# Identification of global biomass supply marginals and their dependency on scale of demand through econometric modelling – a case of using the GLOBIOM tool

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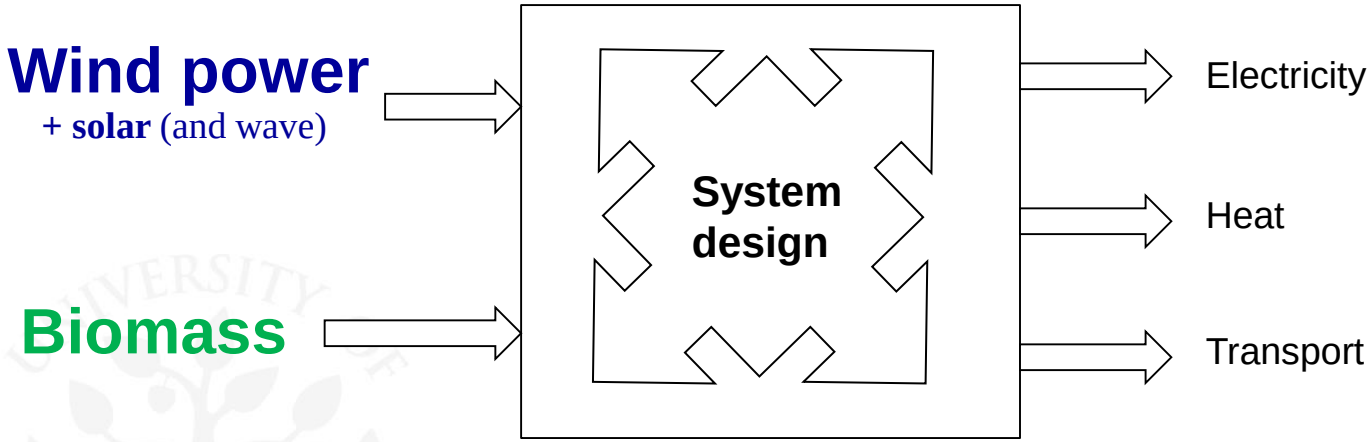
IEA Bioenergy

Co-hosted by IEA Bioenergy Task 38 and Chalmers University of Technology

# Presentation outline

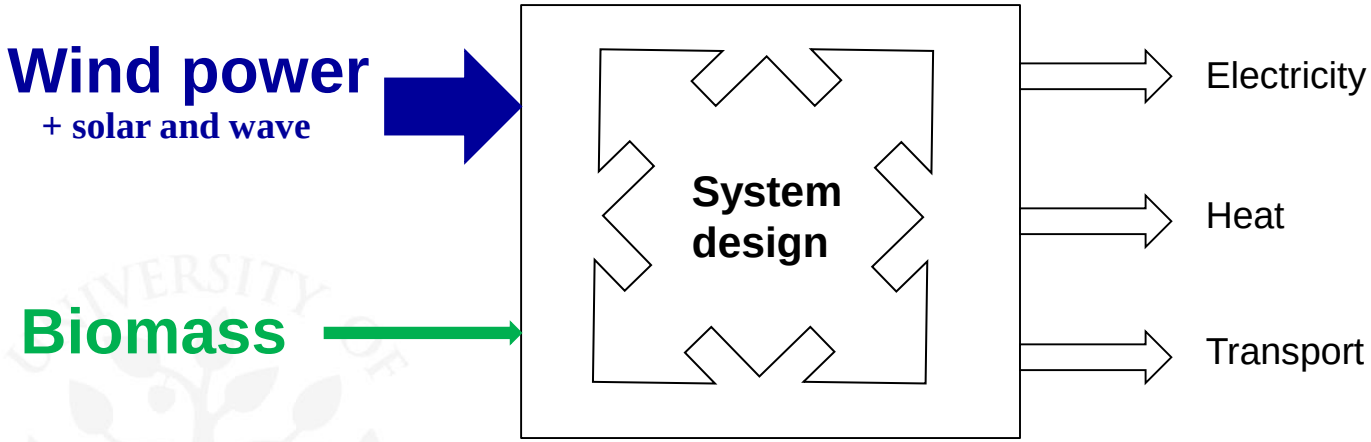
- Biomass demand in renewable energy systems
- Biomass supply and origin

# 100 % renewable energy in DK – how?

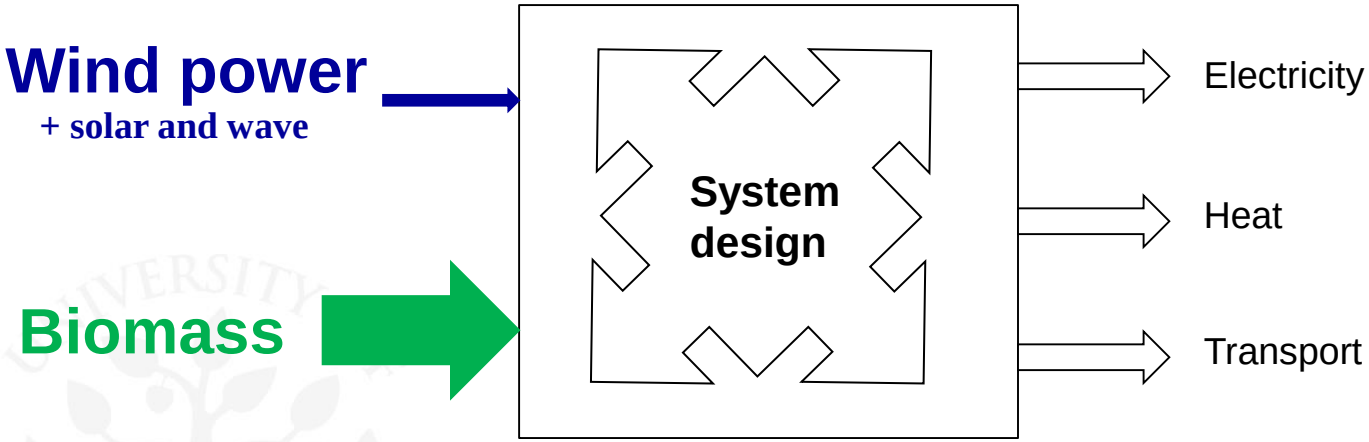



**How do we distinguish a good from a bad system design?**

# Wind energy?


Wind power
+ solar and wave
Biomass
System design
Electricity
Heat
Transport

# Bio-energy?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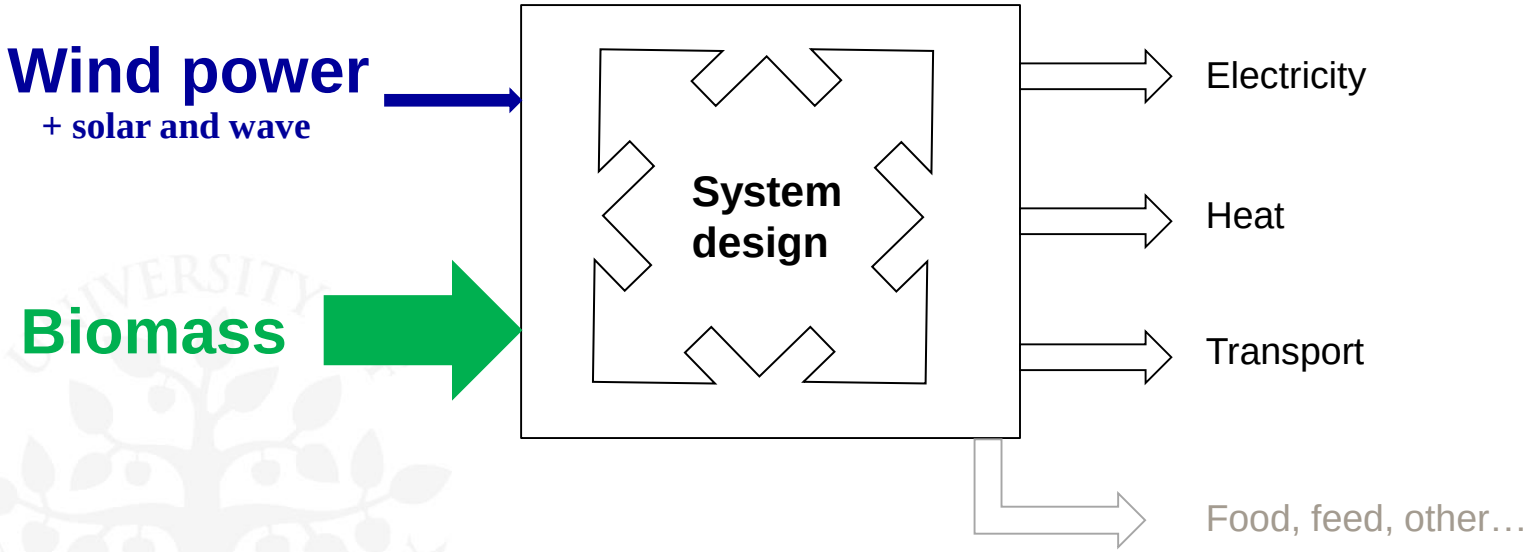

Wind power
+ solar and wave
Biomass
System design
Electricity
Heat
Transport
Food, feed, other…

# Energy system design studies in Denmark

- Climate Commission, 2010
- Energinet.dk, 2010
- Energinet.dk, 2015
- Danish Association of Engineers, 2009
- Danish Association of Engineers, 2015
- CEESA, 2011
- University of Southern Denmark, 2014
- Danish Energy Agency, 2014
- Nordic Energy Technology Perspectives, 2016

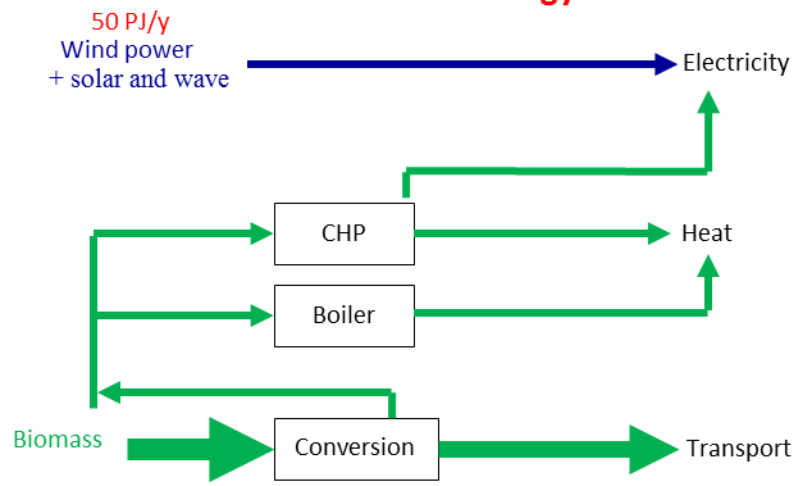
# Analysing biomass dependency

- in four different system configurations

1. Standard bioenergy
2. Electrification
3. Electrolysis
4. Electrolysis + carbon recycling

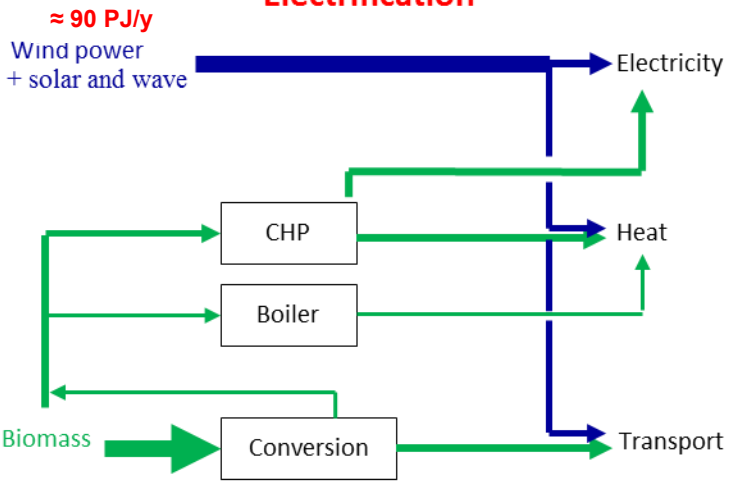
# The 4 system design configurations

## Standard bioenergy



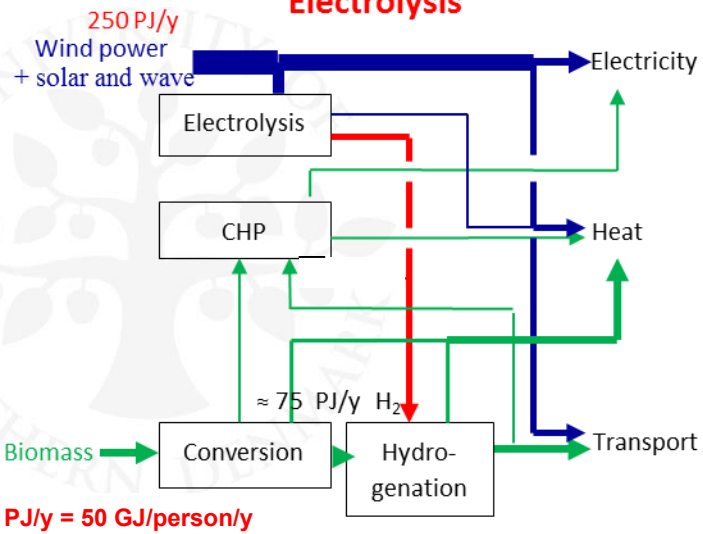

≈ 625 PJ/y = 120 GJ/person/y

## Electrification



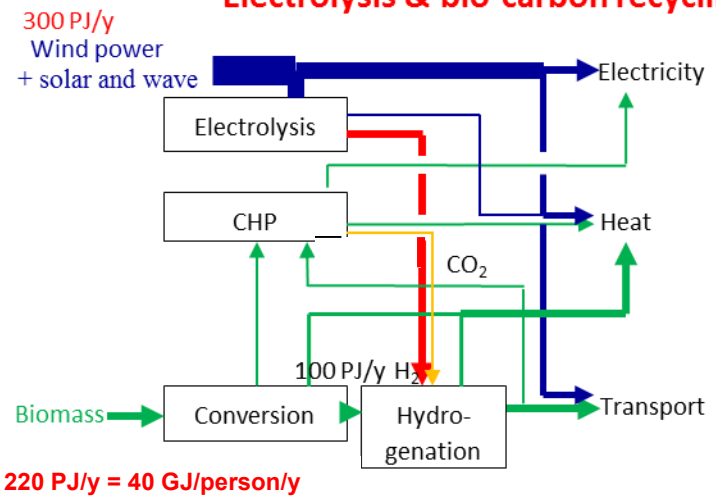

≈ 450 PJ/y = 80 GJ/person/y

## Electrolysis




≈ 280 PJ/y = 50 GJ/person/y

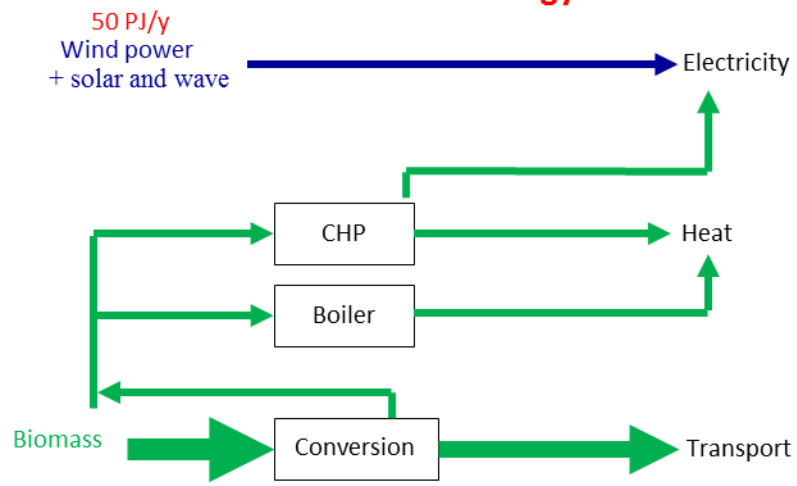
## Electrolysis & bio-carbon recycling




≈ 220 PJ/y = 40 GJ/person/y

# The 4 system design configurations

## Standard bioenergy

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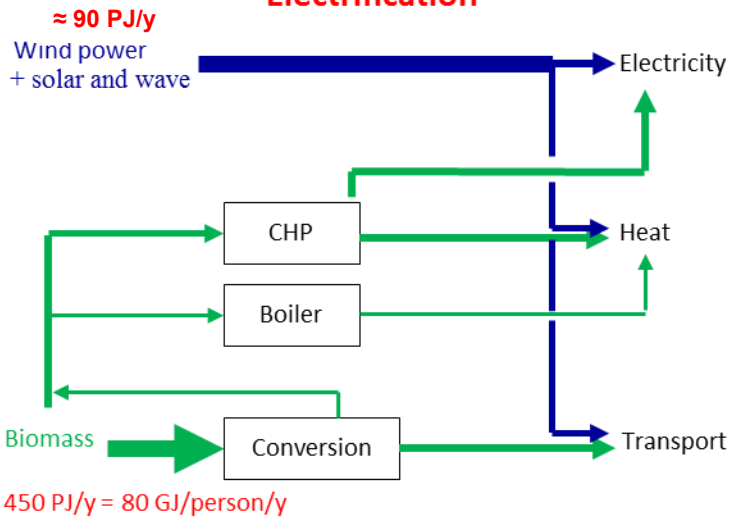


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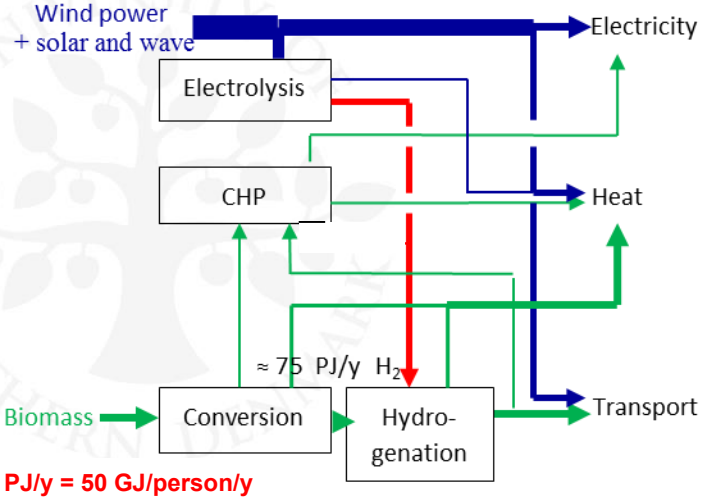


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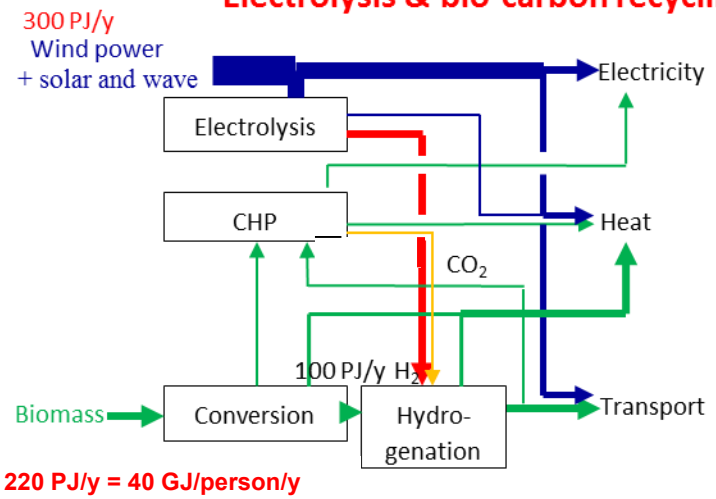
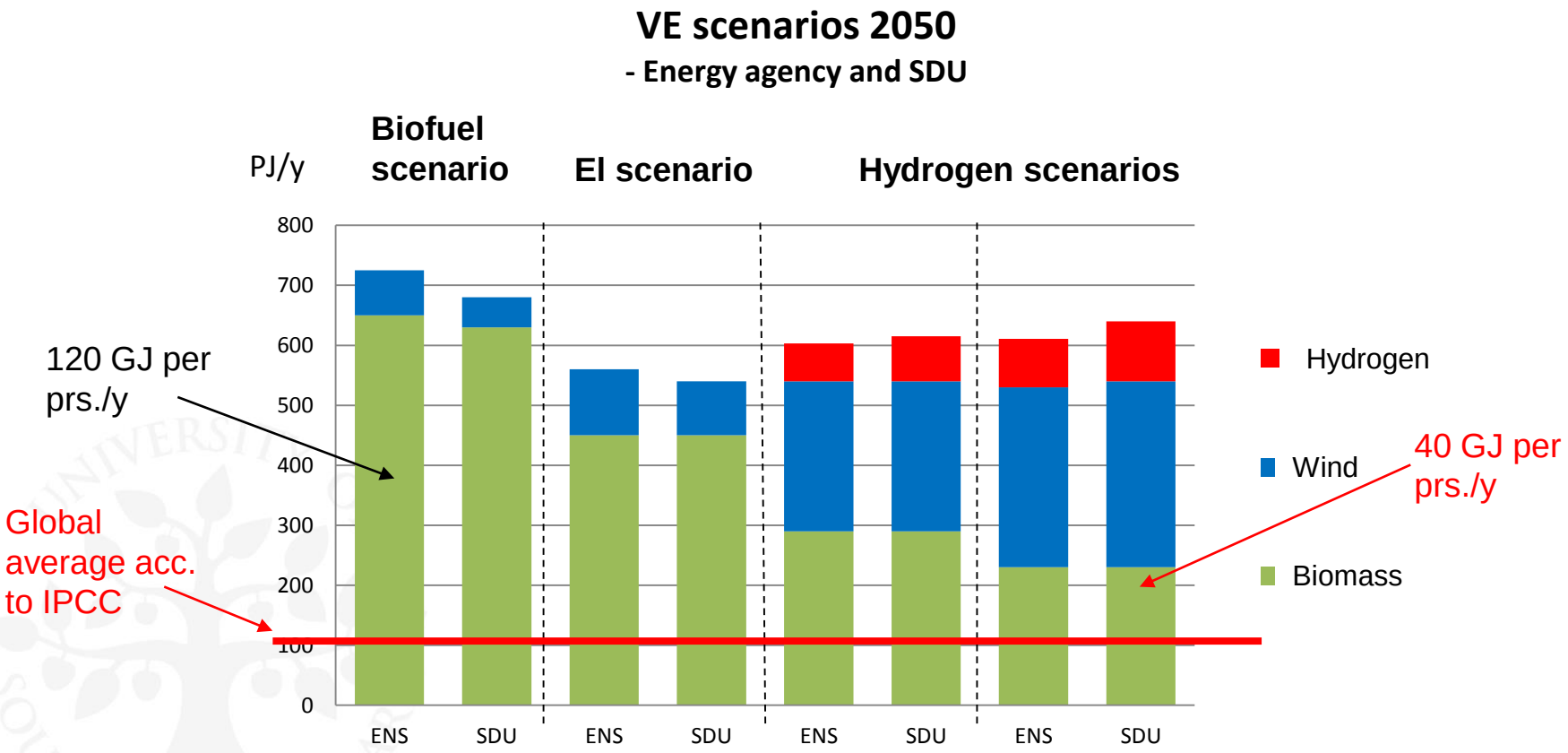



≈ 220 PJ/y = 40 GJ/person/y

Global biomass availability in 2050 = 100 – 300 EJ/year (IPCC, 2011 ) = 10 – 30 GJ/person

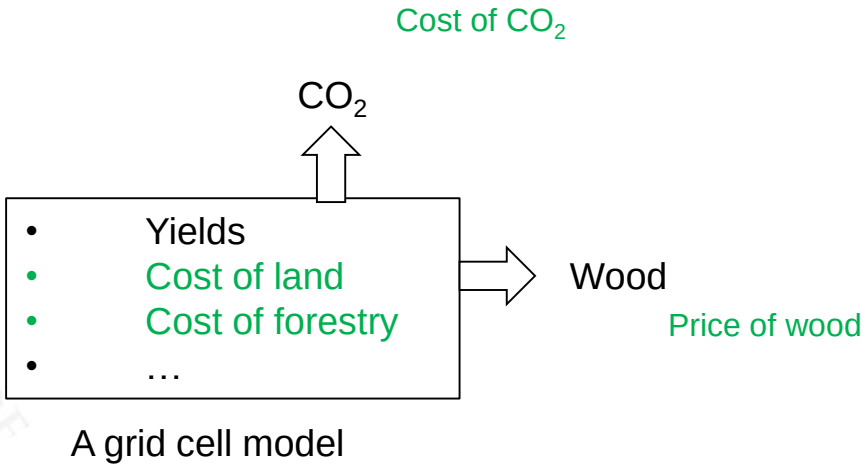
# VE system designs 2050

## – VE resources



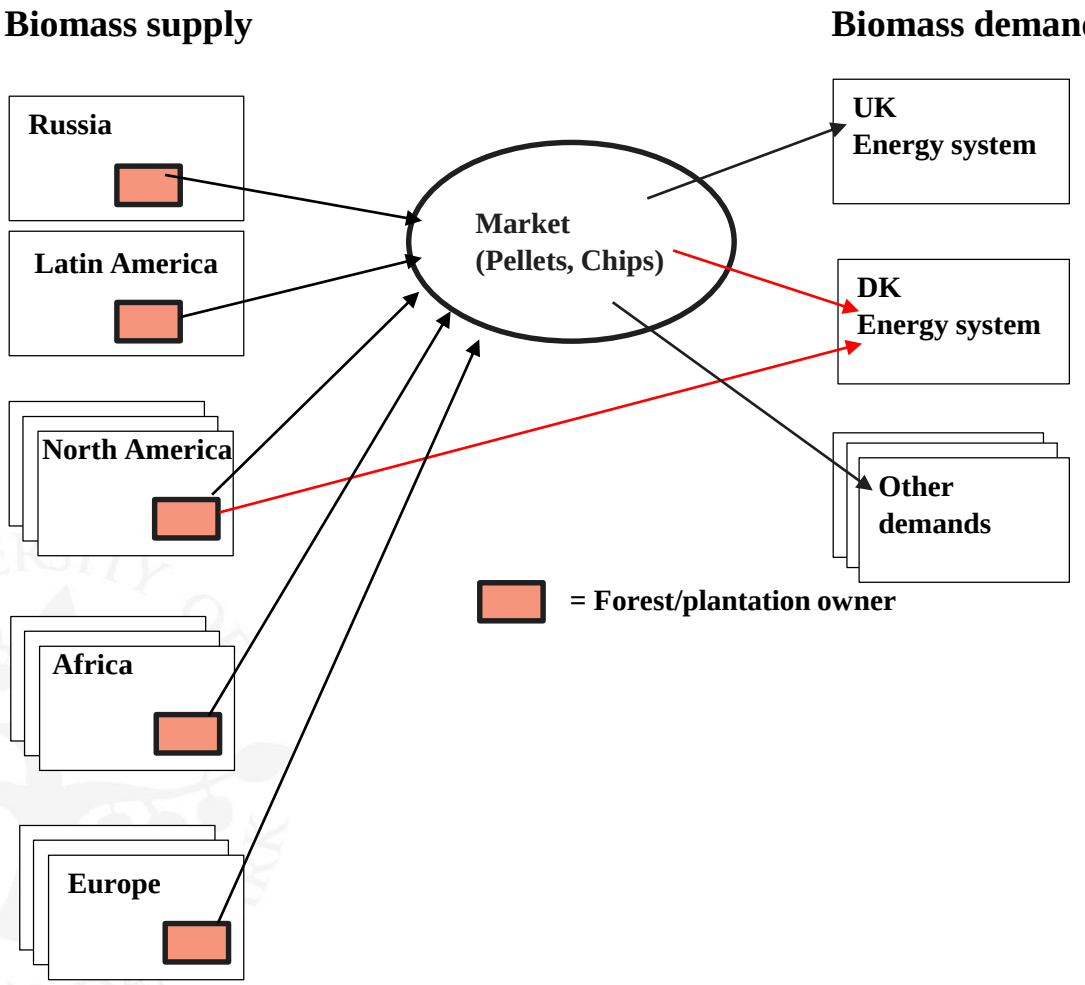

Even the most avanced VE scenario uses twice as much biomass as the 10 – 30 GJ/prs./y available as global average according to IPCC (2011)

# Modelling biomass supply
## - the GLOBIOM econometric model




Based on a partial equilibrium econometric model, the probable suppliers of wood for energy are identified under varying conditions for biomass price and $CO_2$ price

# Identifying the response to a Danish change in demand

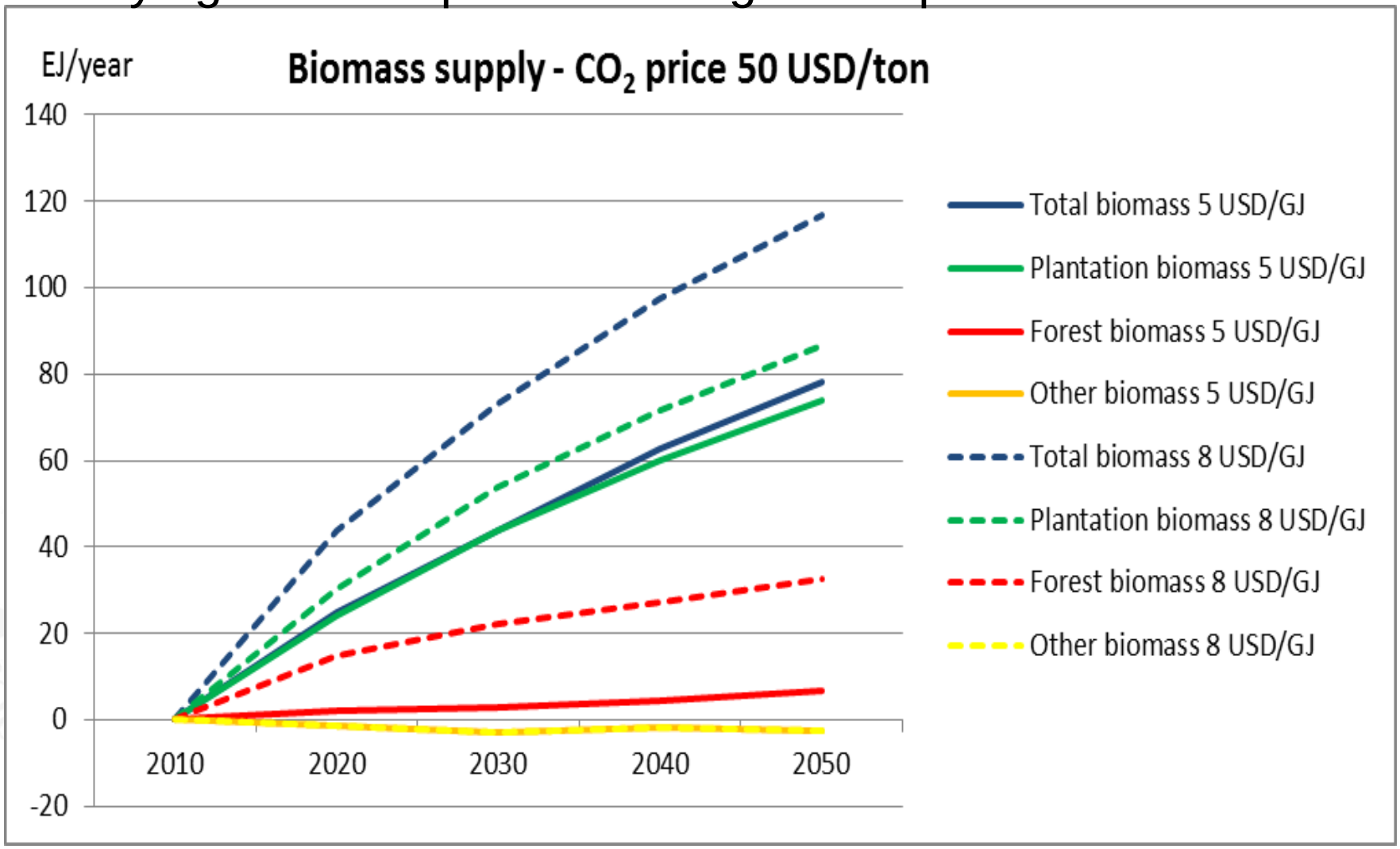


**When identifying the global biomass marginal, the assumption on the scale of global bioenergy production is decisive**

**The scale of bioenergy production is, in turn, dependant on biomass market prices.**

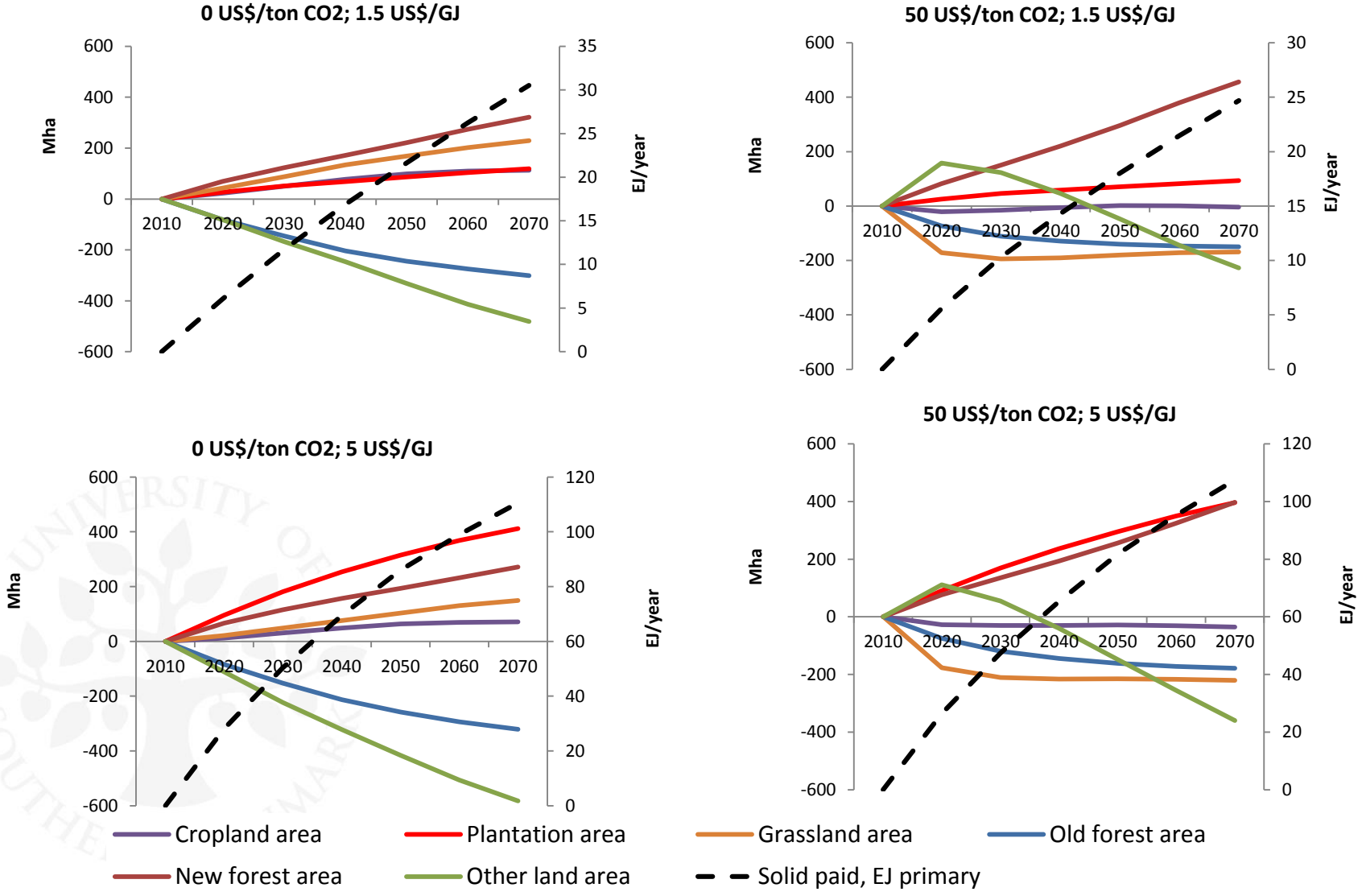
# Partial equilibrium model of biomass supply

- at varying biomass prices and high CO2 price



# Partial equilibrium model of land use change

- at varying biomass and CO2 prices



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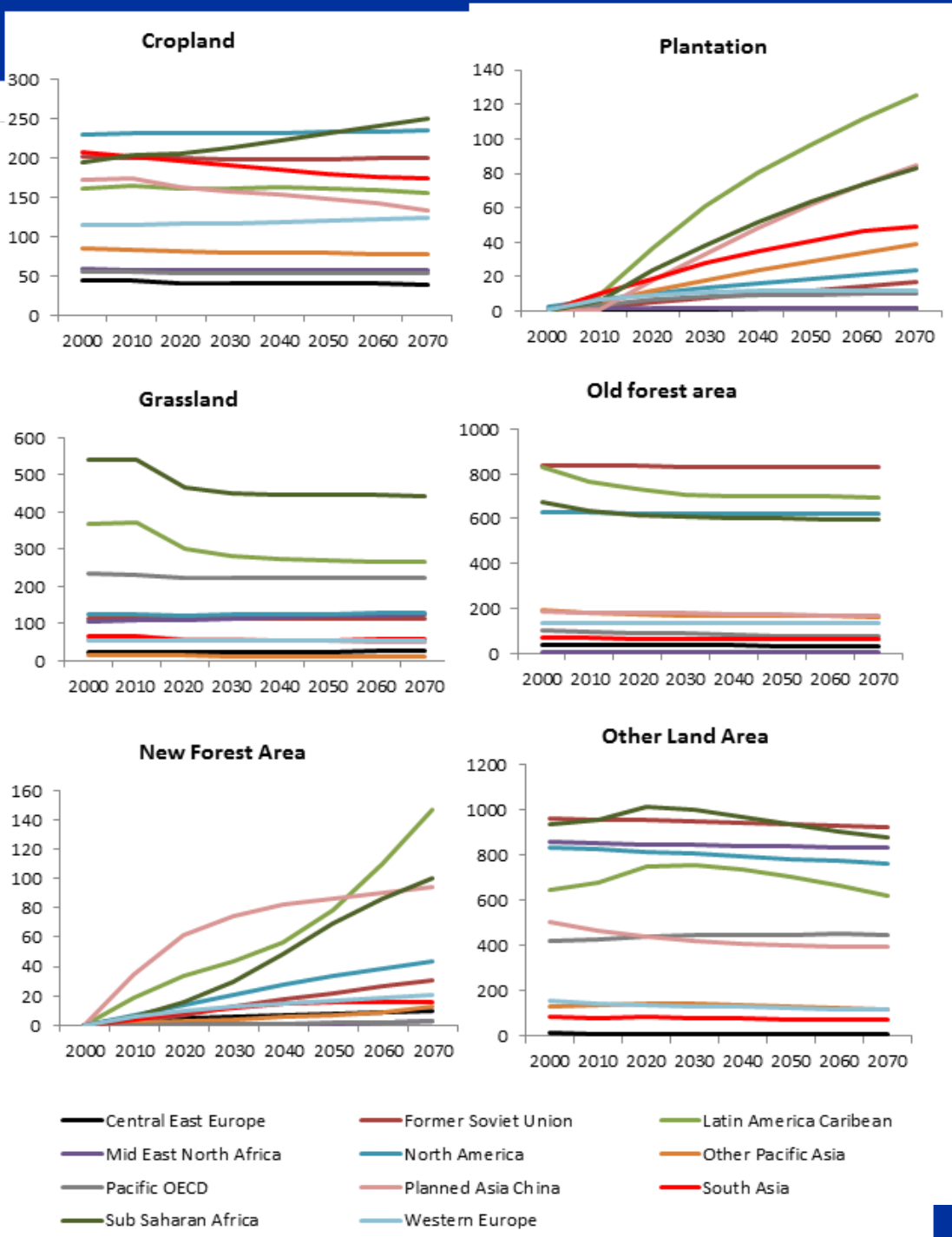
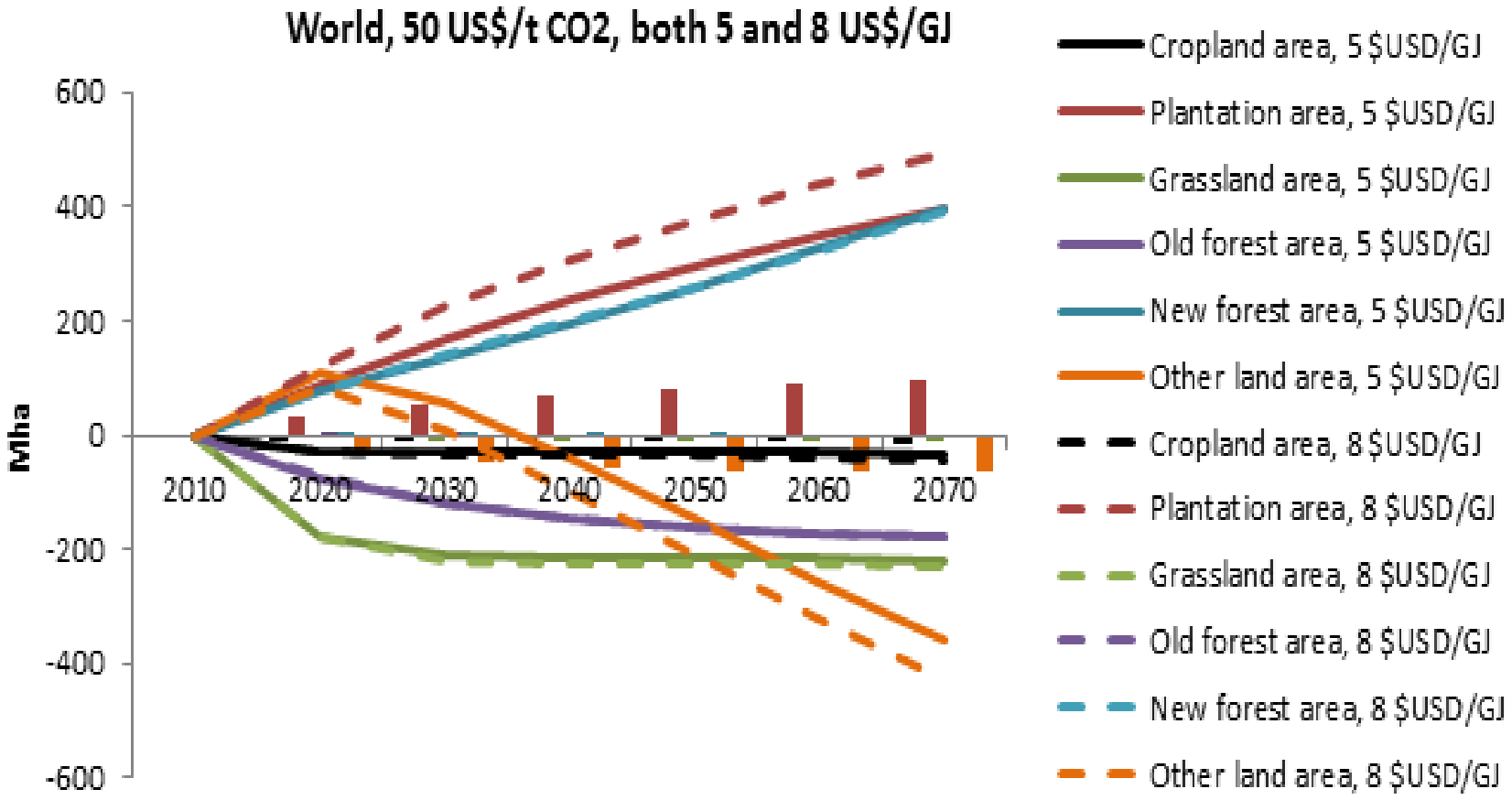


# Partial equilibrium model of land use change

- incremental change at demand increase




- what is the effect of a marginal change in demand?

# Global biomass-for-energy marginals

- overview of most probable candidates in an IPCC 2 °C RE world

| Biomass origin | Scale of availability |
|---|---|
| Plantation on grassland with no or low ILUC | Up to 40 EJ/year |
| Forestry thinnings & residues | Up to 10 EJ/year |
| Yield increases from forestry intensification | Up to 10 EJ/year ?? |
| Plantation on 'other land' (savanna, cerrado, …) | Above 80 EJ/year |
| Harvest from existing forest | … |
| Plantation on forest land | … |

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| Harvest from existing forest | … |
| Plantation on forest land | … |
| New cropping schemes in agricultue | Potentally high e.g. in Denmark |

# The origin of biomass

## - in a global Renewable Energy scenario?

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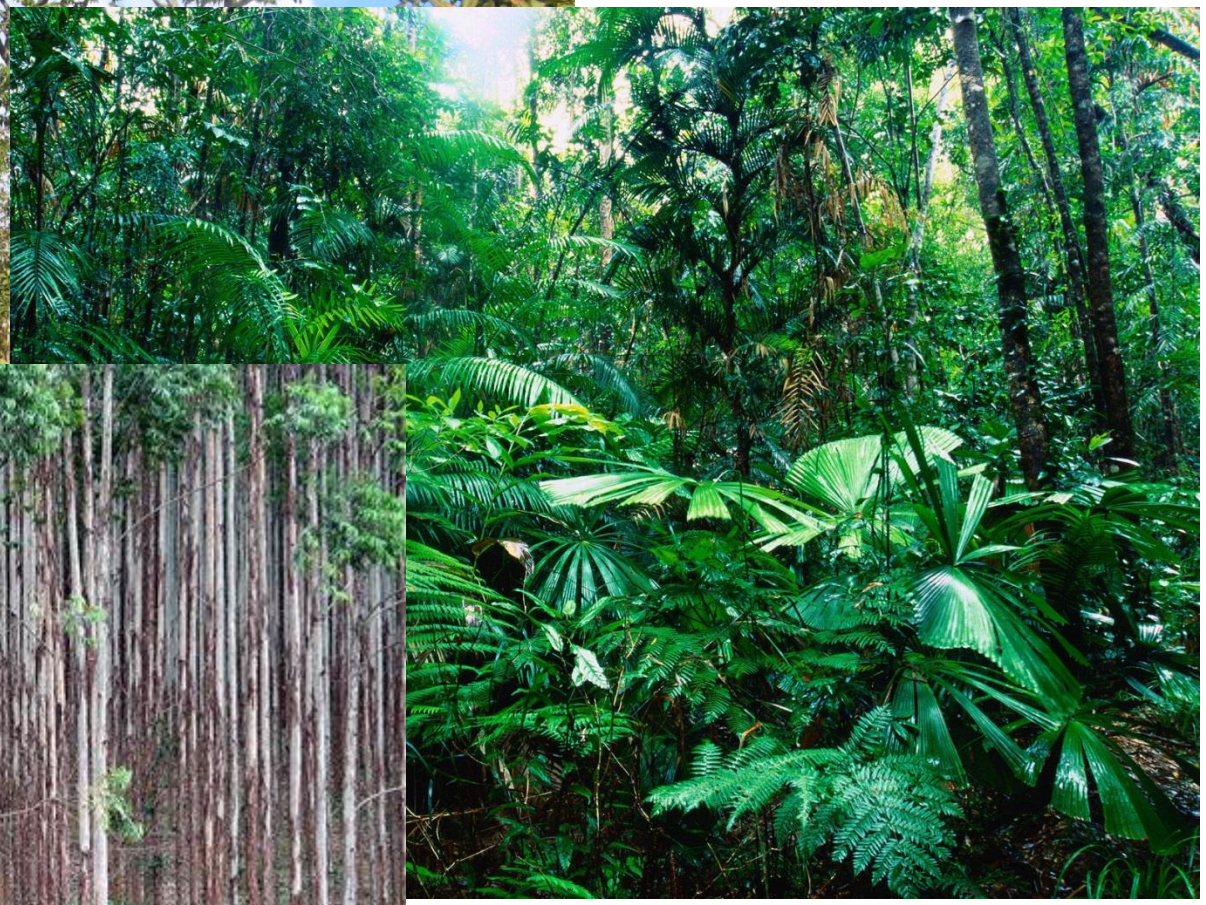

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## - in a global Renewable Energy scenario?

Eucalyptus harvest

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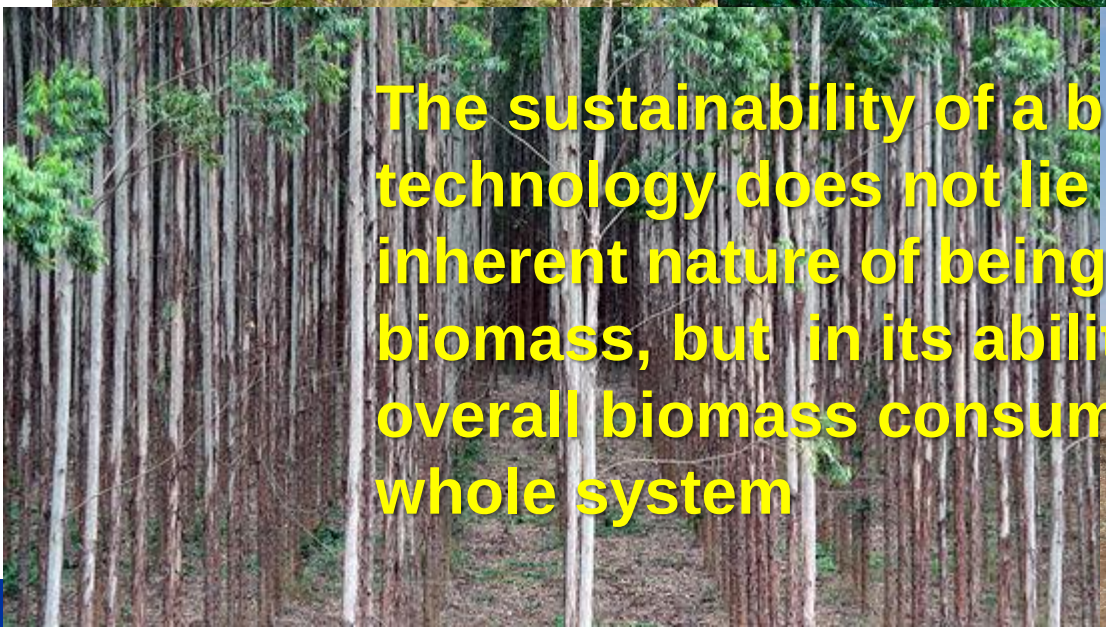

**The sustainability of a bio-energy technology does not lie in its inherent nature of being BASED ON biomass, but in its ability to SAVE overall biomass consumption in the whole system**

# Thank you for your attention