

IAC-22-E7,IPB,11x67999

The New Brazilian National Programme of Space Activities – PNAE (2022-2031): What to expect

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Abstract

Pursuant to art. 1, III, of Law No. 8,854/1994, and Decree No. 1,332/1994, it is incumbent upon the Brazilian Space Agency (AEB) to prepare, update, execute and enforce the Brazilian National Programme of Space Activities (PNAE) and the respective physical and budgetary proposals. The Agency has recently approved the PNAE 2022-2031, through the AEB Ordinance No. 756/2021. This working paper introduces the next decade's PNAE and analyses its elements from a space law and policy perspective. It examines the evolution of the Brazilian national programme and assesses how PNAE 2022-2031 is expected to orient national space activities, enabling and incentivising investments in the space sector and in specific sets of activities, while also providing that national activities are developed in accordance with the State's obligations under international space law. The Brazilian Space Programme (PEB) must focus on meeting the needs of the national society with the greatest effectiveness and efficiency. The first part of the PNAE 2022-2031 presents a strategic vision for the Brazilian space sector. It is the embryo of a national space strategy. Aligned with the Brazilian State's demands, it seeks to point out the strategic nuances for the country's space activities. In the second part, the tactical stratum of the PNAE is proposed, introducing the action axes that will meet its strategic vision, the directions that will guide its deliverables and the systematic organisation for sector programmes. The third part illustrates the set of PNAE's deliverables. In addition to spatial artefacts, the set encompasses programmes, structuring plans and initiatives. The last part presents a schedule with the leading planning events that the Brazilian space sector shall watch within the next ten years. The research methodology is bibliographical and documental, through qualitative analysis, and the historical and analytical methods are applied herein.

Keywords: Space Law; Space Policy; PNAE.

Acronyms/Abbreviations

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (ARRA)

Alcântara Space Centre (CEA)

Brazilian Space Agency (AEB)

Brazilian Space Programme (PEB)

Brazilian Space Programme Development Committee (CDPEB)

Brazilian Space Regulation (REB)

Brazilian Supreme Court (STF)

Catholic University of Santos (UNISANTOS)

China-Brazil Earth Resources Satellite (CBERS)

Convention on International Liability for Damage Caused by Space Objects (LIAB)

Convention on Registration of Objects Launched into Outer Space (REG)

Global Open Collecting Data System Federal University of Santa Catarina (GOLDS-UFSC)

Federal University of Rio Grande do Sul (UFRGS)

Low Earth Orbit (LEO)

Moon Village Association (MVA)

National Defence Strategy (END)

National Development Policy of Space Activities (PNDAE)

National Programme of Space Activities (PNAE)

National System for the Development of Space Activities (SINDAE)

Pluriannual Investment Plan (PPA)

Procedure for Selection and Adoption of Space Missions (PROSAME)

Scintillation Prediction Observations Research Task (SPORT)

Secure World Foundation (SWF)

Strategic Space Systems Programme (PESE)

Strategic Space Objectives (OEE)

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST)

1. Introduction

This paper aims to analyse the new Brazilian National Programme of Space Activities (PNAE) 2022-2031, and what can be expected for the next decade.

The Brazilian Space Programme (PEB) must meet society's needs, with the highest possible levels of effectiveness and efficiency. It is with this objective that the PNAE 2022-2031 is established as an instrument of the Brazilian State [1].

The impacts of space activities are present in strategic sectors of modern societies, such as communication, logistics, urban mobility, civil defence, mining, environment, health, education, and science, among others. In addition, they are essential for precision agriculture, consolidation of smart cities, use of renewable energies, and for the transition into a more digital and inclusive society [1].

Each State presents its peculiarities regarding the real needs of space applications. In Brazil, autonomy in the space sector is not complete. Thus, ways of providing space goods and services that meet the needs of the population must be pursued, with their own technology and adequate to the Brazilian socio-geographic contexts. Society must be aware of the importance of this process to consolidate its support for the country's space activities.

Immense challenges lay ahead. The PNAE is the most important programme in Brazilian space policy and, therefore, must reflect the main desires of Brazilian society. This article aims to present to the international scientific community on which bases the PNAE is constructed and what are its main objectives and challenges.

2. Material and methods

The research methodology is bibliographical and documental, through qualitative analysis. It focuses on the historical and analytical review of the primary sources of the national programmes for space activities. It also uses a critical review of secondary sources on the subject.

3. Space law and policy in Brazil

3.1 The Brazilian legal framework of space law

First, in attendance to the significance of space activities as a strategic matter to any country, especially

with regard to sovereignty, the 1988 Brazilian Federal Constitution defined space law and policy as an assignment of the Union [2]. The Union is exclusively in charge of legislating about space law, air law, and aerospace navigation and defence, as well as exploring aerospace navigation, independently or through concession or permit [2]. However, the Brazilian space law framework is not clearly defined and is under construction.

At the International level, Brazil is a party to four of the Space Treaties: a) the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies – Outer Space Treaty (OST), b) the Convention on Registration of Objects Launched into Outer Space (REG), c) the Convention on International Liability for Damage Caused by Space Objects (LIAB), and d) the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (ARRA).

Even though the enactment of national space law is not an international obligation, States parties to the OST shall adopt procedures to authorise and supervise national space activities, whether public or private. An increasing number of States own legal frameworks to regulate the space sector, focusing on their particular needs and interests regarding the use and exploration of outer space [16, p. 184-186] – law is regarded as a major reference for the development of space policies, and an important instrument for their implementation [17, p. 32]. Furthermore, coherent legal frameworks, in principle, provide clarity and legal certainty to attract private operators and steer their participation to promote national interests [17, p. 34].

At the domestic level in Brazil, rules regarding space activities are scarce and fragmented, although it is possible to identify the efforts of national institutions to regulate the subject [3]. Law No. 8,854, of 10 February 1994, created the Brazilian Space Agency (AEB) as a federal civilian agency hierarchically under the Presidency of the Republic and bestowed with financial and administrative independence [4]. The Presidential Decree No. 1,332, of 8 December 1994, endorsed the revised version of the National Development Policy of Space Activities (PNDAE), formulated by the AEB [5]. In 1996, the Presidential Decree No. 1,953, of 10 July 1996, instituted the National System for the Development of Space Activities (SINDAE) to promote domestic interest in the sector [6]. The Presidential Decree No. 9,839 of 14 June 2019 deals with the Brazilian Space Programme Development Committee (CDPEB, Portuguese acronym), which advises the President on making proposals for subsidies to the space programme, development, and utilisation of technologies, and supervising the execution of measures to enhance the Brazilian Space Programme [7]. Finally,

the AEB Ordinance No. 698, of 31 August 2021 institutes the Brazilian Space Regulation (REB, Portuguese acronym) for the Operator's Licence for Space Activities and the Launch Authorization in the Brazilian Territory [8].



Fig. 1. Brazilian Federal Constitution by STF

3.2 National Development Policy for Space Activities (PNDAE)

The PNDAE is the policy that establishes goals and guidelines regarding national space programmes and projects. AEB elaborated the updated version of the PNDAE, which was approved by the Presidential Decree No. 1,332, of 8 December 1994 [5]. It is significant that the PNDAE remarks the potentialities of space technology for meeting domestic needs, particularly in light of Brazil's characteristics as one of the world's largest countries, with its population concentrated on the coast, its rainforests, and its extensive national borders, among other factors [3].

The policy's general goal is to promote the country's capacity to use space technology for solving national demands and for the benefit of Brazilian society. It also presents a set of guidelines that must be followed when planning and executing the proposed goals.

Among those guidelines are: a) priority to solving national issues; b) concentration of efforts for mobilising programmes; c) purpose-oriented scope; d) careful investment analysis; e) results-driven international cooperation; f) incentives for industry's participation; g) optimised use of resources; h) capacity building in strategic technologies; i) pragmatism in the conception of new space systems; j) valorisation of scientific activities; k) emphasis on space applications; l) coherence between autonomous programmes; m) conciliation between technological and scientific objectives and applications; n) dual-use technology export control; and o) other guidelines [5].

3.3 National Programme of Space Activities (PNAE)

The National Programme of Space Activities (PNAE) is the main tool for the implementation of PNDAE, in pursuance of its goals and in accordance with its guidelines.

Produced by AEB, each PNAE covers ten-year periods, is subject to annual revisions, and establishes scientific programmes, projects and research, applications, and technological training of specific natures, in addition to programmes and activities of general scope. The first PNAE covered the 1996-2005 period, followed by PNAE 1998-2007, PNAE 2005-2014, PNAE 2012-2021, and, finally, the current edition, PNAE 2022-2031.

3.4 Former PNAEs

3.4.1 PNAE 1996-2005

The very first PNAE considered that Brazilian space activities, including research, applications, and technological development, should be carried out to fulfil the needs of national society [9]. At the time, it emphasised a context of little commercial interest in space activities, except for communication systems, and that the purposes of the programmes should primarily serve governmental demands, such as Earth observation.

Among its purposes, the Agency expected to take advantage of certain areas that appeared as a result of the country's peculiarities, particularly those related to its geographical position. As example, the document presented a constellation of Low Earth Orbit (LEO) satellites for communication in remote regions of the county; small remote sensing satellites for applications, illustratively, in real-time monitoring of land use changes, including deforestation or even, depending on the availability of higher resolution images, in border patrol and surveillance tasks in the Amazon region; and satellite-based tele-education systems, particularly targeting remote regions.

Thus, the programme proposed to seek increased integration within the scope of international programmes, through cooperation of scientific or technological nature with other countries. Its main purpose was to create means for Brazilian society to have access to the resources provided by satellite applications, especially in Remote Sensing, Meteorology, Oceanography, Telecommunications, Geodesy, and Navigation [9].

The programme listed seven major goals, which included: a) ensuring capacity to extract all the potential associated with images and data obtained by Earth observation satellites; b) establishing and maintaining centres of scientific excellence in all sub-areas of space systems applications which could provide means to defend domestic interests in international forums; c) acquiring and maintaining the essential means for the

autochthonous realisation of international quality meteorological forecasts; d) achieving and maintaining technical-scientific vanguard in the main areas of knowledge concerning the dynamics of the South Atlantic Ocean; e) conceiving means and systems that would allow new uses of satellite telecommunications, particularly those aimed at uses of recognized social importance; f) building capacity to effectively use high-precision international positioning systems and satellite navigation aids, and to design, specify and develop subsystems or equipment that would provide opportunities for greater national participation in those systems; and, g) developing application areas that have not been adequately explored, yet had proven to be attractive and compatible with available financial resources [9].

Among the remote sensing applications, the programme made reference to the launching of the first China-Brazil Earth-Resources Satellites (CBERS) as a concrete goal. Planned to be launched in 1997, the first satellite of the series was launched in 1999, and the second launch was only in 2003.



Fig. 2. CBERS-04A

3.4.2 PNAE 1998-2007

The PNAE 1998-2007 was the first revision of the first PNAE. It maintained the purposes and the major goals of the first document. In terms of results, it was similar to the first version, due to the close period, and collected the outcomes already foreseen in the first one [10] [11].

3.4.3 PNAE 2005-2014

The third version of PNAE was launched in 2005, to cover national space activities up to 2014 [12]. Its priorities were mostly implementation strategies. A large part of the programme focused on the continuation of previous projects, regarding satellites and launchers plans, of which only the CBERS project had been materialised [11].

The programme focused on building an enabling scenario for the pursuance of national autonomy on space activities, encouraging the engagement of all actors: government, academy, and industry. It enumerated six guiding principles: a) focus on meeting

the needs of public users of space goods and services; b) autonomy in small satellites and respective launching vehicles; c) adoption of safety and quality standards compatible with international standards; d) pursuing the sustainability of space activities' financing model through commercialization of space goods and services; e) integrating industry and academia among the institutions involved with the implementation of the PNAE, with emphasis on training human resources, managing the knowledge generated within those institutions, and using planning methods, techniques and tools identified as strategic and technological for the space area [12].

PNAE 2005-2014's priorities were summarised in ten items: a) continuation of the national Satellite Launch Vehicle; b) maintenance and update of the Brazilian Data Collection System, eliminating the need for specific satellites; c) completion of the Multimission Platform project and its payloads; continuation of the CBERS projects; d) implementation of the Alcântara Space Centre's (CEA) infrastructure and commercial launching spots; e) investments in research and development, focused on the management of critical technologies, with the participation of academia and industry; f) adoption of projects that met the demands of national activities in Earth Observation, Scientific and Technological Missions, Telecommunications, and Meteorology; g) maintenance, and escalation to industry level, of the successful sounding rocket programme; h) increasing the participation of domestic industry in development activities and projects covered by the programme; and i) adoption of international cooperation instruments that involved technology transfer and coincided with national interests [12].



Fig 3. CEA logo

3.4.4 PNAE 2012-2021

The fourth version of the PNAE began introducing the highest priority choice for the decade: industrial advancement [13, p. 7]. The main goal continued to be meeting the growing space needs and demands of Brazilian society.

The programme proposed eight strategic guidelines: a) consolidating Brazilian space industry, increasing its

competitiveness and leveraging its innovation capacity, including through the use of State's purchasing power, and international partnerships; b) developing an intense programme for critical technologies, encouraging training in the sector, with greater participation from academia, government science and technology institutions, and industry; c) expanding partnerships with other countries, prioritising the joint development of technological and industrial projects of mutual interest; d) encouraging financial support to programmes through public and/or private partnerships; e) promoting greater integration and governance of space activities in the country, through increased synergy and effectiveness of actions among its main actors and the creation of a National Space Policy Council, led directly by the Presidency of the Republic; f) improving legislation to boost space activities, favouring and facilitating governmental purchase, increasing resources for the Space Sector Fund, and implementing tax relief for industry; g) fostering the training and qualification of specialists for the Brazilian space sector, both in the country and abroad; h) promoting public awareness of the relevance of the study, use, and development of the Brazilian space sector [13].

4. The new PNAE 2022-2031

Like the previous versions, the novel National Programme of Space Activities, PNAE 2022-2031, is structured upon the Brazilian Space Programme's purpose to serve society's needs. The new PNAE is constructed as an important tool for national infrastructure, since almost every economic activity in the country is provided by space products. Among those are telecommunications, logistics, mobility, civil defence, mining, environmental monitoring, health, education, science, agriculture, smart cities, and others. Thus, by supporting current public policies, the programme aims to promote a more inclusive and modern society through space applications [1].

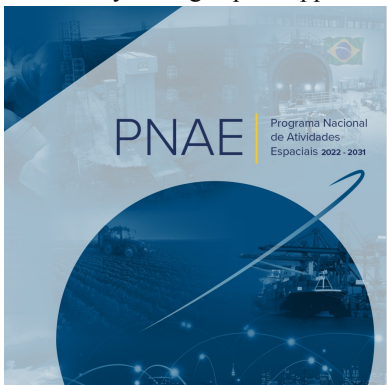


Fig 4. PNAE 2022-2031 cover

The new programme is divided into three major sections: the strategic dimension; the tactical dimension; and the sectorial dimension. Each dimension includes a set of goals for the Brazilian current space policy.

4.1 Strategic Dimension

From a strategic dimension, the policy proposes a "Future Vision: to become the South American leader in the space market". The policy chose five factors that are critical to strengthening Brazilian space sector: a) articulation and convergence between the various actors – government, industry, academia, and society; b) public awareness on the space theme; c) creating opportunities for investment in the space sector; d) prioritising technologies that can provide innovation and become products in the short and medium term; e) and harmonising civil and national defence initiatives in the space sector [1]. Although the military uses of outer space are off the scope of the PNAE, the programme acknowledges that dual-use capacity is inherent to space technologies [14, p. 322], and highlights the strategic value of prioritising civil projects in alignment with defence interests, especially in a budgetary constraint scenario.

The Strategic Dimension of the new PNAE encompasses seven clear targets to enable an increasing presence of the Brazilian Space Programme as a State priority, to encourage entrepreneurship, competitiveness, scientific and technological development, and to reach self-sufficiency in national space activities. There are, therefore, seven Strategic Space Objectives (OEE, Portuguese acronym).

4.1.1 OEE.1

The first objective (OEE.1) is to "establish, develop and maintain a Brazilian State Space Programme, with guaranteed short, medium, and long-term resources". First, the PNAE shall interact with the Pluriannual Investment Plans (PPA, in the Portuguese acronym). The PPAs are four-years budget plans which are tools for the integration of public policies into consolidated plans. Therefore, the first strategic objective is fundamental to develop feasible and pragmatic proposals.

The policy must be coherent from an internal perspective, but also compatible with other public and private initiatives. The AEB has identified that a tool to pursue this strategy is to establish a formal procedure, based upon risk evaluation, for the adoption of projects and missions. Such a procedure could guarantee better decision-making and transparency [1].

4.1.2 OEE.2

The new PNAE maintains a clear focus on society's needs. The second strategic objective (OEE.2) is to promote "effective service to the needs of society and the State in general". Since it deals with applications for people's lives, it considers the importance of effective deliverables. Thus, the Space Programme shall interact with other departments of the Administration, as well as non-governmental entities and other representatives of the society.

Cooperation mechanisms and integration can amplify the impacts of space activities in the set of national policies. One of those fundamental integrations is with the Strategic Space Systems Programme (PESE, Portuguese acronym), the instrument that seeks to address in detail the present and future needs of National Defence, which the National Defence Strategy (END, Portuguese acronym) defines. Brazil's geographical characteristics and international commitments show that it is from space that surveillance, control, and the defence of national territory, airspace, and jurisdictional waters can be carried out effectively [1, p. 23-24].

4.1.3 OEE.3

The third strategic objective (OEE.3) is to "develop the national industry to consolidate it competitively in the markets for space goods and services and to generate socio-economic benefits for the country". The first strategy for that is to encourage national industry. Although the major consumer of space industries' goods is the State, industry cannot depend exclusively on it. That is why space policy must also promote an enabling environment for the accomplishment of investments, by the private sector, that considers the opportunities created by private businesses. Again, it is important to create channels between public entities, universities, research institutes, development institutions and companies in the space sector, along with foreign partners. A second strategy to implement OEE.3 is to focus on the complementarity between the space sector and other sectors. The development of a vigorous space industry depends on the existence of a productive chain. Thus, it includes not only the space industry but also related sectors, such as logistics infrastructure. Therefore, PNAE considers it crucial to enhance the production chain and integrate it with foreign partners, to foster the use of Brazilian existing space infrastructure for launches and in the integration, testing, tracking and control of space vehicles [1, p. 25-26].

4.1.4 OEE.4

The fourth strategic objective (OEE.4) is "stimulating business and entrepreneurship in the national private sector for the development and use of space goods and services". Brazil should engage other

users of space applications and promote innovative initiatives. Since costs are decreasing, it is important to encourage national space economy through entrepreneurship.

Consolidating space centres that welcome private companies' operations is a way of stimulating the private sector. Actions to operationalise private launches from the Alcântara Space Centre (CEA) are a striking example of such a policy. In February 2020, Brazil signed the Agreement on Technology Safeguards Associated with U.S. Participation in Launches from the Alcântara Space Centre. Afterwards, in May 2020, AEB released the first public call for civil launches from Alcântara and, in April 2021, a second public call was launched. Later, in August 2021, the novel regulation on operator's licence for the execution of space launch activities from the Brazilian territory was published, revoking the previous instruments on the subject [8]. Apparently, the next step will be the issue of an ordinance regulating insurance requirements for launch operations, since a public consultation was held by the Agency in April 2022.

Commercial launching centres can generate incomes and contribute to regional development. Accordingly, the new PNAE alerts to the obligation of complying with International Law and the treaties and conventions to which Brazil is a party [1, p. 27-29].

4.1.5 OEE.5

As a fifth objective (OEE.5), the policy states to "foster the development of scientific, technological, and innovation skills for the space sector". According to the new PNAE, scientific and technological development must depart from the current needs of the national space sector, considering the efforts such initiatives will demand and the practical benefits they are expected to generate. The Brazilian State must also provide enabling conditions for innovation, including the prospecting of new funding sources and the establishment of a regulatory environment that encourages research and development. Thus, actions shall focus on human resources development. From childhood to adulthood, citizens must recognize the importance of space applications. The technical and graduation programmes will capacitate people to integrate space activities' production chains, which carry a high added value and the potential to catalyse the generation of income and the economic development of the country [1, p. 30-32].

4.1.6 OEE.6

The sixth strategic objective (OEE.6) is to ensure "non-dependence on the development and control of national space systems". This goal relates to sovereignty and autonomy. The main argument is that to guarantee sovereignty over the space data the country needs, it is

essential that the means to provide them are under national domain [1, p. 33].

4.1.7 OEE.7

Accordingly, the last strategic objective (OEE.7) is to “consolidate the understanding of the direct and indirect potential and existing benefits of the space sector for Brazil in all sectors of society”. It is a goal of the new PNAE that society shall recognize the space sector as essential for the country. Increasing visibility, transparency, and developing evaluation methods should be strategies to achieve that standard. Thus, the policy suggests the structuring of a national information system for the space sector [1, p. 34].

4.2 Tactical Dimension

The second part of the PNAE 2022-2031 delivers the “Tactical Dimension” and unfolds the seven strategic objectives into action axes which, together with the Priorities for the Brazilian Space Programme section, indicate the lines of action for the Brazilian Space Sector. It focuses on factors that the space programme shall prioritise and key sectors. Among those factors are: gross domestic product, general benefits to society, national development, transversality among public policies, dependence on space services, and the global scenario. The key sectors are: agriculture, infrastructure, mining, environment, education, civil defence, public security, and national defence. The action axes organise activities in accordance with the strategic dimension, to deliver the results through the Sectorial Dimension [1, p. 36-42].

Any sector of society, represented by a public or private institution, is entitled to propose a Sectorial Programme to the AEB. A Sectorial Programme is an initiative, a project, or a mission that wishes to use space activities to create solutions for issues on Earth. Upon approval from the AEB, the Sectorial Programme becomes part of the PNAE and expands its interfaces with space activities taking place in the country. The agency analyses the characteristics of the programme, its relevance, technical and financial feasibility, and its synergy with other initiatives [1, p. 46-47].

The tactical dimension of the new PNAE gives guidance on governmental decision making in support of space activities within the next ten years, defining criteria related to the actual impacts they are expected to produce on most important sectors listed in the programme.

4.3 Sectorial Dimension

The third part of the PNAE encompasses the Sectorial Dimension. It considers five budget scenarios (that vary from R\$1,2b to R\$13,2b approximately US\$

230m to US\$2,55b) to execute the programme’s initiatives, which are categorised into four types of investment: a) space missions; b) access to space; c) skill development; d) infrastructure and applications [1, p. 50-57]. The programme presents some infrastructure initiatives and categorises them within the types of investment. In the “space missions” category, the programme presents “Procedure for Selection and Adoption of Space Missions” (PROSAME, Portuguese acronym) and the creation of a “Chamber of Federal Demands”. In “skill development”, it includes the digital platform “Brazilian Space Sector Observatory”; the “Integrated Development Programme for the Alcântara Space Centre”, the “Catarina Constellation”; the “Incubate Space Programme” for entrepreneurship; the “Mapping of Brazilian Space Technologies”; the “Technological Route”; the continuation of the human resources programme, “UNISPACE Programme”; the “Strategic Studies Network”; the “Artemis Programme”; the “AEB Learning Programme”; the “Support Programme for Standardisation and Quality Activities in the Space Area”; the “Academic Nanosatellite Programme”; and the “Microgravity Programme”. In “infrastructure and application”, once more it proposes the “Brazilian Space Sector Observatory”; the “Alcântara Space Centre” with the “Integrated Development Programme for the Alcântara Space Centre”; the “Catarina Constellation”; the “Chamber of Federal Demands” and the “AEB Learning Programme”; and the “BRICS Cooperation” initiative [1, p. 58-69].

The PNAE also describes the ongoing projects which are included as space missions and access to space. The satellites CBERS-4, CBERS 04A, and Amazonia 1 are the Operational Space Missions. Then the SPORT (Scintillation Prediction Observations Research Task), NanoMIRAX, GOLDS-UFSC (Global Open coLlecting Data System – Santa Catarina Federal University), and ITASAT2 are nanosatellites in development. The launching projects for access to space are the “Rocket Engine S50”, the “Suborbital Microgravity Platform”, the “Suborbital Vehicle VS-50”, and the “VLM-1 Microsatellite Launch Vehicle” [1, p. 70-75]. Moreover, the policy presents a set of space missions that have been admitted. The development of space missions will depend mainly on the budget of the space programme for the coming years. Among those projects are “Amazonia 1B”, “Amazonia 2”, “SABIA-Mar”, “PMM Multimission Platform Transfer to Industry”, “P100 – Multi-mission platform for 200 kg class satellites”, “TURISAT”, “Equatorial Atmosphere Research Satellite”, “Galileo Solar Space Telescope Multimission Platform”, “Essentia Constellation”, “BIOMESAT”, “AgroBio Mission”, “AQUAE Mission”, “PMX Microsatellite Multimission Platform”, “MAPSAR”, “CBERS5”,

“CBERS6”, “Mirax”, “GEMOET-1”, “SGDC-2”, “SelenITA”, and the “VL-X Family” [1, p. 82-90].

5. Conclusions

This paper sought to explain how the Brazilian national space policy works, focusing especially on its main document: the PNAE.

The programme has existed since 1996 and is intended to be the space policy tool to be observed within ten year periods. The AEB is responsible for formulating and publishing the PNAE. So far, the country has had 5 PNAEs: 1996-2005; 1998-2007; 2005-2014; 2012-2021; and, finally, the current edition, 2022-2031.

The present work focused mainly on the current PNAE 2022-2031, explaining its main objectives and methodology. The programme is structured upon the understanding that the Brazilian space sector must act in a way that continuously supports national public policies. The rationale promoted by the new PNAE is that space activities are enablers for the development of solutions for concrete domestic problems, and can produce results that are beneficial for Brazilian society. Thus, a strengthening of the space sector is expected to happen, not only through public initiative and support but, increasingly, through private investment and entrepreneurship.

Effective governance is considered to be key to steering the sector in the direction of the goals the programme lists. The Brazilian proposal is to build an enabling environment that promotes connection among players in the space sector and, equally critical, with other sectors. Such a scenario will facilitate the identification of opportunities, converging interests, common challenges and shared expectations, promoting synergies, leveraging the use of available resources, and stimulating investment growth in the coming years.

The PNAE 2022-2031 indicates new perspectives for national space activities. In addition to support for industrial development, through initiatives assessed on a case-by-case basis – which historically has been the main strategy of the former PNAEs – there is also a clear focus on the profitability and social benefits generated by space goods and services. This new perspective is a cornerstone of policies to build financially sustainable models for the space sector.

Along its three major sections – the strategic, tactical and sectorial dimensions – the latest PNAE designs a roadmap for decision making concerning public investment in future missions. Instead of defining, in advance, the projects that will be supported within the coming decade, like the previous PNAEs, this new model provides degrees of flexibility and adaptability that are expected to facilitate adjustments to various possible investment scenarios and needs that

constantly change in contexts of rapidly evolving technology.

A major challenge for the strengthening of the national space sector in a private context is legal clarity and certainty. The absence of a comprehensive space act establishing general rules for national space activities can be an obstacle when rights and obligations cannot be clearly and systematically identified among other national legal instruments – regulation of satellite services taxes being an example of that.

Nevertheless, continuous efforts for the development of a space law framework, concerning most pressing and strategic national interests, can be noted, especially with regard to the operationalisation of launches from the Alcântara spaceport (CEA). The 2021 space regulation for operator’s licence and launch authorisation is a paramount step towards this goal and, although many concerns still need to be addressed, such as the enactment of insurance regulation for liability purposes, the public consultation held by the AEB in April 2022 signals that such a regulation can be expected soon.

The role that national space law will actually play in the implementation of the policies designed in the PNAE 2022-2031, and in addressing legal uncertainties at the domestic level, may be perceived in the coming years. Nonetheless, the current development of Brazilian space law and policy indicates that there is growing awareness of the importance of developing clear and coherent law and policy instruments to promote private participation, and to guarantee it happens in accordance with national interests and in compliance with the State’s international obligations.

Acknowledgements

The authors thank their affiliate institutions, the Brazilian Space Agency (AEB), the Catholic University of Santos (UNISANTOS), the Federal University of Rio Grande do Sul (UFRGS), the Moon Village Association (MVA) and the support of the Secure World Foundation (SWF).

References

- [1] Agência Espacial Brasileira. PNAE 2022-2031. <https://www.gov.br/aeb/pt-br/programa-espacial-brasileiro/politica-organizacoes-programa-e-projetos/programa-nacional-de-atividades-espaciais> (accessed 09.06.2022).
- [2] Presidência da República, Constituição Federal da República Federativa do Brasil de 1988. http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm (accessed 13.06.2022).

- [3] I. Grosner, A. Simões, M.S.R. Huidobro. *What is Brazil Doing to Develop Its Commercial Space Program?* In: A. Froehlich. *Space Fostering Latin American Societies: Developing the Latin American Continent Through Space (Part 3)*, Springer, Cham, 2022.
- [4] Presidência da República, Lei N° 8.854/1994. http://www.planalto.gov.br/ccivil_03/leis/18854.htm (accessed 13.06.2022).
- [5] Presidência da República, Decreto N° 1.332/1994. https://www.planalto.gov.br/ccivil_03/decreto/1990-1994/d1332.htm (accessed 13.06.2022).
- [6] Presidência da República, Decreto N° 1.953/1996. http://www.planalto.gov.br/ccivil_03/decreto/1996/d1953.htm (accessed 13.06.2022).
- [7] Presidência da República, Decreto N° 9.839/2019. http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2019/Decreto/D9839.htm#art10 (accessed 27.06.2022).
- [8] Agência Espacial Brasileira. Portaria N° 698/2021. <https://www.in.gov.br/web/dou/-/portaria-n-698-de-31-de-agosto-de-2021-341897559> (accessed 27.06.2022).
- [9] Agência Espacial Brasileira. PNAE 1996-2005. <https://www.gov.br/aeb/pt-br/centrais-de-conteudo/publicacoes/institucional/PNAE1996.2005.pdf> (accessed 27.06.2022).
- [10] Agência Espacial Brasileira. PNAE 1998-2007. https://www.gov.br/aeb/pt-br/centrais-de-conteudo/publicacoes/institucional/copy2_of_PNAE1998.2007.pdf (accessed 28.06.2022).
- [11] F.M. Made e Vellasco; H.F. Nascimento, *A governança do setor espacial brasileiro: a AEB no exercício do Centro Estratégico do Sindaé*. Revista do Serviço Público, ed. 71 (2020), p. 183-211. <https://revista.ena.gov.br/index.php/RSP/article/view/4664#:~:text=O%20centro%20estrat%C3%A9gico%20e%20governan%C3%A7a,implementa%C3%A7%C3%A3o%20bem%20sucedida%20do%20Pnae> (accessed 28.06.2022).
- [12] Agência Espacial Brasileira. PNAE 2005-2014. <https://www.gov.br/aeb/pt-br/centrais-de-conteudo/publicacoes/institucional/PNAE2005.2014.pdf> (accessed 28.06.2022).
- [13] Agência Espacial Brasileira. PNAE 2012-2021. <https://www.gov.br/aeb/pt-br/centrais-de-conteudo/publicacoes/institucional/PNAEPortugues.pdf> (accessed 04.07.2022).
- [14] K.U. Schrogl, J. Neumann, Article IV, in: S. Hobe, B. Schmidt-Tedd, K.U. Schrogl (Eds.), *Cologne Commentary on Space Law: Outer Space Treaty*, Russian ed., BWV • Berliner Wissenschafts-Verlag GmbH, Berlin, 2017, p.285-349.
- [15] Agência Espacial Brasileira. PNAE 2022-2031 Sumário Executivo.
- [16] I. Marboe, *National Space Law*, in: F. von der Dunk; F. Tronchetti (Eds.), *Handbook of Space Law*, Edward Elgar Publishing, U.K./U.S., 2015, pp. 127-204.
- [17] F. von der Dunk, *Current and Future Development of National Space Law and Policy*, in: United Nations Office for Outer Space Affairs, *Disseminating and Developing International and National Space Law: The Latin America and Caribbean Perspective: Proceedings, United Nations/Brazil Workshop on Space Law*. New York, 2005, p. 31-58.