabotage and long-haul navigation.

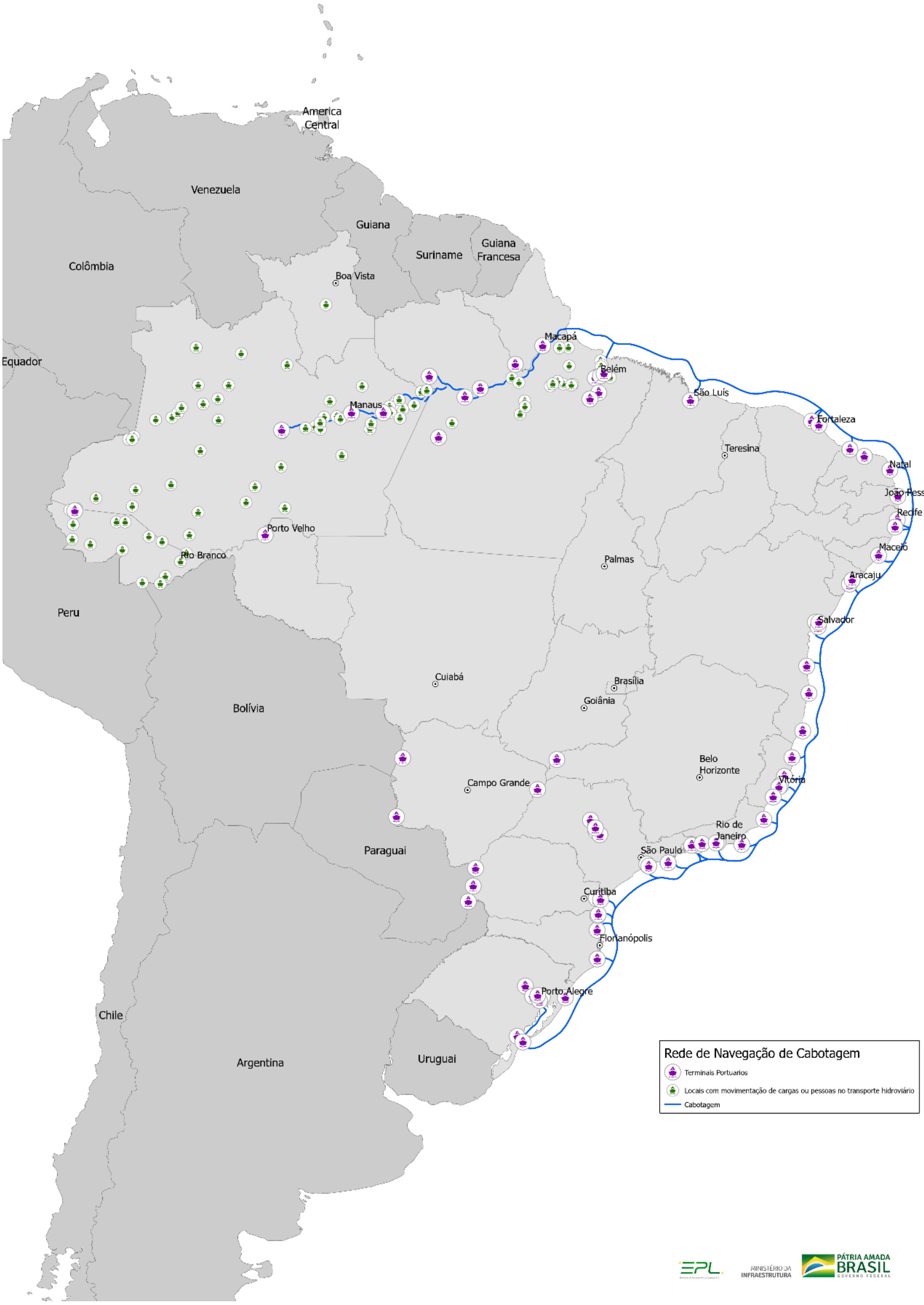
The cabotage (Picture 17) and long-haul (Picture 18) routes of the network for Base Year 2017 were structured based on information regarding the sea routes commonly used by vessels navigating these stretches, characterizing routes that adhere to the reality of that transport.

The length of the cabotage routes mapped for Base Year 2017 is 11.007 km, of which 8.859 km are coastal cabotage routes and 2.148 km are inland cabotage routes.



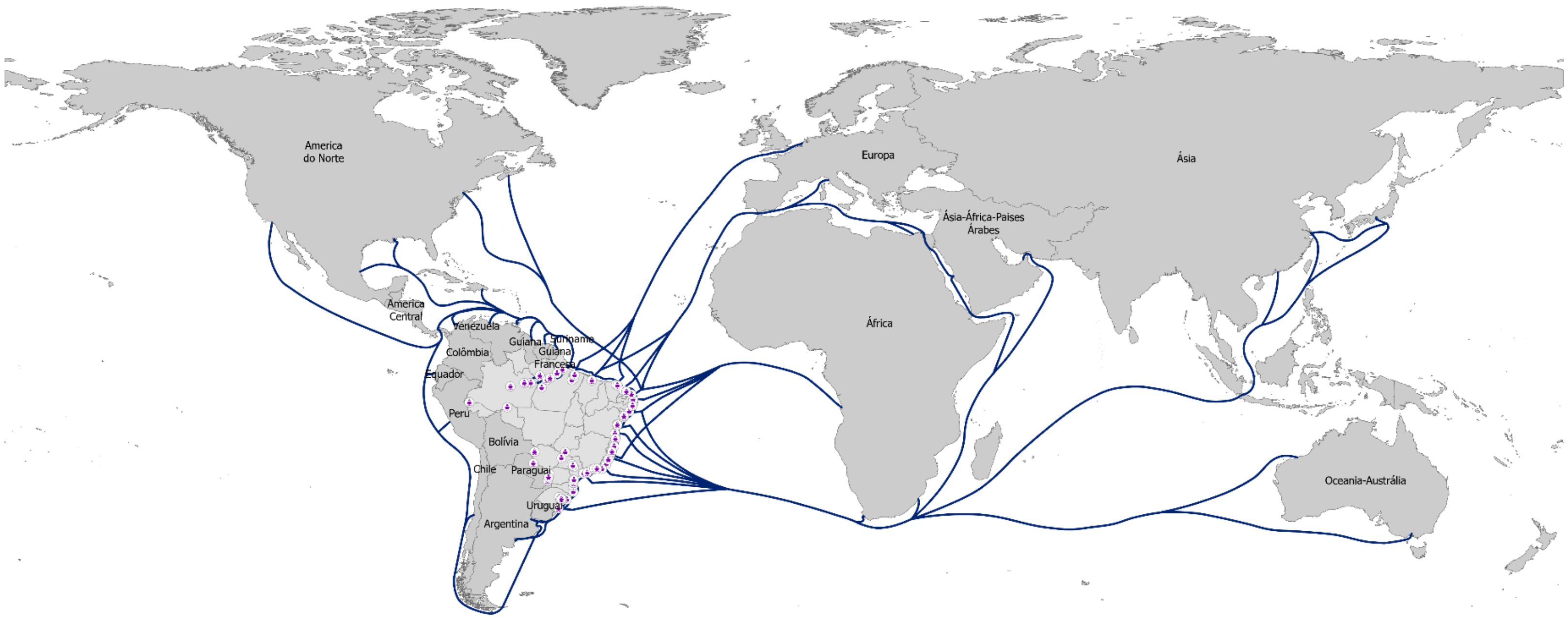
Picture 16: Waterway Network (base year 2017)

Source: EPL (2021)



Picture 17: Cabotage Navigation Network (base year 2017)

Source: EPL (2021)



Picture 18: Long-Haul Navigation Network (base year 2017)

Source: EPL (2021)

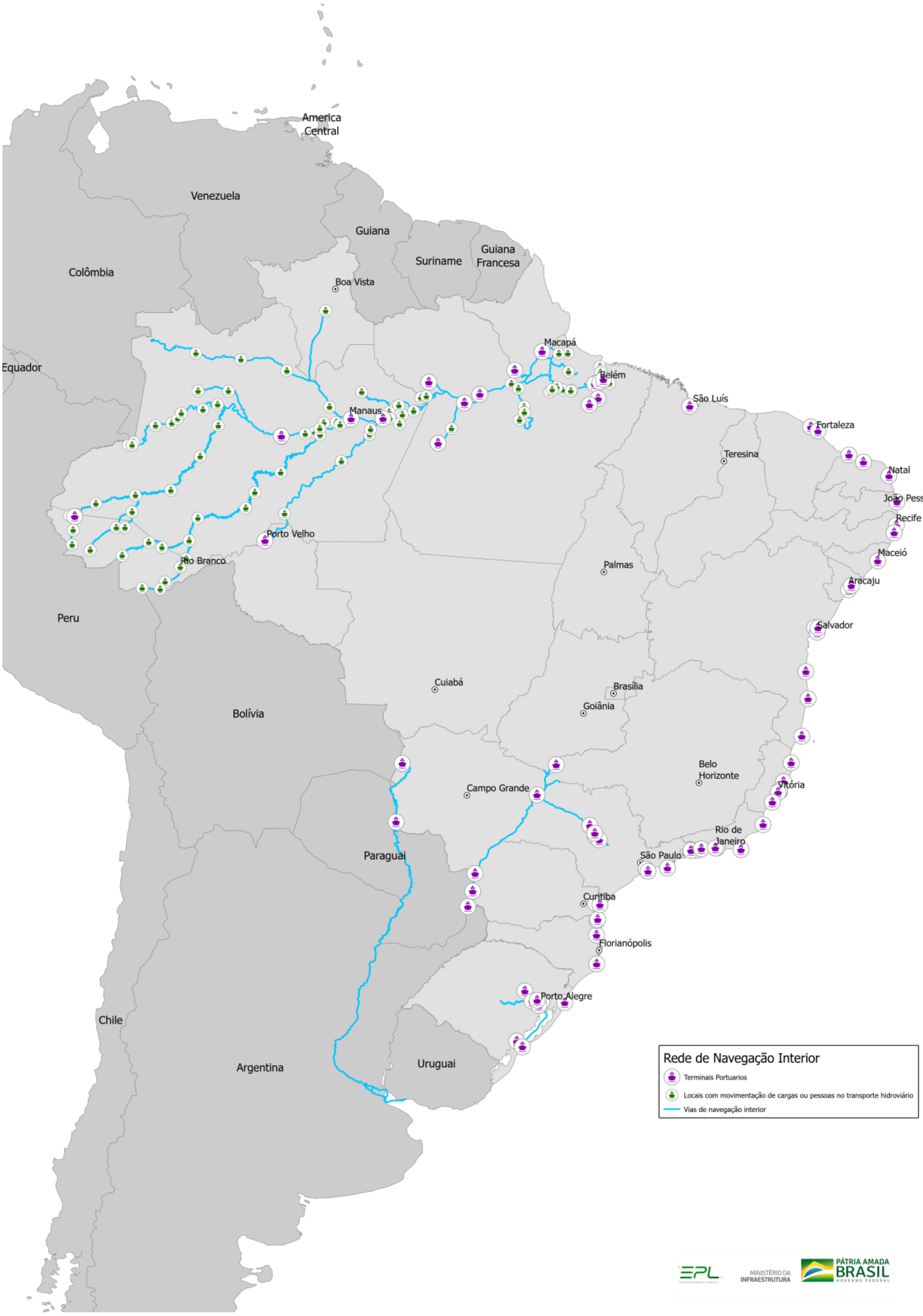
The inland navigation network for Base Year 2017 (shown in Picture 19) was structured based on information from ANTAQ (National Water Transportation Agency), the Strategic Waterway Plan - PHE, Freight movement data extracted from electronic Invoices, and the movement of people extracted from the Road and Waterway Links Survey by IBGE (2016). These data refer to economically navigated and/or waterway passenger transport routes, which total 19.867 kilometers.

On Picture 19, the configuration of 4 preponderant inland navigation basins is highlighted. A basin in the North Region, formed by the Amazon River, and some of its navigable affluents (among them are Xingú, Tapajós, Madeira, Acre, Andirá, Solimões, Japurá, Juruá, Tarauacá, Envira, Negro, Uatumã, Branco and Trombetas rivers), totaling 16.817 kilometers of navigable waterways, of which 1.831 kilometers are also navigated for cabotage transport and 1.394 kilometers are also navigated for long-haul transport. This inland navigation basin in the North Region encompasses 10 port-cities and 103 locations with Freight or people handling in waterway transport.

Another basin observed is formed by the navigable routes of the Paraná, Tietê, Paranaíba and Grande rivers, in the State of São Paulo and borders of the states of Minas Gerais, Goiás, Mato Grosso do Sul and Paraná, totaling 1.665 kilometers of navigable routes.

In Rio Grande do Sul, specifically in the metropolitan mesoregions of Porto Alegre and the southeast of Rio Grande, there is another inland navigation system formed by the waterways of Lagoa Mirim, Lagoa dos Patos, Rio Jacuí and Rio Taquari, totaling 379 kilometers of navigable routes.

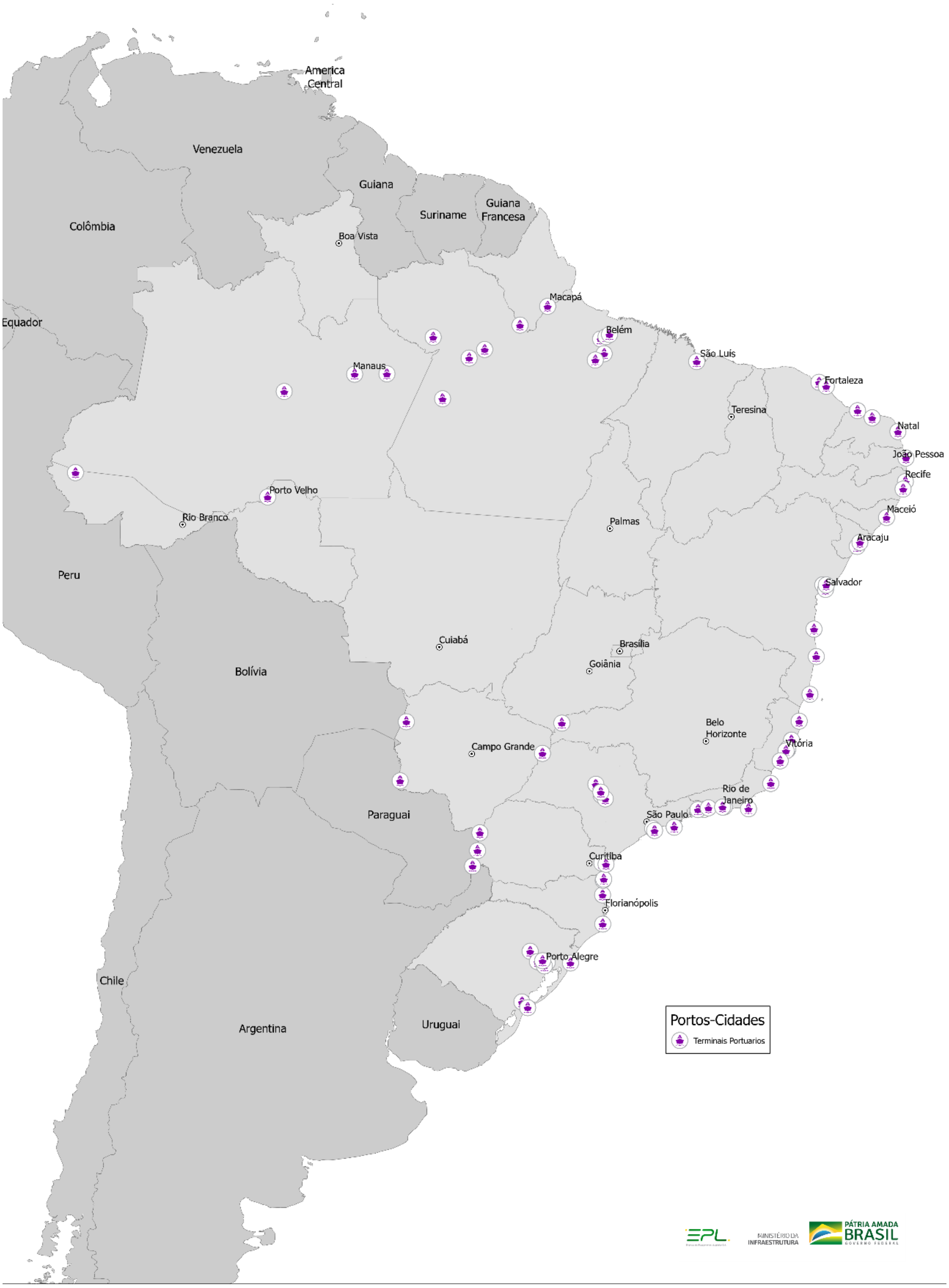
On the border between the State of Mato Grosso do Sul and Paraguay, the navigable stretch of the Paraguay River is 614 kilometers long in the national territory. After crossing Paraguayan territory and entering Argentina, navigation continues along the Paraná River to the Rio de la Plata on the border between Argentina and Uruguay. The international extension of the Paraguay-Paraná waterway system is 2.332 kilometers.



Picture 19: Inland Navigation Network (base year 2017)

Source: EPL (2021)

On NLP 2035, the concept of port-city was used and, thus, the port areas belonging to the same municipality were aggregated. 79 port-cities were contemplated in the model, with active port facilities, whether public or private. We sought to guarantee the specificities in each case analyzed, considering specific impedances both for the port-city and for the type of Freight handled. Picture 20 shows the port-cities considered.



Picture 20: Port-cities (base year 2017)
Source: EPL (2021)

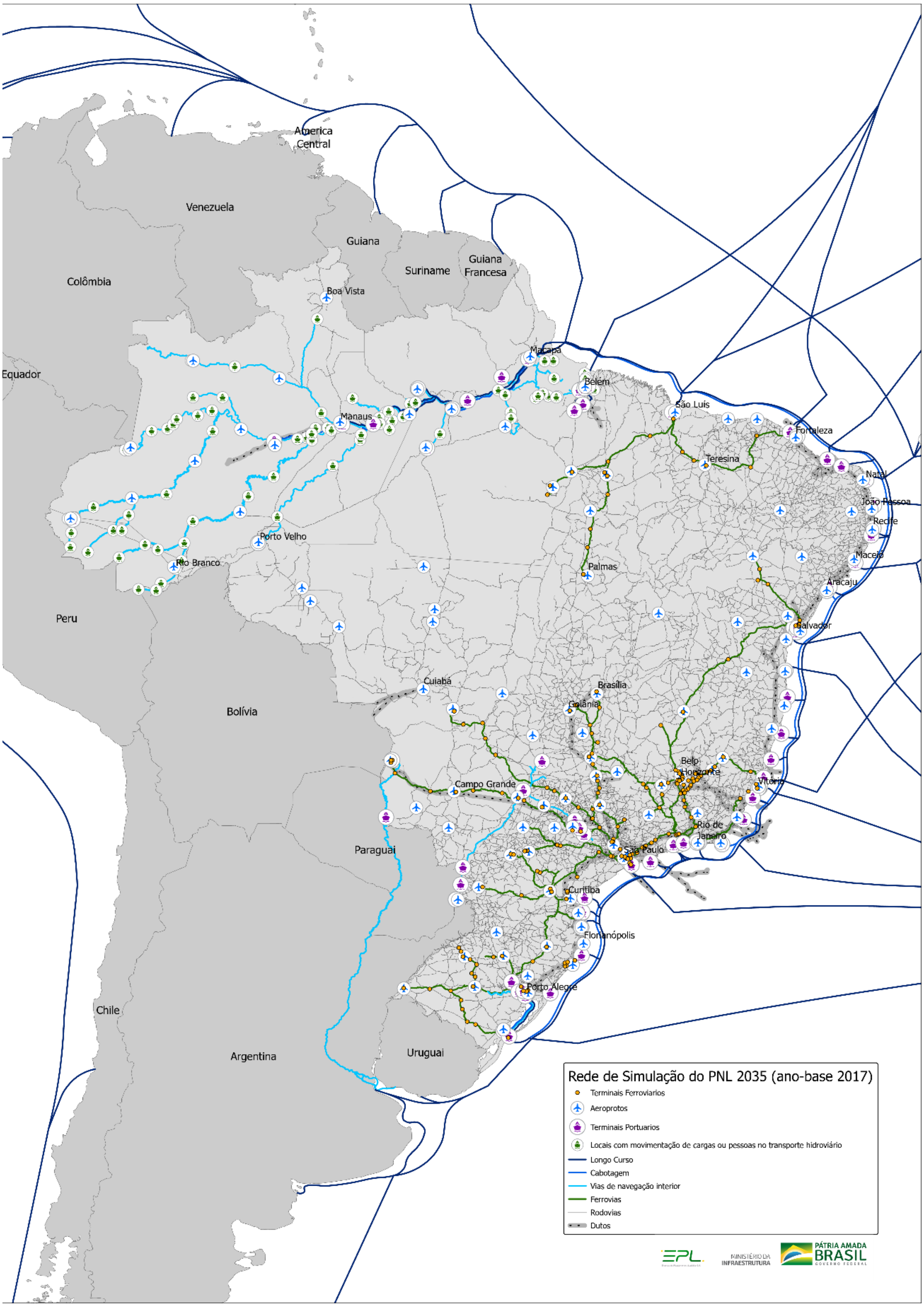
The simulation network considered in the functional model of integrated simulation of the NLP 2035, base year 2017, can be seen in Picture 21 and its general numbers in Table 4. The functional model of integrated simulation of the NLP comprises the roadway, railway, and waterway modes of transport, for the traffic allocation of Freight matrixes and of roadway transport people matrixes (by automobile and by bus).

The other modes of transport that complete the Freight matrix (airway and pipeline), as well as the interurban transport of people by airway, railway, and waterway modes, are also included in the scenarios simulated in the NLP 2035, as well as are accounted for in the scenario evaluation indicators. However, the simulation of these attributes occurs through specific models at the same time as the functional model of integrated simulation. The models differ in methodological aspects and considered assumptions, but they guarantee the compatibility and harmonization of the input databases and their results. In the field of airway transport, for example, both the baseline scenario (2017) and the future forecast are based on what is taken from the National Airway Plan 2018-2038, considering the methodological adherence of that plan in relation to the NLP 2035 and the validity of this instrument of planning. The demands for the future network, however, were resized as will be discussed later.

Table 4: NLP 2035 Simulation Network in numbers (base year 2017)

Network Component	Amount
Roadways	331.807 km
Railways	21.286 km
Inland Waterways	19.651 km
Coastal cabotage navigation routes	8.859 km
Inland Cabotage Routes	2.148 km
Inland long-haul routes	1.394 km
Pipeline Network	23.300 km
Airports with regular flights	117
Port-cities	79
Other places with Freight or people movement in the waterway transport	103
Railway Terminals	195
Municipalities	5.570
International Zones	19

Source: EPL (2021)



Picture 21: NLP 2035 Simulation Network (base year 2017)

Source: EPL (2021)

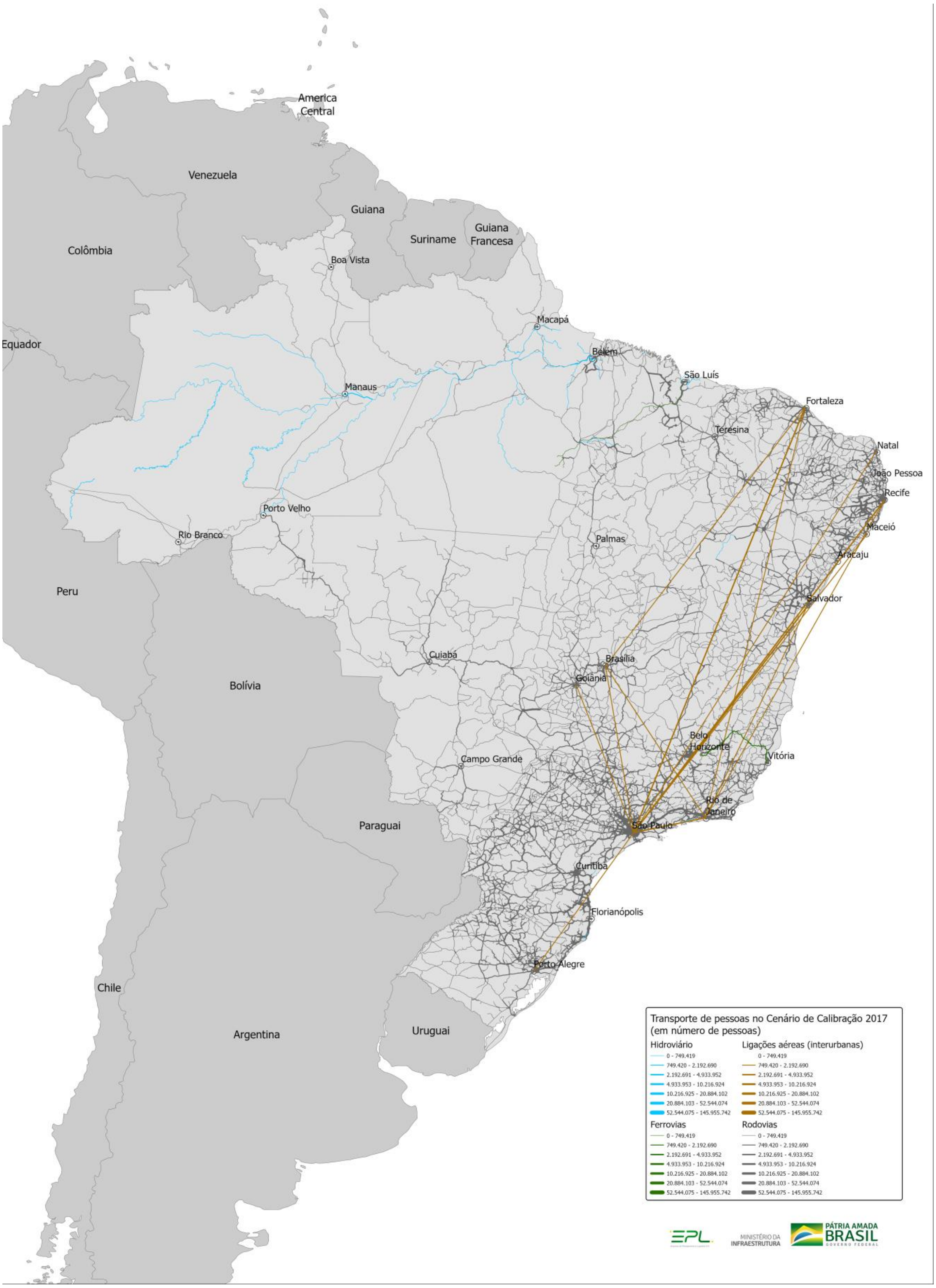
4.3. ALLOCATED FLOWS

Following the NLP 2035 development methodology, the origin-destination matrixes were then allocated in the simulation network. Picture 22 shows the results of the allocation of the people transport origin-destination matrixes in the simulation network, considering the 2017 Base Year Scenario. The lower class of the airway transport mode is omitted in the map for better visualization.

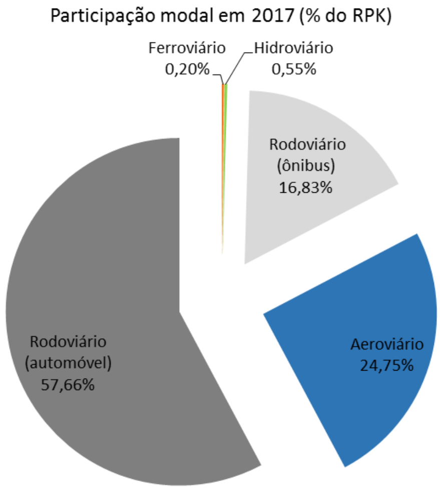
There is a greater prevalence of interurban road transport flows of people in the national territory, with greater concentration in the connections between cities that create local networks with capitals and with regional and sub-regional centers. This prevalence of interurban road transport flows does not only occur in the region of the Amazon River Basin where waterway flows predominate. The predominant airway flows at the city of São Paulo and Rio de Janeiro in relation to capitals in the Northeast, Midwest, Belo Horizonte, and Porto Alegre are also noteworthy.

The modal share for the interurban transport of people, based on the model developed for the NLP 2035, is shown in Picture 23, and it is the most complete picture of this type of flow ever mapped in national plans and studies. It is observed that private road transport, by automobile, is predominant in interurban travel and represents approximately 57% of the RPK of the interurban transport of people matrix in Brazil in 2017. Subsequently, air transport represents approximately 24% of the RPK and road transport by bus 16% of the intercity transport matrix of people in Brazil in 2017. The waterway and railway modes[7] together represent less than 1% of the RPK of the interurban transport people matrix in Brazil in 2017.

7 Only regular railway passenger transport is considered. Thus, the data do not cover tourist and celebratory rail transport.



Picture 22: Allocated Interurban Flow of People (Base Year 2017)
Source: EPL (2021)



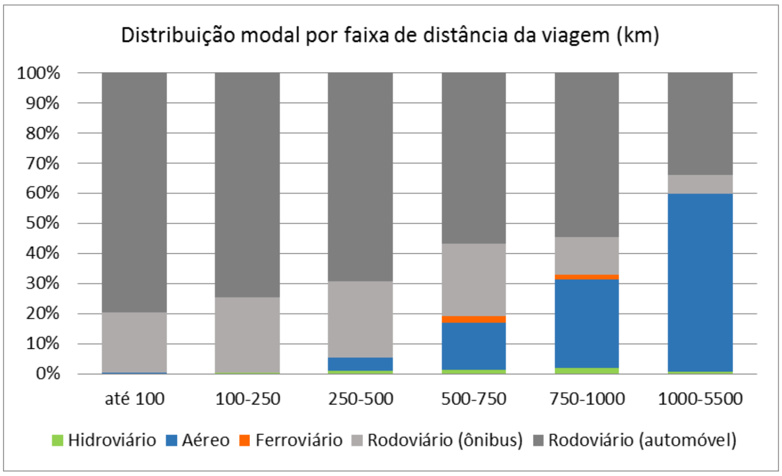
Picture 23: Interurban transport matrix for people in Brazil in 2017 (in people, km or RPK)

Source: EPL (2021)

(On Picture: (clockwise) Modal Participation In 2017 (RPK%) – Railway/Waterway/Road (bus)/Airway/Road (automobile).

Despite the low participation in the RPK of interurban transport of people, the waterway mode is fundamental for transport in certain regions of the country, such as the Amazon Region.

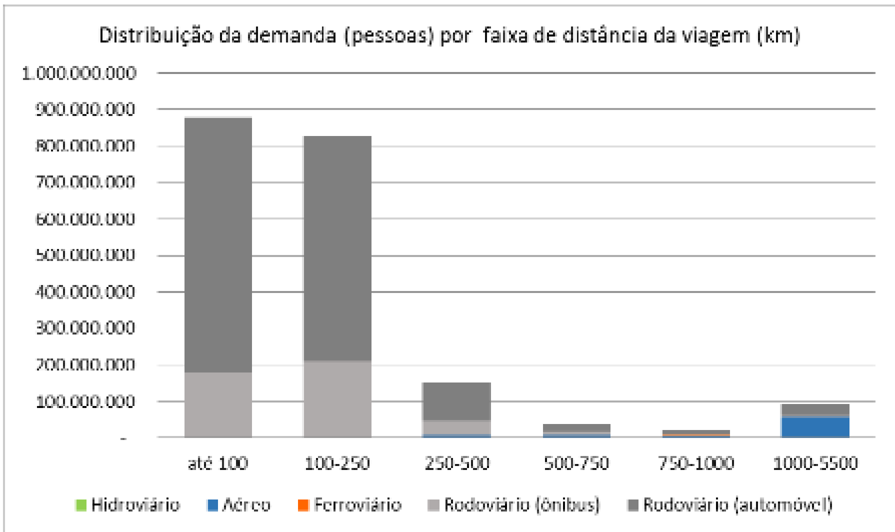
In relation to the modal distribution of interurban people transport in 2017 by travel distance[8], it is observed that individual road transport is only not the most representative in trips with distances greater than 1.000 kilometers. In Picture 24, it is observed that there is a tendency to change from people road transport to air transport in longer trips.



Picture 24: Modal distribution of people transport, in RPK, by travel distance, in 2017 (%). Source: EPL (2021). (On Picture (from left to right): Modal distribution by travel distance (km) - Waterway/Airway/Railway/Road (bus)/Road (automobile))

8 Travel distance refers to the road distance between the origin and destination of the trip.

Looking at the distribution of people's travels by displacement distance, Picture 25 shows that most trips taken in 2017 were between locations with a distance of at most 250 kilometers (85% of all trips). It is noteworthy that road trips by automobile are concentrated in displacements within this distance range.



Picture 25: Distribution of people's travels by travel distance, considering the modes of transport (people). Source: EPL (2021). (On Picture: (from left to right) Distribution of demand (people) by travel distance (km) Waterway/Airway/Railway/Road (bus)/Road (automobile))

On the other hand, although trips with distances greater than 1.000 kilometers represent approximately 72% of the airway trips made in 2017, only 5% of people who traveled in 2017 took trips in this distance range.

Railway trips refer to the transport of people on the Carajás Railway and the Vitória-Minas Railway.

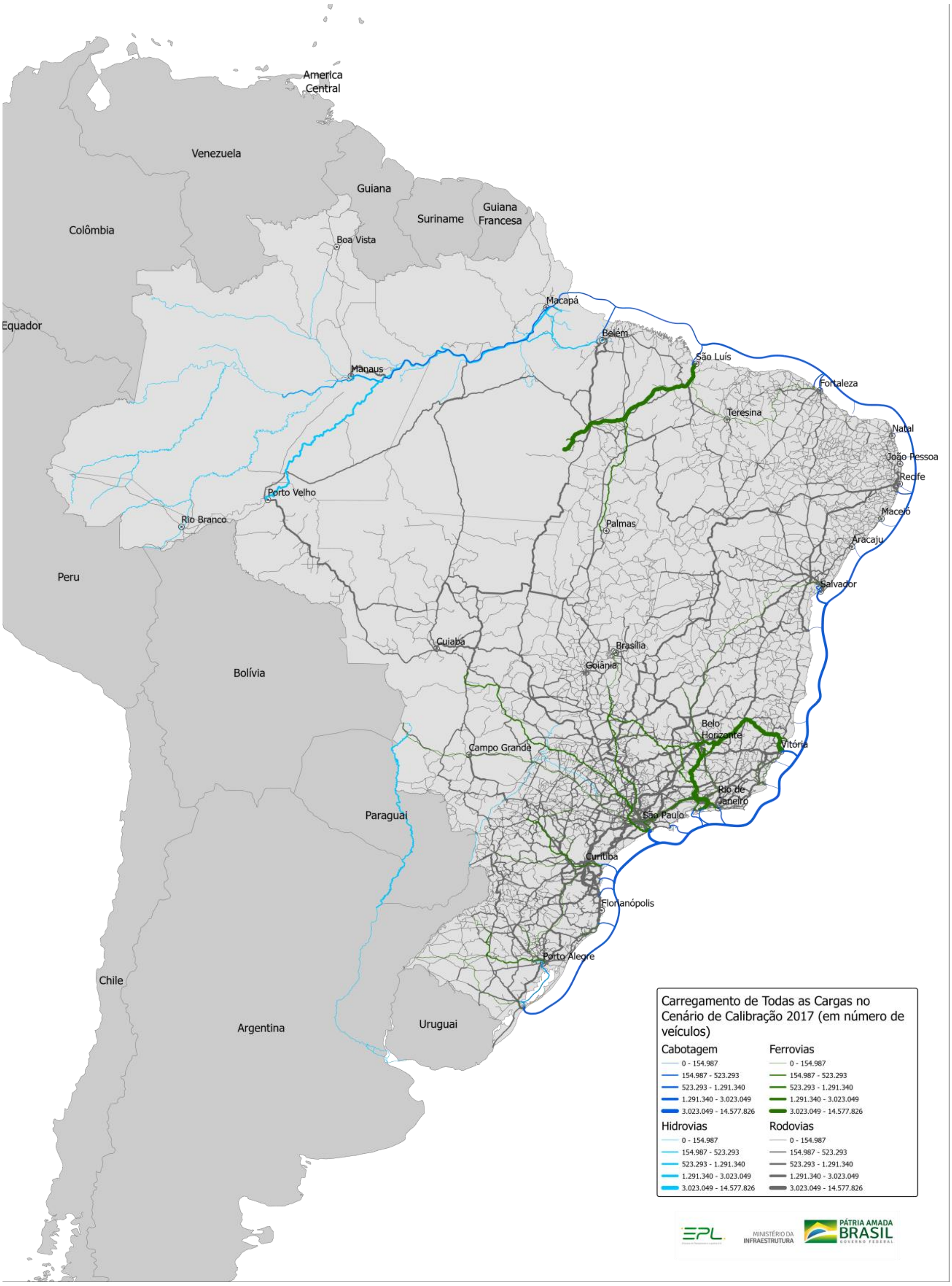
Table 5 shows the distribution of the modal matrix by travel distance for base year 2017.

In Pictures 26 to 34, the results of the allocation of Freightes origin-destination matrixes to the simulation network are presented, considering the 2017 Base Year Scenario.

Table 5: Distribution of the modal matrix of people transport by distance; Base Year 2017.

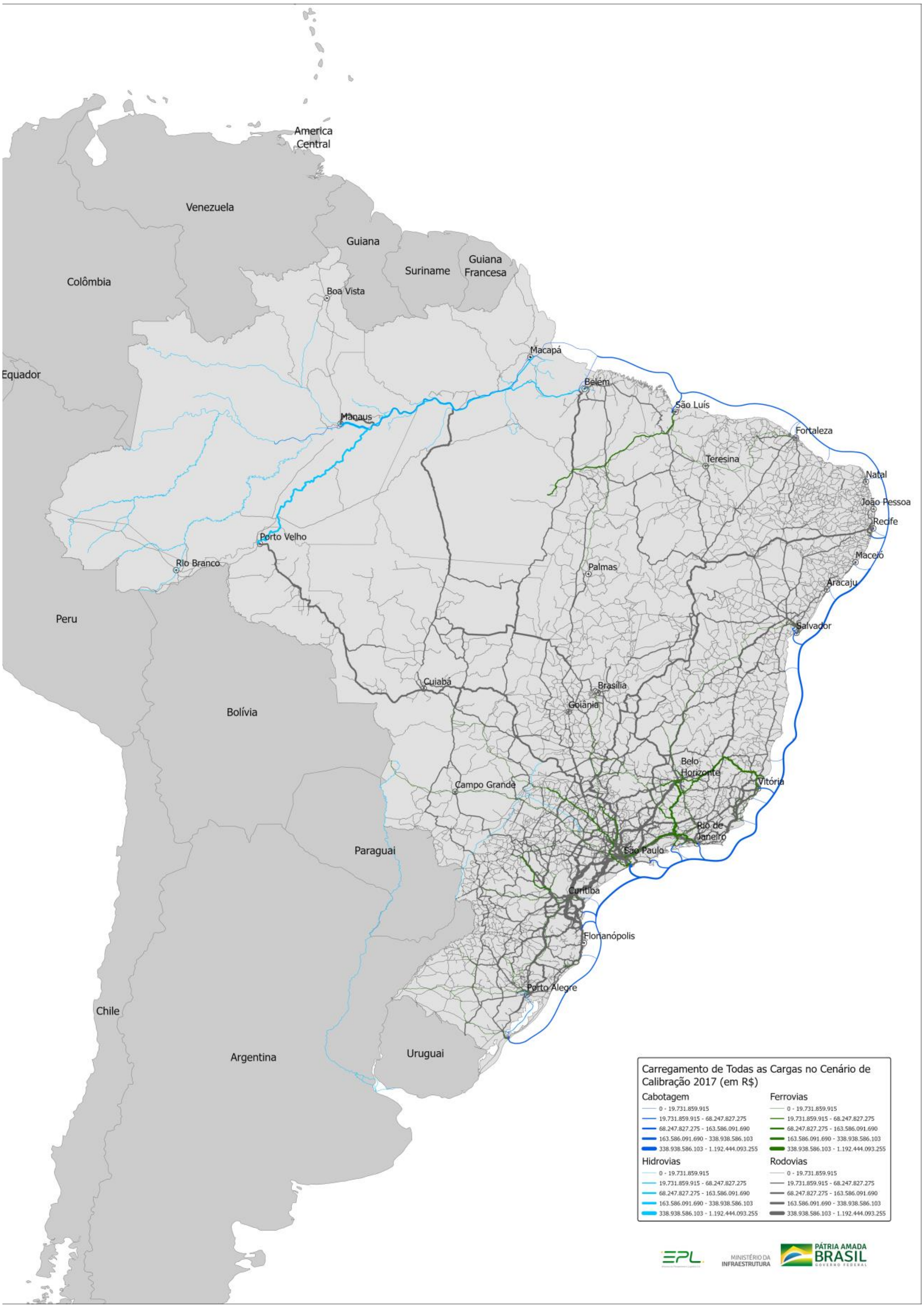
Distance Range	Waterway	Airway	Railway	Roadway (Bus)	Roadway (automobile)	Total
up to 100	26,87%	0,41%	2,76%	40,32%	46,99%	43,66%
100-250	29,78%	2,24%	0,00%	46,84%	41,46%	41,08%
250-500	20,61%	9,25%	0,00%	8,80%	7,16%	7,63%
500-750	7,67%	8,04%	72,46%	2,16%	1,51%	1,96%
750-1000	5,97%	7,62%	24,78%	0,58%	0,73%	0,99%
1000-5500	9,10%	72,44%	0,00%	1,30%	2,15%	4,67%
Total	100%	100%	100%	100%	100%	100%

Source: EPL (2021)



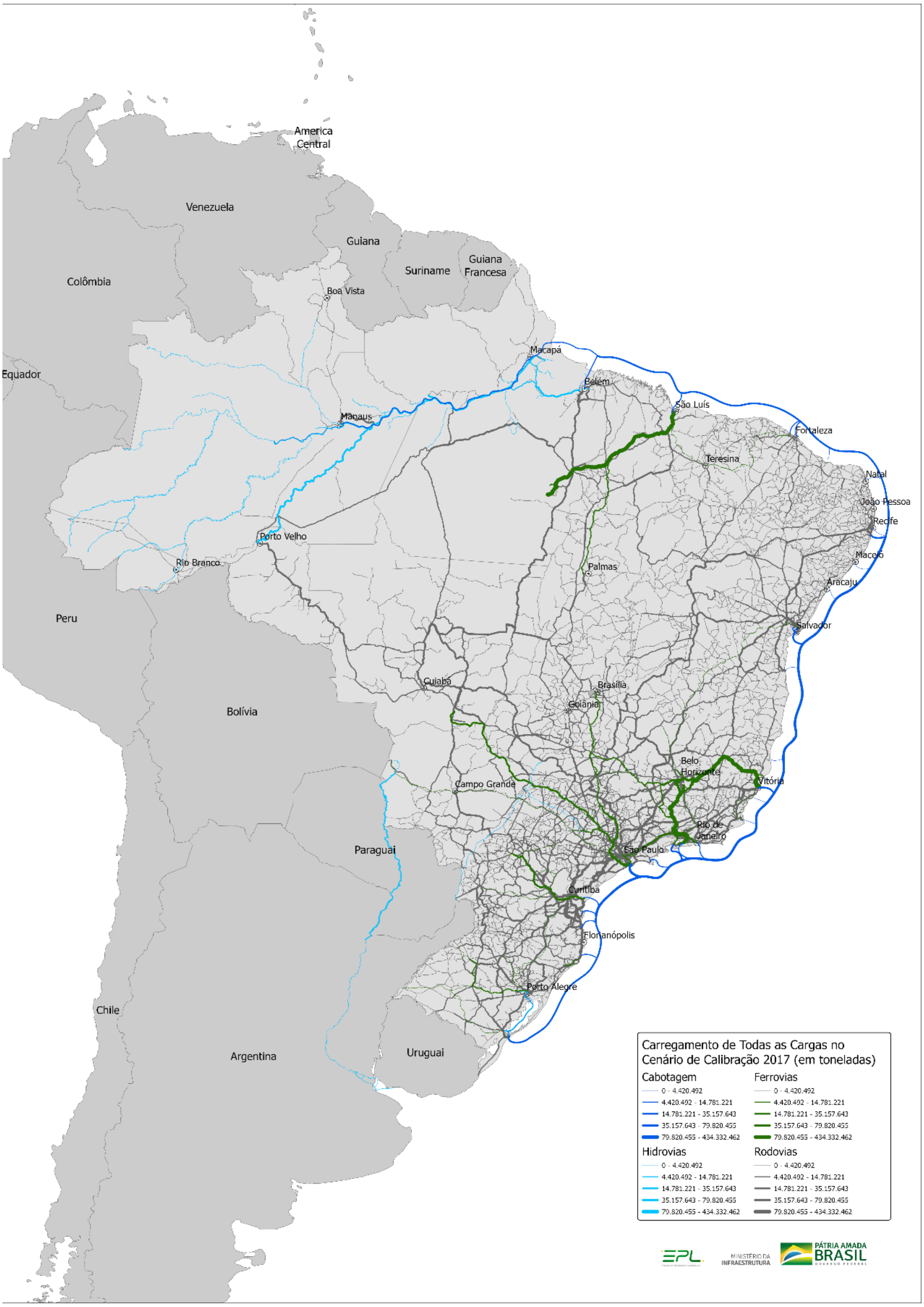
Picture 26: Allocated Flows 2017 - All Vehicles (Freight)

Source: EPL (2021). (On Picture: Loading of all Freight into the calibration scenario 2017 (in number of vehicles) - Cabotage, railway, waterway, road)



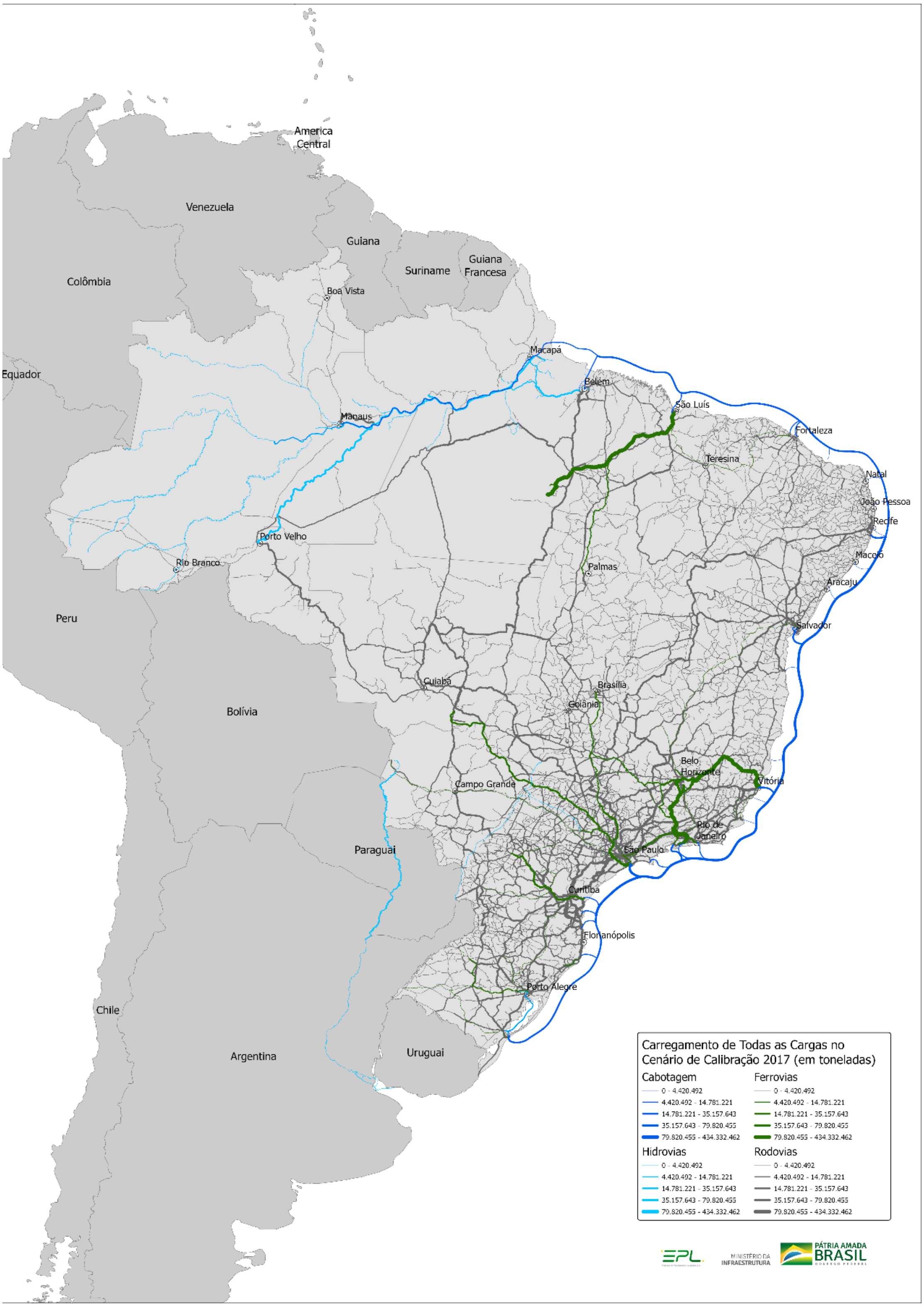
Picture 27: Allocated Flows 2017 - All Freightes (by value)

Source: EPL (2021). (On Picture: Loading of all Freight into the calibration scenario 2017 (in R$) - Cabotage, railway, waterway, road)



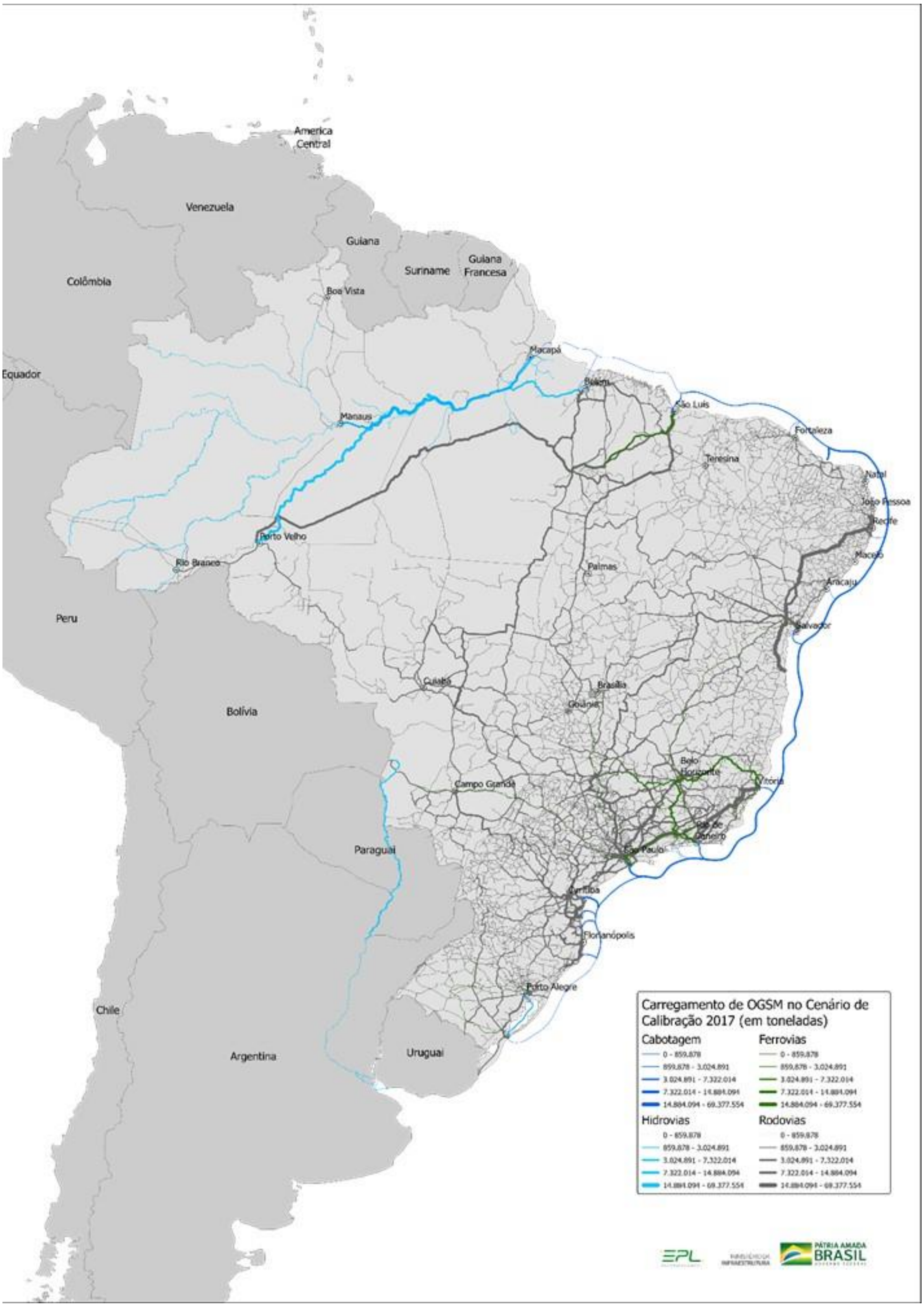
Picture 28: Allocated Flows 2017 - All Freight (by weight)

Source: EPL (2021). (On Picture: loading of all Freight into the calibration scenario 2017 (in tons) - Cabotage, railway, waterway, road)



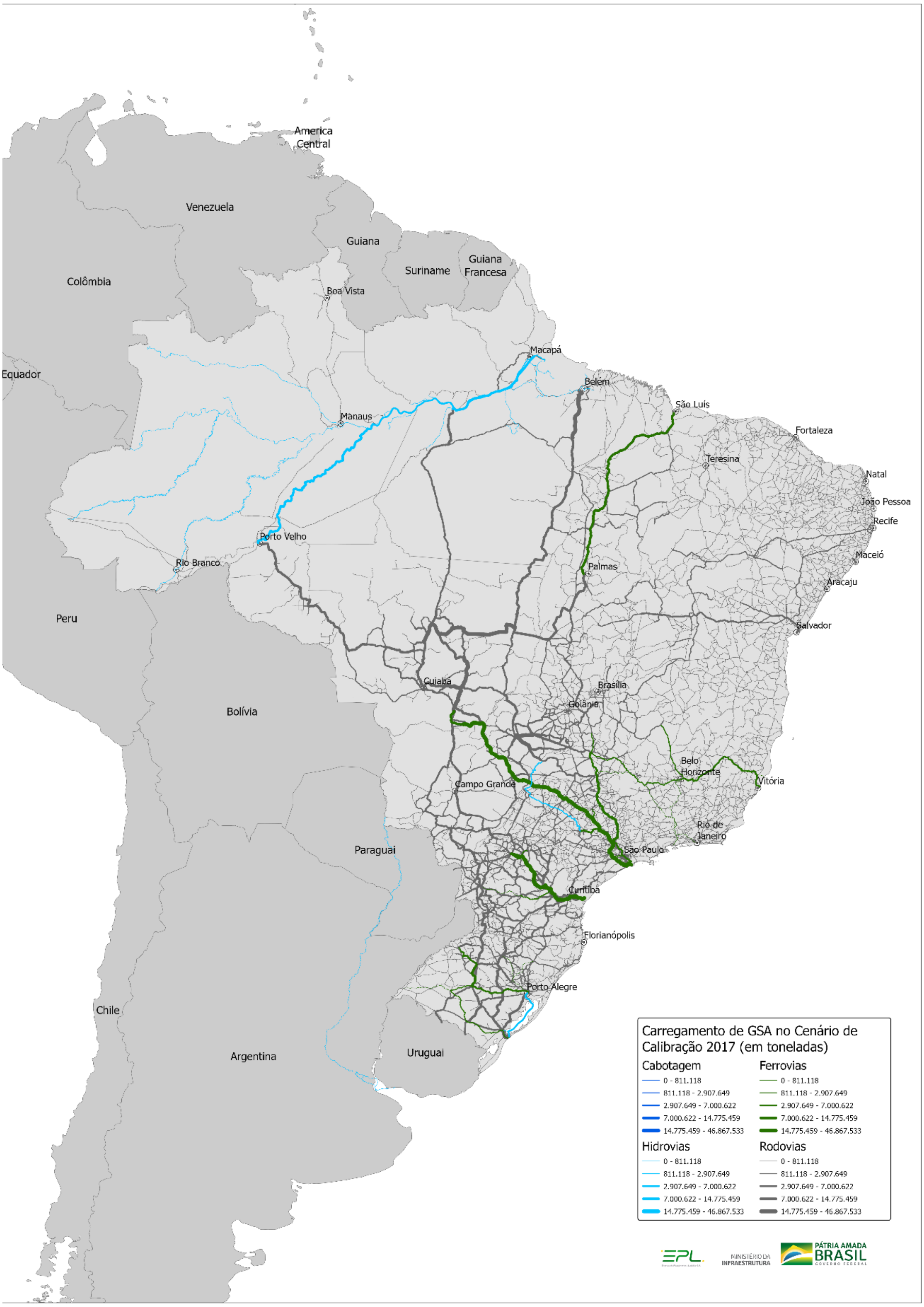
Picture 29: Allocated Flows 2017 – Solid Mineral Bulk - GSM (by weight)

Source: EPL (2021). (On Picture: GSM Freight into the calibration scenario 2017 (in tons) – Waterway/Pipelines/Railways)



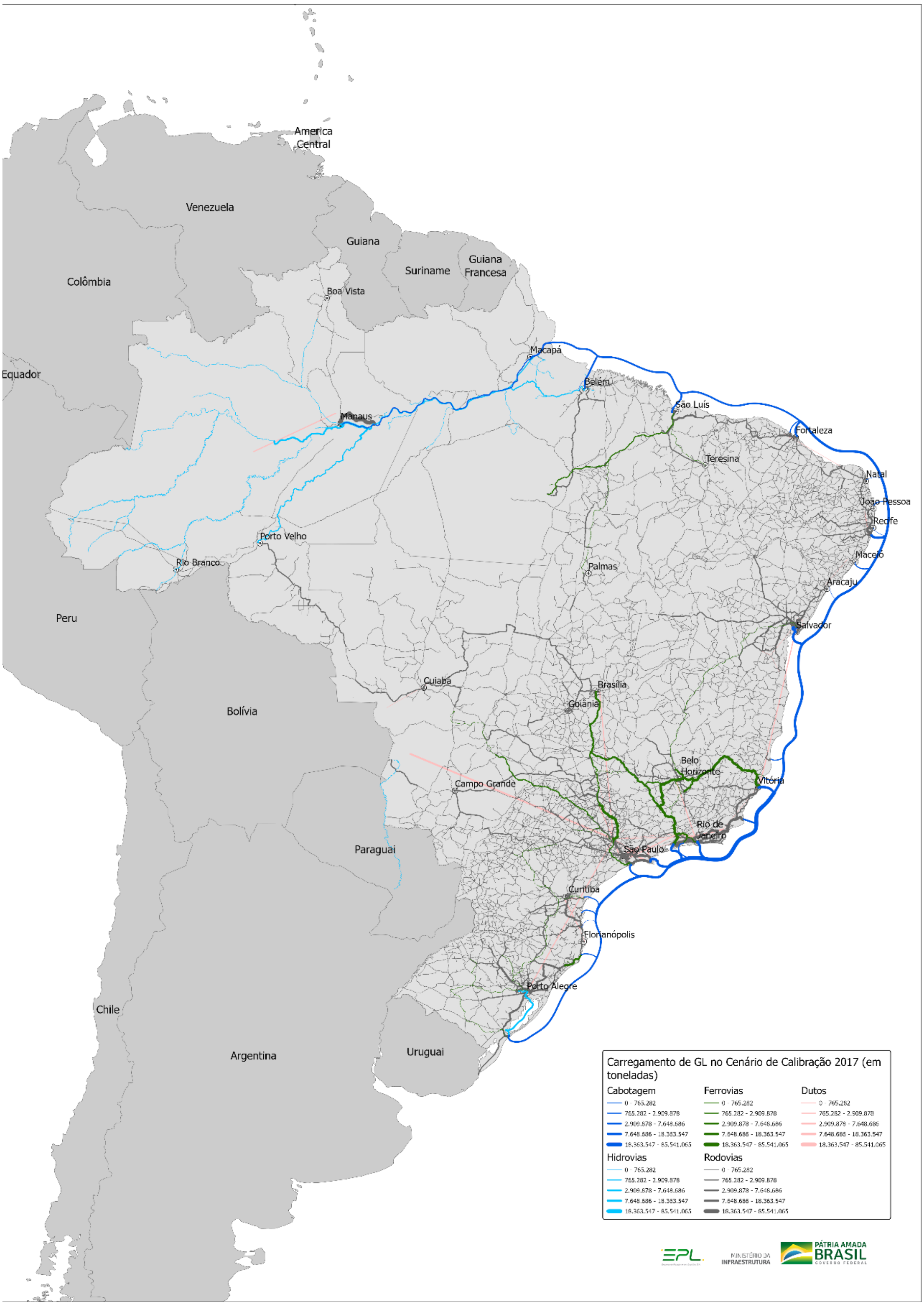
Picture 30: Allocated Flows 2017 - Other Solid Mineral Bulk - OGSM (by weight)

Source: EPL (2021). (On Picture: OGSM Freight into the calibration scenario 2017 (in tons) – Cabotage/Railways/Waterway/Road)



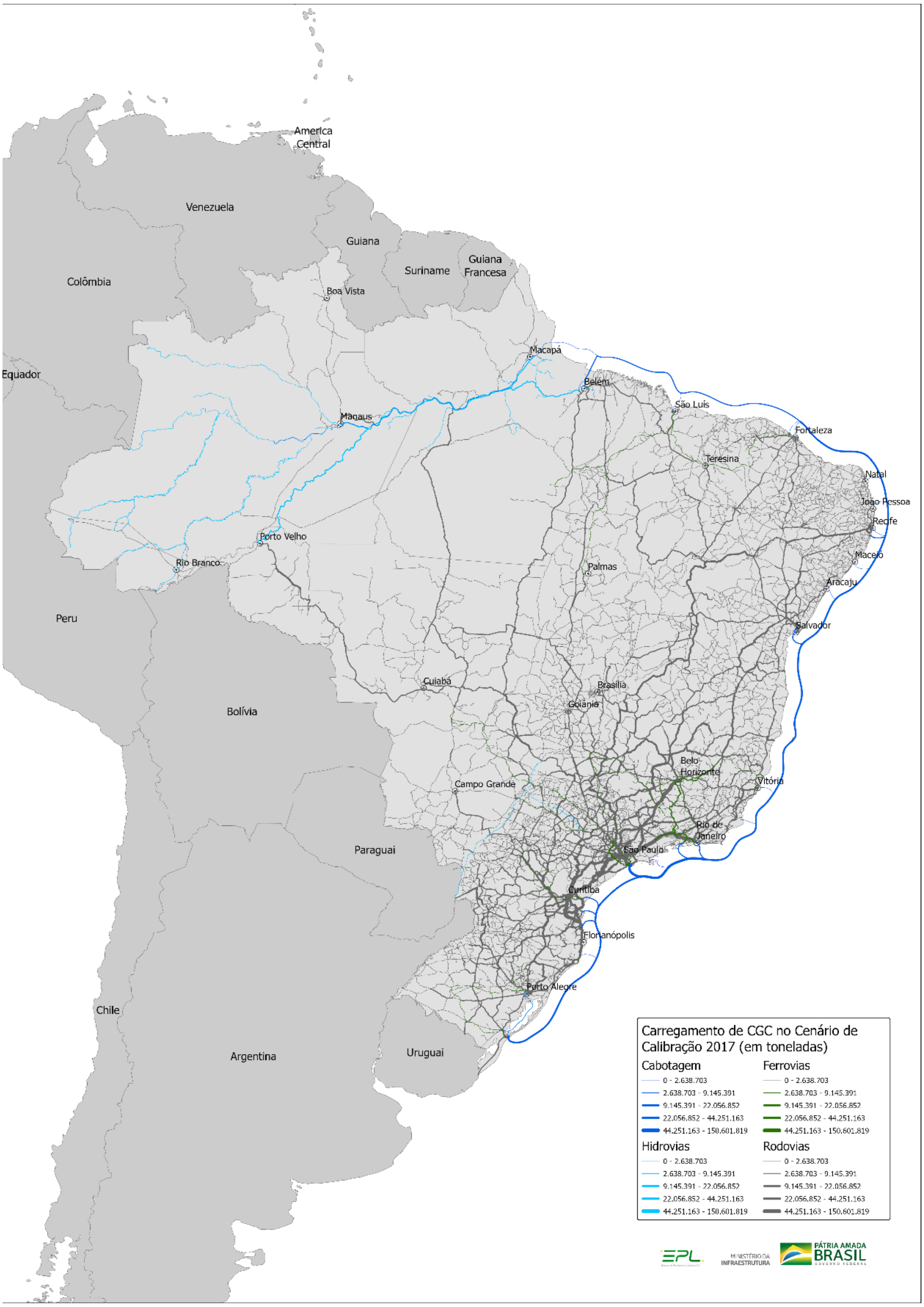
Picture 31: Allocated Flows 2017 – Solid Agricultural Bulk – GSA (by weight)

Source: EPL (2021). (On Picture: GSA Freight into the calibration scenario 2017 (in tons) – Cabotage/Railways/Waterways/Roads)



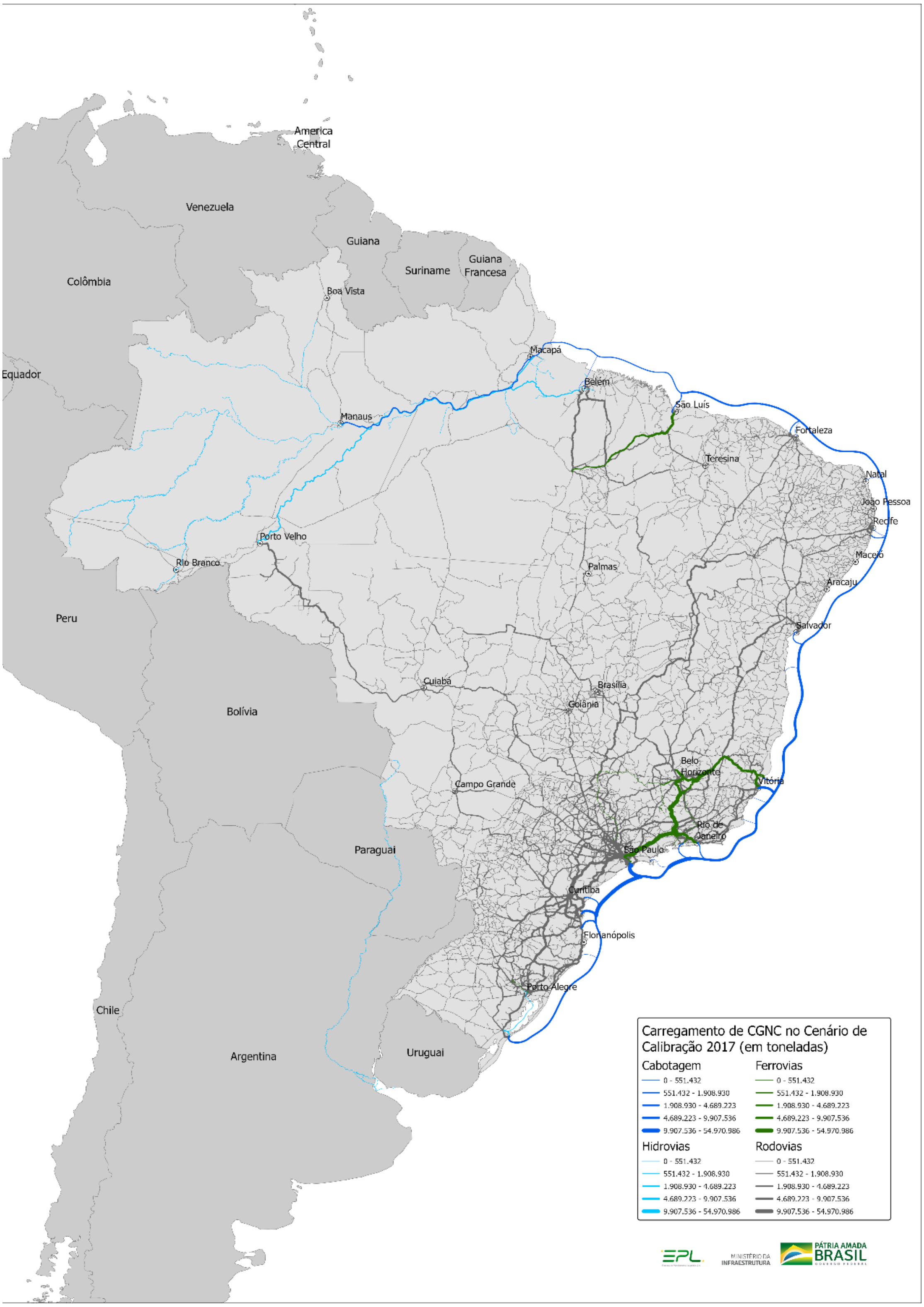
Picture 32: Allocated Flows 2017 - Liquid Bulk - LB (by weight)

Source: EPL (2021). (On Picture: LB Freight into the calibration scenario 2017 (in tons) - Cabotage, railways, pipelines, waterway, roads)



Picture 33: Allocated Flows 2017 - Containerized General Freightes - CGC (by weight)

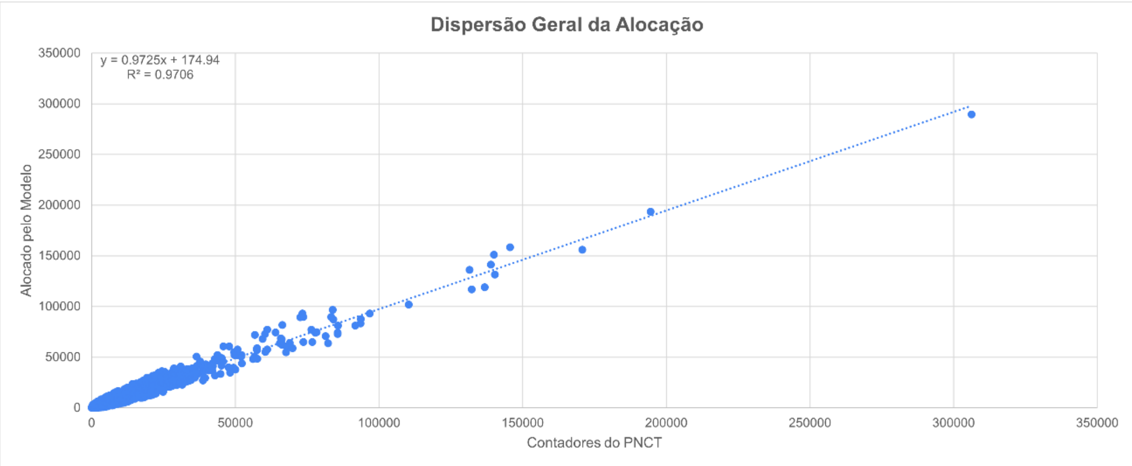
Source: EPL (2021). (On Picture: CGC Freight into the calibration scenario 2017 (in tons) Cabotage/Railways/Waterway/Roads)



Picture 34: Allocated Flows 2017 - Non-containerized General Freightes - NCGC (by weight)
Source: EPL (2021). (On Picture: NCGC Freight into the calibration scenario 2017 (in tons) – cabotage/railways/waterways/roads)

The allocation of demand in the network went through a calibration process, which consists of the adaptation and adjustments of the results of the allocation of the functional model of integrated simulation, taking as reference values real movement data on the roadways (from the National Traffic Counting Plan – PNCT) and data referring to the general behavior of Freight distribution in large-capacity modes of transport (aggregated data from rail transport and port handling).

One of the parameters adopted to verify the calibrated model, which is the General Calibration of Dispersion, which measures the numerical difference between the volumes allocated by the model and those perceived by the PNCT calibration posts, can be seen in the graph on Picture 35.



Picture 35: Overall Dispersion of Allocation
Source: EPL (2021)

From the analysis of the allocated flows, it can be seen that the model used was able to represent the flows in the most representative transport corridors in the country with great assertiveness.

Comparing the Freight flows by value (Picture 27) and by weight (Picture 28), it is observed that the spatial distribution of Freight flows by weight in the national territory is not reflected in the Freight flows by value. The concentration of values is in the surrounding areas, and between the cities of Curitiba and São Paulo, with a certain extension to the cities of Rio de Janeiro, Belo Horizonte, Vitória, Florianópolis and Porto Alegre.

For the transport of GSM, as can be seen in Picture 29, a concentration of the most representative Freight flows, by weight, in the railways with great capacity to transport iron ore, the Carajás Railway - EFC, the Vitória-Minas Railway – EFVM and MRS Logística – MRS.

On the transport of OGSM (Picture 30), there are very prominent transport corridors connecting the ports to the countryside, representing the flows of fertilizers to the producing areas, using both roads and railways. In addition, it is important to highlight the movement of iron ore sub products and other minerals (such as bauxite, salt) by railway and cabotage and the internal roadway distribution of other minerals (such as cement) throughout the country.

Regarding GSA transport, in which soybean, bran, corn and sugars are grouped, Picture 31 shows the representation of the transport corridors that enable exports through the ports of the Arco Norte and the Southeast and South Regions. On the Arco Norte, the movements in the navigable route of the Madeira River, BR-163/MT/PA, BR-155/158/MT/PA and North South Railway (Ferrovia Norte Sul – FNS) are evident. Likewise, for the Southeast and South Regions, there is the flow of GSA by railways, such as Rumo Malha Norte, Rumo Malha Sul, Rumo Malha Paulista, FCA e EFVM, the use of the Tietê-Paraná and navigable routes on the South (Lagoa Mirim, Lagoa dos Patos, Rio Jacuí and Rio Taquari), as well as a representative use of the roadway network, both as a feeder for high-capacity modes and for the direct distribution of grains to ports and the domestic market.

The distribution of LB, which includes the macro products Biodiesel, Ethanol, Natural Gas, Diesel oil and Petrochemicals, is shown in Picture 32. A representative portion of LB begins to be internalized throughout the country through ports, from where they are preferably transferred to high-capacity modes available, a situation that in Picture 32 is made evident by the allocated flows in the railways that are directly connected to the ports. The movement of liquid bulk through cabotage is also noteworthy, being the most representative group of Freightes for this mode of transport. In addition, the capillarity characteristic of the internal distribution of LB, as shown in Picture 32, is guaranteed by the large road transport corridors, mostly composed of federal roadways, complemented by state roadways.

Although they have different forms of Freight conditioning, as can be seen in Pictures 33 and 34, the CGC and NCGC groups have similar behaviors in relation to the allocation of flows and infrastructure used. The exception is a greater use of railways (EFVM and MRS) and cabotage for the transport of NCGC in the Southeast of the country, and the use of a more comprehensive road network for the transport of NCGC throughout the entire national territory. In general, for both CGC and NCGC, there is the use of the road network throughout the national territory and a greater concentration in the transport corridors of the South and Southeast regions of the country. Cabotage and railways are used on a smaller scale for CGC compared to NCGC. Inland navigation is practically not used for CGC and NCGC.

The results obtained after the calibration for year 2017 validate the functional model of integrated simulation to be used in the simulation of future scenarios, even though it may result in certain differences in relation to real data when analyzing some specific infrastructures. However, for the strategic analysis required in the NLP 2035, the results proved to be very consistent. Table 6 shows the TKU calculated for the 2017 Scenario for all modes.

Table 6: TKU calculated in the 2017 Scenario (of Calibration) for all modes of transport.

Mode of Transport	2017 TKU (Billions)	Modal Share 2017
Road transport	1.549,84	66,21%
Railway	414,12	17,69%
Coastal Cabotage	215,49	9,21%
Waterway	130,60	5,58%
Pipelines	29,55	1,26%
Airway	1,32	0,06%
Total	**2.340,96**	100,00%

Source: EPL (2021)

This adherence can be verified by comparing the TKU generated by the simulation model in relation to the official data published by the respective regulatory agencies in the official electronic addresses.

This behavioral comparison can be performed using as a basis the TKU values allocated to each mode in the 2017 Baseline Scenario of calibration. For the railway mode, a volume of 414.13 billions of TKU is allocated in the model. As published by the ONTL[9], with data from the Monitoring System for the Inspection of Rail Transport – SAFF/ANTT (National Agency of Land Transportation), year 2017 recorded a total of 375,2 billion TKU, generating a TKU difference of the order of 9,40%. When investigating the origin of a difference like this, a differentiation was observed in the way these values are calculated, and the number calculated during the calibration process considers network overlaps, making the Rumo Malha Paulista railway, for example, experiment a TKU above the one observed by the SAFF/ANTT system, as it adds the volumes that come from other networks (passage flows). By removing the overlap, for comparison purposes, a TKU of 393.16 billion TKU is obtained, generating a real difference of between the TKUs.

Compared to information published by ANTAQ[10] (which consolidates inland navigation data: cabotage, waterway and long-haul), it is observed that the 2017 Baseline Scenario presents values higher than those identified by that agency (130,61 billion TKU calculated in NLP 2035, against 66 billion TKU calculated in the ANTAQ publication for year 2017). These differences are due to the greater coverage of Freight handling locations in navigation considered in the NLP 2035: as shown in section 4.3, in the inland navigation system of the Amazon Region alone

9 Available at **https://ontl.epl.gov.br/paineis-analiticos/painel-de-indicadores-de-transporte-e-logistica/movimentacao-e-trafego/ferroviario/**

10 The ANTAQ document can be seen at **http://portal.antaq.gov.br/wp-content/uploads/2020/05/TKU-versao-final.pdf** (p.33).

were considered 10 port-cities and 103 places with Freight loading and unloading , which comprise, in addition to the small terminals (IP4) managed by the federal government, other terminals managed by the State Governments and municipalities close to the rivers' banks that handle goods, not necessarily in infrastructure classified as terminals.

Considering the percentages of the difference in TKU found by the simulation model, then in the process of calibration, with the values published by official sources, except for the methodological considerations mentioned above, associated with the adherence observed in the model's calibration posts, allow us to say that the assertiveness experienced is adequate for the purpose of this Plan.

It is noteworthy that this comparison should not be carried out directly in terms of TKU, since the matrix used for the NLP 2035 is unique in its amplitude and granulometry, with the percentage and order of magnitude comparison being more appropriate in relation to the matrix. When these TKU volumes are converted to a percentage transport matrix, the percentage difference between the analyzed transport matrixes is minimal, as compared to modal share estimates carried out in NLP 2025.

A direct comparison between the data presented in NLP 2025 with those in the present issue is not adequate. NLP 2025, for example, used an inter-regional matrix, segregated by micro-regions, while the NLP 2035 uses data by municipality. Furthermore, simulation and travel allocation models have significantly different inputs and methodological precepts. For these reasons, new values for the modal share were estimated for year 2015, adopting the basis of the current NLP and deflating it for the year mentioned. It means that if NLP 2025 were prepared under the same methodology and databases, the modal share for year 2015 would result in values close to those presented in Table 07.

Table 7: Results published by the NLP 2025 and results found by the NLP 2035 loaded with year 2015 matrixes.

Mode	Values calculated for 2015 on the NLP 2025		Values recalculated for 2015 with the NLP 2035 methodology		Differences in modal share
	2015 TKU (Billions)	2015 Modal Share	2015 TKU (Billions)	2015 Modal Share	
Coastal cabotage	249,90	10,47%	259,51	10,11%	-0,36%
Railway	356,80	14,95%	387,28	15,09%	0,14%
Waterway	125,30	5,25%	130,57	5,09%	-0,16%
Roadway	1.548,00	64,86%	1.759,02	68,52%	3,66%
Airway	0,60	0,03%	1,33	0,05%	0,02%
Pipeline	106,10	4,45%	29,34	1,14%	-3,31%
Total	**2.386,70**		**2.567,04**		

Source: EPL (2021)

This demonstration makes it clear that although there is a difference in TKU between official sources and that allocated by the model, this difference is based on the rich and innovative way that the origin and destination matrixes were formed, and the greater amplitude of representation of the transport network in the current Plan, the percentages that make up the country's transport matrix are quite similar, allowing for the model to have been considered calibrated and adjusted to reality, whether in its mathematical or behavioral form.

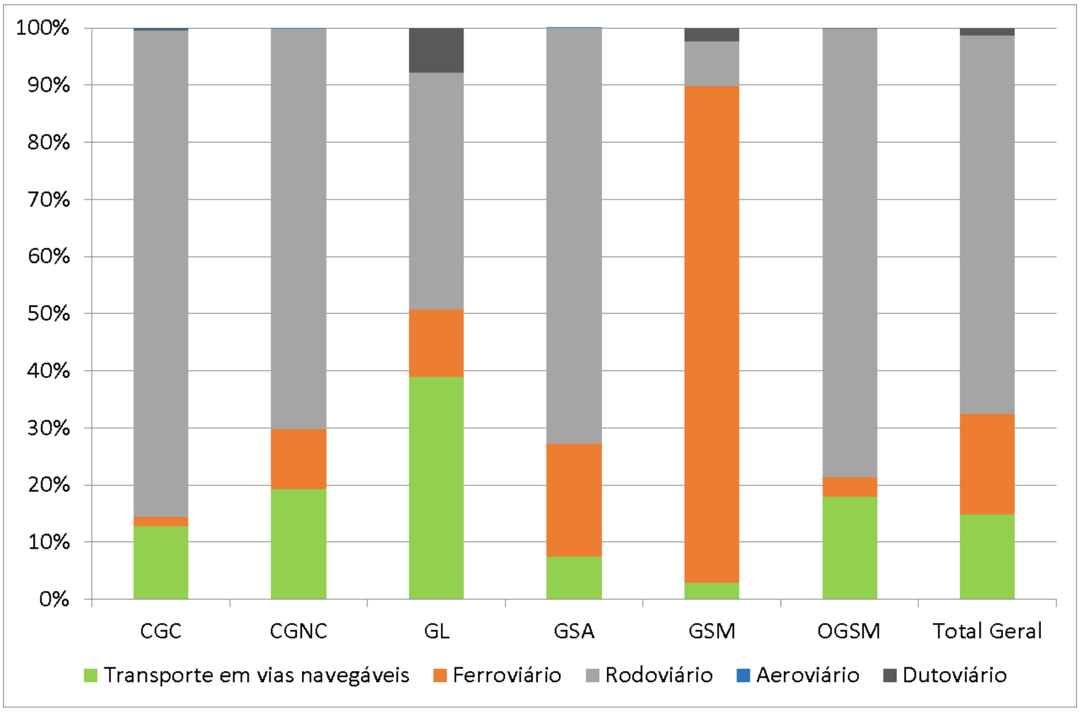
Regarding the Freight VKU for Base Year 2017, when it comes to the distribution by weight, there is a difference between the modes. Table 8 presents the VKU calculated for the 2017 Scenario for all modes, and shows that, from the perspective of the value of transported Freight, the transport system is even more concentrated in the road transport mode. However, there is evidence of a good participation of waterway transport in the national matrix of value.

Table 8: VKU calculated in the 2017 Scenario (of Calibration) for all modes of transport.

Mode of Transport	2017 VKU (Trillions)	2017 Modal Share
Roadway	6.914	83,25%
Coastal Cabotage	478	5,75%
Waterway	459	5,53%
Railway	352	4,24%
Pipelines	57	0,68%
Airway	46	0,55%
Total	**8.306**	100%

Source: EPL (2021)

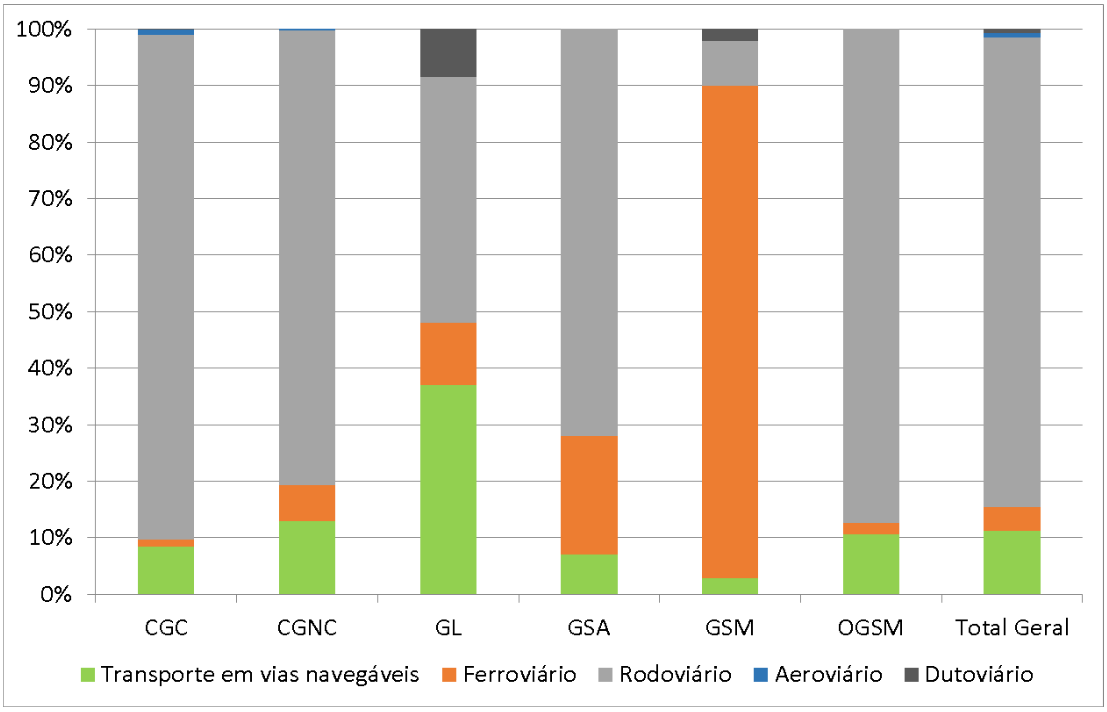
The specific results of the Freight transport matrix for year 2017, with the modal share by Freight group, are shown in Pictures 36 and 37.



Picture 36: Modal share by Freight group in Brazil in 2017 (TKU in %).

Source: EPL (2021)

(On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



Picture 37: Modal share by Freight group in Brazil in 2017 (VKU in %)
Source: EPL (2021)
(On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)

There is a prevalence of road transport in practically all Freight groups, except for the GSM group and with lesser importance for LB. For GSM the prevalence is of rail transport, and for LB there is the most prominent participation of transport in waterways (inland and coastal cabotage). This preponderance of road transport is even greater when the modal share by value is observed in relation to the modal share by weight, except for the GSA and GSM groups whose profiles of the modal share in weight and in value are similar.

4.4. STRATEGIC LAYER OF ANALYSIS

An important aspect present in the methodological structure of the NLP 2035 is the design of the Strategic Layer of Analysis (CEA), built with the aim of characterizing the strategic, systemic, and intermodal vision of the Plan, highlighting the set of infrastructures that have greater capacity to impact on the national strategic indicators.

To reach the CEA, the concept of infrastructure relevance was adopted in view of the density of Freight flows, both in weight and in value, and the number of people who go through them.

Studies related to *strategic logistical corridors* developed by the Ministry of Infrastructure were also used as input data for defining the CEA. This network is made up of the following links:

a. Strategic Road Network;

b. Railway Network;

c. Waterway Network:

i. Main inland waterways;

ii. Coastal cabotage routes.

And by the following nodes:

a. Ports;

b. Waterway transshipment terminals;

c. Railway transshipment terminals;

d. Strategic Airports;

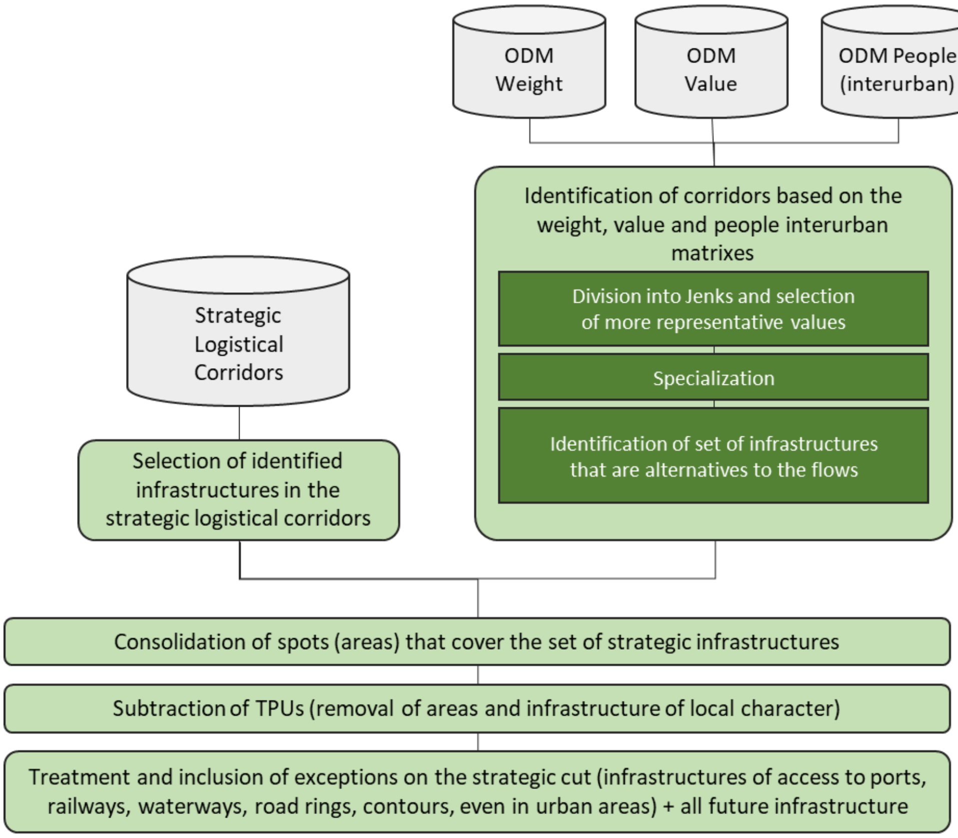
e. Border points with other countries;

f. Critical points regarding road accidents registered by the Federal Highway Police.

The Strategic Layer of Analysis is fundamental for the NLP 2035, since the simulation of the transport network sought a broad level of detail, to ensure a closer approximation of the represented model with reality - both in terms of the simulated network (roads, local roads, railways, waterways, etc.), and in terms of territorial aggregation (inter-municipal). However, when simulating a network of this magnitude and granulometry, there is a risk that the aggregated results of the scenarios may be impacted by local and regional aspects that interfere in the macroflows of transport of products and people that are the object of the strategic analysis of the NLP. Due to this fact, it was necessary to filter a layer that represents the strategic analysis cut, so that the indicators' calculation for these scenarios is limited to this cut.

The project of strategic logistical corridors developed by the Ministry of Infrastructure converges to the need to identify a strategic analysis cut. However, the current NLP database has data that allows aggregating and complementing the analysis of these corridors, since it was possible to develop a Freight origin-destination matrix that maps transport flows previously invisible to national planning, both in value and in weight. Furthermore, the origin-destination matrix of interurban transport of people, developed from mobile telephony data, also allows the identification of new flows and the expansion of the vision of people transport in Brazil, complementing previous studies.

For the definition of CEA, the methodology presented in Picture 38 was developed, based on information from the origin-destination matrixes, information basis of the NLP and its allocation behavior in the calibrated scenario of the most relevant pairs of the origin and destination matrix by weight and by value, in addition to the people matrix, its result being complemented by the georeferenced information basis raised in the project of strategic logistical corridors of the Ministry of Infrastructure, so that the result was fully in line with the needs of an NLP scenario analysis.



Picture 38: Identification Methodology of the NLP 2035 Strategic Layer of Analysis/ Source: EPL (2021)

The final CEA was consolidated with the inclusion of new infrastructure and the exclusion of infrastructure located in urban areas. The results of the CEA[11] are indicated on Table 9 and Picture 39.

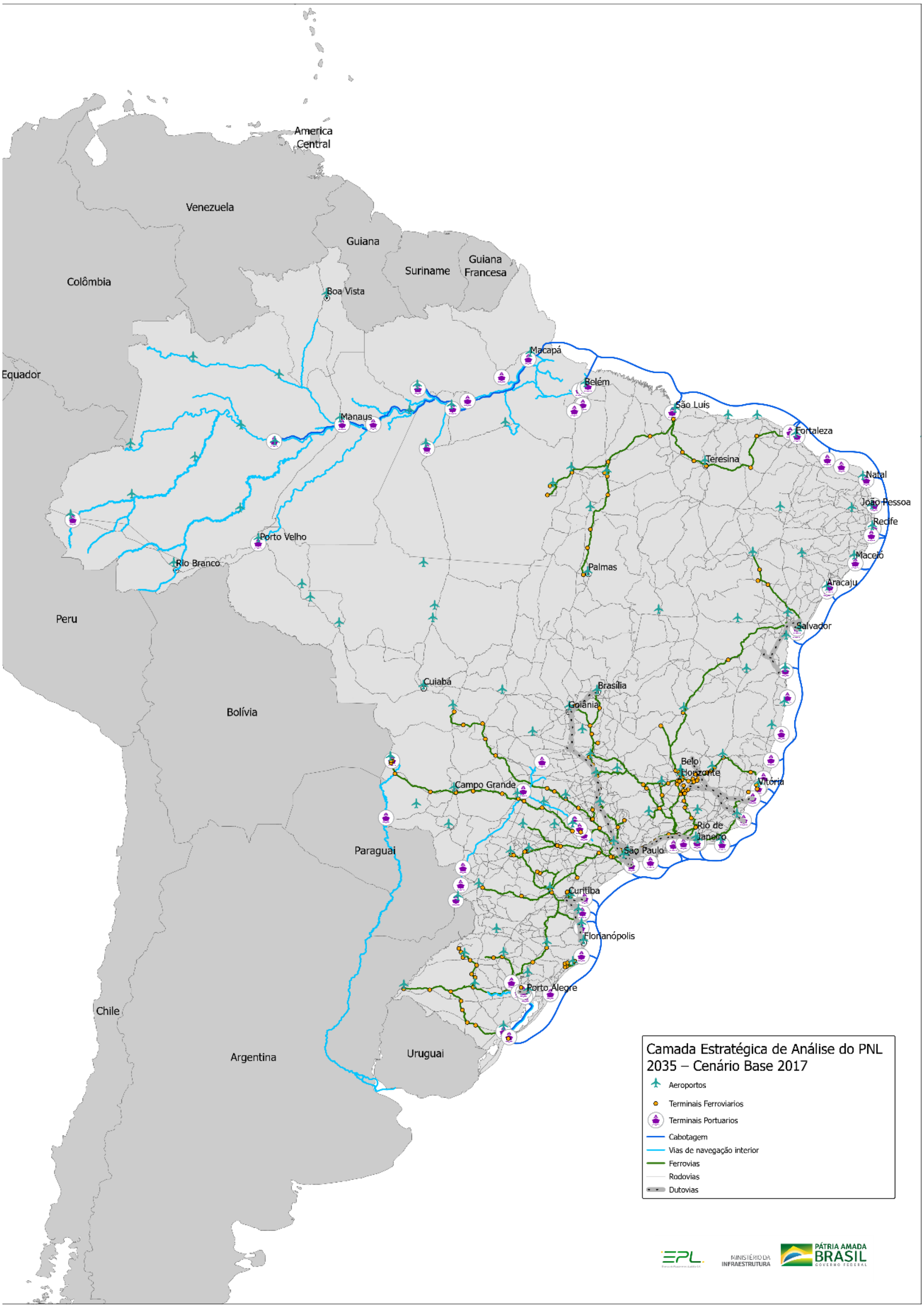
Table 9: NLP 2035 Strategic Layer of analysis in numbers/ Source: EPL (2021)

CEA 2017 Components	Amount
Roadways	157.580 km
Railways	21.286 km
Inland waterways	18.641 km
Coastal cabotage routes	8.859 km
Pipelines	23.300 km
Airports (with regular flights)	117
Port-cities	79
Railway Terminals	195

11 High-resolution maps for the Strategic Layer of Analysis for years 2017 and 2035 are available in the paths indicated in Appendix V of this report.

As a result, CEA brings together 48% of the roadways in the national transport network, 100% of the railways, waterways with the movement of Freight or passengers, ports, airports with regular flights and pipelines. This cut is responsible for more than 90% of all national transport production, that is, more than 90% of the TKU (Useful Ton-Kilometer), more than 90% of the VKU (Useful Value-Kilometer) and more than 90% of the quantity of people on interurban commuting.

The observation of the CEA (Picture 39) reinforces the importance of inland navigation and air transport in the Amazon Biome region. Both the Amazon biome region and the Pantanal biome region present density and granulometry of the transport network in the CEA smaller than in other Brazilian regions and biomes. Other regions with smaller transport network density and granulometry, but larger than in the Amazon and Pantanal regions, are part of the states of Tocantins, Goiás, Minas Gerais and the countryside of the Brazilian Northeast. Finally, it is noteworthy that, for each simulated scenario, the CEA is changed, as interventions or new projects can reconfigure the main transit paths for Freight and people in the national territory.



Picture 39: NLP 2035 Strategic Layer of Analysis - 2017 Baseline Scenario
Source: EPL (2021)

4.5. INDICATORS SYSTEM

The indicators system for the scenarios of the NLP 2035 assessment was conceived based on the view that the Plan must carry out a diagnosis of the transport network in view of the current demand and the strategic prognosis in projected scenarios, indicating needs and opportunities to achieve the objectives of the National Transportation Policy – NTP, resulting in guidelines for further detailing and deepening in the Sectorial Plans.

The indicator system has the role of measuring the objectives of the NLP to allow the evaluation and comparison between scenarios. Therefore, it is characterized as a system of final indicators, as presented, and detailed in Appendix I.

The *objectives* of the NLP regarding the development of the transport network, as commented in section 2 of this Executive Report, are:

1. To provide an accessible, efficient and reliable system for the mobility of people and goods;

2. To ensure operational safety in all modes of transport;

3. To provide a rational and efficient road matrix;

(...)

9. To promote cooperation and international physical and operational integration;

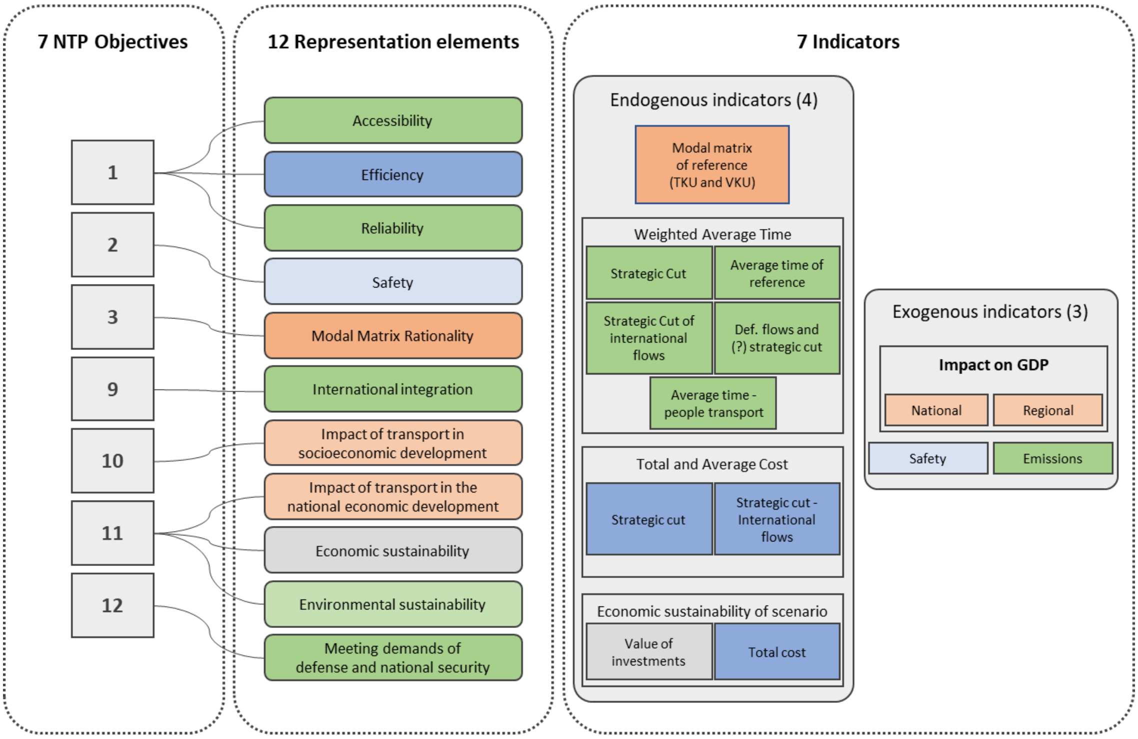
10. To consider regional particularities and potential in sectorial transport planning;

11. To act as a vector for the country's socioeconomic and sustainable development;

12. To ensure adequate road infrastructure for national security and defense operations.

Based on the definition of each objective, the representation elements were listed, that is, the endogenous elements (which concern the transport system) or exogenous (which concern the environment in which the system is inserted) to which the development actions should be directed.

An in-depth study was carried out to conceptualize and determine the metrics of the indicators to objectively measure each of the elements, in line with the simulation models used in the NLP 2035 and its results. Picture 40 systematizes the objectives of the NLP (with numbering referring to the objective in the NTP), the elements of representation and the scenario evaluation indicators.



Picture 40: NLP 2035 Indicator System
Source: EPL (2021)

5. DESIGN OF FUTURE SCENARIOS

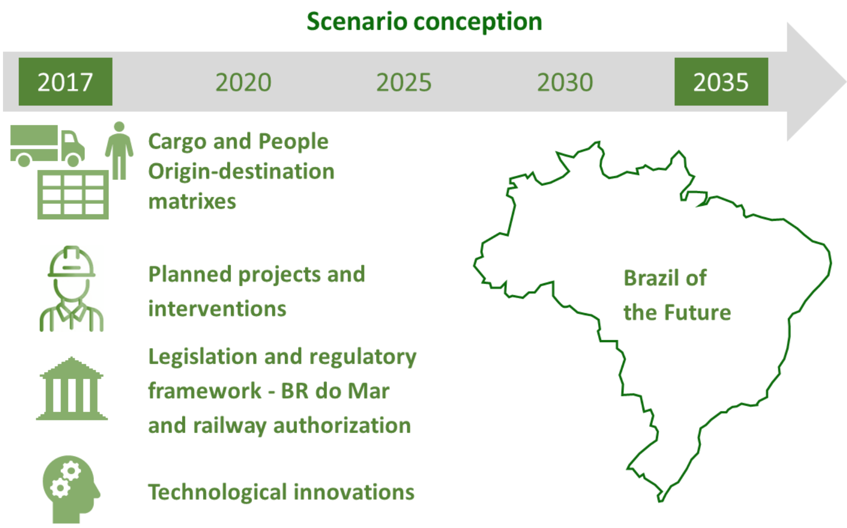
The design of scenarios aims, in terms of Strategic Transport Planning, to help public agents make decisions that considerably impact the sustainability and efficiency of the system planned in future time horizons. The use of such analysis allows, therefore, that the impacts and possible risks and returns to society associated with these decisions are estimated before taking any action. Within the scope of MINFRA, the analysis of scenarios will, on a large scale, guide strategic decisions, the prioritization of current actions and the development of Sectorial Plans.

The NLP proposes to contrast different configuration scenarios of the Brazilian Transport System, as a hypothesis for the development of the transport network according to ongoing actions and trends, having as a starting point the Freight and people origin-destination matrixes from year 2017 and establishing projections until 2035.

The scenarios of interest make it possible to glimpse at the impacts of different configurations that consider the list of projects and interventions in transport infrastructures provided for by the Federal and State Governments, possible significant changes in the Legislation and Regulatory Frameworks (provided they can be made tangible in some of the simulated attributes) , different macroeconomic development scenarios, as well as changes arising from new transport and logistics technologies.

On regard to changes in legislation and regulation of the sector, the impact of the approval of Law Nº 4.199/2020 called “BR do Mar”, was selected for the simulation of scenarios with the new NLP methodology, considering its relevance and potential to change the Brazilian modal matrix, and of some specific railway stretches, which may be made feasible from the new legal framework for railway authorization, considering its potential to encourage the exploitation of railway services under an authorization regime.

Picture 41 shows the aspects considered in the formulation of 2035 scenarios.



Picture 41: Aspects considered for the formulation of scenarios
Source: EPL (2021)

From the combination of these aspects, the following scenarios for the 2035 horizon were constructed and analyzed:

- Scenario 1 - Projects in progress - Referential: Considers the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP (Multi-year Plan) 2019-2023, the implementation of partnership projects qualified in the Investment Partnerships Program - PPI, until May 2021, limiting economic analyses and referential parameters' perspectives[12]. It does not incorporate proposals that come from regulatory changes and technological innovations.

- Scenario 2 - Planned projects - Referential: Considers the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of partnership projects qualified in the PPI until May 2021 and the implementation of the short-term project portfolio consolidated by MINFRA. Economic analyses remain limited to the reference; it does not incorporate proposals arising from regulatory changes and technological innovations.

- Scenario 3 – Planned Projects - Transformative: Considers the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of partnership projects qualified in the PPI until May 2021 and the implementation of the short-term project portfolio consolidated by MINFRA. The economic parameters are reconfigured, in accordance with a Transformative context. It does not incorporate proposals arising from regulatory changes and technological innovations.

- Scenario 4 - Planned projects and "BR do Mar" - Referential: Takes into account the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of projects from qualified partnerships in the PPI until May 2021, the implementation of the consolidated short-term project portfolio of MINFRA and the assessment of impact of "BR do Mar". The economic projections are of reference and technological innovations are not included.

- Scenario 5 - Planned projects and technological innovations - Referential: Considers the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of projects from qualified partnerships in the PPI until May 2021 and the implementation of MINFRA's consolidated short-term project portfolio. Technological innovations are tied into

12 The economic perspectives of "reference" and "transforming" observe the guidelines and parameters established on Decree Nº 10.531, of October 26, 2020, which institutes the Federal Development Strategy for Brazil in the period from 2020 to 2031.

prospects, while the economy is restricted to referential parameters and regulatory changes are not included.

- Scenario 6 - Projects proposed by society and markets - Referential: Takes into account the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of projects from qualified partnerships in the PPI until May 2021, the implementation of MINFRA's consolidated short-term project portfolio, the partnerships and investments consolidated by the State Governments, the infrastructures provided for in the Strategic Waterway Plan - PHE, and the National Plan of Port Logistics - PNLP, and the contributions arising from the public consultation of the NLP 2035. Economic analyses remain limited to referential parameters. It does not incorporate proposals arising from regulatory changes and technological innovations.

- Scenario 7 - Planned projects and railway authorizations - Referential: Takes into account the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of partnership projects qualified in the PPI until May 2021, implementation of MINFRA's consolidated short-term project portfolio and the impact assessment of specific railway stretches that may be made viable based on a new legal framework for railway authorization. Economic analyses remain limited to referential parameters and do not incorporate technological innovations.

- Scenario 8 - Merge of scenarios 1 to 7 - Transformative: Takes into account the maintenance and completion of infrastructure projects in progress and with a budget provided for in the MYP 2019-2023, the implementation of qualified partnership projects in the PPI until May 2021, the implementation of MINFRA's consolidated short-term project portfolio, the assessment of impact of “BR do Mar”, the assessment of impact of specific railway stretches that can be made viable from a new legal framework for railway authorization, the infrastructures provided for in the Strategic Waterway Plan – PHE, in the National Plan of Port Logistics – PNLP, the contributions arising from the public consultation of the NLP 2035 and the improvements brought about by Technological Innovations, considering a transformative economic perspective.

- Scenario 9 – Main opportunities for the development of the national transport network – Referential: based on the analyses of the previous scenarios, it identifies the set of projects and actions that would configure a situation with moderate disbursement and more significant strategic impacts on the NTP's objectives. Economic analyses remain limited to referential parameters.

- Counterfactual Scenario - This is a future scenario of inaction, so that its indicators can be used as a basis for comparison with other simulated future scenarios. It considers the same transport supply network as in 2020, with demands for year 2035.

Table 10 presents a summary of the combination of aspects considered in the construction of each scenario of the NLP 2035[13].

Other scenarios can be performed using as reference the simulation in the NLP 2035 models, even after the final publication of this document. The main objective is to make simulation a dynamic planning tool, capable of incorporating policy or network changes.

Table 10: Synthesis of the combination of aspects considered in the construction of 2035 scenarios/Source: EPL (2021)

Scenario	Offer	Demand	Regulatory Variation	Technological Innovations
1	Qualified projects + provided for in the MYP	Referential	-	-
2	Qualified projects + provided for in the MYP + short-term MINFRA portfolio	Referential	-	-
3	Qualified projects + provided for in the MYP + short-term MINFRA portfolio	Transformative	-	-
4	Qualified projects + provided for in the MYP + short-term MINFRA portfolio	Referential	*BR do Mar*	-
5	Qualified projects + provided for in the MYP + short-term MINFRA portfolio	Referential	-	Yes
6	Qualified projects + provided for in the MYP + short-term MINFRA portfolio + state partnerships and investments + PHE + PNLP + contributions from public consultation	Referential	-	-
7	Qualified projects + provided for in the MYP + short-term MINFRA portfolio + Authorized railway stretches	Referential	Authorized Railway stretches	-
8	Qualified projects + provided for in the MYP + short-term MINFRA portfolio + state partnerships and investments + PHE + PNLP + contributions from public consultation + Authorized railway stretches	Transformative	*BR do Mar* and authorized railway stretches	Yes
9	Project group with more significant strategic impact and moderate disbursement	Referential	-	-
Counterfactual	Existing network (base year 2020) - nothing to do	Referential	-	-

5.1. PROJECTION OF ORIGIN-DESTINATION MATRIXES

5.1.1. Projection of Freight origin-destination matrixes

To carry out the projections of the Freight matrixes for year 2035, two studies were used: the matrixes resulting from the GLOBION methodology, a 2°C temperature growth scenario,

13 The identification of the projects considered in each of the nine scenarios of the NLP 2035 is presented in Appendix VI.

developed under the Decentralized Execution Term (TED) 01/2016 signed between EPL and IPEA (Institute for Applied Economic Research); and production and trade projection studies carried out by IPEA in partnership with the Ministry of Economy.

The latter uses a model of computable general equilibrium (CGE), taking as inputs for calibration the GLOBION model and the GDP projections developed by DIMAC (Department of Macroeconomic Policies and Studies)/IPEA, also used as a basis for Decree Nº 10.531/2020, which institutes the Federal Development Strategy to Brazil from 2020 to 2031.

Freight projections were made from the origin of the flows and using expansion rates. Each rate represents the value’s division in 2035, compared to the value in 2017, for the model used (GLOBION or IPEA/ME), so that, applied to an OD pair of the matrix used in the 2017 Origin-Destination Matrix, the value of the flow in question in 2035 may be estimated.

For each origin and product zone, there are fees for export flows; import flows; domestic effluents. The following rules are applied for the expansion of matrixes:

- For all flows departing from zone of origin X (national) to zones abroad, export flow rates apply;

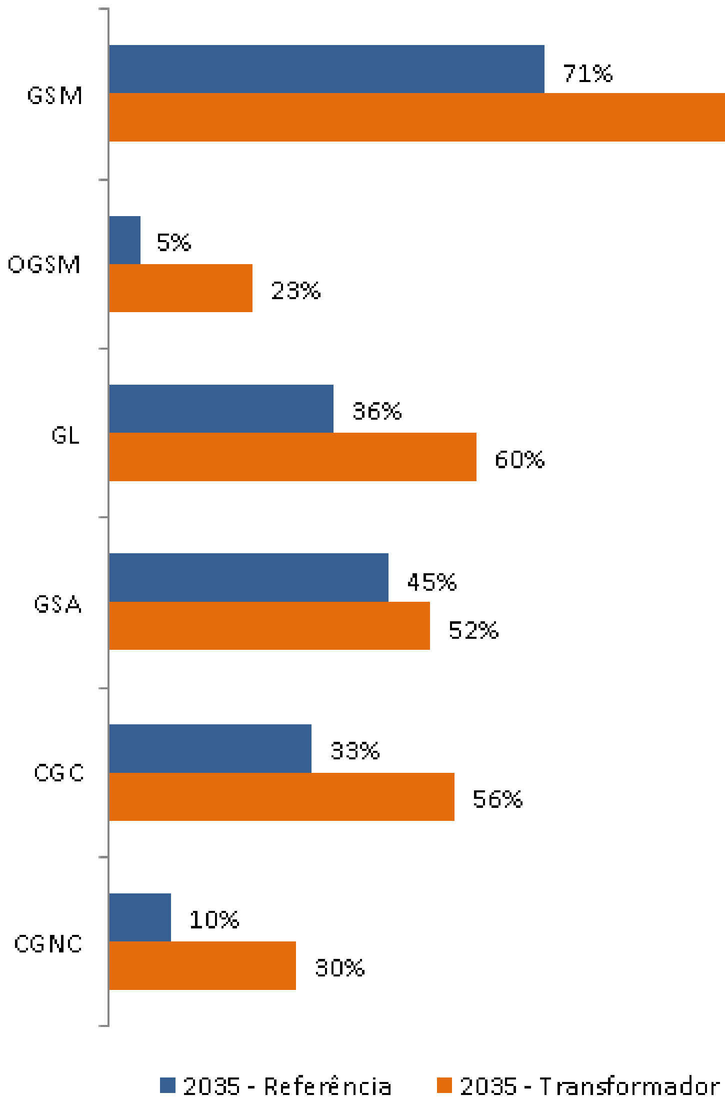
- For all flows departing from zone of origin X (national) to national zones, domestic flow rates apply;

- Finally, for all flows departing from overseas zones to destination zone X (national), import flow rates apply.

The projection for the pipeline and airway modes was based on statistical methods of time series. For the airway mode, the volume of air Freight was projected in relation to the variation of the state's Gross Domestic Product (GDP). Specific projections were made for the states of São Paulo, Rio de Janeiro, Amazonas, and Pernambuco due to the role of these states in air Freight handling in Brazil.

For pipeline transport, different methodological strategies were adopted for gas, oil, and ore pipelines. For oil pipelines, time series statistical methods were used, obtaining an estimate for each state that has a pipeline based on GDP. For gas pipelines, regression methods in the horizontal section were used to calculate a volume - national GDP elasticity. As for ore pipelines, due to the specificity of their operation, rates equal to those of the municipality that dispatched the Freight were adopted. It is noteworthy that the Mariana mine pipeline, deactivated in 2015, was reactivated in the projections for 2035, as indicated by the operating company.

The 2017 matrixes total 3.859 billion tons. The sum of the expanded matrixes under the referential scenario adds up to 5.154 billion tons and, under the transformative scenario, 5.978 billion tons. The growth rates of the Freight origin-destination matrixes between years 2017 and 2035 for the referential and transformative scenarios, for the Freight groups, are shown in Picture 42.



Picture 42: Growth rates of the volumes of Freight origin-destination matrixes between 2017 and 2035, by Freight groups/ Source: EPL (2021)
(On Picture: GSM/OGSM/LB/GSA/CGC/NCGC/2035 – Referential/2035 – Transformative)

The projected O/D matrixes are products of the NLP 2035, and are publicly available on an accessory basis to this Executive Report. The detailed demand of projection methodology will be the subject of a specific publication later.

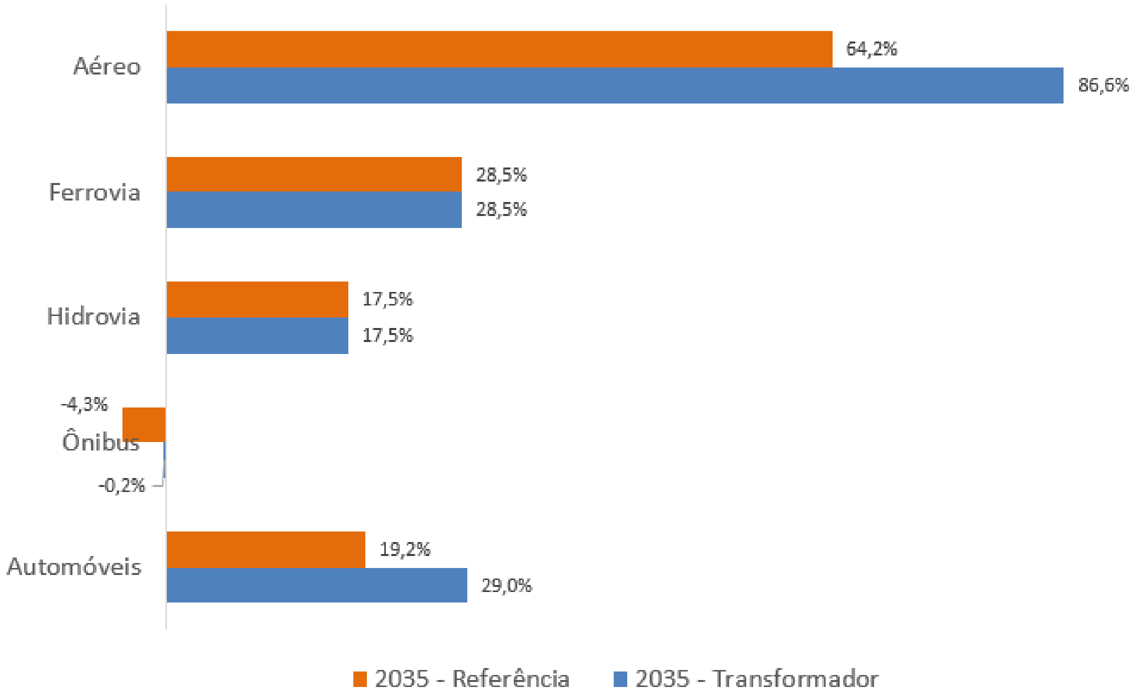
5.1.2. Projections of interurban origin-destination matrixes of people

The expansion of interurban origin-destination matrixes of people took place from the result of an elasticity regression model that diminishes the movement between Territorial Planning Units - TPUs in relation to the Gross Domestic Product (GDP) and to the population of origin.

To expand the passenger matrix, a general flow expansion model was adopted, applied to all modes. This model resulted from statistical analysis that linked the volume of travels to the population and GDP of the TPU. Subsequently, specific interurban passenger volumes were estimated for buses and airway, waterway, and railway modes. These volumes were discounted from the general expansion of the matrix, to obtain the estimated volume of interurban passengers with automobiles.

For the expansion of the bus matrix, a statistical model with data in panels by state was used. For transport by waterways, the population growth rate of each state was adopted, according to the methodology of the 2013 Strategic Waterway Plan. Due to its particularity, the projection for the railway mode was made using the moving average of the last three years. Finally, the airway projections were based on the projections of the National Airway Plan (PAN 2018), adjusted for the reference and transformative economic scenarios.

The growth rates of the origin-destination matrixes of interurban people transport between years 2017 and 2035 for the referential and transformative scenarios, for the different modes of transport, are shown in Picture 43.



Picture 43: Growth rates of the volume of people transported in the interurban origin-destination of people between 2017 and 2035, by mode of transport/Source: EPL (2021). (On Picture: Airway/Railway/Waterway/Bus/Automobiles/2035 – Referential/2035 – Transformative)

The projected O/D matrixes are products of the NLP 2035 and are publicly available on an accessory basis to this Executive Report. The detailed demand of projection methodology will be the subject of a specific publication later.

5.1.3. Origin-destination matrixes for 2050

Although the focus of this NLP is the strategic analysis for the year 2035, comparing the demand with the supply for that year, the methodologies described were also applied to envision the future demand for the transport of Freight and people for the year 2050[14]. With this, it is possible to verify the needs and opportunities identified for 2035, which tend to intensify even more in the long term. The data are used in an accessory way in the analysis of prognosis, needs and opportunities, but mainly, they are inputs for the development of Sectorial Plans and the General Partnership Plan, which normally has a broader horizon for projects and interventions.

5.2. PROJECTS AND INTERVENTIONS IN INFRASTRUCTURE CONSIDERED IN THE NLP 2035

For the simulations of future scenarios of the Brazilian transport network, it is important to consider the infrastructure projects and interventions that are in the process of being implemented or studied. The estimate of the overall impact on the network and the analyses resulting from future scenarios quantitatively and qualitatively show the potential of the set of public and private initiatives.

Decisions of public or private investments in transport infrastructure depend on a series of processes that the Integrated Transport Planning aims to subsidize. As previously mentioned, (in section 1.1), the NLP identifies needs and opportunities, which support studies in the Sectorial Plans, the General Plan of Partnerships and the General Plan of Public Actions for the maturing of the form of interventions implementation (whether through public investment or partnership with the private sector) and then there is enough data and technical justifications to consolidate the proposals into projects. The projects, in turn, follow specific stages to enter the qualification priorities of the PPI (Investment Partnership Program) or the budget priorities of the future MYPs (Multi-Year Plans).

In this logic, new needs and opportunities identified in this NLP 2035, and detailed in the Sectorial Plans, may come to compose new projects to be implemented from the MYP 2024-2027 cycle or inserted in the PPI, when applicable, as the projects mature. Therefore, it is important to reconcile long-term planning whose subsidies are the results of this NLP 2035, with short and medium-term planning.

In parallel to the planning process, there are a series of projects and initiatives in different phases of study, design, or implementation at the federal and state levels, as well as concession contracts already signed that foresee interventions in the horizon of this Plan.

To be included in the Plan, and made compatible in future scenarios, MInfra and EPL carried out consultations and requests to all States and the Federal District, to all the Ministries that deal directly or indirectly with interventions in transport infrastructure, in addition to

14 The projected O/D matrixes are shown in Appendix IV of this Executive Report.

surveying within entities linked to the Ministry of Infrastructure (Regulatory and State Agencies), to gather data on projects and interventions in progress, programmed, or planned.

There were also 06 (six) participatory meetings in December 2020, with public and private entities, representing the transport systems, the market and accessory systems, and a public webinar to discuss the NLP methodology and gather contributions to increase the simulation of future scenarios in the NLP.

The surveys and meetings carried out resulted in a database with more than 2.700 projects or interventions in transport infrastructure that were analyzed to select which ones are suitable for incorporation into the NLP, considering: criteria on the relevance of the impact on the network (if it has local, regional or national impact); the location of the project (whether urban or rural centers); the type of development or intervention; the current state (design or implementation phase); and whether there is enough minimum data to be considered in the NLP models (such as location or description that allows for the identification of the type of intervention intended).

After this analysis, more than 1.800 projects or interventions analyzed were selected for consideration in the NLP scenarios[15]. Of this total, 1.700 projects or interventions are actions of the Federal Government, with 66% carried out through partnerships with the private sector and 34% directly by the public administration.

These projects or interventions were also categorized into two main groups: those considered in Scenario 1 “Projects in Progress” and those considered in the evolutionary scenarios in relation to the transport network offered. All projects or interventions in the implementation phase, those included in the MYP 2019-2023, those already qualified in the PPI, and those relating to existing partnership contracts, which represent 75% of the actions. The other projects for alternative development scenarios are those included in project portfolios or instruments under study or planned in medium-term programs, such as the *Pró-Brasil* (Pro-Brazil) program.

One of the highlights of the future scenarios according to the mapped projects is the significant development foreseen for the railway mode in the Brazilian transport network. Under the “Projects in Progress” scenario, the *Ferrogrão*, the Central-West Integration Railway/FICO, the West-East Integration Railway/FIOL 1, 2 and 3, the New *Transnordestina* Railway to Eliseu Martins/PI, the North-South / FNS (stretch from Ouro Verde/GO to Estrela D'Oeste/SP), in addition to the reactivations of the inactive stretches represented by the FCA, FTL, Rumo Malha Sul and Rumo Malha Oeste.

15 Appendix VI presents the identification of the projects considered in each scenario of the NLP 2035, as well as those coming from Public Consultation contributions.

From Scenario 2 onwards, the second stage of the Central-West Integration Railway/FICO, up to Lucas do Rio Verde/MT, the Railway-484, Railway-267 (Pantanal railway) are added.

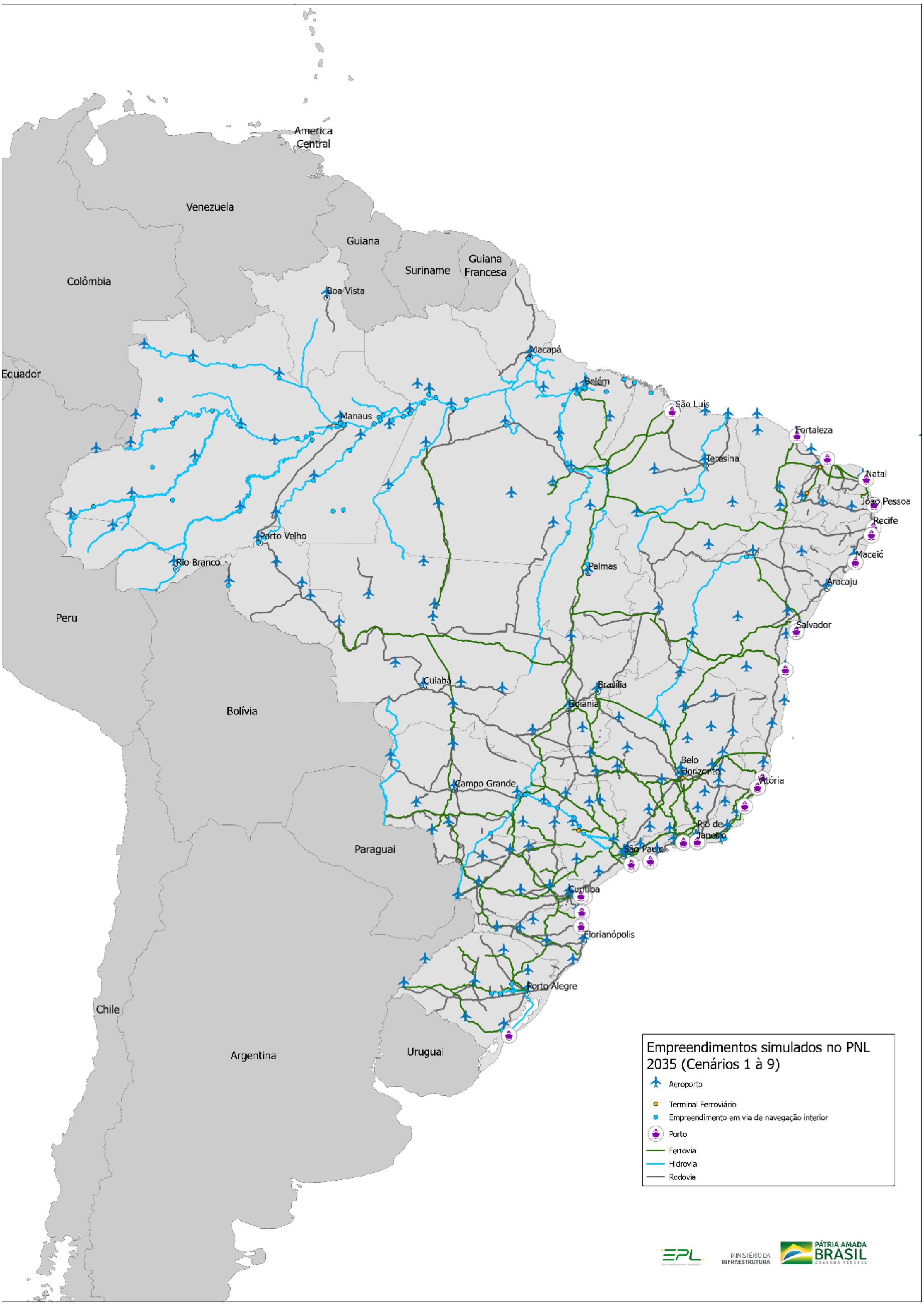
For the Ports, all evolutions expected in port leases, concessions and planned privatizations were considered, which generates an impact on the capabilities of port-cities in future scenarios.

The projects and interventions on the roadways have different characteristics, from adjustments, paving, duplication, or implementation of new infrastructures as provided for in the instruments and sources surveyed. Planned works and interventions on the concession roadways also incorporate the simulated scenarios. About 8.26% of the road grid from the simulated network underwent some type of intervention in the future NLP scenarios. It is important to highlight that for future simulations, it is assumed that the remaining stretches of roadways that are not targets of mapped interventions will also be available and in adequate traffic conditions. Therefore, for the NLP indicators, the maintenance costs of these stretches are also computed.

Regarding airports in future scenarios, in addition to the current concessions and qualified direct investments with resources from the FNAC (National Civil Aviation Fund), already provided for in MYP 2019-2023, the perspective of Development Scenario 2 that is in the National Airway Plan - PAN 2018-2038 (MTPA, 2018) was adopted. The scenario was considered as a reference both for mapping investments and for calculating indicators and other estimates in the NLP. However, demand projections were updated according to the macroeconomic scenarios considered in the NLP and the O/D matrix of potential airway connections[16].

The map below shows the infrastructures impacted by the projects or interventions considered in the scenarios of the NLP 2035. On the map, the integral sections of transport infrastructure are highlighted, even if the interventions are in parts of the infrastructure, for better visualization.

16 The O/D matrix potential airway connections was the product of the "Study of potential routes for the domestic air transport of passengers", according to the seminar available at: **https://youtu.be/DiT9MtJA9W8**



Picture 44: Transport infrastructure that had interventions considered in the NLP 2035 (Scenarios 1 to 9)/Source: EPL (2021)

In the Picture above, both the infrastructure affected by planned changes in the list of projects and interventions from public sources are referenced, and the proposals for projects from society and the market that were simulated in Scenarios 6 and 8.

5.3. LEGISLATION AND REGULATORY FRAMEWORK

5.3.1. Simulation of Impact from *BR do Mar*

The BR do Mar project[17] is an initiative of the Ministry of Infrastructure that aims to encourage cabotage in the country, by increasing supply, encouraging competition, reducing costs involved, expanding routes, and balancing the Brazilian transport matrix.

Cabotage is navigation between ports or points in Brazilian territory using sea or river routes. It is a low-cost mode of transport and is suited to the country's geographic structure, comprising an extensive coastline and numerous navigable waterways. However, currently this mode of transport is responsible for only 9% of the Brazilian logistics matrix, approximately. This mode of transport is, still, considered a promising alternative for the coming years, having presented an average growth rate of 10% per year between 2010 and 2019, in the general Freight container segment. When considering the period from January to October 2020, compared to the same period of the previous year, cabotage has already grown by more than 14%.

The general Freight and container transportation segments are those with the greatest growth potential for cabotage, as liquid and solid bulk are already stabilized markets, although they have also been growing. If the tendency of recent years is maintained, in 2021, cabotage should grow by more than 10% compared to 2020, and with the implementation of *BR do Mar* this value should be even higher.

The cabotage incentive program foresees action in four thematic axes: fleet, costs, ports, and naval industry, with specific initiatives being developed for each of them. With the increased use of cabotage, freight costs are expected to be reduced, which can be passed on to consumers, and the entry of new users in this modality. Besides, this project will facilitate the flow of products between national ports, contributing to the development of the matrix.

EPL estimates indicate that cabotage currently costs on average 60% less than roadway and 40% less than railway. This difference is mainly since cabotage is a high-capacity mode of transport with a low risk of theft and damage to the Freight, which allows for a scale gain, to reduce the cost by unit.

By simulating labor simplifications, changes in taxes, reduction of bureaucracy and the time that Freight and ship are stopped at the port, EPL concluded that BR do Mar can generate

17 Bill Nº 4.199/2020, sent by the President of the Republic to the National Congress, has already been approved by the Plenary of the Chamber of Deputies and now proceeds for deliberation, as a matter of urgency, by the Federal Senate, which shall discuss the impacts and decide about the next steps for the proposal.

reductions of more than 15% compared to the value that is currently practiced in this transport[18]. The impact of this reduction is simulated in a specific scenario in this NLP.

For example, a container flow from Manaus to Santos, by cabotage, costs nowadays, on average, R$0,0423/tku to travel 6.112km. The implementation of *BR do Mar* has the potential to reduce this amount to R$0,0360/tku. Another route evaluated is the one from Santos to Suape (2.332 km), by cabotage, which costs nowadays, on average, R$0,0423/tku and has the potential to be reduced to R$0,0364/tku. This changes not only the specific routes, with the entire distribution of Freight throughout the territory, leading to changes in costs and average times for the entire logistical scenario.

Furthermore, the increased use of cabotage will bring important socio-environmental benefits, such as the generation of jobs, the strengthening of the national shipbuilding industry, the reduction of pollutant emissions, the number of accidents and traffic jams on the highways, among others.

Another estimate made by EPL shows that a 60% increase in the volume of containers transported by cabotage will generate a reduction of more than 530 thousand tons of CO2 equivalent per year, when compared to the road transport mode. On average, the road mode emits 6 times more pollutants than cabotage, when evaluating the transported volume and length.

Finally, cabotage is not a medium that directly connects producers and consumers, door-to-door. Due to its advantage being verified on long distance routes, it does not compete directly with the market that is more adherent to the road transport mode. Road transport will continue to meet demand, now in a complementary way to cabotage, taking goods from the port to the final consumer or even from the producing areas to the port, however, performing shorter routes and serving a greater volume of Freight in less time.

With the reduction of bureaucracy promoted by the *BR do Mar* project, it is estimated that the sector will experience, in the coming years, an increase in the offer of cabotage ships, in addition to the improvement of port infrastructure and the reduction of fuel costs. Foreign companies will also be allowed to operate in cabotage transport, with potential competitive gains for the sector. Together, it is believed that these factors will contribute directly to an

18 The estimate of impact of *BR do Mar* comes from a study carried out by the National Observatory of Transport and Logistics - ONTL available at the following address: **https://ontl.epl.gov.br/wp-content/uploads/2021/03/importancia-da-navegacao-de-cabotagem.pdf**

increase in the flow of goods transported through cabotage, and indirectly to the reduction in the logistical costs of waterway transport as a whole[19.]

5.3.2. Simulation of impact of specific railway segments

Changing the regulatory framework for the railways, making the entry of private operators into the railway system more flexible through the exploration authorization, encourages private investment for the exploration of this mode of transport, providing job creation and economic growth, thus being able to produce a relevant impact on the transport network over the next 15 years.

In addition to the issue of private agent freedom, it should be noted that the legal framework establishes a set of principles, among which the reduction of logistical costs, the increase in the offer of mobility and logistics, which are directly articulated within the scope of the NLP 2035. Regarding the guidelines, it is indicated that railway transport should expand its network, modernize it, and update the systems, to optimize the infrastructure, in addition to encouraging investment on infrastructure, integration of railway networks and services' efficiency – elements that are also consistent with the issues raised in this NLP.

The expansion of exploration possibilities of the railway transport service made possible by the alteration of the legal framework of the railway sector makes possible the immediate realization of new investments, considering the inherent flexibility of the authorization exploration regime. Additionally, it favors the reuse of non-operational railway stretches, as well as the construction of railway infrastructure in its own facilities, to provide better integration with factories, mining, port facilities, airports, etc.

In line with what is practiced in the main international railway hubs, the change in the legal framework allows for greater freedom and a better business environment for the railway industry, making investment conditions more flexible, making it more predictable, as well as greatly facilitating the meeting of supply and demand from railway infrastructure to the industrial, agricultural, and mining sectors.

Thus, given the transforming, development, and expansion potential of the national railway network, it was decided to include a specific scenario in the NLP 2035 to analyze the impact of

[19] As described in this item, Bill Nº 4.199/2020 will bring great benefits to national transport. However, the Scenario simulated in the NLP reflects the impact of *BR do Mar* in the limit of the project components that managed to be converted into numerical attributes and that could be inserted in the mathematical model, such as, for example, cost reduction. However, as it is a project that addresses several other action fronts, the result of this simulation does not capture or quantify the entire positive impact arising from this legislative initiative.

some specific railway stretches that can be made true by this new delegation mode of rail transport.

It is noteworthy that the possibility of new railway stretches based on the new legal framework are not fully possible to be identified at first, so that only a few sections with operating interests were included in the simulation, until the moment of development of the Scenarios presents in this document[20].

5.4. TRENDS IN TRANSPORTATION AND LOGISTIC TECHNOLOGIES[21]

To prepare Brazilians' transport infrastructure and services for an integrated global context, it is essential to observe the trends that will change the logistic – known until then – in the coming years. Failure to observe these trends can harm the competitiveness of Brazilian products in the foreign market and aggravate logistical problems of internal demands, as several countries are redesigning their infrastructure, legislation and transport operations based on new technologies that seek a more environmentally and economically sustainable logistic.

The incorporation of disruptive technologies in the transport and logistics environment is a reality, and one of the drivers of this new dynamic is national and international e-commerce. The freight transport, whether for the final consumer or for raw material in specific production chains tends to approach on-time delivery. Different companies around the world already offer same day or next day delivery services, even in international transport, as pointed out by the report of the World Economic Forum (WEF, 2018). An estimate by DHL (2016) pointed out that international e-commerce would occupy 22% of foreign trade by 2020, and the annual growth rate will be, on average, 17% by 2025. Brazil is part of this environment as that of the main consumer markets.

To meet the demands with an expectation of immediate delivery, the infrastructure and services in Brazil need to take advantage of the technologies potential to maintain international competitiveness. New business concepts emerge and thrive in the world in a matter of months, changing conservative economic growth trends, the needs of companies

[20] During the development period of the NLP 2035, the Ministry of Infrastructure had the six requests for specific railway authorizations described in this Scenario. However, after the launch of the Railway Authorization Program - *Pro Trilhos*, through Provisional Measure Nº 1.065/21, of August 30, 2021, other requests were made, which tends to enhance the impacts observed in this Report and indicates the need for future update/revision of the present scenario.

[21] The section includes a summary of Appendix VII - DETAILS OF TECHNOLOGICAL TRENDS STUDIED. All the references presented, the details of all the technologies and trends studied, as well as the results of the attributes changed in the scenario simulation are contained in the document presented in the Appendix.

and the population and, above all, the way in which logistics is inserted on these environments.

But what can we expect for the future? The Internet of Things (IoT) is one of the trends that will impact all modes of transport. Connecting equipment, vehicles, Freight and obtaining information that enables advanced analysis is the basis for increasing the logistical efficiency of the future. Big Data and Artificial Intelligence will organize the complex chain of events that make up the national and international transport system. Virtual applications and platforms will bring together industries, producers, wholesale, retail, transport companies, truck drivers and consumers, following the trend of *sharing services and capabilities and dynamic routing*, increasing the efficiency of transport.

Vehicles of all types will be *less polluting*, will consume *less fossil fuel*, and will require *less human interaction*. *Drones* will overcome geographic barriers and bring dynamic delivery. "*Smart*" roadways, terminals, railways, ports, and airports will increasingly incorporate advanced data analyses, integrated with the different technologies mentioned and with *robotics*. Warehousing will be minimized, and *stocks will be virtual*, due to the high turnover and the management of supply and demand information. *Real-time communication* will be provided by *5G networks* or future generations. These and other innovations will be the components of *Industry 4.0* in the context of logistics and transport, and will change productivity, safety, transport times and costs and, therefore, they are considered in the NLP 2035 in specific scenarios.

The impacts of these trends in transportation and on logistic technologies were incorporated into the 2035 scenarios through changes to the simulation model parameters related to costs, supply, demand, time, and pollutant emission levels of the modes of transport.

Several technologies were studied for future impact assessment on the transport system. Using data from the World Economic Forum (WEF, 2016; WEF, 2018), among other studies and sources, it was possible to assess the trend of technology deployment in Brazil, the magnitude of the impact and the effective estimate in the attributes of the simulation models.

Among the technologies evaluated, some resulted in perspectives that are still distant to be adopted in the Brazilian transport system to the point of having a significant impact on the 2035 Scenario, as is the case of autonomous trucks and locomotives and VTOL (Vertical Take-Off and Landing - aircraft and vertical takeoffs), autonomous or manned, to transport people in interurban flows. Other technologies have already resulted in significant impacts on the attributes of transport and logistics recently, as is the case of mega ships aimed mainly at the transport of containers.

The concept of MAAS (Mobility as a Service) is a trend for the transport of people, and the applications that work in this area are already present in interurban transport subsystems (interstate transport or intercity transport). However, such trends change business models, as operations require regulatory updates; nevertheless, they do not have significant impacts on the attributes currently evaluated in the NLP 2035 simulation models[22].

Another set of technologies have significant perspectives of impact on logistics and national transport, such as the digital transformation in logistics, which includes the use of IoT, Big Dada, AI, and Advanced Analytics to increase logistics efficiency from the planning to execution of transport. It is estimated that this set of applied technologies should raise vehicle utilization rates by 3.15% in the road transport mode and 5% in other modes, reduce vehicle maintenance costs by 18.9% in the road transport mode and 30% in other modes of transport, and a reduction of up to 5% of the cost of road transport through more efficient routing.

The applications and platforms of vehicle capacity sharing can also drive cost reductions, especially in freight road transport, and with greater impact on autonomous truck drivers, with the prospect of a further 3.2% reduction in total logistics costs.

Electric trucks that are already in experimental phases in Brazil, and starting operations in some countries, project a reduction of up to 13.7% in the cost for trucks with a payload below 1 Ton (mainly aimed at urban distribution in the last mile) and 6.85% for general Freight vehicles over medium distances. This is for new vehicles that will incorporate the fleet in future horizons.

Efficiency in ship propulsion is also an aspect that can reduce cabotage costs by an additional 3.76% per year, as the fleet is renewed. Smart ports will enable increased efficiency, optimization of capacities and reduction of Freight processing times, generating up to 10% reduction in total port cost.

Still, electric or hybrid vehicles as a global road transport trend for the next few years tend to cause an impact of reduction of up to 8% in polluting gas emissions.

These attributes were incorporated into the NLP 2035 in a future scenario, which resulted in an unprecedented glimpse of the national transport system, with results presented in this report.

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22 In addition to the attributes that can be simulated in this NLP (cost, time, supply, demand, and emissions, among others), in the case of applications and initiatives under the concept of MAAS, the impacts on transport quality and on the distribution of demand among modes it can be significant and amenable to simulation in future scenarios. However, the lack of current regulation is a factor that hinders implementation in Brazil and, in turn, the objective estimation of impacts.

6. PROGNOSIS

The simulated scenarios in the heart of this National Logistics Plan, as well as the appropriate referrals to the Sectorial Plans, were objectively observed, as to their generalized behavior for the Freight groups, as well as their calculated indicators.

The form of construction of the NLP, its model and its scenarios prevent subjective inferences, and the results are observed and discussed below, and they are the result of the mathematical-statistical interaction of the parameters of the models used. It should be noted that within this perspective and the objectivity present in this work, specific characteristics such as, for example, behaviors induced by contractual agreements are not tested for future scenarios. Such visualization would only be possible to be considered in the models through personal or subjective criteria and weightings, which would distort the methodology used in this Plan.

It is noteworthy that to ease the reading and understanding of what is added to scenarios 2 onwards, the names of the scenarios inform the basic dimension of infrastructure investment changed in the specific scenario, accompanied by the term "referential" or "transformative" related to the macroeconomic scenario considered. This way of constructing and presenting the scenarios was chosen to facilitate interpretation in relation to the marginal impacts of the different sets of changes applied to each scenario.

It should also be noted that this Executive Report will essentially discuss some of the differences between the scenarios and their results, refraining from making a direct value judgment in this document. In face of the amount of data generated, the analyses presented here are expedited, and the effective use of this information should generate results throughout the planning process[23]. Therefore, the NLP 2035 is not only the present Executive Report, but mainly the models used, and the vast base of results made up of databases, indicators and geographic views.

Finally, to make this document easier to read, some more relevant or illustrating images are provided, and a dynamic tool for generating maps with the results of the NLP 2035 is made available along with this Executive Report (Appendix III).

23 The planning process to which reference is made includes, in addition to the Strategic Notebooks included in the NLP 2035, the Sectorial Plans, the General Partnership Plan and the General Public Action Plan, in addition to activities inherent to public administration regarding specific analyses and studies for decision making.

6.1. COMPARATIVE EVALUATION BETWEEN SCENARIOS

Tables 11 and 12 below present the results of the indicators calculated for each simulated Scenario, with the following comments on the results.

Table 11: Indicators of Scenario evaluation – Part 1.

Element of representation	Indicator	Mode of Transport	Scenario 2017	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Counterfactual
Rationality of the Transport Matrix	TKU Transport Matrix	Roadway	66,21%	54,54%	51,36%	52,49%	50,84%	46,93%	39,54%	51,61%	32,17%	41,44%	64,99%
Rationality of the Transport Matrix	TKU Transport Matrix	Railway	17,69%	30,71%	34,62%	33,94%	31,09%	36,39%	42,69%	34,22%	47,22%	42,91%	21,12%
Rationality of the Transport Matrix	TKU Transport Matrix	Coastal Cabotage	9,21%	8,84%	8,46%	8,13%	10,62%	10,08%	8,30%	8,62%	12,04%	9,57%	8,39%
Rationality of the Transport Matrix	TKU Transport Matrix	Waterway	5,58%	4,50%	4,21%	4,07%	6,02%	5,16%	8,12%	4,16%	7,22%	4,49%	4,00%
Rationality of the Transport Matrix	TKU Transport Matrix	Airway	0,06%	0,05%	0,05%	0,05%	0,05%	0,05%	0,05%	0,05%	0,05%	0,06%	0,05%
Rationality of the Transport Matrix	TKU Transport Matrix	Pipelines	1,26%	1,36%	1,30%	1,31%	1,38%	1,39%	1,30%	1,34%	1,31%	1,55%	1,44%
Rationality of the Transport Matrix	VKU Transport Matrix	Roadway	83,25%	68,54%	67,17%	68,89%	65,35%	60,17%	47,23%	66,11%	41,47%	52,58%	83,73%
Rationality of the Transport Matrix	VKU Transport Matrix	Railway	4,24%	19,04%	20,41%	19,25%	20,44%	26,61%	38,59%	21,54%	43,68%	34,92%	4,94%
Rationality of the Transport Matrix	VKU Transport Matrix	Coastal Cabotage	5,75%	6,38%	6,33%	6,05%	7,69%	6,97%	6,03%	6,20%	6,91%	6,68%	6,07%
Rationality of the Transport Matrix	VKU Transport Matrix	Waterway	5,53%	4,59%	4,65%	4,43%	5,07%	4,80%	6,82%	4,72%	6,66%	4,30%	3,74%
Rationality of the Transport Matrix	VKU Transport Matrix	Airway	0,55%	0,63%	0,63%	0,60%	0,63%	0,63%	0,58%	0,62%	0,55%	0,66%	0,67%
Rationality of the Transport Matrix	VKU Transport Matrix	Pipelines	0,68%	0,82%	0,82%	0,79%	0,82%	0,82%	0,75%	0,81%	0,72%	0,86%	0,87%

Source: EPL (2021)

Table 12: Indicators of Scenario evaluation – Part 2.

Element of representation	Indicator	Mode of Transport	Scenario 2017	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Counterfactual
Environmental Sustainability	Volumes of greenhouse gases emitted (Gg CO2 eq.)	All	154.574.520	191.504.623	194.911.677	222.181.562	186.475.751	170.660.080	176.771.991	190.802.128	186.228.545	182.102.696	197.760.942
Accessibility	Weighted average time – Freight (seconds/km)	All	108	106	107	105	114	114	113	107	133	122	101
Accessibility	Weighted average time – people (seconds/km)	All	47	43	45	51	43	41	42	46	43	42	43
Efficiency	Freight transport cost (R$ Bi)	All	435,53	547,61	542,19	651,77	562,89	475,22	456,17	589,15	513,39	523,53	596,50
Efficiency	Average cost of Freight transport (R$/1000TKU)	All	209,11	173,85	162,79	169,00	179,39	151,05	127,13	182,21	130,06	158,58	206,00
Efficiency-International integration	Average cost of Freight transport - international cut (R$/1000TKU)	Roadway	326,02	377,29	391,16	402,10	390,28	371,65	397,89	378,76	437,98	428,77	318,46
Reliability	Relative variation of weighted average time for Freightes (the lower, the better)	All	0,38	0,37	0,37	0,35	0,46	0,45	0,44	0,37	0,64	0,54	0,30
International Integration	Weighted average time for Freightes on the international cut (seconds/km)	Roadway	82	74	74	75	74	74	74	74	74	74	75
Meeting the demands of defense and national security	Weighted average time for Freightes on the defense and national security cut (seconds/km)	Roadway	80	75	75	75	75	78	76	76	81	79	74
Economical sustainability	Disbursement (R$ Bi)-Investments	All	N/A	372,71	422,45	422,45	466,17	422,45	766,85	453,31	801,26	420,92	0,00
Economical sustainability	Disbursement (R$ Bi)-Maintenance	All	N/A	354,47	356,56	360,60	358,33	357,38	373,20	358,36	383,93	363,57	322,37
Economical sustainability	Disbursement (R$ Bi)-Total	All	N/A	727,18	779,01	783,06	824,50	779,83	1140,05	811,67	1185,19	784,49	322,37
Safety	Safety Index	Roadway	N/A	0,96	0,94	1,05	0,92	0,91	0,89	0,93	0,92	0,90	1,00
Impact of Transport on the National Economical Development	Impact of Investments on GDP	All	N/A	6,62%	7,13%	7,65%	7,58%	7,14%	11,38%	7,46%	10,55%	7,21%	2,49%
Impact of Transport on the Regional Development	Impact of Investments on GDP – by region - North	All	N/A	13,98%	15,07%	16,16%	16,02%	15,09%	24,04%	15,75%	22,28%	15,23%	5,26%
Impact of Transport on the Regional Development	Impact of Investments on GDP – by region - Northeast	All	N/A	5,01%	5,40%	5,79%	5,74%	5,41%	8,62%	5,65%	7,99%	5,46%	1,89%
Impact of Transport on the Regional Development	Impact of Investments on GDP – by region - South	All	N/A	6,26%	6,74%	7,23%	7,17%	6,75%	10,76%	7,05%	9,97%	6,82%	2,35%
Impact of Transport on the Regional Development	Impact of Investments on GDP – by region - Southeast	All	N/A	5,52%	5,95%	6,38%	6,32%	5,96%	9,49%	6,22%	8,80%	6,01%	2,08%
Impact of Transport on the Regional Development	Impact of Investments on GDP – by region - Midwest	All	N/A	11,25%	12,13%	13,00%	12,89%	12,14%	19,35%	12,68%	17,93%	12,26%	4,23%

Source: EPL (2021)

The calculated indicators present a macro strategic view for each scenario, where it is possible to observe the degree of adherence of each change made in the simulations to the objectives of the National Transportation Policy.

6.1.1. Rationality of the transportation matrix

The Brazilian transportation matrix in the current diagnosis is highly dependent on road transport. It is observed that for the base year of the NLP (2017) 66.21% of the Useful Ton Kilometer (TKU)[24] concentrated in this mode, and 83.25% of the Useful Kilometer Value (VKU). This means that, in addition to playing a considerable role in the transport of large volumes, road freight transport is largely responsible for transporting high value-added goods for a large part of the demands, from their origin to their destination.

One of the objectives of the NTP, absorbed by the NLP, is to build a “rational” transport matrix. It is understood in the concept applied by the aforementioned policy, that the matrix would become more rational when the participation of public modes of transport[25] and large capacity (railways, cabotage and inland navigation transport) were more representative in the production of transport. The NLP, then, through the simulations presented, manages to provide an effective and objective response of possible values to be achieved for the Brazilian transportation matrix that would indicate the rationality of the matrix.

It is observed in Table 11 that during the implementation of the project portfolio currently in progress, the participation of railway freight transport already tends to rise from 17.69% to 30.71% (Scenario 1). Completing other projects foreseen in Scenario 2, such as the second segment of FICO, from Água Boa/MT to Lucas do Rio Verde/MT, the modal share exceeds 34%.

In some simulated scenarios, railway transport reached high levels of participation in the modal matrix, as in scenarios 6 and 8, even surpassing the participation of road transport. However, such scenarios require high investments in infrastructure, vehicles, and operation to materialize. The results of other scenarios, such as 2, 3, 7 or 9, demonstrate that specific and strategically chosen projects, and a lower investment level, are sufficient to envision a rational participation of large-capacity modes in the Brazilian transport matrix. The average trend is that the production of railway transport will grow 193% in the next 15 years, and that the participation in this way will be around 35% with the realization of a strategically planned railway network.

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24 TKU and VKU calculations only consider domestic Freight transport and the segments in national territory in respect to export and import Freight. Therefore, the values for long-haul navigation and stretches of roadway or airway transport outside the national territory are not presented.

25 Open to the general public. The transport via pipelines is excluded from this concept, which is used exclusively by the private holder of the infrastructure.

Coastal cabotage, on the other hand, tends to represent 9.31% of the modal matrix in the average of the simulated scenarios, although an effective growth of 56.94% accumulated over the next 15 years in the transported TKU is projected. In Scenario 4, due to the trend of reducing logistical costs for this mode caused by the simulation of *BR do Mar*, the participation of the mode may reach 10.62%. A 15% increase in this mode's participation in the matrix.

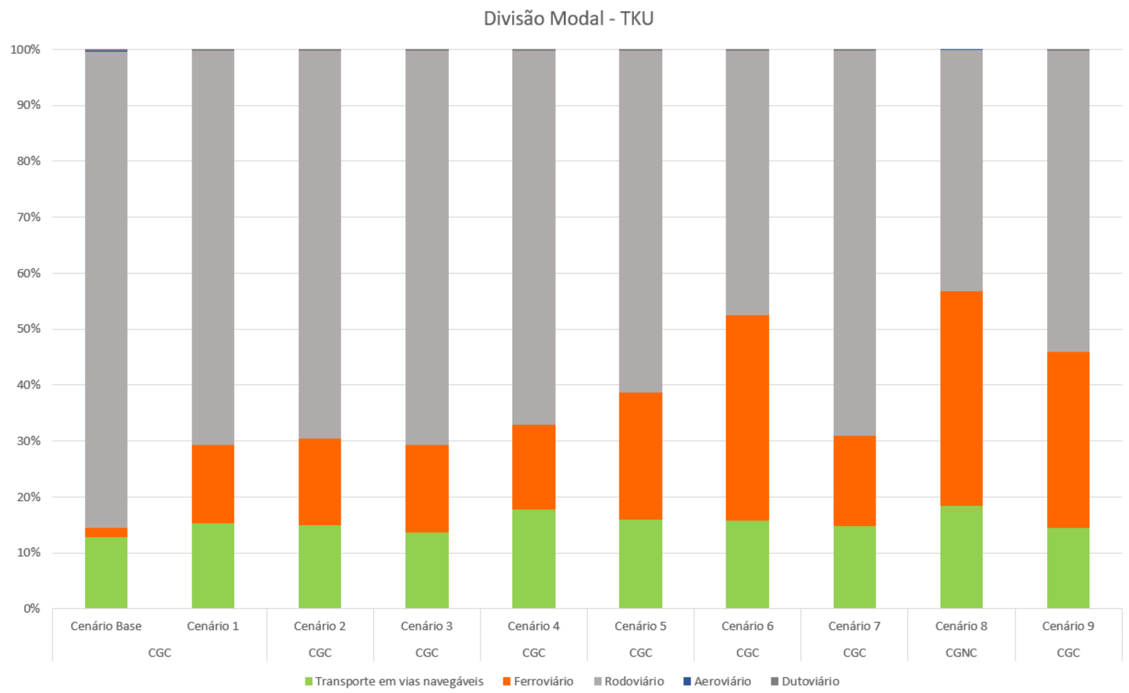
Freight transport in inland navigation presents greater growth possibility in scenarios 8 and 6, where significant interventions and projects that were planned in the Strategic Waterway Plan (2013) were simulated. With high investments in locks, dams, demolition works, dredging and signaling of different basins, it would be possible to solve navigability issues on the São Francisco, Araguaia, Tocantins and Tapajós rivers, adding more economically navigable stretches and effective movement of Freight or people. Scenario 6 indicates that the participation of waterway transport may rise from 5.58% in 2017 to 8.12% of the Brazilian transport matrix, with a TKU growth of 123%. However, this growth would be associated with investments of over R$46 billion in these improvements, which reinforces the need for pre-feasibility analyses to be carried out for these projects in the Waterway Sectorial Plan.

The modal share of the Brazilian matrix in terms of value reveals Freight transport through another aspect. It is observed, for example, that airway transport, despite representing a small share of transportation, has a share of 10 (ten) to 12 (twelve) times greater in the production of transport in value than in weight, which is not observed in any of the other modes of transport. Road transport, however, is largely responsible for the transport of high-value goods in the Brazilian territory, even in perspectives for the future scenario, where its participation tends to represent, on average, 62.12% of the matrix.

A potential trend to be put in this perspective, however, is the transport of high value-added goods by railways, classified in this Plan in the groups of Containerized General Freight and Non-Containerized General Freight. The simulations show that new railroads foreseen in the simulated scenarios, when considered as alternatives and with the capacity to transport containers, raise the railway participation in the value matrix from 4.24% (2017) to 24.94% on average.

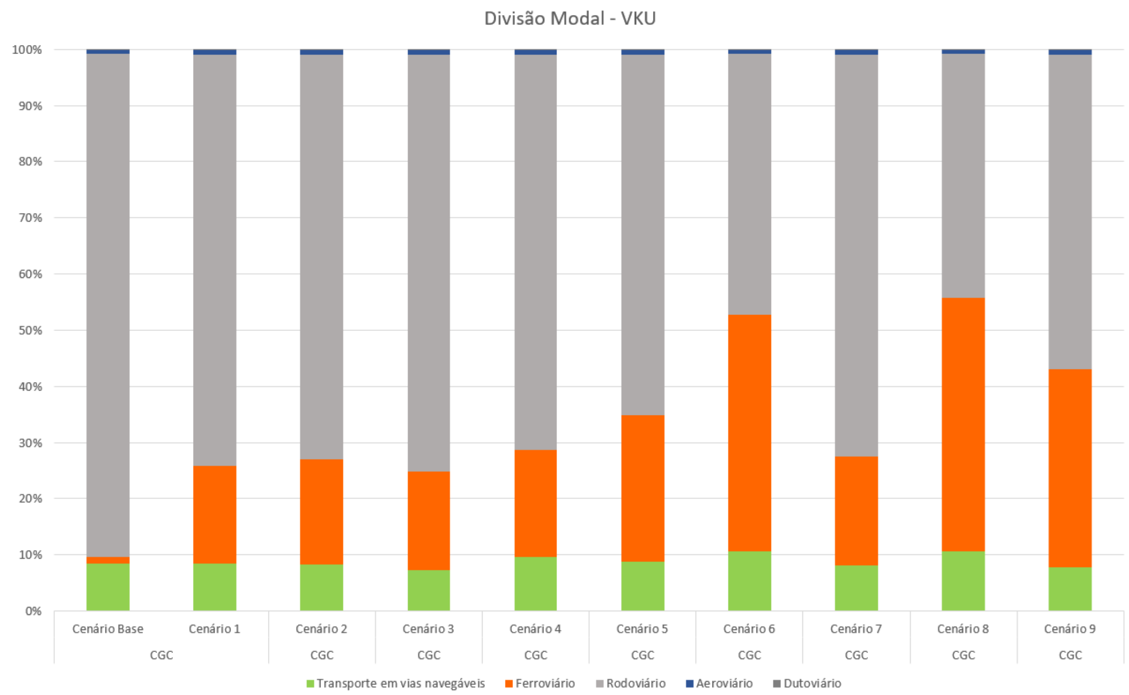
Pictures 45 to 56 show the TKU and/or the VKU, with the modal share of the simulated scenarios by Freight group. In general, scenarios 8, 9, 6 and 5, in this sequence, have the highest cumulative shares of large-capacity transport (railway and waterway), except for the LB Freight group, in which Scenario 5 has more participation of large-capacity transports than Scenario 6.

Considering that scenarios 6 and 8 are the ones that consider the largest offer of infrastructure, the modal distribution presented by Freight group corroborates the relevance of the technological innovations, simulated in Scenario 5, and of the infrastructures selected in Scenario 9, for all groups of transported Freight.



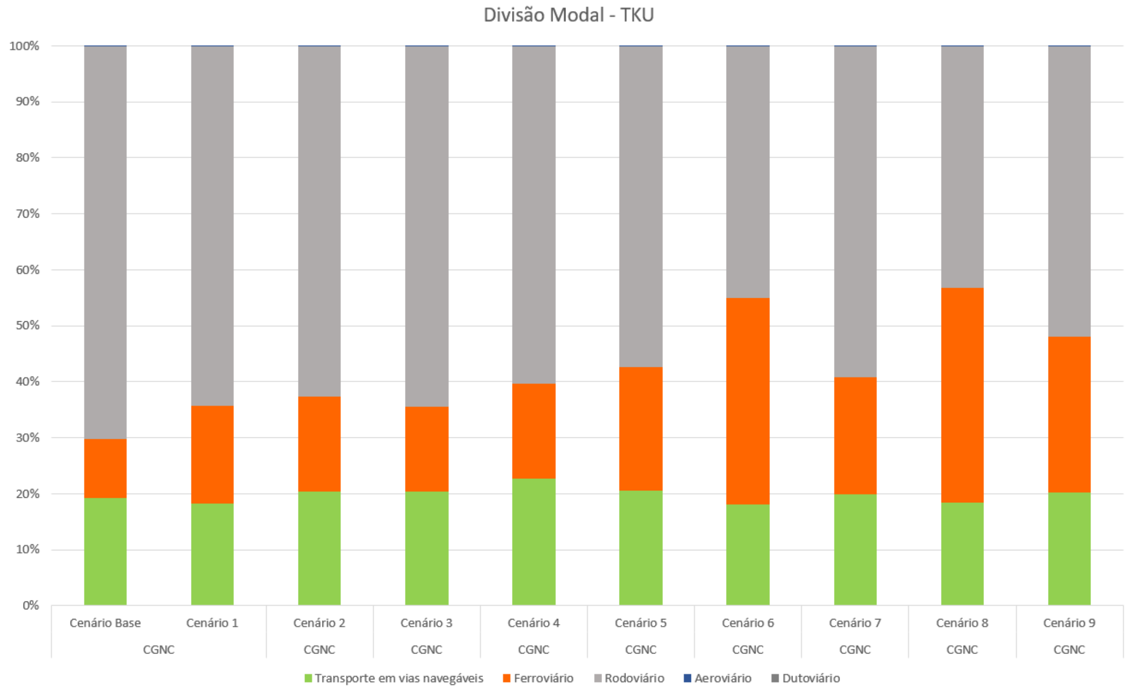
Picture 45: Modal share of CGC's TKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



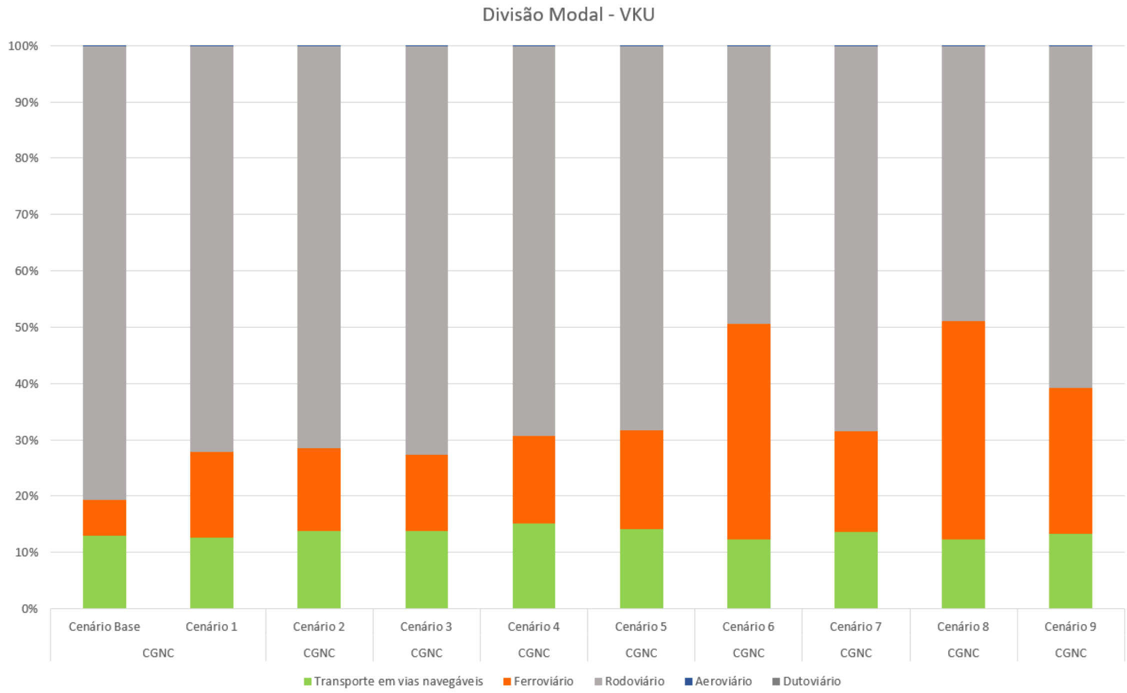
Picture 46: Modal share of CGC's VKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



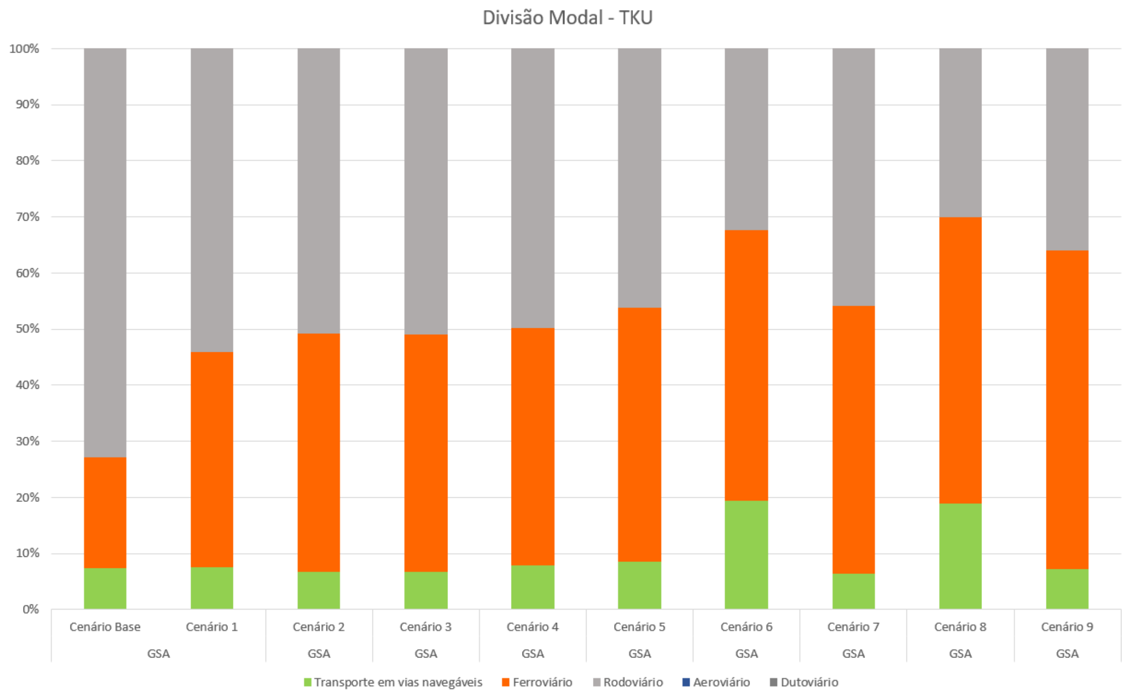
Picture 47: Modal share of NCGC's TKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



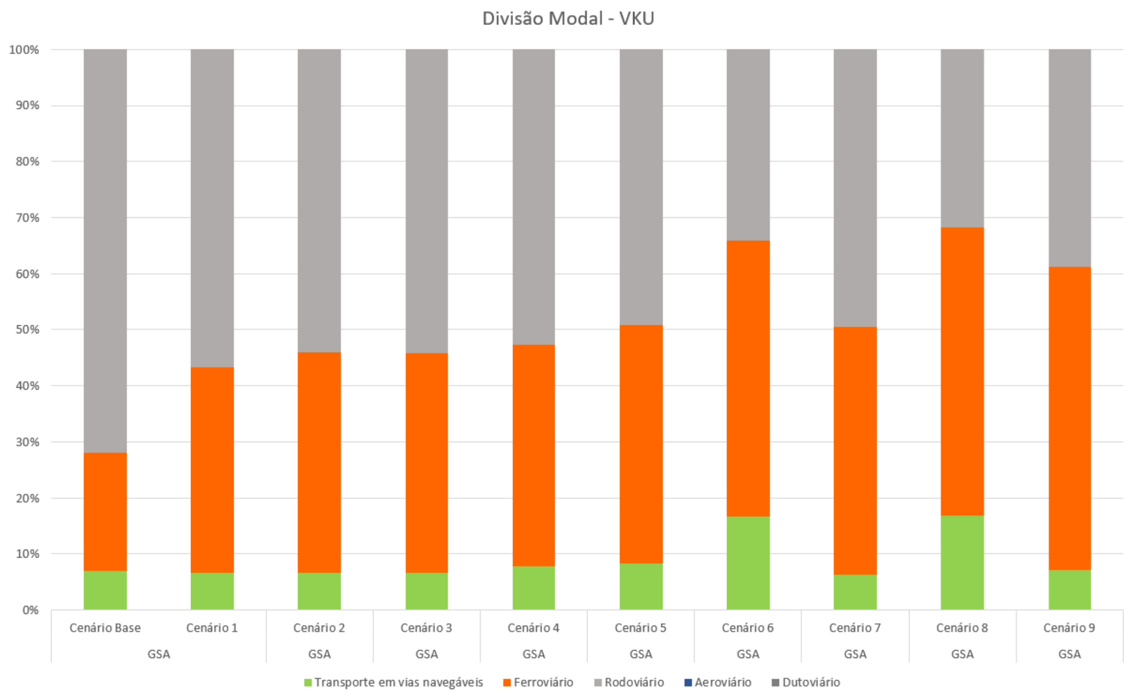
Picture 48: Modal share of NCGC's VKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



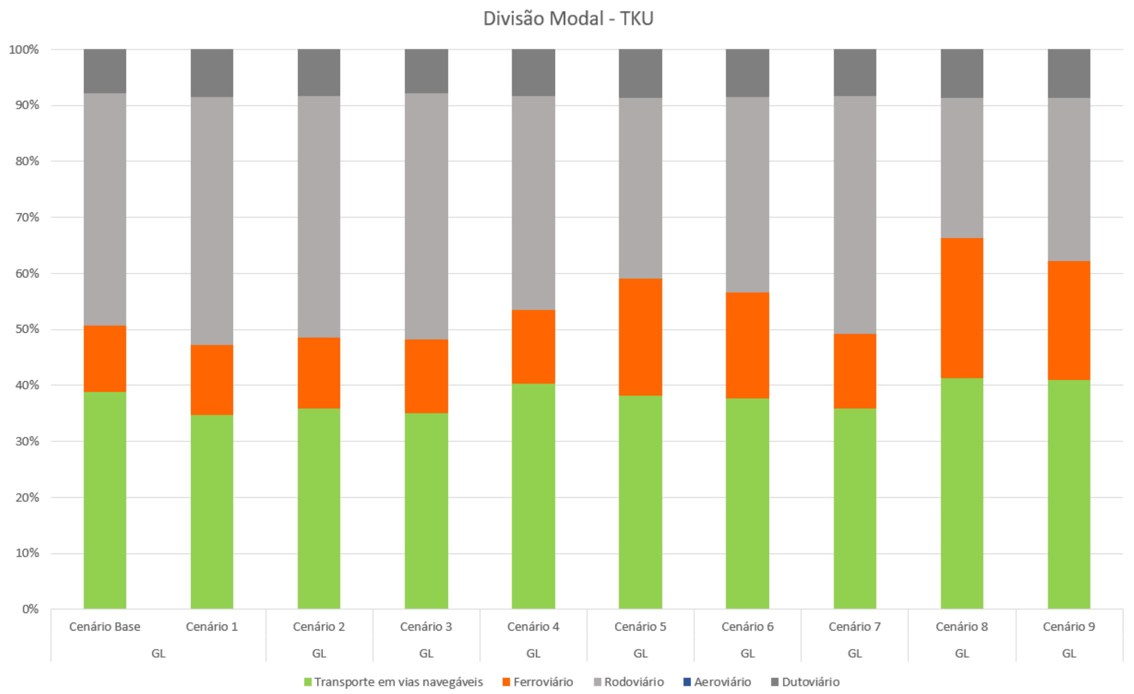
Picture 49: Modal share of GSA's TKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



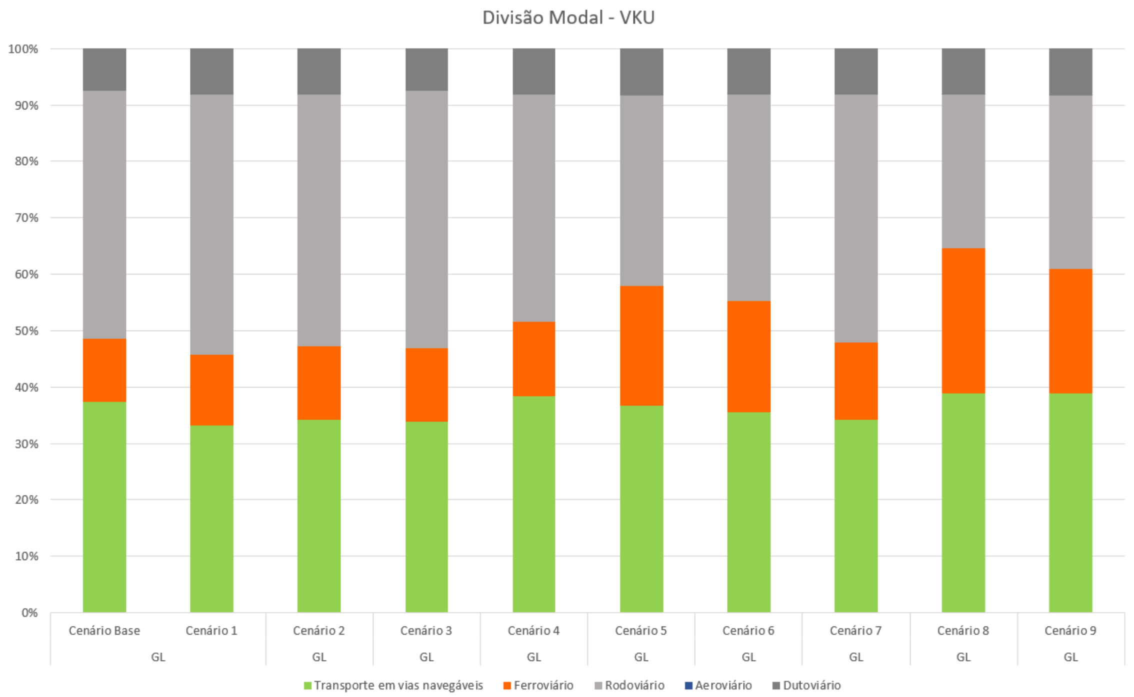
Picture 50: Modal share of GSA's VKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



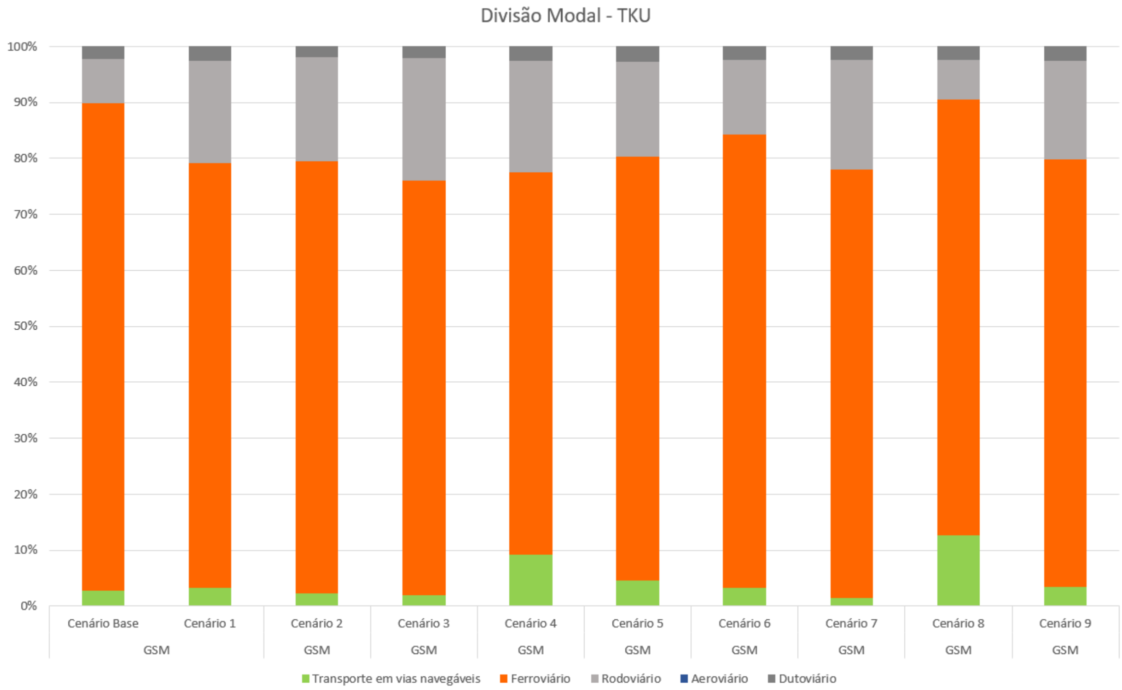
Picture 51: Modal share of LB's TKU for the simulated scenarios

Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)

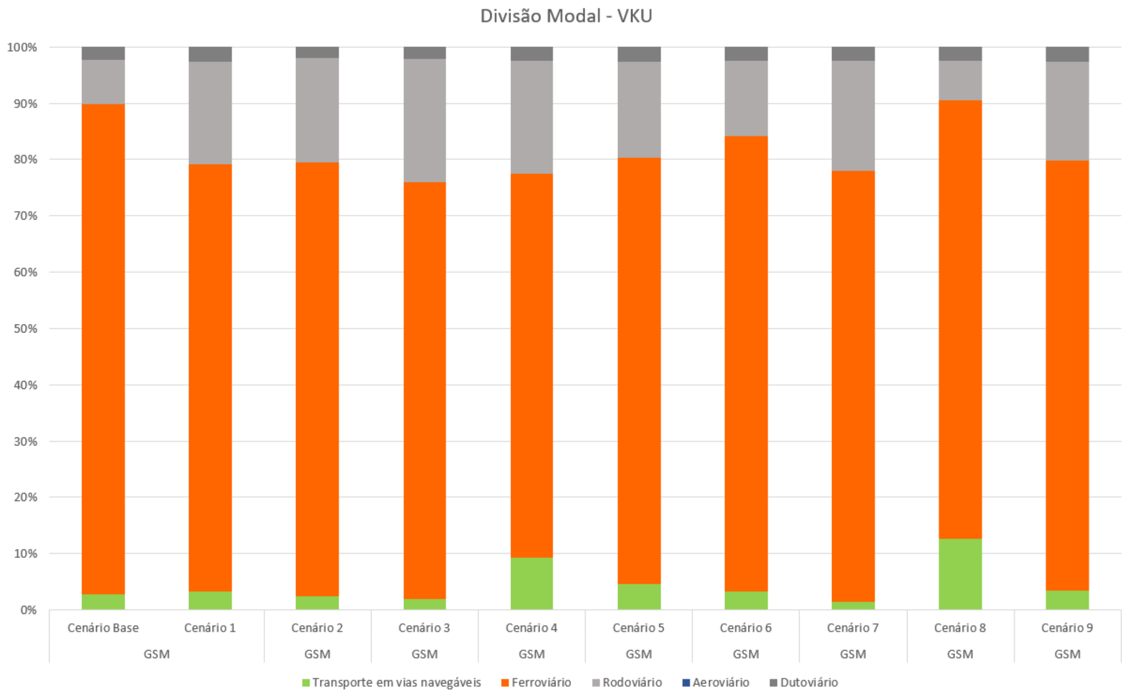


Picture 52: Modal share of LB's VKU for the simulated scenarios

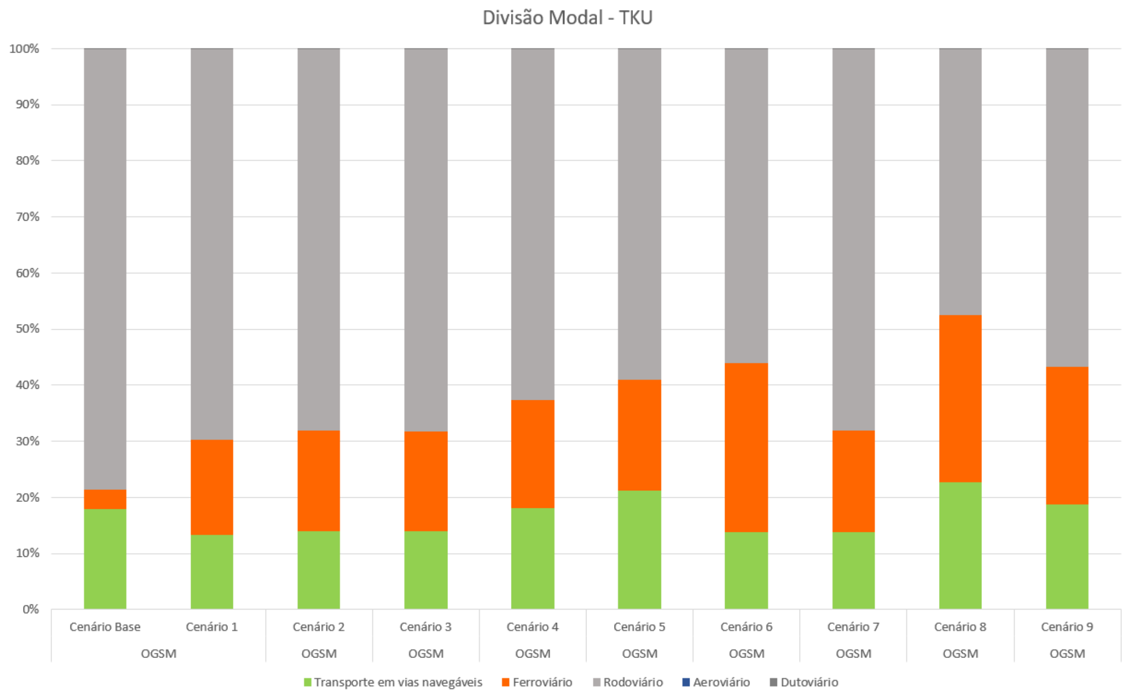
Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



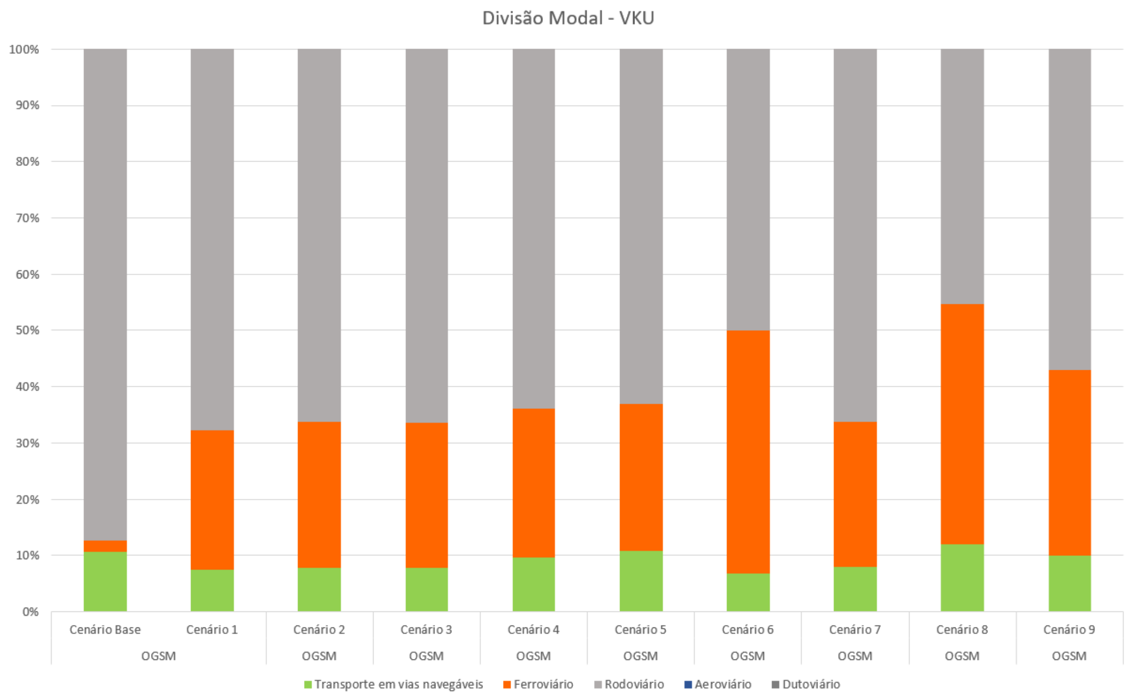
Picture 53: Modal share of GSM's TKU for the simulated scenarios
Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



Picture 54: Modal share of GSM's VKU for the simulated scenarios
Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



Picture 55: Modal share of OGSM's TKU for the simulated scenarios
Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)



Picture 56: Modal share of OGSM's VKU for the simulated scenarios
Source: EPL (2021). (On Picture: Waterway transport, Railway, Roadway, Airway, Pipelines)

6.1.2. Environmental Sustainability

The advent of technological innovations in the transport sector tends to have a positive impact on the reduction of greenhouse gas emissions, as seen in Scenario 5, which presented a 14% reduction on emissions when compared to the Counterfactual Scenario. A breakdown of emissions by mode of transport for these scenarios is presented in Table 13.

Table 13: Projections of equivalent CO2 emissions by mode of transport, for the Counterfactual (2035) and 5 (2035) scenarios

Mode	Counterfactual Scenario	Participation	Scenario 5	Participation
Roadway	159.946.980,00	80,90%	126.374.467,00	74,10%
Railway	8.185.806,00	4,10%	13.205.876,00	7,70%
Coastal cabotage	3.970.508,00	2,00%	5.096.269,00	3,00%
Pipeline	1.486.436,00	0,80%	1.812.257,00	1,10%
Airway	24.171.212,00	12,20%	24.171.212,00	14,20%
Total	**197.760.941,50**	**100%**	**170.660.080,30**	**100%**

Source: EPL (2021)

It was observed that the scenarios that project a transport production growth in high-capacity modes also showed an improvement in the indicator when compared to the counterfactual option. The result observed in Scenario 3 indicates that strong economic growth in a transport network with capacity constraints would take more Freightes to the road transport mode and, in consequence, would project negative impacts on polluting gas emissions.

In the general average of the simulated scenarios, the equivalent CO2 emissions calculated for 2035 would be at 189.939.999 Gg, which would represent a growth of 22% in relation to the level of the Baseline Scenario, but still, a reduction of 5% in relation to the Counterfactual Scenario, even considering the increase in the amount of goods and people transported in the planning horizon, in 2035. This configuration indicates that the projects planned and simulated in the scenarios, when implemented, tend to positively impact the achievement of this strategic objective.

The reductions of emission can also be accounted for monetarily. According to the parameters of the Cost-Benefit Analysis Methodology used by EPL, each ton of CO2eq not emitted corresponds to R$ 71,43 in 2020 values. This means that, in the average of the simulated scenarios, the environmental gain from the evolution of the matrix of transport for less polluting modes would be of R$ 620,72 million.

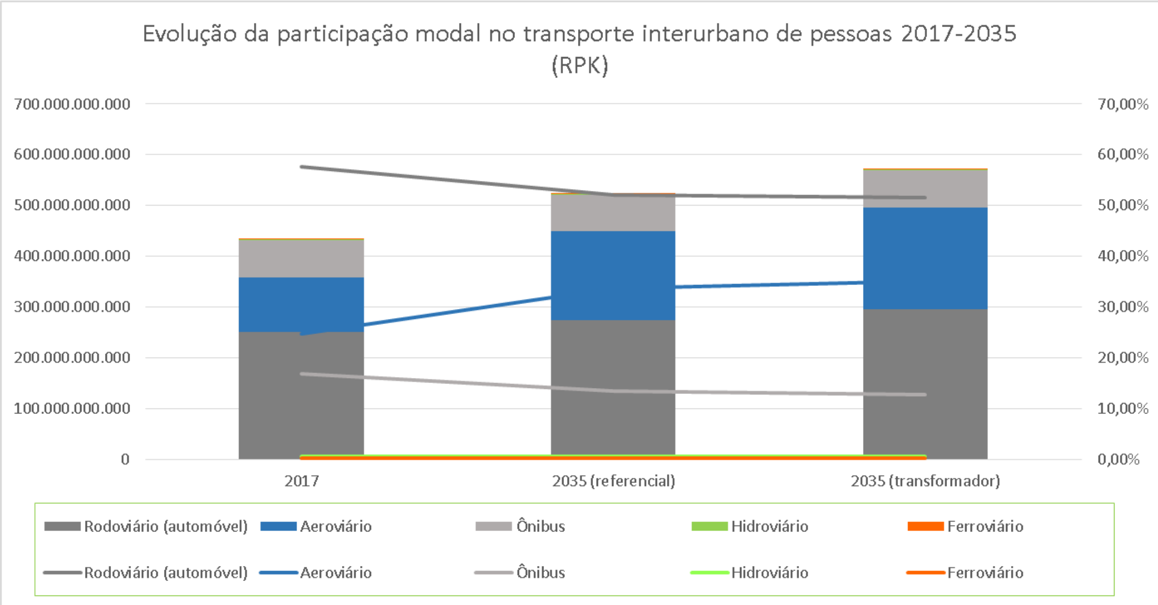
6.1.3. Accessibility

Regarding accessibility, it is observed that the weighted average time for transporting Freight shows an increase in relation to the value for year 2017 in various scenarios (4, 5, 6, 8 and 9). Even the improvements observed in scenarios 1, 2, 3 and 7 are little (average 1.85% reduction in average transport time). While for the 2017 baseline scenario an average of 108 seconds/km is projected (equivalent to an average speed of 33 km/h), for the future scenarios an average of 113 seconds/km is projected. This is because the trend observed for the transport of Freight in the horizon of the NLP is an increase in high-capacity modes of transport, such as railways and cabotage. Despite being more efficient and of lower cost modes of transport, on the other hand, such modes carry out transport at lower speeds, impacting the weighted averages of each scenario. The average variation in Freight transportation time in future scenarios is 3.54%, higher than the initial value.

Through these analyses the NLP highlights challenges for achieving all the NTP's objectives at the same time, as it identifies the dichotomy between the objectives of rationality in the modal matrix, efficiency, and accessibility. As trends towards improvement in matrix rationality and costs are observed, there is a negative impact on transport times. This highlights a general need that must be addressed by the actors of the transport subsystems, in particular, of the waterway and railway transports, as the need for modernization and changes in transport technology is evident; there is a need to compensate the increase in the average time of Freight transport in a future horizon.

The average accessibility provided for the movement of people in the national territory had an average time of 47 seconds/km (or 77 km/h) in 2017. The weighted average time considers all modes of transport, weighted by the respective participation of modes in interurban transport matrix. Therefore, this average value for 2017 is mainly influenced by the road transport modes by automobile and by air transport, which corresponded to 57.66% and 24.75% of the RPK (people.km) in the modal share of the year, respectively. The weighted average time for transporting people changes in the projections for year 2035, ranging from 41 seconds/km in Scenario 5 to 51 seconds/km in Scenario 3.

The decrease in the average time for transporting people in Scenario 1 indicates that ongoing interventions and projects positively impact the accessibility of people on interurban travel, since despite the increased demand, better fluidity conditions are offered, with 43 seconds/km, which is equivalent to an average speed of 83 km/h. The expansion and adaptation of the airport network through concessions and investments in regional airports, provided for in the National Airway Plan and also simulated in the NLP from Scenario 1, ensure adequate accommodation of the potential demand for air transport, which tends to occupy a greater participation in the modal share of interurban transport in the future (Picture 57), and with this, there is better reduction of travel times.



Picture 57 – Evolution of the modal participation in the interurban transport of people 2017, 2035 referential (Scenarios 1, 2, 4, 5, 6, 7 and 9) and 2035 transformative (Scenarios 3 and 8)/Source: EPL (2021). (On Picture: Evolution of the modal participation on the interurban transport of people 2017-2035 (RPK)/Road (automobile), Airway, Bus, Waterway, Railway)

In Scenario 3, there is an upward trend in travel time, due to the increase in the volume of vehicles, both of Freight and people, on the roadways, generating impacts on average road times when we consider this scenario of transformative economy. Even with the perspective of increasing the participation of the airway mode in the matrix, the transport time by roadway has more influence on the future average.

6.1.4. Efficiency

From the perspective of efficiency of the transport system, it is observed in Table 12 that in 2017 the system had a total cost of R$ 435,53 billion for the freight transport, which represented 6.6% of the national GDP. The total cost of transport tends to increase in 2035, which is expected both because of the increase in the amount of Freight and because of the development of the transport network. However, the share of this cost in relation to GDP would remain practically unchanged in Scenarios 1 to 4 and 9; it would decrease in scenarios 5, 6, and 8, which demonstrates an effective reduction in transport costs. But in Scenario 7 the share of the total cost in the Brazilian GDP would show a small increase. Among the future scenarios presented, the one with the lowest total costs is Scenario 8, which simultaneously simulates a network of modes of transport with high capacities offered and with impacts of innovative technologies in transport systems, leading to better use of vehicles and infrastructure and to effective reductions in operating and maintenance costs.

The Average Transport Cost per 1000 TKU tells us how much it would cost to transport 1000 tons on 1 kilometer of the network, considering all modes in the Strategic Layer of Analysis. In Scenario 1, it is observed that the average cost of transport tends to reduce, from R$ 209,11/1000TKU to R$ 173,85/1000TKU (17% reduction), indicating that ongoing projects are moving towards a more efficient transport network. With the alteration of the network through other projects, as well as the consideration of other variables, an average cost of up to R$127,13 can be reached, as in Scenario 6, evidencing an effective reduction of 39%.

When analyzing this indicator along with the matrix rationality and accessibility indicator (average time to Freight transport), it can be said that the positive impacts predicted in Average Costs and Matrix Rationality are more evident, and, in greater scales, than the losses foreseen in the Average Times for the transport of Freight.

The Average Cost for the international cut focuses on the analysis of infrastructures that are part of the Strategic Layer of Analysis, but that also contribute to international integration (roadways that contribute to flow to and from land borders, ports, and international airports). It is observed that the average cost of this group of infrastructures is higher than the overall cost of the Strategic Layer of Analysis. For the 2017 Scenario, the average cost of the international cut is 56% higher than that of the entire Strategic Layer of Analysis. The results obtained for this indicator in the future horizon demonstrate the increase in costs in any scenario, evidencing a general need, which must be observed in the Strategic Sectorial Plans, seeking to add the same benefits observed in the reduction of average costs for the infrastructure of the Strategic Layer of Analysis, in those that belong to the international scope.

6.1.5. Reliability

The Reliability indicator measures the variation of the Average Freight Transport Times of the scenarios to the Strategic Layer of Analysis compared to a hypothetical Average Time that represents the network time under free flow conditions, that is, without the interference of operational problems, clogging and capacity constraints in the infrastructure in general. Therefore, it seeks to represent how close the scenario time is to a shipper’s ideal transport expectation. The smaller the indicator value the better the Reliability condition, as it indicates that the Average Transport Time in the scenario is close to the expected time.

Just like in the Accessibility indicator, the migration of certain Freightes to high capacity and lower operational speed (railway, coastal cabotage and inland navigation) modes, compared to the Baseline Scenario, in which the roadway mode has greater participation, affects the expectation of Total Average Time, and, therefore, affects the distance to a reference free flow time. Because of that, scenarios such as 4, 5, 6, 8 and 9, which concentrated greater participation in high-capacity modes show a worsening in this indicator.

Other scenarios, such as 1, 2, 3 and 7, show some improvement (approximately 5%).

6.1.6. Safety

The Safety Index is calculated exclusively for the roadway mode, which is the most representative among the modes in terms of number of accidents, due to the magnitude of the number of trips, the number of external variables that interfere with safety and the risks involved in relation to the other modes. The Index projects a probability of safety in relation to the Counterfactual Scenario. The lower the value, the safer the road system is in relation to the option of doing nothing, and issues such as the physical characteristics of the roads, the number of trips in each stretch and the probability of accidents are variables that feed the estimate.

In the perspective considered here, scenarios 1 and 2 would already present an improvement in safety, indicating that both the set of projects in progress, as those predicted in Scenario 2, would add about 5% more safety than the Counterfactual Scenario, due to the interventions such as duplication, capacity increase, paving and adaptations of stretches planned in relation to the current network. In Scenarios 4 to 9, the improvements would be more significant, with an average reduction in the Index of 9%.

Scenario 3, which considers the economy in a transformative scenario, leads to an increase in some production flows and, consequently, to an increase in the number of trips, in conflict with a network with limited capacities in railways, ports and waterways. The alternative found for the flows in this scenario is the service by roadway, even on long distances. With a greater number of road trips by heavy and light vehicles, the probability of accidents increases, leading to a 5% more critical safety situation. This analysis results in a necessary guideline for the development of the Land Transport Sectorial Plan, which, in the case of considering a transforming economy, should also consider adequate investments in roadways to reduce the probability of accidents.

6.1.7. International integration

The indicator of Weighted Average Time for Freightes in the international section observes the accessibility provided by the roadways that contribute to the flow to and from land borders, ports, and international airports, representing a “last mile” access. Future scenarios present an Average Travel Time of 74,20 seconds/km, equivalent to an average speed of 49 km/h, indicating a reduction and, consequently, an improvement of 9% compared to the Travel Time in 2017 (82 seconds/km).

In all scenarios, there is practically the same degree of improvement in the indicator, reinforcing the average value as a trend.

6.1.8. Responding to defense and national security demands

The Weighted Average Time for people in the Defense and National Security Section assesses the accessibility provided for the displacement of national defense and security forces. Roadway sections that are part of municipalities where Army, Air Force, Navy bases, Federal Highway Police posts, Federal Police posts and headquarters, borders, ports and stretches that feed international airports are considered. Therefore, this indicator demonstrates how accessible the transport system is to the demands of such entities.

The average time observed in this indicator is smaller than the representative one for the general average of Freight transport, which is expected, since in this case, only the roadway mode is considered responsible for the immediately close access to the points of interest for safety and national defense. In 2017, the average travel time for this cut is 80 seconds/km, which is equivalent to a speed of 45 km/h. The trend for future scenarios is a reduction in

Travel Time to 76 seconds/km, on average. Only Scenario 8 shows a worsening trend in Travel Time (81 seconds/km), but with low impact.

6.1.9. Economic Sustainability

The economic sustainability of the scenarios is assessed using estimated data on disbursements for the provision of infrastructure.

Disbursements comprise investments and expenses on projects and interventions considered in the NLP. As already mentioned in this publication, for Scenario 1, the completion of projects currently under way (and with a budget provided for in MYP 2019-2023) and the implementation of partnership projects already qualified in the PPI (Investment Partnership Program) are considered. In scenarios 2 to 5, however, in addition to those provided for in Scenario 1, other works that are part of planning instruments or of specific Ministry of Infrastructure programs are considered, whose projects are in different stages of development, such as those compiled for the portfolio proposal that would make up the *Pró-Brasil* (Pro Brazil) program. Scenarios 6 and 8 bring together society and markets proposals, forecasts from previously developed sectorial plans, and a wider range of state government projects. Scenario 7 considers the increase in investments foreseen for the case of railway projects via authorization, while Scenario 9 has a specific methodology for the selection of projects that comprise it, as detailed in section 6.10. As the network varies, the investments in the scenarios are also quite varied, and constitute valuable data for the cost-benefit evaluation of each hypothesis.

It is noteworthy that the investments include both public and private actions, as well as the amount of investments already guaranteed in the existing concession contracts, thus representing a more faithful picture of the cost of infrastructure to be compared with its benefits.

In addition to the investment values, a value for the maintenance of the entire network is estimated, since it is considered that even infrastructures not affected in the interventions mapped for the simulation of future scenarios, would need financial support to ensure availability under equal conditions of the Baseline Scenario (2017), in the horizon of 2035. The estimate of this value is based on average costs and applied across the entire network that is part of the Strategic Layer of Analysis that did not undergo intervention or investment in each scenario. For this reason, the values are different for each scenario.

Among the simulated options, Scenario 1 is the one with the lowest disbursement value (R$730,03 billion) since all other scenarios are an addition to the network in relation to this one. Scenarios 2, 3, 5 and 9 present an expected disbursement at the same level, of R$ 769 billion, representing an increase of 5% compared to Scenario 1. The other scenarios have more significant variations, with scenarios 6 and 8, those with the highest disbursements, reaching the need for R$ 1,17 trillion in Scenario 8, due to the extensive transport network offered.

It is important to highlight that despite the careful work of surveying future investments there are still forecasts in the transport subsystems that are not accounted for in this amount. As an example, we have all the investment by the private sector and the logistics and transport market in equipment, rolling stock and technology, which add and equally affect the system's results, as verified in Scenario 5 simulations. Another relevant amount is the investment with the prospect of being made effective in Private Use Terminals – TUPs and other authorized port facilities. According to the monitoring of the National Water Transportation Agency - ANTAQ[26], about R$ 46,76 billion are foreseen in the authorizations already carried out. However, as such forecasts are not characterized as investment commitments and depend on a series of variables and decisions made by the authorized person they are not computed in this indicator. The same happens with the investments foreseen for the pipeline subsystem, which depends exclusively on the initiative and expenditure of the private market.

The Disbursement indicator must be analyzed along with the others, assessing whether the gains observed in the variations of the other indicators in relation to Scenario 1 would justify a greater disbursement.

6.1.10. Impact on national and regional economic development

According to the projections of future scenarios of the NLP 2035, interventions in infrastructure have significant potential on economic development. The national impact of the completion of ongoing projects and interventions or qualified partnerships would already generate an additional growth potential of 6.65% in future national GDP, which would be increased over 7.01% in any of the other scenarios. That is, with 5% more investment (as seen in the previous indicator), there is a potential for at least 8% more impact on economic development. Considering that the impact on GDP tends to be cumulative year by year, the results observed corroborate with the State's strategy of promoting economic development through investment in infrastructure.

The scenarios with the highest expectations for the impact of investments in transport infrastructure on economic development are, again, scenarios 6 and 8, with an average of 10.8% positive impact on GDP, due to the considerably broader transport offer than the other scenarios. However, it is observed that to reach this level of impact on development, which is 63% higher than expected in Scenario 1, an investment 106% higher than in the first Scenario would be necessary. Other scenarios, on the other hand, manage to aggregate representative gains with less variation in investments, such as scenarios 2, 3, 5 and 9, which approximate the impact variation in the economy to the variation of investments.

When evaluating this index from a regional perspective, it is clear that regions with a lower density of transport infrastructure tend to have greater potential for economic development when investments are made. The North Region, for example, has an identified impact potential of up to 23.68%, if Scenario 6 investments are considered, and an average impact of

[26] Dashboard of Private facility monitoring. Available at: http://bit.ly/painel_instalacoes_privadas

15.68% as a trend. Another highlight is the Midwest Region, target of significant investment planning, such as the North-South Railway, FICO and *Ferrogrão*, which may generate impacts of up to an additional 19.06% in the GDP projection for 2045, due to the investments made until 2035.

6.2. SCENARIO 1 – PROJECTS IN PROGRESS

The first scenario to be analyzed has as changes in the infrastructure supply only the projects and interventions considered to be in progress, as well as the projection of the origin and destination matrixes in a scenario of referential growth.

The main transforming highlights of the transport network in this Scenario are associated with the complete implementation of FIOL until its connection with the North-South Railway, of FICO between Mara Rosa and Água Boa/MT, connecting with the aforementioned North-South Railway, and of *Ferrogrão* which, according to the scenario results, may attract volumes in the order of 100, 90 and 40 million tons for year 2035, respectively.

Large-scale interventions and investments in the country's main roadways considered in the Scenario, both those carried out by the Government or by the Concessionaires, impact the fluidity and travel times, as seen in the results of the indicators in Section 6.10. In this context, we highlight interventions on BR-163/MT, MT-407, BR-060/153/262 DF/GO/MG, BR-040/DF/GO/MG, BR-470, BR-282/153 /SC, SC-412, BR-153/080/414/GO/TO, BR-116/493/RJ/MG, BR-116/465/101/SP/RJ and the concession of the Paraná Integrated Highways, which bring together a series of federal and state stretches, among other interventions and investments in highways.

There is also a massive increase in the flow of “other cereals” by cabotage, leaving Rio Grande do Sul and going up the Brazilian coast to supply cities in the Southeast and Northeast, a product that is part of the group of general containerized Freight.

The volume of containerized general Freight between the northeast and the south of the country also grows, with intense exchange between the ports present in this space. This behavior can be explained by the population concentration in the States along this route, with a high consumption of industrialized goods and of high added value.

The great roadway corridor for the exchange of general Freightes (CGC and NCGC) between São Paulo/SP, Rio de Janeiro/RJ and Belo Horizonte/MG is intensified through the road infrastructure that connects these urban centers. In this sense and for the same Freight, Curitiba/PR has a great synergy of connection with the most populated cities in the southern region of the country. Regarding the second type of Freight, there is the formation of a corridor between BR-364/RO and BR-319/AM, with a pronounced exchange of Freight between the states of the Midwest and Southeast regions and Manaus/AM.

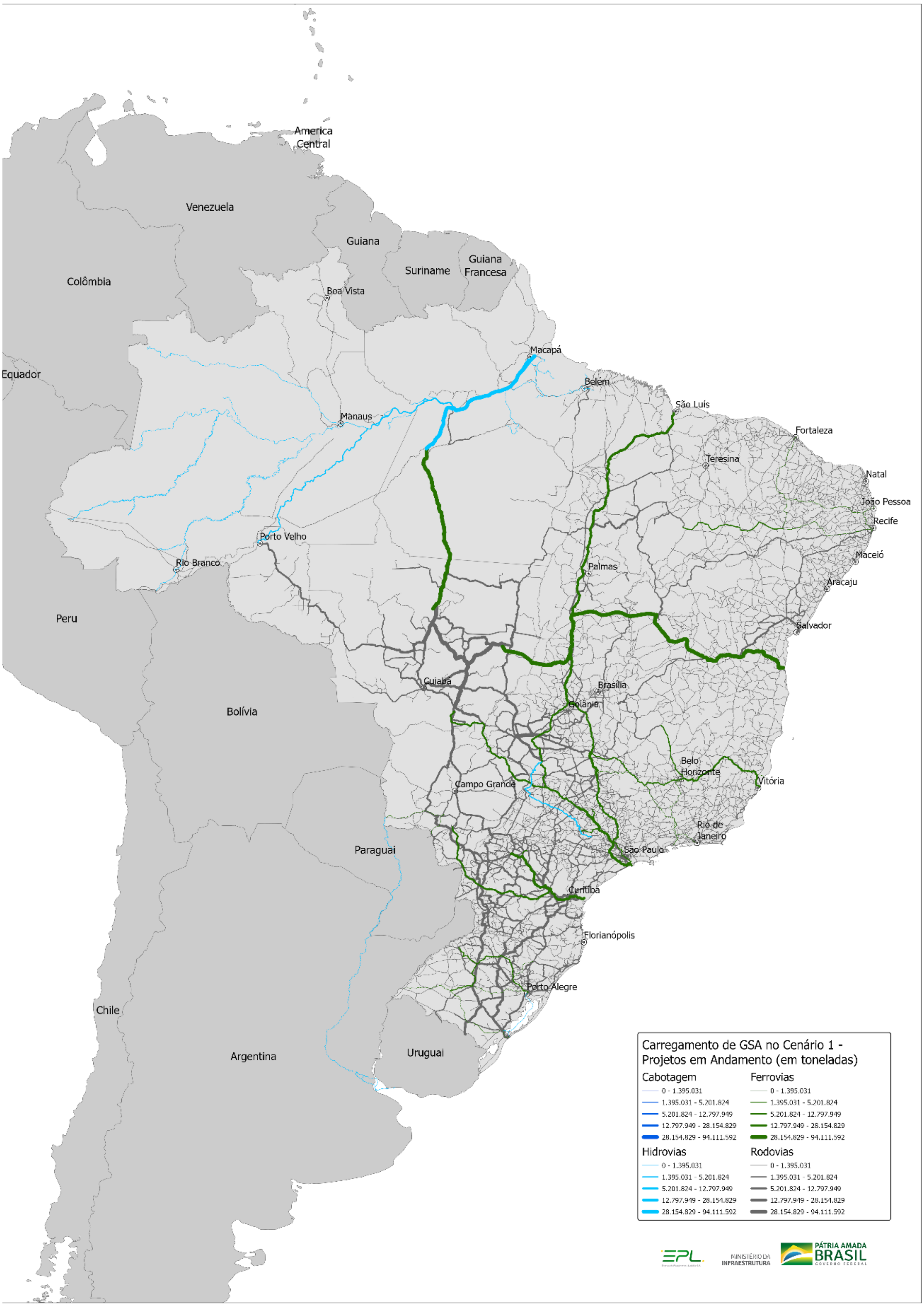
It is also shown that although BR-163 transfers part of its allocated volume (in tons) to the railways, it remains important in terms of value, with relevant VKU for both CGC and NCGC.

For the agricultural bulk, there is the formation of a central corridor, using the North-South Railway in all its active length, with a load of petrochemicals (LB), following a trend already observable in 2017 and complemented in the present scenario by the activation of FNS/TC and FICO, both for value (VKU) and weight (TKU).

On a smaller scale, but still relevant, the central section of the North-South Railway presents a volume of general Freight being transported connecting the countryside of São Paulo/SP to the Brazilian Northeast through this central corridor.

Returning to the approach about railways, FIOL presents a considerable attractiveness for solid agricultural bulk, draining soy loads from the region of Barreiras/BA and the “baixo MATOPIBA”, for use at the port in Ilhéus/BA, in addition to providing continuity for the flow of agricultural bulk that enters the railway network through the first part of FICO, passing by the North-South Railway.

This connection drive reinforces the need for competitive port capacity in Ilhéus/BA. This phenomenon can be seen in Picture 58.



Picture 58 - SCENARIO 1 – Projects in Progress – GSA Freight.
Source: EPL (2021)

The main difference in this scenario, taking 2017 as a reference, is associated with the behavior generated by the implementation of the *Ferrogrão* railway, connecting the city of Sinop/MT to the port of Miritituba, in Itaituba/PA. The volumes attracted by the railway include the GSA Freightes from western Mato Grosso, which previously opted for the exit on the Madeira River, in Porto Velho, north and center of the state, which were divided by the exit on BR-163 to the north and, mainly, to the Rumo Malha Norte Railway, in the city of Rondonópolis/MT. It should also be highlighted that the reduction in the volume potentially allocated on the BR-158 MT/PA, in relation to the baseline scenario (2017), for the GSA Freight group. However, it was observed that in the sum of all Freight groups, in value, the referred highway still has loading relevance in Scenario 1.

The functional model of integrated simulation, given its level of disaggregation, presents the movements of smaller scale producers making a web of interconnection for high-capacity and lower-cost corridors, which, once again, validates the model's behavior.

Although in smaller volume, the Rumo Malha Norte Railway still presents itself as an interesting solution for the flow of soybean and corn, components of the solid agricultural bulk, from Mato Grosso, increasing its volume of GSA transported in the countryside of São Paulo, especially in Fernandópolis, Votuporanga, São José do Rio Preto, Santa Adélia and Pradópolis, for taking sugar.

On its way to the north of the country, the North South Railway, in its central section, captures the volume of GSA produced by the MATOPIBA region, not taken by the FIOL system, forwarding these volumes to the port of Itaqui, in São Luiz/MA for export. In this scenario, trends of high saturation of port capacities in this region were observed.

The reactivation of the North/South branch of the Rumo Malha Oeste Railway presents a potential for taking GSA produced by the state of Mato Grosso do Sul, in the region of Maracaju and Dourados, taking it to Santos/SP.

Finally, the hypothesis of reactivation of the Rumo Malha Sul railway stretches reveals a potential central flow corridor in the southern region of Brazil, taking the Freightes produced by this region to the ports.

In terms of the transport matrix, drawing a direct parallel with the calibration scenario, there is an increase in the importance of railways, increasing by around 13% in the Brazilian transport matrix. In turn, the road transport mode loses about 11% of its representation in transported TKU, thus reducing the distance between this mode and the railway. It is important to see that all modes of transport will present significant growth in their production; however, the results indicate different rates, which vary even more according to the determinants of the other simulated Scenarios.

Changes to the simulation network and Freight flows in Scenario 1 are reflected in the modal share by Freight group both in weight and in value. Table 14 presents a comparison of the modal share by Freight group and mode of transport in Brazil between Base Year 2017 and Scenario 1, in TKU percentage.

Table 14: Brazilian transport matrix simulated on scenarios 2017 and 1, in weight.

Mode	Base-Year 2017 Scenario		Scenario 1- Projects in Progress-Refential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.549,84	66,21%	1.869,70	54,54%
Railway	414,13	17,69%	1.052,66	30,71%
Coastal Cabotage	215,49	9,21%	303,12	8,84%
Inland Navigation	130,61	5,58%	154,25	4,50%
Pipelines	29,56	1,26%	46,75	1,36%
Airway	1,33	0,06%	1,74	0,05%
Total	**2.340,96**	**100%**	**3.428,22**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

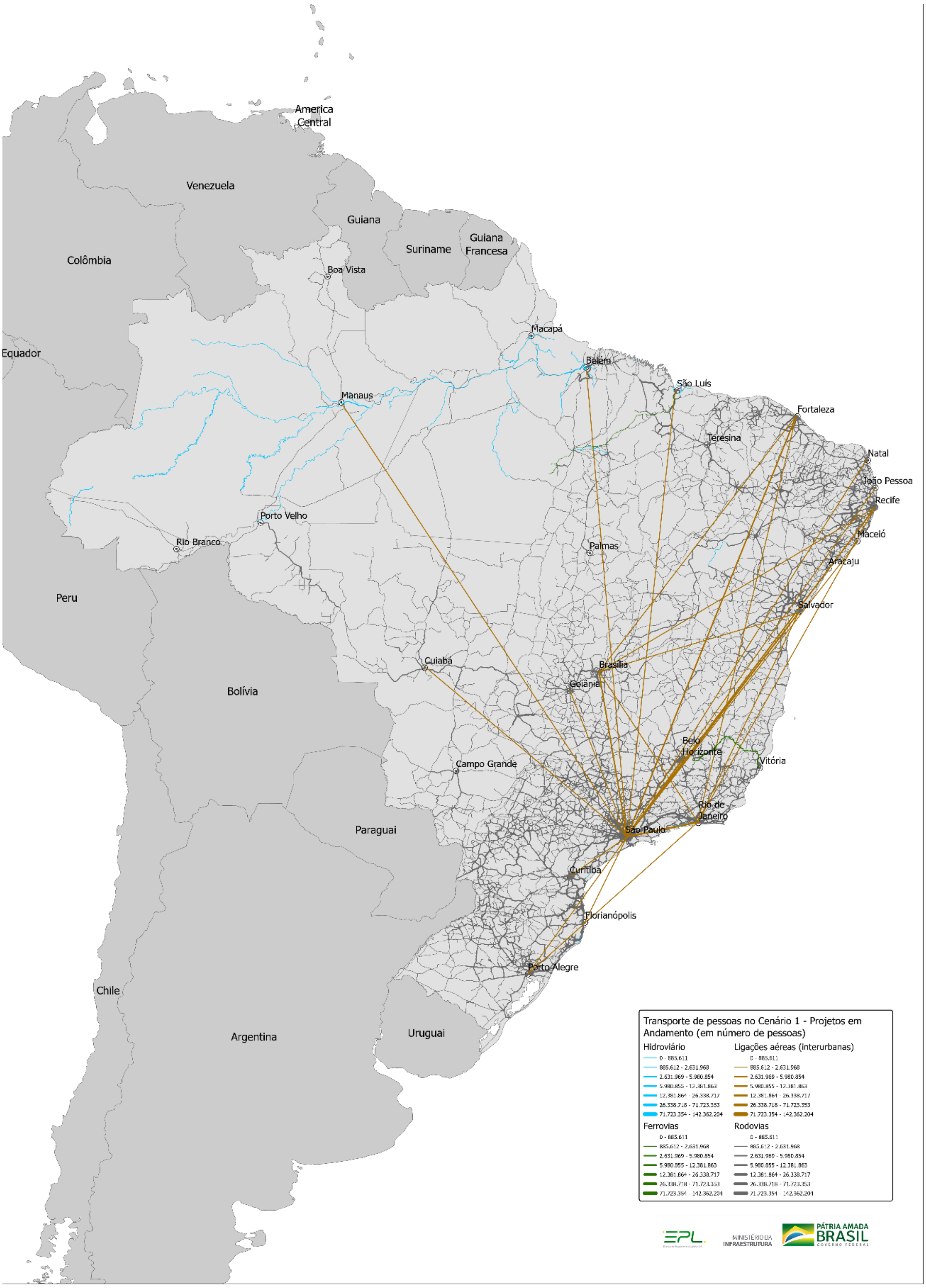
Regarding the transport of people, the main change is related to the increase in the number of airports with regular flight operations, which, according to the Scenario absorbed from PAN 2018-2038 to NLP 2035, will reach 164 airports with commercial flights. This increase in supply, associated with the trend of evolution of demand for air transport observed historically, and with the perspective of continuity for the next few years, makes this the fastest growing mode of interurban transport, with domestic demand reaching 126 million passengers transported in 2035[27] - an increase of 64% compared to the 2017 baseline scenario. The automobile roadway, the main responsible for the interurban transport of people in the territory, will continue to maintain its position in the modal matrix, but will grow at a lower rate, accumulating 19% until 2035, and reaching 1.8 billion trips per year.

In this scenario, interurban bus transport, including both interstate and inter-municipal buses, tends to remain stable over the next few years, while the demand observed in other modes grows. Overall, the demand for interurban buses tends to fall 4% by 2035, reaching 420 million passengers transported. In interstate roadway services, the fall is smaller, 2.8%. This trend resulting from the projections of the interurban transport of people matrix for a reference scenario and the modal share and sequential allocation according to the characteristics of the

27 On NLP 2035, a double-counting of passengers is not considered due to connections, and, because of this, the value may seem a little smaller in comparison to ANAC (National Civil Aviation Agency of Brazil) data. Here it is considered that each person transported is counted as a passenger, no matter how many connections are taken in the same interurban trip.

scenario is explained by the increase in the number of trips by automobile, mainly for short and medium distances, and in airway transport, for long distances. With the improvement in the income conditions of the population considered in the reference macroeconomic scenario, there is an increase in the rate of motorization, in the number of discretionary interurban trips, and, consequently, the migration of part of the demand to automobiles and airway transport.

Picture 59 shows the allocated interurban flows of people in Scenario 1.



Picture 59: Allocated Interurban Flows of People - Scenario 1
Source: EPL (2021)

6.3. SCENARIO 2 - PLANNED PROJECTS - REFERENTIAL

The second simulated scenario differs from the first thanks to the increase in investments in transport infrastructure foreseen by the Ministry of Infrastructure. Such investments, amounting to R$780,44 billion *reais*, increase the country's railway and roadway network, waterways, and port and airport systems. All projects in Scenario 1 are considered, and others that, although not yet considered as ongoing, have advanced projects, or are included in short-term investment portfolios of the Ministry of Infrastructure, such as the projects provided for in the study carried out to propose the *Pró-Brasil* (Pro Brazil) program.

Among the infrastructures with the most significant investments, the extension of *Ferroeste* to Dourados/MS and the second leg of FICO to Lucas do Rio Verde/MT stand out. Among the interventions on the roadways, for example, investments arising from the new Concession of BR-040/495/MG/RJ, and public or private interventions on BR-230/PA, BR-419/MS, BR-101 /BA/SE/AL/PE/PB/RN, BR-060/153/262/DF/GO/MG and BR-381/262/MG/ES. An important work in the inland navigation system considered in this scenario is the demolition of *Pedral do Lourenço* (Lourenço's stone), on the Tocantins River, in Santa Terezinha do Tauri/PA.

The importance of an integrated and intermodal planning such as the one presented here is observed when it is verified that local changes in transport infrastructures do not only reconfigure their surroundings. New conditions for the supply of transport capacities, times and costs tend to impact entire freight and people transport corridors and affect path decisions. The simulation model seeks to represent such behaviors.

The first observable consequence of this greater availability of transport capacity is seen in general Freightes (CGC and NCGC). The central railway network, formed by the North-South Railway – Central Section, FICO to Lucas do Rio Verde/MT and the FIOL Complex (FIOL I, II and III) are presented as a corridor for capturing and distributing general Freight to the countryside.

With the attributes of newly inaugurated railways (wide gauge, operational speed of 45km/h and high capacity), these railways are presented in a similar way to the trunk corridors defended by Vuchic (2008) for urban displacement, where a large-capacity mode performs transport over longer distances and modes of reduced capacity, with greater accessibility, play the role of capillarity and local distribution. The impact of changes in railway infrastructure in the reconfiguration of the entire network is then observed, especially in the roadway modes and port capacities.

With the data from the simulated scenarios, the need for the Land Transport Sectorial Plan, and the Port Sectorial Plan is evident, to absorb the local demands of the NLP 2035 Scenarios to verify ways to meet the needs identified by the increased demand on access roads to the railway terminals, and by the increased demand in ports, respectively.

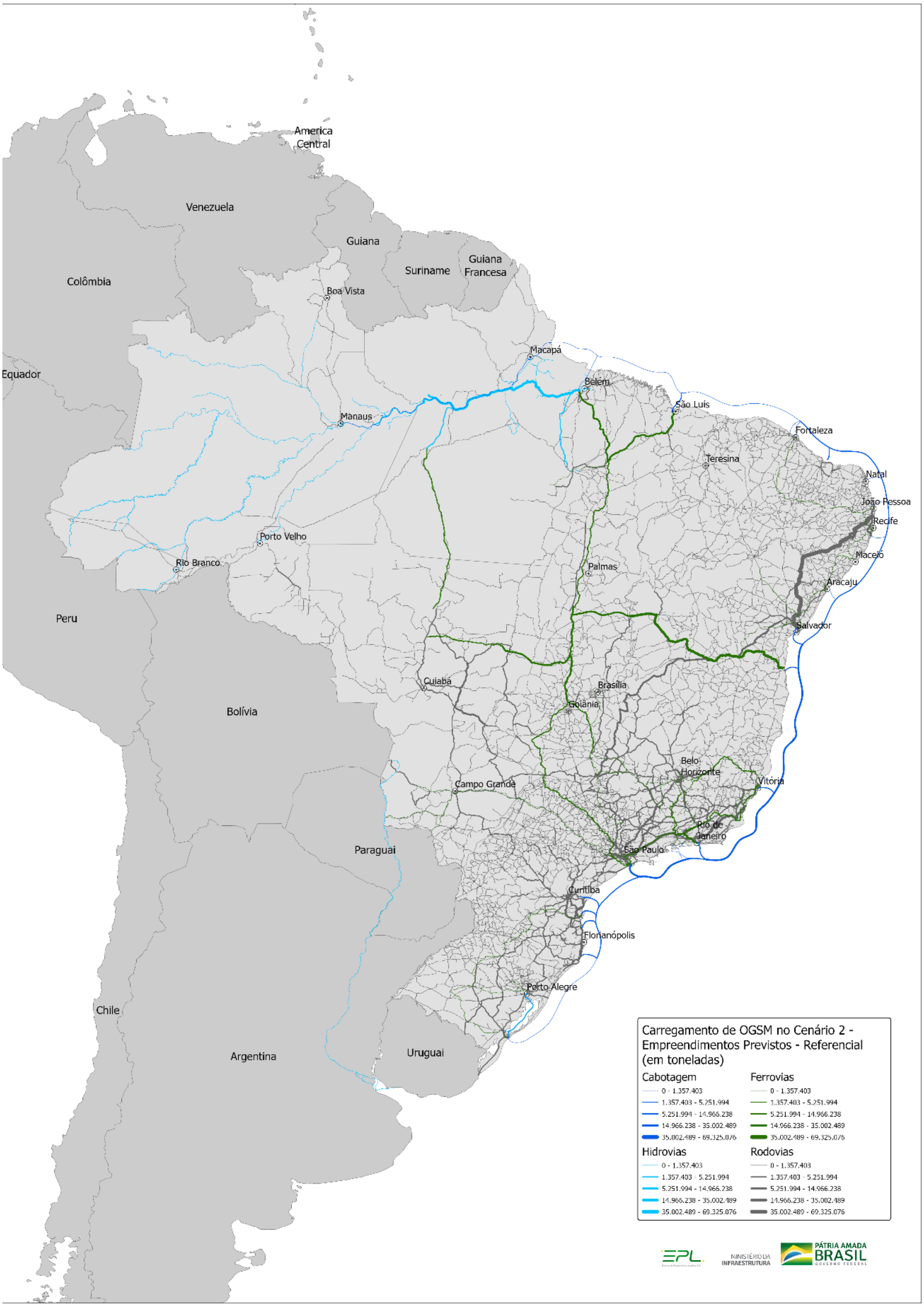
Although there is the prevalence of the central railway network, as seen in Scenario 1, the leading role of the state capitals of São Paulo, Rio de Janeiro, Minas Gerais, and Paraná remains as central for general Freight, due to the high concentration of industrialization in the South and Southeast regions of the country.

In this way, there is the transport of general Freight by cabotage on the Brazilian coast, especially on the coast of Santa Catarina, Paraná, São Paulo, and Rio de Janeiro, with traces of above-average movement up to Sergipe.

Regarding liquid bulk, the behavior maintains its similarity, being mainly based on the Brazilian coast. The North-South Railway - Central Section (FNS-TC) and the North-South Railway – North Section (FNS-TN) present, although discreetly, a characteristic of potential corridor for the interiorization of petrochemical Freightes belonging to this group.

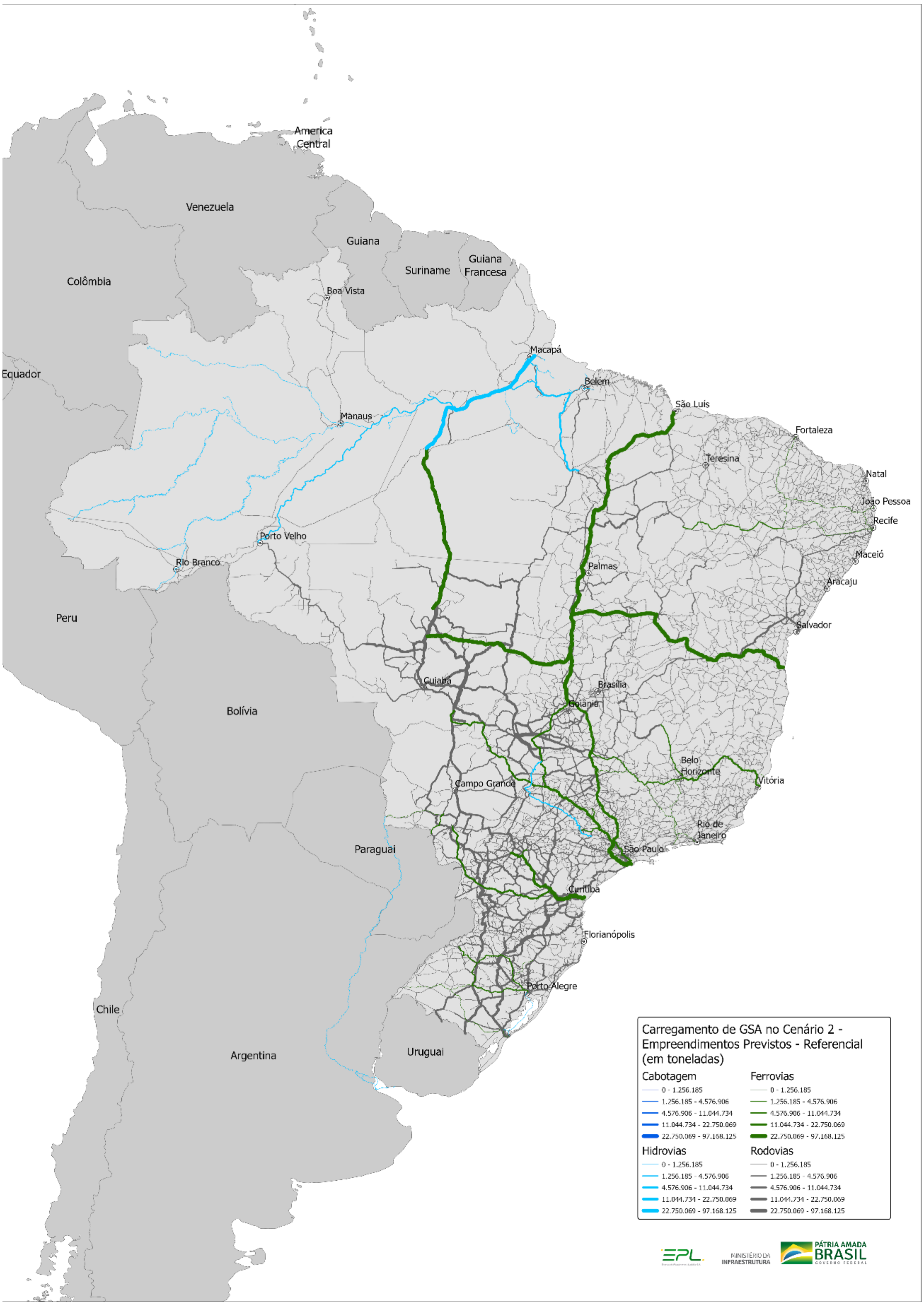
Regarding iron ore, represented by the GSM group, the behavior is very similar to that seen in Scenario 1, with the exception of Freight from Mato Grosso do Sul, which finds in the EF-484 a faster alternative with greater capacity for shipping, in search of the port of Santos/SP, since, for future scenarios, there is no expectation of the operation of this material in the ports of Paraná.

In turn, the OGSM group, shown in Picture 60, has an interesting change in behavior regarding the interiorization of fertilizers, since the main movement passes from Rumo Malha Paulista, to the FIOL complex and the FNS-TN and FNS-TC, entering by FICO to reach Mato Grosso. Regarding “Other Minerals”, a component product of the OGSM, the FIOL complex, they present a centralizing behavior that is quite in line with the expectations materialized by the demand study, probably due to the movement of mines present in that location.



Picture 60 - SCENARIO 2–Planned projects – OGSM Freight.
Source: EPL (2021)

Finally, solid agricultural bulk is the group that shows the greatest change in general behavior, with a movement that is highly concentrated in the central railway network. In this scenario, the GSA group uses the FICO/FIOL/*Ferrogrão* system as a double flow corridor, as well as making use of inland navigation on the upper Tocantins River, made possible by the demolition of *Pedral do Lourenço* (Lourenço's Stone), and intensifying navigation on the Tapajós River, giving continuity to the Freight captured by *Ferrogrão*, as shown in Picture 61.



Picture 61 - SCENARIO 2–Planned projects – GSA Freight/Source: EPL (2021)

The scenario presented a result that indicates potential shipments for production from Mato Grosso, both for *Ferrogrão*, as for FICO and the current Rumo Malha Norte. The observed shipments are in the order of 37, 130 and 12 million tons, respectively. However, it is important to point out that the competition between these three flow options depends on a series of factors that are variable in relation to time, and of partial control by the respective network operators, such as the conditions of cost offer and speed, and even conditions beyond the reach of railway operators, such as the port capacities of the facilities to which they make connections for export. Test simulations indicate that any changes to these parameters can result in considerably different Freight distribution settings.

FNS-TC and FNS-TN present GSA volume also coming from the MATOPIBA region, taking these Freightes to the port of Itaqui, in São Luiz/MA.

Completing the analysis of agricultural bulk, once again the production in the region of Santa Maria/RS, Cacequi/RS, Tupanciretã/RS and Cruz Alta/RS uses the reactivated infrastructure of the Rumo Malha Sul to form a corridor to the North to use the infrastructures of Paraná. The persistent behavior in different scenarios is a strong indication of the potential and needs to be explored in the central region of Rio Grande do Sul and the western border of Santa Catarina.

Regarding the distribution of the Brazilian transport matrix estimated for Scenario 2, Table 15 is presented. In this table, directly comparing with the one seen in Scenario 1, an even more pronounced growth in the relevance of the railway mode in comparison is observed, mainly with the roadway mode, reaching 34.62% of the modal share in 2035.

Although larger volumes of CGC and NCGC appear in cabotage, in Scenario 2 there is an attraction of cabotage Freightes to the central railway system, slightly reducing the participation of cabotage in the transport matrix, in this scenario.

Table 15: Brazilian transport matrix simulated on scenarios 1 and 2, in weight.

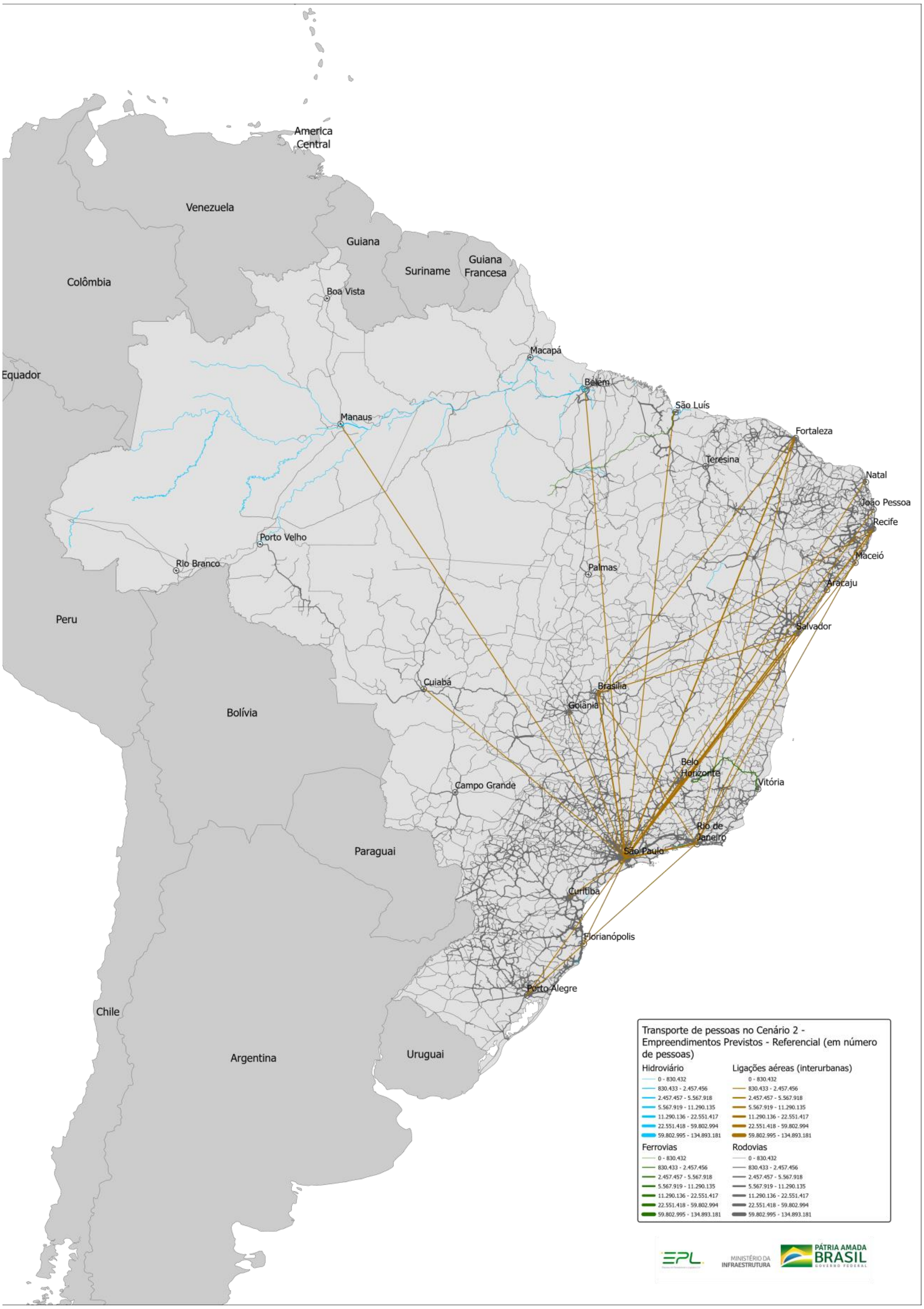
Mode	Scenario 1- Projects in Progress-Referential		Scenario 2- Planned Projects - Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.869,70	54,54%	1.852,79	51,36%
Railway	1.052,66	30,71%	1.248,79	34,62%
Coastal Cabotage	303,12	8,84%	305,24	8,46%
Inland Navigation	154,25	4,50%	151,97	4,21%
Pipelines	46,75	1,36%	46,75	1,30%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.428,22**	**100%**	**3.607,27**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

In relation to the transport of people, it can be considered that the behavior of the interurban flows allocated is similar to that observed in Scenario 1, since there are no changes in supply foreseen in the airway, waterway or railway modes compared to that Scenario. The allocation of road transport by car, on the other hand, undergoes minor changes. Changes in the railway network for Freight also impact the flows of trucks on the highways, and with this, some relevant connections for the transport of people are more saturated, especially in the South and Southeast regions, where such flows are more intense, generating some impact in travel times (see Section 6.1.3 – Accessibility).

Picture 62 shows the allocated interurban flows of people in Scenario 2.



Picture 62: Allocated Interurban Flows of People - Scenario 2/Source: EPL (2021)

6.4. SCENARIO 3 - PLANNED PROJECTS - TRANSFORMATIVE

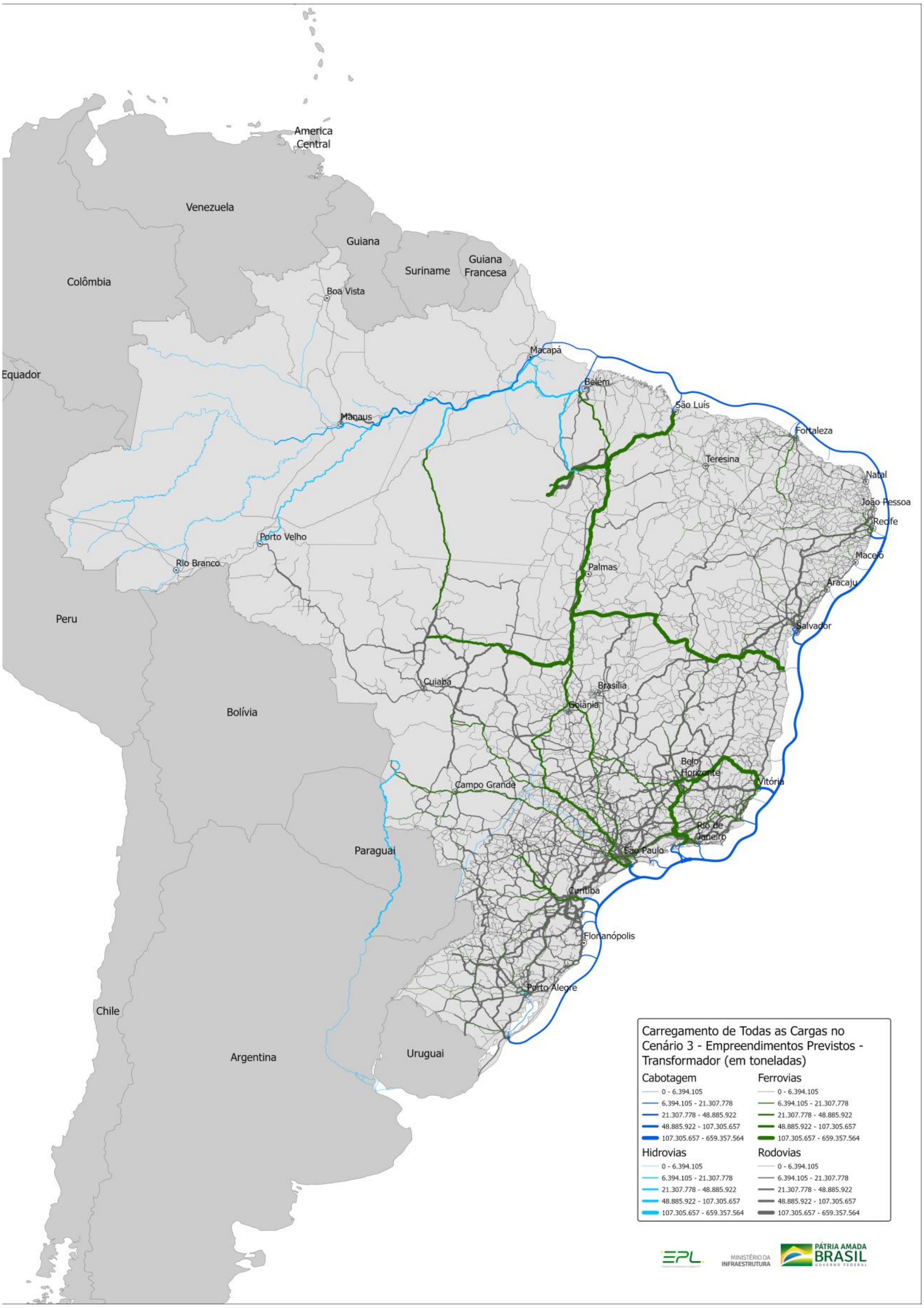
In time, the Transformative scenario mimics Scenario 2 in terms of supply and of Planned Projects, however with the alteration of the origin and destination matrixes which, for this scenario, start to count with a high growth.

Far from a situation where greater growth would only make the volume of Freight transported in each mode more pronounced, this scenario presents the inherent complexities of transport. A more pronounced growth of the matrixes causes a reorganization of the country's transport matrix – when compared to the situation on scenario 2.

This behavior is mainly justified by an unequal growth for different Freight groups, as well as an equally unique growth for the products that are part of the same Freight group.

A highlight observed in this Scenario is that the iron ore originating from Parauapebas and destined for export finds even greater restrictions on the capacity to transport it in Itaqui than in the previous scenarios, being induced to look for alternatives in Pará (Vila do Conde, in Barcarena/PA and Belém/PA).

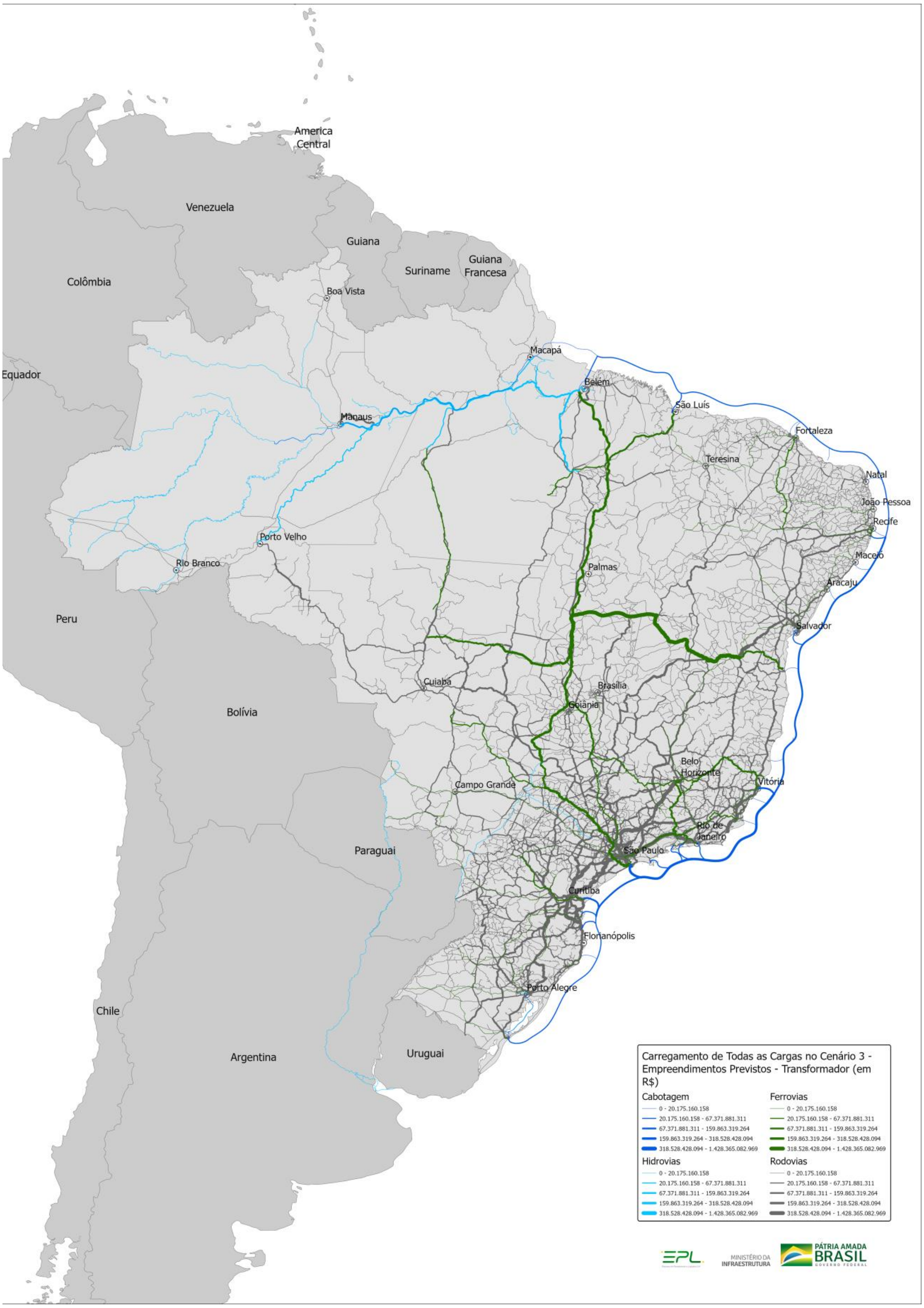
Pictures 63 and 64 show the allocated Freight flows in Scenario 3 by weight and by value, respectively.



Picture 63: Allocated Flows Scenario 3 - All Freightes (by weight)

Source: EPL (2021)

(On Picture: Loading of all the Freightes on Scenario 3 – Planned Projects – Transformative (in tons)/Cabotage/Railway/Waterway/Road)



Picture 64: Allocated Flows Scenario3 - All Freightes (by value)

Source: EPL (2021)

(On Picture: Loading of all the Freightes on Scenario 3 – Planned Projects – Transformative (in R$)/Cabotage/Railway/Waterway/Road)

Table 16 shows the modal share of Scenario 3, in comparison to Scenario 2. It is observed that, although the modal distribution in percentage values does not change significantly, the nominal values in TKU show significant growth in this Scenario, as a result of the higher volume of Freightes in transport. Only the value of TKU transported in the roadway mode in Scenario 3 for 2035 approaches the total TKU transported in the 2017 baseline Scenario.

In this situation, from a weighted perspective, if the national macroeconomic scenario develops as indicated in the transforming trends of the Federal Development Strategy for Brazil (Decree Nº 10.531/2020), the Freight transported on the roadways will be equivalent to the total transported on year 2017. In this way, the allocation data from this scenario tend to indicate a critical scenario for Brazilian roadways, with inputs being characterized as needs to be worked on in the Land Transport Sectorial Plan.

Table 16: Brazilian transport matrix simulated on scenarios 2 and 3, in TKU.

Mode	Scenario 2-Planned Projects - Refential		Scenario 3- Planned Projects-Transformative	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.852,79	51,36%	2.197,25	52,49%
Railway	1.248,79	34,62%	1.420,63	33,94%
Coastal Cabotage	305,24	8,46%	340,49	8,13%
Inland Navigation	151,97	4,21%	170,52	4,07%
Pipelines	46,75	1,30%	54,84	1,31%
Airway	1,74	0,05%	1,95	0,05%
Total	**3.607,27**	**100%**	**4.185,68**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

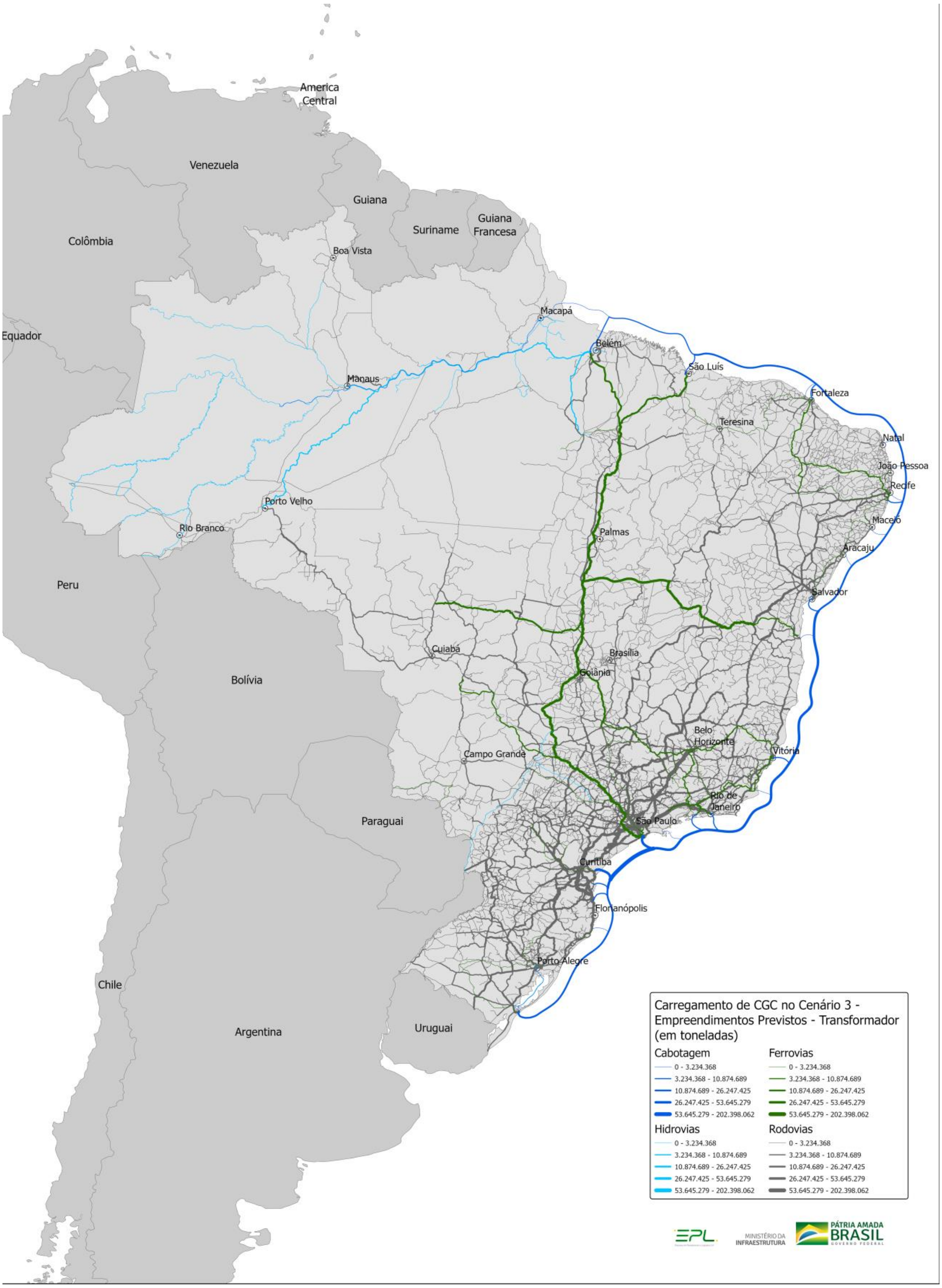
The inequality of growth between the matrixes observed in Scenario 3 causes industrialized Freightes predominantly forming the CGC and NCGC groups, to grow above other products. As general Freightes have a slightly higher time cost, that is, they are Freightes for which demands "prefer to pay a little more money for it to arrive faster", this concentrates the growth in the roadway mode, causing it to exceed the growth of railways, when comparing the results of this scenario with Scenario 2.

This picture is quite evident when looking at pictures 65 and 66, which detail the behavior of General Containerized Freight and Non-Containerized General Freight, respectively.

For the CGC, it is possible to observe the coastal roadways of Santa Catarina gaining importance for the traffic of this type of Freight, placing the port of Imbituba/SC to function apparently as an auxiliary outflow hub to the port of Paranaguá/PR. Still, there is a considerable increase in the relevance of the roadways that connect Rio Grande do Sul to other states in the southern region.

Similarly to what was observed between Imbituba/SC, Curitiba/PR, São Paulo/SP, Rio de Janeiro/RJ and Belo Horizonte/MG, there is a formation of a hub for general Freightes in

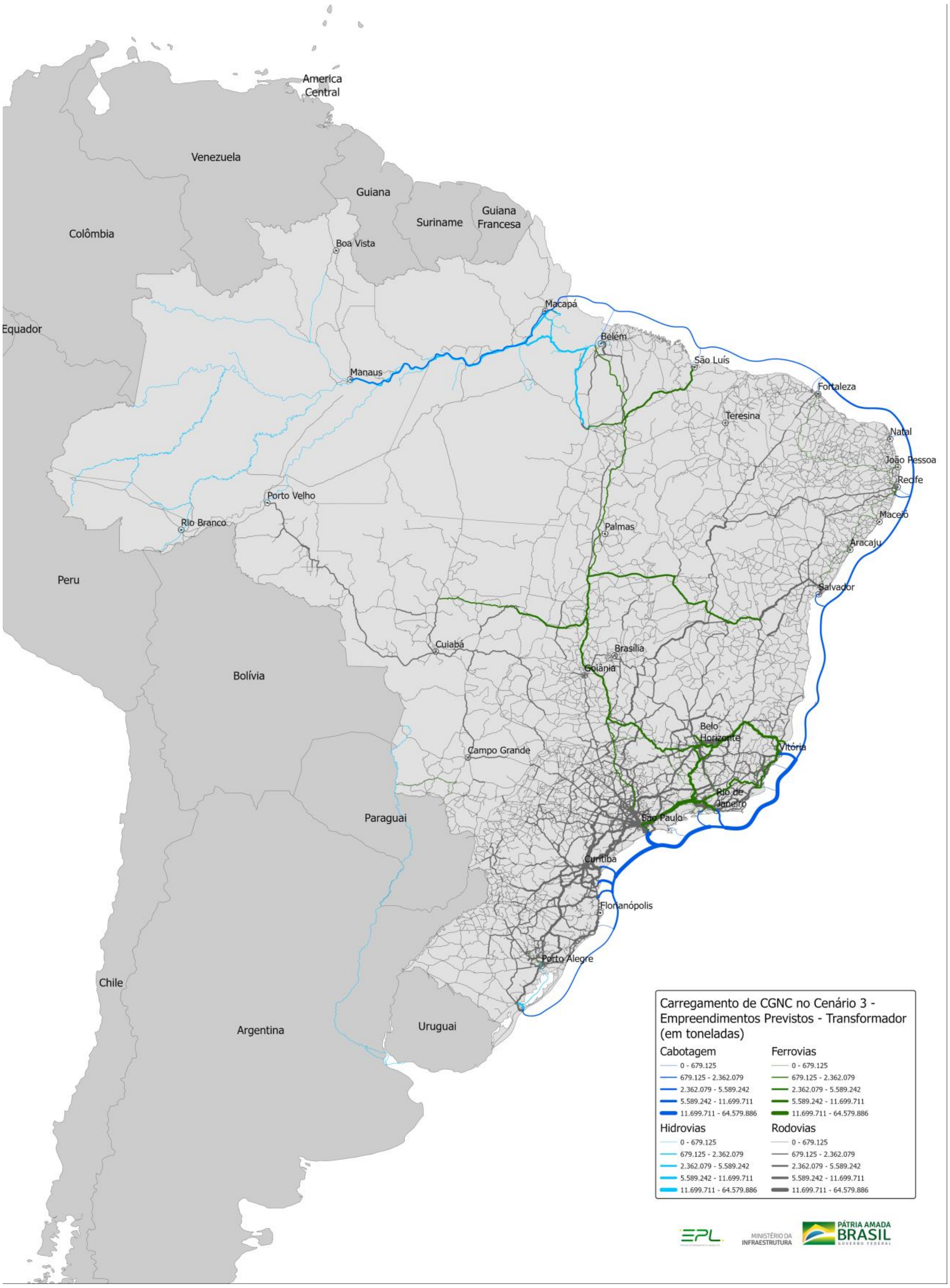
Salvador/BA, with a clear center profile distributor for the geographically close coastal strip, in the Northeast Region.



Picture 65 - SCENARIO 3–Planned projects – Transformational Economy – CGC Freight.
Source: EPL (2021)
(On Picture: CGC Freight on Scenario 3 – Planned Projects – Transformative (in tons)/Cabotage/Railways/Waterways/Roads)

For NCGC Freightes, there is a pronounced use of BR-364 and BR-319 roadways, which in this scenario are presented as paved. There is a choice of this mode for this region, both because of the time sensitivity for transport, and because the port of Porto Velho does not work with Freightes of this type, with no prediction of future changes, making it impossible to make a modal choice at the location. This does not mean, in fact, that the observed Freightes will be consolidated, but it points out needs that should have alternatives studied for this transport corridor, whether by roadway or by inland navigation and ports, in the respective Sectorial Plans.

Picture 66 shows the NCGC shipments in Scenario 3.



Picture 66 - SCENARIO 3 – Planned Projects – Transformational Economy – NCGC Freight.
Source: EPL (2021)
(On Picture: NCGC Freight on Scenario 3 – Planned Projects – Transformative (in tons)/Cabotage/Railways/Waterways/Roads)

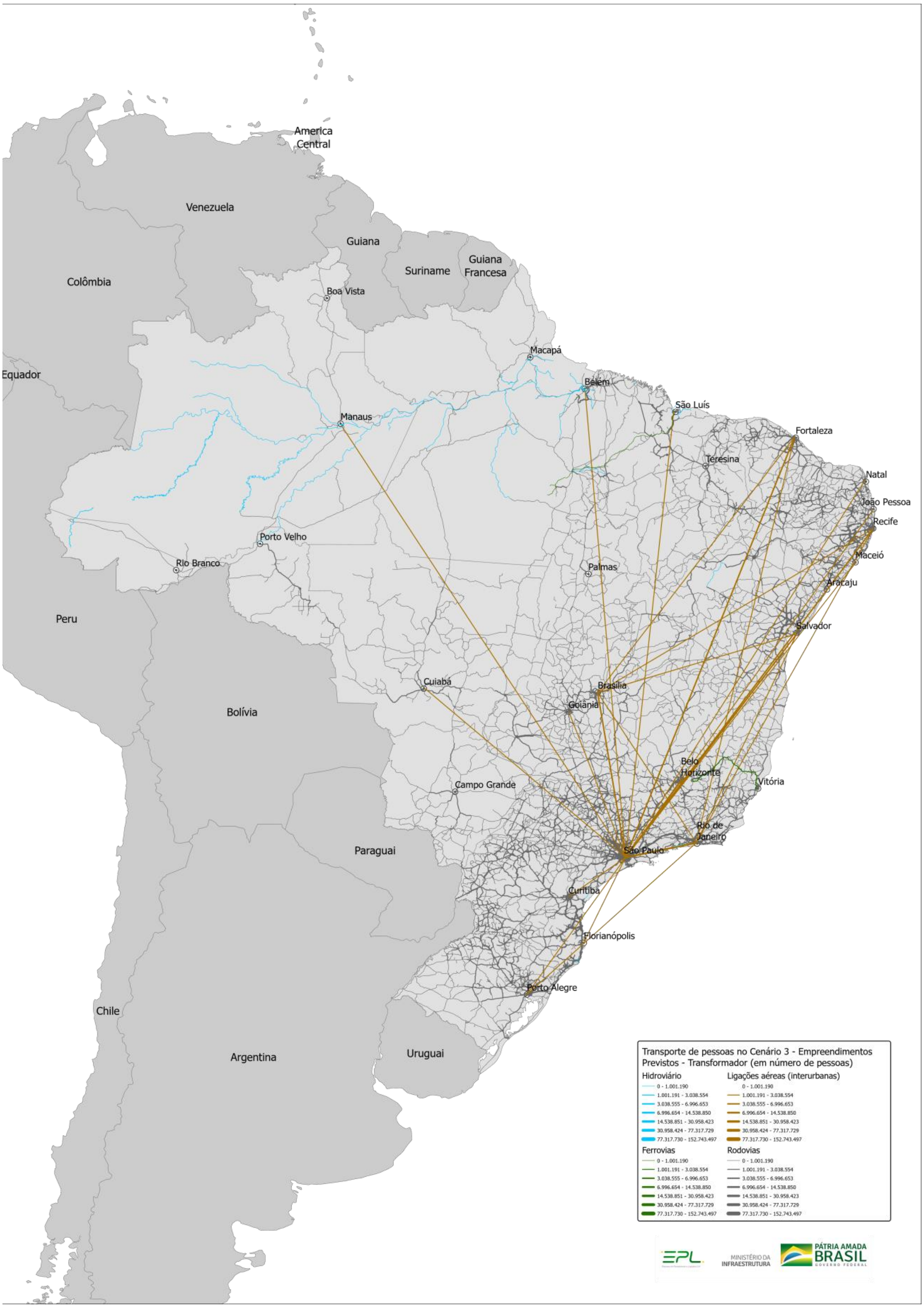
Once again, the central railway assembly appears loaded with general Freightes, while for older railways the Freightes are generally not allocated to this mode, as observed in Scenario 2. This behavior makes it clear that the speed and capability of the new railways are attractive for transporting this type of product by railway. Once again, the navigable waterway in the upper Tocantins River stands out.

For the GSA, GSM, OGSM and LB categories, the behavior observed in this scenario is quite similar to that seen in Scenario 2, with an increase in transported volumes in different proportions, regions or allocated infrastructure.

In relation to the transport of people, the phenomenon that is observed is the intensification of the trends observed in the previous scenarios. With the increase of income, airway transport and interurban automobile transport, which by nature are discretionary, tend to grow even more vigorously. Domestic airway transport can reach 143 million transported passengers, experiencing an accumulated increase of 87% compared to the 2017 Baseline Year Scenario, and automobile transport to 1.9 billion people, accumulating a growth of 29%. Waterway and railway transport grew at rates similar to road transport, but maintained the low representation in the interurban transport matrix identified in the other scenarios, mainly considering that no changes in the offer for such modes were simulated.

With the impact of increased income and intense economic growth, bus travel does not show a drop as observed in the previous scenarios, but remains, in total, at the same level as observed in the 2017 Baseline Year Scenario, with 438 million passengers in interurban trips, and with it, losing representativeness in the modal share.

The growth of truck and automobile trips on roadways has a significant impact on the average travel time for transporting people, as seen in section 6.1.3 - Accessibility. Picture 67 shows the interurban flows of people in Scenario 3.



Picture 67: Allocated Interurban Flows of People - Scenario 3

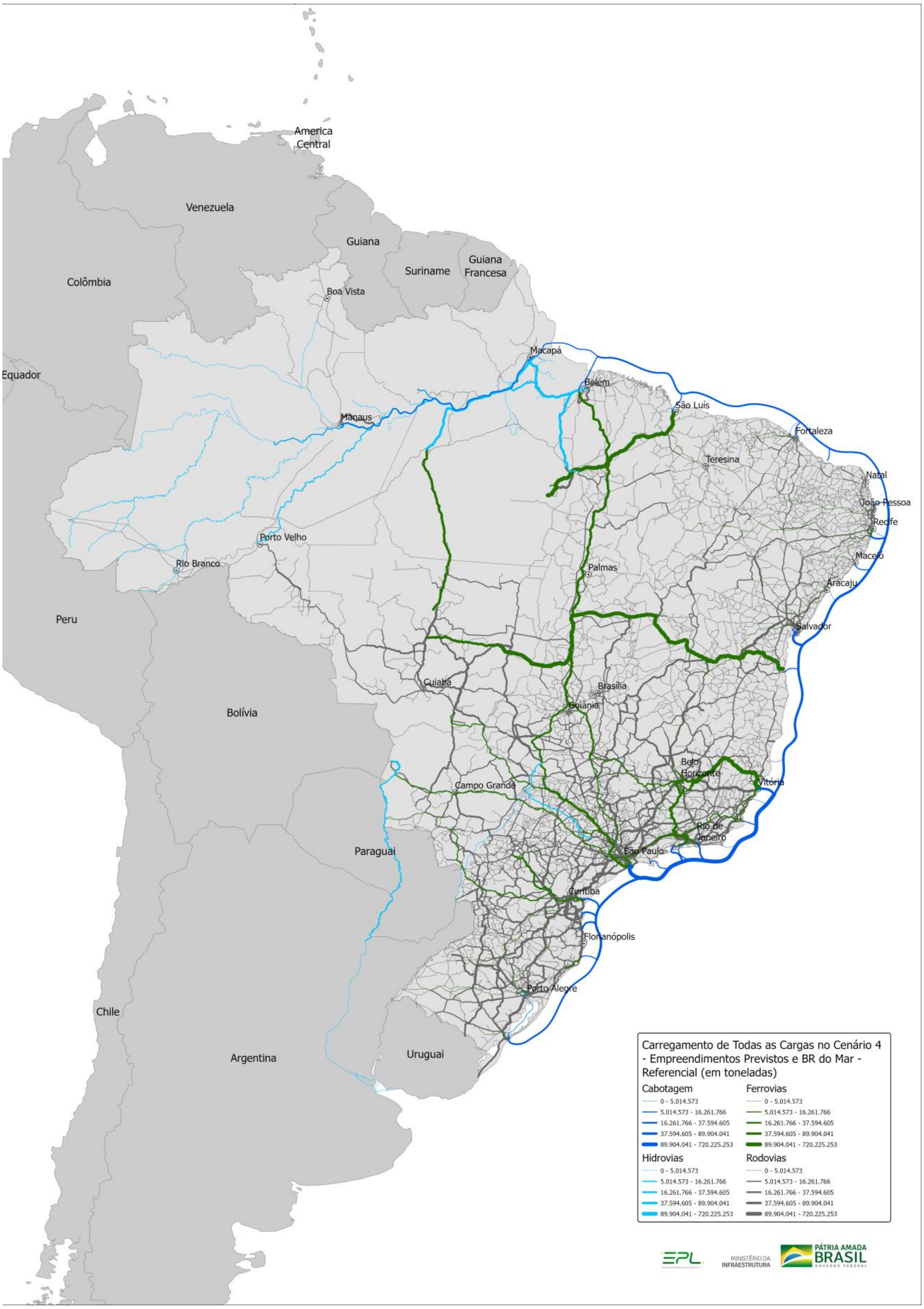
Source: EPL (2021)

6.5. SCENARIO 4 - PLANNED PROJECTS AND *BR DO MAR* REFERENTIAL

The *BR do Mar* Scenario presents all the characteristics observed in the model used for Scenario 2, with a reduction in cabotage costs of around 15%, according to the study mentioned earlier in this report.

Such cost differentiation is enough to cause a considerable volume of Freight to migrate from the roadways along the Brazilian coast, and from part of the railways to the ports, using cabotage as a means of displacement. Port capacity, however, greatly interferes in the allocation of traffic, and therefore, an increase in port capacity was simulated, based on the premise that, with the increased attractiveness for coastal cabotage, some investments or operational interventions to adjust the capacity would be made. Such investments were also duly calculated to compose the investment indicator, maintaining the consistency of the assessment of this scenario.

Picture 68 shows the Freight flows from Scenario 4, by weight, for all modes of transport.



Picture 68: Allocated Flows Scenario 4 - All Freightes (by weight)

Source: EPL (2021)

(On Picture: Loading of all Freightes on Scenario 4 – Planned Projects and BR do Mar – Referential (in tons)/Cabotage/Railways/Waterways/Roads)

The cost reduction is enough to increase the attraction of general Freight that, even with its slightly more pronounced time cost, now have cabotage as an adequate way of traveling between cities on the Brazilian coast. The other behaviors, both for the transport matrix and for the allocated Freightes, remain similar to those of Scenario 2, in regard to allocated tons and values.

Table 17 presents the Brazilian transport matrix simulated on scenarios 2 and 4, in weight. In Scenario 4, cabotage and waterway transport, which include cabotage on inland navigation, gain more representation in the modal share of the matrix.

Table 17: Brazilian transport matrix simulated on scenarios 2 and 4, in weight

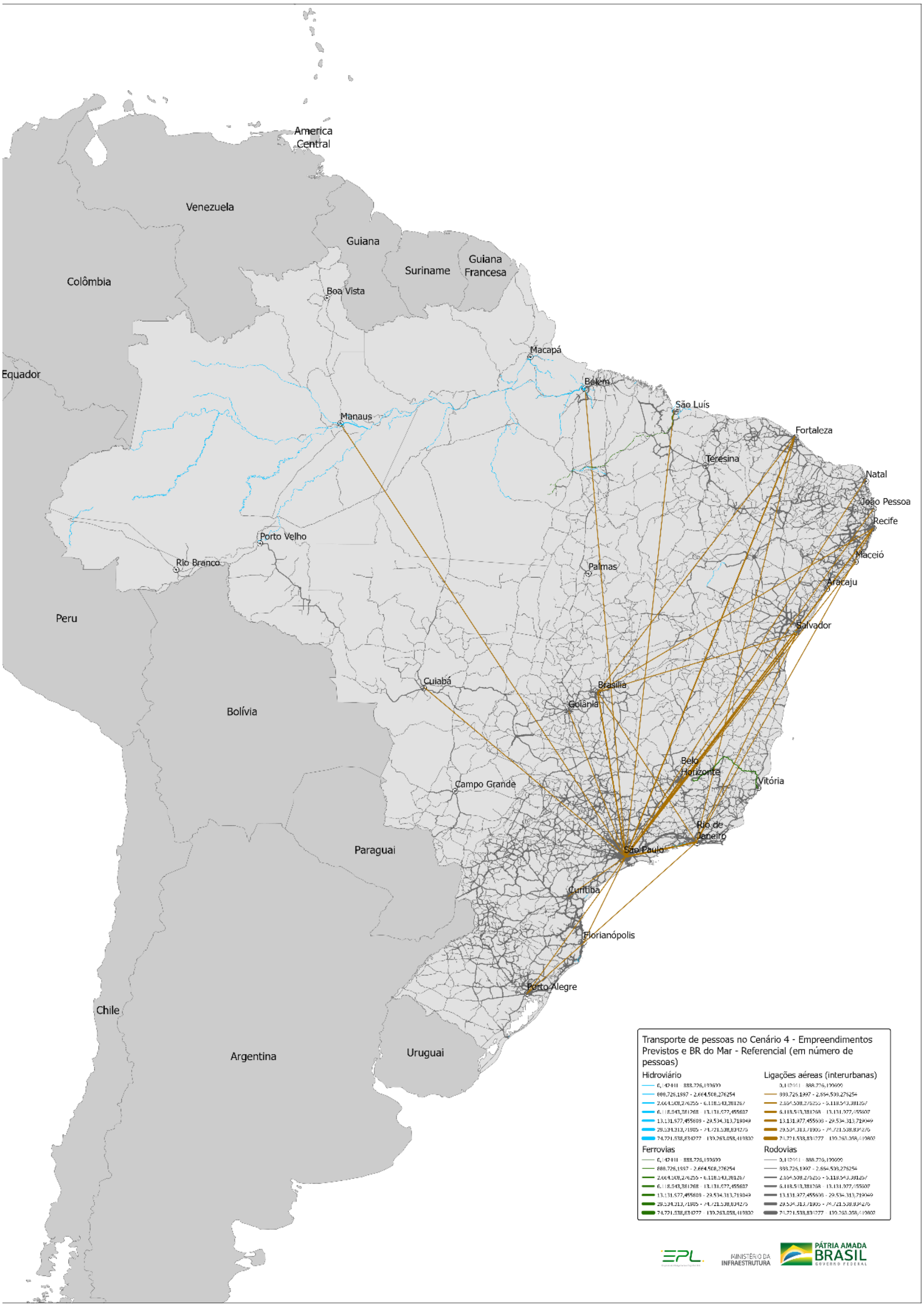
Mode	Scenario 2- Planned Projects-Refential		Scenario 4- Planned Projects and BR do Mar-Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.852,79	51,36%	1.721,03	50,84%
Railway	1.248,79	34,62%	1.052,37	31,09%
Coastal Cabotage	305,24	8,46%	359,5	10,62%
Inland Navigation	151,97	4,21%	203,74	6,02%
Pipelines	46,75	1,30%	46,75	1,38%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.607,27**	**100%**	**3.385,13**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

In relation to the transport of people, the reduction of Freightes transported on the roadways improves the roadways levels of service, with an impact on the average travel time (see Section 6.1.3 – Accessibility). There are no other significant changes for the interurban transport of people compared to Scenario 2.

Picture 69 shows the interurban flows of people in Scenario 4.



Picture 69: Allocated Interurban Flows of People - Scenario 4

Source: EPL (2021)

6.6. SCENARIO 5 – PLANNED PROJECTS AND TECHNOLOGICAL INNOVATIONS REFERENTIAL

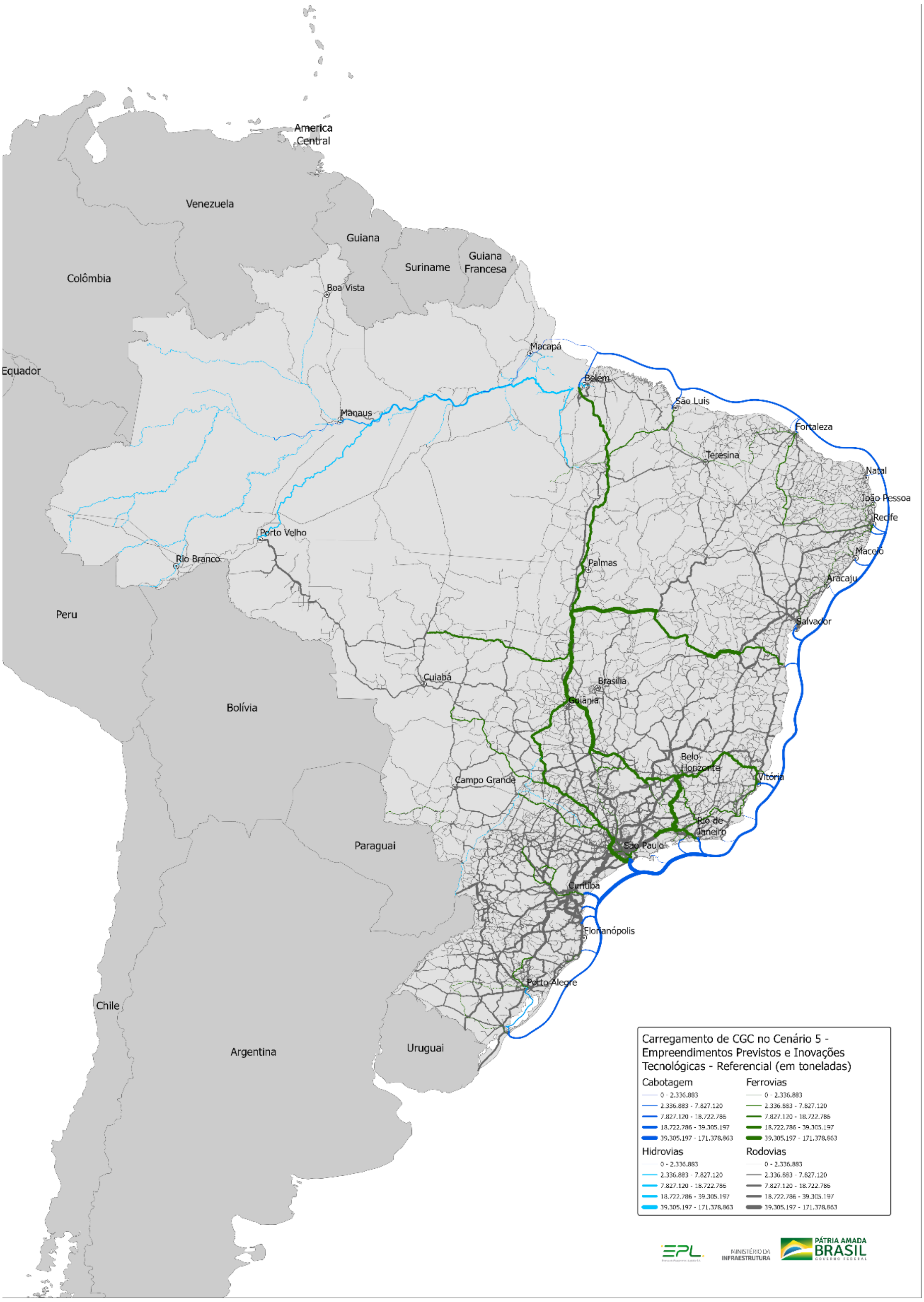
In turn, the scenario of technological innovations, presented as Scenario 5, causes changes in the model, especially regarding transport costs – mimicking an improvement in logistical efficiency, as well as in vehicle emissions. This cost adjustment is also observed at the port interface, given the improved performance of the ports.

With this generalized reduction in costs, considering that the impedance for determining routes and modes takes into account the displacement time[28] and the travel cost, travel times become more important. With this, we can observe in the results greater modal shifts between Freightes, causing some “traditional” routes that presented greater saturation impact to be replaced by paths that are less saturated and more likely to offer lower impedance.

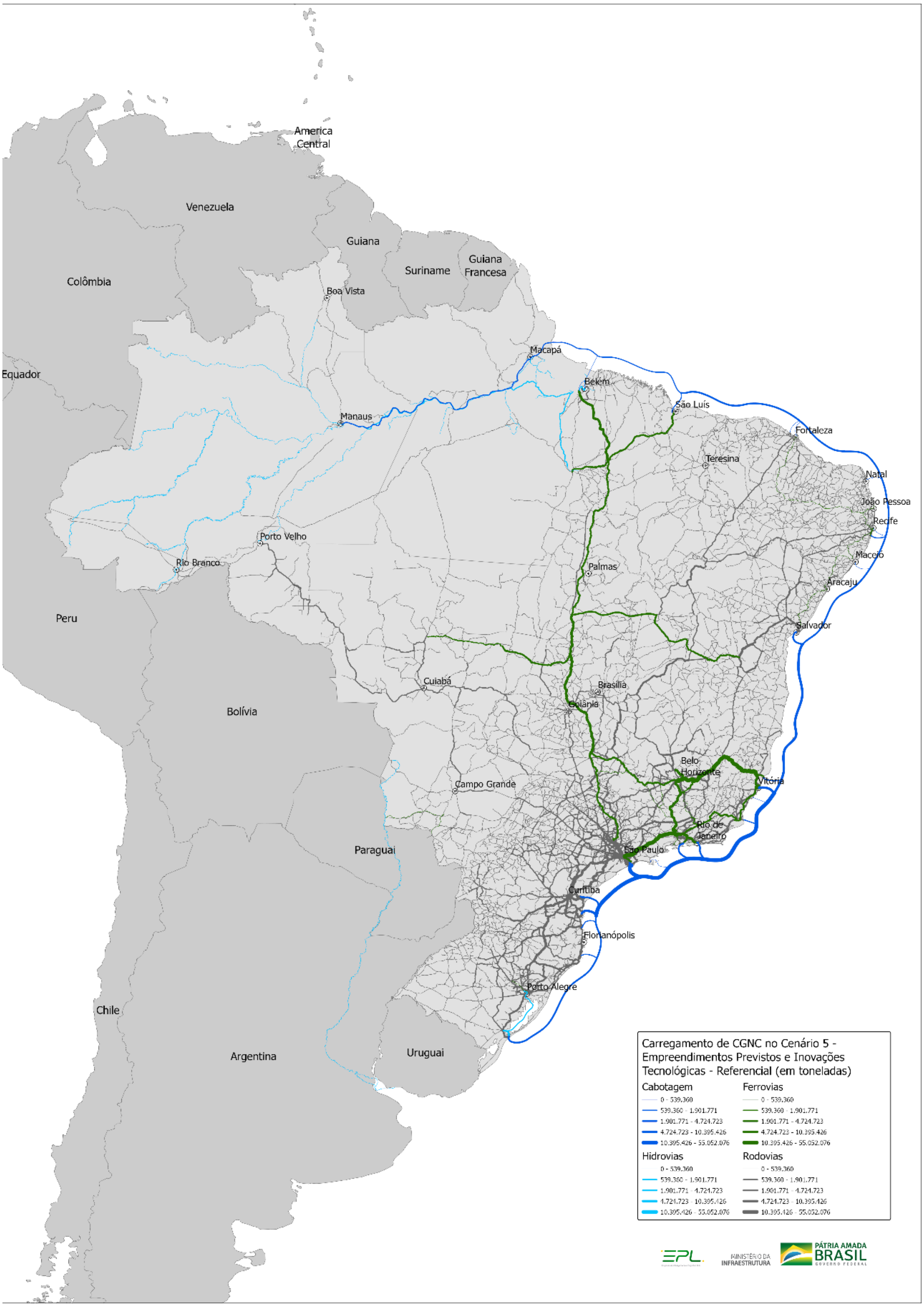
This phenomenon is quite visible when we consider the expansion of the use of the North-South Railway in its central section, which has higher speeds and capacities, for the transport of containerized and non-containerized general Freight (pictures 70 and 71).

The same phenomenon, in turn, is not replicable in "old" railway transport infrastructure and, with speed and capacity being the biggest differences between new and old railways in this scenario, the possibility that the gain in the attractiveness of railways for general Freight is open is more closely linked to capacity and speed than to the cost of transport itself. This hypothesis must be tested in detail within the Land Transport Sectorial Plan.

[28] Non-monetized displacement time, that is, one that keeps its units and temporal properties and is closer to what is observed in the real world. Further details about the impedance modeling, as well as the model will be presented in a separate publication, to be released in the second half of 2021.



Picture 70 - Flows Allocated in Scenario 5 - Containerized General Freightes by Weight
Source: EPL (2021)
(On Picture: CGC Freight on Scenario 5 – Planned Projects and Technological Innovations – Referential (in tons)/Cabotage/Railways/Waterways/Roads)

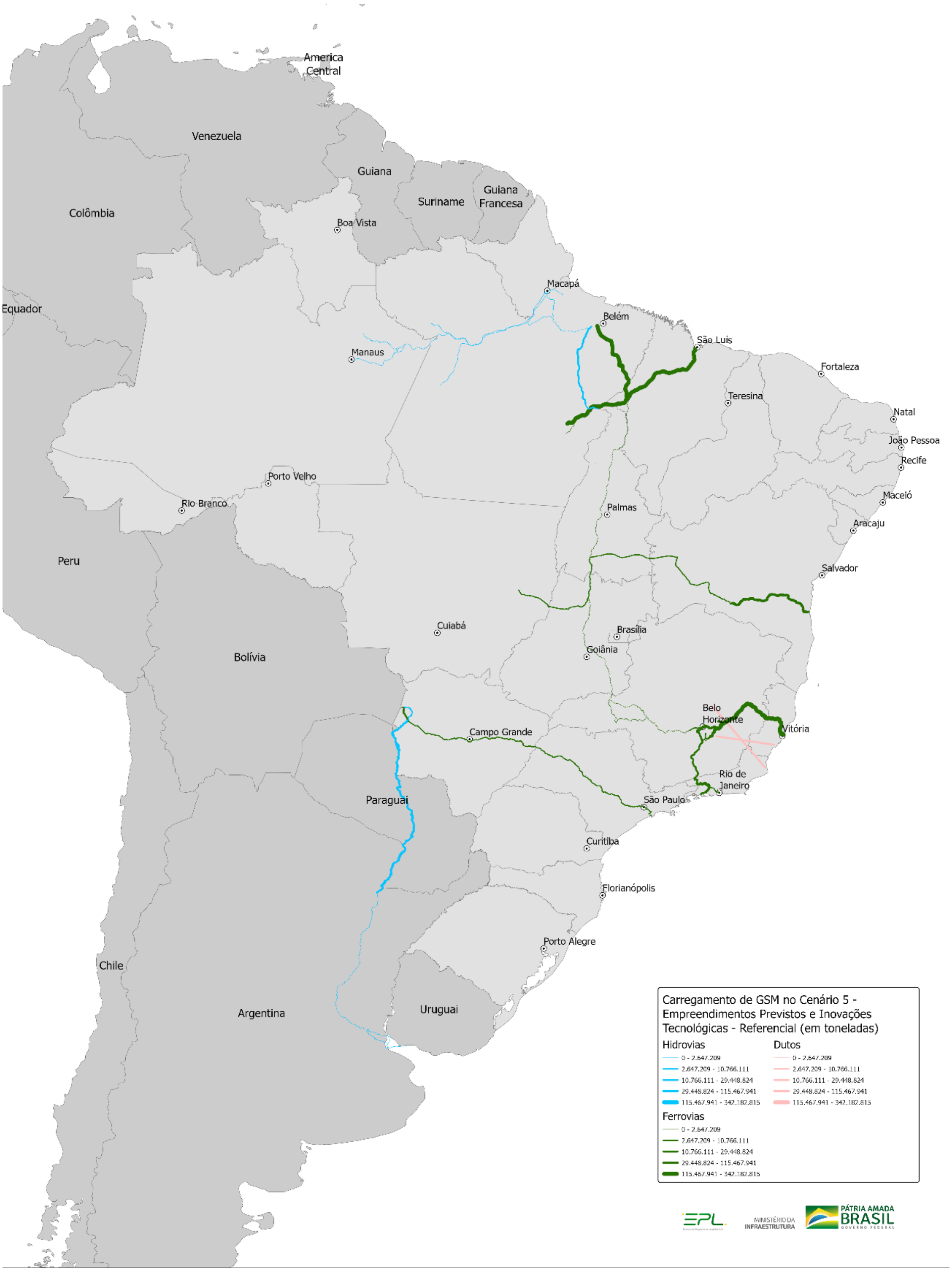


Picture 71 - Flows Allocated in Scenario 5 – Non-containerized General Freightes by Weight

Source: EPL (2021)

(On Picture: NCGC Freight on Scenario 5 – Planned Projects and Technological Innovations – Referential (in tons)/Cabotage/Highway/Waterway/Roads)

This same phenomenon is also visible in the displacement of iron ore that is found in the waterway of the Tocantins River, overcoming Pedral do Lourenço (Lourenço's Stone), and in the North-South Railway, in its stretch between Açailândia and Barcarena, interesting parallels to reduce saturation from the Port of São Luiz, as seen in Picture 72.



Picture 72- Allocated Flows Scenario 5 – Solid Mineral Bulk by Weight/Source: EPL (2021)

Due to the context presented, there is a very interesting reflection in the transport matrix. Although railway transport reduces in absolute numbers, it increases its percentage in modal share, precisely because of the reduction in the importance of road transport. In turn, transport through coastal cabotage receives an increase of around 40 billion TKU, thus raising its participation in the transport matrix to around 10%.

The growth in coastal cabotage results on an increase of the attractiveness of waterways because of their synergy and "similar functioning", bringing about 20 billion additional TKU annually to waterways.

Table 18 presents the transport matrix simulated on scenarios 2 and 5, in TKU.

Table 18 - Brazilian transport matrix simulated on scenarios 2 and 5, in TKU.

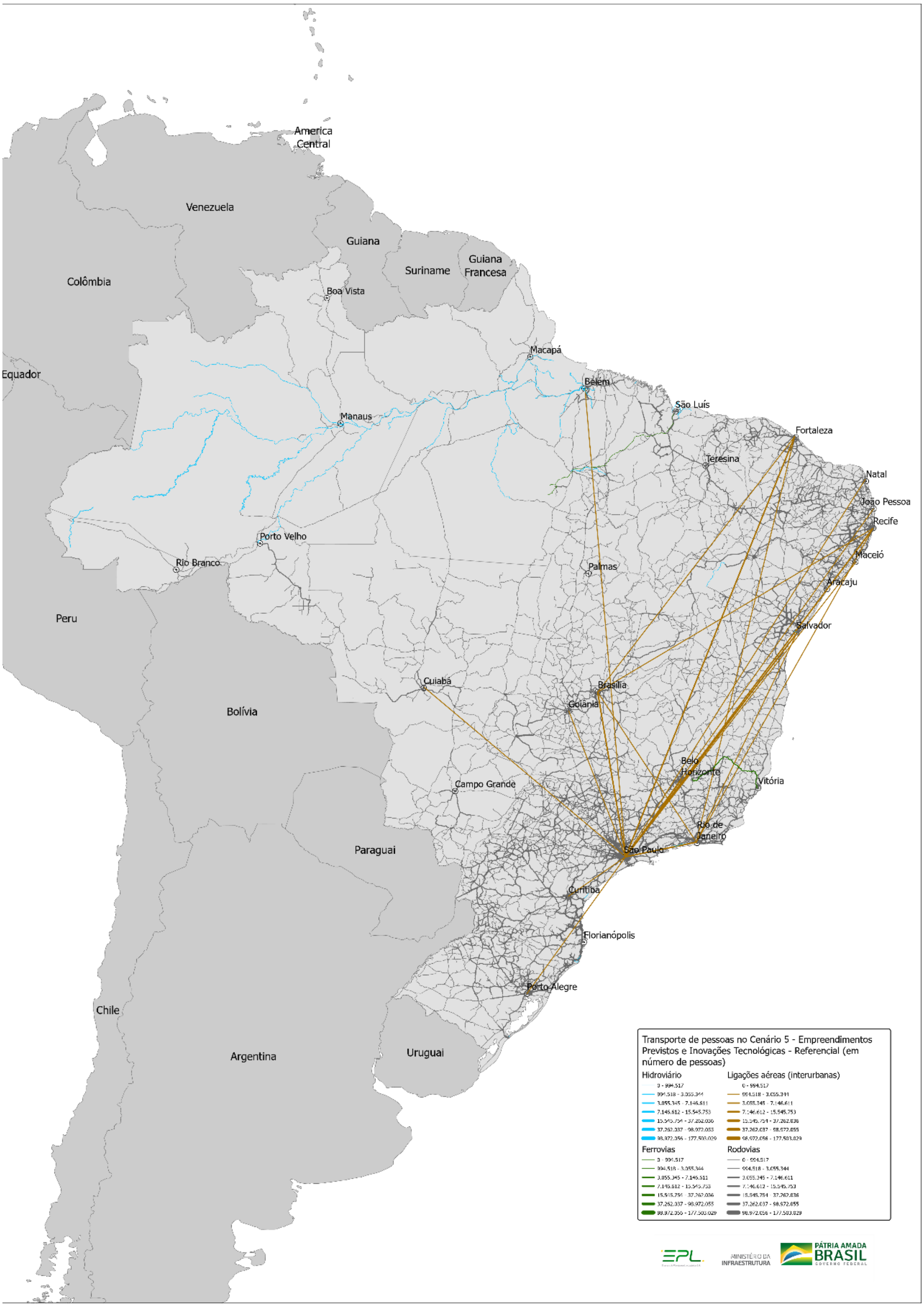
Mode	Scenario 2- Planned Projects - Referential		Scenario 5- Planned Projects and Technological Innovations- Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.852,79	51,36%	1.583,88	46,93%
Railway	1.248,79	34,62%	1.228,17	36,39%
Coastal Cabotage	305,24	8,46%	340,25	10,08%
Inland Navigation	151,97	4,21%	174,29	5,16%
Pipelines	46,75	1,30%	46,75	1,39%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.607,27**	**100%**	**3.375,07**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

The cost reduction seen on this scenario has a similar impact on the transport of people by automobiles and buses. Given a more cost-sensitive distribution of Freight vehicles, road saturations are distributed differently from Scenario 2, causing the routes chosen by these vehicles to intensify in some corridors. This configuration even impacts the Safety Index, which has a drop of three percentage points, as shown in Section 6.1.

Picture 73 shows the interurban flows of people allocated on Scenario 5.



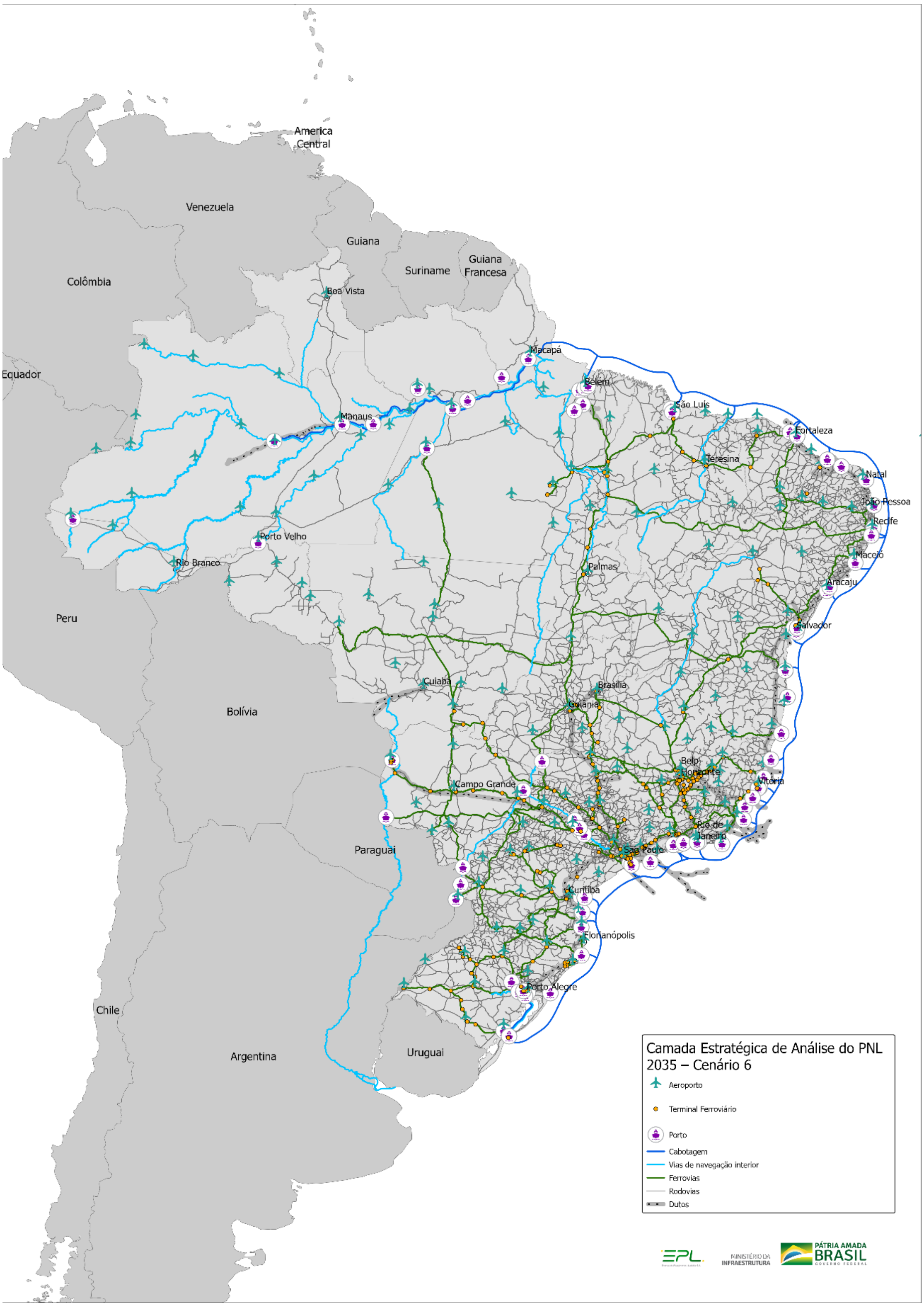
Picture 73: Allocated Interurban Flows of People - Scenario 5

Source: EPL (2021)

6.7. SCENARIO 6 - PROJECTS PROPOSED BY SOCIETY AND MARKETS - REFERENTIAL

The sixth scenario tested for the National Logistics Plan absorbs the contributions made during the Public Consultation, reflecting projects desired by society and by the states that had not been absorbed in the version made available in the aforementioned social participation process.

In this sense, the aforementioned scenario is the “richest” in terms of transport infrastructure supply, which transforms several “previously known” flows, causing Freight distributions across the country to be changed considerably. This abundance of infrastructure offer is quite visible when looking at the Strategic Layer of Analysis of Scenario 6, which comprises the Strategic Layer of Analysis of the 2017 Baseline Year Scenario, plus the entire infrastructure added in Scenario 6, as shown in Picture 74.



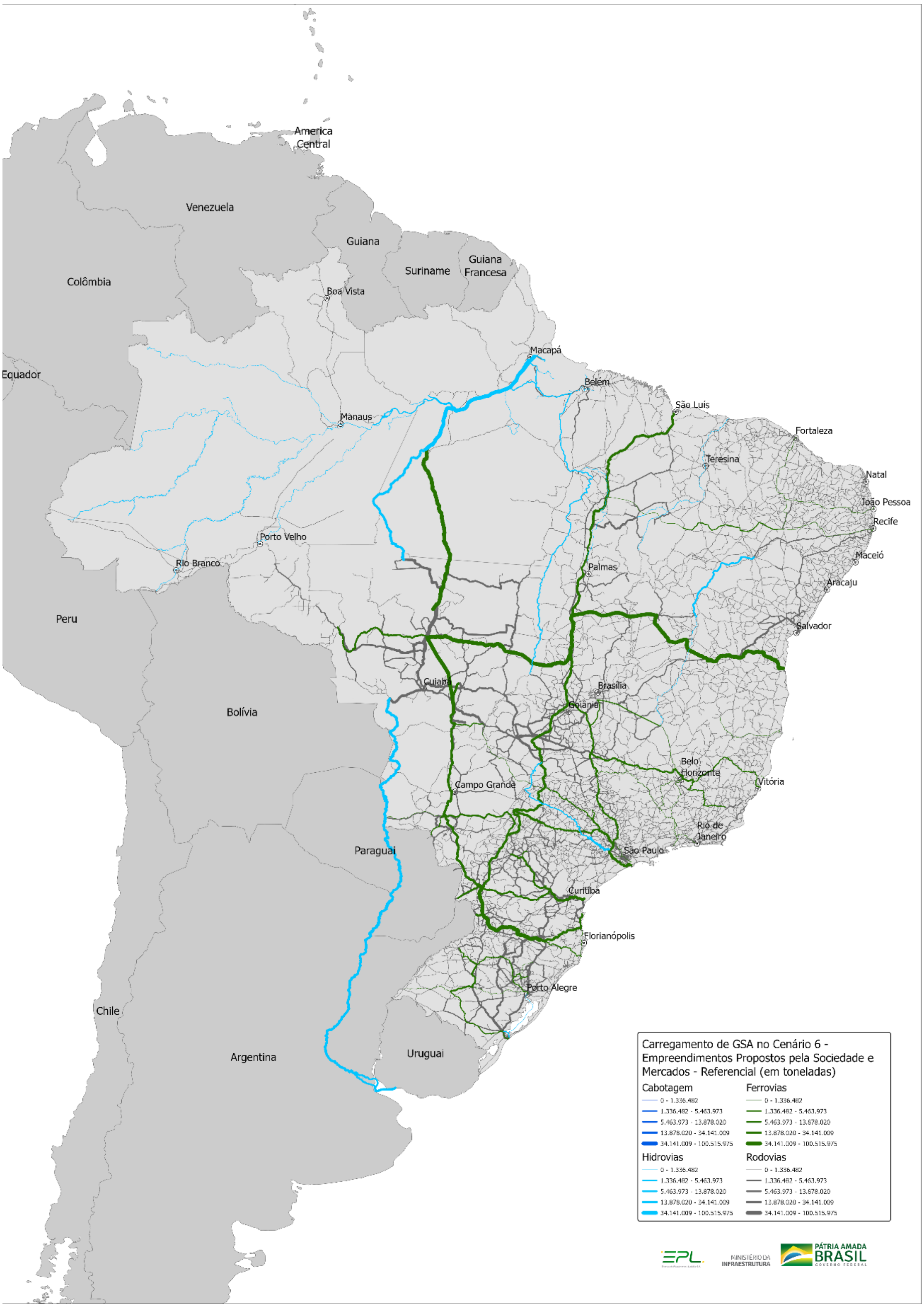
Picture 74 – Strategic Layer of Analysis considered for Scenario 6
Source: EPL (2021)

The first point that stands out in this scenario is the integration of the FICO railway, which for this scenario is extended to Porto Velho/RO, with the general Freight corridor already observed since Scenario 1, using roadways BR-319/AM, BR -364/RO, and the Rio Madeira waterway. Within the perspective that this Plan allows us to observe, there is a "need for a solution" for the corridor that connects Manaus/AM to the center of the country, especially to the consumer markets of Mato Grosso, Goiás and northern Mato Grosso do Sul, thus as a possibility of better integration with the Bolivian production and consumption market.

The railway connection that connects the East and West of the State of Santa Catarina, and the Litorânea Railway, connecting to Santa Catarina's ports, stand out. In this context, a general Freight corridor is formed, interconnected with the North-South Railway in Chapecó/SC. This same integration corridor is relevant in terms of the volume of Freight transported to Solid Agricultural Bulks, which will use the new infrastructure of the EF-484 and the Rumo Malha Norte to seek consumer markets in the countryside of Paraná, Santa Catarina and Rio Grande do Sul through that great corridor.

Still dealing with the effects of the new infrastructures, the extension of the waterway of the Paraná and Paraguay rivers, north of Corumbá/MS, has the effect of a significant increase in the volume of Freight transported, especially of GSA being imported and exported. Likewise, the other waterways also present Freight attractiveness, both for their transportation cost and their availability.

Picture 75 shows the GSA flows allocated in Scenario 6, by weight.



Picture 75 – Allocated Flows Scenario 6 – Solid Agricultural Bulk - GSA (by weight)
Source: EPL (2021)

With this, the volume of Freight in inland navigation doubles, in value and in percentage, in relation to Scenario 2. There is also the maintenance of the volume of Freight transported through coastal cabotage, with a marginal loss and which may be seen as an "equality" given the possible statistical variance of the model.

However, still with a very relevant number of works, the roadway mode has its participation in the transport matrix reduced, in relation to Scenario 2, being lower than the volume transported by the railways. This is since, in Scenario 6, the railway network starts to have high gauge integration, with projects that cross the country with the same transport structure. Furthermore, the railway mode has a network topology and no longer linear corridors. This topology favors interregional Freight exchanges over longer distances, leading the Freight vehicles to circulate as the first mile/last mile.

Table 19 presents the transport matrix simulated on scenarios 2 and 6.

Table 19- Brazilian transport matrix simulated on scenarios 2 and 6, in TKU

Mode	Scenario 2- Planned Projects - Referential		Scenario 6- Projects Planned by Society and Markets- Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.852,79	51,36%	1.418,87	39,54%
Railway	1.248,79	34,62%	1.531,83	42,69%
Coastal Cabotage	305,24	8,46%	297,68	8,30%
Inland Navigation	151,97	4,21%	291,18	8,12%
Pipelines	46,75	1,30%	46,75	1,30%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.607,27**	**100%**	**3.588,06**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)
Source: EPL (2021)

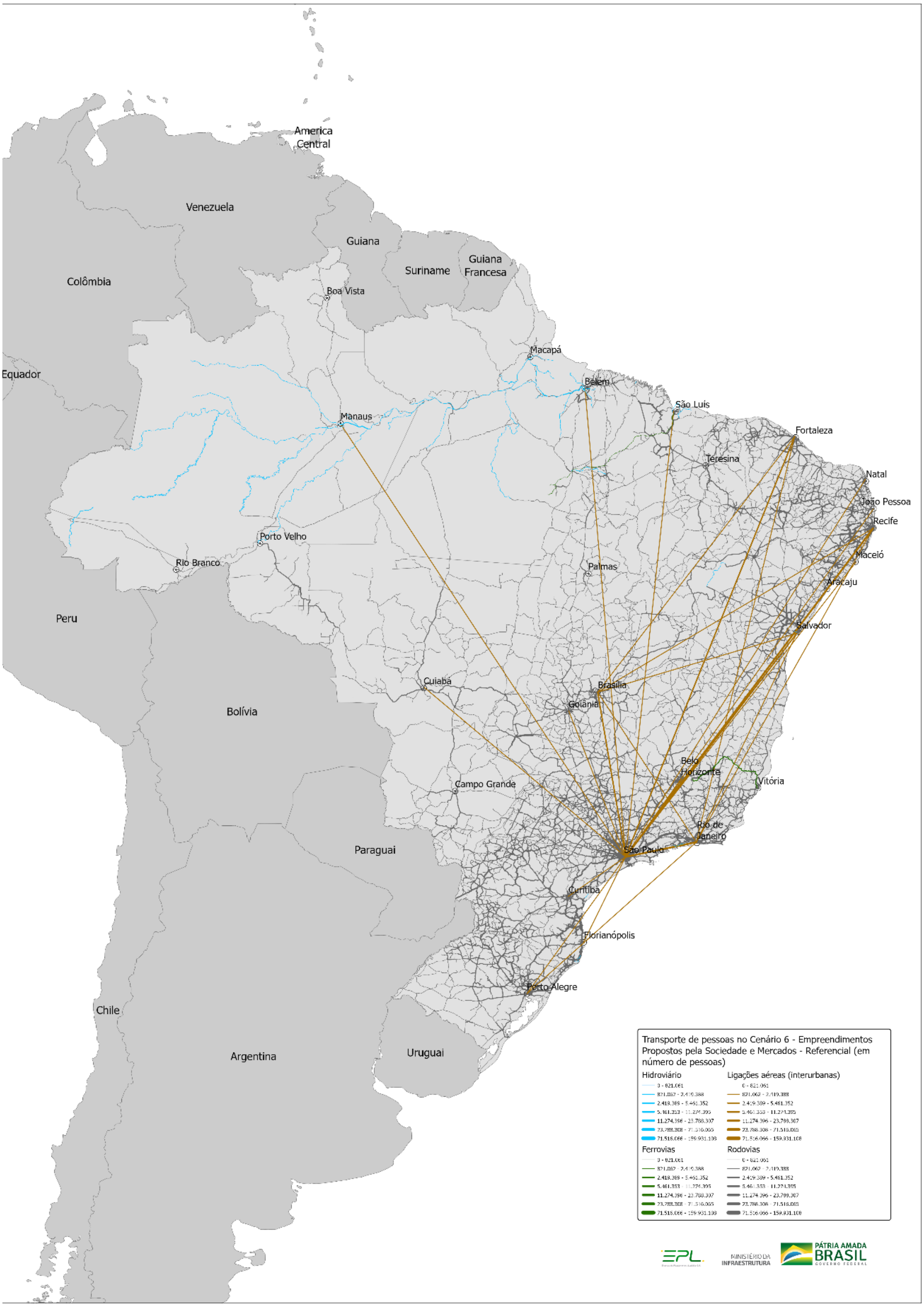
This setting of the scenario leads to two generalized effects relevant to the analysis:

- A reduction in the total TKU, which means that Freightes are traveling less within the country to reach their destination or a port, reflecting on the transport cost per TKU; and

- Even with all indications of capacity improvements in ports, some port-cities (which include public and private ports in just one rational element) present a "saturated" movement, that is, part of the rationality of national transport is independent only of supply displacement infrastructure (roads), it is important to prioritize, rationalize and structure the transshipment interfaces, represented mainly by the ports, to meet future scenarios, a problem to be faced in the context of the Port Sectorial Plan.

For the transport of people, investments in roads end up offering a very virtuous effect, both by offering more infrastructures with higher capacities and speeds, and by capturing Freight for other modes, which reduces the impedance for displacement and increases the attractiveness for the main corridors of people displacement.

Picture 76 shows the interurban allocated flows of people in Scenario 6.



Picture 76: Allocated Interurban Flows of People - Scenario 6/Source: EPL (2021)

6.8. SCENARIO 7 – PLANNED PROJECTS AND RAILWAY AUTHORIZATIONS – REFERENTIAL

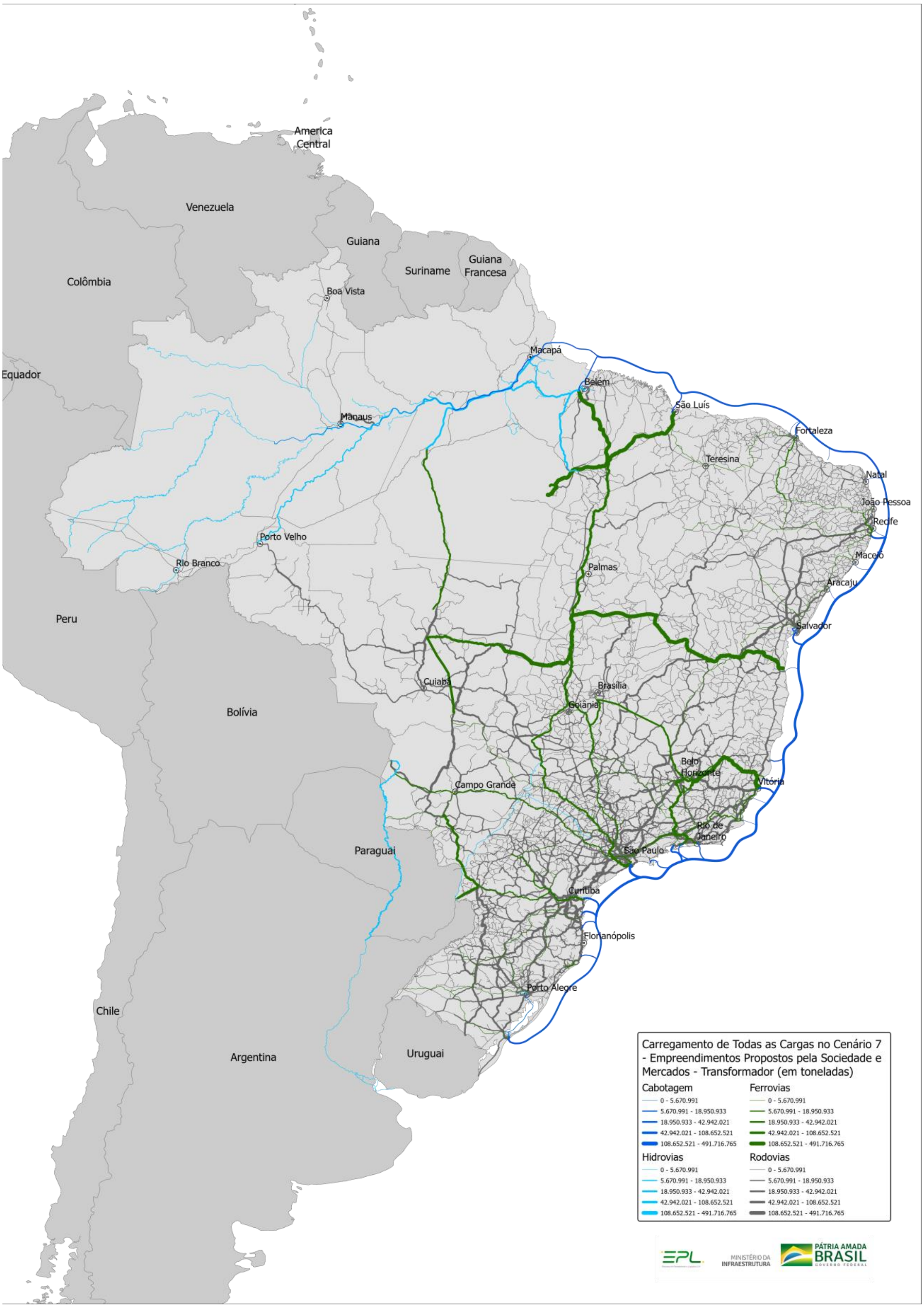
In Scenario 7 we sought to simulate the impact of the operation of new specific railway stretches that have a declared interest in operating under an authorization regime[29]. The excerpts in question are:

- TUP Açu – Anchieta, integration with EF-118;
- Foz do Iguaçu – Cascavel / Dourados – Maracajú, integration with Ferroeste;
- TUP Alcântara, integration with EFC;
- Sete Lagoas – TUP São Mateus, integration with EFVM e FCA;
- Rondonópolis – Cuiabá – Lucas do Rio Verde, integration with Rumo Malha Norte;
- Luziânia – Unaí – Pirapora, integration with EFVM;

The simulation was carried out on a preliminary basis, since there is no available and complete information for all cases, to the point of obtaining greater assertiveness in terms of terminal capacities, their exact location, railway layout and operational and technological conditions. Therefore, hypothetical traces were considered based on the information available in the processes dealing with the interest of operation, which resulted in different impacts on the transport network.

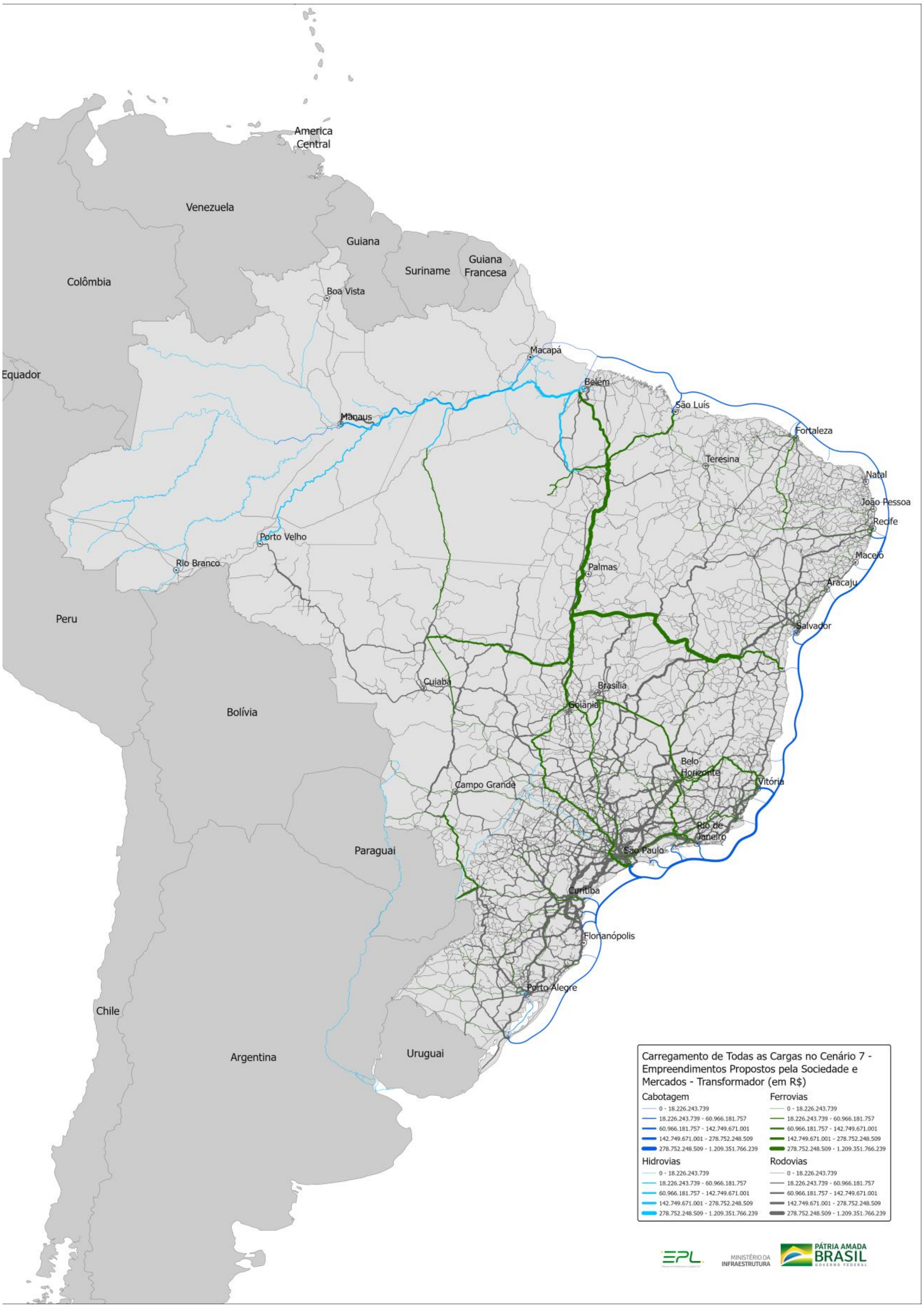
Pictures 77 and 78 show the allocated Freight flows on Scenario 7.

[29] During the period of development of the NLP 2035, the Ministry of Infrastructure had the six requests for specific railway authorizations described in this Scenario. However, after the launch of the Railway Authorization Program – *Pró Trilhos*, through Provisional Measure Nº 1.065/21, of August 30, 2021, other requests were made, which tends to enhance the impacts observed in this Report and indicates the need of future update/revision of the present scenario.



Picture 77: Allocated Flows Scenario 7 - All Freightes (by weight)

Source: EPL (2021)



Picture 78: Allocated Flows Scenario 7 - All Freightes (by value)

Source: EPL (2021)

Firstly, it is noteworthy that the simulation is not exhaustive in terms of the potential stretches for operation under the authorization regime and, it is also recalled that in the future scenarios of the NLP 2035, one of the assumptions adopted was the simulation of all railways stretches existing grids, even if inactive in the 2017 baseline scenario. With this, it is expected to capture operational potential, which in turn, could also find execution feasibility through authorizations in the event of the return of railway sections underutilized by the current Concessionaires.

Table 20 presents the modal share for Scenario 7 compared to the Counterfactual Scenario.

Table 20: Brazilian transport matrix simulated in scenarios Counterfactual and 7, in TKU.

Mode	Counterfactual Scenario		Scenario 7- Projects Planned and Railway Authorizations-Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	2.103,89	64,99%	1.798,70	51,61%
Railway	683,73	21,12%	1.192,84	34,22%
Coastal Cabotage	271,63	8,39%	300,47	8,62%
Inland Navigation	129,37	4,00%	144,91	4,16%
Pipelines	46,75	1,44%	46,75	1,34%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.237,11**	**100%**	**3.485,41**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL(2021)

This Scenario provides a greater capture of GSA Freight for the railways connecting the Southeast and South ports, moving part of the Freight that, in Scenario 2, for example, would be drained through the Arco Norte. The railway connections of the Rumo Malha Norte network provide smaller covered lengths when compared to the FICO-FNS-FIOL system, and for this reason, the total TKU, as well as the railway TKU, are slightly lower in Scenario 7 when compared to Scenario 2. On the other hand, both show significant gains in relation to the Counterfactual Scenario (Table 20).

It was observed that the increase in Freight attributed to the currently existing grids and greater flow through the Southeast and South ports would impact a higher cost for the system when compared to Scenario 2, for example, as well as a higher average cost, due to higher occupations of the available capacities of these infrastructures, and at higher operating costs than new railroads. This type of impact is mainly due to the extensions of the Rumo Malha Norte network and the Luziânia – Unaí – Pirapora link. Both provided greater Freight capture for the currently active railway networks that connect to the ports in the Southeast.

On the simulations carried out, there were behaviors that showed the need for more detailed data on the projects considered, as well as the expansion of the views of these proposals for a more systemic look. The EF-118 connections with the ports of Açu and Anchieta and the *Ferroeste* extensions to Foz do Iguaçu and Maracajú, captured a reasonable amount of Freight compatible with the local impact and its extensions.

The connection from the Carajás Railroad to the future Port of Alcântara, faced difficulties in the allocation of Freight. As the NLP 2035 model works with annualized and aggregated flows, the Freight of a given origin/destination/product/year is indivisible and looks for the most appropriate path in terms of cost and time to meet your need for movement between the different options offered in the intermodal network. It so happens that, in this case, the iron ore export flows, as well as other products considered as potential for the railway, were allocated in the operating segment of the EFC that connects with the Port of Itaqui, or in different alternatives in Pará (Vila do Conde, in Barcarena/PA and Belém/PA), because of offering more attractive cost conditions, even considering saturations in these locations and the impact of this on costs. It is observed that, in the case of the railway in question, the project needs to provide for very attractive competitive conditions, and also take into account any increases in the capacity of the existing flow options.

Similarly, the simulated connection between the city of Sete Lagoas/MG and the TUP of São Mateus/ES also presented low competitiveness in relation to the existing flow option by FCA, from Governador Valadares/MG to Vitória/ES, which has cost and capabilities that are more attractive than the reference situation. Under the simulated conditions, not a lot of Freight was attracted to this railway.

However, the extension of the northern network, from Rondonópolis, passing through Cuiabá, to Lucas do Rio Verde, showed potential for loading, exceeding 50 million tons/year in both directions, with most of the Freight (58%) directed to the North, with the objective of achieving integration with FICO and following the flow through the Arco Norte through the FICO-FNS-FIOL railway system. The part of the Freight directed to the ports in the Southeast enhances the competitiveness among the options for shipping this productive region abroad.

The railway link between Luziânia/GO, Unaí/MG, Pirapora/MG and the FCA grid also shows potential for attracting Freight to the ports in the Southeast, with potential Freight of over 20 million tons.

Among the currently inactive railway stretches, several had good shipments in Scenario 7. There was an increase of 17.5 billion TKU for the railway mode from shipments in currently inactive stretches, in addition to the corresponding increase in the supply of the networks they comprise.

In the Rumo Malha Oeste network, there was a potential to load 7MM tons of Iron Ore per year, in addition to about 75.000 tons of Other Minerals. This Freight is essentially captured from the reactivation of sections that connect Corumbá, Porto Esperança and Miranda, in Mato Grosso do Sul.

Similarly, the reactivation of Rumo Malha Paulista, on the Araraquara-Barretos branch, in São Paulo, the stretch from Barrinha/SP to Araraquara/SP would attract around 400.000 tons of sugar per year.

The reactivation of stretches of the *Transnordestina Logística* Railway (FTL), between Aracajú and Maceió, also had the potential to attract around 500.000 tons a year, mainly from NCGC.

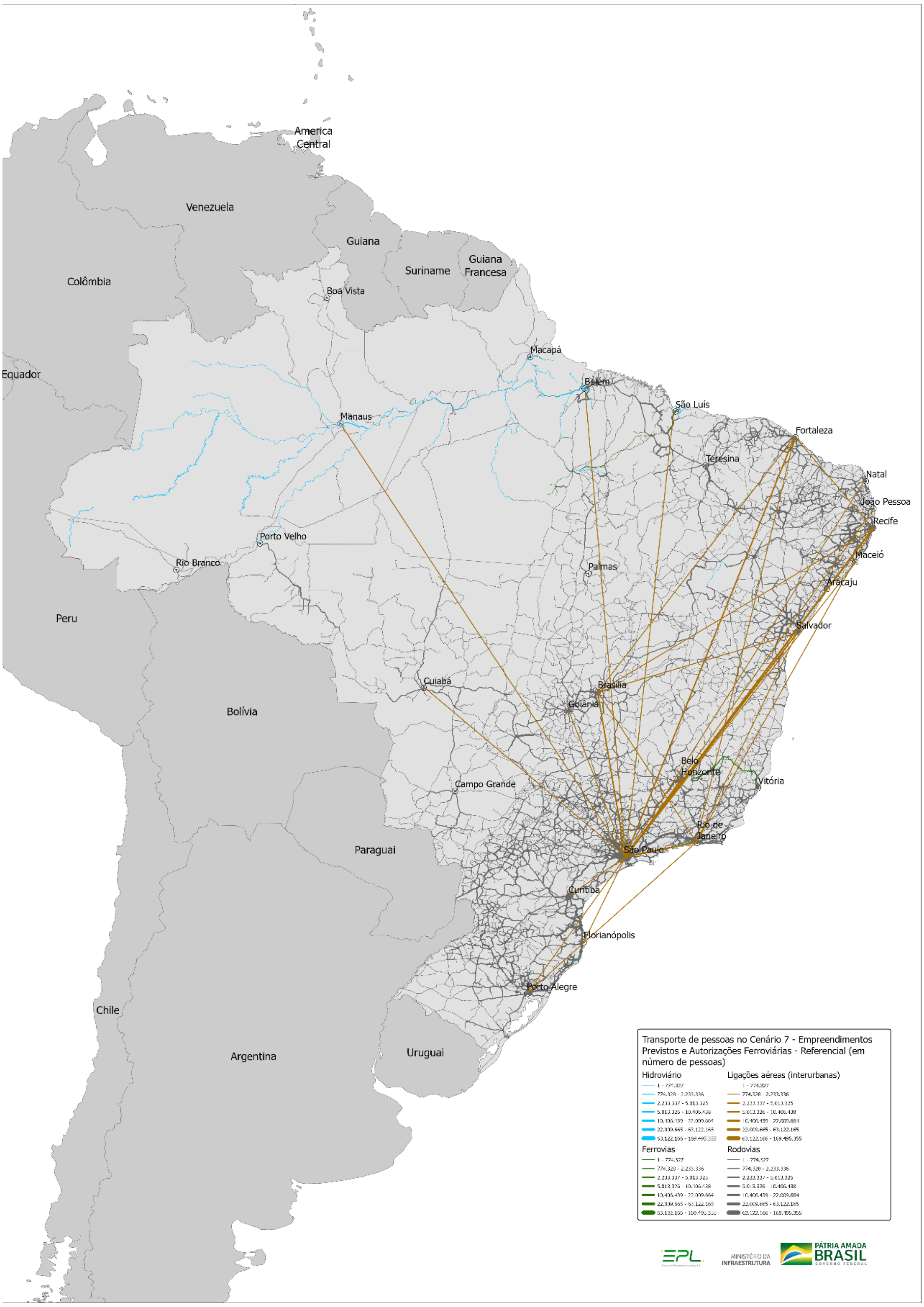
In general, it was observed that the shortlines simulated in Scenario 7, along with the potential stretches reactivated in this and other future simulated scenarios, have the potential to increase the railway TKU by 12%, or 128 billion TKU, with an impact on the reduction of the average cost of the entire transport system by 3.5%, which would bring a reduction of R$ 8,46 billion per year in costs spent on transport in Brazil.

The level of CO2eq emissions of the national transport system has a reduction potential with the shortlines and reactivated stretches of 1.630.898 Gg (or 1.631 tons). In financial terms, this corresponds to savings of BRL 116,49 million[30].

There were no significant changes in the configuration of Freight transport in other regions not affected by the activation of inactive stretches or by the simulation of the new stretches considered.

Picture 79 shows the allocated interurban flows of people on Scenario 7, which do not show relevant changes in relation to Scenario 2.

[30] According to parameters of the Cost-Benefit Analysis Methodology used by EPL, each ton of CO2eq not emitted corresponds to R$71,43 in 2020 values.



Picture 79: Allocated Interurban Flows of People – Scenario 7
Source: EPL (2021)

6.9. SCENARIO 8 – MERGE OF SCENARIOS 1 TO 7 – TRANSFORMATIVE

The eighth scenario simulated and presented for this Plan is a superposition of all the previous scenarios. Although the combination of specific effects of each of the scenarios simulated independently can potentialize behaviors, making a deeper analysis difficult, the scenario plays an important role in being a comparison hyperbole, allowing more discrete effects in the previous scenarios to present themselves in an "exaggerated" way for a conscious and scientifically adequate discussion.

This superposition of effects thus appears in the modal matrix, as seen in Table 21. As this scenario has a transformative matrix, its most appropriate comparison is in relation to Scenario 3.

Table 21 - Brazilian transport matrix simulated on scenarios 3 and 8, in TKU.

Mode	Scenario 3- Projects Planned-Transformative		Scenario 8- Merge of Scenarios 1 to 7-Transformative	
	TKU (bilhões)	Modal share	TKU (billions)	Modal share
Roadway	2.197,25	52,49%	1344,47	32,17%
Railway	1.420,63	33,94%	1973,57	47,22%
Coastal Cabotage	340,49	8,13%	503,15	12,04%
Inland Navigation	170,52	4,07%	301,70	7,22%
Pipelines	54,84	1,31%	54,84	1,31%
Airway	1,95	0,05%	1,95	0,05%
Total	**4.185,68**	**100%**	**4.179,68**	**100%**

Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021)

In this context, there is a reduction in road freight transport of about 850 billion TKU, which is absorbed by the high availability of railways, the effect of Scenario 6, and the reductions in port and cabotage costs, the effect of scenarios 4 and 5.

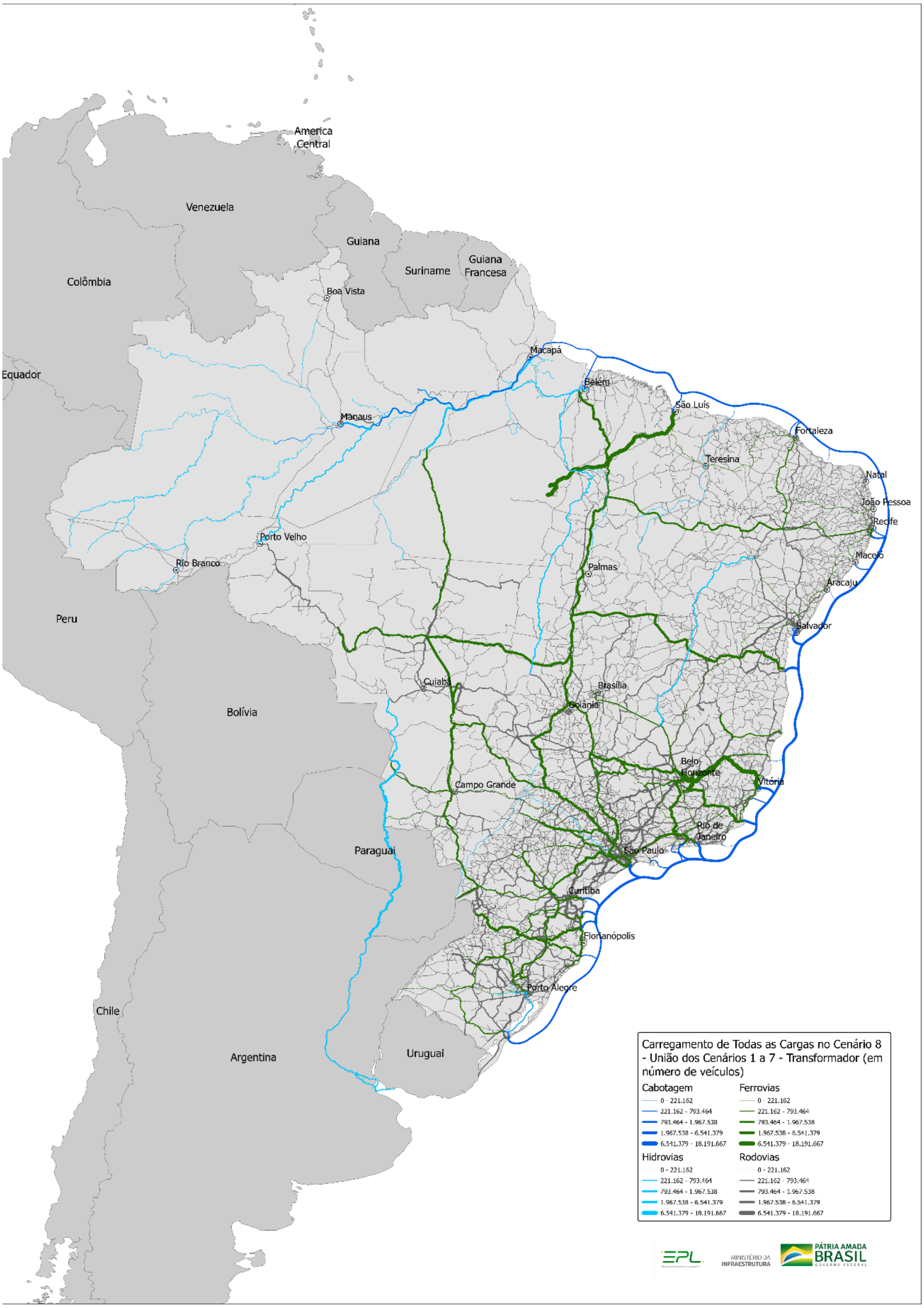
In the perspective proposed for Scenario 8, and within the precautions and limitations necessary for this type of analysis, it is possible to reaffirm that high-capacity transport presents itself as an opportunity to adjust the rationality of the transport matrix. It is also possible to reiterate that, although we can imagine scenarios with very high availability of infrastructure, moderate costs for modal transfer and for displacements, the importance of road freight transport has a minimum value of about 33% in the TKU division, even in hypothetical scenarios and quite disadvantageous for that mode. This situation is explained by the Brazilian territorial dynamics, which results in a high number of “first and last mile” trips, which can be rationalized.

Another observation regarding the hyperbole of Scenario 9 is the confirmation of the non-rejection of General Freightes and Non-containerize General Freightes to railway infrastructure. This attractiveness, to be reaffirmed within the PSTT (Transportation Systems Sector-Specific Plan), may offer a different paradigm for analyzing the viability of railways that, potentially, no longer act as "end-to-end" commodity flow conveyors and present a potential attractiveness for the distribution of medium and long distance of industrialized Freight on the countryside.

The map of the total number of freight vehicles in Scenario 8, shown in Picture 80, allows us to precisely observe the aforementioned assertions, as well as the simultaneous operation of the different railway projects, without the cancellation or "theft" of freight between them.

A relevant fact to be highlighted is that both in Scenario 8 and in Scenario 6, the amount of Freight in large-capacity modes would be such that the vehicular fleets would need considerable investments and expansion, not computed in the simulations of this NLP. The sea fleet, for example, would need to offer a capacity twice as large as that currently available, evidencing the need for market initiatives and promotion of shipbuilding if the development of the transport system is configured as in this Scenario.

It is reinforced that scenario 8 unites all the variables from the previous scenarios, and probabilistically, we can say that the greater the number of variables and projects, the lower the chance of the development of the transport network being configured in this way.

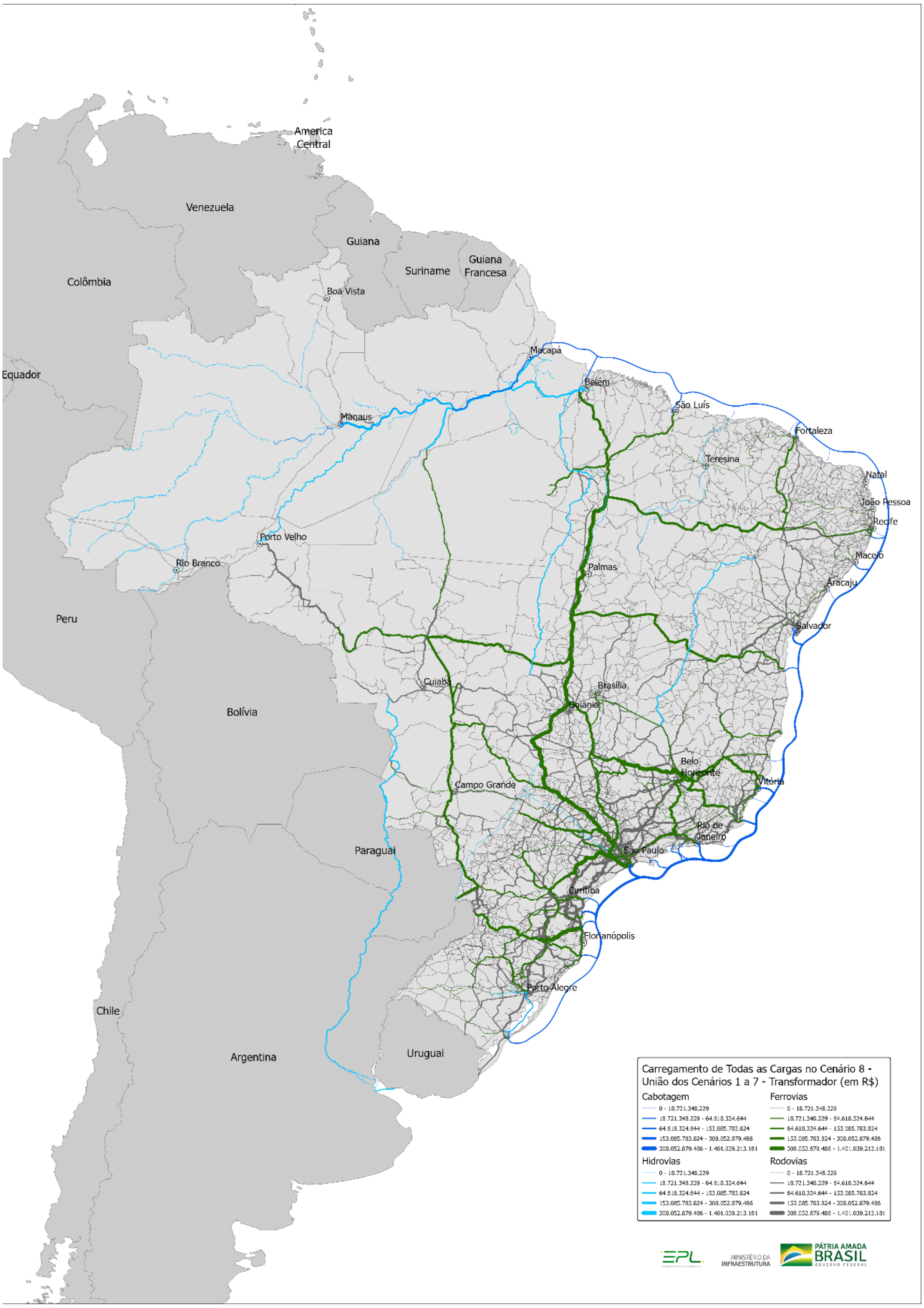


Picture 80 - Allocated Flows Scenario 8 - All Freightes in Vehicles

Source: EPL (2021)

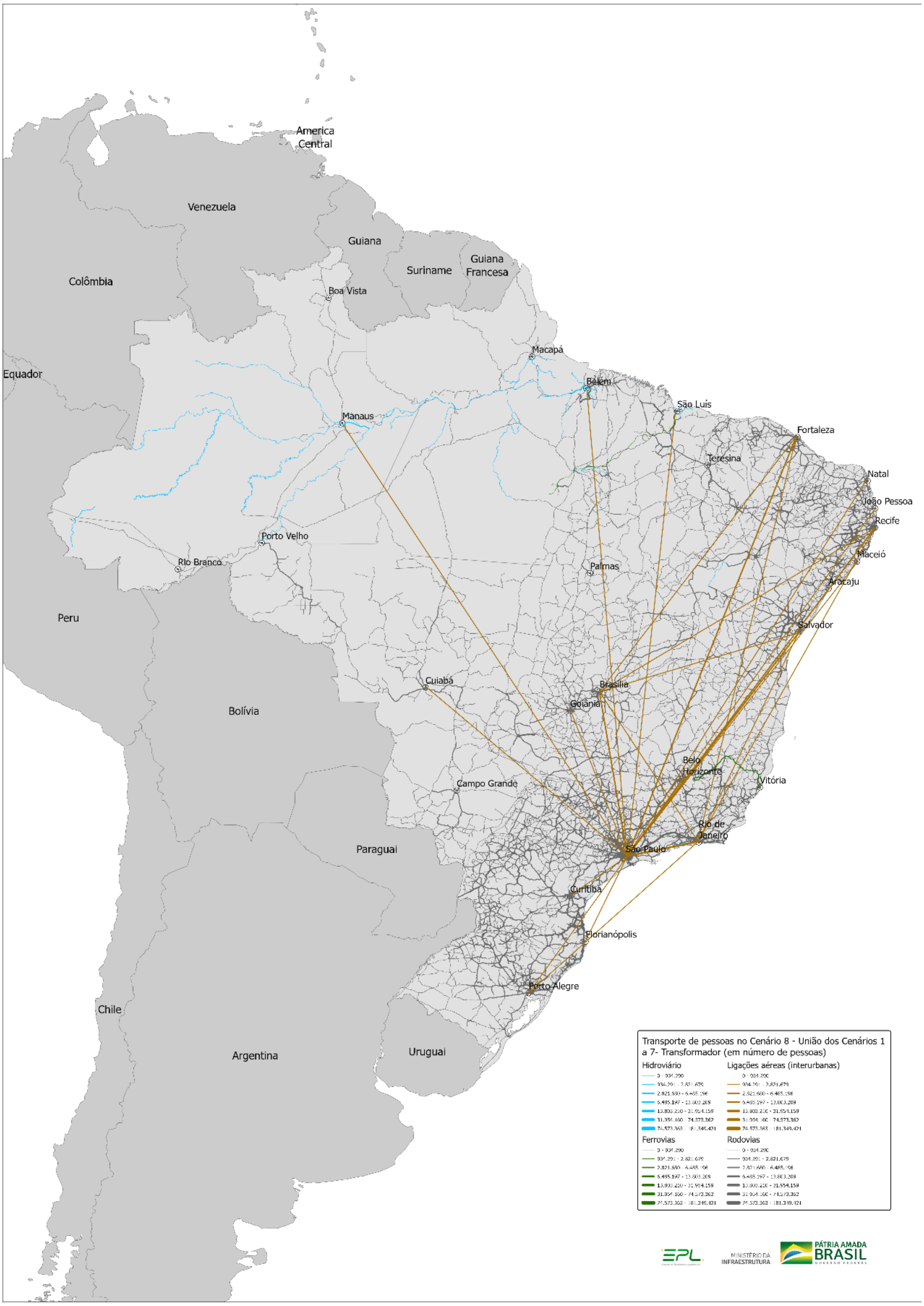
The distribution of Freight by value (VKU) shows the ports in the South and Southeast regions, in particular the ports of Santa Catarina, Paraná and São Paulo, as potential centers for attracting Freight for subsequent internal distribution in the country through the railways.

Picture 81 shows the allocated Freight flows in Scenario 8, by value.



Picture 81: Allocated Flows Scenario 8 - All Freightes (by value)
Source: EPL (2021)

Picture 82 shows the allocated interurban flows of people in Scenario 8, which reinforces the same trend of increased demand for air transport in long-distance interurban flows observed in the other scenarios.



Picture 82: Allocated Interurban Flows of People – Scenario 8

Source: EPL (2021)

6.10. SCENARIO 9 – MAIN OPPORTUNITIES FOR THE DEVELOPMENT OF THE NATIONAL TRANSPORT NETWORK – REFERENTIAL

6.10.1. Scenario 9 Conception

Scenario 9 simulated and presented in this NLP 2035 has its conception based on a specific methodology, which raises the clarifications presented here.

After the simulation of the different Scenarios of the NLP 2035, the number of variables involved and the variety of results demonstrate the need for strategic transport plans to present flexibilities and different hypothesis for the development of the planned systems. On the other hand, the amount of data and the findings of the simulations carried out make it possible to identify specific action opportunities that can configure gains in meeting the objectives of the National Transportation Policy.

In this dichotomy, the option is to draw one more scenario for the NLP 2035, not to stiffen the development path of the transport network, but to configure itself as another development option, this time, based on the choice of infrastructure in a systemic analysis and linked to the variables studied in the plan, which, as recorded, do not cover the totality of intervening variables in the territory transformation process through its interaction with the transport systems.

Based on the different projects and interventions simulated in Scenarios 1 to 8, the objective of Scenario 9 is **to select the projects that caused the most transformative positive impacts in the previous scenarios, seeking to build a more economical transport network development alternative, but which preserve part of or the major positive impacts.**

To this end, the following methodology was adopted:

- Selection of analysis scenarios;
- Selection of indicators that underwent major changes between scenarios with changes exclusively in infrastructure;
- Spatialization of indicators (calculation of each indicator by geographic unit);
- Selection of regions that achieved significant improvements according to the indicators;
- Selection of infrastructure with the most representative impacts in these regions;
- Calculation of an overall impact factor for these infrastructures;
- Linking with the simulated works/projects/interventions that affected the infrastructures with the greatest impact factors;
- Ordering of works/projects/interventions by impact factor and selection, up to a pre-established investment limit;

- Simulation of works/projects/interventions in the functional simulation model of the NLP 2035; and
- Scenario Evaluation.

Detailing the procedures further, we start by **selecting the analysis scenarios**. As the ultimate goal of the construction of Scenario 9 is the search for infrastructure that has the most impact on the NTP's objectives, it would not be appropriate to evaluate scenarios that simulate changes beyond the infrastructure, as it is not possible to clearly identify whether a certain change in an indicator was caused by change in infrastructure, or by another simulated variable, such as the impact of *BR do Mar*, changes in costs arising from transport technologies or differentiated economic growth (transforming matrix).

Thus, the impacts of the indicators between scenarios 2, 6 and 7 were exclusively analyzed in relation to Scenario 1. In all these scenarios, the same transport matrix (referential) is used and there are no variations in terms of technology. The differences between these scenarios can be exclusively explained by changes in the simulated transport networks. The comparison to Scenario 1 is justified by the fact that the construction of the proposal for Scenario 9 cannot conflict with projects considered "in progress", that is, those already qualified in the PPI, when it comes to partnerships with the private sector, or with a budget provided for in the Pluriannual Plan (PPA), as it is a government commitment to implement it. Therefore, for Scenario 9 all projects from Scenario 1 are considered, plus the selection of projects or interventions that cause more transforming impacts

For the **selection of analysis indicators**, the variation of values found in scenarios 2, 6 and 7 in relation to Scenario 1 was observed for each element of representation.

The indicators showed the maximum variations as shown in Table 22. It is observed that part of the indicators does not show great variations between the scenarios, which highlight needs that will be addressed in Chapter 7. Other indicators are not suitable for the regionalized analysis proposed here: the “Disbursements” indicator is an input, which reflects interventions in infrastructure, and therefore, cannot be evaluated as a result of the simulation. However, the “Impact of investments on GDP” is also not applicable to this type of analysis on a geographic scale due to the General Equilibrium model adopted, which has statistical representation and is explanatory at the national level, or at most, in large regions. The use of this model in smaller units would bring distortions and low representativeness to the results.

Table 22: Maximum variation of indicators of scenarios 2, 6 and 7 in relation to Scenario 1.

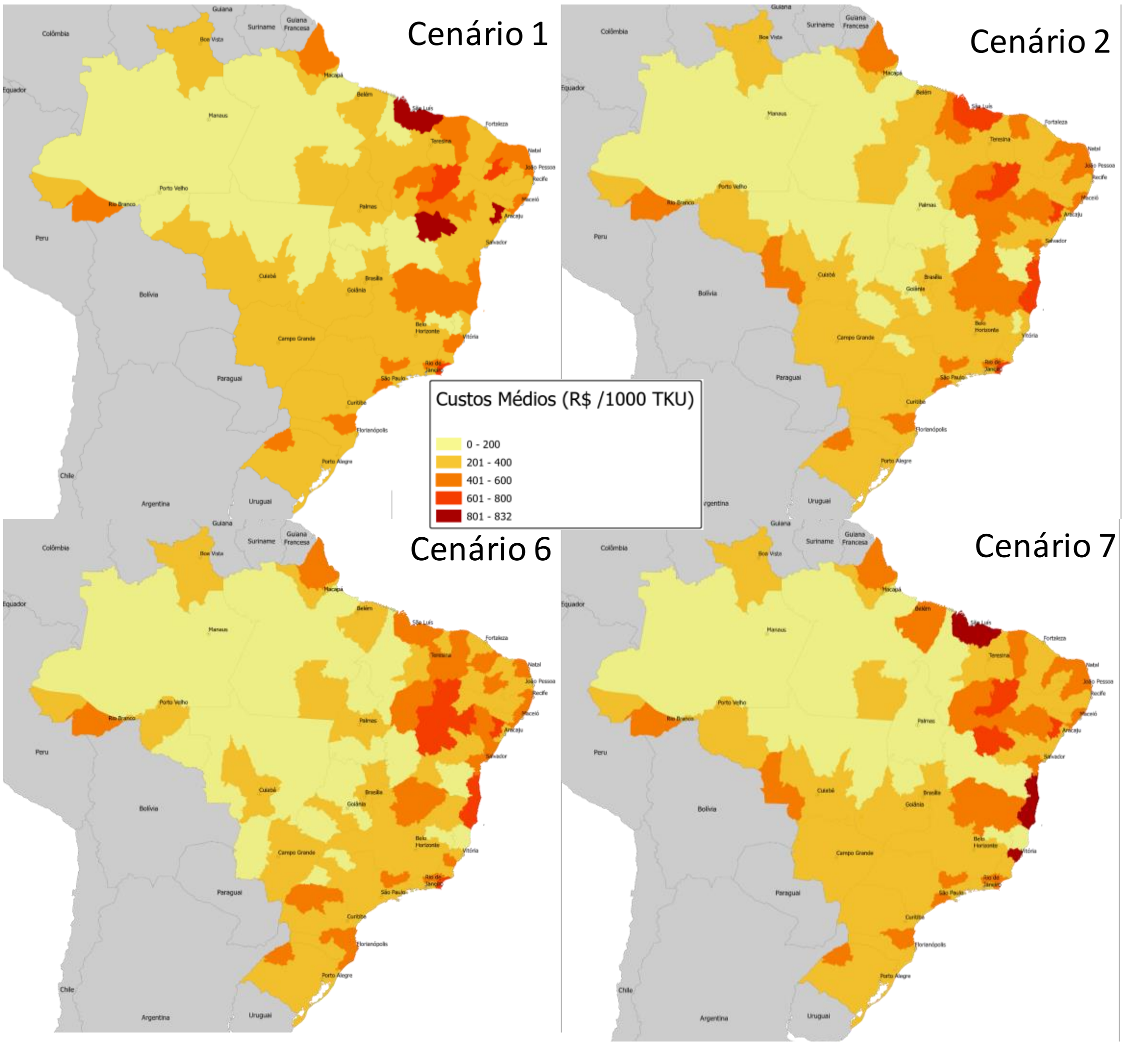
Indicator	More transformative variations in indicator results
Volumes of greenhouse gases emitted	-7,69%
Weighted average time for Freight transportation	0,13%
Weighted average time for people transportation	-4,13%
Freight transportation cost	-16,70%
Average cost of Freight transportation	-26,87%
Average cost of transportation – International clipping	0,39%
Relative Weighted Average Time Variation for Freightes	-0,90%
Weighted average time for Freightes in the international clipping	-0,63%
Weighted average time for Freightes in the defense and national security clipping	-0,16%
Disbursement	N/A
Safety Index	-6,52%
Impact of investments on GDP	N/A

Source: EPL (2021)

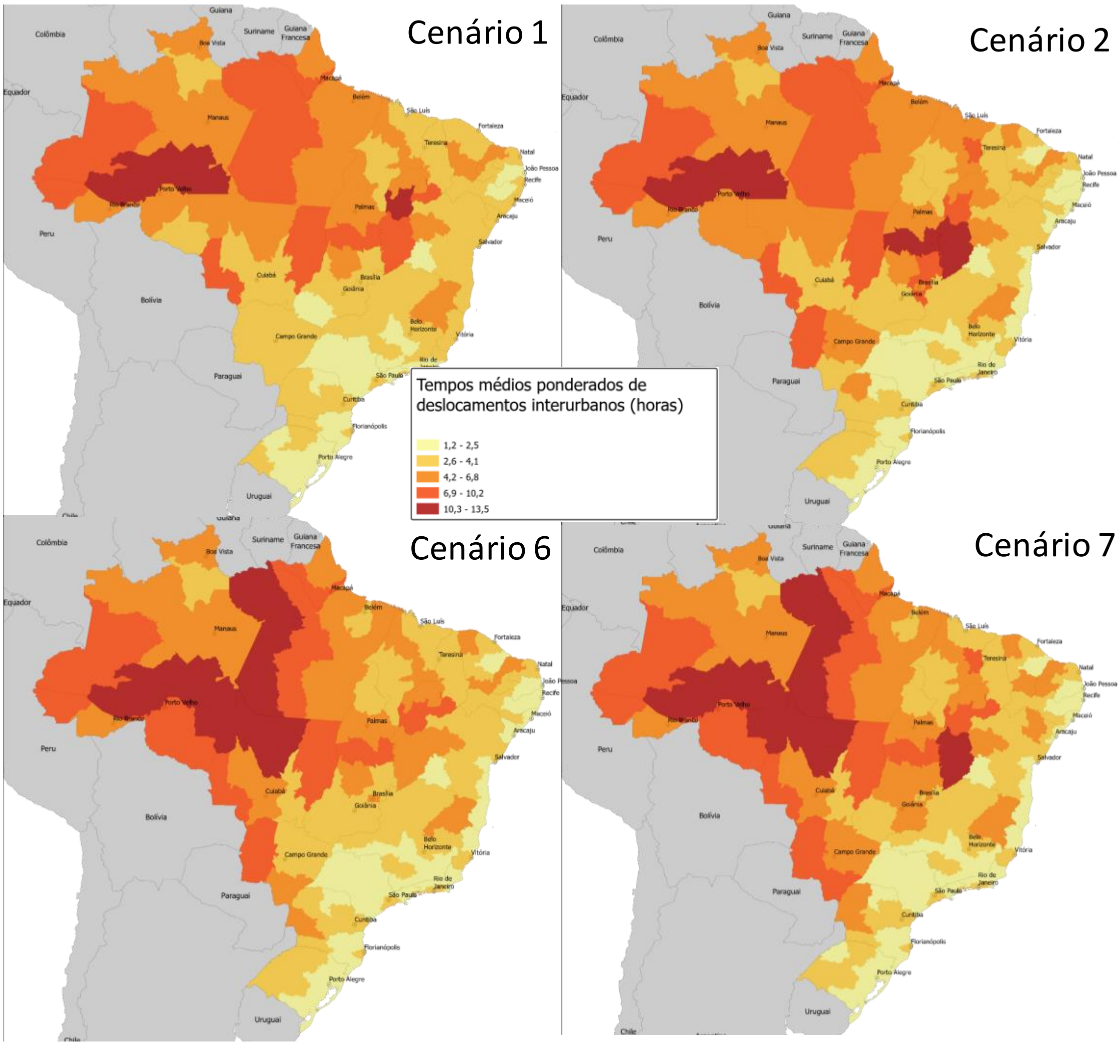
Given the explanations of the exceptions, it is evident in Table 22 that the indicators of **"Average Freight transportation cost", "Weighted average time for transporting people", "Volume of greenhouse gases emitted" and "Safety Index"** were the ones that presented the most transformative reductions in the simulated Scenarios, with all maximum variations above 4%. In other words, it can be assumed that some infrastructure changes that were simulated in scenarios 2, 6 and 7 impacted Greenhouse Gas Emissions, Interurban Travel Time for People, Cost for Freight Transport and Road safety. The Total Cost of Freight Transport has also changed greatly. However, this indicator has a direct correlation with the Average Cost, which was more impacted and still it is just an additional way of measuring the same representation element (Efficiency). The use of this metric is then dismissed, as it would lead to the same conclusions as Average Cost.

Then, we moved to the **spatialization of indicators**, which consists in calculating each indicator by geographic unit. The “Intermediate Geographical Regions”, established by the IBGE (2017), which correspond to an intermediate scale between the Federation Units and the Immediate Geographical Regions, was adopted as the appropriate geographic unit for this analysis. These regions organize the territory, articulating the Immediate Geographical Regions through a higher hierarchy pole differentiated from the private and public management flows and the existence of more complex urban functions. In addition to presenting adequate sizes to capture impacts of transport infrastructures of national relevance, which mostly cross municipal boundaries or population arrangements, such geographic dimensions group municipalities with evident socioeconomic relationships in their immediate surroundings.

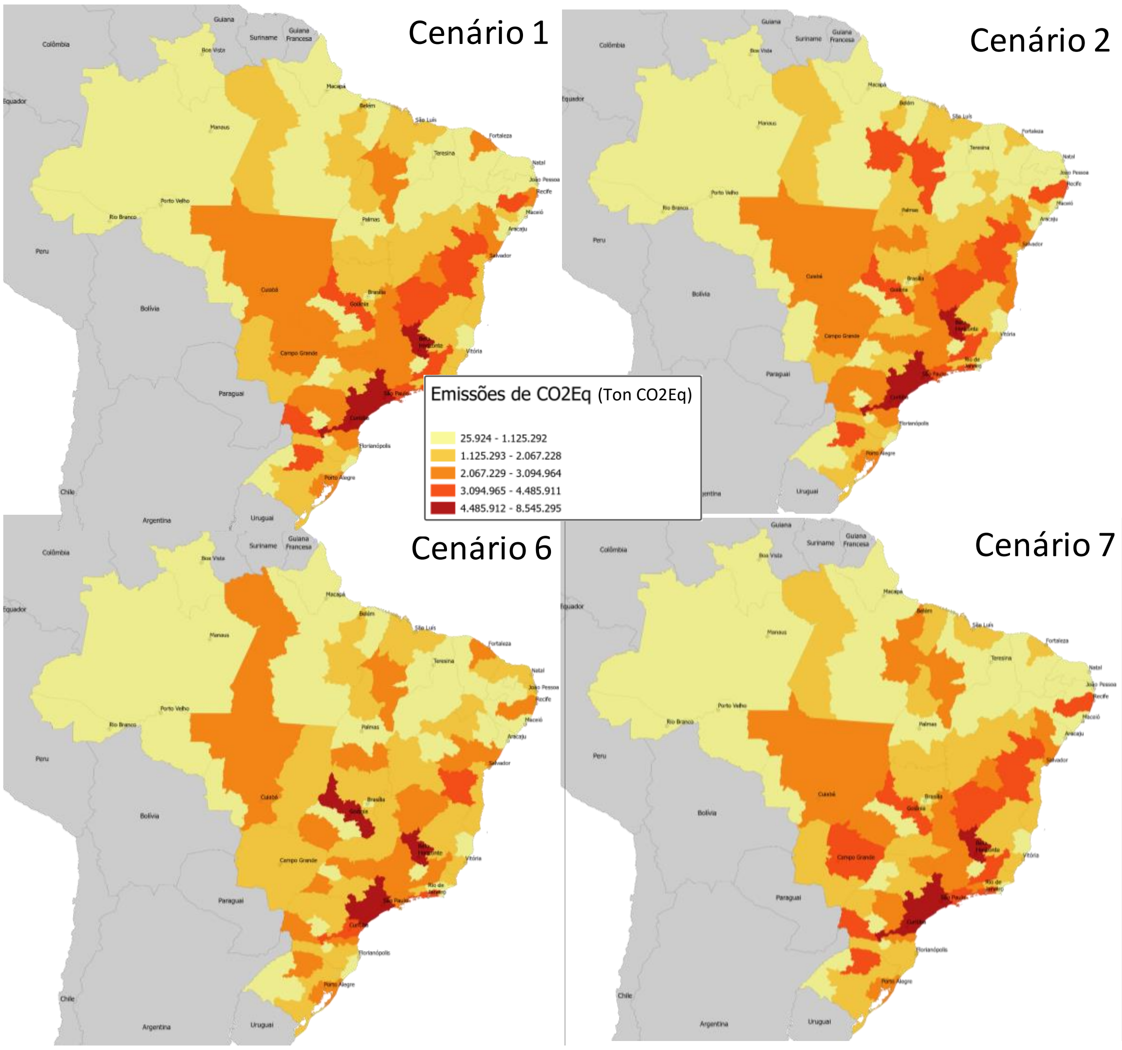
For the selected indicators and scenarios, the values for each Intermediate Region were observed, adopting the calculation methodologies presented in Appendix I applied in this smaller unit, with an adjustment in the Average Time for Transportation of People indicator, which in this case is presented in “hours” and weighted by the volumes of interurban travel of the TUPs that make up the Intermediate Regions. The value, then, represents a weighted average time that the population located in each unit would take to meet their main demands for interurban travel. The results can be seen in pictures 83 to 86.



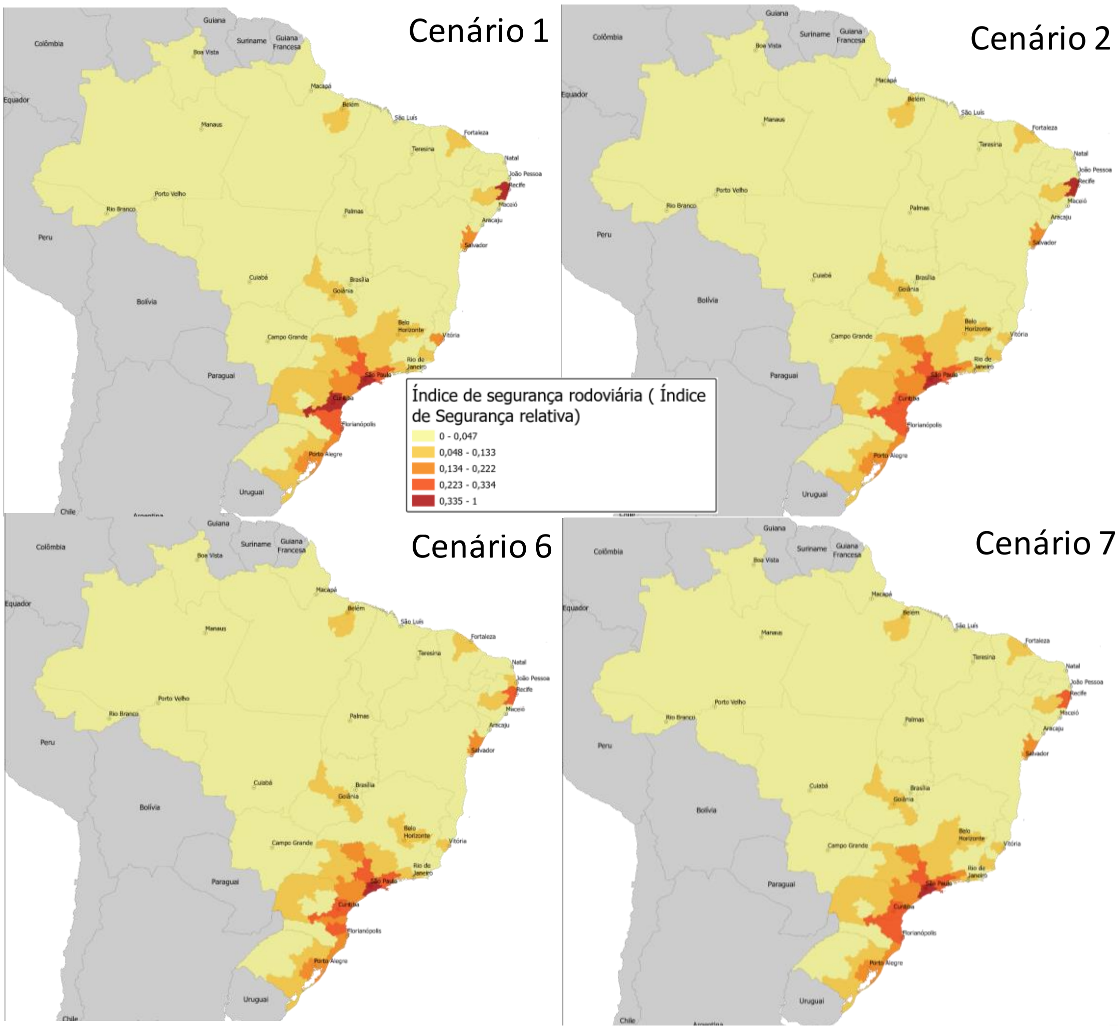
Picture 83: Average cost of Freight transport for Scenarios 1, 2, 6 and 7, in R$/1000TKU, by Intermediate Geographic Region/ Source: EPL (2021)



Picture 84: Weighted average time of People transport for Scenarios 1, 2, 6 and 7, in hours, by Intermediate Geographic Region/Source: EPL (2021)



Picture 85: Volumes of greenhouse gas emissions emitted for Scenarios 1, 2, 6 and 7, in Ton of CO_2Eq, by Intermediate Geographic Region/Source: EPL (2021)

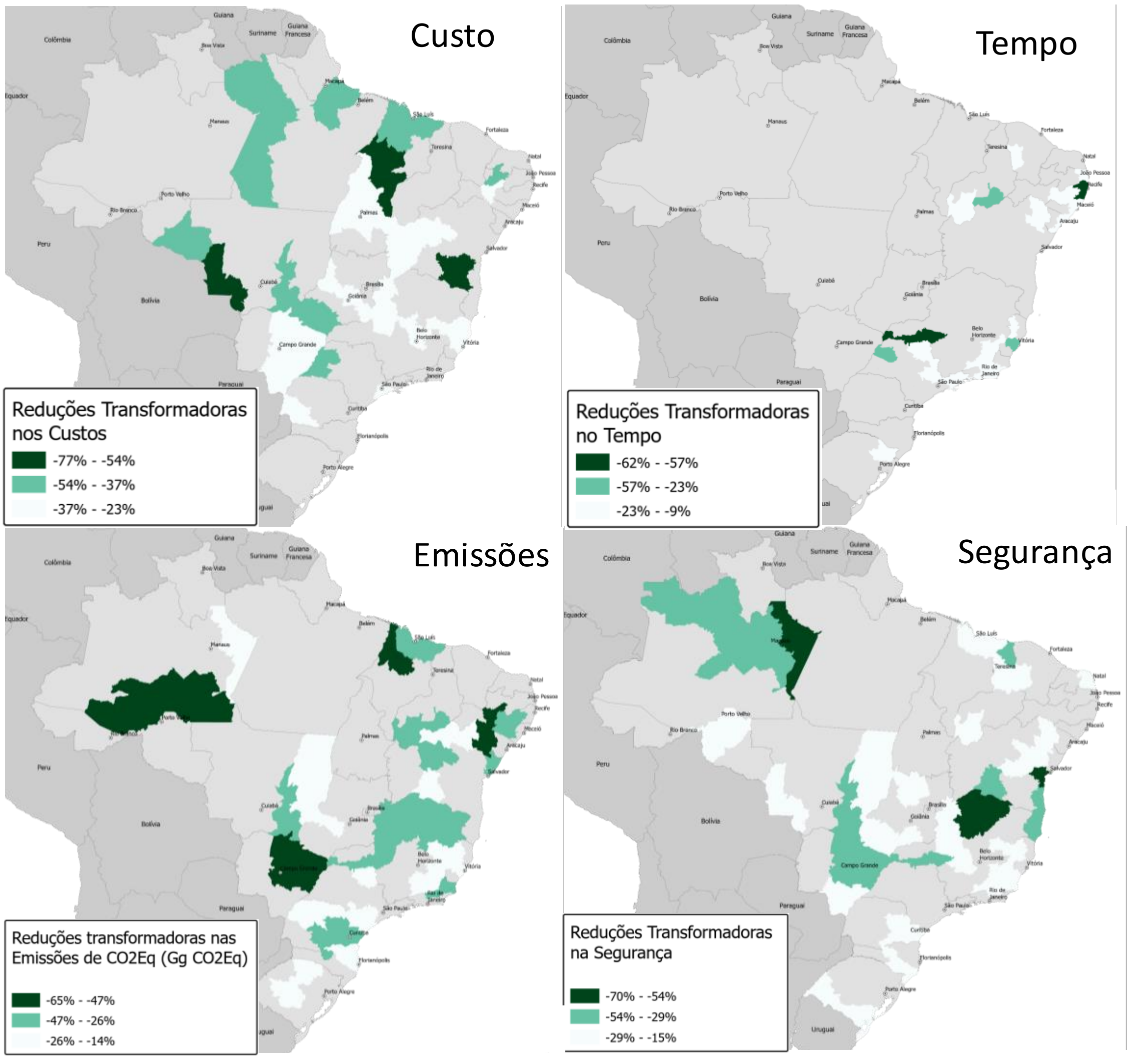


Picture 86: Safety index for Scenarios 1, 2, 6 and 7, by Intermediate Geographic Region/Source: EPL (2021)

Based on the observed values, the regions that **obtained significant improvements according to the indicators** were identified. For this, the level of improvement in the indicators' values was evaluated according to the variation of scenarios 2, 6 and 7 in relation to Scenario 1. The regions that suffered the most significant changes were selected as the most impacted, in this case, those that fit into the three largest classes in a classification of 5 classes by the jenks method[31].

[31] The jenk classification aims to minimize the variance within each class and maximize the variance between classes. Thus, it can be stated that the values within each class are significantly similar, while each class is significantly different.

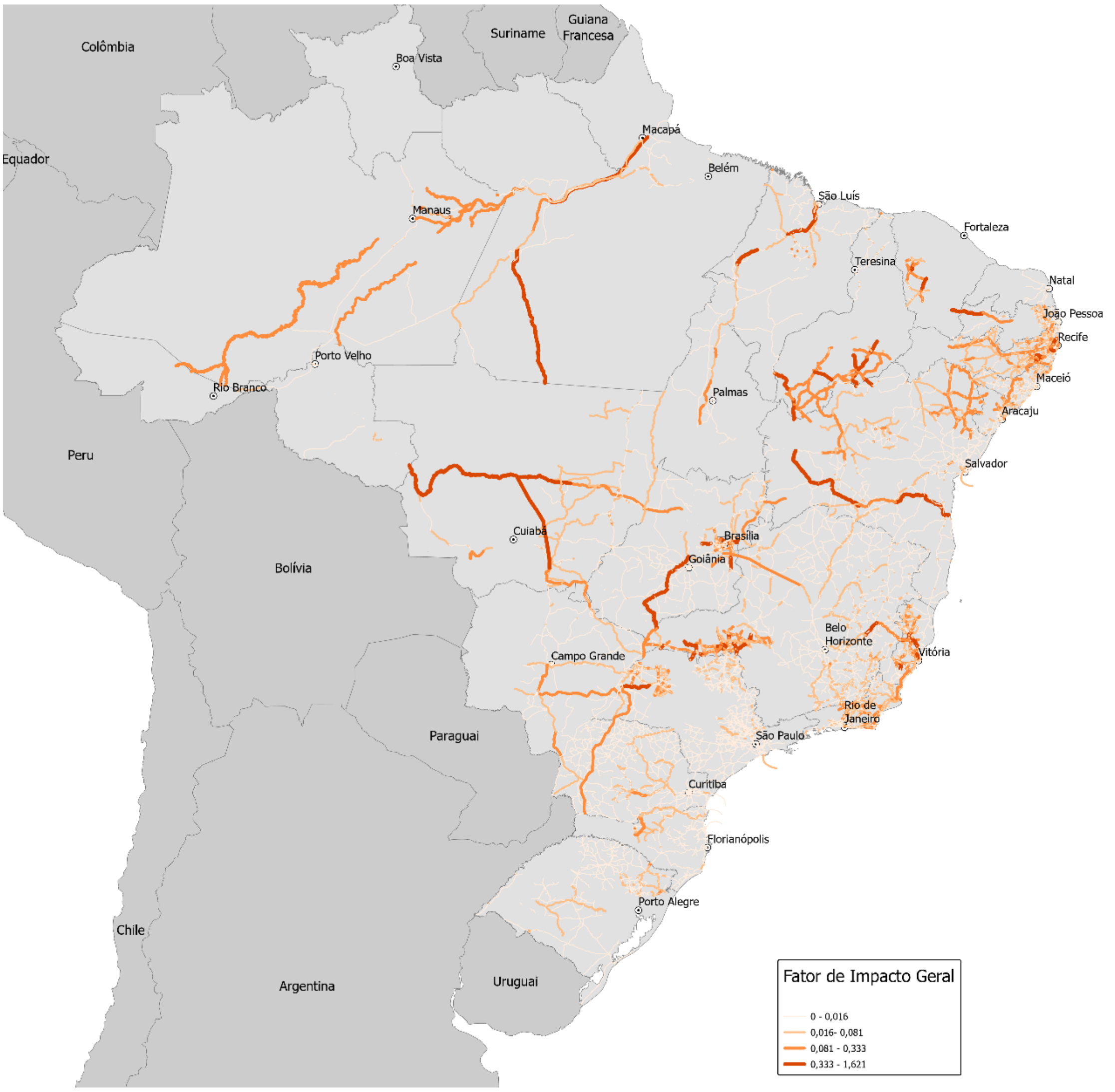
Picture 87 shows the maps with such regions and the respective improvement values in any of the three scenarios evaluated in relation to Scenario 1.



Picture 87: Changes in the Indicators of Average Freight Transport Cost, Weighted Average Time for Freight, Volume of Greenhouse Gases Emitted and Safety Index, in relation to Scenario 1, by Intermediate Geographic Region/ Source: EPL (2021)

Observing the data from each of the selected regions, it was decided to **select the infrastructures with the most representative impacts in these regions**, which are those with the highest representation in terms of TKU, RPK (people.km), the relationship between TKU and absolute emissions and the probability of accidents on the road stretch, for the indicators of "Average Freight transportation cost", "Weighted average time for transporting people", "Volume of greenhouse gases emitted" and "Safety Index", respectively .

The infrastructures selected in these regions are likely to cause the positive impacts observed in the strategic indicators. For each of them, an “impact factor” was assigned, which corresponds to the product between the representativeness of the infrastructure in the Intermediate Region and the level of relative reduction observed in the region for each indicator. The same transport infrastructure can have beneficial impacts on different indicators, and for this reason, **an overall impact factor for these infrastructures** was calculated, adding the specific impact factors for each indicator after normalizing the data. It should be noted, however, that this impact factor is not a sufficient attribute for the final ranking of project portfolios, in the context of Integrated Transport Planning - ITP, and it is desirable to carry out pre-feasibility or other complementary analysis provided for throughout the other stages of the ITP that consider specific factors of the projects. The selected transport infrastructure stretches and their respective overall impact factors can be seen in Picture 88.



Picture 88: Factor of Impact of Transportation infrastructure on indicators /Source: EPL (2021)

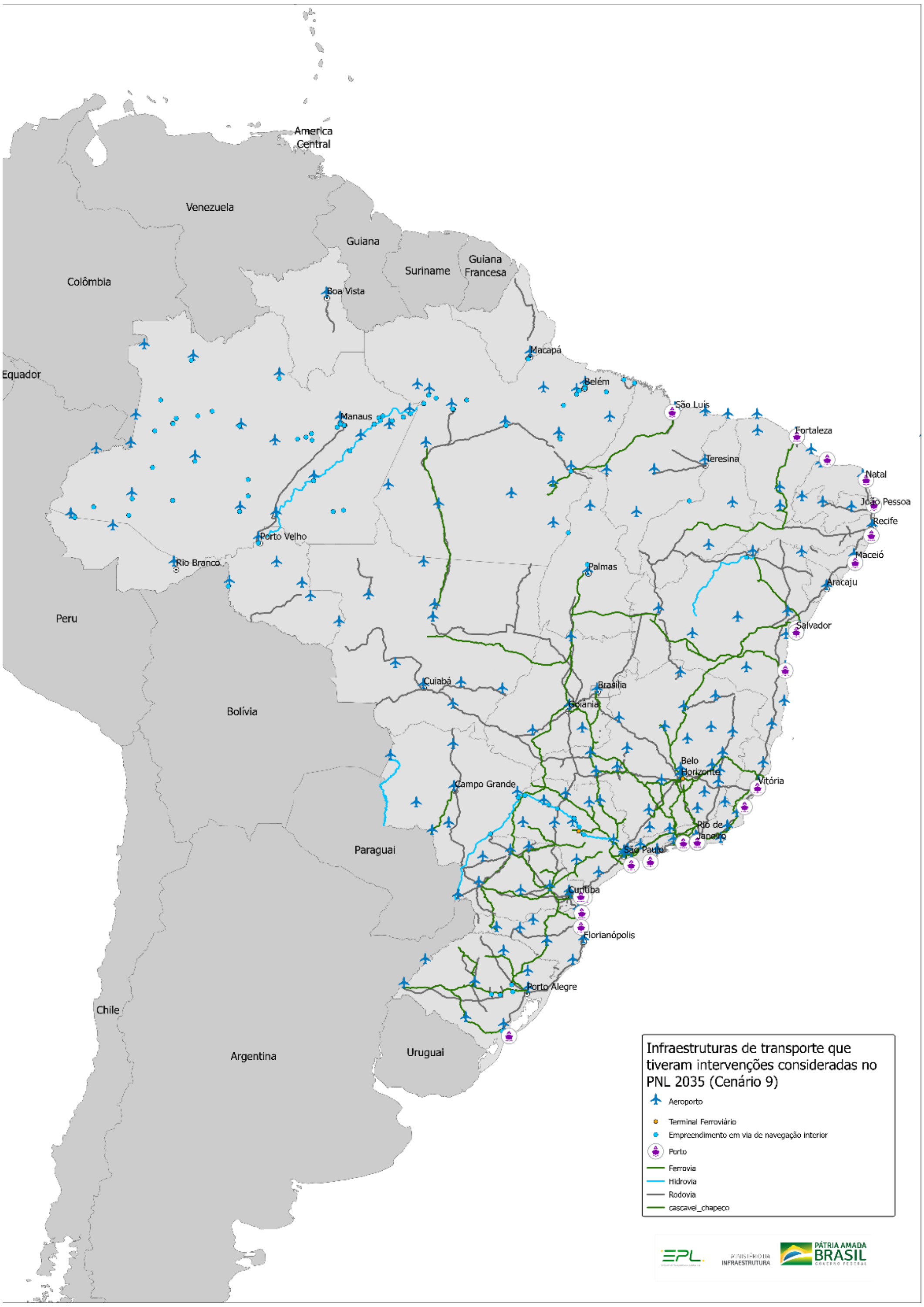
Until then, the infrastructures were evaluated to identify what is likely responsible for the transformative impacts observed in the regionalized indicators and which, consequently, tend to be the main responsible for the improvements observed in the general indicators of the scenarios. Then, the work was focused on **linking the simulated works/enterprises/interventions** in each scenario, which should explain the best impacts on infrastructure. To this end, infrastructures were crossed with the projects and interventions considered in the NLP to simulate scenarios, including those arising from recommendations in a Public Consultation, as presented in section 5.2 of this report, and listed in Appendix VII.

When a link is observed between the selected infrastructure and the simulated projects/interventions, which can be the construction of the infrastructure, improvements, expansions, etc., the general impact factor of the infrastructure is attributed to the intervention, assuming that the change in the network was the generator of the positive impact observed in the indicators. This hypothesis must be validated when simulating the scenario with these activated interventions and the consequent evaluation of the results.

The next step was the **ordering of works/projects/interventions by factor of impact and selection, up to a pre-established investment limit.** This limit is associated to the objective of constructing Scenario 9, which must necessarily be a more modest development option than the other simulated scenarios, even considering probable budgetary limitations for public authorities and referential economic growth, which also limits private investments.

As mentioned, Scenario 9 is built from Scenario 1, which includes ongoing projects and interventions. Scenario 1 already requires an investment amount of around R$ 375,56 billion over the next 15 years, of which, regarding the Federal sphere, around 85% would already be insured in partnership contracts with the existing private sector in or under construction. The second scenario, so far, with the lowest investment value among the simulated ones is Scenario 2, with R$ 410,3 billion needed, contemplating, in addition to the projects in Scenario 1, others foreseen within the scope of the Ministry of Infrastructure. Therefore, an alternative scenario to be considered as having a lower cost, must reach, at most, the value of Scenario 2. It implies that the limit of projects or interventions with greater impact to be added to Scenario 1 to compose Scenario 9, is R$34,74 billion.

With this logic, **the ordering of works/projects/interventions by factor of impact** and selection was carried out, up to a limit of R$ 34,74 billion of the main interventions in federal infrastructure that are not included in Scenario 1 and were simulated in the others. As a general result for Scenario 9, we have the block of projects shown in Picture 89.



Picture 89: Transportation infrastructures that had interventions considered in the NLP 2035 (Scenario 9) /Source: EPL (2021)

It is important to highlight that the results of this selection consider limited variables and may not be the best alternative for the development of the national transport network. Important aspects, such as the cost/benefit ratio of each infrastructure, in particular analysis, as well as the degree of market attractiveness (marketing potential) of the enterprise, are equally relevant and determinant for the consolidation of the proposals and, therefore, any Scenario exposed in the NLP 2035, including Scenario 9, has a guiding character for the Integrated Transport Planning process, lacking the maturation of actions during the following phases of management, aimed at implementing actions.

The **simulation** of this scenario was carried out in the functional simulation model of the NLP 2035, followed by its **evaluation**, both at the strategic level of comparison of results of the indicators (Section 6.1) and the logistical behavior, detailed in the following section.

It is noteworthy that the configuration of this scenario resulted in significant gains, especially in the indicators of "Average Freight transport cost", "Weighted average time for transporting people", "Volume of greenhouse gases emitted" and in the "Safety Index", validating the methodology used for its construction and establishing this block of projects and interventions in infrastructures as the main opportunities for the development of the national transport network, according to the analysis and variables considered in this NLP 2035.

6.10.2. Analysis and results of Scenario 9

Scenarios from 3 to 8 are changes made from the transport network configuration in Scenario 2. Scenario 9, based on the methodology described in the previous section, can be understood as a development alternative to Scenario 2, maintaining the same level of investments, but with a selection of projects focused on the most significant impacts on strategic indicators.

In Scenario 9, there was a reduction in the total TKU of about 50 billion compared to Scenario 2, which is consistent with the hypothesis of a more efficient scenario, which allocates the same amount of Freight, in smaller distances, indicating the realization of more direct travels. This impact is also reflected in the average cost per 1000 TKU.

In this context, we observed an increase in railway transport, which would represent around 42% of the transport matrix, entering the margin of symmetrical balance with roadway transport. However, the present balance does not occur with the simple objective of “matching numbers”, but rather through the implementation of railways that communicate with each other and that start to operate in a network topology, connecting isolated railway corridors, as shown in Table 23.

The present scenario brings to the front the integrated planning of different modes, the only mechanism capable of supporting such results, and its logical interconnection point: the railway and port terminals. Although it is almost automatic to give importance to railways and waterways, ports and railway terminals are the elements that guarantee, in fact, that a transport infrastructure will attract Freight and which Freightes will be attracted.

Table 23 - Brazilian transport matrix simulated on scenarios 2 and 9, in TKU

Mode	Scenario 2- Planned Projects - Referential		Scenario 9- Main opportunities for the Development of the National Transport Network-Referential	
	TKU (billions)	Modal share	TKU (billions)	Modal share
Roadway	1.852,79	51,36%	1.466,70	41,53%
Railway	1.248,79	34,62%	1.518,67	43,01%
Coastal Cabotage	305,24	8,46%	338,64	9,59%
Inland Navigation	151,97	4,21%	158,81	4,50%
Pipelines	46,75	1,30%	46,75	1,32%
Airway	1,74	0,05%	1,74	0,05%
Total	**3.607,27**	**100%**	**3.531,30**	**100%**

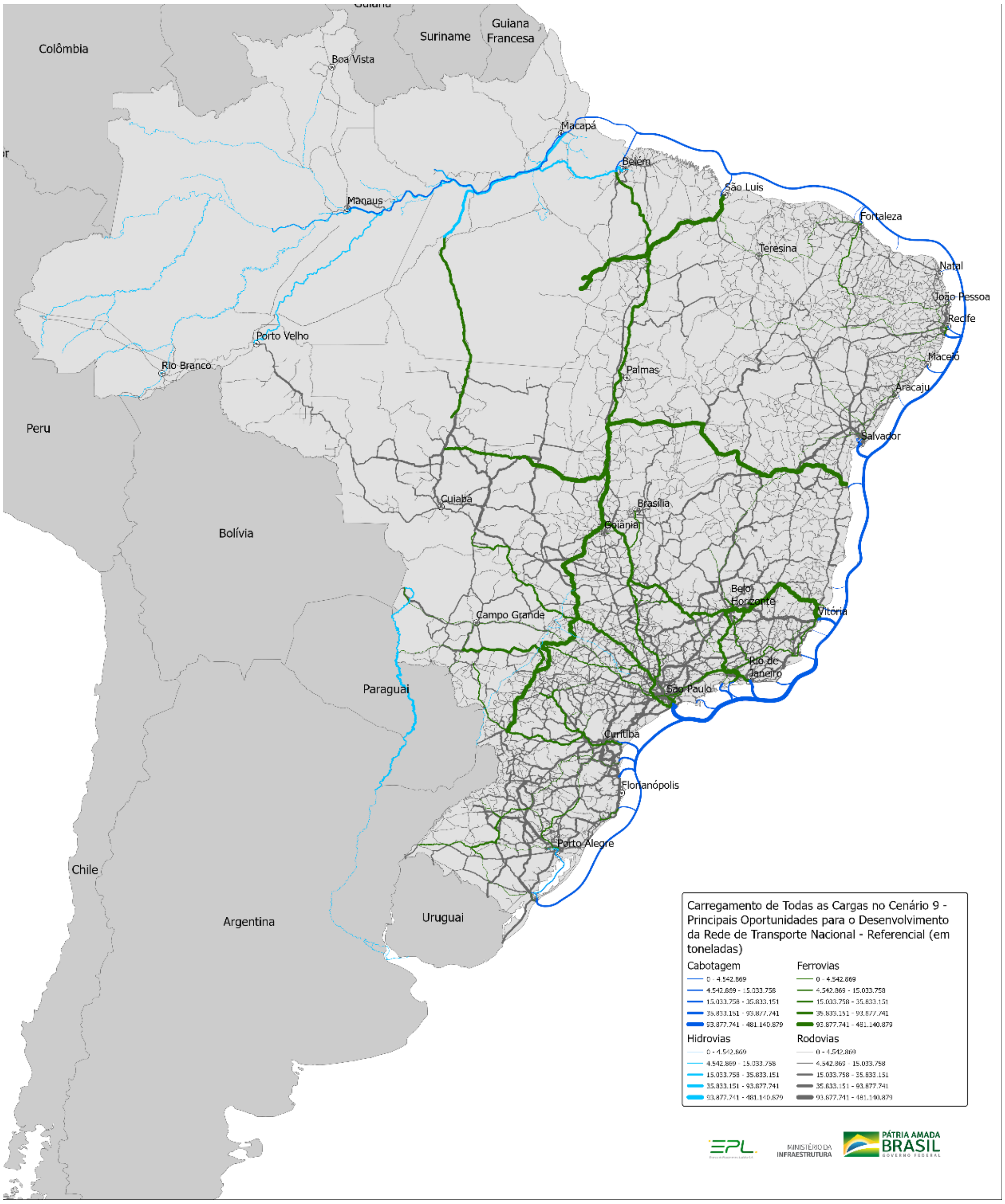
Observation: Inland navigation includes the cabotage on inland and long-haul inland navigation)

Source: EPL (2021).

Thus, it is possible to observe an overloaded performance of certain railway terminals and ports, which is a necessary point to be addressed in the sectorial plans, obviously in an integrated manner between the modes.

The efficiency of the proposed infrastructures becomes even clearer when we test the two main transport volumetric units covered in this Plan, the TKU and the VKU.

Observing Picture 90, we can identify that the proposed infrastructures achieve a good attractiveness of transported volumes, balancing internal distribution paths and routes to ports, both to internalize Freightes and to take them on the path of exports.

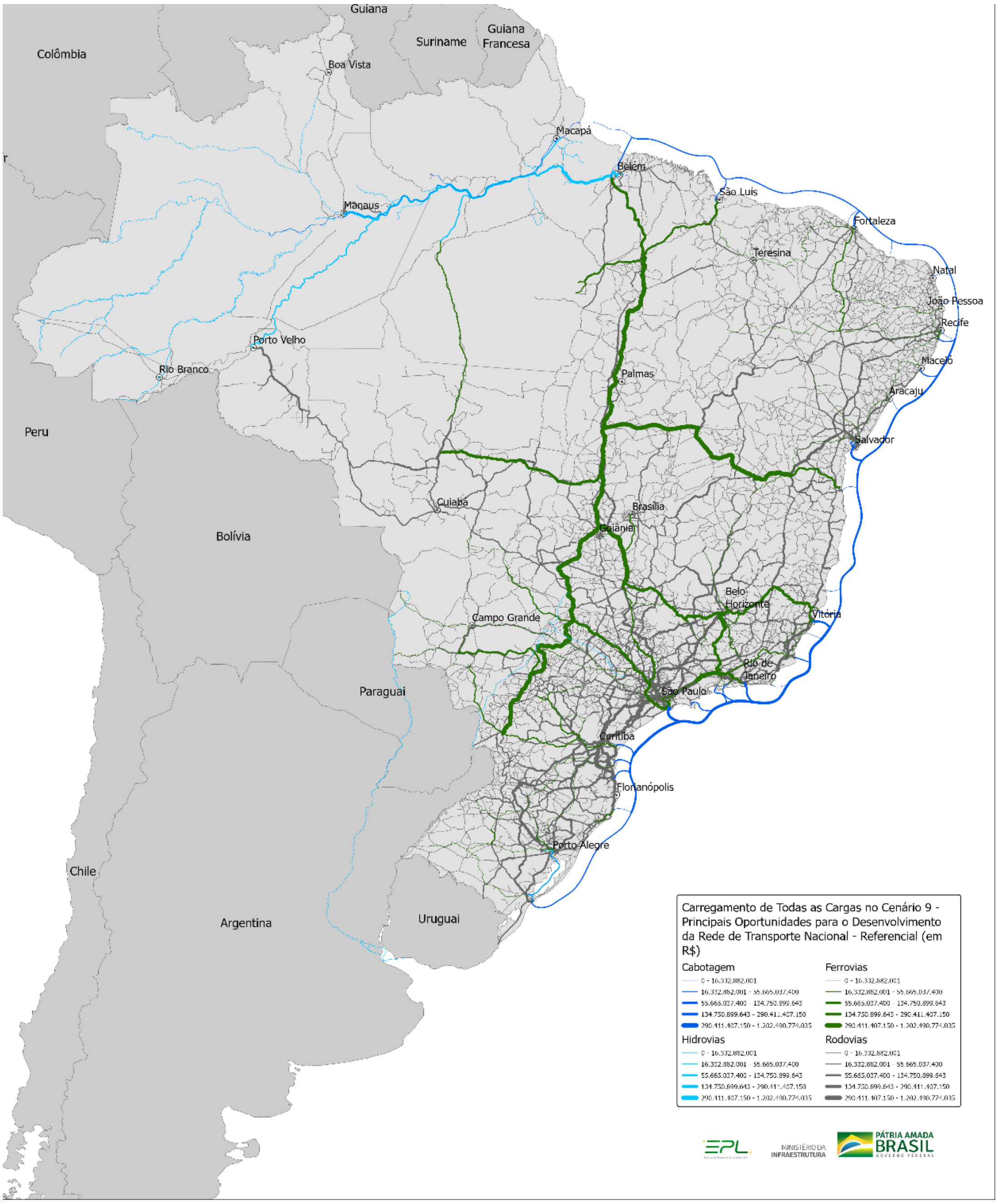


Picture 90 - Allocated Flows Scenario 9 - All Freightes - in tons/Source: EPL (2021)

Secondly, we can observe that the same infrastructures manage to attract to themselves a considerable scale of values, having the same effect observed for the weights, that is, balancing and better distributing the Freight paths in the national territory, as shown in Picture 91.

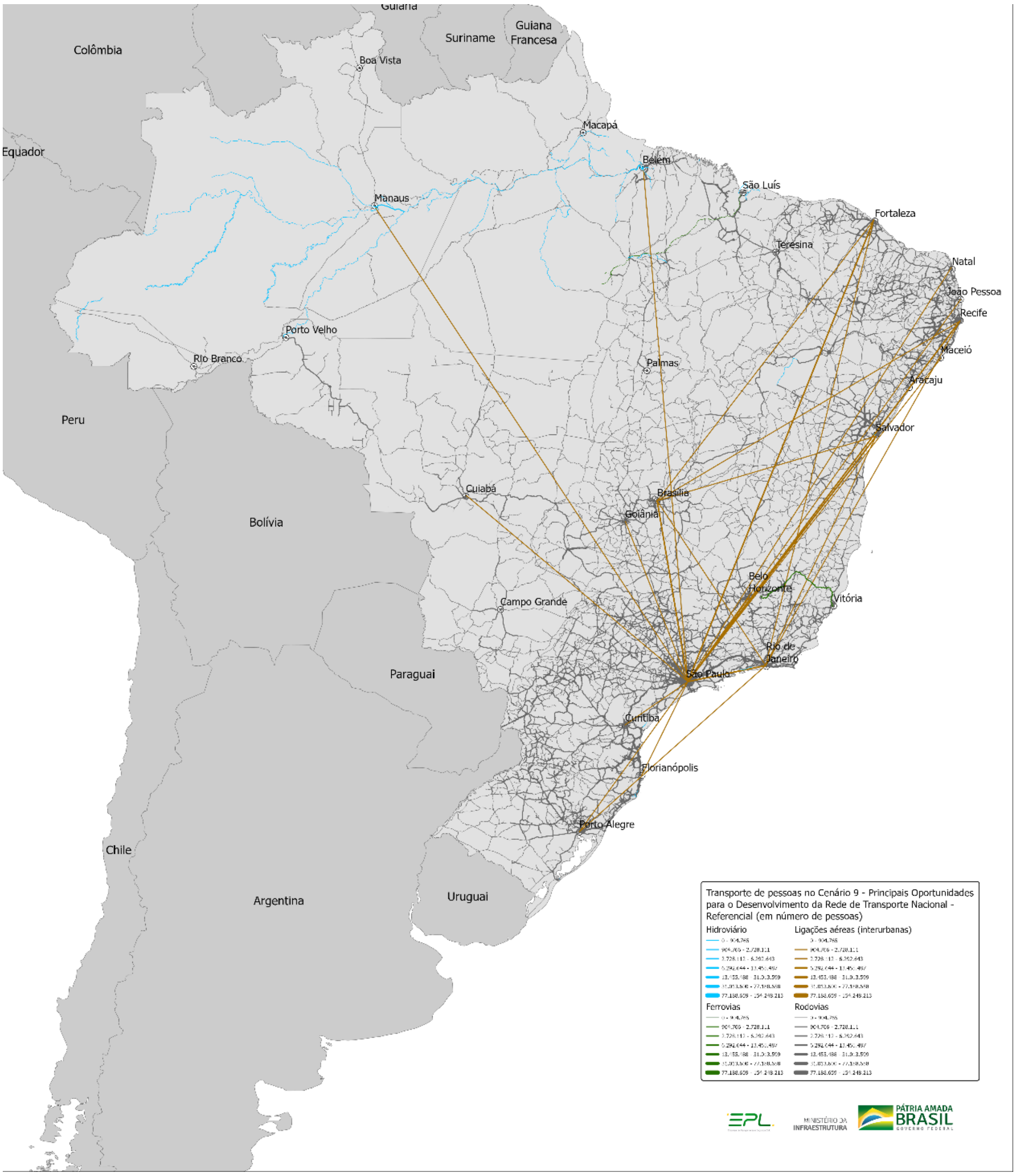
Both containerized and non-containerized general Freightes benefit from the proposed scenario by finding a means of distribution that directly connects Belém/PA to Chapecó/SC, allowing industrial and transformation centers in the countryside of São Paulo, Goiás and Manaus/AM are rationally interconnected with their internal consumer markets.

This behavior in network structure allows, therefore, an improvement in the indicators of time, average cost and, mainly, reliability, demonstrating that this set of infrastructures has a "concentrated effect" and making the grid behave in an integrated way and as a connected network.



Picture 91 - Allocated Flows Scenario 9 - All Freightes - in *Reais*
Source: EPL (2021)

Picture 92 shows the allocated interurban flows of people in Scenario 9, which reinforces the same trend of increased demand for air transport in interurban intercity flows observed in the other scenarios.



Picture 92: Allocated Interurban Flows of People – Scenario 9

Source: EPL (2021)

7. NEEDS AND OPPORTUNITIES

Based on the changes observed in spatial behavior and in the conformation of corridors generated by the displacement of Freightes and the transport of people in the transport network, this chapter presents the main needs and opportunities identified in the National Logistics Plan to achieve the objectives of the National Transportation Policy. The needs and opportunities must be analyzed in the Tactical Sectorial Plans, as recommended by Ordinance Nº 123, of August 21, 2020, of the Ministry of Infrastructure, following the instruments of Integrated Transport Planning.

Since planning is a dynamic process, the results presented here do not limit the scope of the Tactical Sectorial Plans. In fact, the analysis that these instruments will perform in their respective scopes will result in a broader range of priorities in the planned initiatives and projects. The needs and opportunities exposed here must receive adequate attention in seeking to meet them, as these are issues that the NLP has already identified as adhering to the national strategic objectives. Throughout the planning cycle, other scenarios and updates to the NLP may be published and, consequently, new needs and opportunities may be added to, in time, be evaluated in the Tactical Sectorial Plans.

The opportunities can be understood as the main elements that were simulated and evaluated in the NLP, and that positively impacted the objectives of the National Transportation Policy. They can be classified into more general aspects, which concern all transport subsystems or the entire national territory, or specific aspects, related to infrastructures or individual geographic regions.

The needs are the deficiencies observed in the NLP analyses, and they can also be described in general aspects, with guidelines for all Tactical Sectorial Plans, or for specific infrastructures and regions.

7.1. GENERAL OPPORTUNITIES

In the scenarios of the NLP 2035, in addition to changes in infrastructure, other variables are simulated and can be configured as general opportunities when there are positive impacts on indicators linked to strategic objectives.

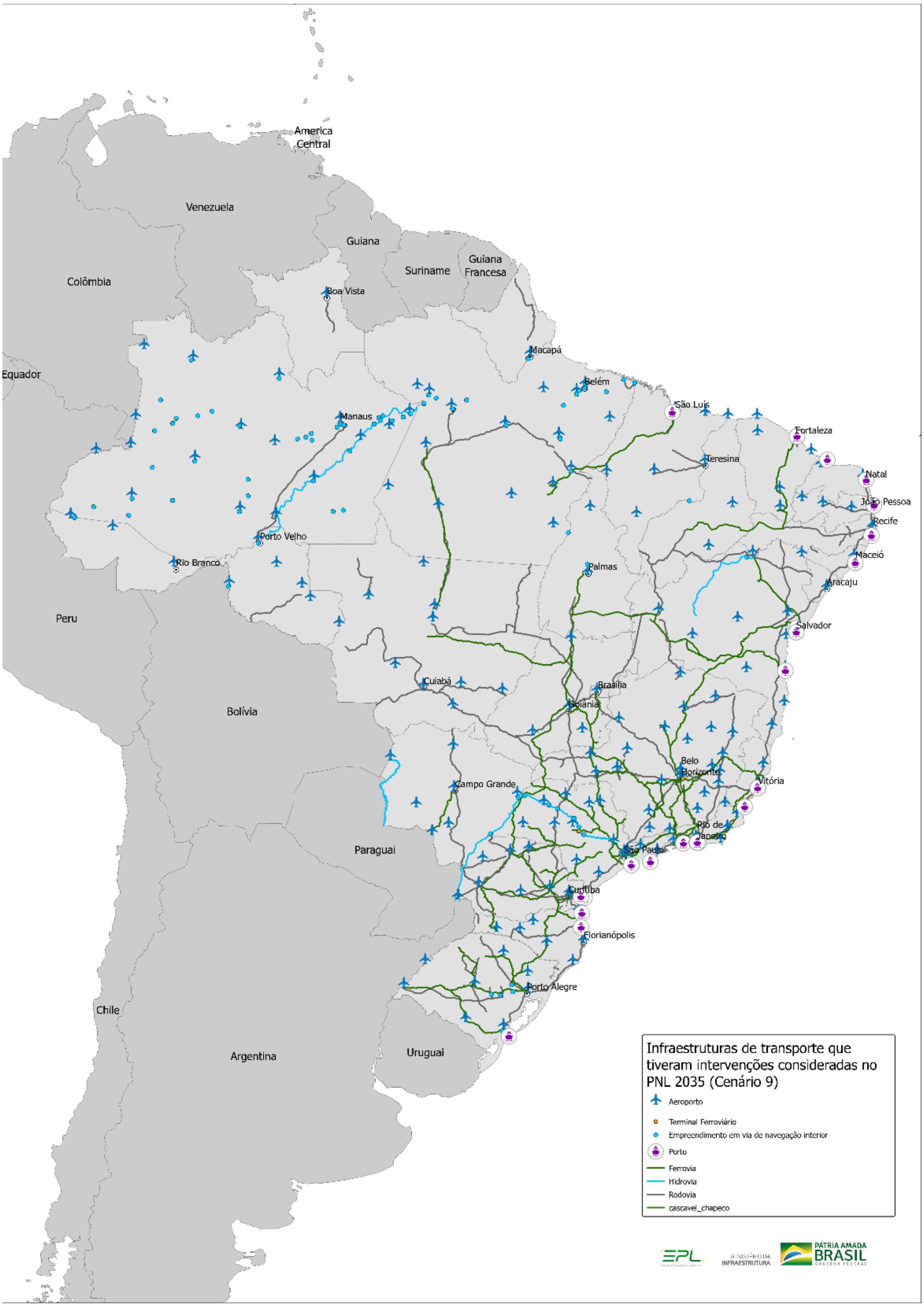
Scenario 5, which considers a range of technological innovations applied to logistics and transport, as described in Appendix VII, projects for the future a transport network with conditions of supply, use and costs different from those of other scenarios. The results observed are positive in several aspects. Scenario 5 is the one with the lowest level of greenhouse gas emissions, due to the consideration that part of the national car fleet will be replaced by hybrid or electric vehicles by 2035. The total cost and average cost for transporting Freightes are also among the lowest of the evaluated scenarios, due to the trends of digital transformation in logistics, using technologies that aim to increase the efficiency of different modes of transport, as well as fleet renewal.

What Scenario 5 demonstrates is that with certain investments that can be made by the transport market itself, taking advantage of the technology currently available in the world, improvements in the system can be achieved at similar or even greater intensities than those resulting from interventions and investments in infrastructure. It is evident that the **stimulus to technological innovation in the transport and logistics sector is a general opportunity to be considered in the management of transport systems**, and the Tactical Sectorial Plans should look for initiatives to foster such development.

The regulatory variations studied in scenarios 4 and 7, which deal with the impact of *BR do Mar* and the glimpse of the operation of railway authorizations with an interest already expressed in the Ministry of Infrastructure, respectively, also present general impacts consistent with the objectives of the NTP. Both, when compared to Scenario 2, present positive impacts on environmental sustainability, since, by capturing Freightes from road transport for large-capacity modes, waterway and railway transport reduce polluting gas emissions. Furthermore, the impact on economic development observed in these scenarios is also greater, configuring **both *BR do Mar* and the Railway Authorizations as opportunities consistent with aspects of the National Transportation Policy.**

7.2. SPECIFIC OPPORTUNITIES

The specific opportunities identified in the NLP 2035 are the interventions and projects simulated in the scenarios that present the most significant impacts on the strategic objectives. Scenario 9, as discussed in section 6.10.1, has precisely the role of selecting which infrastructures and interventions significantly affected the indicators. Therefore, **the opportunities for specific projects and interventions for the development of the transport network are, precisely, the relation considered for simulated interventions in Scenario 9**, as detailed in Appendix VI, and spatialized in Picture 93, identifying the affected infrastructure. It should be noted that the picture below does not show all the infrastructures relevant to the network, but only those infrastructures that had sections or components that were the object of implementation or improvement.



Picture 93: Transportation infrastructures that had interventions considered on the NLP 2035 for Scenario 9 – Group of identified specific opportunities /Source: EPL (2021)

As the methodology used to select this block of priorities was based on the impact of interventions, and also, considering that the objectives of the NLP are quite diversified, the pure result of this scenario presents a balance between investments in different modes, ensuring the contribution of each type of infrastructure in a set of specific and relevant elements for the NTP, both for the transport of Freight and for the transport of people. Table 24 summarizes the investments required for this scenario.

Table 24: Necessary investments in infrastructure provided for on Scenario 9

Transport Mode	Planned Investment (R$)
Airports	18.952.496.875
Railways	168.590.904.839
Waterway	3.618.257.775
Ports	59.508.740.781
Road	158.187.671.533
Total	**408.858.071.803**

Source: EPL (2021)

The Tactical Sectorial Plans must evaluate such projects in their own future analysis scenarios, including, from the perspective of pre-feasibility analysis, seeking directions for their implementation, provided that they are supported by the specific complementary results of their cost/benefit ratios and other analysis carried out in tactical planning.

7.3. GENERAL NEEDS

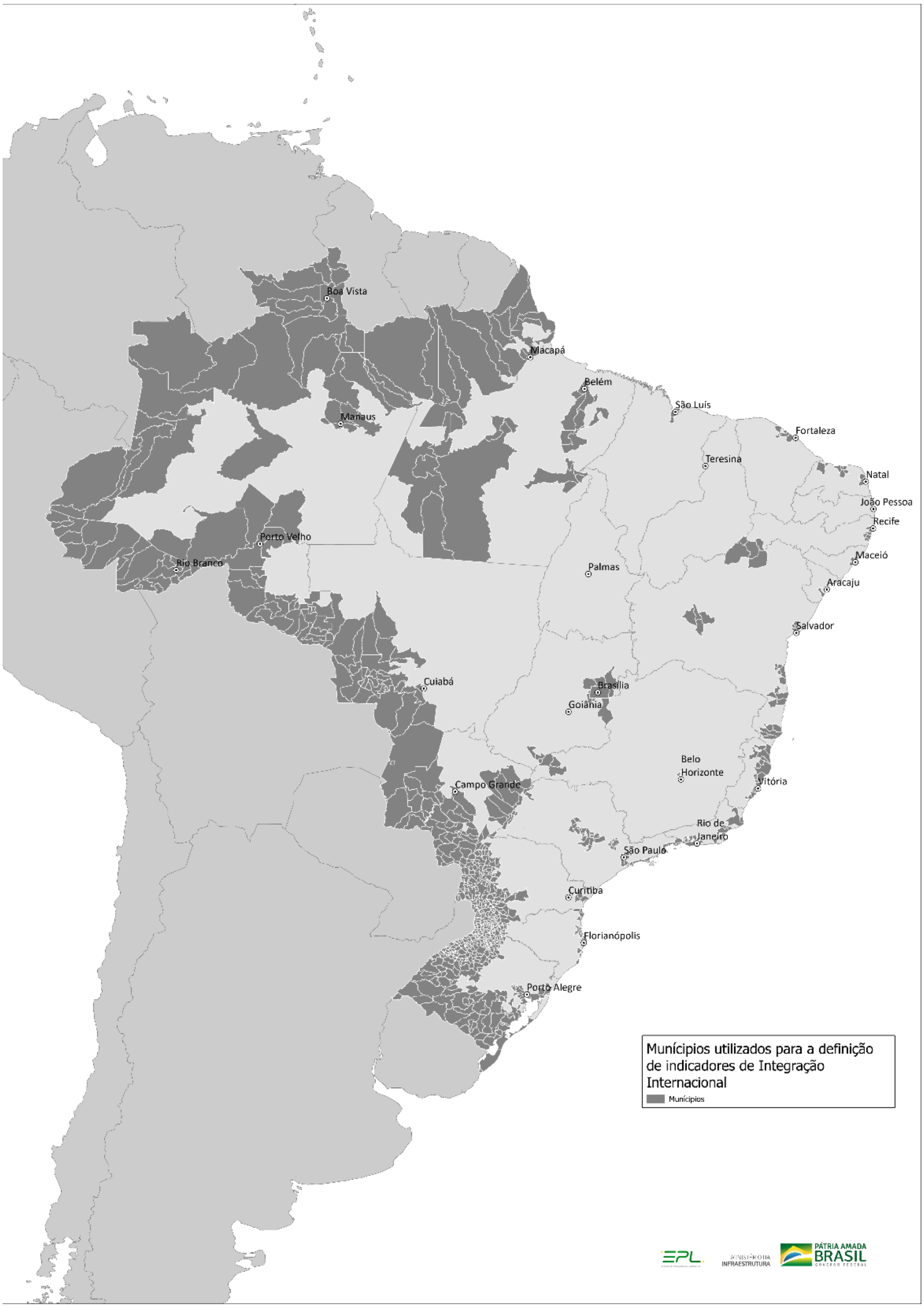
During the comparative analysis between the scenarios, exposed in Section 6.1, some general needs were observed, particularly in the objectives that did not show significant improvements in the future horizon. This indicates that none of the simulated variables for these needs, in any of the scenarios, supports the achievement of these goals.

One of these objectives is accessibility, specifically for Freight transportation. It was observed that as the transport system tends to evolve towards changing the modal matrix in a more rational perspective, and with modest costs, transport time is negatively affected, as the current technological framework of the railway and waterway modes have lower operating speeds, when compared to road transport. Therefore, **the need for railway and waterway transport modes (cabotage and inland navigation) is evident to develop initiatives aimed at modernizing their fleets and operating improvements to compensate or mitigate the drop in average speed caused by Freight migration.**

Another aspect evaluated in the NLP 2035 is related to the objective of international integration. The Freight Transport Cost indicator for the international section, which also has the function of measuring this objective, is already at a level approximately 56% higher than the average cost of the entire network. But, in addition, what was observed is that none of the variables simulated in the scenarios had a positive impact on this average cost. Therefore, **there is a need for the Strategic Sectorial Plans to assess and develop solutions for areas considered to be of interest for international integration, seeking to reduce their transport**

costs, especially in road transport, which provides immediate access to these locations (last mile).

The areas considered to be of interest for international integration are selected from the study of the roads that contribute to flow to and from borders, ports, and international airports, as shown in Picture 94.



Picture 94: Municipalities used to define International Integration indicators/Source: EPL (2021)

Scenario 3, which simulates the behavior of the national transport system in the face of accelerated economic development, also presents general results that should be absorbed as a warning for the Tactical Sectorial Plans and the governance of the system as a whole. The general behavior of this scenario demonstrates that the amount of potential Freight to be transported would be so high in 2035 that it would encounter significant bottlenecks in the railway mode and in ports, generating a large number of trips by road. In addition, the booming economy itself would also increase the number of trips by car, considerably increasing the risk of accidents on the highways. The result of the Security index projected for this scenario reflects this behavior, indicating that the network would be around 5% more insecure than the counterfactual option. Even more serious, the index indicates that in this situation, the network would present probabilities of accidents occurring around 23% higher than today's levels.

From this analysis, **two general needs emerge, considering the accelerated economic development hypothesis: the high-capacity transport modes anticipate their capacity expansions (mainly railroad and ports) and the road transport mode to invest in additional solutions for accidents prevention.**

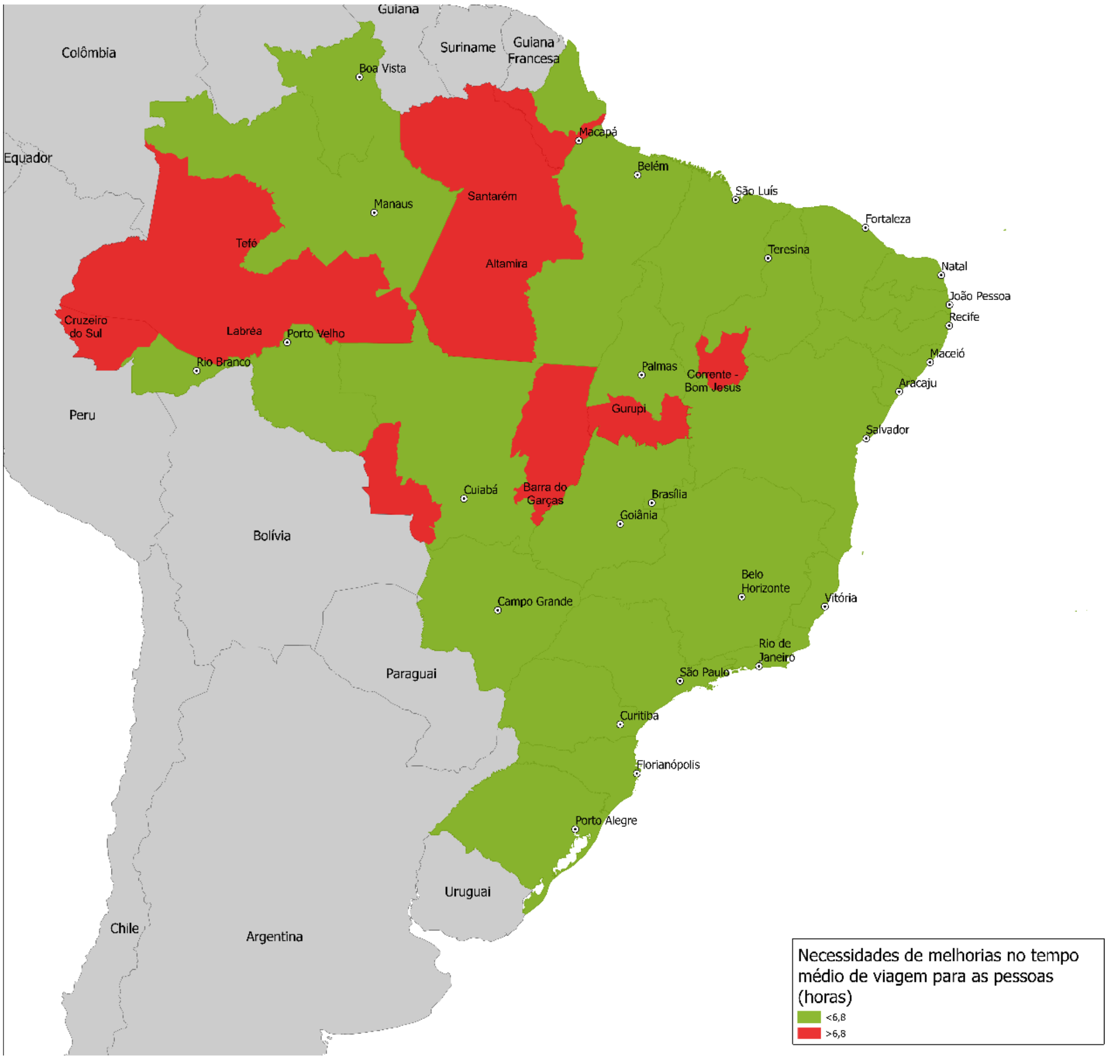
7.4. SPECIFIC NEEDS

The spatialization of the main indicators affected in the NLP 2035 Scenarios by changes in the supply of transport infrastructure, carried out for the impact analysis and construction of Scenario 9 (Section 6.10.1), also made it possible to identify the Intermediate Regions in Brazil that have discrepant indexes of cost, time, emissions, and safety, in relation to the rest of the transport network. When there is no change in these differing conditions throughout any simulated scenario, a specific need for improvement is identified, which should generate solutions in the Tactical Sectorial Plans.

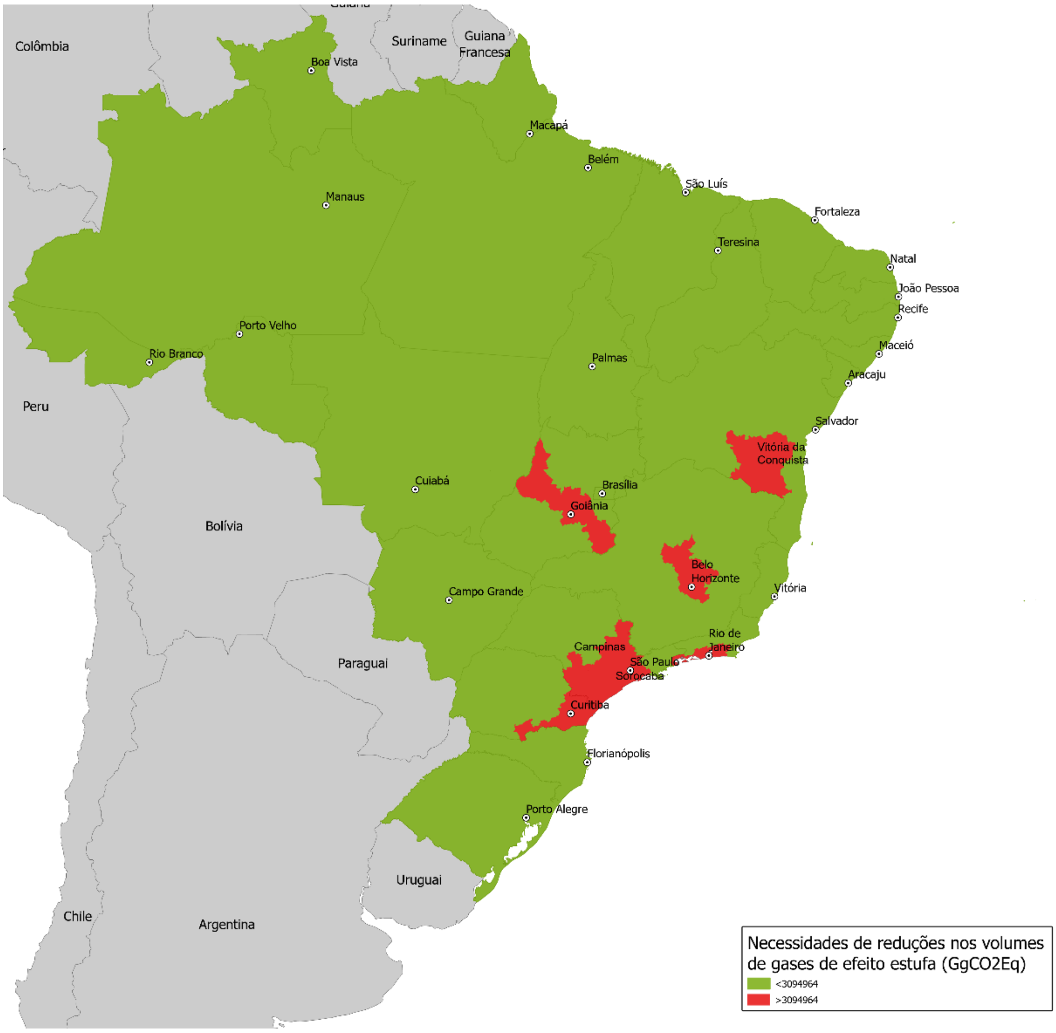
By classifying the indicators by Intermediate Geographic Region with the jenks method, which group statistically similar values, it was possible to identify the regions that, in all scenarios, remained at low levels (in the two classes with the most unfavorable values) for the indicators of "Average cost of transporting Freight", "Weighted average time to transport people", "Volumes of greenhouse gases emitted" and "Safety Index" for 2035, as shown in pictures 95 to 98. The municipalities that make up the Intermediate Geographic Regions comply with the aggregation proposed by IBGE[32].

[32] Regional division of Brazil into immediate geographic regions and intermediate geographic regions: 2017/IBGE, Geography Coordination. - Rio de Janeiro: IBGE, 2017. 82p. Available at: https://www.ibge.gov.br/geociencias/organizacao-do-territorio/divisao-regional/15778-divisoes-regionais-do-brasil.html?=&t=sobre

Picture 95: Intermediate Geographic Regions in need of improvements on the Average Freight Transport Cost index /Source: EPL (2021)



Picture 96: Intermediate Geographic Regions in need of improvements in the Average Travel Time index for people/Source: EPL (2021)



Picture 97: Intermediate Geographic Regions in need of improvements in the greenhouse gas emissions index/Source: EPL (2021)

Picture 98: Intermediate Geographic Regions in need of improvements in the road safety index
Source: EPL (2021)

Considering that no project simulated in the NLP 2035 resulted in improvement of the indexes in the regions shown in the previous maps, these regions should be the target of specific analysis in the Tactical Sectorial Plans, seeking to propose new projects and interventions, or prioritizing existing actions or under study in these areas, as long as they are related to the expected impact of each mode on the selected indicators.

Considering that each mode of transport has its specificities and potential to affect different indicators, an analysis was carried out seeking to address the regions for each Tactical Sectorial Plan and its expected impact.

The modes of transport that have a positive impact on average freight transport costs are mainly those with large capacity: railway, waterway and coastal cabotage, which in turn are impacted by port costs. With the little more subtle impact, but still significant in some regions of the country, changes, adjustments, or expansions in the road infrastructure also tend to generate cost reductions. Considering this, the regions that lack improvements in the average costs of Freight transportation are addressed for analysis and provision of solutions to the Land Transport Sectorial Plans (which cover road and rail transport), the Waterway Sectorial

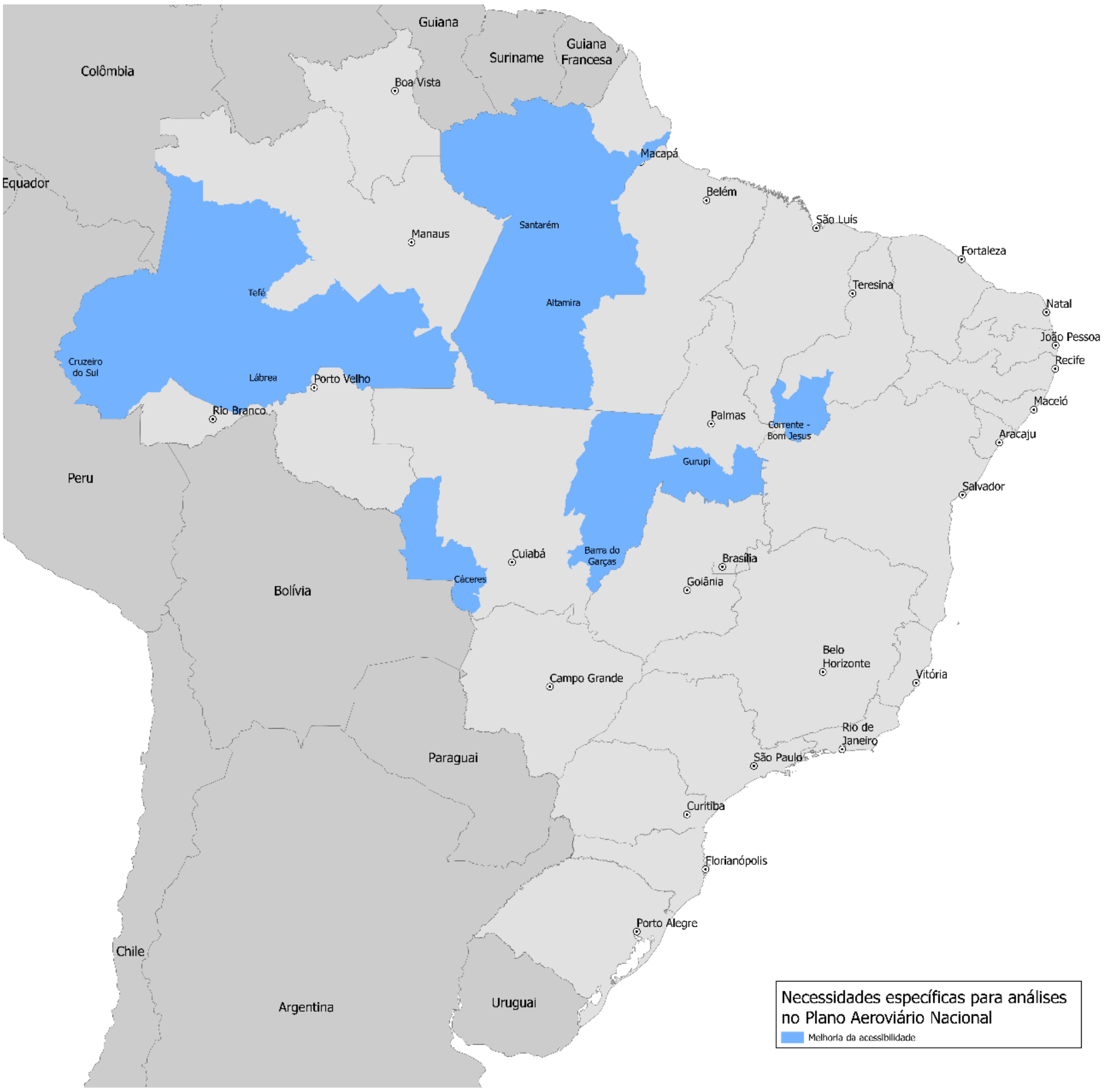
Plan, if the Intermediate Geographic Region in question is close to or belongs to one of the navigable or potentially navigable waterway basins and, to the Port Sectorial Plan, when the Intermediate Geographic Region comprises one or more than one port-cities considered in the planning.

Regarding accessibility for transporting people, airport infrastructure tends to have a transformative impact. Improvements in road transport also add faster transport conditions and, consequently, accessible, when in regions where road infrastructure is precarious or transport is carried out by inland waterways. Therefore, the identified accessibility improvements are addressed both to the National Airway Plan and to the Land Transport Sectorial Plan, with regard to road transport.

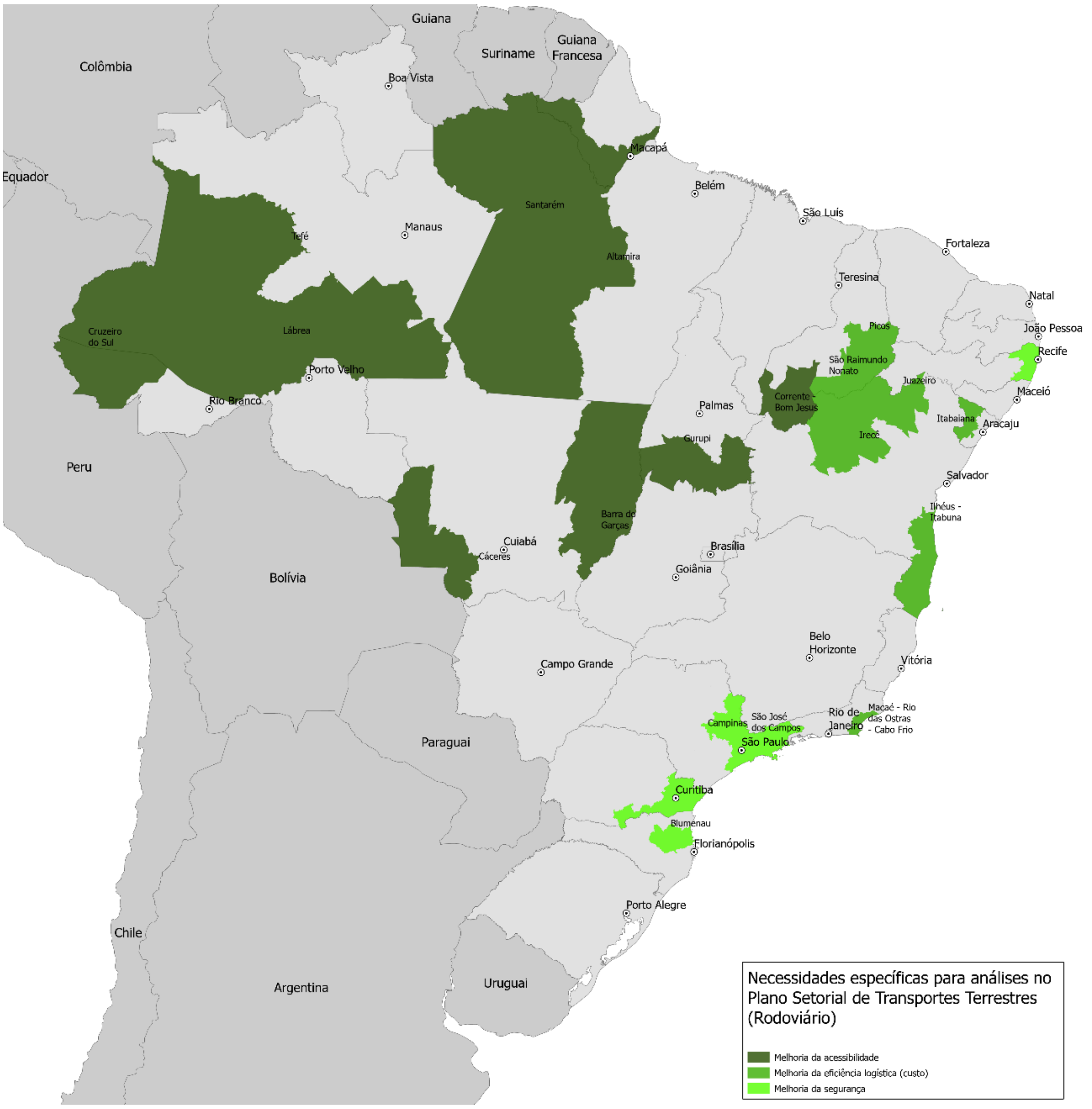
The positive impact on the reduction of greenhouse gas emissions, on the other hand, corroborating the environmental sustainability of the transport system, is expected when there is a migration of Freight from road transport to large-capacity modes, or operational improvements that ensure reductions in the burning of fuels. Thus, the Intermediate Regions that present large emission rates were addressed to be analyzed in detail in the Land Transport Sectorial Plan (which covers road and rail transport), in the Waterway Sectorial Plan, if the Intermediate Geographic Region in question is close to or belong to one of the navigable or potentially navigable waterway basins, and in the Port Sectorial Plan, when the Intermediate Geographic Region includes one or more than one Port-city considered in the planning.

For the road safety index, as it is an exclusive indicator for this mode, the need for work in critical regions only in the Land Transport Sectorial Plan was considered.

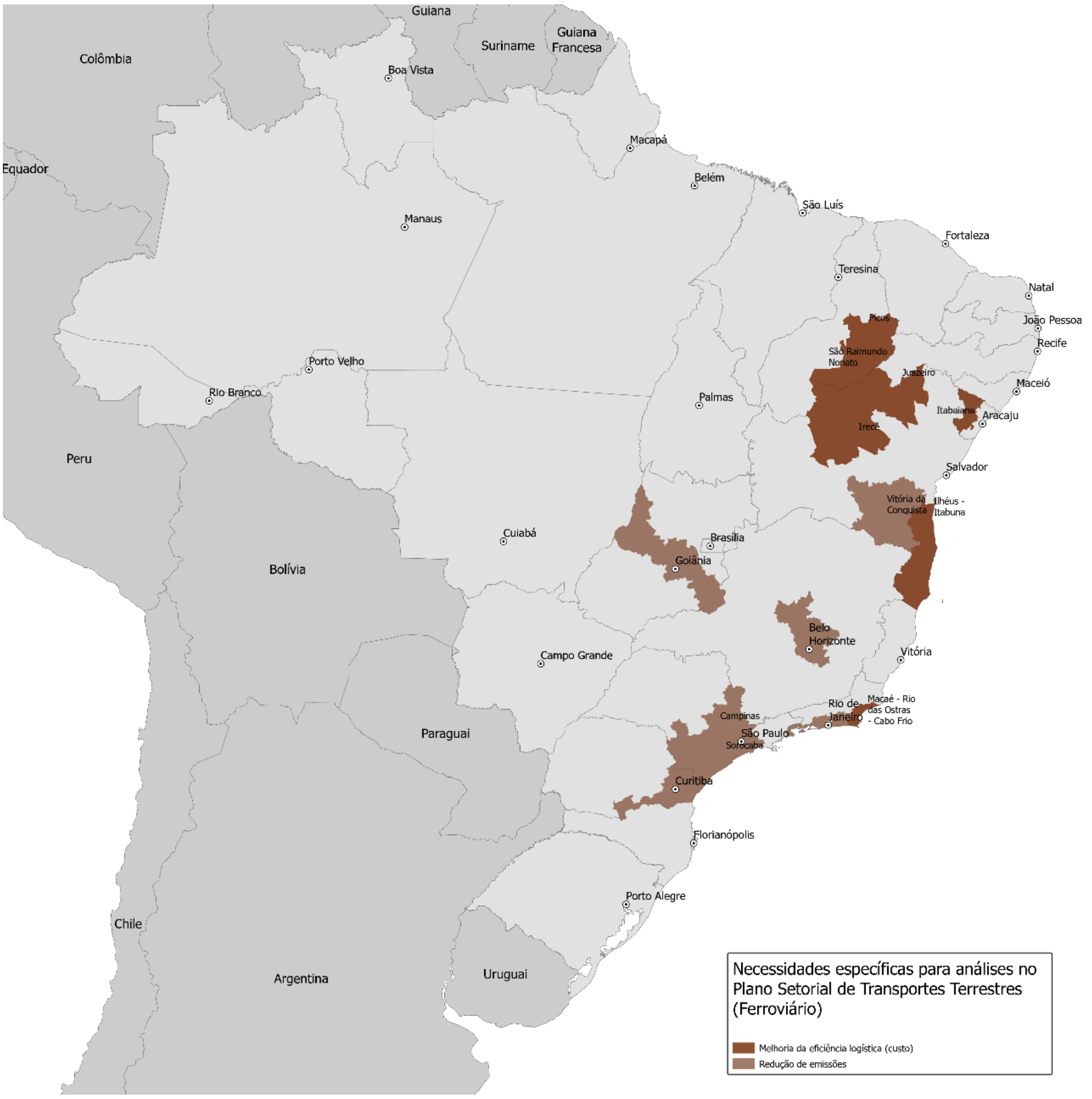
The results of these **specific needs allocated by the Tactical Sectorial Plan can be seen in pictures 99 to 103.**



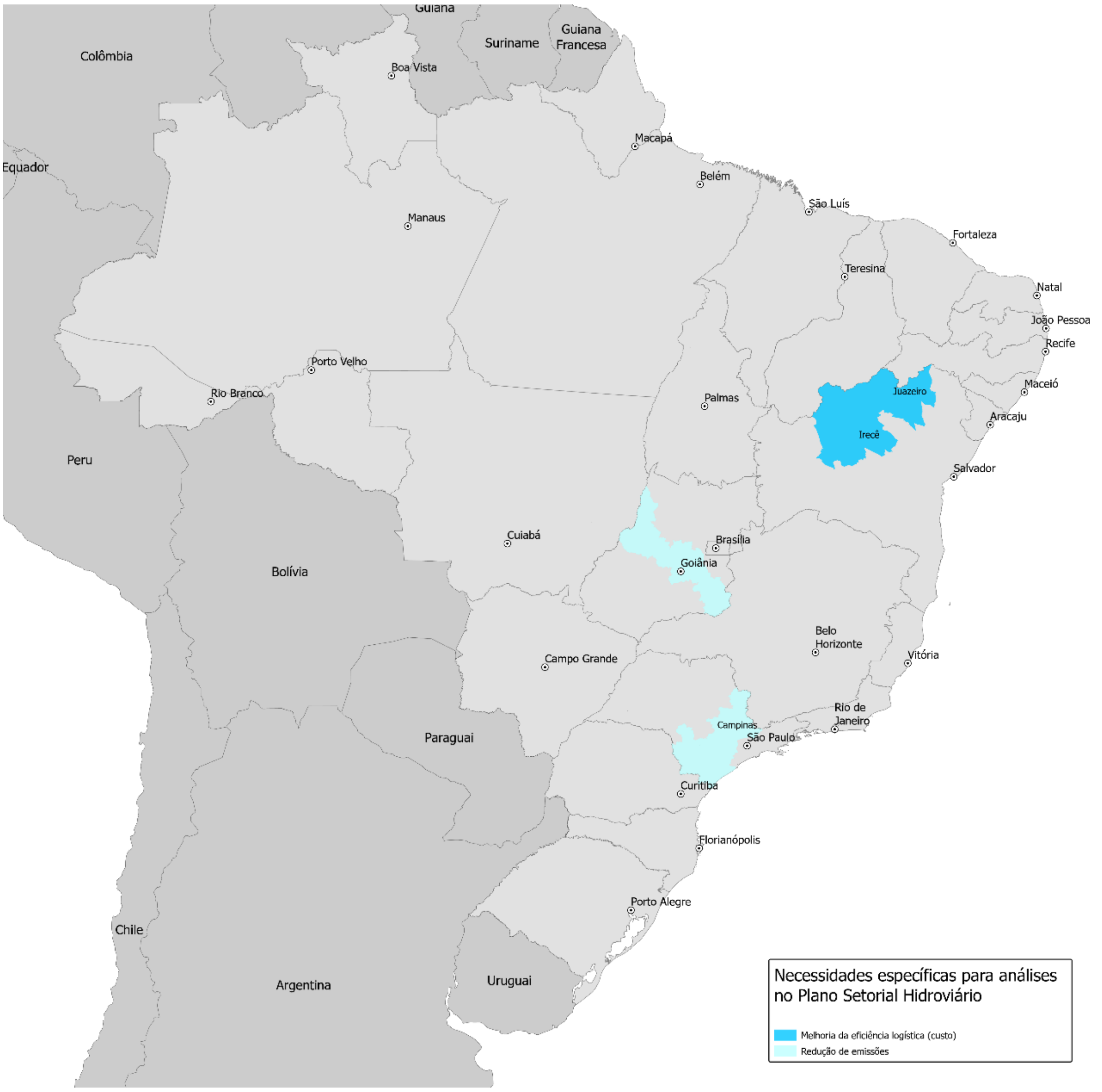
Picture 99: Intermediate Geographic Regions and indicators with specific needs for analysis in the National Airway Plan/Source: EPL (2021)



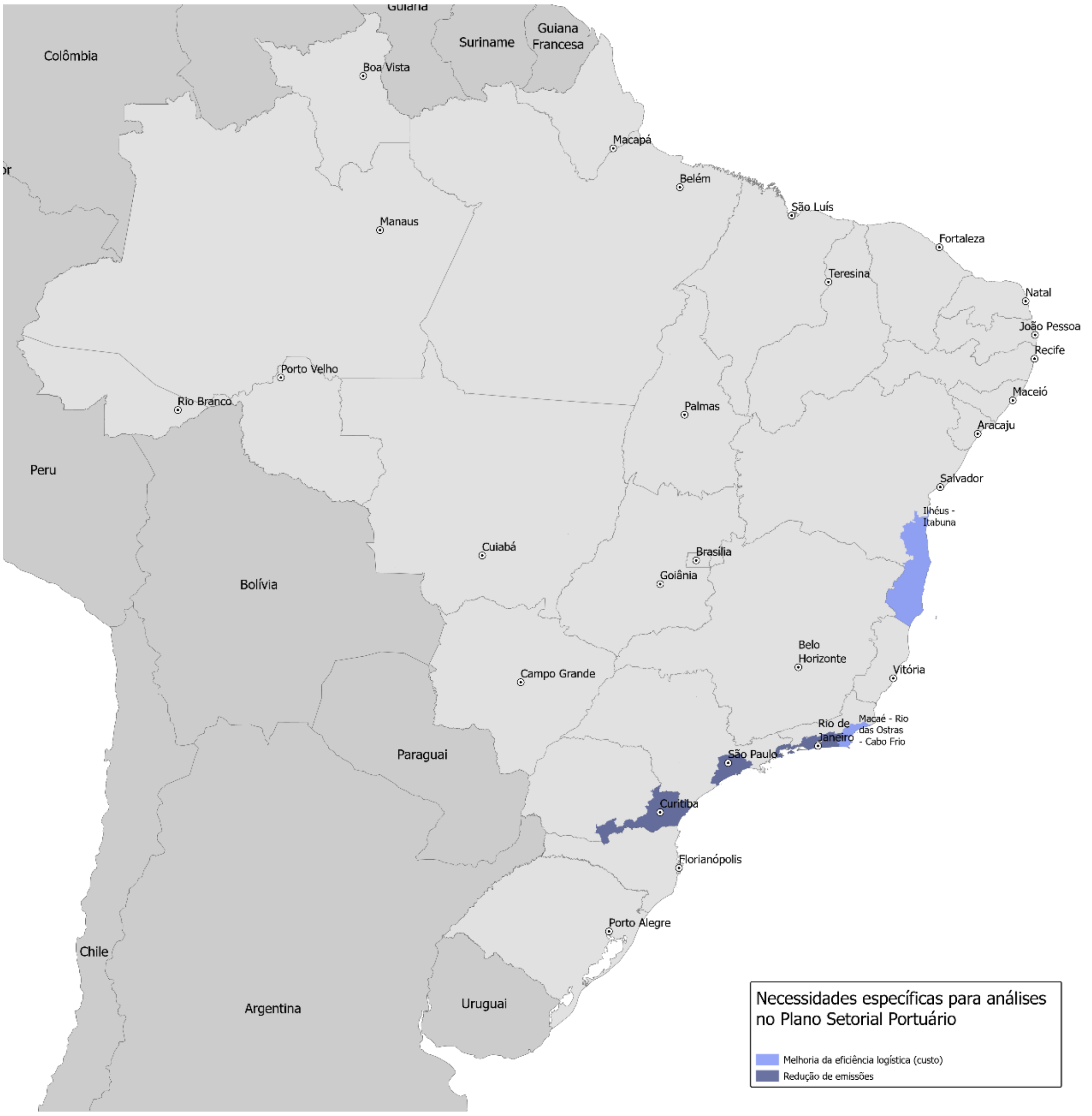
Picture 100: Intermediate Geographic Regions and indicators with specific needs for analysis in the Land Transport Sectorial Plan, roadway mode/Source: EPL (2021)



Picture 101: Intermediate Geographic Regions and indicators with specific needs for analysis in the Land Transport Sectorial Plan, railway mode/Source: EPL (2021)



Picture 102: Intermediate Geographic Regions and indicators with specific needs for analysis in the Waterway Sectorial Plan/Source: EPL (2021)



Picture 103: Intermediate Geographic Regions and indicators with specific needs for analysis in the Port Sectorial Plan/Source: EPL (2021)

As already discussed, **the selection of these needs does not limit the performance of the Sectorial Plans to this scope, but indicates areas that should be the target of priority analysis to help achieve the objectives of the National Transportation Policy.**

7.5. TRENDS IN LOGISTIC FLOWS

This section presents an overview of the main logistical flow behaviors evidenced in most of the simulated scenarios, configuring sectorial trends that can be valuable information for the understanding of the future transport system and for the decision-making of public authorities and private initiative in short term, in addition to highlighting alerts on issues that must also be observed in the Sectorial Plans.

In relation to the flow of GSA Freight, the infrastructures tend to be quite dependent, in all scenarios, on the set of railways referred to in this document as the central railway set, formed by FICO, FIOL, *Ferrogrão* and FNS, with the Rumo Malha Norte as a complementary structure.

In Scenario 9, the transforming impact of the South section of the North-South Railway is also observed.

However, in all of the observed scenarios, the state highways that serve as access to both the terminals provided for in the new railways and those that serve as access to the federal highways stand out, and they are quite loaded, including in road infrastructure that today are unpaved. As an example, we can mention MT-322, which is part of the Strategic Layer of Analysis and works as a connection channel between northeastern Mato Grosso and the infrastructure of *Ferrogrão* to the west and FNS/TC to the east.

This type of interaction between the large-volume corridors to be implemented, or already implemented and with greater allocation potential in the future scenarios observed in this Plan, **should also be studied by the Land Transport Sectorial Plan**, so that the capillary structures are consolidated support and loading of large flow modes.

Still addressing the GSA transport infrastructure, in all scenarios Freightes coming from Uruguay are observed, as well as from the center of the state of Rio Grande do Sul and the western border of Santa Catarina using the Rumo Malha Sul, to access the Port-city of Paranaguá/ PR. This behavior may indicate a repressed potential for both the ports of Rio Grande do Sul and Santa Catarina, as well as a potential Freight to be studied in future studies for the Malha Sul railway.

In addition, there is a mutually exclusive behavior, in principle, between the Rumo Malha Oeste and EF-484, regarding the GSA originating in Mato Grosso do Sul towards the ports. This behavior is another factor to be observed by the PSTT to confirm or reject the behavior on a more focal scale and, consequently, give the necessary treatments.

Focusing on the transport of iron ore, the implementation of the EF-484 has a potential to attract production in southern Mato Grosso. This movement characteristic requires further proof on a deeper scale, intuiting the timely confirmation of the mines present in that state, their potential, and the adherence of the Freight corridor to mineral production points, since this type of Freight is not willing to be transported by roadway mode.

The interventions tested in the midst of the scenarios envisioned attract Freight that was once transported by inland navigation, on the Paraguay River waterway, and this "mode change" may change the arrangement observed by the Waterway Sectorial Plan - PSH and by the Port Sectorial Plan - PSP. Therefore, this dynamic transcends the isolated analysis on a single plane, and the system as a whole and its consequences must be observed.

There is also the identification of a potential corridor to be studied and dealt with, if its behavior is ratified, between Rio de Janeiro/RJ and Campos dos Goytacazes/RJ. This excerpt presents a volume of OGSM and LB which, by confirming their potential for the future scenario, may give rise to greater attention by the PSTT.

Fertilizers, unlike the other components of the OGSM group, have favoritism for changing routes to access the countryside as the railway networks of the central complex become active. This phenomenon can occur both due to an eventual lower saturation of the ports in the North, in relation to the ports currently used, as well as the effect of new railway infrastructures, which have higher speeds and capacities.

This configuration changes the dynamics of interiorization of such products, which no longer occupy the Rumo Malha Norte and São Paulo railways, starting to observe lower impedance (cost and time) when accessing the national territory through the northern ports. **The Port Sectorial Plan needs to be aware of the diversity of Freightes attracted, identified in the NLP and with the potential to be detailed by the PSTT and PSH, so that the ports have adequate capacity and equipment for their treatment and internalization.**

With specific regard to CGC and NCGC Freightes, treated below as general Freightes, these are the Freight groups for which the greatest challenges have been identified. The behavior observed, in which the new railway infrastructures attract these loads, gives a clear sign that the attractiveness for the general load in the railway mode is directly related to the capacity and speed experienced.

In all scenarios where the central railway set appears as active, an important system for the distribution of general Freight throughout the countryside of Brazil is formed there and, consequently, an important VKU system for general Freight, that is, a corridor of distribution of Freight is formed with the highest value in the center of the country. The impact of the southern part of the North-South Railway is evident in scenarios 6 and 9, where the largest share of the railway VKU in the transport system is seen.

The potential to be harnessed from this type of analysis, unprecedented in this Plan, is immense, but it requires more attention and a more detailed look to be provided by the PSTT, to guarantee an auxiliary network for the capillarization of Freightes and deliveries in a wider range. In a closer look, to be broken down during the PSTT, it is observed that accessibility is restricted to a distance of 200km from the location of the terminals, with the possibility that this will expand with the density and improvement of infrastructure auxiliary highways and implementation of logistic integrating centers.

For this same group of products, there is great relevance in TKU and VKU for the BR-364 MT/RO, with the clear conformation of a Freight flow corridor between these states and the other states of the Midwest regions, as well as North and Southeast. This time, it is possible to observe an eventual opportunity to study logistical integrations in a northwestern Brazilian axis, increasing its attractiveness.

Derived from this axis, there is an atypical behavior in the model to be confirmed and/or rejected by the Sectorial Plans. As the port organized in Porto Velho/RO was not expected to expand its range of products, aiming to meet a greater volume of Freightes in the general Freight group, Freightes opt for travel via BR-319 (AM), even in the scenarios in which it remains entirely unpaved, due to the non-existence of the alternative link model with Manaus/AM. At this point, it is **the responsibility of the Port Sectorial Plan to analyze this future scenario for ports in the North Region so that, based on this confirmation, it is possible to study, both within the scope of the PSH and within the scope of the PSTT,**

whatever the behavior of the Freight will be if there is the possibility of access to the waterway.

This care, of **observing the port infrastructures of the North Region for general Freight, presents itself as a challenge for the Port and Waterway Sectorial Plans.** This need arises from the fact that it is possible to identify, in the scenarios, general Freightes that travel in "unconventional" directions to access ports that actually transport these Freightes. This situation has the potential to reduce Brazilian logistical efficiency, increasing transport costs for products manufactured or consumed in this region.

Approaching liquid bulk, there is great potential for the transport of petrochemicals between Bahia and the Southeastern states, especially Rio de Janeiro and São Paulo, as well as for chemical products that, due to their behavior, fit for the present model as general loads. Thus, it is necessary to observe the capacities of ports and the analysis of cabotage transport so that there is a balance in the mode of transport.

Changing the approach from product groups to specific modes and works, it is possible to observe in the model, in all the scenarios, that there is a potential for transport between the states of the South and Southeast regions (except for Minas Gerais) for general Freight by cabotage, to be studied and confirmed.

Although general Freightes experience a higher time cost, which initially takes their transport to the road mode, **the reduction of port costs in various scenarios shows a potential attraction for some Freightes of this group of products that, in confirming themselves in the Sectorial Plan**, can be explored as a latent potential.

In turn, the waterways of Rio Grande do Sul, together with its lacustrine navigation, have a specific potential to be studied from the improvement of efficiency in this way, especially because production points close to these infrastructures have consumer markets identified in the origin and destination matrix, in regions close to the Brazilian coast. Thus, the promotion and improvement in this way, being the object of a study that rejects or ratifies such finding can lead to an increase in the competitiveness of the Rio Grande do Sul production.

Likewise, there is a visible formation of a value corridor between Porto Alegre/RS and São Paulo/SP, in a stretch that overlaps important highways, such as BR-101 and BR-116, and the Rumo Malha Sul, as can be seen in the VKU maps for the Scenarios (Appendix). This behavior can be observed and is of deep interest for demand studies for an eventual pre-feasibility analysis, requiring, once again, rejection or ratification for further studies.

In the scenarios where **the Tocantins River waterway appears as active, it plays a relevant role, both in terms of TKU and VKU, presenting itself as a corridor for different types of products, but mainly for OGSM and GSA. Its dual relevance, in terms of value and weight, places this infrastructure as a point of special attention for PSH.**

Regarding air transport, the NLP 2035 considered the Development Scenario 2 presented in the National Airway Plan 2018-2038 as a reference scenario. The set of 164 airports planned for the future horizon, comprising metropolitan and regional airports with regular flight operations, are established as important backbones for the intercity transport of people. The integration of this way with road transport, as observed in the projected future matrix, completes a main network of displacements where large distances tend to be increasingly performed by air transport, while small and medium distances, by road transport, especially by private car.

The growth scenarios project that the share of air transport should grow from 25% in 2017 to up to 35% in 2035 (in RPK), reinforcing the need for the airports provided for in **PAN Development Scenario 2, which should be considered as a point of departure for plan updates.**

It is reinforced that the Sectorial Plans will also present as sub products, the Sectorial Private Partnership Plans, indicating the opportunities for partnerships with the private sector according to the pre-feasibility analysis carried out, which can be done with the demands and data presented in the NLP 2035.

8. GOVERNANCE OF INTEGRATED TRANSPORTATION PLANNING

As briefly discussed in the introduction, the NLP is part of the Integrated Transport Planning (ITP), established by Ordinance nº 123/2020 and complemented by Ordinance 792/2021. In this sense, it is noteworthy that the NLP does not end in itself, but must be understood as a cog in a planning system. The planning teams from different areas of the Ministry of Infrastructure, aware of the risks inherent to long-term planning, especially its adherence to decision-making and the execution of plans, molded ways for the plans to become effective tools for decision-making.

Thus, the ITP brings from its conception elements related to decision making under great uncertainties and adaptive dynamic planning (Marchau et.al, 2019[33]). On this perspective, there is an awareness of the uncertainties inherent to any work that intends to predict and act towards the achievement of long-term goals, in the case of 15 to 30 years, and which includes a high degree of complexity. Therefore, every new information, such as changes in the expectations of actors, changes in the situation, or any previously unknown condition that may have an impact on future scenarios and on the decision-making must be systematized and considered in updates that improve the manager's ability to make decisions more assertively.

Then, it is worth highlighting the elements already discussed that were part of the initial framework of the NLP and that are fundamental to the greater ability to perceive future scenarios: the origin-destination matrixes of people and Freight obtained with innovative methodologies and technologies; modeling considering a network that encompasses all modes; and the use of scenarios and a system of indicators that aim to signal impacts. In addition to these elements, a greater integration and systematization of the performance of different actors is needed to improve the decision-making process, making planning an important tool to choose from.

For this purpose, the ITP sought to establish reference and integration elements to support the manager with as much information as possible at the time of decision making. In this sense, the NLP is the element that serves as an initial reference to be used in the elaboration of the Sectorial Plans. These, in turn, will be monitored since their elaboration and, later, will form integrated actions in the General Partnership Plans and General Public Action Plans, which facilitate the elaboration of the Partnership, Multiannual and Budget Plans.

[33] Vincent A. W. J. Marchau& Warren E. Walker & Pieter J. T. M. Bloemen& Steven W. Popper (ed.), 2019. "Decision Making under Deep Uncertainty," Springer Books, Springer, DOI:10.1007/978-3-030-05252-2, July.

Notice that all the different plans will have the possibility of adaptation, as new information, contingencies, and events are added, configuring a dynamic planning system.

To assist the integration between the NLP and the Tactical Level Plans, the Tactical Planning Orientation Guide was prepared to assist in the construction of this system, approved by Ordinance Nº 792/2021. The Guide lists information to be observed by the Tactical Plans that should or may be obtained from the NLP, such as the need to establish objectives, indicators and goals at the tactical level and indication of programs, projects, and initiatives by the sectorial plans.

There is, also, as established by Ordinance Nº 123/2020, the requirement for monitoring and evaluation activities, in line with the Practical Guide for the Ex Ante Analysis and the Practical Guide for Ex Post Analysis, both published in 2018 by the Federal Government, as well as the adherence to the General Guide on Socioeconomic Cost-Benefit Analysis of Infrastructure Investment Projects is suggested, published by the Ministry of Economy in 2021. The publication of these guides comes in the wake of the establishment of a state culture focused on planning and evaluation of public policies that pay attention to the efficiency and effectiveness of public action.

In this sense, for dissemination and adherence to this culture, the broad participation of different actors in a transparent process is essential, such as entities of the federation (States, Federal District and Municipalities), other ministries, associations, confederations, and society in general.

Considering this context, fundamental points for the discussion and participation of society were established for the preparation of the NLP, as well as specific monitoring, reviewing, and updating elements for the NLP, which will be dealt with below.

8.1. SOCIAL PARTICIPATION

Throughout 2020, EPL and MINFRA promoted a series of Webinars with representatives of Federal and State Governments, Industry, logistic operators, and transport users. In these forums, we sought to proactively provide transparency and gather contributions for the preparation of the new NLP.

Responses to inquiries received at these Webinars are presented in Appendix II.

The Public Consultation, which took place between March and May 2021, is also focused on transparency and, above all, enabling the improvement of the 2035 NLP, through the contribution of agents working in the public and private sectors of the various segments of Brazilian society. With the completion of Public Consultation, the receiving of criticism and suggestions from interlocutors in the planning, industry, commerce, tourism, transport, agriculture, and environment sectors of the Federal and State governments, as well as associations, confederations and segment and related federations, in addition to entities and bodies representing transport service users and individual participation by those interested in the topic was expected.

During the public consultation, the preliminary results of the NLP 2035 were presented and contributions from the listed agents were received. The contributions received led to several adjustments and the development of a new participatory Scenario (Scenario 6), with society and market views on the development of the national transport network.

The material resulting from the Public Consultation was analyzed by the EPL's technical team, and the contributions that could be used were incorporated in the final version of the NLP 2035 or in case it is not possible to include in this version of the NLP, they were duly answered as explained in Appendix II.

8.2. NLP MONITORING, EVALUATION, REVIEWS AND UPDATES

The dynamic character given to the NLP is due to the systematic of constant monitoring of the projects and indicators evaluated in the simulated scenarios, resulting in periodic reviews and four-year updates.

Following the Public Consultation, once the final Executive Report of the NLP 2035 and its annexes were published, the NLP Booklets will be developed and disclosed, in which relevant aspects of the Plan will be detailed. The following publications are already planned, and others are under discussion and may be part of the set of NLP 2035 publications:

a. Methodological Section: Origin-Destination Matrixes;

b. Methodological Section: Transport Modeling and Calibration;

c. Methodological Section: Demand Projection;

d. Strategic Section: Strategic Logistical Corridors; and

e. Strategic Section: Environment.

The revisions to the NLP will involve monitoring the projects, objectives, economic projections, sectorial legislation, and technological innovations evaluated in the Plan's scenarios. Thus, whenever necessary, new simulations will be carried out to adjust the NLP scenarios in light of the reality observed in each period of analysis.

It is also worth mentioning the provisions of MINFRA’s Ordinance nº 123/2020, that the Integrated Transport Planning will have a thirty years horizon and will be updated respecting cycles of 4 years. Thus, the NLP should be published by the end of the first year of execution of the Multi-Year Plan, being the benchmark for the identification of needs and present and future opportunities for the supply of transport subsystem capacity, while it will indicate needs for studies of new infrastructures and the improvement of existing infrastructures under the Sectorial Planning.

However, considering that this Plan is part of the first cycle of the Integrated Transport Planning under the aforementioned ordinance and, observing its transitory nature, it is exceptionally presented that this NLP will have the 2035 horizon and will include the transport of people and goods from the federal road, railway and waterway subsystems, and the road and logistical connections between these subsystems and those with the road systems of the States, the Federal District and the Municipalities.

It should be added that the processes of elaboration of the Sectorial and General Plans for Partnerships and Public Actions, which also provide for moments of consultation with society, will also provide important inputs for the updating and revision of the NLP, considering that these Plans will assess the needs and opportunities of each mode of transport, in a more detailed perspective, of a tactical nature, which was not possible to capture in the planning scale of the NLP. This way, the monitoring of Integrated Transport Planning - ITP provides a continuous element of identification of interfaces and intermodal convergence points to be considered in later versions of the NLP, in a continuous, two-way cycle of supplying and obtaining data between the plans in question.

At each cycle of planning, the NLP will be fed by the initiatives and actions proposed in the sectorial plans, which will compose the future scenarios to be simulated. In parallel, the advances observed in the variables that shaped the scenarios simulated in the previous version of the NLP will be evaluated, seeking to identify the proximity between the execution and the prediction hypothesis.

During the transport subsystems Management process, which goes beyond the planning cycle, the NLP 2035 offers the results of the evaluation indexes whose minimum values observed in each indicator for the future Scenarios can be considered as goals, seeking to reach agreement with the chosen and effectively implemented short-term actions. However, with both endogenous and exogenous indicators to the transport system, the goals should be points of reach for all actors in the system, including the Government, in all spheres of action, the private entities that operate in the system, and their users.

For the next version of the NLP, to be published by the end of 2024, potential evolutions have already been identified, both regarding the input data of the NLP, aiming at greater adherence of the model to reality, as with regard to the evolution of transport planning methods. Such expectations, however, depend on a series of internal actions by EPL and MINFRA, as well as cooperation with other entities and investments for their realization.

8.3. FINAL CONSIDERATIONS

The National Logistics Plan - NLP 2035 marks the resumption of national Transport Planning, and, at the same time, incorporates a more modern vision of the planning process, with innovative methodology, absorption of the best international references and a vision of Integrated Transport Planning based on flexibility and strategic vision, characteristics required for a plan of this acting dimension. It also makes the paths for the tactical planning phase very clear, which is more specific and focused on the objectives and particularities of each mode of transport. Besides that, it provides the Government, society, and the market with a vision of the future that helps assess the different decisions that will shape the real development scenario of the national transport network.

The NLP 2035 is a State plan, and as such, it does not propose to compose a package of short-term projects. The different development paths presented here are hypothesis that depend on the simulated variables and decisions, as well as other characteristics that are not easily captured in an objective modeling, such as the market potential of projects, the international market view on attractiveness, resources for investments in infrastructure in Brazil, the different legislative and regulatory bases that can develop over the years, affecting transport subsystems, the public budget, agreements and contracts between private entities. The NLP 2035 presents quite clearly that changing a single variable in one of the transport subsystems can lead the entire network to considerably different paths. This is one of the main contributions of this plan and reinforces that the biggest gain offered here is not the data and results of the future forecast, but the resumption of planning as a continuous process, capable of monitoring and evaluating the dynamics of the changes that may occur in the next years.

There is no perfect scenario among those presented in NLP 2035. There is no preferred scenario. The main contribution of the NLP is to demonstrate how decisions and actions of different actors in transport systems can transform the territory in different ways. Keeping the strategic objectives clear and fixed, the subsequent planning cycles tend to gradually adapt the short-term actions to the desired positive results, guiding the opportunities that should be kept as a priority, and the needs that should be the focus of solutions' development.

Table 25 presents some of the main characteristics of the simulated scenarios for 2035.

It is evident, from the assessment of the different Scenarios, that the evolution of the transport system to achieve the goals of the National Transportation Policy can only be achieved with joint initiatives between the different actors in the system, as well as through innovative strategies that enhance the results expected.

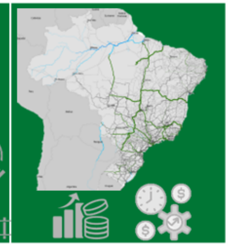
Although this NLP does not specify the way to implement the different simulated projects and actions, there are clear trends to be evaluated in the initiatives of the sectorial plans, such as:

- Regulatory flexibility: it is observed, in this plan, that the improvement in indicators that measure the achievement of the NTP's objectives occurs more significantly when there is considerable development of infrastructure and implementation of new structural elements (new railways, new airports, etc.). This indicates that the regulatory framework that enables this expansion must be flexible enough to provide development at the pace required to anticipate the positive impacts of investments in transport infrastructure.
- Private participation in investments: among the simulated scenarios, there is a need for disbursements in transport infrastructure of R$730 billion (Scenario 1) to R$1.172 billion (Scenario 8). About 80% of the investment considered in Scenario 1 (R$315 billion) comes from the private sector, and of these, 80% (R$253 billion) are already insured in existing concession contracts. With the need for more investments in infrastructure and the increase in system maintenance costs, given the increasingly

relevant budget constraints of the public sector, the arrangement of private partnerships in transport infrastructure is a desirable trend to achieve more promising scenarios. On this perspective, it is essential that the projects analyzed in more detail in the sectorial plans seek solutions that adhere to the economic and social needs of the country, but also that they are attractive to the market.

- Territorial equity: As observed in the national and regional economic development indicator in the different scenarios of the NLP 2035, investments in infrastructure tend to generate transformative impacts on the economy and society, especially in regions with a low density of transport infrastructure, and consequently, with greater distortions in terms of costs and travel times. The potential of these investments was verified in scenarios that consider, for example, the structuring railway network formed by FICO, North-South Railway and FIOL, as well as *Ferrogrão*, providing the flow of agricultural bulk through the ports in the north of the country and distribution alternatives of general Freight at lower cost. Such opportunities characterize the trend that investments in these regions, in addition to generating economic development, generate territorial equity. Therefore, the investment strategy aimed at less developed regions in terms of infrastructure also feeds a public policy of equity that is established at a level higher than transportation planning, corroborating the territorial and social development of the nation.

Table 25: Main characteristics of simulated scenarios for 2035

								
1	2	3	4	5	6	7	8	9
• Rational modal split • Lower investment • Reasonable improvement on the average costs of transport • Positive impacts on several indicators	• More rational modal split • Needs more investment than scenario 1 • Considerable improvement on the average costs of transport • More safety	• More valuable freight on the road transport • High transport cost • Less safety • High level of emissions • More needs to be resolved in a mightier economy	• More freight in coastal shipping and inland navigation • Longer travel times • More need for investment in the port sector	• Need for innovation and investments in technology on the part of the market • More freight on railways, including high value merchandise • High impact on the reduction of transport costs • High impact on the reduction of emissions • More safety	• Large investment need (2xC1) • Efficient modal split (60% on high-capacity modes) • High impact on the reduction of transport costs • High impact on the reduction of emissions • Longer travel times (freight), shorter for people • High economical impact	• More investment in railways • Moderate impact on reduction of emissions • Longer travel times (freight), shorter for people • Differentiated local impacts according to simulated short lines proposals	• Need for large investments • Feeding trunk modal share • Road transport almost exclusively with the feeding and distribution function • High impact on cost reduction • Emission reduction • Longer travel times • Combination of variables outside the direct control of the executive power	• Low investment (compared to scenarios 2 to 8) • Rational modal split, with more valuable freight on railways • Lower transport cost • Shorter travel time for people • More safety • Emission reduction • Longer travel times for freight.

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APPENDICES

APPENDIX I: NLP 2035 INDICATOR SYSTEM.

Available at: https://filecloud.epl.gov.br/owncloud/index.php/s/4zB38Le74Zmn4FQ

APPENDIX II: ANSWERS TO WEBINARS AND PUBLIC CONSULTATION.

Available at: https://filecloud.epl.gov.br/owncloud/index.php/s/zczr3Rcis2zynJ8

APPENDIX III: FREIGHT VISUALIZATION IN DIFFERENT SCENARIOS.

High resolution maps available at:

Base - 2017	https://filecloud.epl.gov.br/owncloud/index.php/s/c2TCVggjj2kBdHj
Scenario 1	https://filecloud.epl.gov.br/owncloud/index.php/s/RvAiNCYCOJsW9dY
Scenario 2	https://filecloud.epl.gov.br/owncloud/index.php/s/nO2bA3nVbbrCnUH
Scenario 3	https://filecloud.epl.gov.br/owncloud/index.php/s/WbyUMVaaaiULmuP
Scenario 4	https://filecloud.epl.gov.br/owncloud/index.php/s/dURdLM9wIAHPJOF
Scenario 5	https://filecloud.epl.gov.br/owncloud/index.php/s/PvXClbRZgkAKLcU
Scenario 6	https://filecloud.epl.gov.br/owncloud/index.php/s/UYj4crtiZ7JKXtR
Scenario 7	https://filecloud.epl.gov.br/owncloud/index.php/s/DDBpP9uhuh7pAY9
Scenario 8	https://filecloud.epl.gov.br/owncloud/index.php/s/Li8Wvt1IzxJE3NM
Scenario 9	https://filecloud.epl.gov.br/owncloud/index.php/s/M1Bprs68hr9pIPT

APPENDIX IV: ORIGIN-DESTINATION MATRIXES.

Databases with O/D matrixes available at:

Freight - 2017	https://filecloud.epl.gov.br/owncloud/index.php/s/6t2MwFu2lOZ3e0w
Freight - 2035_referential	https://filecloud.epl.gov.br/owncloud/index.php/s/bE5Ii7MM8GTaEY4
Freight - 2035_transformative	https://filecloud.epl.gov.br/owncloud/index.php/s/usJec68q7CBd1CE
People - 2017	https://filecloud.epl.gov.br/owncloud/index.php/s/LsbcgkmXzEb8z5X
People - 2035_referential	https://filecloud.epl.gov.br/owncloud/index.php/s/yobCot235zn06Yq
People-2035_transformative	https://filecloud.epl.gov.br/owncloud/index.php/s/KseEJkUFBXuqUwY

APPENDIX V: STRATEGIC LAYER OF ANALYSIS.

High resolution maps for the Strategic Layer of Analysis available at:
https://filecloud.epl.gov.br/owncloud/index.php/s/g6THXDi0S5nDOJa

APPENDIX VI: TABLE OF PROJECTS SIMULATED BY SCENARIO.

Available at: https://filecloud.epl.gov.br/owncloud/index.php/s/LqOZ3BJ0C9xzuet

APPENDIX VII: DETAILING OF STUDIED TECHNOLOGICAL TRENDS.

Available at: https://filecloud.epl.gov.br/owncloud/index.php/s/wj4BHocx3BsW8my

APPENDIX VIII: TABLE OF PORTS, PRIVATE USE TERMINALS AND FREIGHT TRANSSHIPMENT STATIONS BY PORT-CITY SIMULATED ON SCENARIOS

Available at: https://filecloud.epl.gov.br/owncloud/index.php/s/nWp3eAiaK6i8Hdj

For more and updated information, data and systems about Brazilian's Integrated Transport Planning, visit:

https://www.gov.br/infraestrutura/pt-br/assuntos/politica-e-planejamento/politica-e-planejamento/planejamento-integrado-de-transportes

or

https://ontl.epl.gov.br/planejamento/

ANNEXES

ANNEX I: ORDINANCE Nº123, OF AUGUST 21, 2020, BY THE MINISTRY OF INFRASTRUCTURE

Available at: https://www.in.gov.br/en/web/dou/-/portaria-n-123-de-21-de-agosto-de-2020-273770905

ANNEX II: ORDINANCE Nº792, OF JULY 1, 2021, BY THE MINISTRY OF INFRASTRUCTURE

Available at: https://www.in.gov.br/en/web/dou/-/portaria-n-792-de-1-de-julho-de-2021-330276820

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or

https://ontl.epl.gov.br/planejamento/