



# PEGRES project

**P**aper, bio**E**nergy and **G**reen chemicals from nonwood **RES**idues by a novel biorefinery



# PEGRES project

## Paper, bioenergy and green chemicals from nonwood residues by a novel biorefinery

### Leader of the consortium

Prof. Juha Tanskanen

### Responsible leaders of the project:

Professor Juha Tanskanen

Professor Jouko Niinimäki

Professor Hannu Manner

### Funding applied for, number of person-years and funding period:

Applied funding from Academy of Finland covers salaries for one post doctoral researcher and two doctoral students for four years during 1.1.2007-31.12.2010.

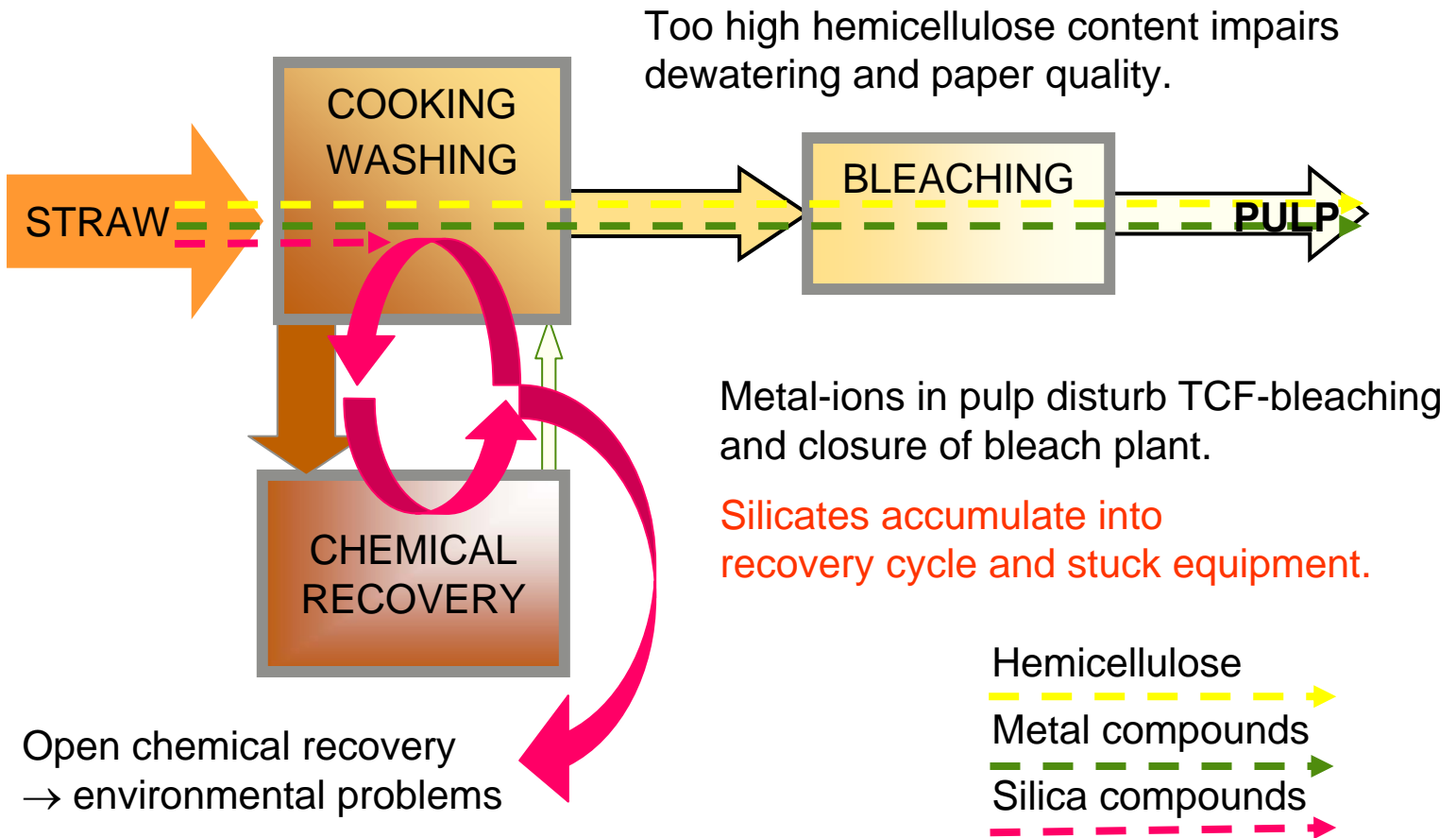
### Sites of research:

- University of Oulu, Process and Environmental Engineering, Chemical Process Engineering Laboratory (CPE Lab);
- University of Oulu, Process and Environmental Engineering, Fibre and Particle Engineering Laboratory (FPE Lab);
- Lappeenranta University of Technology, Department of Chemical Technology, Laboratory of Paper Technology (LUT)



# Problems related to nonwoods

- **Si** in alkaline processes



# Aim of the PEGRES project

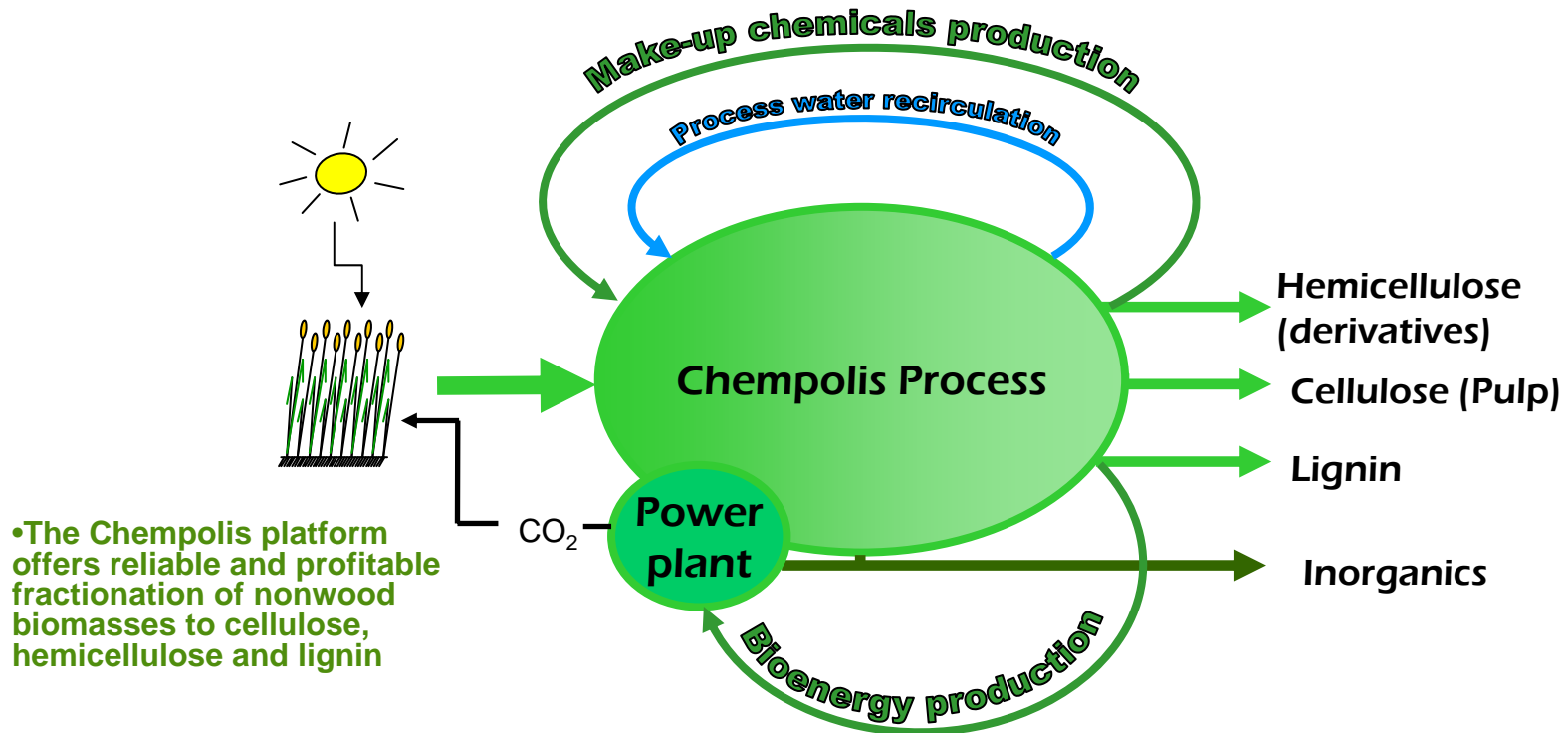
**A conceptual process model for a sustainable biorefinery characterized by:**

- 1. Self-sufficient overall production in terms of energy and process chemicals*
- 2. Total utilization of nonwood biomass into selected high value added products*
- 3. Integrated production of paper and papermaking chemicals from lignocellulosic biomass, especially from nonwood feedstocks*



# 1. Self-sufficient overall production in terms of energy and process chemicals

is obtained by implementing the nonwood fractionation method of Chempolis Company



Chempolis process form a solid backbone for the pursued biorefinery



# Chempolis process

based on long term research in Finland

- 1984-1990 Basic research in KCL, Kemira and universities
- 1990-1994 Demonstration of operations in large scale pilot mill
- 1995-2000 Development of the Chempolis process
- 2001- Industrialisation of the Chempolis process
- 2004 Completed engineering of the first mill in China

Globally patented with over 50 granted patents



## ***2. Total utilization of nonwood biomass into selected high value added products***

### ***Nonwood pulp***

### ***Green chemicals***

#### **Utilization of the hemicellulose fraction**

- Optimal production of furfural and its derivatives
- Production of organic acids
- Ethanol route?
- Derivatives from sulphur free nonwood lignin

### ***Bioenergy***

#### **Utilization of lignin fraction**

- Lignin based liquid biofuel?

### ***Compound fertilizer***

#### **Utilization of inorganics**

- Ash from combustion of the lignin fraction
- Sludge from the bleaching filtrate concentration



### ***3. Integrated production of paper and papermaking chemicals from lignocellulosic biomass***

#### ***Tree-free paper furnish***

##### **Co-production and behaviour of fillers**

**Inorganic; binding of CO<sub>2</sub> gases (PCC), silicates**

**Organic; raw material based fines**

**Multicomponent; charged fillers including PCC, silica and organic material**

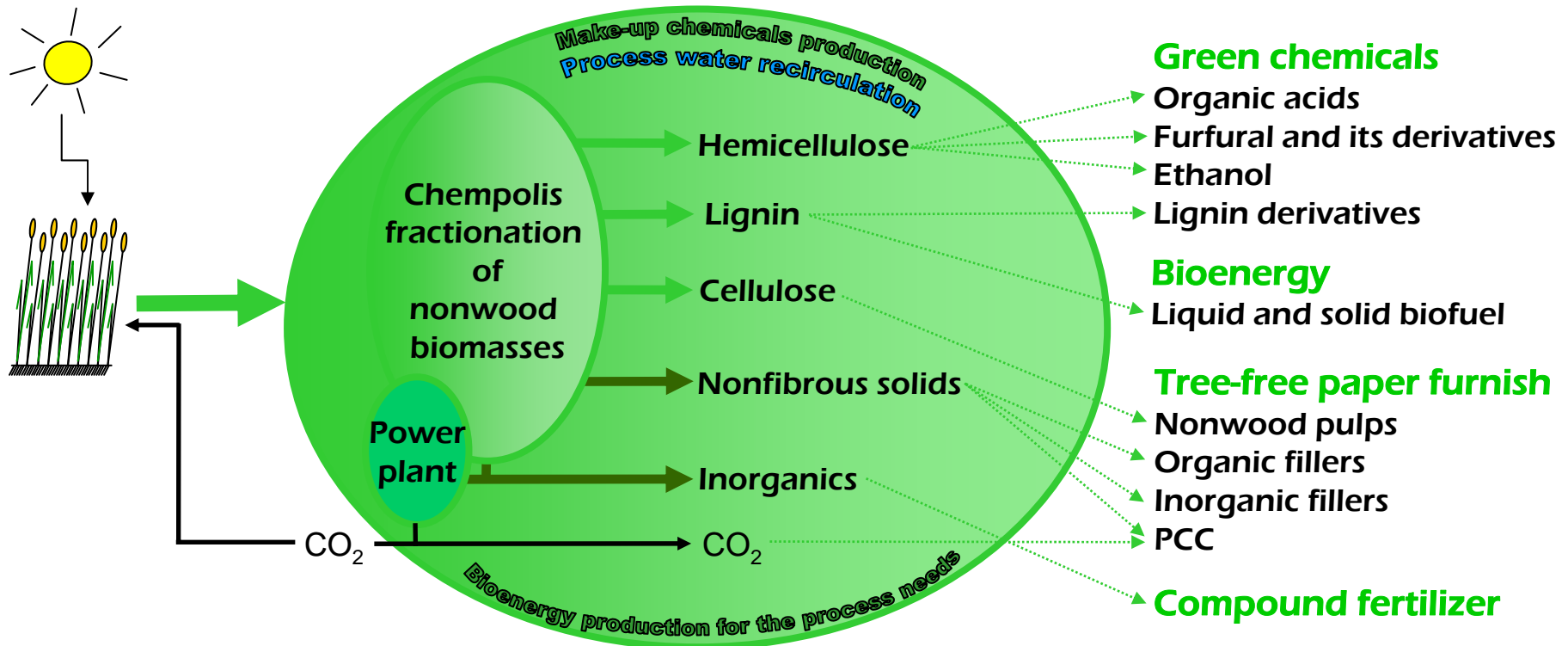
##### **Functionality of tree-free paper**

**Utilization of the strengths of nonwood fibres**

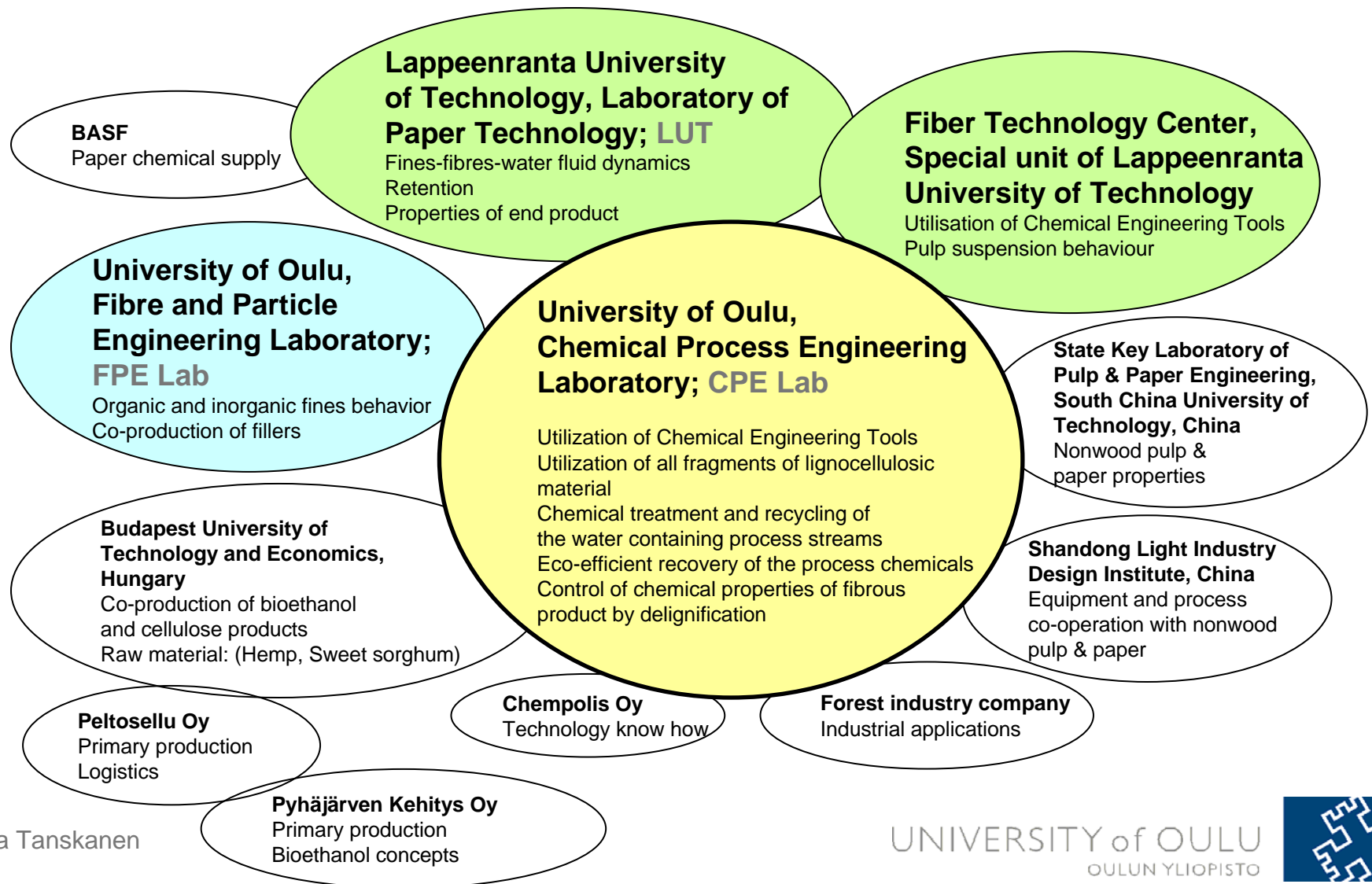
**Suppressing of negative effects of nonwood fines**



# A Nonwood biorefinery



# PEGRES – Consortium parties



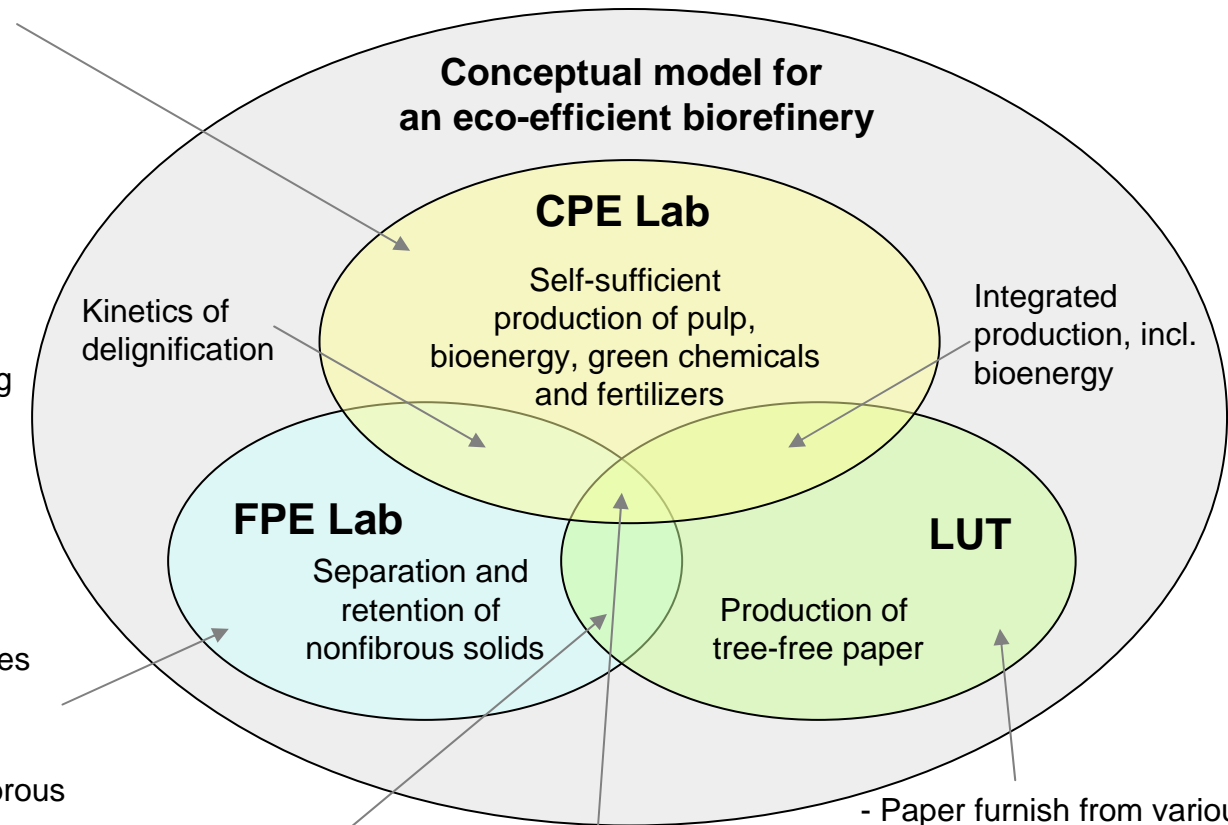
# PEGRES – Consortium parties

- Conversion of hemicellulose to green chemicals
- Conversion of lignin to selected value added green chemicals
- Production of bioenergy
  - combustion / liquid biofuel
  - potassium compounds
- Production of fertilizers from boiler ash and spent bleaching chemicals
- Process integration – self-sufficiency in terms of energy and process chemicals

- Retention/separation of silicates
- Separation of sand and other impurities
- Retention/separation of nonfibrous organic solids (fines)

Behavior of nonfibrous solids in nonwood pulp suspensions

- TCF bleaching and recycling of water
- Production of multicomponent filler



- Paper furnish from various nonwood fibres
- Fillers, pigments, exploitation of co-produced multicomponent fillers
- Linting/bonding of nonfibrous cells
- Retention

