European Commission

JRC report on forest bioenergy

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Presentation based on the **JRC Bioenergy report** (Camia A., Giuntoli J., Jonsson R., Robert N., Cazzaniga N.E., Jasinevičius G., Avitabile V., Grassi G., Barredo J.I., Mubareka S.)

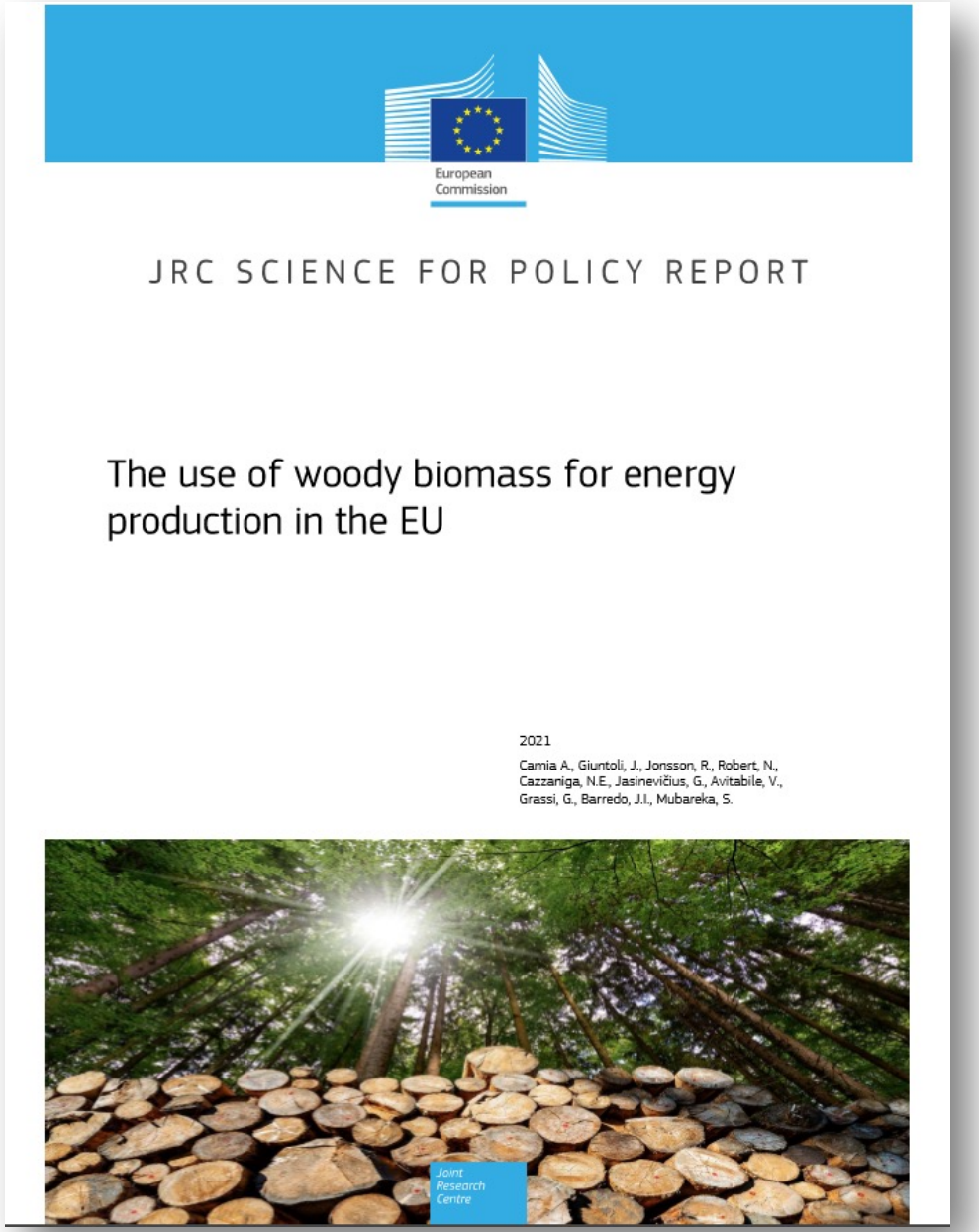
Woody Biomass – Climate Workshop April 15, 2021

Joint Research Centre

Outline

- Introduction and overview (Sarah Mubareka)
- Framing the problem (Jacopo Giuntoli)
- Pathways analysed (Jacopo Giuntoli)
- Carbon accounting (Giacomo Grassi)

Introduction and overview



Aim of the JRC report

To inform the EU climate and energy policies that govern the use of forest biomass for energy:

- Renewable Energy Directive (REDII),
- Emissions Trading Scheme (ETS),
- Land use, land-use change and forestry (LULUCF).

..within the context of the Green Deal (i.e. <u>considering also ecosystem health</u>)

> 50% of the renewable energy in the EU comes from wood

https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122719/jrc-forest-bioenergy-study-2021-final_online.pdf

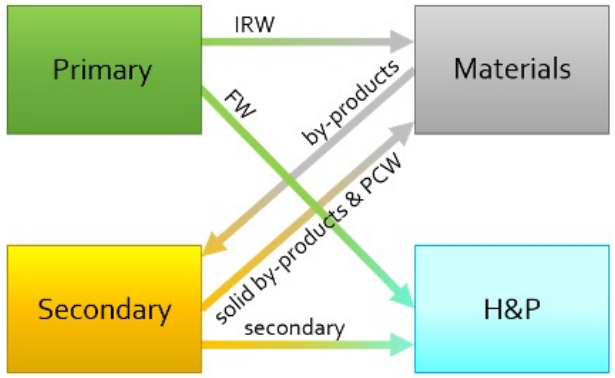
Wood Resource Balance and wood flows in the EU

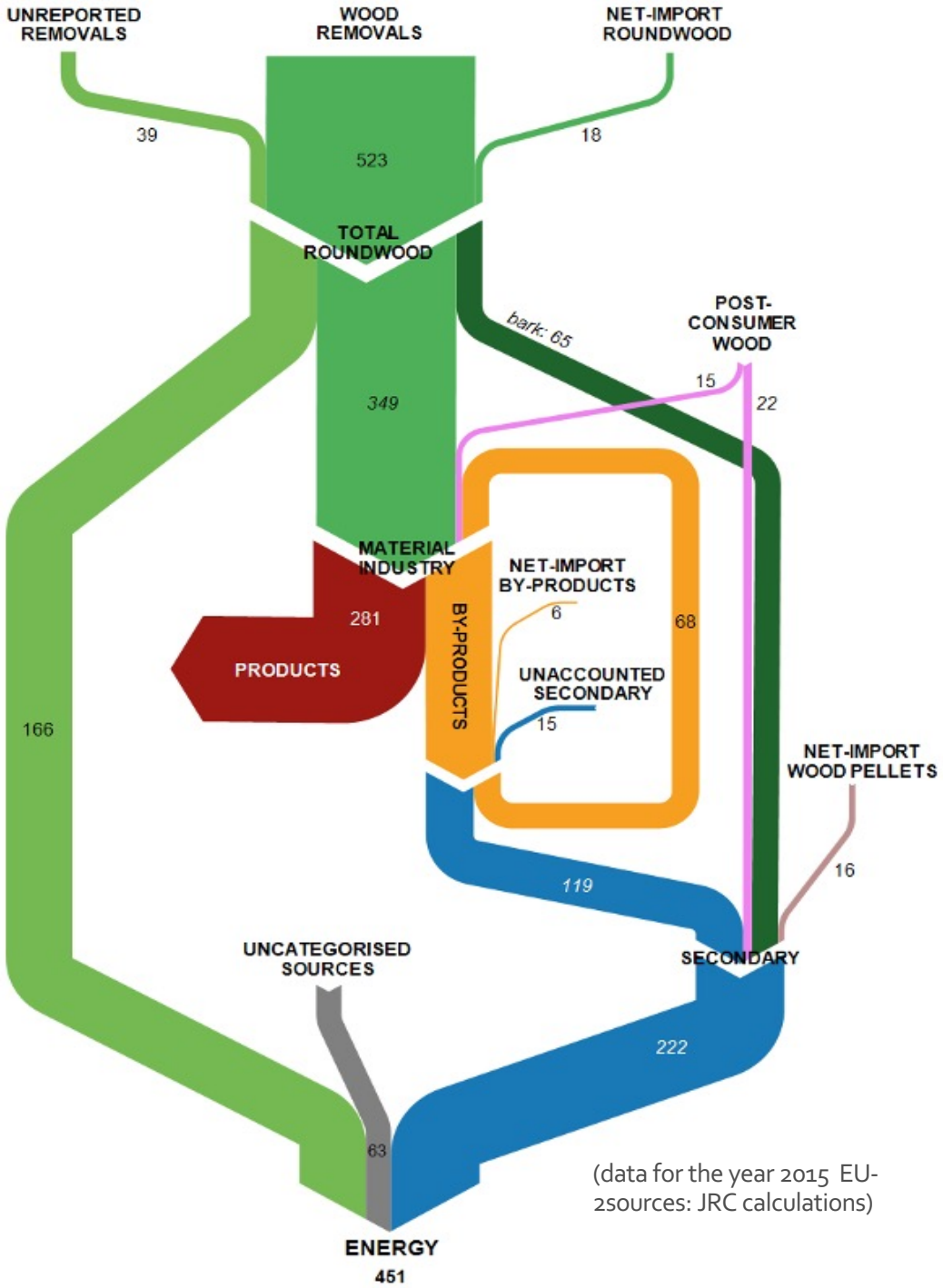
EU-28

Wood Resource Balance 2015 (all units in SWE)

	SOURCES	1000m³	%	%	1000m³	USES	
PRIMARY	Industrial roundwood (conifer): Removals	271,449	29.5%	18.9%	174,100	Sawmill industry (conifer)	MATERIALS
PRIMARY	Industrial roundwood (non-conifer): Removals	79,224	8.6%	2.1%	18,885	Sawmill industry (non-conifer)	MATERIALS
PRIMARY	Industrial roundwood (conifer): Net-trade *	9,410	1.0%	0.3%	2,873	Veneer sheets industry	MATERIALS
PRIMARY	Industrial roundwood (non-conifer): Net-trade *	6,815	0.7%	1.1%	10,001	Plywood industry	MATERIALS
PRIMARY	Fuel wood (conifer): Removals	34,780	3.8%	5.2%	47,734	Particle board industry	MATERIALS
PRIMARY	Fuel wood (non-conifer): Removals	73,811	8.0%	3.3%	30,281	Fiberboard industry	MATERIALS
PRIMARY	Fuel wood: Net-trade *	-535	-0.1%	2.2%	20,324	Mechanical pulp industry	MATERIALS
PRIMARY	Bark	65,731	7.1%	12.5%	114,861	Chemical pulp industry	MATERIALS
SECONDARY	Sawmill residues	87,508	9.5%	0.3%	2,880	Semi-chemical pulp industry	MATERIALS
SECONDARY	Other industrial residues	11,128	1.2%	1.1%	9,848	Dissolving pulp industry	MATERIALS
SECONDARY	Wood chips and particles: Net-trade *	2,982	0.3%	4.1%	37,958	Wood pellets industry	MATERIALS
SECONDARY	Other wood residues: Net-trade *	3,218	0.3%	18.0%	165,930	Direct Wood	H&P
SECONDARY	Wood pellets	37,958	4.1%	24.1%	222,287	Indirect Wood	H&P
SECONDARY	Wood pellets: Net-trade *	15,698	1.7%	6.8%	62,864	Unknown Wood	H&P
SECONDARY	Black liquor	67,153	7.3%				
	Post-consumer wood	36,714	4.0%				
	Unaccounted sources	117,782	12.8%				
	Total sources	**920,826**			**920,826**	**Total uses**	

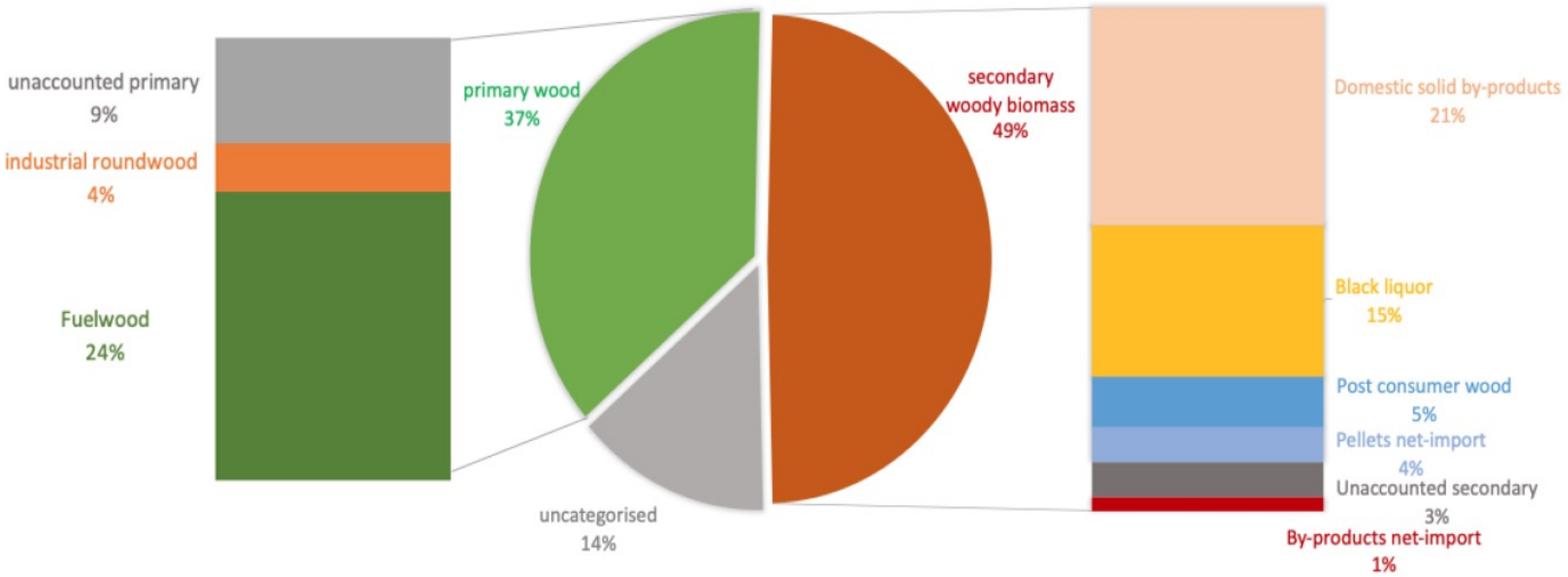
- Wood flows highly complex
- Reported **uses** are up to 20% larger than the reported **sources**



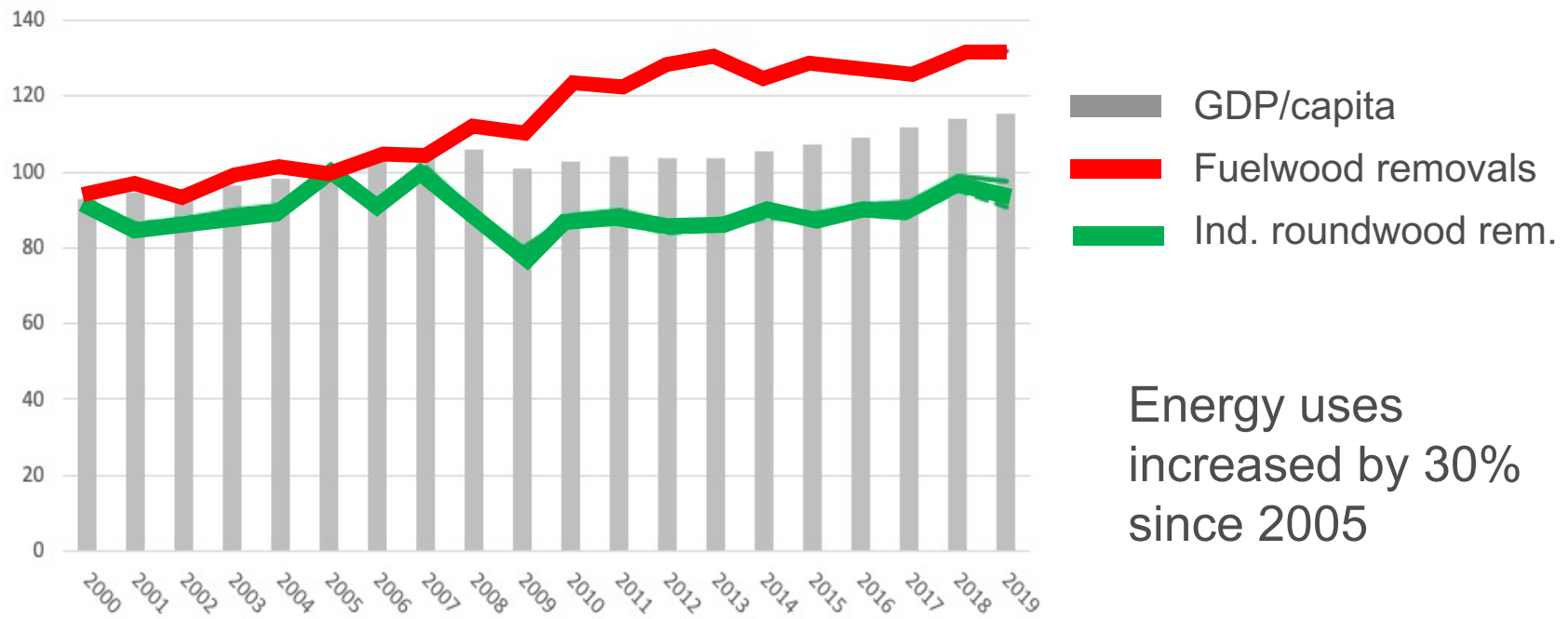


(data for the year 2015 EU-2sources: JRC calculations)

Wood used for bioenergy (EU, 2015)



EU wood use and GDP per capita (2005 = 100)



Energy uses increased by 30% since 2005

(Camia et al. 2021)

Forest bioenergy governance in EU – issues with current problem framing

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Main issues in forest bioenergy governance

1. INDETERMINACY

- The debate for almost a decade now has focused on answering this question: “Does forest bioenergy mitigate climate change?”
- This question has no answer. It is not ‘uncertain’, it is “indeterminate”. It is dependent on modelling approaches and the assumptions about hypothetical futures.
- Authors might come to equally valid, but opposite answers depending on assumptions chosen.
- This issue is the ‘epistemic trap’ in which we fell.

Main issues in forest bioenergy governance

2. ETHICS

- The assumptions chosen will align (consciously or unconsciously) with the worldviews and ethical values of the authors;
- Supporters of bioenergy usually have more ‘anthropocentric’ view of human-nature relationship, while opposers of bioenergy are usually aligned with more ‘conservation’ values → different ‘concerns’ and definitions of ‘sustainable bioenergy’
- This heavy ethical component has been ignored → instead trying to ‘rely on science’ to find THE answer.
- Polarization & controversy

Some elements for a de-toxified framing

- The question is not whether to achieve GHG targets, but rather HOW.
- There are intrinsic ethical aspects in this discussion that should be made explicit.
- There are no right or wrong answers and we should stop looking for them.
- ‘Science’ won’t solve the debate, but can help with the problem boundaries: e.g. by acting as science arbiter (‘What are the likely impacts of specific policy options?’), or by answering a different set of questions (**Under which conditions** forest bioenergy can mitigate climate change?), or by presenting other ‘uncomfortable knowledge’ that might have been overlooked in current problem framing.

Pathways analysed

Problem framing for the report

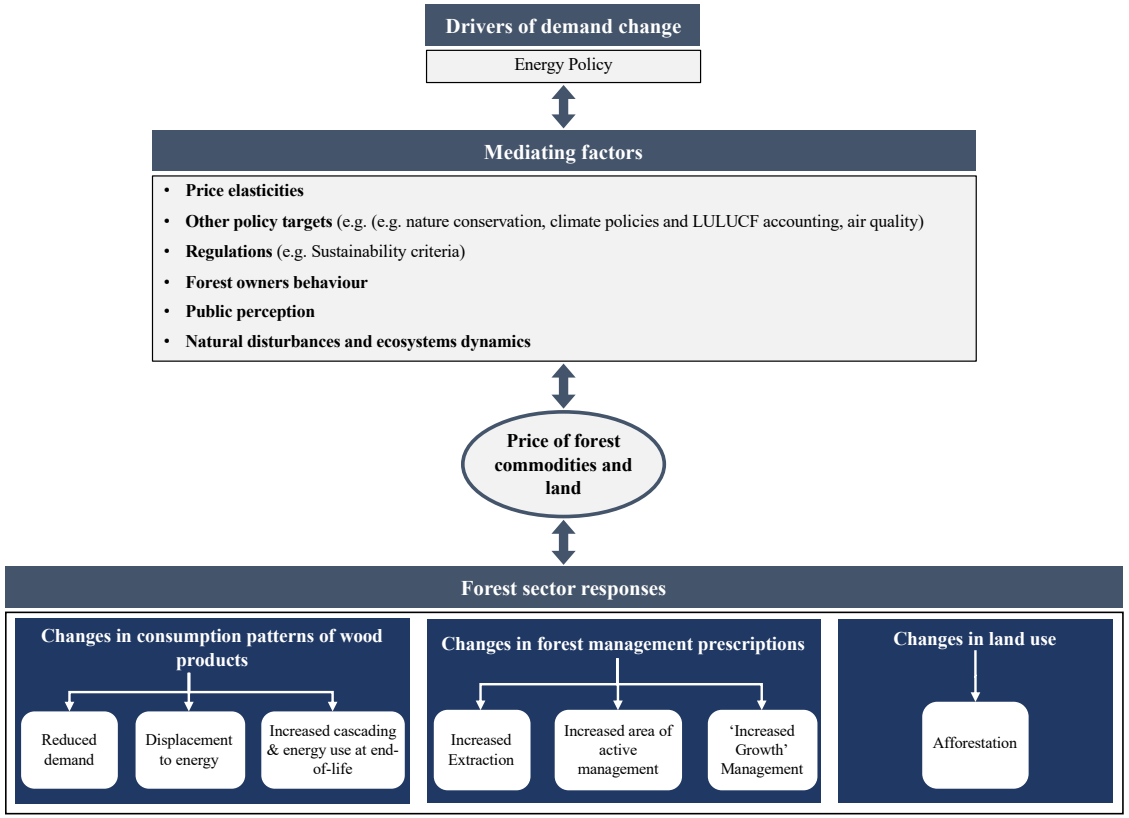
- Forest ecosystems in Europe and around the world are in **poor condition**
- Bioenergy places additional demand of wood on forest ecosystems, causing likely **changes in forest management practices**, being this directly or indirectly.
- Bioenergy is peculiar among other renewable energy sources, at the nexus of two of the main environmental crises of the 21st century: the **climate** and **biodiversity emergencies.**
- A lot has been said and written about the **carbon impacts** of forest bioenergy. IA of the REDII presented all those aspects and those findings are still valid. Therefore, for this report no additional research has been done on this aspect.
- Instead, the bioenergy literature lacks assessments of potential impacts on forest **biodiversity** and **ecosystems**. Risks of promoting **bio-perversities**.

Method

- No clear quantitative method for impact assessment on biodiversity and ecosystems' condition
- We use a literature review and synthesis to bridge the disciplinary divide between ecological literature and bioenergy literature
- We focus on three interventions and several outcomes for each

Interventions	Counterfactuals	Outcomes assessed
Removal of logging residues	Stem-only harvest. Residues left on the forest floor to decay	1. Habitat relevance 2. Impacts on community composition (e.g. changes in species richness indicators or changes in assemblages) 3. Impacts on species populations (e.g. species abundance) 4. Impacts on nutrients budget and availability 5. Impacts on Soil Organic Carbon 6. Impacts on productivity of the forest
Afforestation	Former land use is maintained	1. Impact on community composition 2. Impact on species populations 3. Impact on carbon stocks 4. Impacts on water cycle
Conversion of natural forests to plantations	Management regime of the naturally regenerating forest continues unchanged	1. Impact on community composition 2. Impact on species populations 3. Impact on carbon stocks 4. Impacts on soil quality

Why these interventions?



- Change-oriented;
- Providing 'additional' biomass;
- 'Aspirational' as directly or indirectly linked to bioenergy;
- More traditional management already studied;
- Other interventions should be looked into.

Source: Giuntoli et al. (2020). Carbon accounting of bioenergy and forest management nexus. A reality-check of modeling assumptions and expectations. *Renewable and Sustainable Energy Reviews* 134: 110368

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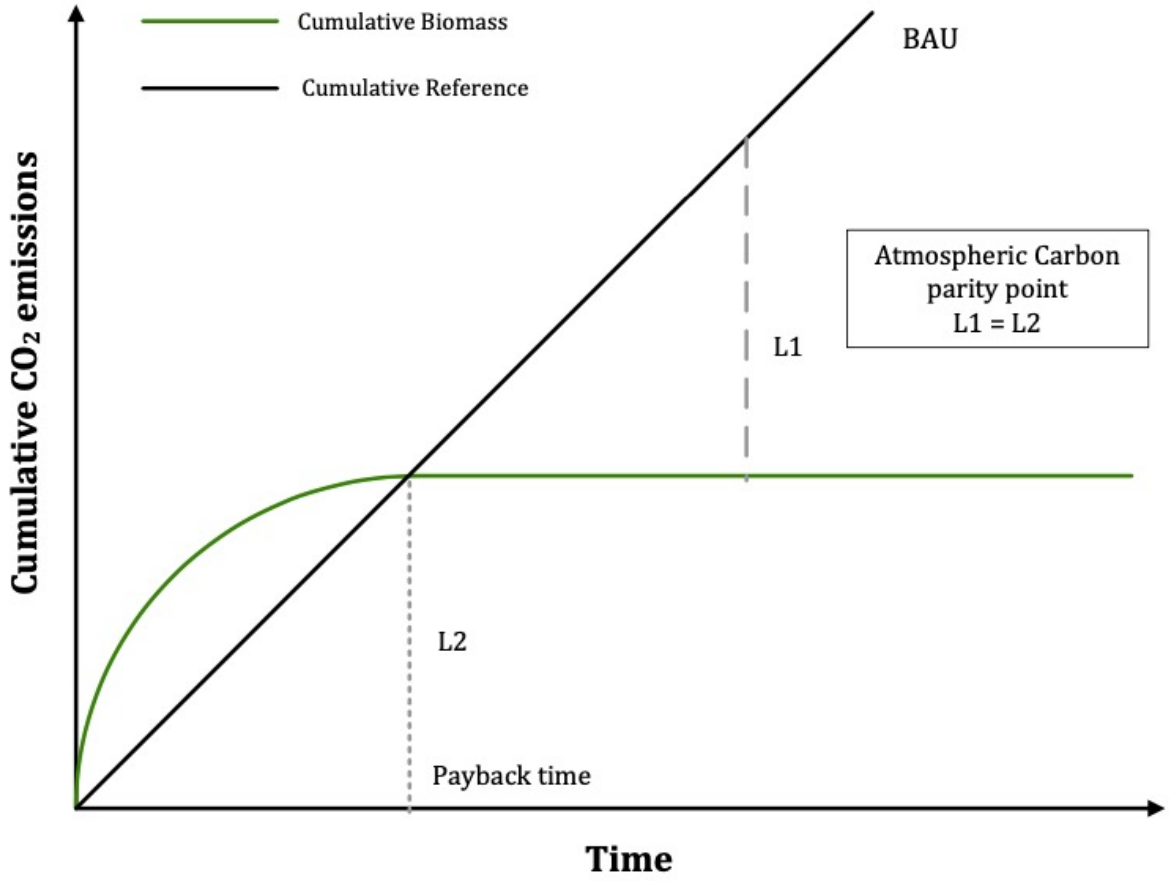
Results: impacts on biodiversity and ecosystems' condition

- The results of the literature review are synthetized in a qualitative assessment through the definition of **pathways archetypes**.
- The impacts are categorized as:
  - **High risk (✗)**: negative effects on biodiversity or ecosystem condition's attributes;
  - **Neutral – Positive (✓):** negligible or positive effects on biodiversity or ecosystem condition's attributes;
  - **Medium/high risk (✗!)**: the pathway can potentially have negative impacts on biodiversity, but the actual impact depends on other confounding variables (e.g. landscape availability of deadwood, local conditions, local forest management guidelines etc…) and the final impact could be positive or negative depending on them;
  - **Medium/low risk (!✓):** pathway is likely to cause little or no negative impacts on local biodiversity, but specific conditions should be investigated to make sure that's the case.

Results: impacts on carbon emissions



Source: Agostini et al. (2014). Carbon accounting of forest bioenergy conclusions and recommendations from a critical literature review. JRC Technical report. https://publications.europa.eu/en/publication-detail/-/publication/e6c29d5b-2bef-4ec4-93f5-c3f672af0b47

The impacts are categorized as:

- **Short-term**: these are pathways which are likely to achieve carbon savings compared to fossil sources immediately or within one or two decades.
- **Likely medium-term**: these are pathways which are likely to achieve carbon mitigation within three to five decades.
- **Unlikely medium-term**: these are pathways which are not likely to achieve carbon mitigation before five decades.
- **Long-term**: these are pathways which are likely to achieve carbon mitigation only in a century scale or even never.

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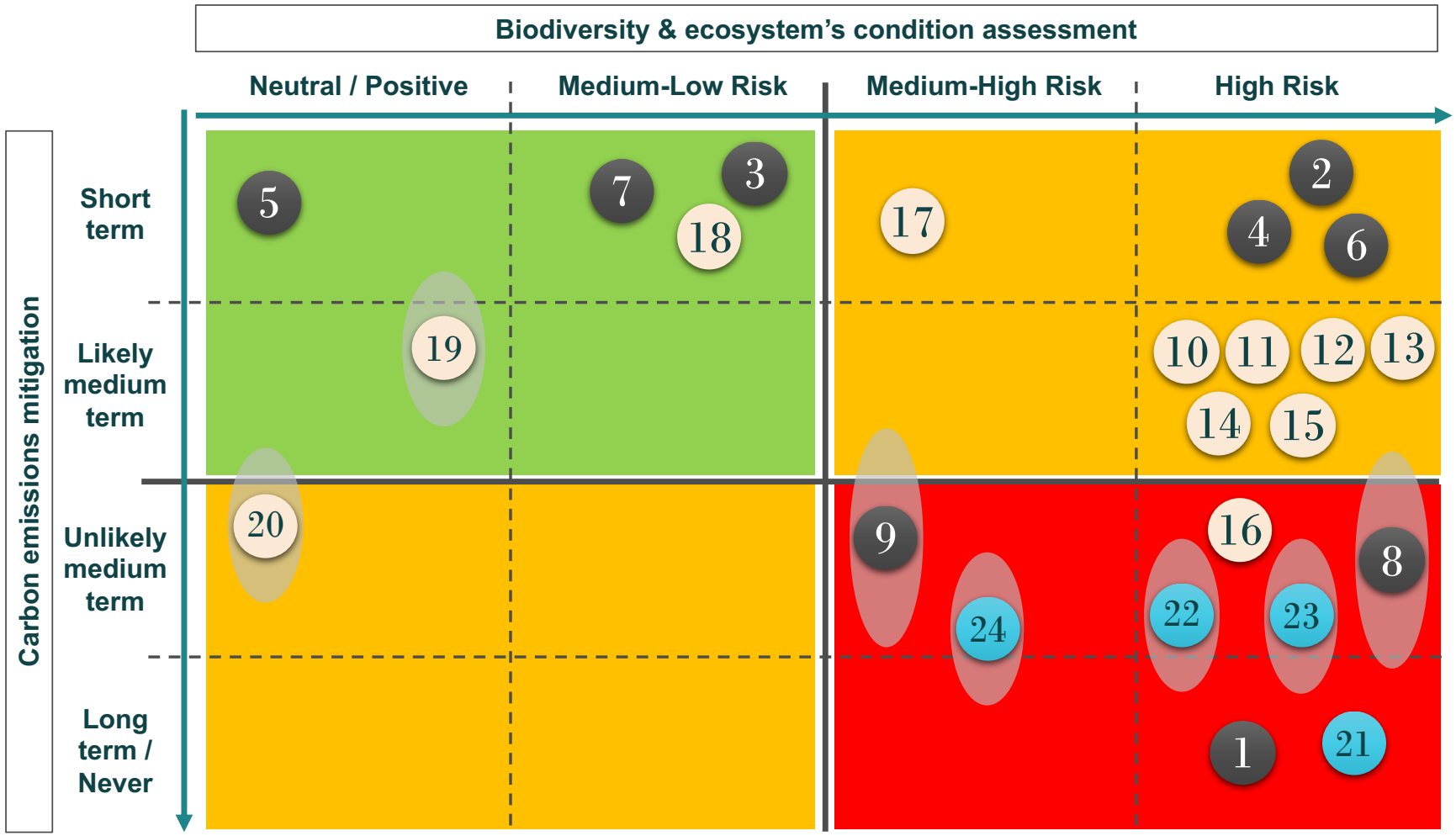
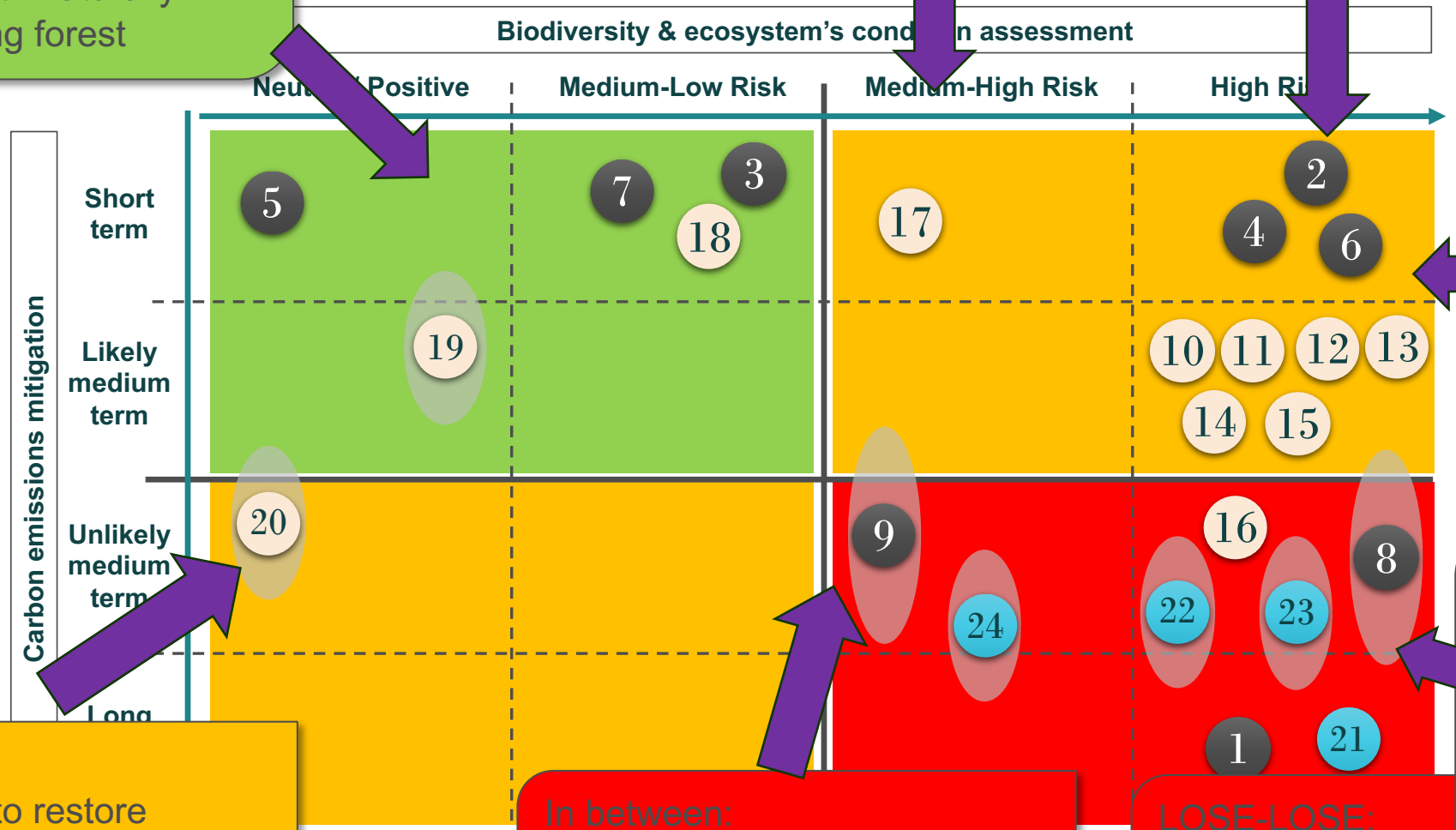


	ID	Pathway description
Logging residues removals	1	Coarse Woody Debris removal
	2	Fine Woody Debris (Slash + foliage/needles) removal above landscape threshold
	3	Fine Woody Debris (Slash + foliage/needles) removal below landscape threshold
	4	Fine Woody Debris (Slash - Coniferous) removal above landscape threshold
	5	Fine Woody Debris (Slash - Coniferous) removal below landscape threshold
	6	Fine Woody Debris (Slash - Deciduous) removal above landscape threshold
	7	Fine Woody Debris (Slash - Deciduous) removal below landscape threshold
	8	Low stumps removal above landscape threshold
	9	Low stumps removal below landscape threshold
Afforestation	10	Natural grassland afforestation with monoculture plantation
	11	Natural grassland afforestation with polyculture plantation
	12	Natural grassland afforestation with other planted forest
	13	Anthropogenic heathland afforestation with monoculture plantation
	14	Anthropogenic heathland afforestation with polyculture plantation
	15	Anthropogenic heathland afforestation with other planted forest
	16	Natural forest expansion on anthropogenic heathland
	17	Former agricultural land afforestation with monoculture plantation
	18	Former agricultural land afforestation with polyculture plantation
	19	Former agricultural land afforestation with other planted land managed with low intensity
	20	Natural forest expansion on former agricultural land
Conversion to plantation	21	Conversion of primary, old-growth forest, to plantation
	22	Conversion of native naturally regenerating forest to monoculture plantation
	23	Conversion of native naturally regenerating forest to polyculture plantation
	24	Conversion of native naturally regenerating forest to other planted forest managed with low intensity

WIN-WIN:
- Slash (below threshold)
- Afforestation of former agricultural land with mixed forest or with naturally regenerating forest

Afforestation of agricultural land with monoculture plantation

- Removal of slash above threshold
- Removal of slash + needles/leaves



TRADE-OFF:
Good for climate mitigation but detrimental for local biodiversity

Afforestation of grasslands and anthropogenic heathlands

LOSE-LOSE:
- Conversion of natural forest to plantation
- Stumps above threshold

TRADE-OFF:
Interventions to restore biodiversity which could generate climate benefits in the long-term as a by-product.

In between:
- Stumps below threshold and in climates with high decay rates

LOSE-LOSE:
- Coarse woody debris
- Conversion of primary forest to plantation

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Key messages

- ✓ **Win-win options exist**!
- ✓ The risk of lose-lose pathways might be mitigated by national guidelines and voluntary standards, but we cannot comment if they are sufficient, especially for extra-EU feedstocks → **Verify fit-for-purpose & precautionary principle**.
- ✓ More **research** is needed:
  - Collect empirical data on ecosystems' conditions and biodiversity attributes, as well as synthesis
  - Expand large-scale systemic assessments to go beyond carbon accounting and include more and more indicators for biodiversity and ecosystem conditions
  - Expand research to other interventions (e.g. thinning operations, agroforestry establishment, coppice conversion or restoration) and to other attributes (e.g. impacts on physical soil properties)
  - Important to look at case studies on smaller spatial scales, which could help decision makers in promoting pathways which are win-win at a local scale.

Carbon accounting

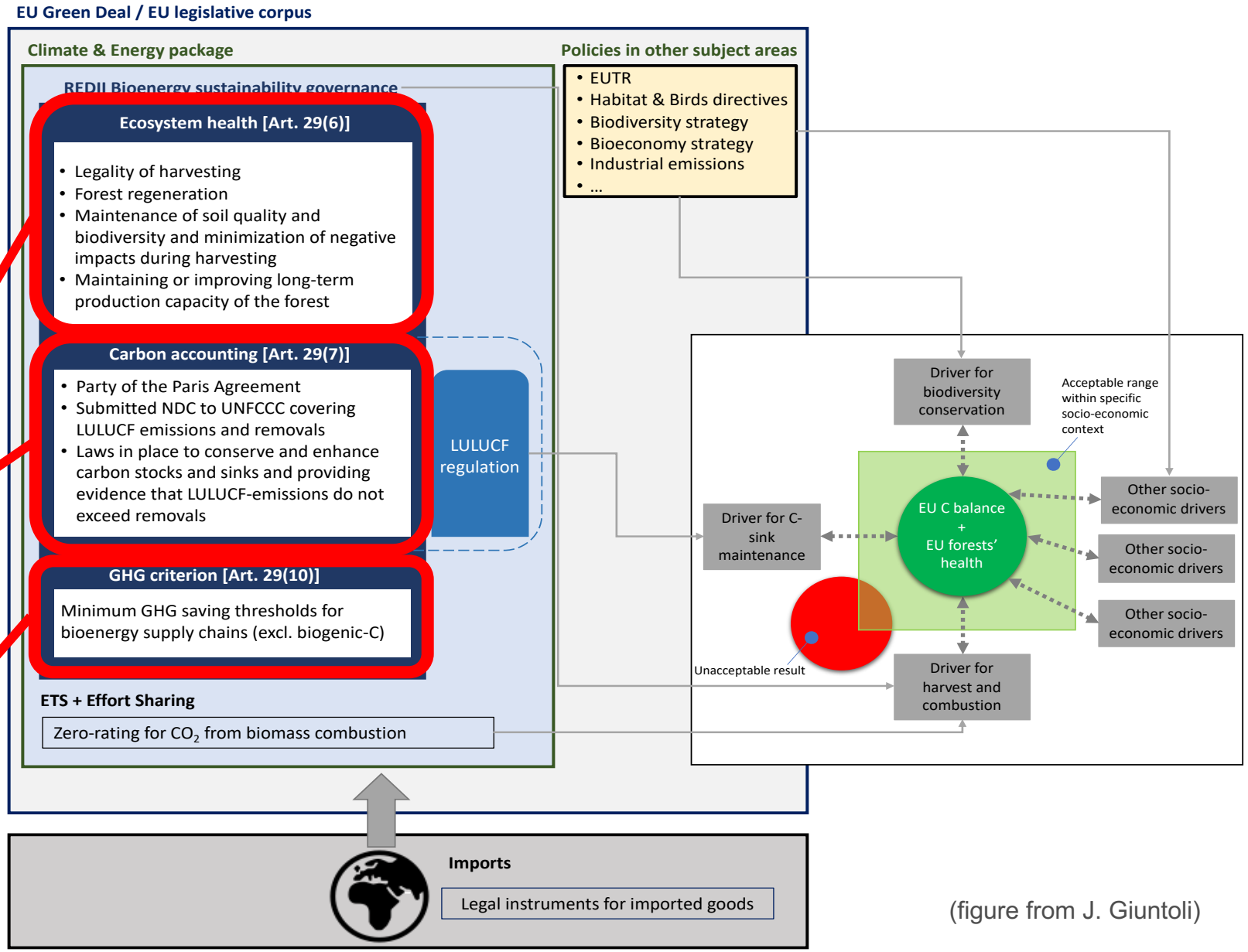
REDII: sustainability, carbon accounting and other policies

Dir. 2018/2001 (art. 29) lists criteria that forest biomass used for bioenergy must comply with in order to count towards each country's renewable energy target.

Sustainable use of forests: only biomass produced with practices that do not degrade the ecosystem's health

Carbon accounting: links REDII with LULUCF and thus with the EU climate accounting

GHG criterion: minimum thresholds of GHG savings for bioenergy supply chains, aimed at promoting the more efficient ones. Biogenic-C not included because included in LULUCF



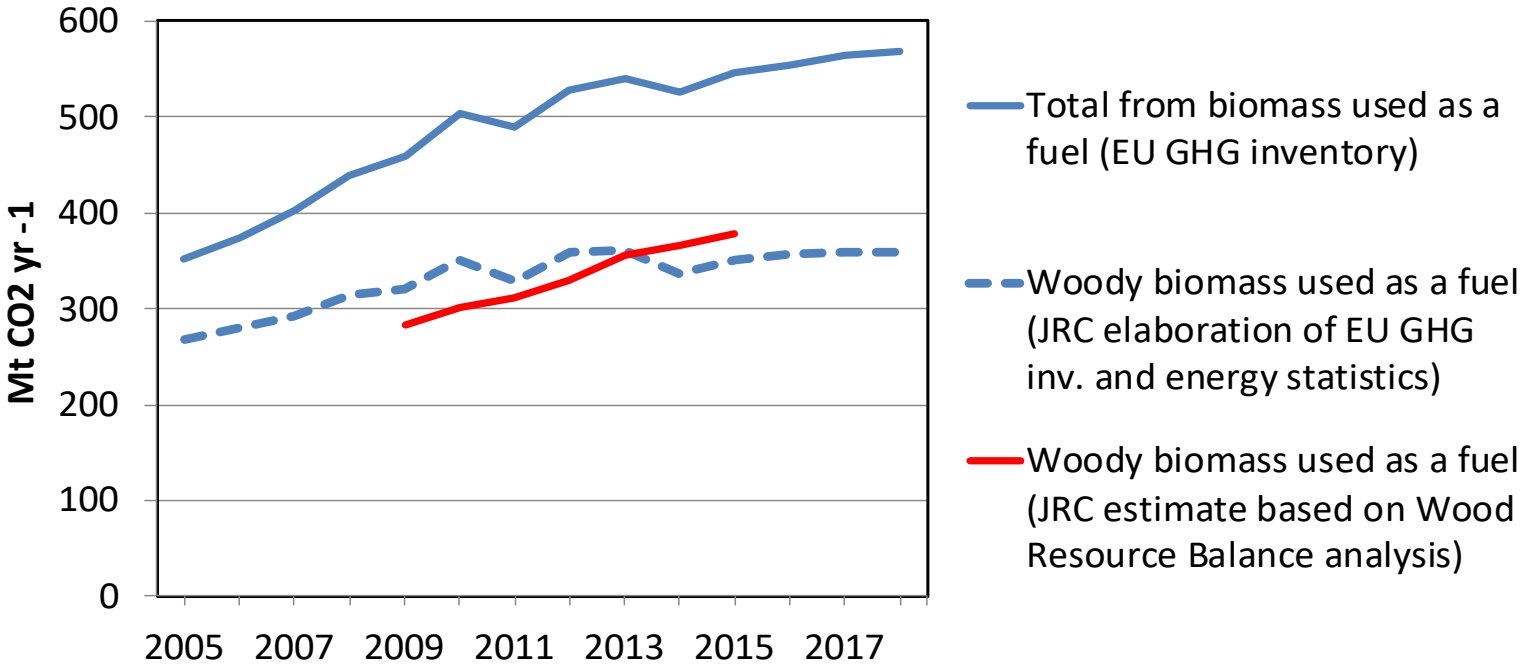
(figure from J. Giuntoli)

GHG emissions from forest bioenergy

In the EU, in 2015 woody bioenergy:

- emitted ≈ 350-380 Mt CO2
- displaced ≈ 250-270 Mt CO2

What counts is *which* wood is used.



In 2015, the origin of woody bioenergy was:

- ≈ 20% primary wood, stemwood (at least half from coppice)
- ≈ 17% primary wood, other (tree tops, branches, etc.)
- ≈ 49% from secondary sources (by−products of wood industries, bark, post−consumer wood)
- ≈ 14% uncategorized

→ The majority of forest bioenergy used in the EU is based on residues (room for improvement)

→ The ≈ 33% increase from 2005 to 2018 mainly associated to fuelwood

→ The large uncertainty in the statistics prevents to assign a high confidence to any conclusion ☹

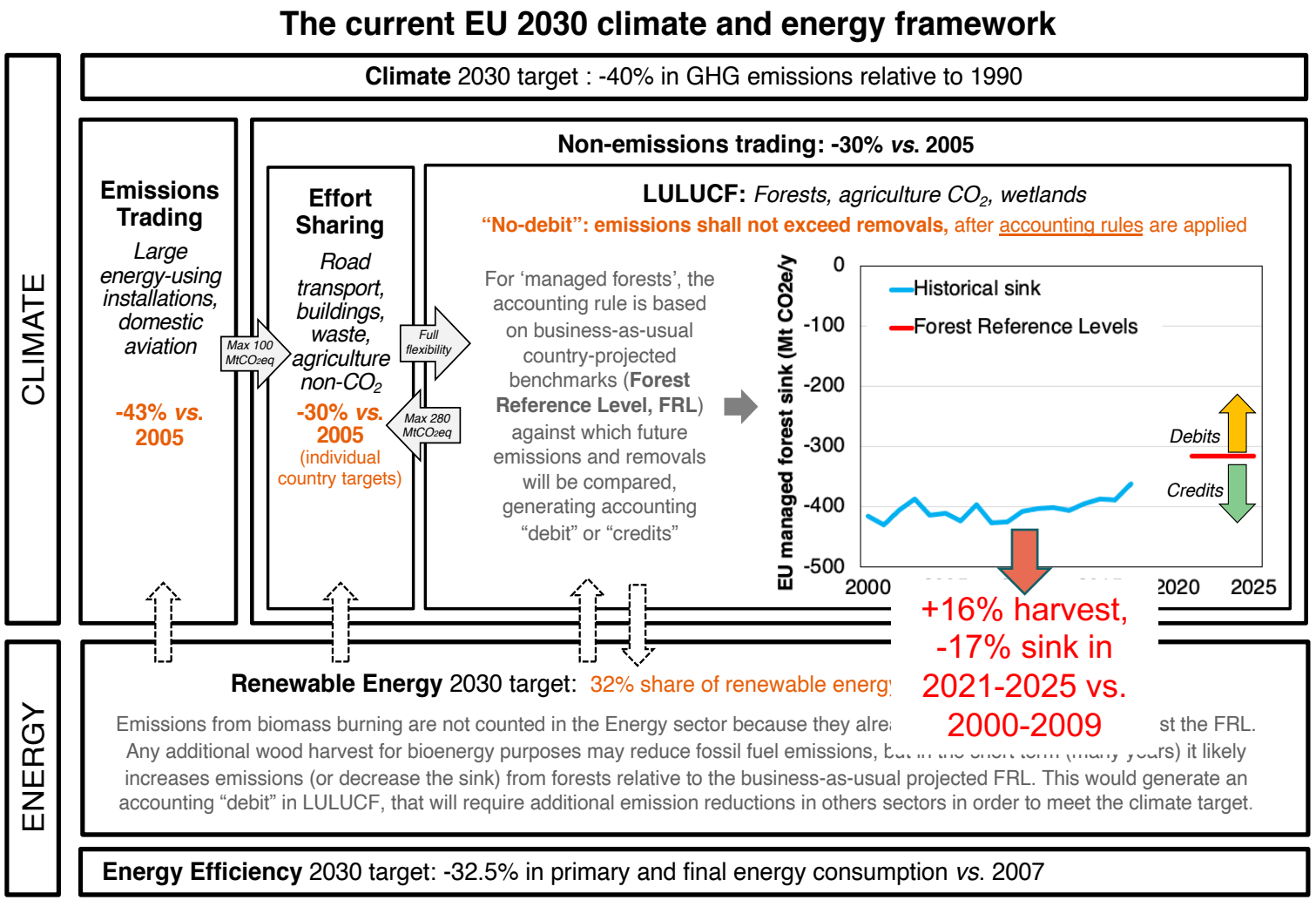
WHERE the carbon impact of bioenergy is accounted

Emissions from bioenergy are not counted at the point of biomass combustion because *already* counted under LULUCF, as a change in carbon stocks reported annually in the GHG inventory.

This is the approach adopted by the IPCC/UNFCCC for GHG inventories, with the aim to guarantee **practicability** and **avoid double counting*.**

* The biomass burnt for energy comes from different and complex pathways: some is a primary wood harvested few months before, some is secondary wood harvested few years before, some is waste wood from biomass harvested even decades before. Since the LULUCF sector *reports the annual change in carbon stocks*, **accounting forest bioenergy under the energy sector would imply a retrospective** (and unrealistic) **attribution of what is burnt to the biomass harvested in specific past years**, and an ex-post subtraction of this harvested amount from the LULUCF accounting, **to avoid double counting**.

HOW LULUCF accounts for emissions from bioenergy



Forest Reference Levels (FRLs) are country projections against which future GHG fluxes will be compared → the **impact of any change in management or wood-use relative to a historical period (2000-2009) will be reflected in the climate accounts.**

Trade-offs exists in harvesting for bioenergy

Claims that EU assumes bioenergy as **C neutral** are outdated (however, FRLs do not count the impact of increasing harvest due to *age-related dynamics)*.

RISKS across the REDII - LULUCF interface

The LULUCF accounting *per se* cannot guarantee a positive climate impact of bioenergy.

Poor communication and **possible mismatch of incentives** can still produce unintended outcomes (e.g. too much forest bioenergy with negative climate outcomes):

- **REDII**, through the zero-rating accounting and by considering forest biomass as renewable (thus ensuring access to specific incentives), incentivizes economic operators to make an increasing use of forest bioenergy, stimulating the demand of wood → *short term signal*.
- **LULUCF**, determining the level beyond which any additional *domestic* harvest (including for bioenergy) will be "fully paid" in terms of carbon, disincentives countries to harvest beyond this limit (unless this is compensated by extra forest growth, or unless the extra harvest generates enough extra GHG-savings in others GHG sectors) → *medium term signal*

How does the harvest trend in the JRC report compares with Ceccherini et al.?

Ceccherini measured clear-cuts, not total harvest

While this was *unfortunately* not clear in the abstract, it was explained *five* times in the text

We note that the GFC data-set is sensitive to clear-cuts instead of the actual wood harvest, which can be complemented by thinning operations that may not be seen by the satellite—such as when the change in crown cover is not large

Our approach has limitations in the detection of small-scale silvicultural practices.

Although the GFC clearly does not require full clear-cuts to detect forest-cover loss, it is not able to reliably capture partial removal of trees caused by forest thinning, selective logging,

addition, most changes occurring below the canopy cannot be detected by optical instruments, potentially leading further to an underestima-tion of actual harvest wood.

30 m. Small-scale silvicultural practices such as thinning or selective logging—which are relevant in some EU countries—could therefore not be fully detected.

Furthermore, the Suppl Information acknowledged and quantified this for each country, e.g.:

Member State	Share of final cut on the managed area (or volume in case of CBM)
Sweden	≈ 37%, as total area

Sweden. The lack of correlation between the GFC data and harvest-removal data is probably due to: (1) when large disturbance

Sweden); and (3) for this country, final felling covered (in terms of area) about 37% of the area annually affected by fellings between 2000 and 2015[56]. This area is not statistically correlated with the total amount

At EU level, ~ 40-50% of harvest appears to come from clear-cuts (final fellings)

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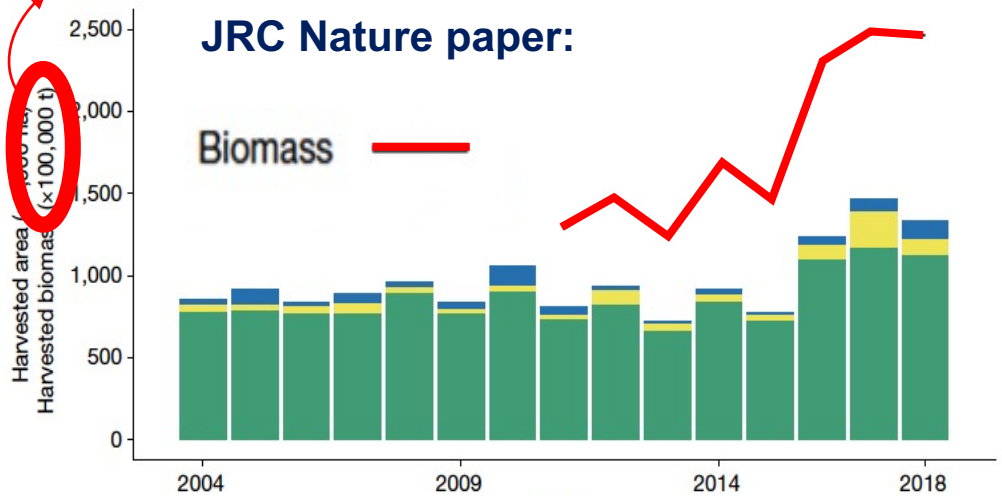
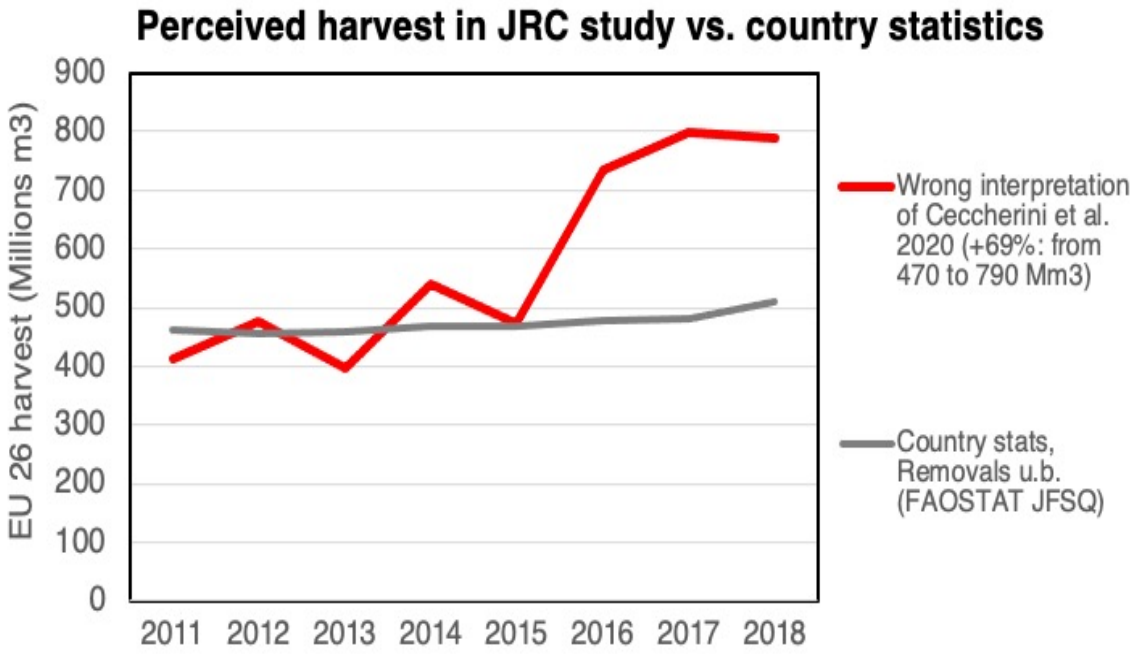
How does the harvest trend in the JRC report compares with Ceccherini et al.?

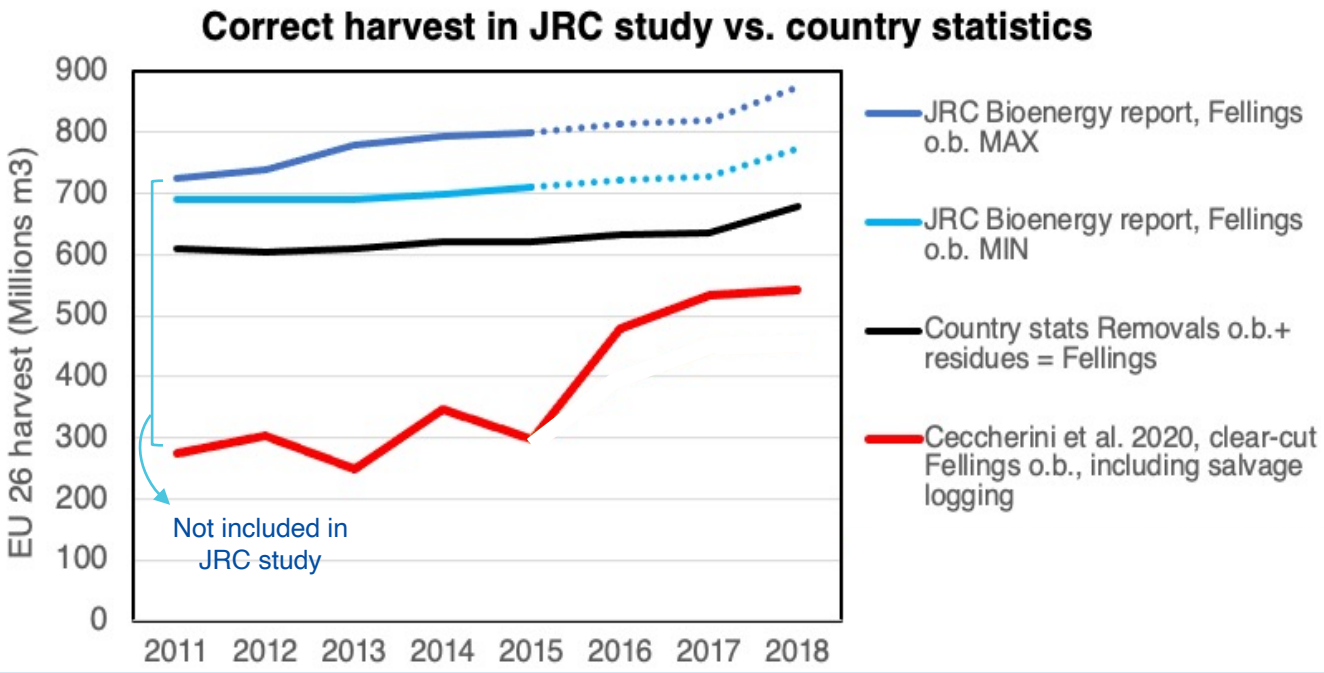
Tonnes of clear-cut fellings overbark (JRC study) *cannot be compared with* m3 of total removals underbark (country statistics)

Multiply by ~ 2 to obtain m^3



When latest and more realistic statistics are used, *JRC results are well below country statistics*





CONCLUSIONS on carbon accounting (1)

Different viewpoints / **concerns** on the impacts of forest bioenergy **are legitimate.**

So far, the most vocal suggestions to address these concerns were (suggestion/*counterargument*):

- **Stop considering bioenegy as carbon neutral**
  Bioenergy is NOT assumed C neutral in the EU climate framework. LULUCF already accounts the the carbon impact of any change in management and wood use
- **Count emissions from biomass burning at the point of combustion**
  It would be very difficult to avoid a double counting in LULUCF
- **Legally restrict the feedstock to be used for bioenergy (e.g. 'residues' only)**
  REDII Imp. Ass (2016) concluded that it is difficult to implement and likely ineffective: re-assessing this is legitimate, but it was outside the scope of the JRC report
- **Stop consider woody biomass as renewable source of energy**
  It would reduce the risks of negative impacts, but also the opportunity of positive impacts.

Risks of negative climate impact exist. *Reducing* these risks is possible by proper implementation of existing EU/national legislation. If this is enough or not, *it's a policy decision*.

CONCLUSIONS on carbon accounting (2)

To a large extent, there are no ‘right’ or ‘wrong’ answers: solutions depend on worldviews, attitude towards risks and effectiveness on policy implementation, which cannot be settled by 'science’.

A constructive contribution from the **scientific community** would imply **integrated modelling** of **all** forest sector options (i.e. C stored in forests and in HWP, material substitution and bioenergy), taking into account biodiversity, health and socio-economic aspects.

(don’t ask *'does bioenergy mitigate CC?’* but *'under which conditions can bioenergy mitigate CC*?’)

This would help to **refine / complement** the general principles (e.g. **prioritising residues** and the **circular use of wood**) and the **win-win** and **lose-lose options** available in the literature (e.g. Matthews et al. 2018, JRC bioenergy report) with **local / country scale analyses**.

From **countries** it would be needed:

- **Greater awareness of the RED/ETS-LULUCF links** and **trade-offs**;
- **Governance tools / incentives that encourage win-win and discourage lose-lose pathways**;
- **A timely/reliable monitoring** of the use of forest bioenergy !!!

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