Substainable biofuels for the transport sector

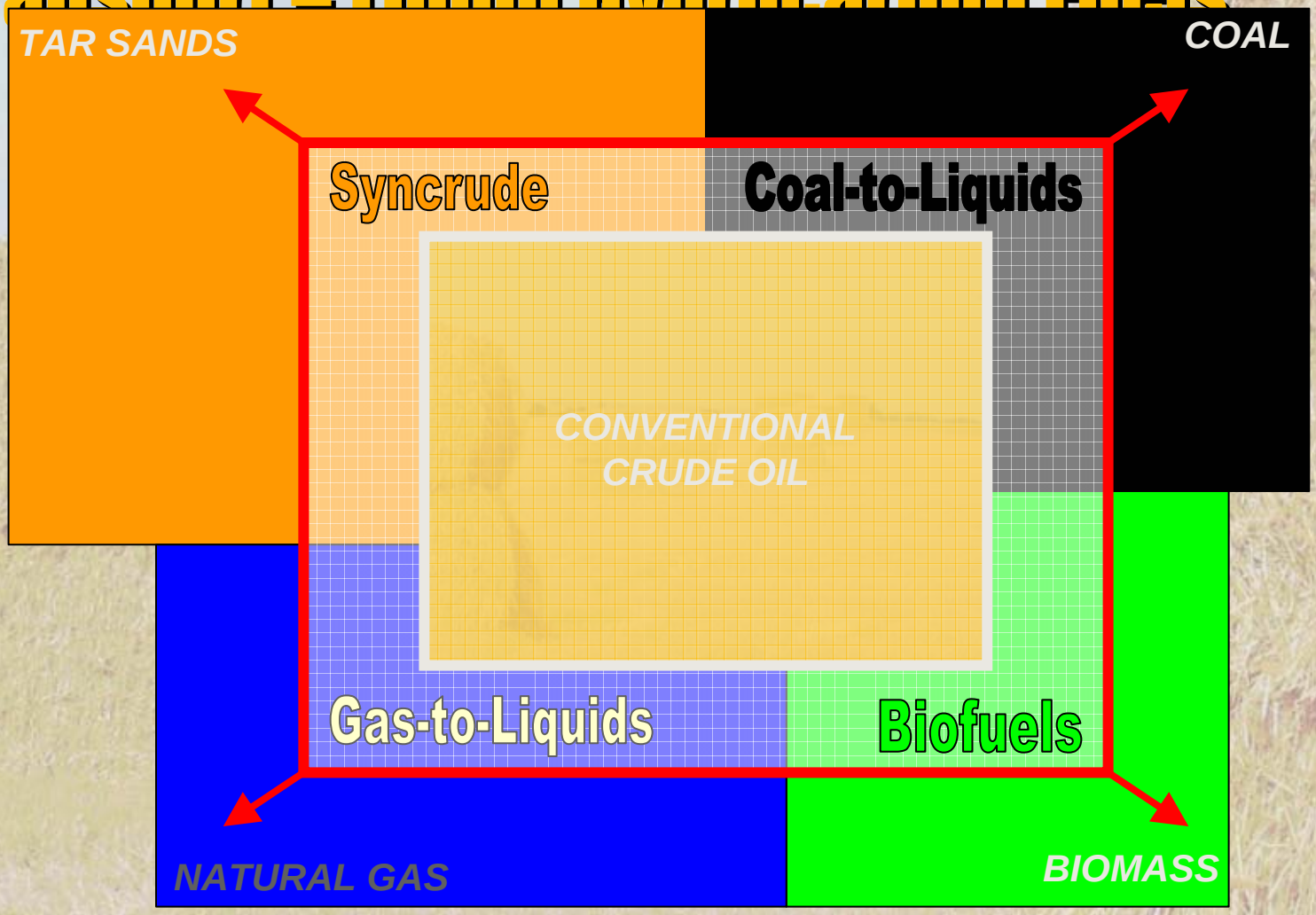
Round Table:
Biofuels: Linking Support to Performanace
Paris 7th and 8th June 2007

Birgitte K. Ahring
DTU & BioGasol

Oil - what our demand increase is bringing

- Climate change – obvious !
  - High oil prices, leading to:
    - Rush for unconventional oil
      - tar sands (Alberta, +15-20% GHG)
      - coal-to-liquid, (China ? +100% GHG)
    - Rush for biofuels
      - Nature destruction (±1 hectare/car needed)
      - ‚Full tanks, empty plates ?' (tortilla-crisis)
      - The poor switch to wood for cooking - deforestation
    - Increased geopolitical tensions
- TRANSPORT IS KEY

Transport = Liquid Hydrocarbon Fuels




BiC
BIOCENTRUM-DTU
DTU
PROCESS
END USE
Biofuel (good)
Biofuel (bad)
Crude Oil (avg.)
Tar Sands
CTL
CO2

What does this quality approach imply ?

- More climate effect and -certainty
- Options for reducing 10% by 2020
  - Improve oil production process (no tar sands, no CTL, no flaring, 1-2% ?)
  - Improve refineries (1-2% ??)
  - Efficient biofuels (6-8% ??)
  - Other options (LPG, CNG, biogas, electrcity, hydrogen ? (0-1% ??)
- Burden of proof rests with fuel supplier
  - If no reporting: ‚worst case' assumption
  - Supplier can gain carbon points by proving the fuel is better through a properly audited reporting trail

What does this quality approach imply ? 2

- Market incentive 1: produce as cheaply as possible a tonne of greenhouse gas reduction
  - A litre of biofuel with 80% climate effect is worth 4 times more than a litre with 20% climate effect
- Market incentive 2: climate certification of biofuel (business necessity ad opportunity, rather than of threat)

Advantages quality approach over quantity approach

- More effective and efficient climate policy
- More choice for fuel suppliers – also helps energy security
- Quicker transition to 2nd generation biofuels – fewer food security issues and better image for biofuels
- Petrol and diesel based on ‘unconventional oil’ will become unmarketable in Europe and California – a second-class product

Statement from US Department of Energy

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

The Unique Role of Biomass

While the growing need for sustainable electric power can be met by other renewable, biomass is the only renewable that can meet our demand for carbon-based liquid fuels and chemicals.

Bioethanol – Production technologies

Current technology:

Starch-based ethanol

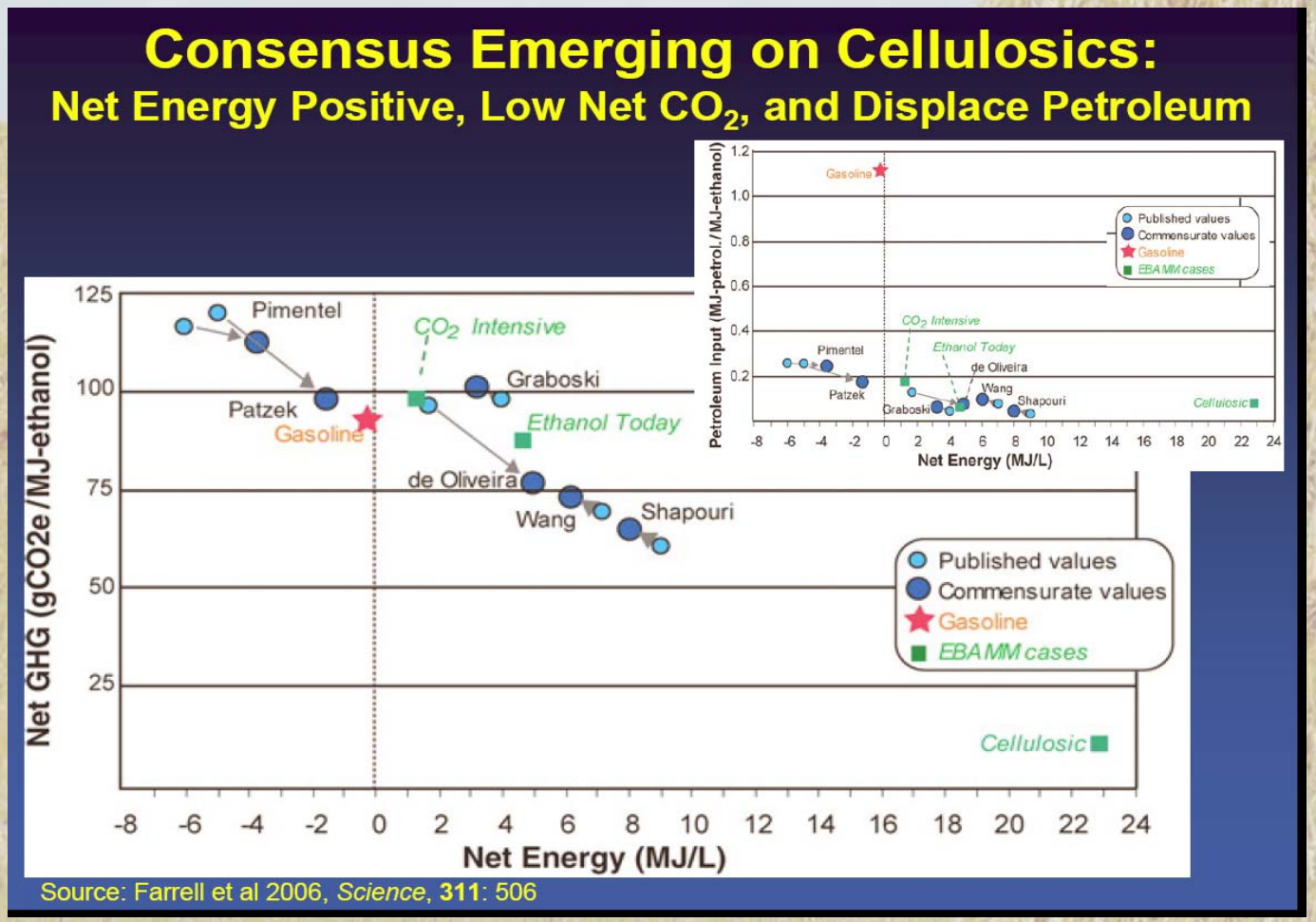
Biomass: Corn, grain, sugar

The future technology:

Lignocellulose based ethanol

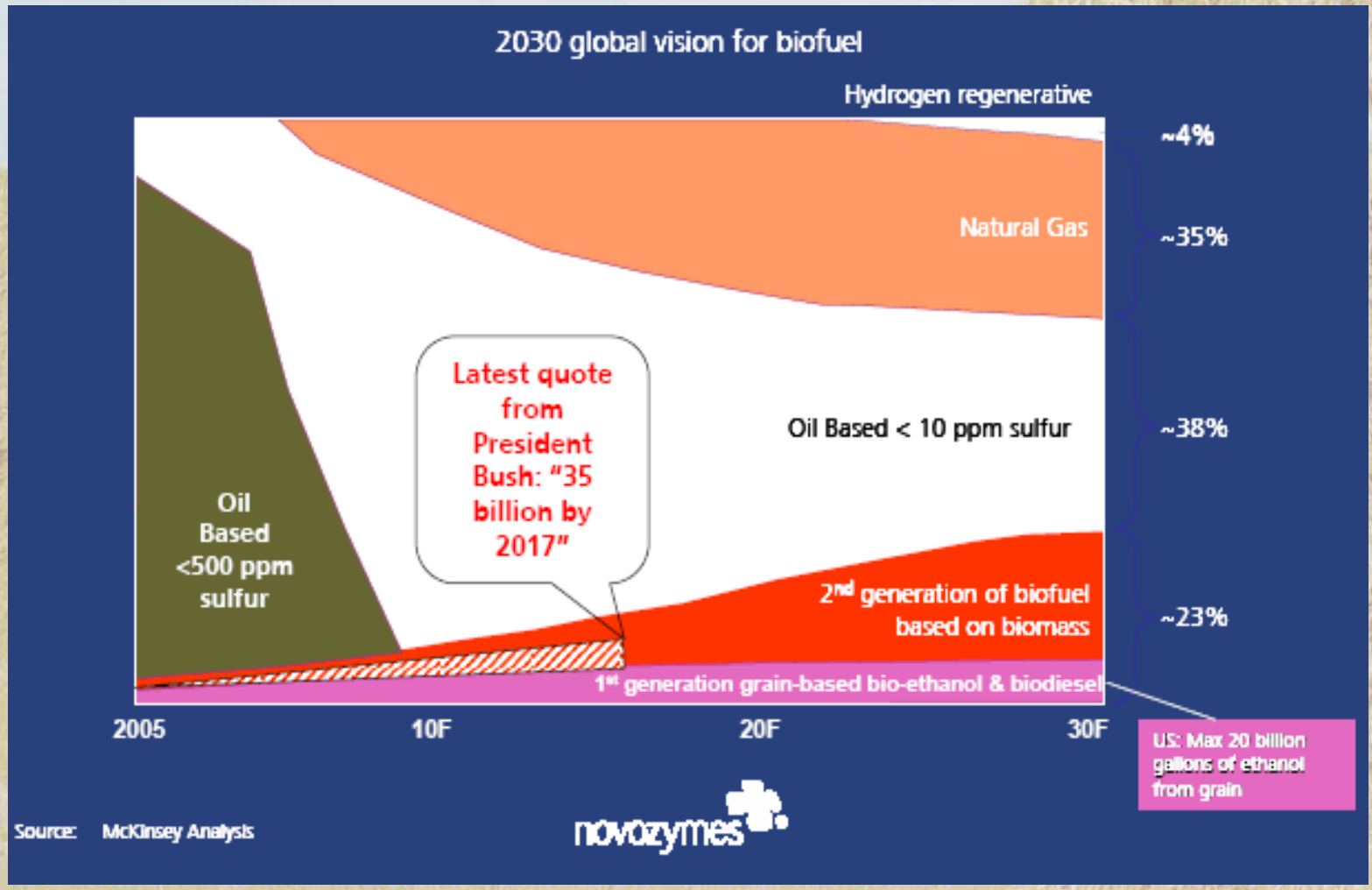
Biomass: Corn stover, straw, bagasse, wood etc.

Comparison values for 1 and 2 Generation biofuels



Source: Farrell et al 2006, *Science*, **311**: 506

2030 global visions for 2 Generation biofuels



6 selected cellulosic ethanol projects for DOE funding, February 2007

Abengoa Bioenergy Biomass of Kansas, LLC of Chesterfield, Missouri, up to $76 million

The proposed plant will be located in the state of Kansas. The plant will produce 11.4 million gallons of ethanol annually and enough energy to power the facility, with any excess energy being used to power the adjacent corn dry grind mill. The plant will use 700 tons per day of corn stover, wheat straw, milo stubble, switchgrass, and other feedstocks.

ALICO, Inc. of LaBelle, Florida, up to $33 million. The proposed plant will be in LaBelle (Hendry County), Florida

The plant will produce 13.9 million gallons of ethanol a year and 6,255 kilowatts of electric power, as well as 8.8 tons of hydrogen and 50 tons of ammonia per day. For feedstock, the plant will use 770 tons per day of yard, wood, and vegetative wastes and eventually energycane.

6 selected cellulosic ethanol projects for DOE funding, February 2007

BlueFire Ethanol, Inc. of Irvine, California, up to $40 million

The proposed plant will be in Southern California. The plant will be sited on an existing landfill and produce about 19 million gallons of ethanol a year. As feedstock, the plant would use 700 tons per day of sorted green waste and wood waste from landfills.

Poet Energy (formerly Broin Companies) of Sioux Falls, South Dakota, up to $80 million

The plant is in Emmetsburg (Palo Alto County), Iowa, and after expansion, it will produce 125 million gallons of ethanol per year, of which roughly 25 percent will be cellulosic ethanol. For feedstock in the production of cellulosic ethanol, the plant expects to use 842 tons per day of corn fiber, cobs, and stalks.

6 selected cellulosic ethanol projects for DOE funding, February 2007

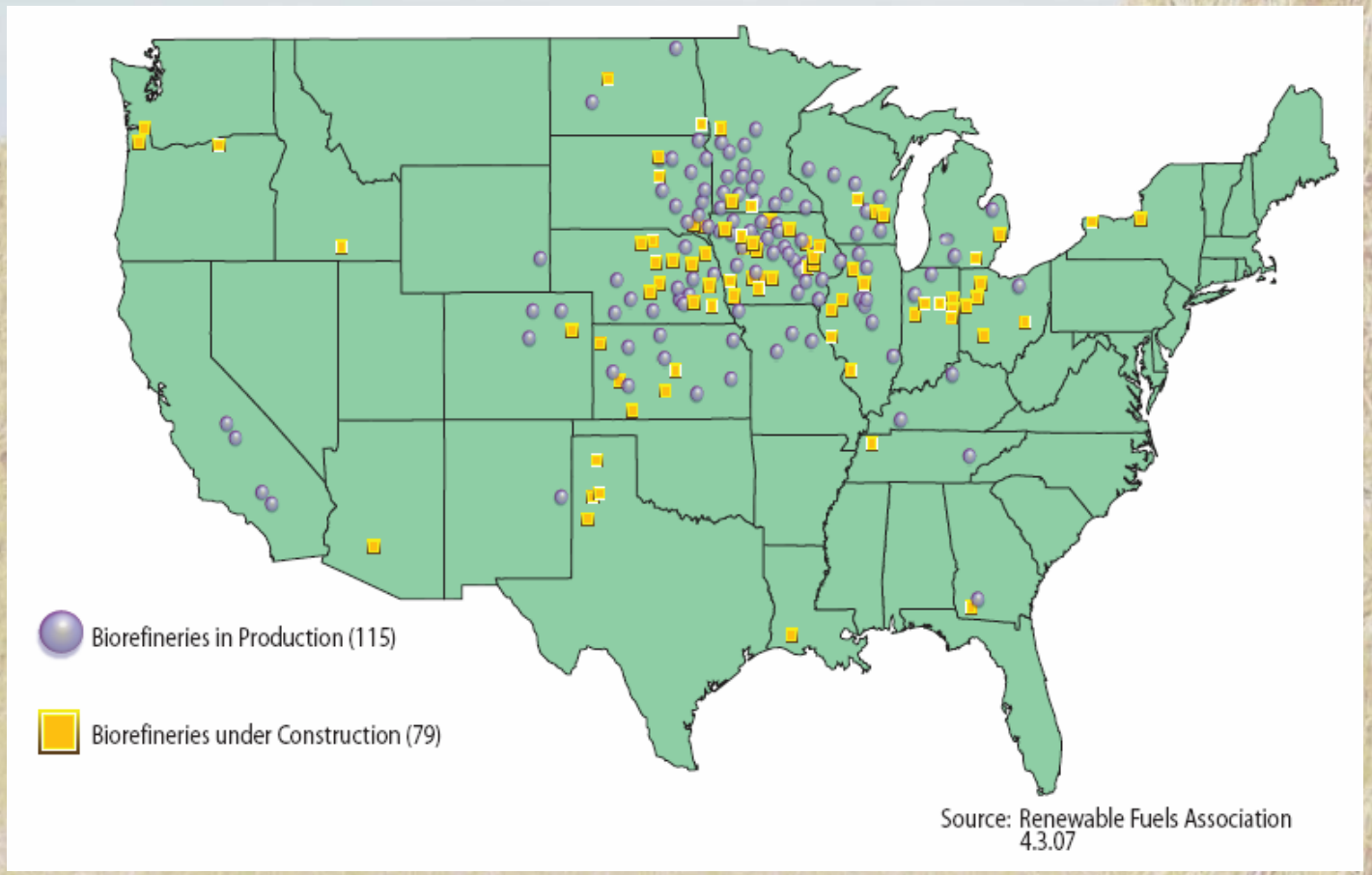
Iogen Biorefinery Partners, LLC, of Arlington, Virginia, up to $80 million

The proposed plant will be built in Shelley, Idaho, near Idaho Falls, and will produce 18 million gallons of ethanol annually. The plant will use 700 tons per day of agricultural residues including wheat straw, barley straw, corn stover, switchgrass, and rice straw as feedstocks.

Range Fuels (formerly Kergy Inc.) of Broomfield, Colorado, up to $76 million

The proposed plant will be constructed in Soperton (Treutlen County), Georgia. The plant will produce about 40 million gallons of ethanol per year and 9 million gallons per year of methanol. As feedstock, the plant will use 1,200 tons per day of wood residues and wood based energy crops.

Bioethanol facilities in USA



Companies active within the 2 Generation

Abengoa (Spain): Abengoa is among the World's largest ethanol producers. During the summer of 2007 Abengoa will have a 2G demonstration plant in operation in Salamanca-Spain. The plant will on a daily basis convert 70 tonnes of agricultural residues (such as wheat straw) into ethanol. The plant will produce 5 mn liters of ethanol per year.

BioGasol (Denmark): BioGasol opened its pilot plant in September 2006; the capacity of the fully integrated pilot plant is 16.400 liters of ethanol per year. BioGasol has started design of a 2 G demonstration plant with a capacity of 10 mn liters of ethanol per year. The complete plant will be in operation in April 2009.

Celunol (US): In November 2006 Celunol put an ethanol plant in operation in Jennings. During the summer of 2007 a 2 G plant at the same site will produce 5.3 mn liters of ethanol per year. In January 2007 Celunol opened a small 2G pilot plant in Japan, producing 1.4 mn liters of ethanol per year based on wood residues.

Companies active within the 2 Generation

Iogen (Canada): Iogen has a 2G pilot plant. Iogen has plans for a full scale plant that will be in operation by the summer of 2007 producing 75.7 mn liters of ethanol per year.

Mascoma (US): In the State of New York Mascoma plan to start construction of a pilot plant the summer with a yearly capacity of 1.9 mn liters of ethanol. The plan is to put the plant in operation late 2007/early 2008.

Poet Energy (US): Poet Energy is among the World's largest ethanol producers and US´s second largest producer. Poet Energy plans to build a 2G plant in Iowa in 2009 with a capacity of 190 mn liters of ethanol per year. The plant will later be expanded to produce 473 mn liters of ethanol per year.

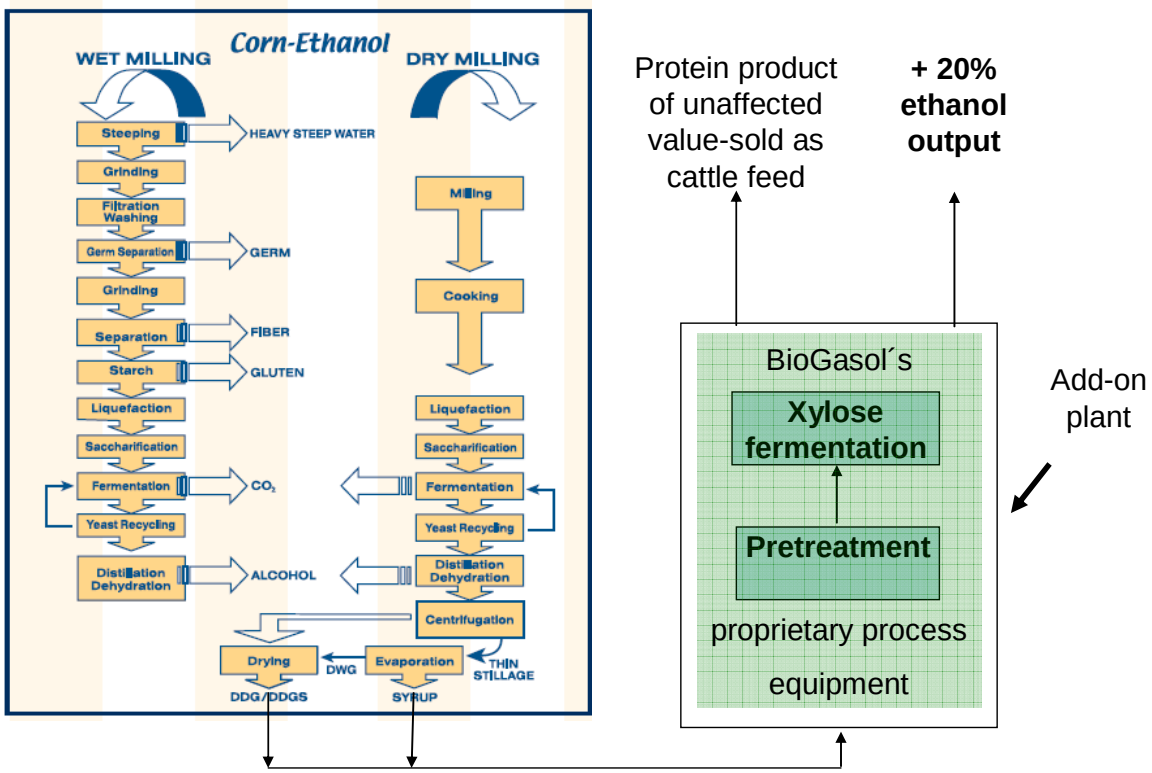
Companies active within the 2 Generation

SunOpta (Canada): Sunopta has developed a pre-treatment process. Together with GreenField the have plans for a 2G demonstration plant in Ontario or Qubec. Sunopta also has planer for a 2G demonstration plant in China in a corporation with China Resources Alcohol Corporation. This plant will be in operation late 2007 producing 6.4 mn liters of ethanol per year.

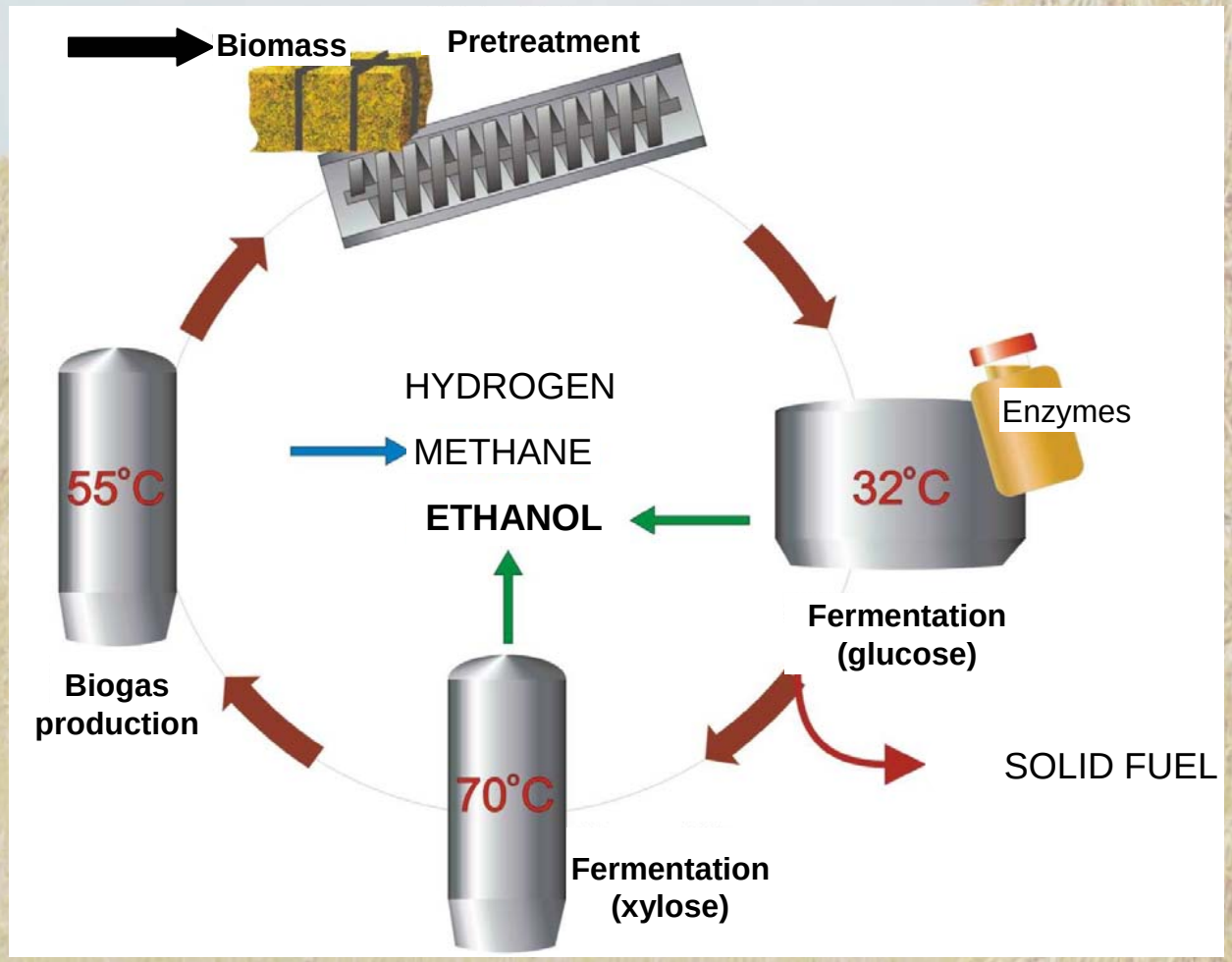
TMO (UK): TMO has plans for 2G demonstration plant in Rotterdam, The Netherlands. The plant will be put in operation early 2008 producing about 12 mn liters of ethanol per year.

Xethanol (US): Xethanol will build a 2 G demonstration plant in Augusta producing 189 mn liters of ethanol per year from the summer of 2007. Xethanol will also build a pilot plant in Bartow, Florida. The feed stock is residues from citrus production. The pilot plant will initially produce 0.2 mn liters of ethanol per year increasing to, 1.9 mn liters of ethanol ethanol a year after first production.

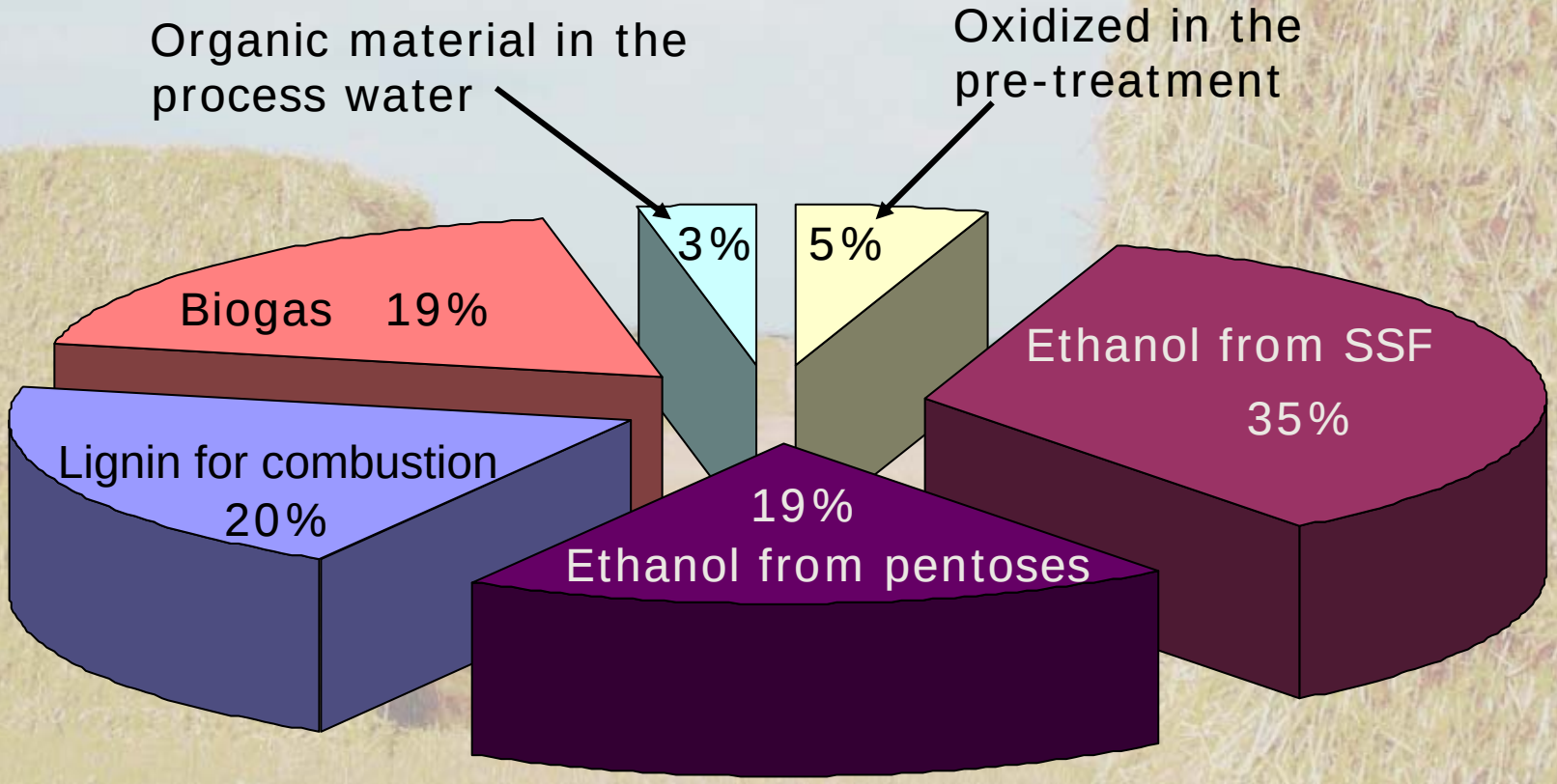
Add-on plant based on 2.generation process technology



The MaxiFuels Concept

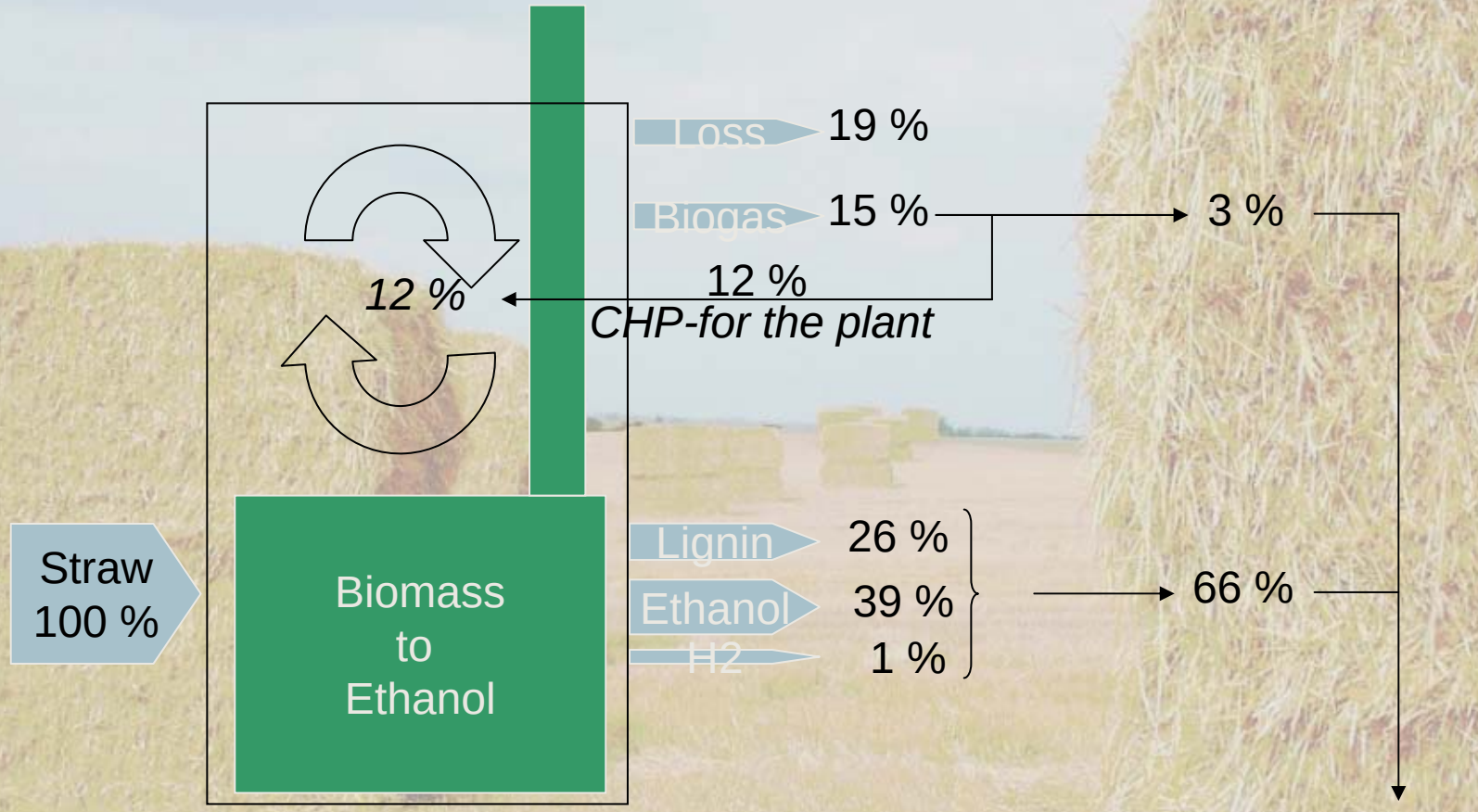


Optimized use of the biomass



Mass balance based on COD

Maxifuel Energy Balance
η=0.69



Net effective use of energy content in wheat straw: **<u>69 %</u>**