



# **European Perspective of Forest-Based Bioenergy Development**

## **AAAS Annual Meeting**

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UPM-Kymmene Corporation

# UPM – Kymmene Corporation

## What we do



Revenues 10 billion €/a



Magazine &  
Catalogue Papers



Newsprint &  
Directory Papers



Fine &  
Speciality Papers

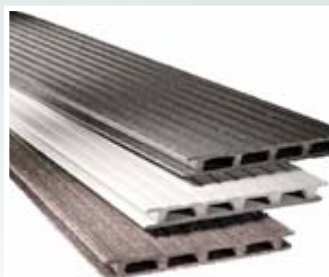


Label Stock &  
RFID Tags

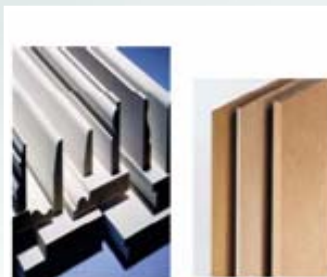


Plywood &  
Timber

New business development



Wood Plastic  
Composites



Wood Panels



Smart  
Labels

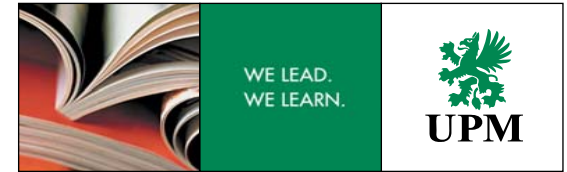


Bio-  
Chemicals



Bio-  
Fuels

# Outline



## European targets for GHG reduction and renewable energy

### Bioenergy in Europe

- Primary energy sources
- Major biomass sources
- Potential to increase the use of bioenergy

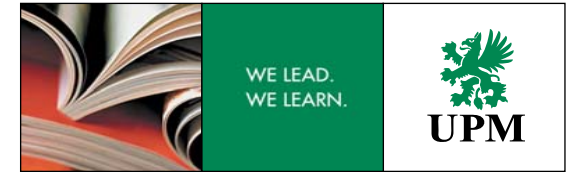
### European incentives for technology development

- European Technology platforms
- Biofuels TP:s Strategic Research Agendas

### Major technologies under development

- Bioenergy concept for pulp and paper mills including BtL, Pyrolysis oil and LC-ethanol

### Conclusion



## European targets for GHG reduction and renewable energy - Political framework

- In the Summit of the Heads of State on March 8 and 9 in Brussels, a milestone was set in EU policy making
- The Heads of State set very ambitious EU **mandatory targets for the new EU Energy & Climate Change policy for 2020:**
  - At least **-20% CO<sub>2</sub>** emissions compared to 1990
  - **20% energy efficiency improvement**
  - A **20% share of renewables** of all energy produced
  - A **10% biofuel target of all motor fuels**
- The heads of state called this ***“The new industrial revolution”***

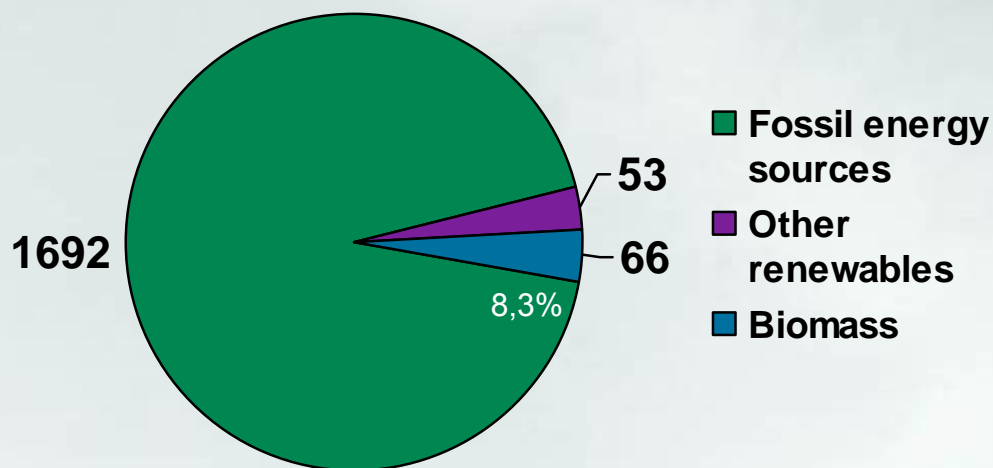
# Bioenergy in Europe

## Bioenergy Demand in the EU27



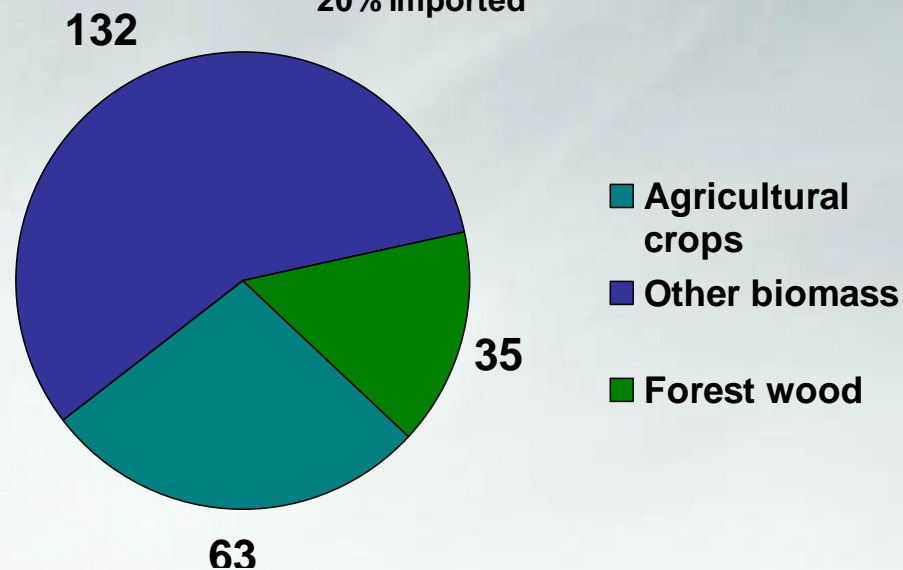
**European energy portfolio in 2005 (Mtoe)**

Total primary energy consumption 1811 Mtoe



**Biomass scenario for 20% share in 2020 (Mtoe)**

Maximum biomass contribution 230 Mtoe of which 20% imported



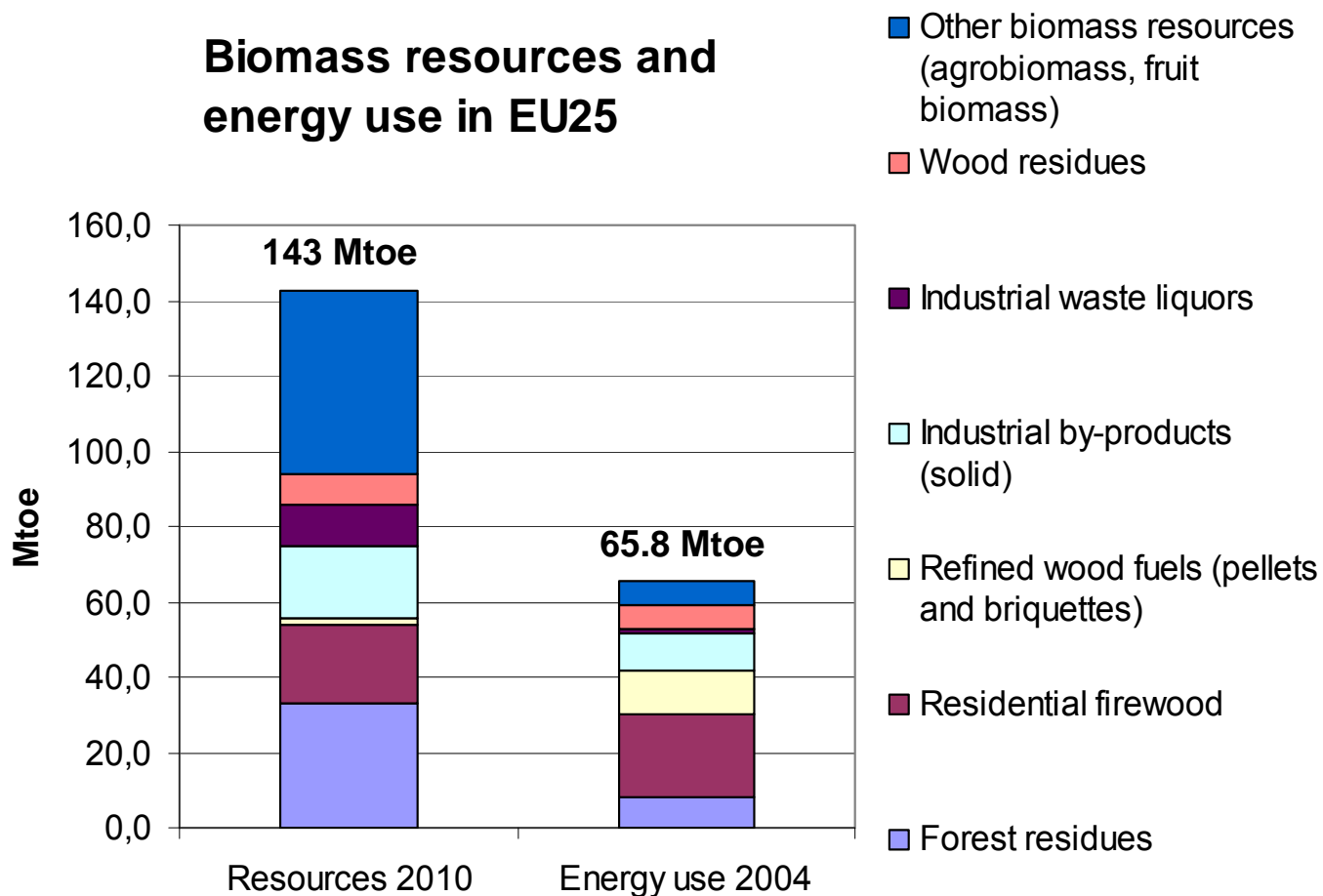
- Renewables = hydro, wind, geothermal, solar, biomass, biodegradable waste
- Wood biomass in 2004 was 61.2 Mtoe

# Bioenergy in Europe

## Biomass Resources and Energy Use



**Biomass resources and energy use in EU25**



Excluded:  
Lithuania  
Italy  
Slovenia  
Malta  
Cyprus

# Bioenergy in Europe

## Facts about Wood in EU27

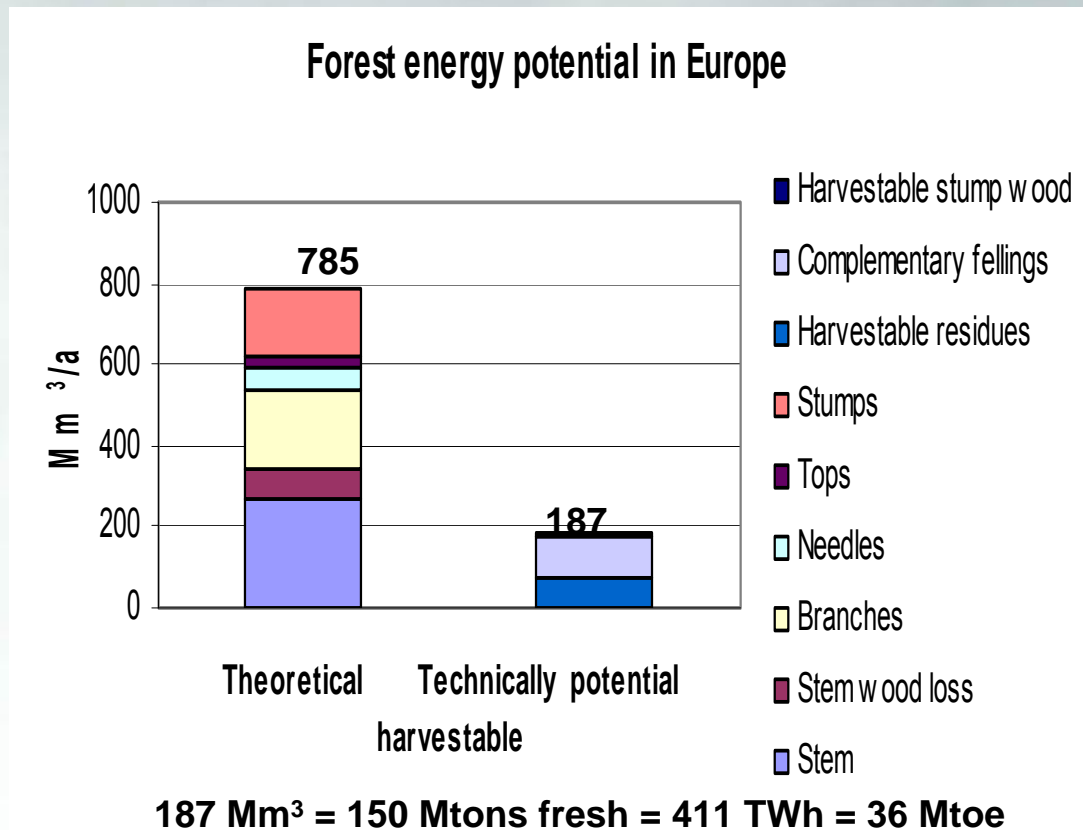


<b>Growing stock</b>	<b>19 692Mm<sup>3</sup></b>
– Commercial	16 860 Mm <sup>3</sup>
– Annual change rate (2000-2005)*	239 Mm <sup>3</sup>
– <i>Ratio between fellings and increment</i>	70 %

<b>Roundwood production</b>	<b>438.0 Mm<sup>3</sup></b>
– 77 % coniferous	
– Industrial use	383.2 Mm <sup>3</sup>
– Fuel wood	54.8 Mm <sup>3</sup>

<b>Forest wood potential for energy</b>	<b>187.0 Mm<sup>3</sup></b>
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\* Sustainably utilizable surplus of commercial growing stock  
40 % this is in France and Germany alone





# Bioenergy in Europe

## Availability Constraints

### ***Physical***

- Land availability/quality: marginal land have to meet both economic & sustainability criteria
- Efficiency of agricultural lifestyle: optimised water management, cropping strategies, etc.
- Accessibility of resources, lack of infrastructure to handle bulky materials

### ***Market***

- Food, feed, etc.: work towards optimising synergies

### ***Sustainability***

- Biodiversity
- Carbon emissions from land use change

### ***Behavioural aspects***

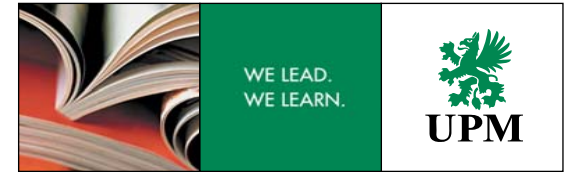
- Increase consumer awareness with education, labelling, promotion campaigns, etc.
- Enhance communication with involved parties i.e. agriculture & forest communities

**Constraints in diversifying feedstock sources must be overcome!**



# Bioenergy in Europe

## Diversifying Feedstock Sources 1/4



Energy crops: development of harvesting and handling technologies of reed canary grass for CHP plants



**Total agricultural area 15 000 ha for reed canary grass in Finland**

# Bioenergy in Europe

## Diversifying Feedstock Sources 2/4

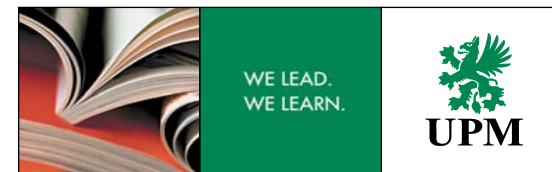
### Bundling method for undelimited pulp- and energy wood thinnings -optimising logistics

- Targets:
  - to **improve logistics by compacting the material** before forest- and road/train transportation
  - **procure pulp- and energy wood with the same machine** for pulp, energy or biofuel use at the same time
- The main challenge is to **improve the production of the prototype machine from actual 9 bundles/h to approx. 12 bundles/h**
- Timeline: prototype number 2 ready in may 2008



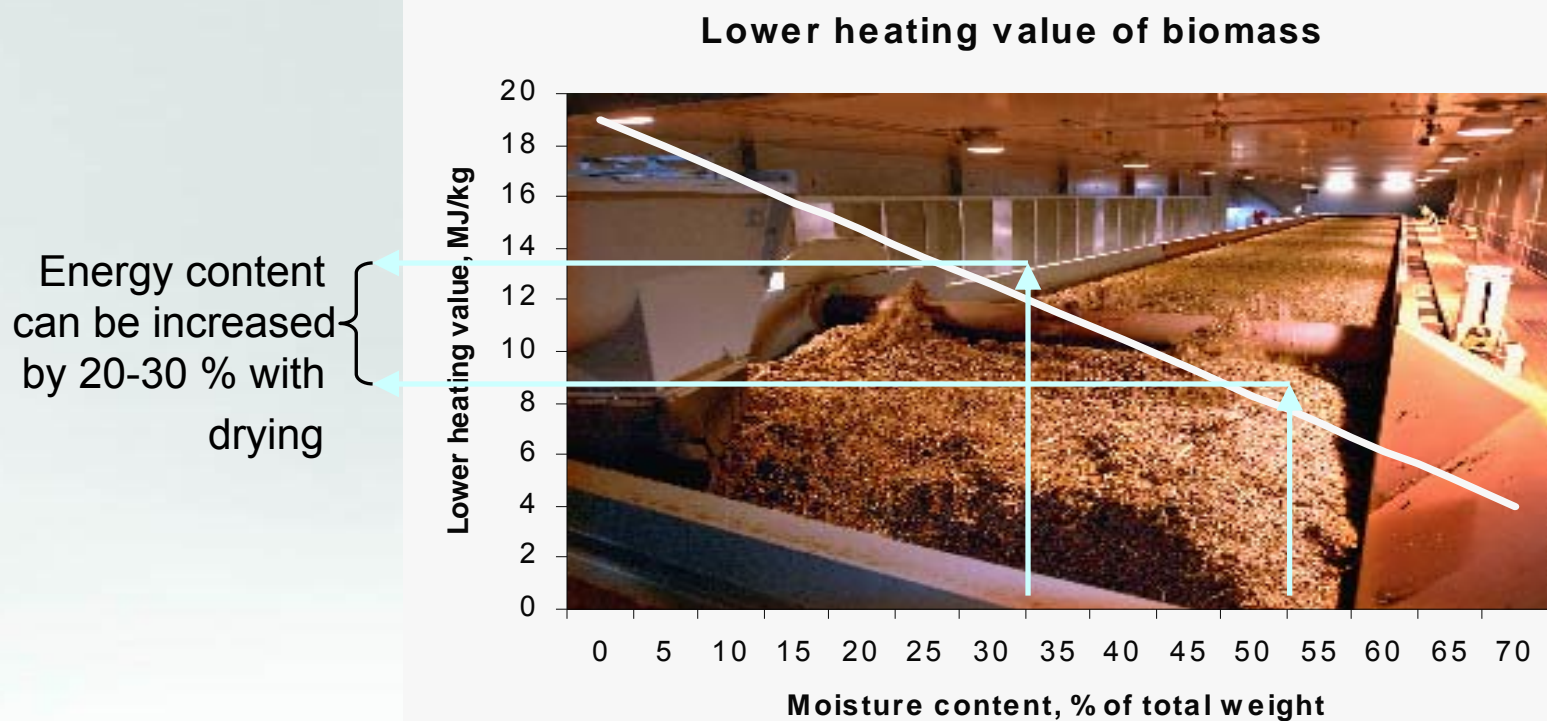
# Bioenergy in Europe

## Diversifying Feedstock Sources 3/4



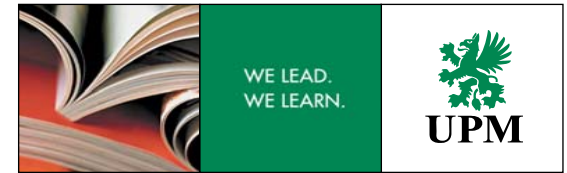
### Biomass dryer – improving quality of biomass feedstock

Biomass dryer is an example of efficient use of secondary or waste heat in a low temperature wire dryer with advantage of increasing heating value of wet feedstock, improving feedstock quality and lowering feedstock need



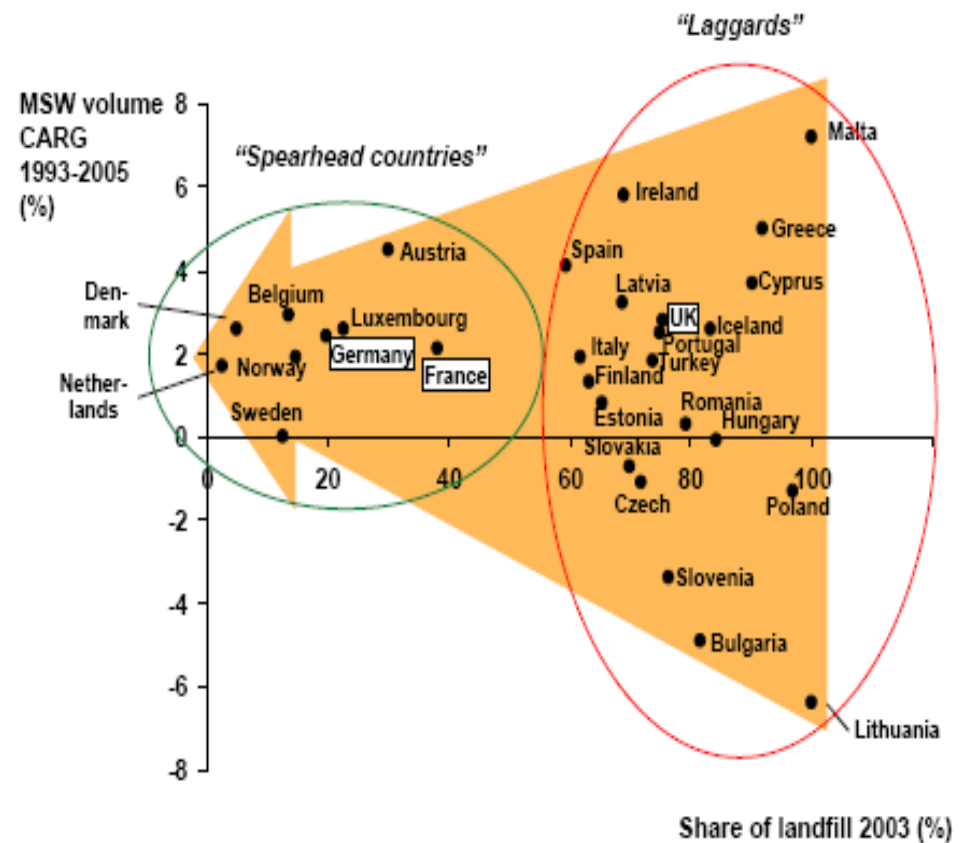
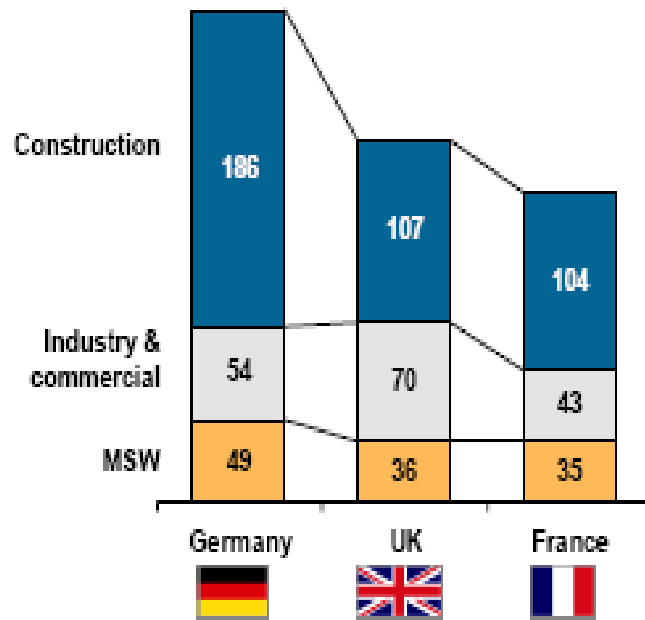
# Bioenergy in Europe

## Diversifying Feedstock Sources 4/4

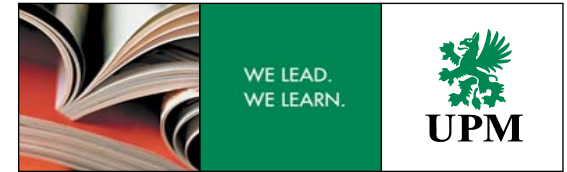


EU 1 billion t/a waste (CIW ~ 25%)

Waste segments (MTons)



# Outline



## European targets for GHG reduction and renewable energy

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### European incentives for technology development

- European Technology platforms
- Biofuels TP:s Strategic Research Agenda

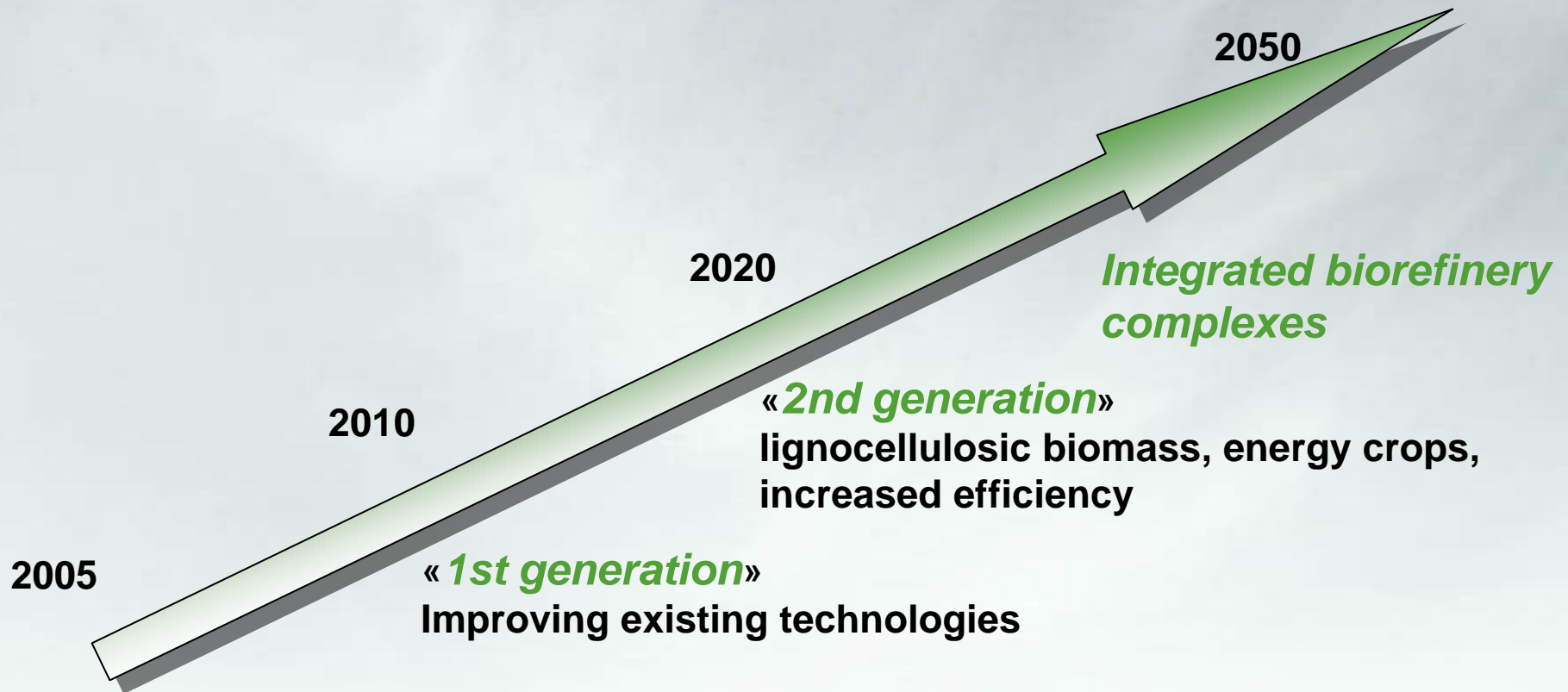
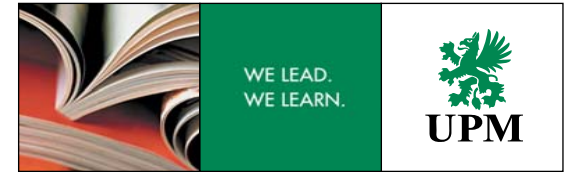
### Major technologies under development

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# European technology development

## Vision report: Outline of technology roadmap

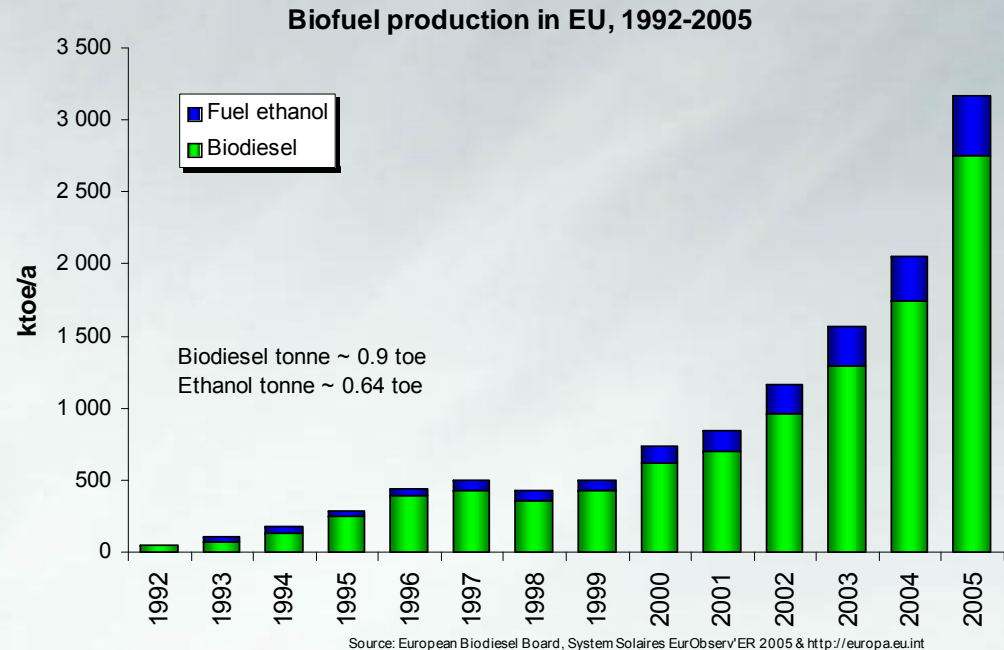


# European technology development

## The Driving Vision – Biofuels TP



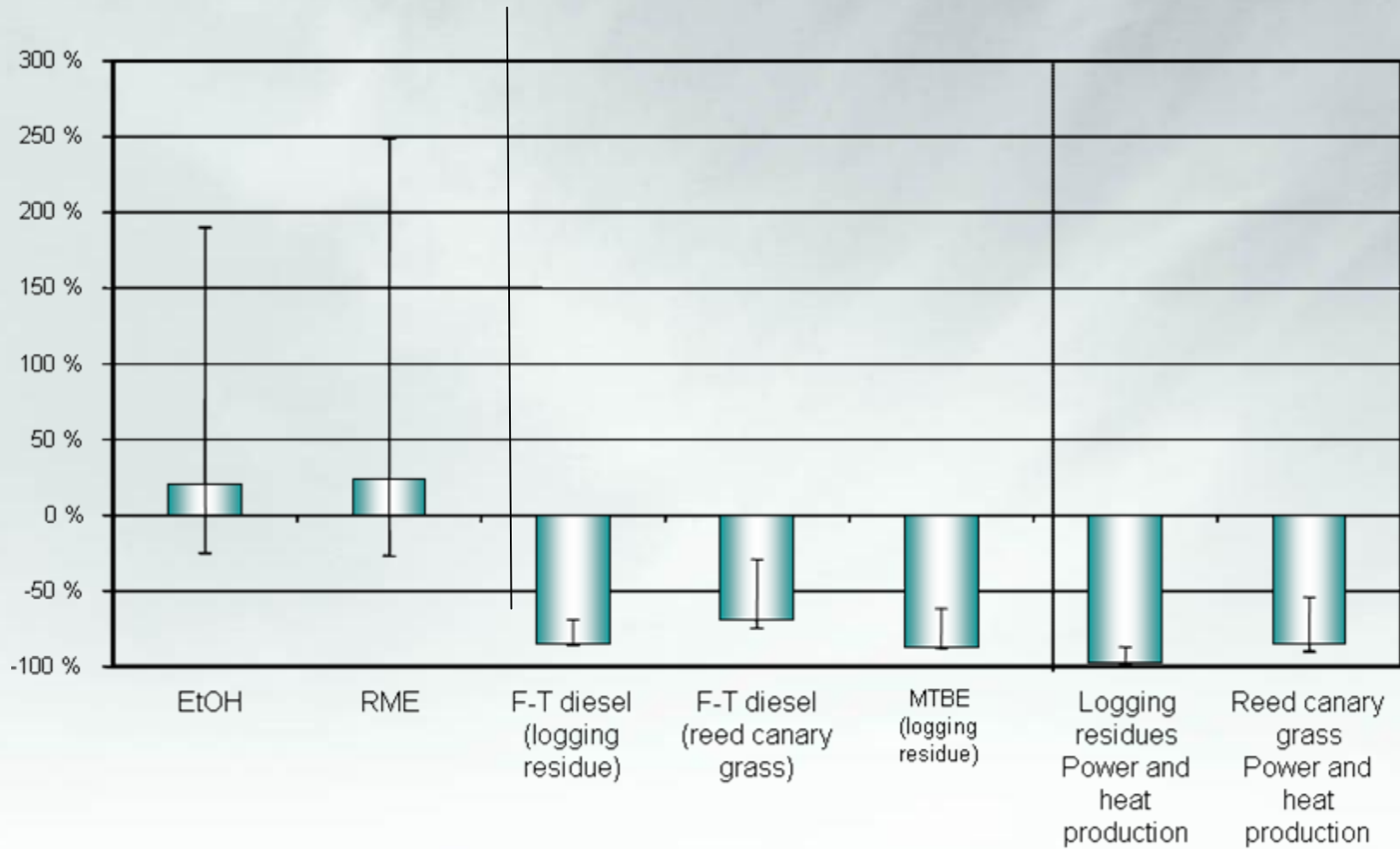
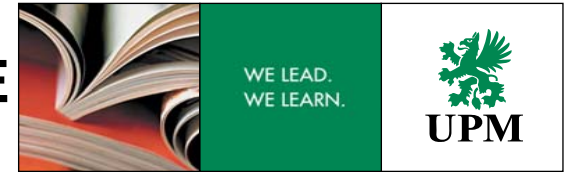
- By 2030, the European Union covers **one fourth of its road transport fuel needs** by clean and CO<sub>2</sub>-efficient biofuels.
- A **substantial part is provided by a competitive European industry.** This significantly decreases the EU fossil fuel import dependence.
- Biofuels are produced using **sustainable and innovative technologies**; these create opportunities for biomass providers, biofuel producers and the automotive industry.



**18 Mtoe of biofuels needed in 2010 to fulfill the EU target of 5.75% (energy)**  
**In 2005 the share of biofuels was about 1%**

# Relative Impact of Different Biofuels on CHGE

## - WTW Results in Finnish Conditions

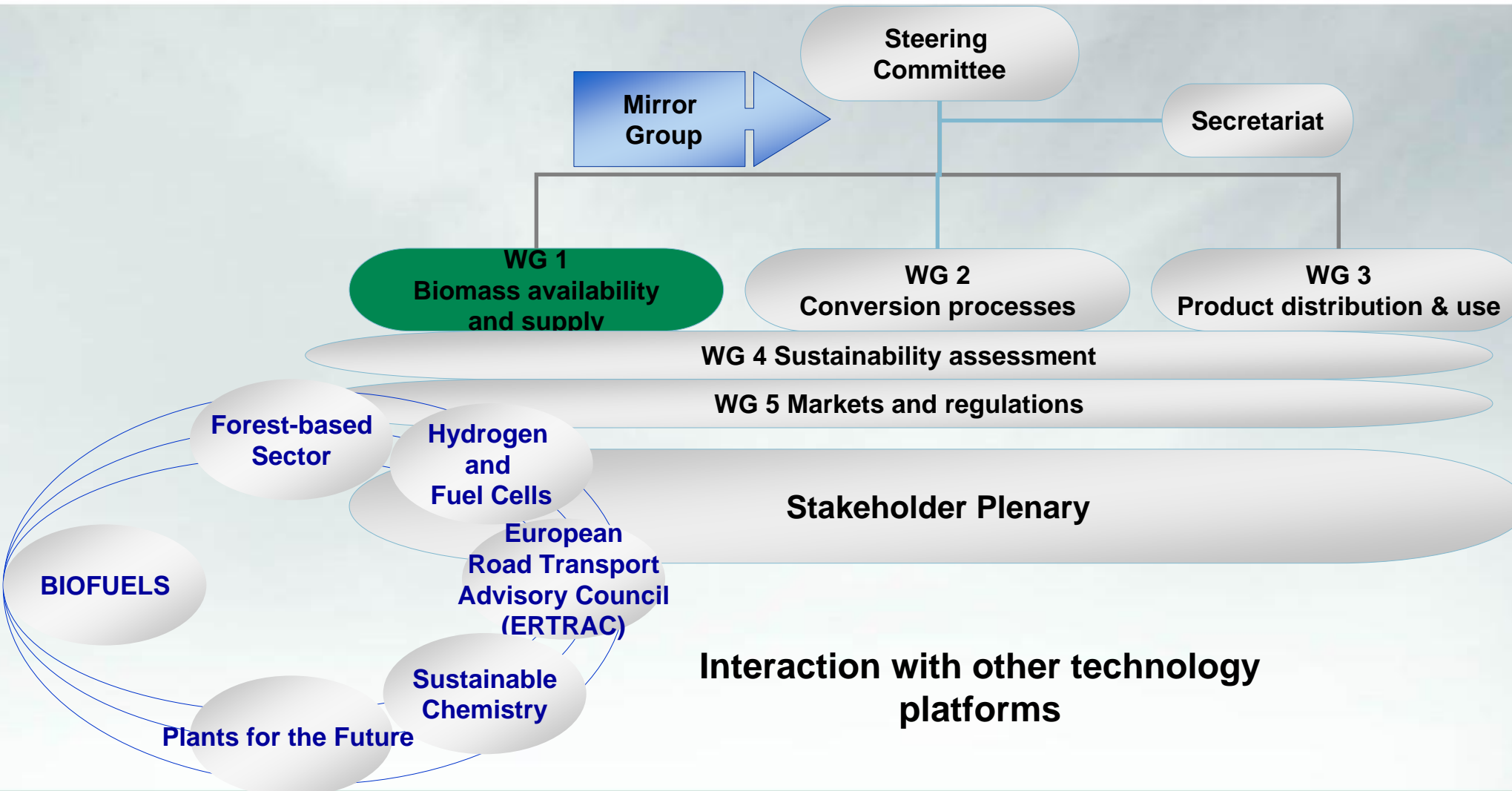
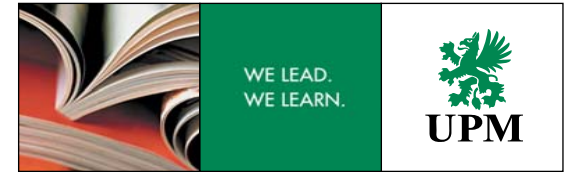


← 1st generation biofuels →   ← 2nd generation →   ← Heat and Power generation →



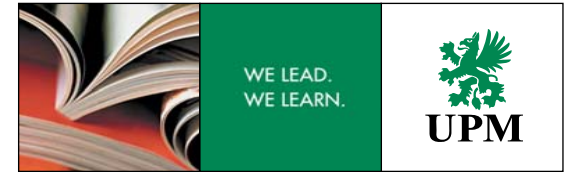
# Biofuels Technology Platform

## Structure and Interactions



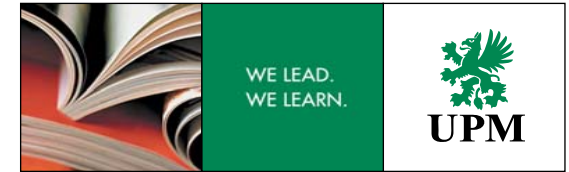
# Forest Technology Platform

## Strategic Research Agenda



- Five Strategic Objectives are covered:
  1. Development of innovative products for changing markets and customer needs
  2. Development of intelligent and efficient manufacturing processes, including reduced energy consumption
  3. Enhancing availability and use of forest biomass for products and energy
  4. Meeting the multifunctional demands on forest resources and their sustainable management
  5. Regarding the sector in a societal perspective





# European technology development

## Technology Development Strategy - *Overview*

### •Three main areas of technology development are critical to ensure successful development of biofuels in the EU:

#### ▪Feedstock:

- ✓managing competition for land resources (food&fodder vs bioenergy) and for different biomass applications (transportation fuels, heat, power, industrial raw materials)
- ✓Increasing yield per hectare and developing efficient supply logistics both for dedicated crops and residues

#### ▪Conversion technologies:

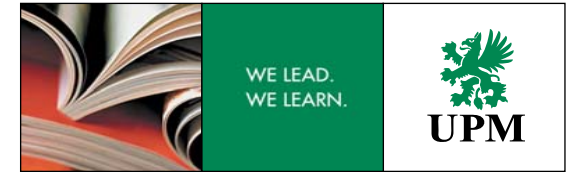
- ✓developing energy efficient and reliable biomass-to-fuel conversion processes with feedstock flexibility and high quality product

#### ▪End-use technologies:

- ✓optimisation of fuel-engine environmental and energetic performance ensuring compatibility with existing and future infrastructure and vehicles

### •The winning options (combination of land, feedstock, conversion and end product) will be those best addressing strategic and sustainability targets:

- High level of GHG reduction with sound management of other key environmental issues (biodiversity, water use, local emissions ...)*
- Security and diversification of energy supply for road transport*
- Economic competitiveness and social acceptance*



# European technology development

## Key R&D&D-Priorities

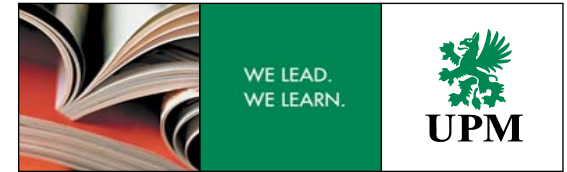
### •Feedstocks:

- ✓ Develop availability-cost curves for different sources of biomass (energy crops, forestry and agriculture residues, wastes) and geographical locations; develop interfacing systems analysis (supply-demand, market interdependencies, impact of policies)
- ✓ Develop new high-yield agricultural and forest systems with breeding of crops and trees optimised for biofuel production
- ✓ Develop efficient biomass logistic systems (harvesting/collection/storage) for different conversion concepts at different scales

### •Conversion processes:

- ✓ Improve current conversion processes to their full potential (biodiesel, bioethanol from starch-sugar) for higher GHG reduction, increased flexibility for different raw materials and lower cost
- ✓ Develop thermochemical and biological conversion processes with feedstock flexibility for different lignocellulosic biomass (BtL, L-C bioethanol)
- ✓ Develop integrated biorefinery concepts making full use of a variety of biomass feedstocks to obtain diverse high-value bioproducts
- ✓ Demonstrate at pilot and industrial scale reliability and performance of new technologies

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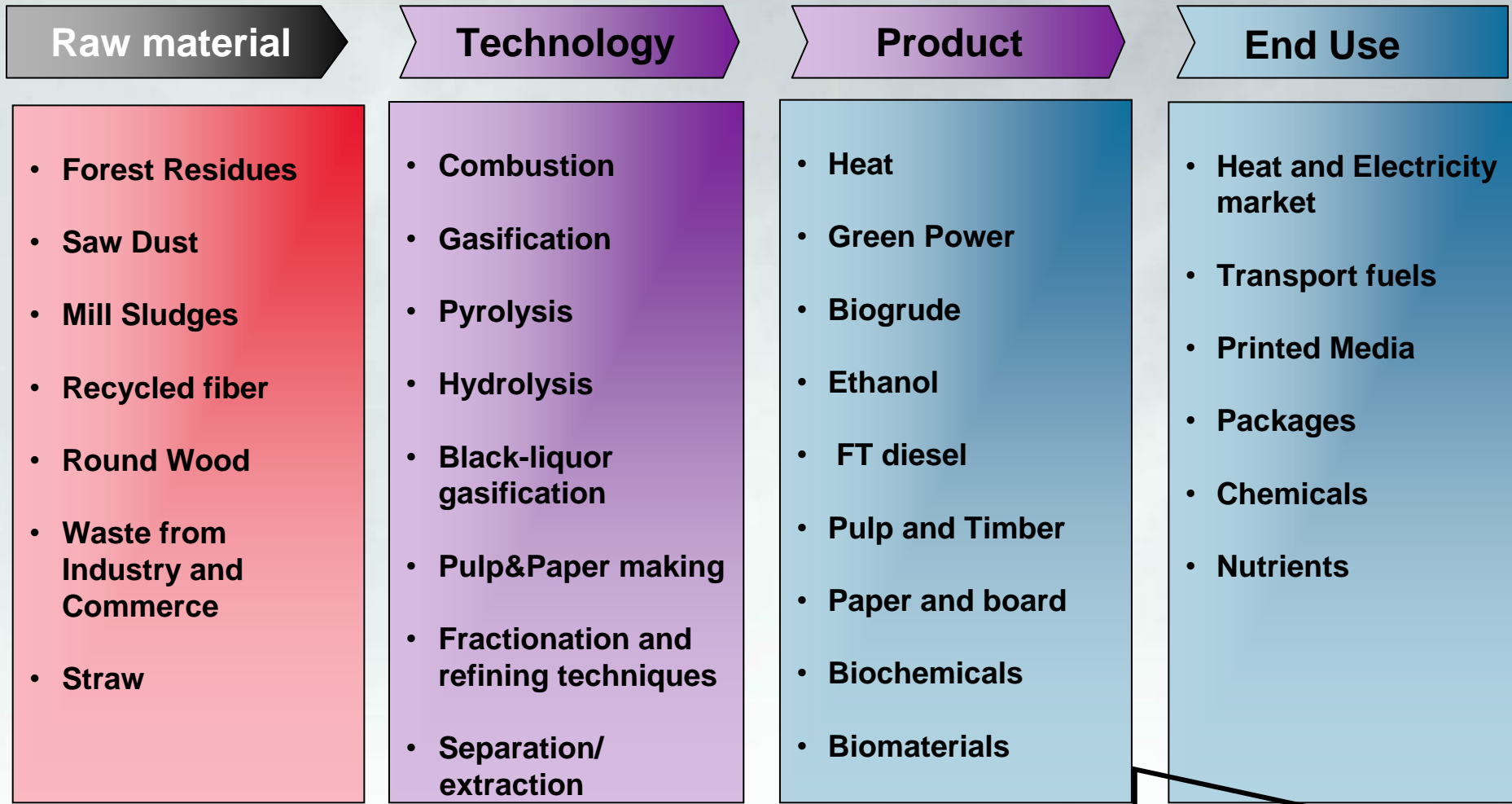
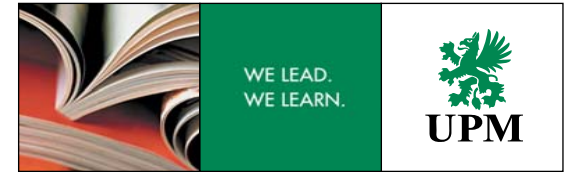
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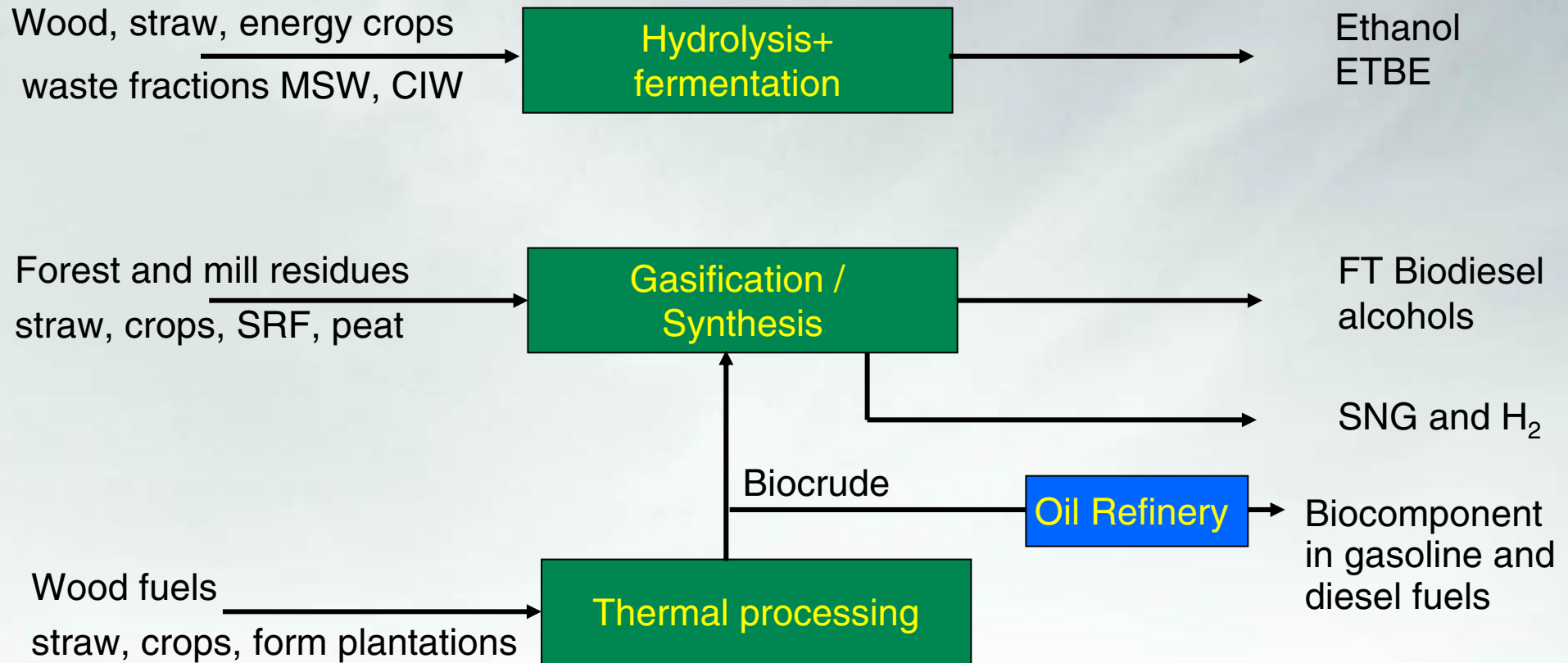
## Forest Industry Value Chain



**Process integration and value chain optimization**

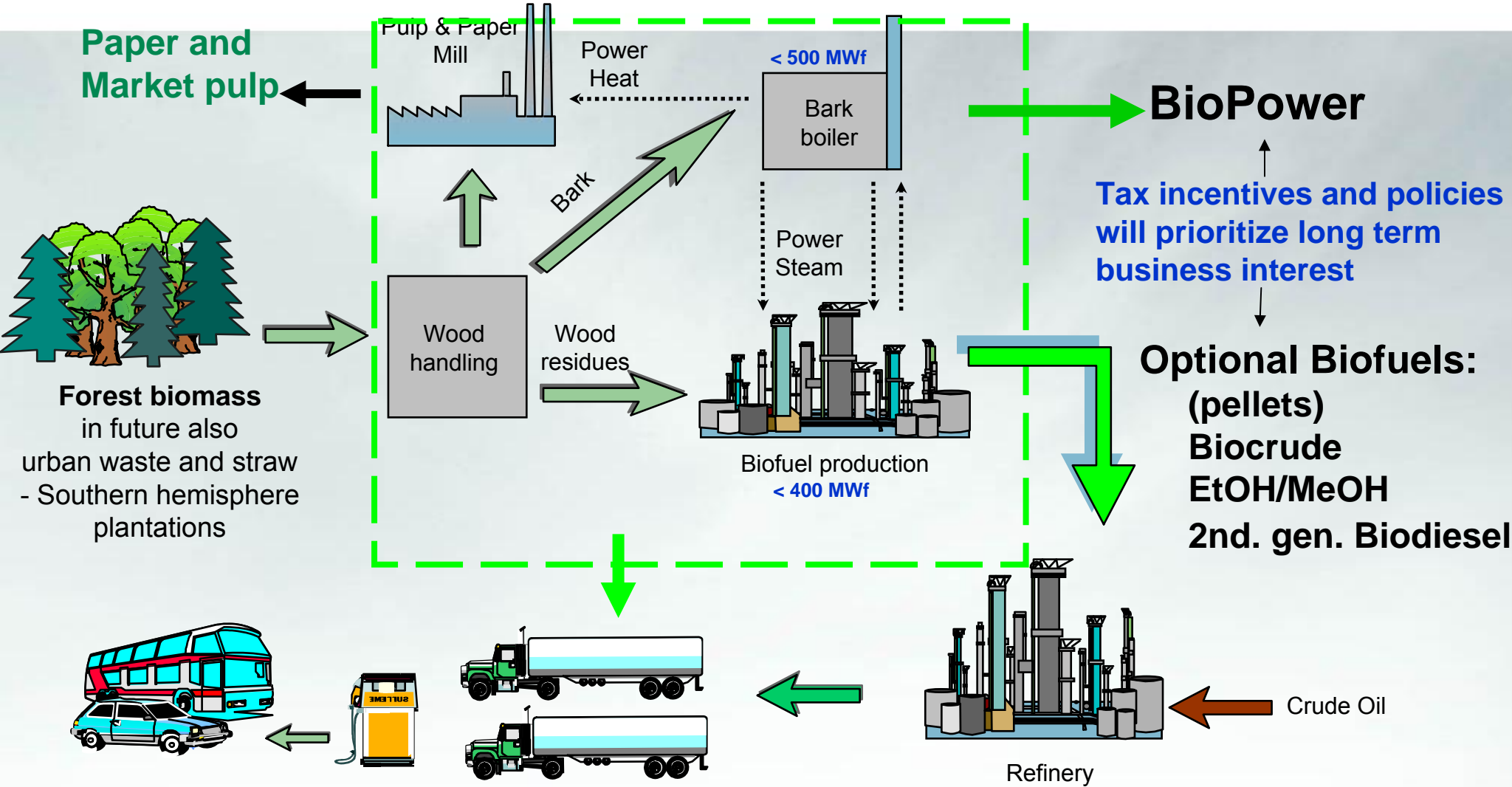
# Major technologies under development

## Transport Fuel Conversion Processes - 2nd G



# Major technologies under development

## Biofuels for Forest Industry

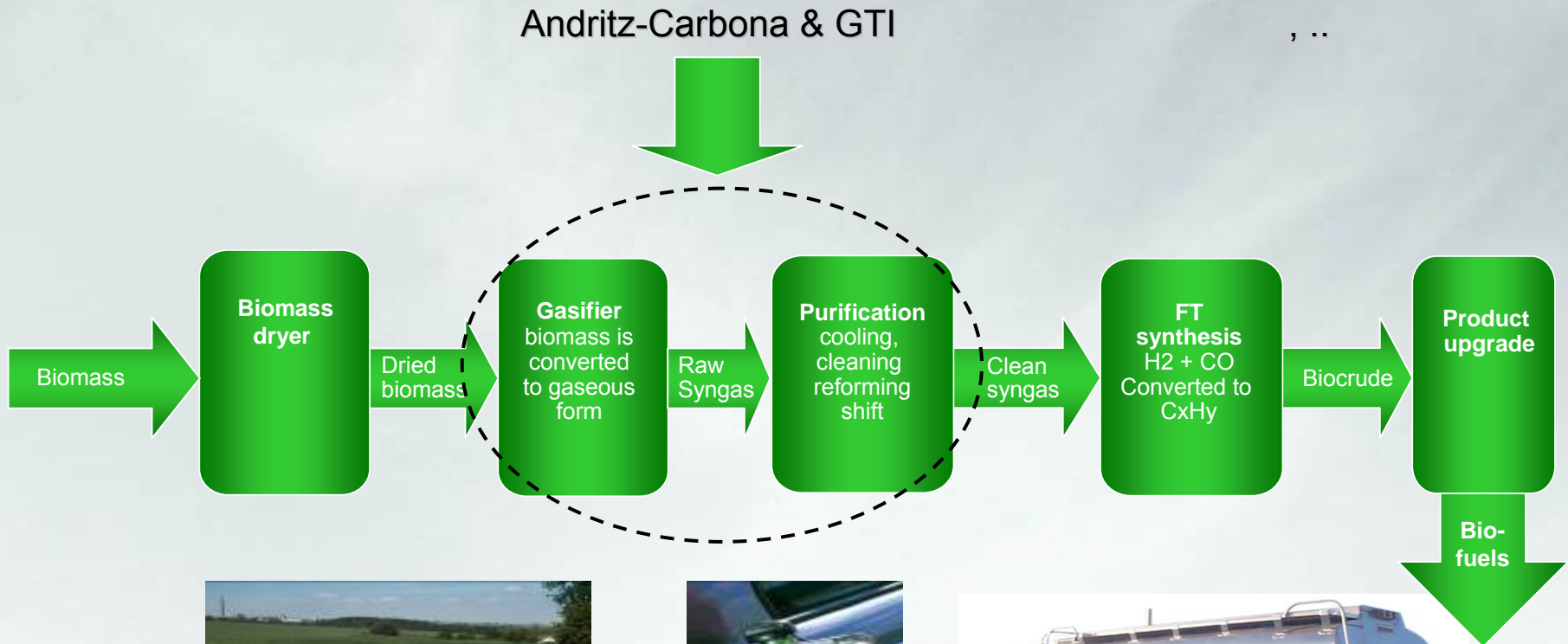
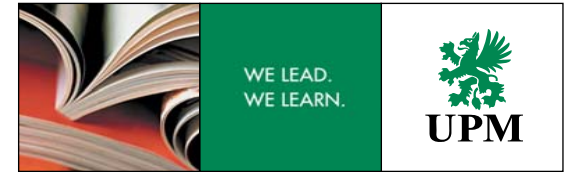


- Added value from biorefinery and high system efficiency -



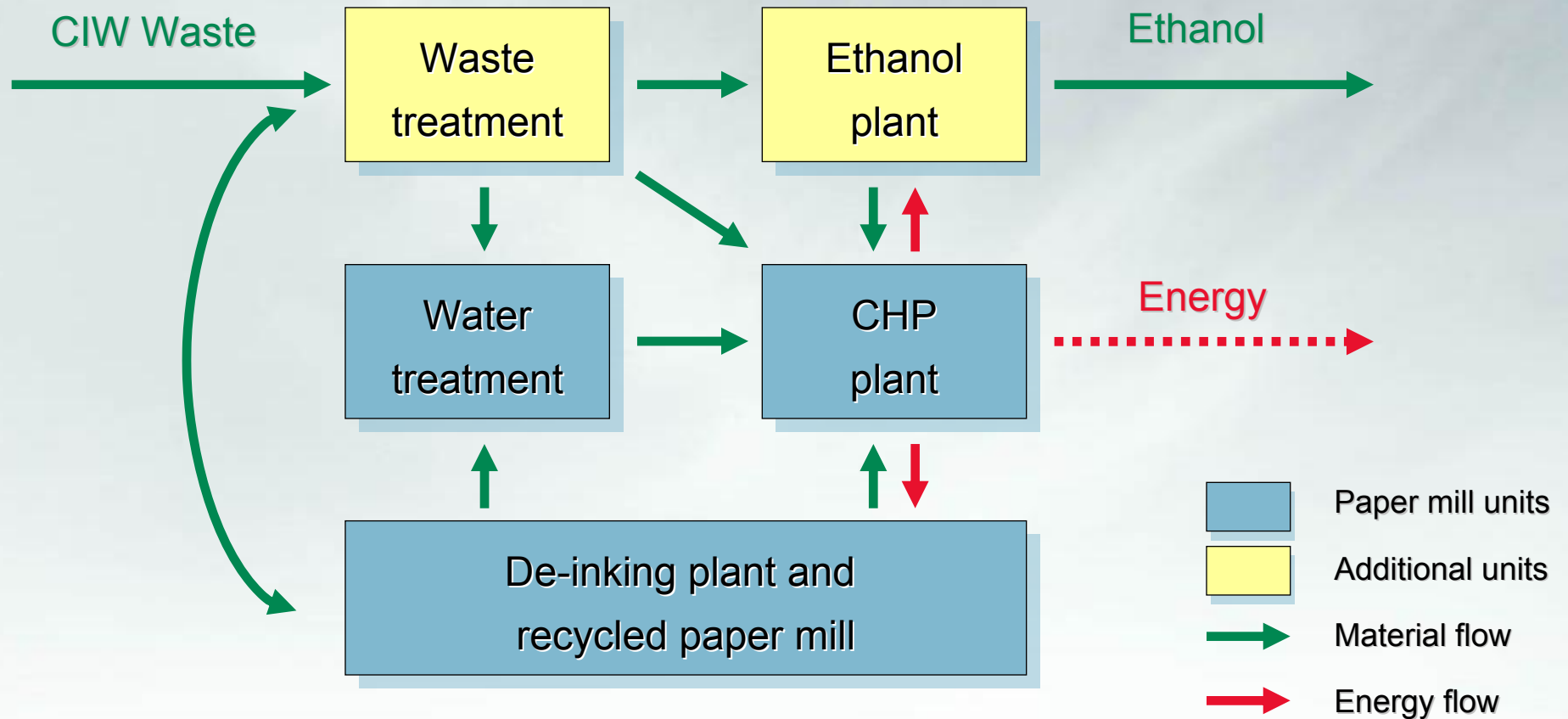
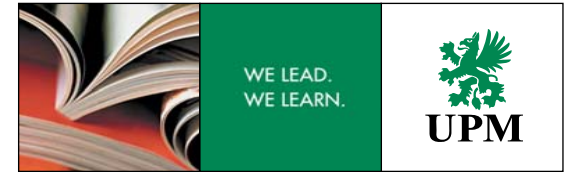
# Major technologies under development

## UPM's Biomass to Liquids Development



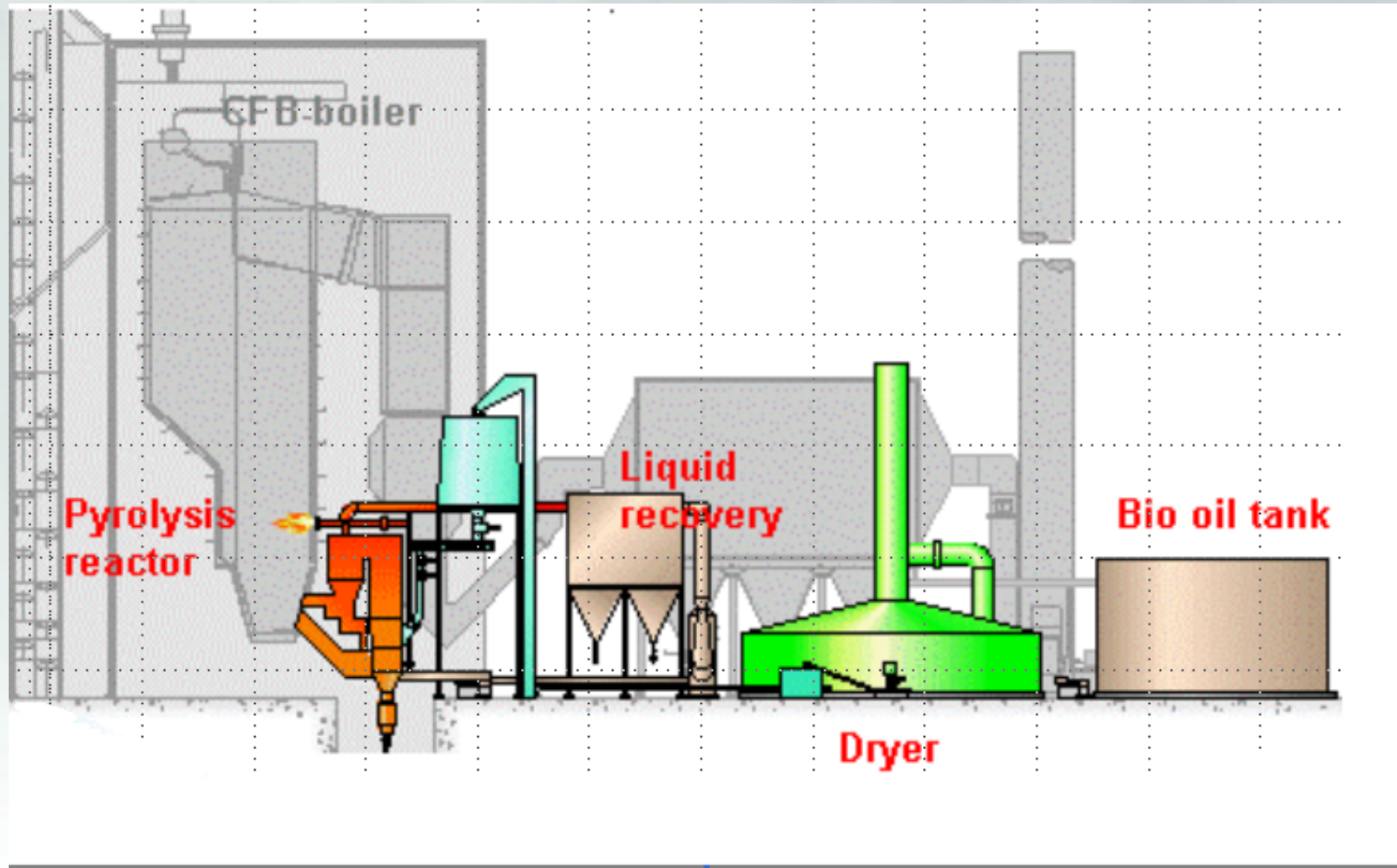
# Major technologies under development

## 2G ethanol concept at paper mill



# Major technologies under development

## Integrated Pyrolysis to Fluidized Bed Boilers



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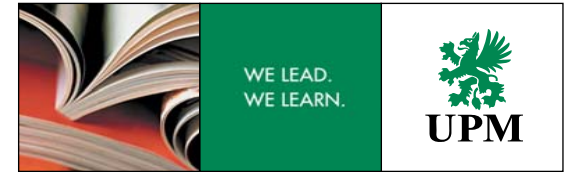
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## Conclusions

- Targets are set in EU Energy & Climate change policy
- European goal on reduction of greenhouse gas emissions will have a strong steering effect on future activities in the field of bioenergy
- Renewable energy is a key element of a sustainable future
  - reduction of GHG emissions, security of supply
  - new opportunities for rural economies,
  - the EU has great potential for increased production of biomass
  - targets can be met without disrupting food and food markets
- Production of biomass is demand-driven
  - Decoupled CAP income support: farmers respond to market signals,
  - Rural development - positive incentives for renewable energy development in rural areas
- *Research and technological development: more advanced and more cost-efficient biomass production and conversion technologies*

# Conclusion

## Three Steps Forward



•*Step 3: Adaptation of strategy to climate change*

•*Step 2: Forest, agro and waste biomass*

•*Step 1: Feedstock. energy crops*

*Harvesting technologies*

•*Step 3: Integrated Biorefineries Complexes*

•*Step 2 BtL, LC-ethanol, Bio-oil*

•*Step 1: 1G Ethanol*

*Conversion technologies*