

# Demonstration of Second Generation Bio-Ethanol Based on Wheat Straw

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VP, partnerships and stakeholder relations

**Inbicon**



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# AGENDA

- DONG Energy / Inbicon
- IBUS - the Background
- The Technology
- The Future

# DONG Energy - Inbicon



## KEY FIGURES

2007

Turnover:

€ 5.6 bn.

EBITDA:

€ 1.3 bn.

Tot. assets:

€ 12.0 bn.

Empl: 5.100



# DONG Energy and Cellulosic Ethanol

- 10+ years experience with biomass for power plants
- 1.3 mio tonnes in 2007
- In 2002-2006 coordinator of EU-project: Co-production Biofuels
- Now further development and commercialization of 2nd generation technology in subsidiary "Inbicon"



# IBUS – the EU Project: Partners and Budget

- IBUS : Integrated Biomass Utilisation System
- Contractors:
  - Risø (DK – national laboratory)
  - RVAU (DK – agricultural university)
  - Sicco K/S (DK – innovation company)
  - TMO Biotec Ltd (UK – thermophilic microorg.)
  - DONG Energy (DK - utility)
- Coordinator: DONG Energy
- Project Budget: € 13,5 mill.
- EU Contribution: € 6,5 mill.
- Time Frame: 01.12.2002 – 30.06.2006





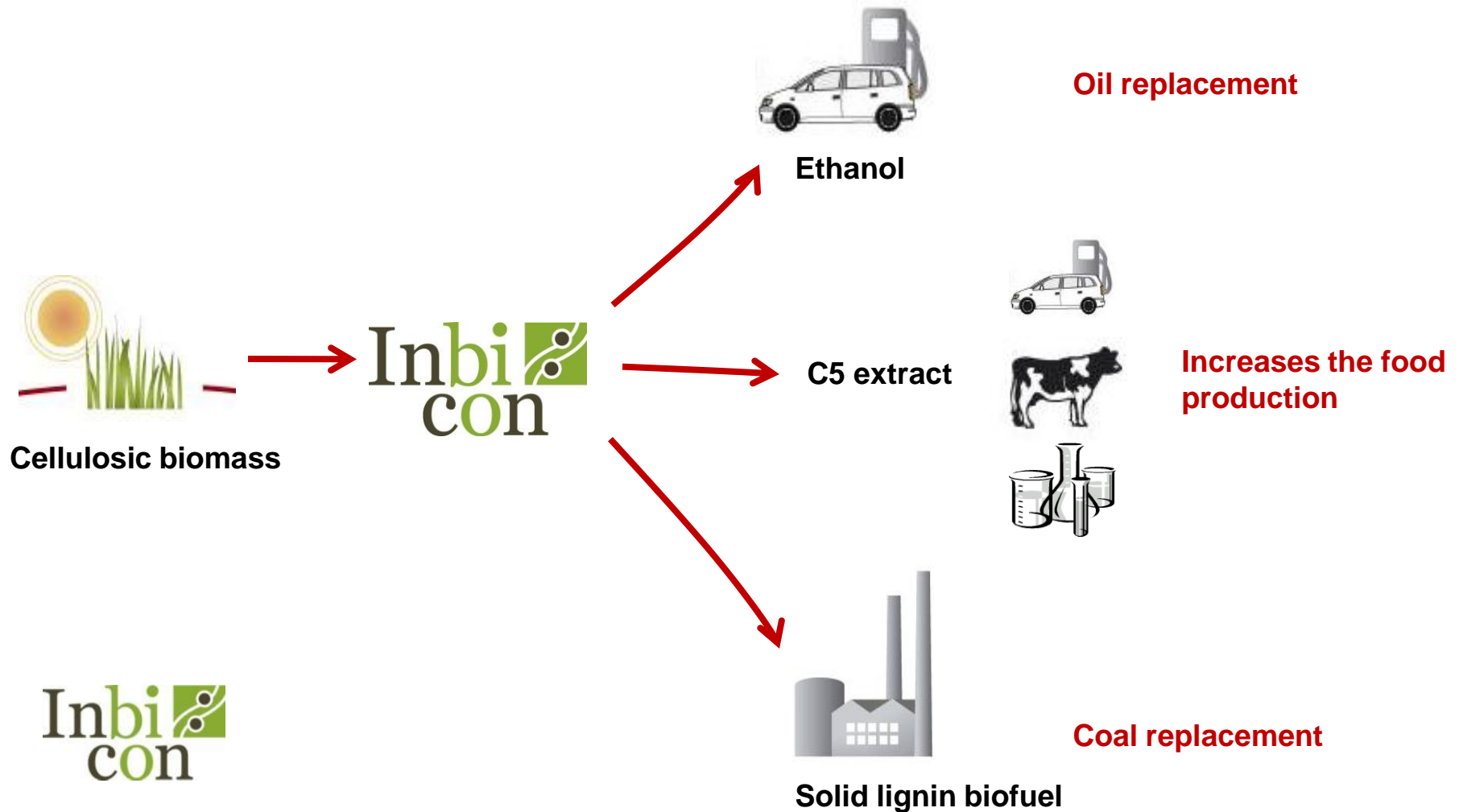
# IBUS – the EU Project: Photo Opportunities



August 2005:  
Inauguration of the second pilot plant

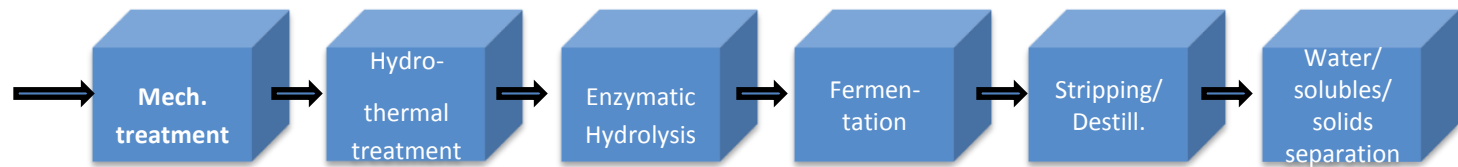


# Intelligent use of biomass



# Focused Development

- Reduces Technological Risk



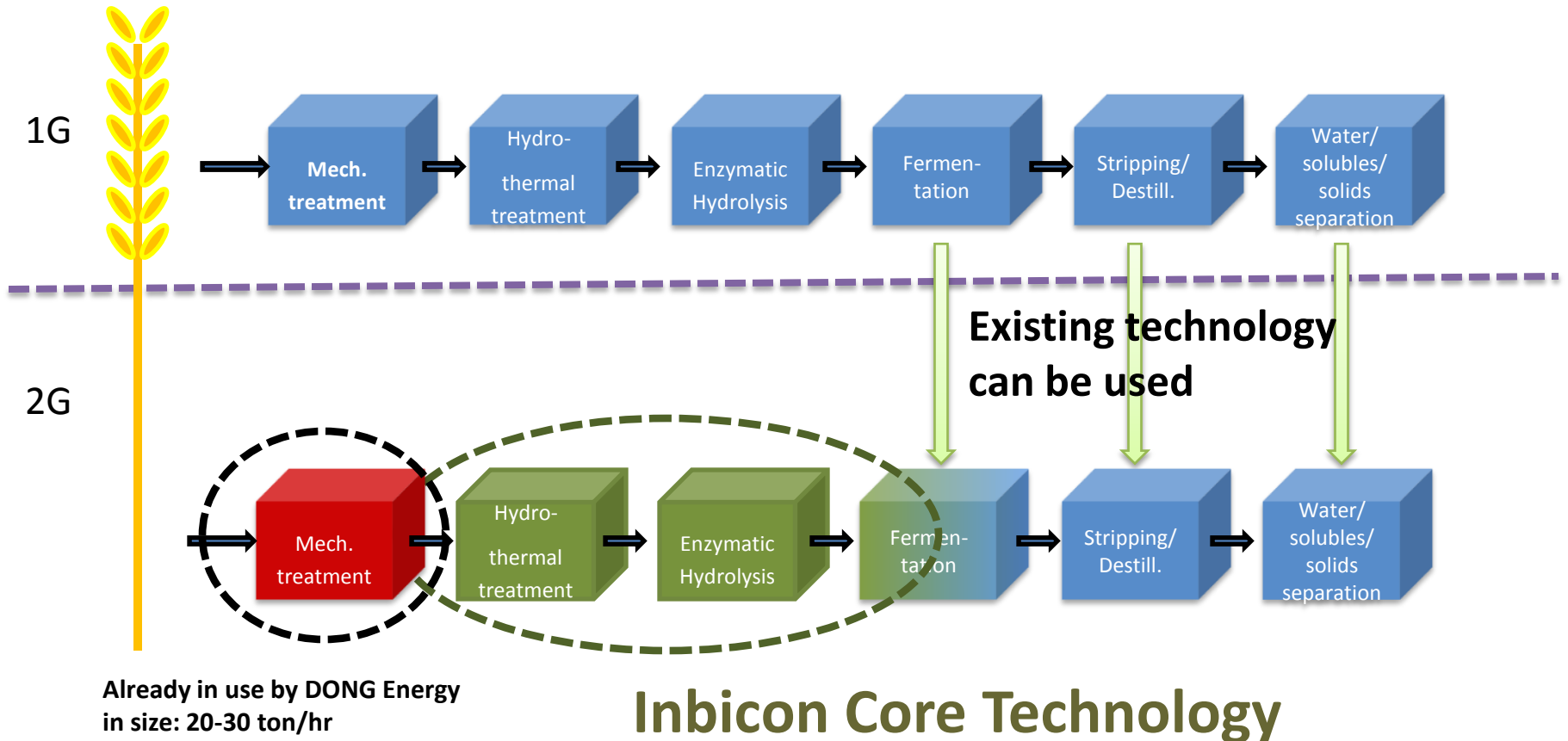
2G

## How do we make the transition to cellulosic ethanol?

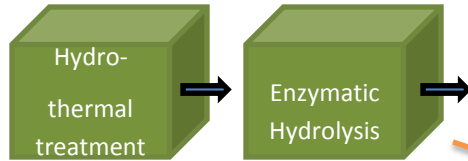


# Focused Development

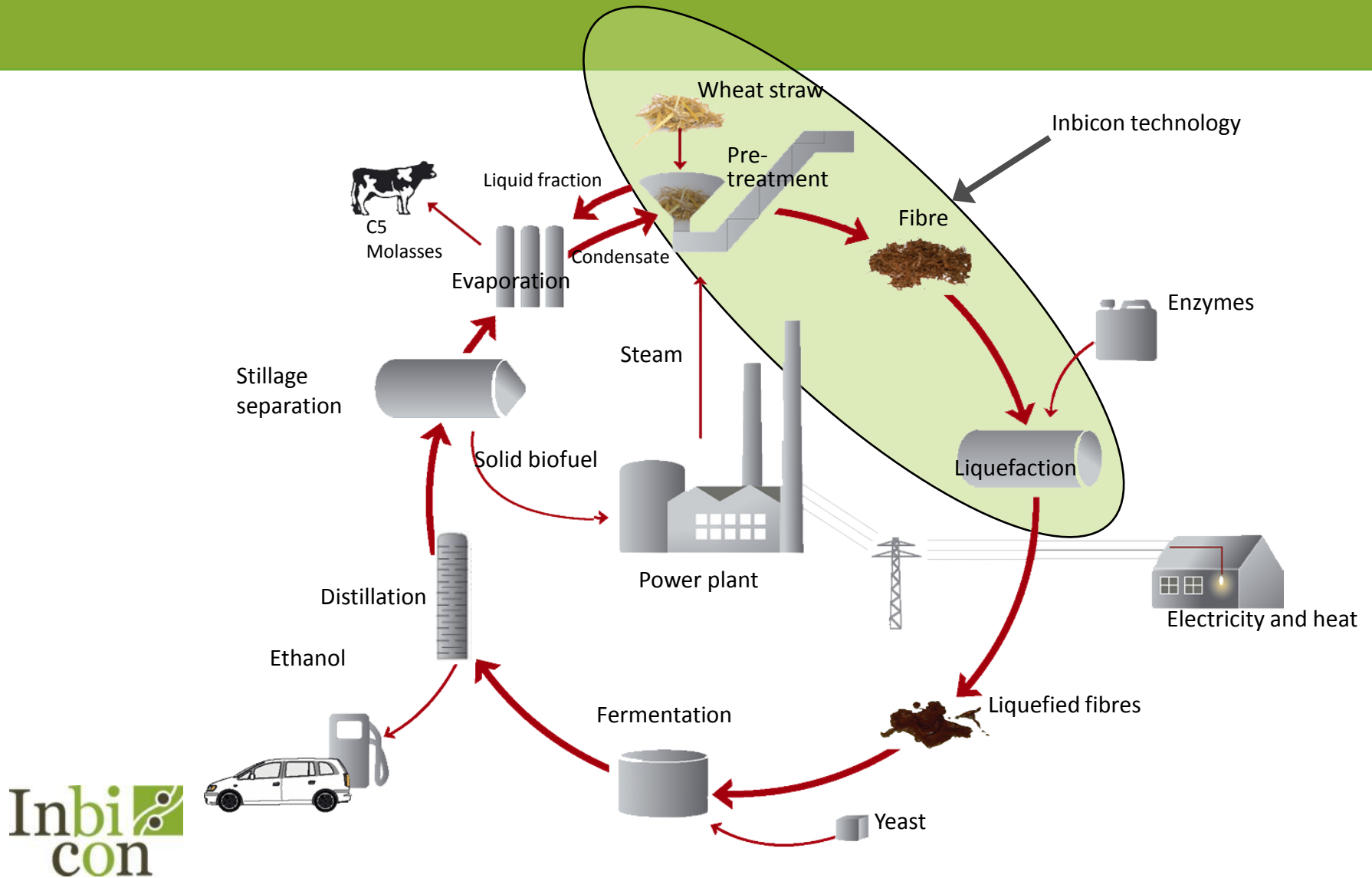
## - Reduces Technological Risk



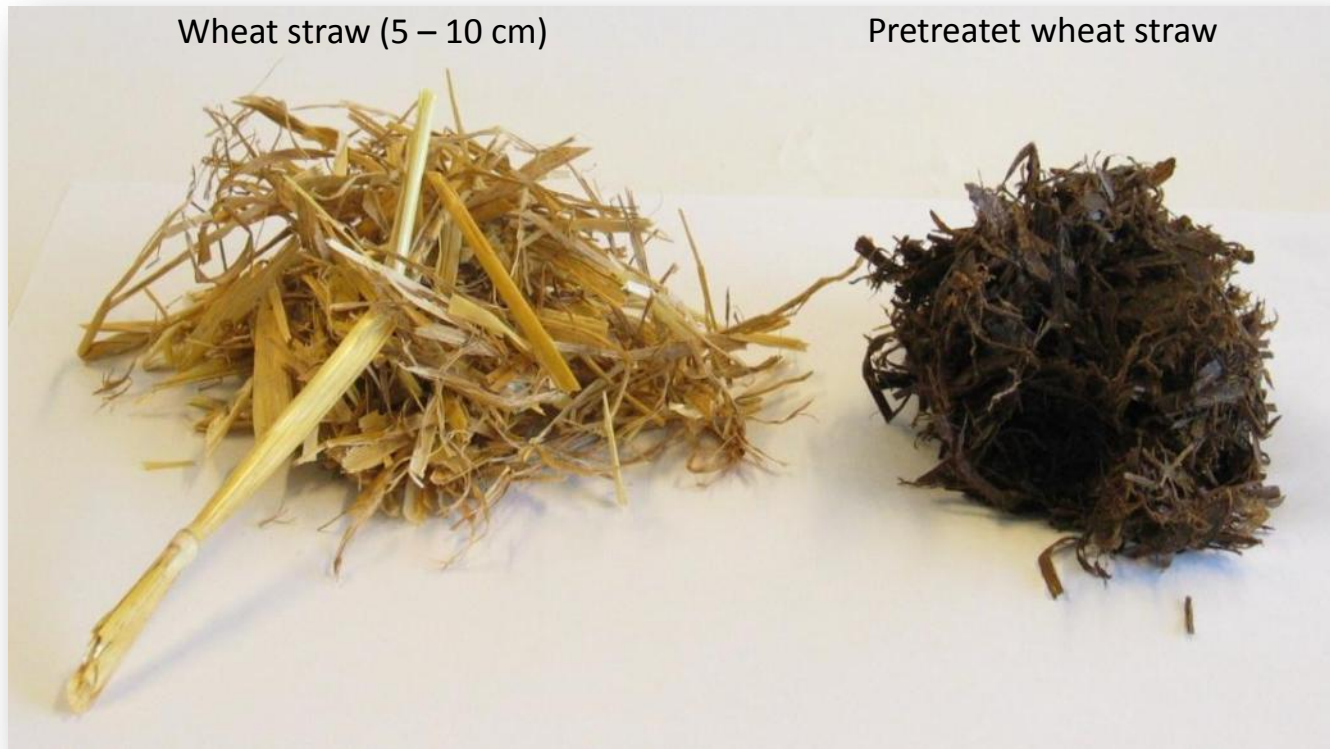
# Inbicon Core Technology



# Inbicon Technology

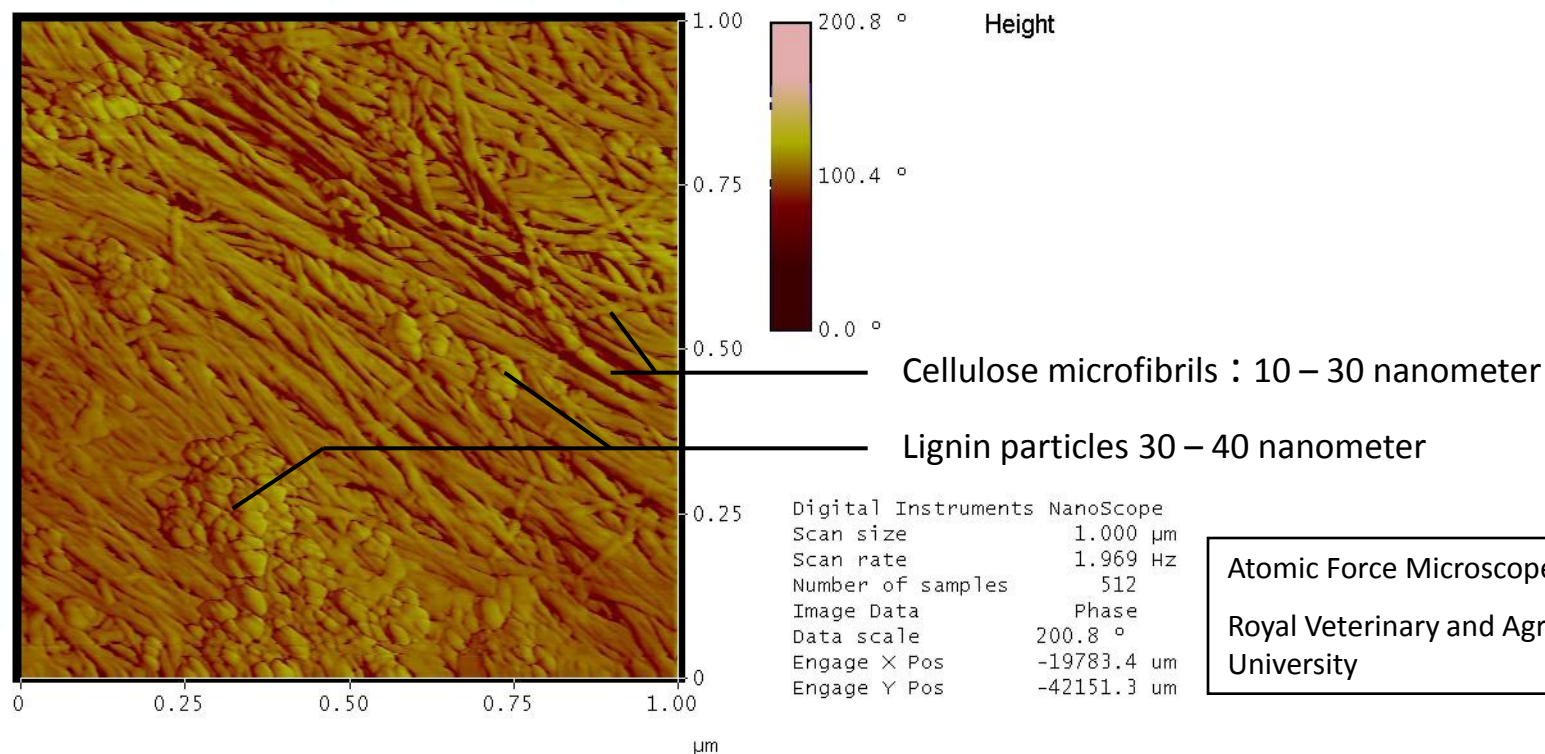


# Inbicon Technology: Pretreatment



# Inbicon Technology: Pretreatment

Height Angle Surface Normal Clear Calculator



Atomic Force Microscope:

Royal Veterinary and Agricultural  
University



# Inbicon Technology: Enzymatic Liquefaction – High DM

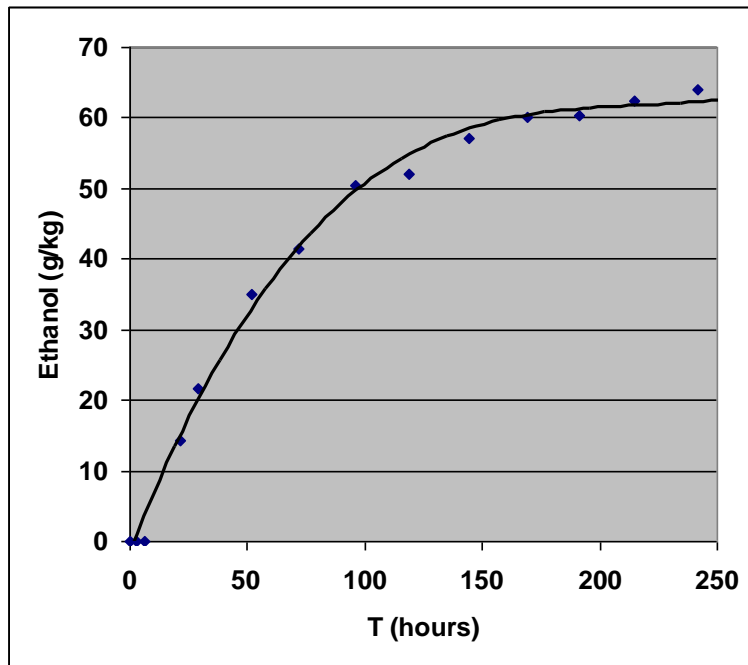


## **5 Chamber Reactor**

- for 5 simultaneous tests,  
now at CPH University



# Inbicon Technology: SSF Results



## Ethanol concentration:

- 63 g/kg incl. suspended material
- 83 g/l in liquid fraction (excl. suspended material)
- 105 ml/l (10,5 vol%) in liquid (excl. suspended material)
- NOTE: Process not yet optimised, simple bakers yeast used

# Present Pilot Plant: 100kg/hr Pretreatment





# Present Pilot Plant: 1000kg/hr Pretreatment





# Present Pilot Plant: Distillation



# Inbicon Advantages

## High dry matter

- Reduces Energy consumption by up to 60 % compared to competitors
- Reduces hardware cost, due to smaller equipment sizes

## Flexibility

- Technology can be used to process various kind of biomass and waste
- The Inbicon Core Technology can be used as pre-treatment for production of various products

## Integration

- Higher efficiency
- In-house knowledge of powerplants
- +20 years of operating experience

# Inbicon Advantages: High Dry-Matter Throughout the Process

## Competitor Technology (15 % Dry-matter)

- Reference

## Inbicon Technology (40 % Dry-matter)

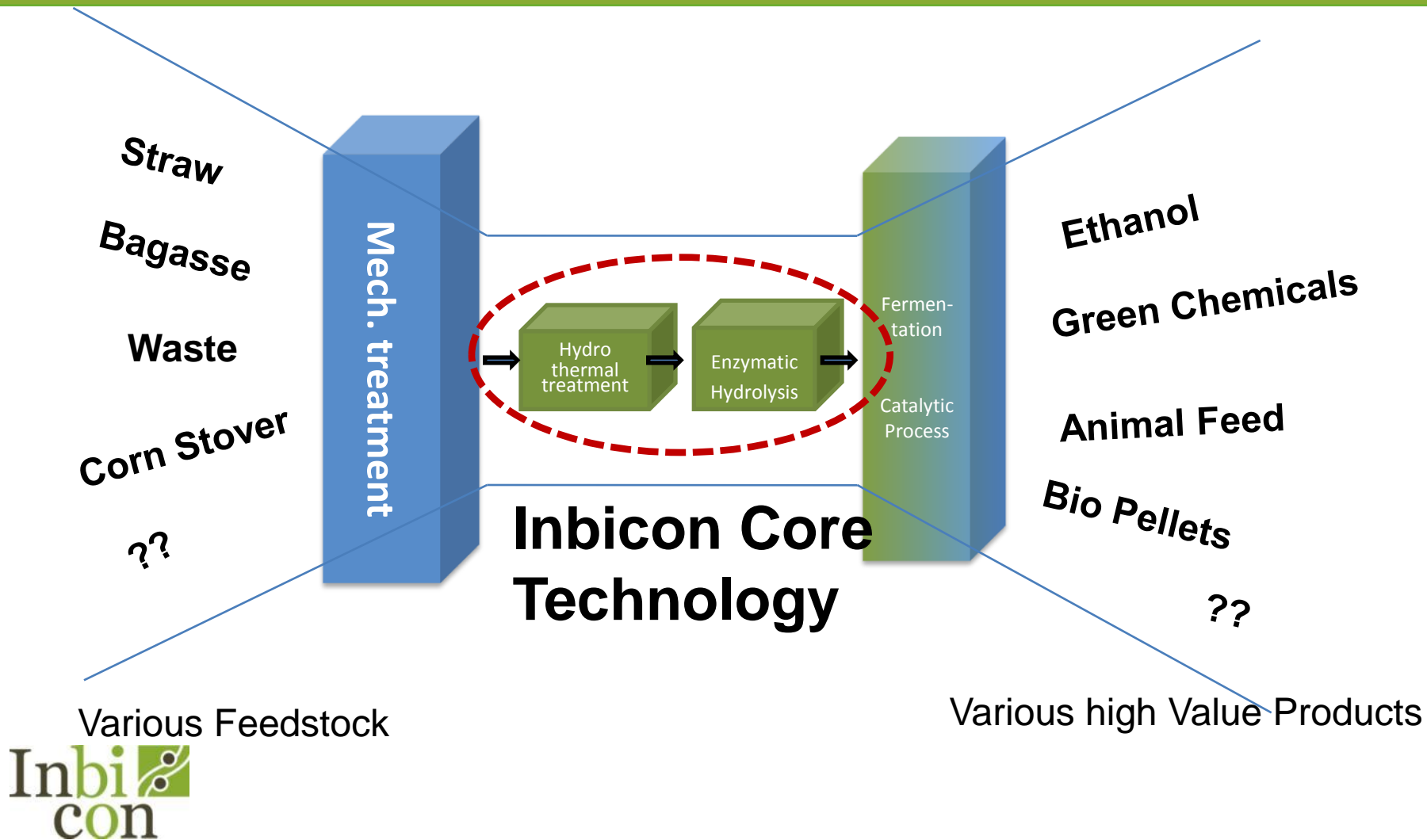
- Steam consumption reduced by **59 % !**
- Power consumption reduced by **32 % !**
- Investment reduced by **17 % !**

**Substantial savings in energy and investment, when the Inbicon high dry-matter technology is used**

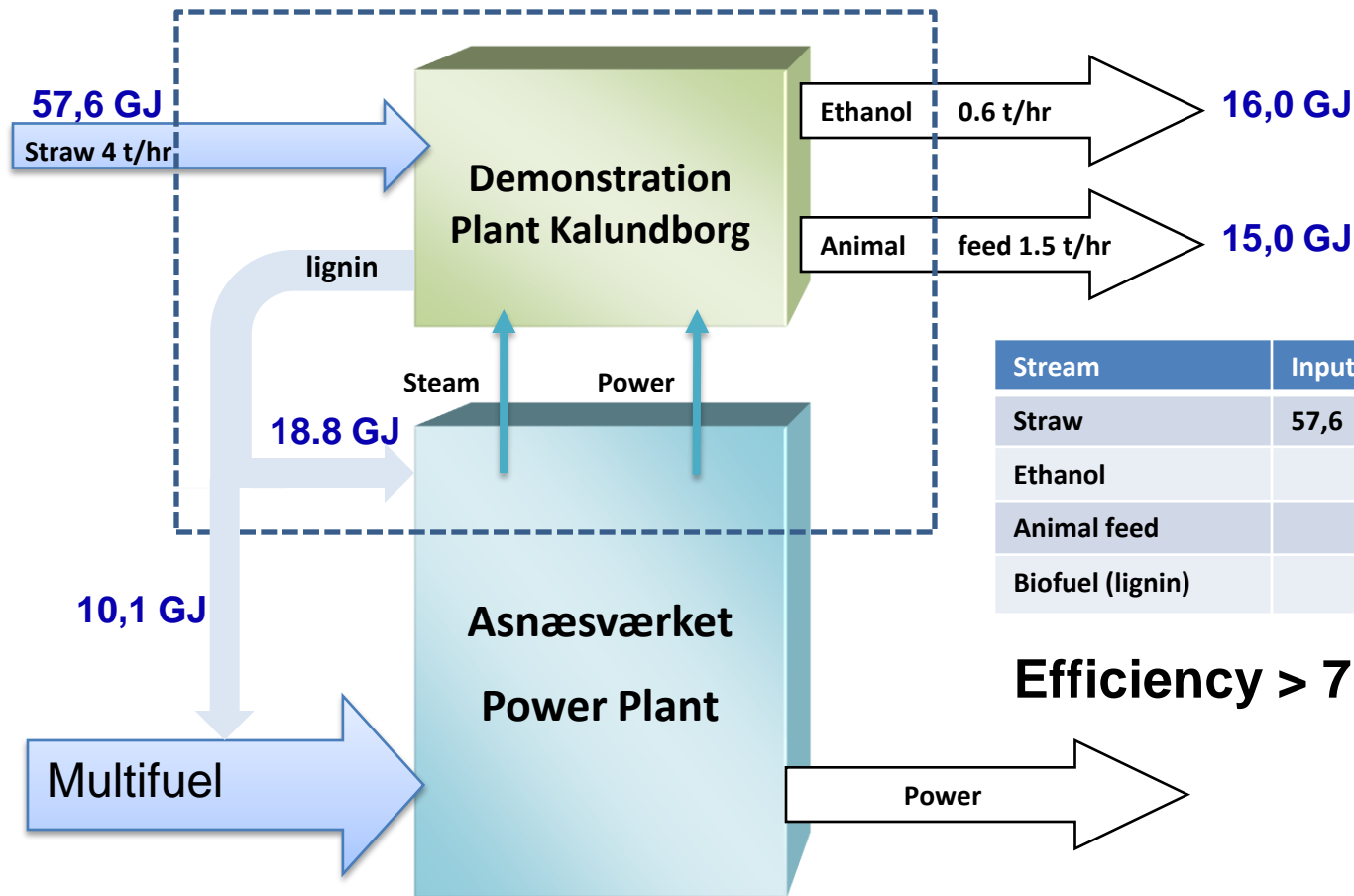




# Inbicon Advantages: Multi Utilisation of Technology



# Inbicon Advantages: High Energy Efficiency

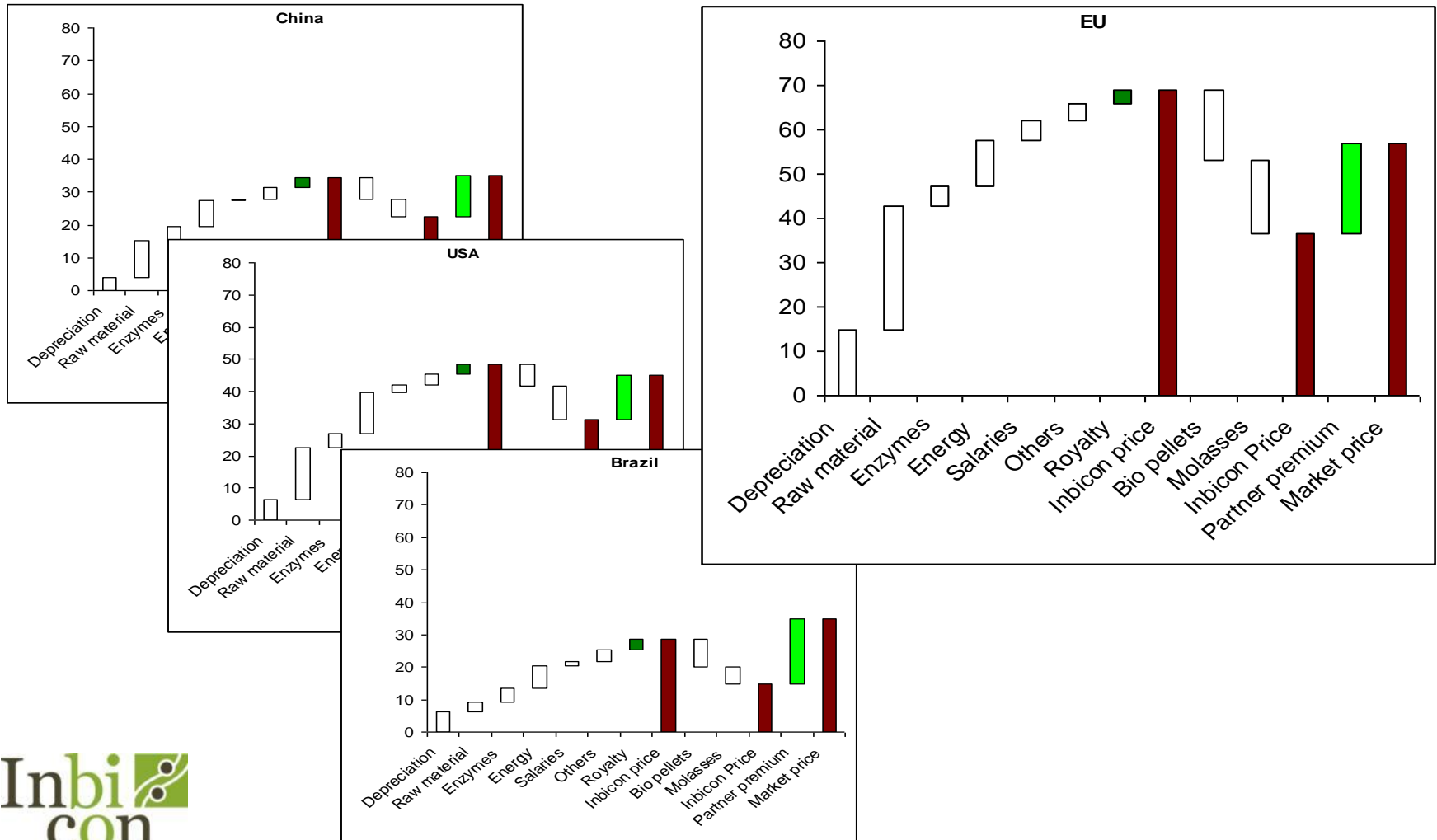


**Efficiency > 71% !**



By utilization of the integration advantage:  
**additional 1.5 kg CO<sub>2</sub> per litre ethanol can be saved !**

# Inbicon Technology is Competitive

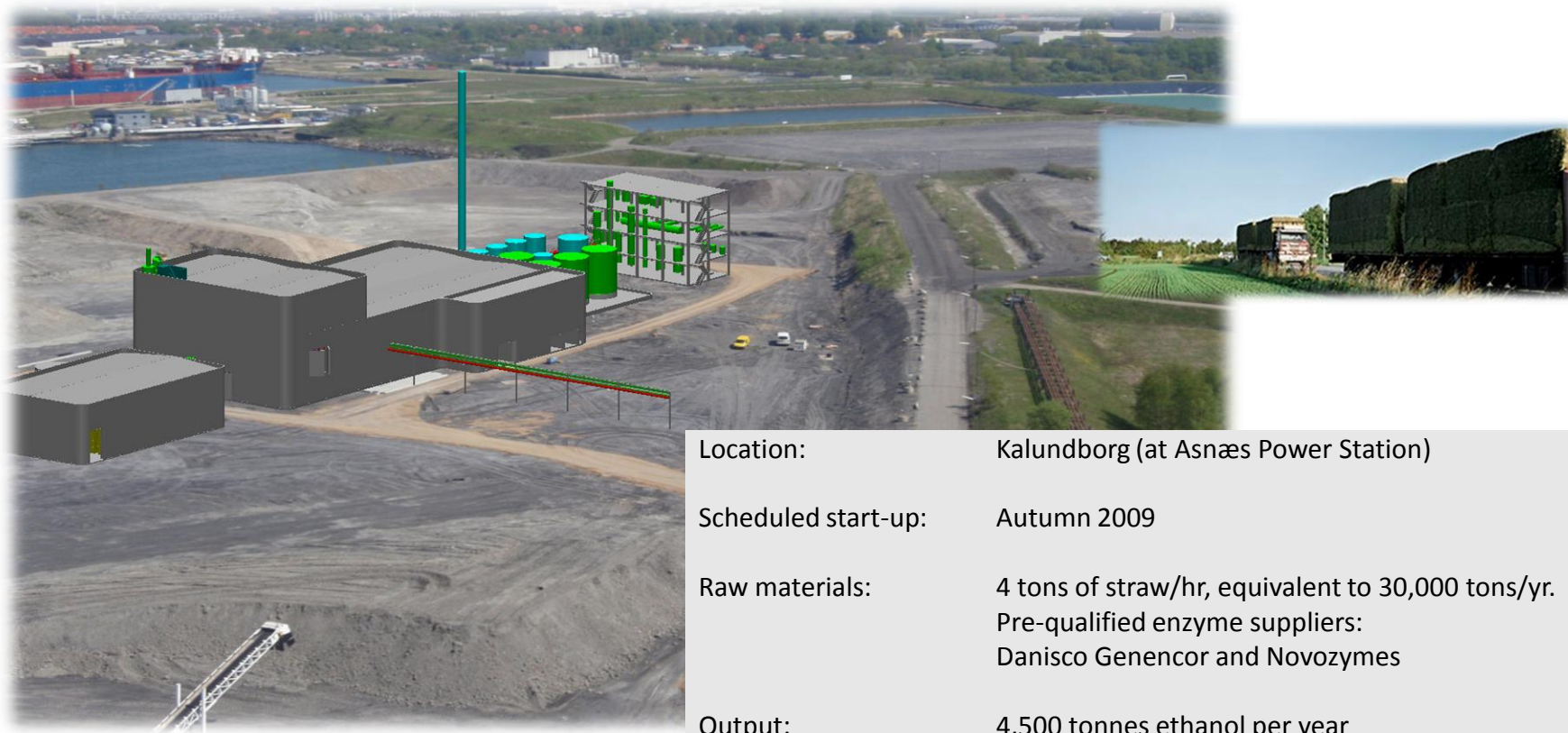


# Inbicon Technology: Status September 2008

- IBUS is optimised on wheat straw
- Successfully tested on bagasse (sugar cane), corn stover
- Successful pre-treatment, liquefaction and fermentation
- Dry Matter 20-40 % in all process steps
- Only enzymes, yeast and water added
- > 11 vol/vol % ethanol after fermentation
- Successful distillation (less than 0.1 % in stillage)
- 100 t/day Demonstration plant under construction

# Demonstration plant – 2009

Ready for the Climate Summit



Location:	Kalundborg (at Asnæs Power Station)
Scheduled start-up:	Autumn 2009
Raw materials:	4 tons of straw/hr, equivalent to 30,000 tons/yr.
	Pre-qualified enzyme suppliers: Danisco Genencor and Novozymes
Output:	4,500 tonnes ethanol per year 75,600 GJ of biofuel per year 11,250 tonnes of C5-molasses (70% DM)

# Celebration of start of the Construction





# Excellent Publicity!!



# The Construction Site 04 Sept. '08



# The Plant





# Further Development / Partners

- Inbicon is continuing the development and maturing of the technology
- Inbicon wants to contribute to demonstration plants around the world with pretreatment technology
- Inbicon wants to find partners for integration into new and existing ethanol plants
- Inbicon will not supply C5 fermentation, but offer test facilities and C5 molasses for partners who can supply C5 technology as add-on technology to our customers
- Inbicon has partnered with Tom Corle/The G-team for marketing in North America

# Thank You



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