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ESTRATÉGIA NACIONAL DE ESPECIALIZAÇÃO INTELIGENTE 2030

AGÊNCIA NACIONAL DE INOVAÇÃO

TECHNICAL DATA

Title
National Smart Specialisation Strategy 2030

Author
National Innovation Agency

Coordination
Alexandre Almeida

Technical Team
Américo Veloso Bento
Ana Margarida Lopes

External Experts
António Manuel Figueiredo
António Pontes
Eduarda Ramalho
José Carlos Caldeira
Luís Soares
Maria Elisa Babo
Mariana Rodrigues
Mário Rui Silva
Rui Azevedo
Sérgio Costa
Sofia Henriques

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INTRODUCTORY NOTE

A dynamic NSSS to keep pace with the speed of Innovation

This document presents the National Smart Specialisation Strategy (NSSS). The NSSS is of strategic importance, being the aggregator of a national smart specialisation strategy as a means of promoting innovation.

This strategy represents the outcome of two years of preparatory work carried out by ANI, along with stakeholders from the entire national innovation system, without exception. This task took the form of 43 seminars and workshops, with the participation of companies, research centres, interface centres, partner institutions, regional agents, business associations, experts, in a broad process of assessment that, in the context of the pandemic, was mainly carried out in digital format and involved more than 2000 people.

Thus, the NSSS presented here allows overcoming some of the identified constraints, namely, the excessive number of priorities that existed in the NSSS 2020 with a strong correlation between them and their misalignment with the horizontal model of the European strategy. Besides said constraints, the NSSS now presented allows overcoming the poor articulation that was seen with overlaps and inconsistencies between the NSSS and the RSSS, proposing an articulated vision. This is a NSSS that results from a collaborative construction process, as a result of the work done by the regions and which resulted in the RSSS, now gathered in a vision for the country. Thus, it was possible to obtain a living and dynamic document that allows to follow the different innovation cycles that are getting shorter and faster; a NSSS with such flexibility that it can keep up with innovation and not hinder development. As a result, this document presents a NSSS structured in 6 major areas: Digital Transition; Materials, Systems and Technologies of Production, Green Transition, Society, Creativity and Heritage; Health, Biotechnology and Food; Great Natural Resources: Forest, Sea and Space.

This is a NSSS that is designed as a facilitator of innovation, in line with the needs and challenges of the national territory and without overlooking the specific features of each Portuguese region.

Prof. Joana Mendonça
President of ANI's Board of Directors

LIST OF ACRONYMS AND ABBREVIATIONS

AD&C	Agency for Development and Cohesion, I.P.
AML	Lisbon Metropolitan Area
ANI	National Innovation Agency
AR	Augmented Reality
TBP	Technological Balance of Payments
S&T	Science & Technology
BAC	Business Activity Code
CCDR	Commission for Regional Coordination and Development
CGC	Computer Graphics Centre
EC	European Commission
CIT	Technological Interface Centre
CO_2	Carbon Dioxide
CoLab	Collaborative Laboratory
PA	Priority Area
NSSS	National Smart Specialisation Strategy
RSSS	Regional Strategy for Smart Specialisation
ESA	European Space Agency
ESO	European Southern Observatory
FTE	Full Time Equivalent
FST	Foundation for Science and Technology
FOS	Fields of Science
GNSS	Global Navigation Satellite System
HERI	Higher Education Research and Innovation
R&D	Research and Development
i5.0	Industry 5.0
IA	Artificial Intelligence
FDI	Foreign Direct Investment
RDI	Research, Development and Innovation
NIS	National Institute of Statistics
IoT	Internet of Things
SNSTP	Survey on National Scientific and Technological Potential
PNI	Pedro Nunes Institute
ISCED	International Standard Classification of Education
IWQ	Institute of Welding and Quality
IT	Institute of Telecommunications
SWL	Single Window Logistics
SPW	Single Port Window
KET	Key Enabling Technologies
KIS	Knowledge Intensive Services
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NTUS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
SDGS	Sustainable Development Goals
NGO	Non-Governmental Organisation
UN	United Nations
OTT	Over-the-top Media
PCT	Patent Cooperation Treaty
ECP	European Ecological Pact
GDP	Gross Domestic Product
SME	Small and Medium Enterprises
PPC	Purchasing Power Parity
PT	Portugal
AR	Autonomous Region
RIS3	Research and Innovation Smart Specialisation Strategy
NIS	National Innovation System
ICT	Information and Communication Technologies
PT	Production Technologies
EU	European Union
GVA	Gross Value Added
VoD	Video on Demand
VR	Virtual Reality

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EXECUTIVE SUMMARY

The National Smart Specialisation Strategy (NSSS) 2030 is the result of a widely participated process within the national innovation system that sought, in an open manner, to contribute to the construction of a strategic vision, define priorities and respective transformative activities that accelerate the transition of the economic model in line with the major European challenges. The present process results from a two-year work, with more than 2000 participants, whose goal was to review the NSSS 2020, evolving its architecture, improving the multi-level articulation, as well as revisiting the overall vision and priorities. The vision for Portugal highlights the quality of life, the creative environment and the scientific and innovative capacity as a means of attracting and retaining talent and business dynamics, which are therefore driving forces for a trajectory of growth and convergence. To this end, the following six priorities of a cross-sectoral nature are key, namely, (i) digital transition, (ii) green transition, (iii) Materials, Production Systems and Technologies, (iv) Society, Creativity and Heritage, (v) Health, Biotechnology and Food, and (vi) Great natural resources. In parallel, there was a concern to involve and combine this work with the development of the seven regional strategies (NTUS II of the mainland, Madeira and Azores), seeking to maximise complementarity at the different territorial levels and to strengthen the multiplying effects of public policy. The governance model is based on a participatory model that seeks to combine top-down policy coordination, with a bottom-up participation model that inspires the public policy, and that should be an accelerator for the RSSS, to the extent that it can sustain or trigger regional cooperation pathways, expanding the joint work of the science and innovation system with the productive system (in particular with the manufacturing industry) that have a place in several NTUS II. Regarding the monitoring and evaluation system, we have structured a proposal with 4 pillars: (i) Implementation, (ii) First level results, (iii) Structural change and (iv) Long-term impacts. This system will allow monitoring implementation in the short term, without losing focus on the transformation goals inherent to the NSSS 2030 and the desired impacts.

In short, the NSSS 2030 is a strategic reference that, besides enabling the fulfilment of the necessary requirements set out in the common European provisions, constitutes an exercise of collective construction and transformation of Portugal, being an unfinished task, permanently evolving and that is not consolidated in this document, but rather evolves within the framework of the Innovation and Smart Specialisation Forums and on an ongoing basis.

FRAMEWORK

This document presents the National Smart Specialisation Strategy 2030, as an improvement of the NSSS 2020, and systematises the review of the National Smart Specialisation Strategy carried out in the last two years. The NSSS allows for the systematisation of thematic priorities for R&D and innovation at national level, articulated with regional development strategies and allowing for the development of multi-regional options.

At the beginning of the 2014-2020 programming period, the European Commission promoted the implementation of a prioritisation exercise for thematic aims related to R&D and Innovation. This task, to be carried out by all Member States, was an ex-ante conditionality for the allocation of funding. In response to said conditionality, Portugal has developed the NSSS, a multi-level strategy, combining the national dimension of sectoral policies, acknowledging the pertinence of an articulation with instruments and policies of territorial nature.

This multi-level architecture sought to coordinate, articulate and optimise different territorial levels of intervention. On one hand, the national level policies, given the competence profile of the institutions, have a broad and transversal territorial scope, defining the context conditions and intervening in the key pillars of the national innovation system and in the national competitiveness driver.

On the other hand, it is reckoned that it is crucial to complement those initiatives, which are necessarily broader, with actions focused on the structural weaknesses of each territory, promoting a fine tuning of the policy through instruments dedicated to the promotion of territorial cohesion. In this sense, it was understood that the structural transformation of the Portuguese innovation system would be accelerated if, as a complement to national Science and Innovation policies, regional policies were promoted to leverage the resources and the specific attributes of the regions in order to directly tackle the existing barriers.

At the outset of the 2021-2027 programming period, ANI, as part of its competences as leader of the NSSS Coordinating Council, promoted the revisiting of the NSSS as it is now an enabling condition for R&D and Innovation just like the RSSS. The option for the multi-level architecture is justified more than ever by the virtues of a system that is able to combine and articulate national framework initiatives, aligned with sectoral policies, with the calibration and specificity of the responses at the level of regions and their territories. This means that the NSSS is a key element for the development of the national R&D and Innovation policy, supported in a complementary way by various sources of funding, public and private, such as the State budget, European funds (namely, the Cohesion Policy Funds, the Recovery and Resilience Plan and the Horizon Europe Programme), as well as private investment.

This document systematises the review work of the National Smart Specialisation Strategy carried out in the last two years, which sought to be an improvement of the NSSS 2020. As part of this task, ANI sought the involvement of regions and stakeholders, creating the multi-level working group with the 7 Portuguese NTUS II, but also stimulating forums for discussion and collective construction of a vision, a rationale and the implementation of transforming actions that are materialised in the priorities proposed for 2021-2027. This

process that, in the space of 2 years, allowed to gather more than 2000 active participants of the quadruple helix, will endure in time through a governance model that ensures a wide and continuous participation, as well as transforming this NSSS in a living and dynamic exercise, adjustable over time.
It is also important to highlight that the current review of the NSSS also sought to capitalise on the learning and the results of monitoring the closing programming cycle, with a view to developing specialisation rationales and models for broad and open participation. In that sense, we had three principles as structuring pillars:

(i) To capitalise on the results of the monitoring and evaluation of the NSSS, as well as the lessons from the past regarding the definition and implementation of strategies for smart specialisation in Portugal;
(ii) Involve the stakeholders of the quadruple helix (Institutions, Companies, Government, Civil Society), in a participative and extended exercise, in line with the principles of collective discovery, to define a bottom-up strategy;
(iii) Ensure multi-level alignment with Regional Smart Specialisation Strategies, as well as European Agendas and Research Agendas, in the context of the 2021-2027 multi-annual financial framework.

The monitoring and evaluation tasks of the Strategy for Intelligent Specialisation carried out by both the NSSS monitoring team and by external experts[1] identified several problems in the formulation of the previous NSSS, which this revision exercise sought to address:

- **Excessive number of priorities in the NSSS 2020 with strong correlation between them** - The priority framework of the NSSS 2020 was excessively vertical. About 80% of the monitored projects advocate framing in 3 or more thematic priorities.
- **Misalignment between the NSSS 2020 priorities and the horizontal model of the European strategy** - European policy has been moving towards a framework or horizontal model, aggregating initiatives around major challenges, for which different innovation and value chains compete.
- **Incipient and deficient multi-level articulation** - The construction process in 2014 was done without articulation, giving rise to overlaps and inconsistencies between the NSSS and the RSSS.
- **Complex monitoring system and with primary data creation** - Evident overlap in listing and indicators, observing high statistical correlation among them. In other cases, the creation of primary information and resources is foreseen, which is difficult to implement and slows down monitoring.
- **Ineffective Governance Model** - Independent evaluation points to the importance of improving governance, making it more agile.

[1] e.g. *Assessment of the implementation of the national and regional research strategies for smart specialisation (RIS3): network, achievements and expected results*, 2019

Stakeholder Involvement

Broad community involvement in policymaking is a principle that lies at the core of the Smart Specialisation Strategies, translated into the concept of Entrepreneurial Discovery Process (Foray et al., 2012). This concept can be defined as a learning process by which a country progressively discovers its priorities in R&D and Innovation, with a view to structural change and to promote sustainable growth and employment (Del Castillo et al., 2015). The idea behind the Entrepreneurial Discovery Forums is that they should be platforms for interaction between stakeholders with a view to generating new technological and market opportunities that can contribute to defining public policy priorities in a bottom-up decision-making process with continuity and sustainability over time.

ANI mobilised the community, created and energised collaborative platforms - Entrepreneurial Discovery Forums. **Thus, the review of the National Smart Specialisation Strategy was carried out with the broad involvement of the stakeholders of the quadruple helix. Since 2019, 43 sessions and workshops open to the whole community were held to discuss the review of the NSSS, which brought together more than 2000 participants, including companies, higher education institutions, research centres, collaborative laboratories, interface centres, clusters, business associations, the central and regional public administration and NGOs[2] .**

Multi-level articulation

In order to ensure multi-level alignment with the Regional Strategies for Smart Specialisation, as well as to harmonise approaches and concepts in the strategy review processes, several initiatives were developed, of which we highlight:

- Creation of an informal working group involving ANI, the 7 regions and AD&C;
- Elaboration of concept notes to support regions in developing the RSSS and to make approaches and language compatible;
- Monitoring of the NSSS 2020 and its effective articulation with RSSS 2020 (statistical and network analyses);
- Proposal for a multi-level architecture of priorities.

The work to revise the NSSS began in 2019 with the main stages of this process summarised in the following figure:

[2] A complete list of the Entrepreneurial Discovery Forums carried out can be found in Annex 1.

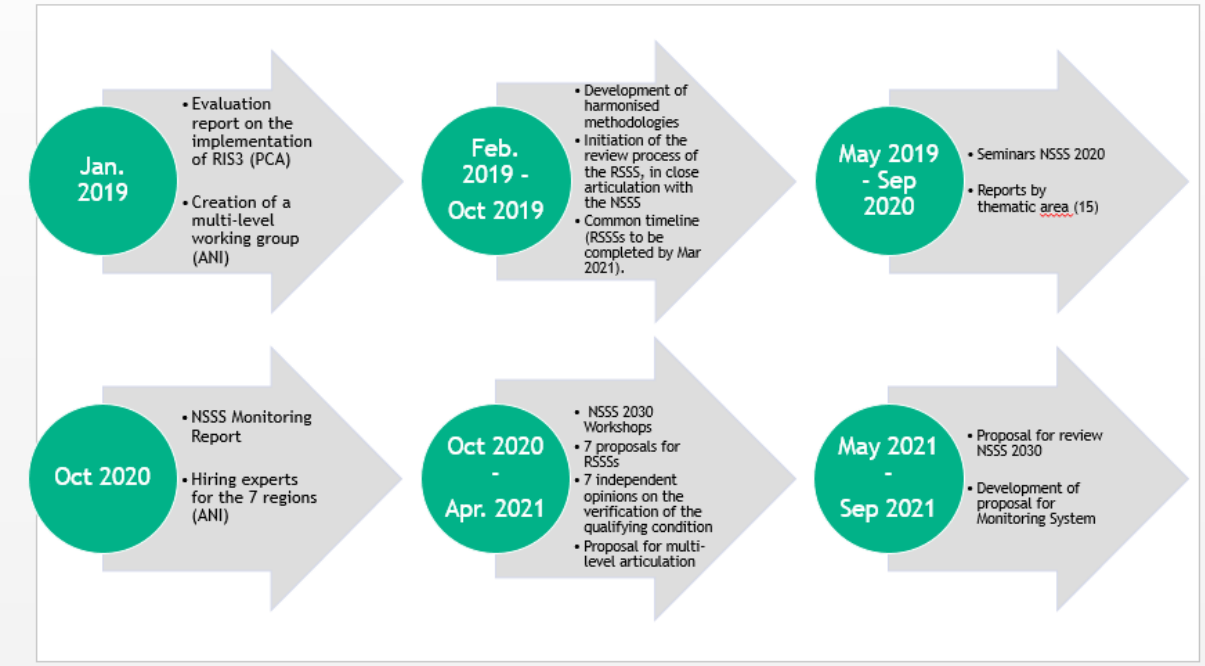


Figure *1* Timeline of the NSSS review work[3]

[3] ANI provided expert support to the 7 NTUS II regions, which several regions have used to support and leverage the development of their RSSS.

I – STRATEGIC VISION

The NSSS 2030 is a strategic reference for prioritising public interventions in the field of R&D and Innovation, aimed at coordinating public policy instruments and enhancing their effects. The rationale behind the NSSS is to catalyse resources around strategic dimensions with the potential to strengthen Portugal in global markets. To this end, it is a matter of building, in a collective manner, and within the scope of a temporally dynamic process, strategies for intelligent specialisation that can be embodied in activities with the potential to produce structural changes.

One of the main challenges in building a strategy for smart specialisation lies in defining a vision for a country or region, resulting from a bottom-up process of broad participation. Based on the distinctive characteristics of Portugal, the global vision, resulting from the structuring process of the NSSS 2030, seeks to achieve the ambition and sense of transformation that should mobilise the stakeholders in the design of a new competitive model based on knowledge and innovation.

The iterative process sought to define the idiosyncratic signature of Portugal and the main elements whose combination allows a new trajectory of growth and development. Among those main elements, the quality of life, the creative environment and the scientific and innovative capacity stand out as attraction and retention factors for talent and business dynamics.

The resulting vision points to an intervention strategy based on the knowledge and innovation nexus, with particular focus on combining the attraction and retention of talent, the digital economy, sustainability, quality of life and the enhancement of scientific, technological and natural resources, retaining, in Portugal a significant part of the economic and social impact of the ongoing transformation process, namely through the creation of more added value, more qualified employment, more technology-based companies, as well as reducing technological dependence from abroad, Thus, within the scope of the NSSS 2030, the vision is summarised in:

VISION

Portugal, an ecosystem of regions of talent and innovation, where sustainability, the creative environment and science converge towards quality of life.

II - ANALYSIS

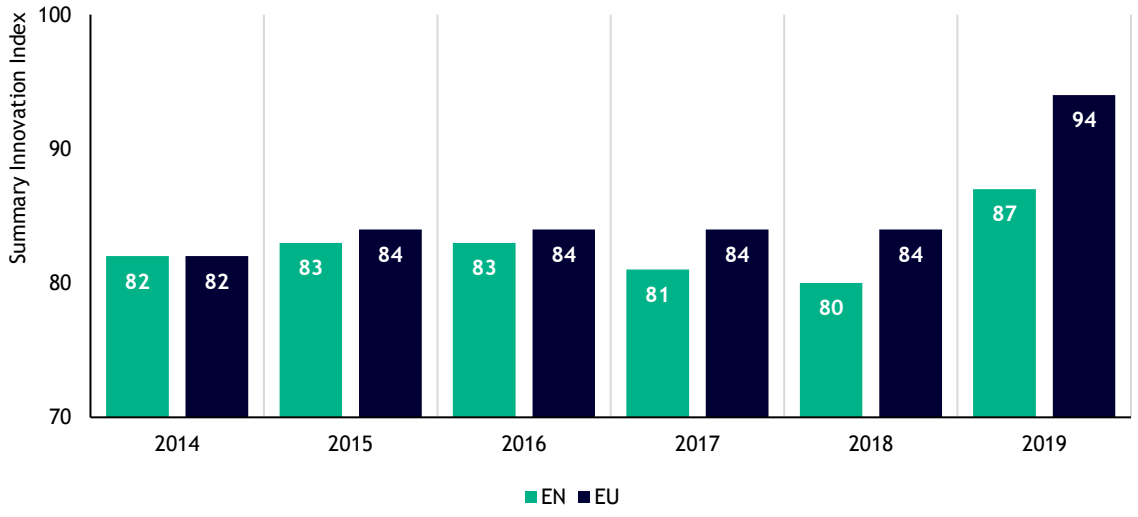
The analysis for the National Smart Specialisation Strategy 2030 was developed over time through periodic exercises that resulted in a set of benchmarks, whose information presented in this chapter is available for consultation.

Among these is the National Innovation Report (produced every two years), which focuses on monitoring measures, identifying trends and characterising the stakeholders in the National Innovation System.

An innovation system presents a set of stakeholders of framework and regulation or production, use and dissemination of knowledge, technology and innovation, whose interactions among themselves and with other entities contribute to the production, dissemination and valorisation of knowledge. The Portuguese case exhibits a high interaction with the European Union, in terms of the regulatory, institutional, economic and social context, as well as in terms of strategic management and structural funds.

Understanding a global and constantly updated vision of the stakeholders of the National Innovation System requires a permanent search for its mapping instruments with periodic publication, of which the National Roadmap of Research Infrastructures, the Mapping of National Technological Infrastructures and the Innovation Portal standout.

Figure 2. Summary Innovation Index of Portugal and European Union between 2014 and 2019



As regards the evolution of the Portuguese case in the last decade, the European Innovation Scoreboard shows a scenario of moderate innovation (figure 2), highlighting as key aspects the attractiveness of the research system, digitalisation and the use of information technology. In 2021, the performance decreased due to what is justified by the reduced performance in indicators performance of third-level education, government support for business R&D, ICT specialists, labour mobility for human resources work in science

and technology and in technologies related to the environment[4]. The decrease in the 2021 Scoreboard is mainly explained by the change in methodology of the community innovation survey and the construction of the scoreboard itself.

The document International Comparative Analysis of the Positioning of the National Innovation System (2019), summarises the last two decades of the Portuguese NIS with a positive evolution, as reflected in the indicators presented in Table 1. Portugal has more qualified human resources, a business base with more R&D activities, a greater diversity of public policies and funding sources to support R&I and national entities specifically empowered to act in this domain. However, constraints to value creation from the knowledge generated by R&D activities persist, mainly due to the nature of low knowledge-intensive activities and the insufficient cooperation processes between business and advanced knowledge-producing organisations. This is demonstrated by the below EU average performance levels in indicators such as "business expenditure as % of GDP" or "public-private co-publications per million inhabitants".

Table 1. Innovation Indicators in Portugal and the European Union in the period 2010-2019

	Indicator	Geography	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Human Resources	Early school leaving rate (18-24 years)	EN	28,3%	23,0%	20,5%	18,9%	17,4%	13,7%	14,0%	12,6%	11,8%	10,6%
		EU28	13,9%	13,4%	12,7%	11,9%	11,2%	11,0%	10,7%	10,5%	10,5%	10,3%
	Population with secondary education (as % of age group 20-24)	EN	59,1%	64,6%	67,8%	70,1%	72,1%	77,0%	77,5%	78,5%	80,8%	82,9%
		EU28	79,3%	79,7%	80,3%	81,1%	82,2%	82,7%	83,2%	83,3%	83,6%	83,9%
	Percentage of population (30-34 years) having completed third-level or equivalent education	EN	24,0%	26,7%	27,8%	30,0%	31,3%	31,9%	34,6%	33,5%	33,5%	36,2%
		EU28	33,8%	34,8%	36,0%	37,1%	38,0%	38,7%	39,2%	39,9%	40,7%	41,6%
	New PhD holders per 1000 inhabitants (aged 25-34)	EN	1,9	1,9	1,9	1,9	2,0	1,9	2,0	1,8	2,0	
		EU28	1,9	1,9	1,9	1,9	1,9	2,0	2,1	2,1	2,1	
	Lifelong learning (per 100 people aged 25-64)	EN	5,7%	11,5%	10,5%	9,7%	9,6%	9,7%	9,6%	9,8%	10,3%	10,5%
		EU28	9,3%	9,1%	9,2%	10,7%	10,8%	10,8%	10,8%	10,9%	11,1%	11,3%
	Companies with ICT training (% total companies)	EN			23,0%		26,0%	22,0%	23,0%	21,0%	19,0%	28,0%
		EU28			19,0%		21,0%	22,0%	22,0%	21,0%	23,0%	24,0%
	PISA - Performance in Science	EN			489			501			492	
		OECD			501			493			489	
Excellence and Attractiveness of the R&D System	No. of PhD students from abroad as % of total PhD students	EN	13,2%	14,8%	16,8%	15,1%	15,8%	21,2%	25,6%	27,3%		
		EU28	19.2%	19,5%	19,9%	19,2%	19,5%	20,5%	21,1%	21,4%		
	International scientific co-publications per million inhabitants	EN	469,1	553,1	841,2	931,1	994,2	1061,2	1139,5	1187,7	1284,9	1408,1
		EU28	335,9	363,0	810,3	863,3	918,6	959,1	1012,5	1051,5	1105,5	1171,8
	Researchers (FTE) per thousand employees	EN	9,1	9,9	10,0	9,1	9,0	9,0	9,5	10,0	10,3	
		EU28	7,6	7,7	8,0	8,2	8,3	8,6	8,7	9,0	9,3	
Financing R&D and Innovation	Public expenditure on R&D (State, Higher Education, as % of GDP)	EN	0,68%	0,64%	0,57%	0,68%	0,67%	0,65%	0,64%	0,64%	0,65%	
		EU28	0,72%	0,71%	0,72%	0,72%	0,71%	0,71%	0,69%	0,69%	0,69%	
	Business expenditure on R&D (as % of GDP)	EN	0,70%	0,69%	0,68%	0,63%	0,60%	0,58%	0,62%	0,67%	0,69%	
		EU28	1,19%	1,24%	1,27%	1,28%	1,30%	1,31%	1,33%	1,37%	1,41%	
		EN	0,15%	0,13%	0,12%	0,02%	0,02%	0,02%	0,02%	0,02%	0,02%	

[4] European Innovation Scoreboard 2021.

Table 1. Innovation Indicators in Portugal and the European Union in the period 2010-2019

	Indicator	Geography	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Collaborative networks	R&D Expenditure - Private Non-Profit Institutions (as % of GDP)	EU28	0,02%	0,02%	0,02%	0,02%	0,02%	0,02%	0,02%	0,02%	0,02%	
	Total R&D expenditure (as % of GDP)	EN	1,53%	1,46%	1,38%	1,33%	1,29%	1,24%	1,26%	1,33%	1,37%	
		EU28	1,92%	1,97%	2,00%	2,02%	2,03%	2,04%	2,04%	2,07%	2,11%	
	Non-technological innovation expenditure (as % of turnover)	EN	0,53%		0,60%		0,64%		1,02%			
		EU28	0,57%		0,69%		0,76%		0,86%			
	Risk capital (incl. early stage and expansion and replacement capital) (as % of GDP)	EN	0,06%	0,08%	0,06%	0,08%	0,08%	0,09%	0,07%	0,05%	0,09%	10,00%
		EU28	0,10%	0,08%	0,10%	0,09%	0,09%	0,09%	0,10%	0,11%	0,12%	0,13%
	SMEs innovating in-house as % of all SMEs	EN	34,10%		33,80%		25,60%		56,80%			
		EU28	31,60%		28,70%		28,80%					
	Innovative SMEs collaborating with other enterprises as % of total SMEs	EN	8,10%		6,80%		7,80%		9,70%			
		EU28	9%		10%		11%		12%			
	Public-private co-publications, per million inhabitants	EN		34,3	36	38,9	40,5	42,1	42,1	43,4	44,1	
		EU28		84,1	85,1	87,6	89,4	92,8	93,6	96,4	95	
Intellectual Property	PCT patents per billion GDP (in PPS)	EN	0,61	0,7	0,69	0,76	0,71	0,96	0,91	0,84		
		EU28	3,85	3,86	3,74	3,79	3,7	3,54	3,52	3,31		
	EU trademarks per billion GDP (in PPS)	EN	5,01	5,23	5,65	5,97	6,58	6,83	7,12	8,11	8,72	8,51
		EU28	6,79	6,97	7,48	7,64	7,72	7,71	7,9	8,05	8,06	7,99
	Community designs per billion GDP (in PPP)	EN	4,64	4,13	5,02	5	4,53	4,47	4,43	4,05	3,79	3,57
		EU28	4,6	4,52	4,56	4,59	4,55	4,36	4,33	4,41	4,15	3,85
Innovative Companies	Companies with innovation activities (%)	EN	60,30%		64,60%		54,00%		66,90%			
		EU28	52,90%		48,90%		49,10%		50,60%			
	SMEs introducing process or product innovations as % total SMEs	EN	44,20%		38,30%		42,10%		57,90%			
		EU28	33,50%		30,60%		30,90%		38,40%			
	SMEs introducing marketing or organisational innovations as % of SMEs	EN	47,40%		42,80%		37,80%		47,40%			
		EU28	39,8%		36,2%		34,9%		35,7%			
	Employment in high-growth potential enterprises in innovative sectors (as % of total employment)	EN	3,1%	3,1%	3,1%	3,1%	3,3%	3,7%	5,0%	4,9%	5,5%	
		EU28	5,1%	5,1%	5,1%	5,1%	5,2%	4,8%	4,8%	5,2%	5,4%	
Economic Impacts	Employment in knowledge-intensive activities (as % of total employment)	EN	8,6%	9,1%	9,0%	9,4%	10,3%	10,7%	10,9%	10,6%	10,9%	11,1%
		EU28	13,5%	13,7%	13,8%	13,9%	14,1%	14,2%	14,2%	14,2%	14,4%	14,6%
	Employment in technology-intensive sectors (industry and services), as % of total employment	EN	2,3%	2,1%	2,2%	2,5%	2,8%	2,7%	2,8%	2,9%	3,0%	3,2%
		EU28	3,8%	3,9%	3,9%	3,9%	3,9%	4,0%	4,0%	4,0%	4,1%	4,2%
	Exports of medium and high technology products (as % of total exports)	EN	36,5%	36,8%	36,5%	35,2%	35,9%	36,8%	37,9%	38,5%	40,1%	42,3%
		EU28	54,6%	53,5%	53,5%	53,1%	54,3%	56,2%	57,1%	56,7%	56,4%	56,9%
	Exports in KIS (knowledge-intensive services) sectors (% of total services exports)	EN	41,0%	43,4%	42,4%	43,7%	43,4%	41,9%	39,6%	37,6%	37,4%	
		EU28	66,8%	67,0%	67,6%	67,4%	68,3%	68,9%	68,9%	68,7%	68,4%	
	Sales of innovations new to the company and to the market (as % of sales volume)	EN	14,4%		12,4%		6,3%		9,8%			
		EU28	13,4%		12,3%		13,4%		13,0%			
Technological Balance of Payments	TBP's claims (in thousands of euros, constant prices, GDP - Base 2016)	EN	1.022,914	1.179.179	1.311.185	1.420.774	1.541.408	1.682.068	1.732.820	2.001.421	2.134.103	2.227.97

Table 1. Innovation Indicators in Portugal and the European Union in the period 2010-2019												
	Indicator	Geography	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Information Society	TBP Credits (as a % of GDP - Constant Prices - 2016 Base)	EN	0,51%	0,59%	68,00%	0,76%	0,83%	0,90%	0,93%	1,05%	1,11%	1,15%
	TBP debits (in thousands of euros, constant prices, GDP - Base 2016)	EN	1.169.812	1.269.960	1.075.223	1.146.194	1.499.547	1.561.209	1.693.500	1.826.160	2.071.110	2.120.065
	TBP debits (as a % of GDP - Constant Prices - 2016 Base)	EN	0,58%	0,64%	0,56%	0,62%	0,80%	0,84%	0,91%	0,96%	1,08%	1,10%
	Technological Balance of Payments Balance (in thousands of euros, constant prices, GDP - Base 2016)	EN	-146.898	-90.802	235.962	274.580	41.892	120.829	39.310	175.270	62.993	107.877
	Technological Balance of Payments Balance (as a % of GDP - Constant Prices - Base 2016)	EN	-0,07%	-0,05%	0,12%	0,15%	0,02%	0,06%	0,02%	0,09%	0,03%	0,06%
	Mobile broadband usage in enterprises with 10 or more persons employed (as % of all enterprises)	EN	25,0%	39,0%	48,0%	54,0%	66,0%	68,0%	70,0%	70,0%	67,0%	67,0%
		EU28	27,0%	47,0%	49,0%	56,0%	64,0%	65,0%	67,0%	69,0%		
	Enterprises with 10 or more persons employed having a website on the Internet (as % of all enterprises)	EN	52,1%	53,7%	51,8%	59,5%	54,3%	61,5%	64,2%	64,8%	62,7%	58,6%
		EU28	67,0%	69,0%	71,0%	73,0%	74,0%	75,0%	77,0%	77,0%	77,0%	78,0%
	E-commerce - enterprises with 10 or more employees selling online (as % of all enterprises)	EN	19,0%	16,0%	14,0%	14,0%	14,0%	19,0%	18,0%	19,0%	19,0%	17,0%
		EU28	13,0%	13,0%	14,0%	14,0%	15,0%	17,0%	18,0%	18,0%	17,0%	18,0%
	Households with broadband Internet connection (%)	EN	50,3%	56,6%	59,7%	61,6%	63,4%	68,5%	73,0%	76,4%	76,9%	78,0%
		EU28	61,0%	67,0%	72,0%	76,0%	78,0%	80,0%	83,0%	85,0%	86,0%	89,0%
	Population (16-74 years old) using the Internet to purchase goods and services in the last 12 months (%)	EN	14,6%	18,1%	22,3%	24,5%	26,3%	31,0%	31,0%	34,1%	36,7%	38,7%
		EU28	40,0%	42,0%	44,0%	47,0%	50,0%	53,0%	55,0%	57,0%	60,0%	63,0%
	Population (16-74 years) using the Internet to interact with public services in the last 12 months, among those who used the Internet in the last year (%)	EN	49,0%	63,2%	61,0%	58,4%	61,8%	61,8%	62,5%	61,3%	55,2%	53,8%
		EU28	58,0%	56,0%	58,0%	54,0%	59,0%	57,0%	58,0%	57,0%	60,0%	62,0%

Source: National Innovation Report (2020).

III - PRIORITY AREAS

The definition of the NSSS 2030 Priority Areas and its architecture results from an exercise that obeyed the following principles: (i) Alignment with the European Agenda, with the FST Research Agendas and the respective scientific areas[5] ; (ii) Development based on the NSSS 2020 priorities and the respective evaluation; (iii) An approach that allows for an effective multi-level articulation with national priorities assuming a more transversal character and regional priorities, a more vertical model.

This exercise sought to address the problems identified in the past, namely the excessive number of vertical and strongly correlated priorities of the NSSS 2020, the misalignment between the NSSS 2020 priorities and the horizontal model of the European Strategy, and the poor multi-level articulation of the NSSS 2020.

Additionally, this task was carried out with the broad involvement of the stakeholders of the quadruple helix, and with a wide participation involving the hearing of more than 2000 participants, including companies, universities, research centres, collaborative laboratories, interface centres, clusters, business associations, the central and regional public administration, as well as NGOs.

This task resulted in a horizontal model, aggregating initiatives around six major Priority Areas, to which different innovation and value chains contribute.

Figure 3 - NSSS 2030 Priority Areas

The NSSS 2030 model represents an improvement in relation to the past, not forgetting the learning achieved in the previous period. In fact, the effort of aggregation and horizontality of the defined priorities has many points of contact with the priorities of the NSSS 2020, as shown in the following table in figure 4.

[5] ICDT_Areas_Cientificas_e_Paineis_Avaliacao.pdf (FST.pt).

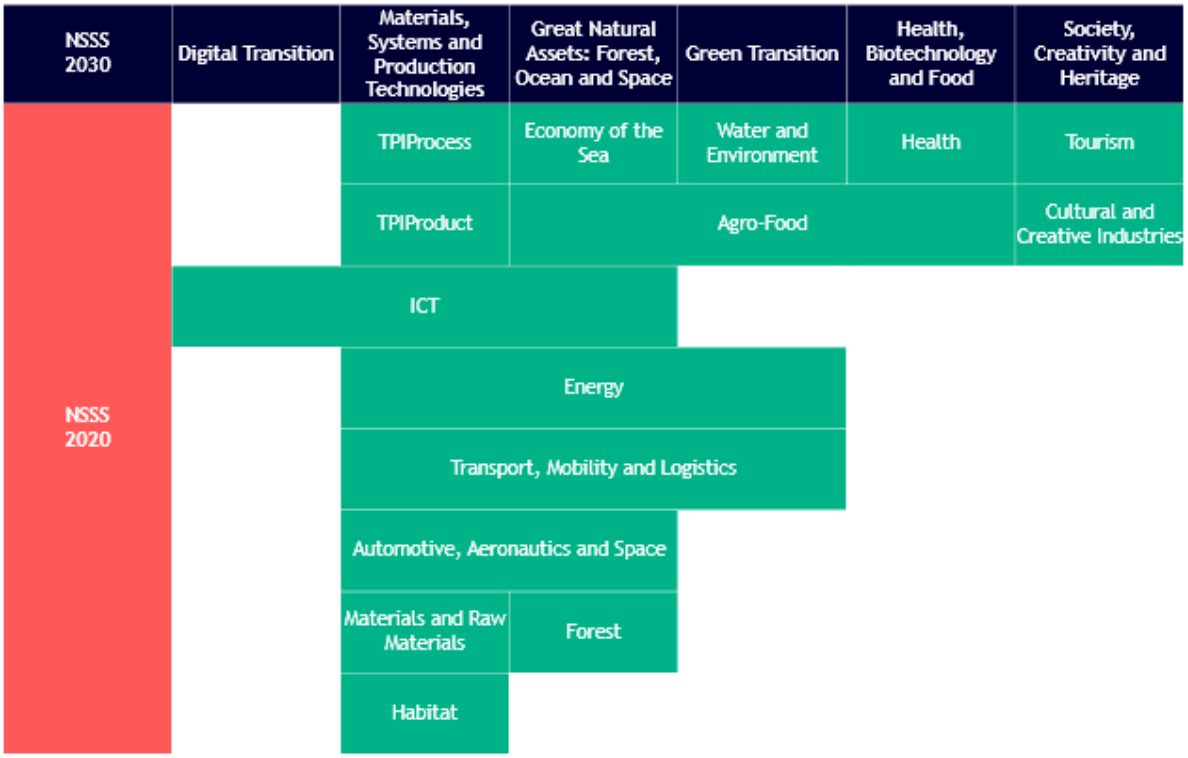


Figure 4 - Development of Priority Areas from the NSSS 2020

DIGITAL TRANSITION

Resources, Business Conditions and Demand Dynamics

This Priority Area (PA) frames the European and national commitment to digital transformation, including transformations in value chains and business models of companies and, in general, changes in the functioning of society as a whole, but also in the development of digital technologies that enable and enhance this transformation.

It naturally has a transversal character, both of sectors linked to the development of technologies, and of some of their main users: information technologies, communications and electronics, production technologies, textiles, footwear, mobility, agro-food, health, aeronautics, space and defence; moulds, special tools and plastics, as well as tourism.

The delimitation of this Priority Area encompasses three main levels of intervention:

- For end-user companies, it will correspond to actions aimed at transforming their business models and processes, both internally and in their external value chain, namely in their relationship with clients and suppliers, through the adoption of innovative solutions based on digital technologies.
- For companies that develop and commercialise these innovative solutions, it will cover actions aimed at creating new products, processes or services, which enhance the digital transformation of their customers, thanks to the use of key digital technologies.
- The aim is also to explore the potential for creating, developing or consolidating a chain of companies dedicated to the development of key digital technologies, thus seeking to retain more added value in the country and increase its technological sovereignty.

In terms of defining the scope of this work, it is also relevant, on the one hand, to identify the main digital key technologies and, on the other hand, to select the most relevant ones in the national context, considering, among other factors, the different degrees of maturity they present (and, therefore, the number of actors and sectors potentially involved or covered and also the time horizon for the respective results and impact).

The following table presents a first segmentation proposal, according to the maturity level of the several digital technologies identified, based on the main European and national roadmaps.

Table *1.* Segmentation of the main digital key technologies

Mature	Recent	Emerging
Big data and data analysis	Blockchain	High performance computing
Augmented reality	Data and edge computing	Quantum computing
Modelling and Simulation	Cloud technologies	
Robotics and Automation Systems	Social networks	
Mobile Communications	Artificial Intelligence	
Systems integration and interoperability	IoT - Internet of things	
	Cybersecurity	

Resources

The relevant knowledge assets for this Priority Area are centred around the areas of Electrical and Computer Engineering and Computer Science and Technology. The country is covered by a set of Universities and Polytechnics, all of which have education and training activities in said areas, constituting not only sources of science and technology, but also catalysing the business fabric around them. Around these knowledge clusters, several research units have been developed, some with around one hundred or more integrated PhD researchers, such as ALGORITMI, INESC-ID, INESC TEC, IT and LARSys. Recently, the creation of CoLAB has strengthened this overview, highlighting DTx - Collaborative Laboratory on Digital Transformation, located in Guimarães, and the VORTEX CoLab, located in Vila Nova de Gaia, with major business involvement (promoted by ALTRAN).

The vast network of Innovation and Technology Centres includes some cases that are already very mature and intrinsically geared towards supporting digital transformation, such as CGC, INOV, PNI and UNINOVA. In the area of Clusters, TICE.PT should be highlighted, one of the first and technologically oriented for this Priority Area, itself the result of a consolidation of previous initiatives, such as TELESAL - Competence Network in Telecommunications and Information Technology (Aveiro), CEDT - Centre of Excellence in Dematerialisation of Transactions (Braga) and the Competence Network for Mobility (Porto). Members of this cluster include, among others: CGC, CEIIA, CENTI, Fraunhofer Portugal, INESC TEC, INOV, IWQ, IT, PNI, Polytechnic of Porto, University of Beira Interior, University of Aveiro, University of Coimbra, University of Minho, as well as the University of Porto.

Complementarily, the PRODUTECH Cluster also integrates a relevant set of members, from companies that develop technologies and solutions, but also representatives of various user sectors of the national industry, enabling the creation of comprehensive partnerships, covering the three levels considered, aiming the development and validation of innovative solutions based on digital technologies and their demonstration in various user sectors. It is essential, however, to highlight the potential of the whole Clusters network, as a relevant asset for the access to the various user sectors, enhancing the dissemination and awareness, the replication of solutions and the acceleration of transformation.

The Digital Innovation Hubs (DIH) initiative also stands out, identified in the Digital Transition Action Plan[6] in order to recognise collaborative networks with specific competences that foster the adoption of advanced digital technologies by companies through development, testing and experimentation. Through the regulation[7] launched in December 2020, a total of 17 collaborative networks were duly approved by the Ministry of Economy and Digital Transition[8,9], where only one of them will not be proposed for integration in the European DIH network.

Business conditions

[6] Resolution of the Council of Ministers no. 30/2020
[7] Order No. 12046/2020 of the Office of the Minister of State, Economy and Digital Transition
[8] Order No. 6269/2021 of the Office of the Minister of State, Economy and Digital Transition
[9] Order No. 11092-B/2021 of the Office of the Minister of State, Economy and Digital Transition

The business sector associated with digital technology companies has had a remarkable development in recent decades, with several success stories, also associated with the development of the country's image at international level. This industry presents a set of already well consolidated companies, particularly in the urban axis Braga, Porto, Aveiro, Coimbra and Lisbon. There are some notable cases, such as the business ecosystems created around the Altice Labs in Aveiro, the University of Minho in Braga or the PNI in Coimbra.

Business projects based on specific markets, such as business management (PRIMAVERA, QUIDGEST, PHC), health (GLINTT, ALERT), critical systems (CRITICAL SOFTWARE), public administration (VORTAL), e-commerce (CTT) or mobility (A-to-Be, the Brisa Innovation and Technology brand), have grown and expanded internationally. It is also here that we find the most notorious cases of globalisation, with the Portuguese unicorns, Farfetch, OutSystems, Talkdesk, Feedzai, Remote, SWORD Health and, more recently, Anchorage Digital, showing the potential for Portuguese technology to assert itself in the competitive global market. Finally, there is a group of more recent companies, taking advantage of the opportunities of digital transformation, many with a deep tech profile, operating in areas as diverse as fintech, digital marketing, cybersecurity, voice recognition, IoT, smart cities, blockchain, circular economy, digital games, AR/VR or AI. Housed in incubators and funding with venture capital are some of their key characteristics.

A quantitative vision of the business reality of this Priority Area, which clearly falls short as it only includes part of the important companies, can be given by the size of the TICE.PT Cluster, through the data presented in the following table referring to 2020.

Table 2. Economic indicators

Indicator	Value
No. of companies	59
Jobs	14.200
Turnover (M€)	4.770
Exports (M€)	1.178
Added Value (M€)	1.195

Source: IAPMEI - https://www.iapmei.pt/Paginas/TICE-PT.aspx

This development was supported by a national market open to innovation, in search of competitive advantages for its own activity, and in government policies that created the right conditions for the maturation of various niches, as in the case of procurement portals.

The country is also endowed with an extensive incubation infrastructure. This ecosystem has been leveraged by the StartUP Portugal initiative - National Strategy for Entrepreneurship, which has promoted its development, funding and internationalisation.

It is important to highlight the role of Venture Capital in the development of new IT and deep tech companies, through companies such as Armilar Venture Partners, Bright Pixel, Bynd, Faber Ventures and Pathena.

In the field of technological startups, reference should be made to the impact of attracting the Web Summit to Portugal since 2016, recognising, on the one hand, the national dynamics in this field and, on the other, giving extraordinary visibility to the country and its companies and entrepreneurs.

Thus, according to the report "The State of European Tech 2019", Portuguese technology companies managed to attract 730 million dollars between 2015 and 2019, placing Portugal in 19th position at European level.

Portugal has also been successful in attracting FDI, by attracting foreign technological companies or reinforcing their investments, highlighting the cases of VAKT, SCHRÉDER, MERCEDES BENZ I.O, NOKIA, REVOLUT, NATIXIS, XING, SODEXO, AMAZON and GOOGLE. The most often mentioned factors of attractiveness are the quality of human resources, linguistic versatility and the quality of existing infrastructures.

Demand Dynamics

The world economy was already in a process of digital transformation, since the massification of the Internet, however, the COVID-19 pandemic accelerated this process with confinements, teleworking and social distancing. In fact, during the pandemic, only those companies that used digital technologies to transform their activity were able to maintain business continuity, demonstrating the criticality and urgency of digital transformation.

The pandemic acted as a demand-pull process, forcing many companies and entities to rapidly adopt business models and modern technologies. The impact was felt at all levels of society and the economy. Long physical supply chains showed their weaknesses, notably those based on Asian suppliers. Production collapsed due the lack of supplies, workers or even orders. Physical sales channels were blocked, with the lockdowns of businesses and/or their customers. After-sales was paralysed with traffic being blocked. And even pre-sales, the sales activity, was strongly affected, with the end of fairs and congresses.

However, against this backdrop, companies producing computer equipment increased sales. E-commerce platforms and online sales exploded. Subscription platforms increased the number of customers. Transport and delivery companies, based on new digital business models, have become a key link between suppliers and customers. The post-pandemic will bring a new normal, but the digital transition, meanwhile underway, must now be deepened and structured. For national companies, located in the Iberian periphery, this change has the benefit of being able to integrate them more easily into the global market and level territorial competition.

We will cumulatively witness the implementation of circular economy models and the respective requirements regarding the management of the life cycle of products and their reuse or recycling, which

will imply, namely, the implementation of inter-company and inter-sector platforms and the massive use of digital technologies.

It is also important to mention the relevant (in terms of size) and structuring role that the State and Public Administration can (and should) play in boosting the economy 4.0 and digital technologies market, as a client and/or development partner, namely through innovative public procurement mechanisms.

On the other hand, there are other factors that may hinder or limit this transformation, putting the Portuguese economy at a competitive disadvantage:

- Lack of human resources with the necessary digital skills. This has been pointed out, in a generalised way, as the main difficulty experienced by companies in digital transformation processes.
- Significant investments associated with digital transformation processes, not only in technology, but also in human resources, organisational changes, etc., and the difficulty in ensuring their return.
- The lack of information and understanding about digital technologies and their effective transformational potential, as well as about the topic of "Industry 4.0" in general, also resulting from the overwhelming "noise" that has been generated in recent years around this area.
- The characteristics of our business fabric, namely in terms of its sectorial diversity and the number and average size of companies (very small), which requires the provision of duly segmented solutions, but at the same time, with controlled costs.

In order to mitigate these barriers, it is crucial that strategies and public policies and programmes favour:

- The development of more cross-cutting technologies and solutions (where possible), carried out by broad and representative partnerships, combined with dissemination and cross-fertilisation processes, thus managing to increase the scope and impact of initial investments and reduce the costs of use for end customers. Developments in Industry 4.0 and digital technologies are particularly suitable for the implementation of such an approach.
- The development of modular and parameterizable solutions together with the implementation of business models that allow for a drastic reduction in time and cost of acquisition and implementation, as well as in operating costs, as has happened, for example, with INTERNET websites.
- The combination of the development and commercialisation of innovative solutions with strong actions for awareness-raising, capacity-building and training of user companies. Considering the characteristics of the business fabric, the implementation of actions of collective nature, carried out by entities that are already very close (geographically and/or relationally) to the enterprises, seems to be an effective option to ensure an intervention with the intended characteristics. Examples of such entities are technology centres, clusters and business associations.
- The implementation of digital transition and economy 4.0 projects by user sectors and companies, especially those that are more innovative (in the sense that they correspond to

significant changes in business models and/or in the respective processes) or correspond to collaborative initiatives, involving and benefiting a considerable number of companies.

At this level, the "National Initiative for Digital Skills e.2030, Portugal INCoDe.2030" stands out. It is an integrated programme that aims to promote digital skills and the re-activation of CPED (Portuguese Coalition for Digital Employability). The deepening of the digital transition will benefit user companies, by increasing their competitiveness and access to markets, but it will also benefit companies supplying digital products and services (platforms, systems, applications, etc.) and, further upstream, those developing the key digital technologies, which will see their market grow at an accelerated rate.

Specialisation Approach

The process of digitalisation of the economy has been underway for several years and its effects are already strong and varied. However, the recent pandemic and the demands resulting from the challenges of sustainability, particularly the Circular Economy, have not only accelerated but, above all, deepened this process, leading companies and sectors to develop and implement new models and ways of doing business, strongly based on the combined use of digital technologies, some of which have already been used for many years, whilst others are now emerging, as a result of the most recent investments in Research and Development.

Some of the most key areas of development that have been identified are, for example:

- Platforms for e-commerce or e-business that implement hybrid models, physical/online, and positioning in various market segments, namely by incorporating advanced technologies for interaction with the consumer/customer (including pre- and post-sales), sales forecasting, etc.
- Platforms and systems that implement business models based on mass customisation strategies, which require the convergence of a considerable number of digital technologies, from product and process modelling and simulation, to AI, to flexible robotics, in addition to significant changes in practically all company processes.
- Platforms and systems dedicated to the new challenges of the circular economy, from the management of the life cycle of products to the reuse or recycling of materials and components. In this case, technologies such as IoT, 5G and cybersecurity take on a critical importance.

This development will enable the development of a very significant number of new products and services (platforms, applications and systems, etc.), which is an opportunity for Portugal to position itself in said segments, taking advantage of its "user" business base, of its scientific and technological assets, as well as of a set of companies that already develop this type of solutions, or that have the capacity to do so in the future.

Complementarily, these digital transformation processes will also induce needs and opportunities for development in the digital key technologies themselves, which corresponds to a third level of intervention. Being more restricted, it is also the one with a higher technological incorporation and, therefore, the potential to generate higher value added per capita, more qualified employment and a more substantial

transformation of the specialisation model of the national business fabric. Although on a smaller scale than in the previous cases, here too there are scientific, technological and business assets that justify a commitment of the national strategy and public policies, at least in some of these technologies.

The resulting vision points to a three-level intervention strategy, covering the whole extent of the digital value chain, which aims to retain in Portugal a significant part of the economic and social impact of the ongoing digital transformation process, namely through the creation of more added value, more qualified employment, more technology-based companies, as well as reducing our technological dependence from abroad (contributing to a better performance of the technological balance of payments):

- The aim is to accelerate the digital transformation of companies from the various user sectors of the national economy, allowing them to take advantage of the potential of the Digital Economy, making them more competitive and bringing them closer to their clients and suppliers, preferably using products and/or services (solutions) from national technological companies.
- For companies providing technological solutions, it is intended that they adopt digital KETs in the creation of new innovative products and services, with strong potential for internationalisation.
- Finally, it is intended to take advantage of this development dynamic to create and/or develop a digital technologies cluster, located upstream of the previous one, in the areas that prove to be most promising, including those that can attract FDI.

Therefore, it is evident from the aforementioned that cooperation and articulation between these three levels is crucial to the success of this strategy.

VISION

To foster the digital transformation of Portuguese companies and society, preferably using products and/or services (solutions) from national technological companies, stimulating the adoption of digital KETs in the creation of new innovative products and services with strong internationalisation potential, as well as the creation and/or development of digital technology clusters in Portugal

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[10] , which define priorities and policies that impact, at various levels, sectors of society and the economy targeted by the strategies for a smart specialisation, recommends an alignment analysis exercise between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could occur between the Priority Area (PA) "Digital Transition" and the different agendas.

Table *3*. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development". ▪ Thematic agenda "People First: a better demographic balance, greater inclusion, less inequality". ▪ Thematic agenda "Climate transition and sustainable resources ▪ Thematic agenda "An externally competitive and internally cohesive country
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo ▪ RSSS Algarve ▪ RSSS Azores ▪ RSSS Madeira
National Strategic Plans	▪ Digital Transition Action Plan ▪ National Roadmap for Research Infrastructures 2020.
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Research and Innovation in Industry and Manufacturing ▪ Thematic Agenda for Research and Innovation in Cyber-Physical Systems and Advanced Forms of Computing and Communication Thematic Agenda for Research and Innovation in Labour, Robotisation and Employment Qualification in Portugal
Competitiveness Clusters	High alignment: ▪ Cluster TICE.PT. ▪ Cluster PRODUTECH - Production Technologies Cluster ▪ Smart Cities Cluster. Moderate alignment: ▪ AEC Cluster - Architecture, Engineering and Construction ▪ AED Cluster Portugal ▪ Portuguese Railway Platform Cluster ▪ Vine and Wine Cluster ▪ Forest Cluster ▪ Petrochemicals, Industrial Chemistry and Refining Competitiveness Cluster ▪ Footwear and Fashion Cluster ▪ Portuguese Sea Cluster ▪ Portuguese Mineral Resources Cluster ▪ Sustainable Habitat Cluster ▪ Textile Cluster: Technology and Fashion ▪ Engineering & Tooling Cluster ▪ Health Cluster Portugal ▪ Automotive Cluster Portugal ▪ Portuguese AgroFood Cluster ▪ Tourism Cluster
Sustainable Development Goals UN	▪ SDG 9 | Industry, Innovation and Infrastructure ▪ SDG 11 | Sustainable cities and communities
European Policies, Programmes and Strategies	▪ Cohesion Policy 2021-2027 ▪ Recovery and Resilience Plan
European Policies, Programmes and Strategies	▪ Digital Europe ▪ Connecting Europe Facilities
Horizon Europe Clusters	▪ Digital, Industry and Space

[10] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative actions

As mentioned above, the implementation of the vision and strategy proposed for this Priority Area implies a concerted intervention at three levels: development of digital technologies, development of solutions based on digital technologies and adoption of the solutions by user sectors and companies.

The identification of the transformative activities of the Priority Area results from the crossing of the capacities/potential of national RDI and Production Capacity of Goods and Services vs. challenges and opportunities identified through an extended stakeholder consultation process, a participatory process that took place in thematic workshops held in late 2020. As a result of the inputs from workshop participants, 5 transformative activities were duly listed. The activities received a globally positive welcome by the participants. Nevertheless, a number of comments and suggestions were made. In view of the discussion, and after (re)considering all the contributions from the various stages of the various workshops, a draft of five transformative activities to be covered by the NSSS's Priority Area "Digital Transition" is presented in Table 4 below.

Table *4*. Transformative Activities of Digital Transition PA

Transformative Activity	Description
Human-centric and socially sustainable systems	i5.0 combined organisation models and production technologies, with the addition of the human factor to artificial intelligence and autonomous production systems, promoting a response to the challenges of society and the re-skilling and up-skilling of people.
Development of advanced digital platforms and solutions for new business models	Promote the development of digital platforms and solutions for new e-commerce and e-business models and processes.
Development of advanced digital platforms and solutions for the optimisation of production chains	Development and adoption of systems for the integration and optimisation of production chains, implementing logics of collective efficiency and circularity.
Promoting the digital key technologies market	To foster technical and scientific capacities and developments, promoting the creation, attraction and growth of companies producing digital, communication and software technologies.
Adoption of digital platforms and solutions by user sectors	Act on the demand side, stimulating the digitalisation of the national economy through the adoption of digital platforms and solutions.

Within the scope of the aforementioned stakeholder exercises, it was possible to characterise, throughout

the distinct phases of the innovation cycle, the main public policy instruments and the desirable combination of them. This work is summarised in Table 5 where we cross-reference the spectrum of public policy instruments for innovation with transformative activities. The aim of this task was to characterise which instruments have the greatest relative importance for the achievement of transformative activities, thus allowing us to identify the best combinations of policy instruments for each priority and, respectively, for each transformative activity.

Policy-mix - Policy instruments to be mobilised by transformative activity

Table 5. Transformative Activities Model vs. Instruments[11]

Instruments / Transformative Activities	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in enterprises	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services Market	Support to Demonstrator and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and projects	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
Human-centric and socially sustainable systems	Very relevant	Very relevant	Very relevant	Very relevant			Very relevant	Very relevant						Very relevant	Very relevant	Relevant		Relevant
Development of advanced digital platforms and solutions for new business models	Very relevant					Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant
Development of advanced digital platforms and solutions for the optimisation of production chains	Very relevant					Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant
Promoting the digital key technologies market	Very relevant	Very relevant	Very relevant			Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant
Adoption of digital platforms and solutions by user sectors	Relevant		Very relevant			Very relevant	Relevant	Very relevant				Very relevant	Very relevant		Very relevant	Relevant		

Very relevant

Relevant

[11] In detail in Table 8. Model Transformative Activities vs Intervention Areaswith the Instruments in the matrix boxes

Table 6. Transformative Activities vs. Intervention Areas Model

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
Human-centric and socially sustainable systems	▪ Support for advanced training - namely master and doctorate programmes in companies	▪ Support for Collaborative R&D Projects ▪ Collective Efficiency Strategies - Support for inter-cluster collaborative work aimed at defining requirements and disseminating the solutions provided	▪ Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in enterprises		▪ Collective Actions for Qualification	
Development of advanced digital platforms and solutions for new business models	▪ Support for advanced training - namely master and doctorate programmes in companies	▪ Support for Collaborative R&D Projects - aimed at developing the various platforms through full and extended partnerships, also involving end users ▪ Collective Efficiency Strategies - Support for inter-cluster collaborative work aimed at defining requirements and disseminating the solutions provided	▪ Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in companies, namely through articulation with collaborative R&D projects (hiring researchers and students who participated in the execution of R&D projects)	▪ Entrepreneurship Programmes - creation of new companies supplying platforms and services. ▪ FDI attraction - attracting international business development centres. ▪ Financial Instruments - aimed at supporting the creation of new or the reorientation of existing companies towards these markets.	▪ Financial Incentives for Investment ▪ Innovative Public Procurement and Technology Services Market - promoting the development of advanced digital products and services with application in the public sector. ▪ Support for Demonstrator and Pilot Projects - support for projects to demonstrate the use of digital platforms and solutions in various sectors and segments of the economy. ▪ Collective skills actions - training a considerable number of workers in new digital technologies to empower developer companies.	▪ Support for insertion in international networks, programmes and projects - namely HEU and Digital Europe ▪ Financial Incentives for Internationalisation - To support the internationalisation of companies in this sector. ▪ Collective Actions for Internationalisation - aimed at reinforcing Portugal's image as a country that produces digital platforms and solutions for electronic commerce and business, especially in specific market niches
Development of advanced digital platforms and solutions for the optimisation of production chains	▪ Support for advanced training - namely master and doctorate programmes in companies	▪ Support for Collaborative R&D Projects - aimed at developing the various platforms through full and extended partnerships, also involving end users ▪ Collective Efficiency Strategies - Support for inter-cluster collaborative work aimed at identifying opportunities, defining requirements and disseminating available solutions	▪ Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in companies, namely through articulation with collaborative R&D projects (hiring researchers and students who participated in the execution of R&D projects)	▪ Entrepreneurship Programmes - creation of new companies supplying platforms and services. ▪ FDI attraction - attracting international business development centres. ▪ Financial Instruments - aimed at supporting the creation of new or the reorientation of existing companies towards these markets.	▪ Financial Incentives for Investment ▪ Innovative Public Procurement and Technological Services Market - promoting the development of advanced digital products and services with application in the public sector, aiming at their integration in circular economy processes ▪ Support for Demonstrator and Pilot Projects - support for projects demonstrating the use of digital platforms and solutions in various circular economy processes and chains. ▪ Collective skills actions - training a considerable number of workers in new digital technologies to empower developer companies.	▪ Support for insertion in international networks, programmes and projects - namely HEU and Digital Europe ▪ Financial Incentives for Internationalisation - To support the internationalisation of companies in this sector. ▪ Internationalisation Collective Actions - aiming at reinforcing Portugal's image as a producer country of digital platforms and solutions for Circular Economy, especially in specific sectors or value chains
Promoting the digital key technologies market	▪ Support for advanced training - including doctoral programmes in the most emerging digital technologies and doctorates in industry ▪ Support for S&T units and projects - Support for the creation of scientific infrastructures in new areas, fundamental R&D projects in the most emerging technologies and proof-of-concept projects (of scientific results)	▪ Interface Organisations and Collaborative Platforms - creation of new entities and capacity building of existing ones. Exploratory R&D activities. ▪ Support for Collaborative R&D Projects - aimed at developing advanced technologies and solutions ▪ Collective Efficiency Strategies - Support for inter-cluster collaborative work aimed at identifying opportunities, defining requirements and disseminating available solutions	▪ Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in companies, namely through articulation with collaborative R&D projects (hiring researchers and students who participated in the execution of R&D projects)	▪ Entrepreneurship Programmes - creation of new technology-based companies, namely in the most emerging areas. ▪ Attraction of FDI - international technological companies, namely in the most emerging areas. ▪ Financial Instruments - appropriate to the specificities of scientific and technological entrepreneurship.	▪ Financial Incentives for Investment - aimed namely at supporting the development and expansion of companies producing digital technologies. ▪ Innovative Public Procurement and Technology Services Market - promoting the development of advanced digital products and services with application in the public sector ▪ Support for Demonstrator and Pilot Projects - demonstrating the potential of new digital technologies. Valorisation by Portuguese companies of the results of European projects. ▪ Collective skills actions - training a considerable number of workers in new digital technologies.	▪ Support for insertion in international networks, programmes and projects - namely HEU and ESA ▪ Financial Incentives for Internationalisation - To support the internationalisation efforts of companies in this sector, namely in reference events (not necessarily only fairs). ▪ Collective Actions for Internationalisation - aimed at reinforcing Portugal's image as a country that produces advanced digital technologies and solutions.
Adoption of digital platforms and solutions by user sectors	▪ Support for advanced training, namely master's degrees and doctorates in companies	▪ Interface Organisations and Collaborative Platforms - Support to TIC, COLABs and business associations in the effort of dissemination and demonstration of the use of digital platforms and solutions by the various user sectors ▪ Collective Efficiency Strategies - Supporting the Clusters in their efforts to disseminate and demonstrate the use of digital platforms and solutions by the various user sectors	▪ Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in companies - Aiming to strengthen internal capacities and competences for the endogenisation, valorisation and management of digital platforms and solutions.		▪ Investment Financial Incentives - aimed at supporting user companies' investments in the acquisition and/or use of digital platforms and solutions ▪ Innovative Public Procurement and Technology Services Market - through the acquisition and/or use of digital platforms and solutions ▪ Collective qualification actions - training of a considerable number of workers of user companies in management and use of digital platforms and solutions.	▪ Support for insertion in international networks, programmes and projects - namely HEU and Digital Europe, in clusters and domains more focused on application sectors/domains

MATERIALS, SYSTEMS AND PRODUCTION TECHNOLOGIES
Resources, Business Conditions and Demand Dynamics

The Priority Area "Materials, Systems and Production Technologies" has transversal characteristics, from the associated technologies presenting a potential for exploitation and application in various economic activities, and in multiple industrial sectors, to its synergy with other Priority Areas such as Digital Technologies and the Circular Economy.

The development of materials and their use is crucial to increase the competitiveness and resilience of several economic activities, namely through the valorisation of natural resources existing in the territory, the recycling of post-consumer and industrial waste, and the development of new smarter materials. The innovative solutions of smarter and sustainable materials, associated with eco-design and optimisation of value chains, will contribute to the development of sustainable and functional products and systems, where the promotion of the efficient use of resources will be essential to ensure a contribution to those that are signatories to the aims of sustainability, carbon neutrality and circular economy.

Some industry segments present challenges (associated to a certain stagnation) that can be overcome by using new materials, intelligent materials and advanced production technologies, namely Additive Manufacturing. It should also be added that the imminent changes in the supply chain of materials pose challenges/opportunities in terms of changing the energy model, namely through materials from the valorisation of endogenous resources (minerals, biomass, marine) and recycling.

The development and use of materials from renewable sources such as cork, cellulose, natural fibres and resins, biomaterials/biopolymers or synthetics with biological influence (biomimetics) also have an important potential application. Also of note are materials suitable for Additive Manufacturing, which will play an extremely important and pivotal role in the creation of an industry capable of mass-producing customised goods.

The wide range of application of materials (smart materials, multifunctional, self-healing, among others), the national importance of polymers for application in automotive and lightweight products, associated with advanced manufacturing technologies and others framed in KET's, will be essential to leverage the national Manufacturing Industry (IT). It should be noted that materials have relevant opportunities in application sectors of the present and future, such as the sectors of the Sea, Energy, Space, Health, Automotive and Aeronautics and Defence.

Mineral resources, endogenous and biomaterials, due to their abundance and ability to respond to societal challenges, deserve explicit emphasis. The development of biomaterials from biomass, biodegradable and biomimetic materials, the extraction of compounds with high added value, the valorisation of marine resources, more environmentally friendly solvents are opportunities for the industrial sector in Portugal.

Associated to Materials, Advanced Production Technologies (APT) are a relevant pillar for the strengthening of the existing industrial fabric and the creation of new companies, crucial for the positioning of national industry in new markets and in the production of new products with high added value.

There is a need to create a symbiosis between Materials and Production Technologies to enable the creation of functional materials, to produce intelligent, sustainable and high added value products/systems, and a more sustainable, flexible, customized, resilient, decarbonized industry, close to the consumer. The investment in the area of additive manufacturing, not only in terms of equipment production and equipment adaptation, but also in terms of the development of materials and associated product and process engineering solutions, should be strongly considered. This is a technological area with application potential in various application sectors.

Advanced manufacturing technologies play a vital role in smart manufacturing as it combines industrial automation with advanced computing, information and connectivity systems applied to manufacturing.

Resources

In terms of the main assets and resources related to the Priority Area of Materials, Systems and Production Technologies, there are several scientific, technological and industrial stakeholders in Portugal. Transversally, there are exceptionally good competences in engineering and at a competitive cost when compared to the cost of other countries, which enhances the attraction of foreign investment in Research and Development (R&D), and the attraction for the creation of engineering centres in the country (e.g., BOSCH, Continental, Autoeuropa, Vestas...)

The R&D capacity and skills in Portugal also allows for the capture of foreign investment or services from international companies. As an example, there are companies that have settled in Portugal such as Vestas, but also companies such as Bosch, PSA and AutoEuropa that invested in the launch of a programme/project to train national suppliers in specific areas of high scientific and innovation intensity.

There is in Portugal a wide network of entities/organisations with critical mass of scientific and technological skills in the areas of materials, industrial manufacturing technologies and advanced technologies that can facilitate the response to the challenges posed by industry and that can anchor value, namely the network of Technology and Innovation Centres (TIC) covering several areas of knowledge namely: Automation and Robotics, Electronics and Instrumentation, TIC, Telecommunications, Construction Technologies, Production Technologies, Materials Technologies, Nanotechnology, Mechanical Engineering, Industrial Engineering, Energy, Health, Chemistry, Biotechnology, Environment, Quality, Safety, Metrology, and Agricultural, Forestry and Food Technologies.

In scientific production, mostly generated by higher education institutions, COLAB and Research Centres, Portugal has important skills in the areas of materials, industrial and manufacturing technologies, advanced technologies and functional and sustainable materials.

Portugal thus has, in general, an excellent network of Higher Education Institutions, Interface Entities and Clusters that can facilitate the response to the challenges posed by industry (e.g., integrated systems with different capital goods).

In terms of materials, Portugal still has biomass in quantity, which allows it to circumvent the low rate of coverage of exports by imports that occurs in many cases in the supplies of national industry, namely in the textile and plastic sectors. In the Energy area, the abundance of materials can foster a critical mass effort at the level of exploration and transformation of resources (EMIRI Technology Roadmap, Sept. 2019). In said areas, Portugal is less favourably positioned. There are areas in which resources exist, but sufficient skills are not yet developed, as is the case of lithium.

In terms of materials, it is crucial to value the territory's endogenous resources, namely Biomass, Mineral Resources, Sea Resources and Post-industrial and Post-consumption Waste, with a clear focus on the bioeconomy and on recycling, waste transformation and re-use.

With regard to advanced production technologies, it is crucial to leverage on digitalisation skills to apply them to new goods of more complex, integrated and intelligent equipment, in a clear commitment to Industry 4.0.

Thus, at the level of the Priority Area of Materials, Systems and Technologies of Production, it is essential to have a clear focus on improving the existing value chains in Portugal, given that these present themselves as a great asset that can be valorised and maximised. However, it is equally important to identify complementary or disruptive areas that can contribute to the creation of new jobs and the generation of added value for our economy, such as, for example, the area of energy in terms of energy storage systems, in terms of engineering and surfaces, and in terms of the exploration of exploration systems and sea resources.

Business conditions

The field of "Production Materials, Systems and Technologies" is the pillar of an Industry that wants to be technologically advanced and competitive, with potential application in various national sectors.

For example, in 2020 the most important export sectors were Automotive, Agro-Food, Rubber and Plastics, Metal Products, Textiles and Clothing and Pulp and Paper (ITGS- International Trade in Goods Statistics). All these sectors have as important characteristics the intensive use of materials and advanced or emerging technologies. It is also noteworthy that of the 10 most exporting companies in 2019, 6 are linked to the Automotive Sector and 3 are linked to Materials (paper, polymers and metals).

In the industrial field, Portugal is at a more advanced stage in terms of production technologies than in terms of materials. However, it should be noted that the biomass sector is already quite advanced,

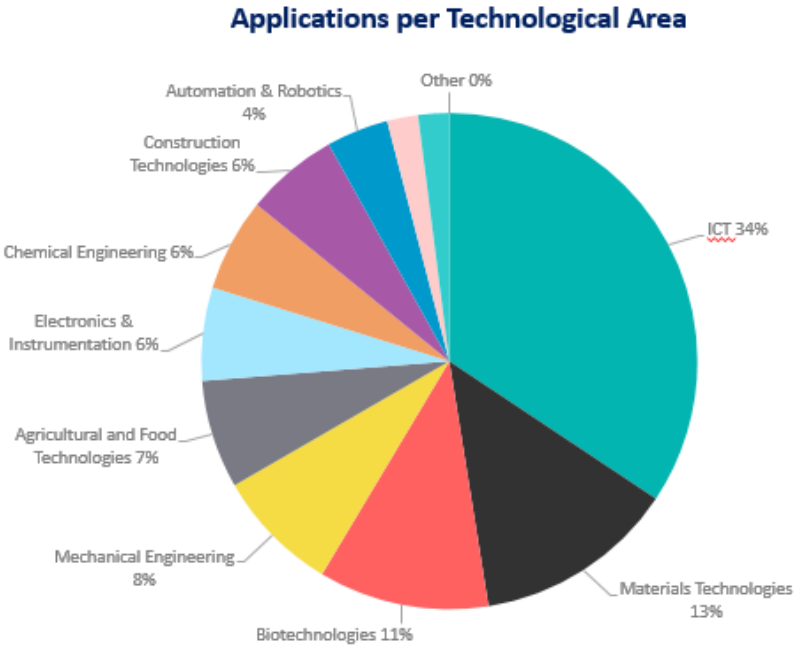
namely in the production of various products. Despite this, its exploitation potential is still extremely high considering the area and quantity available in Portugal.

There is a set of application sectors, (involving production and materials technologies), with great economic and export relevance, with business organisations and qualified and competitive clusters (moulds and polymer transformation, textiles, clothing and footwear, cork, paper, metal mechanics, ceramics, agro-food...).

In fact, the Priority Area "Materials, Systems and Production Technologies" is relevant in various sectors in Portugal, making use of wide-ranging technologies, namely Advanced Production Systems, Micro and Nanotechnologies, Advanced Materials, Laser Assisted Production, through the use of existing scientific and technological capacities and infrastructures, reinforcing the existing business fabric or through the creation of new companies, especially in the Manufacturing area.

In recent years, large investments in this Priority Area have been intensified, as can be seen in figure 5. Between 2014 and 2020, ANI received applications distributed by the following technological areas that are framed within the Production Materials, Systems and Technologies Domain. The number of companies participating in the applications far outnumbered the non-corporate entities.

Figure 5. Distribution by technological area of the applications received by ANI between 2014 and 2020[12]



[12] Source: ANI, 2020.

There has been relevant progress and investment in the area of Advanced Materials. These materials are typically characterized by having their own added value, namely materials for application in existing technology and knowledge intensive industries, or in new industries and markets. Often Advanced Materials simultaneously present different functionalities (multifunctional materials) and contribute to an economically and environmentally more sustainable industry. The functionalization of materials and surfaces is at the core of the creation of new products.

The valorisation of materials and resources on their own, materials for productive tools and additive manufacturing, the development of functional and intelligent surfaces, the multifunctionality and compatibility of materials, new fibrous materials, composites and binders with environmental considerations, are fundamental for developing and obtaining products with high added value.

This can only be achieved through a close articulation between higher education institutions, Technology and Innovation Centres and Companies, with the aim of responding to the current and future challenges of the industry, namely in the scope of the topics listed by the European Green Deal and the Digital Europe Programme.

Demand Dynamics

Portugal shall seize the opportunities arising from the growth trends of flexible manufacturing, customisation, integration of solutions and rapid response to differentiate itself, developing symbioses between materials and technologies, making use of its strong and diversified engineering skills, and create high added value products/solutions, focusing on diversity in high variety and low volume. This requires a multidisciplinary and networking effort.

Due to the dimension and characteristics of Portuguese companies, there are great opportunities and competitive potential in equipment for small series and customised systems (flexible automation, robotics, sensors, intelligence in equipment) where there is the capacity to incorporate digital transformation technologies in equipment.

As mentioned above, Portuguese companies should invest in a technological and more qualified entrepreneurship approach where digital transformation technologies are crucial. The focus on knowledge for the manufacture of production cells and integration of technologies for customized and flexible production at mass production costs is fundamental.

It is necessary to continue to invest in an industry of equipment goods with added functionality so that we can maintain and increase the volume of exports always focusing on solutions of higher added value. Most of the basic equipment is imported from other countries, which have held the market for several years, and Portuguese companies need complementary and specific systems or solutions, which can and should be developed by companies in Portugal.

It is important to follow a strategy of searching high value-added niches for the Portuguese industry in general. As a result of the interactions between stakeholders, 4 points/levels in the value-chain were

identified where it is imperative to act: i) materials; ii) equipment; iii) process; iv) product. It is in the process and in the product where it is necessary less time to act. In the others we will have to have market and positioning and leverage research, as well as development strategies that allow supporting the national industry in the medium and long term.

The automotive, transport and mobility sector have undergone transformational changes due to advances in connectivity technologies, data analytics and the emergence of new mobility services. With these rapid changes in the industry landscape, it is important and necessary for companies to insert themselves in global chains such as that of automotive components. Other sectors should follow the same example (sea, energy, space, health, aeronautics) of insertion in value chains of large reference companies (anchor companies) already existing, in different application sectors.

We highlight the fact that it is necessary to identify the needs of our industry, so that we can define, at the level of materials and capital goods, which should be the investments of the future. At the same time, we must look at advanced materials and technologies from the point of view of their own specificities, which in themselves may attract direct investment in Portugal.

It is important to define what really has an impact in the national economy. The moulds industry is a sector with an important weight in the economy, very connected to the automobile application sector. However, there is an enormous potential of moulds that may have solutions for the aeronautical and space application sector, diversifying in this way its area of application and maximizing economically due to their high added value.

Another trend is smart products, materials and nanomaterials, surface engineering that are transversal to all industrial sectors, and where there is a growing demand for this type of knowledge/solutions, as well as customer orientation as a service and the integration between technology and people.

In terms of time frame, it is expected, in a first phase, that digital transformation technologies for the industry will be the strongest trend, where issues of automation, sensing, data processing and treatment, and even the development of artificial intelligence solutions, are included. In a second phase, one of the recommended aspects will be sustainability, in terms of resource efficiency and energy efficiency, so that we can move towards more complex levels associated with the circular economy. Finally, the third wave will be associated with the exploration of materials, namely biointelligent systems, through the integration of biological elements and the fusion between biological elements and intelligence. We should also invest in new business models and logistics models that are extremely important both for the issue of customised production and small series, but also for the circular economy and sustainability.

The development of an advanced and structured recycling industry in Portugal (mechanical, chemical and thermochemical) presents itself as a necessity and opportunity for the valorisation of materials and the development of advanced technologies. Investing in productive areas and in the alignment of value chains, where the valorisation of the end of life of products will be structural, becomes fundamental to

be able to respond to the challenges and objectives of the European Green Deal, namely, to achieve carbon neutrality by 2050.

Thus, it becomes structural to think of products through materials and eco-design and include the valorisation of their end of life through recycling processes, in a clear approach to the circular economy and the reduction of the carbon footprint.

Specialisation Approach

The Priority Area " Materials, Systems and Production Technologies " focuses on the development and use of materials with innovative characteristics (intelligent materials, multifunctional materials, biomaterials, biodegradable and biomimetic materials) and of advanced and/or emerging manufacturing technologies (Photonics, Micro and Nano Manufacturing, Industrial Biotechnology, etc.) which, crossing with digital technologies, have a wide application in industrial sectors.

Portugal shall seize the opportunities arising from the growth trends of flexible manufacturing, customisation, integration of solutions and rapid response to differentiate itself, developing symbioses between materials and technologies, making use of its strong and diversified engineering competencies, and create high added value products/solutions, focusing on diversity in high variety and low volume. Portugal shall focus on the development of intelligent and sustainable products, advanced technologies for recycling, including the disassembling of products and systems.

The transformative potential of Materials and Advanced Production Technologies will tend to be reflected in the deepening of the modernisation of existing and consolidated activities in Portugal (Textile, Clothing and Footwear, Furniture and Habitat, Components for the Automobile and Aeronautical Industries, etc.), in the transition to segments of higher added value (e.g. from mass machining to precision mechanics with applications in health or aeronautics and increasing the national component of exports) and in diversification, through the exploitation of related variety, in this case with emphasis on the production of capital goods with increased functionalities and on the engineering of advanced production systems.

VISION

A focus on the development of intelligent and sustainable products, through the development and use of materials with innovative characteristics and advanced and/or emerging manufacturing technologies, enhancing the transition of companies to segments of higher added value and the development of the national supply of production of capital goods with increased functionality, as well as for the engineering of advanced production systems

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[13] , which define priorities and policies that impact, at various levels, sectors of society and the economy targeted in the strategies for a smart specialisation, recommends an alignment analysis exercise between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could be verified between the Priority Area "Materials, Production Systems and Technologies" and the different agendas (according to Table 7).

Table 7. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development". ▪ Thematic agenda "Climate transition and sustainable resources
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Research and Innovation in Industry and Manufacturing ▪ National Roadmap for Research Infrastructures 2020.
Competitiveness Clusters	▪ High alignment: ▪ Cluster PRODUTECH - Production Technologies Cluster ▪ Cluster Engineering and Tooling ▪ Petrochemicals, Industrial Chemistry and Refining Competitiveness Cluster
UN Sustainable Development Goals	▪ SDG 7 | Affordable and Clean Energy ▪ SDG 9 | Industry, Innovation and Infrastructure ▪ SDG 11 | Sustainable Cities and Communities ▪ SDG 12 | Responsible Consumption and Production
European Policies, Programmes and Strategies	▪ Cohesion Policy 2021-2027 ▪ Recovery and Resilience Plan ▪ Digital Europe ▪ European Green Deal ▪ Made in Europe
Horizon Europe Clusters	▪ Digital, Industry and Space ▪ Climate, Energy and Mobility ▪ Food, Bioeconomy, Natural Resources, Agriculture and Environment

[13] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative activities

The identification of the transformative activities of the Priority Area results from the crossing of the national RDI capacities/potential and production capacity of goods and services vs. challenges and opportunities identified through an extended stakeholder consultation process, a participatory process that took place in thematic workshops held in late 2020. As a result of the inputs from workshop participants, five transformative activities were listed. The following table presents these five transformative activities covered by the NSSS Priority Area "Materials, Production Systems and Technologies".

Table 8. Transformative Activities of the DP Materials, Systems and Technologies of Production

Transformative Activity	Description
Capital goods with increased functionality and advanced production systems	Development and production of equipment goods with added functionalities that have associated higher added value solutions and allow the development of integrated and customised equipment systems.
Advanced production technologies for the exploitation of endogenous resources	Leverage the endogenous resources valorisation industry (of biological and non-biological origin), and the extraction of high added value compounds and the development of materials through Industrial Biotechnology.
Materials and composites, functionalised for intelligent and high added value applications	Development and production of advanced materials and components, with increased functionalities (intelligent surfaces, integration of functionalities, sustainability and recyclability, etc.).
Smart and sustainable products and systems with a focus on design for separation and self-assembling technologies	Creation of more intelligent and sustainable solutions, associated with eco-design and the optimisation of value chains, contributing to the development of sustainable and functional products and systems, maximising and reducing the cost of reusing materials.
Additive manufacturing	Development and dissemination of technologies and materials for additive manufacturing, aiming at their application in multiple sectors, allowing the production of customised products with high added value.

Policy-mix - Policy instruments to be mobilised by transformative activity

Table 9. Transformative Activities Model vs. Instruments[14]

Transformative Activities \ Instruments	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in enterprises	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services Market	Support to Demonstrator and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and projects	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
Capital goods with enhanced functionalities and advanced production systems	Relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Relevant	Relevant	Relevant	Very relevant	Relevant	Very relevant		Very relevant	Relevant	Very relevant
Advanced production technologies for the exploitation of endogenous resources	Relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant		Very relevant	Very relevant	Relevant	Relevant		Very relevant	Relevant	Relevant
Materials and composites, functionalised for intelligent and high added value applications	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant				Very relevant	Relevant	Very relevant		Very relevant	Relevant	Relevant
Smart and sustainable products and systems with a focus on design for separation and *self-assembling* technologies	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Relevant		Very relevant	Relevant	Relevant
Additive manufacturing	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant				Very relevant	Relevant	Relevant		Very relevant	Relevant	Very relevant

Very relevant | Relevant

[14] In detail in Table 6. Transformative Activities vs Intervention Areas Model with the Instruments in the matrix boxes

Table 10. Transformative Activities vs. Intervention Areas Model

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
Capital goods with increased functionality and advanced production systems	• Support for advanced training • Support for S&T units and projects	• Interface Organisations and Collaborative Platforms • Support for Collaborative R&D Projects • Technology Transfer Collective Actions • Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D • Support for scientific and technological employment in enterprises	• Entrepreneurship Programmes • Attracting FDI • Financial Instruments	• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market • Support to Demonstrator and Pilot Projects • Collective Actions for Qualification	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation • Collective Actions for Internationalisation
Advanced production technologies for the exploitation of endogenous resources	• Support for advanced training • Support for S&T units and projects	• Interface Organisations and Collaborative Platforms • Support for Collaborative R&D Projects • Technology Transfer Collective Actions • Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D • Support for scientific and technological employment in enterprises	• Entrepreneurship Programmes • Financial Instruments	• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market • Support to Demonstrator and Pilot Projects	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation • Collective Actions for Internationalisation
Materials and composites, functionalised for intelligent and high added value applications	• Support for advanced training • Support for S&T units and projects	• Interface Organisations and Collaborative Platforms • Support for Collaborative R&D Projects • Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D • Support for scientific and technological employment in enterprises		• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market • Support to Demonstrator and Pilot Projects	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation • Collective Actions for Internationalisation
Smart and sustainable products and systems with a focus on design for separation and *self-assembling* technologies	• Support for advanced training • Support for S&T units and projects	• Interface Organisations and Collaborative Platforms • Support for Collaborative R&D Projects • Technology Transfer Collective Actions • Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D • Support for scientific and technological employment in enterprises	• Entrepreneurship Programmes • Attracting FDI • Financial Instruments	• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market • Support to Demonstrator and Pilot Projects • Collective Actions for Qualification	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation • Collective Actions for Internationalisation
Additive manufacturing	• Support for advanced training • Support for S&T units and projects	• Interface Organisations and Collaborative Platforms • Support for Collaborative R&D Projects • Technology Transfer Collective Actions • Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D • Support for scientific and technological employment in enterprises		• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market • Support to Demonstrator and Pilot Projects	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation • Collective Actions for Internationalisation

GREAT NATURAL RESOURCES - FOREST, SEA AND SPACE

Resources, Business Conditions and Demand Dynamics

The emergence of the so-called *NEW SPACE* and the developments observed in micro, mini and nano-satellite technology, rocket and launcher construction, as well the emergence of the first private space missions substantially change the demand conditions for Space and Earth Observation Technologies and their Applications. The opportunities arising at the level of telecommunications services, of applying the results of Earth Observation Technologies applications from space in various activities, and also in navigation substantially, widen the field of advanced users for this type of technological developments.
There is also another relevant vector of advanced demand to be considered related to the production of the mentioned mini-satellites and launching devices. Here, a direct demand can also be referred, namely the industrial production of these devices and an indirect demand raised by the availability of all the complementary inputs for their production (development of software solutions and complementary technological devices).
One of the great opportunities for the development of Earth observation technologies lies in their use in mitigating and combating climate change, as the Thematic Agenda for Research and Innovation points out, since "the challenges related to the atmosphere are thus strongly linked to the understanding and modelling of the processes interfacing with its lower boundary. In this context, the monitoring of variables related to the surface energy balance is particularly relevant, being also linked to the water and carbon cycles. New sensors - active and passive - will open new opportunities to estimate surface variables (temperature, radiative and energy fluxes, parameters related to the condition and water stress of vegetation, or primary productivity). This type of products and data has immense potential to increase efficiency in the assessment and management of agricultural and forest resources, with local/national applicability, or at continental scale: crop development, pest/disease risk, irrigation needs, forest inventory, identification of forest fires, burnt areas and their regeneration. It is expected that the very high spatial resolution observations, made available without restrictions via Copernicus (e.g. Sentinel-1 and Sentinel-2), will have a major impact in said areas, but also in others such as land cover and land use mapping and spatial planning, or in the field of geological hazards in terms of deformation and detection of mass movements. The integration of GNSS space reference systems (GPS and Galileo) with SAR sensors (e.g., Sentinel-1) can provide an effective contribution to prevention and emergency response, allowing the development of deformation monitoring services at national or transnational level. The development of monitoring systems can also be crucial in safeguarding natural resources, namely in the monitoring of underground water reserves, or in the detection and preservation of raw materials, in particular critical elements, strategic/used in high technologies"[15] .
In the case of Forestry, it is not only a matter of public momentum. Given the extremely high percentage of private forest ownership, the use on a larger scale of these technologies is dependent on the emergence of new forms of private collective management of the forest, for example forest investment and management funds, the only way to bring into forestry valorisation a myriad of small owners and

[15] *Thematic Agenda for Space and Earth Observation Research and Innovation*

producers without the slightest individual investment capacity at that level.

While there are application areas such as agriculture and the vineyard and wine economy where private business dynamics on their own may ensure a greater intensity of use of these technologies, in line with the size of the stakeholders, which can be extended to large-scale private forestry (e.g. NAVIGATOR projects in this area), the application areas of land use planning, forestry (small property, management, planning and prevention), risk protection, traceability and the low-density approach depend on a strong public impulse.

With regard to the Sea, Portugal has a geostrategic position at the crossroads of international maritime traffic routes. The Portuguese ports can dispute a position in global logistics networks as the gateway to Europe and connection with other continents, network of commercial and fishing ports that cover the entire continental coast and island regions. These have an important role not only from a commercial point of view but also as potential innovation hubs in the area of the blue economy, estuarine and river areas with potential use for aquaculture, deactivated salt pans that can be reconverted for semi-intensive aquaculture, infrastructures to support the development of ocean technologies (test area in Aguçadoura, Viana do Castelo and Peniche), knowledge of the proximity of fishing communities that should be enhanced in new dynamics of the blue economy. The valorisation of these territorial assets is, however, faced with regulatory and bureaucratic constraints that limit the licensing of activities and access to the sea.

In terms of scientific knowledge and technological capacity, there are several RD&T centres in the fields of marine biology and engineering, which should be combined to develop solutions with application to the blue economy. Highlight for the entities recognized under the Interface Program that operate in the area of the Sea as the CoLab + Atlantic, B2E, GreenColab and S2AQUAcoLAB, as well as the Centres of Technological Interface INESCTEC, INEGI, CEIIA, WAVEC, IWQ, besides other centres such as CIIMAR, CESAM, CCMAR and Higher Education Institutions such as the Polytechnics of Porto, Leiria and Viana do Castelo and the Universities of Minho, Porto, Aveiro, Lisbon, Évora and Algarve. These organisations have relevant specific skills in a truly diverse set of areas such as marine biotechnologies, materials engineering, underwater robotics and sensors, automation, artificial intelligence, virtual and augmented reality, internet of things, data science, high performance computing, blockchain, communications, cybersecurity, among others.

In terms of existing knowledge assets for Space, Portugal's membership to ESA and ESO is of outstanding importance as levers for development and international scientific recognition in this area, with the funding of the former and the logic of equity in the return of Portugal's investments for that Agency assuming the key role of funding for national research in the area. With the broad representation and leadership of the Exact Sciences, the Natural Sciences and the Engineering and Technology Sciences complete the map of scientific areas that have stood out in the area of space and Earth observation.

The existing knowledge in the field of data science also presents a potential to be considered, although there is no robust information on the existence of business assets that are already in the field developing activities focused on the exploitation of this knowledge and its transformation into market-access products.

Among the existing technological assets, mention should be made of the emergence of technology-based

companies initiated with the Portuguese Technology Transfer Initiative (PTTI) between 2012 and 2014 and subsequently strongly advanced with the creation in 2014 of the ESA BIC Portugal (European Space Agency Business Incubation Centre in Portugal). The construction of the INFANTE satellite supported by ANI as a mobilising programme involving practically the entire space innovation ecosystem in Portugal is a relevant stage in the development of the critical mass of technological assets associated with the Space and Earth Observation domain.

The AED (Aeronautics, Space and Defence) cluster represents, in itself, an asset in terms of the involvement of companies in taking advantage of the technological development opportunities that this domain raises, whether in terms of its infrastructure and hardware dimension, or in terms of the software industry component, namely in terms of applied R&D to enable the development of technological solutions already existing in the market that require complementary RTD necessary for the formatting and implementation of the application opportunities mentioned. Its composition is relevant as an asset, as it integrates Universities and Research Centres where the main knowledge assets are located, industry with products for both aeronautics and defence and technological companies (Systems and TIC). The cluster members that take on the role of interface centres with industry and business in general include the following: CEiiA, CISTER (ISEP), IDMEC (IST), INEGI, INESC TEC, o INOV INESC (Lisbon), IWQ, ISR (IST), Instituto de Telecomunicações (U. Aveiro), PIEP (U. Minho), to which FEUP, the University of Coimbra, the University of Évora, the Lusófona University and the Atlantic University are added.

At another level, PORTUGAL SPACE, the Portuguese Space Agency created by the Portuguese Government with the mission to implement the National Strategy for Space, Portugal Space 2030, organised in five structuring projects: Blue Worlds, Space-based Autonomous Navigation, New Markets for nano and microsatellites, Space Innovation Ecosystem in Santa Maria Azores and Space-based Sustainable Environments and Green Islands that intersect with 6 fields of action: Space Security, Earth Observation, Telecommunications and Navigation, Science and Exploration, Technology and Space Transportation.

At this level, it is important to mention the SPACEPORT project in Santa Maria in the Autonomous Region of the Azores, which involves the construction of facilities, assembly, integration and test centres and launch support services, which is articulated with the so-called Atlantic Constellation project financed within the scope of ESA activities.

Portugal Space also welcomes, in its collaborative partnership, some research centres, among which there are also units with collaborative activities with the AED Cluster: Aeronautical and Astronautical Research Centre (AEROG), AIR CENTRE, COLAB + Atlantic, CA3 - Computation Intelligence Group of the Centre for Technologies and Systems, of Universidade Nova, CEDIS - Centre for R&D on Law and Society, CEG Centro de Estudos Geográficos, CICGE - Centro de Investigação em Ciências GeoEspaciais, CIMA Universidade do Algarve - Centro de Investigação Marinha e Ambiental, CITEUC Universidade de Coimbra - Centro de Investigação da Terra e do Espaço, CITEVE, C-MAST, C2TN, Instituto de Astrofísica e Ciências do Espaço, INESC TEC, IPFN - Instituto de Plasmas e Fusão Nuclear, LARSyS - Robótica e Sistemas de Engenharia, IPMA. NOT, PIEP, LIBPhis - UNL, Faculty of Sciences UP, LIP and UCILeR – School of Law of U. Coimbra.

Another asset that can be referred to as a cross-activity is made up of four Collaborative Laboratories: FOREST WISE (in the forestry area and bringing together large companies such as NAVIGATOR with their

own use of earth observation technologies to manage their forestry assets), the CoLAB da Vinha e do Vinho, COLAB Atlântico and MORE Colab.

The business conditions for developing the transformative opportunities associated with space-based Earth observation technologies can be segmented into three broad groups:

I. A group of already relatively consolidated companies that emerged in the market around value creation opportunities in the scope of the so-called Institutional Space, largely dependent on large projects of European and international agencies and national agencies such as NASA, dominantly related to upstream activities in the space value chain. This group includes companies such as Active Space Technologies, Aero3Plus, AeroHelice, Celestia Portugal, Critical Software, Edisoft, D-Orbit, EMBRAER, GMV, INDRA, Motofil Aeronáutica, SPI Portugal and TEKEVER. In addition, the recent creation of the first Portuguese satellite operator, Geosat.

II. A group of companies already installed, and which recognise opportunities to enhance their technologies, products and services in space and Earth observation technologies, thereby diversifying their portfolio of sectors. Companies such as AFIPRE (precision cutting), AIR OLESA (moulds and precision machines), ALMADESIGN (industrial design), BBE Engineering (additive manufacturing), CABLOTEC (electronic systems), CODI (additive manufacturing), Controlar (electronics and automation), EFACEC, ENFLEXUS (signalling) ETI (training and simulation), FREZITE (cutting tools), GMV (integrated modular aviation), IBEROMOLDES (moulds and tools), Kristaltek (precision machines), Novacable (aeronautics wiring), Omigron Engenharia (design), Optilink (optimised optical wiring), Ricardo&Barbosa (moulds and tools), SISMA (high precision CNC machinery), Stratosphere (materials), UBIWHERE (software). It is within this group that we have observed the migration of representative companies, namely from the metal-mechanics sector, from the automotive sector first to the aeronautics field and then to the space sector;

III. Finally, a set of new technology-based companies, associated either to technology-based entrepreneurship framed and encouraged by the organisation of ESA BIC in Portugal, with its different antennas in the territory, or to other fronts for the boosting of technology-based entrepreneurship. According to ESA BIC records, the 30 start-up projects, created since the beginning in 2014, are distributed over the following areas: aviation (2); energy (2); marine exploration (1); health (1); transport and logistics (4); Earth observation technologies and tourism (2); infrastructure and smart cities (5); security and defence (5); food and agriculture (3); environment and natural resources (3).

The densification of this business fabric will essentially be carried out from by increasing the number of companies that may be additionally attracted to the development of technologies complementary to earth observation technologies (robotics and precision machinery, materials and structures, telecommunications, additive manufacturing, control technologies, sensors) and from the intensification of technological entrepreneurship, whose reinforcement is essential to achieve a better balance between incumbents and new companies. Densification will also tend to occur through the emergence of collaborative projects between the three groups of companies mentioned above.

In this context, the creation of the first Portuguese space integrator, which corresponds to a progression in the value chain of the complete assembly of satellites, should be referred to as illustrative of the

business dynamics underway. MAGELLAN ORBITAL integrates CEIIA, EFACEC, OMNIIDEIA, TEKEVER and IDD.

Likewise, densification will be further enhanced by the arrival to the ecosystem of companies and relevant stakeholders in the application sectors of Earth observation technologies, agriculture, forestry, vineyard and wine economy, sea, among others. In the most relevant stakeholders, the existence of in-house corporate R&D activities may accelerate densification, as it can give rise to collaborative R&D projects capable of generating demand pull innovation, in this case dictated by the specificities of the applications.

Another structuring factor for the densification of business conditions will be the attraction of foreign direct investment. It is already well represented in the group of more consolidated companies associated to the initial impulse of the "institutional space". It should be added that this group and the group of installed companies that saw in the space a new and promising business opportunity, are characterised by being strongly internationalised, which will tend to facilitate the attraction of structuring FDI. This appeal will depend largely on the potential for creating knowledge-innovation in this area, which seems to be assured given the development observed in the national scientific research capacity in line with the major European evolution trends in this area.

In terms of business conditions for the Sea, the fish industry, in its conservation, freezing and transformation segments, is made up of small and medium-sized companies with a long tradition, mainly oriented towards the external market. It faces a set of constraints related to the scarcity of raw materials for the operation of fish processing and conservation activities, which has been accentuated, either by the decrease in stocks and restrictions on captures, or by the increase in fish consumption worldwide. It is a sector that is very dependent on the external market, worldwide, both in terms of fish imports and exports. Over the years the industry has undergone modernisation processes in the areas of production automation, information systems, food safety and product traceability, and the development of new products to respond to current trends in demand. In this context, global demand is tending to increase, the substitution of land protein by sea protein is a trend that is being encouraged for environmental reasons, and consumers are giving more and more relevance to product differentiating factors such as organic production, the quality and authenticity of the products, the proximity and/or consumption of local/regional products, compliance with sustainable production or capture practices, food safety, indication of origin and the traceability of the products along the chain up to the final consumer.

The naval industry, comprising shipbuilding, maintenance and repair and ancillary industries, is highly dependent on external markets (reduced number of national shipowners). It is a sector that evolves in a cyclic way, despite the loss verified in the last years, especially with the situation experienced by the Viana do Castelo Shipyard, the main shipbuilding shipyard in the country, has experienced recent dynamics that go in the direction of establishing new competences. The dynamics of West Sea and the response to some new market segments in the area of vessels for cruise tourism, vessels for the Navy or even the participation in a project of adaptation of a ship for natural gas propulsion have contributed to this. Also of note is the dynamics of other smaller shipyards, such as Nautiber, in the construction of fishing boats for the African market or boats for tourism activities, with electric propulsion. In the area of ship maintenance and repair, Lisnave, one of the major international maintenance shipyards, stands

out, as well as the opportunities to develop intelligent solutions for the structural assessment of ships and the adjustment of maintenance and repair plans. The demand trends are towards the manufacture of more efficient ships, using materials that are more resistant, lighter and less demanding in maintenance, using propulsion systems and fuels with low environmental impact and, in time, the construction of autonomous vessels to assist in offshore activities and transport of goods and passengers over short distances. In the maintenance and repair segment, the demand trends are towards the development of technologies and products that allow reducing the time of maintenance activities and repair of vessels, without dry-docking, in order to minimize the period of immobilization of the vessels.

Portugal has capabilities in the metal-mechanics industry, in manufacturing composite materials, in cable manufacturing, shipyards, naval project and design companies, and skills in robotics and digital areas, which can be combined to meet some medium-term challenges, namely the design and construction of mixed passenger and goods transport vessels, or vessels to support offshore aquaculture, or even a pilot project for an autonomous vessel that allows the development of skills for more ambitious future projects.

National ports, as a result of cooperation processes with universities and RTD centres, have undergone a remarkable process of modernisation, particularly with regard to the digitalisation of port processes (SPW, SWL, cargo manifest). There has been noteworthy progress in port operations and port-ship connections, and there is room for development in the connections between ports and the logistics chain on land. There is the emergence of new businesses and new companies in the logistics sector, technological start-ups using digital technology that are contributing to the growth of the sector's value chain (for example Mitmynid). In parallel there is also a process of adaptation to the new environmental model with the development of solutions in the area of energy efficiency and decarbonisation. Here the demand trends are towards the automation of port activities, the continuation of the digital transformation processes of the logistics chain, energy efficiency and decarbonisation.

In emerging sectors the business fabric is rarefied, in the case of marine biotechnologies the business fabric is characterised by small companies (for example Allmicroalgae, A4F, Biotrend, AlgaPlus ...) whose production has to be scaled up in marine renewable energies, besides EDP and its involvement in the Wind Float Atlantic project, some companies are emerging that are interested in developing and testing prototypes supported by new technologies (waves and wind), for example CorPower and SeaWind, using the infrastructures of Viana do Castelo and Aguçadoura.

There has been an evolution towards the so-called precision aquaculture through the installation of sensor systems that allow the collection and processing of relevant information for the management and automation of production processes and biomass growth monitoring. This development results from the collaboration between companies providing digital services, mostly start-ups, and aquaculture companies.

The emergence of some startups with intervention in the development of new technological solutions applied to established and emerging activities of the economy of the sea, is the result of the action of an ecosystem of support for the incubation and acceleration of companies that brings together a set of incubators, for example UPTEC MAR, the business incubator of Figueira da Foz, the Mare Startup, CRIA and incubation and acceleration programmes, promoted, namely by Beta I and the Blue Ocean

Foundation, among others. The incubation and acceleration of companies in the Sea industry is a slow process, with high or unknown risk, which makes it difficult to attract the necessary capital to scale up the business before less risky application alternatives with greater return. Recently, and following the creation by the EC of the Blue Invest Platform, as well as the creation of the Blue Invest Fund, a movement of greater interest for businesses in the Sea industry was generated, with the guidance of some national funds - Portugal Venture, Indico, Capital2C, among others, towards these sectors.

Regarding emerging activities, Portugal continues to be a sought after destination for testing prototypes in the area of marine renewable energy (wind and wave), especially in the areas of Aguçadoura and Viana do Castelo, this attraction may be strengthened by Brexit, the exit of Scotland from the EU where is located an important test centre for marine renewable energy, associated with the set of context conditions such as good accessibility and milder climate, can strengthen Portugal's position in the matter. However, and for this purpose, there is a set of constraints to be overcome related to the slowness of the licensing processes and the conditions of access to the sea.

Specialisation Approach

The Specialisation Approach of the Great Natural Resources: Forest, Sea and Space, presents itself as one of the NSSS wildcard Priority Areas, i.e. an emerging area based on the opportunities for developing new products (technologies) and services at the level of rocket construction and launches, construction of mini, micro and nano-satellites and associated services (management of their operation and the data they provide). The exploration of production niches for these devices and their articulation with the manufacturing processes of the aeronautic and automotive industries (from which companies representing the metal-mechanic sector migrated to aeronautics and space) have as a common element the observation of land and sea from space and territory as a major aggregating element of application opportunities. In fact, these opportunities are essentially anchored in a broad set of potential applications of these technologies for which there is potential for assets (R&D, organisation and knowledge transfer). It focuses on business development opportunities (involving representative incumbents and new companies) that result from the interaction between those assets and the application opportunities in different branches of activity (defence, agriculture, forestry, vineyard and wine economy and territory). If defence constitutes a separate family in the application opportunities, the remaining application domains have those opportunities strongly associated with the mitigation of climate change effects.

The development of the specialisation process will largely depend on the articulation that will be achieved in terms of R&D activities and business investment between the so-called upstream of the value chain (still largely articulated with what is conventionally referred to as "institutional space") and the downstream focused on the diversified universe of applications for information obtained via satellite. On the upstream side, Portugal does not exactly have companies or large companies specialised in space issues, but on the contrary companies that have found business opportunities in the hardware dimension (launchers, satellites), namely by taking advantage of some transversal production technologies (as seems to be the case of the FREZITE Group. The downstream dimension is essentially linked to the exploitation of application generation opportunities associated with mini-nano-satellite production

opportunities driven by the reduction of barriers to entry resulting from the decrease of production unit costs. The emergence of the NEW SPACE approach is not limited to this downstream dimension, being practically transversal to the entire value chain. As is well known, the NEW SPACE marks a change in the world market - the emergence of private operators and the emergence of the public sector with functions not of construction, but of regulation.

In this context, the Priority Area is defined based on the potential for technological developments associated with the multiple applications of earth and sea observation technologies from space, largely driven by the reduction in barriers to entry into the satellite production market as a result of the lower cost of investment and launch technologies.

The scope of the Priority Area is thus determined both by the opportunities for technological developments referred to above and by the sectors of economic activity with the most significant potential for applying them.

If Earth observation technologies, and their multiple applications are a common element, the territory represents an important aggregating element, reinforced by the consideration of the defence economy as a regional development factor, in the perspective of dual use applications, civil and military, in line with European opportunities.

The transversality of the Sea theme presents consolidated and emerging value chains, some interrelated, others not so much, and encompassing a remarkably diverse range of products and services, produced according to vastly different processes and using a wide range of technologies and skills. The Sea intersects with the transversal domains of specialisation, for example, the Priority Area of Digital Transition is transversal, being especially important for the ports, transport and logistics sector, as well as for the naval, fishing and tourism industries and emerging activities. The priority industry of Materials, Systems and Production Technologies is also important for all sectors, with emphasis on the naval industries and the fishing industries, especially with regard to production technologies. And the Green Transition domain is transversal to all activities, with emphasis on ports (energy efficiency, bunkering), maritime transport (emissions reduction) and the naval industry (new vessels and new propulsion systems). Based on the conclusions of the work carried out by Forum Oceano on the "Sea Challenges 2030" the main changes that are intended to be accomplished in the Sea topic, are the following:

- Preserving biodiversity and fish stocks and increasing the added value of fishing;
- To increase the scale of national production of fish in aquaculture;
- Promote the autonomy and innovation of the fish processing and conservation sector;
- Promote the biotechnological exploitation of non-traditional living marine organisms;
- To continue the process of modernising ports in line with the smart ports concept and to qualify them as hubs of technological innovation in the blue economy;
- Restructuring the naval industries to meet new challenges;
- Position Portugal as an attractive place for testing, technology development and prototyping;
- Map and characterise soil and subsoil mineral resources.

The soil component is by its very nature an aggregate designation, involving agriculture, the vineyard and wine economy and the territory in general. Application opportunities not yet clearly defined, such as those of the application of these technologies to real estate were not considered in the assignment,

which does not mean that they should not be followed up. The defence sector has been added for these reasons, and because of the recognition of the latter as a factor in regional development.

In short, it is an emerging domain, not only at the level of technological developments associated with the production of minisatellites and complementary applications (articulation with the Digital Transition and Production Materials, Systems and Technologies domains), but also in terms of application sectors. Although it should be considered an emerging domain in these two dimensions, it offers the Portuguese economy interesting opportunities for business rejuvenation, new niches of activity for companies already installed in branches of metalworking, production of capital goods and digital technologies and strong innovation in production methods more adapted to the climate change scenario.

VISION

Consolidating the use of opportunities for articulation between R&D activities and business investment in forestry, the sea and in space and Earth observation technologies and their transversal applications.

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[16] , which define priorities and policies that impact, at various levels, sectors of society and the economy targeted by the strategies for a smart specialisation, recommends an exercise of alignment analysis between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could be verified between the Priority Area "Great Natural Resources: Forest, Sea and Space" and the different agendas.

Table 11. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development". ▪ Thematic agenda "People First: a better demographic balance, greater inclusion, less inequality". ▪ Thematic agenda "Climate transition and resource sustainability". ▪ Thematic agenda "An externally competitive and internally cohesive country".
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo ▪ RSSS Algarve ▪ RSSS Azores ▪ RSSS Madeira
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Research and Innovation on the Sea. ▪ Thematic Agenda for Research and Innovation on Space and Earth Observation. ▪ Thematic Agenda for Research and Innovation on Agri-Food, Forests and Biodiversity. ▪ Thematic Agenda for Research and Innovation on Climate Change.
Ministry of Health/DGS	▪ National Health Plan. ▪ National Programme for Prevention and Control of Infection and Antimicrobial Resistance - PPCIRA. ▪ National Programme for the Promotion of Healthy Diet - PNPAS. ▪ National Health Information Ecosystem Strategy - ENESIS 20-22.
Competitiveness Clusters	▪ AED - Aeronautics, Space and Defence ▪ Sea ▪ AgroFood ▪ PRODUTECH ▪ Smart Cities ▪ TICE ▪ Vine & Wine ▪ Engineering&Tooling
European Policies, Programmes and Strategies	▪ Recovery and Resilience Plan; ▪ Cohesion Policy 2021-2027.
Horizon Missions Europe	▪ Adaptation to Climate Change, including societal transformation; ▪ Smart Cities with a Climate Neutral Impact; ▪ Healthy oceans, seas and coastal and inland waters.
Clusters Horizon Europe	▪ Health; ▪ Culture, Creativity and Inclusive Societies; ▪ Civil Security for Society; ▪ Digital, Industry and Space; ▪ Climate, Energy and Mobility; ▪ Food, Bioeconomy, Natural Resources, Agriculture and Environment.
Others	▪ National Strategy for the Sea ▪ European Ecological Pact; ▪ GALILEO; ▪ COPERNICUS; ▪ EGNOS; ▪ PORTUGAL SPACE.

[16] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative activities

The scope of identification of the Transformative Activities set out in the following table took into account the participation achieved in the three workshops held, supplemented by the documentary analysis.

Table 12. Transformative Activities of the DP Great Natural Resources - Forest, Sea and Space

Transformative Activity	Description
New models for access to space	Design, development and construction of satellites, rockets and micro-launchers and space, ocean and Earth observation systems.
Applications Market and Complementary Digital Technologies	Development and commercialisation of applications based on Earth observation technologies and their respective articulation with digital technologies and KETs.
Earth Observation Technologies	Strengthening advanced demand for Earth observation technologies by boosting levels of related variety and promoting market demand dynamics for the development of models for monitoring, prediction and analysis of Forest, Soil, Defence and Maritime Surveillance, and as well as the effects of climate change.
Valorisation of natural resources	Valorisation of endogenous resources associated with vegetable production and forestry through research and development of green biotechnology and the promotion of technologies and innovation in transformation.
Marine exploration technologies	Promoting modern technologies for the exploitation of the oceans, including blue biotechnology, promoting the valorisation of waste and effluents from fishing activities, increasing research into substances and micro-organisms with health and cosmetic applications and treatment through bioremediation, monitoring and safety, developing coastal management technologies, minimising the impact of rising sea levels, ocean mining and underwater communications.
Intelligent navigation and logistics	Development of competitive positioning in the global market through digitalisation, standardisation, Service Level Agreement opportunities and evolution of the Smart Port concept, including autonomous navigation and reduction of environmental impacts.

Policy-Mix - **Policy instruments to be mobilised by transformative activity**

Table 13. Transformative Activities Model vs. Instruments

Transformative Activities \ Instruments	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in enterprises	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services Market	Support to Demonstrator and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and projects	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
New models for access to space	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Applications Market and Complementary Digital Technologies	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Earth Observation Technologies	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Valorisation of natural resources	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Marine exploration technologies	■	■	■	■	■	■	■	■	■	■	■		■	■		■	■	■
Intelligent navigation and logistics	■	■	■	■	■	■	■	■		■	■	■	■	■		■	■	■

Legend	Truly relevant	Relevant

Table 14. Model Transformative Activities vs. Intervention Areas with the Instruments in the matrix boxes

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
New models for access to space	▪ Support for advanced training, including doctoral programmes in enterprises ▪ Support to attract international researchers in the framework of exchanges generated by structuring European projects. ▪ Support for S&T units and projects with priority for those with the greatest potential for participating in European networks and associated structuring projects.	▪ Support for Collaborative R&D Projects focused on the development of national technological devices. ▪ Collective Efficiency Strategies - support for structuring projects of collaboration between clusters - AED, TICE, Engineering & Tooling and Production Technologies.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in companies, namely the integration of PhD graduates and attracting international talent.	▪ Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and Technology Services Market: programme to leverage the PORTUGAL SPACE in terms of national technology development. ▪ Support for Demonstrator and Pilot Projects that highlight the potential for generating national technology and wider participation in European projects/issues.	▪ Support for insertion in international networks, programmes and projects: participation in activities and projects of the European Space Agency. ▪ Financial Incentives for Internationalisation: incentives to participate in structuring projects at an international level, namely European space missions.
Applications Market and Complementary Digital Technologies	▪ Support for advanced training - doctoral programmes focused on the integrated mobilisation of various scientific-technological disciplines (data science, ICT, software engineering, digital technologies. ▪ Support for S&T units and projects that promote the integrated mobilisation of various scientific-technological disciplines (data science, ICT, software engineering, digital technologies.	▪ Support for Collaborative R&D Projects that focus on the integrated mobilisation of various scientific-technological disciplines (data science, ICT, software engineering, digital technologies and that involve established companies).	▪ Financial and Tax Incentives for Business R&D Support for scientific and technological employment in companies.	▪ Technology-based Entrepreneurship programmes focused on exploring the production of new TOT-based applications. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment, namely with the involvement of specialised international financial institutions. ▪ Support for Demonstration and Pilot Projects that enhance the integration of various subject areas.	▪ Support for participation in Horizon Europe. ▪ Internationalisation Collective Actions focused on raising finance from specialised capital at international level.

Table 14. Model Transformative Activities vs. Intervention Areas with the Instruments in the matrix boxes

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
Earth Observation Technologies	▪ Support for advanced training. ▪ Support for S&T units and projects focused on increasing the intensity of knowledge incorporation in the agricultural, forestry and marine sectors.	▪ Support for Collaborative R&D Projects involving companies in the area of TOT with complementary investment demands in digital technologies, defence and maritime surveillance. ▪ Interface Organisations and Collaborative Platforms: support to Interface Centres and COLAB with projects encouraging the use of TOT in the agriculture, forestry, sea, defence and maritime surveillance sectors. ▪ Technology Transfer Collective Actions - promotion of TOT diffusion in the agriculture, forestry, sea, defence and maritime surveillance sectors. ▪ Collective Efficiency Strategies: support for the involvement of the MAR, AGROFOOD, Vine & Wine and Forestry Industries Clusters, AED, TICE and Engineering & Tooling.	▪ Financial and Tax Incentives for Business R&D with strong emphasis on support for Proof of Concept, agriculture and intelligent forestry projects. ▪ Support for scientific and technological employment in enterprises.	▪ Technology-based Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and Technological Services Market - support for structuring public projects in the area of forest and smart land management. ▪ Support for Demonstrator and Pilot Projects of TOT-based enterprise technology services to support agriculture, forestry, smart planning and maritime surveillance.	▪ Support for insertion in international networks, programmes and projects - with emphasis on support for participation in Horizon Europe and the participation of national companies in European programmes for defence and marine surveillance. ▪ Financial Incentives for Internationalisation.
Valorisation of natural resources	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer. ▪ Collective efficiency strategies.	▪ Financial and fiscal incentives for business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial instruments.	▪ Financial instruments for investment. ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective actions for internationalisation.
Marine exploration technologies	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Support for Collaborative R&D Projects. ▪ Technology transfer class actions. ▪ Collective efficiency strategies.	▪ Financial and fiscal incentives to Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ FDI attraction.	▪ Support to Demonstrator and Pilot Projects	▪ Support for insertion in international networks, programmes and projects.
Intelligent navigation and logistics	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer. ▪ Collective Efficiency Strategies.	▪ Financial and fiscal incentives for business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes; ▪ Financial instruments.	▪ Financial instruments for investment; ▪ Innovative Public Procurement of Technological Services; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects; ▪ Financial incentives for internationalisation; ▪ Collective actions for internationalisation.
Legend	Truly relevant	Relevant				

GREEN TRANSITION

Resources, Business Conditions and Demand Dynamics

One of the structuring aspects of the "green transition" is its direct alignment with policies, strategies and targets assumed at national and European level, which may also act as a catalyst for some demand dynamics.

In this context, the European Green Pact (EEP) stands out, establishing a vision for 2050 of a prosperous and carbon-neutral Europe, where economic growth is decoupled from resource use. And sets out investments and instruments to, among other objectives, boost resource efficiency through the transition to a clean and circular economy, invest in environmentally friendly technologies, support industrial innovation, deploy cleaner, cheaper and healthier forms of public and private transport, decarbonise the energy sector and ensure increased energy efficiency of buildings), as well as a new Circular Economy Action Plan, which sets out objectives and strategies to increase the sustainability of products, empower consumers, focus action on the most resource-intensive sectors with the greatest potential for circularity (focusing on electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings and food) and reduce waste production.

At a national level, we highlight the Action Plan for the Circular Economy in Portugal 2017-2020 (which defined the need to establish sectoral agendas for the built environment, public procurement, tourism, textiles and footwear and retail and distribution, as well as the focus on industrial symbioses, circular cities and circular businesses), and the Thematic Agenda for Research and Innovation Circular Economy (which also identifies as pillars of transition and opportunities the design of new products, processes and services, the sustainable management of resource cycles, new business models, behaviour and consumption and governance and territory).

On the other hand, within the scope of energy transition and decarbonisation, it is important to highlight the National Energy and Climate Plan (PNEC 2030), which establishes as targets for 2030 the reduction of CO_2 emissions by about 45-55% compared to 2005, a 35% reduction in primary energy consumption, a 47% share of renewable energies in gross final consumption by 2030, including sectoral targets of 80% renewables in electricity (focusing on solar and onshore/offshore wind, solar thermal geothermal and wave technologies, distributed generation, storage and optimisation of transport and distribution networks), 20% in transport (focusing on sustainable and electric mobility, decarbonisation of energy consumption, strengthening of public transport and modal interconnection and promotion of advanced biofuels and hydrogen, and 49% in heating and cooling (focusing on biomass, high-efficiency cogeneration, renewable gases, heat pumps and solar thermal).

In turn, the National Strategy for Hydrogen (EN-H2) sets concrete goals to boost the supply and consumption of hydrogen in the various sectors of the economy, creating the necessary conditions for a true hydrogen economy in the country, namely to reach in 2030 a share of 5% in final energy consumption, 5% in road transport consumption, 5% in industrial consumption, 15% injected into natural gas networks and the creation of 50 to 100 hydrogen filling stations. Also, the Roadmap for Carbon Neutrality 2050 defines relevant objectives for the specialisation rationale, namely the reduction of 90% of emissions in 2050 (compared to 2005).

These benchmarks also identify that, within the energy system, transport and the power sector have the greatest decarbonisation potential in the 2020-2030 decade, with more intense decarbonisation expected in the buildings sector in the 2030-2040 period and in industry in the 2040-2050 decade.

In this scope and as regards identified assets with valorisation potential supported by critical mass of competences, scientific and technological infrastructures and non-technological conditions in Portugal (especially, but not limited to, the value chains or activity sectors of construction, forestry and bio-resources, agro-food, textile and fashion, metalworking, waste management, plastic, water and sea economy), the following typologies may be categorised:

- Production of advanced materials and secondary raw materials.
- Valorisation and reuse of bio-resources, waste and by-products.
- Ecodesign, energy efficiency and circularity labelling, standardisation, digitalisation and productive efficiency.
- Cities, networks and sustainable mobility.
- Renewable electricity.
- Energy and carbon efficiency.
- Technological R&D interfaces - companies, clusters and collaborative laboratories.
- Consolidated research centres in several areas of activity - inshore and offshore renewable energies (e.g. FCUL, FEUP, IST, University of Aveiro, University of Évora, University of Algarve, WAVEC), microgeneration systems (e.g. University of Aveiro), biofuels (e.g. University of Aveiro, FEUP), energy analysis, smart grids and vehicles (e.g. INESC-TEC, LNEG), energy storage (e.g. Vasco da Gama CoLab - partnership between University of Porto and EFACEC, IST), construction and demolition materials (e.g. University of Coimbra, University of Aveiro), ceramics and composite materials (e.g. University of Minho, University of Coimbra).
- Competences at the level of training and applied knowledge - PhD programmes in sustainable energy systems (FST, UCoimbra, IST, ISEG, FEUP, FCUL), in energy and bioenergy (UNOVA of Lisbon), in energy systems and climate change (UAveiro) and in environment and sustainability (CENSE).

With regard to business conditions, the main aspects are identified (by subdomains) from the perspective of transformation dynamics:

In the circular economy, there is knowledge and capabilities for creating new materials and processes, as well as (and no less relevant) for improving and optimising existing assets. Some of these dynamics have been explored by companies and other consolidated entities in the market to diversify their activities and/or to optimise their products and services (e.g. Jerónimo Martins Group, SONAE, Corticeira Amorim, AdP Group, GALP Energia, LIPOR, Vilartex, Interface, LNEC, LREC Azores, LREC Madeira), as well as giving rise to start-ups (e.Fibernamics, To-Be-Green, Feltrando, Fruta Feia Cooperative), often supported by entrepreneurial support ecosystems (mainly through incubation mechanisms and strategic and organisational support promoted by interface entities of higher education and research centres). There are business stakeholders with maturity and capacity for transformative intervention (e.g., in the forestry, agro-food and construction sectors) to explore and apply new technological developments and opportunities for industrial symbioses (e.g., Navigator, Altri, GYPTEC Ibérica - Gessos Técnicos, Grupo

Soja de Portugal). The development and application of the identified assets (if duly supported by adequate normative, investment and scale contexts) have potential and capacity not only for the internal market, but also to be competitive at an external level.

As for renewable electricity, there are several national companies (and also foreign companies operating in Portugal) consolidated (e.g., EDP Renováveis, EDA Renováveis (Azores), EEM (Madeira), DST, Coopérnico - Cooperativa de Energias Renováveis, Iberdrola. Solar and onshore wind energies are already able to be competitive in terms of cost. There are business conditions to invest in marine energy in the medium term (although with some constraints in the short term - such as costs and licensing processes). As far as Hydrogen is concerned, there is potential in terms of business conditions, but its competitiveness will depend a lot on the evolution of production costs.

For sustainable mobility there are domestic and foreign companies prepared to meet the demand for electric mobility. The issues of storage and the density and accessibility of filling stations are critical for sustainable mobility (hydrogen/electricity). There are consolidated companies that have invested in technological development to optimise their performance and the reduction of operating costs, and there is potential for new business models and "national stars" in the sector (e.g., hydrogen transport companies, largest producer of bicycles in the European Union).

Smart cities and smart grids have energy services and circularity companies with the potential to scale solutions, the capacity for micro- and medium-scale solutions and the ability to provide components and services to integrate the systems.

Energy and carbon efficiency has significant potential in the area of urban regeneration/renovation and building efficiency (with interconnection to the circular economy). It has potential for industrial efficiency and articulation with Economy 4.0 solutions, knowledge and pilot projects to explore technologies and methods for carbon capture, storage and use, both applied to territories and economic activities (e.g. cement factories, refineries), through synergies between companies and research centres (e.g. REPSOL; STRATEGY CCUS project, with a partnership between CIMPOR, the General Directorate of Energy and Geology, U Évora and UNL). However, there are constraints in leveraging the capacity and competitiveness of the business fabric in the development and commercialisation of solutions in this area, namely in terms of standardisation and homologation.

Sustainable agriculture and forestry identify knowledge and capabilities (e.g., in collective efficiency structures - such as clusters and CoLab - to act in this area, including in the mobilization of available technology to provide services and applications). However, it has constraints in leveraging the capacity and competitiveness of the business fabric in the development and commercialisation of solutions in this area, namely the issue of forest and rural fires (which destroy assets and condition the security and stability of investments).

Specialisation Rationale

The scope of the Green Transition Priority Area is defined on the basis of the potential of technological and organisational developments associated with circularity, material and energy efficiency and the decarbonisation of the economy, seeking to leverage a development based on the transition to a regenerative socioeconomic model that is environmentally efficient, economically viable and socially equitable, decoupled from the use of resources and tending towards carbon neutrality, in accordance with the ambitions assumed in national and European policies until 2050.

This context is simultaneously determined by the aforementioned opportunities for developing technological and organisational solutions and, on the other hand, by the sectors of economic activity with the greatest potential for applying them.

Having an eminently transversal nature, and being fully aligned with European policies and opportunities, this Priority Area offers the national economy interesting opportunities to boost business in different dimensions (both in the optimization of existing activities, and in the creation of new niches of activity for companies already installed or in the creation of new business models and new companies), in any case with better conditions of competitiveness and adaptation to climate, economic and social change scenarios.

The implementation of this vision will require a set of changes in the production specialisation model that creates effective conditions for circularity (from the reorganisation and redefinition of production planning (e.g. product design), to material, energy and carbon efficiency of production processes, and the recirculation of by-products and materials), focusing on the management of natural resources, production modernisation and efficiency, sustainability of materials and territory(ies), and energy efficiency and security.

VISION

Exploring opportunities for the development and application of innovative solutions that contribute to the transition to a competitive and carbon neutral socio-economic system, through a more circular economy that promotes material, energy and carbon efficiency, productive efficiency and sustainability of the territories.

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[17] , which define priorities and policies that impact, at various levels, on the sectors of society and economy targeted by the strategies for a smart specialisation, recommends an alignment analysis exercise between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could be verified between the "Green Transition" Priority Area and the different agendas.

Table 15. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "People first: better demographic balance, greater inclusion, less inequality". ▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development". ▪ Thematic agenda "Climate transition and resource sustainability". ▪ Thematic agenda "An externally competitive and internally cohesive country".
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo ▪ RSSS Algarve ▪ RSSS Azores ▪ RSSS Madeira
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Research and Innovation on "Agri-Food, Forests and Biodiversity". ▪ Thematic Agenda for Research and Innovation on "Climate Change". ▪ Thematic Agenda for Research and Innovation on "Urban Science and Cities for the Future". ▪ Thematic Agenda for Research and Innovation on "Circular Economy". ▪ Thematic Agenda for Research and Innovation on "Industry and Manufacturing". ▪ Thematic Agenda for Research and Innovation on "Sustainable Energy Systems".
Competitiveness Clusters	▪ AEC Cluster - Architecture, Engineering and Construction ▪ AED Cluster Portugal ▪ Portuguese Railway Platform Cluster ▪ TICE.PT ▪ Footwear and Fashion Cluster ▪ Mineral Resources Cluster of Portugal ▪ Petrochemicals, Industrial Chemistry and Refining Competitiveness Cluster ▪ Sustainable Habitat Cluster ▪ Smart Cities Cluster Portugal ▪ Textile Cluster: Technology and Fashion ▪ Engineering & Tooling Cluster ▪ Portuguese AgroFood Cluster ▪ PRODUTECH - Production Technologies Pole ▪ Collective efficiency structures of the Azores Autonomous Region ▪ Collective efficiency structures of the Madeira Autonomous Region
European Policies, Programmes and Strategies	▪ Cohesion Policy 2021-2027 ▪ Recovery and Resilience Plan
Horizon Europe Clusters	▪ Health. ▪ Civil Security for Society. ▪ Digital, Industry and Space. ▪ Climate, Energy and Mobility. ▪ Food, Bioeconomy, Natural Resources, Agriculture and Environment.
Other	▪ 2030 Agenda for Sustainable Development. ▪ Biodiversity Strategy 2030. ▪ Paris Agreement on Climate Change. ▪ Plan to Achieve the 2030 Climate Goal. ▪ European Ecological Pact. ▪ Action Plan for the Circular Economy (included in the European Green Pact). ▪ Urban Agenda of the EU. ▪ European Climate Law. ▪ Action Plan for Circular Economy in Portugal 2017-2020. ▪ Regional Agendas for the Circular Economy. ▪ National Energy and Climate Plan (PNEC 2030). ▪ National Strategy for Hydrogen (EN-H2). ▪ Roadmap to Carbon Neutrality 2050. ▪ Long-term Strategy for Building Renovation. ▪ Long-term National Strategy for Combating Energy Poverty.

[17] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative activities

The scope of identification of the Transformative Activities set out in the following table took into account the participation achieved in the three workshops held, supplemented by the documentary analysis.

Table 16. Transformative Activities of the PA Green Transition

Transformative Activity	Description
Circularity	Design and implementation of technological and social solutions that facilitate the operationalization of circular models and the promotion of a sustainable bioeconomy with applications in value chains such as construction, forestry, agro-food, waste management, plastics or the marine economy.
Adaptation to climate change and sustainable exploitation models	Adaptive transformations to climate change and development of sustainable models of agriculture and forest exploitation.
Decarbonised industrial production	Development and implementation of technologies and production systems with a lower carbon footprint, encompassing the optimisation of industrial activities and infrastructures, the integration of thermal storage solutions and the capture, storage and management of carbon use.
Decarbonised cities and territories	Integrated and systemic solutions for the decarbonisation of urban structures at various levels, integrating technological, digital, social, cultural, planning and territorial governance solutions in communities.
Innovative production, management and monitoring systems for Water and Energy	Valorisation of endogenous resources such as water and energy, promoting research and innovation in production, management of use and monitoring of networks, facilitating the interconnection, efficiency and complementarity of systems.
Energy storage	Development and application of new materials, technologies and systems for more efficient energy storage, enhancing reliability and penetration of renewable energies and energy transition.

Policy-mix - **Policy instruments to be mobilised by transformative activity**

Table 17. Transformative Activities Model vs. Instruments

Areas of Intervention / Transformative Activities	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in enterprises	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services Market	Support to Demonstrator and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and projects	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
Circularity	■	■	■	■	■	■	▪	■	▪		▪	■	▪	■	■	■	■	■
Adaptation to climate change and sustainable exploitation models	■	■	■	■	■	■	▪	■	▪		▪	■	■	■	■	▪		
Decarbonised industrial production	■	■	■	■	■	■	▪	■	■	■	■	■	▪	■	■	■	■	■
Decarbonised and circular cities and territories	■	■	▪	▪	▪		■	▪	■		▪	■	■	■	■	■	■	■
Innovative production, management and monitoring systems for Water and Energy	■	■		■	■		■	▪	■	■	▪	■	■	■	■	■	■	■
Energy storage	■	■		■	■		■	▪	■	■	▪	■	■	■	■	■	■	■

■ Very relevant ▪ Relevant

Table 18. Model Transformative Activities vs. Intervention Areas with the Instruments in the matrix boxes

	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
Circularity	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms. ▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer. ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective Actions for Internationalisation.
Adaptation to climate change and sustainable exploitation models	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms. ▪ Support for Collaborative R&D Projects. ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects.
Decarbonised industrial production	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms ▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer. ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective Actions for Internationalisation.
Decarbonised and circular cities and territories	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms. ▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective Actions for Internationalisation.

Innovative production, management and monitoring systems for Water and Energy	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective Actions for Internationalisation.
Energy storage	▪ Support for advanced training. ▪ Support for S&T units and projects.	▪ Support for Collaborative R&D Projects. ▪ Collective Actions for Technology Transfer.	▪ Financial and Tax Incentives for Business R&D. ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes. ▪ FDI attraction. ▪ Financial Instruments.	▪ Financial Incentives for Investment. ▪ Innovative Public Procurement and the Technology Services Market. ▪ Support for Demonstrator and Pilot Projects. ▪ Collective Actions for Qualification.	▪ Support for insertion in international networks, programmes and projects. ▪ Financial incentives for internationalisation. ▪ Collective Actions for Internationalisation.
LEGEND	**Truly relevant**	**Relevant**				

HEALTH, BIOTECHNOLOGY AND FOOD

Resources, Business Conditions and Demand Dynamics

In few areas, such as "Health, Biotechnology and Food", research and innovation play such a key role. This is understandable, of course, because of the results that new products, processes or services can bring in terms of health, longevity and quality of life of people and populations - in addition to the added value for the economy.

Within the national research and innovation ecosystem, the fields of Health, Biotechnology and Food stand out due to the density, quality, productivity and internationalisation of their universe of stakeholders. In fact, the map in Portugal shows an incredibly considerable number of R&D Units, Associated Laboratories, Research Infrastructures, Technological Interface Centres, Collaborative Laboratories and Competitiveness Clusters in the domains in question[18] . In terms of quality, in the case of the R&D Units, for example, these have been evaluated very positively by independent international evaluation panels, with a considerable number being classified as Excellent or Very Good[19] . In terms of scientific production, the medical and health sciences deserve to be highlighted, with a growth of around 10% per year over the last decade, and currently representing close to 30% of Portuguese publications, with around half of the publications with international co-authorship[20] .

At the base of this success is a high-quality higher education system, responsible for the training, every year, of thousands of qualified professionals in areas such as medicine, nursing, therapy and rehabilitation, diagnostic and therapeutic technologies, biomedical sciences, pharmaceutical sciences, nutrition sciences, biomedical engineering and biotechnology, among others.

A positive evolution in terms of R&D investment has been observed among business entities operating in the Health, Biotechnology and Food areas, which is reflected, for example, in the frequent presence of these companies in the SNSTP rankings, especially pharmaceutical companies, which are also among those employing the most PhD holders, namely in R&D activities[21] .

The national Healthcare value chain essentially comprises, in productive terms (industrial production), activities linked to the pharmaceutical/biotechnology and medical technologies/medical devices industries. Upstream, in addition to R&D activities, are the manufacture/supply of raw materials and components - including areas such as chemistry, polymers, fine metalworking, moulds, textiles, ICT and nanotechnologies. Downstream, there are the distribution and wholesale and retail of health products, as well as human health activities - including establishments providing care and complementary health services.

Portuguese companies are internationally recognised for the quality of their products and services and for their ability to develop, manufacture and supply a wide range of solutions, with a high degree of flexibility. On the other hand, the existing business base is still, in its entirety, relatively dense and, in certain areas of activity, still focused on products with a lower degree of technological incorporation

OBJ, *ANI, ANI*

[19] *Results of the Evaluation of R&D Units 2017/2018, DGEEC*

OBJ, *DGEEC, DGEEC*

OBJ

and added value - for example, generic drugs or mass consumption medical devices. Its future evolution may present different dimensions depending on the stage of development and the specific conditions of each activity. In some cases, there is a need for consolidation and growth of the core of existing companies, while in other cases the challenges focus on new entrepreneurship in emerging segments, in addition to the challenge of attracting external entrepreneurial initiative. Among the core industrial activities in Health in Portugal, the pharmaceutical/biotechnology area stands out, both in terms of industrial production, GVA and exports. In 2019, Portugal exported more than 1,570 million euros in health goods (2.63% of Portugal's total export value), with around 80% corresponding to products in the pharmaceutical industry - making Portugal the 30th largest exporter of pharmaceutical products in the world[22] .

[22] *GVA and Exports from the Health sector, by type of product (thousand euros), INE/AICEP*

Specialisation Approach

Health is a universal concept, which crosses history and societies. As a socio-economic domain, Health also assumes a significant relevance in the modern world, positively dragging along other related and/or tributary domains, among which (niches of) Biotechnology and Food stand out.

Within Health, an industry that has been deserving special attention in recent times has been, precisely, Biotechnology - Biotechnology for Health or Bio-Health.

In Portugal, there are multiple strategic vision documents that propose the channelling of investment into the areas of Biotechnology and Life Sciences in a logic that "allows Portugal to position itself as a centre for Research and Development - Portugal as a Hub for R&DT in Biotechnology and Life Sciences - and as a strategic pillar of production capacity in the EU - Portugal as Europe's Factory for Health, reinforcing the EU's autonomy and resilience to disruptions in global distribution chains."[23]

The connection between Food and Health has also been receiving growing attention, both from a scientific and socio-economic point of view. "The current increase in awareness of the role of food in health and quality of life has stimulated research into genetic resources with added nutritional value, including endogenous and under-exploited national resources, and encouraged the creation of new functional food solutions with a positive impact on consumer health".[24]

In line with the major global and national agendas that pursue goals of greater health and quality of life for people, as well as a more competitive and resilient economy, the NSSS's focus on a Priority Area that brings together "Health, Biotechnology and Food" will be the basis for the virtuous and synergistic transformation of these three areas of activity in which Portugal brings together, albeit asymmetrically, substantial knowledge assets and business conditions, and whose demand dynamics - internal and global, current and future - increasingly imply that these areas intersect and complement each other, enhancing the development of innovative products, processes and services that incorporate more knowledge and technology, in the areas of medicine, medical technologies and digital health, and healthy food. This will involve, on the one hand, stimulating the production and convergence of scientific knowledge in multiple fields (life and health sciences, pharmaceutical sciences, biotechnology, chemistry and materials sciences, food sciences, and computer and information sciences) and, on the other hand, promoting its increasing transfer to the entrepreneurial and business fabric, while at the same time encouraging the qualification of people and organisations, improving context conditions, and stimulating demand. The resulting transformation will result in more innovative, robust and resilient organisations and value chains that are more competitive internationally and generate greater added value.

The definition of a Priority Area dedicated to "Health, Biotechnology and Food" appears, therefore, as a more than justifiable, highly desirable scenario, as it contradicts the usual siloed vision of these three so relevant and closely linked areas - in this context, Health may be seen as the core element of this Priority Area, to which also converge Biotechnology for Health and Food for Health. Thus, the term Health can be interpreted in the broadest sense, as a socio-economic objective, which also encompasses Biotechnology for Health and Food for Health.

OBJ

[24] R&I Agenda on Agri-Food, Forests and Biodiversity

VISION

Portugal as an international hub in R&I and a reference of quality and competitiveness in the manufacture of innovative products and the provision of innovative services in the areas (intersections and divergent technologies) of Health, Biotechnology and Food.

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[25] , which define priorities and policies that impact, at various levels, on the sectors of society and the economy targeted by the strategies for a smart specialisation, recommends an exercise of alignment analysis between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could be verified between the Priority Area "Health, Biotechnology and Food" and the different agendas.

Table 19. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development". ▪ Thematic agenda "People First: a better demographic balance, greater inclusion, less inequality".
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo ▪ RSSS Algarve ▪ RSSS Azores ▪ RSSS Madeira
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Health Research and Innovation, Clinical and Translational Research. ▪ Thematic Agenda for Research and Innovation in Agri-Food, Forests and Biodiversity. ▪ National Roadmap for Research Infrastructures 2020.
Ministry of Health/DGS	▪ National Health Plan. ▪ National Programme for Prevention and Control of Infection and Antimicrobial Resistance - PPCIRA. ▪ National Programme for the Promotion of Healthy Diet - PNPAS. ▪ National Health Information Ecosystem Strategy - ENESIS 20-22.
Competitiveness Clusters	▪ Health Cluster Portugal. ▪ Cluster TICE.PT. ▪ Portuguese Sea Cluster. ▪ Portuguese AgroFood Cluster. ▪ Sustainable Habitat Cluster. ▪ Smart Cities Cluster. ▪ Textile Cluster: Technology and Fashion. ▪ Engineering & Tooling Cluster.
Sustainable Development Goals UN	▪ SDG 2 | Zero Hunger. ▪ SDG 3 | Good Health and Well-being.
European Policies, Programmes and Strategies	▪ EU4Health. ▪ Pharmaceutical Strategy for Europe ▪ European One Health Action Plan against AMR ▪ Food 2030 ▪ Farm to Fork Strategy ▪ ESFRI Roadmap ▪ Cohesion Policy 2021-2027 ▪ Recovery and Resilience Plan.
Horizon Europe Clusters	▪ Health Food, Bioeconomy, Natural Resources, Agriculture and Environment
Horizon Missions Europe	▪ A Climate Resilient Europe: Prepare Europe for climate disruptions and accelerate the transformation to a climate resilient and just Europe by 2030 ▪ Conquering cancer: mission possible ▪ 100 Climate-neutral Cities by 2030 - by and for the Citizens ▪ Mission Starfish 2030: Restore our Ocean and Waters ▪ Mission Starfish 2030: Restore our Ocean and Waters
Horizon Europe Partnerships	▪ EU-Africa Global Health ▪ Innovative Health ▪ Chemicals Risk Assessment ▪ ERA for Health Research ▪ Health and Care Systems Transformation Personalised Medicine ▪ Rare Diseases ▪ One Health/AMR Antimicrobial Resistance (AMR) ▪ Agroecology living labs and research infrastructures ▪ Animal health (PAH) ▪ Safe and Sustainable Food Systems ▪ EIT Health-KIC ▪ EIT Food-KIC

[25] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative activities

The workshops with stakeholders sought to know their opinion on how relevant are the main knowledge assets existing in Portugal in a set of areas related to "Health, Biotechnology and Food" and how relevant are these areas in/for the competitiveness and internationalisation of Portugal in the domain in question.

Table 20. Transformative Activities of the Health, Biotechnology and Food PA

Transformative Activity	Description
New medicines and derivative technologies	Development of new therapeutic approaches, namely through the creation of innovative medicines, chemically and/or biologically/technologically based, and innovative solutions and interventions in the areas of antimicrobial resistance.
Diagnostic solutions, remote technologies and data for personalised medicine	Development of medical diagnostic technologies, multifactorial integration and artificial intelligence, as well as new paradigms for response organisation, remote assistance and use of health data.
One Health solutions for public health promotion	Development of human-centric, integrated and multidimensional technologies that contribute to new models and solutions for human health, animal health and environmental health, from an individual and societal perspective.
Digital health solutions for chronic diseases and active and healthy ageing	Creative and innovative digital health solutions to support the chronically ill and/or for active and healthy ageing, in terms of inclusion and effective quality of life, remote monitoring, self-care, therapy and the adoption of personalised diets, among others.
Raw materials, novel, healthy, safe and sustainable food and personalised nutrition	Development of foods for specific medicinal purposes, functional foods and personalised diets in response to consumer awareness of food quality and safety.

Policy-Mix - Policy instruments to be mobilised by transformative activity

Table 21. Transformative Activities Model vs. Instruments

Instruments / Transformative Activities	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services	Support for Demonstration and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
New medicines and derivative technologies	Relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Relevant		Very relevant	Relevant	Relevant
Raw materials, novel, healthy, safe and sustainable food and personalised nutrition	Relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant			Relevant	Very relevant	Very relevant	Relevant		Relevant	Relevant	Relevant
Digital health solutions for chronic diseases and active and healthy ageing.	Relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Relevant		Very relevant	Relevant	Relevant
Diagnostic solutions, remote technologies and data for personalised medicine	Relevant	Very relevant	Relevant	Very relevant	Relevant	Very relevant	Very relevant	Very relevant	Relevant		Relevant	Very relevant	Very relevant	Relevant		Very relevant	Relevant	Relevant
One Health solutions for public health promotion	Relevant	Very relevant	Relevant	Relevant	Relevant	Very relevant	Relevant						Very relevant	Relevant		Very relevant		

Very relevant Relevant

Table 22. Model Transformative Activities vs. Intervention Areas with the Instruments in the matrix boxes

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
New medicines and derivative technologies	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer; ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D; ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes; ▪ FDI attraction; ▪ Financial Instruments.	▪ Financial Incentives for Investment; ▪ Innovative Public Procurement and the Technology Services Market; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects; ▪ Financial Incentives for Internationalisation; ▪ Collective Actions for Internationalisation.
New, healthy, safe and sustainable food and personalised nutrition.	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer; ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D; ▪ Support for scientific and technological employment in enterprises.	▪ Financial Instruments	▪ Financial Incentives for Investment; ▪ Innovative Public Procurement and the Technology Services Market; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects; ▪ Financial Incentives for Internationalisation; ▪ Collective Actions for Internationalisation.
Digital health solutions for chronic diseases and active and healthy ageing.	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer; ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D; ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes; ▪ FDI attraction; ▪ Financial Instruments.	▪ Financial Incentives for Investment; ▪ Innovative Public Procurement and the Technology Services Market; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects; ▪ Financial Incentives for Internationalisation; ▪ Collective Actions for Internationalisation.
Diagnostic solutions, remote technologies and data for personalised medicine.	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer; ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D; ▪ Support for scientific and technological employment in enterprises.	▪ Entrepreneurship Programmes; ▪ Financial Instruments.	▪ Financial Incentives for Investment; ▪ Innovative Public Procurement and the Technology Services Market; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects; ▪ Financial Incentives for Internationalisation; ▪ Collective Actions for Internationalisation.
One Health solutions for public health promotion.	▪ Support for advanced training; ▪ Support for S&T units and projects.	▪ Interface Organisations and Collaborative Platforms; ▪ Support for Collaborative R&D Projects; ▪ Collective Actions for Technology Transfer; ▪ Collective Efficiency Strategies.	▪ Financial and Tax Incentives for Business R&D.		▪ Innovative Public Procurement and the Technology Services Market; ▪ Support for Demonstrator and Pilot Projects.	▪ Support for insertion in international networks, programmes and projects.

SOCIETY, CREATIVITY AND HERITAGE
Resources, Business Conditions and Demand Dynamics

The Priority Area "Society, Creativity and Heritage" has as a defining element the relevance of symbolic, cultural and creative capital in innovation and differentiation of the product or service, as well as in the response to social, economic, technological and cultural transformations. Competitiveness and innovation will thus result from competitive advantages based on the valorisation of specific resources and assets, some more rooted in the territory, others resulting from cultural and creative processes.

Resources

In the construction and renewal of symbolic capital, the creative processes and contexts and artistic and cultural production are highly relevant. The Creative Industries (considering the activities usually included under this designation, namely visual and performing arts, literature, cultural heritage, architecture, film and audiovisual, books and publishing, design and fashion design, advertising, video games and entertainment software, crafts) are central to the Priority Area (DP), not only as an application sector, but also as a sector that produces knowledge and goods and services associated with creativity (in content and artistic and cultural expressions, at the level of design, communication).

In the Creative Industries, research related to the knowledge base and the production of technologies is spread across several organizations, especially those of higher education (Universities and Polytechnic Institutes). We are talking about activities within a quite comprehensive field, which includes areas of Communication Sciences, in the scientific domain of Social Sciences, Arts and History and Archaeology, in the domain of Humanities, with strong links to Information and Communication Technologies, in the domain of Engineering and Technology Sciences. This scope is translated by a simultaneous presence, in terms of research and innovation, in at least three of the thematic agendas that FST promotes, namely, Portuguese Architecture, Culture and Cultural Heritage and Cyber-Physical Systems and Advanced Forms of Computation and Communication.

In the field of Associated Laboratories and R&D units within higher education institutions, universities and polytechnics, the set of centres devoted to research areas and projects related to the various areas of activity of the creative industries is quite wide, including in the fields of culture, communication, media, languages and literature, history, arts, architecture, heritage, memories, heritage, archaeology, design, etc.

Currently, in Portugal, there is still a big gap between the academic sector and business organizations dedicated to media, content production, arts and cultural heritage. But beyond this "gap" in relation to business entities, there is also a huge distance between academic structures dedicated to research and to the transfer of knowledge and technology and public institutions that intervene in the cultural sector. In fact, in the field of creative industries and, in particular, in certain sectors of cultural activity, the presence of public and third sector agents and institutions is still quite representative. However, this gap

is manifested, not only in relation to companies, including large companies in the case of television and radio, but also to institutions of a public and non-profit nature, such as important foundations dedicated to the arts and heritage.

In the case of higher education, the development of thhigher-levelel training offer, in scientific and disciplinary areas of arts and humanities, communication sciences and information and communication technologies, has allowed a progression at the level of human resources qualification with undeniable impact in the entrepreneurial organizations and institutions of the cultural and creative sector. In this sense, it is unquestionable that there has been, at national level, a process of qualification of specific competences, not only at the level of higher education institutions, but, in parallel, in large media companies, in small and medium enterprises of the creative sectors, in artists and creatives, in organizations of the cultural sector.

As far as technological competences are concerned (computing, intelligent networks and systems, interactive multimedia, immersive environments and augmented reality, etc.), and considering that the creative industries are technology-intensive, and in particular digital technologies, there is a high deficit for a large majority of organisations in the sector, especially in cultural and artistic segments (such as music, dance and theatre, literature, among others).

Thus, the potential for cooperation and collaboration between research centres and organizations in the sector, institutional and business, is enhanced through the skills of sector professionals, despite the more general gap in digital skills.

With regard to non-technological resources, namely associated with the territory and owned or managed predominantly by organisations in the sector of tangible and intangible cultural heritage (including museums, archives and libraries), there has been a huge bottleneck in terms of the ability to integrate these assets into other spheres of the creative industries (content production, media, etc.) and other sectors, including tourism, associated with low investment in the digitisation of these assets. It is desirable that the main research and technology centres may open more frequent opportunities for partnership with the holders of that heritage, including the public administration, national and local, foundations and other associations of cultural interest, with a view to a faster and wider process of digitization of these assets and their availability in easy access.

In Tourism, there is immense potential for creating value from the specific assets of the territory, namely by mobilising resources for supply in new tourism segments. In this framework, the territory should be seen as encompassing natural and cultural heritage, memories and social identities, as well as the "creative atmosphere" in certain cities, heritage value and memory of certain spaces that support vibrant dynamics of creation and consumption.

Portugal has good conditions to leverage the emergence and consolidation of new segments such as Creative/Experience Tourism, in which the visitor plays a very important active role and responds to the motivations of self-fulfilment, experimentation, emotional involvement and development of skills,

besides being one that can be developed, not only in large cities, but also in smaller towns and rural areas, reflecting new alternative forms of tourism based on the relationship between culture, territory and tourism. It also has great conditions to boost nautical tourism.

From the training point of view, Portugal has a good network of Schools of Hospitality and Tourism, which cover the mainland, and whose training offer includes initial certification courses with double certification, on-the-job courses and technological specialization courses, all corresponding to ISCED level IV.

Also, from the point of view of higher education, Portugal has courses in Tourism in several Polytechnic Institutes and Universities.

The creation in 2021 of the first collaborative laboratory in the tourism area - KIPT (Knowledge to Innovate Professions in Tourism).

Still, there are relevant deficits from the point of view of training and that negatively affect the tourism activity, as in the cases of the aspects associated with entrepreneurship, business models, brand management and digital marketing, internationalisation.

As for the Fashion Industries, the resumption of growth and competitiveness of the fashion sectors in Portugal in recent years is part of a recomposition of competitive advantages, based on an increasingly broad control of the value chain upstream and downstream of production, in the strict sense, as well as the refocusing of business models, based less on competitiveness via production costs, and more on the incorporation of added value via conception, design and product development, logistics and flexibility in terms of procurement, production and distribution and increased capabilities in terms of marketing, image and presence in international markets. Within the Fashion ecosystem we highlight: (i) the training and qualifications system, with the existence of a consolidated offer at the level of higher education and vocational training provided by various entities; (ii) Fashion Design, the training area with the largest offer within the training associated with Fashion; (iii) R&D and Technological Services, highlighting a marked dynamism of business R&D and the existence of Competence Centres in various technological fields, with research and development and innovation functions, as well as providing technological services (CITEVE, CTCP, CENTI); (iv) External Promotion and Events, highly leveraged by the programmes aimed at supporting and promoting the internationalisation of companies, especially targeted at SMEs, which mainly involve participation in international fairs and prospection visits or trade missions to referenced markets, and participation in national events promoting the fashion sector. The role of associations and entities of the fashion sector is particularly relevant in the development of internationalisation actions of collective nature, as well as fashion events in Portugal. Among these associations are CENIT, ANIVEC, ATP, ASM, CITEVE, APPICAPS, AORP, or associations of general scope such as ANJE.

From the point of view of resources and assets, and across the various sectors, the following aspects should be highlighted:

- The need for further research on demand trends, which are changing significantly, particularly in the tourism and fashion industries. Similarly, the need for further research into business models.
- In the field of training, gaps to be filled in training for entrepreneurship and business models, for digital transformation and technologies, for sustainability, for marketing and communication, namely digital marketing and brand management, and for internationalisation.
- The centrality of design competencies.
- The relevance of interface organisations and collaborative-type networks and platforms, involving research units, organisations exploring technological opportunities and developing technologies, and end-users. At this level, the main deficits are in the Creative Industries.

Business conditions

Considering the current structural profile of the national economy, the PA proposed refers to activities with a particularly important economic relevance, being Tourism and Fashion Industries (Textile, Clothing, Footwear, Goldsmithery and Jewellery) consolidated economic activities with a strong export contribution. Furniture and Decoration, as well as Wine, also stand out in terms of economic relevance and growing internationalisation.

The Creative Industries have a more limited nature, especially in terms of the tradable goods economy, but with high growth potential in activities such as design, architecture, advertising, audiovisual and multimedia content, video, computer games, music, etc. We are talking about a very heterogeneous sector, whether in terms of the typology of its agents, business, public administration and third sector (non-profit), the size of organizations, business or third sector, the respective business models, and the cross effects of these various differences in matters such as consolidation and qualification of activities, internationalization, attraction of foreign direct investment, innovation capacity.

In terms of number of companies, the creative industries sector (considering the delimitation established by NIS in the Culture Statistics, according to the European Satellite Accounts for Culture) has had a growing dynamic in the last five years (variation between 2015 and 2019 of 16.3%, with a total of 9148 companies) and represents 5% of the total number of companies in the national economy, with a total of 65,175 companies in 2019. Within the creative industries, the most representative sub-sectors / segments (greater than 10%) in terms of number of companies are, in descending order of percentage in total, Theatre, Music, Dance and other artistic and literary activities (38.1%), Architecture activities (14.2%) and Design activities (10.7%). Motion picture, video and television programme production activities only represent about 4.5% of the total companies, while Radio Activities and Television activities represent respectively 0.4% and 0.1% of the total companies in the sector and Sound Recording and Music Publishing activities represent about 0.6% of the total.

The media segment (which includes, broadly speaking, radio activities, television activities, news agency

activities, publishing of books, newspapers and other publications) has a very important role, either as a productive sector (including the largest companies and groups of companies, with more recent and relevant impacts of business strategies of verticalisation linked namely to the sector of communication and information technologies), or as a service provider, or even in attracting FDI. The main stakeholders of the sector, which remain relatively dependent, in their business and corporate strategies, on the system and legal framework of national regulation of the media sector, do not have today a relevant role at the level of tradable goods and services, and are the main consumers of both the segment of national audiovisual and multimedia production and imports.

On the other hand, the global area of audiovisual and multimedia content production, which is much more fragmented, represents a segment with vastly distinctive characteristics, where small and micro companies predominate, as well as freelancers. Despite a close relationship with the main television operators, the national audiovisual and multimedia content production sector has, and will tend to benefit greatly, from the expansion of demand for content by these and other platforms (including OTT platforms), mainly by Internet operators, namely as an effect of the growing growth of VoD services. According to recent studies, the increased market presence of companies and services with VoD-centric business models will accentuate competition strategies based on content quality and exclusivity. This is also a trend that will favour the positioning of certain companies in this segment of national content production and that may be facilitated by the fact that the country currently has an offer of talent that is already relevant.

In terms of tradable goods, the export capacity of audiovisual production companies remains quite restricted (around half of the companies do not export and those that do export do so with small percentages of their portfolios and productions). Internationalisation is still a significant focus of these companies, although it is being done largely through co-productions, including in the European context. The audiovisual production sector, associated with interactive multimedia, represented in 2019 only nearly 10% of exports of cultural goods, with the largest share of these exports in recorded media (CD, DVD and others). The evolution of exports in the 5-year period between 2015 and 2019 is overall positive (variation between these two years of around 82%), but in the case of audiovisual and interactive media not recorded on support, this variation is relatively stable, with some sweep within the period that is recovered in 2019.

The strongest sectors of the creative industries in the production of tradable goods belong to the handicraft segment, whether the group of handmade and ornamental goods, or jewellery, followed by the group of published and printed goods (where newspapers and periodicals present the largest share of exports). While craftsmanship has maintained a positive trend in the period between 2015 and 2019, with significant growth in export volume (in value), the publishing sector presents a distinct behaviour, with a regressive trend in export volume, which is also fundamentally associated to the media segment (printed newspapers and periodicals). The latter trend reflects the transformations in the weight of

online media in these sectors.

In other segments, such as design, architecture and advertising, the business conditions are also quite diverse, with medium-sized companies alongside a sizeable number of small and micro-enterprises. These are sectors with markets, in general, with little regulation and which may be based, fundamentally, on talent and authorship, on the visibility and notoriety of their creatives, or, on the other hand, on market intervention strategies based on production capacity and technological innovation.

Another characteristic of the creative industries sector, which runs through its various segments in a more or less regular way, is related to the deficit of technological entrepreneurship and/or qualified entrepreneurship that still manifests itself in general, and that comes especially from the lack of skills developed by professionals, artists and creatives, with training courses within the areas of arts and humanities and outside the technological areas. It should be added that this situation is further aggravated by the lack of financing models or instruments that are more suitable to the profile of these agents, including venture capital.

Tourism represents a widely consolidated sector, with a significant weight in the national economy and a strong export orientation. However, it includes groups of economic activities inserted in quite different realities, which is also reflected in different basic business conditions.

The flourishing of tourism activity in Portugal in the pre-COVID 19 phase was driven, not only by the expansion of the supply of accommodation, but also by a significant increase in tourist entertainment companies.

With the arrival of the pandemic, we have witnessed an extraordinarily strong and sudden retraction in travel, both globally and nationally, with direct and immediate repercussions on the demand for services offered by tourism businesses. According to data from NIS' System of Integrated Business Accounts (which considers only companies), in 2018, the business fabric associated with tourism was made up of 45,450 companies: 82% in accommodation (BAC 55), 10% in travel agencies, tour operators and the like (BAC 78) and 8% in tourist entertainment (BAC 93293), 33,970 more units than in 2013. The overall figure reflects an average annual growth of 32% between those two years. The average annual increase was 37% in accommodation, 33% in tourist entertainment and 10% in travel agencies, tour operators and the like.

The business fabric corresponded, also in 2018, to a total of 128,144 jobs, 62,362 more than in 2013, translating an average annual increase of 14% between the two years. In terms of personnel in service, it was the tourist entertainment activities that registered the most significant growth (57% increase in average annual terms), followed by accommodation (average annual variation of 25%) and, finally, travel agencies, tour operators and the like (14%).

As for the Fashion Industries, considering BAC 13, 14, 15 and 3212 (respectively, Textile Manufacturing, Clothing Industry, Leather and Leather Products Industry and Jewellery, Goldsmithery and related articles), together the latter recorded, in 2019, a GVA of 3,290,146,999 €, representing 14.4% of the GVA of the Manufacturing Industry and 3.2% of the GVA of the entire business sector covered by the System

of Integrated Business Accounts (NIS). According to the same source, for the same sector, and in the same year, the Fashion Industries had 187,570 employees, representing 25.2% and 4.5% of the employees of the Manufacturing Industry and the total business sector, respectively.

Also in 2019, considering sections XI (Textiles and textile articles), XII (Footwear and other...) and XIV (which mainly includes jewellery and goldsmithery) of the Combined Nomenclature, the Fashion Industries ensured 7,421,261,393 euros of exports, representing 12.4% of the country's total exports of goods.

Apart from the industrial activities mentioned above, the fashion industry also includes wholesale and retail activities as well as technical services such as design.

In recent years, except for the period affected by the COVID-19 pandemic, the fashion industry in Portugal has resumed a dynamic of robust growth in production and a positive development in terms of productivity.

As other aspects of the recent evolution of the fashion ecosystem, we highlight (i) the upgrading observed in the private label model, (ii) the continued consolidation and internationalisation of brands created or managed from large-scale distribution, and (iii) a wave of new brands associated with young designers with notoriety gained at fashion events and/or with family connections to the industry.

Private label production, with a quantitative relevance in clothing, has seen a major evolution in the last few years, driven by the presence in Portugal of big international buyers (global brands), by some loss of competitiveness of Asian producing countries, and by a remarkable improvement of Portugal's international image in terms of creativity and modernity. The "made in Portugal" became a positive differentiation factor. In terms of organisation model, and positioning in the value chain of the major international buyers, national companies operating under private label regimes are currently undergoing a significant upgrade. In addition to ensuring manufacturing with quality and short delivery times, they began to ensure the design and development of products and collections in a process of co-creation and co-design with their advanced customers. This change is allowing, not only more added value, but also a better understanding of fashion trends in international markets and the accumulation of internal skills in design and product development.

From the point of view of brand management, this new emphasis on "private label" production, while in itself positive, may have ambivalent impacts. On the one hand, it may discourage companies from producing under their own brand and specialising in private labels. Conversely, based on accumulated internal competencies and a better perception of international markets, it may encourage companies to diversify their strategy, creating and managing their own brands. In fact, there are currently several cases of companies that have decided to complement their private label activity with the creation of their own brand.

In terms of business conditions and across the different sectors, we have identified a set of common challenges:

- The unavoidable relevance of digital channels and online services as channels for promotion, sales and a more personalised relationship with customers.
- The need to promote global corporate brands or brands with international projection, as a central element of competitive repositioning in value chains and of internationalisation strategies, as well as the promotion of collective brands.
- The need to promote qualified and creative entrepreneurship in more emerging segments, namely in differentiated or specialised support services (design services, digital, marketing in general, digital marketing, brand management), as well as the need to consolidate / scale very atomised business organisations (in this case, more in the Creative Industries).
- Associated to the previous challenge, the relevance of capitalisation instruments and financial incentives adequate to the preliminary stages (creation, incubation and acceleration of business projects).
- The attraction of FDI is also a crucial element for the upgrading of business conditions in the Creative Industries with particular relevance in the Media, but also, in general, as an element of a greater insertion of companies in global value chains. This insertion can, however, have an ambivalent effect, on the one hand ensuring greater access to international markets, but, on the other, discouraging the establishment of global brands or with international projection by domestic producers.

Demand dynamics

In relation to the Creative Industries, many of the evolution trends of final consumption are especially related to the impacts of technological transformations, not only on the products and services themselves, but also on the development of business models and the organisation of stakeholders as regards the distribution and dissemination/transmission of said products. The content production segment is perhaps one of the areas where changes at the level of distribution and transmission of contents deriving from the impact of digital technologies have manifested themselves to a higher degree. Currently, with the multiplication of available platforms, and the growth of online digital content distribution, the trends towards the consolidation of a new behaviour of the final consumer of contents are clear, with a much more active position in the organisation and programming of its content visualisation. In addition to a growing trend to replace television by other non-linear platforms, with à la carte streaming services, the end consumer has more freedom to define its own programming, to select its content (contributing to a growing competition for quality), to select the platform and support (computers or smartphones) on which it watch the content and to choose when it does that viewing.
Complementarily, in these and other end-markets of cultural and creative content, in the audiovisual and digital, but also in services related to heritage, visual and performing arts, the development of the habits and forms of consumption has been conditioned by a growing valorisation that the consumer

attributes to the personal experience. This is also a trend that manifests itself very markedly in the case of tourism.

The global demand dynamics in the creative industries sector are greatly impacted by the evolution of the digital technological model and information and communication technologies, including its effect on the transformation of consumption habits and consumer needs and preferences. The dynamics in Portugal, in most segments of the creative industries, have followed these global transformations relatively more slowly.

In general terms, the dynamics of demand in the creative industries in Portugal are strongly conditioned by the small scale of the domestic market and by various constraints on exports, not only related to the sector, but also to some dimensions of public policy (regulation in the media sector, lack of incentives for the internationalisation of companies, etc.).

In the audiovisual content production segment, for cinema and television, although in a distinct manner in each of these domains, the digital transformation and the changes that the distribution/broadcast business is undergoing, may bring opportunities for companies to reach global markets. Soon, some of the greatest opportunities may be related to the expected growing national presence of these large stakeholders, which operate in multi-platforms, and particularly in mobile platforms.

Finally, it should be noted that there has been a growing demand from different national economic sectors, and at a global level, for creativity and content support, whether for product or service development, based essentially on design, or for marketing and promotion activities, mobilizing content and creativity, through audiovisual production for advertising, graphic design for brand promotion, among others. In this case, some segments of the creative industries can also benefit from a growth in demand for proximity induced by other, larger-scale, economic sectors, whether they be Fashion or Tourism, or other sectors that are more representative in the context of the national economy (food, health, biotechnology, etc.).

As far as Tourism is concerned, until 2020, it presented a dynamic global demand, tending to be segmented. With the pandemic crisis of COVID 19, tourism suffered a strong shock, both internationally and nationally.

Without losing the medium/long term vision and the trends that have already been gradually revealing themselves in the last few years, it is expected that some concepts will have a high potential for expansion. An example of this will be accessibility, strongly associated with the notion of accessible tourism, which does not discriminate tourists and is definitely focused on people. Sustainability will take on increasing importance, reflecting the growing environmental awareness of tourists, as well as a full range of initiatives at global, European and national level. The customisation of local accommodation will also gain strength. With the movement towards increased teleworking, the coexistence of tourism and professional activity will tend to grow, and a greater demand for accommodation which provides adequate conditions for work and, preferably, which also enables pleasant enjoyment of the territory in

which it is located is to be expected.

At the same time, certain tourism segments also have robust growth potential. These include Nature Tourism with new products (such as cycling, walking, among others), Industrial Tourism (jewellery, handicrafts, jewellery, among others), Literary Tourism, Nautical Tourism, Creative Tourism and Experience Tourism (favouring unique destinations, authentic, with a strong identity and in which the tourist interacts and learns intensely with local communities, developing a process of co-creation), as well as Health and Well-being Tourism.

As for the Fashion Industries, the latter have experienced high growth worldwide in the last three decades, with double-digit annual rates. But this growth was interrupted by the outbreak of the COVID 19 pandemic.

The emergence of global brands has primarily benefited companies from a small number of developed countries with a tradition in fashion (notably France, the UK, Italy and, subsequently, Spain, not forgetting, outside Europe, the USA). At the same time, it has made the management and internationalisation of brands originating from follower countries more demanding.

The COVID 19 pandemic has accentuated all the trends associated with a greater weight of digital channels in promotion, sales and distribution logistics. Conversely, it may lead to a reshoring of value chains, as a reaction to the disruptions observed during the pandemic. In the European case, the reshoring or refocusing of value chains could also be accentuated by greater consumer sensitivity to the dimensions of sustainability and social rights.

In this context, the Fashion Industries in Portugal may benefit, in the post-COVID economy, from a greater share in responding to European demand. At the same time, they will have to increasingly invest in creating and managing brands with international notoriety, and in affirming the creative and cosmopolitan environments typical of Fashion cities.

Specialisation Approach

The Priority Area "Society, Creativity and Heritage" focuses on the mobilisation of intangible dimensions, at the level of symbolic, cultural and creative capital, including intangible dimensions rooted in the territory, and their transformation into value at various stages of the value chains, from creation/design to consumption of products and services, as well as in response to social, economic, technological and cultural transformations. From this perspective, PA does not have a sectoral entry. Nevertheless, it is considered that the sectors in which these differentiating assets have the greatest weight in competitive positioning are Tourism, Fashion, Furniture and Decoration, certain segments of the Agro-Food and Creative Industries, and in the latter case, in addition to being a sector of application, these are also producers and suppliers of knowledge and technologies.

The core of the activities we most directly associate with this Priority Area (Tourism, Fashion, Creative

Industries) has the particularity of containing a high potential for synergies.

Considering the definition of the Priority Area and of the application sectors, a positive aspect of this Priority Area is its territorial coverage, namely with the potential to integrate low density territories and deprived urban areas. Likewise, in terms of coverage of knowledge areas, the potential to integrate Social Sciences and Management Sciences is highlighted.

VISION

Leveraging product and service differentiation based on symbolic, cultural and creative capital, and boosting territorial resources and assets, in response to social, economic, technological and cultural transformations

Alignment with National, European and International Priorities and Policies

The existence of both national and European/international benchmarks[26] , which define priorities and policies that impact, at various levels, on the sectors of society and economy targeted by the strategies for a smart specialisation, recommends an exercise of alignment analysis between the different agendas. The following table lists, in a non-exhaustive way, the main (potential) points of alignment that could be verified between the Priority Area "Society, Creativity and Heritage" and the different agendas.

Table 23. Alignment of Benchmarks with the Priority Area

Source	Alignment
Portugal 2030 Strategy	▪ Thematic agenda "An externally competitive and internally cohesive country ▪ Thematic agenda "Digitalisation, innovation and skills as drivers for development".
Regional Strategies for Smart Specialisation	▪ RSSS North ▪ RSSS Centre ▪ RSSS Lisbon ▪ RSSS Alentejo ▪ RSSS Algarve ▪ RSSS Azores ▪ RSSS Madeira
Thematic Agendas for Research and Innovation MCTES/FST	▪ Thematic Agenda for Research and Innovation in Culture and Cultural Heritage ▪ Thematic Agenda for Research and Innovation in Tourism, Leisure and Hospitality
Competitiveness Clusters	▪ Textile Cluster: Technology and Fashion ▪ Footwear and Fashion Cluster ▪ Tourism Cluster ▪ TICE.PT Cluster ▪ Portuguese AgroFood Cluster ▪ Vine and Wine Cluster
Sustainable Development Goals UN	▪ SDG 9 | Industry, Innovation and Infrastructure
European Policies, Programmes and Strategies	▪ Digital Europe ▪ Connecting Europe Facilities ▪ Creative Europe ▪ Cohesion Policy 2021-2027 ▪ Recovery and Resilience Plan
Horizon Europe Clusters	▪ Culture, Creativity and Inclusive Society
National Specific Agendas	▪ Internationalisation Programme 2030 ▪ Programme for the Valorisation of the Interior ▪ Programmes launched by RCM no. 106/2020, Expansion of National Breadth Projects for the Development of the Interior (EXPANDIR) and Operational Endowment of Territories and Support for Revaluation (DOT@R) ▪ National Reading Plan (PNL) ▪ National Cinema Plan (PNC) ▪ National Arts Plan (PNA) ▪ Know-how Programme (National Programme for Traditional Arts and Crafts) ▪ National Architecture and Landscape Policy ▪ Tourism Strategy 2027 ▪ Sustainable Tourism Plan 20-23 ▪ Tourism 4.0 Programme

[26] Including the measures defined in the *Common Strategy for Cross-Border Development* approved at the 21st Luso-Spanish Summit in 2020.

Transformative activities

The identification of the transformative activities of the Priority Area results from the crossing of the capacities/potential of national RDI and Production Capacity of Goods and Services vs. challenges and opportunities identified through an extended stakeholder consultation process, a participatory process that took place in thematic workshops held in late 2020. As a result of the inputs from workshop participants, 5 transformative activities were listed. The following table presents the 5 transformative activities covered by the Priority Area "Society, Creativity and Heritage".

Table 24. Transformative Activities of the DP Society, Creativity and Heritage

Transformative Activity	Description
Design activities	Promotion of design activities in all areas of specialisation (product design, fashion design, interior design, graphic and visual design, webdesign), as a transformative activity.
Brands, Marketing and Corporate, Institutional and Territorial Communication	Creation and management of corporate and territorial brands and their articulation with the set of Marketing and Corporate and Institutional Communication activities, with a view to greater awareness and differentiation of products and services and the leverage of internationalisation.
Creative, artistic and cultural processes	New forms of distribution, accessibility, diversity and mediatisation of culture and creativity, including the production of multi-platform cultural and artistic content, intensifying the relationship between higher education institutions and research centres and the ecosystem of content (audiovisual, video, music, multimedia), to enhance the development of new languages and new business models.
New segments of tourism supply and experience	Exploring the potential of new tourism supply segments associated with the enhancement of creative, cultural and heritage assets, the territory, landscape and natural resources, including attraction and capitalisation around major events, as well as responding to new consumer preferences and existing assets.

Innovative solutions for an inclusive, creative and resilient society	Actions to promote a more inclusive society, to promote cultural heritage and to respond to social, economic, technological and cultural transformations, mobilising the interdisciplinarity of social sciences and humanities for a better understanding of contemporary transformations in society, including social innovation.

Policy-mix - Policy instruments to be mobilised by transformative activity

Table 25. Transformative Activities Model vs. Instruments

Transformative Activities \ Instruments	Support for Advanced Training	Support to S&T Units and Projects	Interface Organisations and Collaborative Platforms	Support for Collaborative R&D Projects	Technology Transfer Collective Actions	Collective Efficiency Strategies	Financial and Tax Incentives for Business R&D	Support for scientific and technological employment in enterprises	Entrepreneurship Programmes	Attracting FDI	Financial Instruments	Financial Incentives for Investment	Innovative Public Procurement and Technology Services Market	Support for Demonstration and Pilot Projects	Collective Actions for Qualification	Support for insertion in international networks, programmes and projects	Financial Incentives for Internationalisation	Collective Actions for Internationalisation
Design activities	Very relevant		Relevant			Very relevant		Relevant	Very relevant		Relevant	Very relevant	Relevant		Very relevant		Relevant	Relevant
Brands, Marketing and Corporate and Institutional Communication	Relevant					Very relevant			Relevant				Relevant		Very relevant		Very relevant	Very relevant
Creative, artistic and cultural processes	Very relevant	Very relevant	Relevant		Very relevant	Very relevant	Relevant	Very relevant	Very relevant		Relevant	Very relevant				Very relevant	Very relevant	Very relevant
New segments of tourism supply and experience	Relevant					Very relevant			Very relevant		Relevant	Very relevant			Very relevant		Very relevant	Very relevant
Innovative solutions for an inclusive, creative and resilient society	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant	Very relevant								Relevant	Very relevant	Very relevant		

Very relevant

Relevant

Table 26. Transformative Activities vs. Intervention Areas Model

Areas of Intervention / Transformative Activities	Technological inputs upstream of enterprises	Technology transfer / Interfaces	Business R&D	Business resources	Innovation and Dissemination	Internationalisation
Design activities	Support for advanced training	• Interface Organisations and Collaborative Platforms ▪ Collective Efficiency Strategies	▪ Support for scientific and technological employment in enterprises	• Entrepreneurship Programmes ▪ Financial Instruments	• Financial Incentives for Investment • Innovative Public Procurement and Technology Services Market ▪ Collective Actions for Qualification	• Financial Incentives for Internationalisation ▪ Collective Actions for Internationalisation
Brands, Marketing and Corporate and Institutional Communication	Support for advanced training	▪ Collective Efficiency Strategies		▪ Entrepreneurship Programmes	• Innovative Public Procurement and Technology Services Market ▪ Collective Actions for Qualification	• Financial Incentives for Internationalisation ▪ Collective Actions for Internationalisation
Creative, artistic and cultural processes	• Support for advanced training ▪ Support for S&T units and projects	• Interface Organisations and Collaborative Platforms ▪ Collective Efficiency Strategies	• Financial and Tax Incentives for Business R&D ▪ Support for scientific and technological employment in enterprises	• Entrepreneurship Programmes • Attracting FDI ▪ Financial Instruments	• Financial Incentives for Investment ▪ Innovative Public Procurement and Technology Services Market	• Support for insertion in international networks, programmes and projects • Financial Incentives for Internationalisation ▪ Collective Actions for Internationalisation
New segments of tourism supply and experience	▪ Support for advanced training	▪ Collective Efficiency Strategies		• Entrepreneurship Programmes ▪ Financial Instruments	• Financial Incentives for Investment ▪ Collective Actions for Qualification	• Financial Incentives for Internationalisation ▪ Collective Actions for Internationalisation
Innovative solutions for an inclusive, creative and resilient society	▪ Support for advanced training ▪ Support for S&T units and projects	▪ Interface organisations and collaborative platforms ▪ Collective efficiency strategies			▪ Collective Actions for Qualification	▪ Support for insertion in international networks, programmes and projects

IV - ARTICULATION WITH REGIONAL STRATEGIES FOR SMART SPECIALISATION

The management and operationalization of a multi-level model presents various challenges and complexities and therefore special relevance was given to the stabilisation of a rationale that, within the scope of entrepreneurial discovery processes, would contribute to the NSSS review process to promote the strengthening of complementarities between the thematic priorities of national nature and those of the regional nature identified in the assessment of the Strategies for Intelligent Specialisation, namely by enhancing the coherence and complementarities of the priorities of national and/or regional framework and avoiding overlaps (if undesirable).

In order to facilitate this multi-level articulation, already in the preparatory work of the NSSS 2030, the regions were involved through the informal Multi-Level Working Group, created by the National Innovation Agency, in line with the proposal presented at the NSSS Coordinating Council meeting of 20 September 2017, involving the 7 NTUS II regions of Portugal, as well as the Agency for Development and Cohesion, IP. The methodological approach to the process of reviewing the strategies for smart specialisation also involved the preparation of reference documents (concept notes) to support the regions in developing the RSSS and making approaches and language compatible.

The following table summarises the alignment between the Priority Areas of the NSSS 2030 and the priorities defined in the Regional Strategies for Smart Specialisation of the 7 Portuguese regions for the period 2021-2027, observing a greater intensity of alignment the darker the colour of the intersection.

Table 27. Alignment between the NSSS 2030 Priority Areas and the Regional Smart Specialisation Strategies

NSSS 2030	S3 Norte		S3 Centro		S3 Lisbon		S3 Alentejo		S3 Algarve		S3 Azores	S3 Madeira	
Digital Transition	Technologies, State, Economy and Society	Industrialisation and Advanced Manufacturing Systems	Materials, Tooling and Production Technologies	Digital Technologies and Space	Digital Transition	Higher Education	Digitalisation of the economy		Digitalization and ICT		Digital Transformation and Economy 4.0	Digital Technologies and Economy 4.0	
Materials, Systems and Production Technologies	Industrialisation and Advanced Manufacturing Systems		Materials, Tooling and Production Technologies	Digital Technologies and Space	Digital Transition	Higher Education	Sustainable Bioeconomy						
Green Transition	Sustainable Mobility and Energy Transition		Natural Resources and Bioeconomy	Energy and Climate	Transport and Mobility	Higher Education	Sustainable Energy	Mobility and Logistics	Environmental Sustainability		Circular Economy, resources and territory	Environment, Climate Action and Geo-biodiversity	Circular Economy, Energy Transition, Resources and Territory
Health, Biotechnology and Food	Life and Health Sciences	Agri-Environmental Systems and Food	Health and Wellness	Natural Resources and Bioeconomy	Health	Agri-food	Social Innovation and Citizenship		Health, Wellness and Longevity	Endogenous Land Resources	Agriculture and Agro-industry	Quality of life and social challenges	Health and Wellness	Agriculture, Food
Society, Creativity and Heritage	Creativity, Fashion and Habitats	Territorial Assets and Tourism Services	Culture, Creativity and Tourism		Cultural and Creative Industries	Tourism and Hospitality	Cultural and Creative Ecosystems	Tourism and Hospitality Services	Tourism	Creative and Cultural Industries	Tourism and Heritage	Tourism	
Great Natural Resources: Forest, Sea and Space	Agri-Environmental Systems and Food		Digital Technologies and Space		Blue Economy	Transport and Mobility	Sustainable Bioeconomy	Mobility and Logistics	Economy of the Sea		Space and Data Science	Atlantic Dynamics and Geostrategy	Marine Resources and Technologies
	Resources and Economy of the Sea		Natural Resources and Bioeconomy		Higher Education				Endogenous Land Resources		Sea and Blue Growth		
Legend	**Partial**	**Comprehensive**	**High**										

V - MONITORING AND EVALUATION

Currently, the model of innovation policy design tends towards an increasingly "evidence-based" model, which questions traditional approaches and their effectiveness. The NSSS is, in itself, an attempt to change the way strategy is designed, resources are allocated, and policies are managed.

In this revision, monitoring and evaluation have greater importance, reflected in an updated monitoring system with the need to combine qualitative and quantitative analysis.

In the scope of the Interreg Europe Monitor RIS3 project, ANI was challenged to develop an adequate monitoring and evaluation system for the smart specialisation model, characterising the levels of change and transformation targeted in the dimensions of governance and process, operational, strategic and structural change, as well as in different time horizons of short, medium and long term. In this sense, ANI composes a system based on 4 pillars of analysis assumed as reference among several of the participating regions, comprising:

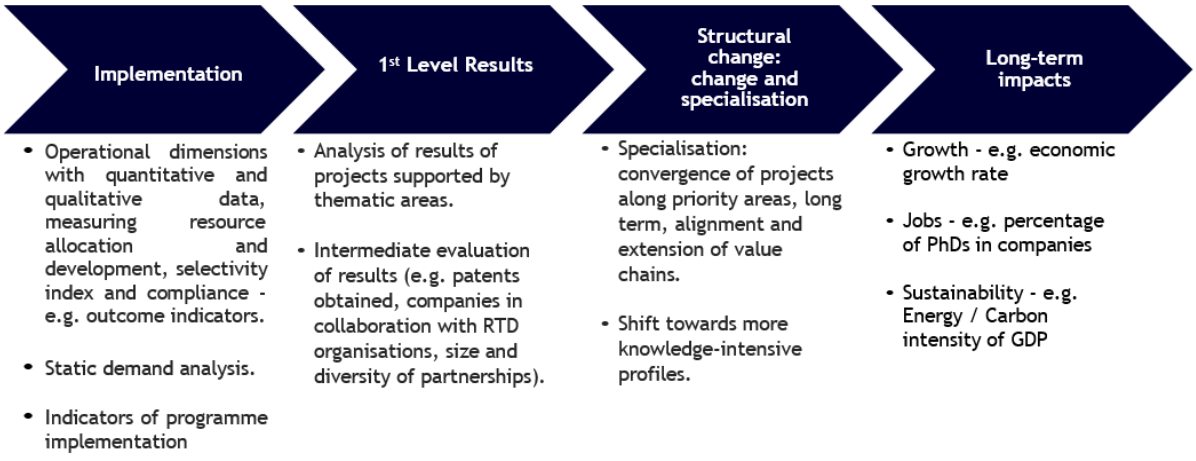


Figure 6. Monitoring and evaluation system

In the governance and process (implementation) dimension, the monitoring and evaluation system should reflect the activities developed by the public stakeholders, namely as regards the active participation of players in the process of strategy formulation and of defining the focus of policy instruments. Governance also includes the monitoring of a particularly sensitive dimension, such as the interconnection of policy instruments and strategies in multi-level models, namely the articulation between European, national and regional priorities, as well as the promotion of synergies and the convergence of instruments around the rationales of smart specialisation. It is also essential to monitor how the strategies are translated, normatively, and how they impact on the design and implementation of public policy instruments, being particularly relevant to assess the suitability of these instruments to each of the Priority Areas (including identifying potential gaps and/or misalignments). Complementarily, reports will be prepared by Priority Area that reflect the participatory dynamics of the stakeholders and allow inferences to be made as to the need to revise the strategy and policy-mix.

Implementation

GOALS	INDICATORS
1 Selectivity: ensure concentration in the allocation of resources to projects within the NSSS/RSSS. Effectiveness of selection: degree of discrimination provided by the NSSS/RSSS.	▫ Share of supported covered.
2 Demand analysis: proxy for the assessment of the existence of critical mass and demand trends, inferring the need for adjustments in the areas.	▫ Cumulative distribution of supported projects by priority area; by support instrument. ▫ % of projects framed in multi-areas. ▫ Cumulative distribution of projects framed by priority area, by support instrument.
3 Alignment with the structuring objectives of the NSSS.	▫ Indicators of programme achievement in relevant PI in the NSSS.
4 Participation in the entrepreneurial discovery process	▫ Number of participants in the entrepreneurial discovery process.

Figure 7. Monitoring and evaluation system: Implementation dimension

In the dimension of 1st level results, the indicators that result from the information systems of the European funds are particularly relevant. These make it possible to reflect the first level impacts on the competitiveness of a set of stakeholders in the national innovation system, with the intention that these impacts generate a positive knock-on effect on the entire NIS.

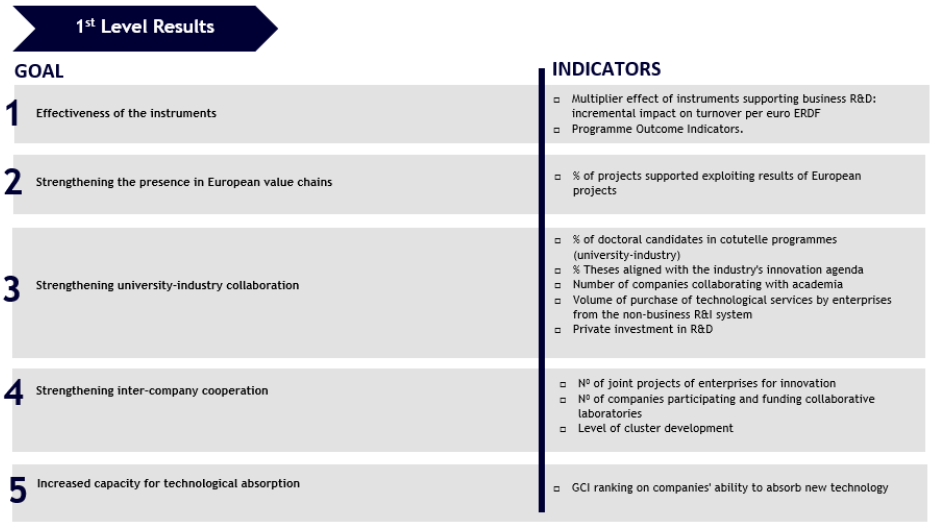


Figure 8. Monitoring and evaluation system: "1st level results" dimension

The objective of the structural change dimension is to evaluate whether the implementation of the strategy translated into an effective specialisation of the economy, a thematic concentration of resources and alignment in value chains, as well as the change in structural dimensions of the national innovation system with decisive impacts on the performance of the economy. Of note within these impacts is the increase in the propensity of companies to invest in R&D and their capacity to absorb and create knowledge.

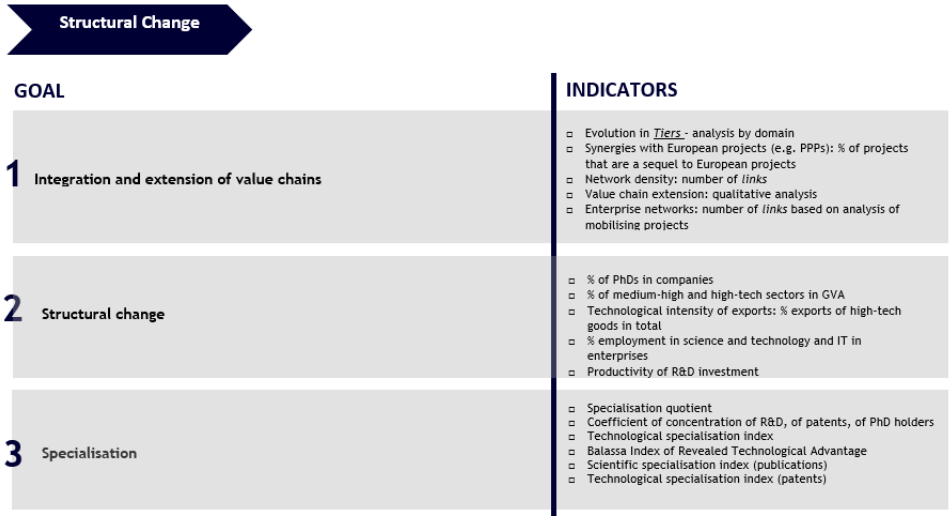


Figure 9. Monitoring and evaluation system: "Structural change" dimension

Finally, in the dimension of long-term impacts, we find the purpose of RIS3, that is, to promote the optimization and integration of value chains around a result-driven model that translates into a greater capacity for innovation and economic growth. In the case of Portugal, said impacts impose the transformation of the exporting and competitive economic model capable of driving a trajectory of economic growth and employment that ensures prosperity and convergence with Europe and that can build, endogenously, dynamic competitive advantages to face external shocks of supply and demand. These impacts must be reflected in employment (profile and quality, including salaries), in GDP, in competitiveness and innovation indexes and in a profile of greater environmental sustainability of the economy.

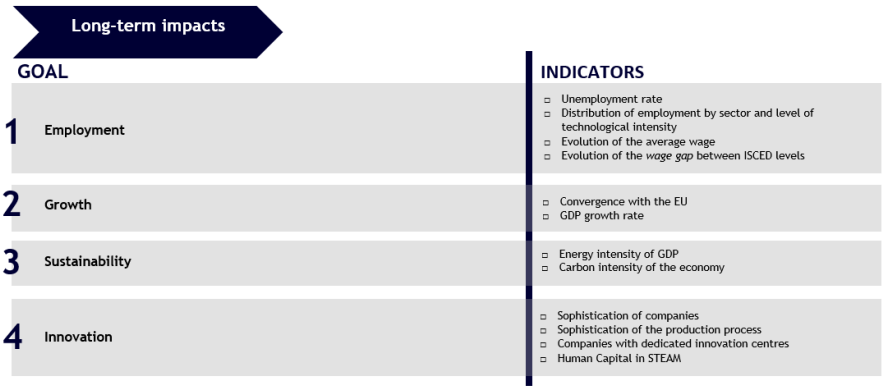


Figure 10. Monitoring and evaluation system: "Long-term impacts" dimension

The indicators for the monitoring system shall be appropriate to the Smart Specialisation priorities set. As far as possible, the indicator battery will draw on common EU indicators, result indicators, input and output indicators based on official statistical sources and complemented through questionnaire surveys, network analysis, impact analysis, as well as correlation patterns.

At the same time an online platform based on interactive visualisations will be implemented, allowing simplified access to the indicators under analysis and facilitating the management of regional and national data in an open way (e.g.: network visualisation of the partnerships established in the projects funded at regional, national and European level).

An observatory will be created to accompany this multi-level monitoring process, responsible for its development, implementation and production of thematic evaluation reports on a biannual basis.

The Monitoring and Evaluation System to be implemented is therefore dynamic, interactive and flexible, based on a multilevel and holistic approach, and involving the various stakeholders of the national and regional research and innovation systems. It should capture the evolution dynamics of the systems based on a limited set of indicators that should reflect the main dimensions of the

policy-mix, either at the level of national and European support instruments (PRR, Portugal 2020, Portugal 2030, Horizon Europe, etc.), either at the level of the legal framework and the ongoing reforms.

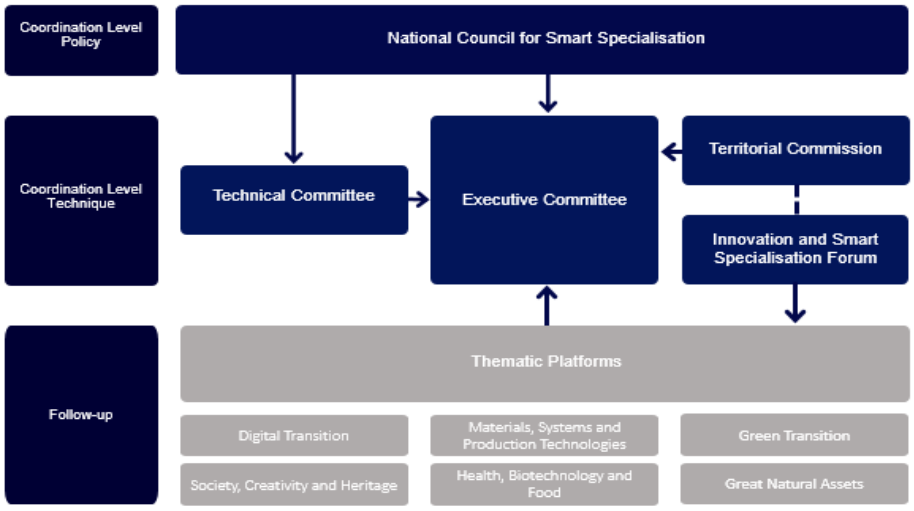
To this end, and according to the governance model described in the following section, it gathers cross-referenced information from both the monitoring of the implementation of the national strategy and the various regional strategies, including the entrepreneurial discovery processes.

VI - GOVERNANCE MODEL

The smart specialisation paradigm requires effective articulation between different sectoral policies, as well as advocating a participatory and open governance exercise, with the constant participation of the quadruple helix in the executive work.

The governance model must ensure the necessary political coordination, with a dedicated executive component that guarantees the permanent operational governance of the NIS, assisted by technical support structures that ensure the effective confluence of national sectoral policies, their articulation and coordination throughout the innovation cycle, and optimise the impact of the public effort to accelerate the transformation of the national innovation system. The achievement of this plan should include a territorial dimension and promote the complementarity of interventions, adjusted according to the state of maturity of the different regional innovation systems and the RSSS.

Thus, the Portuguese approach assumes a multi-level architecture that combines national strategies with strategies of regional incidence. The governance model should also ensure an adequate strategic and operational articulation, guaranteeing that the strategies and policy instruments complement and reinforce each other, without overlapping. The RSSS, directed to accelerate the consolidation of regional innovation systems, and whose policy instruments have a dedicated regional scope, have their own governance model, legitimized by the respective Regional Councils, which allow the specialization of policy instruments according to the specific characteristics of each region, complementing the national policy intervention. In this sense, the governance model of the NSSS should allow a fruitful combination and articulation between national policies and territorialised policies. In the light of the above, the following model is proposed:



National Council for Smart Specialisation

Composition

Governmental areas responsible for implementing public policies, i.e., the members of the Government responsible for the areas of the economy, which it coordinates, the presidency, the sea, culture, science, technology and higher education, health, the environment, territorial cohesion and regional development and agriculture, as well as representatives of each of the regional governments of the Autonomous Regions.

Responsibilities

- Defining strategic orientations;
- To monitor the operationalization of the NSSS sectoral policies;
- Approve revisions and updates to the NIS;
- Decide on the mobilisation of policy instruments to pursue manufacturing activities in line with the smart specialisation rationale underlying each priority;
- Approve the annual activities plan and report (after receiving the opinion of the Technical Commission).

Ordinary periodicity[27]

Annual meeting (in the first quarter of the year for approval of the plan and activity report)

Executive Committee

Composition:

This is a body under the responsibility of ANI, which has a team dedicated permanently to the exercise of its powers.

Responsibilities:

- Manage and coordinate the measures that implement the NSSS 2030;
- Propose the review and update of the NSSS to be approved by the National Council for Smart Specialisation;
- Draw up proposals for policy measures;
- To produce the monitoring and evaluation reports, ensuring the adequate reporting of information on the NIS;

[27] *At the 1st meeting, regulations should be proposed that will establish the regularity of the meetings and other provisions necessary to ensure their proper functioning*

- To draw up the Annual Plan and Activity Report;
- To execute the approved Plan of Activities;
- Ensure compliance with the requirements of the enabling condition of the programming cycle.

Ordinary[28] *:*
Ongoing activity.

National Thematic Platforms

Composition:
Each national thematic platform will include a representative of ANI and other members representing the quadruple helix, as well as a system of rotating members is proposed, with 1/3 of the representatives being replaced each year.
In each national thematic platform, there should be a representative appointed by the Forum for Innovation and Specialisation to ensure the functional articulation and, with the status of observers, a representative of each regional entity with responsibility for boosting the RSSS and a representative of AD&C.

Responsibilities:
The thematic platforms will constitute themselves as thematic working groups, supported by independent experts, who will seek to maintain the dynamics of collective construction of rationales for specialisation and the consequent continuous development in the definition of priorities and the respective transforming activities, producing prospective analyses, as well as critical evaluations on each of the priority areas, elaborating policy recommendations.
The Platforms assume a strategic advisory role to the Executive Board in the context of the specific dynamics of the NSSS areas.

Ordinary[29] *:*
Quarterly meetings.

Technical Committee

[28] *At the 1st meeting, regulations should be proposed that will establish the regularity of the meetings and other provisions necessary to ensure their proper functioning*
[29] *At the 1st meeting, regulations should be proposed that will establish the regularity of the meetings and other provisions necessary to ensure their proper functioning*

Composition

The coordination is the responsibility of ANI, represented by the head of the Executive Committee. This Technical Committee will also include a representative from FST, a representative from IAPMEI, a representative from AICEP, a representative from AD&C, a representative from CNCTI, a representative from each CCDR and one from each autonomous region.

The entities responsible for financing sources of the NSSS/RSSS, such as the Managing Authorities of the European funds, the Mission Structure of Recuperate Portugal or the Environmental Fund may also participate (without voting rights), when the nature of the subject justifies it.

Responsibilities

- To give its opinion on the plan and report of activities proposed by the Executive Committee;
- To advise and support the Executive Committee, with regard to thematic interventions and the mechanisms for articulating their operationalization with Innovation, Science and Industrial policies;
- Advise and support the Executive Board in the differentiated operationalization of policies in the territories;

Ordinary periodicity[30]

Quarterly meetings.

Territorial Commission

Composition

A representative of each regional entity with the responsibility of promoting the RSSS and a representative of AD&C. The coordination will be assured in rotation by a representative of each of the regions.

The representative of the Executive Committee shall sit on this Committee (without voting rights) to ensure functional articulation.

Responsibilities

- Ensure strategic concertation and articulation of initiatives;
- Define guidelines for the articulation of interventions between the RSSS and the NSSS;

[30] *The 1st meeting must propose the regulations that will establish the regularity of the meetings and other provisions necessary to ensure their proper functioning.*

- Define proposals for the dynamization and articulation of the Entrepreneurial Discovery processes;
- Coordinate and animate the Innovation and Smart Specialisation Forum.

Ordinary periodicity[31]
Quarterly meetings.

Innovation and smart specialisation forum

The Innovation and Smart Specialisation Forum is at the heart of the open process underlying the concept of smart specialisation and is a privileged space for interaction and articulation between the Regional Platforms, ensuring alignment of entrepreneurial discovery processes and the incorporation of the dynamics of the National Thematic Platforms. It promotes open discussion, aiming to identify the transformations sought, which transformative actions are necessary and the results to be achieved, and is therefore a relevant instance in the operational realisation of the smart specialisation rationale.

Composition
A representative of each regional entity with responsibility for promoting the RSSS and the coordinators of each of the Regional Thematic Platforms; the representative of the Executive Commission and a representative of each of the National Thematic Platforms will sit in this forum (without the right to vote) to ensure functional articulation.
The coordination and running of this forum are the responsibility of the Territorial Commission.

Responsibilities

- To ensure the debate and articulation between regional thematic platforms and the concertation of strategies with national platforms, producing prospective analyses and critical evaluations on each of the priority themes, elaborating policy recommendations and inducing articulation processes between the NSSS and the RSSS;
- Support the regions in structuring interventions within the framework of the dynamization of entrepreneurial discovery processes and thematic platforms;
- Produce prospective analyses and critical evaluations on each of the priority themes, drawing up recommendations for the specialisation policy.

[31] *The 1st meeting must propose the regulations that will establish the regularity of the meetings and other provisions necessary to ensure their proper functioning.*

Ordinary periodicity[32]

Half-yearly meetings.

VII - ANNEXES

Annex 1 - List of completed Entrepreneurial Discovery Forums

Table 28. Entrepreneurial Discovery Forums

	Theme	Date	Local
1	Production Technologies and Process Industries	12/10/2019	Pedro Nunes Institute, Coimbra
2	Forest	29/10/2019	RAIZ, Aveiro
3	Water and Environment	20/11/2019	BLC3, Oliveira do Hospital
4	Materials and Raw Materials	04/12/2019	INL, Braga
5	Energy	09/01/2020	ITeCons, Coimbra
6	Production Technologies and Product Industries	21/01/2020	INEGI, Porto
7	Information and Communication Technologies	06/02/2020	Institute of Telecommunications, Aveiro
8	Cultural and Creative Industries	21/02/2020	Oliva Creative Factory, S. João da Madeira
9	Transport, Mobility and Logistics	10/03/2020	Sines Industrial and Logistics Area, Sines
10	Health	16/06/2020	Digital event (in partnership with CINTESIS and FMUP)
11	Habitat	23/06/2020	Digital event (in partnership with Centro Habitat and CTCV)
12	Agri-food	26/06/2020	Digital event (in partnership with PortugalFoods)
13	Economy of the Sea	08/07/2020	Digital event (in partnership with Fórum Oceano)
14	Automotive, Aeronautics and Space	14/07/2020	Digital event (in partnership with CEiiA)
15	Tourism	17/07/2020	Digital event (in partnership with Turismo de Portugal)
16	General	08/10/2020	Digital event
17	Health, Biotechnology and Food	02/12/2020	Digital event
18	Uses of the Sea	02/12/2020	Digital event
19	Materials and KETs	03/12/2020	Digital event
20	Digital Technologies and Economy 4.0	03/12/2020	Digital event
21	Symbolic Capital and Specific Assets	04/12/2020	Digital event
22	Circular Economy	04/12/2020	Digital event
23	Digital Technologies and Economy 4.0 II	04/12/2020	Digital event
24	Space, Soil and Forest	07/12/2020	Digital event
25	Uses of the Sea II	07/12/2020	Digital event
26	Symbolic Capital and Specific Assets II	09/12/2020	Digital event
27	Energy Transition and Decarbonisation	10/12/2020	Digital event
28	Uses of the Sea III	10/12/2020	Digital event
29	Health, Biotechnology and Food II	10/12/2020	Digital event
30	Materials and KETs II	11/12/2020	Digital event
31	Space, Soil and Forest II	14/12/2020	Digital event
32	Uses of the Sea IV	14/12/2020	Digital event

Table 28. Entrepreneurial Discovery Forums			
	Theme	**Date**	**Local**
33	Circular Economy II	15/12/2020	Digital event
34	Uses of the Sea V	15/12/2020	Digital event
35	Uses of the Sea VI	16/12/2020	Digital event
36	Symbolic Capital and Specific Assets III	16/12/2020	Digital event
37	Digital Technologies and Economy 4.0 III - E4.0	17/12/2020	Digital event
38	Digital Technologies and Economy 4.0 IV - KET	17/12/2020	Digital event
39	Health, Biotechnology and Food III	17/12/2020	Digital event
40	Energy Transition and Decarbonisation II	18/12/2020	Digital event
41	Space, Soil and Forest III	18/12/2020	Digital event
42	Materials and KETS III	18/12/2020	Digital event
43	General	27/05/2021	Digital event

Annex 2 - Self-assessment of the fulfilment of the qualifying condition

Under Cohesion Policy, the common European provisions set the preconditions to be met under each policy objective. For Objective 1 "A smarter Europe by promoting innovative and smart economic transformation", the condition to be fulfilled concerns the demonstration of "Good governance of the national or regional smart specialisation strategy". The table below presents a self-assessment exercise on the fulfilment of the above enabling condition.

CONDITION DESCRIPTION		
Good governance of the national or regional strategy for smart specialisation		
Compliance criteria		
The strategy or strategies for smart specialisation are supported:		
Sub-criterion	**Complies (Y/N)**	**Justification**
1. For an updated analysis of the challenges facing the diffusion of innovation and digitisation;	**Y**	Portugal periodically produces diagnoses and analyses of the National Innovation System, seeking to identify market failures and system failures that justify public policy intervention. The National Innovation Report promoted by ANI, with an annual edition, will be the main tool for a complete and updated analysis of the challenges of innovation diffusion and digitalisation, to which can be added the results of the Entrepreneurial Discovery Forums and the analysis of the technology transfer processes.
2. The existence of a competent regional/national institution or body responsible for managing the strategy for smart specialisation;	**Y**	ANI assumes the coordination of the NSSS 2014-2020 Coordinating Council and is proposed as an executive entity under the revised governance model for the NSSS 2030.
3. Monitoring and evaluation tools to measure performance in achieving the strategy's objectives;	**Y**	Portugal has implemented monitoring and evaluation systems for the NSSS and the RSSS based on input, output, structural change and outcome indicators. Within the scope of this system, two monitoring reports have already been produced. This document formalises the structure of the monitoring and evaluation system in the NSSS 2030.
4. For effective cooperation among partners ("business discovery process")	**Y**	In the 2014-2020 programming period, under the NSSS, Entrepreneurial Discovery Forums and forums to induce cooperation between partners were promoted throughout the country. In this context, it is important to highlight the promotion of research agendas by FST that support the review process of the NSSS. In parallel, within the scope of the NSSS, 15 thematic workshops were held, to which must be added another 28 Entrepreneurial Discovery Forums aimed at the review of the NSSS and with the participation of about 2000 stakeholders. Each of these events has associated reports and were held using methodologies of collaborative construction of strategic recommendations.
5. For actions necessary to improve national or regional research and innovation systems, where applicable;	**Y**	The evaluation of the national innovation system identifies the need to improve the flows of knowledge transfer and the valorisation of that knowledge. In this sense, several initiatives of analysis and design of new policy instruments have been promoted in order to identify the necessary actions to improve the national and regional systems. A notable example of this work is the analysis produced on the networks and dynamics of knowledge transfer and international benchmarking, as well as the evaluation study done by the OECD.
6. With actions to support industrial transition, where applicable;	**Y**	The proposed the NSSS 2030 defines as priorities the digital transition and the green transition. Within the scope of the digital transition, there is a clear focus on the promotion of new patterns of production and production organisation, but also on the digitalisation of management and business models, seeking to effect a true and profound transformation. In what concerns the green transition, the focus on circularity, on sustainable production models and on the development and choice of green

CONDITION DESCRIPTION
Good governance of the national or regional strategy for smart specialisation

Compliance criteria

The strategy or strategies for smart specialisation are supported:

Sub-criterion	Complies (Y/N)	Justification
		technologies are key steps for the industrial transition to an operating model of lower energy intensity and less carbonic intensity. With regard to this condition and notwithstanding other strategic benchmarks contributing to the fulfilment of this condition, it is important to highlight the benchmarks (i) Strategy for Industry 4.0, (ii) Action Plan for the Circular Economy and (iii) Roadmap for Carbon Neutrality 2050 as evidence of compliance. At the level of the regions, circular economy action plans are being prepared and forums are being stimulated that highlight the verification of this enabling condition. These strategic orientations are aligned with European priorities and are a set of transformative actions that translate into actions to support the digital transition.
7. by measures aiming to strengthen cooperation with partners located outside a given Member State in Priority Areas supported by the strategy for smart specialisation	**S**	Integration of Partnerships with similar entities in sharing good practices and implementation of transformative actions for smart specialisation and participation in cross-border strategies (North of Portugal/Galicia). In PT2020 measures were created to stimulate the internationalisation of companies and other entities of the NIS, namely within the scope of their participation in international R&D+i networks. This effort is evident in the growing participation of Portuguese entities in H2020. At the same time, international cooperation processes have been developed based on RIS3 and even the construction of cross-border RIS3 strategies. The participation of Portuguese regions and national institutions in international cooperation projects based on RIS3 rationale is straightforward evidence (e.g., RIS3 Monitor, Impact RIS3t, Innova FI, RIS3 Lagging Regions, Vanguard Initiative...)

Annex 3 - Alignment of the NSSS 2030 with scientific areas

Table 29. Alignment of the NSSS 2030 with scientific areas

	Scientific Areas (FOS Classification of the Frascati Manual - Adapted)						
	Exact Sciences	Natural Sciences	Engineering and Technology Sciences	Medical and Health Sciences	Agricultural Sciences	Social Sciences	Humanities
Great Natural Resources: Forest, Sea and Space							
Health, Biotechnology and Food							
Society, Creativity and Heritage							
Green Transition							
Digital Transition							
Materials, Systems and Production Technologies							
Legend	Partial	Comprehensive	High