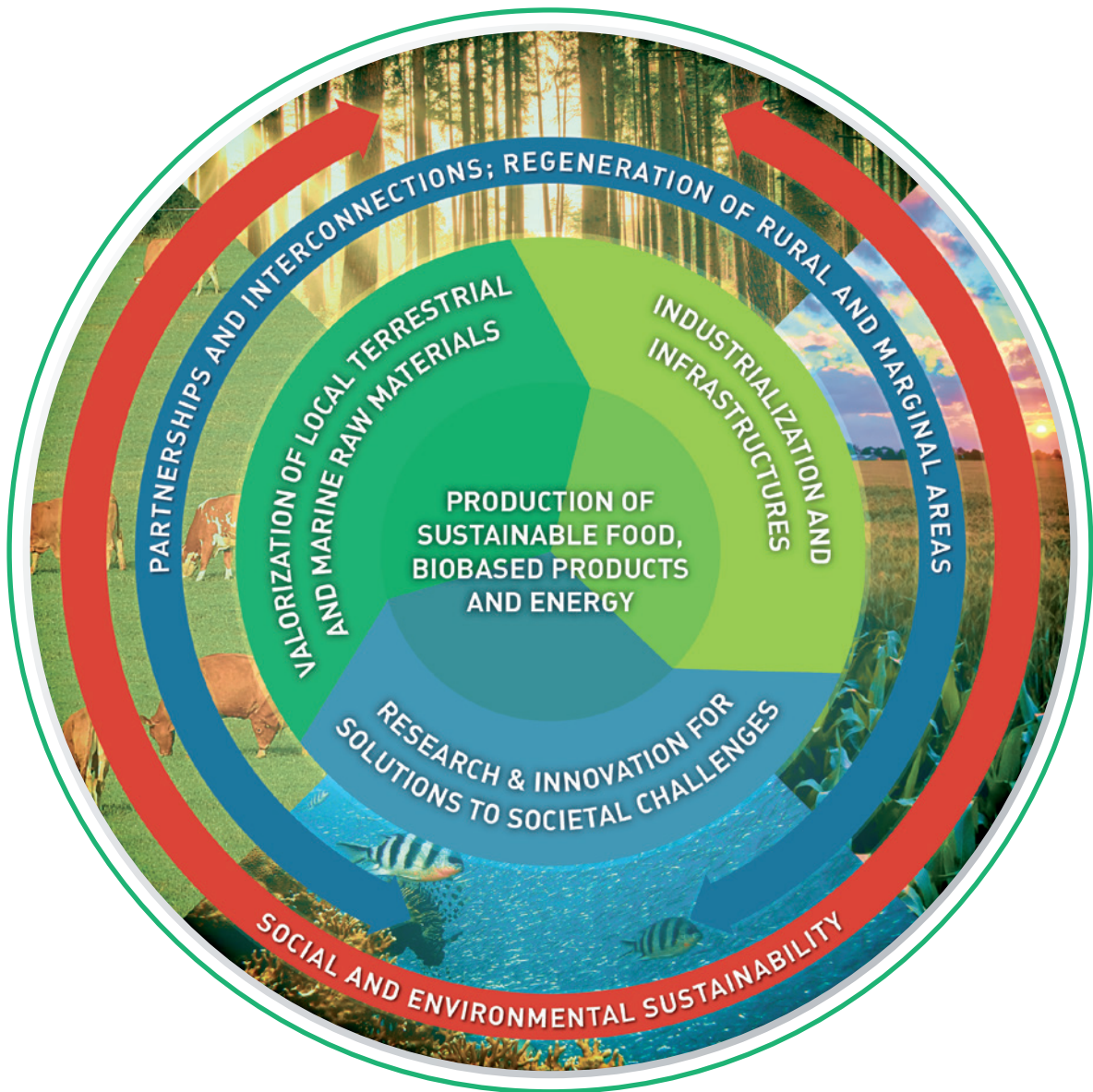


BIT

bioeconomy in Italy



A new bioeconomy
strategy for a
sustainable Italy



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PREFACE

The European Commission defines the bioeconomy as “the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. To be successful, the bioeconomy needs to have sustainability and circularity at its heart. This will drive the renewal of our industries, the modernization of our primary production systems, the protection of the environment and will enhance biodiversity”. The bioeconomy comprises those parts of the economy that produce and use renewable biological resources from land and sea - such as crops, forests, fish, animals and micro-organisms - to provide food, materials and energy (Europe’s bioeconomy Strategy, European Commission, 2018).

Thus, it includes primary production - such as agriculture, forestry, fisheries and aquaculture - and industrial sectors using and/or processing biological resources, such as the food and pulp and paper industries and parts of the chemical, biotechnological and energy industries. These elements are at the heart of a sustainable development that delivers strong communities by creating a flourishing economy that respects the environment. This is done by reducing dependence on fossil fuels and finite materials without overexploiting renewable resources, preventing biodiversity loss and land use change, regenerating the environment and creating new economic growth and jobs and leveraging on local diversities and traditions - in particular in the rural, coastal and industrial areas (including those that have been abandoned) - in line with the principles contained in the Juncker’s Agenda for Jobs, Growth, Fairness and Democratic Change.

The global population increase, the adverse impacts of

climate change and a reduction in ecosystem resilience all call for an improved use of renewable biological resources, i.e. for more sustainable primary production and more efficient processing systems able to produce food, fibres and other bio-based products with fewer inputs, less waste and greenhouse gas emissions and with greater benefits for human health and the environment. A waste management system that fully considers the potential of agricultural, forestry, and municipal (biogenic) wastes and residuals is also essential to enable the circular economy. In line with the European Strategy, the Italian bioeconomy means integrating the sustainable production of renewable biological resources and converting these resources and waste streams into value added products such as food, feed, bio-based products and bio-energy.

This strategy aims to provide a shared vision of the economic, social and environmental opportunities and challenges associated with the creation of an Italian bioeconomy based on longer, more sustainable and locally routed value chains. It also represents a significant opportunity for Italy to enhance its competitiveness and role in promoting sustainable growth in Europe and the Mediterranean area.

The bioeconomy strategy will be part of the implementation processes of the National Smart Specialization Strategy, focusing in particular on the areas of “Health, Food and Life Quality” and “Sustainable and Smart Industry, Energy and Environment”. It will be implemented in synergy with the principles of the [Italian National Strategy for the Sustainable Development](#) for ensuring environmental sustainability and economic growth reconciliation.

A TRULY INTEGRATED ITALIAN BIOECONOMY ECOSYSTEM



Sustainable
agriculture and
forestry



Sustainable and
competitive agrifood
sector for a safe and
healthy diet



Aquatic living
resources and
marine and maritime
bioeconomy



Biobased
industries

EU level

Regional level

National level

INDUSTRY

CIVIL SOCIETY

RESEARCH

INSTITUTIONS

ITALIAN BIOECONOMY STRATEGY
Integrating sectors, systems, actors and institutions



EXECUTIVE SUMMARY



The Italian bioeconomy relies on all major sectors of primary production, i.e., agriculture, forestry, fisheries and aquaculture, those processing biological resources, such as the food and drink, wood and pulp and paper industries along with biorefineries, and parts of the chemical, biotechnological, energy, marine and maritime industries. It is currently making about EUR 330 billion/y of turnover and 2 million jobs.

The present Italian bioeconomy Strategy (BIT) aims at achieving an increase of 15% in the current performance of the Italian bioeconomy by 2030. This will be done by:

- a) Improving the sustainable production and quality of products in each of the sectors and interconnecting and leveraging the sectors more efficiently; allowing an effective valorization of national terrestrial/marine biodiversity, ecosystem services and circularity by creating longer and more locally routed value chains, where the actions of public and private stakeholders integrate across the board at the regional, national and EU level; regenerating abandoned/marginal lands and former industrial sites;
- b) Creating: i) more investments in R&I, spin offs/start-ups, education, training, and communication, ii) better coordination between regional, national and EU stakeholders/policies, iii) better engagement with the public, and iv) tailored market development actions.

The strategy also includes actions addressed to promote the bioeconomy in the Mediterranean area, mainly through an effective Italian participation in the BLUEMED and PRIMA initiatives for a greener and more productive region, wider social cohesion and greater political stability in the area.

The BIT R&I agenda and priority actions are accompanied by measures creating and guaranteeing the framework conditions required for its effective implementation. BIT will be part of the implementation processes of the National Smart Specialization Strategy, in particular the areas focusing on “health, food and life quality” and “sustainable and smart industry, energy and environment”, and it will be implemented in synergy with the Italian National Strategy for the Sustainable Development and its principles for ensuring environmental sustainability and economic growth reconciliation.



BIOECONOMY – AN INTRODUCTION

Food security, sustainable management and the use of agriculture, forestry, marine biological resources and inland waters, alongside the biobased industry, are among the most important elements influencing European society and the wider world.

The bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products, services and processes across four macro-sectors¹:

1. Agrifood
2. Forestry
3. Biobased industry
4. Marine bioeconomy

This document proposes a transition towards a circular bioeconomy by integrating the bioeconomy and the circular economy models into a vision where the production and use of renewable bio-resources and their conversion into value added products is part of a circular

system, that will make businesses more economically viable and sustainable in the long term².

A circular bioeconomy needs to build both on local resources and facilities and on the improved interaction and integration among the economic sectors concerned, public and private stakeholders, the civil society (especially NGOs) and existing policies at International, European and Member States level³.

A definition of a common framework for a wide range of established and emerging policy, technology and market needs is required through the sharing of challenges and experiences implemented at global, European, national and regional level.

1.1 IN THE GLOBAL AND EU CONTEXT

Currently, more than 50 nations worldwide are proposing actions and strategies to boost their bioeconomy, the economic dimension of which is steadily increasing.

1 A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment, European Commission, 2018
 2 Closing the loop - An EU action plan for the Circular Economy, COM/2015/0614 final
 3 Global bioeconomy Summit 2015 Communiqué

1. BIOECONOMY – AN INTRODUCTION

In Europe, the bioeconomy is already worth EUR 2.3 trillion in annual turnover and accounts for 8.2% of the EU's workforce (18 Million of jobs). The bioeconomy is a central element to the functioning and success of the EU economy. The deployment of a sustainable European bioeconomy would lead to the creation of jobs, particularly in coastal and rural areas through the growing participation of primary producers in their local bioeconomies (EU Updated bioeconomy Strategy, 2018). Furthermore, the food industry is the largest in the EU and there is still potential for growth, with new businesses and industries emerging in both traditional and novel food and non-food sectors. The updated EU bioeconomy strategy will unlock the potential of available bio-resources in the various bioeconomy and blue economy sectors in a sustainable and socially responsible way. This updated version puts sustainability and circularity at his hearth to drive the renewal of the European industries, the modernization of the primary production systems, the protection of the environment and enhance biodiversity.

Three years after adoption, the Circular Economy Ac-

tion Plan is fully completed. Its 54 actions have been delivered, even if the work on some of them continues beyond 2019.

On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the Circular Economy Action Plan. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources as well as ecosystems is minimised.

The Mediterranean area deserves a specific focus: it is characterized by high levels of hydric stress that, together with climate change, have a negative impact on agriculture. This has a negative influence on standards of living, with social and economic stress acting as a major cause of instability, which in turn contributes to migration, both internally, from rural to urban territories, and externally, in particular towards Europe. For food security reasons, a sustainable management of water provision and use and of



1. BIOECONOMY – AN INTRODUCTION



food systems is required to provide clean water and affordable food for the region's inhabitants. PRIMA⁴ is an initiative launched by Italy, aimed at making water provision and food systems more efficient, cost-effective and sustainable, at helping solve bigger problems relating to nutrition, health and social wellbeing, and ultimately helping address mass migration trends.

The BLUEMED Initiative⁵ - also promoted by Italy -, aims, in line with the two other regional initiatives EU-SAIR and WEST MED regional initiatives, to create new 'blue' jobs and sustainable economic growth in the marine and maritime sectors in the area. The Mediterranean Sea is a basin with unique bio-geo-physical characteristics that contributes significantly to the EU economy by supporting 30% of global sea-borne trade. It has more than 450 ports/terminals, which host the world's second largest market for cruise ships, half of the EU's fishing fleet and a unique cultural heritage

and natural patrimony. However, it is facing serious environmental challenges related to climate change, growing maritime traffic and pollution, the overexploitation of fish stocks, invasions of alien species, etc. At the same time, local biodiversity and deep sea resources, tourism, renewable energy production, marine aquaculture etc. are major local opportunities for 'blue' growth and the creation of jobs in areas that are currently underexploited. BLUEMED was initiated by the EU MS of the area as a way of addressing/implementing such challenges and opportunities via a common and shared vision and a Strategic R&I Agenda.

The bioeconomy could therefore contribute greatly to the regeneration, the sustainable development and the political stability of the area and, in turn, to a reduction in the migration phenomenon (for example with reference to the implementation of local investment projects with a high social and infrastructural impact, as outlined in the "Migration Compact" document proposed by the Italian Government). Italy in particular, through the two initiatives it is coordinating, can play a key role in achieving this aim.

4 Partnership for Research and Innovation in the Mediterranean Area: prima4med.org, 4prima.org

5 researchitaly.it, bluemed-initiative.eu

1. BIOECONOMY – AN INTRODUCTION

1.2 AT ITALIAN LEVEL

In Italy the entire bioeconomy sector (including agriculture, forestry, fisheries, food and beverages production, paper, pulp and tobacco industries, textiles from natural fibers, leather, bio-pharmaceuticals, green chemistry, biochemicals and bioenergy) accounted for a total turnover of EUR 330 billion in 2017, and around 2 million employees. ¹

These estimates include all sectors of primary production at land and sea, those of biomass transformation and of products coming out from it including bioenergy, plus the exploitation of wastewater (12,100 Mio €) and of the municipal organic fraction (6,804 Mio €).

However the potential for the substitution of renewable inputs within the chemical industry is high: according to one estimate⁶, in the current technological framework (not considering therefore economic and environmental sustainability), around 40% of chemical products could theoretically be produced with renewable inputs. Beyond this potential (theoretical) substitution, the share of effective substitution will strongly depend on industrial and environmental policy and technological innovation.

Agriculture

Agriculture is an important economic sector in Italy, accounting for EUR 33 billion of contribution to Gross Value

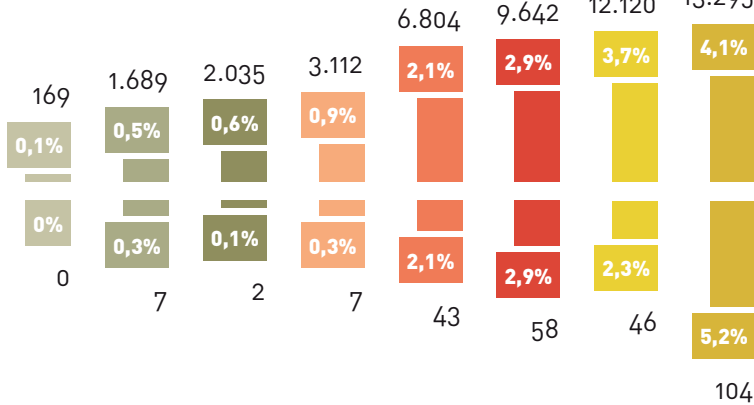
Added (2.1%) (ISTAT, 2018). The total agricultural area in Italy amounts to 16.5 million hectares, of which 12.6 million are in use. In 2017, the value of the production from agriculture, forestry and fisheries amounted to EUR 57 billion. Around 912,000 people are employed in agriculture, forestry and fisheries. Rural development is an important priority, mainly in marginal areas without access to the same services of public interest as towns and cities. Various rural development challenges are emerging in several regions. Rural diversification is important; sustainability, social media, big data availability and new business models may well bring a new dimension to rural life. Furthermore, thanks to the variety of its territory and the long and diversified historical heritage, Italy enjoys a unique variety and richness in food traditions. This is considered one of the most important distinguishing features of Italian agriculture and one of the main strengths of the sector in international competition on the agriculture/food markets.

Agriculture and forestry have a vast potential in the context of the biobased and circular economy, ranging from the efficient management of resources, biodiversity, protection, soil and land sustainable management, production of ecological and social services, enhancement and re-use of residuals and wastes, as well as the production of bioenergy and bio-products through the adoption of sustainable production models and the efficient use of renewable resources.

6 Intesa Sanpaolo-Assobiotec "Report on bioeconomy in Europe", March 2019

1 bioeconomy in Italy in 2017

- Food industries, beverages and tobacco
- Agriculture, forestry, fisheries and aquaculture
- Bio-based apparel
- Paper industry
- Bio-based textiles
- Bio-based pharmaceutical
- Wood industry



- Water cycle
- Bio-based furniture
- Biodegradable waste recovery and management
- Bio-based chemicals
- Bioenergy
- Bio-based plastics and rubber
- Biofuels

Turnover: 328.036
(million euro)

Employment: 2.013
(th. person employed)

Source:

Intesa Sanpaolo-Assobiotec "V Report on bioeconomy in Europe", March 2019

1. BIOECONOMY – AN INTRODUCTION

Food Industry

The industry sector relies mostly on very small SMEs (over 88% of the companies have fewer than 9 employees) but, in spite of this, it has proved to be a resilient sector, capable of growing also during the economic crisis. This is due to its unique structure, especially based on the market success of Italian products worldwide, thanks to well-known trademarks and brands and also to the fact that the high value given by the social, cultural and environmental attention found in Italian products is protected by Geographical Indications



(almost 822 products - Italy is the first EU Member State in terms of number of registered products). ²

The Food Industry opens up huge opportunities for innovation and growth in the bioeconomy sector. The National Agrifood Technology Cluster “CL.A.N.”, a multi-stakeholder network of the key national players of the agrifood chain, from companies to research centres, microbe collections and institutions, gave an important contribution on this matter through the drawing up of an Action Plan that identifies the most significant challenges and research priorities for the Food Industry with respect to the reuse of byproducts. These include:

- Obtaining new foods and/or fodders for zootechnical purposes, innovative ingredients and/or bioactive compounds for developing health-giving foods with a high nutritional value obtained from byproducts generated by the agrifood processing industries;
- Adopting innovative processes to exploit byproducts left over from agroindustry processing, to be placed on the market as new products for the food, fodder and agricultural sector;
- Reducing disposal costs and finding new economic returns from agrifood byproducts;
- Analysing techniques to recuperate low cost byproducts and their functional components, with a low environmental impact.

7 clusteragrifood.it

1. BIOECONOMY – AN INTRODUCTION

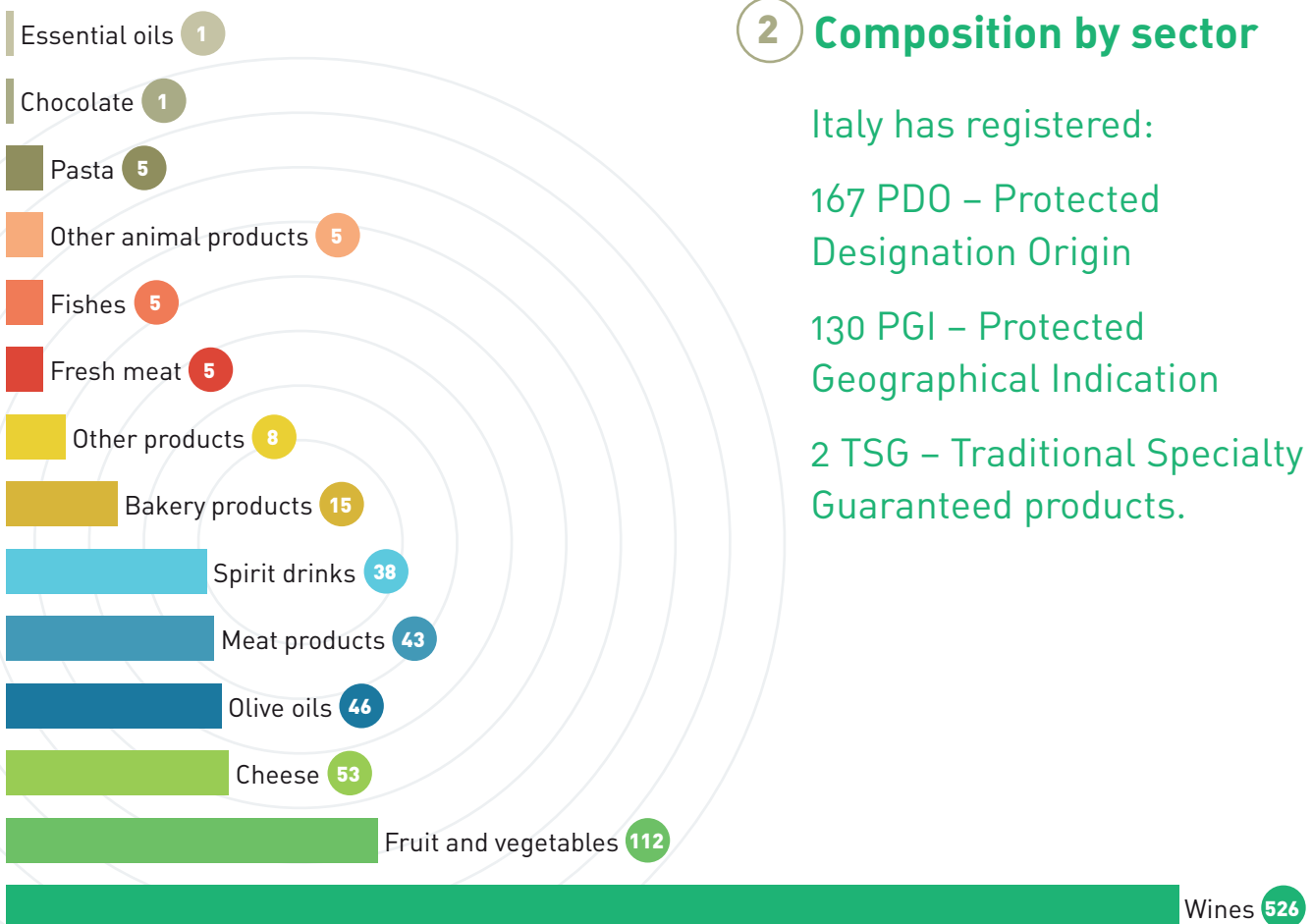
Forestry

Forest surface in Italy covers 11 million hectares - approximately 39% of the national surface territory. Thanks to its Mediterranean positioning, together with its diverse landscape spanning from sea to high mountains, Italian forests host a wide variety of plant ecosystems. However, forest management needs to be improved, as does the accounting for its products and ecosystem services (INFC 2015). It is worth noting that

the sustainable forest management of Italian forests covered 10% of the total national Kyoto target for CO2 emission reduction and that there is a national carbon credit market for voluntary emission compensation.

The whole wood/furniture supply chain in 2017 amounted to more than 80,000 companies, employing about 400,000 people, with an annual turnover of EUR 40 billion⁸, while the industry based on cellulose has an an-

8 FederlegnoArredo, 2016



Source: Report Qualivita 2018

2 Composition by sector

Italy has registered:

167 PDO – Protected Designation Origin

130 PGI – Protected Geographical Indication

2 TSG – Traditional Specialty Guaranteed products.



The AGRIFOOD CLUSTER gave an important contribution to the bioeconomy through the national flagship project So.Fi.A. (Sustainability of Agrifood supply chain) in terms of:

Valorization of dairy byproducts, especially residues of ricotta cheese (scotta) and cheese whey for recovery of their bio-molecules. A specific experimental campaign was conducted focused on double ultrafiltration steps followed by nanofiltration on scotta and cheese-whey with the separation and concentration of proteins, lactose and peptides. The liquid intermediates obtained after ultrafiltration were conferred to other partners of the project for post-processing treatment (enzymatic hydrolysis, oxidation) to turn bio-molecules in bio-active and functional substances as pre-biotics, functional peptides, lactulose and lacto-bionic acid.

Strategies for the reutilization and valorization on beef processing byproducts and wastes. The production of new food (Bone Chips for gelatin, tallow, and food proteins) and non-food products (tallow and animal flour for the production of energy and depilated hides) to be included in various national and international industrial sectors represents the final goal. The byproducts which could not be valorized otherwise, will be used for the production of electric and thermal energy directed to satisfy the energy needs of the company. The aim of the So.Fi.A. project, to valorize the beef hides, is the development of a biotechnological method for hair removal and exploitation of proteins, bioactive peptides and collagen of the obtained products and of

fleshings generated from processing.

New solutions for the efficiency of processes in the fresh-cut vegetables industry and valorization of wasted biomass. Within So.Fi.A., new technologies for reducing wasted biomass production using integrated drying processes and associated energy recovery devices are under study. In addition, composting and recycling waste into “on-farm” system is aimed at simplifying biomass management, reducing environmental impact.

Other important initiatives led by food companies: SUSTAINABLE FARMING for ITALIAN HIGH QUALITY DURUM WHEAT CULTIVATION - a landmark project aimed at shifting towards more sustainable durum wheat cultivation in order to improve production and soil efficiency through the optimization of operations and inputs, as well as to reduce soil degradation. It is followed up by a Handbook for Sustainable Cultivation of Durum Wheat and a Web based Decision Supporting System (DSS) implemented through the incorporation in a standalone entity of all public and private research, on-field trials, agronomic principles, soil-climate-crop modeling, environmental footprint.

EU flagship initiatives: AgriMax project (BIO BASED INDUSTRIES JOINT UNDERTAKING - H2020-BBI-PPP-2015-2-1): Agri and food waste valorisation co-ops based on flexible multi-feedstocks biorefinery processing technologies for new, high added-value applications. The project combines flexible processing technologies to valorize residues and by-products from the agriculture and food processing industry to extract valuable biocompounds used to produce active ingredients, such as packaging and agricultural materials.



1. BIOECONOMY – AN INTRODUCTION

nual turnover of about EUR 22 billion, over 3,800 companies and over 72,000 employees. However, it should be noted that in such an important industry, 80% of the wood used is imported from other countries. Therefore, one of the primary objectives is to increase the degree of self-supply in this area.

Solid biomass fuels (among these wood) represent the main renewable source of energy on a national scale. The bioenergy sector has also shown strong growth during the last few years, becoming a very dynamic segment - including biomass producers and traders, stove producers, energy plant managers etc. - within the forest-wood sector. In the development of the bioeconomy it is important to grow and support bioenergy through which it will be possible to reach the goal of decarbonising the energy sector and also increase, through biogenic processes, the absorption of CO₂ in biomass, in agricultural and forestry soils (carbon sequestration). Beyond the domain of wood-based products, non-wood (or wild) forest products and forest-related ecosystem services deserve to be mentioned. The former include a number of products - such as mushrooms, truffles, herbs, cork etc.- which often have a strong link to traditional knowledge, local economies and forest management practices. While in many cases economic activities related to these products remain largely informal, there is an increasing number of cases where wild product production has become more structured and more important than wood production in terms of direct and indirect income opportunities, job creation, visibility and rural development potential.

In addition, processed wood is converted into a few and traditional low value products while more room should also be made to expand the role of wood in the bio-construction industry. The current lack of integration and of efficient chains between the primary production and the wood processing industry is limiting both socio-economic growth and the international competitiveness of the whole value chain.

With regards to ecosystem services, although these are not (or are just marginally) included within official national accounting systems, they are increasingly recognised as an important component of forest ecosystems⁹.

Bio-based industry

The bio-based industry is the segment of the bioeconomy that uses renewable biological resources in innovative industrial processes for manufacturing biomass-derived goods/products and services. Hence it concerns industrial sectors which traditionally use biological resources as their main feedstock or catalysts (forest-based sector, bio-fuels/bio-energy, biotechnology) and others for which biomass is part of the raw material portfolio (e.g. Chemicals, Plastics, Consumer goods).

Thanks to the levels of innovation already achieved through a number of proprietary technologies developed in the chemistry and industrial biotechnology sectors, the investments made, the range of products such as green catalysts and microbes, and the value chains available, Italy is playing a leading role in the bio-based industry.

⁹ The implementation of PES mechanisms is recalled by Art. 70 of the 2015 Budget Law (Collegato Ambientale alla Legge di Stabilità, 22nd December 2015) and related norms/regulations.

1. BIOECONOMY – AN INTRODUCTION



SPRING

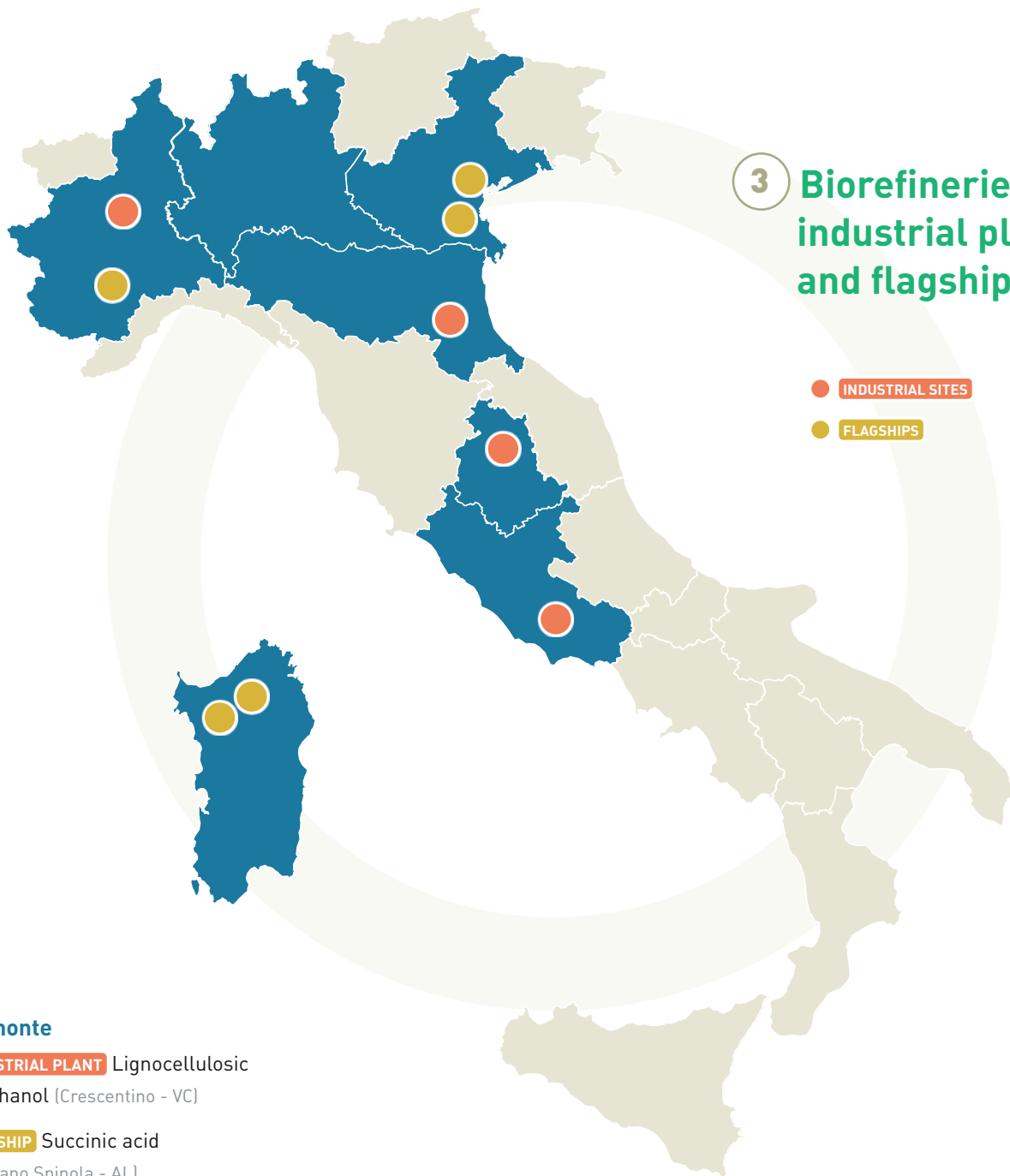
*Sustainable Processes and Resources
for Innovation and National Growth*

Italian Cluster of Green Chemistry

SPRING's Roadmap built upon its members' priorities and objectives, establishes a common ground in the discussion with regional, national and European institutions which the Cluster considers as key partners for achieving the long-term objectives related to the transition towards a new model centered around the concept of "sustainable regions" and present the main innovation breakthrough for Italian Biobased Industries.

- A. Achieving a Near-to-zero waste country by completely reusing biowaste as bio-char, biogases, and biobased products.
- B. Reverting disused industrial sites into next generation biorefineries.
- C. Maintaining and reinforcing Italian excellence in R&D in a global contest facing more and more aggressive policies developed by the major countries and the growing interest of the most important chemical companies.

This is a fundamental macro-sector, as it supplies inputs and knowledge for technologies expected to mitigate environmental emergencies, as in the case of bio-plastics production. Bio-based plastics and rubber account for about 1690 Million of euro of turnover and involve 7000 employees. Bio-materials are gaining attention also for applications as building envelopes and in the construction sector in general. Electricity and heating from biomass and bio-energy in a broad sense (2035 million euro of turnover corresponding to 0,6 % of the bioeconomy and 2000 employees, namely 0,1%) are consolidated sectors, together with next-generation bio-fuels (169 million euro). Also bio-pharmaceuticals (turnover: 15022 million euro, corresponding to 4,6 % of bioeconomy and 36000 employees), bio-cosmetics and bio-based chemicals (Turnover 3112 million euro with 7000 employees) are highly specialized sectors taking part in the bioeconomy. Bio-textiles (turnover of 16440 million euro accounting 5% of bioeconomy and 76000 employees) and bio-based apparel (32804 million euro corresponding to 10 % of the bioeconomy and employing 200000 workers) are crucial segments of the bioeconomy, strongly connected to high value manufacturing productions of the made in Italy. The Bio-based industry also embraces production activities aimed at the effective valorization of biological materials for residential buildings (e.g. vertical indoor agriculture, etc.), bio-waste, urban, agricultural and industrial effluents/wastewater, agriculture and livestock residues, the production of bio-methane, bio-fertilizers, bio-lubricants, and essential amino acids for feed production. Bio-based chemistry is one of the few sectors where our country is a leading player in a high-tech environment, with large private investments, and important projects underway for the reconversion of industrial sites affected by the crisis into bio-refineries for the pro-



3 Biorefineries: industrial plants and flagships

- INDUSTRIAL SITES
- FLAGSHIPS

Piemonte

INDUSTRIAL PLANT Lignocellulosic bioethanol (Crescentino - VC)

FLAGSHIP Succinic acid (Cannano Spinola - AL)

Emilia Romagna

INDUSTRIAL PLANT based on vinification scraps and byproducts (Faenza - RA)

Veneto

FLAGSHIP 1.4 BDO from renewable raw materials (Adria - RO)

FLAGSHIP for the production of biofuels from vegetable oils biomass (Porto Marghera - VE)

Umbria

INDUSTRIAL PLANT Bioplastics based on starch and polyesters from vegetable oils (Terni)

Lazio

INDUSTRIAL PLANT Biodegradable polyesters (Patrica - FR)

Sardegna

FLAGSHIP Bases for biolubricants and bioadditives for rubber (Porto Torres - SS)

FLAGSHIP Azelaic acid and pelargonic acid (Porto Torres - SS)

1. BIOECONOMY – AN INTRODUCTION

Italian Flagships

Italy has important projects for the reconversion of industrial sites affected by the crisis into biorefineries for the production of bioproducts and biochemicals from renewable sources, with positive impacts on employment, the environment, product profitability and integration with oil-based products, enabling greater specialisation and competitiveness. Some of these projects, coordinated by leading Italian players in bio-based industries sector have been recognized as flagship initiatives in Europe by the BBI Joint Undertaking.



First2Run: Flagship demonstration of an integrated biorefinery for dry crops sustainable exploitation towards biobased materials production.



BIOSKOH's: Innovation Stepping Stones for a novel European Second Generation BioEconomy.

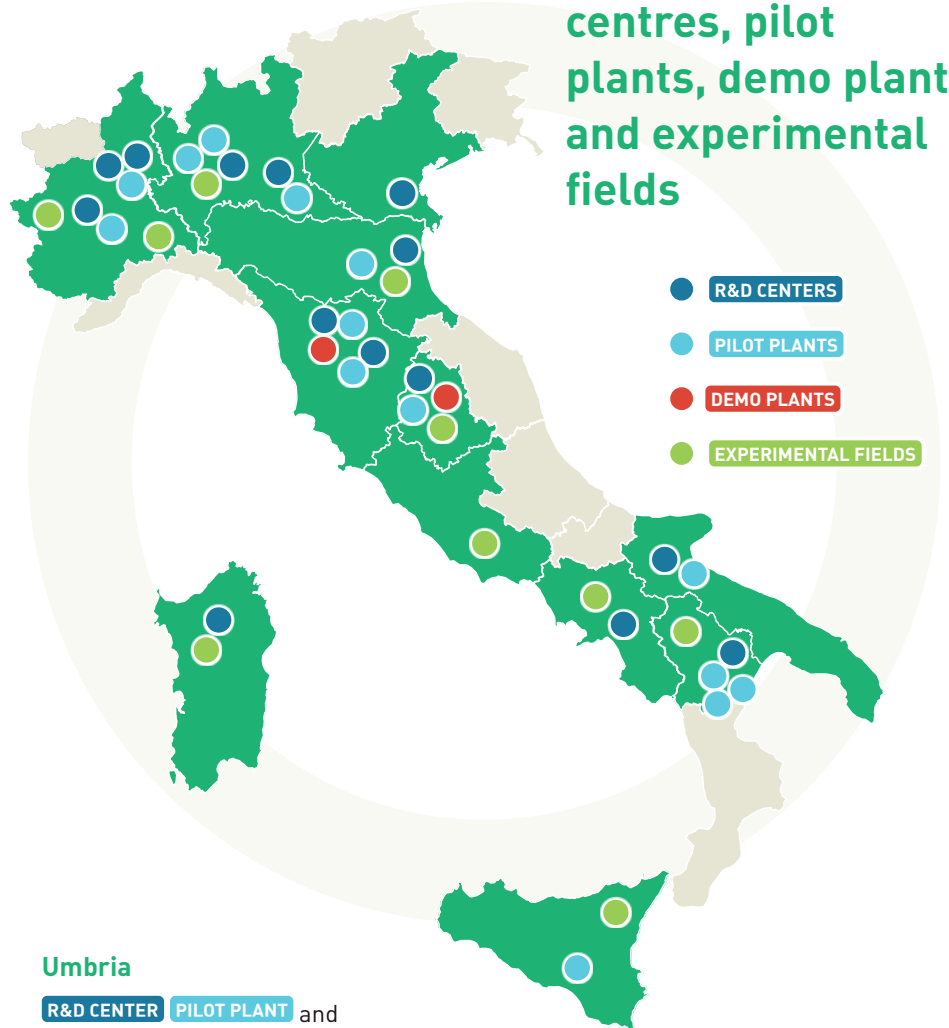
duction of bio-products and bio-chemicals from renewable sources. Over a billion euros has already been invested in the re-industrialisation of decommissioned or no longer competitive sites of national importance and for the construction and launch of four flagship plants - the first of their kind in the world. (3) (4)

Notably, the Italian bio-based industrial sector is characterized by a network of large, medium and small-sized companies which work together, leveraging on the sustainable production and efficient use of biomass, following a cascading approach to increase the added value of agricultural production with complete respect for the biodiversity of local areas, in collaboration with the agricultural world and creating partnerships with local actors. Italy is also the second EU country (after Germany) for the production of biogas and bio-methane with 1,924 installed plants and the total Bio-energy production is 19,400 GWh (Terna, 2017).

There are other factors that have contributed to Italy's success in bio-based chemistry: the existence of the Cluster of "Green Chemistry" SPRING¹⁰, a national platform which brings together over 100 of the main stakeholders of the value chain, from farmers to entrepreneurial associations; it represents a proven, effective collaboration between public and private stakeholders, and research bodies with strong competences on the main value chains of the biobased industry; a network of large, medium and small-sized companies which work together (the main sectors represented are: bio-based chemicals, oleochemistry, bio-lubricants, cosmetics, wheat and corn wet-millers, bio-plastics, bio-methane).

¹⁰ clusterspring.it

Biobased R&D centres, pilot plants, demo plants and experimental fields



Piemonte

R&D CENTER Bioplastics and biochemicals from renewable raw materials (Novara)

R&D CENTER Chemistry from renewables (Novara)

R&D CENTER Biochemicals and biofuels from renewables (Rivalta Scrivia - AL)

PILOT PLANT Fatty alcohols (Rivalta Scrivia - AL)

PILOT PLANT Biomonomers (Novara)

EXPERIMENTAL FIELDS

Lombardia

R&D CENTER Biolubricants (San Donato Milanese - MI)

R&D CENTER Green chemistry, process engineering and biolubricants (Mantova)

PILOT PLANT for biobased butadiene (Mantova)

PILOT PLANT for biobased coatings (Cernusco sul Naviglio - MI)

PILOT PLANT for biomaterials from mycelia and scraps (Varese)

EXPERIMENTAL FIELDS

Veneto

R&D CENTER for new technologies development in the biotech-sector (Adria - RO)

Emilia Romagna

R&D CENTER Bioelastomers (Ravenna)

PILOT PLANT for PHA (Bologna)

EXPERIMENTAL FIELDS

Toscana

R&D CENTER and **PILOT PLANT** for biolubricants and biopesticides (Sesto Fiorentino - FI)

R&D CENTER **PILOT PLANT** and **DEMO PLANT** on bioenergy, biofuels and bioproducts (Scarperia e San Piero - FI)

Umbria

R&D CENTER **PILOT PLANT** and **DEMO PLANT** Oleaginous crops and biolubricants from local crops (Terni)

EXPERIMENTAL FIELDS

Lazio

EXPERIMENTAL FIELDS

Campania

R&D CENTER on biotechnologies (Piana di Monte Verna - CE)

EXPERIMENTAL FIELDS

Puglia

R&D CENTER to characterize biomass and biomaterials, organic waste and sludge, residues and agro-food byproducts (Foggia)

PILOT PLANT Anaerobic digester plant, pyrolysis/gasification plant, photobioreactors plant (Foggia)

Basilicata

R&D CENTER for green biotechnologies (Matera)

PILOT PLANT for conversion of non-food cellulosic biomass into cellulosic glucose (Rotondella - MT)

2 PILOT PLANTS for steam gasification of biomass (Rotondella - MT)

EXPERIMENTAL FIELDS

Sardegna

R&D CENTER for biochemicals from vegetable oils (Porto Torres - SS)

EXPERIMENTAL FIELDS

Sicilia

PILOT PLANT for cellulose extraction from citrus for textiles (Caltagirone - CA)

EXPERIMENTAL FIELDS

1. BIOECONOMY – AN INTRODUCTION



National Technology Cluster Blue Italian Growth (CTN-BIG)

CTN BIG aims at generating new opportunities for the technological development and innovation of the national marine and maritime industrial system, integrating public and private research.

BIG addresses the definition of:

- technological and innovation development roadmaps, aligned and integrated (at regional and national level) with the corresponding European and Mediterranean ones;
- long-term scenarios for technology in Italian industry;
- building of a common system of research infrastructures for sea economy.

The trajectories identified for the cluster actions are:

- marine environment and coastal zone
- blue biotechnology
- renewable energies from the sea
- abiotic marine resources
- marine biotic resources
- shipbuilding and marine robotics
- skills and jobs
- research infrastructures
- sustainability and economic uses of the sea

Marine bioeconomy

Italy is characterized by over 8000 km of coastline, 40% of whose jurisdiction space is under water. It can therefore count on remarkable sea-based resources (food, microbes, energy, materials, landscape). Currently, bioeconomy related activities are responsible for about 20% of the turnover and job opportunities of the present Italian blue economy, which were estimated at about € 45 Billion/y and 835,000 employees¹¹. These activities include fishery and marine aquaculture, the exploitation of marine algae, microbes, enzymes, and byproducts and biowaste of fishery and aquaculture products processing, biomonitoring and bioremediation of marine water/sediment systems. In particular, Italy is, respectively¹², the second biggest European fish producer and ranks fourth in Europe for aquaculture production. Nevertheless, about 75% of national consumption is covered by imports. Sea based tourism is responsible for 19.1% of the presences in the country and is the second contributor to the significant part of the Italian economy driven by foreign visitors. In addition to this, 64% of Italians choose marine locations for their vacations.

Within this context, CTN BIG represents a single aggregative organization at national level, whose goal is improving the performances of the Italian system in the areas of research, innovation, and growth of human capital of the sea economy, fostering the cooperative and complementary links between the 31 public players, 41 private players and 10 regional ones.

¹¹ VII rapporto sull'economia del mare, Unioncamere 2018

¹² Facts and Figures on the common fisheries policy 2018

1. BIOECONOMY – AN INTRODUCTION

1.3 BIOECONOMY AT REGIONAL LEVELS

The availability of local competitive biological feedstocks is an important requirement for bioeconomy industries. Italian regions, at an individual level, have a high level of agricultural and natural landscape specificity linked to the biodiversity of cultivated plants, animals, related ecosystem services and their diverse cultural heritage.

A recent collaborative work for the drawing up of a Position Paper on bioeconomy (6/129/CR08b/C11), developed by the Conference of the Italian Regions, monitored the strategic position of the regions with respect to three pillars of the bioeconomy: Marine bioeconomy, Agrifood,

the Bio-based industry. The study paves the way to interregional cooperation in the bioeconomy, especially between neighboring territories, opening up also the necessary dialogue with national programs and strategies. **5**

The Italian regions are particularly motivated when it comes to keeping rural economies alive, putting into place regional economic cycles and supporting agro-industrial local projects with the strategic idea of using bio-resources in a more innovative and efficient way. Some of the initiatives carried out demonstrate the potential and the socio-economic impact of the development of the bioeconomy at a local level.

5 Strategic positioning of the Regions with respect to the three main pillars of bioeconomy

(from the Conference of the Italian Regions, elaborated on the bioeconomy Position Paper)



1. BIOECONOMY – AN INTRODUCTION

The Agrifood sector is a priority in the strategic plans of all the regions, reflecting the value and importance of the sector linked to the quality and strong identity of the products. The agrofood system issues related to quality, sustainability and recovery of environmental value, and the relationship between food and health are central to the vision of the regions.

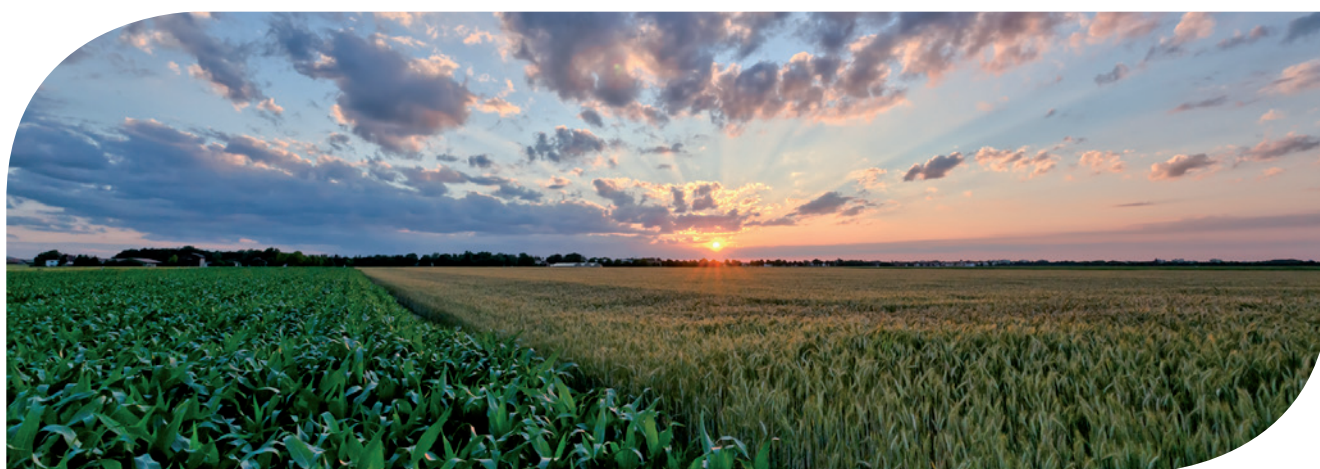
The regions see great potential in the development of the bio-based industry - the second sector in the strategic assessment. The potential is largely related firstly to the exploitation of food chain wastes and byproducts, with the aim of reducing the environmental impact, and secondly to the development and increase of crops production in marginal and underutilized agricultural areas and increase of intermediate crops, such as catch crops and cover crops. Some territories host important projects for the reconversion of de-industrialized sites into biorefineries for the production of bioproducts and biochemicals from local renewable sources, leading to positive impacts on employment, environment, product profitability and

integration with regional agriculture systems.

The Italian regions are willing to establish a distributed bioeconomy system built on modular and multiple concepts, by building cross territorial links and interregional value chains. The key components of the Distributed Business Models are the distributed units and the modular nodes. Each module or production site is a node of its own, and is linked to several other nodes according to the needs and deliverables of each node.

The analysis provided by Intesa Sanpaolo in 2017¹³, shows clearly how each territory, with its own specificity, can play an important role in the national bioeconomy and national bioeconomy strategy, due to the different geographical allocation of biological resources, technologies, skills and expertises. This picture confirms the fact that bioeconomy could become a key area of development for each territory, taking advantage of strengths and potential of each region.

13 "La Bioeconomia in Europa - 3° Rapporto" (2017)



EXAMPLE OF REGIONAL PROJECTS

✓ One recent example of an industrial reconversion is a new plan for the production of bio-butandiol at an old chemical site. The factory, which will produce 30 thousand tons of bio-butandiol per year, hired 51 employees at the end of 2015. It will be the first facility in the world capable of producing butandiol (BDO) directly from sugars rather than from fossil sources. This is done through a low-impact process and the co-products are completely reused. Some of these projects are coordinated by leading Italian players in bio-based industries sector and have been recognized as flagship initiatives in Europe by the BBI Joint Undertaking.

✓ Other interesting cases are focused on the possibility of using agricultural residues as a source of renewable energy - very common in several regions - thanks to the existence of public subsidies for investments. Agro-energy offers farmers the potential to earn extra income and often pushes for cooperation among farmers in order to aggregate the biomass needed to manage a bioenergy plant. The most accepted and widespread model is a grid of a diffused small-medium size agro-energy plant producing bio-methane, that in many cases uses zoo-technical waste integrated with solid matter deriving from cultivated crops. An example of this kind of initiative can be seen in the Veneto Region, where 14 farmers active in cereal production, cooperated in setting up a 1MW biogas plant fed with the waste of their production, creating a 2 million Eur/year turnover, making farm jobs more stable and creating new jobs for plant management and service.

✓ The Biopower project in Tuscany tackled the challenge of energy production by using renewable sources

through a diffused network of small sized plants. The project involves 7 enterprises and has reduced the environmental pressure by saving 1,000,000 TEP, at the same time producing 17 new jobs.

✓ Another important initiative developed in Tuscany is related to the production of 20,000 tons of soil compost per year from local organic waste coming from the urban separate collection and treated in three industrial composting plants. The initiative provides a supplement to industrial fertilizer production lines, as well as organic fertilizer for farmers and public administrations. 30% of the mixed compost is used by the industry and the rest by local farmers on various crops in the provinces of Florence, Pistoia and Pisa.

✓ Aquaculture is an important sector in Italian regions where there is a high availability of water and sea coast. One of the objectives of aquaculture is to reduce energy consumption and minimize the environmental impact. One initiative developed and supported by the Veneto Region relates to the cultivation of mussels with a continuous rope and a biodegradable retention net. The projects led to a 50% in fuel reduction and waste, and an increase in production of up to 9,5 tons.

✓ Microalgae cultures have a strong potential for industrial developments thanks to the higher yield capacity per unit of land used when compared to green plants, and the production of a variety of fine biochemicals. A Best Practice on microalgae cultures has been supported by the Liguria Region and the BIOFAT EU project. The industrial pilot initiative is developing rapidly, covering a 8,000 sqm greenhouse surface and employing 15 people, demonstrating the potential of producing oil and fine products for pharmaceutical and cosmetics.



RAW MATERIALS SOURCES AND THE OPPORTUNITIES OF BIOWASTE: THE IMPACT OF THE BIOECONOMY ON THE ENVIRONMENT AND NATURAL CAPITAL CONSERVATION

From the environmental viewpoint, the bioeconomy raises both opportunities and challenges.

The opportunities are linked to the gradual shift in production processes from non-renewable to renewable resources in order to limit the environmental pressure on ecosystems. Higher value is placed instead on their conservation as, beyond their intrinsic or existing value connected to other services, they can provide important services for the economy, - including the strategic importance of finding nature-based solutions to cope with climate change and hydrological risks. Furthermore, the bioeconomy implies the possibility of decreasing dependence on resources not widely available in Italy. Producing more from renewables may ease the problem of waste management as these sources are more easily reabsorbed by the nature receptors.

However, the bioeconomy can also lead to a number of challenges. One necessary condition is the economic, environmental and social sustainability of products and processes. Especially in the food and fish industry, there are many examples of unsustainable management for both the environment and human health. The Value Added and utility for the society can be increased by improving the quality of products and reconciling economic and

environmental needs: increasing the value added of the bioeconomy sectors should not be done by importing raw renewable materials from countries with less strict environmental regulations, as this could result in shifting the environmental damage abroad.

It is clear, therefore, that the opportunities and challenges in building a sustainable and flourishing Italian bioeconomy vary according to the source of biomass in the bioeconomy sectors, according to the need for “using better what we already use” and “using well what we don’t use yet”.

The stock of renewable natural resources, including forests, water, land, landscapes, terrestrial and marine plants and animal species not only supplies food, raw materials, energy, fresh water and medicinal products for human consumption, but represents overall the most significant part of the total value of our natural capital. The sustainable management of this stock offers other benefits to human society and the environment through a continuous flow of regulatory, supporting and cultural ecosystem services that are worth accounting for.

Agriculture based on sustainable practices responds to its primary function of food production while enhancing the correct management of natural resources (soil, wa-

2. RAW MATERIALS SOURCES AND THE OPPORTUNITIES OF BIOWASTE

ter, air), biodiversity and contributing to genetic diversity conservation.

Between 1960 and 2000, the European countryside experienced a dramatic change in land use. Further land abandonment is forecast to continue until 2030¹⁴, according to the Institute for European Environmental Policy and Eurostat survey. Estimates indicate an overall decrease in agriculture, grasslands and semi-natural habitats of more than 30 million hectares and an increase in urbanization. Activating synergies between agriculture, forestry, and the industrial sector in order to reuse residuals and waste for the production of bio-products and bioenergy, could help in bringing marginal and abandoned lands back into cultivation. Agriculture is already responding well today to the model of the circular economy - as in the case of the production of biogas and digestate, with positive impacts on organic soil matter.

Nature provides us with an enormous range of raw materials from which it is possible to synthesize various chemical intermediates which are similar to those obtained from raw fossil materials. It also has a wide variety of molecules and processes for synthesizing which are extremely interesting, yet until today, remain largely unexplored. As a consequence of energy-related and environmental problems arising from the use of fossil energy, renewable raw materials such as vegetable oils, starch from corn and potatoes, cellulose from straw and wood, lignin and amino acids as well as the exploitation

of algae are becoming increasingly important as industrial feedstocks. Through physical, chemical and biological processes these materials can be converted into fuel, chemical intermediates, polymers and specialties in general for which mineral oil has been used to date. We need to further valorize this potential of the agricultural sector within the circular economy. Innovative, sustainable bioeconomy sectors should follow this general approach for the use of raw materials:

- **determination of the most suitable species** (identification of autochthonous crops, plants, algae) and biomass at a local level (dedicated low-impact crops or not fragile marine areas), most suitable with respect to technical and environmental prerequisites in agriculture and biorefinery processes;
- **identification and use of marginal and/or contaminated lands**, in line with international policies on climate change and biodiversity, sustainable intensification policies, and in synergy with regional and local policies;
- **promotion of novel and efficient use of biomass** (by extracting all possible value from renewable resources, starting from food and feed components, or their conversion to materials and bio energy; or the production of new sustainable advanced materials such as biofillers, biopolymers, oils, resins, elastomers, from non food or residual biomass etc.)

14 "Agri-environmental indicator - risk of land abandonment" 2013: farmland abandonment due to economic, structural, social or difficult regional factors is estimated to have a higher risk in southern Member States (ec.europa.eu).



2. RAW MATERIALS SOURCES AND THE OPPORTUNITIES OF BIOWASTE

- **construction of new supply chains integrated with agriculture forestry and the industrial sectors**, ensuring competitiveness and profitability for all participants in the value chain;
- **reliance on eco-labelled, certified forest products**, preferably from local chains through a cascade use of wood products.

Also within the context of the **Common Fisheries Policy**, the sustainable use of fish stock is at the basis of the functioning of the marine ecosystem, as well as of the future livelihood itself of fisheries and marine bio-based economy. This is even more crucial in the Mediterranean Sea where the overexploitation and the introduction of invasive alien species threatens local fish and their habitats. To this end, aquaculture can be a viable solution to the sustainable management of the fisheries and it is no coincidence that it is prioritized in the EU Blue Growth Strategy and BLUEMED Strategic Research and Innovation agenda . However, caution is required to mitigate potential negative impacts of intensive aqua-farming, through monitoring the release of nitrogen and phosphorous in the coastal zones.

The increasing use of **residuals and byproducts** for the production of materials and energy is at the foundation of a sustainable circular bioeconomy, reducing the pressure on raw renewable sources and dependence on fossil fuels.

Biowaste comes both from the primary vegetal production (those arising in-field e.g. cereal straw, sugar cane tops and leaves) (about 10 million t/y), and livestock production (about 130 million t/y) along with the bio-residuals and waste from the primary food biomass processing and food making e.g. husks, hulls, shells, bagasse, etc. (about 15 million t/y). In addition, there are forest residuals arising in-field e.g. thinnings, tops and branches (up to 40% of above-ground forest biomass) and residue from primary processing at sawmills or pulp and paper mills e.g. sawdust, chips from off-cuts, black liquor (about 11.5 million t/y). Finally, the organic fraction of municipal waste collected in the country was above 6.5 million t/y in 2017¹⁵. Such residual streams are currently only partially and poorly valorized (mostly via biogas production) and mainly disposed of in landfills, with consequent high external costs and negative environmental impacts. Many of them, and in particular the agro-food industry byproducts, waste and effluents, could be cheap and abundant sources of biobased chemicals and materials, along with substrates for tailored biotechnological productions which, in turn, could enable the preparation of value-added biobased fine chemicals, materials and bio-fuels.

However, the “end of waste” criteria, as well as a national revised regulation on waste and residuals, along with clear indications on the potential use of the products and on their quality assessment would contribute greatly to boosting the efficient and valuable exploitation of these forms of biomass.

15 ISPRa; Rapporto Rifiuti Urbani, 2018).



3

BIOECONOMY IN EVERYDAY LIFE



COMPOSTABLE CARRIER BAGS AND WASTE BAGS

Biodegradable shopping bags, thanks to their dual use (i.e. first carrier bags and then waste bags), facilitate the separate collection of organic waste reducing the risks of littering in the environment. Thanks to biodegradability, compostability, transparency, resistance to humidity and pathogens they have proved to be a key tool to encourage the separate collections of organic waste and to produce high quality compost.



FOOD PACKAGING

Compostable food-packaging solutions allow the diversion of food scraps due to "food contaminated packaging" from Municipal Solid Waste, and therefore from landfill and/or incineration, to organic waste.



COMPOSTABLE BAGS, GLOVES FOR FRUIT & VEGETABLES AND LABELS

The switch from traditional plastic products to biodegradable and compostable ones contributes to reduce the generation of waste that is not easily recyclable, to increase the organic waste collection and reduce its contamination. Moreover, compostable label could substitute standard fruit labels, one of the main pollutants of compost.



COMPOSTABLE PACKAGING

Non-food compostable packaging such as toilet paper, kitchen roll, napkins, films for magazines can be disposed of with the organic waste.



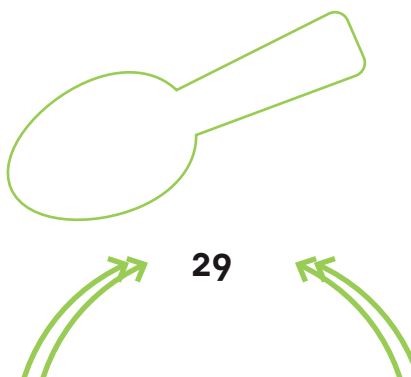
COMPOSTABLE PRODUCTS FOR FOODSERVICE

The use of biodegradable and compostable foodservice ware simplifies post-consumer disposal operations. It can in fact allow to obtain homogeneous waste streams, ready for recovery by organic recycling, avoiding its contamination and, reducing environmental impact and waste management costs.



BIOGAS

Organic gas produced by the anaerobic digestion of biomass that can be used as fuel for the production of electricity and heat or as fuel as a result of a refining process biomethane.



3. BIOECONOMY IN EVERYDAY LIFE



NEW FUNCTIONAL COLD PRESSED OILS

An innovative vegetable oil produced using olives and tomatoes only by mechanical processes.

- Olive oil naturally enriched in carotenoids.
- A good alternative to chemical extraction of functional compounds.
- An oil dressing naturally enriched and suitable for vegetarian, vegans and gluten-free diets.



COMPOSTABLE CAPSULES

Biodegradable and compostable capsules can be collected with the organic waste and sent for industrial composting, where the capsule and used coffee are recycled together into compost, with significant reduction of packaging waste which cannot be easily recycled.



BIODEGRADABLE COSMETICS INGREDIENTS

Thanks to their biodegradation these products prevent sewage sludge contamination and microplastics dispersion into the sea.



CARBOXYLIC ACIDS

Carboxylic acids are the basic constituents of bio-based plastics. They are intermediate in the production of plasticizers, for complex esters used in the lubricants sector and in pharma/cosmetic formulations, herbicide as well as being used in the formulation of plant protection. Some carboxylic acids and their esters and glycerine are well-known products commonly used in cosmetics applications.



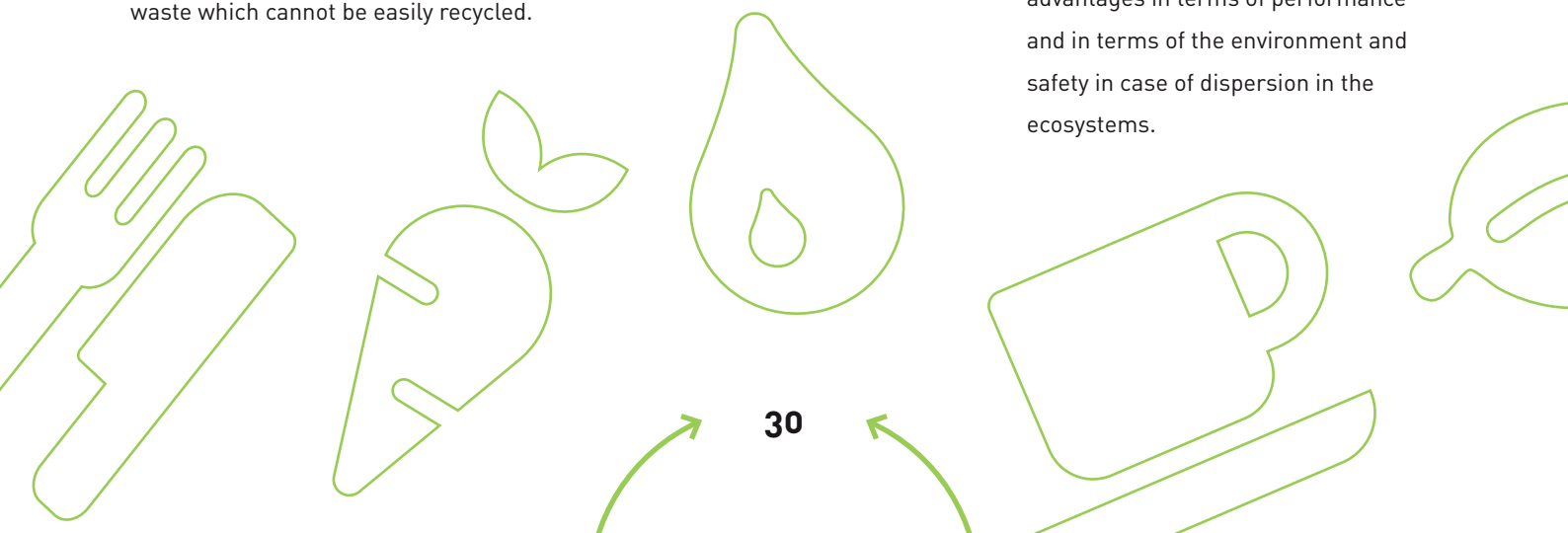
MICROBIOPASSPORT, A TOOL TO MEASURE THE IMPACT OF FOOD ON INTESTINAL HEALTH

The Microbiopassport is the first patented tool for gut microbiota analysis, which translates in user-friendly way the complex output obtained by the next generation sequencing characterization of the intestinal microbial ecosystem and its pervasive effects on human health. The Microbiopassport is being used by several food companies to assess the efficacy of their food products.



BIODEGRADABLE LUBRICANTS

They represent an ideal solution for machinery operating in ecologically sensitive areas (such as agricultural, forest, marine or urban), offering advantages in terms of performance and in terms of the environment and safety in case of dispersion in the ecosystems.



3. BIOECONOMY IN EVERYDAY LIFE



MULCHING FILMS

Biobased and biodegradable mulching film provides an agronomically and environmentally efficient alternative to traditional plastic mulching film. They biodegrade in the soil so they do not have to be removed at the end of the growing season, simplifying plastic waste management operations and significantly reducing the possibility of pollution.



BIODEGRADABLE HERBICIDES

These products from renewable origins could be used for weed control in total respect of the environment without any negative effects on water and soil.



INNOVATIVE PLASTER WITH LOW ENVIRONMENTAL IMPACT

- Upporttape made from bioresin-films; these substances are derived from potato starch (100% bio-compostable).
- Central pad containing no preservatives.
- Innovative adhesive solvent-free and without natural rubber latex.
- Packaging made of recycled cardboard.



BIOETHANOL

Renewable biochemicals and energy source made by fermenting the sugar and starch components of plant byproducts - mainly sugarcane (bioethanol). Next generation of biofuel from lignine or other biomass as algae.



DIGESTATE PELLETS

Organic fertilizer rich in nutrient elements such as nitrogen, phosphorus and potassium, produced by anaerobic digestion of agricultural biomass.



WOOD RECYCLING

Efficient management of wood recycling has undeniable environmental and financial sustainability advantages, triggering virtuous mechanisms based on the regeneration of the raw material for the creation of new products to be placed on the market. The recycled material is used in the production of particle (chipboard) or fiber (MDF) panels, for the furniture industry, for the creation of wood-cement blocks for the building industry, for pallet blocks (platforms), for pulp for the paper and compost industry. In a logic of correct cascade use, only a minimal residual part is destined to energy production.

3. BIOECONOMY IN EVERYDAY LIFE



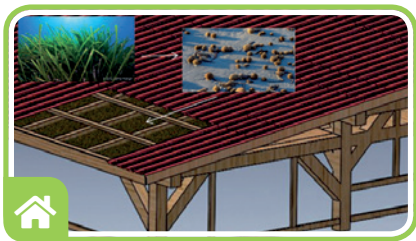
BIOACTIVE COMPOUNDS FROM MEAT BY PRODUCTS

Optimization and validation of modified response surface methodology to extract bioactive peptides from poultry and fish byproducts.



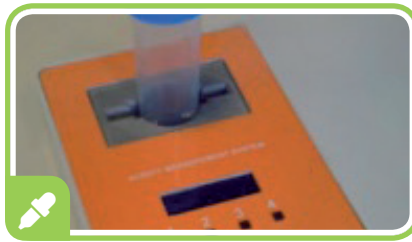
PLASTICIZERS

Plasticizers for specialty elastomers and PVC, as well as an innovative type of bio-extender oil for general purpose elastomers.



MARINE BIOMATERIALS FOR SUSTAINABLE BUILDING

Posidonia Oceanica laid on the shore is used as a high efficient, durable and fireproof thermal and acoustic insulator for building, helping to solve also the problem of its disposal.



PORTABLE ELECTRONIC SYSTEMS FOR OLIVE OIL QUALITY CONTROL

The portable electronic systems allow quick and in-situ analysis of olive oil quality (free acidity and total phenol content).

- Based on impedance analysis and optical transmission measurements.
- Battery operated.
- Use of non-toxic reagents.
- Quick response (30 sec for free acidity and 10 min for total phenol content).



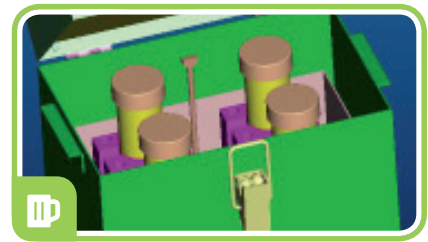
MARINE MICROORGANISMS FOR BIOREMEDIATION

Some marine bacteria produce bio-surfactants during growth on hydrocarbons, their use for the biodegradation of petroleum hydrocarbons in the marine environment is more efficient to that of surfactants of non-marine and of synthetic origin.



MULTIPLE USES OF MARINE ALGAE

Macro and microalgae are used as food, as a fertilizer, for pharmaceuticals, cosmetics, and for feeding terrestrial animals on farms. Other important applications are the production of renewable fuels, of CO2 filters and of 100% biodegradable plastic.



BIONSENSOR FOR BACTERIAL CONCENTRATION MEASUREMENT

A portable device for quick and in-situ analysis of bacterial concentration in liquid and semi-liquid food samples.

- Based on impedance analysis.
- Embedded mini-thermal chamber.
- High sensitivity.
- Quick response: 3 to 12 hours depending on the sample bacterial concentration.

Successfully tested with many types of food-samples: ice-cream, raw milk, WATER, BEER.

3. BIOECONOMY IN EVERYDAY LIFE



BIO-INNOVATION IN RECIPES

Use of natural products to replace products derived from chemical synthesis processes, to support the diversification of products and diets (snacks and sweets using derivatives of an algae called "Spirulina" rich in essential nutrients like proteins, vitamins, minerals, essential amino acids and Omega 3 and 6).



NATURAL DYES

Such as enocyanin from the anthocyanin group, extracted from red grape skins.



SPREADABLE PRODUCTS

Rich in bioactive phenols based on olive oil byproducts such as vegetation water and olive pomace.



TOMATO SAUCE

Enriched in fiber by using an ultra-micro milling which allowed to re-use both seeds and peel of tomato.



RECTIFIED CONCENTRATED MUST

It is a liquid and transparent grape sugar, made up of equal parts of glucose and fructose, suitable to meet the growing demands for healthier and more natural foods, as it has a greater sweetening power than sucrose, a reduced caloric intake, a better digestibility and assimilation.



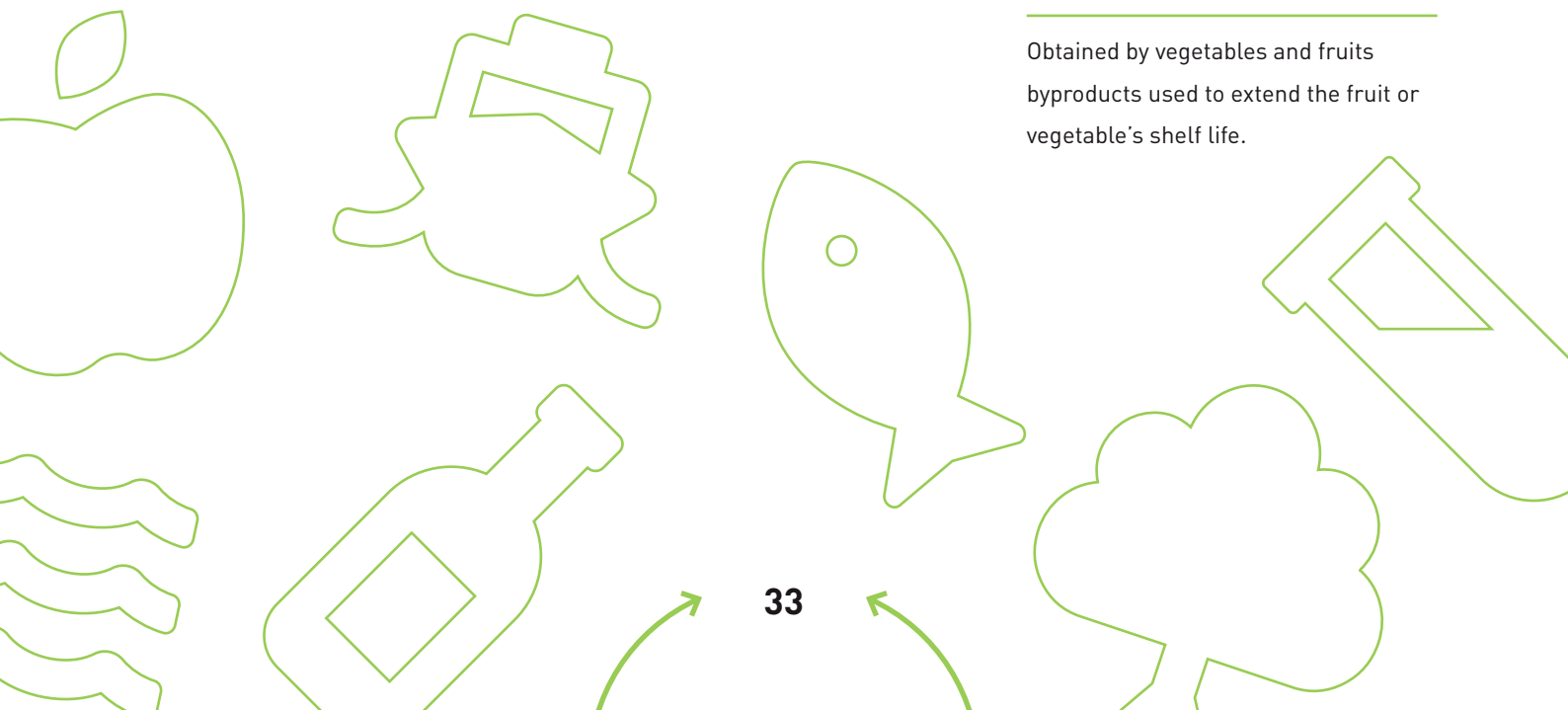
BAKED GOODS AND FRESH PASTA

Enriched with bioactive compounds recovered from bran and wheat germ.



EDIBLE SKINS

Obtained by vegetables and fruits byproducts used to extend the fruit or vegetable's shelf life.







4

THE SOCIAL DIMENSION OF THE BIOECONOMY

To meet the bioeconomy challenge of “reconnecting economy, society and environment” it will not be sufficient simply to employ biomass for industrial applications or to use regenerative instead of fossil raw materials. It does not mean simply integrating biological knowledge into existing technology.

To meet the challenge, a transition must take place also from a social point of view, stimulating social awareness and dialogue, as well as better supporting innovation in social structures leading to more conscious behaviour. Greater knowledge of what is being consumed - especially food products and processes - would lead to improvements in health conditions and lifestyle, stimulating a demand pull on sustainable innovation by companies. For this reason, it is crucial to further develop ecolabeling.

This transition process in the economy and society needs to take place in a holistic way, and in order to exploit the major potential benefits of this process, citizens must become the key players in the necessary social transformation that the bio-based economy can stimulate.

Social dialogue and an understanding of the challenges and opportunities of the bioeconomy play a decisive role in the demand for new products and services, and hence for the associated innovations and technological developments. Actions such as public procurement need to be turned into participatory actions allowing commitment, understanding and potential for replication.

The bioeconomy, due to its intrinsic characteristics, has the potential to achieve a more profound integration between economic, environmental and social objectives. However, this is possible only through investment in new capacities of consensus building for public and private sectors:

- on the part of companies through **business models which involve costumers, workers, users and stakeholders affected by their activities (primarily citizens) in a common vision concerning sustainability**; while the development of new products, services and investments related to the bioeconomy creates new economic value, jobs, relations and collaborations, it should also be clear that the bioeconomy is able to meet social needs and is aimed at improving human well-being, enhancing an individuals' capacity to act.
- on the part of the government, **through a diffused adoption of a participatory and place-based approach which conveys a new concept of a territory as a space of endogenous material and immaterial assets, and networks of economic, social, cultural, institutional relationships and interactions**; the bioeconomy is an opportunity to reassemble fragmented knowledge and capabilities into new stocks and flows of productive knowledge, building on new innovation processes; this will also help towards creating a common identity among people in the territories.



LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

The bioeconomy has strong synergies with many EU and National strategic plans, norms and funding measures which give opportunities to improve action plans and specific measures for the bioeconomy. In brief, the legislative and funding framework is composed as follows:

5.1 NATIONAL SMART SPECIALISATION STRATEGY

The Italian bioeconomy Strategy is part of the implementation process of the [National Smart Specialization Strategy \(SNSI\)](#). The Smart Specialisation Strategy aims to identify priorities for investment in research, development and innovation that complement the resources and productive capacity of territories to build comparative advantage and sustainable growth path in the medium and long term. In the programming period 2014-2020, Research and Innovation Strategies for Smart Specialisation [RIS3] are an ex ante conditionality for the use of European Structural and Investment Funds' resources devoted to the thematic objective "strengthening research, technological development and innovation".

The SNSI is implemented through specific initiatives of the National Operational Programmes 2014-2020 for Research and Innovation (NOP R & I) and for Enterprise and Competitiveness (NOP E & C) and through strategic plans funded by public resources from cohesion policy, national and regional ordinary funds, and private resources.

With reference to the bioeconomy, two strategic plans have been defined: Agrifood and biobased economy¹⁶, both of which are pillars of this Strategy. They derive from an interactive process of cooperation between public and private sector defined entrepreneurial discovery process.

The Italian bioeconomy Strategy lays down the policy framework for these two action plans that are related to the main spheres where the bioeconomy and the biotechnologies have the greatest impact.

The two Plans have fallen within the scope of a recent support measure (grants and subsidised loans) of 562.7 million euros in favor of industrial research and development launched between November 2018 and January 2019 by the NOP "E & C". The companies having participated in the call absorbed all available resources¹⁷.

¹⁶ The Plan identifies macro projects for: the reconversion of industrial areas in crisis through the bioeconomy; the creation of territorial supply chains at the service of national multiproducts and multi-input biorefineries; the transformation of Italy in the first country towards zero organic waste sent to landfills with its complete reuse as compost for soil fertility, biogas, chemical substances and materials.

¹⁷ For further information click on the following NOP website link the mise.gov.it

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

5.2 EU LEGISLATIVE FRAMEWORK

The role of agricultural policies in supporting bioeconomy. Within the framework of the European strategy on bioeconomy, a close integration between EU sectoral policies - mainly industry, circular economy, climate and energy and agriculture - is an essential element to cope with global EU goals. As agriculture plays a key role in EU bioeconomy, accounting for 3/4 of occupation and 2/3 of turnover, new synergies with current policy tools and CAP measures are expected to unlock bioeconomy potential in rural, coastal as well as in urban areas. In this context of CAP post 2020, the definition of the new National Strategic Plan is a huge opportunity. Local and regional bioeconomy value chains are consolidated realities in Italy and the challenge of the new CAP is to find appropriated tools and measures supporting them while promoting the creation of the new ones in a long period perspective. It's not a completely novel pathway and many actions are still working on this direction in the local development strategies of current Rural Development Plans, such as Cooperation measures and LEADER approach, but also support for young farmers to promote diversification toward extra agricultural activities. Local development and diversification are key concept enhancing the role of agriculture for the development of a national bioeconomy plan and - focusing on "green architecture" of the new CAP - many opportunities for farmers can arise implementing dedicated actions and strategies aimed at encouraging the reuse of agricultural waste or byproducts, for

instance, with priority criteria and award mechanisms. In this framework, the promotion of sustainable production intensification, the development of biocosmetics, nutraceuticals, animal feed, biofertilizers (organic fertilization of soils through digestate and compost), bioproducts and biomaterials (green chemistry, construction, etc.) are included, as well as the growth of bioenergy and advanced biofuels.

The European Forest Strategy of 2013, updated in 2018, represents the reference framework and European direction for forest actions and interventions carried out, in various capacities, by the EU and its Member States. The multifunctional role of forests is promoted and the principles of Sustainable Forest Management and cascade use of wood products are implemented. The role of forests in mitigation and adaptation policies to cope with the consequences of climate change is reinforced. The strategy promotes the adoption of measures aimed at increasing sustainable management and the use and recycling of forest products to increase the development of an effective bioeconomy and stimulate an offer of renewable and environmentally compatible raw materials, support the territorial economic development, employment, the supply of goods and services to citizens and the safeguarding of environmental resources.

Circular Economy Package. In December 2015, the EU adopted the Circular Economy Package "Closing the loop - An EU action plan for the Circular Economy"¹⁸ defining ambitious targets and a timeline to reduce the

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pressure on natural resources and boost the market for secondary raw materials. The Circular Economy package introduced specific economic instruments and promoted industrial symbiosis, incentivizing other mechanisms to reduce future waste generation under a circular bioeconomy philosophy (e.g. design for recycling, reduced packaging).

Marine Strategy Framework Directive D.lgs n. 190/2010 (MSFD). The aim of the Directive is to achieve Good Environmental Status (GES) for the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The Marine Strategy is the principal instrument to establish and promote an approach founded on sustainable development based on preserving and protecting marine biodiversity and finding solutions to current problems such as marine litter, pollution from contaminants, and the sustainability of fisheries.

Climate change strategy is a big challenge for the medium and long term future. In the meantime, it requires the transformation of the energy system in order to reduce GHG emissions into the atmosphere by increasing the share of clean and renewable energy, as well as the reduction of the energy intensity of the overall system. On the other hand, it implies increasing the resilience and adaptive capacity to cope with climate change impacts. The EU legislative framework for the first aspect

(mitigation) is given by the Climate and Energy Package¹⁹ by 2030, that strengthens the Paris agreement which entered into force in November 2016, as well as the 2050 Low-Carbon Economy²⁰. With regards to the second pillar (adaptation), in 2013 the EU adopted the European Adaptation Strategy²¹ that, among other objectives, promotes adaptation measures in key vulnerable sectors including green infrastructure and coastal zone management to increase the resilience of urban, rural and coastal areas with respect to climate change and other environmental forcing compromising anthropic areas adaptation and livability.

Directive 2008/98/EC on waste (Waste Framework Directive). The Directive aims at setting the basic concepts and definitions related to waste management, explaining when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and byproducts. The Directive clearly establishes that bio-based recyclable products and compostable bio-degradable products represent an opportunity to foster a sustainable bio-economy and decrease the Union's dependence on imported raw materials. To this aim further research and innovation should be stimulated to substitute fossil fuel-based feedstock with renewable resources. The Directive introduces the "extended producer responsibility", and its amendment issued on 30 May 2018 (Directive 2018/851)²² includes three new recycling and recovery targets:

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20 ec.europa.eu

21 eur-lex.europa.eu

22 eur-lex.europa.eu

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

- **by 2025**, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55% by weight;
- **by 2030**, the preparing for reuse and the recycling of municipal waste shall be increased to a minimum of 60% by weight;
- **by 2030**, the preparing for reduction of 50% in food waste, in line with the 2030 Agenda for sustainable development;
- **by 2035**, the preparing for reuse and the recycling of municipal waste shall be increased to a minimum of 65% by weight.

5.3 STANDARDS, CERTIFICATION AND LABELS

Along with directives, strategies and policy packages, standards, certifications and labels are valuable regulatory tools which can support the establishment of a sustainable bio-based economy. Sustainability standards set the minimum requirement in terms of principles, criteria and indicators to assess sustainability. Certification schemes show that a product complies with such standards. Finally, a label (or eco-label) is given as a result of a certification process, which communicates to the end user compliance with predefined sustainability requirements. Hence, standards, certifications and labels support innovation and create markets for bio-based products by overcoming perceived uncertainty about the products' properties and communicating their benefits.

Against this background and within the framework of the Lead Market Initiative, introduced in 2006 to boost the market uptake of bio-based products, the European Commission issued a number of standardization mandates to the European Committee for Standardization (CEN):

- **M/429** for the elaboration of a standardization programme for bio-based products;
- **M/430** on bio-polymers and bio-lubricants;
- **M/491** on bio-solvents and bio-surfactants;
- **M/492** for the development of horizontal standards for bio-based products.

As part of the EU mandate M/429, the CEN technical committee CEN/TC411 was created in 2011 with the aim of covering horizontal aspects of the bioeconomy, including a consistent terminology, methods for determining bio-based content in a product, application of Life Cycle Assessment (LCA) and sustainability of biomass used, and guidance on the use of existing standards for the end-of-life options. Three more CEN Technical Committees deal with specific bio-based products and applications. Overall, four Technical Committees have been established with the following objectives:

- **CEN/TC 411 - Horizontal standards.** Standards covering terminology, bio-based content determination, LCA, sustainability criteria, end-of-life options, Requirements for B2B communication, Requirements for B2C communication (Mandate 492)

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- **Bio-solvents.** Standards covering requirements and test methods (Mandate 491)
- **CEN/TC 276 - Bio-surfactants.** Standards covering requirements and test methods (Mandate 491)
- **CEN/TC 19 - Bio-lubricants.** Standards covering recommendation for terminology, determination of aerobic biological degradation and criteria and requirements for bio-lubricants (Mandate 430)
- **CEN/TC 249 - Bio-polymers.** Standards covering terminology, determination of bio-based carbon content, template for reporting (Mandate 430).

The new National Forest Strategy, foreseen by the Art. 8, Com. 1, of the new Consolidated Law on forests and forestry chains (TUFF - Legislative Decree 3 April 2018 n. 34), updates the 2008 sector strategy (Framework Program for the national forest sector) and proposes to build a shared and far-sighted strategic vision for the management, protection and enhancement of the heritage and forest sector. Consistent with the European indications and international commitments signed by the Italian Government, it presents itself as a new tool for sharing and implementing strategic proposals on socio-economic development and environmental protection, paying particular attention to the role of forests and its products in the bioeconomy.

5.4 ITALIAN LEGISLATION

The [Environmental Annex to the Stability Law 2014](#) «Measures for promoting the green economy and limiting the excessive use of natural resources»²³ defines the important milestones for future Italian environmental strategies. The main focus is on the green economy and the circular economy, in particular through: Green Public Procurement (GPP) with environmental minimum criteria for new purchases by the public sector defined also by Labelling and Certifications (Emas, Ecolabel, Environmental Footprints, Made Green in Italy); incentives for the purchase of post-consumption materials, the management of specific waste fractions (including composting) and incentives to increase the share of collected waste; creation of a Natural Capital Committee, that can provide data on natural biomass consumption and monitor the impact of public policies on natural resources and ecosystem services conservation; the establishment of a system of Payment for Ecosystem and Environmental Services and the production of a Catalogue of environmentally friendly and harmful subsidies.

Specifically, the Law establishes that, to ensure the achievement of the social, economic and environmental goals coherent with the financial and budgetary annual planning, every year, the Committee sends to the Presidency of Council of Ministers and to the Ministry of Economy and Finance a Report on the State of the Natural Capital in Italy. Two editions of the Report have

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been released in 2017 and 2018 respectively²⁴. The aim of the Reports is to provide environmental information and data expressed in both physical and monetary units and monitor the implementation, effectiveness and efficiency of policies and actions in order to protect the environment as well as the state of the environment and the Natural Capital. At the same time, the first edition of the Catalogue of environmentally friendly and harmful subsidies²⁵ has been released in 2016 by the Italian Ministry of the Environment. The Catalogue analyses the subsidies by sector: agriculture, energy, transport, VAT and other subsidies, considering both fiscal expenditures and direct subsidies, with reference to the financial effect in 2016.

One of the most important aspects of the Environmental Annex was the update of the [National Sustainable Development Strategy](#), built upon the 2030 Agenda for Sustainable Development²⁶ adopted by the UN in September 2015. Among the 17 Sustainable Development Goals (SDGs) of the UN agenda, some of them are strictly related to the bioeconomy:

1. **SDG2** - End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
2. **SDG7** - Ensure access to affordable, reliable, sustainable and modern energy for all.

3. **SDG8** - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
4. **SDG9** - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
5. **SDG12** - Ensure sustainable consumption and production patterns.
6. **SDG14** - Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
7. **SDG15** - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Taking into account the principles of the Agenda 2030 and the SDGs, the National Sustainable Development Strategy²⁷ defines a set of strategic choices and national objectives divided in six areas²⁸. A preliminary list of implementation tools has been identified in a wide and open process of consultation and associated to each of the six areas. The strategic choices related to the bioeconomy are:

24 minambiente.it and minambiente.it

25 minambiente.it

26 sustainabledevelopment.un.org

27 Approved by CIPE resolution no. 108 of 22 December 2017

28 The 5 Ps of the Agenda 2030 (People, Planet, Prosperity, Peace and Partnership) and the Sustainability Vectors

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People:

1. Fighting poverty and social exclusion, eliminating territorial differences.
2. Promote health and wellbeing.

Planet:

1. Halt the loss of biodiversity.
2. Ensure the sustainable management of natural resources.
3. Create resilient communities and territories, preserve landscapes and cultural heritage.

Prosperity:

1. Fund and promote sustainable research and innovation.
2. Ensure sustainable production and consumption patterns.
3. Decarbonize the economy.

The [Green Public Procurement \(GPP\) National Action Plan \(NAP\)](#)²⁹ document outlines the strategy for the diffusion of GPP in Italy, the commodity categories, the reference environmental targets to be attained -both qualitative and quantitative - and the general methodological aspects.

Based upon the [Code of Public Contracts](#)³⁰, the GPP

NAP aims to spread and implement nationwide the adoption of sustainable purchases in Italy.

The above mentioned Environmental Annex established, from 2016, the compulsory commitment for the [Italian Public Administration to the Code](#). Italy thus became the first country in the world to adopt such an obligation. The new [Code of Public Contracts](#)³¹ has further reinforced the statement by defining more specifically the [Environmental Minimum Criteria \(EMC\)](#) for the eligibility of applicants to participate in public tenders. Since 2011, a number of Decrees from the Ministry of Environment, Land and Sea have been issued to define EMC by commodity category.

With reference to waste, legislative decree 152/2006 sets the same 65% target on municipal waste as the EU within the Circular Economy package. The "[National Program for Waste Reduction](#)"³² also considers the target of 50% share of "green purchases" by the public sector, and defines specific measures for biodegradable waste, valorization of agro-industry byproducts and minimizing food waste. Specifically, regarding composting, the recent Decree of Ministries Council Presidency on 7 March 2016³³ defines the requirements for the Italian regions in terms of organic waste to be treated through composting.

29 Approved through Interministerial Decree 11 April 2008 and updated with the Decree 10 April 2013

30 D. Lgs. 12 April 2006, n. 163

31 Decree 18/04/2016, n. 50

32 minambiente.it

33 gazzettaufficiale.it

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The updates of the “National Energy Strategy”³⁴ and the “National Plan for Climate and Energy”³⁵ provide the framework within which the different sources of energy will develop in order to achieve the targets on GHG emission reduction and renewable energy share. In addition, Italy has adopted a “National Adaptation Strategy”³⁶ and is putting into place the “National Adaptation Plan”. The bioeconomy can play a significant role in both senses, in terms of providing clean energy sources and ensuring a long-term conservation of natural resources and ecological systems, also through nature-based solutions.

The National Biodiversity Strategy (NBS), adopted in October 2010, aims to merge and integrate biodiversity conservation targets and the sustainable use of natural resources within sectoral policies, while the National ratification of Nagoya Protocol, on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, is still in progress (although in 2014 the EU Regulation 511/2014 “on compliance measures for users of the Nagoya Protocol Arising from their Utilisation in the Union” entered in force at EU level).

The National Marine Strategy D.lgs n. 190/2010 was enacted to transpose the Marine Strategy Framework Directive at national level and with the aim of achieving

the Good Environmental Status for the Italian marine waters within a sustainable development perspective. DM 17/10/2014 specifies the requirements and targets necessary to achieve the GES, whilst the DM 11/02/2015 defines the indicators associated with the GES and regulates the drawing up of the monitoring programs necessary to evaluate it.

5.5 FUNDING PROGRAMMES

Many programs at EU, national, regional and local level can fund and contribute to regulating bioeconomy actions. However, it is necessary to improve the integration of programming in a common strategic framework and strengthening the capability of financial mechanisms to ensure the long term stability of bio - investments - beyond the programming period of public administration budgets.

This function should be performed by the Cohesion Policy Funds that in the current programming period (2014-2020) make resources available along seven (plus three) years in thematic objectives and investment priorities consistent with the bioeconomy development³⁷.

Cohesion Policy Funds, according to their rules, are therefore allowed to support investments structured and amortized over the medium to long term by integrating and stabilizing resources from the ordinary

34 Published in 2017 mise.gov.it

35 In accordance with EU legislation, Italy submitted the Plan proposal to the Commission on 8 January 2019. It was subsequently opened on the dedicated portal energiaclima2030.mise.gov.it a public consultation closed on 5th May. The final text will be published within 2019

36 minambiente.it

37 For further information click on the following European Commission website link ec.europa.eu

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national policy, in order to create a funding matrix in which programming and financial needs are blended.

The European Agricultural Fund for Rural Development (EAFRD), for instance, focuses on new value chains based on the smart and integral use of agro waste and specialized crops for industrial uses to be grown on marginal lands, creating the necessary interface for agro-energy and bio-based industries. Regional EARDF programs identify also specific KETs (green biotechnologies and “omics”, precision farming, nanotechnologies) such as drivers for innovation and competitiveness of local systems.

The table below illustrates the funding opportunities opened up by the Cohesion Policy resources for the bioeconomy in Italy in 2014-2020 period.

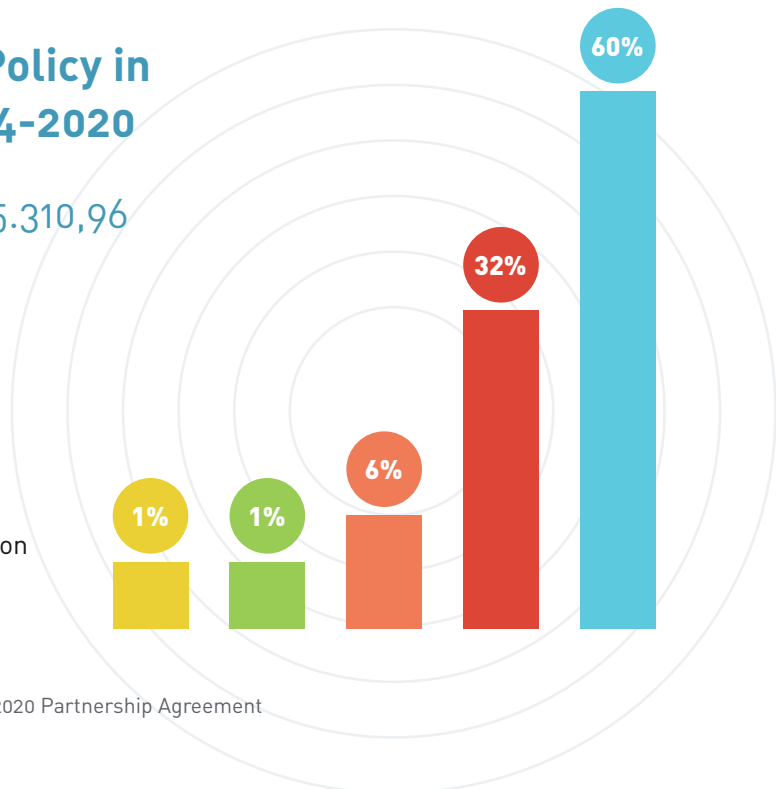
In the next programming period (2021-2027) bioeconomy investments will still be able to benefit from the resources of the cohesion policy that will strongly focus on the thematic objectives *Smarter Europe and Greener, carbon free Europe*: 65% to 85% of European Regional Development Fund and Cohesion Fund resources will be allocated to these priorities³⁸. 6

38 See the EU Commission brochure “Regional development and cohesion beyond 2020: the new framework at a glance” ec.europa.eu

6 Italian Budget for Cohesion Policy in the programming period 2014-2020

Total resources in million EUR 125.310,96 (EU and National contributions)

- European Structural and Investment Funds (ESIFs)
- European Territorial Cooperation programmes
- Fund for European Aid to the Most Deprived (FEAD)
- Complementary Programmes Action Plans for Cohesion
- Italian Development and Cohesion Fund (FSC)



Source: Agency for territorial cohesion elaboration on data from 2014-2020 Partnership Agreement

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At European level, a very important role could be played also by direct funding grants from the European Commission or its executive agencies, such as Horizon 2020 that with its three pillars - [Excellent Science](#), [Industrial Leadership](#), and [Societal Challenges](#) - and two specific objectives - [Spreading Excellence and Widening Participation](#) and [Science with and for Society](#) - which add an important funding system (EUR 77.028 billion³⁹). The societal challenge 2 “Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the bioeconomy” specifically addresses the main topics of bioeconomy (“using better what we already use” and “using well what we don’t use yet”) with a total budget amounting to EUR 3.851 billion⁴⁰, in the period 2014-2020. Some priorities of the bioeconomy are also supported by the societal challenge 3 and 5 and the NMPB pillar of Horizon 2020. Another part of the Horizon 2020 budget available for bioeconomy is implemented by one of the seven public private partnerships (PPPs) operating under Horizon: the Bio-Based Industries (BBI) Joint Undertaking. It aims to develop new bio-refining technologies to sustainably transform renewable natural resources (waste, agriculture residues) into bio-based products, materials and fuels.

The new “Horizon Europe” should allocate about €10 Bln for the Global Challenge “Food, bioeconomy, Natural Resources, Agriculture and Environment” Cluster 5, in the 7 years 2021-2027.

Other opportunities could be supported also by national and regional ordinary budget, tax incentives, such as Patent boxes, and private investments.

At national level, the new Industry 4.0 plan⁴¹ provides opportunities for enterprises also of the bioeconomy domain for enhancing research, innovation and competitiveness. The core of Industry 4.0 (I 4.0) is to connect physical and digital systems, complex analyses of big data and real-time settings through use of smart machines, inter-connected and connected to internet. The plan provides intense financial support to enterprises through hyper-depreciation and super-depreciation schemes (an increase in the rate of depreciation for innovative digital investments), tax credit for research and development and innovation expenditure, Venture Capital and Start-ups. The plan also provides financial support for the implementation of public-private Competence Centers, aimed to offer formation and orientation services for enterprises.

39 Estimated final amount in million euro and in current prices (2013) - ec.europa.eu

40 See note n. 19

41 sviluppoeconomico.gov.it

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The bioeconomy investments will benefit not only from the incentive measures activated in past years (eg energy efficiency, the SME Fund) but also from the new investment support initiatives provided, on the proposal of the Ministry of Economic Development, by the budget law for 2019⁴² as for example the Venture Capital Fund of Funds⁴³, the National Innovation Fund⁴⁴ as well as from a greater commitment to research and development activities related to Sustainable Development thanks to the creation of the Mediterranean Technopole Research Institute⁴⁵.

Further incentive measures will be implemented thanks to the provisions of the Growth Decree recently approved by the Council of Ministers:

- the Plan for Important Investment in the Special Economic Zones which provides for carrying out a specific financial instrument that enhances direct and indirect investments, in order to better exploit the attractiveness of new investments and stimulate the development in areas on which the SEZs insist.

- incentives to support research and development projects for accompanying the transition processes towards circular economy, based on 2020 resources availability of the Development and Cohesion Fund and the Revolving Fund for enterprises, in a way consistent with the principles, criteria and limits set by EU Regulation no. 651/2014.

A very significant role could be played by **National Technological Clusters** as defined by the Italian Ministry for Education, University and Research in the National Research Plan 2015-2020. Clusters have been set up to create permanent dialogue platforms between public research network and enterprises. Clusters directly linked to bioeconomy (Agrifood⁴⁶, Green Chemistry⁴⁷, Smart Factory⁴⁸, Blue Growth⁴⁹ and Energy) are priority areas of intervention in the framework of the National Research Plan.

42 Law 30 Dicembre 2018, n. 145

43 Law 145/2018 article 1, paragraph 206-209

44 Law 145/2018 article 1, paragraph 116-121

45 Law 145/2018 article 1, paragraph 732-737

46 clusteragrifood.it

47 clusterspring.it

48 fabbricaintelligente.it

49 clusterbig.it

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MAJOR EUROPEAN BIOECONOMY R&I PROJECTS COORDINATED BY ITALY FUNDED IN THE FRAMEWORK OF HORIZON2020 (SOCIETAL CHALLENGES 2, 3, 5) AND RELATED PUBLIC PRIVATE PARTNERSHIPS AND INITIATIVES (2014-2018)

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Agricolus Decision Support System	Agricolus DSS	15/02/2016	TEAMDEV SRL	SME-1
Unique radar-drone used for subsurface water detection for precision agricultural irrigation	AGRI-DONE	16/05/2016	ADANT SRL	SME-1
A resource-efficient granulation process for advanced formulation of any compound in food and pharma production	AGS	17/12/2015	POLIBIOTECH SRL	SME-1
Antibiotic resistance-free meat and dairy products	ARMeD_free	22/01/2017	SACCO SRL	SME-1
Automated system for packaging fresh meat with reduced waste/giveaway, processing time, human involvement and contamination	AUTOMEATIC	01/05/2017	GRASELLI SPA	SME-1
New bio-based food packaging materials with enhanced barrier properties - BioBarrier	BioBarr	05/05/2017	TECNOALIMENTI S.C.P.A.	JTI-BBI-RIA BBI-2016-R05
3Bee Hive-Tech	3Bee Hive-Tech	31/01/2018 (CLOSED)	3BEE SRL	SME-1
BIOPEN	BIOPEN	27/04/2017	CIAOTECH Srl	JTI-BBI-CSA BBI-2016-S03

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PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Mobilization of a plurality of voices and mutual learning to accelerate the Bio-based sector	BIOVoices	04/10/2017	AGENZIA PER LA PROMOZIONE DELLA RICERCA EUROPEA	CSA BB-05-2017
BLUEMED	BLUEMED	27/09/2016	CONSIGLIO NAZIONALE DELLE RICERCHE	CSA BG-13-2016
Breeding for Resilient, Efficient and Sustainable Organic Vegetable production	BRESOV	27/04/2018	UNIVERSITÀ DEGLI STUDI DI CATANIA	RIA SFS-07-2016-2017
Cost-effective CO2 conversion into chemicals via combination of Capture, ELeCtrochemical and BI-ocHEMICAL CONVersion technologies	CELBICON	04/02/2016	POLITECNICO DI TORINO	RIA ISIB-06-2015
Controlling mIcRo-bIomes CircuLa-tions for bEttEr food Systems	CIRCLES	05/10/2018	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	IA LC-SFS-03-2018
COMPostable cap-SULE for instant coffee delivery based on an innovative chemical functionalization of biobased plastics	COMPSULE	28/10/2015	POINT PLASTIC SRL	SME-1
Valorisation of corn processing byproducts into plastic bio-composites	CORNposite	27/02/2016	CORN VALLEY SRL	SME-1
Optimum, sustainable solution for seed drying and conservation	DryCoolerSeeds	25/11/2015	MARCOLD GROUP	SME-1

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PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Optimum, sustainable solution for seed drying and conservation	DryCoolerSeeds	23/02/2018	MARCOLD GROUP	SME-2
Design of an agricultural greenhouse for intensive growing of microalgae in fresh / sea water with a syngas production plant and organic farming of chickens and pigs outdoors	ECO-LOGIC GREEN FARM	22/07/2015	SOCIETÀ AGRICOLA SERENISSIMA S.S.	SME-2
Stacking of ecosystem services: mechanisms and interactions for optimal crop protection, pollination enhancement, and productivity	EcoStack	24/07/2018	UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II	RIA SFS-28-2017
A feasibility study to investigate and verify the commercial and industrial viability of a wastewater processing solution to generate bioplastics from agri-food and municipal wastewater sources	EggPlant	29/02/2016	EGGPLANT SOCIETÀ A RESPONSABILITÀ LIMITATA	SME-1
Establishing a Multi-purpose Biorefinery for the Recycling of the organic content of AHP waste in a Circular Economy Domain	EMBRACED	03/05/2017	Fater S.p.A.	JTI-BBI-IA-DEMO
Food treatment process based on high voltage nanopulsed electric discharges in liquid phase	EMILK	20/08/2015	LASERLAM SRL	SME-1

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PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Effective Management of Pests and Harmful Alien Species - Integrated Solutions	EMPHASIS	19/02/2015	UNIVERSITÀ DEGLI STUDI DI TORINO	RIA SFS-03a-2014
Enhance New Approaches in BioBased Local Innovation Networks for Growth	ENABLING	05/10/2017	FEDERUNACOMA SRL UNIPERSONALE	CSA RUR-10-2016-2017
Separation, fractionation and isolation of biologically active natural substances from corn oil and other side streams	EXCornsEED	26/04/2018	UNIVERSITÀ DEGLI STUDI DI ROMA LA SAPIENZA	JTI-BBI-RIA BBI.2017.R4
Flagship demonstration of an integrated biorefinery for dry crops sustainable exploitation towards biobased materials production	FIRST2RUN	10/06/2015	NOVAMONT SPA	BBI-IA-FLAG
Linking genetic resources, genomes and phenotypes of Solanaceous crops	G2P-SOL	05/02/2016	ENEA	RIA SFS-07b-2015
Green Aquaculture Intensification in Europe	GAIN	27/04/2018	UNIVERSITÀ CA' FOSCARI VENEZIA	RIA SFS-32-2017
First industrial use of bio and eco-compatible geopolymers produced from metakaolin to manufacture tanks for wine, beer, vinegar and olive oil production and storage via 3D printing technology	GeoFood	21/05/2016	CIBAS DI POLI FABIO & C SAS	SME-1

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PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Drone-based integrated monitoring system for early detection of crop pathology and pest control in high tech greenhouse agriculture	GIDROM	26/08/2015	ABO DATA SRL	SME-1
Smart cuvette and portable Time-Resolved FRET for fast analysis of milk	I-Cuvette	25/11/2017 (CLOSED)	ISS BIOSENSE SRL	SME-1
Jellyfish Barge - A floating greenhouse	JFB	20/05/2015	PNAT SRL	SME-1
Development of Integrated Web-Based Land Decision Support System Aiming Towards the Implementation of Policies for Agriculture and Environment	LANDSUPPORT	13/04/2018	UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II	RIA RUR-03-2017
Mobile wireless Device microcantilever-based biosensor to identify and measure the aflatoxin B1 in animal food and M1 in the milk-chain	MEDluM	19/11/2015	INFORMATICA SYSTEM S.R.L.	SME-1
A sustainable organic solution to the decline of bees	MICRO4BEE	22/02/2016	MICRO4YOU SRL	SME-1
Modelling and Imaging Development for precision Agriculture	MIDA	12/05/2017 (CLOSED)	METACORTEX Srl	SME-1

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PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Microbial Uptakes for Sustainable management of major banana pests and diseases	MUSA	10/05/2017	CONSIGLIO NAZIONALE DELLE RICERCHE	RIA
Integrated and innovative key actions for mycotoxin management in the food and feed chain	MycoKey	09/02/2016	CONSIGLIO NAZIONALE DELLE RICERCHE	RIA SFS-13-2015
Nite Carbon Nanoclusters, a natural antioxidant for the food industry made from agricultural waste	NCN	05/02/2018	HYDRA SRL	SME-1
A Revolutionary, Safe and Cost-effective Industrial Process for Gluten Detoxification in Cereals	New Gluten World	16/10/2016	NEW GLUTEN WORLD S.R.L.	SME-2
Automatic Hydraulic Jack with improved capacity, safety and efficiency for agricultural implements	Novel Jack	09/11/2017 (CLOSED)	SIMOL SPA	SME-1
Vegetable ozone therapy for the defence of greenhouse crops	O3MET	15/09/2015	MET s.r.l.	SME-1
Advanced solutions for ensuring the overall authenticity and quality of olive oil	OLEUM	08/07/2016	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	RIA SFS-14a-2014
From plants for plants: enhancing crop potential and resilience through reliable new generation biostimulants	Plants for Plants	04/12/2015	LANDLAB SRL	SME-1

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Pest Organisms Threatening Europe	POnTE	29/10/2015	CONSIGLIO NAZIONALE DELLE RICERCHE	RIA SFS-03a-2014
Professional support to the uptake of bioeconomy RD results towards market, further research and policy for a more competitive European bioeconomy	ProBIO	16/02/2015 (CLOSED)	AZIENDA SPECIALE INNOVHUB - STAZIONI SPERIMENTALI PER L'INDUSTRIA	CSA ISIB-08b-2014
PROViding smart DELivery of public goods by EU agriculture and forestry	PROVIDE	27/05/2015	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	RIA ISIB-01-2014
Increasing grain quality through advanced oxidation treatment during storage	QUALIGRAIN	01/10/2014 (CLOSED)	LA SANFERMESE SpA	SME-1
Fermentation processes for functional foods from RAPeseed, Sunflower and Other EU matrices Devoted to Young animals. Zero-miles model boosting safety and competitiveness of livestock sector	RAPSODY	27/01/2015 (CLOSED)	METHODO CHEMICALS SRL	SME-1
A Novel Double Wheel Rake Machine to provide high quality fodder and high operational speed	RA-RAKE	28/06/2017	REPOSSI MACCHINE AGRICOLE SRL	SME-2
A Novel Double Wheel Rake Machine to provide high quality fodder and high operational speed	RA-RAKE	19/11/2016	REPOSSI MACCHINE AGRICOLE SRL	SME-1

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Novel Products for Construction and Automotive Industries Based on Bio Materials and Natural Fibres	ReInvent	04/05/2018	CENTRO RICERCHE FIAT SCPA	JTI-BBI-IA-DEMO BBI.2017.D5
RESources from URban Blo waSte	RES URBIS	01/01/2017	UNIVERSITÀ "LA SAPIENZA" DI ROMA	RIA CIRC 05-2016
Innovative oxygen-free wine bottling process	RiCaMo	22/06/2016 (CLOSED)	ENTER S.R.L.	SME-2
RLTProFood - Remote Lighting Technology for processing and production of food	RLTProFood	02/09/2015	IODA SRL	SME-1
On-field innovative system to detect very low concentrations of aflatoxins in milk	SAFEMILK	31/01/2017	IDP SRL	SME-1
Novel Ozone and Thermal Shock Conservation Process for Vegetables	SCHOCKO3	25/05/2015	FIORDELISI SRL	SME-1
A compact, unmanned, renewables-powered and self-sufficient vessel able to pick up marine litter and to treat it on board for volume reduction and energy recovery	Sea Litter Critters	12/02/2016	IRIS SRL	SME-1
Short supply chain Knowledge and Innovation Network	SKIN	23/09/2016	UNIVERSITÀ DEGLI STUDI DI FOGGIA	CSA RUR - 10-2016

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Scale-up of low-carbon foot-print material recovery techniques in existing wastewater treatment plants	SMART-PLANT	01/06/2016	UNIVERSITÀ POLITECNICA DELLE MARCHE	IA WATER 1b-2015
Solaris energy tobacco for the creation of a European sustainable biojet fuel value chain	SOLARIS	09/08/2017	IDROEDIL SRL	SME-2
Sustainability Transition Assessment and Research of Bio-based Products	STAR-ProBio	28/04/2017	UNIVERSITÀ DEGLI STUDI DI ROMA UNITELMA SAPIENZA	RIA BB-01-2016
Detergent free steam cleaning system for modular conveyor belts in the food industry	Steammatic	30/04/2017	REA STEAM CLEANING SRL	SME-1
Submersible Tension Leg Fish Cage for Mariculture in Unsheltered and Offshore Areas	SubCage	17/12/2015	REFA MED SRL	SME-1
Application of high power ultrasounds (HPUs) to improve the sustainability in meat TENDERize and BRINE processes	TENBRIN	14/11/2016	RI-LAVO SRL	SME-1
Development and demonstration of an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry	The Blue Growth Farm	03/05/2018	RINA CONSULTING SPA	IA BG-04-2017

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
A novel and integrated approach to increase multiple and combined stress tolerance in plants using tomato as a model	TomRes	28/04/2017	UNIVERSITÀ DEGLI STUDI DI TORINO	RIA SFS-01-2016
Insect-borne prokaryote-associated diseases in tropical and subtropical perennial crops	TROPICSAFE	28/04/2017	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	RIA SFS-11-2016
Innovative tag system providing affordable time-temperature quality control of individual temperature sensitive products	T-TAG	28/11/2016	SCRIBA NANOTECNOLOGIE SRL	SME-1
Innovative biomaterials production from wine industry waste	VegeaTextile	03/04/2018	VEGEA SRL	SME-2
Virome ngs analysis of pests and pathogens for plant protection	VIROPLANT	27/04/2018	CONSIGLIO NAZIONALE DELLE RICERCHE	RIA SFS-17-2017
Xylella fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy	XF-ACTORS	11/10/2016	CONSIGLIO NAZIONALE DELLE RICERCHE	RIA SFS-09-2016
SaFe and sustainable solutions FOR the integRatEd USE of non-conventional water resources in the Mediterranean agricultural sector	FIT4REUSE	2019	Alma Mater Studiorum - University of Bologna (UNIBO)	RIA A PRIMA Project

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
A novel integrated and sustainable approach to monitor and control Blue-tongue in the Mediterranean region	Blue-Med	2019	Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise (IZSAM)	RIA A PRIMA Project
FRUIT CROPS ADAPTATION TO CLIMATE CHANGE IN THE MEDITERRANEAN BASIN	FREECLIMB	2019	Università degli Studi di Milano - La Statale (UMIL)	RIA A PRIMA Project
Utilization of local genetic diversity to understand and exploit barley adaptation to harsh environments and for pre-breeding	GENDIBAR	2019	Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Centro di Genomica e Bioinformatica (CREA-GB)	RIA A PRIMA Project
IMProving RESilience to Abiotic stresses in durum wheat: enhancing knowledge by genetic, physiological and "omics" approaches and increasing Mediterranean germplasm biodiversity by crop wild relatives-based introgressomics	IMPRESA	2019	Dipartimento di Scienze Agrarie e Forestali - Università degli Studi della Tuscia (DAFNE)	RIA A PRIMA Project
Developing new strategies to protect strawberry crop in Mediterranean countries	ed-Berry	2019	Alma Mater Studiorum University of Bologna (UNIBO)	RIA A PRIMA Project
Towards a sustainable water use in Mediterranean rice-based agro-ecosystems	MEDWATERICE	2019	Università degli Studi di Milano (UMIL)	RIA A PRIMA Project

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

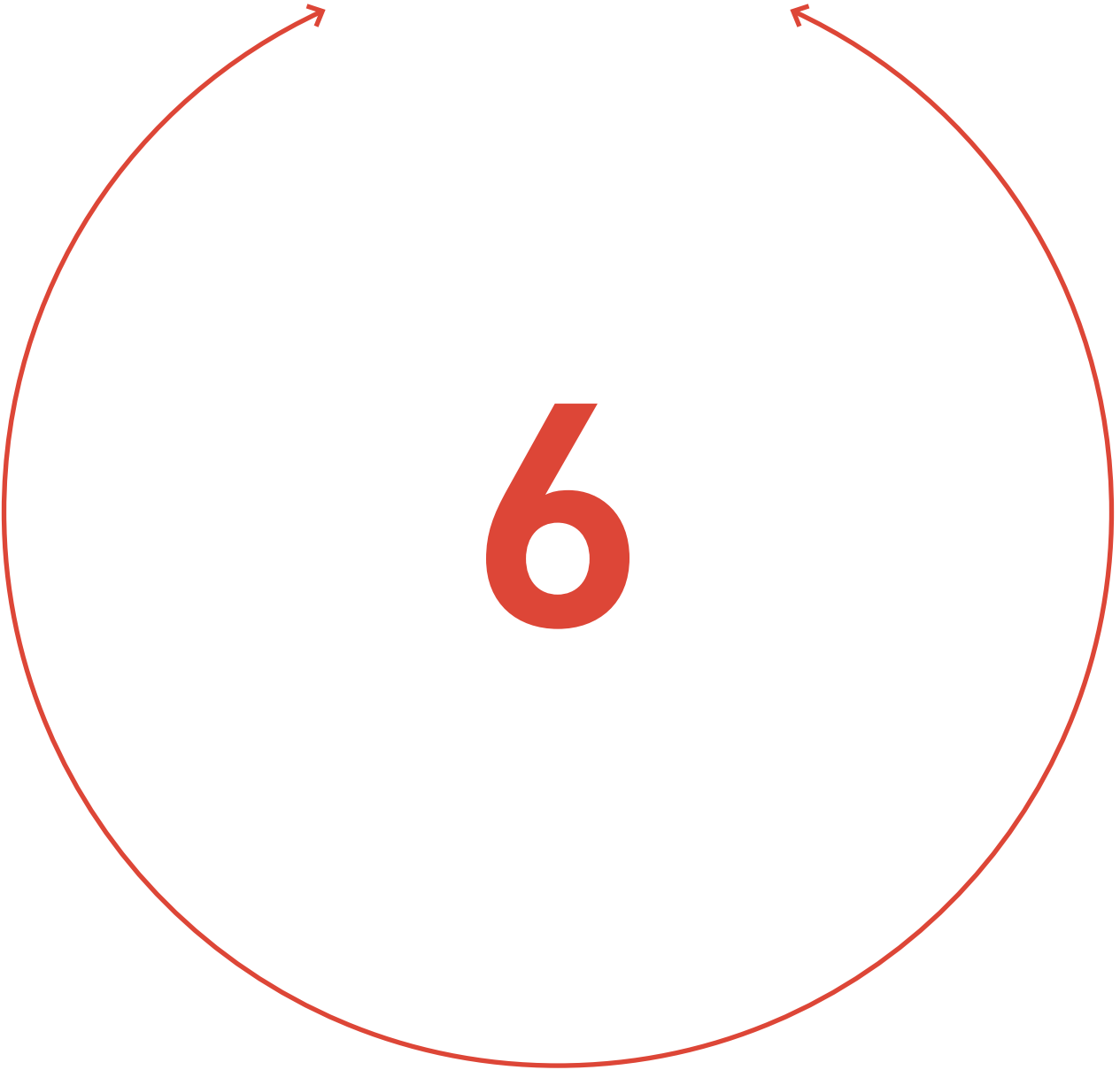
PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
Self-sufficient Integrated Multi-Trophic AquaPonic systems for improving food production sustainability and brackish water use and recycling	SIMTAP	2019	University of Pisa (UNIPI)	RIA A PRIMA Project
Strategies for increasing the WATER use efficiency of semi-arid Mediterranean watersheds and agrosilvopastoral systems under climate CHange	SWATCH	2019	Dipartimento di Ingegneria civile, ambientale ed architettura, Università di Cagliari (UNICA)	RIA A PRIMA Project
ADAPTING MEDITERRANEAN VEGETABLE CROPS TO CLIMATE CHANGE-INDUCED MULTIPLE STRESS	EG-ADAPT	2019	Università degli Studi di Torino (UNITO)	RIA A PRIMA Project
Valorisation of thistle-curdled CHEES- Es in MEDiterranean marginal areas	VEGGIE-MED-CHEESES	2019	Università Politecnica Delle Marche (UNIVPM)	RIA A PRIMA Project
Partnership for Research and Innovation in the Mediterranean Area	4PRIMA	31/05/2016	MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITÀ E DELLA RICERCA	CSA SC5-12-2016
Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels	BECOOL	1/6/2017	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	RIA SC3 LCE-22-2016
Advanced sustainable BIOfuels for Aviation	BIO4A	01/05/2018	CONSORZIO PER LA RICERCA E LA DIMOSTRAZIONE SULLE ENERGIE RINNOVABILI	IA SC3 LCE-20-2016-2017

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
BIOMethane as SUstainable and Renewable Fuel	BIOSURF	1/1/2015 (closed)	ISTITUTO DI STUDI PER L'INTEGRAZIONE DEI SISTEMI (I.S.I.S) - SOCIETÀ COOPERATIVA	CSA SC3 LCE-14-2014
Building Research environments fostering Innovation, Decision making, Governance and Education to support Blue growth	BlueBRIDGE	1/9/2015 (closed)	CNR	RIA Infrastructure di ricerca
Engineered microbial factories for CO2 exploitation in an integrated waste treatment platform	ENGICOIN	2018/01/01	IIT FONDAZIONE ISTITUTO ITALIANO DI technological	RIA NMBP BIOTEC-05-2017
de-FLuoridation technologies for imprOving quality of WatEr and agRo-animal products along the East African Rift Valley in the context of aDaptation to climate change	FLOWERED	02/05/2016	UNIVERSITÀ DEGLI STUDI DI CAGLIARI	RIA SC5 WATER-5c-2015
FREE and open source software tools for WATer resource management	FREEWAT	02/12/2014 (Closed)	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO S ANNA	CSA WATER-4a-2014
Innovative Method for Affordable Generation IN ocean Energy	IMAGINE	1/3/2018	UMBRA GROUP SPA	RIA SC3 LCE-07-2016-2017
Increasing Social Awareness and ACceptance of biogas and biomethane	ISAAC	1/1/2016 (closed)	AZZERO CO2 SRL	CSA SC3 LCE-14-2014

5. LEGISLATIVE FRAMEWORK, FUNDING MEASURES AND MARKET PULL MEASURES

PROJECT TITLE	PROJECT ACRONYM	PROJECT SIGNATURE DATE	PARTICIPANT LEGAL NAME	PROJECT INSTRUMENT/ FUNDING SCHEME/TOPIC
DevelopMent AnD application of integrated technological and management solutions FOR wasteWATER treatment and efficient reuse in agriculture tailored to the needs of Mediterranean African Countries	MADFORWATER	22/04/2016	ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA	RIA SC5 WATER-5c-2015
Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems	MED-GOLD	30/10/2017	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE	RIA SC5-01-2016-2017
Marine Ecosystem Restoration in Changing European Seas	MERCES	1/6/2016	SZN	RIA SC5-07-2015
Managing crOp water Saving with Enterprise Services	MOSES	26/05/2015 (closed)	ESRI ITALIA SPA	IA SC5 WATER-1a-2014
Project Ô: demonstration of planning and technology tools for a circular, integrated and symbiotic use of water	PROJECT O	08/05/2018	IRIS SRL	IA SC5 - CIRC-02-2016-2017
Urban metabolism accounts for building Waste management Innovative Networks and Strategies	URBAN_WINS	03/05/2016	COMUNE DI CREMONA	RIA SC5 WASTE-6b-2015



CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

The strategy aims at interconnecting the main bioeconomy sectors, creating longer, more sustainable and locally routed value chains.

As a consequence, it would allow Italy to increase its competitiveness and role in promoting sustainable growth in Europe and in the Mediterranean basin. It promotes the integration of research and innovation needs and opportunities, policy, business, and cultural attitude into a single systemic vision for the bioeconomy which is in line with the development model of the circular economy. A circular economy approach also fosters sectorial integration in a long-term perspective. Looking at the overall long term objective, the strategy defines some guiding principles and specific targets in the vision; then presents an analysis of problems and opportunities for each sub-sector and, in particular, for their interconnections. As a result of this analysis, a research agenda, and some support measures to overcome obstacles are defined.

GENERAL OBJECTIVE

To increase current Italian bioeconomy turnover (currently about EUR 330 billion/y) and jobs (about 2 M) by 15% by 2030, while increasing the level of circularity in the economy.

VISION

a TO MOVE *“from sectors to systems”*...
...by i) multidisciplinary approaches aiming at foster the integration of transformative technologies and practices; ii) interconnecting effectively the main bioeconomy sectors, across sustainable value chains, embracing the production of bioresources (i.e., Agriculture, Livestock, Aquaculture, Forestry, Marine systems) their processing and valorization of final products (i.e. the food and drinks industry, wood, paper, leather, textiles, chemical and pharmaceuticals industries, and the energy sector), by leveraging traditional sectors deeply rooted in the territory, as well as the public and private stakeholders in local communities.

b TO CREATE *“value from local biodiversity and circularity”*...
...by i) reversing progressive soil degradation and involving the implementation of technologies and practices enhancing carbon accumulation in soil; ii) valorizing the marine and rural biodiversity across new values chains of quality food, feed, biochemicals and innovative materials, that will implement sustainable and circular production models, but also through the regeneration of abandoned lands/industrial sites or the identification and exploitation of byproducts and biowastes, effluents and civil wastewater.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

c) TO MOVE *“from economy to sustainable bioeconomy”* ...

...by i) respecting natural harvest cycles and regeneration growth rates, monitoring and evaluating organic matter in soil; ii) -decarbonising agricultural and forestry systems through transformative technologies and practices fostering multi-disciplinary approaches to food, feed, bioproducts and soil regeneration; iii) developing new regenerative measures to optimise land use and improve soil quality such as the use of compost in agriculture, as well as new policy measures and socio-economic models based on the symbiotic society approach; iv) preserving ecosystem services also through compensation measures and the limitation of pollution and waste generation; v) fostering the development of low-impact innovative products, biodegradable chemicals/materials/products in order to protect the quality of water and soil and to prevent marine litter issues; vi) promoting new models based on symbiotic society approaches in cooperation with social sciences and humanities, to spread knowledge on the bioeconomy.

d) TO MOVE *“from concept to reality”*...

...via i) a more coherent political commitment towards the bioeconomy; ii) efficient alignment between regional, national and EU policies through coordination of relevant stakeholders via the national technology clusters; iii) investments in targeted programs for R&I, flagship, education, training; iv) engagement in a public dialogue while increasing social awareness through the professional and efficient communication of the benefits of the bioeconomy, and v) tailored actions for market development vi) also through the definition of standards and certifications.

e) TO PROMOTE THE *“bioeconomy in the Mediterranean area”*...

...via the exploitation of initiative such as, PRIMA, BLUEMED, ENI ENPI INTERREG initiatives, as well as the macro-regional initiatives on blue growth EUSAIR and WEST MED, aiming at a long-term coordination of European and non-EU countries of the area towards R&I, flagship, training activities in the field of bioeconomy. Such trans-national synergies and complementarities provide added value to regional, national and EU investments, while promoting Mediterranean primary production and industry within a perspective of enhanced social cohesion and political stability, a healthier environment and new occupational opportunities.



6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

6.1 THE CHALLENGES

✘ PROBLEMS

- High presence of marginal/abandoned/degraded lands in relation to climate change, urban and industrial facilities.
- Use of virgin land to build new industrial and urban areas, reducing soil availability.
- Abandoning of rural areas due to limited profitability of farms and unsatisfactory logistics services.
- Weak and poorly organized local value chains.
- Price volatility and increasing competition at world-wide level.
- Lack of innovation in agriculture to respond to climate change, water scarcity and alien pests/plants.
- Lack of effective communication, education and training of farmers about new business opportunities and innovation management.
- Lack of policies to protect farmers' income in the current value chains.

✔ OPPORTUNITIES

- A quite rich local biodiversity and agricultural ecosystem services to be discovered, protected, valorized through the empowerment of local communities.
- Regional specificities appropriate for implementing innovative multi-purpose cropping systems to regenerate marginal/abandoned/degraded land, and to create value for local rural communities.
- Innovative precision-farming and breeding techniques, enabled by available digital services, allowing for input reduction, sustainable and resilient intensification of agriculture while preserving biodiversity.
- New techniques available for monitoring and modeling soil-organic-matter dynamics.
- Territory regeneration schemes based on low-input farming methods.
- Local crops/varieties available regionally and prone to be adapted to climate change and low-input cultivations.
- Novel satellite-based technology available for effective mapping of abandoned, marginal and contaminated lands, thus enabling integrated

land-use planning.

- New business models for the diversification of rural incomes, adding value to local production and products/food and increasing the integration with other economic sectors such as bio-based industry.
- Availability of underexploited agricultural, forestry and breeding residues and side streams with high potential for the production of valuable bio-based chemicals, nutraceuticals, energy.
- Increased attractiveness of the agro-food sector for the new generations, thanks to novel professional and entrepreneurial opportunities within a bioeconomy perspective.
- Exploiting the role of agriculture (including urban and peri-urban agriculture, indoor vertical agriculture) in a circular bio-based society systemic perspective, linking primary production, ecosystems and human health
- Legislative opening (European fertilizer directive 27 March 2019) about recovering and recycling of phosphorus (sewage sludge, manure and food waste) as fertilizer.

Agriculture

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

✗ PROBLEMS

- Abandonment of forests belonging to national and regional heritage with consequent biodiversity depletion;
- Ecosystem degradation due to climate change;
- Lack of strategies for the management, genetic improvement and valorization of autochthonous forestry production;
- Limited reliability and completeness of existing national statistics on forest resources, including a National Agriculture and Forest Sink register;
- Insufficient integration with the national wood processing industry, which imports medium/low quality/cost wood;
- Lack of education and training of forest company managers in new business opportunities.

✓ OPPORTUNITIES

- Availability of forest certification schemes and Life Cycle Analysis practices for a more sustainable exploitation of valuable national wood and deriving materials, also for the production of added value products and energy through tailored biorefinery schemes;
- Availability of independent Sustainable Forest Management schemes for a tailored management and exploitation of forests;
- Availability of innovative techniques, based on digital services, enabling input reduction, sustainable and resilient intensification of forestry;
- Availability of nature-based and eco-designed solutions (including new sustainable organic fertilizers and bio-pesticides) enabling the preservation of biodiversity, the implementation of low-impact management protocols;
- Business innovation with local value chains deriving from forest products, like mushrooms, truffles, herbs, cork etc. as a contribution to rural development opportunities.

Forest

✗ PROBLEMS

- Unsustainable fishing and under-exploited marine aquaculture;
- Sea productivity adversely affected by pollution (chemical pollutants, litter etc.), invasive species and climate changes;
- Increasing import of fish from areas with low environmental regulation and monitoring;
- Environmental pressure on coasts stemming from tourism and recreation activities and urbanization.

✓ OPPORTUNITIES

- Environmentally safe practices for marine aquaculture (also offshore);
- High potential at local level for the construction of more robust aquaculture supply chains, also according to multitrophic schemes;
- Potential for intensifying CO₂ fixation by marine habitats;
- New emerging business models for connecting tourism to ecosystem valorization;
- Unique landscape and cultural heritage of coastal areas as resource of local communities and worth to be preserved and valorized according to sustainable and integrated schemes;
- Exploitation of marine bioenergy production potential.

Marine bioeconomy

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY



✗ PROBLEMS

- Rapidly growing global food demand (between +50 % and +100 %, according to the latest foresight studies) with increasing pressure on farming systems;
- Weak connection with the primary production sectors and small size and fragmentation of supply value chains;
- Low efficiency of food making chains with high resource consumption and excessive production of byproducts/ waste (≈ 15 M T/y);
- Inability to exploit byproducts and production residues due to unsuitable terms and conditions set by national legislation;
- High level of product counterfeiting and imitations;
- Social reluctance to change dietary behavior and reduce food-waste generation;
- High environmental impact of single use plastics;
- Lack of coordination among the stakeholders operating in the different sectors of bioeconomy.

✓ OPPORTUNITIES

- Wide availability of “typical/quality” food products (DOP, IGP, STG, etc.) to be valorized, preserved and protected;
- Large availability of food byproducts to be valorized through the production of food ingredients and feed, as well as waste to be converted into biobased chemicals, materials, energy, fertilizers and compost;
- Availability of new emerging global markets seeking for safe and high quality foods;
- High potential for creation of new markets at global level, thanks to the recognized Italian leadership in the sector;
- New Urban Food Systems to overcome the dichotomy between urban and peri-urban areas, with local food production and distribution of fresh and high nutritional value products;
- Potential for developing alternative protein sources (insects, algae etc.) and novel food microbes utilizing pedoclimatic national areas and existing industrial infrastructures taking advantage of climate change and anticipating novel food security needs;
- Potential for the establishment of a permanent collaboration among the National Technology Clusters representing three key sectors of the bioeconomy: CL.A.N. (Agrifood), Spring (Green Chemistry) and BIG (Blue Growth).

Food
industry

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY



✘ PROBLEMS

- Limited and discontinuous accessibility to sustainable non food feedstocks;
- Limited market for national biobased products, also due to their higher cost with respect to “petrol-based” products;
- Spread of products that do not comply to international standards and labeling on biobased and biodegradable products, and insufficient clarity/transparency in the labeling;
- Lack of regulations and specific end- of- waste criteria regarding classification and use of industrial biowaste (lack of knowledge of contaminants fate and of criteria to be fulfilled for waste to be accepted and used by industry);
- Huge and risky investments needed for research and buildup of industrial flagship investments and infrastructures in the sector;
- Short life and slow growth of startup companies due to the lack of facilities for pre-industrial scaling-up and competent regional poles for effective technology transfer;
- Fragmentation of standards and certification schemes in the biogas and biomethane production sector.

Biobased industry

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

✓ OPPORTUNITIES

- Large availability of agricultural, forestry and breeding residues and side streams with underexploited potential;
- Availability of former oil refineries/industrial sites that can be partially converted into biorefineries;
- Availability of expertise and of already assessed lab scale processes for the conversion of residues, by-products and side streams into biochemicals, food/feed ingredients, biomaterials and high-quality organic fertilizers;
- Availability of new emerging technologies for capturing and converting CO₂ into fertilizers, chemicals and polymers, thus enabling the lowering of GHS;
- Availability of methods for the valorization of stabilized digestates from biorefinery and bioenergy plants, to provide soils with assimilable organic carbon;
- Availability of abandoned/marginal lands for the production of autochthonous or planted industrial biomass;
- Availability of successful case studies on biobased products developed in Italy (i.e. compostable shopping bags/foodservice ware, biodegradable mulch film/bioherbicides/biolubricants) and price premiums for environmental sustainable products (Made green in Italy);
- Availability of prominent national collections of microbes (bacteria, yeasts, molds, fungi, algae, etc, also from the sea), enzymes and genetically improved microbes of industrial interest;
- Availability of a large number of very creative and innovative research groups, start-ups, spin-offs working in the sector;
- Availability of a large network of biomethane producing facilities (mainly fed with agrifood biowaste and municipal organic waste);
- Availability of new regenerative processes for cleaning polluted areas and engineering measures for the reconversion of abandoned industrial and urban sites, promoting the valorisation of brownfields rather than virgin land;
- Possible integration of wastewater purification plants with biorefineries for the integrated valorization of organic fraction introduced in and the activated sludge generated by the plants and exploitation of potential of production of biochemicals of anaerobic digestors;
- Availability of efficient collection systems for organic waste and of large quantities of national biowaste (i.e., Food industry byproducts and waste: ≈ 15 M T/y; agriculture residues: ≈ 10 M T/y; livestock effluents: ≈ 150 M T/y; Wastewater sludge: ≈ 3 M T/y; Municipal organic fraction: ≈ 6.5 M T/y);
- Pioneering initiatives leveraging on on bioeconomy “every-day products” for informing, educating and engaging urban communities in urban re-generation projects (e.g. BioCities);
- High potential of urban-bioeconomy for the enhancement of the wet fraction of urban waste with the consequent production of compost to improve soil fertility in urban and rural areas.

Biobased
industry

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY



✘ PROBLEMS

- Weak cooperation between European and non-Member States of the area with a limited integration of knowledge and efforts across sectors and countries;
- Inability of some local communities to provide affordable food, good quality water and to ensure healthy seas also due to adverse climate context, demographic trends and social, political and economic instability;

✔ OPPORTUNITIES

- Availability of large amounts and wide varieties of biomass, byproducts and waste streams from local agriculture, livestock production, forestry and food industry;
- Availability of the international cooperation program PRIMA and the BLUEMED initiative addressed to improve the sharing and the joint exploitation of knowledge, technologies, capacities, and investments in the agrifood sector and marine bioeconomy to guarantee local food security and safety, employment and economic growth;
- Advocacy for enhancing public understanding of the socio-economic and environmental value of the bioeconomy in the Mediterranean;
- Agriculture and food systems represent a potent force for shaping city infrastructure, improving public health, feeding growing populations, rebuilding communities, reconnecting people to nature, restoring degraded environments and revitalizing economies.

Contribution to the Euro-Mediterranean bioeconomy



6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

6.2 THE STRATEGY

The Italian bioeconomy has enormous potential for stimulating growth if the above-mentioned challenges and opportunities are addressed and turned by each sector into resource-efficient and environmentally sustainable production strategies and processes able to guarantee improved supplies of new, safe and high quality foods and bio-based products and services - including bioenergy, via competitive and low carbon supply chains.

The bioeconomy embraces several sectors and broad value chains, which must be interconnected more efficiently. Conversely, scientific disciplines and technologies require a stronger integration, leveraging on an effective engagement of public and private stakeholders. This in turn will facilitate cooperation among education providers, researchers, innovators, communicators and representatives of consumers in order to create the socio-economic and technological context for the effective and locally routed implementation of the required cross-cutting interdisciplinary innovation.

The present strategy intends to deliver new knowledge, technologies, services, capacity building, but also contribute to fill the gaps related to regulations and public awareness. More specifically the strategy aims at:

- Increasing circularity in the economy;
- Boosting sustainable and locally routed economic growth by bridging gaps between research and economic sectors, including an emphasis on Small Medium Enterprises (SMEs);

- Supporting the alignment of EU, national, regional policies, regulations and coordination of local stakeholders;
- Ensuring that the bioeconomy reconciles technological advances and progress without undermining environment conservation and the resilience of the ecosystems;
- Promoting knowledge-based economic activities and policy making;
- Supporting cross-disciplinary education and training for researchers as well as for technical careers;
- Catalyzing informal learning, tertiary education and technology/knowledge transfer to support the jobs in the wider bioeconomy domain;
- Promoting the bioeconomy in the Mediterranean area via the exploitation of potential of PRIMA and BLUEMED initiatives addressed to improve Mediterranean primary production and bioindustry potential, thus creating new jobs, social cohesion and political stability in the area.

6.3 THE R&I AGENDA

The main R&I needs and opportunities for boosting the Italian bioeconomy are reported below. The list is mainly based on the results of Italian stakeholders consultation process carried out on 2016 for the preparation of “Agrifood” and “Biobased economy” action plans in the framework of implementation of National Smart Specialization Strategy and later, in 2017, for the set up of the first Italian bioeconomy strategy BIT approved on April 2017. A few new inputs have been recently introduced in the section below during the BIT revision, also for better aligning it to the new priorities identified by the new European bioeconomy strategy published in 2018.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

PRIORITY

Sustainable agriculture and forestry

a. To boost sustainable and resilient primary production through actions and R&I aimed at:

- Implementing more effective models of agricultural and forestry production, such as climate smart agriculture and forestry, precision farming, ecological intensification, agroecology and regenerative agriculture to improve the productivity and resilience of animals and plants;
- Implementing techniques, based on digital services and satellite monitoring, for mitigating soil erosion and preventing hydrogeological disasters;
- Using biodiversity and modern genetic programs to improve the resilience of animals and plants to biotic and abiotic stresses;
- Improving the understanding of microorganisms role as strategic biological players for the resilience but also health and productivity of plants and terrestrial and aquatic/marine animals as well as soil and water ecosystems;
- Boosting organic farming and livestock;
- Reducing GHG emissions by decreasing the use of fertilizers;
- Adopting multidisciplinary approaches based on the concept of Water-Energy-Food nexus to assess the global sustainability of production processes, throughout a specific set of indicators;
- Improving the use and management of water in agriculture;
- Developing tools to plan adequate decarbonisation strategies and assess European agricultural emissions

embedded in international trade;

- Increasing photosynthesis and carbon dioxide (CO₂) sequestration by plants;
- Exploiting the role of agriculture, including urban and peri-urban agriculture, indoor vertical agriculture, and forestry in the circular bio-based society, with a systemic view on the links between primary production, ecosystems and human health.

b. To improve resource management and efficiency through actions and R&I aimed at:

- Adopting of a systemic view of crop and animal production, animal welfare, ecosystems and human health, by interconnecting sectors and value chains, existing knowledge and innovation;
- Development of soil preservation and regeneration schemes, including effective risk-management strategies for the prevention of pollution deriving from the end life of materials and chemicals dispersed in the soil and water streams;
- Valorizing and reusing agricultural and forest residues, also for the production of bioproducts, bioenergy and biofertilizers;
- Creation of locally integrated agro and forestry industrial supply chains for a better valuing of product quality and a stronger contribution to rural development;
- Exploiting valuable national forest raw material for the production of energy and materials for energy efficiency along with high value certified new products, materials and composites derived from wood.



6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

C. To improve multiple functions and benefits of land, rural and abandoned areas through actions and R&I aimed at:

- Developing new processes for the conversion of residues and side streams of agriculture and forestry value chains into bio-products and bioenergy by following a “cascade approach”;
- Development and production of high value certified new wood products, wood-based materials, composites and bioenergy from wood obtained from the sustainable management of forests;
- Supporting farms and forests diversification in the framework of circular bioeconomy, in order to enhance the sustainability of the sector and to keep the added value in the frame of rural economies;
- Promoting the creation of new integrated agricultural value chains based on best practices, on the sustainable use of biomass, and on the restoration of organic matter in soils also in marginal and abandoned lands.

d. To improve human and social capital and social innovation through R&I/actions aimed at:

- Enhancing the skills, the human and social capital of farmers, foresters and other actors of the rural economy, also through education and digital based technologies;
- Involving young land managers in less favored Italian regions in the adoption of good practices, thus creating possibilities for expanding farming and supporting knowledge sharing;
- Supporting young entrepreneurs in the agri-food and forest-wood sectors in less favored Italian areas also through educational programs;

- Preserving and valorizing traditional knowledge and promoting the connection with the ecological and the socio-economic value of agriculture and forestry systems through the transfer of good practices to the young farmers and entrepreneurs.

e. To contribute to improving the primary production in the Mediterranean area through R&I/actions, also promoted by the PRIMA initiative, aimed at:

- Preserving and implementing sustainable biodiverse crops and livestock, to offer a broad choice of genotypes addressing the needs of multi-ethnic societies in the Mediterranean basin;
- Developing molecular techniques and markers to facilitate the control and the selection of crop/livestock genotypes, including microbial companion (beneficial microbiomes as determinants of productivity, quality, safety), suitable for sustainable production in a changing Mediterranean environmental context;
- Designing a consumer-responsive Mediterranean agricultural production system, supported by actions directed to raise the consumer awareness about the high quality of Mediterranean products and to promote their consume;
- Exploiting alternative food sources (insects, algae etc.) and novel food microbes utilizing pedoclimatic national areas and existing industrial infrastructures for anticipating solutions for climate change related novel food security needs;
- Providing integrated pest management solutions, aided by novel control tools, to prevent diseases;
- Mitigating the impact of climate changes on Mediterranean crops and livestock.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

PRIORITY

Aquatic living resources and marine and maritime bioeconomy

a. Boosting sustainable exploiting of marine resources through actions and R&I aimed at:

- Increasing the sustainability of fishery and marine aquaculture also including ethical and ecological aspects;
- Promoting the production and processing of seaweed, jellyfish and phytoplankton as possible sources of human edible proteins but also of biomass for the production of bio-based chemicals, materials, energy, and methane;
- Improving the resilience, ecological compatibility, robustness of the main aquatic production species via breeding programs based on genomics and precision phenotyping;
- Improvement and integration of monitoring and control systems to prevent illegal fishery through ICT, Big Data Analytics and Industry 4.0 technologies;
- Exploiting sustainably the large micro and meso plankton stocks for producing high value substances (e.g. pharmaceutical, cosmetic, nutraceuticals, etc.) and bio-based products as well as enzymes for technological applications;
- Exploiting marine biomass as well as byproducts and waste deriving from fishery and aquaculture value chains within an integrated biorefinery scheme (e.g. for producing pharmaceutical, cosmetic and nutraceuticals);
- Exploiting the deep sea biosystems according to sustainable practices and schemes;

- Implementing new bioeconomy business models at the land/sea interface as well as in wet lands;
- Promoting the increase of the readiness level of the most promising Marine Energy technologies and their integration with other activities at sea (e.g. desalinization process, aquaculture etc.);
- Fostering fisheries as a recreational activity within an ecotourism approach also by strengthening interactions with commercial fishery activity in remote coastal and rural areas.

b. To protect and valorize marine environment through R&I/actions aimed at:

- Promoting biomonitoring and bioremediation of microplastics and xenobiotic compound contaminated sediment systems, mitigation measures for preventing new contamination due to plastics and other and new pollutants and development of marine degradable bio-based plastics to limit/prevent marine litter and pollution;
- Analysing marine ecosystem resilience and regime shifts in relation to climate change and other natural or anthropic pressures, and develop mitigation strategies;
- Promotion of sustainable solutions (i.e. advanced bio-fuels, electric propulsion, electrification of ports) aimed at reducing maritime ports and transport pollution;
- Promotion, conservation and sustainable valorization of the marine landscapes and cultural heritage.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY



C. To contribute to boosting a MED marine bioeconomy through the BLUEMED R&I/actions aimed at:

- Promoting an integrated, multi-disciplinary knowledge for better assessments and forecasts of the Mediterranean Sea ecosystem and biodiversity, and deeper understanding of its vulnerability, resilience and risks, as well as of the strategies for its preservation and sustainable valorization;
- Sustainably exploiting of deep sea biosystems and land/sea nexus;
- Pursuing the ecosystem based management of fisheries in a multispecies context impacted by climate change, to implement the Common Fisheries Policy also by means of a Geographic Information Systems-fishery system;
- Supporting the innovation perspective in aquaculture identifying key species for farming, management strategies for platforms, feed design, diseases;
- Addressing environmental fate and distribution of emerging pollutants to implement appropriate remediation actions;
- Exploiting the bioeconomy potential of the land/sea interface and of the multiple purpose offshore production sites, integrating bioresources and renewable energy production.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

PRIORITY

A sustainable and competitive agri-food system for a safe and healthy diet

a. To improve healthy diets and people's health through actions and R&I aimed at:

- Evaluating, educating and exploiting national consumer preferences, attitudes, needs, behaviour, personalized nutrition and increasing lifestyle and education, and communication;
- Tackling obesity through food formulations/substitutions, changes in retail and catering practices, and changes in consumer behavior;
- Solution able to improve the bioavailability of nutrients, also developing smart and personalized nutrition solutions (e.g. metabotype tailored) stemming on new production/delivery technologies and ICT approaches;
- Further exploiting knowledge on gut microbiome to define consumer needs for a healthy diet;
- Identification and production of new "typical/quality" foods (DOP, IGP,STG, etc.) leveraging on methods aiming at defending their authenticity and traceability;
- Preventing, detecting and remediating biotic and abiotic contamination of food/feed products;
- Combining the healthy aspect of food with improved taste and nutrient content.

b. To improve food safety, security, defense, and integrity through actions and R&I aimed at:

- Developing rapid at-line or on-line detection tools for food and feed safety (vs pathogens, allergens, toxins, chemicals, nanomaterials, etc.) and integrating such

tools in risk analysis protocols;

- Establishing the vulnerability of food and feed to fraud, counterfeiting or intentional contamination or adulteration in order to develop risk prevention, protection, and mitigation strategies for food business operators;
- Developing innovative packaging and smarter supply chains to support efficient delivery to consumers and prolonged shelf-life, reducing waste production;
- Developing ICT tools for smart food utilization and domestic food management;
- Exploiting microbiomes for a more sustainable food system facilitating sustainable production choices and business strategies.

c. To boost sustainable, competitive, and innovative food manufacture through actions and R&I aimed at:

- Preventing food losses and waste production, water and energy consumption and improving food preservation, distribution and logistics, by integrating Industry 4.0 tools and key enabling technologies solutions into value and supply chains;
- Assessing the impact of changing food patterns on the whole supply chain;
- Adopting new Urban Food Systems to overcome the dichotomy between urban and peri-urban areas, with local food production and distribution of fresh and high nutritional value products;
- Promoting of networking among small agro-food enterprises for the development of novel, longer or more



6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

robust supply and value chains at regional or multi-regional level;

- Developing of new models based on symbiotic society approaches in cooperation with social sciences and humanities forecasting a proactive role for prosumers towards more sustainable food production and consumption behavior;
- Involving public authorities, the private sector and civil society in policy design and implementation;
- Developing recycling and reusing supply chains of packaging plastics, overcoming territorial resistance and developing sites capable of increasing the quantity of recycled material, the energy recovery and preventing disposal;
- Developing of new technologies or innovative solutions that accompany food companies in the delicate transition towards the circular economy model.

d. To boost food policies, supply chains, markets, and communities through R&I/actions aimed at:

- Creating knowledge, technology and regulations for the production of food and feed ingredients from local fruit, vegetal and meat industry by- and co-products;
- Promoting short local food chains for health and contrast non-market based networks of food provisioning;
- Developing food products and promoting ethno food marketing, taking account of migration and changing demographics in the country;
- Developing innovation support systems by integrating different production systems, sharing infrastructures and logistic solutions, in order to maximize yields and reduce wastes;

- Develop cohesive and coherent international and industrial policies for the recycling and reuse of packaging plastics, for increase in plant capacity, overcoming territorial resistance and developing sites capable of increasing the quantity of recycled material using all available technologies, and at the same time guaranteeing the forms of energy recovery suitable for preventing disposal.

e. To contribute to improving food production and safety in the Mediterranean basin through R&I/actions, also promoted by PRIMA, addressed to:

- Adopting sustainable technologies to valorize typical byproducts of the Mediterranean agroindustry, with evidence based proved safety, as new ingredients for high quality food with functional properties;
- Generating innovative food-grade nano-biotechnologies to preserve stability and improve bioavailability of bioactive molecules extracted by Mediterranean species and incorporated in functional food;
- Providing eco-innovations for efficiency and the valorization of side-products in Mediterranean agro-food value chains, by integrating different production systems, sharing infrastructures and logistic solutions, in order to maximize yields and reduce wastes;
- Designing innovative business models for quality and sustainability, at territorial level, involving food producers, services and tourism focused on the valorization of the Mediterranean culture.

6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

PRIORITY

Bio-based industries

A. To boost production of biobased products and bioenergy in the framework of a circular economy through actions and R&I aimed at:

- Fostering the demand for bio-based products from a consumers' perspective through gathering evidence on consumers' practices in relation to biobased products and how these may form new market places and develop new innovative and inclusive business solutions using bio-based services;
- Mapping the biomass supply - including novel and alternative feedstocks (biowaste, CO₂, marine biological resources) building on existing knowledge, approaches and tools;
- Boosting the valorization of organic waste and effluent organic matter to obtain high added value bioproducts;
- Creating of knowledge, technology and regulations for the production of food and feed ingredients from local fruit, vegetal and meat industry byproducts;
- Supporting a systemic approach to innovation, for the development of tailored technologies for valorization of specific local biomass, waste streams as well as CO₂, also with the aid of advanced digital technologies for big-data analysis, optimization and automation;
- Improving flexibility in terms of feedstock and products produced by bio and chemical processing integration, and downstream processing, of the current biorefining processes and schemes,(including existing biomethane producing facilities);
- Exploring new, innovative, energy saving logistics and preservation/stabilization strategies for different types of biomasses/biowaste;
- Developing a coherent policy framework and regulations promoting biobased products, education, training, information and communication in the bio-based sector;
- Updating the map of climate-change related risks and implementing mitigation strategies for urban and sub-urban areas, thanks to the use of bioeconomy products coming from local chains and the exploitation of urban farming and the circularity in management of water, wastewater and organic fractions;
- Updating education programs for training new multi-sectorial transdisciplinary professional profiles for bioeconomy and Bioindustries;
- Strengthening the alliance between bioeconomy value chains and manufacturing Italian sectors (e.g. made in Italy) for the development of new business models and products;
- Reconnecting communities and nature in urban settings through projects, research and education: building innovative linkages between humans and regenerative ecosystems to create liveable, healthier and resilient cities (BioCities).



6. CHALLENGES AND GOALS FOR THE ITALIAN BIOECONOMY

b. To foster “Demonstration plants/test beds for cascading use of biomasses” through R&I and actions aimed at:

- Facilitating the use/conversion of former oil refineries/ industrial sites but also biogas/wastewater facilities for the implementation of novel biorefineries;
- Using integrated cross-sectorial evaluation systems and cost-benefit analyses of bio-based products vs traditional products on a global scale and evidence to establish how alternative uses of renewable resources or strategies for energy efficiency which can influence carbon emissions and natural capital stock;
- Creating an optimal network of laboratories, microbial, enzymes collections, etc. supported by new infrastructure to form test beds that can develop process technologies and new products in a demo-scale that underpin the development of biorefineries (industrial scale) for maximising the use of a variety of non food biomass and biowaste;
- Integration of ICT resources (e.g. mediating ICT-based interfaces) within bioeconomy value chains relationship for inter-organizational governance mechanisms, aiming at satisfying the simultaneous need for control, collaboration, and adaptability;
- Developing sustainable, economically viable and scalable methods for CO₂ capturing and reestablishment of carbon in the soil to mitigate soil depletion;

- Integrating catalysis and biocatalysis for efficient valorization of biomass, waste-streams and CO₂, according to a cascade scheme;
 - Setting up Italian bioeconomy business models and products as global benchmarks, as well as references for good practice.
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c. To contribute to boosting a Mediterranean biobased Industry through R&I/actions aimed at:

- Mapping: A - local biodiversity and biomass (types and volumes, including biowaste); B - logistics and biomass preservation/stabilization facilities; C - biorefineries (numbers and types) available in the whole Mediterranean basin;
- Promoting cooperation between laboratories, infrastructures, biorefineries and key private and public stakeholders of the EU MS and non-EU countries of the area;
- Promoting local education, training, information and communication in the biobased sector and on its potential in the area;
- Turning the Mediterranean biodiversity into biobased products for industry;
- Exploiting the bioeconomy potential of the land/sea interface and of the multiple purpose offshore production sites, integrating bioresources and renewable energy production.

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6.4 SUPPORT MEASURES

In order to unlock the innovation potential of the Italian bioeconomy, it is fundamental that the above R&I Agenda is flanked by accompanying measures aimed at creating the framework conditions to boost it by creating competitiveness and productivity, alongside initiatives to increase corporate social responsibility and social awareness on the role of bioeconomy in a changing climate and ecosystem. Such accompanying measures will be adopted and implemented together with the R&I actions listed above. They are aimed at:

1. Ensuring strong coordination among the ministries, other public administrations, industries and firms and national technological clusters of the bioeconomy domain, in order to define a proper and coherent legislative framework, and minimize duplication and fragmentation. A permanent working group on bioeconomy composed of representatives of such organizations will be established with the task of:
 - a. Monitoring the implementation of the bioeconomy strategy;
 - b. Proposing new measures and actions to improve the bioeconomy system - also evaluating the social and environmental impact of subsidies on nonrenewable resources;
 - c. Implementing and coordinating international initiatives to boost the bioeconomy in the Mediterranean basin;
 - d. Guaranteeing the policy coordination among public authorities, with particular attention to the implementation of European policies addressed to waste prevention and minimization, in order to encourage full exploitation of the resources and circularity.
2. Exploring demand-side innovation policy tools such as standardization, to implement strict targets for the separate collection of organic waste, labelling, and public procurement. A life cycle thinking and ecodesign approach should steer the transition, in order to find the right balance between fossil based products (that give an important contribution in the durable goods sector) and bio-based products, especially in sectors where environmental concerns are higher, i.e. by connecting environmental concerns with low-impact solutions which are available and ready to be implemented;
3. Stimulating demand for bioeconomy products and services through enforcing green public procurement, promoting communication and information to consumers to increase their awareness of biobased products, highlighting their positive impacts in social and environmental terms (green jobs, social acceptance, energy efficiency, reduced GHG emissions, lower extraction rate of non-renewable resources, benefits for land and terrestrial ecosystem and biodiversity conservation), adjusting fiscal measures and policies in order to increase private demand for biobased products;
4. Creating, through a cooperation with the stakeholders, a bioeconomy marketplace in order to match the demand and supply of biomass, technology, and services; a database to collect and share data on bi-



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omass and biowaste actual and potential availability, technological processes, research project, in order to put into practice and showcase industrial symbiosis, technological innovation and best practices;

5. Revising academic and advanced-education programs in the context of new economic and productive scenarios while creating initiatives for the education and professional training of new bioeconomy specialists, through programmes for technical schools, academic courses and programmes, and executive masters on bioeconomy - also in partnership with private actors and industrial and agricultural players. Supporting local administrations in enforcing their knowledge and competences on bioeconomy through dedicated training courses and expertise acquisition;
6. Strengthening the coordination of Regions, policy harmonization and best practices sharing, also by supporting local administrations in enforcing their knowledge and competences on bioeconomy through dedicated training courses and expertise acquisition;
7. Valorizing sustainable urban biowaste production by ensuring that separately collected urban biowaste is used for compost and/or anaerobic digestion, as well as valorizing biological wastewaters for the realization of high added-value products. Such measures would minimize the environmental impact (GHG emissions, local pollutants and discharge);
8. Supporting the growth of startup companies through open-access infrastructures for pre-industrial scaling-up and organization of competent regional poles for effective technology transfer;
9. Involving local administrations in defining strategies to create organic waste and effluent organic matter value chains by promoting the adoption of integrated treatment processes that combine purification and valorization;
10. Promoting consumer empowerment through professional and pertinent information and communication of the impact and benefits of the bioeconomy;
11. Supporting corporate social responsibility by proposing a methodological framework for enterprises to highlight the bio-based content and features of bioeconomy processes and products through the application of life-cycle assessment, extended accounting and green reporting to evaluate the net costs of the bioeconomy production including the carbon balance and the environmental footprint, and promoting voluntary labelling or other certificate schemes which are easy-to-understand by final consumers and verified and managed by institutional bodies;
12. Promoting the use of sustainability standards, certification schemes and labels to support the bio-based market and the creation of a 'level playing field' between bio-based products and conventional products. Within this respect, the European project STAR-ProBio (Horizon 2020 Research and Innovation Action) is performing a multidisciplinary study, aiming at the development of: (i) a comprehensive blueprint for sustainability assessment (SAT-ProBio); and (ii) a novel system dynamic model (SyD-ProBio) that would serve as a valuable tool for supporting evidence-informed policy interventions and for creating a level playing field.



IMPLEMENTATION AND MONITORING

Measuring bioeconomy performance through indicators is a complex activity. The bioeconomy involves a wide number of different products, commodities, intermediate goods and technologies and it is an economy in evolution.

A great part of its future development will emerge from the convergence and transformation of markets and industries and from the creation of new markets, phenomena for which statistical data and indicators are currently unavailable. In addition to this, there is still some uncertainty on the constituents of the bioeconomy value chain.

However, it is possible to try to relate the overall objective to a tentative set of **EU key performance indicators (KPI)**⁵⁰ to monitor the bioeconomy developments on the supply and demand side. These indicators refer to Eurostat and national data and allow for the implementation of benchmarking analysis. **7**

Indicators have been selected in function of data availability. There is a general problem of data gaps and quality homogeneity, especially at the most disaggre-

gated data levels. In some cases, it could be difficult to find data for all bioeconomy subsectors or to distinguish between bio-based and non bio-based products and sectors. Therefore, also the construction of monitoring tools is subjected to an evolutionary process of data availability to meet public awareness and assessment needs. **8**

Another set of indicators refers to the sustainability of the bioeconomy in order to monitor the pressure and the impact on the environmental and social systems. **9**

In the implementation phase of the bioeconomy monitoring system, new methodological approaches⁵¹ - currently subject to in-depth analysis at EU level - will be considered to measure the related biophysical indicators. This could also imply an update of the identified indicators to be consistent and comparable with a common EU bioeconomy monitoring system once established.

50 Selected indicators are based on results of BERST project consortium, "BioEconomy Regional Strategy Toolkit", Criteria and Indicators describing the Regional bioeconomy, Cambridge (UK), 31 October 2014 and Correlation of I&M with the developed Criteria, Mol (Belgium), 3 December 2014.

51 JRC Biomass Assessment Study ec.europa.eu; Nuss P., Blengini G.A., Haas W., Mayer A., Nita. V., and Pennington D.P. (2017): Development of a Sankey Diagram of Material Flows in the EU Economy based on Eurostat Data, EUR 28811 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-73901-9, ISSN 1831-9424, doi:10.2760/362116; bioeconomy policy day 16 November 2017, Outcome report, ec.europa.eu and Session on Indicators for the bioeconomy: what do we need, what do we have, what are the gaps? (JRC - De Gasperi) webcast.ec.europa.eu; Alessandra La Notte, Sara Vallecillo, Alexandra Marques, Joachim Maes, Beyond the economic boundaries to account for ecosystem services, December 2018 ncbi.nlm.nih.gov; Camia A., Robert N., Jonsson R., Pilli R., García-Condado S., López-Lozano R., van der Velde M., Ronzon T., Gurría P., M'Barek R., Tamosiunas S., Fiore G., Araujo R., Hoepffner N., Marelli L., Giuntoli J., Biomass production, supply, uses and flows in the European Union. First results from an integrated assessment, EUR 28993 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-77237-5, doi:10.2760/539520, JRC109869; Lier, M., Aarne, M., Kärkkäinen, L., Korhonen, K.T., Yli-Viikari, A. and Packalen, T. (2018). Synthesis on bioeconomy monitoring systems in the EU Member States - indicators for monitoring the progress of bioeconomy. Natural resources and bioeconomy studies 38/2018. 44 p. Natural Resources Institute Finland, Helsinki 2018; Vincent Egenolf and Stefan Bringezu, Conceptualization of an Indicator System for Assessing the Sustainability of the bioeconomy, MDPI, sustainability, 16 January 2019

7. IMPLEMENTATION AND MONITORING

7 KEY PERFORMANCE INDICATORS AT NATIONAL AND REGIONAL LEVEL

CRITERIA	INDICATORS
BIOMASS AVAILABILITY	Agricultural biomass production [kg/capita] - import of agricultural biomass Blue biomass production [kg/capita] - import of blue biomass Forestry biomass production [kg/capita] - import of forestry biomass Waste biomass production (including OFMSW) [kg/capita] - import of waste biomass
PRODUCTIVE STRUCTURE	Firms in total bioeconomy sectors [% of total firms] Firms in bioeconomy subsectors [% of total firms] Innovative start up in total bioeconomy sectors [% of total innovative start up] Innovative start up in bioeconomy subsectors [% of total innovative start up]
EMPLOYMENT STRUCTURE	Employment in total bioeconomy sectors [% of total employment] Employment in bioeconomy subsectors [% of total employment]
HUMAN CAPACITY	Tertiary education [% of total population] R&D employment in total bioeconomy sectors [% of total employment] R&D employment in bioeconomy subsectors [% of total employment] University courses in bioeconomy sectors [% of total university courses] Research Institute in bioeconomy sectors [% of total Research Institutes]
INNOVATION	IPRs (patent, trademark, design) applications in total bioeconomy sectors [number of application per 1000 employees] IPRs (patent, trademark, design) applications in bioeconomy subsectors [number of application per 1000 employees]
INVESTMENT	Private R&D expenditure [index (EU=1)] Public R&D expenditure [index (EU=1)]
DEMOGRAPHICS	Population growth [% year] Population 15-65 years [% of total population] GDP (PPP) [index (EU=1)]
MARKETS	Turnover of total bioeconomy sectors Turnover of bioeconomy subsectors Value added of total bioeconomy sectors Value added of bioeconomy subsectors Exports of total bioeconomy sectors related goods [% of total exports] Exports of bioeconomy subsectors related goods [% of total exports] Imports of total bioeconomy sectors related goods [% of total exports] Imports of bioeconomy subsectors related goods [% of total exports]

7. IMPLEMENTATION AND MONITORING

8 LEGEND FOR BIOECONOMY SECTORS

PRIMARY BIOMASS SECTORS: AGRICULTURE, PAPER INDUSTRY, FORESTRY, FISHERIES AND AQUACULTURE

FOOD INDUSTRIES, BEVERAGES AND TOBACCO

WATER CYCLE

BIODEGRADABLE WASTE RECOVERY AND MANAGEMENT

BIO FURNITURE

BIO TEXTILE & CLOTHING

BIO PLASTICS AND RUBBER

BIO APPAREL

BIO ENERGY

BIO CHEMICALS

BIO FUELS

BIO PHARMACEUTICALS

9 SUSTAINABILITY INDICATORS

OBJECTIVES	SUSTAINABLE PRINCIPLE	INDICATORS
Ensuring food security	Social	Change in food price volatility, Change in macronutrient intake/availability, Change in malnutrition or risk of hunger
Managing natural resources sustainably	Environmental/Social	Change in freshwater availability, Level of water pollution, Change in land use intensity, Land productivity, Rate of biodiversity loss, Secondary material price changes, Organic waste diverted from landfills; forest area subject to planning and certified surface; Water productivity - Water Use efficiency
Reducing dependence on non-renewable resources	Economic/Environmental	Final energy consumption, Energy intensity of the economy, Share of renewable energy in gross final energy consumption. Energy productivity - Energy use efficiency
Coping with climate change	Environmental/Social	Change in greenhouse emissions, Level of emission of air pollutants
Enhancing economic growth	Economic/Social	Change in Employment rate, Job creation in skilled/unskilled labor



ACTORS INVOLVED AND ROAD MAP

The first version of the Italian bioeconomy Strategy BIT was promoted by the Italian Presidency of Council of Ministers in 2016 and approved on April 20, 2017. The current Presidency of Council of Ministers decided to update it. The entities involved in the BIT revision were:

- i) Ministry for Economic Development
- ii) Ministry of Agriculture, Food, Forestry and Tourism
- iii) Ministry of Education, University and Research
- iv) Ministry of the Environment, Land and Sea

- v) Committee of Italian Regions
- vi) Italian Technology Clusters for Green Chemistry SPRING, Agri-Food CLAN, and Bluegrowth BIG

Additional Stakeholders of the Italian bioeconomy were consulted via workshops in the preparation of the first version of the strategy and will be consulted in the near future for the implementation of the present strategy. Citizens and all those interested in the topic are invited to express their views via the website.

THE NATIONAL BIOECONOMY TASK FORCE ESTABLISHED IN MARCH 2019, WHICH WAS ALSO INVOLVED IN THE REVISION OF THE ORIGINAL BIT, IS COMPOSED BY:

Giancarlo Giorgetti, Pamela Morassi, Giacomo Vigna - Presidency of Council of Ministers, Coordination
Andrea Lenzi, Fabio Fava - National Committee on Biosafety, Biotechnology and Life Sciences of Presidency of Council of Ministers Technical & Scientific coordination
Fabio Fava, Franco Cotana - Ministry of Education, University and Research
Elena Lorenzini, Debora Rogges, Cinzia Tonci, Daniela A. R. Carosi - Ministry of Economic Development
Emilio Gatto, Valerio de Paolis - Ministry of Agriculture, Food, Forestry and Tourism, Annalisa Zezza (CREA)
Piergiuseppe Morone, Orecchia Carlo, Pepe Paolina - Ministry of the Environment, Land and Sea
Manuela Bora, Raffaele Liberali - Committee of Italian Regions
Catia Bastioli, Giulia Gregori, Lucia Gardossi - Italian Technology Cluster for Green Chemistry (SPRING)
Luigi Scordamaglia, Patrizia Brigidi, Maria Cristina Di Domizio - Italian Technology Cluster for AgriFood (CLAN)
Roberto Cimino, Emilio Campana - Italian Technology Cluster for BlueGrowth (BIG)

THE NATIONAL BIOECONOMY TASK FORCE ACKNOWLEDGES THE WORKING GROUP WHO EDITED THE FIRST VISION OF BIT PUBLISHED ON APRIL 2017. IT WAS COMPOSED BY:

Paolo Bonaretti, coordinator - Presidency of Council of Ministers
Stefano Firpo and Cinzia Tonci, co-coordination - Ministry of Economic Development
Oscar Pasquali and Fabio Fava, scientific coordination - Ministry of Education, University and Research Luca Bianchi - Ministry of Agriculture, Food and Forestry and Riccardo Aleandri (CREA - MIPAFF)
Francesco La Camera and Giacomo Pallante - Ministry of the Environment, Land and Sea
Raffaele Liberali and Francesco Cellini - Committee of Italian Regions
Ludovica Agrò, Daniela Carosi and Federica Tarducci - Agency for territorial cohesion
Giulia Gregori - Italian Technology Clusters for Green Chemistry (SPRING)
Maria Cristina Di Domizio - Italian Technology Cluster for AgriFood (CLAN)

AND WITH THE SUPPORT OF THE TECHNICAL EXPERTS:

Annalisa Zezza (CREA - MIPAFF), *Fabio Eboli* (MATM - Technical Assistance Unit Sogesid), *Vittorio Maglia* (Cluster SPRING), *Stefania Trenti* (Intesa San Paolo Research Department), and *Serena Borgna* (APRE).



BIT

bioeconomy
in Italy