

# NSE Biofuels Oy

## Wood Based BTL Diesel Development

### 2007 – 2011

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# NSE Biofuels Oy

50%/50% JV owned by Neste Oil Oyj and Stora Enso Oyj

Current business is to produce syngas from woody biomasses to be used as fuel in Stora Enso Varkaus pulp mill's lime kiln

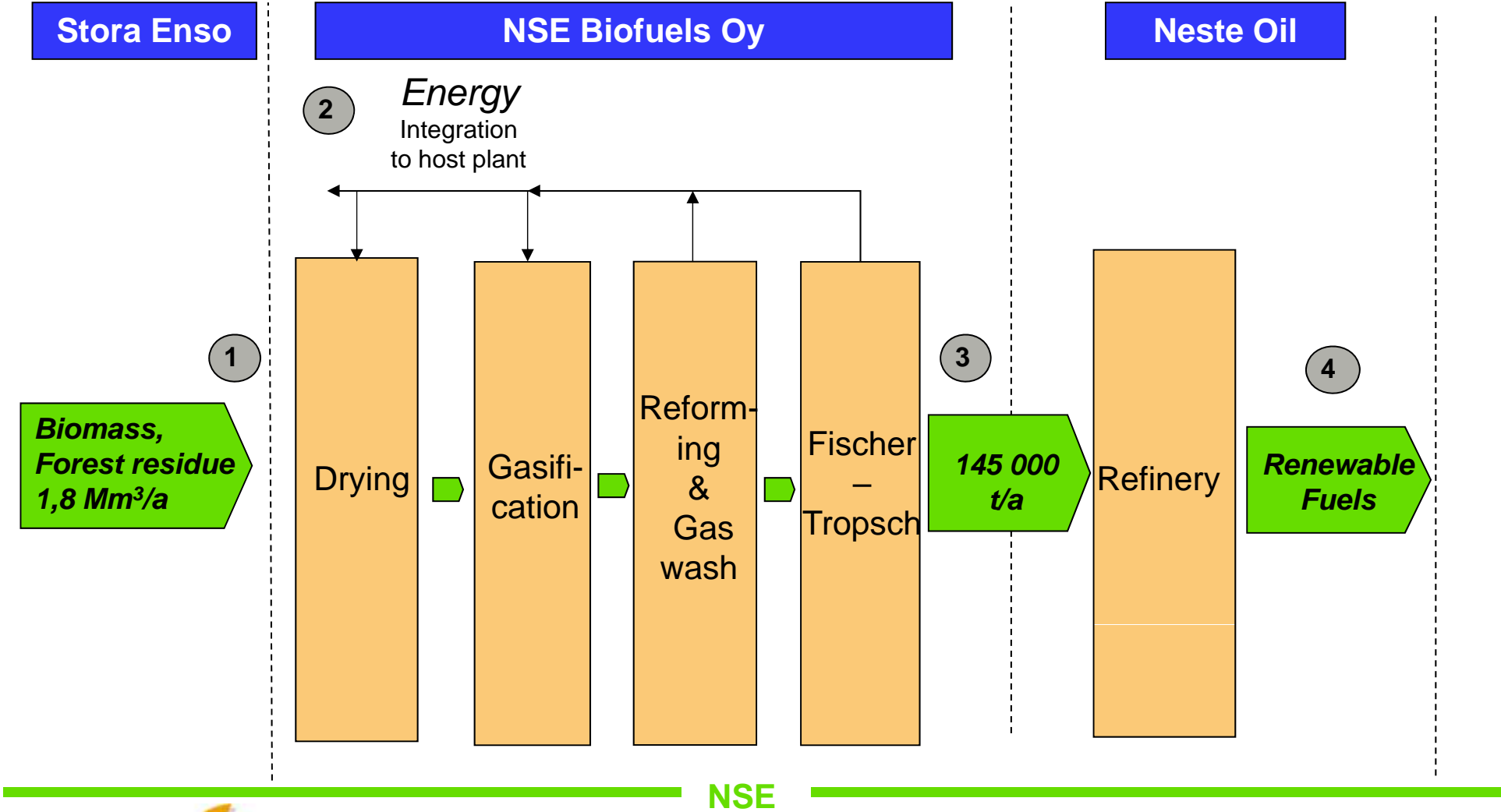
Vehicle and test platform for owners' BTL (Biomass-to-Liquids) development (NOSE- project)

Future goal is implementation of first commercial BTL plant and further develop profitable businesses based on experiences of it and on market demands

# Backbone of NSE BTL concept

- Combined competencies of two different industries:
  - Forest industry has strong raw material supply and logistics know how
  - Oil refining has process, product and distribution know how
- Forest based feed stock, the technical concept allows high tolerance on varying biomass properties
- FT wax offers extension in renewable feed stock base for high quality traffic fuels outside food supply chain
- Efficient energy integration with host plant
- More than 85 % GHG savings compared to fossil traffic fuel
- New, potential business area for forest industry

# Simplified Process Block Diagram for Production of BTL fuels



# NOSE Project Objectives

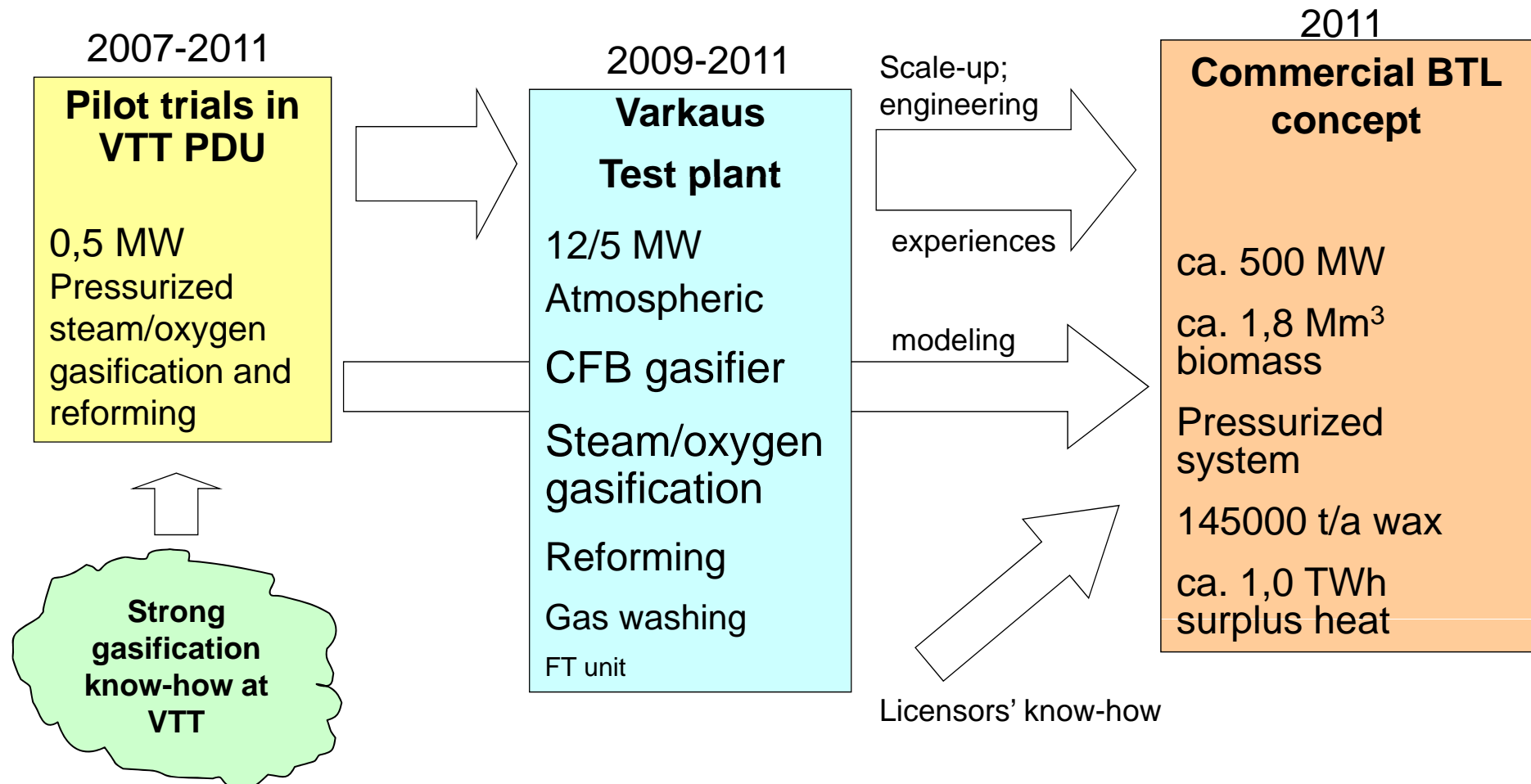
To develop and verify BTL technology based on biomass gasification route

To provide the overall commercial technology concept

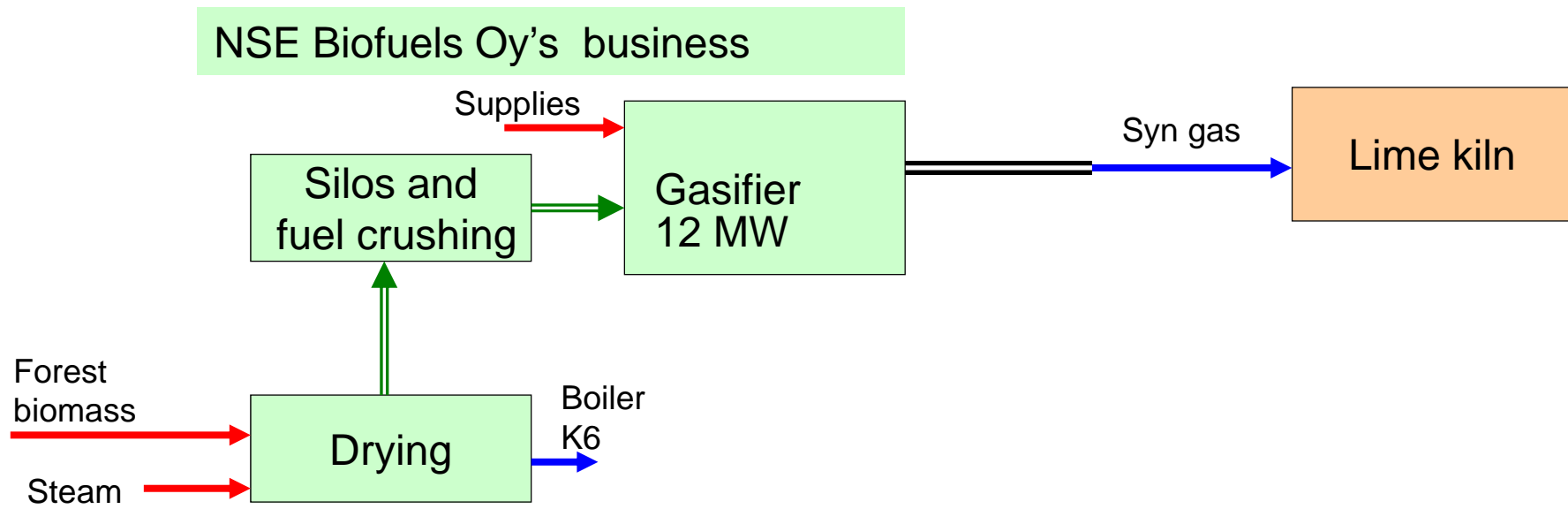
To evaluate the techno-economic feasibility of the production concept

# Stepwise BTL concept development

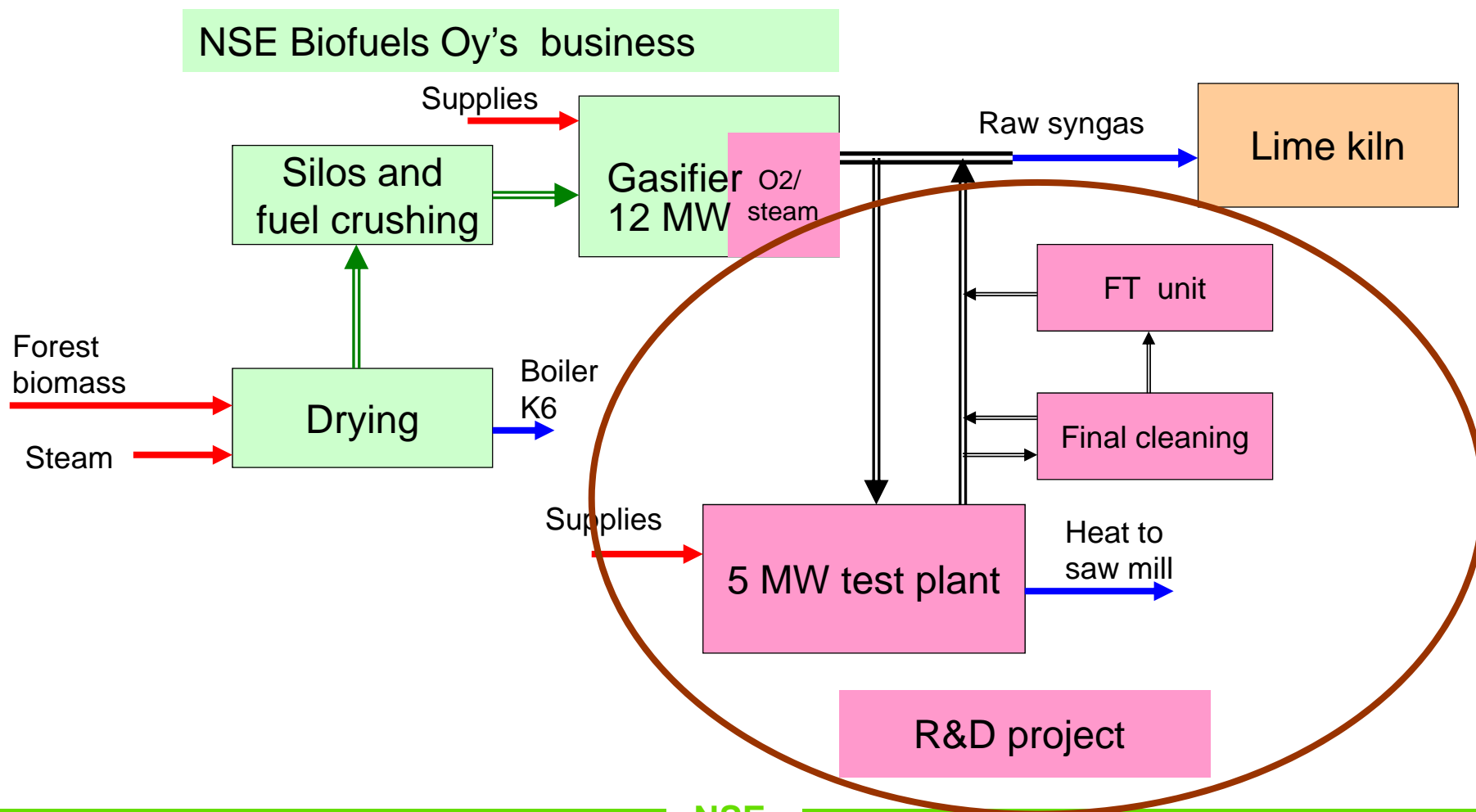
Key technical challenges: Purification of biomass based syngas and catalyst life time.



# NSE Biofuels Oy's current business at Stora Enso Varkaus pulp mill







# NSE Biofuels and integrated test platform





## Development partners

<b>Research &amp; piloting partner</b>	
<b>Gasification supplier</b>	
<b>Process engineering</b>	NESTEJACOBS    NESTE OIL
<b>Feedstock procurement</b>	
<b>Sustainability</b>	NESTE OIL 
<b>Upgrading, distribution</b>	NESTE OIL

## Typical feed stock

	Origin	%
Chips from logging residues	Tree branches and tops from final cutting areas	40-50
Energy wood chips	Small-dimension roundwood from pre-commercial and first commercial thinning wood	30-40
Bark and sawdust	Residues from traditional forest industry	10-20

The forest chips containing a lot of inorganic material (ash, alkali metals and sulphur) are setting the design criteria for the gasifier and downstream gas cleaning process

# Examples of typical feed stock



Energy wood chips, 1



Logging residues, mainly fresh



Logging residues, rotten



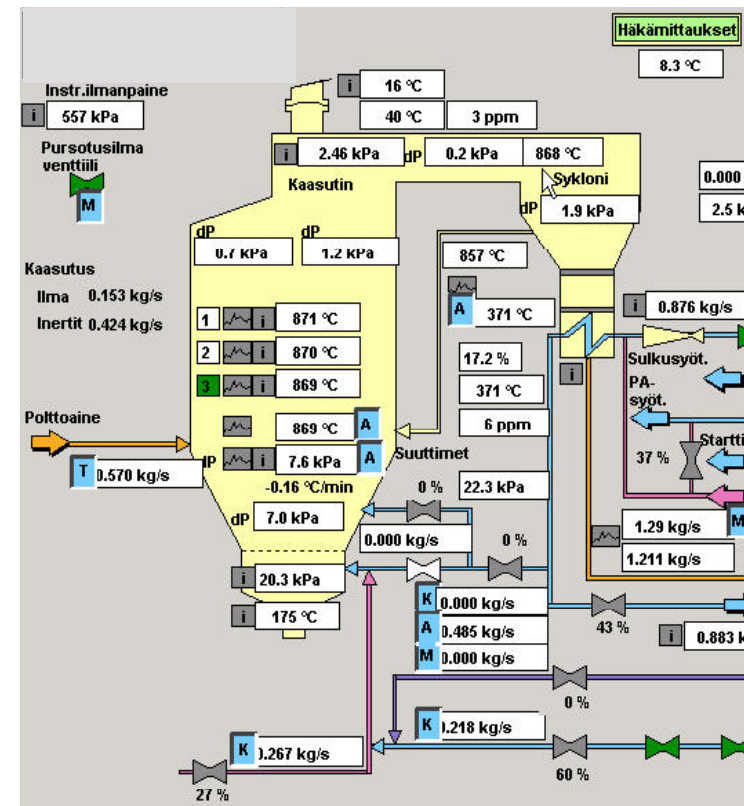
Energy wood chips 2

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# CFB steam/ oxygen gasification at Varkaus test plant

- Gasification temp.: 870 - 890 °C
- Bed material: Blend of limestone and sand
- Oxygen/steam: O<sub>2</sub> 40 - 50 %
- Pressure: atmospheric
- Secondary gas: Steam
- Gas flow to slip stream: 0,4 – 0,6 kg/s
- Typical raw gas composition:

CO	14 %
CO <sub>2</sub>	19 %
H <sub>2</sub>	18 %
CH <sub>4</sub>	5 %
H <sub>2</sub> O	34 %
H <sub>2</sub> S	120-200 ppm



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# Syngas cleaning, key to success

Some highlights:

- Several innovative process steps and sections
- New catalyst technology for catalytic reforming of heavy hydrocarbons e.g. tars developed with VTT
- Removal of some specific organic trace compounds in syngas
- COS and HCN conversion catalytically
- Removal of CO<sub>2</sub> and H<sub>2</sub>S in a unique combined process section
- After final polishing H<sub>2</sub>S content is below 10 ppb

# Fischer-Tropsch synthesis: old invention – new application

Varkaus test plant has on-line FT unit allowing long term testing activities.

High quality FT wax based on bio syngas has been produced with good success

Both slurry and fixed bed technologies has been evaluated for commercial BTL plant.

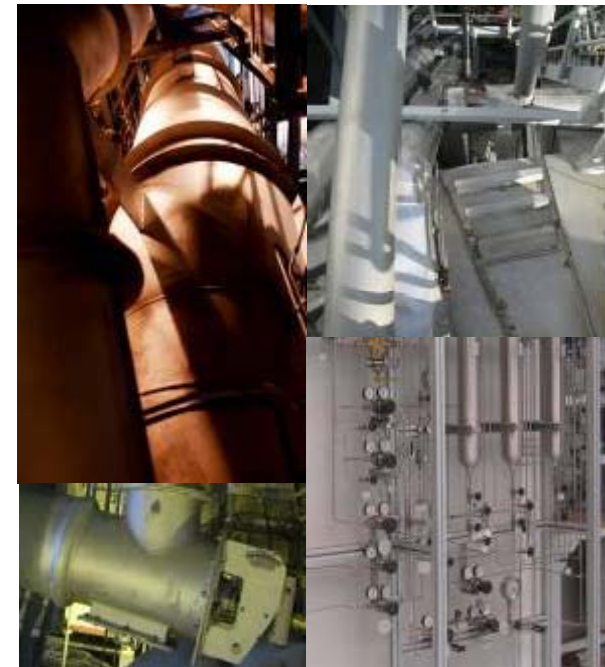


# Readiness to start Basic Engineering is achieved

Commercial BTL process is modelled and the key operational parameters have been estimated and verified.

Technical concept is based on both NSE's own and licensors' technology.

Profitability analysis including CAPEX, OPEX estimates is ready.



## Current status

Trials completed in Varkaus test plant at the end of August 2011.

Developed BTL- technology works and the life time of catalysts is long enough for industrial use.

EIAs of commercial BTL plant have been completed at two potential sites: Neste Oil Porvoo oil refinery and Stora Enso Imatra pulp and board mill integrate.

Decision to start Basic Engineering is waiting for the outcome of NER 300 funding application, expected in Q3-Q4/2012.

To meet the profitability targets of commercial BTL plant is a challenge.

Biomass dryer and air-blown CFB- gasifier continue production of raw syngas for mill's lime kiln.



# Raw syngas in the lime kiln to replace HFO

## PROS

- Lower CO<sub>2</sub> emissions in pulp making
- Lower NO<sub>x</sub>, dust and TRS emissions
- Less rings in the lime kiln ?

## CONS

- Tendency to dust fires in the dry fuel line just before the gasifier
- High focus on safety issues, more tedious to operate
- Kiln capacity is sensitive to biomass moisture, 20-25% is too much
- Lower flame radiation decreases slightly kiln capacity

## SOME REMARKS

- NPE management and quality of reburned lime unaffected
- Easy and flexible change of fuels
- Hard to meet profitability due to narrow market price difference between biomass and HFO
- Biomass dryer and gasifier rather heavy investment

# Biomass-to-Liquids renewable diesel

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STORAENSO 