



Aspetti economici e di policy della Bioeconomia

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di Ferrara

Outline

- Narrative of bioeconomy
- Macro Aspects
 - Governance
 - Policy and investments
- Micro Aspects
 - Consumer, supply & market
 - Type of business model
- Impacts on SDGs e Ecosystem Services
- Discussions

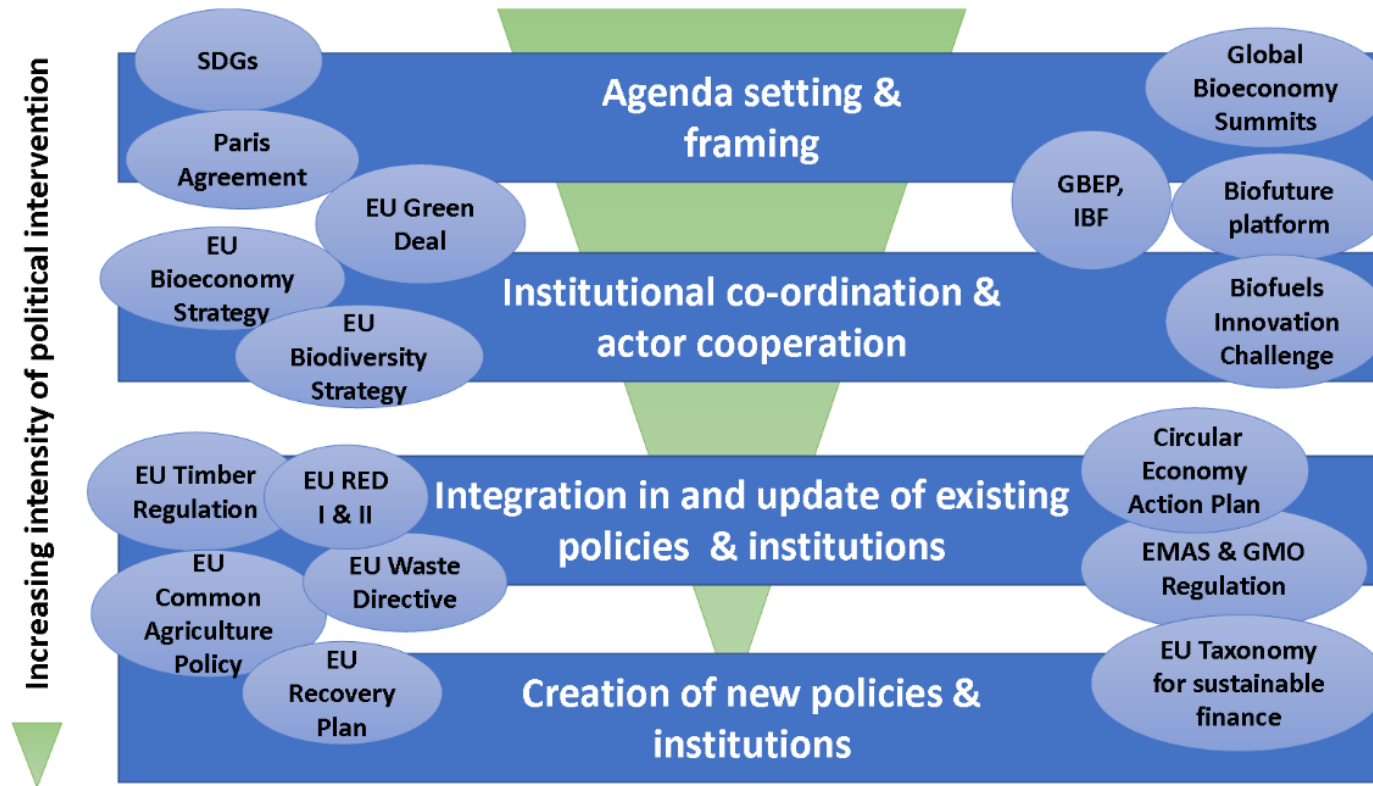
Narratives of bioeconomy

- Crossroads between socio-technical & ecological systems
- “bio” + “economy” -> emerging sector works to bring economics biology, social scientist and ecology together to achieve sustainable development
- Inclusion in S-Economics with green, blue, circular, low carbon on the same frame (Sotiropoulou and Deutz, 2022)
- Three narratives used to explain bioeconomy in economic literature (Vivien, 2019)
 - Bioeconomy as Renewable Resource Economy
 - Bioeconomy as Biotechnology
 - Bioeconomy as Bio-based carbon economy

Macro aspects Strategy & policy

- The shift towards a circular economy and bioeconomy is one of the main focuses of political initiatives aimed at replacing fossil feedstock by renewable biological sources while still achieving economic growth
 - EU Bioeconomy strategy
 - National Bioeconomy strategy & CAP
 - (Multidisciplinary) R&I & HE & (PNR) & Next Generation EU

Macro aspects Governance of Bioeconomy



Source: Iriarte, van Dam & Fritsche (2020)

Macro aspects

Map of (some) policy related to bioeconomy

Policy theme	Global/International	EU (outwards)	EU (internal)	National
Resources/wastes	UNEP 10YP SCP	(Waste & Plastic Directives)	Waste & Plastics Directives	various
	UNEP IRP	?	EPD	various
	G7/20 RessEff	?	Bioeconomy Strategy	various
		?	Circular Economy Strategy	various
Environment	Paris Agreement	ETS		NECPs
	UN FCCC			various
	UN CBD	?	2030 Biodiversity Strategy	Nature protection laws
	UN Water	?	Water Directive	various
	UN CCD	?	?	Land conservation strategies
Energy	IFC, World Bank etc.	(RED)	RED	Energy/bioenergy policies
	UN SE4All	?	EPD	FIT, various
		?	Gas Directive	various
		TEN	Internal market, competition	Market design, grid access etc.
Finance	UNEP FI	?	Taxonomy	various
	UN Compact	?	?	various
Agriculture	WTO	bi-/multilateral Trade Agreements	CAP	CAP implementation; domestic incentives
Forestry	UN-REDD	TR/FLEGT	Forest Strategy	Forest certification & carbon offsetting
	UNFF	(Forest Strategy)		Deforestation laws
	Forest certification			Planting/restocking
				Publicly-owned forests Forestry standards/codes
Legend	Regulatory (comprehensive)		Incentives	Voluntary
	Regulatory (partial)		Strategic/aspirational	

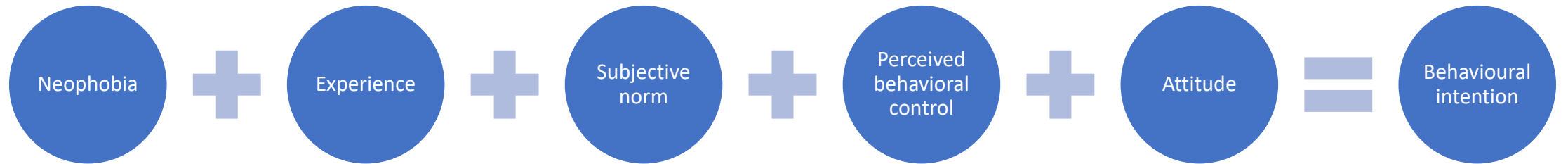
Source: Fritsche et al. (2020)

Macro aspects

Strategy & policy

- Policy agendas are well-articulated & complex (cross sectoral nature & different level of governance - Dietz et al., 2018).
- Different programs & several levels with feedback among policy (Bartolini et al., 2015;2019)
- Subsidies for industrial development & for private R&I are main drivers for innovation in emerging sector (Maes and Van Passel, 2019)
- Role of CAP in supporting private investment (i.e. biogas; short rotation forestry)
- Policies supporting new technology very effective BUT dependency & rental seeking behaviour

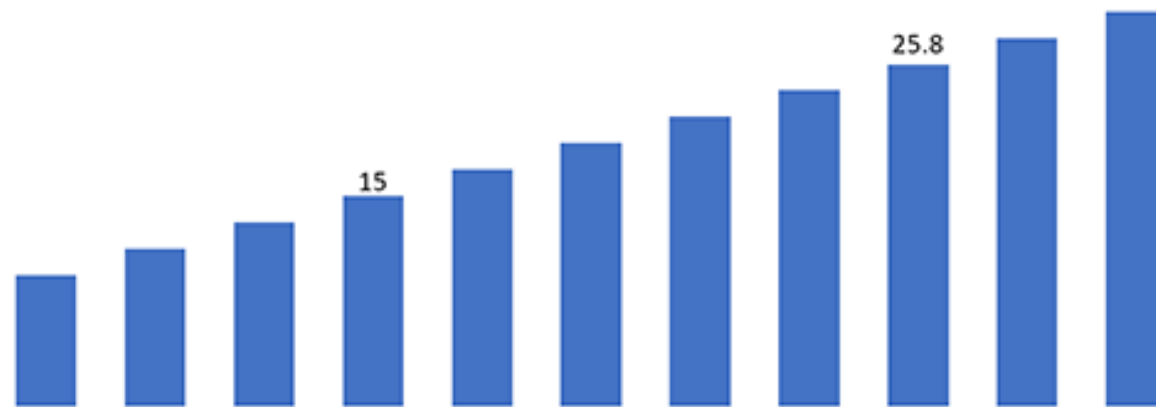
Micro Aspects Consumer



Micro Aspects Consumer

Global Vegan Food Market

Historical Market and Forecast
USD Billion

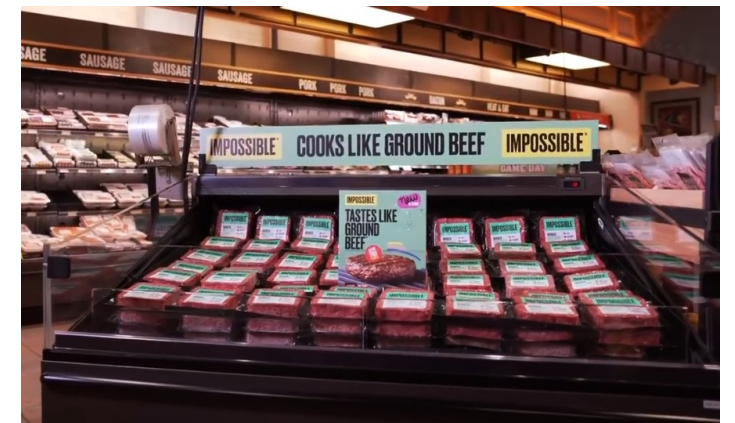


Source: www.expertmarketresearch.com



Micro Aspects technology

- Tools to drive consumers' behavioral change
 - Labels & certifications (Nutriscore, Ecoscore ...)
 - Advertising and testimonials
 - In-store and restaurant Tests
 -



Micro Aspects

Supply & market

- Centrality of production (& availability) of biomass
 - Supply elasticity; scale economy, transaction costs (Viaggi et al., 2021)
 - Farm behaviour models (Bartolini et al., 2018)
- Processing - biorefinery
 - Incentive and organisation (El-Chichakli et al., 2016)
 - Logistic & production & biomass costs (Popp et al., 2021)
 - Actors involved & value added distribution and agency problem (Hatvani et al. 2022)
- Market
 - Interlink among the different value chain (Viaggi et al., 2021)
 - New market affects resource use allocation (Jansen et al., 2021)
 - Price transmission along the supply chain
 - (International) trade-off fossil fuel and energy prices

Micro Aspects Sustainable Business Models

- Business model innovation is a key requirement for industry transformation related to the Bioeconomy (Geissdoerfer et al., 2017)
- Key aspects to design business models in a way that enables the firm to capture economic value for itself through delivering social and environmental benefits (D'Amato et al., 2020):
 - Value proposition (what?)
 - Value creation and delivery (how?)
 - Value captured (for whom?)

Micro Aspects SBM Archetypes

Groupings	Technological			Social			Organisational	
	Archetypes			Archetypes			Archetypes	
Examples	Low carbon manufacturing/ solutions	Circular economy, closed loop	Move from non-renewable to renewable energy sources	Product-oriented PSS - maintenance, extended warrantee	Biodiversity protection	Consumer Education (models); communication and awareness	Not for profit	Collaborative approaches (sourcing, production, lobbying)
	Lean manufacturing	Cradle-2-Cradle	Solar and wind-power based energy innovations	Use oriented PSS- Rental, lease, shared	Consumer care - promote consumer health and well-being	Demand management (including cap & trade)	Hybrid businesses, Social enterprise (for profit)	Incubators and Entrepreneur support models
	Additive manufacturing	Industrial symbiosis	Zero emissions initiative	Result-oriented PSS- Pay per use	Ethical trade (fair trade)	Slow fashion	Alternative ownership: cooperative, mutual, (farmers) collectives	Licensing, Franchising
	De-materialisation (of products/ packaging)	Reuse, recycle, re-manufacture	Blue Economy	Private Finance Initiative (PFI)	Choice editing by retailers	Product longevity	Social and biodiversity regeneration initiatives ('net positive')	Open innovation (platforms)
	Increased functionality (to reduce total number of products required)	Take back management	Biomimicry	Design, Build, Finance, Operate (DBFO)	Radical transparency about environmental/ societal impacts	Premium branding/ limited availability	Base of pyramid solutions	Crowd sourcing/ funding
		Use excess capacity	The Natural Step	Chemical Management Services (CMS)	Resource stewardship	Frugal business	Localisation	"Patient / slow capital" collaborations
		Sharing assets (shared ownership and collaborative consumption)	Slow manufacturing			Responsible product distribution/ promotion	Home based, flexible working	
		Extended producer responsibility	Green chemistry					

Source: Bocken et al., 2014

Impacts

Sustainability of bioeconomy

- Conflicting views on cost and benefits & different risk perception
 - Unconditional sustainability VS competitions for resource use and unknown env. and social impact
- Ecosystem services
 - contribution to provisioning services is quite evident (other ES less investigated)
 - Positive contribution in reducing GHGs or delivering low carbon solution (but broader comparison with BaU scenario)
- Source of biomass relevant for sustainability
- Unclear impact on
 - Diversification of supplies for food, feed, and raw materials
 - contribution or creation of employment and foster rural development
 - Unclear trade-offs or synergies over scale, space and actors (i.e. outsourcing of environmental damages or equity/access/exclusion)

Discussion

- Different views about bioeconomy, different expectation about costs and benefits & trade-off (scale, space, actors, time etc)
- Relevance of acceptability, structural and societal changes & technological development (multilevel perspective)
- Multidisciplinary and plural approach to R&I
- “Need to enhance the transition towards both clean energy and sustainable, resilient, and fair food systems has never been stronger and clear”

Discussion

- Differences between theory and practices
 - New area of investment but also competition for resources (inequality)
 - Scaling-up Innovation
 - Institutional setting / Coherence policy and investment framework
 - Barriers & enablers
 - Business model and organisation models
 - Incentive and policy

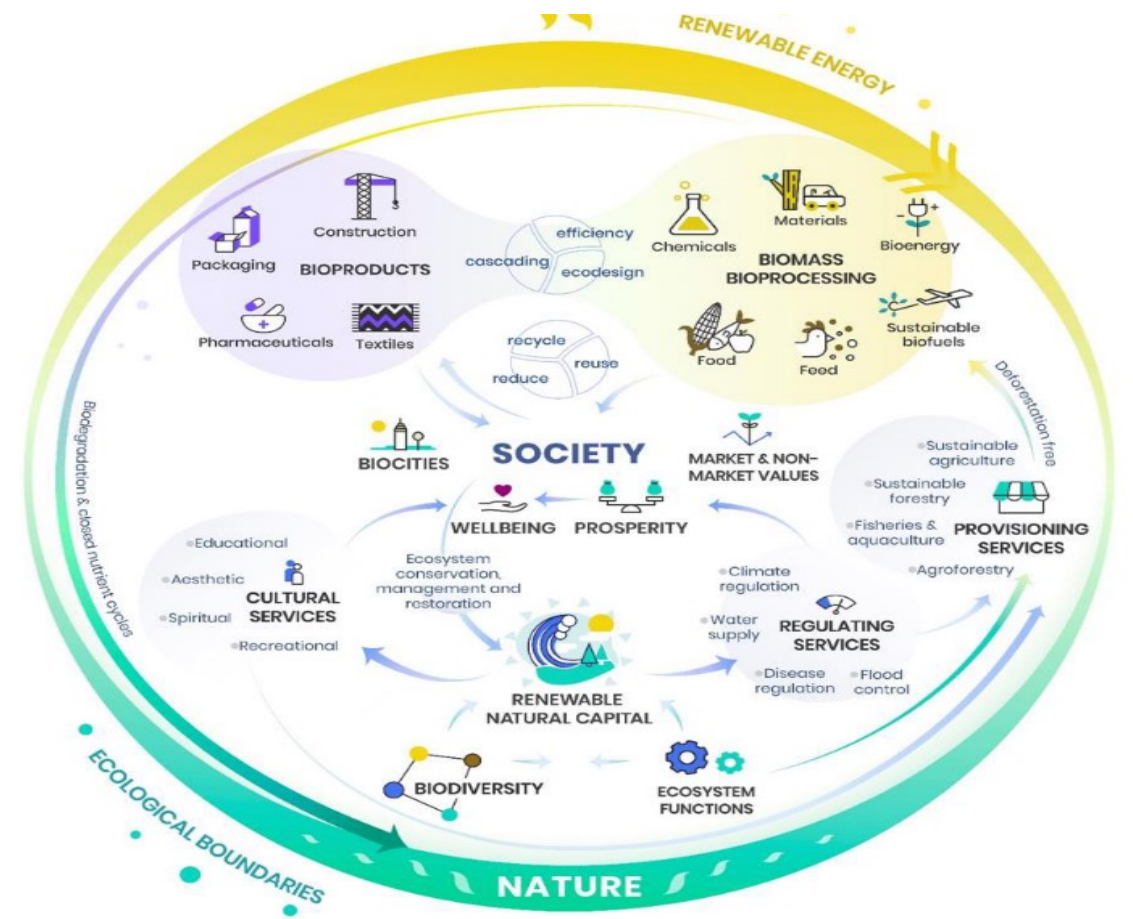
Thank you

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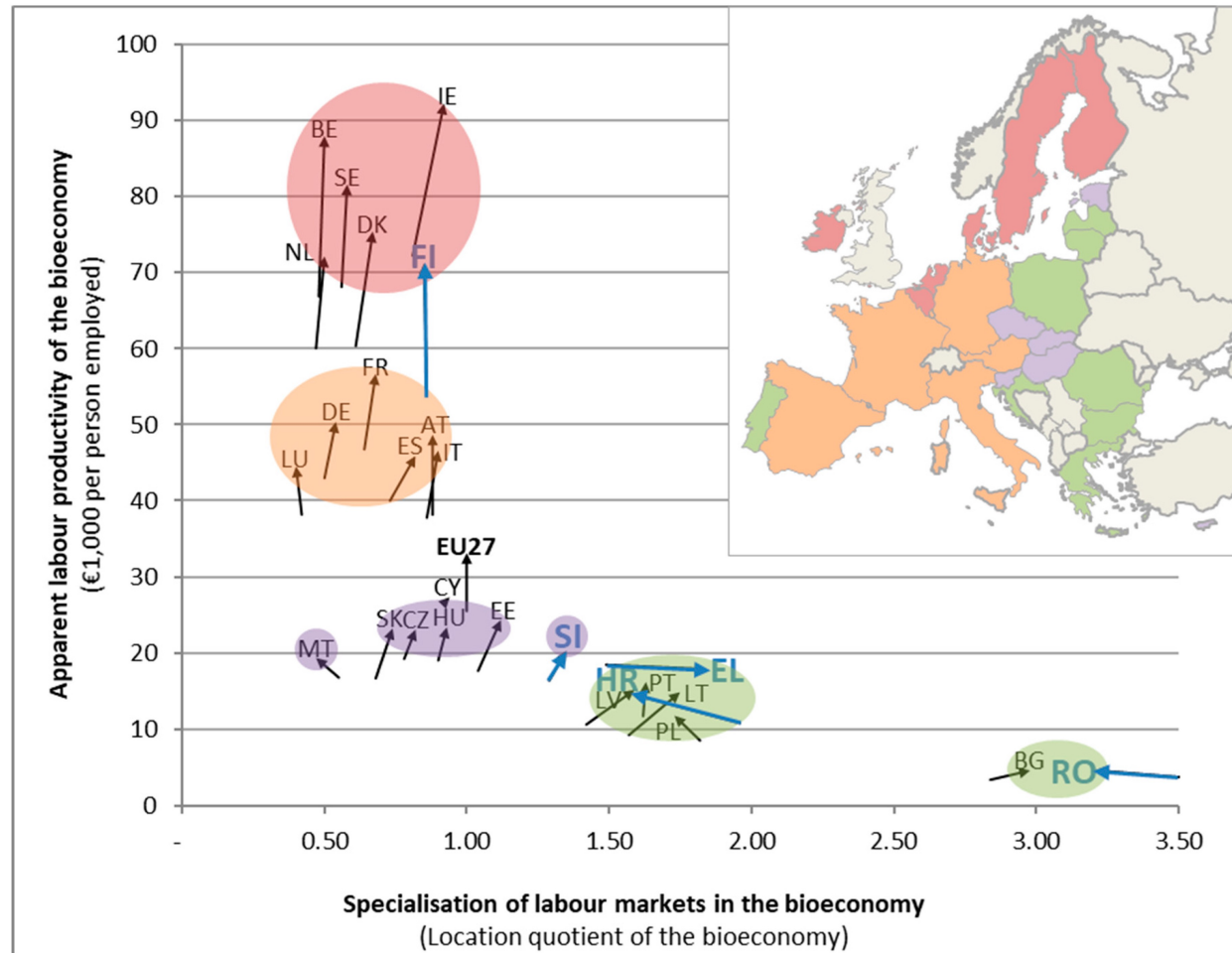
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Micro Aspects

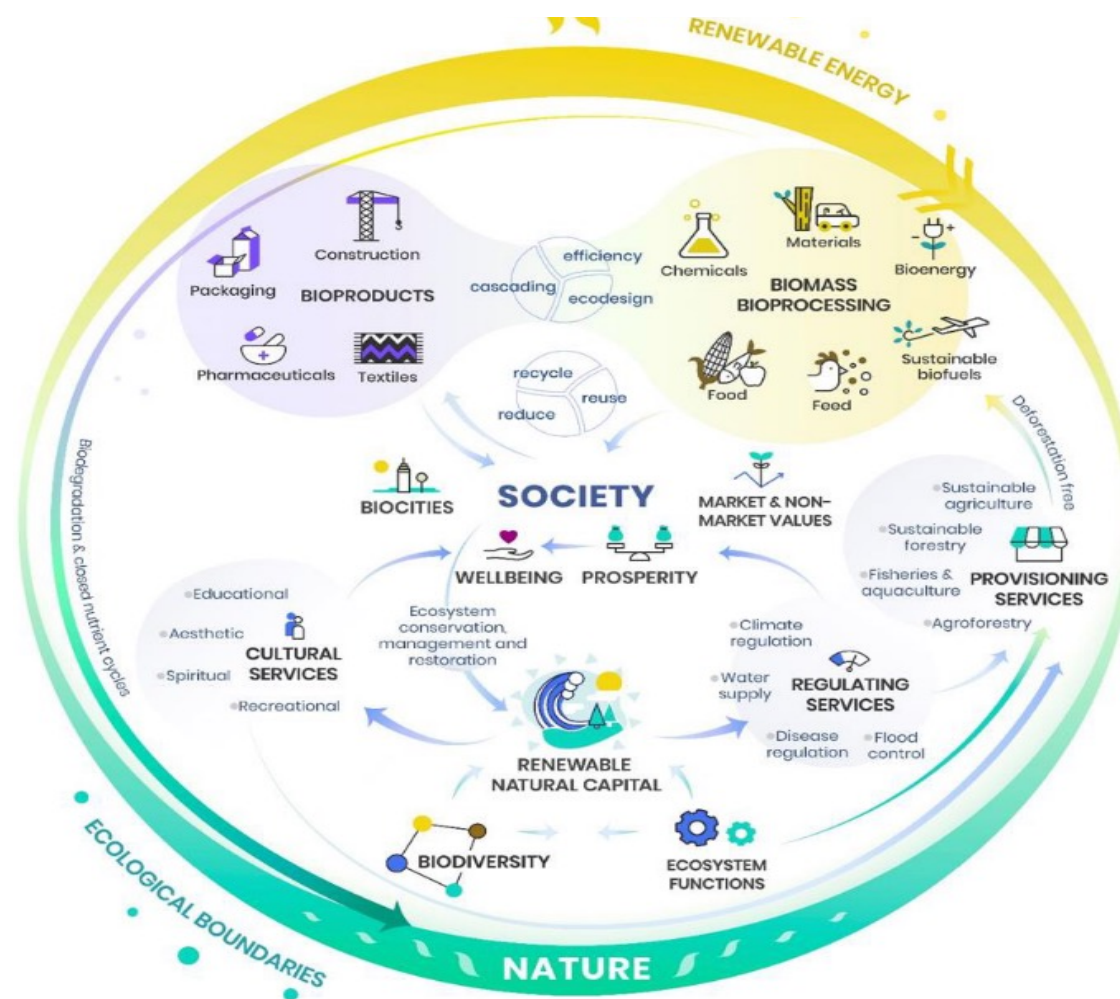
Different trends in country development



Ronzon et al. (2020)

Impacts

Bioeconomy and Ecosystem services



I servizi ecosistemici

Le recenti politiche internazionali hanno fatto registrare un graduale ma deciso spostamento dell'attenzione dal capitale naturale ai servizi ecosistemici.

In realtà i due termini hanno pari importanza, e sono fortemente interconnessi, ma sono aumentate le circostanze, soprattutto politiche e normative, che determinano la necessità di valutare i servizi ecosistemici. **Uno dei motivi è proprio quello che il valore di una risorsa ambientale è spesso proporzionale alla quantità ed alla qualità dei servizi prodotti.**

Ambiente: STRUTTURA E FUNZIONI

L'ambiente, nella sua accezione più ampia, include sia la sua **struttura**, quindi le componenti ambientali e le risorse naturali (ad esempio le specie animali e vegetali, la conformazione del territorio, l'acqua, l'aria), che le **funzioni**, cioè i flussi di utilità generati dalla struttura.

- Struttura → è più propriamente chiamata **CAPITALE NATURALE**, quindi il patrimonio materiale che deve essere tutelato e non consumato in modo irragionevole, per garantirne la conservazione.
- Funzioni → corrispondono ai più noti **SERVIZI ECOSISTEMICI**

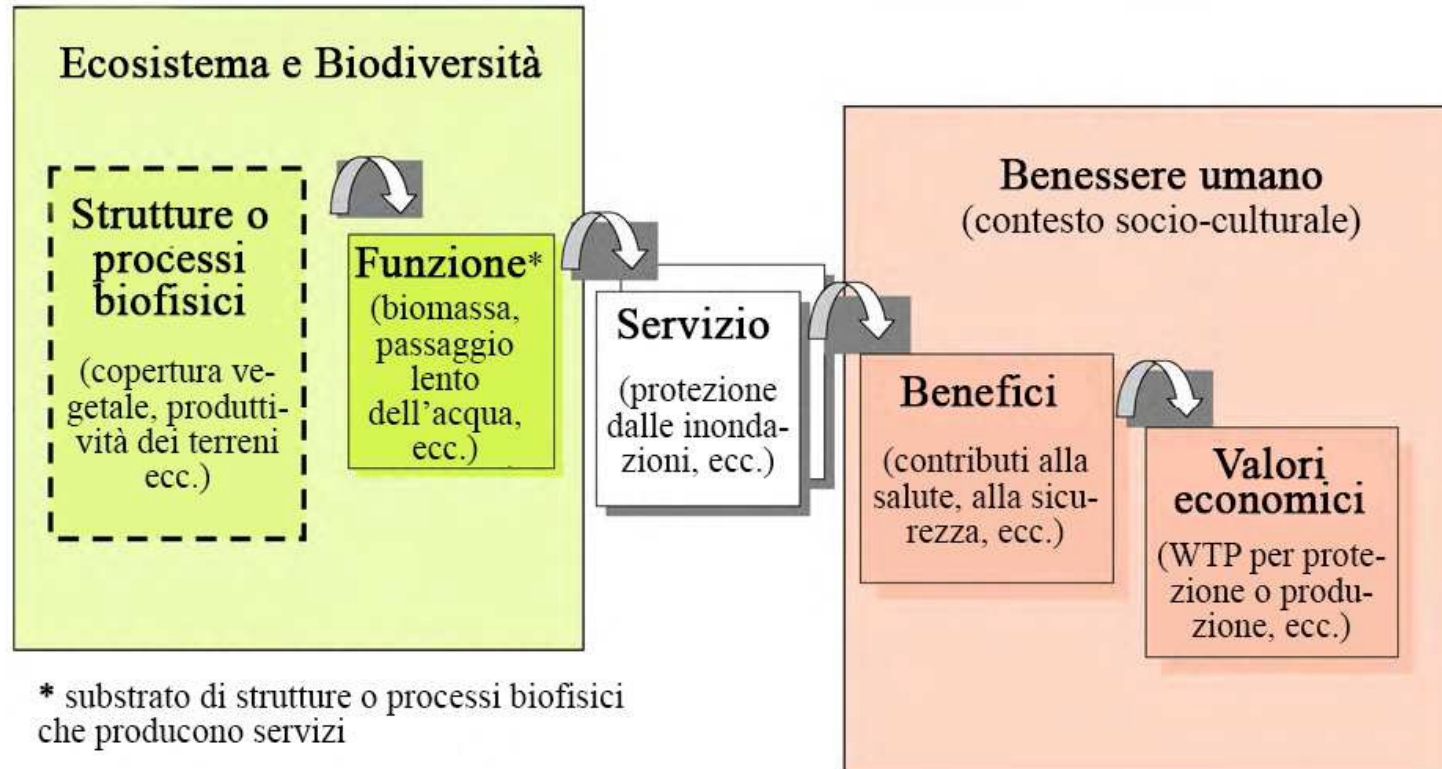
Classificazione dei servizi ecosistemici

I servizi ecosistemici sono stati classificati in quattro diverse tipologie:



- **Servizi eco-sistemici di supporto:** sono quelli che rendono possibile la vita sul nostro pianeta, in quanto “supporto” allo sviluppo delle condizioni necessarie per la vita stessa; ad esempio, il ciclo dei nutrienti, la formazione del suolo, la fotosintesi, ecc.
- **Servizi eco-sistemici di fornitura o approvvigionamento:** sono quelli che forniscono i beni materiali; ad esempio, la disponibilità di cibo, di acqua dolce, di legno e fibre, di combustibili, di risorse genetiche ecc.
- **Servizi eco-sistemici di regolazione:** consentono di regolare i fenomeni naturali, mantenendoli al livello ottimale per lo svolgimento della vita; ad esempio, la regolazione del clima, la regolazione delle inondazioni, la regolazione delle malattie, l’impollinazione ecc.
- **Servizi eco-sistemici culturali:** includono benefici non materiali; ad esempio, il valore estetico, spirituale, educativo, ricreativo, delle relazioni sociali, ecc.

Le interazioni tra i servizi ecosistemici e il benessere umano



Il valore economico dei servizi ecosistemici

I servizi ecosistemici sono stati di recente studiati a fondo, ed è stata riconosciuta a livello internazionale la necessità di una loro quantificazione in moneta. Prevalde, infatti, la convinzione che il punto di partenza per riuscire a tutelare e conservare in modo efficace qualcosa, sia conoscerne il valore economico, per la natura stessa del pensiero dell'*homo oeconomicus*.

Pagamenti per i Servizi Ecosistemici (PES)

I PES portano i servizi ecosistemici in un contesto di mercato facendo sì che i beneficiari di un servizio ambientale (acquirenti) paghino il fornitore del servizio (venditori) per assicurarne la continuità o il miglioramento.

Funzionamento dei PES

Principio

«Il beneficiario paga»



2021 - 2030 Il Decennio delle Nazioni Unite per il ripristino degli ecosistemi

L'Assemblea generale delle Nazioni Unite ha dichiarato gli anni dal 2021 al 2030 [Decennio delle Nazioni Unite per il Ripristino degli Ecosistemi](#): un vero e proprio appello- rivolto ai Governi, alle istituzioni, al mondo accademico, ai singoli cittadini- a tornare a prendersi cura dell'ambiente.

L'iniziativa mira a combinare sostegno politico, ricerca scientifica e forza finanziaria con l'obiettivo di far rivivere milioni di ettari di ecosistemi terrestri e acquatici. Il periodo di tempo individuato per agire non è casuale: secondo gli scienziati, infatti, i prossimi dieci anni saranno cruciali nel determinare il successo della battaglia contro il surriscaldamento globale e della strategia per la conservazione della biodiversità.



UNITED NATIONS DECADE ON
**ECOSYSTEM
RESTORATION**
2021-2030

Impacts

Economic Value of Ecosystem Services

More than half of global GDP – some €40 trillion – depends on nature

Nature restoration will be a central element of the EU's recovery plan from the coronavirus pandemic, providing immediate business and investment opportunities for restoring the EU's economy.



These sectors are all highly dependent on nature, and they generate **more than €7 trillion**.



The **benefits** of biodiversity conservation for the economy:

- ✓ conserving marine stocks could increase annual profits of the seafood industry by more than **€49 billion**
- ✓ protecting coastal wetlands could save the insurance industry around **€50 billion annually** through reducing flood damage losses

Six industries:



Chemicals and materials



Aviation, travel and tourism



Real estate



Mining and metals



Supply chain and transport



Retail, consumer goods and lifestyle

Depend through their supply chain on nature for more than 50% for their gross value added.



Benefits of the **EU Natura 2000 nature protection network** are valued at between **€200-300 billion** per year.

Multifunzionalità e servizi ecosistemici

Secondo l'OCSE (2001), la multifunzionalità è una caratteristica dell'agricoltura che, oltre alla sua funzione primaria di produrre cibo e fibre, fornisce diversi benefici alla società in campo ambientale e socio-economico

Molti di questi benefici si configurano come servizi ecosistemici. Fermo restando che sono servizi ecosistemici di approvvigionamento anche la semplice fornitura di cibo ed altri materiali.

Non-commodity output

La multifunzionalità implica l'esistenza di output non merceologici che possono presentare le caratteristiche di esternalità o beni pubblici (Durand & Van Huylenbroeck, 2003). Gli output sono raggruppati in categorie.

Non-Commodity Categories (NCC)

1- Food Safety

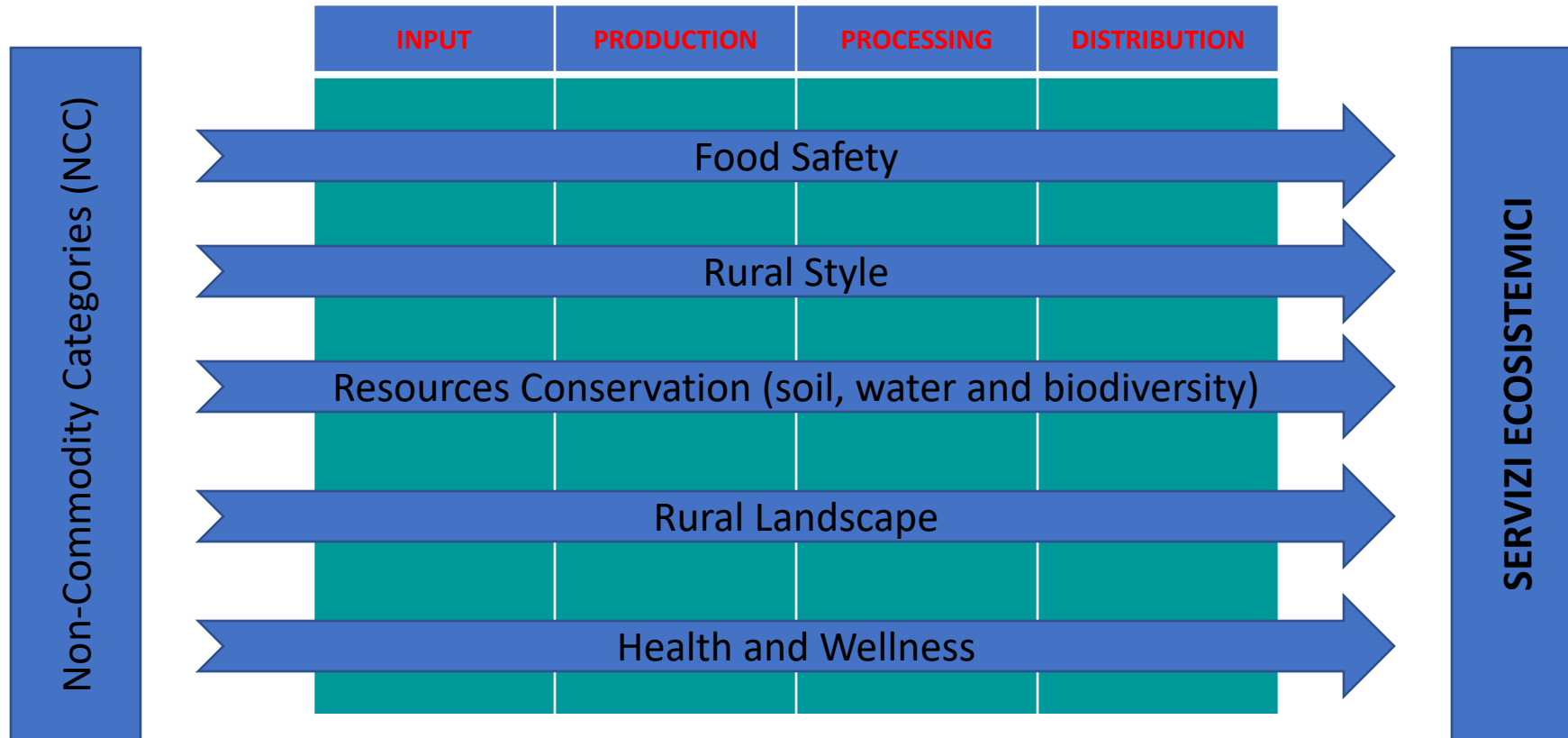
2- Rural Style

3- Resources Conservation (soil, water and biodiversity)

4- Rural Landscape

5- Health and Wellness

Le categorie di NCC riguardano tutte le fasi delle filiere produttive





Innovative (sustainable) business models

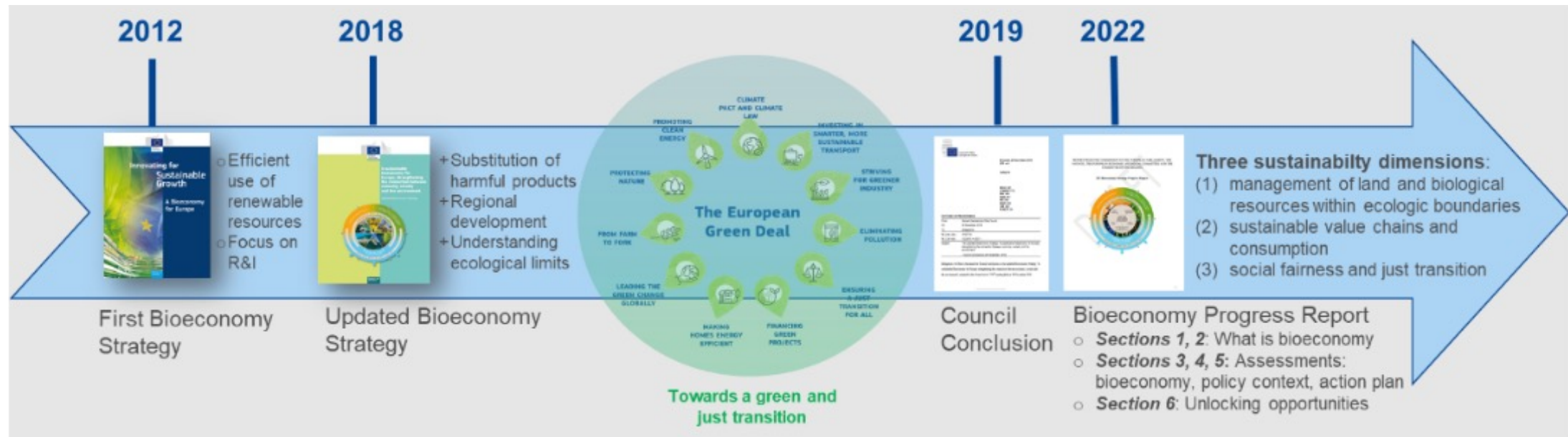
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- Key aspects to design business models in a way that enables the firm to capture economic value for itself through delivering social and environmental benefits (Bocken et al., 2014)
 - Value proposition
 - How to create (and share) value along the supply chain
 - Value creation and delivery
 - What types of actors and network involved in the supply chain
 - How actors' relations and conflicts & interactions between socio-technological and ecological systems
 - Value captured
 - What role of Institutions (formal and informal norms) stabilizing coordination in society and providing stable expectations (Beckert, 2016)
 - Legislation enough to support the development of new products, process, etc.

Sustainability and social acceptability

- number of socially relevant attributes (such as climate change, sustainability, biological resources), the development of the Bioeconomy is connected to visions, imagery and perceptions by the different stakeholders involved.
- Some of them emphasise the general positive perception of renewable vs. non renewable products, in particular at consumer level (Navrátilová et al., 2020), while others emphasise the contrasting views and the different potential positions by different stakeholders. However, the review by Holmgren, D'Amato and Giurca (2020) concludes that most of the scientific literature tends to reproduce policy concepts linked to weak sustainability rather than introducing original
- Media and communication are also important in shaping these aspects. Early work on genetic modifications has shown the potential role of media in changing public opinion. More recent research on this topic though reveals relatively little attention on elaborating novel ideas and rather a discourse mostly driven by government positions (Sanz-Hernández et al., 2020).
- An important part of demand is driven by public policies. This has been relevant up to now in particular in the bioenergy sector, with studies largely focusing on biofuel mandates or biogas production depending on aspect most relevant in each country

Policy & investments

EU bioeconomy strategy



Policy & investments

National Bioeconomy strategy

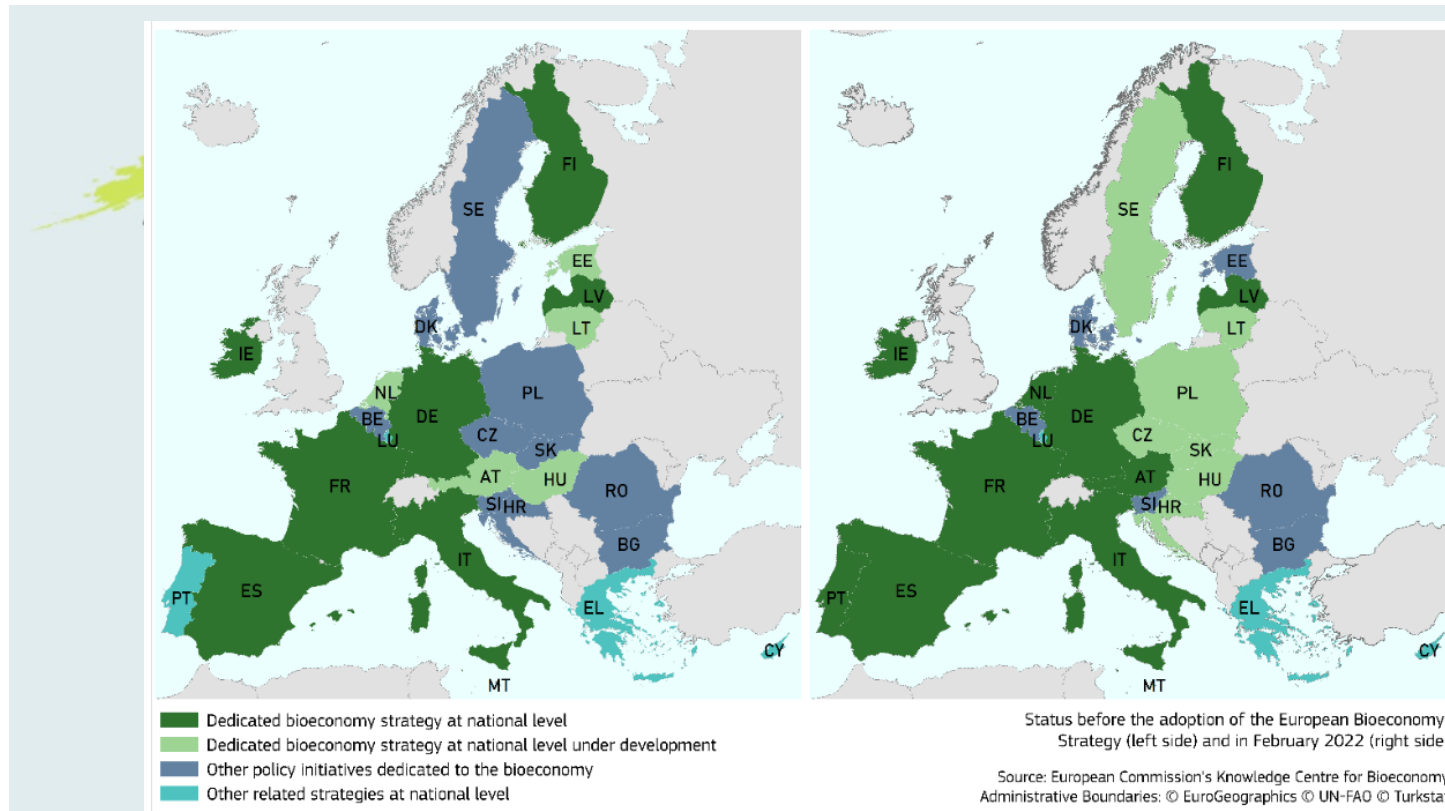
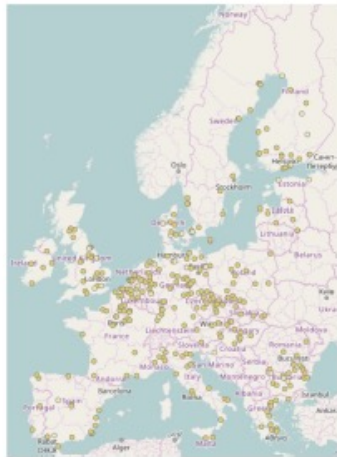


Figure 2. National bioeconomy strategies in the EU before the adoption of the European Bioeconomy Strategy³⁹ (left side) and in February 2022 (right side).⁴⁰

Source: <https://biooekonomie.de/article-map>

Innovative (sustainable) business models

Distribution Biorefinery



■ All biorefineries ■ Bio-based chemicals ■ Liquid biofuels ■ Bio-based composites and fibres

Policy & investments

WP 2023-2024 Expected impacts

- Proposals for topics under this destination should set out a credible pathway to:
 - develop the **circular economy** and **bioeconomy sectors**;
 - ensure **natural resources** are used and managed in **sustainable and circular** manner;
 - prevent and remove **pollution**;
 - unlock the **full potential and benefits** of the circular economy and the bioeconomy, with **clean secondary raw materials**, ensuring **competitiveness** and guaranteeing healthy soil, air, fresh and marine water for all, through better understanding of **planetary boundaries** and wide deployment and **market uptake** of **innovative technologies** and other solutions, notably in primary production (forestry) and bio-based system

Policy & investments

Expectation from bioeconomy

- the potential of a circular, sustainable bioeconomy in relation to growth is linked:
 - to its capacity to increase the **efficiency** of the system,
 - to reduce its environmental **impact** and restoring and enhancing **ecosystem services**,
 - to geographically **redistribute** employment, growth and value added,
 - to **diversify local rural economies**, and to at least partially compensate the decline of the fossil fuel-based economy