Prof. dr. sc.
Stjepan Posavec

Faculty of Forestry and
Wood Technology
University of Zagreb

www.sumfak.unizg.hr

Key aspects and challenges of European Bioeconomy transition: a need for research and innovation

OUTLINE:

- **1. Introduction**
- **2. Forestry-Wood industry**
- **3. Challenges**
- **4. Opportunities**
- **5. Conclusion**

1. INTRODUCTION- Bioeconomy?

- the production, utilization, conservation, and regeneration of biological resources,
- including related knowledge, science, technology, and innovation,
- to provide sustainable solutions (information, products, processes and services) within and across all economic sectors and
- enable a transformation to a sustainable economy (2018).

- EU Council in Lisbon: to establish “the most competitive and dynamic, knowledge-based economy in the world” (EU 2000).

Agriculture and Forestry: provide biomass for bioenergy, bio-based materials, and food products.

Bioenergy: biofuels, biogas, and other forms of renewable energy produced from organic materials.

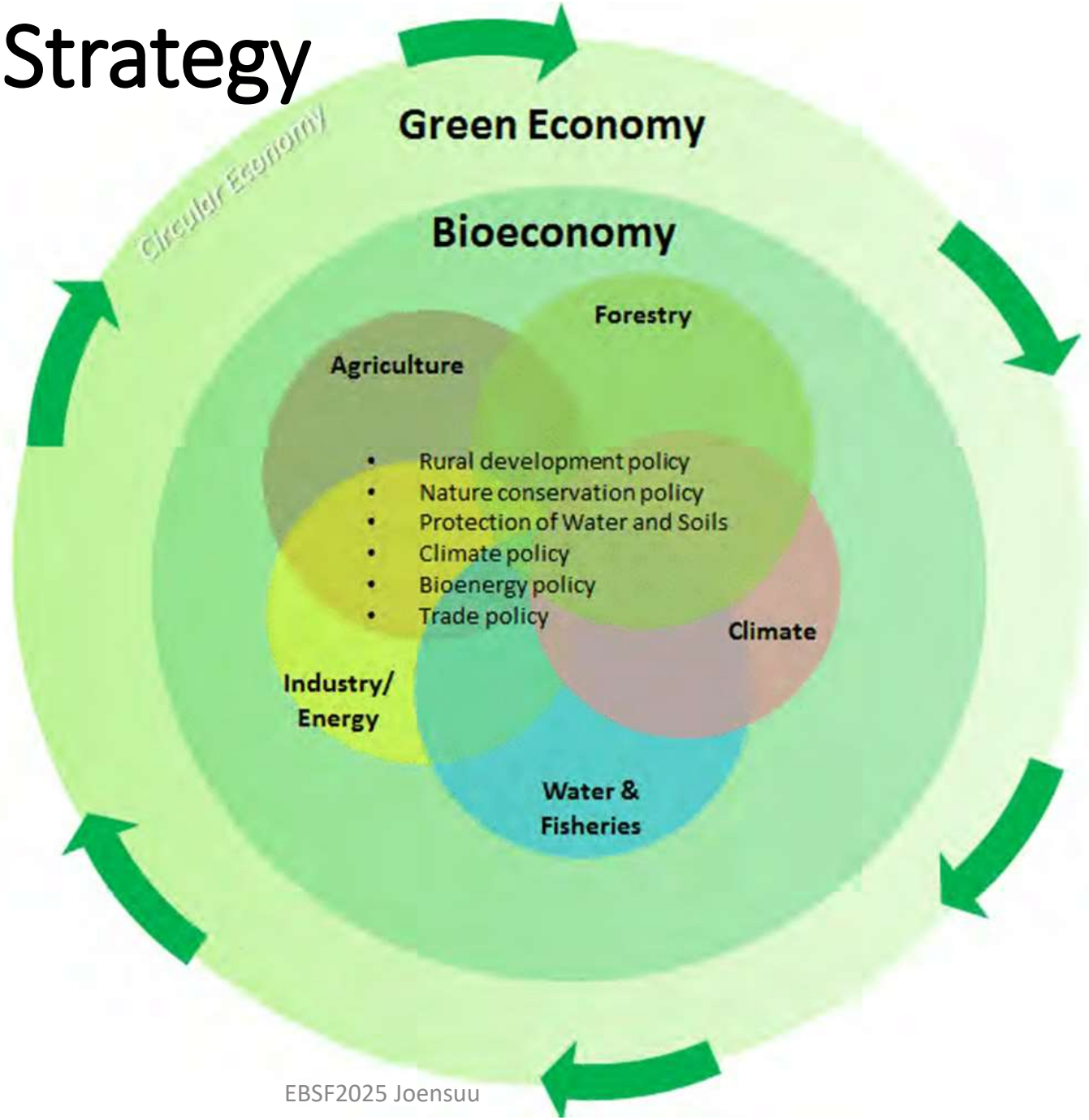
Biochemicals and Bioplastics: sustainable alternatives to petroleum-derived materials

Marine Resources: The exploitation of marine biomass, for biofuels, bioplastics, and other bio-based products.

Waste Valorization: Turning organic waste into biogas, compost, or bio-based materials

EU Bioeconomy Strategy

- transition to a circular, low-carbon, and sustainable economy



EU strategies and regulations

- Circular Economy Action Plan, Green Deal (2020)
- EU Forest strategy 2030: plant 3 billion additional trees
- Climate Change Adaptation Strategy: Fit for 55
- Industrial Policy Strategy (2021)
- Communication on Accelerating Clean Energy Innovation
- Farm to Fork Strategy (2020)
- Regulation on Deforestation-free Products (EUDR) repeals EUTR
- NATURA 2000, LULUCF regulation

Bioeconomy Policies around the World

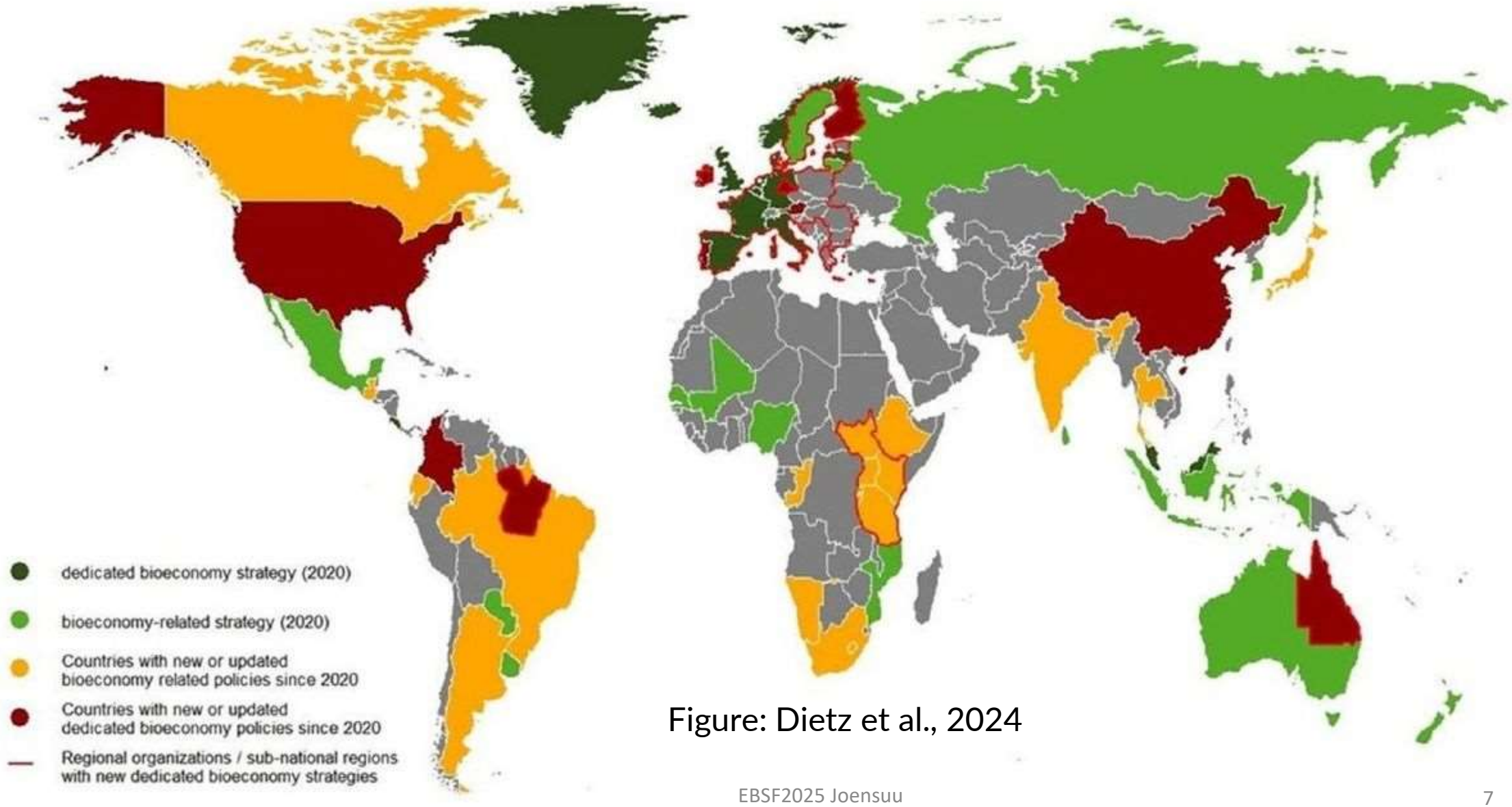


Figure: Dietz et al., 2024

2. FORESTRY AND WOOD INDUSTRY - TEV

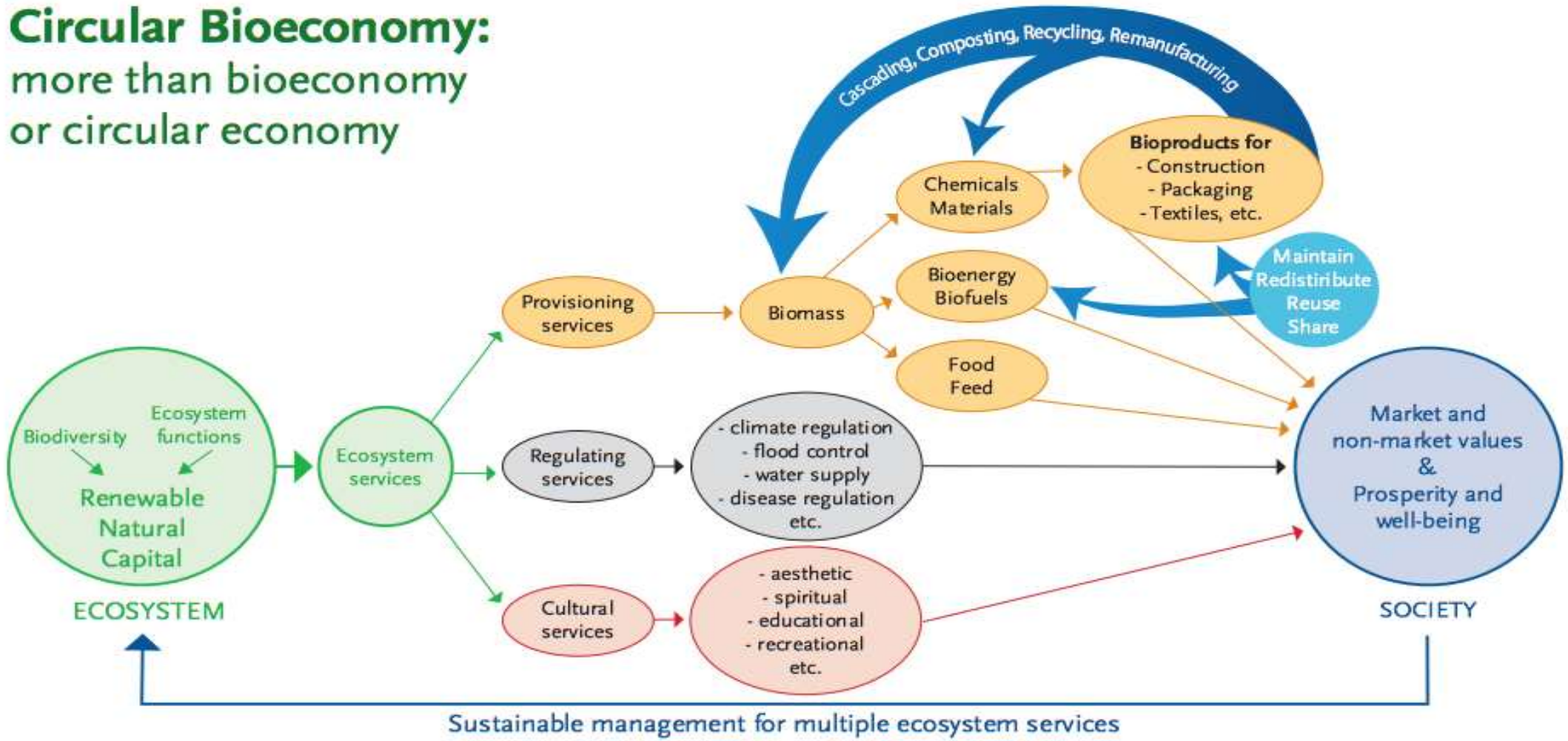
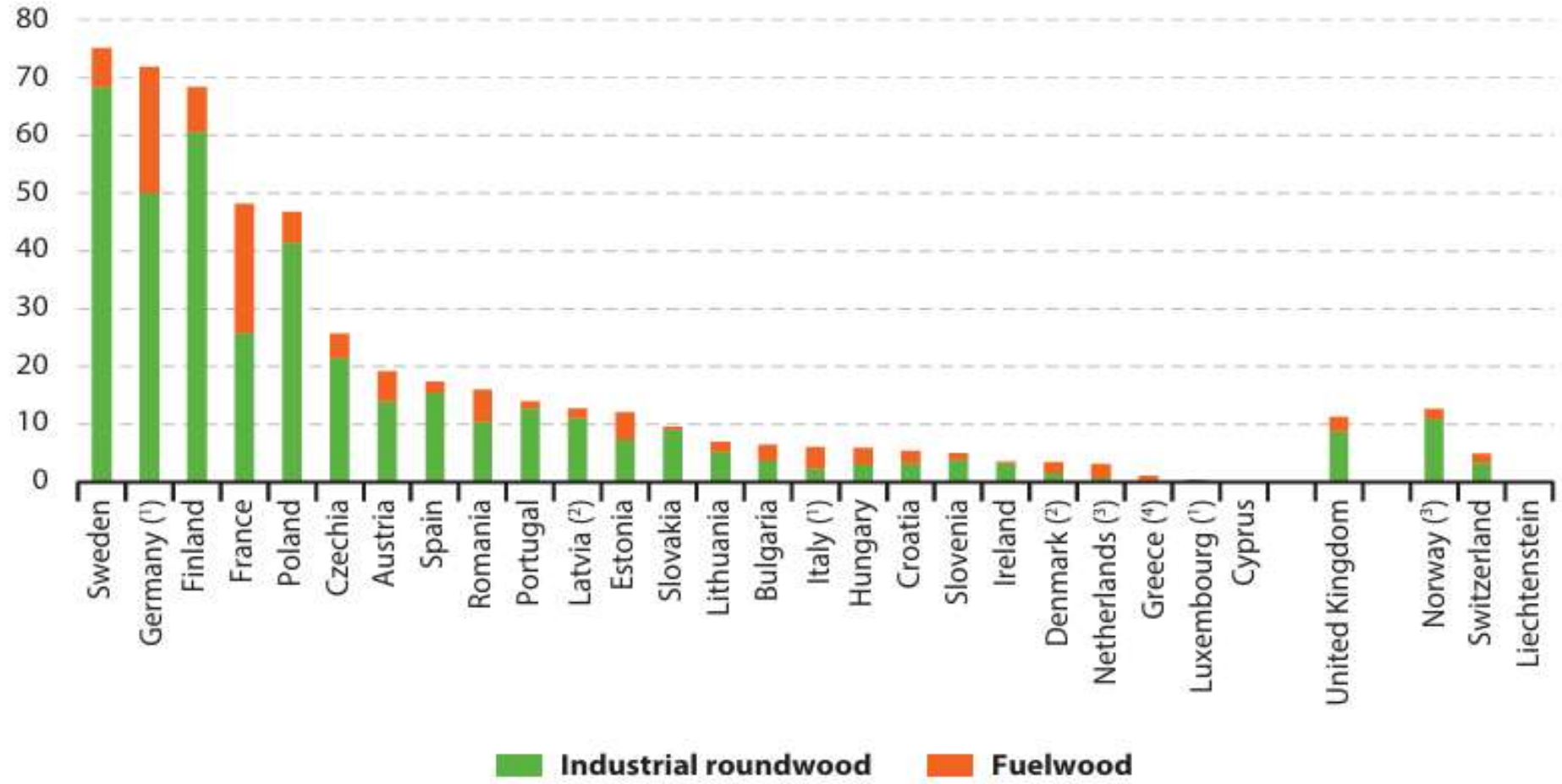


Figure 4. Illustration of circular bioeconomy flows. Source: EFI[2]

Figure 5.3.2: Roundwood production, 2018
(million m^3 under bark)



Note: Malta, not applicable. Belgium: not available.

(1) Estimates.
(2) 2016.
(3) Fuelwood: estimate.
(4) 2013.

Source: Eurostat (online data code: for_remov)

Value of NWFP in EU (Lovrić et al.2020)

- survey involving 17,346 households from 28 European countries (Star Tree project).
- estimated that collected NWFPs represent:

- TEV of **23.3 billion** €/year in Europe,

- which amounts to **20.5 €/ ha** of forest and other wooded land,

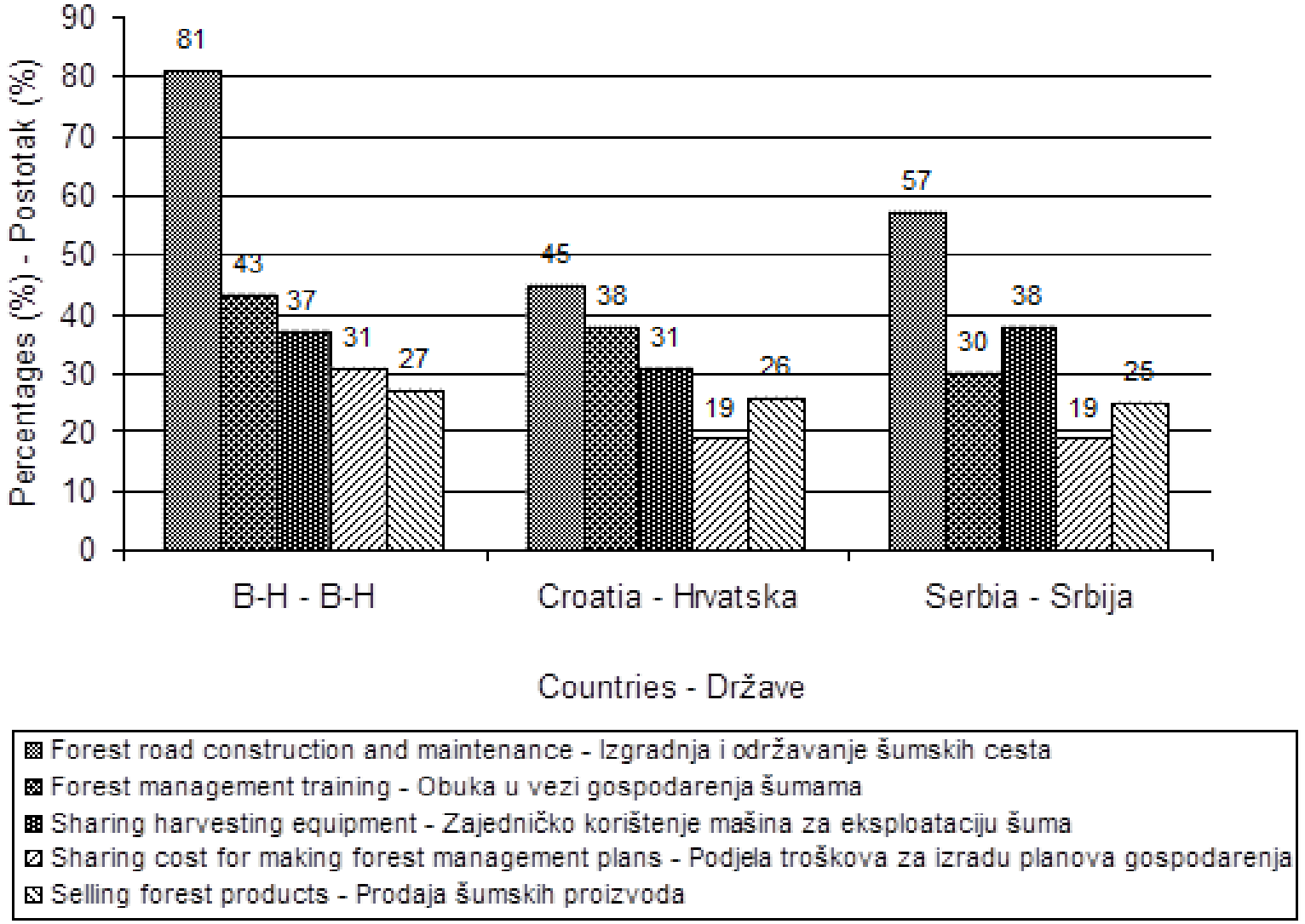
- represents an economic value that is comparable to 70.7% of annual roundwood removals value in Europe (FOREST EUROPE, 2015)

Project collecting and using NWFP in CRO

Pickers collect:	berries	23.9 %
	mushrooms	29.4 %
	edible plants	17.2 %
	medical and aromatic plants	28.9 %
	All of them	0.7 %

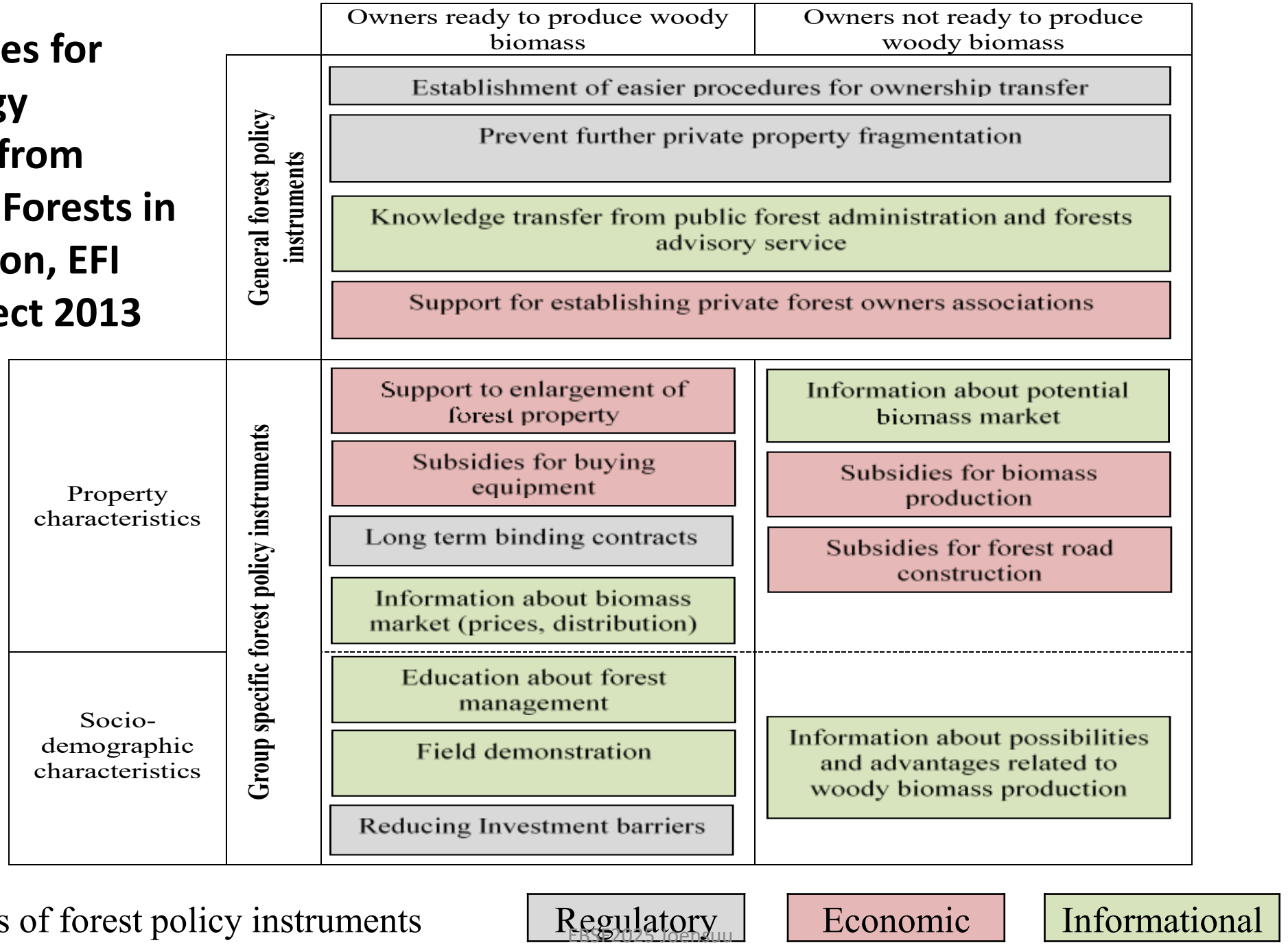
Average usage:	personal needs	99.6 %
	for a gift (for family)	0.8 %
	Sale after processing	1.2 %
	Sale as raw material	2.2 %

The Preconditions for the Formation of Private Forest Owners' Interest Associations in the Western Balkan Region, PRIFORT EFI project 2007



Readiness of private forest owners to cooperate in forest management activities

Opportunities for Wood Energy Production from Small-Scale Forests in the SEE region, EFI FOPER project 2013



Types of forest policy instruments — Regulatory | Economic | Informational

3. CHALLENGES a) Sustainable Forest Management

- Over-exploitation and Deforestation
- Competition for land - forestry, agriculture, urbanization…
- Multiple ecosystem services beyond timber, such as carbon sequestration, biodiversity habitat, water regulation, and recreational spaces.
- Climate Change Impacts: forest fires and storms
- Aforestation of arid regions – biodiversity
- Ocean algae aqua farms – Sargassum (https://www.helmholtz.de/en/newsroom/article/algae-farms-for-climate-protection/)

b) Market and policy development

Market Competition from non-renewable materials, such as plastics, metals, and petroleum-based chemicals - cheaper and easier to produce.

- The prices volatility of forest-based products like timber, paper, and biofuels
- Inconsistent regulations: Policies around forestry, bioenergy, and bio-based products can vary widely between EU member states, leading to regulatory fragmentation and make it difficult for companies

c) Technological Challenges

- **Innovation in Forestry Products**: technological development and scaling up of new forest-based products can be slow and capital-intensive.
- **Harvesting and Processing Efficiency**: challenges in improving the efficiency of harvesting and processing techniques.
- reducing waste, improving the quality of forest products, and minimizing the environmental impact of forest management practices.
- Ensuring efficient transportation, storage, and processing of biomass is essential for the success, influenced by global supply chains

d) Financing and Investment

- **Capital Intensive**: Transitioning to a bioeconomy, developing new forest-based technologies, and ensuring sustainable forestry practices require significant investment.
- challenging, particularly for SMEs that are often crucial for innovation.

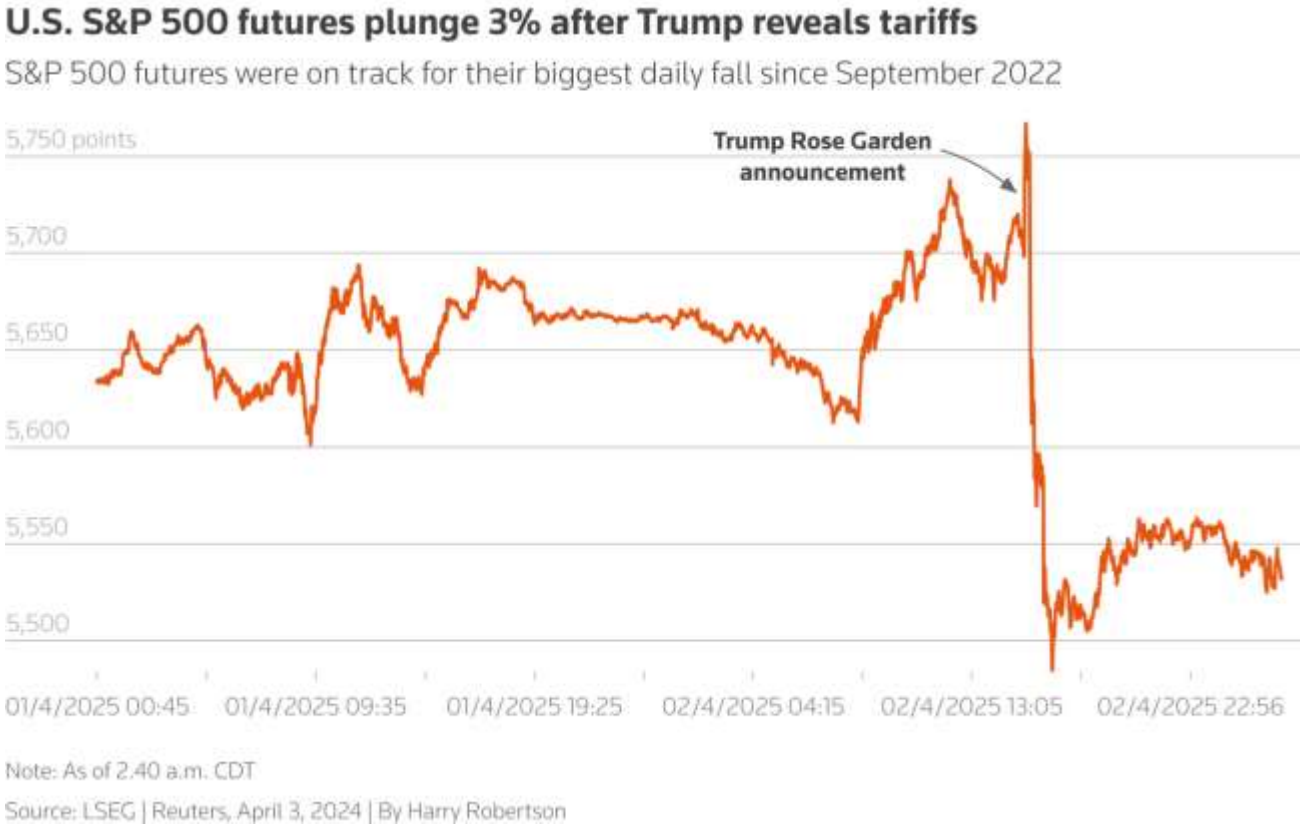
- **Uncertain Returns**: The long-term nature of forestry and bio-based product development often leads to uncertain returns on investment.
- difficult for investors to justify large-scale projects, especially in a rapidly changing economic and policy landscape.

e) Public Perception and Awareness

Important factors for bioeconomy development:

- **positive (chances), or**
- **negative (shocks)**
  Porter 1990!

- **Sociocultural factors play an important role**
- **Greenwashing!**

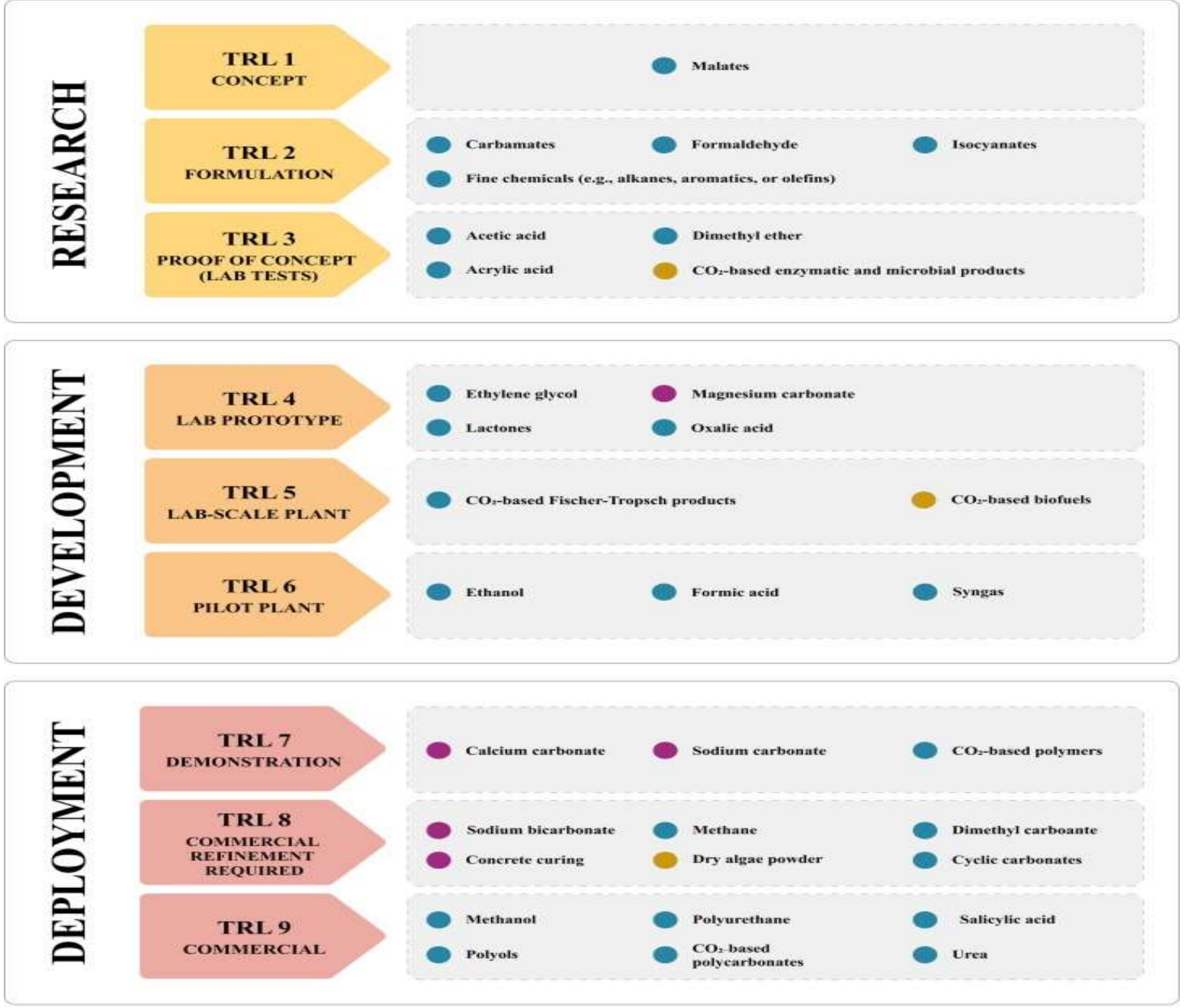


4. OPPORTUNITIES: a) Technology and Innovation

- Continued investment in innovation is needed to improve bio-based processes, make them more efficient, and reduce costs.
- Advancements in biotechnology, genetic engineering, and material science
- Wood biorefinery technologies
- EU bioeconomy transition funding for research and innovation like CLT, liquefied wood biomass etc.

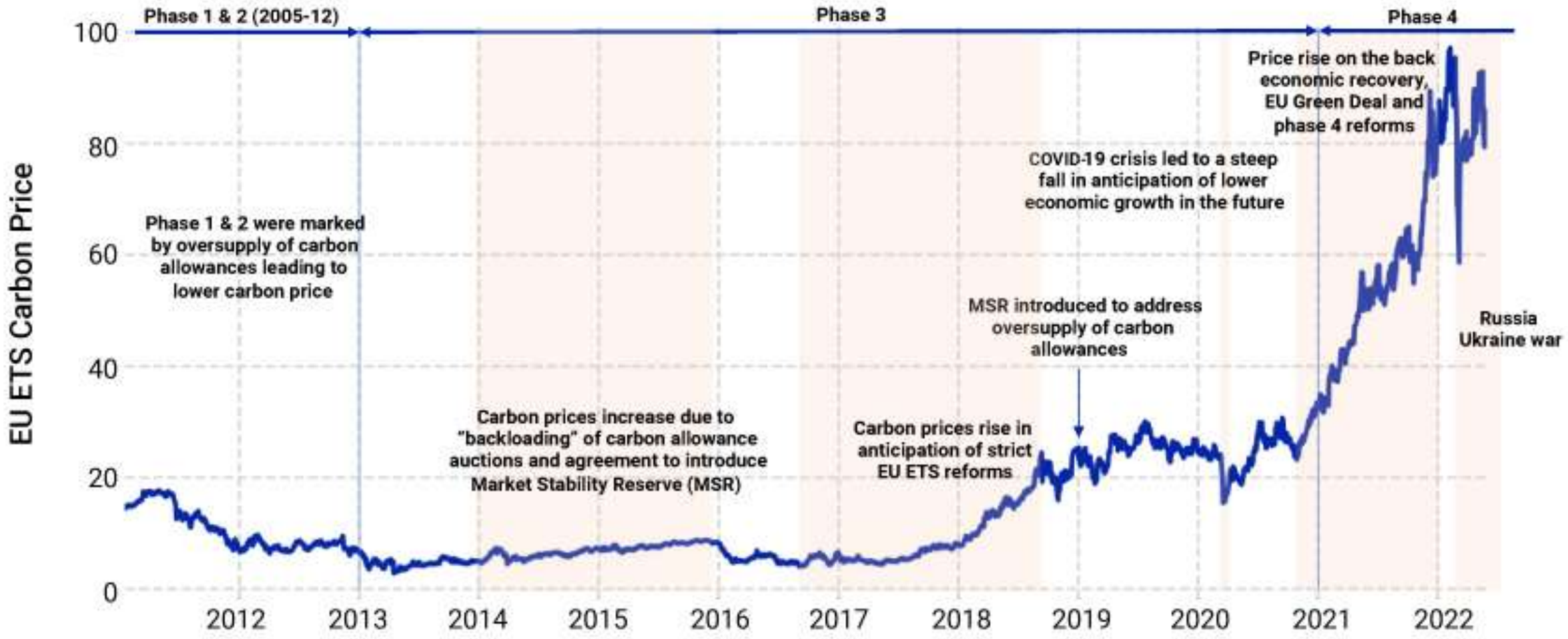
b) Carbon capture and storage (CCS)

- Driving Factors: Rising Environmental Concerns and the Emergence of Gas Injection EOR (Enhanced Oil Recovery) Techniques
- Restraining Factor: safety concerns and the high price of technology
- Pre-Combustion dominates the technology segment by covering major revenue share.
- Power generation leads the end-use industry segment by holding the major revenue share of 64.6%.
- North America holds the highest revenue share of the global CCS market due to strong oil and gas demand and tight regulations on carbon emissions (before year 2025!)



Ref: Bartosz Dziejarski, Renata Krzyżyńska, Klas Andersson, Fuel, Volume 342, 2023

c) EU Emissions-trading systems (ETS) and Carbon market



Source: https://www.msci.com/www/blog-posts/introducing-the-carbon-market/03227158119

d) Jobs and Economic Growth

- The bioeconomy as a major driver of innovation, job creation, and economic growth in Europe.
- Lack of working force in wood based industry
- EU face competition from other regions, such as North America and Asia.
- Cooperation with global partners will be essential to strengthen Europe's position.

Number of people employed in biomass producing and converting sectors

17.19M

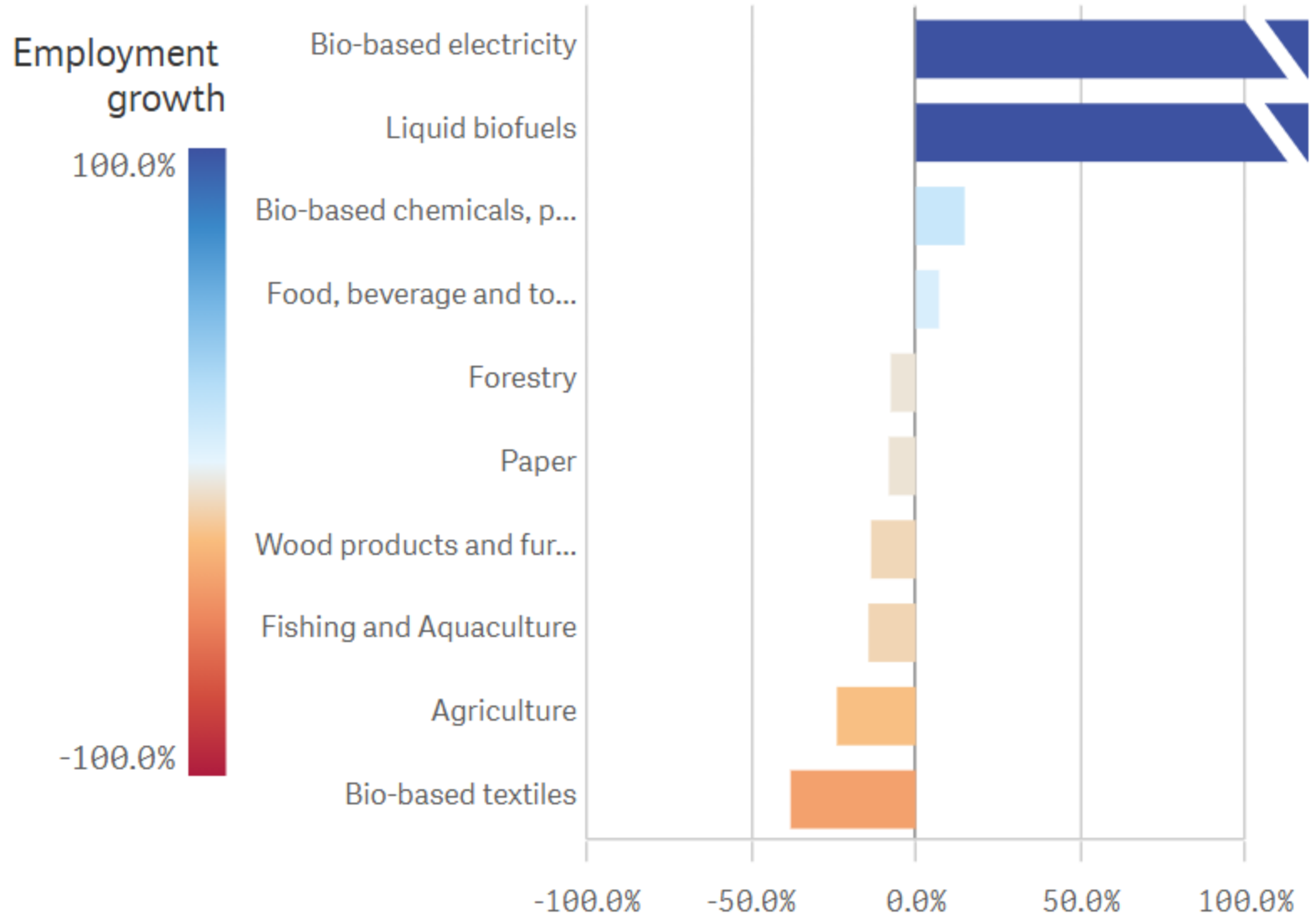
Value added of biomass producing and converting sectors (Billion €)

€728

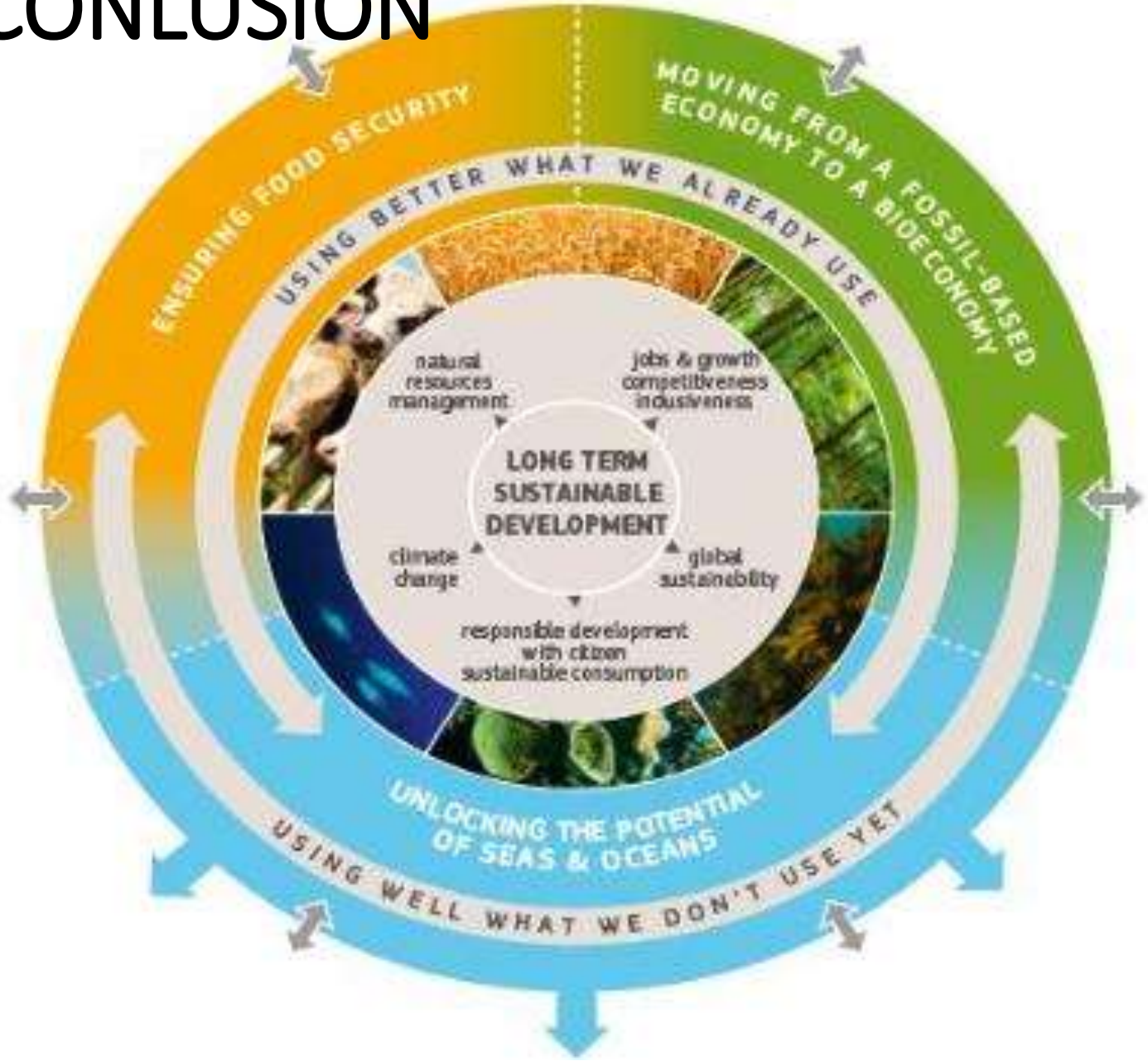
Value added per person employed in biomass producing and converting sectors

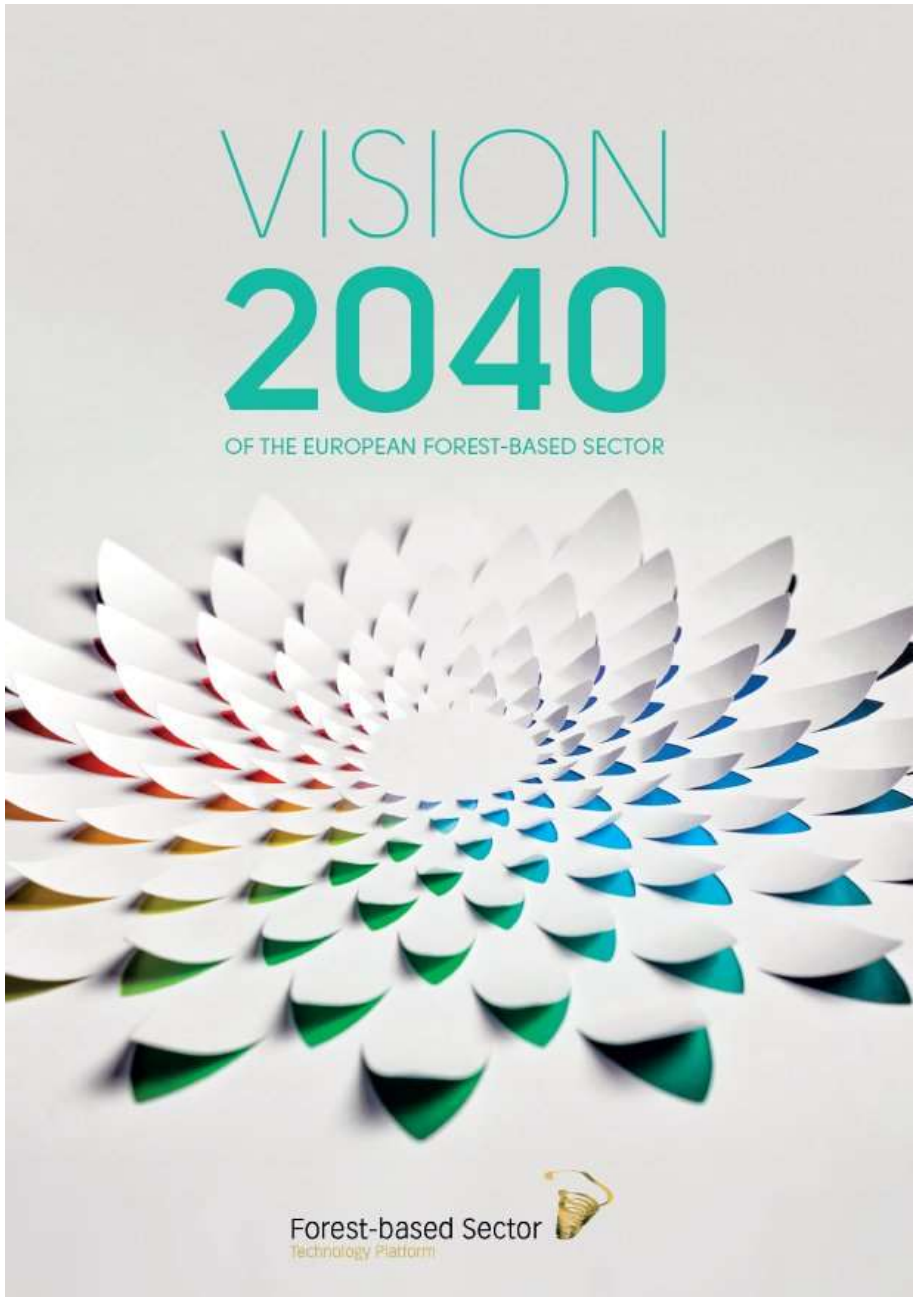
42 k€ ▲ 42 k
EU27

Employment growth between 2008 and 2021 in EU27



5. CONLUSION


ENSURING FOOD SECURITY
USING BETTER WHAT WE ALREADY USE
MOVING FROM A FOSSIL-BASED ECONOMY TO A BIOECONOMY
natural resources management
jobs & growth competitiveness inclusiveness
LONG TERM SUSTAINABLE DEVELOPMENT
climate change
global sustainability
responsible development with citizen sustainable consumption
UNLOCKING THE POTENTIAL OF SEAS & OCEANS
USING WELL WHAT WE DON'T USE YET


VISION
2040
OF THE EUROPEAN FOREST-BASED SECTOR
Forest-based Sector
Technology Platform

Conclusion - Forestry

- Digital technologies are transforming forestry
- The digitalization encompasses new technologies that are revolutionizing how forests are managed, monitored, and utilized.
- create knowledge-based bioeconomy development
- Forestry among the top 10 industries impacted by AI

(Photo Credit: Getty Images)

The world's first AI-controlled forest machine trained in Umeå (Wiberg et al, 2024)

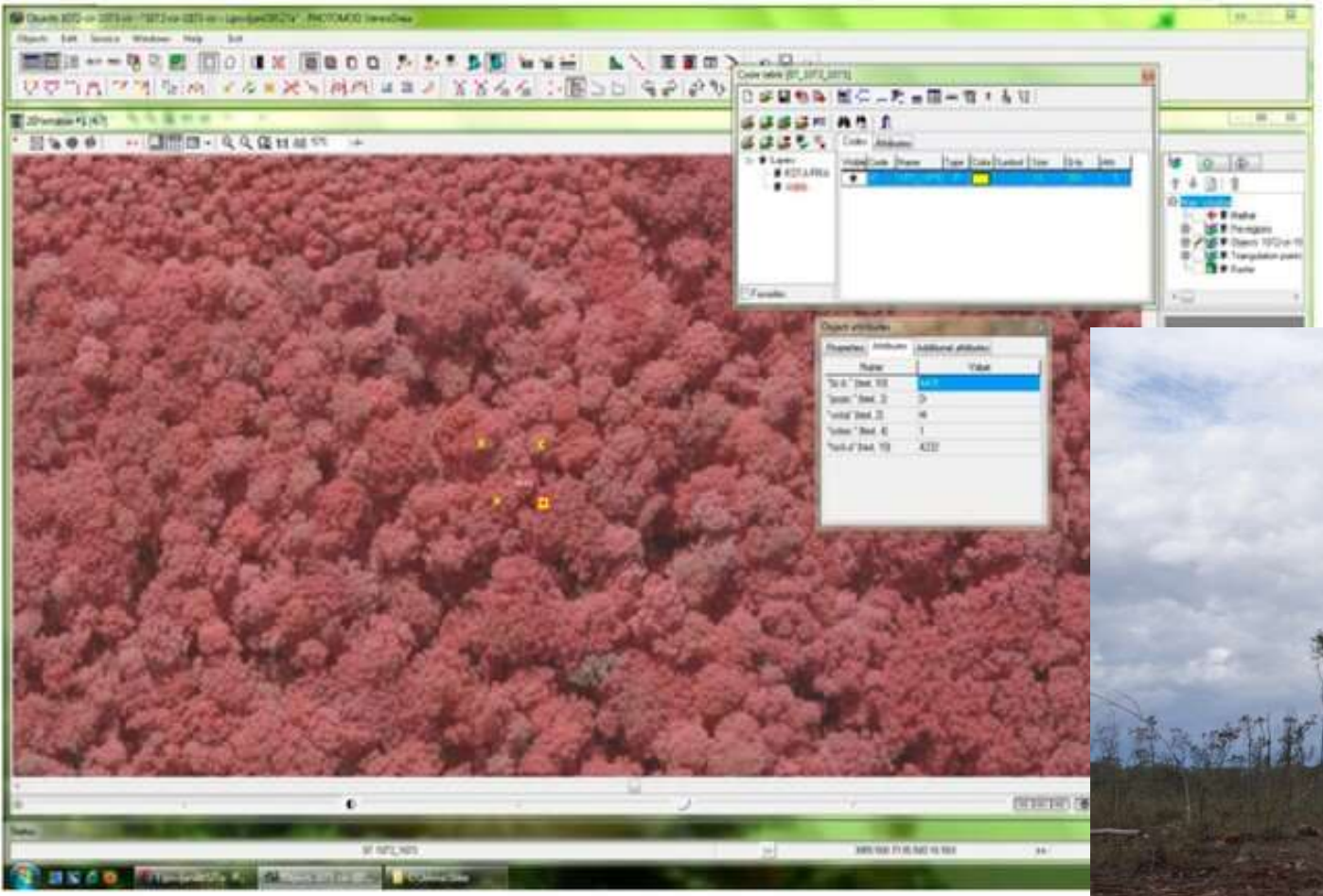


Foto: Pernar et al., remote sensing crown defoliation analyse

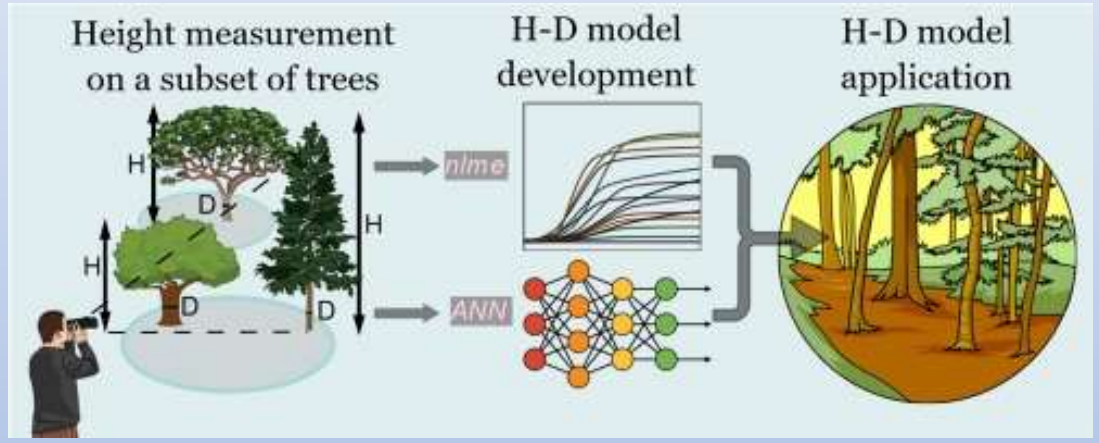
LiDAR (Light Detection and Ranging) and AI are aiding in forest health monitoring, forest restoration and conservation efforts after forest fires, storms etc.

Conclusion - Wood industry

- The integration of **Industry 4.0** technologies is gradually reshaping the wood sector by improving productivity, traceability, and sustainability.
- **IoT** and smart sensors play a central role in optimizing production, to enable real-time monitoring of processes

Innovations

- **AI** and machine learning **(ML)** enhance manufacturing precision and operational efficiency, especially in sawmilling and furniture production.
- Neural networks



Ref: Mitja Skudnik, Jernej Jevšenak, Forest Ecology and Management,2022.

- Enterprise resource planning (**ERP**) systems enhances digital coordination, improves data flow, and supports sustainability by enabling real-time process control and compliance monitoring.

Coordinated effort:

policymakers businesses,

R&D

Investing in technological innovations,

Developing new markets

Fostering public avareness about the NWPS

Multipl.

role of bioeconomy

Visibility and atractivity - new curriculas, networking, promotion


Forestry tradition since 1765 = 260 years
THANK YOU FOR YOUR ATTENTION !