Soberania & Clima

WEBINAR REPORT

Sustainable Innovations and Defence Economics

March, 1st 2024

Soberania & Clima

ABOUT THE EVENT

Webinar: "Sustainable Innovations and Defence Economics". Held on March 1st, 2024. Available at the Sovereignty and Climate Center's YouTube channel.

The event is part of the Webinar Series "Climate, Sustainability, and Defence", held in partnership with the NETZMIL Project (Loughborough University, United Kingdom) and the Training Center on Defence Economics and Force Development (NCAD/ESD).

Participants

Dr Sarah Ashbridge is a principal analyst in Climate Change and Sustainability at the Defence Science and Technology Laboratory, under the UK Ministry of Defence. She was previously a Research Fellow at the Royal United Services Institute (RUSI). Sarah is a military historian and a forensic archaeologist, having recently conducted studies into the operational response to fallen soldiers, the 1906 Geneva Convention and the archaeological legacy of war in Western Europe. Sarah's PhD was funded by the AHRC Heritage Consortium on the topic of Military Identification: Identity Discs 1914-18 and the recovery of fallen soldiers. She has a professional background in project management and has worked on a range of UK and EU-funded programmes. She has worked with the Commonwealth War Graves Commission, Operation Nightingale (Defence Infrastructure Organization - DIO), and Ruben Willaert BVBA in Belgium.

Ms Larissa Querino has a B.A. in International Relations and a M.Sc. in Economics at the University of Brasilia, with a focus on Defence Economics, M.Sc in Economic Development of Latin America at the International University of Andalucía (Spain), a Specialisation in Foreign Trade and International Affairs at FGV. She is a Productivity and Innovation Analyst and a Specialist in Defence Industry Complex at the Brazilian Industry Development Agency (ABDI). Larissa has professional experience with strategic planning and project management and was a lecturer in two higher education institutions, Michelangelo College/Rui Barbosa Institute and Brasilia Higher Education Instituto (IESB).

Mr William Rospendowski is a Superintendent in the Innovation Area 4 (AIN4) at FINEP, based in São Paulo's Office. AIN4 is in charge of representing FINEP in the Southeast region and also accompanying projects from the following sectors: aerospace, defence, security, textile, footwear, education, etc. B.Eng. in Mechanic Engineering at Unicamp and M.Sc. in Science and Technology Policies with distinction at the University of Sussex (UK). At FINEP, William was formerly a Manager at São Paulo's Operational Department and the Aerospace, Defence and Security Industries Department whilst acting as an Adjunct Superintendent of São Paulo's Regional Oversight. He was also an analyst for the President's Cabinet, attending missions to Israel and South Africa and also in the Planning Department. Before joining FINEP, he worked in business consultancy companies in Brazil (Roland Berger) and Argentina (The Mind Company).

Dr Tamiris Santos has a postdoctoral research and a PhD in International Strategic Studies from the Federal University of Rio Grande do Sul (UFRGS), both funded by projects sponsored by CAPES and the Brazilian Ministry of Defence. She has an M.A. in Latin American Integration from the University of São Paulo (Prolam/USP) and a B.A. in International Relations from Unibero. Tamiris is a research associate to the NETZMIL Project at Loughborough University and has published on defence management, interoperability, military innovation and climate change. She's also a guest researcher at Procad ASTROS Project, based in Brazil, and a secretariat member of the Military Innovation Network, based at the Centre of Science and Security Studies (CSSS) from King's College London.

Soberania & Clima

Introduction

The reflection in this report is part of the second cycle of lectures held by the Sovereignty and Climate Centre, the Defence Economics and Force Development Centre (NCAD) of the Brazilian Defence College (ESD) and the NETZMIL Project of Loughborough University (United Kingdom), discussing the role of the defence sector in the face of the climate emergency and the need to propose means to implement energy transition in the scope of the armed forces. In light of this perspective, the speakers of the first webinar, "Climate Change and National Defence", held in November 2023, indicated different positions in the context of the integration of climate change in defence strategies for the UK and Brazil.

Identifying cooperative interagency approaches, the need for operational self-sufficiency, the role of the armed forces in disaster relief operations, and embedding research and innovation into the defence industrial base transformation corresponded to part of the issues and opportunities presented during that first webinar. The speakers also made some recommendations, such as holistic approaches to military adaptation, specific training, and international cooperation as an instrument for the armed forces, etc.

Along this line of discussion, the second webinar, titled "Sustainable Innovations and Defence Economics," aimed at addressing the complex integration between sustainable innovations and the defence industry. On the one hand, this integration presents significant challenges for the transition and transformation of the energy matrix, but, on the other hand, it unearths unique opportunities that might materialise through collaboration between different stakeholders and significant investment in the research, development, and implementation of technologies.

As a starting point to address these issues, it is worth highlighting that this is a notably challenging endeavour. However, the need to transform the defence industry is undoubtedly part of a context of a demand for the transition of an entire productive system. To this end, innovation and sustainability must be considered two sides of the same coin, wherein for different national productive systems, including the defence industry, whatever the action plan for innovation is in force, the maintenance, preservation, and improvement of environmental, social, and economic conditions are imperative principles to ensure the quality of life for present and future generations. However, retaining the armed forces' operability and effectiveness in different countries must never be neglected, depicting the complexity of the challenge for the agenda of decarbonisation and energy efficiency in the defence sector.

In this context, the Brazilian and British defence industries face similar challenges as they advance towards energy transition. While in the UK, the guiding principle for defence is to continue operating to meet the demands of the status quo, in Brazil, there is still no clear definition of the pathways for the decarbonisation of the defence sector. Energy transition is not just a question of adhering to climate commitments, as established in the Paris Agreement; it is also about ensuring future operability amid challenging climate change and economic, environmental, and social scenarios. The rationale guiding the UK's defence highlights the importance of discussing and implementing measures to ensure operational effectiveness even in climate-modified environments, emphasising the shared responsibility of the defence sector regarding globally assumed climate commitments. Thus, it is crucial for Brazil also to begin this debate and take measures to ensure that its defence industry is aligned with the challenges and needs posed by energy transition, aiming at future operability and environmental responsibility.

Soberania & Clima

According to these perspectives, the speakers exposed their views on topics such as the impacts of innovations in energy transition, the consequences for government and defence budgeting, the implementation of sustainable innovations, considering the intersection between the public and private spheres, action in the scope of academia, jointly with the industrial sector; and opportunities and impacts on defence economics, with a view to the UK and Brazil. Apart from an introduction and a conclusion, this report is divided into three different parts, aiming to provide an encompassing picture of the discussions. The first part addresses the talks in a more in-depth manner. The second part then identifies the problems raised by the speakers, along with possible paths to solve them. Lastly, the third part identifies the opportunities for defence, as presented by the speakers.

KEYWORDS
Innovation; Sustainability; Defence Industry; Defence Economics.

Soberania & Clima

WEBINAR REPORT

Sustainable Innovations and Defence Economics

1. Detailed Discussions

Understanding the challenges and opportunities in incorporating sustainable innovation by the defence industry goes beyond its singular role. It also requires a broad analysis of the countries' productive systems, particularly considering their specific contexts. From this perspective, while the UK led the process of industrialisation among the developed countries, advancing towards a post-industrial era with deindustrialisation, Brazil faced a different scenario. Despite being a leader among the late-industrialisation countries until the 1970s-1980s, Brazil did not complete its productive leap, undergoing a premature process of deindustrialisation.

Both countries, however, share the challenge of rethinking innovation in the defence industry, focusing on reducing carbon emissions, which represents not only a crucial opportunity to face environmental challenges and drive sustainability in national defence but also a path to reindustrialisation based on sustainable innovation.

Considering such aspects in the British scenario, Dr Sarah Ashbridge emphasised the importance of a proactive and adaptive approach to facing environmental challenges in defence. She pointed out the collaboration between the public and private sectors, highlighting awareness-raising on sustainability, and mentioned the creation of the Biscuit Books as handbooks for environmental matters in the UK's Armed Forces. She was also favourable to collaboration between the public and private sectors, combined with growing awareness of the importance of sustainability, to safeguard vulnerable populations and effectively fulfil national defence duties.

Ashbridge also emphasised the importance of understanding the threats and risks of climate change to security, encompassing traditional warfighting elements of the British Armed Forces and crucial responses to capacity-building, humanitarian assistance, and disaster relief.

Larissa Querino's reflection presents a Brazilian view of the problem. According to her argument, collaboration between different parts of the public sector and international cooperation is necessary to drive innovation and promote sustainability in the defence industry. Larissa also discussed the intersection between innovation, sustainability, and industrial policies in the Brazilian Agency for Industrial Development (ABDI) scope.

She stressed the importance of the recent industrial policy adopted by the Brazilian government, highlighting its crucial role in steering the actions of government and society towards the country's industrial development. To this end, the effective incorporation of sustainability and decarbonisation represents a significant challenge, given that the lack of clear and strategic guidance specific to integrating sustainability may result in disjointed and insufficient actions to face environmental challenges.

Complementarily, William Rospendowski reflected on the importance of integrating sustainability as an assessment criterion in calls for public funding, developing innovative technologies to foster operational and environmental effectiveness in aviation, promoting interoperability and interagency cooperation between different sectors, and establishing strategic partnerships between companies, research institutions, and the government to maximise the impact of investment in innovative projects.

2. Problems Identified and Paths to Solve Divergences

We previously pointed out some of the speakers' initial remarks on incorporating sustainable innovations by the defence industry. The following analyses addressed challenges that provoke a profound reflection on the paths necessary to solve the divergences discussed:

2.1. SPEAKER 1: SARAH ASHBRIDGE

As a climate change and sustainability analyst at the Defence Science and Technology Laboratory, Dr Ashbridge presented some challenges faced by British Defence regarding her area of expertise. Table 1 summarises the main issues listed by Ashbridge during her speech, together with pathways for adopting the identified solutions.

Table 1. Some challenges faced by British Defence and possible solutions

IDENTIFIED CHALLENGES	PROPOSED SOLUTIONS	PATHWAY TO ADOPT THE SOLUTION
The need to reduce carbon emissions and address climate change in the context of British Defence	Development of new practical handbooks — Biscuit Books — to raise awareness on the reduction of carbon emissions within the defence community	Publication and dissemination of the Biscuit Books, facilitating the understanding of environmental issues and the proposed solutions
Difficulty in balancing the different needs and requirements of different parts of the armed forces regarding sustainable innovations	Integration and collaboration among the different sectors within and outside the scope of defence	Coordination between the public and private sectors to identify areas of synergy and develop sustainable solutions that fulfil the needs of all parties
Limited budgets that hinder the adoption of sustainable technologies	Government mobilisation to drive the defence industry toward sustainability	Financial incentives and policies that support the adoption of sustainable technologies, even if they demand significant capital expenditure upfront
The need to accelerate a cultural and operational change to integrate more sustainable practices into the armed forces	Commitment to innovation and efficiency, change in organisational mindset	Education and training to promote a culture of sustainability, integration of sustainable methodologies into all aspects of military operations
The contradiction between the activities of war and sustainability goals	Search for innovative technological solutions during periods of conflict	Adoption of cleaner and more efficient technologies to reduce the environmental impact of military operations during conflicts
The challenge of maintaining interagency interconnection while advancing in the construction of industrial sustainability for defence	Identification of priority issues and collaboration between different parts of the government and industry	Development of transition strategies that allow for adaptation and sustainability without compromising interconnections and operational efficacy

Understanding the need to raise awareness within the defence sector regarding the threats and risks of climate change to national security, to drive a transformation of both the traditional warfighting elements of the UK Armed Forces and crucial responses to capacity-building, humanitarian assistance, and disaster relief, the Defence Science and Technology Laboratory (DSTL) produced the Biscuit Books[1]. As a UK Defence contribution across various topics, including climate change, these handbooks were developed as quick guides, responding to the pressing need to address climate change and sustainability within the context of the British Armed Forces.

Thus, the Biscuit Books are a tool for effective communication to raise awareness and engage with the defence community members on environmental issues and how they affect military operations. In Sarah's words,

1. Defence Science and Technology Laboratory (2024).Climate change and defence: a DSTL biscuit book. Recovered from: https://www.gov.uk/guidance/climate

> Industry is moving at a pace that it's never moved at before, outstripping policy and governments around the world are struggling to deal with this. The rising pace at which we're experiencing environmental emergencies is causing us to have to reflect on the science and technologies we have today and to question if they're going to be resilient for the future. When Defence is not capable of innovating, a lot of the time, it's civil society that provides these solutions. The work we've been doing through the Biscuit Books has been really to communicate, allowing the community to understand our main issues and how climate change affects the armed forces.

In her opinion, defence has a great opportunity on the path towards sustainability. However, one of the challenges for the UK's defence industry and the armed forces, in general, is the need to balance the different demands for sustainable innovations from the British Army, the Royal Navy, and the Royal Air Force. As explained by Ashbridge, there is a challenge in aligning the needs and requirements that the different institutions and departments subordinated to the Ministry of Defence (MOD) may have and the Ministry's capability to fulfill those demands, especially with limited budgets.

For Sarah, sustainable innovations require significant upfront capital expenditures, which is not traditionally compatible with the financing culture in defence. This may hinder the adoption of sustainable technologies, even if they are economically viable in the long term.

> So there are loads of really big opportunities here. But I think the problem that ministries of defence around the world have is: every single component requires quite a large amount of capital expenditure up front, which is not typically how defence has been funded. It culturally doesn't sit well with the budgets we already have and the way we have of working.

Another challenge she mentioned is the need to accelerate the change process to allow for the adoption of more sustainable practices. This involves a change in the mindset and organisational culture of the Armed Forces in the UK and the integration of sustainable technologies into all areas of operation. It requires a coordinated approach and a commitment to innovation and efficiency.

To this end, Ashbridge emphasised the need for integration and collaboration between different sectors, both inside and outside the scope of national defence. She argues that there are significant synergy opportunities between the defence and private sectors. This means that commercially developed solutions might later apply to the defence sector and vice versa.

> We have to move at a pace which means we can adopt these products at the right moment. It is not just about the defence-specific solutions, so we have to make sure we can integrate with the realities and trends of the economy and the industrial base we're working with.

When questioned on whether the occurrence of wars, such as the war in Ukraine, and disputes, such as that between Taiwan and China, end up marginalising the sustainability agenda in the scope of the UK's defence sector, Sarah stated that, throughout history, the unfortunate circumstance of war has allowed for advances in technological innovation. She gave the example of how the war in Ukraine drove the construction of renewable, more resilient energy systems, such as microgrids[2] . Another example is the creation of hybrid engines, operated in 1917 during World War I. However, Sarah also explained that there is a contradic-

2. Microgrids are local electricity distribution and consumption systems that can operate autonomously and isolated from the utilities' main power grid, ensuring local energy provision. They are made up by the intelligent and controlled integration of several distributed energy generation sources, storage, and charging. These grids play a crucial role as an alternative to the main distribution grid, promoting the generation of energy from clean sources, such as solar and wind power, as well as the integration between energy storage systems, such as batteries. This structure has been one of the options adopted in generating more resilience and sustainability in energy distribution. The challenge in the context of defence is making microgrids viable for immediate use in areas of operations. This type of project has been explored since mid-2011 by the United States, in the scope of the NTEET (Near Term Energy Efficient Technologies) Programme. More information on microgrids and their use by Defence are available respectively at: https://campus-sustentavel.unicamp.br/microrredes/; https://media.defense.gov/2011/Feb/18/2001712194/-1/-1/1/11-040.pdf

tion between war and sustainability, given that most emissions in a war will come from the destruction and the later reconstruction of buildings.

Lastly, about sustainable innovations and Defence Economics, Ashbridge explains that policy is a great driver and that any government that can mobilise its industry will be more likely to have a productive system ready to respond to new demands for industrial sustainability and to promote sustainable innovations for national defence. In terms of applicability, Sarah points out the possibility that each government department could identify three main issues affecting them, as well as the different parts of the government and industry they would need to work together to draft responses to those risks. Generally speaking, she recognises that energy transition can be done since technology tends to evolve rapidly. The question that is left is how countries can adapt in that direction, maintaining their interconnections and advancing in the construction of industrial sustainability in defence.

2.2 SPEAKER 2: LARISSA QUERINO

As a Productivity and Innovation Analyst and Expert on Industrial Defence Complexes at the Brazilian Agency for Industrial Development (ABDI), Larissa Querino presented a practical view on the intersection between innovation, sustainability, and industrial policy at ABDI. Table 2 summarises the challenges identified, the solutions proposed by the speaker, and the pathways suggested to adopt those solutions.

Table 2. Driving Sustainability in the Brazilian Defence Industry

CHALLENGES	PROPOSED SOLUTIONS	PATHWAY TO ADOPT THE SOLUTION
Clear guidance and specific strategies for the integration of sustainability into industrial policy	Establishing detailed targets with a focus on sustainability and decarbonisation	Clear definition of objectives and specific strategies
Insufficient budget for investment in research and development of sustainable technologies in the defence industry	Stimulating access to subsidised resources and financing for developing and adopting sustainable technologies	Provision of resources and incentives to companies and research institutions. Promotion of public-private partnerships and collaboration between different sectors of the economy
Difficulty in achieving interoperability between the armed forces and interagency cooperation to deal with transnational threats	Incentivising interoperability and interagency cooperation among different sectors of defence and public security	Implementation of systems and technologies that allow the efficient exchange of information and resources between the different agencies
A need for technology transfer and the development of local industrial capabilities to mitigate the effects of climate change	Fostering offset agreements and international cooperation in the research and development of sustainable technologies	Negotiation and implementation of offset agreements that allow technology transfer in support of climate change mitigation Establishing international partnerships to share knowledge and resources in research and development

The importance of collaboration between the different sectors of the government, as well as the use of international cooperation to drive innovation and promote sustainability in the defence industry, were some points presented by Larissa Querino, who discussed the intersection between innovation, sustainability, and industrial policy in the scope of ABDI.

Larissa stressed the importance of the recent industrial policy adopted by the Brazilian government, highlighting its crucial role in steering the actions of government and society towards the country's industrial development. To this end, the effective incorporation of sustainability and decarbonisation represents a significant challenge, given that the lack of clear and strategic guidance specific to integrating sustainability may result in disjointed and insufficient actions to face environmental challenges.

Thus, although Brazil has established ambitious missions, such as strengthening agro-industrial chains and expanding the bioeconomy, it is necessary to ensure that these objec-

tives are attained sustainably, considering environmental preservation and the reduction of carbon emissions. Materialising this objective requires sustainability to be seen not only as an environmental concern but also as an opportunity to drive innovation, competitiveness, and the creation of jobs in sectors such as clean energy, energy efficiency, and eco-efficient technologies. To that end, Larissa proposes the establishment of detailed targets with a focus on sustainability and decarbonisation, which involves a clear definition of objectives and specific strategies to ensure that industrial policy contributes effectively to the country's sustainable economic development. This strategy allows a better understanding of the particular challenges and opportunities faced by the national industry while resonating with the defence industry. In this context, ABDI and other government agencies' participation in drafting industrial policy targets ensures a collaborative and multidisciplinary approach that considers different perspectives and expertise to attain effective results.

Another question Larissa addressed was energy transition in the area of national defence, which, from her point of view, presents specific challenges to the industry, even though innovation is inherent to the sector. In her words:

> bioeconomy, sustainable development, and the defence industry walk in the same direction. The defence industry contributes with much innovation to the economy. It must then be in the vanguard of this movement because it has a relevant role in this energy transition and the transition to a greener economy.

Significant changes in the productive system are required to withstand the demands of a green economy, which in turn demand considerable investments in research and development that do not match the budgets available in the defence sector.

Larissa argued that the expenditure for larger budgets is justified because innovation in the defence industry can play a crucial role in energy transition since the solutions developed in this sector have the potential to extend to other sectors of the economy and society. Thus, the search for sustainable solutions in the defence industry not only promotes environmental protection but also strengthens national security by reducing the dependency on non-renewable resources and the vulnerability to extreme climate events.

Subsidised resources and access to financing facilitate the development and adoption of sustainable technologies, reducing financial barriers, stimulating experimentation, and implementing innovative solutions. This involves providing resources and incentives to companies and research institutions. Another possibility lies in promoting public-private partnerships and collaboration between different sectors of the economy, stimulating knowledge transfer and the co-creation of solutions using the know-how and resources from other actors.

> I understand that, in the Brazilian case, it will be a complicated process, considering the matter of defence budgets, always trying to achieve an ideal point, which we often fail at. However, I understand the role of defence and the defence industry as the precursors to new possibilities, technologies, and developments for the industry as a whole because defence innovations will spill over into other economic sectors.

Lastly, Larissa mentioned collaboration through interoperability, interagency and international cooperation. In her argument, the incentive for different collaborations is essential to face global security challenges and the transition to a green economy. Going deeper into the subject, for Larissa, the interoperability between the three Services in Brazil—interagency cooperation between defence, public security agencies, and other actors—is crucial in dealing with transnational threats and complex emergencies. Additionally, international cooperation in developing sustainable technologies in national defence can promote the exchange of knowledge, resources, and best practices between countries.

Offset agreements and other forms of economic cooperation were also mentioned as mechanisms to facilitate technology transfer and promote the development of local industrial

capabilities in developing countries. Such action is fundamental in achieving the goals of the Paris Agreement and mitigating the effects of climate change because environmental challenges do not respect national borders and demand a coordinated global response. According to Larissa,

> Another thing I find interesting is the offset agreements that the defence industry includes in its sales processes abroad because you can, based on a definition of offset, bring to your country the transfer of a technology that can support this issue concerning the mitigation of the effects of climate change.

2.3. SPEAKER 3: WILLIAM ROSPENDOWSKI

As Superintendent in the Innovation Area 4 (AIN4)[3] at the Brazilian Financier of Studies and Research (Finep), responsible for following up on innovation projects in the different areas of knowledge connected to Brazilian industry, Rospendowski reflected on the importance of integrating sustainability as an assessment criterion in calls for public funding, developing innovative technologies to foster operational efficiency in aviation, promoting interoperability and interagency cooperation between different sectors, and establishing strategic partnerships between companies, research institutions, and the government to maximise the impact of investment in innovative projects. Table 3 summarises the challenges identified, the solutions proposed by William, and the pathways suggested to adopt those solutions.

Table 3. Driving Sustainability in the Brazilian Defence Industry

CHALLENGES	PROPOSED SOLUTIONS	PATHWAY TO ADOPT THE SOLUTION
Lack of investment in R&D	Encouraging research and development (R&D) in advanced technologies, sharing resources and knowledge	• Government incentives; • Public-private partnerships; • Subsidies to companies and research institutions
The environmental impact of military aviation	Adopting sustainability practices in aviation	• Investment in cleaner technologies; • Use of biofuels; • Optimisation of flight routes
Lack of interoperability between sectors	Promoting cooperation between different sectors for the sharing of resources and knowledge	• Creation of discussion forums; • Establishment of public-private partnerships; • Programmes for incentive to collaboration
Absence of integrated policies	Developing integrated public policies directed at priority areas and in line with the needs of the country	• Definition of clear and measurable targets; • Simplification of bureaucratic processes; • Creation of specific financing programmes
Budget restrictions in the defence sector	Diversification of sources of financing	• Partnerships with the private sector; • Attraction of foreign investment; • Attraction of resources through crowdfunding; • Use of venture capital funds

To show how Finep has been acting to sponsor technological innovation projects in Brazil, William discussed the “Mais Inovação Brasil” (More Innovation Brazil) programme, which has reached a record volume of 2.18 billion Reais in economic subsidies. The speaker explained that the programme’s objective is to finance technologies critical to Defence and the Armed Forces, aiming to attain 50% development in such technologies in the country. He stressed that one of the assessment points for the proposals sent in is aligning the projects with sustainability and environmental issues.

To William, innovations in the defence industry are important because there is a need to maintain and enhance the country’s defensive capability through such innovations. This includes developing advanced weapons systems, military vehicles, communication sys-

3. AIN4 is responsible for representing Finep in the Southeast region of Brazil and for following up on projects in the sectors of Aerospace, Defence and Security, Textile and Footwear, Paper and Cellulose, Education, and other areas.

tems, cybersecurity, and other devices essential to national defence. Such technologies must be constantly updated to keep up with the evolution of threats and ensure the country's security.

For this, investing in the research and development of advanced technologies is essential, which can be done through government incentives, subsidies, and partnerships with private companies and research institutions. Encouraging innovation in these sectors may lead to the development of more efficient and sustainable solutions. As he states,

> It cannot be a trade-off; it cannot be a choice; it has to achieve both things. That is, I must have the possibility of new technologies, and one must simultaneously achieve gains in operational and environmental efficiency.

One of the sectors in which William defends the need for transformation is military aviation. As he argues, aviation faces significant challenges regarding operational efficiency and environmental impact. Reducing fuel consumption and greenhouse gas emissions, as well as optimising aircraft performance, are crucial objectives for modern aviation. This involves research and development into new materials, more efficient engines, smarter air traffic management systems, and alternative propulsion technologies. These measures can materialise the implementation of cleaner technologies, such as biofuels and electric engines, as well as optimise flight routes and reduce waste of resources.

Regarding cooperation and interoperability, Rospendowski highlighted that these can drive innovation and promote sustainable solutions through collaboration between different sectors, including government, industry, and research institutions. However, like Larissa, William also argued that interoperability between the three single services might face challenges due to differences in organisational culture, priorities, and agendas. Overcoming these barriers demands coordinated efforts and strategic partnerships that can align common interests and promote effective collaboration. One suggestion to overcome such obstacles is sharing resources and knowledge, which can be achieved by creating discussion forums, public-private partnerships, and incentive programmes promoting collaboration between sectors.

Rospendowski also addressed the integration of policies as a fundamental step to ensure innovation efforts are directed to priority areas and aligned with the country's needs. This requires a coordinated approach between the different levels of government and a regulatory structure that encourages innovation and investment in research and development, which may involve the creation of specific financing programmes, the simplification of bureaucratic processes, and the definition of clear and measurable global targets.

Lastly, William discussed the harmony between financing innovative projects and budget restrictions in the defence sector. Just as discussed by Sarah and Larissa, Rospendowski pointed to those restrictions as significant, thus highlighting the importance of efficient resource allocation and careful assessment of priority projects. As an alternative, he points out the importance of diversifying the sources of financing and exploring opportunities for that. This can include partnerships with the private sector, foreign investment, obtaining resources through crowdfunding programmes, and using venture capital funds.

3. Opportunities for National Defence in Brazil

Considering the discussions in the previous sections, it is possible to raise some points of the debate that suggest a promising path to implementing innovation and sustainable practices in the defence industry, with the potential to benefit not only National Defence but also society as a whole. The main points to consider, divided into three aspects, are presented in Table 4 as follows:

Table 4. Strategy to adopt sustainable innovations in the Defence industry

OPPORTUNITY	DESCRIPTION	IMPLEMENTATION
Collaboration between the Public and Civilian Sectors	Collaboration between government, industry, and civil society to drive sustainable innovation in the defence industry	Establishing discussion forums, public-private partnerships, and awareness-raising programmes on sustainability
Industrial and Government Policies	Creation of government policies and strategies to promote sustainable industrial development and integrating sustainability into the defence industry	Defining clear targets, simplifying bureaucratic processes, creating specific financing processes, and establishing partnerships with research institutions and private companies
Financial Incentives	Allocating financial resources, such as economic subsidies and financing, to facilitate development and the adoption of sustainable technologies by the defence industry	Diversifying financing sources, exploring public-private partnerships, and offering incentives for companies and research institutions to develop innovative solutions
Research and Development (R&D)	Investing in the research and development of advanced technologies to drive innovation in the defence industry, focusing on operational and environmental efficiency	Establishing specific R&D programmes, promoting partnerships between research institutions and industry, and providing incentives for developing sustainable solutions
Integration of Public Policies	Coordination between different levels of government to direct innovation efforts to priority areas and promote sustainability in the defence industry	Defining global targets, simplifying bureaucratic processes, creating specific financing programmes, and aligning government policies to sustainability goals
Collaboration and Interoperability	Collaboration between different sectors, including government, industry, and research institutions, to promote sustainable solutions in the defence industry	Establishing strategic partnerships, creating discussion forums, sharing resources and knowledge, and promoting cooperation between the public and private sectors
International Cooperation	Collaboration between countries in the research and development of sustainable technologies to address global challenges, such as climate change	Establishing international agreements, promoting the exchange of knowledge and resources, facilitating technology transfer, and developing local industrial capabilities in developing countries

4. Conclusion

Historically, industrial innovation and sustainability have frequently been viewed as opposite paths. This has resulted from a concept of development in which progress is associated with an industrialisation model dependent on the unlimited use of natural resources, especially the indiscriminate use of fossil fuels. However, in a planet with finite resources, such a system has caused a process of degradation of the physical world whose consequences demand an immediate change in the culture of how innovation is driven in different countries.

However, it is necessary considering the inherent complexity to paradigm changes, which implies further reflection not only on the environmental degradation caused by such a system but also on its dependency on non-renewable resources. Thus, by re-considering these two imminent scenarios, one can infer that delaying this change is negotiating with present and future costs. If such expenditure is necessary for a transformation in the future, it will be much greater than the one necessary in the present.

To the intended ends, it is crucial not to lose sight of the fact that national defence in several countries does not dissociate from this scenario. Additionally, the defence industry is also impacted by this dilemma, and must reconsider its actions to support armed forces operability and sustained effectiveness. Thus, as presented in this report, the horizon of evolutionary possibilities is undoubtedly vast, especially if we take decarbonisation and energy efficiency in the defence sector as a guiding principle.

Wrapping up the discussions of both events held by the Sovereignty and Climate Centre, it is possible to infer that there are some recommended pathways and strategies that are feasible to implement in the short term and that can reverberate in an increase of sustainable practices through national defence and an advancement in its capability to operate in the face of climate emergencies. For instance, the coordination of public policies to define global targets, simplify bureaucratic processes, create specific financing programmes, and align government policies to sustainability goals. Additionally, collaboration and interoperability not limited to the Ministry of Defence and the three single services but especially between different sectors, including the government, the industry, and research institutions.

In conclusion, the development of solutions to the issues related to Sustainable Innovations and Defence Economics is not conceivable without a parallel effort seeking alternatives to overcome budget constraints, the absence of investments in the sector, as well as the lack of interoperability and interagency cooperation. Considering their core aspects is crucial to achieving such solutions. Firstly, it is fundamental that the Ministry of Defence and the Armed Forces can reorganise to establish priorities. This implies efficiently reallocating the budget and, directing it to areas with the most substantial impact. Considering the short, medium, and long-term risks and costs, especially in the face of potential deterioration of defence's capability to operate effectively due to the increase of extreme climate events, which could result in the loss of human lives, infrastructure destruction, increase in the number of climate refugees, impacts on food security, and increase in geopolitical instabilities.

Simultaneously, this scenario also presents an opportunity for the defence industry to respond to the challenges presented by climate change, especially in the development of new efficient technologies from the energy standpoint and advanced technologies for monitoring, logistics, and communication in the face of extreme climate calamities.

In sum, facing the challenges imposed by climate change requires an integrated and strategic approach by the Ministry of Defence and the Armed Forces. These institutions must promote a robust articulation not only at the federal level but also with the whole society, aiming at synergies between public policies and national defence, industry, research, and the environment. This integration will enable greater communication and collaboration between short- and long-term needs, aligned with a sustainable plan for national development. For this purpose, the defence must act strategically to respond efficiently to climate emergencies, ensuring a coherent and effective response to climate adversities, which are increasingly impacting national security and social stability.

Thus, it is imperative that this responsibility be exercised as part of an encompassing national strategy, which promotes coordination and collaboration between all relevant federal institutions. This ensures joint action that maximises available resources and minimises gaps in the country's response capability.

Soberania & Clima

INSTITUTIONAL PROFILE

President Director
Raul Jungmann

Board of Directors
Sergio Westphalen Etchegoyen (President)
Marcelo Furtado
Raul Jungmann

Chief Executive Officer
Mariana Nascimento Plum

Finance Director
Newton Raulino

Projects and Research Team
Bruna Ferreira
Mila Campbell

Communications Coordinator
Valéria Amorim

Intelligence and Information Team
Antônio Augusto Muniz

Technical Team
José Hugo Volkmer

Legal Team
Gabriel Sampaio

Administrative Assistant
Leandra Barra

Autorship
Polianna Almeida

Revision
Bruna Ferreira
Mariana Nascimento Plum
Mila Campbell
Peterson Ferreira da Silva
Tamiris Santos

Translation
Guilherme Monteiro

Graphic Design and Layout
Pedro Bopp

SPONSORS:

ABIMDE Associação Brasileira das Indústrias de Materiais de Defesa e Segurança

PARTNERS:

Loughborough University

ESCOLA SUPERIOR DE DEFESA ESD

Webinar Report.
Sustainable Innovations and Defence Economics.
Brasília. Sovereignty and Climate Center

14p.

Keywords:
1. Innovation; 2. Sustainability; 3. Defence Industry; 4. Defence Economy.