NILE

(New Improvements for Ligno-cellulosic Ethanol)

Background

- Bioethanol = mature biofuel for transport (Brazil, USA)

- Ethanol from ligno-cellulosics =
  - best biofuel in terms of CO_2 emission reduction (IEA)
  - necessary for diversification of raw materials
  - necessary for low cost ethanol
  - time table = after 2010

→ research having an impact on the medium to long term

Aims

- To prepare the mass production of bioethanol from ligno-cellulosic feedstocks, *i.e.* at a competitive cost for its incorporation in fuels, by developing and designing a reliable and viable process.

- To be ready for the next steps (> 5.75%) of the European directive on biofuels.

- To allow Europe to have a leading position on this technology.

Nile *vs* call for proposals

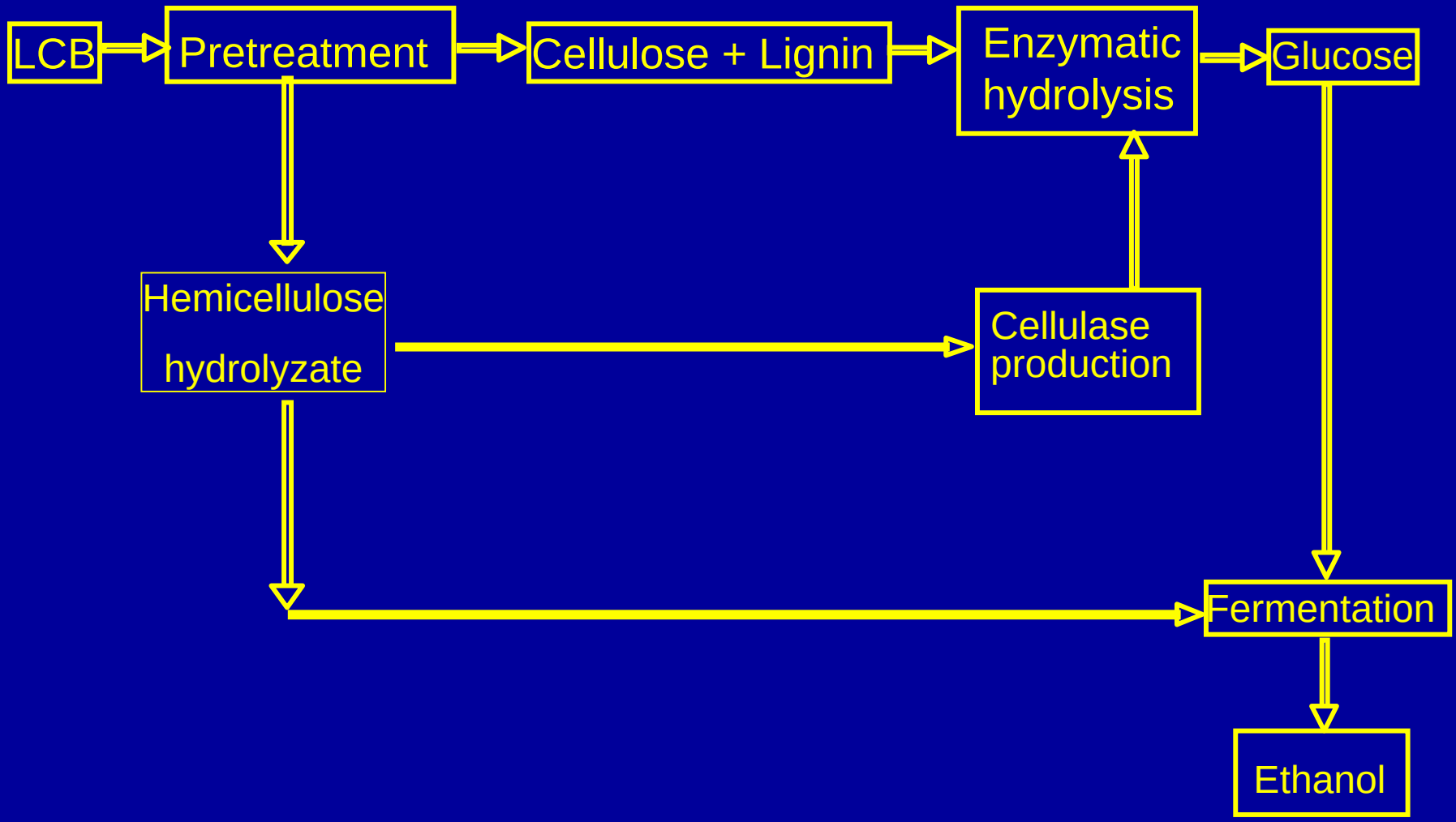
- adresses the general objectives of the priority 6.1 of the work programme: Sustainable Energy Systems and the targets of 6.1.3.2.3 research activity, New and Advanced Concepts in Renewable Energy Technologies

- matches the topic « cost effective liquid biofuel production from biomass »
  - bioethanol from lignocellulosic feedstock for transport
  - process development and optimisation from lab to pilot-scale
  - assessment in terms of cost , environmental benefits and socio-economic aspects

- is an integrated project:
  - improvement of EU competitiveness
  - focussed on technology development
  - to development and pilot phase
  - training and dissemination components

the NILE project

Ethanol production from lignocellulosic biomass : typical flow sheet



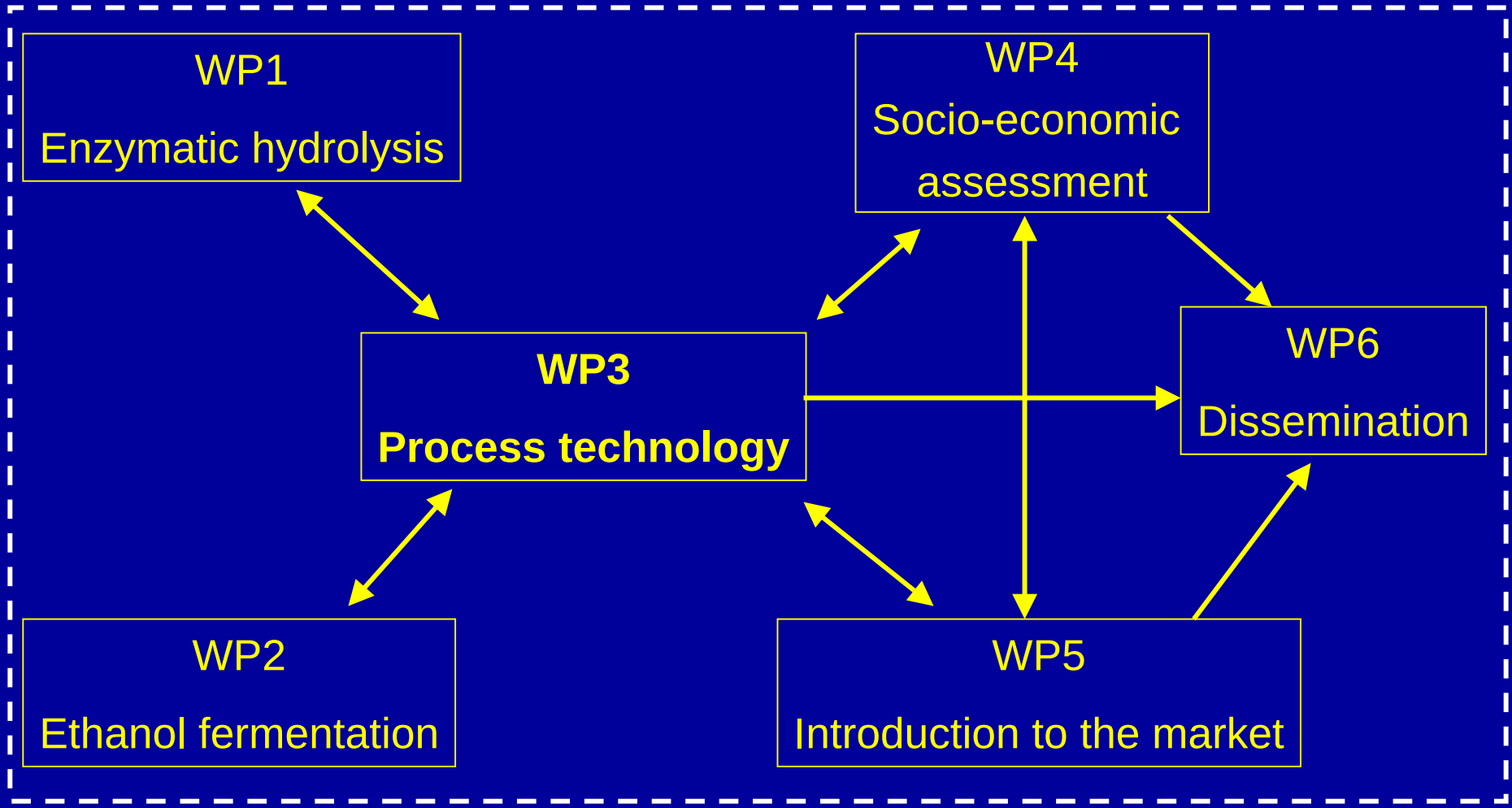
Guidelines for the NILE project

- **Innovative** solutions to main obstacles
- Validation of the different steps and the whole process at a **pilot scale**
- R & D in strong relation with **stake holders** (involved in the various steps of the project)
- **Synergy** in the partnership
- **Expertise** of the partners in their respective fields

- **Duration**: 4 years

Organization of NILE

WP7: Coordination and management / core group



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WP1: Enzymatic hydrolysis

Main objective

- To perform an efficient and cost-effective conversion of the ligno-cellulosic raw material into fermentable sugars using innovative solutions

Main tasks

- Selection of appropriate enzymes and substrate-targeting modules
- Improvement of catalytic efficiency of individual enzymes and cocktails for saccharification
- Genome modeling and development of fungal expression enzymes
- Production of enzymes and fermentable sugars (lab & pilot scales)

WP2 - ethanol production

Objective

- To accomplish conversion of hydrolyzed material to ethanol at a high yield (= including pentoses) and rate

Main tasks

- Improvement of pentose fermentation by *Saccharomyces cerevisiae*
- Fermentation of LCB hydrolyzates
  - lab and pilot scales
- Simultaneous saccharification and fermentation
  - lab and pilot scales

WP3 - Process technology

Objectives

- Verification and optimisation of technology (several options can be considered).
- Design of production units: to obtain basic data at a representative pilot-scale for scale up to production plants.
- Technico-economic evaluation.

WP3 - Process technology: tasks

- Pretreatment
- Lignin handling (dewatering)
- Whole process configuration
- Scale up (pilot plant tests - 2 tons of dry substance/500 l ethanol per 24 hours, complete plant with recirculation of process streams)
- System analysis and design
  - modeling
  - process integration
  - mass and energy balances
  - cost estimation

WP4 - Socio-economic and environmental impacts

Objective

- Economic estimation of the whole process
- LCA

Tasks

- Analysis of the costs for different (limited) case studies.
- Cost-Benefit-Analysis on the overall economy for a market introduction of liquid biofuels within the EU
- Life Cycle Assessment: analysis of different environmental effects throughout the overall provision chain.

the NILE project

WP5 - Introduction to the market

Objective

- **To address issues specifically related to the supply, distribution and use of ligno-cellulosic ethanol as a biofuel** (involvement of end-users)

Main tasks

- **Supply, distribution, and**
- **Use**
  - **Impact on pollutant emissions (especially non-regulated ones) in terms of quantity and quality**
  - **Compatibility with engine materials (polymers, metallic materials)**
  - **Stability during storage**

WP6 - Dissemination

Objective

- To ensure an efficient and coherent dissemination policy in a multidisciplinary and trans-national context

Tasks

- Communication plan
- Internet site
- Workshops
- Training
- Publications
- Press

WP7 - Management

Organization

- Coordination: Institut Français du Pétrole
- Core group: IFP + WP leaders (INRA, VTT, ETEK, Lund University, AEBIOM, FIAT, BAFF, SEKAB, Ethanol producer, X-socio-economic)

NILE - consortium

- 22 partners
- 9 companies (most industrial ones)
  - Enzyme and yeast producers
  - Ethanol producer
  - Ethanol distributor and supplier
  - Car manufacturer

  5 SMEs involved (+ others as subcontractors)
- 9 Universities - Academic
- 3 Res. Cent.
- 12 countries