

# Sustainability of bioenergy: from theory to practice. Overview of concepts, policies and case studies

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# Context: Many Projects and Studies

-  Global Assessments and **Guidelines** for Sustainable Liquid Biofuel Production in **Developing Countries** (FAO/UNEP/UNIDO)
-  **GBEP** **Indicators** for Sustainable Bioenergy  
Global Bioenergy Partnership <http://www.globalbioenergy.org>
-  **IEA Bioenergy** Sustainability of certified **wood bioenergy** feedstock supply chains: **Ecological, operational and international policy perspectives**. IEA Bio Tasks 40 + 43
-  Joint Workshops on **extending the RED to forest bioenergy**  
[www.iinas.org/redex.html](http://www.iinas.org/redex.html)
- **biomass** policies Sustainable bioenergy in EU28 [www.biomasspolicies.eu](http://www.biomasspolicies.eu)
-  **S2Biom** Resource-efficient bioeconomy in Europe [www.s2biom.eu](http://www.s2biom.eu)
-  **BioTrade2020+** Supporting a Sustainable European Bioenergy Trade Strategy (IEE)  
[www.bioenergytrade2020plus.eu](http://www.bioenergytrade2020plus.eu)

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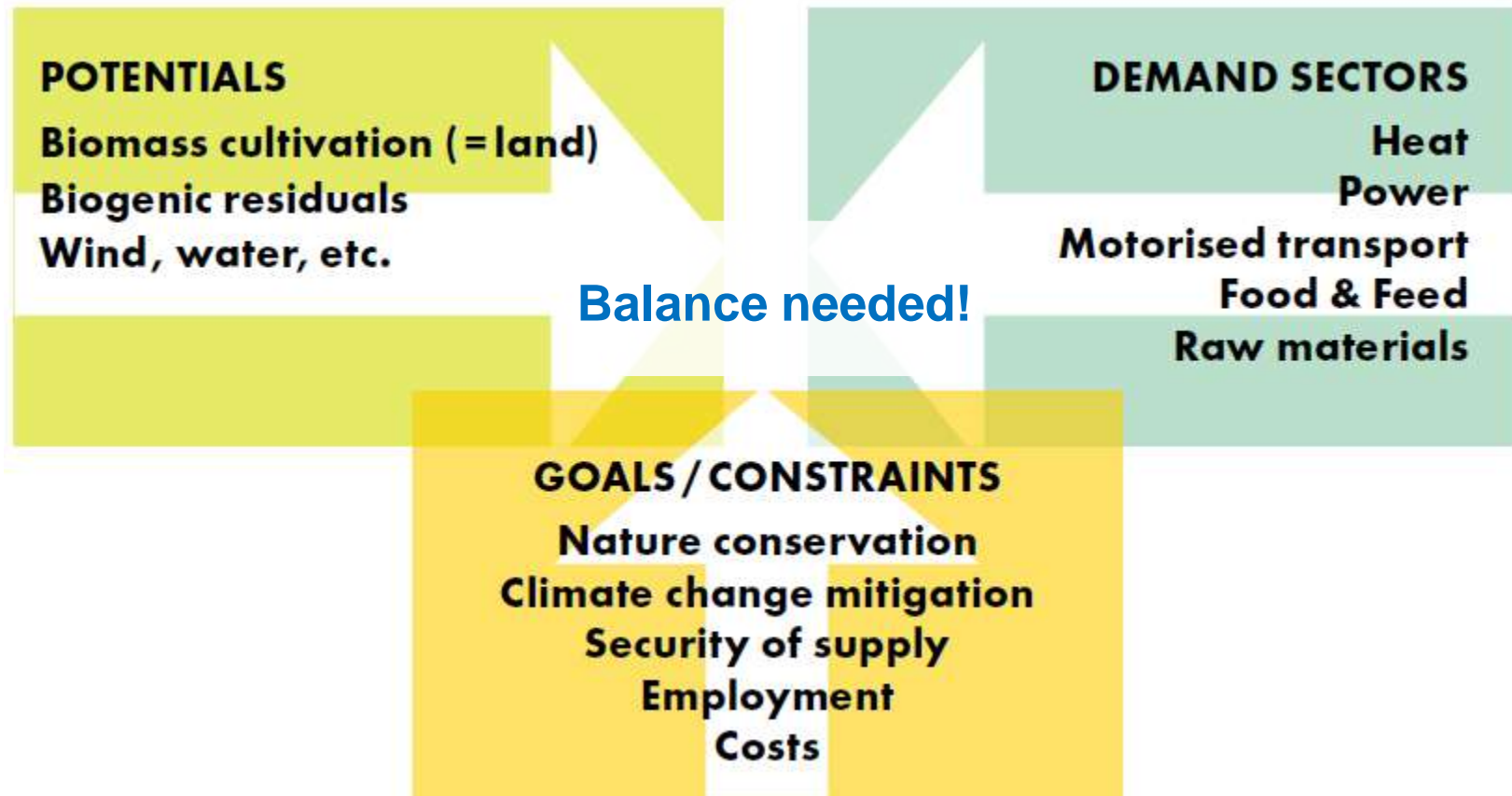
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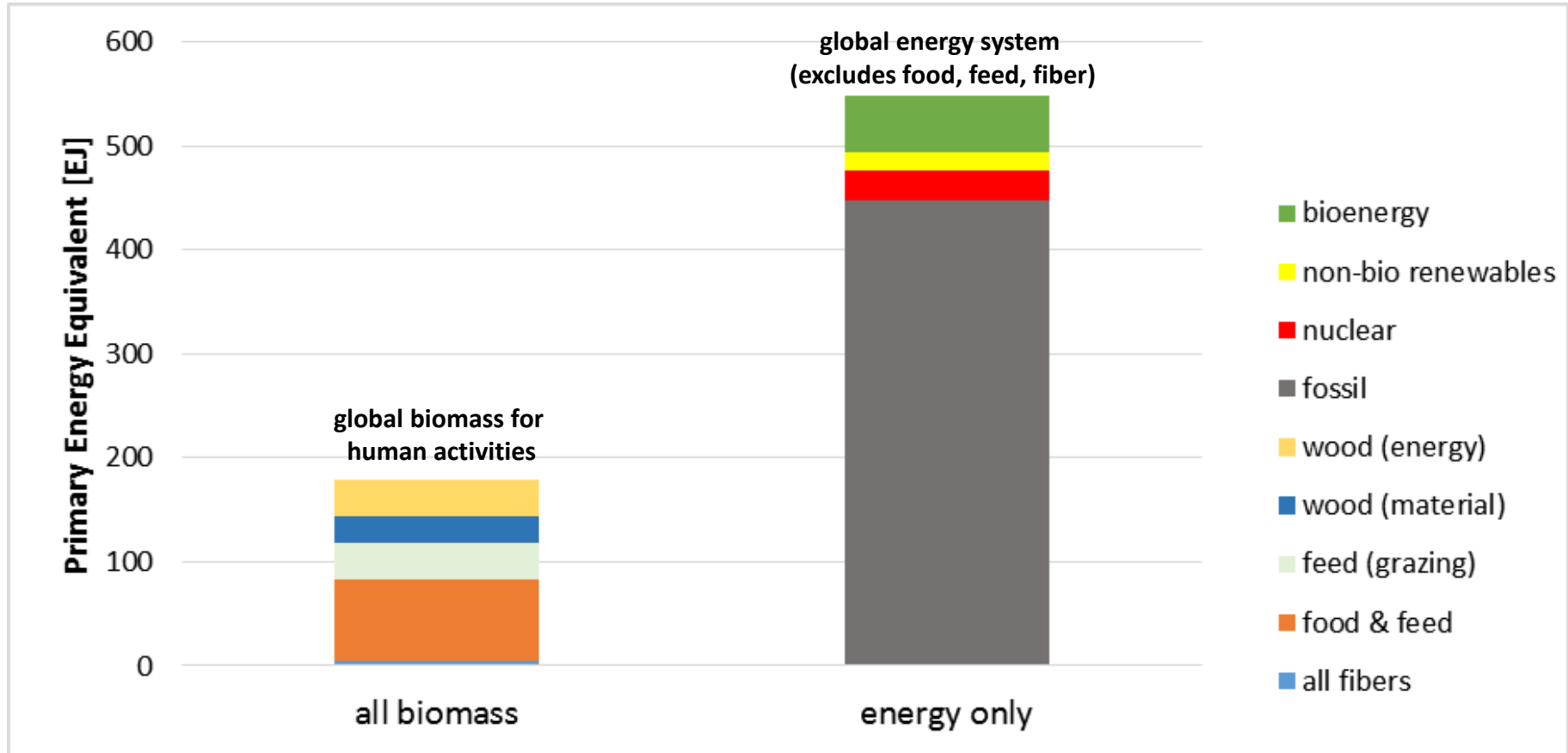
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# Competing Uses for Biomass...



Source: IINAS, IFEU, Shell (2012)

# Bigger Picture (I)



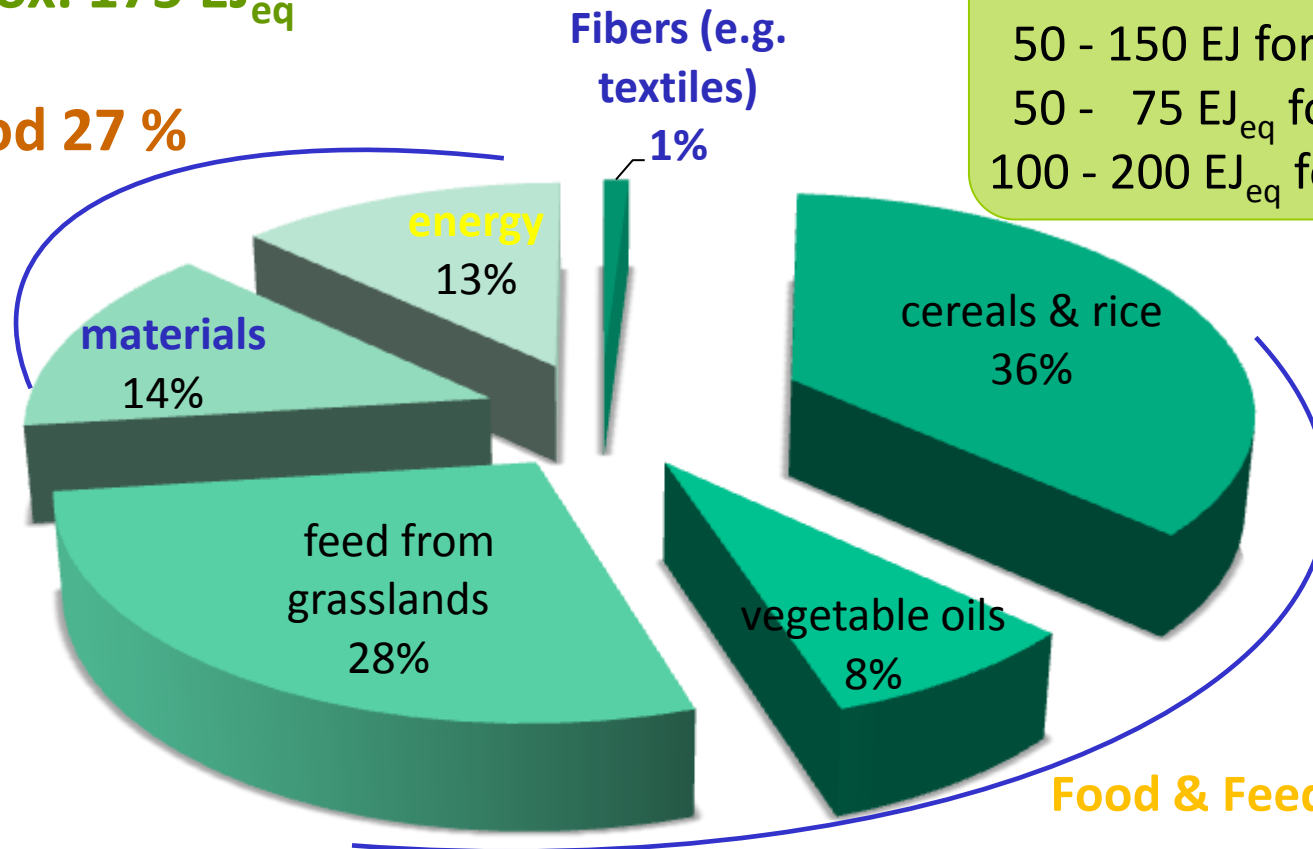
Source: IINAS calculation for 2010 based on IEA (2014) and nova (2012)

# Bigger Picture (II)

Current global biomass use for all human activities:

approx. 175 EJ<sub>eq</sub>

Wood 27 %



**Biomass demand by 2050:**

50 - 150 EJ for energy +

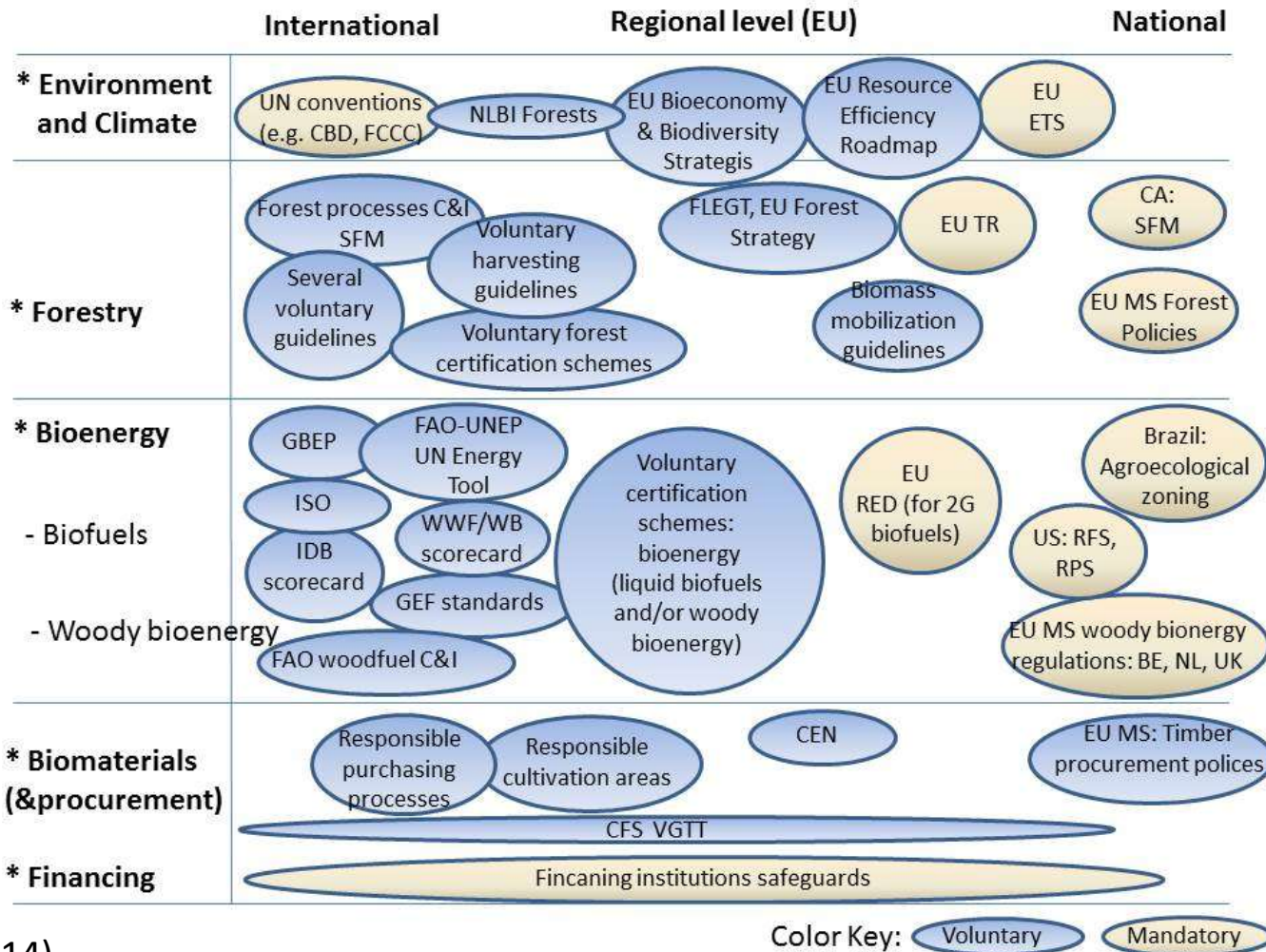
50 - 75 EJ<sub>eq</sub> for materials +

100 - 200 EJ<sub>eq</sub> for food & feed

Food & Feed 72 %

Source:  
IINAS, EFI, JR (2014)

# Map of selected initiatives related to sustainability of forest bioenergy



Source:  
IINAS, EFI, JR (2014)

# Selected policies

- **EU: EU RED** for biofuels and bioliquids. For **forest bioenergy**:
- **UK:** Demonstrate SFM (Category A: forest certification scheme or Category B: equivalent credible evidence)
- **NL:** Energy Agreement and negotiated sustainability criteria (NTA8080 and FSC)
- **US: RFS** (Renewable Fuel Standard 2) + Clean Power Plan. **California:** Low Carbon Fuel Standard
- **BR:** Agroecological zoning (federal level and state level for various crops e.g. sugarcane)
- **MZ:** National Biofuels Policy and Strategy (2009)



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# Sustainable Biomass...

- **Key Criteria (preliminary list):**
  - **Resource** efficiency: make the most out of **limited** resource land (>100 GJ/ha), residues (> 60%), incl. **cascading**
  - GHG emissions savings, including iLUC (**agricultural** crops, incl. SRC) + C stock changes (for **forest** bioenergy and **straw**)
  - **Biodiversity**: high-biodiverse areas and **management** practice (**all** cultivation systems, incl. forestry)
  - Air emissions, water and soil impacts
  - **Food, fuelwood & land tenure** security
  - Balance of (rural) **employment & income**



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Bioenergy = opportunities, but development **needs steering** (GBEP Sustainability Indicators  
[www.globalbioenergy.org](http://www.globalbioenergy.org))

Key role for bioenergy in developing contexts:

- **Agriculture** (often underdeveloped) → bioenergy investment **helps** improving yields & infrastructure
- In the **forestry sector** → rural development + access to modern energy can reduce deforestation pressure
- **Reducing land competition** → **Intercropping** with food and agroforestry + **cultivation of perennial crops** on low-carbon and degraded land improves C balance and helps restoring soils



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# Case: Ethanol in Sierra Leone

- Makieni project ([www.addaxbioenergy.com/en/the-makeni-project.php](http://www.addaxbioenergy.com/en/the-makeni-project.php))
- Sugarcane plantation (approx. 10,000 ha) + ethanol refinery (85 MI/a)
- Biomass power plant (approx. 100,000 MWh) and related infrastructure
- 2,750 employees
- RSB certified
- Germany supports national VGGT implementation project in Sierra Leone (through FAO) → opportunity to mainstream Addax experience!



# Case: Eucalyptus in Uruguay

- Forestal Oriental (UPM, Uruguay) [http://www.upm.com/EN/ABOUT-UPM/Businesses/Pulp/Plantations/Forestal\\_Oriental/Pages/default.aspx](http://www.upm.com/EN/ABOUT-UPM/Businesses/Pulp/Plantations/Forestal_Oriental/Pages/default.aspx)
- 230,000 ha of land (degraded grassland), 60 % eucalyptus approx. → Pulp mill. 2 nurseries
- Fomento: programme that encourages the landowners to diversify their land use with sustainable plantation forestry
- ISO 9001, ISO 14001, OHSAS 18001
- Forest Management and Chain-of-Custody Standards FSC and PEFC
- Part of the New Generation Plantations Project



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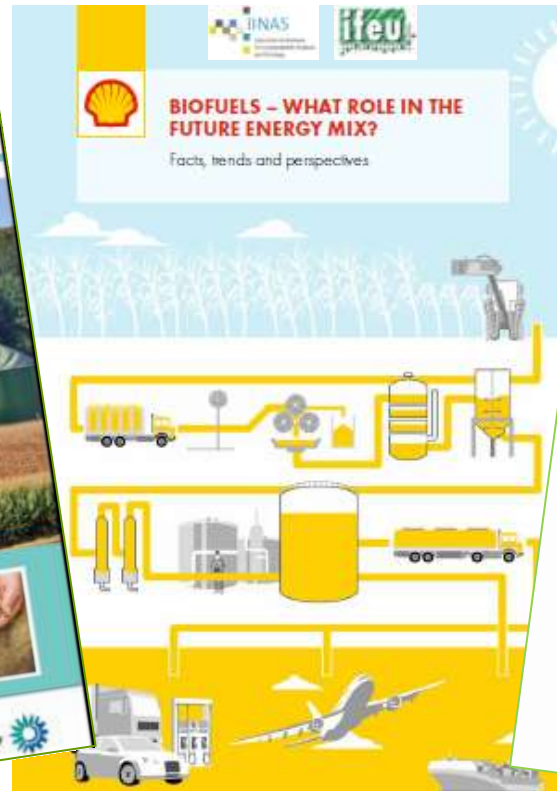
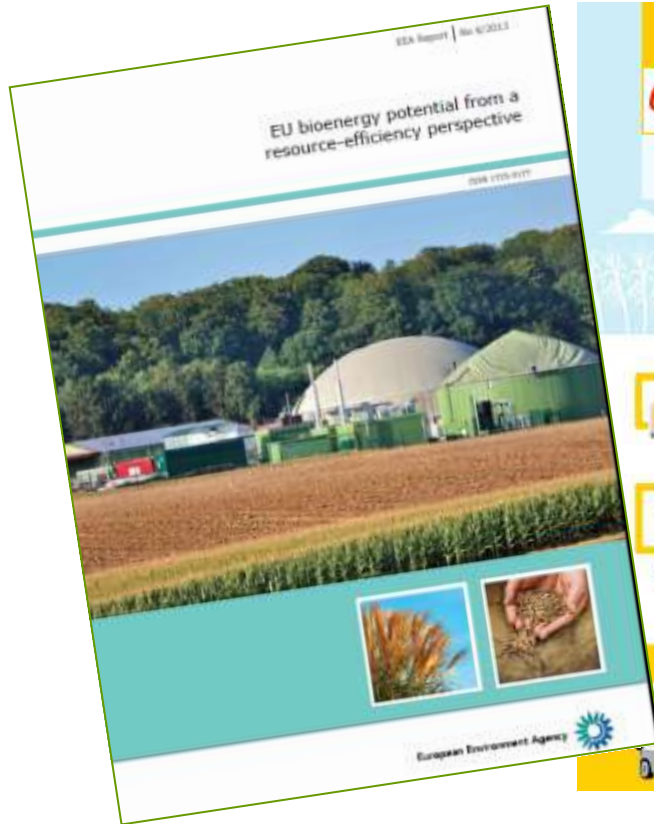
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# Final Thoughts

- **Harmonization** of schemes is needed
- **Coherent sustainability requirements** for all bioenergy (electricity, heat, transport) and biomaterials, biorefineries etc. needed
- **Bioeconomy**: **not** food (or fuelwood) vs. fuel but **land use**
- Opportunities with residues and wastes (cascading) and marginal and degraded land : **yes**, but consider trade-offs
- Address **social** effects (positive and negative)
- **Improve** indicators: C balances, maps for biodiversity and nutrient depletion risk (“**go**” areas!)
- **Integrated** agro-energy-water and forest-energy projects needed to deliver on synergy opportunities
- **Holistic vision** of sectors, risks and opportunities

# More Information



[www.iinas.org](http://www.iinas.org)

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# GHG accounting of forest bioenergy

- Bioenergy is **C-neutral** in the **long-term**
- **IPCC** budget approach, **but** sub-target of max. 0.1 °C increase per decade meant to protect biodiversity and to limit ocean acidification
- **Differentiation** needed: forest; forest product; material displacement and energy substitution
- Geographical scale: stand level vs. **landscape** level
- Models + simplified approaches: 5-20 years **payback** for most **residues** = nearly C neutral

# Low Climate-Risk Feedstocks?

Woody biomass source for energy use	Time horizon for CO <sub>2</sub> emission reduction					
	short (10 years)		medium (50 years)		long (centuries)	
	Coal	gas	coal	gas	coal	gas
Boreal, stems final harvest	---	---	-	--	+	+
Temperate, stems final harvest	---	---	+/-	-	++	+
Harvest + thinning residues, landscape care & salvage wood*	+/-	+/-	+	+	++	++
SRC on marginal agricultural land	+++	+++	+++	+++	+++	+++
SRC replacing forest	-	-	++	+	+++	+++
industrial residues, wastes	+++	+++	+++	+++	+++	+++

-; --; ---: **bioenergy system emits more** CO<sub>2</sub>eq than reference fossil system **in given time frame**

+/-: GHG emissions of **bioenergy and fossil are comparable** in given time frame

++; +++: **bioenergy system emits less** CO<sub>2</sub>eq than reference fossil system **in given time frame**

\*For harvest/thinning residues & salvage wood, balance depends on alternative use (burning) and decay rates

Source: own compilation based on JRC (2013)

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