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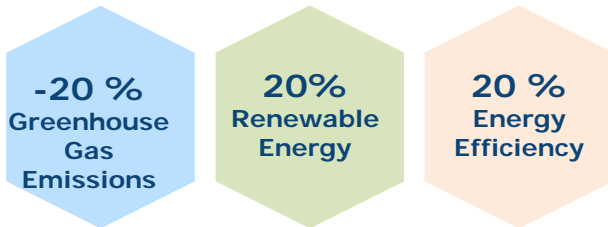
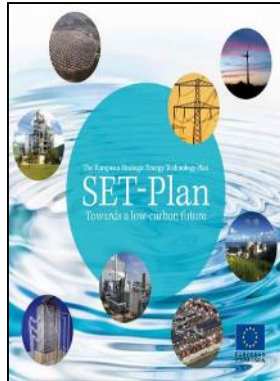
# BIO4 FUELS

ADVANCED BIOFUEL PRODUCTION WITH  
ENERGY SYSTEM INTEGRATION

Bio4Fuels will develop innovative technology to convert biomass and organic residues to sustainable fuels and energy

# The Scene for BioFuels

- Links to policy agenda: 2020 targets for energy & climate
- Focus on individual technologies with market and target impact up to 2020

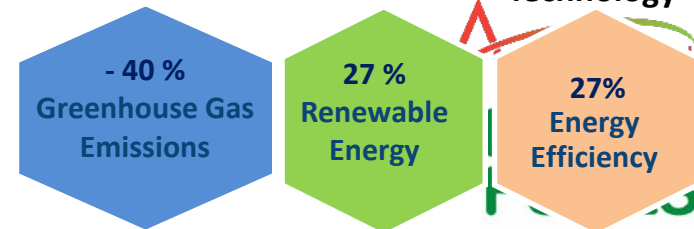
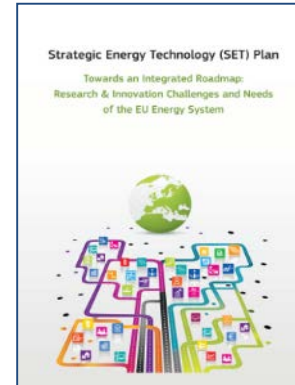


## RED II

- Renewable target: 32%
- Targets for Renewable Transport:
  - 14% overall,
  - 3.5% advanced

## Paris Agreement

- Limit Global warming to 1.5°C
- Reduction in CO2 emissions by 80-95%



- Links to policy agenda: 2030 targets for energy & climate
- Focus on :
  - Consumer
  - Energy Efficiency
  - System optimization
  - (Supply) Technology

# Introductory comments on Transportation Energy

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- Our market economy is based on growth
- Growth is based on energy, cheap energy which is abundantly available
- Today's energy systems
  - Limited cross sectorial integration
  - Overall efficiency is not a topic, sub-optimization in each individual sector
  - Fossil energy carriers have a high environmental cost
- New integrations across energy systems are needed
  - Sustainable sourced biobased feedstocks
  - Biomass as feedstock for energy, chemicals, materials and food/feed
  - Comprehensively improved environmental record, means energy AND carbon efficiency
  - Transportation: symbiosis of electricity, gaseous and liquid fuels



# Introductory comments on Transportation Energy

- Our market economy is based on growth
- Growth is based on energy, cheap energy is abundantly available
- Today's energy systems
  - Limited cross sectorial integration
  - Overall efficiency is not a top priority for each individual sector
  - Fossil energy carriers have low marginal cost
- New integration systems are needed
  - Sustainable energy stocks
  - Biomass energy, chemicals, materials and food/feed
  - Companies with good environmental record, means energy AND carbon capture
  - Transport: symbiosis of electricity, gaseous and liquid fuels

**Low Energy Return of Investment**  
**Renewable fuels are more expensive**



# Energy transition:

## De(fossil)carbonization of transport

Phase out fossil fuels

Simultaneously  
Reduce/remove carbon  
loss from feedstock  
during processing

Sustainable  
produced biomass

Efficient conversion  
technologies

Liquid renewable  
fuels



Optimization along a value chain

Sector coupling



Competitive renew-  
able electricity

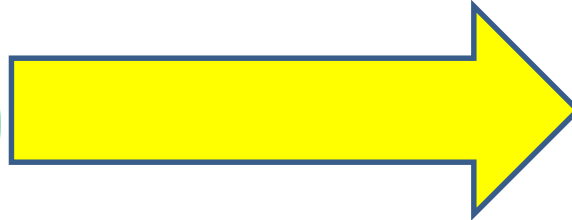
Electrification of  
society and industry

Hydrogen as  
energy carrier

# Core Focus



Economics of Process



Sustainability of value chain

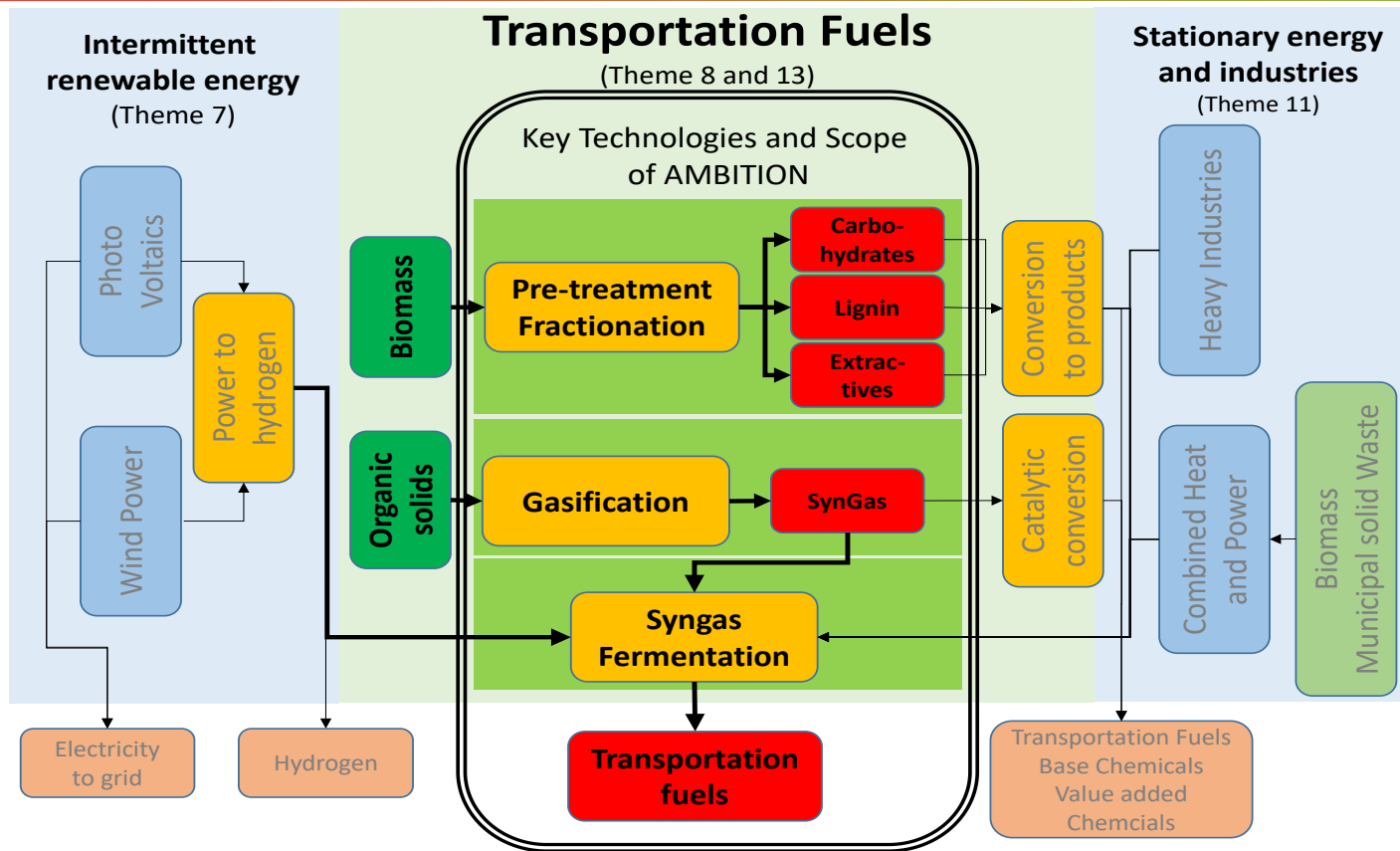


AMBITION

BIO4  
FUELS

# AMBITION Approach

## Advanced biofuel production with energy system integration



### Technologies

- Biochemical
- Thermochemical
- Chemical

### Stakeholders

- Resource owners
- R&D institutes
- Industry
- Authorities
- NGOs

Bio-resource ,  
Environment, Climate

Primary Biomass  
Conversion

Secondary Conversion and  
upgrading

Process design and  
End Use

SUSTAINABILITY

### Markets

Aviation fuel • Heavy Diesel • Biogas • Valorised Side Streams



Bio-resource  
Availability &  
management  
**NIBIO**

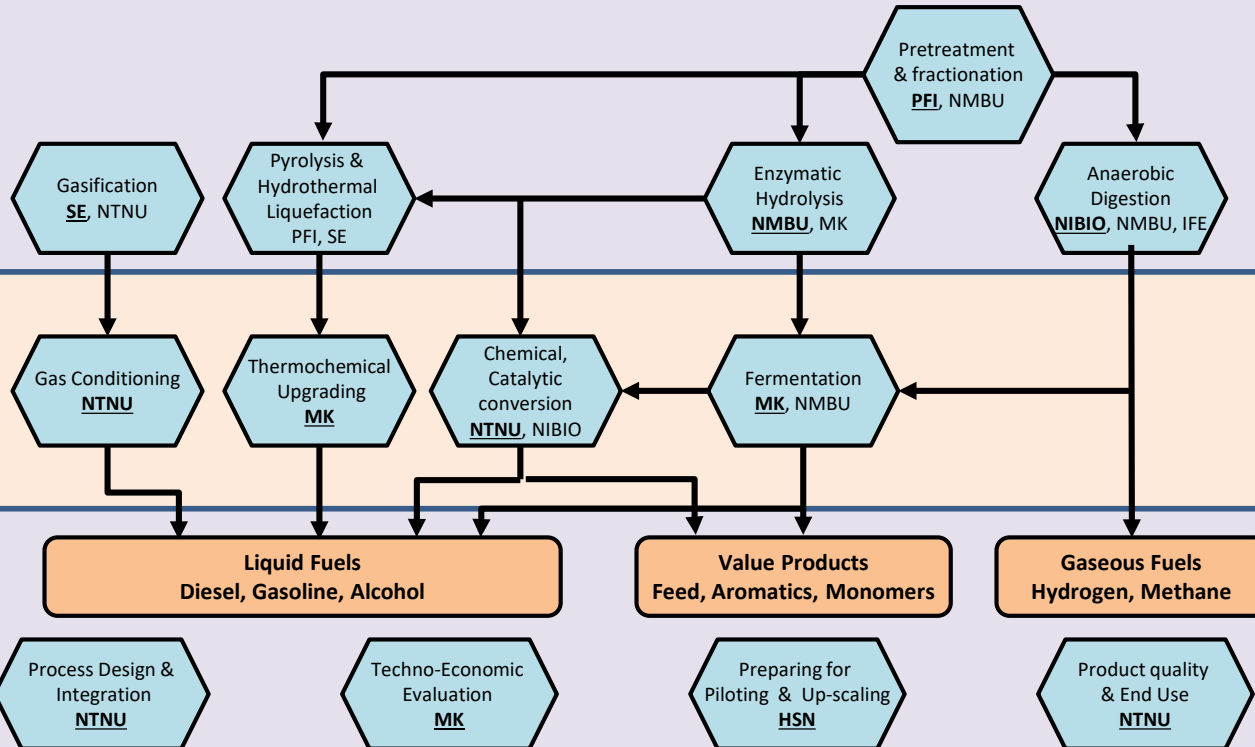
Benchmarking of  
Environmental  
performance  
**NTNU**

Economics &  
Policy  
**NMBU**

## Bio-resources

### LIGNOCELLULOSIC BIOMASS

### OTHER RESIDUES



## Primary Conversion

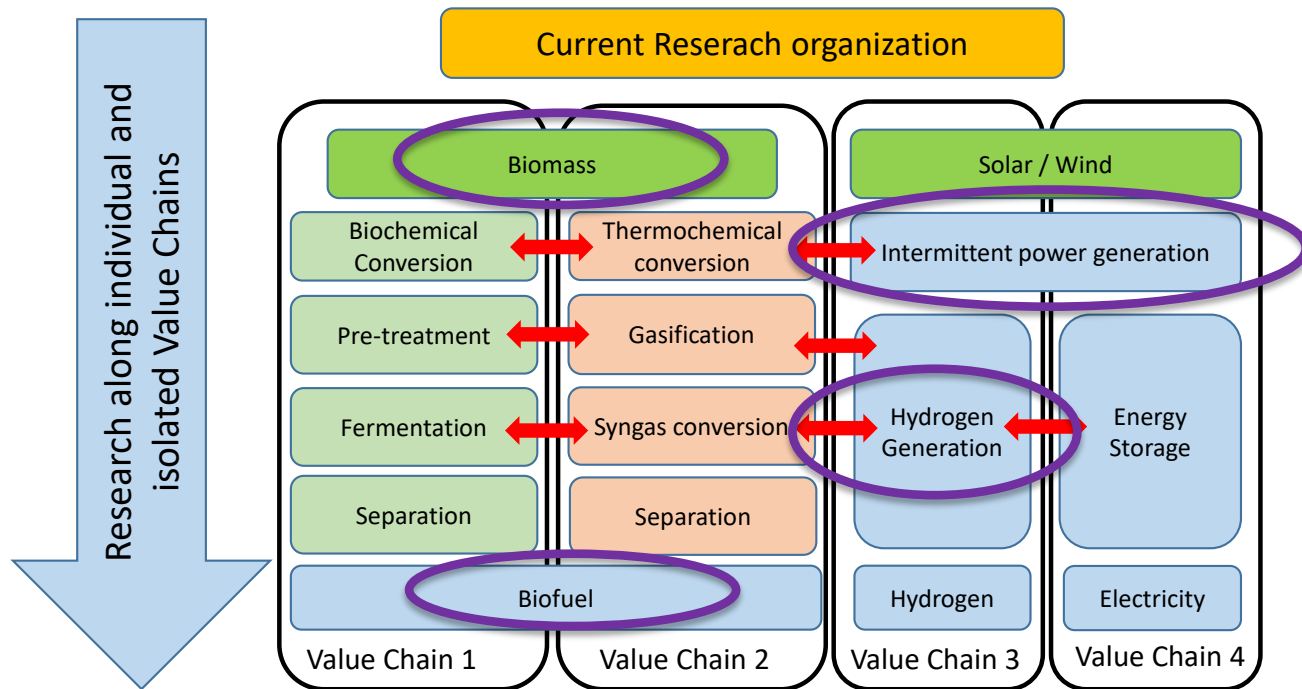
## Secondary Conversion & Upgrading

## Products & End Use

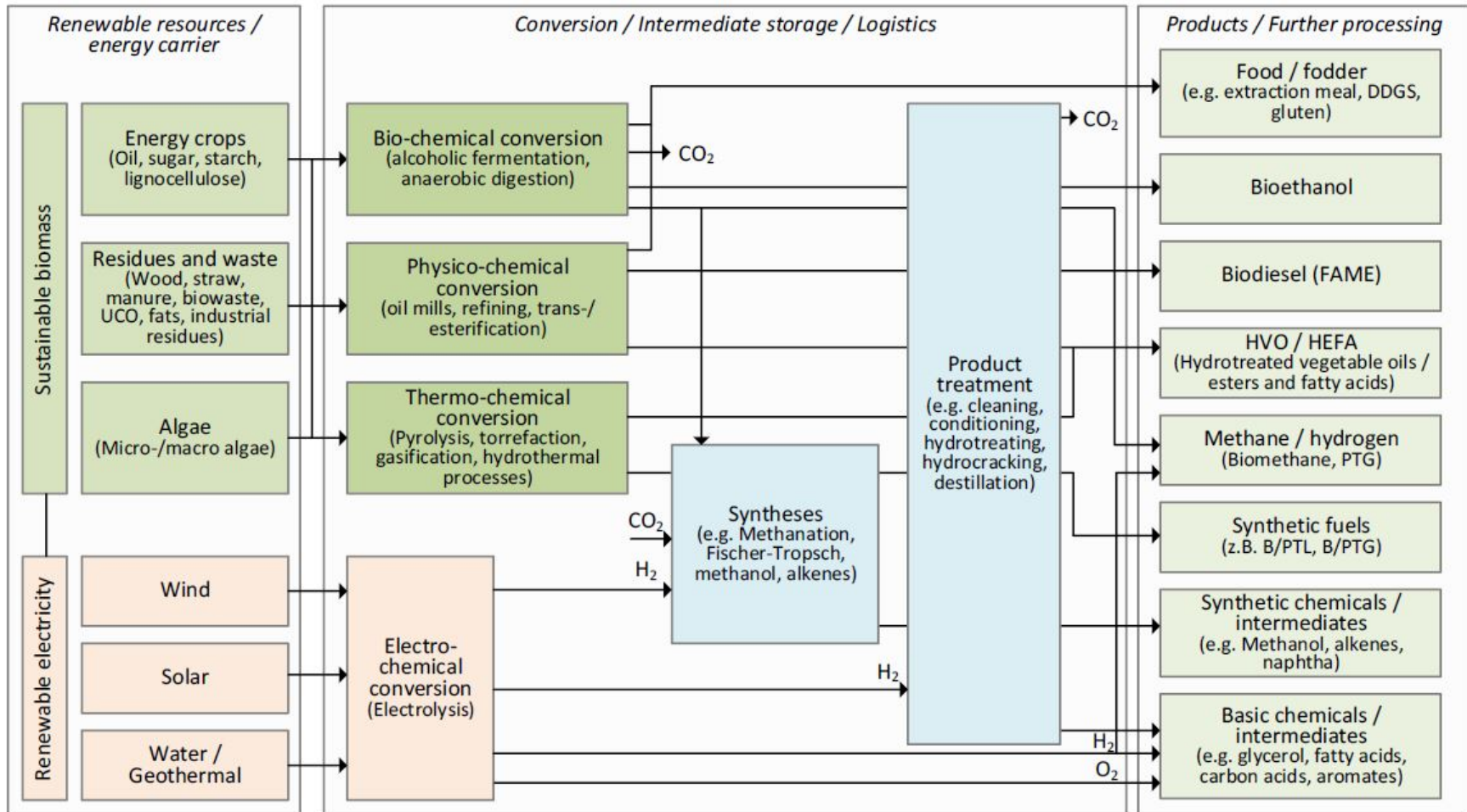
# Joint – Objectives

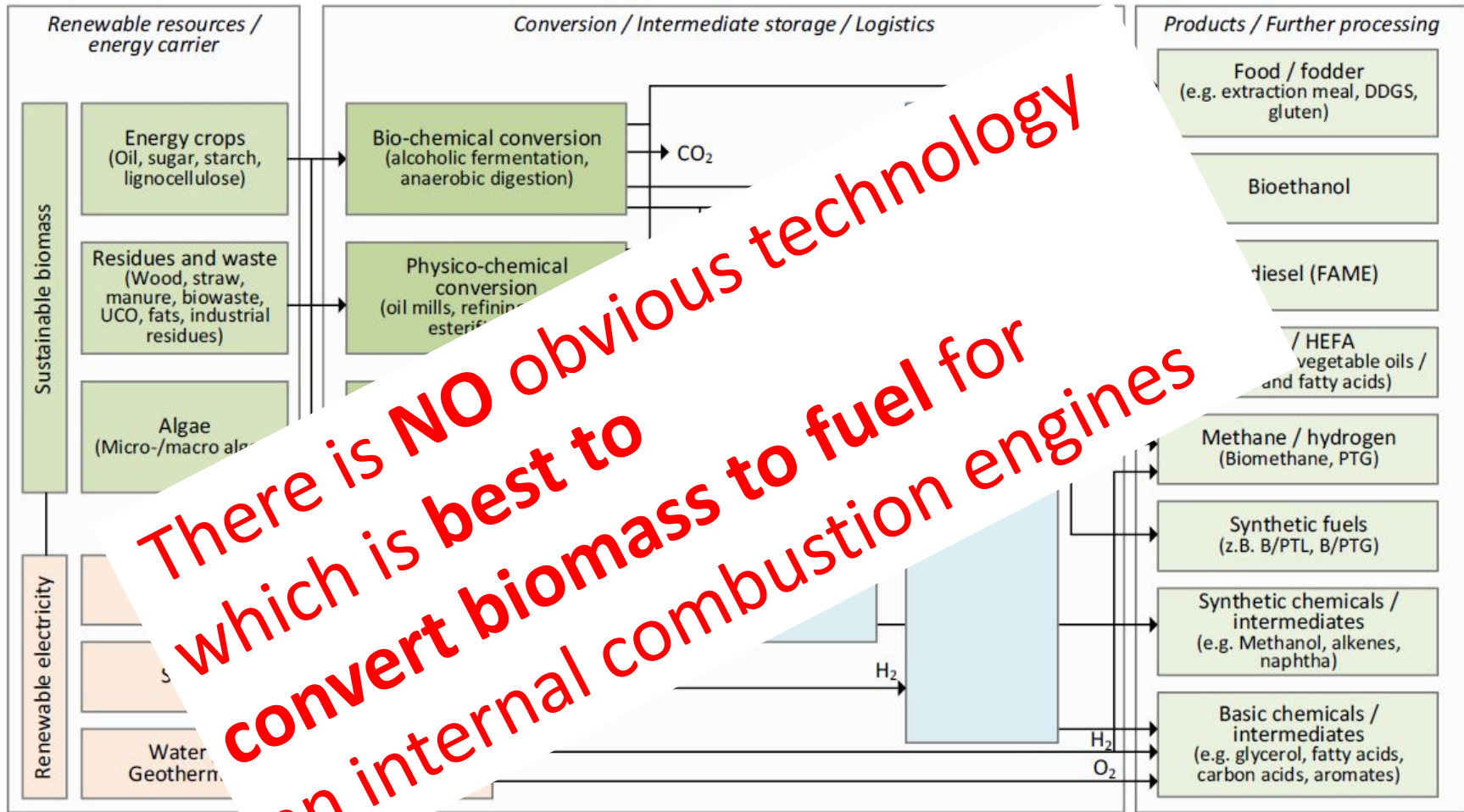
- ❑ **Development of innovative key unit operations in biofuels production:**
  - ❑ Development of efficient conversion technologies
    - ❑ Gasification and gas cleaning
    - ❑ Biomass Pretreatment / Fractionation into clean fractions
    - ❑ (Syngas) Fermentation and anaerobic digestion
  - ❑ Facilitate their integration along a value chain as well as across value chains
- ❑ **Evaluation of the technical, economic and environmental feasibility of integrating biofuels production from lignocellulosic biomass into today's energy system**

# Energy systems integration is needed: Parallel arrangement of Research and Development



Mass and energy integration is both feasible and environmentally benign.







Thanks for your attention!