UNIVERSITÀ DEGLI STUDI DI PADOVA

University of Padova
Circular Economy Summer School 2022

Forest biomass in the circular bioeconomy: potentials and limitations

Davide Pettenella
davide.pettenella@unipd.it

TESAF Dipartimento Territorio e Sistemi Agro-Forestali Università di Padova

1

Module organization

- Definitions of bioeconomy and circular economy
- The general policy objectives
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - 1st paradox, connected to the targets
  - 2nd paradox, connected to the instruments
- A final remark

These slides can be download from the web (search with «pettenella»)

2

Module organization

- **Definitions of bioeconomy and circular economy**
- The general policy objectives
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - 1st paradox, connected to the targets
  - 2nd paradox, connected to the instruments
- A final remark

3

Definitions

Bioeconomy (bio-based e., bio-resources e., nature-based e., bio-technology e.): '*the knowledge-based production and utilization of biological resources, innovative biological processes and principles to sustainably provide goods and services across all economic sectors*' (Global Bioeconomy Summit 2015)

Circular economy is "*one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles*" (the Ellen MacArthur Foundation)

4

Synergy: an EFI proposal

Circular Bioeconomy:
more than bioeconomy
or circular economy

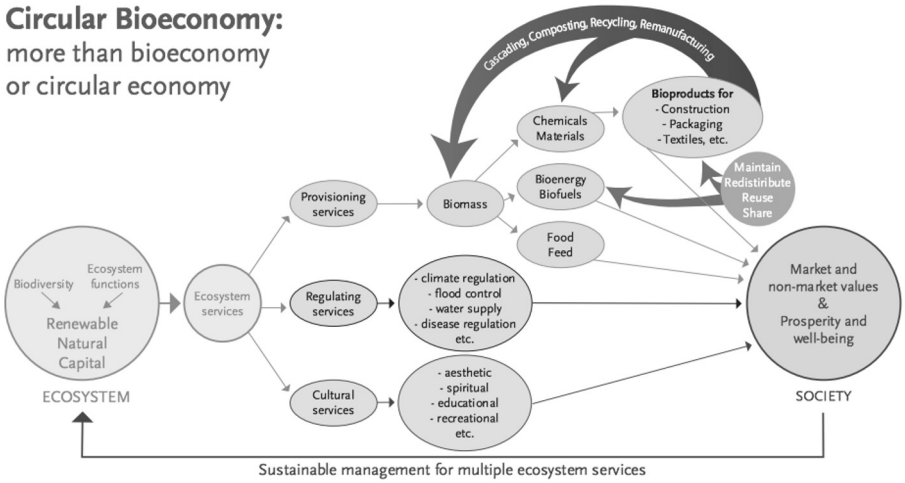


Figure 4. Illustration of circular bioeconomy flows. Source: EFI[7]

5

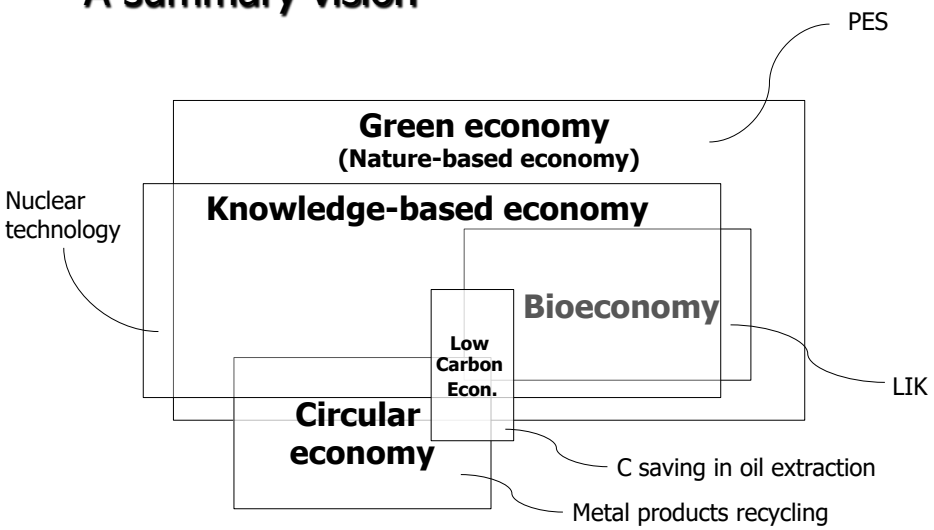
Other similar and connected terms …

- Green economy
- Circular economy
- Circular bio-economy
- Bio-resources economy
- Bio-technology economy
- Knowledge-based bioeconomy
- …

→ **Borders/meanings not always clearly defined!**

6

A summary vision



A risk: are we playing with the words?

7

Bioeconomy and circular economy: fuzzy concepts

No consensus was found in the literature as to whether they present:

- a **concept** (Cooper 2007, p. 27; Rose 2007, p. 6–7; Thorup Larsen 2007, p. 9; Schmid, Padel & Levidow 2012; Arancibia 2013, p. 79; McCormick & Kautto 2013, p. 2593**),**
- a **paradigm** (Kitchen & Marsden 2011, p. 753; Marsden 2012, p. 258),
- a **master narrative** (Levidow, Birch & Papaionnou 2012, p. 100)
- or a **discourse** (Cooper 2007, p. 37; Birch & Tyfield 2013).

(Staffas, Gustavsson, & McCormick, 2013) (Pülzl, Kleinschmit, & Arts, 2014) taken from material prepared by Carmen Rodrigez and Valentino Govigli

8

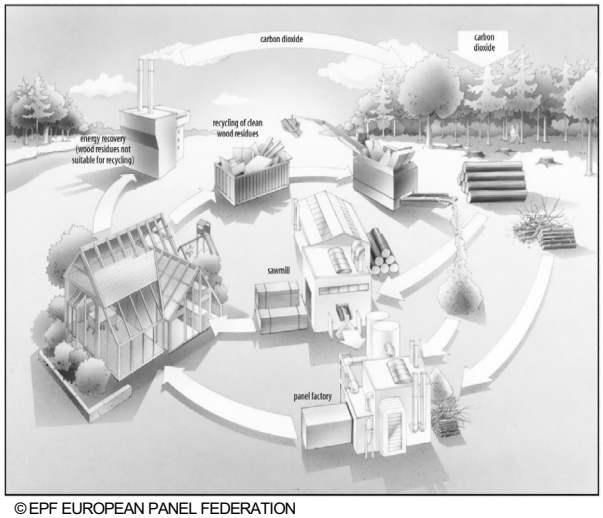
Contents related to the forestry sector

Bioeconomy:
FFF: food, feed & fibres
Fibres for energy (power and bio-fuel), bio-plastic, bio-textile (MMCF: man-made cellulosic fibres like viscose from dissolving pulp) and other bio-chemicals (for pharmaceutics use, cosmetic, leather processing, other industrial uses)
How much to produce? No concerns (in more recent time: biodiversity protection)

Circular economy (from a linear economy: that based on fossil resources)
No-waste economy. "Cascade approach"

9

Cascading approach
(EU Forest Strategy for 2030)



(…) *wood should be used* ***as much as possible for long-lived materials and products to substitute their carbon intensive and fossil-based counterparts****, for example in buildings and furniture, whilst acknowledging that not all wood is fit for such purpose.*

(…) ***Bioenergy will continue to have a notable role if biomass is produced sustainably and used efficiently, in line with the cascading principle*** *and taking into account the Union's carbon sink and biodiversity objectives as well as the overall availability of wood within sustainability boundaries*

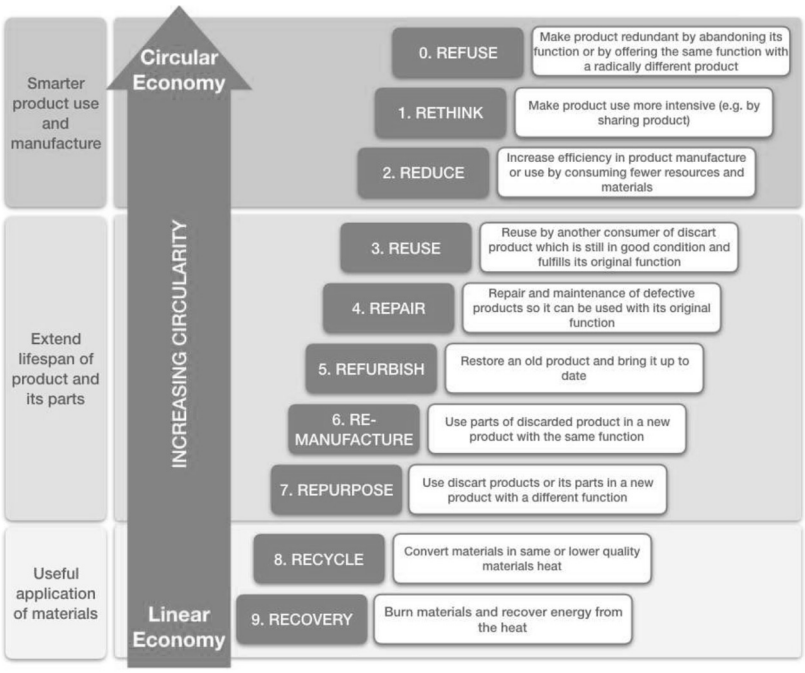
10

Contents related to the forestry sector

Bioeconomy:
FFF: food, feed & fibres
Fibres for energy (power and bio-fuel), bio-plastic, bio-textile (MMCF: man-made cellulosic fibres like viscose from dissolving pulp) and other bio-chemicals (for pharmaceutics use, cosmetic, leather processing, other industrial uses)
How much to produce? No concerns (in more recent time: biodiversity protection)

Circular economy (from a linear economy: that based on fossil resources)
No-waste economy. "Cascade approach"
Circular economy: a concept that can be applied also to non-renewable resources
RRR: recover, recycle, repair
No much concern about the other "Rs":

11



12

A global view: Bioeconomy Policies/Strategies around the World (www.gbs2015.com)

13

Five points about the bio-economy strategies and visions that demand critical attention (Staffas *et al.*, 2013)

- **Sustainability focus** → Sustainability is not heavily emphasized and it is over shadowed by economic growth
- **Scarcity of resources** → Only mentioned in a few of the documents
- **Measures of success** → Few measures are presented in the documents, but the importance of measures is highlighted
- **Consumption patterns** → Not addressed (except for the documents by Finland and Sweden)
- **Stakeholder interaction** → This is acknowledged in the documents as critical, but needs increased efforts.

20

Opposite views of circular bio-economy

A. Adaptive strategy ("Old wine in new bottles") → conventional wisdom of externality correction (i.e., "getting prices right" giving the true value to resources, reducing the consumption of natural capital; weak sustainability concept; low Carbon economy); focus on innovation and technological change

B. Alternative strategy: "**Strategies for synergies**" (M.Toman, 2012): which consider not only the protection of natural capital, "*but it stresses as well the importance of addressing equity and social inclusion challenges in moving toward a green economy*".

21

The social and political components of the circular bioeconomy (green economy)

"Policy action requires looking across a very wide range of policies, not just explicitly „green" (i.e. environmental) policies." (OECD 2011, page 18)

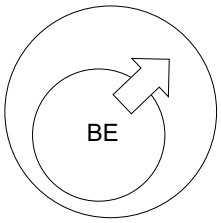
(Green economy) "will also involve achieving smooth and just adjustment in labor markets by ensuring that workers have the means to find opportunity in change. ***More generally, the success of a green growth strategy will rest on addressing political obstacles and distributional concerns about the costs of change***." (OECD 2011, page 20)

"The key aim for a transition to a green economy is to eliminate the trade-offs between economic growth and investment and gains in environmental quality and social inclusiveness… the environmental and social goals of a green economy can also generate increases in income, growth, and enhanced well-being" (UNEP 2011, page 16)

22

A difference that is not outspoken nor defined (Staffas *et al*., 2013)

Economy with a process of internal change



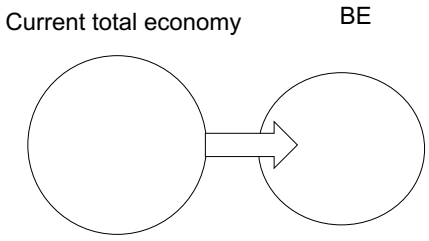
- **Bioeconomy (BE)** → a sub-part of the nation's total economy (often in relation to white biotech and life science)

23

This could be, **more than a dream**, a **nightmare for the forest resources** in Europe: already the EU 2030 objectives for the use of forest biomass are perceived by some scientists excessive,

what could happen in case with develop the bio-plastic, bio-textile, bio-pharmaceutics use of forests?

- **Bio-economy (BE) under a growth pattern of material consumption**→ an economy where renewable resources instead of fossil ones and mineral constitute feedstocks for both energy, food, feed and materials



24

Module organization

- Definitions of bioeconomy and circular economy
- **The general policy objectives**
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - 1st paradox, connected to the targets
  - 2nd paradox, connected to the instruments
- A final remark

25

- The EU consumed approximately one billion tonne of biogenic (45%) and fossil (54%) carbon for the functioning of its economy in 2018.
- The carbon is used to provide food (25%), energy (56%) and materials (19%) and only a very small fraction of the carbon used today is from recycled origin (1%).

26

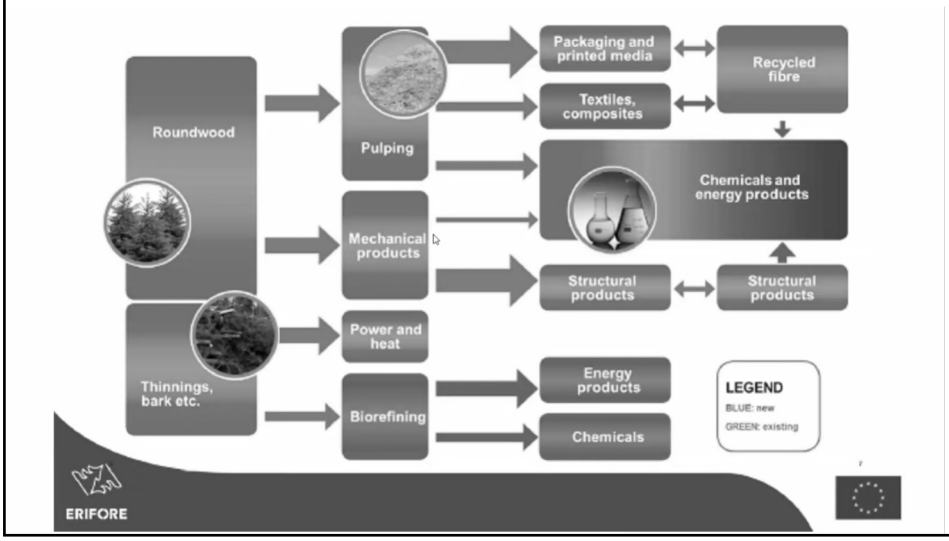
The most ambitious, simple and well-defined, intersectoral target: the decarbonization of the EU economy

- -55% GHG emission below 1990 levels by 2030 (7 years and 10 months ahead)
- Net zero GHG emissions in 2050

Decarbonization: substitution of
- fossil fuels with renewable energy
- raw materials based on petrol, using biomass
- energy intense materials (e.g., cement, steel) with biomass

27

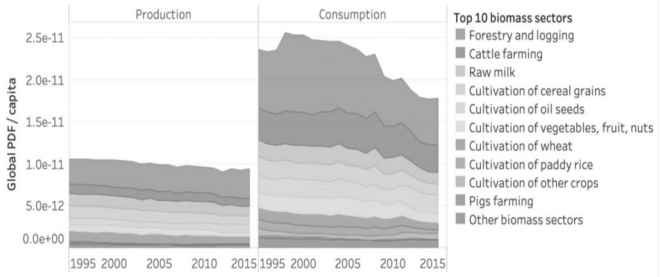
Circular bioeconomy value chains development



28

Bioeconomy made in?

Domestic and total land-use related biodiversity loss implied by the EU biomass production, consumption, and imports (excluding land use by households)



Source: own elaboration supported by L. Cabernard based on methods from Cabernard, Pfister & Hellweg (2019); data from Exiobase v3.4 (https://www.exiobase.eu); PDF = potentially disappeared fraction of species; note that In Exiobase, land use data show a decreasing trend (particularly after 2011), while other studies show an increasing trend (Di Fulvio et al. 2019)

More than 1/3 of biomass inputs for the EU bioeconomy are **sourced and imported from extra-UE areas**

… but the internal expansion potentials are in theory quite large

29

The EU depends heavily on agricultural imports; only China imports more. Last year* (2019), *the region bought in one-fifth of the crops and three-fifths of meat and dairy products consumed within its borders (118 Mt and 45 Mt, respectively).

nature

Explore content ~ About the journal ~ Publish with us ~ Subscribe

nature > comment > article

COMMENT | 26 October 2020 | Correction 12 November 2020 | Correction 21 December 2020 | Correction 03 March 2021

Europe's Green Deal offshores environmental damage to other nations

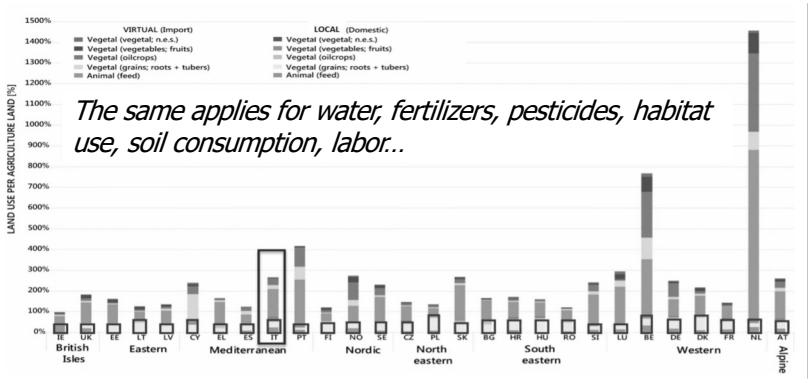
Importing millions of tonnes of crops and meat each year undercuts farming standards in the European Union and destroys tropical forests.

Richard Fuchs ✉, Calum Brown & Mark Rounsevell

30

Demand for land for biomass production on the rise (dependency)

Imported (green) and domestic (blue and red boxes) land use for EU countries



The same applies for water, fertilizers, pesticides, habitat use, soil consumption, labor…

Source: Cadillo-Benalcazar *et al*., 2020

31

Embodied deforestation (agriculture and forest commodities)

Table S7. The 10 largest importers of embodied forest loss.

Country	Forest transition stage	Imports of embodied forest loss (Mha yr^{-1})	Percentage of total imports
China, mainland	4. Post	0.20	14%
India	4. Post	0.10	7%
Russian Federation	4. Post	0.09	6%
The U.S.	4. Post	0.07	5%
Japan	4. Post	0.06	4%
Germany	4. Post	0.05	3%
Italy	4. Post	0.04	3%
United Kingdom	4. Post	0.04	3%
Egypt	Unclassified	0.03	2%
Brazil	3. Late	0.03	2%
All other	Not applicable	0.69	50%

⇦ 40,000 ha/yr

Source: Pendrill *et al.*, 2019

32

How to deal with a very relevant increase of demand for biomass in the future?

A. Non-forest related answers

- 30% of the territory under protection; 10% under strict protection
- Reducing our Carbon and biodiversity footprint from import

33

Limited impacts of the Grean Deal on EU internal supply of food

Policy commitments of the 'Farm to fork' and CAP policies by 2030:

- to **reduce fertilizer use** in Europe by **20%** and
- **pesticides** by **50%**
- **one-quarter of land to be farmed organically**
- to plant **3 billion trees**
- to **restore 25,000 kilometres** of **rivers**
- **Changing the CAP** that is based on subsidies on area, not production

→ Better quality but not higher quantity of food commodities → more land needed for food production → no much room for increasing non-food internal production

34

Other non-forest solutions

- Blue biomass?
- Vertical farming?
- Sustainable intensification? Gene-editing techniques?
- …

Probably limited, technologically feasible solutions, but with economic and social feasibility problems in the short-run

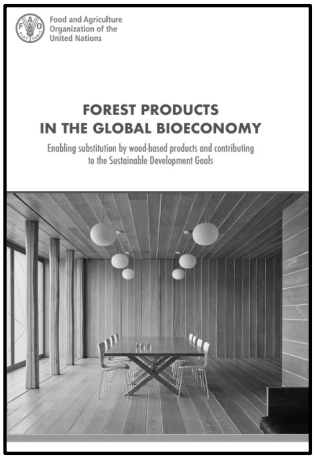
35

36

How to deal with a very significant increase of demand for forest biomass supply in the future?

B. Forest-related answers

- Wood for energy: let's assume the full adoption of a cascade approach and a remarkable increase in efficiency in residential uses
- Forests biomass to replace commodities from fossil resources or in general from energy-intensive materials



37

5 strategic sectors
(for fossil product substitution)

- Engineered wood products

  Cross-Laminated Timber (CLT or X-LAM): +37% annual growth (2014-20)

  Laminated Veneer Lumber (LVL): +6% annual growth

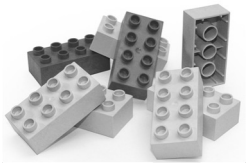



- Foams and wood insulation

38

5 strategic sectors
(for fossil product substitution)

- Bio-plastics
- Wood-based composites (e.g., : PWC- *Plastic-Wood Composite)*
- Bio-textile products



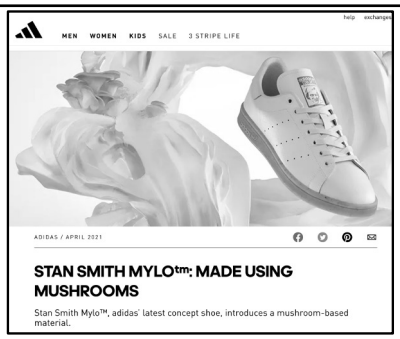



39

… non forgetting the other industrial forest products

- cork
- resin
- tannin
- rubber
- nuts
- aromatic, medicinal, food (wild and semi-wild) plants
- mushrooms
- …

41



https://www.adidas.com/us/blog/

https://www.dotzero.com/

42

The role of the forestry sector in the EU circular bioeconomy

- Forestry, manufacture of paper and wood products (included the furniture industry) employed 2.6 million persons in the EU, **19.5% of the total employment in the EU bioeconomy** (13.5 million persons) (Ronzon and M'barek, 2018).
- Wood biomass is the **first renewable energy resource** in Europe
- **80% of the biodiversity** is connected to the presence of forest ecosystems
- High **mitigation potential** of forest and HWP (Harvested Wood Products)

→ Forest = the "green infrastructure" of Europe

43

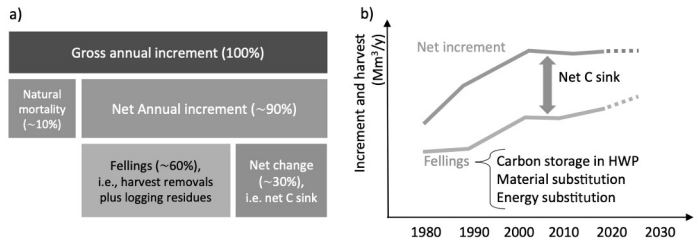


Figure 3. a) Main components determining the net carbon sink (blue box) in forest biomass; the numbers are approximations for the EU (2004-2013), based on Camia et al. (2021). b) Conceptual illustration of the historical trend in the net increment and fellings (based on Nabuurs et al., 2013) of forest biomass and their short-term projected evolution (based on FRLs, Korosuo et al., 2021).

2018

Source: Grassi et al, 2021

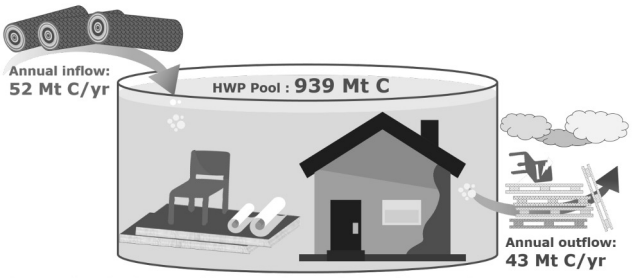


Figure 4. The carbon dynamics of the HWP pool in 2018 for the EU[3] (EEA, 2020).

44

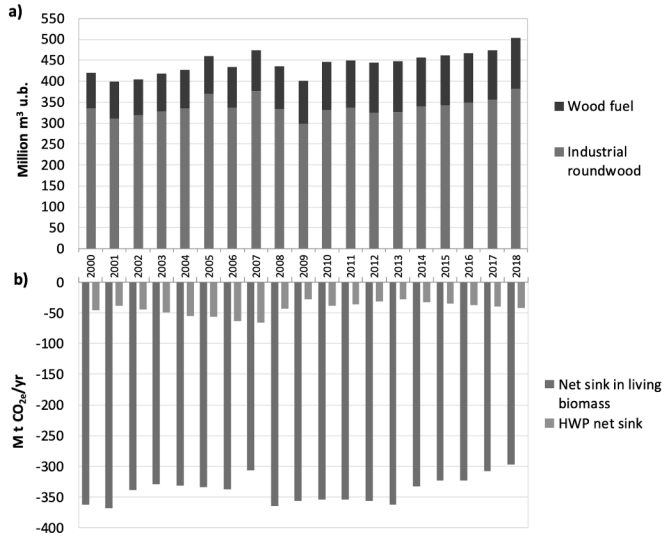


Figure 5. Evolution of a) roundwood removals by wood product (industrial roundwood and wood fuel, FAOSTAT, 2021); b) net carbon sink in living biomass in 'forest remaining forest' not accounting CO_2 emissions from fires [14] and net sink in HWPs from the EU GHG inventory (EEA, 2020) in the EU from 2000 to 2018.

Source: Grassi et al., 2021.

46

A personal view: in trying to promote a circular bioeconomy there are two paradoxes

- Policy science = a social science
- Lessons contents = based on personal experience, limited perspectives, interests (the teachers are also actors) → biased view

One of the representation of the forest reality

Your informed critical opinion and personal re-interpretation are THE objectives of my teaching, not the learning of MY ideas and opinions (even if I will strongly try to support them!)

47

Module organization

- Definitions of bioeconomy and circular economy
- The general policy objectives
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - **1st paradox, connected to the targets**
  - 2nd paradox, connected to the instruments
- A final remark

48

1st paradox, connected to the targets of policy action

The increasing political role of the **non-market components** of forestry economy: from an economy based on wood and other commodities to an economy based on environmental and social services

Social and environmental approach

Vs.

Technological approach

The key-idea of **circular bioeconomy** where forestry, together with agriculture and fishery, should produce **more goods** becoming the engine of a new growth

49

Currently the dominant vision in the EU is the second one, but with an increasing opposition

Examples:

"EU definition of bioeconomy comprises those parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms **– to produce food, materials and energy"** (Europe's Bioeconomy Strategy, European Commission, 2012).

It "includes **agriculture, forestry, fisheries, food** and **pulp and paper production**, as well as parts of chemical, biotechnological and energy industries" (European Commission 2012b: 5).

50

An example: contrasting positions/coalitions emerged while discussing the EU Forest Strategy for 2030

Bioeconomy and climate-change mitigation *vs* Biodiversity and adapatation to climate-change

Brussels, 23 June 2021

JOINT STATEMENT

Draft new EU Forest Strategy: time to really consider the opinion of EU forest and forest-based sector

51

A strong emphasis on biorefinery within the bioeconomy framework

- A **key factor** in the transition to a bio-based economy will be the **development of biorefinery systems** (Scarlat *et al.*, 2015)
- Biotechnology and the biorefinery concept are **essential components** of the bioeconomy (McCormick and Kautto, 2013)
- The bioeconomy is integrating traditional agricultural, forest and marine biomass feedstock production systems with a **range of biorefinery options and applications** (SCAR, 2014)
- Biorefineries are increasingly **at the core** of the bioeconomy vision at the EU level and worldwide (World Bioeconomy Summit, 2015)

52

The technological (dominant) approach (modified from Toman, 2012; Pettenella, 2015; Secco *et al.*, 2015)

	Technological approach
Focus on	• Technological innovations • Large scale investments • Value chain perspective • Sectoral development • Vertical integration
Input/output diversification	1 or more inputs Diversification in outputs
Market power	Increasing role of business owning/controlling the (new) technologies
Model regions	Northern EU (UK, Scandinavian countries)

53

Technological approach: example 2, Finland

- Largest investment in the history of Finnish forest industry
- **100%** of wood raw material used
- **1.3 million tonnes** of pulp/year + bioproducts (e.g. textile fibres, biocomposites, lignin products, fertilisers…) and bioenergy
- **+4.000 jobs** created (including value chain and consumption) → **61.000** jobs expected in 30 years

Äänekoski bioproduct mill

1.2 EUR BILLION	1,3 MILLION TONNES	240 %	6.5 MILLION M³
INVESTMENT	CAPACITY	ELECTRICITY SELF-SUFFICIENCY	USE OF WOOD

55

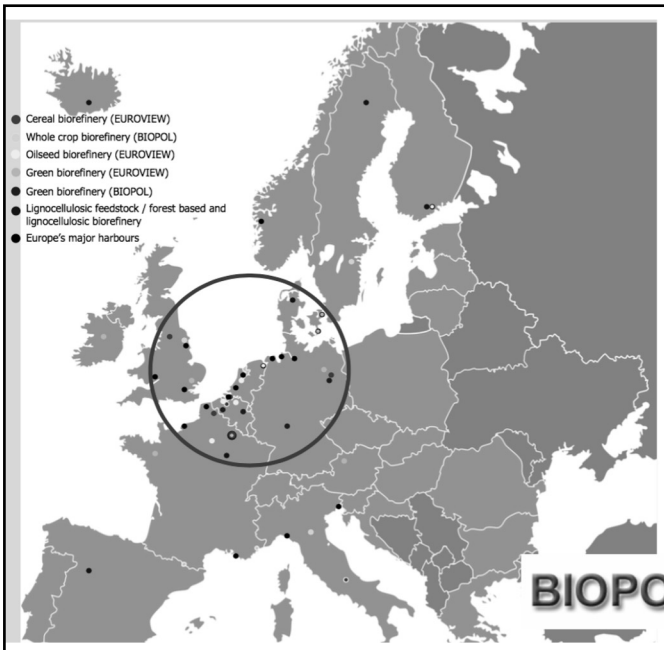
2 large biorefinery models

(Europabio, 2011, European Commission, 2012, Ceapraz *et al*, 2016)

A. **Port-biorefinery → strongly connected to global flows of raw materials**, key-logistic location (inside/nearby harbors, along channels…), high specialization, threshold effects, and economies of scale

B. **Territorial biorefinery → strongly connected to local/surrounding territory** and (in general terms) dependent on a more diverse and more thorough valuation of various biomasses

58



75% of the biorefinery sites and 70% of the largest sea harbors are located within a circle consisting of France, Germany, Denmark, Belgium, the Netherlands, and the UK

Source: Reith and Steinmetz (2009); Fava (2015)

59

And… what about the rest of EU?

Does this approach really support rural development and general economic growth?

Is it the most appropriate approach for the Southern Europe context?

60

Average values of the ecosystem services

Average economic **value for biodiversity and recreation services** provided by European forests (benefit transfer approach; TEEB, 2009)

	Mediterranean EU Latitude 45-65	Northern and Central-Northern EU Latitude 65-71	Scandinavian EU Latitude 35-45
Range US$ (2000)	356-615	123-182	123-255
Average $ (2000)	485.5	152.5	189.0
€ (2000)	379,3	119,1	147.7
€ (2008)	467.1	146.7	181.9

Source: TEEB Report; CLIBIO project cit. in ten Brink *et al*. (2009); figures ha/year

62

The social approach

(modified from Toman, 2012; Pettenella, 2015; Secco *et al.*, 2015)

	Technological approach	Social approach
Focus on	• Technological innovations • Large scale investments • Value chain perspective • Sectoral development • Vertical integration	• Social innovations • Small scale • Networks • Cross-sectoral development • Horizontal integration (= forests and agriculture as the green infrastructures for rural development)
Input/output diversification	1 or more inputs Diversification in outputs	Diversification in the use of inputs High added value products & services
Market power	Increasing role of business owning/controlling the (new) technologies	Role of networks, groups, associations, public-private partnerships…
Model regions	Northern EU (UK, Scandinavian countries)	Southern EU (Mediterranean region)

63

The social and environmental components of the bioeconomy

(Circular and bioeconomy) "*will also involve achieving smooth and just adjustment in labor markets by ensuring that workers have the means to find opportunity in change.* ***More generally, the success of a green growth strategy will rest on addressing political obstacles and distributional concerns about the costs of change***." (OECD 2011, page 20)

"***The key aim for a transition to a green economy*** *is to eliminate the trade-offs between economic growth and investment and* ***gains in environmental quality and social inclusiveness****… the environmental and social goals of a green economy can also generate increases in income, growth, and enhanced well-being*" (UNEP 2011, page 16)

64

Social Innovation in Mediterranean forests

Example 1: Produtos silvestres do Alentejo (Portugal)

- 7 municipalities
- 16 associations and cooperatives
- 5 research institutes
- 2 national business associations
- 59 individual private promoters

International cooperation/exchange of best practices

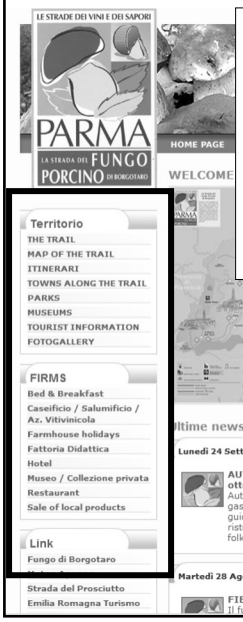
…but local knowledge, specialties and typical products, niche markets

Source: www.alentejosilvestre.com

65

Social Innovation in Mediterranean forests

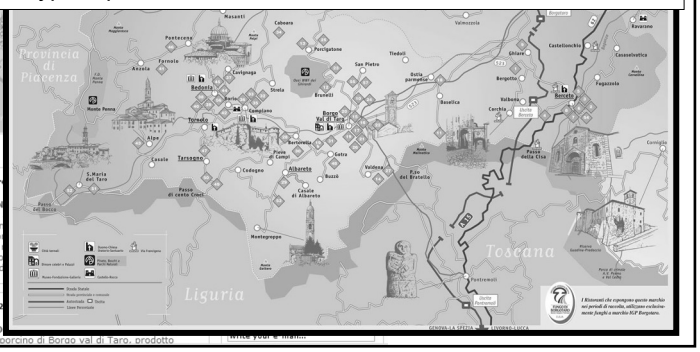
Example 2: Borgotaro network (territorial marketing)



Enterprises: 62

15 Agro-tourisms/ Farm businesses
12 Hotels/Guest quarters
8 B&B/Inns/Hostels
9 Cheese, sausage and wine growing and producing factories
2 Didactic farms
3 Museums/Private collections
30 Restaurants/Porterhouses
26 Typical products sellers

Imago product:
Boletus mushroom



66

The real innovative and crucial aspects of the **circular bioeconomy** for the forestry sector are related to **equity, social inclusiveness, tenure security, employment**, i.e. to social and political issues, more than to problems connected to natural science or technology

Unfortunately, it seems that the prevailing vision for many sectoral stakeholders (also among the representatives of the family forests!) of the **circular bioeconomy in the forest sector = innovative industrial pulp-chemical plants producing pulp, bioplastic, biofuels**, …

67

Module organization

- Definitions of bioeconomy and circular economy
- The general policy objectives
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - 1st paradox, connected to the targets
  - **2nd paradox, connected to the instruments**
- A final remark

68

2nd paradox, connected to forest policy instruments

- The need to protect natural resources much exposed to degradation through an active and intense **regulative policy action** (command and control instruments: regulations, taxes, thresholds and standards, legal requirements, …. at national and international level)
- The need to enhance the use of **voluntary, market-based mechanisms**, also to actively involve civil society in the management of natural resources

69

A paradox connected to the **instruments** of policy action

Sticks *Carrots* *Sermons*

70

Instruments of public policy

- **Passive: Command and control (regulative instruments) ("stick"):**
  - Taxes and fees (Eco-taxation: "who pollutes, pays")
  - Licenses, permits, thresholds, standards, …
- **Active: stimulus to economic incentives (based on voluntary participation) ("carrot"):**
  - Tax deduction, tax exemption
  - Incentives and compensation
  - **Market-based instruments:**
    - Payments for Environmental Services (PES) and PES like schemes
    - Socially responsible procurement policies
    - Tradable permits, deposit-refund systems, offset schemes
    - Standard setting, certification & labeling,
    - Technical support, provision of services (e.g. seedling, irrigation water, infrastructures, … provided at no price or at below costs prices), direct management of some economic activities (e.g.: hospital, school, forests, …)
- **Information ("sermon")**
  - Technical assistance, Training & education, R&D

71

Instruments for the policy-making process and related costs implementation

	Tools	Direct costs for the public sector	Transaction costs for the public sector	Approach	Participation by the privates	
Passive: Command and control	Thresholds, limitations, constraints	Relatively low	Relatively low	Top down	Compulsory	sticks
Active: creation of new sources of income	Tax deductions, tax exemption	Relatively high			Voluntary or imposed by the State	sticks
	Fixed compensation				Voluntary	carrots
Soft tools	Marked-based instruments: - PES schemes	Zero costs	Relatively high	Bottom up	Voluntary	carrots
	- PES-like schemes	Very low	Low	Mixed	Compulsory for some parties	carrots
	- PPP	Relatively high	Low	Top down	Voluntary	carrots
	- Land acquisition by public authorities or large companies (lease, concessions, …)		Low		Normally voluntary	carrots
	- Tradable permits (cap & trade schemes)	Relatively low	Low	Mixed	Compulsory for some parties	carrots
	- Certification and labelling (premium price)	Zero costs	Zero costs	Bottom up	Voluntary	carrots
	- Sponsoring, donations (philanthropy)					carrots
	- Information, provision of services, goods free of charge or a low prices	Relatively high	Low	Mixed		sermons

72

A paradox connected to the **instruments** of policy action

• we stress the need to enhance the use of **voluntary, market-based mechanisms and social innovations**, linked to the idea to actively involve civil society in the management of forest resources …

•… but we tend to increase the use of **regulative policy tools such as:** Natura 2000, DD of the EU-TR and now Zero Deforestation and Forest Degradation, EU standard for SFM, EU standards for bioenergy (REDI, II and III), 30% of protected areas and 10% of fully protected, enhanced conditionality and eco-schemes (3% of set-aside farmland for biodiversity) … and of the **direct control of forest resources** (State forest enterprises): the old set of instruments

73

In this way public administrations **tend to concentrate on bureaucratic control**, while the new options to develop the forestry sector would require a **proactive public administration** open to partnership, negotiation, innovative attitude in sharing responsibilities, advisory services, providing good and clear signals …

74

Module organization

- Definitions of bioeconomy and circular economy
- The general policy objectives
- Two paradoxes in implementation of circular bioeconomy policies in the forestry sector
  - 1st paradox, connected to the targets
  - 2nd paradox, connected to the instruments
- **A final remark**

75

A basic concern about the coherence of the circular bioeconomy policy

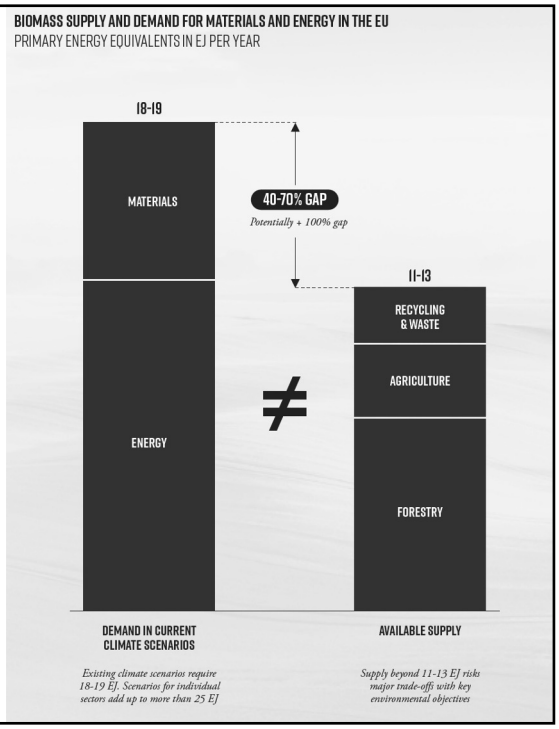
The issue of **future biomass availability** to feed the circular bioeconomy (and reach the decarbonization targets) is not much considered:

which trade-off with the increased protection of European forests? With the quality and quantity of forests outside the EU (embodied deforestation and forest degradation)?

76

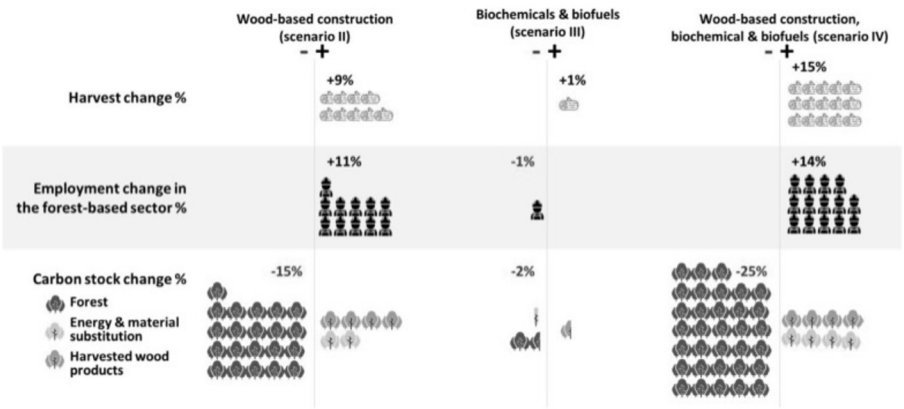
A growing gap between biomass consumption and production in the UE

Source: Material Economics (2022). EU Biomass Use in a Net-Zero Economy.A course correction for EU biomass



82

How scenarios compare with respect to the business-as-usual scenario



Source: Jonsson et al., 2021 https://doi.org/10.1016/j.techfore.2020.120478

83

«…not only is there no empirical evidence supporting the existence of a decoupling of economic growth from environmental pressures on anywhere near the scale needed to deal with environmental breakdown, but also, and perhaps more importantly, such decoupling appears unlikely to happen in the future»

Source: Parrique et al., 2019

Is the the idea of a circular bioeconomy based on full substitution of fossil resources with (woody) biomass a **concrete and feasible policy** or a **rhetoric commitment**?

84

Documents

- Grassi, G., et al. (2021). Brief on the role of the forest-based bioeconomy in mitigating climate change through carbon storage and material substitution, Sanchez Lopez, J., Jasinevičius, G. and Avraamides, M. editor(s), European Commission, 2021
- **Council Resolution of 15.12.1998 on a forestry strategy for the European Union (1999/C 56/01)**
- **Communication on the implementation of the EU Forestry Strategy, COM(2005) 84 final**
- **EU Forest Action Plan, COM(2006) 302 final**
- **White Paper Adapting to climate change: Towards a European Framework for Action, COM(2009)147 final**
- Hetemäki L. et al., 2017. Leading the way to a European circular bioeconomy strategy. EFI From Science to Policy (5) http://www.efi.int/files/attachments/publications/efi_fstp_5_2017.pdf
- **Material Economics (2022). EU Biomass Use in a Net-Zero Economy. A course correction for EU biomass**
- **Forest strategy-related information http://ec.europa.eu/agriculture/fore/index_en.htm**

85