



Sustainable Chain Assessment Of Biofuel-driven Biorefineries

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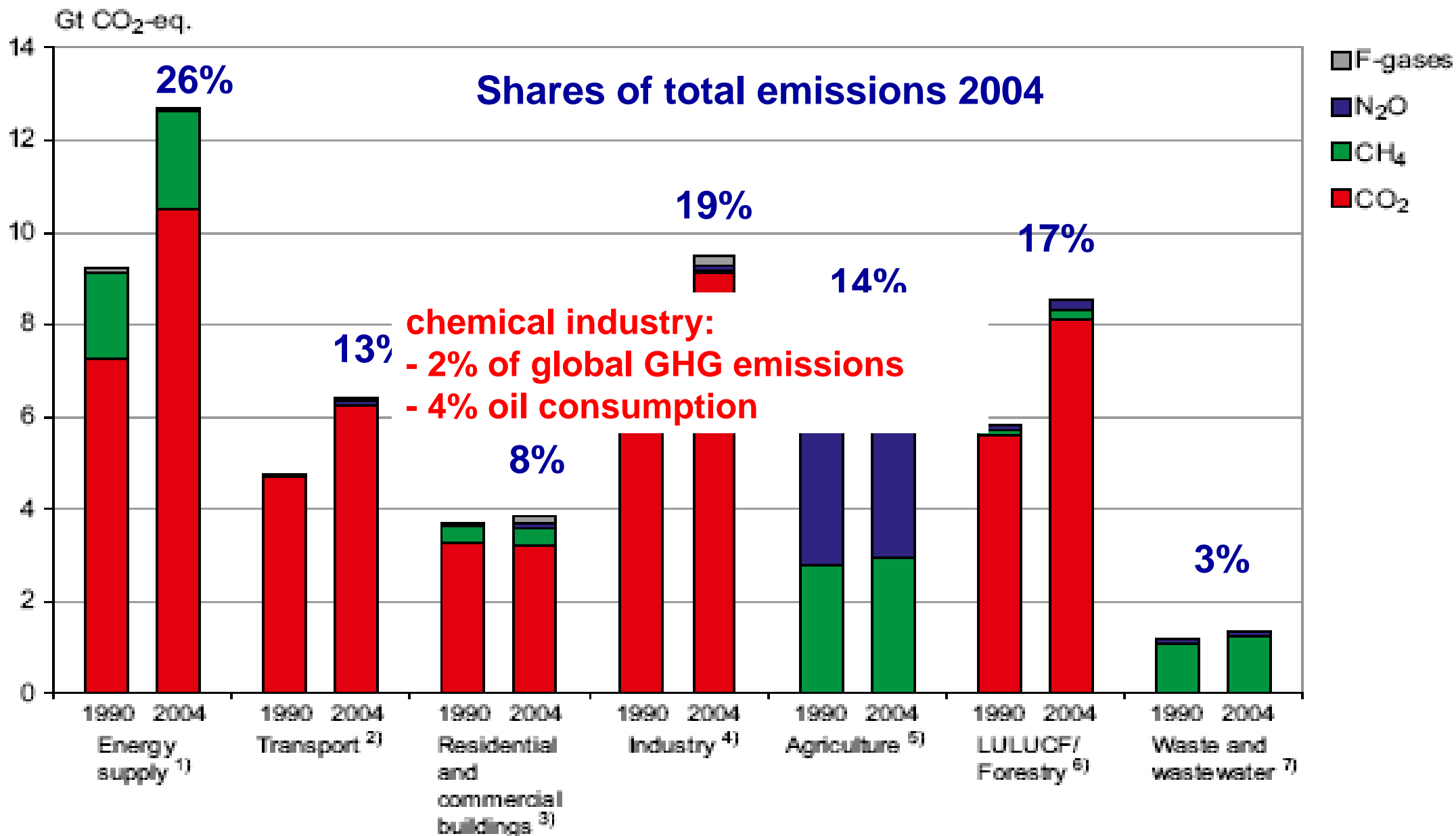
IEA Bioenergy | Task 42 Biorefinery

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KOOPERATION

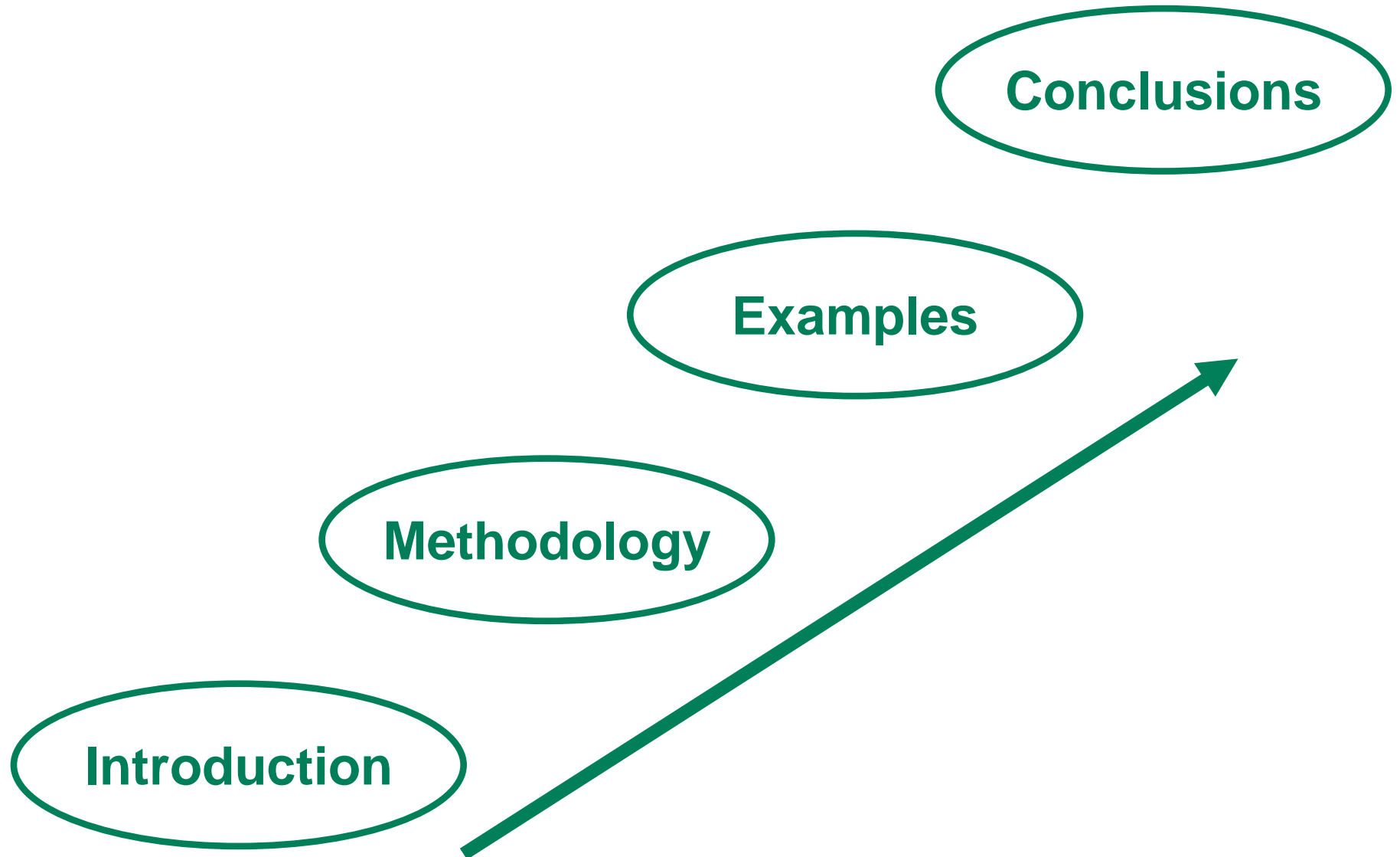
Italian Stakeholder Meeting - 4 April 2011, Tortona, Italy

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Development Greenhouse Gas Emissions per Sector 1990 - 2004



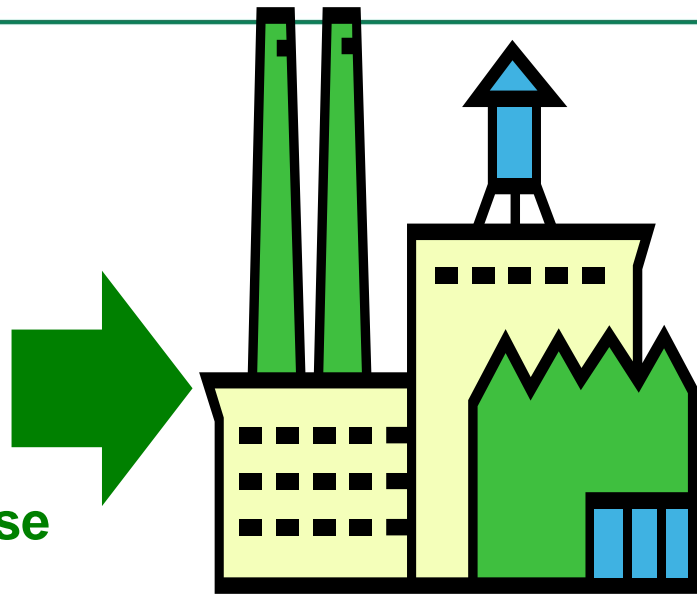
Outline



Scheme of a Biorefinery

Biomass Resources

- oil
- starch
- sugar
- lignocellulose
-



Biorefinery

Based on different conversion processes

- Bio-chemical
- Thermo-chemical
- Physical-chemical
- Others

Bioenergy

- liquid/gaseous transport biofuels
- electricity
- heat
- solid fuels

Bioproducts

- bulk chemicals
- fine chemicals
- animal feed
- food
- materials
- fertilizer
- gases
-

„Bioenergy-driven“ Biorefinery Concepts

Transportation biofuels:

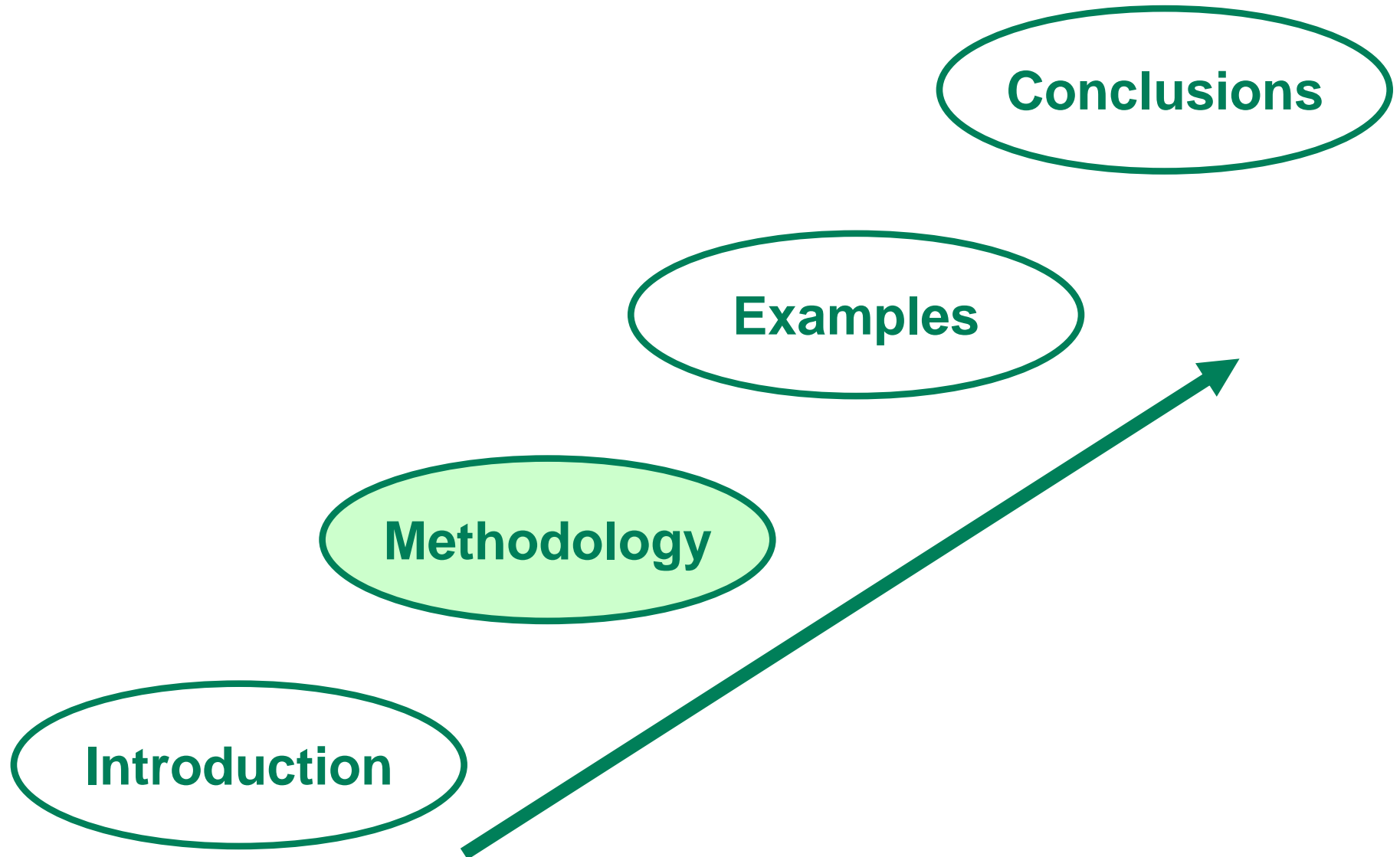
- ✓ Biodiesel
- ✓ Bioethanol
- ✓ FT-Biofuel
- ✓ Biomethan from biogas and SNG (synthetic natural gas)

Biomass feedstocks:

- ✓ Oil crops and residues
- ✓ Starch and sugar crops
- ✓ Wood
- ✓ Staw
- ✓ Gras
- ✓ Saw mill residues
- ✓ Sulfite spent liquor
- ✓ Algae

Draft suggestion from IEA Bioenergy Task 42
for most interesting
Biorefinery concepts up to 2025

Outline



Sustainability Assessment of Biorefineries



**Environmental
aspects**

**Economic
aspects**

**Social
aspects**

Based on

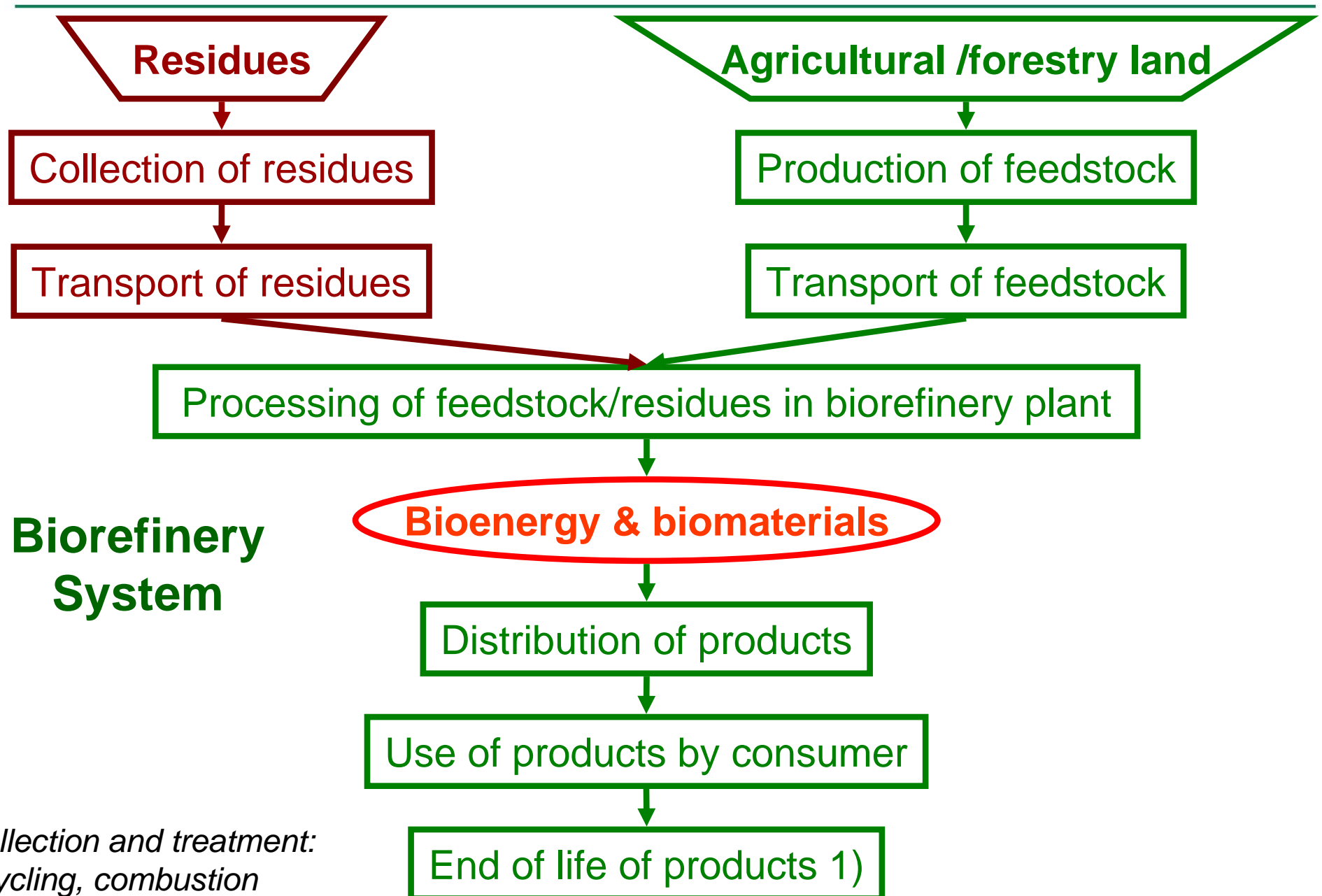
✓ ***Whole value chain***

✓ ***Life cycle***

✓ ***Comparison to
conventional system***

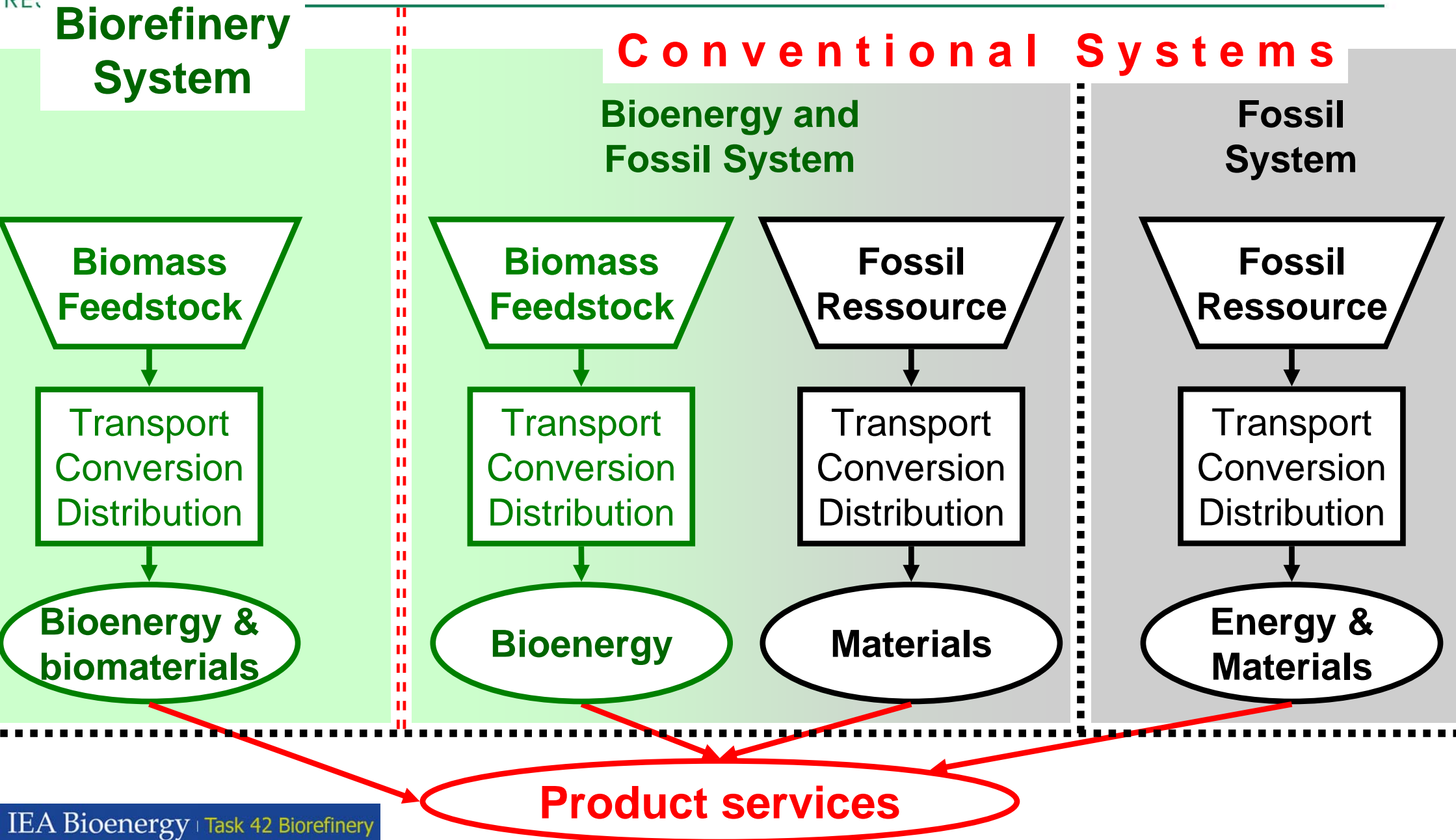
Sustainability

The “Value Chain of a Biorefinery”



1) Collection and treatment:
e.g. recycling, combustion

What are the „Conventional Systems?“



Biorefinery system

Reference system with fossil resource

Land use change (LUC)

Collection of residues

Residues

Cultivation of biomass

Area

Reference use

Fossil resource

Extraction of fossil resource

Production conventional product

Transport of fossil resource

Transport of feedstock

Products of reference use

Processing to fossil products

Processing to bioproducts

Distribution of fossil products

Distribution of bioproducts

Use of fossil products

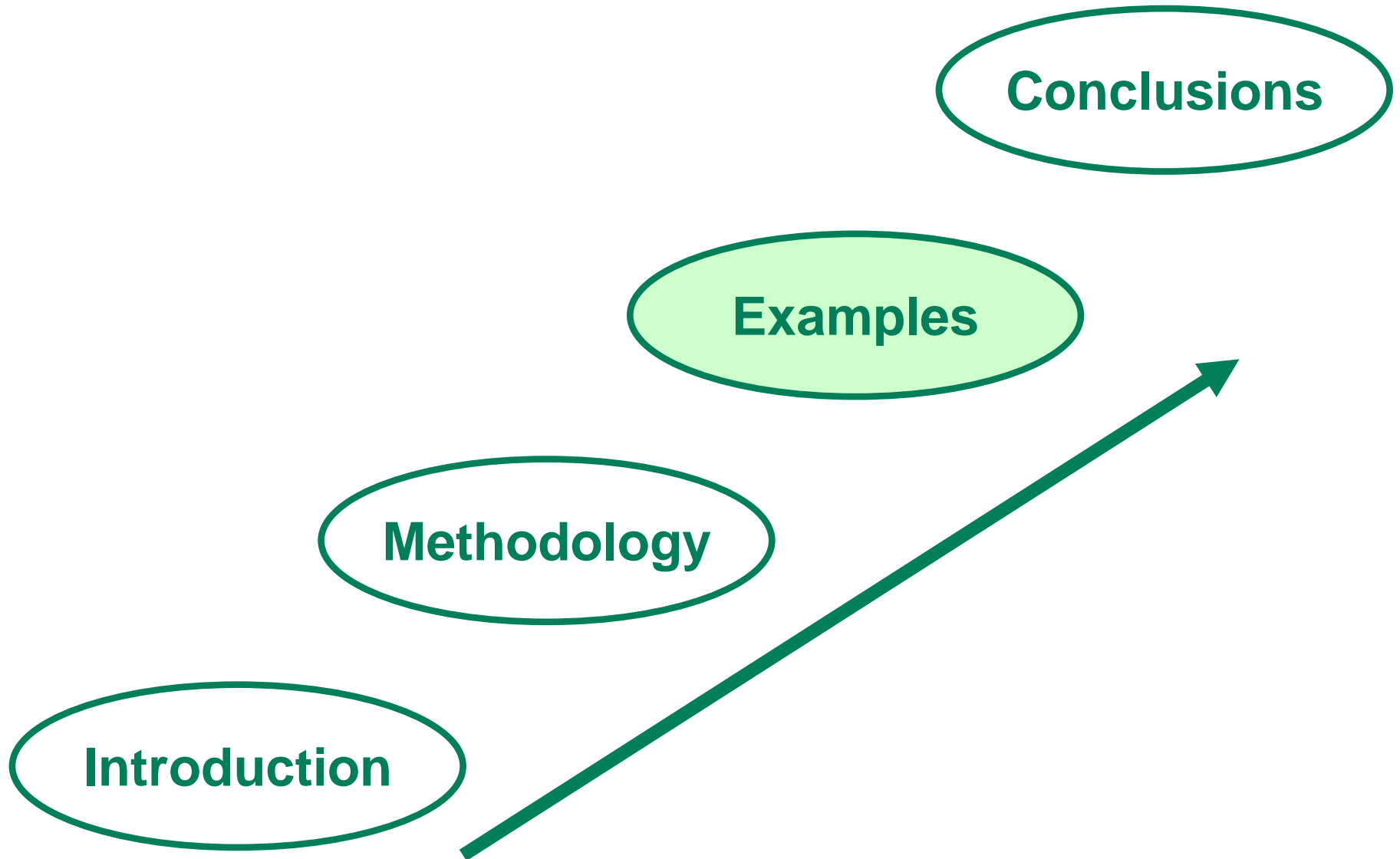
Use of bioproducts

End of life of bioproducts

Product services

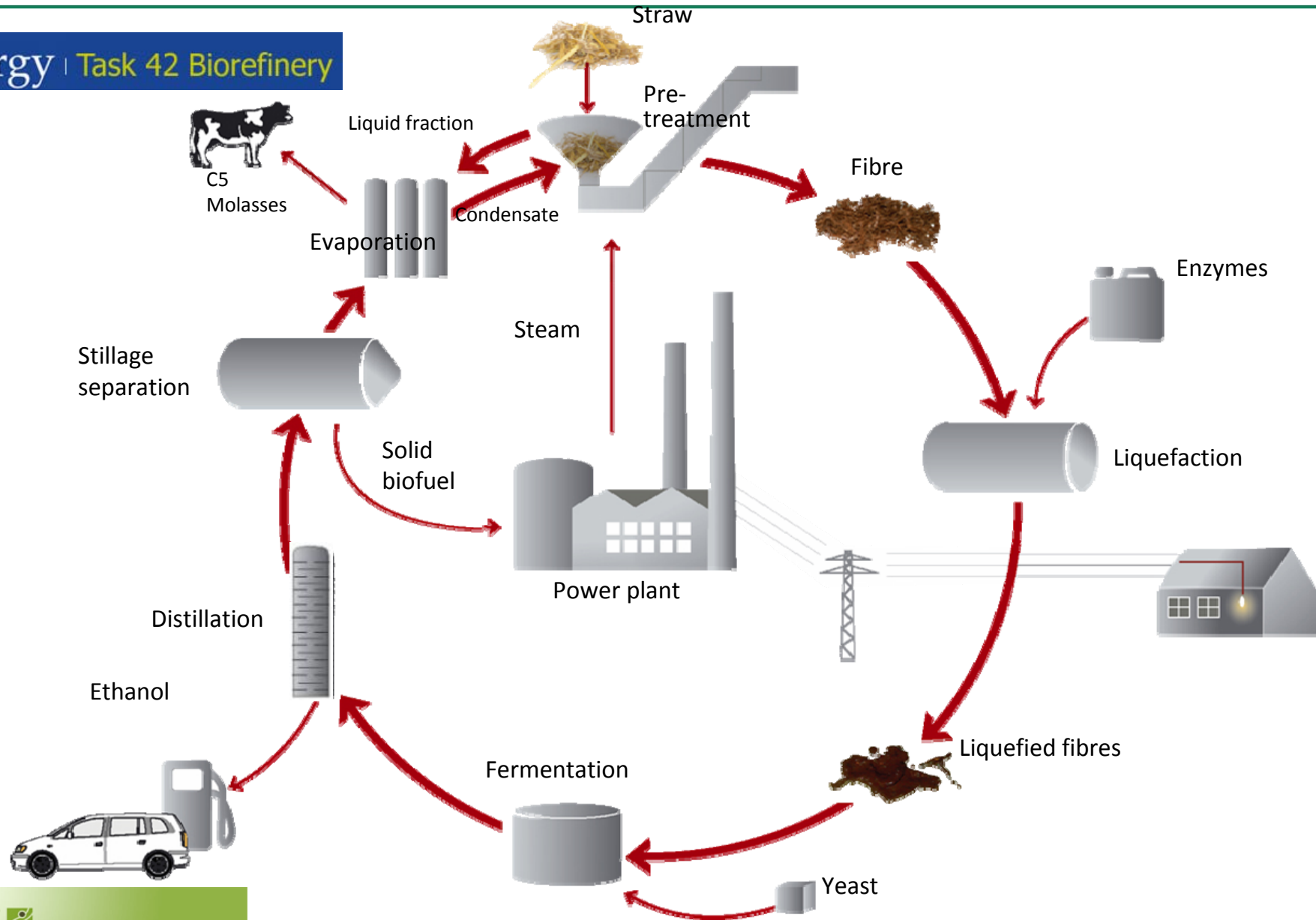
End of life of fossil products

Outline



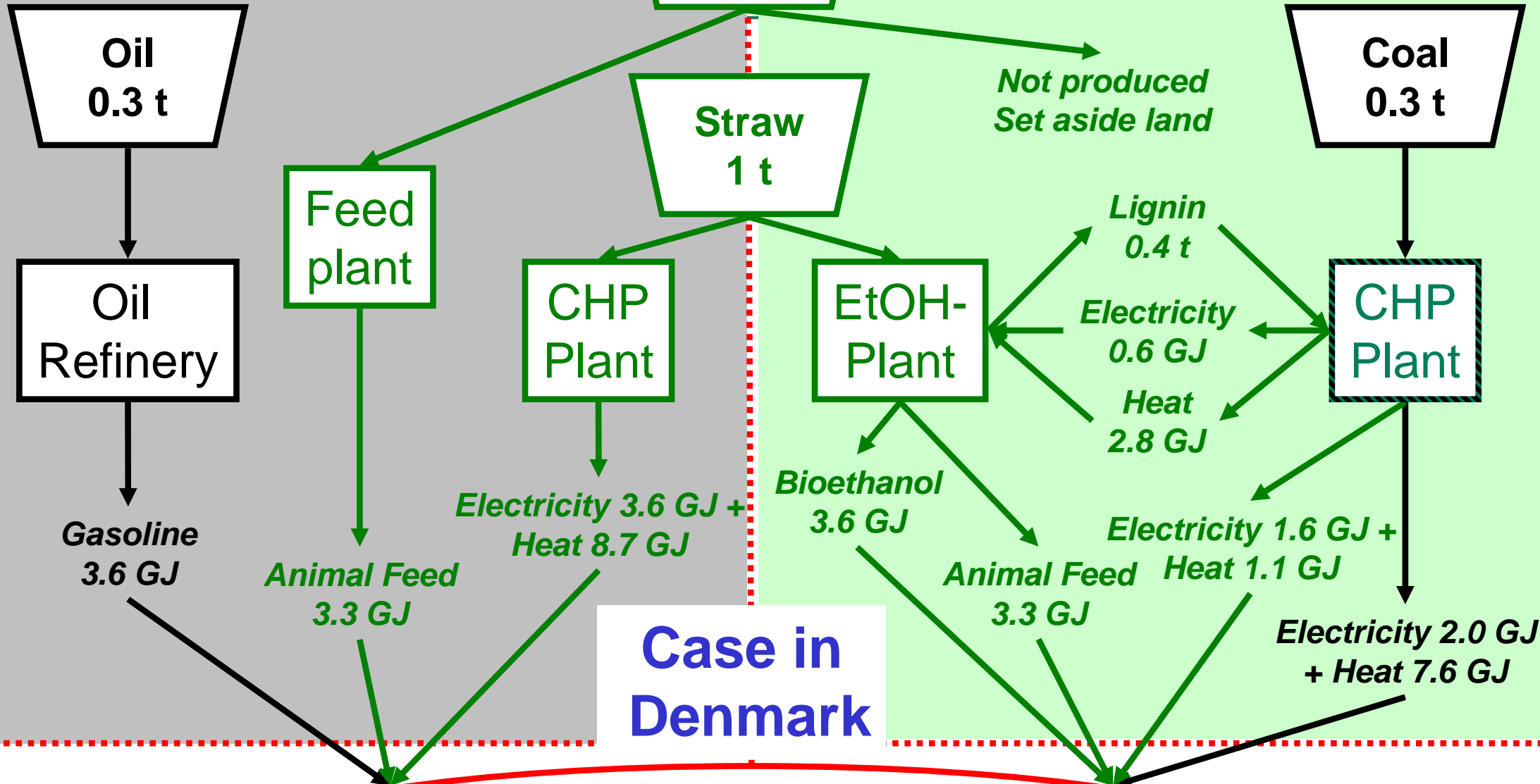
Example 1: Demonstration Plant IBUS Biorefinery Denmark

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Conventional System

Biorefinery System



3.6 GJ Transportation fuel + 3.6 GJ Electricity + 8.7 GJ Heat + 3.3 GJ Animal Feed

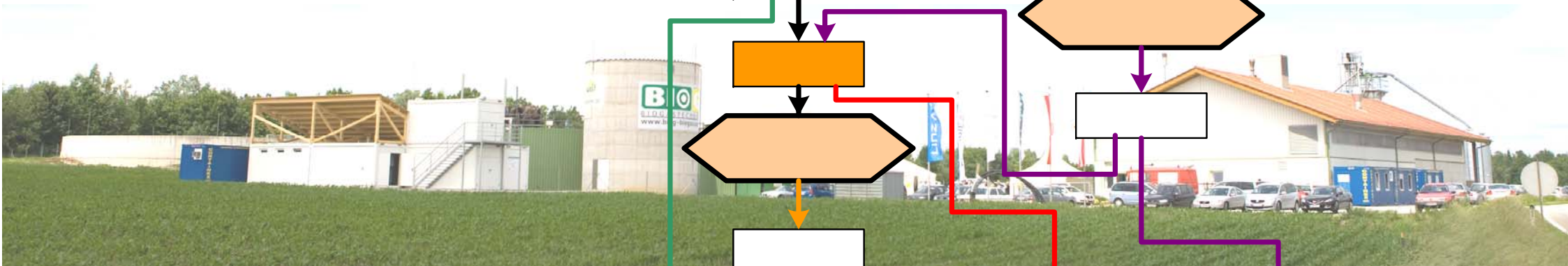
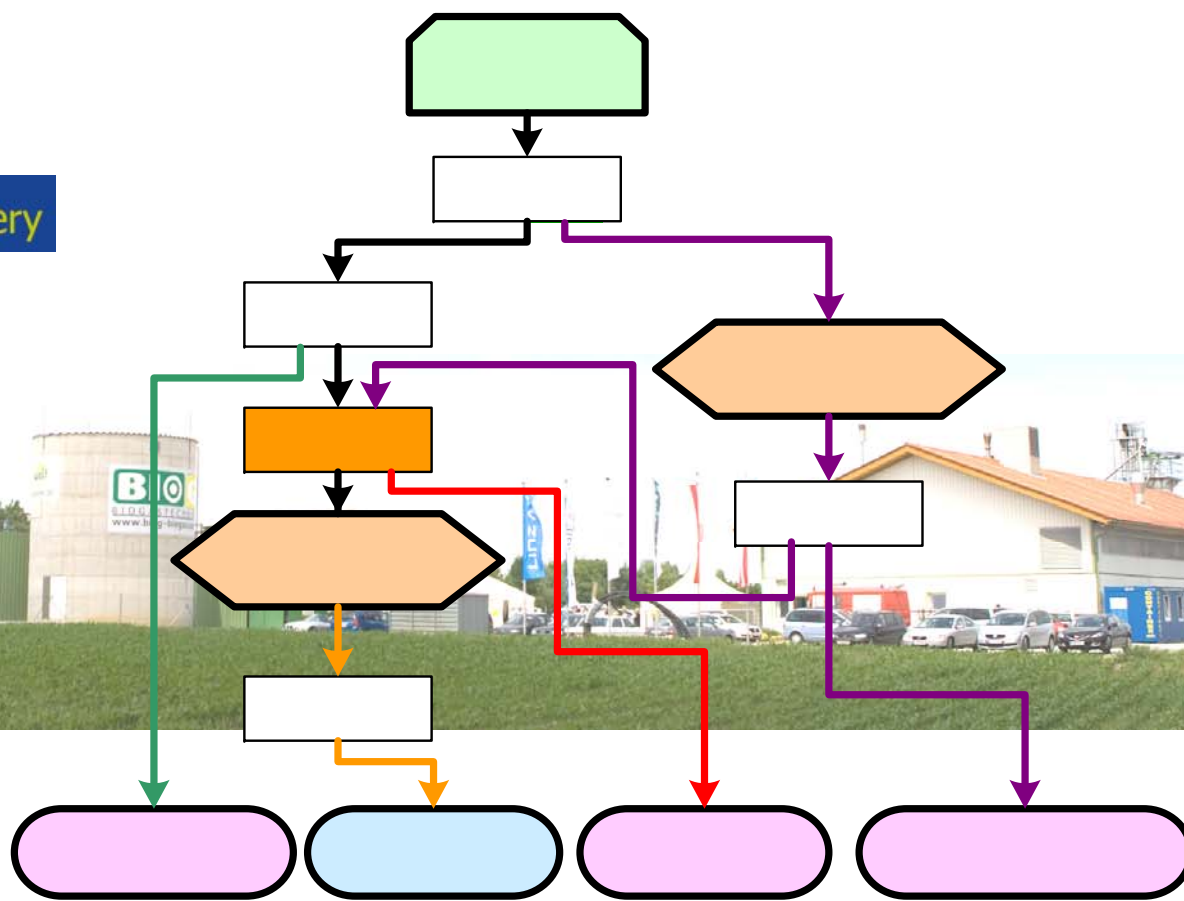
Example 2: Demonstration Plant „Green Biorefinery“, Austria

Upgrading of grass silage to

- lactic acid,
- amino acids and
- biogas (biomethan)

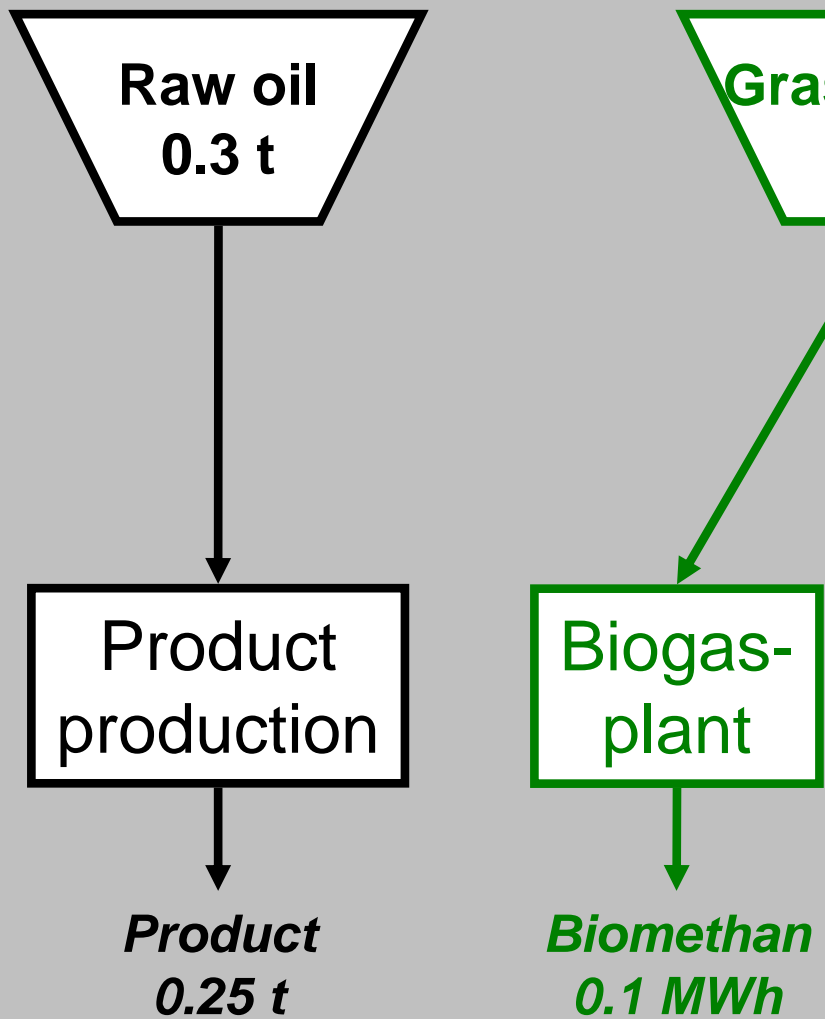
“A Two Platform Biorefinery with Grasses for Biomethan - Biogas, organic solution”

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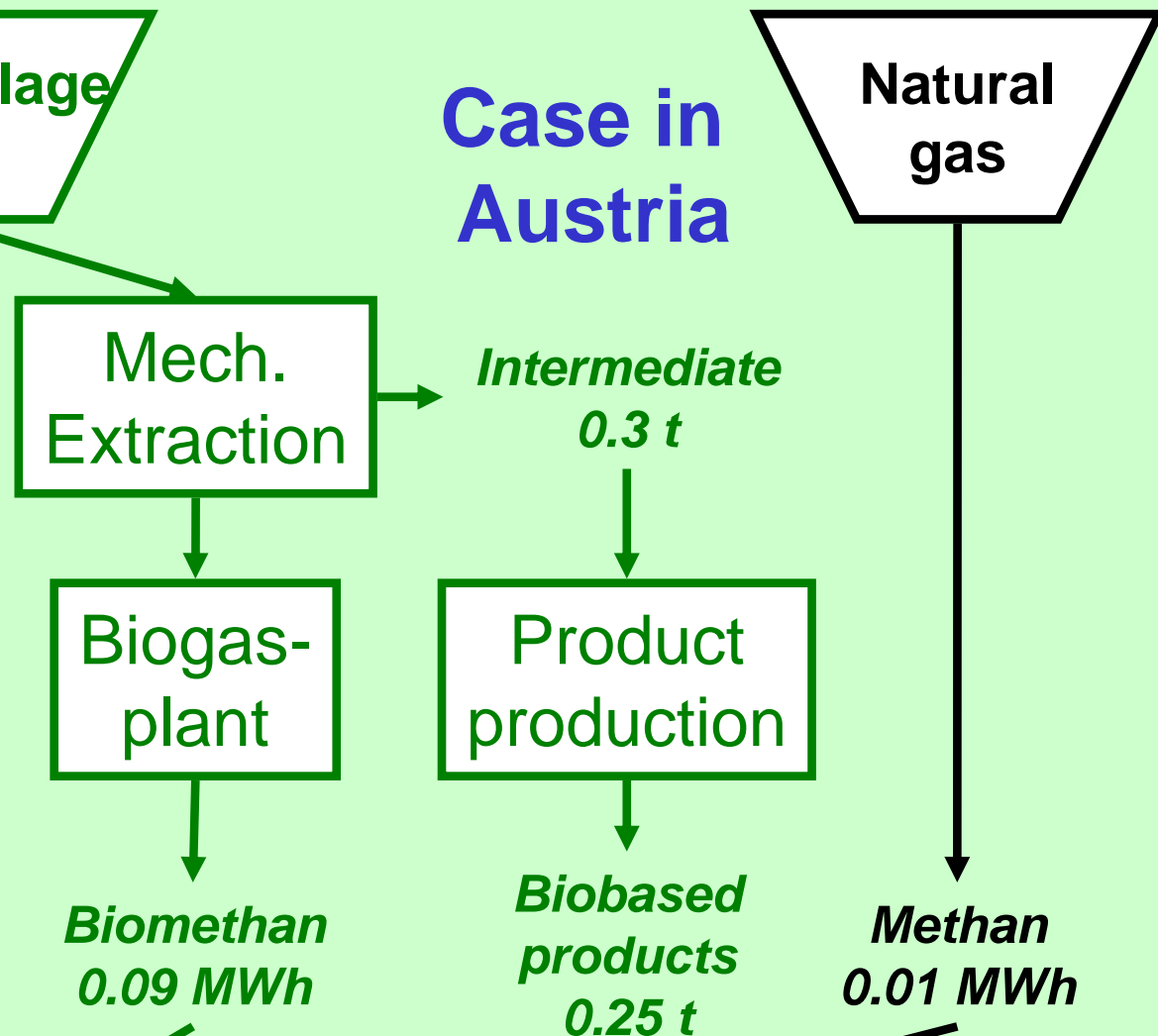
Conventional System

Biogas and raw oil



Biorefinery System

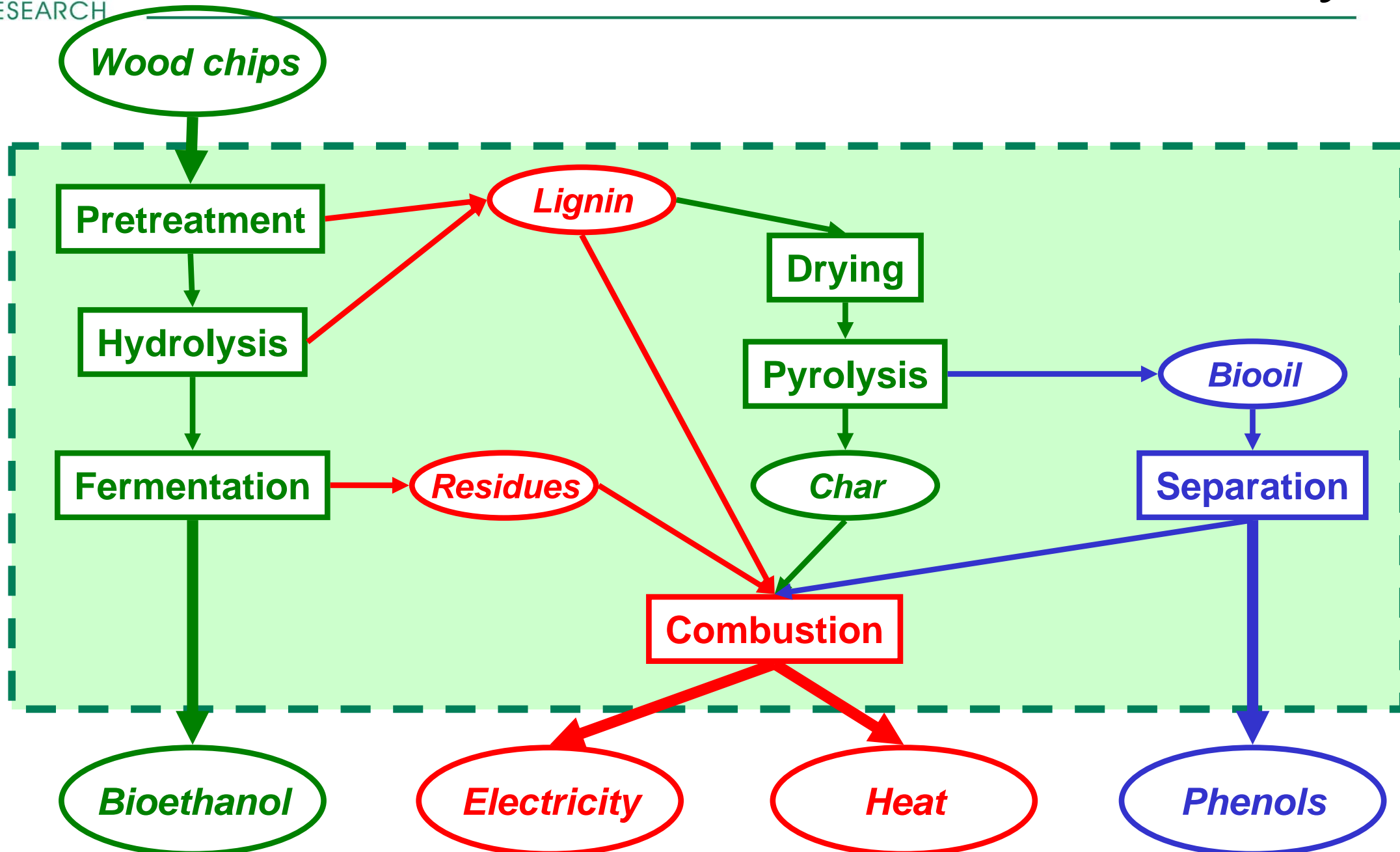
Biorefinery and natural gas



Case in Austria

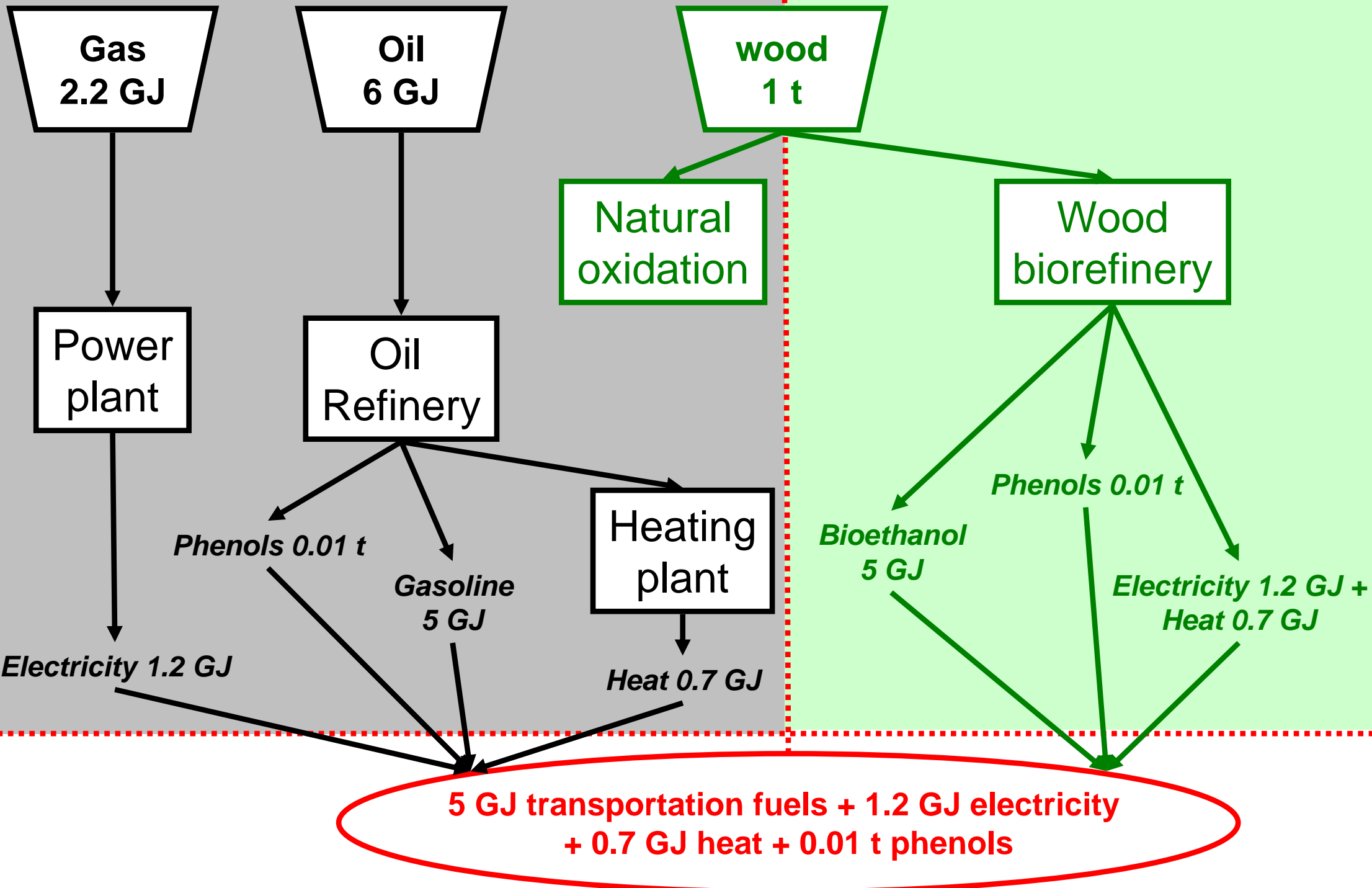
0.1 MWh Methan and 0.25 t Products

Exampel 3: Wood Bioethanol Biorefinery



Conventional System

Biorefinery System



Wood Bioethanol Biorefinery compared to Conventional Systems

Systems	Product services			
	Heat 110 GWh/a	Electricity 175 GWh/a	Transportation service *) 1,000 Mio. km/a	Phenols 5,600 t/a
Wood bioethanol biorefinery	wood			

*) Bioethanol: 100.000 t/a

**) Combined heat and power

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Wood polygeneration, con. phenols	wood			oil

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Wood heating, natural gas, gasoline, con. phenols	wood	natural gas	gasoline	oil

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Fossil reference system	oil	natural gas	gasoline	oil

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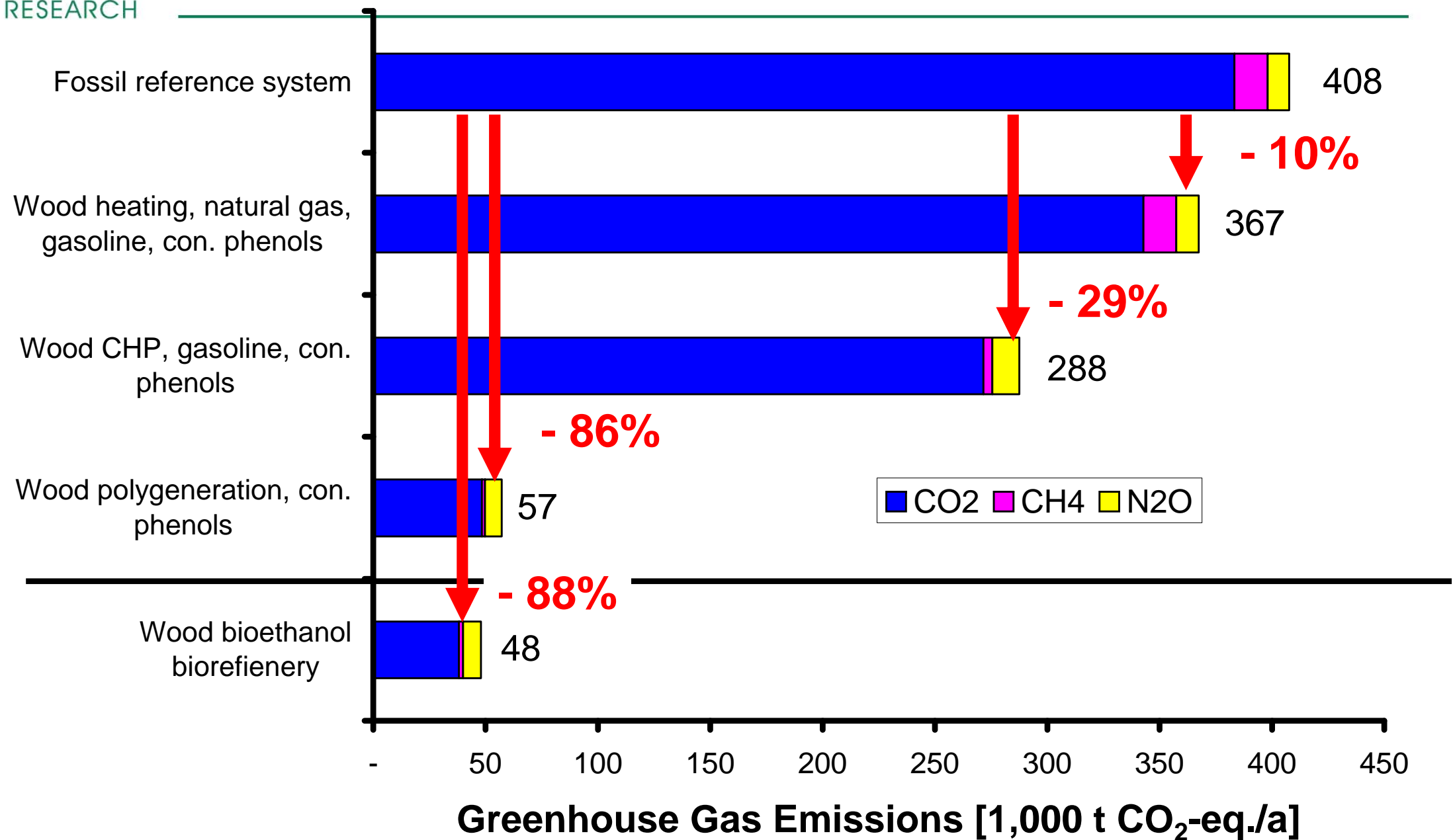
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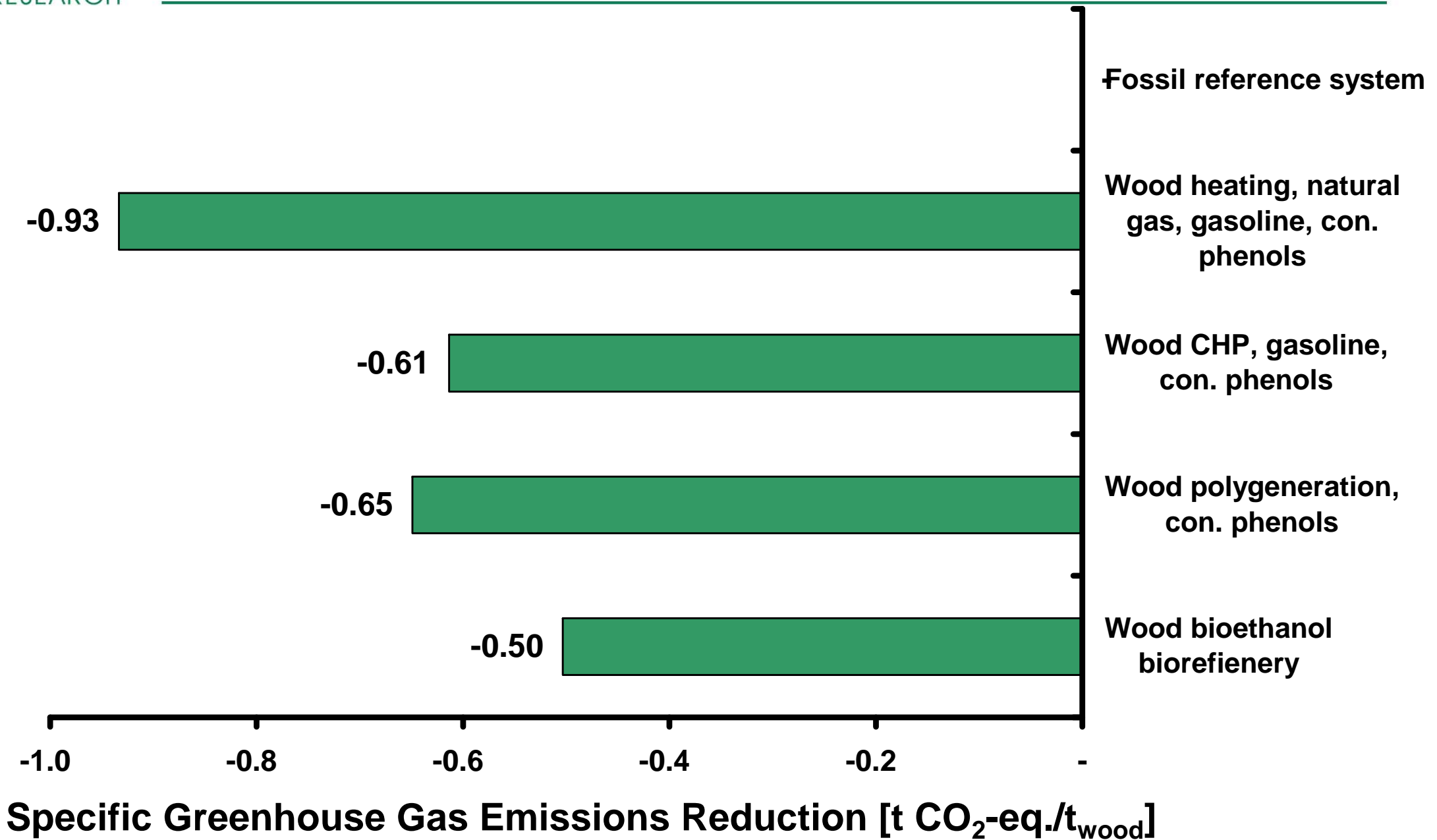
Conventional systems

*) Bioethanol: 100.000 t/a
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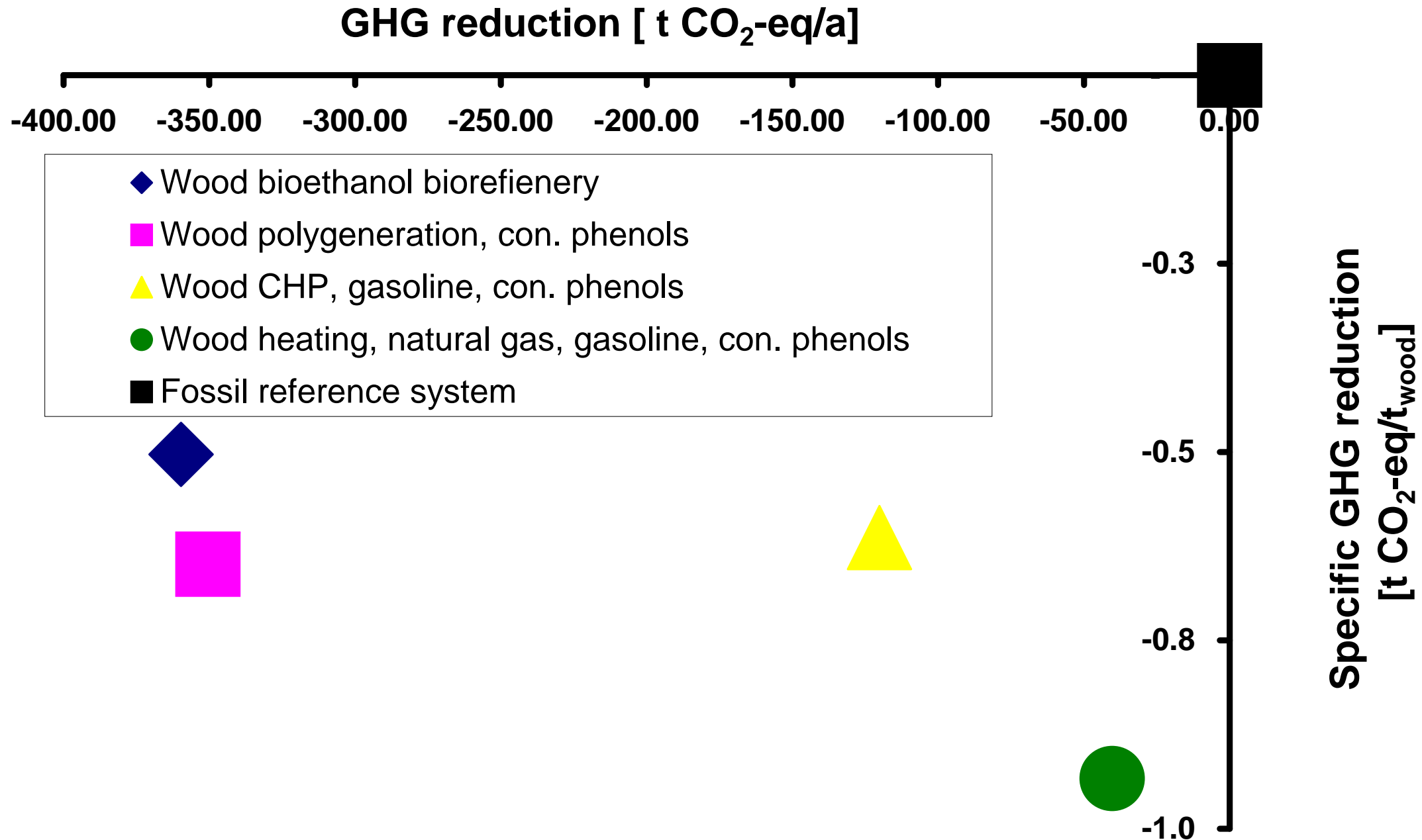
Annual Greenhouse Gas Emissions



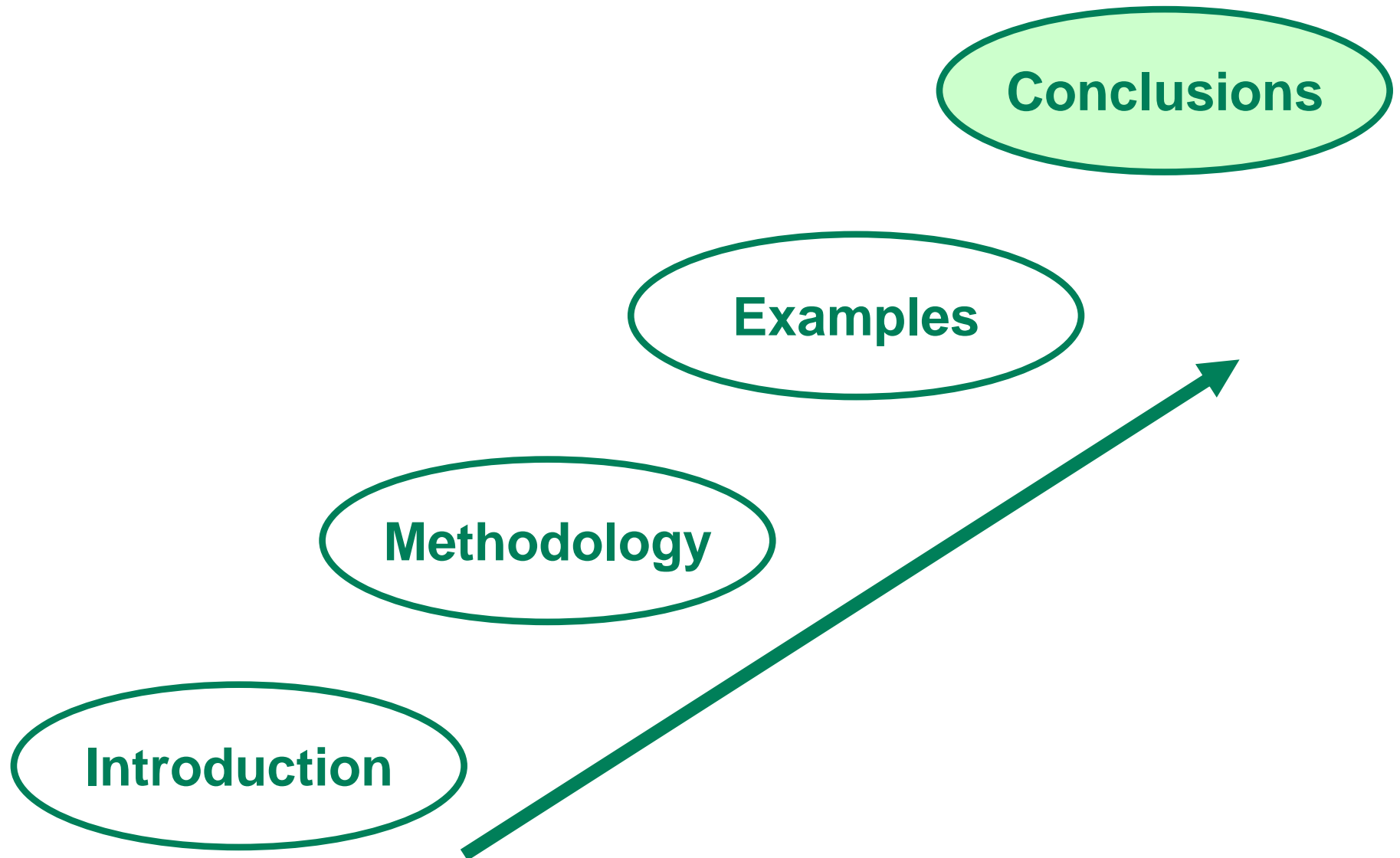
Specific Greenhouse Gas Reduction



Indicator for Environmental Evaluation: Trade Off



Outline



Conclusions

Outlook: Case studies will be analysed by IEA Bioenergy Task 42 „Biorefineries“

Relevant for all aspects of sustainability: economic, environmental and social

Comparative assessment of systems providing same services by considering same amount of biomass and land

Conventional system includes different fossil and biomass based systems (e.g. for heat&electricity)

Sustainability assessment of biorefineries on whole chain approach by using same amount of biomass and land