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Working Paper

Linking the "recovery and resilience plan" and smart specialisation: The Italian case

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Linking the 'Recovery and Resilience Plan' and Smart Specialisation. The Italian Case

JRC Working Papers on
Territorial Modelling and Analysis
No 10/2022



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Linking the ‘Recovery and Resilience Plan’ and Smart Specialisation. The Italian Case

Francesco Prota and Gianfranco Viesti

JRC TEL REPORT

JRC Working Papers on Territorial Modelling and Analysis No 10/2022

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Linking the ‘Recovery and Resilience Plan’ and Smart Specialisation. The Italian Case

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Abstract

This study aims at analysing possible synergies between the Italian National Recovery and Resilience Plan and the Smart Specialisation Strategies for 2021-2027 of Italian regions. Although Smart Specialisation Strategies are not explicitly mentioned in the Plan, we found that sixteen initiatives have a strong link with S3s priority areas, and thirty-one initiatives can be classified as having a medium link. For the remaining initiatives the potential links are weak.

Much can be done to increase coherence between S3 and recovery projects, even a posteriori, by considering how the two planning processes complement one another. Obviously, the effective achievement of synergies between the Italian National Recovery and Resilience Plan and the regional Smart Specialisation Strategies will depend on many factors; in particular, a good policy mix and the involvement of relevant regional actors within the governance of the Plan.

Keywords: Recovery and Resilience Plan; Smart Specialisation Strategies; Covid-19 crisis; Innovation; Public policy; Italy.

JEL Classification: H50; O30; R10

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Executive Summary

This study aims at analysing possible synergies between the Italian National Recovery and Resilience Plan (NRRP) and the regional Smart Specialisation Strategies (S3s) for 2021-2027. This analysis is particularly relevant in the Italian case given the huge resources of the NRRP and the need for a structural transformation of the productive structure of many regions.

In this report we adopt the methodological approach followed in Marques Santos (2021) to analyse the alignment of investments in the Portuguese Recovery and Resilience Plan with the Smart Specialisation Strategies priorities. This methodology is applied to the Italian case to understand how (and to what extent) the investments envisaged in the Italian NRRP can directly or indirectly support the implementation of the S3s priorities in the various regions.

The Italian NRRP is by far the largest in Europe, amounting to €235.6 billion. In addition to investments, it also includes several reforms on which the Italian government relies heavily. The Italian government expects the NRRP to provide an important stimulus to economic growth from 2021 to 2026, as a direct effect of spending. Possible structural increases in productivity in the medium-long term are more difficult to estimate as they will depend on the ability of the Plan to influence the behaviour of businesses and citizens.

In the programming period 2014-2020, Italy had adopted a multi-level approach to Smart Specialisation with twenty-one regional strategies and one national strategy. For the new programming period 2021-2027, the European Commission has dedicated the bulk of its budget to promoting a Smarter Europe through the confirmation of the smart specialisation approach and has requested national and regional authorities to update their S3s. The elaboration of the new strategies has proceeded slowly since Italian regional administrations were mainly focused on addressing the consequences of the pandemic. More in general recovery money planning has overloaded administrative capacity at the expense of Structural Funds planning which faces delays. The analysis of the specialization areas selected in the available S3s and the priority thematic areas into which each strategy is divided shows some continuity with the previous S3s in the identification of priority themes. The influence of the new priorities of the European Commission in favour of a greener, digital and inclusive economy is however evident in all regional Smart Strategies.

After identifying the actions in the Italian NRRP directly and indirectly related to R&D and Innovation investments and matching them with Smart Specialisation priorities for 2021-2027, we estimate that about 28 percent of the Plan could potentially support the achievement of the Italian regions Smart Specialisation Strategies objectives. Direct support actions account for €40 billion, while indirect support initiatives account for €25 billion.

Although Smart Specialisation Strategies are not explicitly mentioned in the NRRP, we found that sixteen initiatives have a strong link with S3s priority areas. These are mainly included in two components: “M1C2

Digitisation, Innovation and Competitiveness component of the productive system” and “M4C2 From Research to Business”. Thirty-one initiatives can be classified as having a medium link. For the remaining initiatives the potential links are weak.

It is also expected that the reforms which are an essential part of the Plan could help in addressing the obstacles that hamper innovation.

Much can be done to ensure coherence between S3 and recovery projects, even a posteriori, by considering how the two planning processes complement one another. Obviously, the effective achievement of synergies between the Italian National Recovery and Resilience Plan and the regional Smart Specialisation Strategies will depend on many factors; in particular, a good policy mix and the involvement of regional actors within the governance of the NRRP which, as we have shown, has a top-down structure.

1. Introduction and methodological approach

This study aims at analysing possible synergies between the Italian National Recovery and Resilience Plan (NRRP) and the regional Smart Specialisation Strategies (S3s) for 2021-2027.

As known, the NRRP presented by Italy is by far the largest in Europe, amounting to €235.6 billion. Besides the investments, it envisages a consistent reform package. In the intentions of the Italian government, the NRRP should constitute a game changer in the inertia which has characterized the last twenty years of Italy's economy. The country has in fact experienced a period of persistent economic stagnation mainly due to the decline of productivity, which in turn is largely driven by a series of structural deficiencies afflicting both the private and public sector (Giordano and Zollino, 2021). In the short-term the aim of the NRRP is to repair the economic and social damages caused by the health crisis, but in the medium/long-term, the Plan should tackle the weaknesses that have been weighing down on Italy's economy and society for decades: the long-standing inequalities between the country's geographical areas, gender inequality, weak productivity growth and a low rate of investment in human and physical capital, as well as driving a comprehensive ecological transition.

Theoretically, the Smart Specialisation Strategies should foster the development of innovative activities and enable regions to transform themselves by developing new competitive advantage based on their specific strengths, potentials and opportunities (Foray, Eichler and Keller, 2021).

The possible overlap between NRRP and S3s is evident to the extent that the investments envisaged in the Plan can address the obstacles that limit the regions' innovative potential. ⁽¹⁾ It is therefore important to analyse whether these investments are actually coherent with the strategic priorities identified in the regional S3s. This analysis is particularly relevant in the Italian case given the huge resources of the NRRP and the need for a structural transformation of the productive structure of many regions.

In this report we adopt the methodological approach followed in Marques Santos (2021) to analyse the alignment of investments in the Portuguese Recovery and Resilience Plan with the Smart Specialisation Strategies priorities. We apply this methodology to the Italian case to understand how (and to what extent) the investments envisaged in the Italian NRRP can directly or indirectly support the implementation of the S3s priorities in the various regions.

More in details, the steps we follow are as follow:

- Identify the actions in the Plan directly and indirectly related to R&D and Innovation investments (by direct linkage we mean the investments that can financially support any phase of innovative

⁽¹⁾ It is useful to recall that over the 1999-2019 period, the low level of investment, especially in the public sector, was one of the factors that hindered the growth of the Italian economy. The investment component of the NRRP aims to address this challenge, focusing resources on measures that should help to increase the country's growth potential in the long term.

projects that are aligned with Smart Specialisation priority areas, while by indirect linkage we mean the investments that may address any barrier, obstacle or challenge affecting the regional innovation ecosystem)

- Categorise R&D and Innovation actions in the NRRP by thematic areas. If no information is available, the action is considered with a potential benefit for all the innovation priorities of the strategies
- Regionalisation of investments (when information available) to identify which regions at NUTS 2 level will benefit from them. If no information is available regarding the localisation of the investment, it is categorized with a potential benefit for all the regions. Nevertheless, if the investments are targeted for specific economic activities, regionalisation can also be related to the territorial sectorial concentration
- Identify S3 innovation priorities for the 2021-2027 period for each Italian region
- Draft a map to identify potential links between the NRRP and the Smart Specialisation Strategies. Links are classified into three categories: strong, medium, and weak (Table 1)

Table 1. Summary of the criteria to classify the link intensity between NRRP and S3s

Criteria	Strong (●●●)	Medium (●●)	Weak (●)
Final beneficiaries	Only actors of the regional innovation ecosystem	Not only actors of the regional innovation ecosystem, but actions are related to the mitigation of a main known barrier to innovation activities	Not only targeted for actors of the regional innovation ecosystem and/or priorities areas of Smart Specialisation
RRP investment area or sector	Aligned with S3 innovation priorities	Aligned with S3 innovation priorities	Aligned with S3 innovation priorities
Location of the investment (% Total)	Above the average	Close to the average	Below the average or non-existent in the territory but the region can benefit from its results

Source: Table 3 in Marques Santos (2021)

Box 1. New Generation Initiative and Recovery and Resilience Facility (RRF)

The NRRP is designed within the European framework of the New Generation Initiative (NGEU) and the consequent Recovery and Resilience Facility (RRF). The Plan is financed, for the first time, by joint European borrowing that relies on the Member States' future contributions to the EU Budget, for approximately €800 billion: approximately €338 billion in grants and approximately €386 billion in loans.

NGEU identifies common goals, which are translated into common allocation for the beneficiaries towards green and digital transition. It destines resources to the Member States, both as grants and as loans, based on indicators related to their economic problems and to the impact of the Covid-19 pandemic. In this way, it is particularly beneficial to the Mediterranean countries, starting with Italy and Spain, which have been allocated particularly substantial resources. NGEU accompanies the EU budget allocations for the period 2021-2027, for approximately €1.2 billion, defined during 2021 with approval of the new

“Financial Perspectives”. All NRRPs contain implementation and spending objectives to complete along a timeline, which will be checked by the European Council and are preliminary to the disbursement of the subsequent instalments of payment.

The report is organized as follows. Section 2 briefly presents the context of the impact of the Covid pandemics in Italy and the framework of its regional economies. Section 3 presents the Italian NRPP, with a particular focus on its possible territorial impact. Section 4 provides an in-depth analysis of the Plan with regards to the S3, listing its investments that are directly linked to research and innovation activities, presenting their sectoral and, when available, territorial coverage. Section 5 contains the same analysis for investment that may be considered indirectly linked to research and innovation. Section 6 presents a first, provisional framework of the S3 in the Italian regions.

2. The Italian context in a snapshot

The Covid-19 pandemic, started at the beginning of 2020, has severely affected global economy due to the sudden combination of demand and supply shocks as well as due to the severe implications on the health care systems. ⁽²⁾ This is particularly true in the European countries such as Italy, one of the countries that was hit the hardest by the first wave of the pandemic crisis with a drop in GDP of ten percentage points in 2020 compared to the previous year (Figure 1).

Furthermore, in Italy the regional impact of the recession has been highly heterogeneous due to the sectoral structure and therefore the relative importance of the sectoral activities most exposed to the COVID-19 shock, such as tourism, and the long-lasting economic and social divide between the North and the South (Ascani, Faggian and Montresor, 2021).

As well known, Italy has been characterised by a strong North–South divide since the country’s political unification in 1861, with the Southern part of the country, commonly referred to as the “Mezzogiorno”, constantly lagging behind (Fina, Heider and Prota, 2021). Regional territories greatly differ in terms of population, per capita gross domestic product, employment, and innovation performance (see Table A1 in appendix). In particular, only seven regions are classified as “strong innovator” according to the regional innovation scoreboard, the regional extension of the European innovation scoreboard. ⁽³⁾

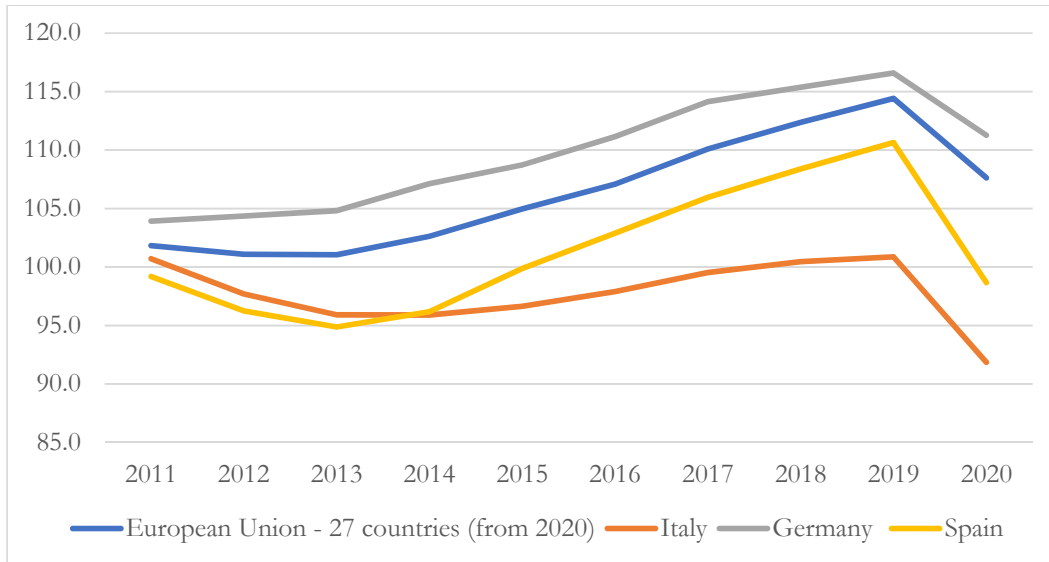
In the aftermath of the pandemic, the Italian SMEs suffered the most from the situation. Figure 2 provides a breakdown of the most pressing problems faced by SMEs in the period April–September 2020, i.e., immediately after the outbreak of the pandemic. Finding customers and cost of production and labour

⁽²⁾ On 22 April 2020, Italy was the third country in the world by the number of reported COVID-19 infection cases, and the second by the number of deaths among the infected patients.

⁽³⁾ https://ec.europa.eu/info/research-and-innovation/statistics/performance-indicators/regional-innovation-scoreboard_en

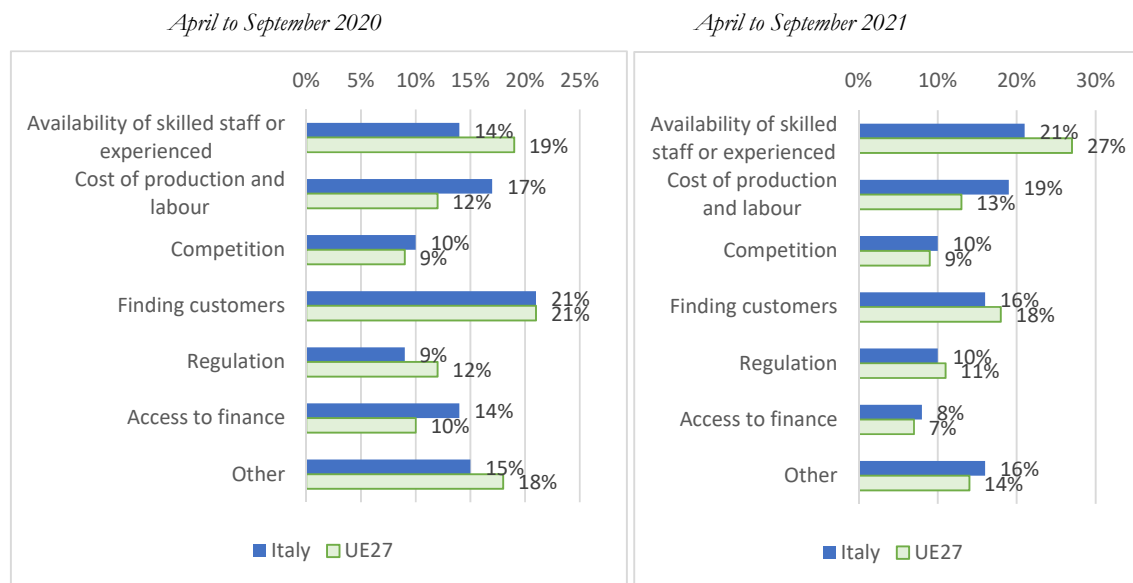
were the most urgent problems for Italian firms. The fifteen percent of SMEs expressed the most urgency concerning the “Other” category, within which the COVID-19 pandemic is the main issue. After a year this percentage has risen to sixteen percent.

Figure 1. GDP change by selected European countries (index 2010 = 100)



Source: Authors' elaboration based on Eurostat data

Figure 2. Most pressing problems for SMEs in Italy



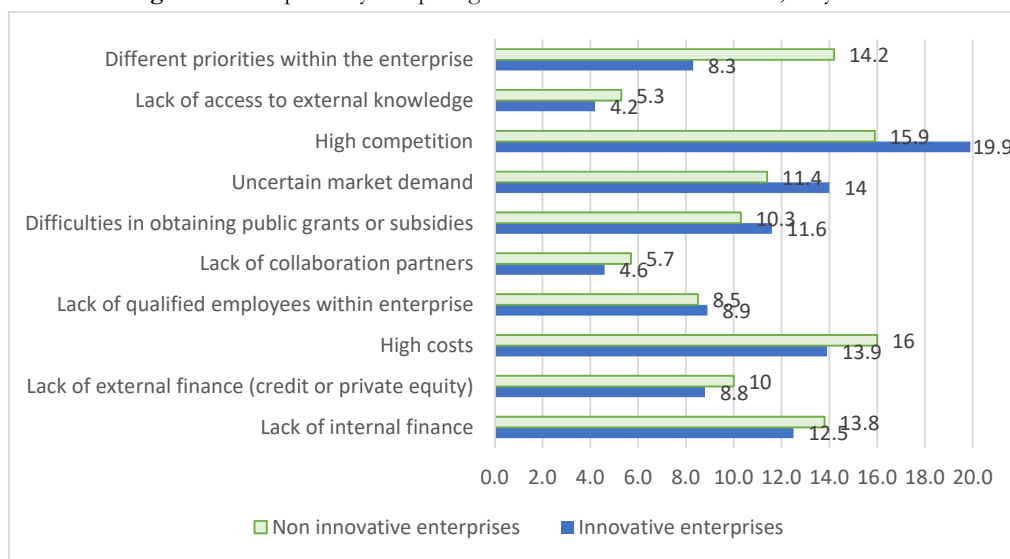
Note: Percentages in the figure indicate the percentage of SMEs that consider a specific problem to be the most urgent.

Source: Authors' elaboration based on Survey on the Access to Finance of Enterprises

According to the Community Innovation Survey, before the pandemic, the main obstacles to innovation activities in Italy were mainly related to high competition and high costs (Figure 3). These two obstacles were reported by both innovative and non-innovative firms.

Uncertain market demand, difficulties in obtaining public grants or subsidies and lack of external finance are other relevant obstacles to innovation activities for innovative firms.

Figure 3. Enterprises by hampering factor for innovation activities, Italy - 2018



Note: Percentage of firms that have indicated the level of importance of hampering factors as high.

Source: Own elaboration based on Community Innovation Survey

More in general, the “dwarfism” of the Italian productive system is strictly interrelated to the ability of firms to adopt new technologies in order to develop innovation of products and processes and invest in human capital. These features of Italian industries profoundly affect the average productivity of the economy. ⁽⁴⁾

⁽⁴⁾ Had Italy had the same firm size structure as Germany, its average labour productivity would have been more than 20 percentage points higher, surpassing the German level. Differences in the sectoral composition between the two countries have a much smaller role in explaining the low productivity of Italian firms.

3. The Italian NRPP

The Italian NRPP is by far the largest in Europe, amounting to €235.6 billion. There are three reasons for this:

1. the allocation criteria assign large amounts of EU funding to the country (€191.5 billion) ⁽⁵⁾
2. Italy is the only large EU Member State that has completely activated not only the grant component of NGEU (€68.9 billion), which is the largest of the entire Union together with Spain, but also the entire loan component of the RRF (€122,6 billion), unlike France, Germany, Spain, or Poland (Figure 4)
3. at the same time, the Italian government has programmed the use of other resources into the NRPP: European funds (from the REACT-EU programme, valid for 2021-2022 as “a bridge between the programming of the Structural Funds 2014-2020 and 2021-2027”, for €13.5 billion); a Complementary Fund (CF), relying on national budget resources, amounting to €30.6 billion. The implementing decree of the Complementary Fund has allocated a further €10 billion (not included among the previous allocations) for the railway network.

⁽⁵⁾ https://ec.europa.eu/info/sites/default/files/1_en_annexe_proposition_part1_v15.pdf

Figure 4. NRPP of Member States

	Submission date	Financial allocation requested (grant/loan)	Maximum (indicative) financial allocation (grant/loan*)	Share of maximum (indicative) grant allocation in general governmental expenditure (2019)**	Ratification of Own Resources Decision
Belgium (BE)	1/5/2021	5.9/-	5.9/32.8	2.4%	✓
Bulgaria (BG)			6.3/4.2	28.4%	✓
Czechia (CZ)	2/6/2021	7.1/-	7.1/14.3	7.7%	✓
Denmark (DK)	30/4/2021	1.6/-	1.6/21.9	1.0%	✓
Germany (DE)	28/4/2021	27.9/-	25.6/240.9	1.6%	✓
Estonia (EE)			1/1.9	9.1%	✓
Ireland (IE)	28/5/2021	1/-	1/18.7	1.1%	✓
Greece (EL)	28/4/2021	17.8/12.7	17.8/12.5	20.5%	✓
Spain (ES)	30/4/2021	69.5/-	69.5/84.8	13.3%	✓
France (FR)	29/4/2021	40.9/-	39.4/168.4	2.9%	✓
Croatia (HR)	15/5/2021	6.4/-	6.3/3.7	24.7%	✓
Italy (IT)	1/5/2021	68.9/122.6	68.9/122.7	7.9%	✓
Cyprus (CY)	17/5/2021	1/0.227	1/1.5	11.2%	✓
Latvia (LV)	30/4/2021	1.8/-	2/2	17.1%	✓
Lithuania (LT)	15/5/2021	2.2/-	2.2/3.2	13%	✓
Luxembourg (LU)	30/4/2021	0.093/-	0.1/2.8	0.4%	✓
Hungary (HU)	12/5/2021	7.2/-	7.2/9.7	10.8%	✓
Malta (MT)			0.3/0.8	6%	✓
Netherlands (NL)			6/55.3	1.8%	✓
Austria (AT)	1/5/2021	4.5/-	3.5/27.2	1.8%	✓
Poland (PL)	3/5/2021	23.9/12.1	23.9/34.8	10.7%	✓
Portugal (PT)	22/4/2021	13.9/2.7	13.9/14.2	15.3%	✓
Romania (RO)			14.2/15	17.6%	✓
Slovenia (SI)	1/5/2021	1.8/0.7	1.8/3.2	8.6%	✓
Slovakia (SK)	29/4/2021	6.6/-	6.3/6.3	15.7%	✓
Finland (FI)	27/5/2021	2.1/-	2.1/16.4	1.6%	✓
Sweden (SE)	28/5/2021	3.2/-	3.3/6.3	1.4%	✓

Notes:

* Calculation of the maximum loan that can be requested by each Member State is based on the ceiling of 6.8% of 2019 GNI (Article 14 of the RRF Regulation). See: First Recovery and Resilience Dialogue with the European Commission, Directorate-General for Internal Policies, European Parliament, May 2021.

** Calculation based on Eurostat data.

Source: European Commission, Eurostat and Parliament's Directorate-General for Internal Policies.

The NRRP precisely sets out the timing for spending this money from 2021 to 2026; in relation to this, the decision with which the EU approved the Italian Plan envisages progressive allocations as the targets and the milestones are met.

However, not all this sum activates new investments. In the text of the NRRP it is stated that the total contains €69.1 billion for “loans for existing projects”; during 2021 the precise magnitude of this figure has been revised. These funds are devoted to projects already financed by national resources. However,

the NRRP does not provide a detailed list of these projects; this suggests caution in the Plan's allocation of funds for the various measures, given that some investment funding include resources, in some cases substantial, that were already allocated. There are two reasons for this: (1) since these projects are already in progress, Italy can report to the EU on the state of progress already made during the earliest years of the Plan; (2) it "returns" substantial resources to the national budget in such a way as to reduce the impact of the NRRP on the national debt. In this context it must be noted that the NRRP "borrows" approximately €20 billion from the Development and Cohesion Fund (Fondo Sviluppo e Coesione, FSC), which funds the national cohesion policy ⁽⁶⁾.

According to the official text, the total sum of €235.6 billion is composed as follows: RFF €191.5 billion, of which grants (68.9), loans for new projects (53.5), loans for existing projects (69.1); React-EU €13.5 billion; Complementary Fund €30.6 billion.

At the same time, it must be considered that the NRRP investments are additional with respect to the normal Italian budget allocations and to the other European policies. It is particularly important that the NRRP is additional to the European Structural and Investment Funds (ESIFs) available in Italy for 2021-2027. Those are larger than in the previous planning period, especially in the Centre-North. On December 22nd, 2021, the final draft of the Italian Partnership Agreement for the ESIFs 2021-2027 has been officially approved and sent to the EU Commission. It will be essential for national and regional operational programmes to be different from those of the past, to take account of the complementarity with the NRRP. This might reinforce the impact of the NRRP. However, some caution is needed, due to the following reasons:

1. the EU definition of Structural Funds (SF) Regulations has been delayed, more than in the past, for the very reason that the Commission offices have concentrated their priorities on the NRRP. This means that spending of the SF will start with a considerable delay already accumulated
2. implementation of the NRRP will place a considerable extra burden of work on the administrations involved in the SF
3. there may be a priority to include the most of completed investment projects in the NRRP, given the need to close the whole Plan by mid-2026 (while the deadline to certify ESIFs expenditures is end 2029).

The Italian government foresees that the NRRP will provide an important stimulus to the economic growth from 2021 to 2026, as a direct spending effect. It is difficult to estimate possible structural increases in productivity caused in the medium-long term by the investment; and this will depend greatly on the Plan's effects on the behaviour of companies and citizens (Table 2).

⁽⁶⁾ The budget of the Development and Cohesion Fund will be replenished, albeit partially after 2027.

Table 2. Macroeconomic impact of the Italian NRRP (percentage deviations from the base scenario)

	2021	2022	2023	2024	2025	2026
GDP	0,5	1,2	1,9	2,4	3,1	3,6
Private consumption	-0,2	-0,6	-0,6	0,0	1,0	1,9
Total investments	2,8	7,6	11,6	12,5	11,8	10,4
Import	0,2	1,0	1,9	2,7	3,4	4,0
Export	-0,2	-0,5	-0,2	0,6	1,6	2,7

Source: NRRP

3.1. Structure of the Plan

In addition to investments, the Plan also includes several reforms (e.g., justice, public administration, competition) on which the Italian government is particularly reliant, and these also have a precise timeline of milestones. The Plan also includes two other important areas of reform: taxation and social welfare.

The NRRP covers practically all public policies in Italy. The entire implementation of the Plan, investments and reforms, will have a quantitative and qualitative influence on the Italian policies throughout the 2020s. For example, there will be important consequences of the new investments envisaged by the NRRP on the need of current central and local expenditure necessary to implement the new services (in many spheres, from urban transport and railways to nursery schools, to the health service); at present there are no estimates or indications to this regard.

The structure of the NRRP has been affected by its preparation process, which was particularly complex for several reasons: (1) the relatively short time available between approval of NGEU (July 2020) and delivery of the Plan to the EU Commission (April 2021); (2) a lack of previous long-term programming in many important areas of public intervention (from industrial policies to the health service) to use as a framework; (3) the need to tackle the pandemic and emergency economic interventions at the same time; (4) the change of government.

The Plan has a similar structure to the Plans of the other EU Member States, following the guidelines given by the Commission. It has 6 broad Missions: digital transition; green transition; infrastructures for a sustainable mobility, education and research, inclusion and cohesion, health (Table 3).

Table 3. Components of Italy's NRRP

Mission (M)	Component (C)	RRF resources (€ billion)	Share
Mission 1: Digitalisation, innovation, competitiveness, culture and tourism	M1C1. Digitalisation, innovation and security in the public administration	9.7	5.1%
	M1C2. Digitalisation, innovation and competitiveness in the production system	23.9	12.5%
	M1C3. Tourism and culture 4.0	6.7	3.5%
Mission 2: Green revolution and ecological transition	M2C1. Circular economy and sustainable agriculture	5.3	2.7%
	M2C2. Renewable energy, hydrogen, grid and sustainable mobility	23.8	12.4%
	M2C3. Energy efficiency and renovation of buildings	15.4	8.0%
	M2C4. Protection of land and water resources	15.1	7.9%
Mission 3: Infrastructures for sustainable mobility	M3C1. Investments in the rail network	24.8	12.9%
	M3C2. Intermodality and integrated logistics	0.6	0.3%
Mission 4: Education and research	M4C1. Strengthening the provision of education services: from crèches to universities	19.4	10.1%
	M4C2. From research to business	11.4	6.0%
Mission 5: Inclusion and cohesion	M5C1. Employment policies	6.7	3.5%
	M5C2. Social infrastructure, households, the community and the third sector	11.2	5.9%
	M5C3. Special interventions for territorial cohesion	2.0	1.0%
Mission 6: Health	M6C1. Local networks, facilities and telemedicine for local healthcare	7.0	3.7%
	M6C2. Innovation, research and digitalisation of the national health service	8.6	4.5%
	Total	191.5	

Source: European Commission, SWD(2021) 165.

The six Missions are articulated in sixteen Components (further sub-divided into forty-three areas of intervention for coherent projects), plus forty-nine sectorial reforms. However, the division into Missions is indicative because the content of each one is relatively heterogeneous.

Table 4 reports the contribution of each Component of the Italian Plan to the pillars of the Recovery and Resilience Facility Regulation.

Table 4. Coverage of the six pillars of the Recovery and Resilience Facility by the Italian NRRP components

	Green transition	Digital transformation	Smart, sustainable and inclusive growth	Social and territorial cohesion	Health and economic, social and institutional resilience	Policy for the next generation
M1C1 Digitisation, Innovation and Security component of the Public Administration	●	●	●	●	●	●
M1C2 Digitisation, Innovation and Competitiveness component of the productive system	○	●	●		●	
M1C3 Tourism and Culture 4.0	○	○	●		●	
M2C1 Green Business and Circular Economy	●	○	●	●		
M2C2 Energy Transition and Sustainable Local Mobility	●	○	●	○		
M2C3 Energy Efficiency and Requalification of Buildings	●		●	●	○	
M2C4 Protection and Enhancement of Land and Water Resources	●	○	●	●		
M3C1 High-Speed Rail and Road Maintenance	●	●	●	●	●	
M3C2 Intermodality and Integrated Logistics	○	○	●		●	
M4C1 Enhancement of Skills and Study Support	●	●	●	●		●
M4C2 From Research to Business	●	●	●			●
M5C1 Employment Policies		●	●	●	●	●
M5C2 Social infrastructures, Families, Communities and the Voluntary Sector	○	○	●	●	●	
M5C3 Special Interventions for Geographical Cohesion,	○		●	●	●	●
M6C1 Proximity Assistance and Telemedicine	○	○		●	●	
M6C2 Healthcare Innovation, Research and Digitisation	○	●	○	●	●	

Note: ● component significantly contribute to the EU pillar, ○ component partially contributes to the EU pillar

Source: Commission Staff Working Document, Analysis of the recovery and resilience plan of Italy (SWD/2021/165 final)

Within the six Missions there are 133 “lines of investment”. Some of these include interventions that are quite differentiated, so that these can be more usefully quantified as being at least 157. To these are added the 30 lines of investment of the Complementary Fund, amounting to an overall total of 187. The lines of investment vary greatly in size: some amount to over €10 billion, while others are worth tens of millions. Therefore, any analysis of the Plan’s areas of intervention must inevitably begin by regrouping the specific lines of investment and by carefully analysing these.

Overall, around two-thirds (62%) of the Plan budget consists of public investments; a fifth (19%) is dedicated to business incentives and around a seventh (12%) to current public expenditure.

3.2. Implementation

Since the NRRP includes investments that have already been funded and are already being carried out and given the possibility of including expenditures made in 2020, the implementation of the Plan has already been under way; this will allow Italy to gradually provide the EU Commission with progress reports and obtain the next instalments of funding, as happened at end December 2021.

The ways in which the NRRP is implemented are diversified. (1) In some cases, the Plan precisely identifies the projects to carry out, and therefore also identifies the implementing body and final beneficiaries; these cases will involve transferring the relative resources for implementation and then monitoring progress of the projects. For example, this is the case of many investments regarding the railway network, which the Italian Railway Company (*Rete Ferroviaria Italiana*) will carry out according to the calendar of the Plan; another example are the investments in the cultural heritage of the major Italian cities contained in the CF and of which a complete list is already available. (2) In some cases, a central administration (*Ministero*) will directly implement investments, as in the case of interventions regarding the justice system. (3) In some cases, implementation is linked to a preliminary repartition of resources between Regions and Municipalities, to be carried out by the national administration (*Ministero*) responsible for the line of investment, according to criteria already available, or dependent on implementation legislation yet to be formulated; for instance, the investment for school buildings, coordinated by the Italian Ministry of Education. (4) In yet other cases, the national implementing body responsible for the line of investment will issue calls for proposals, and local administrations will compete to obtain allocation of resources; once the resources are allocated, the local authorities will be responsible for the implementation stage. This is the case, for example, of the substantial resources that the NRRP allocates to the creation of nurseries, and also of many important interventions related to the innovation policy, which will be mentioned below. (5) Lastly, a part of the Plan concerns “over the counter” interventions: available resources that can be allocated on demand to businesses (this concerns several measures, one of which is the substantial amount of funding for “Transition 4.0”) or to private citizens, such as the very large *bonus* for building renovation works.

Thus, the implementation process is quite articulated. In several cases, planning activities will be necessary, both for the measures that are directly carried out by central administrations, and for those implemented by local authorities that will participate in the calls for proposals. This is challenging because of the very large number, as recalled, of lines of investment and their very amount. New regulations have been introduced to accelerate the procedures involved in public investments.

The governance of the NRRP has been defined by DL 77/2021. This provides for a significant number of bodies procedures, with the creation of a “Control Room” at the Presidency of the Council of Ministers, with the different Ministers involved and the assistance of a new Technical Secretariat. At the Ministry of the Economy there will be a "Central Service for the NRRP" to coordinate operations, monitoring,

reporting and controlling implementation of the Plan. A “Permanent Board of discussion”, with a consulting role, has also been established with the economic, social and territorial stakeholders.

3.3. Territorial structure of the NRRP

In most cases, the Plan follows strictly sectorial (and not territorial) lines. Compared to the normal implementation of public policies, it is evident that the role of the Regional Administrations is much less important; the entire definition process of the Plan followed a top-down approach, defined by the national executive. On the other hand, the municipal administrations will certainly be very important in the implementation process. According to a government assessment, “Regions and local bodies are responsible for a significant share of the investments envisaged by the Plan”, amounting to €87.4 billion (including NRRP and FC), in particular for Ecological Transition (Mission 2), Inclusion and Cohesion (Mission 5) and Health (Mission 6). This figure mostly refers to the municipal administrations; the Regional Administrations should have a role in planning some public network services as for the health service, via the Local Health Authorities (*ASL*). However, the municipal administrations will have the crucial responsibility for planning and implementing many interventions envisaged in the other missions of the Plan. IFEL-ANCI (national association of municipalities) has estimated that these interventions will amount to €67.2 billion.

This will pose some very important problems. The municipal administrations across the entire country are greatly under-staffed, especially when it comes to younger and professionally qualified personnel. This situation is considerably more pronounced in the South. Equally important problems will arise in the future when the municipal administrations need to use their own current resources to activate the new services enabled by NRRP investments. In addition, some administrations face difficulties because they already have high levels of debt, which restricts their capacity for current expenditure; this includes important cities like Turin, Naples, Palermo and Catania.

The NRRP has three “transversal” goals: it aims to reduce gender, generational, and territorial gaps. In order to reduce territorial inequality, the Plan allocates to the South 40% of the total investment. Which specific investments will be funded by these resources? It is impossible to be certain, yet.

Detailed analysis of all the NRRP and CF investments shows that 22 out of €82 billion will be allocated to already defined projects in the South. This mostly involves large-scale network interventions, especially for the railways, already selected and to be carried out by large publicly owned companies like *Rete Ferroviaria Italiana* and for broadband connections. There are also specific indications for some measures, of relatively limited amounts, specifically for the South, like those for the Special Economic Zones (SEZ).

There is no geographical indication in 122 of the 187 NRRP and CF lines of investment. These include almost all the measures regarding industrial policy (innovation and business incentives) and most

interventions related to public services. Allocation of these will depend (1) on the demand from businesses and families for the incentives envisaged in the Plan; (2) on the decisions concerning territorial allocation of the direct investments by the central Administrations and by their allocation programmes; (3) for a large extent, on the outcome of calls for proposals to which the municipal administrations will participate and, therefore, on the criteria used to formulate the calls. On July 15, the government proposed an amendment to Decree-Law 77 in order to establish the principle that the in calls for proposals regarding the NRRP, a share of 40% must be destined to the South. The cogency of this legislation remains to be verified, as does the issue of whether it proves to be more or less sufficient, according to the different investment lines.

4. NRPP, research and innovation: directly linked investments

4.1 The overall picture

To prepare this report all NRPP lines of investment have been analysed, selecting those that show a link to S3 strategies. It is important to note that the NRPP does not contain any explicit reference to Smart Specialization Strategies.

Following the methodology previously illustrated, they have been sub-divided into those directly linked with research and innovation strategies and those that may have an indirect link. Among the former, we were able to find 46 lines of investment, for a total amount of 40 billion euros (about 17 percent of the entire Italian NRRP). Due to their contents and orientation, they have been subdivided into 7 groups: Transition 4.0; Start-up; Research and cooperation with business for research; European programmes; industrial promotion; promotion tools; intellectual property (Table 5).

Table 5. Investments of the NRRP with a direct link to research and innovation

#	Mission	Component	Description	Amount (€ million)	Contribution to S3s	Innovation related	area-	Territorial indications	Linkage with S3s
Incentives to firms for the adoption of digital technologies									
111	1	2	Transizione 4.0 -Credito di imposta beni materiali	8870	tax credit for new investment in digital technologies (tangibles)	all		no	•••
112	1	2	Transizione 4.0 – Credito di imposta beni immateriali	1910	tax credit for new investment in digital technologies (intangibles)	all		no	•••
113	1	2	Transizione 4.0 – Credito imposta altri beni immateriali	290		all		no	
114	1	2	Transizione 4.0 – Credito di imposta R&S	2020	tax credit for new investment in digital technologies (R&D)	all		no	•••
115	1	2	Transizione 4.0 – Credito imposta formazione	300	tax credit for new investment in digital technologies (training)	all		no	•••
Start-ups									
121	2	2	Start up nella transizione ecologica	250	venture capital for new “green” firms	ecological transition		no	••
122	4	2	Start up	300	venture capital	all		27% South	•
123	5	1	Imprese femminili	400	new firms financing	all		no	•
Research and university-research centres-firm cooperation									
131	4	2	Infrastrutture di ricerca	1580	PPP for research infrastructures	all		no	•••
132	4	2	Partenariati/20iomedic di base	1610	PPP for research activities	20% ecological transition		40% South	•••
133	4	2	Campioni nazionali di ricerca	1600		several innovation areas		40% South	
134	4	2	Ecosistemi innovazione	1300	PPP for innovation	No		40% South	•••
135	CO MPL		Ecosistemi innovazione Sud in contesti marginalizzati	350		no		100% South	
136	4	2	Centri trasferimento tecnologico	350	technology transfer	no		40% South	••
137	4	2	Dottorati innovativi per fabbisogni delle imprese	600	PhD in cooperation with firms	all		30% South	••
138	4	1	Dottorati innovativi: ricerca, pubblica amministrazione, beni culturali	432	researchers	no		no	•
139	4	2	PNR PRIN	1800	research activities	6 clusters of Horizon		no	••
140	4	2	Giovani ricercatori	600	researchers	no		no	•
141	4	1	Didattica e competenze universitarie avanzate	500		no		no	
142	6	2	Ricerca 20iomedical nel SSN	524,1	biomedical research	health		no	••

143	CO MPL		Ricerca sanitaria	500	research (health technologies)	health	no	•••
European programs								
151	4	2	IPCEI	1500	participation in EU IPCEI	batteries, microelectronics, hydrogen	90% South	•••
152	4	2	Horizon	200	participation to Horizon calls	6 clusters of Horizon	80% South	•••
Sectoral initiatives								
161	1	2	Investimenti ad alto contenuto tecnologico	340	industrial development	microprocessors	no	••
162	1	4	Sat com	385		space	no	••
163	1	4	Osservazione terra	200		space	Basilicata	••
164	1	4	Filiera spaziale	275		space	no	••
165	1	4	In orbit economy	150		space	Basilicata	••
166	1	4	Tecnologie satellitari ed economia spaziale	571		space	no	••
167	CO MPL		Tecnologie satellitari ed economia spaziale	800		space	no	••
168	2	2	Produzione impianti energetici innovativi	675		energy	no	••
169	2	2	Rinnovabili e batterie – produzione fotovoltaico	400		energy	Puglia	••
170	2	2	Rinnovabili e batterie – Eolico	100		energy	no	••
171	2	2	Rinnovabili e batterie – Batterie	500		batteries	no	••
172	2	2	Produzione di bus elettrici	300		transportation	no	••
173	2	2	Idrogeno – Elettrolisi	450		hydrogen	no	••
174	2	2	Idrogeno in aree industriali dismesse	500		hydrogen	50% South	••
175	2	2	Idrogeno in settori hard to abate	2000		hydrogen	Puglia	••
176	2	2	Idrogeno per trasporto ferroviario	300		hydrogen	no	••
177	2	2	R&S nell'idrogeno	160		hydrogen	no	••
178	2	4	Ripristino e tutela degli habitat marini	400		green	no	•
179	2	1	Innovazione nell'agroalimentare	500		food	no	•••
Promotion instruments								
181	CO MPL		Accordi per l'innovazione	1000	Increase of financing for Innovation agreements	all	no	••

182	1	2	Competitività e resilienza delle filiere produttive	750	Cluster contracts	12 industries	South	●●
183	CO MPL		Contratti di filiera agroalimentari	1203,3	Cluster contracts: food	food	no	●●
Intellectual property								
191	1	2	Proprietà industriale	300	Intellectual property strategy	all	no	●

Note: ●●● strong link, ●● medium link, and ● weak link.

Source: Authors' elaborations based on PNRR, regional smart strategies and other official documents

4.2 Directly linked measures: Transition 4.0

The principal NRRP intervention is Transition 4.0, providing tax credits to promote the digital transformation of Italian businesses (and following on from the previous “Impresa 4.0”) with funding of €13,380 million. A total of €8,870 million (111) is available for investments in material assets directly connected with digital transformation of production processes, and a further €1,910 million is available for intangible assets (112), in addition to €290 million for intangible assets of a “different type” (113). Then €2,020 million will cover tax credits for research, development and innovation (114); €300 million for training in digitisation and development of the necessary skills, focusing particularly on SMEs and on redundant workers (115). The aim is to provide incentives to around 15,000 businesses per year. Past experience shows that the fruition of these tax credits depends on the size of the business and the sector in which it operates, and on geography. The regional distribution of the tax credits granted in 2017 was highly concentrated in Lombardy, Emilia-Romagna and Veneto (Bratta, Romano, Acciari and Mazzolari, 2020). It is possible to imagine that Transition 4.0 will contribute to further polarisation of the innovation investments of Italian companies in the three strongest regions.

4.3 Directly linked measures: Start-ups

There are three different NRRP lines of investment in favour of new businesses. The first, (121) “Support for start-ups and venture capital for ecological transition”, consists of €250 million. It aims to encourage the growth of an innovation ecosystem (with the focus on sectors like renewables, sustainable mobility, energy efficiency, refuse treatment, batteries) through direct and indirect venture capital investments. The intervention has a dedicated fund (“Green Transition Fund”, GTF), and 4 principal areas of action: 1) indirect investments of €100 million in existent Venture Capital funds; 2) indirect investments of €50 million in the “pre-seed” and “seed” start-up phases; 3) direct investments of €50 million in the initial and growth stages of start-ups to consolidate the action of VC funds that are already active; 4) investments in “venture building” with €50 million.

“Start-up funding” (122) will contribute €300 million to the National Innovation Fund, managed by the *Cassa Depositi e Prestiti* to support the development of venture capital in Italy. This will support 250 innovative SMEs with investments totalling €700 million. The NRRP estimates that the sub-division of the funding will see 73% allocated to the Centre-North and 27% to the South, considering the current trends regarding venture capital.

A further measure (123) provides €400 million to support the “Creation of Women’s Businesses”, to increase the number of women in entrepreneurship, systemising and redrawing the existent measures to support the creation of business projects led by women or involving a majority of women. The resources related to this investment will be used to create a “Women’s Business Fund”, to add funding to some

existent measures, and the new Fund for women in business established by the 2021 Italian Budget Law (amounting to €20 million per year in 2021 and 2022).

4.4 Directly linked measures: Research and research-business collaboration

Different NRRP interventions will provide direct finance for infrastructures and research activities. One measure (131) provides €1,580 million for the creation of an integrated system of research and innovation infrastructures to connect industry with academic research. This will fund the creation or consolidation of important pan-European research infrastructures and dedicated innovation infrastructures, promoting the combination of public and private investments. A maximum number of 30 (existent or new) infrastructure projects is envisaged. If the specific characteristics of the project allow this, research and innovation infrastructures will be funded and managed through public-private partnerships (PPPs). The public funding to the PPPs will cover 49% of the total capital investment and personnel costs.

“Extended partnerships among Universities, research centres, businesses and funding of basic research projects” (Measure 132), has been allocated €1,610 million and aims to fund up to a maximum of 15 research and innovation programmes, carried out by partnerships consisting of Universities, research centres and businesses (20% of which will involve green issues).

“Strengthening of research structures and creation of “national R&D champions” on some Key Enabling Technologies” (133), envisages investments of €1,600 million to finance the creation of national research centres capable of reaching a critical threshold of research and innovation through collaboration involving Universities, research centres and business. Essential elements of every national centre will be the creation and/or renewal of relevant research structures, the involvement of firms in the preparation and implementation of research projects, and the support for start-ups and creation of spin-offs. The sectors chosen for this intervention are advanced simulation and big data, environment and energy, quantum computing, biopharma, agritech, fintech, digital transition of industry, sustainable mobility, applied technologies for cultural heritage, technologies for biodiversity. A call for proposals will be published to select up to five networks of universities, research bodies and companies in any one of the scientific and technological areas involved.

“Creation and consolidation of “innovation ecosystems”, and the construction of “territorial R&D leaders” (Measure 134) has been allocated €1,300 million. According to the NRRP, innovation ecosystems represent an innovative model of economic and social innovation: places for collaboration between universities, research centres, local institutions and society, in order to carry out high-level training, innovation and applied research. The measure envisages funding 12 “territorial R&D champions” (existent or new) as a result of a call for proposal. The selection procedure will be directed in such a way as to identify at least one project per “regional area” (it is not entirely clear what this term means). In relation, Article 1, comma 2, a), no. 4 of the Complementary Fund allocates a further €350 million for “Ecosystems for innovation in

the South in marginalised urban contexts” (135). The relative call for proposals was published by the Territorial Cohesion Agency in September 2021.

Mission 4, Component 2 contains the investment for “Consolidation and thematic and territorial expansion of the centres for technological transfer for industry” (136), with €350 million of funding. This aims to support a network of 60 centres tasked with providing businesses with advanced technological services and innovative services. Art. 42 of Italian Decree-Law 19/2020, already envisaged a programme to support technological transfer, creating the “Fund for technological transfer”. The same article envisages initiatives to favour the collaboration of public and private operators in innovation and spin-off projects. It also envisages an agreement between MISE (Ministry of Industry) and ENEA (National Agency for Energy), which has in turn set up the “Enea Tech Foundation”. The aim is to finance at least 205 projects and 42 new hubs, with the estimated value of services (public and private resources) of €600 million, involving at least 4,500 SMEs.

“Innovative doctorates” (137) provides €600 million to finance University PhD courses that meet the innovation needs of businesses and to promote the recruitment of researchers. The aim of this measure is to consolidate high-level skills, especially in the areas of Key Enabling Technologies, through dedicated PhD programmes, with the contribution and involvement of businesses, and to provide incentives for companies to recruit junior researchers on temporary contracts. The measure envisages 5,000 PhD grants for 3 years (a total of 15,000) by 2024, with private co-financing and an incentive for companies to recruit 20,000 research fellows. No less than 30% of the available places will be assigned to the universities in the South.

A further measure (138) aims to increase the number of doctoral students engaged in research, in connections with the public administrations and management of cultural heritage. The specific aim is to increase the number of PhD students by 3,600, 3,000 new PhD graduates for public administration are envisaged; in collaboration with the Ministry of Culture, there will be funding for 600 doctorates to improve efficient management and development of the country’s cultural heritage. At least 30% of the resources should be allocated to the South.

The Fund for the National Research Programme (PNR) and new research projects of outstanding national interest (PRIN) will receive €1.800 million (139). The main areas of PNR intervention reflect the six Horizon clusters: i) health; ii) humanistic culture; iii) social systems; iv) digital, industry, aerospace; v) climate, energy, sustainable mobility; vi) food, bioeconomy. Up until 2026, the investment will fund 5,350 projects. The recipients of the intervention are Universities, research centres, and researchers.

To “Financing for projects presented by young researchers” will be allocated €600 million (140). The aim here is to offer young researchers new opportunities, in order to keep them within the Italian economic

system. The measure provides support for the research of a maximum number of 2,100 young researchers, through annual calls for proposals.

A sum of €500 million will be used for universities (141) for: the enrolment of 500 PhD students over 3 years on programmes dedicated to digital and environmental transition; the creation of 3 *Teaching and Learning Centres* (TLC) to improve teacher training; the creation of 3 *Digital Education Hubs* (DEH) to improve the ability of higher education to offer digital training to university students and workers; the implementation of 10 transnational educational initiatives; support for 5 internationalisation projects involving the Advanced Artistic and Musical Training (AFAM) institutions. 30% of the doctoral students should be enrolled in the universities of southern Italy and the islands; one of the three TLCs and one of the 3 DEHs will be established in the Southern regions; at least one internationalisation initiative of the AFAM institutions will be promoted by the institutions in the South.

The measure “Valorisation and reinforcement of National Health Service biomedical research” (142) allocates €524.1 million in order to reinforce the capacity of Italy’s research centres in studying rare diseases; it will also enable technological transfer between research and business for at least 420 projects: €100 million to implement 100 “proofs of concept”; 100 rare disease and rare tumour research projects; 324 research projects on highly disabling diseases.

Article 1, comma 2 l) of the Complementary Fund (143) allocates €500 million to finance research regarding technologies for the health service, in order to improve diagnostics, monitoring, treatment and rehabilitation. The initiatives involve data management and innovative technologies for in-person and remote diagnosis, distance treatment, support for clinical decision-making, health and treatment management using artificial intelligence, treatment of fragile and chronic patients, assessment of the impact of environmental factors and lifestyle on health, monitoring and transition towards sustainable lifestyles. The projects concern: robotics, sensors, bio-mechatronics, ICT technologies, cloud computing, artificial intelligence, and telemedicine. The investment will be implemented in four broad initiatives: robotics and digital tools, distance monitoring, process re-engineering, and data mining. For each initiative, funding will go to 4-5 big industrial research and experimental development projects.

4.5 Directly linked measures: Participation in European programmes

One NRRP measure (151) provides €1,500 million to integrate the IPCEI (Important Projects of Common European Interest). Fund introduced by the 2020 Budget Law. To date, Italy is part in 3 IPCEI: two on batteries, and the other on microelectronics. On 30 March 2021, a call for proposals was launched for the IPCEI new generation infrastructures and services cloud. A further 2 IPCEIs will be launched soon, one regarding sustainable hydrogen (in particular from renewable energies) and a second on microelectronics (5G and smart mobility). The measure provides for public support - via incentives - to the participation of Italian companies and research centres; 90% of the resources will be allocated to the South.

“Partnerships – Horizon Europe” (152) provides €200 million to support participation in the Horizon Europe programme, in particular for: key digital technologies; the transition to clean energy; blue ocean; innovative SMEs. The South will receive 80% of this funding.

4.6 Directly linked measures: industrial promotion

The NRRP contains many measures aimed at specific technological areas and production sectors.

“High-tech investments” (161) provides €340 million for innovation in microprocessors. It envisages support for investments in machinery, plants and equipment for avant-garde technological industries, complementing the Transition 4.0 measures. The aim is to have an annual production capacity of at least 374,400 substrates of silicon carbide, employing at least 700 more highly qualified workers.

A series of measures concern aerospace. There is a fund of €385 million for the “Sat Com” programme (162), connected with the technological development of connectivity. It concerns the creation of secure communication networks based on innovative solutions, like application in quantum key distribution via satellite. The line “Observation of the Earth” (163) (200 million) regards applications to improve territorial management (environment, security, management of cultural and archaeological heritage, natural disasters), risk prevention and the management of the digitised society of the future (smart cities). One of the actions involves reinforcing the Matera Space Centre of excellence, which is already a base for satellite operations connected with remote observation. “The Italian space industry” (164) provides €235 million to increase the competitiveness of companies via two programmes: Space Factory 4.0 (development of intelligent factories for the production of small satellites, also through digitalisation of production processes, in line with Transition 4.0) and “Space access programmes” (development of green technologies for the future generations of rocket engines and launch vehicles). “In orbit economy” (165) (€150 million) aims to improve the management of in orbit missions, via the development of systems, approaches and technologies that optimise the lifespan of a satellite (“In-Orbit Servicing”). It envisages: a programme dedicated to the development of new servicing capacities through projects to develop independent and remote-controlled robotics and the use of artificial intelligence; the construction of three further telescopes to create an observation and tracing network for space debris, with the control centre of Matera Base. “Satellite technologies and space economy” (166) has funding of €571 million and aims to set up at least 2 terrestrial telescopes and other infrastructures (Article 1, comma 2, letter a) no. 3 of the Complementary Fund (167) assigns a further €800 million to satellite technologies and space economy, to reinforce the systems for monitoring the earth and outer space, consolidating Italian competences in this sector.

“Promotion of innovative energy plants” (168) has funding of €675 million and aims to set up plants with a total installed capacity of 200 MW from renewable energy sources, in particular: a) from wind turbines and floating photovoltaic plants, together with energy storage systems (100 MW); b) from wind turbines and floating photovoltaic plants, together with wave-power plants and other high-efficiency systems,

integrated with energy storage systems (100 MW). The interventions will be financed using the “Agreements for innovation” (*Accordi di Innovazione*) for industrial research and experimental development and the “Development Contracts” (*Contratti di Sviluppo*) aimed at highly strategic and innovative investments amounting to no less than €20 million.

“Renewables and batteries” assigns €1,000 million to reinforcement of the Italian photovoltaic energy, wind turbines, and production of batteries for transport and for the electricity industry. The aim is to use €400 million to increase photovoltaic production (169) from the present level of 200 MW/ year to at least 2 GW/year in 2025, and at least 3 GW/year in 2026, producing high-efficiency solar panels based on an innovative cell model (“tango”). A total of 48 projects will be funded using the measure “Contratto di Sviluppo”. The NRRP indicates the construction of a factory to produce flexible “Midsummer” panels (in the Modugno industrial zone, Bari province). It allocates €100 million for wind turbines (170), again through *Contratti di Sviluppo*, to carry out 12 installation and repowering projects involving wind farms. For the battery industry (171), €500 million will finance the two IPCEI projects in which Italy is involved (Batteries 1 and Batteries 2).

“Electric buses” (172) invests €300 million for the technological reinforcement of Italy’s bus manufacturing sector by expanding the production capacity and improving vehicles’ environmental impact; it will support 45 projects of industrial transformation via “*Contratti di Sviluppo*”.

Different measures involve the hydrogen sector. The first (173) assigns €450 million for the installation of around 5 GW of electrolysis capacity by 2030 and the development of further technologies necessary to support the final use of hydrogen (e.g. fuel cells for lorries). The investment of the “Production of hydrogen in former industrial areas” (174) has €500 million to promote the production and use of hydrogen in industry and local transport, with the creation of “Hydrogen Valleys” (industrial areas whose economy is partly based on hydrogen), via the installation of electrolyzers to produce hydrogen dedicated RES in the area. At least 50% of resources will go to the South. “Use of hydrogen in hard-to-abate sectors” (175) assigns €2,000 million to the progressive decarbonisation of “hard-to-abate” industrial sectors, in coordination with the hydrogen IPCEI in which Italy intends to participate. For the hard-to-abate industries other than iron and steel, the project aims to promote the transition from methane to green hydrogen through sustainable and innovative transformation projects on the production cycles. A general call for proposals will be launched for the industrial sectors that use methane as a source of energy (cement, paper mills, ceramics, glass factories, etc.) to support research, development and innovation in their industrial processes and to finance pilot projects and their industrial “scale-up”. For the steel industry, the aim is to use methane, gradually mixed with low-carbon hydrogen and subsequently with green hydrogen. There will be 2 projects (not precisely detailed, but likely to be connected with the Taranto plants), one amounting to €1.6 billion and the other to €400 million. “Experimentation of hydrogen for rail transport” (176) assigns €300 million for the conversion of non-electrified railway lines to hydrogen, supporting research into the development of high-

pressure electrolysers and high-capacity storage systems with the possibility of using metal or liquid hydrides. “Hydrogen research and development” (177), assigns €160 million to the development of four principal lines of research: i) production of green hydrogen; ii) development of hydrogen storage and transport technologies and technologies for its transformation into other derivatives and green fuels; iii) development of fuel cells; iv) improvements to the resilience of present infrastructures for more widespread use of hydrogen. These will be connected with the IPCEIs.

“Restoration and protection of marine habitats” (178) allocates €400 million to finance large-scale interventions to restore and protect the marine habitats in Italian waters. This will be achieved by strengthening the national research system and observation of coastal and marine ecosystems and reinforcing the availability of updated research vessels. There will be 22 projects.

“Innovation and mechanisation in the food and agriculture sector” (Measure 179) has €580 million to support the modernisation of agricultural machinery for precision agriculture, to: use agriculture 4.0 technologies; update agricultural vehicles to reduce emissions; for the processing, storage and packaging of food products; reduce/eliminate waste; encourage reuse for energy (with particular reference to olive oil).

4.7 Directly linked measures: Promotion tools

Further funding for the “Innovation Agreements” is provided by Article 1.2.F of the Complementary Fund (181), which assigns €1,000 million. The Innovation Agreements are signed by the Ministries, other public administrations and proponent companies in order to support investments with an important technological impact on business competitiveness and in order to safeguard employment levels and increase the presence of foreign companies in Italy. The projects eligible must envisage industrial research and experimental development, aimed at creating new products, processes or services or at improving these considerably, via development of the technologies listed in the EU Horizon Programme. The NRRP provides for the use of the “Innovation Agreements” for industrial research and experimental development as part of some measures already mentioned in this report (e.g., 168 and 174).

“Competitiveness and resilience of production systems” (182) assigns €750 million to investment projects in several production systems: agrifood, automotive, furnishing and design, shipbuilding, aerospace, building and property, energy and utilities, fashion and beauty, mechanics, media and TLC, transport and logistics, and tourism. The aim of this measure is to expand the “Development Contract” in order to strengthen the entire production system through “Cluster contracts”. Article 1, comma 2, h) of the Complementary Fund (183) then specifically assigns €1,203.3 million to “Production system and district contracts for the agrifood, fishery and aquaculture sectors, forestry, floriculture and nursery sectors” (25% is for organic production).

4.8 Directly linked measures: Intellectual property

The NRRP provides for the “Reform of the industrial property system” and assigns €300 million (without indicating its precise use) to this goal. The reform is aimed at the definition of a long-term strategy for industrial property.

5. NRPP, research and innovation: indirectly linked investments

5.1 The framework

Twenty-four NRRP and CF lines of investment indirectly linked with research and innovation can be identified, with total funding amounting to around €25 billion; these have been reorganised into 6 groups: reinforcement of digital citizenship; reinforcement of education, active labour market policies, digital infrastructures, special economic zones, promotion of the green and digital economy (Table 6).

Table 6. Investments of the NRRP with an indirect link to research and innovation

#	Mission	Component	Description	Amount (€ million)	Contribution to S3	Innovation related	area- Territorial indications	Linkage with S3
Digital citizenship								
211	1	1	Servizi digitali ed esperienza dei cittadini	2013		Digital	no	••
212	1	1	Competenze digitali di base	195	public procurement: new digital services	Digital	no	•
213	COMPL		Servizi digitali e cittadinanza digitale	350		Digital	no	•
214	COMPL		Servizi digitali e competenze digitali	250		Digital	no	•
215	COMPL		Polis - Case dei servizi digitali	800		Digital	Internal areas	•
Education								
221	4	1	ITS	1500	education	All	no	
222	4	1	Orientamento attivo scuola-università	330		All		••
223	4	1	Didattica digitale integrata - formazione personale scolastico	800		All	no	•
224	4	1	Nuove competenze e nuovi linguaggi	1100		All	no	•
225	4	1	Scuola 4.0	2100	public procurement: new digital services	All	no	•
Active Labour market policies								
231	5	1	Politiche attive del lavoro e formazione (GOL)	4400	labour market	All	no	•
Digital infrastructures								
241	1	2	Reti ultraveloci - Connettività a 1 giga	3863,5	better digital connections	All	45% South	••
242	1	2	Reti ultraveloci - Italia 5G	2020		All	no	••
Special economic zones								
251	5	3	ZES	630	locational advantages	All	100% South	•
Promotion of green and digital economy								
261	2	1	Progetti faro di economia circolare	600	public procurement	satellites and AI	60% Centre-South	••
262	2	1	Isole verdi	200		Green	19 Small Islands	•
263	2	4	Monitoraggio acque	500		digital, satellites	no	•
264	2	4	Bonifica siti orfani	500		Digital	no	•
265	1	1	Cybersecurity	623		Digital	no	•
266	1	3	Strategia digitale per il patrimonio culturale	500		Digital	no	••

267	2	2	Innovazione digitale dei sistemi aeroportuali	110	Digital	13 main airports	●
268	2	4	Digitalizzazione parchi nazionali	100	Digital	24 National Parks	●
269	1	1	Digitalizzazione grandi amministrazioni	611	Digital	no (Lazio)	●
270	2	4	Riduzione perdite reti idriche	900	Digital	45% South	●

Note: ●●● strong link, ●● medium link, and ● weak link.

Source: Authors' elaborations based on PNRR, regional smart strategies and other official documents

5.2 Indirectly linked measures: digital citizenship

The measures for digital citizenship are included in this report because they may encourage innovation in business, to meet new public demand for advanced digital services.

“Digital services and citizens’ experience” (211) assigns €1,973 million to a series of interventions: to improve the experience of public digital services, defining reusable models for the provision of services that guarantee requirements of accessibility; to improve the accessibility of public digital services; to promote the adoption of digital applications for payments between citizens and the public administrations (PagoPA, IO) with a single app; to promote the adoption of national digital identity platforms; to develop a single platform for notifications; to promote the adoption of mobility systems as services in the metropolitan cities, to digitalise local transport and provide integrated mobility.

“Basic digital competences” (212), assigns €195 million to improve citizens’ digital skills and to overcome the *digital divide*, via the creation of a network of centres for digital facilitation and reinforcement of the Digital Civil Service, with the recruitment of young people to help users learn basic digital skills.

“Digital services and digital citizenship” (213), and “Digital services and digital citizenship” (214) of the Complementary Fund co-finance these interventions with €350 and €250 million, respectively. “Polis. Digital service houses” (215), also belongs to the CF and allocates €800 million for the creation of “Houses for digital services” in 4,764 municipalities with fewer than 15,000 residents in inland areas of Italy.

5.3 Indirectly linked measures: education

The measures for education may encourage innovation in business by raising the educational level of new workers and, partly also via the public procurement for advanced digital services.

“Higher Technical Institutes” (*Istituti Tecnici Superiori – ITS*) (221) assigns €1,500 million to increase the number of ITS; reinforce their laboratories with technologies 4.0; train teachers to adapt training programmes to the needs of local companies; develop a national digital platform for job vacancies aimed at students with professional qualifications, double the numbers enrolled at present.

“Active school-university orientation” (222), allocates €330 million for the organisation of 50,000 short courses taught by university professors and teachers to a million pupils from the third year of high school onward.

“Integrated digital teaching” (223) assigns €800 million for the creation of a national coordination hub and an integrated network of local training poles, in collaboration between schools, provincial adult education centres, regional school departments, universities and research centres. There will a catalogue of around 20

training courses on the use of digital teaching in all subjects, and for computer skills and AI at all levels of education and in adult education.

“New skills and new languages” (224) assign €1,100 million for the integration of all school curricula with activities, methodologies and contents to develop STEM skills, digital and innovation skills and multilingualism. It also provides for a mandatory *coding* course for all students.

“School 4.0” (225) has €2,000 million of funding and aims to accelerate the digital transition of the Italian school system with four initiatives: transformation of around 100,000 traditional classes into *connected learning environments*, with online teaching devices; workshops for the digital professions; digitalisation of school administrations; internal wiring of around 40,000 school buildings.

5.4 Indirectly linked measures: active labour market policies

The intervention on active labour market policies may favour innovation in business through requalification of supply and a better match between supply and demand on the job market.

“Active labour policies and training” invests €4.4 billion in a wide-ranging reform of active policies and professional training, supporting professional retraining and the return to work of those in transition and unemployed; in close collaboration with the Regions, essential levels of training will be identified for the categories most at risk. The reform is organised with two lines of intervention: 1. adoption of the national programme Employability Guarantee for Workers (*Garanzia Occupabilità Lavoratori*, GOL), as the national programme responsible, with provision of specific services and personalised professional planning; 2. adoption of the National New Skills Plan, to reorganise training for workers in transition and unemployed, through reinforcement of the professional training system.

5.5 Indirectly linked measures: digital infrastructures

Reinforcement of digital infrastructures can encourage innovation processes by increasing the availability and quality of digital connections for data transmission.

“Ultra-fast networks - 1 giga connectivity” (241), assigns an investment of €3,863.5 million for 1 Gbps connectivity (“Italy at 1 Giga” Plan) to around 8.5 million families, companies and other bodies in the “grey” and “black” areas (“market failures”) not included in the previous public intervention plans.

In parallel, “Ultra-fast networks - Italy 5G” (242) will invest €2,020 million to provide incentives for the development and spread of 5G infrastructure: in areas with insufficient demand (market failure) (“Italy 5G” Plan, with €1 billion of funding); along 2,645 km of European transport corridors (€420 million) and 10,000 km of roads (€600 million), to allow the development of services supporting road safety, mobility, logistics and tourism.

5.6 Indirectly linked measures: Special Economic Zones

The measure regarding the Special Economic Zones (SEZ) (251) can encourage innovation processes by creating better localisation opportunities for businesses (also following new investments) in the South.

With €630 million, the investment aims in particular to ensure adequate development of connections linking SEZs to the national transport networks, especially with the Trans-European Network programme (TEN-T), in order to make the implementation of the SEZs effective. The principal interventions regard: “last mile” connections between industrial areas and National Integrated Transport System to reduce transport times and costs; primary urbanisation to implement the agreements with economic operators ready to invest; transport networks that reinforce safety levels.

5.7 Indirectly linked measures: promotion of the green and digital economy

The many NRRP measures connected with green and digital transition include some lines of investment that may be relevant for research and innovation processes, given that they activate public demand for advanced services and directly involve applied research and innovative requirements.

The aim of “Circular economy flagship projects” (261), with €600 million to invest, is to improve the system of separated refuse collection and the treatment/recycling plants. In order to achieve these objectives, a monitoring system will be developed across the country system using satellites, drones and AI technologies. “Green islands” (262), envisages an investment of €200 million, concentrated on 19 small islands, which will act as a “laboratory” for the development of models that are “100 percent *green*” and self-sufficient. “Water monitoring” (263), will invest €500 million to develop a system of remote monitoring for large areas of the country, making it possible to identify and predict areas of risk caused by climate change, with data collection and processing using satellites, drones, remote sensors and the integration of existent monitoring systems; continuous function telecommunication networks; central and regional control rooms, *cyber security* systems and services. “Reclamation of abandoned sites” (264), invests €500 million for the reclamation of polluted sites where there is no longer any industry. For this purpose, it will require the use and development of innovative technologies to identify areas with real needs of reclamation to enable development of these areas. The investment of €623 million for “Cybersecurity” (265) also includes the reinforcement of a national network of laboratories for selection and certification. “Digital strategy for cultural heritage” (266) uses €500 million to finance, among others, new infrastructures, and software services.

In the same way, “Digital innovation for airport systems” (267) uses €110 million to finance the development of new software and digital systems. The same happens for “Digitalisation of natural parks” (268), which envisages an investment of €100 million. Even more important is “Digitalisation of the larger public administrations” (269), which invests €611 million. Lastly, “Reduction of water losses” (270) invests €900 million to improve water networks with digitalisation and innovative systems to transform them into “intelligent networks”.

6. Smart specialisation strategies in Italy: revisions and challenges

In the programming period 2014-2020, Italy has adopted a multi-level approach to Smart Specialisation with twenty-one regional strategies and one national strategy. For the new programming period 2021-2027, the European Commission has dedicated the bulk of its budget to promoting a Smarter Europe through the confirmation of the smart specialisation approach and has requested national and regional authorities to update their S3s.

The elaboration of the new strategies has proceeded slowly since regional administrations were mainly focused on addressing the consequences of the pandemic. (7) More in general recovery money planning has overloaded administrative capacity in many Member States at the expense of Structural Funds planning which now faces delays.

In May 2022, eighteen Italian regions have revised their strategies, while Campania, Basilicata and Molise are still revising their strategies. The assessment by the European Commission is in progress. The national strategy is still under revision, too.

As regard the revision process of the national Smart Specialisation Strategy it should be noted that on December 15th, 2020, the CIPE (the Italian Inter-ministerial Committee for Economic Planning) approved the National Research Programme (NRP) 2021-2027 submitted by the Ministry of Universities and Research. It is a multiannual framework programming tool designed to contribute, among other things, to the 2021-2027 Cohesion Policy Objectives and the Next Generation EU initiative. It is likely that the national Smart Specialisation Strategy will follow the priorities identified in the NRP.

The NRP 2021-2027 is divided into system priorities, major research and innovation areas, and related areas of intervention, national plans, and missions. The six major research and innovation areas and their focus areas reflect the six clusters of Horizon Europe and consider the national Smart Specialisation Strategy areas. The main areas of research and innovation are structured at a more refined granularity level (28 areas of intervention) and broken down in line with the national context's specific features highlighted by the administrations' consultation and contributions. The National Plan for Research Infrastructures and the National Plan for Open Science are an integral part of the 2021-2027 NRP.

With reference to the regional S3s analysed, it is interesting to note that only in the documents relating to smart strategies of Emilia-Romagna, Piemonte, Autonomous Province of Trento, Veneto, Toscana, Abruzzo, Lazio, Lombardia, Puglia, Sardegna and Sicilia the NRRP is explicitly referred to. However, the Smart Specialisation Strategies of Piemonte, Emilia-Romagna, Veneto, Sardegna and Sicilia are the only ones to indicate possible synergies between S3 priorities and NRRP missions. There is currently no clear

(7) It is important to note that a major challenge in updating S3s is the lack of sustained evidence on the results and impact of the strategy in the closing period.

alignment between the Italian RRP and 2021-2027 Smart Specialisation strategies in the majority of the Italian regions. It seems evident a separation of the NRRP logic from the S3 logic.

Table 7 shows the specialization areas selected in the available S3s and the priority thematic areas into which each strategy is divided. Overall, the analysis shows some continuity with the previous S3s in the identification of priority themes. The influence of the new priorities of the European Commission in favour of a greener, digital and inclusive economy is evident in all regional Smart Strategies.

Table 7. S3s 2021-2027: regional priorities

Lombardia						
<i>Specialization areas</i>						
Aerospace	Agri-food	Green industry	Creative and cultural industries	Health industries	Advanced manufacturing	Sustainable mobility
<i>Priority thematic areas</i>						
<ol style="list-style-type: none"> Space integrated systems and space systems Fixed and mobile wing integrated aeronautical systems Electro- mechanical systems and avionics, New technologies for production and infrastructures 	<ol style="list-style-type: none"> Sustainable and competitive agri-food supply chain Individual well-being (healthy ageing through systems, food, supplements and nutraceuticals) Food safety and security 	<ol style="list-style-type: none"> Energy efficiency also in buildings Renewable energies Emission reduction Energy storage Smart grids Power system flexibility Nuclear energy Material recycling Reduction of water consumption and recovery Internal environmental quality Air, water and soil quality 	<ol style="list-style-type: none"> Innovative solutions for environmental surveying Smart systems for the analysis of territorial and remote sensing systems and integrated geophysical systems Digital detection and 3D virtualization technologies Development of diagnostic, preservation and monitoring technologies Design and fashion Advanced textile industry Multimedia 	<ol style="list-style-type: none"> E-health New diagnostic systems Drugs and innovative therapeutic policies Prevention Health monitoring Rehabilitation 	<ol style="list-style-type: none"> Advanced manufacturing processes Mechatronics for advanced manufacturing systems Modelling, simulation, forecasting methods and tools ICT Sustainable manufacturing technology Advanced materials Strategy definition and management methodologies. 	<ol style="list-style-type: none"> Structural weight reduction Reduction of CO2 signature through alternative transmissions and fuels Development and dissemination of innovative and efficient urban goods logistical systems through sustainable means Related vehicles (control systems) Vehicle safety systems Advanced materials

Piemonte					
<i>Cross-cutting components of innovation</i>					
Digital transition		Ecological transition		Social / territorial impact	
<i>Specialization areas</i>					
Aerospace	Mobility	Green technologies	Advanced manufacturing	Food	Health

Valle d'Aosta		
<i>Specialization areas</i>		
Mountain of excellence	Sustainable mountain	Smart mountain
<i>Development trajectories</i>		
<ol style="list-style-type: none"> Industry 4.0 Advanced materials 	<ol style="list-style-type: none"> Energy efficiency and renewables Agriculture Circular economy Health Sustainable mobility 	<ol style="list-style-type: none"> Digitization, artificial intelligence, Big Data Connectivity Monitoring of the territory Valorisation of the cultural heritage

Veneto
<i>Priority areas of specialisation</i>

Smart agri-food	Smart Manufacturing	Smart Health	Culture and Creativity	Smart Living & Energy	Smart Destination
<i>Technological trajectories</i>					
<ol style="list-style-type: none"> 1. Development of agriculture and precision zootechnics 2. Development of more efficient products and equipment and enabling technologies for production in organic farming 3. Innovation and resources for the optimization of the nutritional status and the eco-sustainable phytosanitary defence of crops 4. Recovery of by-products from the production/processing of agri-food chains 5. Innovative and more sustainable packaging for agri-food products 	<ol style="list-style-type: none"> 1. Smart management of production systems through the implementation of "digital twin" solutions 2. Innovative processes for the treatment and/or reuse of industrial waste 3. New machines and systems made with innovative materials and components, and aimed at safety, energy saving and rational use of resources 4. Sustainable supply chain tools and "green" energy solutions for manufacturing 	<ol style="list-style-type: none"> 1. Improve the health and well-being of consumers, through foods that can bring useful and functional elements to the improvement of health 2. Assistive services and technologies 3. Innovative textile materials and wearable health and safety technologies 4. Development of molecular diagnostic systems 5. Development of technologies for prevention diagnostics and early diagnosis 6. Systems for the prevention of cognitive decline 	<ol style="list-style-type: none"> 1. Recognizability and communicability product 2. Technologies for the cultural heritage 3. Innovation and digitalization in "Made in" processes 4. Business models and Value Added services 5. Technologies for the design and prototyping of creative products 6. Advanced digital technologies for the creative and cultural market 7. Development of digital tools for the enhancement, fruition and promotion of the cultural and creative system 	<ol style="list-style-type: none"> 1. Domotics and automation to improve the quality of life 2. Innovative solutions and materials for the living 3. Development of technological solutions and integrated smart city management systems 4. Technologies for building design and management 5. Safety and privacy in places of life 6. Solutions for independent living 7. Innovation and digitalisation of technological systems used in the market 8. Improvement of waste management capacity, in particular development of innovative systems 9. Planned urban regeneration 	<ol style="list-style-type: none"> 1. Development of methods and technologies in favour of integrated systems between agri-food, tourism and ecology 2. Virtual technologies and realities for the enhancement of tourism and artistic and cultural heritage 3. Technological solutions for the enhancement of integrated opportunities for sustainable hospitality in naturalistic areas 4. Development of digitization to encourage the engagement of tourism demand 5. Big data for tourism

<p>6. Development of innovative systems for food processing</p> <p>7. Development of complete traceability systems</p> <p>8. Control systems for food safety</p> <p>9. Microbiome for the improvement of agricultural production</p> <p>10. Energy balance in greenhouse systems</p> <p>11. Resilient ecosystems</p>	<p>processes and product life renewal</p> <p>5. Development of 4.0 enterprise systems and tools through the integrated, innovative and multi-scale design of components, products and equipment</p> <p>6. Development and production of innovative materials</p> <p>7. Innovative solutions for agile reconfiguration</p> <p>8. Innovative solutions for spaces and inclusive and human-centric work organization</p> <p>9. Artificial intelligence for the renewal of the business formula</p> <p>10. Data enhancement through digital solutions</p>			<p>10. Technologies for the decarbonisation of PA companies</p> <p>11. Technologies for monitoring environmental pollution and sustainable use of water resources</p> <p>12. Smart mobility systems for the territory</p>	
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	11. Development of technologies for energy symbiosis				
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Friuli Venezia Giulia				
<i>Specialization areas</i>				
Energy transition, circular economy and environmental sustainability	Smart Factory and Sustainable Development of Made in Italy supply chains	Maritime Technologies - Sustainable Waterborne Mobility and its land connections	Health, Quality of Life, Agri-food and Bioeconomy	Cultural heritage, design, creative industries, tourism
<i>Development trajectories</i>				
<ol style="list-style-type: none"> 1. Application of the circular economy at the system level (area, network, supply chain) 2. Energy sustainable buildings 3. Energy efficiency systems for industry 4. Smart grids 	<ol style="list-style-type: none"> 1. Solutions and technologies for product innovation 2. Sustainable development and commercial resilience for the regional made in Italy supply chains 3. Solutions and technologies for process innovation 4. Technologies for the management and development of the organization 5. Innovation of social systems and enhancement of human resources in manufacturing 	<ol style="list-style-type: none"> 1. Green mobility 2. Smart mobility 3. Sea made in FVG 	<ol style="list-style-type: none"> 1. Systems and solutions for health and care support 2. Innovative biomedical solutions and systems 3. Active & assisted living solutions and systems to support fragility 4. Solutions and systems for innovative therapies 5. Promote the safety and security of production and the resilience of value chains 	<ol style="list-style-type: none"> 1. System creation for Creative Industries 2. Research Development and Technological Innovation for Creative Industries 3. Tourism 4.0 4. Sustainable innovations to build greener destinations 5. System development for competitiveness through national and international levers and areas for creative industries

			6. Support the development of smart and resilient local communities 7. Introduction of innovative systems for the collection, integration, sharing and distribution of products and related information	
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Autonomous Province of Bolzano			
<i>Specialization areas</i>			
Automation and Digital	Food and Life Science	Alpine technologies	Green Technologies
<i>Cross-cutting fields</i>			
Sustainability	Digitalization	Creative Industries	Education and permanent training

Provincia Autonoma di Trento			
<i>Specialization areas</i>			
Sustainability, Mountains and energy resources	ICT and Digital transformation	Health, nutrition and lifestyles	Smart industry
<i>Technological trajectories</i>			
1. Smart agriculture (with special attention to the mountains)	1. Artificial intelligence	1. Smart healthcare & telemedicine	1. Fast prototyping (additive manufacturing 3D printing)

<ul style="list-style-type: none"> 2. Circular bioeconomy 3. Sustainability of production processes 4. Technologies and systems for conservation and protection of resources 5. Renewable energies: production, management and storage 6. Smart systems for sustainable mobility 7. Smart systems and energy efficiency (smart grid and smart building) 	<ul style="list-style-type: none"> 2. Advanced computing & data (Big data and Open data) 3. Cyber security 4. PA digital transformation (for society and the economy) 5. Technologies for tourism and sport 6. Quantum technology 	<ul style="list-style-type: none"> 2. Technologies for territorial medicine 3. Personalized medicine 4. Preventive medicine and medical devices 5. Prevention and well-being: advanced diagnostics and lifestyles 6. Technologies for food safety, quality and traceability 	<ul style="list-style-type: none"> 2. Smart materials and sensors 3. Integrated systems and micro systems 4. Collaborative robotics man and machine integration & automation 5. Economy based on digital services (digital servitization)
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Liguria		
<i>Specialization areas</i>		
Marine technologies	Safety and quality of life	Health and life sciences
<i>Sub sectors</i>		
<ul style="list-style-type: none"> 1. Maritime technologies 2. Protection and valorisation of the marine - coastal environment 3. Logistics, security, and automation in port areas 	<ul style="list-style-type: none"> 1. Smart Mobility 2. Smart environment 3. Factories for the future and automation 4. Monitoring of the territory 	<ul style="list-style-type: none"> 1. Technologies for regenerative, predictive and personalized medicine 2. Diagnostic platforms 3. Technologies for rehabilitation, assistance, integration and education 4. Technologies and methods for the use of big data in healthcare

Emilia-Romagna														
<i>Specialization areas</i>														
Agri-food		Mechatronics and Motors		Construction		Health industries		Creative and cultural industries		Tourism		Energy and sustainable development		Innovation in services
<i>Priority thematic areas</i>														
Clean, safe and accessible energy	Circular economy	Climate and natural resources	Blue growth	Innovative Materials	Digitization, artificial intelligence, big data (businesses and PA)	Manufacturing 4.0	Connectivity of ground and space systems	Sustainable mobility	Cities and communities of the future	Valorisation of cultural heritage, cultural and creative activities, tourism	Well-being of the person, nutrition, lifestyles	Health	Social innovation and participation	Inclusion and social cohesion

Toscana					
<i>Technological priorities</i>					
Digital technologies		Advanced manufacturing technologies	Advanced materials and nanotechnologies	Technologies for life and the environment	
<i>Fields of application</i>					
Digital transition, circular economy, SME		Energy and Green Economy	Culture and Cultural Heritage	Health	Smart Agri-food

Umbria						
<i>Specialization areas</i>						
Health	Agri-food	Smart factory - Aerospace	Energy and environment	Secure and inclusive communities	Made in Italy, design and creativity	Green chemistry
<i>Priority trajectories</i>						
<ul style="list-style-type: none"> E-health, advanced diagnostics, medical device and mini-invasiveness Biotechnology, bioinformatics and pharmaceutical development Regenerative, predictive and personalized medicine Nutraceuticals, nutrigenomics and functional foods Active & healthy aging: technologies for active aging and home care 	<ul style="list-style-type: none"> Nutrigenomics Functional Foods and Food Products innovative for human well-being and animal Food Security Food quality Innovative and sustainable packaging Shelf life 	<ul style="list-style-type: none"> Advanced systems for customized production Innovative, evolutionary and high efficiency production systems Technologies, processes and systems for aerospace 	<ul style="list-style-type: none"> Solutions and technologies aimed at a more efficient and sustainable use of resources, replacement and management of dangerous substances, containment and reduction of environmental impacts Business models for the circular economy Technologies and processes for the reuse, re-manufacturing and recycling of products, components and materials including recovery of "bioactive" components of 	<ul style="list-style-type: none"> Technologies for the diffusion of the digital culture in the enterprises and for the active participation of the citizenship Technologies for the smart cities Solutions and technologies to support open innovation, the social innovation of e-inclusion Solutions and technologies for teaching, digital schools and experimentation of innovative solutions 	<ul style="list-style-type: none"> Development and implementation of methodologies to support the collaborative interactions Development and implementation of collaborative digital solutions Development and implementation of methodologies to support product / process innovation in companies Development and implementation of digital solutions for product / process innovation 	<ul style="list-style-type: none"> Ecodesign of low-impact chemical and / or biotechnological technologies and processes that also include the use of materials deriving from renewable sources and / or waste from a regenerative chemistry perspective, and in line with a circular economy that is capable of safeguarding natural resources from pollution and impoverishment Innovative technologies for the recovery and enhancement of plastic materials deriving from

			<p>nutritional and therapeutic interest</p> <ul style="list-style-type: none"> • Components, technologies and systems for renewable energy, energy harvesting and microgeneration • Development of solutions for emission control, efficiency and energy saving • Efficient storage • Low carbon transport • Smart grids 	<ul style="list-style-type: none"> • Technologies, platforms and services for enterprise and technology transfer • Technologies for territorial intelligence system • Smart and sustainable mobility technologies and systems for logistics and people • IT technologies to support civil protection activities • Implementation of technological solutions for the qualification of online services for citizens, economic and social actors 	<ul style="list-style-type: none"> • Development and implementation of methodologies to support innovative destination governance • Development and implementation of digital solutions for destination governance 	<p>renewable sources or post-consumer recovery</p> <ul style="list-style-type: none"> • Ecodesign of compostable biomaterials, bio-based products, bio-chemicals and hybrid and sustainable chemicals • Development and validation of processes for the production of Key Starting Materials (KSM) in order to create backup production technologies to prevent a possible "shortage" • Creation of know-how on innovative technologies that can give flexibility and competitiveness to Umbrian companies • Definition of innovative technologies for the optimization and development of safer and even automated processes based on the
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						<p>use of safe solvents, control of the generation and emission of toxic substances, supported by analytical methodologies / techniques useful for the prevention and monitoring of dangerous chemical processes</p> <ul style="list-style-type: none"> • Ecodesign of formulations based on new non-toxic and eco-sustainable chemical additives deriving from agricultural production waste or biomass
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Lazio								
<i>Specialization areas</i>								
Aerospace	Agri-food	Automotive e sustainable mobility	Blue economy	Green economy	Creative and digital industries	Cultural heritage and cultural technologies	Life sciences	Safety
<i>Development trajectories</i>								

<ul style="list-style-type: none"> •Environmental sustainability • Digitization •Competitiveness and security 	<ul style="list-style-type: none"> •Sustainability • Quality and safety • Nutrition and health 	<ul style="list-style-type: none"> •Efficient and clean internal combustion engine technologies • Integrated safety and driver assistance systems • Human-machine interface (HMI), comfort and quality •Sustainable manufacturing •Clean and sustainable e-mobility technologies •Technologies for light structures •Technologies for flexible and clean production • Innovative materials 	<ul style="list-style-type: none"> •Marine environment and coastal belt • Blue biotechnology • Renewable energy from the sea •Abiotic marine resources •Marine biotic resources •Shipbuilding and marine robotics 	<ul style="list-style-type: none"> • Circular economy • Bioeconomy • Energy 	<ul style="list-style-type: none"> •Smart, personalized and functional fashion • High-level digital integration and service supply chains • Technologies and tools for diagnosis, conservation and preservation of tangible heritage • Use and understanding of heritage and archives through new technological models of artificial intelligence • New models and platforms for the management of museums, archives and tangible and intangible heritage • Product customization and shelf innovation 	<ul style="list-style-type: none"> • Data modelling • Digitization technologies • Basic platform for heritage data • Tools for heritage data • Tools for heritage applications • Intangible heritage 	<ul style="list-style-type: none"> • E-Health, advanced diagnostics, medical device • Biotechnology, bioinformatics and pharmaceutical development • Regenerative, predictive and personalized medicine • Nutraceuticals, nutrigenomics and functional foods • Active & healthy ageing 	<ul style="list-style-type: none"> • Resilience to disasters • Combating crime and terrorism • Border security and external security • Cybersecurity, digital security and cybernetics • Quantum technologies
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					<ul style="list-style-type: none"> Technologies, cultures, creativity and design for the enhancement of Made in Italy Immersive reality and new platforms of augmented reality, virtual reality and gamification, for the entertainment sector and for other areas of application Enabling technologies in educational and training inclusion paths 			
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Marche						
<i>Specialization areas</i>						
<i>Consolidated production areas</i>				<i>Production areas with new potential for the future</i>		<i>Innovation in intangible assets</i>
Furniture	Fashion	Mechanical sector	Agri-food	Creative and cultural industries	Health industries	Services sector and tourism
<i>Strategic drivers</i>						

Environmental sustainability, circular economy, energy	Digital transformation	Safety at workplaces, homes, and cities	Wellbeing and quality of life for people and communities	Social inclusion and integration
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Abruzzo					
Domains					
Automotive	Aerospace	Agri-food	Life sciences	Fashion/Design	Sustainable mobility and tourism
Development trajectories					
<ul style="list-style-type: none"> Multi-energy commercial vehicles with more sustainable powertrains and equipped for the last mile Materials and technologies for improving the relationship between performance, quality, weight and cost Low environmental impact materials, smart materials and related production processes in favor of a circular economy Green factory Connected vehicles and connected mobility services 	<ul style="list-style-type: none"> Design, development and implementation of electronic systems, micro and nanotechnologies applied to sensors and power electronics Systems and applications for the monitoring and control of systems and environment and tracking of people and objects Earth communication and observation systems also by satellites and drones 	<ul style="list-style-type: none"> Technology Transfer Environment and sustainability Product innovation Technological innovations to improve quality and food safety Marketing and communication innovation 	<ul style="list-style-type: none"> Personalized medicine Highly efficient pharmaceutical and personal care processes and products 	<ul style="list-style-type: none"> Methods, models and technologies for design Innovation and technology transfer for production Methods, models and technologies for marketing and sales Fashion textile design 	<ul style="list-style-type: none"> Strengthen the capacity of research, innovation and the introduction of new technologies Reaping the benefits of digitization for citizens and businesses Sustainable growth and competitiveness Developing S3 skills

<ul style="list-style-type: none"> • Smart and digital factory • Techniques and systems for monitoring, control and certification of the quality of on-line products • Human capital qualification, upskilling and reskilling 	<ul style="list-style-type: none"> • Cyber security • Development of secure processing and storage platforms oriented towards cloud-oriented and multi access edge computing • Development of innovative satellite platforms and Payloads 				
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Puglia										
<i>Specialization areas</i>										
Sustainable manufacturing					Health and environment			Digital, inclusive and creative communities		
Advanced mechanics, electronics and automation	Automotive	Aerospace	Agri-food	Fashion	Furniture	Health industries and wellness	Energy and environmental systems	Creative and cultural industries and tourism	Advanced services	
<i>Priority thematic areas</i>										
• New materials	• Electrification of propulsion systems	• Technologies and applications of remotely piloted	• Sustainability of the agri-food chain	• New fabrics and applications	• Environmental sustainability	• Energy efficiency in buildings	• Digital health	• Environmental monitoring	• Access to cultural events	• Green last mile logistics
• Advanced connectivity	• Hybrid propulsion					• Eco-design applied to	• Personalized and precision medicine,	• Environmental recovery		• Smart logistics

<ul style="list-style-type: none"> Artificial intelligence Virtual Reality and advanced human-machine interfaces Automation and robotics Sensors 	<ul style="list-style-type: none"> systems and alternative fuels Advanced connectivity Artificial intelligence Virtual Reality and advanced human-machine interfaces 	<ul style="list-style-type: none"> autonomous guided systems Aeronautical manufacturing technologies Microsatellites and space services 	<ul style="list-style-type: none"> Quality, traceability and food safety Nutraceuticals Precision agriculture 	and product circularity	furniture and furnishing elements	<ul style="list-style-type: none"> Smart and safe home 	<ul style="list-style-type: none"> advanced diagnostics Medical systems Technologies for rehabilitation, active aging Medical devices and drugs 	<ul style="list-style-type: none"> Recovery, recycling and valorisation of waste Intelligent management of energy systems Technologies for energy and energy efficiency 	<ul style="list-style-type: none"> Intelligent management of cultural heritage Smart and sustainable tourism Development of new contents and connected innovative services 	<ul style="list-style-type: none"> ICT AND R&D IT security and privacy Cloud Computing Big data and data fusion Artificial intelligence
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Calabria								
<i>Innovation areas</i>								
Agriculture 4.0 and agri-food	Environment, circular economy and biodiversity	Eco-sustainable construction, energy and climate	Tourism and culture	ICT, digital technologies and innovative tertiary sector	Smart manufacturing	Logistics and sustainable mobility	Life sciences	Blue economy
<i>Development trajectories</i>								

<ul style="list-style-type: none"> • Development of precision agriculture and agriculture of the future • Product / process innovation in the food industry, including sustainability and the circular bioeconomy • Systems and technologies for packaging, storage and traceability and safety of food products • Strengthening the competitiveness and sustainability of supply chains 	<ul style="list-style-type: none"> • Systems, techniques and technologies for environmental safety, environmental monitoring and the prevention of critical or risk events • Technologies, devices and "embedded" electronic systems, smart sensor networks, internet of things for the earthquake protection of the territory • Innovative systems, technologies, logical and physical platforms for the treatment of waste water and waste in order to reduce the environmental impact in the perspective of the circular economy 	<ul style="list-style-type: none"> • Innovative components, technologies and systems for the efficient and green production, storage and distribution of alternative energy with low environmental impact • Smart systems and technologies for the reduction of greenhouse gas emissions • Systems and technologies for smart buildings, eco-sustainable construction, energy efficiency, environmental sustainability • Innovative and environmentally friendly materials 	<ul style="list-style-type: none"> • Systems, applications and technologies for tourism, the enjoyment of culture and the attractiveness of the regional territory • New technologies and applications for the diagnosis, recovery, management and protection of the cultural, artistic, landscape and environmental resources of the territory • Technologies for audio-video productions, video games and digital publishing • Technologies and models of co-creation of 	<ul style="list-style-type: none"> • Digital ecosystems • Cyber-security • "Embedded" electronic systems, smart sensor networks, internet of things, big data and AI • Technologies for the diffusion of ultra-broadband connection, web economy, e-commerce 	<ul style="list-style-type: none"> • Innovative production processes with high efficiency and for industrial sustainability • Evolutionary and adaptive production systems for customized production and smart solutions • Innovative and environmentally friendly materials, smart sensors • Technologies for advanced design and digital craftsmanship 	<ul style="list-style-type: none"> • Optimization of the logistics system and increase of interoperability and co-modality in the traffic of goods • Green logistics • Smart and sustainable mobility systems, technologies, prototypes and pilot projects 	<ul style="list-style-type: none"> • Active & healthy aging: technologies for active aging and home care • E-health, advanced diagnostics, medical device and mini-invasiveness • Regenerative, predictive and personalized medicine • Advanced IT systems and services for the planning, organization and management of health services and processes • Nutraceuticals, nutrigenomics and functional foods 	<ul style="list-style-type: none"> • Blue biotechnologies linked to marine activities in coastal areas • Innovative technologies and systems for activities related to the sea • Technological enhancement of ecosystem services associated with the marine resource • Production and use of innovative and environmentally friendly materials and development of innovative technologies in the sectors of the marine extraction industry, the
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	<ul style="list-style-type: none"> Ecological biodiversity, ecosystem services, natural capital and enhancement of landscape contexts 	<ul style="list-style-type: none"> Technologies for smart grids, renewable sources, distributed generation and storage systems 	new experiential and cognitive tourist routes					shipbuilding chain and the naval industry <ul style="list-style-type: none"> Experimentation and development of advanced control and monitoring and safety systems for navigation and maritime transport
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Sicilia						
<i>Specialization areas</i>						
Agri-food	Blue economy	Energy	Life Sciences	Smart Cities and Communities	Tourism, cultural industries, Cultural Heritage	Environment and sustainable development
<i>Cross-cutting objectives</i>						
Strengthen the innovation capacity of the regional production system (green and digital transition)		Scouting for innovative subjects and proposals			Innovation as a common good	

Sardegna					
<i>Specialization areas</i>					
Aerospace	Agroindustry	Biomedicine	ICT	Smart networks for efficient energy management	Tourism, culture and environment
<i>Development trajectories</i>					
<ul style="list-style-type: none"> • Implementation of a research, development and experimentation capacity with particular reference to drones • Creation of a regional hub for monitoring the environment, territory and space in order to ensure the safety of citizens • Development of innovative materials and innovative technologies in space, avionics and photonics 	<ul style="list-style-type: none"> • Process innovation • Product innovation • Innovation and by-product valorization 	<ul style="list-style-type: none"> • Integrated development chain (preclinical and clinical) of new diagnostic systems and innovative, pharmacological and non-pharmacological treatments, for health care, cosmetics and human well-being • Biomedical informatics technologies for the development of an efficient interaction and integration of the regional health system with public and private scientific and technological research 	<ul style="list-style-type: none"> • Cloud, big data, open data, cyber-physical systems, internet of things • 3D digitization • New businesses (products and services) of the digital economy applied to the most innovative sectors such as biomedical (bioengineering or biomedical engineering) • New businesses (products and services) of the digital economy applied to the traditional tourism and agri-food sectors • Solutions for home care, safety and health to make the 	<ul style="list-style-type: none"> • Promote and strengthen the training and qualification of human capital • Promote the transfer of research results achieved in the region • Support the quality and effectiveness of innovative products • Develop innovative services to improve the quality of life of citizens and increase the attractiveness of the territory (PA efficiency) 	<ul style="list-style-type: none"> • Competitive growth of the tourist offers (product innovation) • Governance of sector (process innovation)

		<ul style="list-style-type: none">• Omics and biotechnology technologies for the development of prevention, diagnosis and personalized care methods and associated with bioinformatics analysis and process automation technologies	regional health system resilient		
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7. Conclusions

In this report we have analysed how and to what extent the investments under the Italian NRRP may potentially support directly and indirectly the achievement of the S3s goals. Direct support actions account for €40 billion, while indirect support initiatives account for €25 billion. This means that about 28% of the Plan has been identified as potential contribution to Italian regions Smart Specialisation Strategies objectives.

It is also expected that the reforms which are an essential part of the Plan could help in addressing the obstacles that hamper innovation.

Although Smart Specialisation Strategies are not explicitly mentioned in the NRRP, we found that sixteen initiatives have a strong link with S3s priority areas. These are mainly included in two components: “M1C2 Digitisation, Innovation and Competitiveness component of the productive system” and “M4C2 From Research to Business”. Thirty-one initiatives can be classified as having a medium link. For the remaining initiatives the potential links are weak.

Much can be done to ensure coherence between S3 and recovery projects, even a posteriori, by considering how the two planning processes complement one another. Obviously, the effective achievement of synergies between the Italian National Recovery and Resilience Plan and the regional Smart Specialisation Strategies will depend on many factors; in particular, a good policy mix and the involvement of regional actors within the governance of the NRRP which, as we have shown, has a top-down structure.

At the moment, only a few preliminary considerations can be made on the regional breakdown of the first phase of implementation and limited to a few interventions. These preliminary considerations are based on the characteristics of Italian regions in terms of economic structure and production specialization, and on the NRRP’s implementation mechanisms. ⁽⁸⁾

As a general rule, the Italian government has decided to earmark 40 percent of geographically allocable resources to Southern regions, nevertheless, given the NRRP’s implementation mechanisms, the compliance with the clause could only be assessed ex post.

With reference to the measure “Transition 4.0”, which provides tax credits to promote the digital transformation of Italian businesses, for example, it is possible to look at the past experience that shows that regional distribution of tax credits tends to be concentrated in a few Northern regions (Bratta, Romano, Acciari and Mazzolari, 2020) and, therefore, it is reasonable to argue that the share of “Transition 4.0”

⁽⁸⁾ The implementation mechanisms are as follow: (i) a share of the funds has already been handed over to entities within the wider public sector; (ii) a share will be managed directly by the central government; (iii) a share has been allocated by the ministries responsible to public actors (regions, local government, local health units); (iv) a share is to be allocated directly by central government to individuals, firms and citizens; (v) a significant share will be subject to competitive tenders issued by central government, with local government or other local public bodies (or public-private partnerships) generally called on to take part.

investments for the South could be around 10/15 percent, a result not surprising given that the use of this type of incentives depends on the number and size of existing firms. According to the Department for Cohesion Policies (Dipartimento per le Politiche di Coesione), the first estimates based on the ongoing measures indicate that 19,7 percent of the resources has been so far allocated to the South. More in general, according to the Department for Cohesion Policies (Dipartimento per le Politiche di Coesione), for the measure managed by the Ministry of Economic Development (Ministero dello Sviluppo Economico) the degree of resource absorption will depend on the level of participation and quality of the potential beneficiaries localised in the South.

On the contrary, for the Special Economic Zones we have a clear regional breakdown: 63 million in Abruzzo, 24 million in Molise; 136 million in Campania; 50 million in Basilicata; 124 million in Puglia; 112 million in Calabria; 118 million in Sicilia; 10 million in Sardegna.

Another interesting example is the national program called “Employability Guarantee for Workers”, which is the heart of the active labour market policies reform: the Ministry of Labour has allocated about 45 percent of the first tranche of resources to southern regions.

Briefly, it is evident that monitoring the implementation of the plan from a territorial point of view will be essential to measure the impact of the various measures and its ability to induce a structural change in the Italian economy.

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Appendix

Table A1. Main indicators of Italian regions

	Population - 2020	GDP per inhabitant in percentage of the EU average - 2019	Employment in industry (except construction) - 2020 (per 100 inhabitants)	Regional innovation index 2021 score relative to EU	Innovation index - Performance subgroup
Piemonte	4.311.217	102	10,4	97,8	Moderate innovator +
Valle d'Aosta/Vallée d'Aoste	125.034	124	5,0	67,4	Emerging innovator +
Liguria	1.524.826	103	5,1	88,3	Moderate innovator
Lombardia	10.027.602	127	11,2	102,3	Strong innovator -
Provincia Autonoma Bolzano/Bozen	532.644	154	7,7	94,8	Moderate innovator +
Provincia Autonoma Trento	545.425	124	7,7	107,1	Strong innovator -
Veneto	4.879.133	108	12,5	102,8	Strong innovator -
Friuli-Venezia Giulia	1.206.216	103	10,8	106,6	Strong innovator -
Emilia-Romagna	4.464.119	118	11,6	109,4	Strong innovator
Toscana	3.692.555	102	8,5	101,3	Strong innovator -
Umbria	870.165	85	8,2	98,8	Moderate innovator +
Marche	1.512.672	89	12,2	90,6	Moderate innovator +
Lazio	5.755.700	110	4,0	100,4	Strong innovator -
Abruzzo	1.293.941	81	8,4	84,7	Moderate innovator
Molise	300.516	69	6,5	82,9	Moderate innovator
Campania	5.712.143	61	4,3	83,3	Moderate innovator
Puglia	3.953.305	62	4,5	74,1	Moderate innovator -
Basilicata	553.254	75	6,2	79,7	Moderate innovator -
Calabria	1.894.110	56	2,3	68,2	Emerging innovator +
Sicilia	4.875.290	58	2,7	70,3	Moderate innovator -
Sardegna	1.611.621	69	2,9	70,4	Moderate innovator -

Source: Own elaboration based on Eurostat data and Regional Innovation Scoreboard



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