

# Grön plast -- polyeten från biomassa

BIOPLAST

DTU 17 February 2009

*Thomas Hjertberg*

Chalmers / Borealis

## Why produce polymers from renewable feed stock ?

1. Decrease the oil dependence; price & availability
2. Decrease outlet of CO<sub>2</sub>
3. Drastically increase the environmental image of polymers – sustainable material
4. To be prepared for political decisions
5. Demand from customers
6. Recycling via energy recovery (bio fuel)

## Polymers and the environment -- opinion

What is the answer if you ask the public about their opinion on the combination plastics and environment ????

*Negative!!!*

Why??

- *????*
- *it litters*
- *too much unnecessary plastics*
- *plastics are made of oil*



*Polymers from renewable resources are perceived much more positively!*

## Opinion & political measures

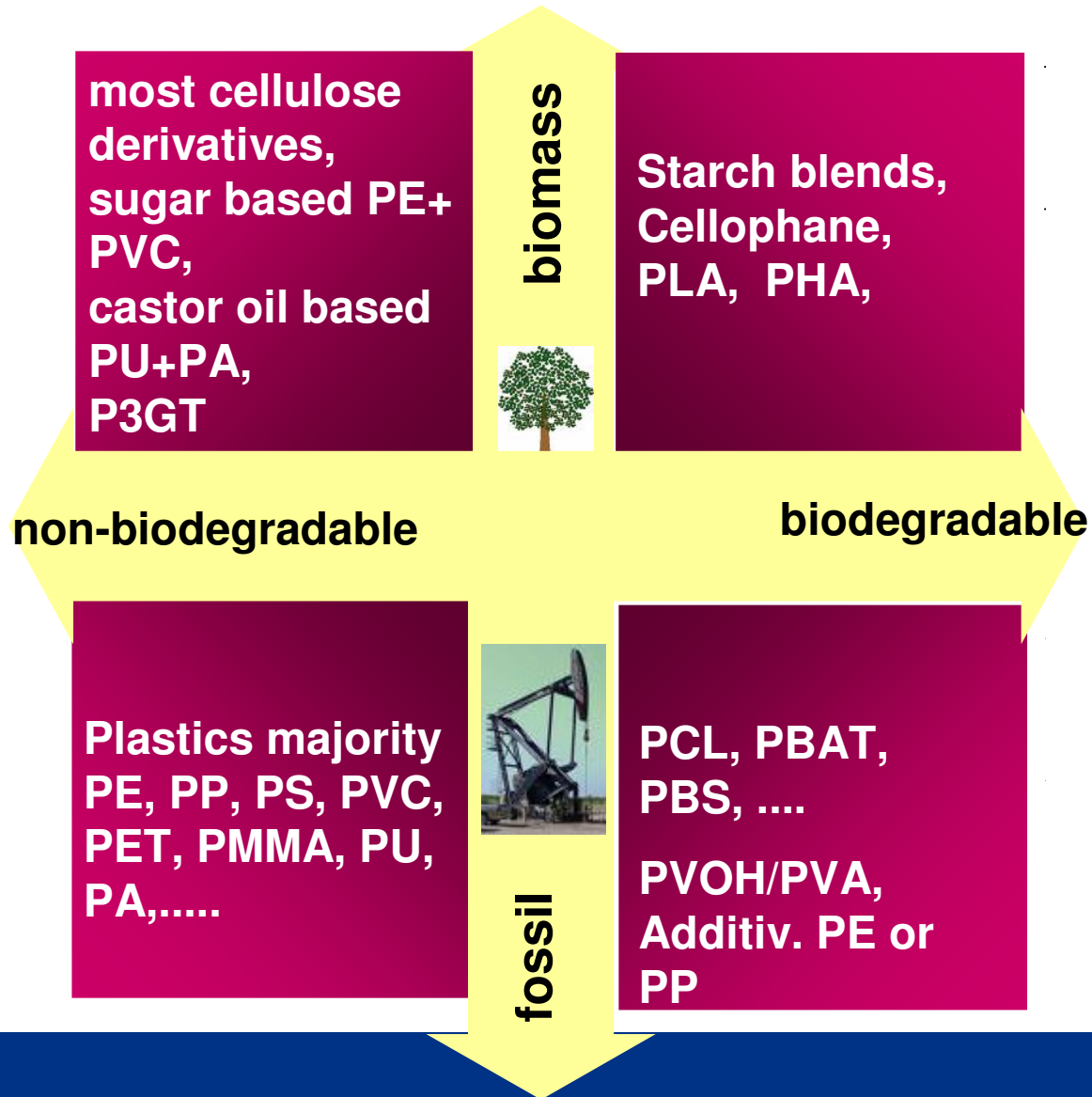
### Driving forces:

- CO<sub>2</sub> - greenhouse effect
- Fossil feed stock is limited

### Consequences:

- Consumer behavior - sometimes
- EU directives on recycling (sometimes counterproductive for the environment!)
- EU directives on renewable feed stock
  - already existing for fuel: 2005 – 2 %; 2010 – 5.75 %
  - **when does it arrive for polymers???**

# What do we mean by bioplastics?



## Renewable resources for polymers -- possibilities

### *The most discussed alternatives:*

- Polymers from nature, e.g. starch (MaterBi), bio fibers
- Polymers through bioprocesses, e.g. PHB with bacteria or plants (ICI to Monsanto to Metaolix)
- Monomers through bioprocesses, e.g. lactic acid (PLA) with yeast (NatureWorks, Cargill), or propandiol (Sonora, DuPont)

**Total production capacity 2007: ca 300 000 ton**

## Polymers based on biopolymers

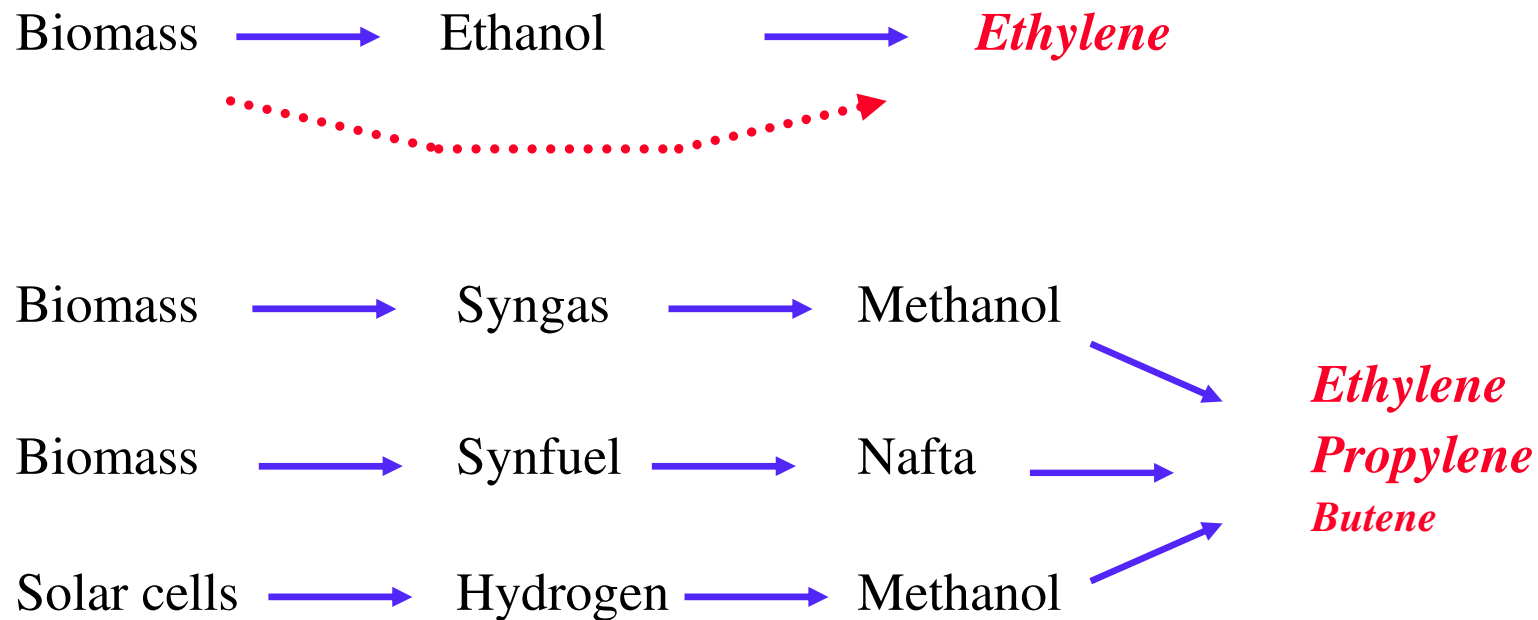
- renewable resources
- hydrolysable– more or less compostable
- short term applications or specific properties
- cost level?? - PHB ~100 SEK/kg → PLA 25-35 SEK/kg
- often water sensitive, e.g. permeability
- if demands on long life time??
- LCA – biodegradable polymers ??



*Renewable feed stock for the synthetic polymers of today*

## Renewable feed stock for petrochemistry

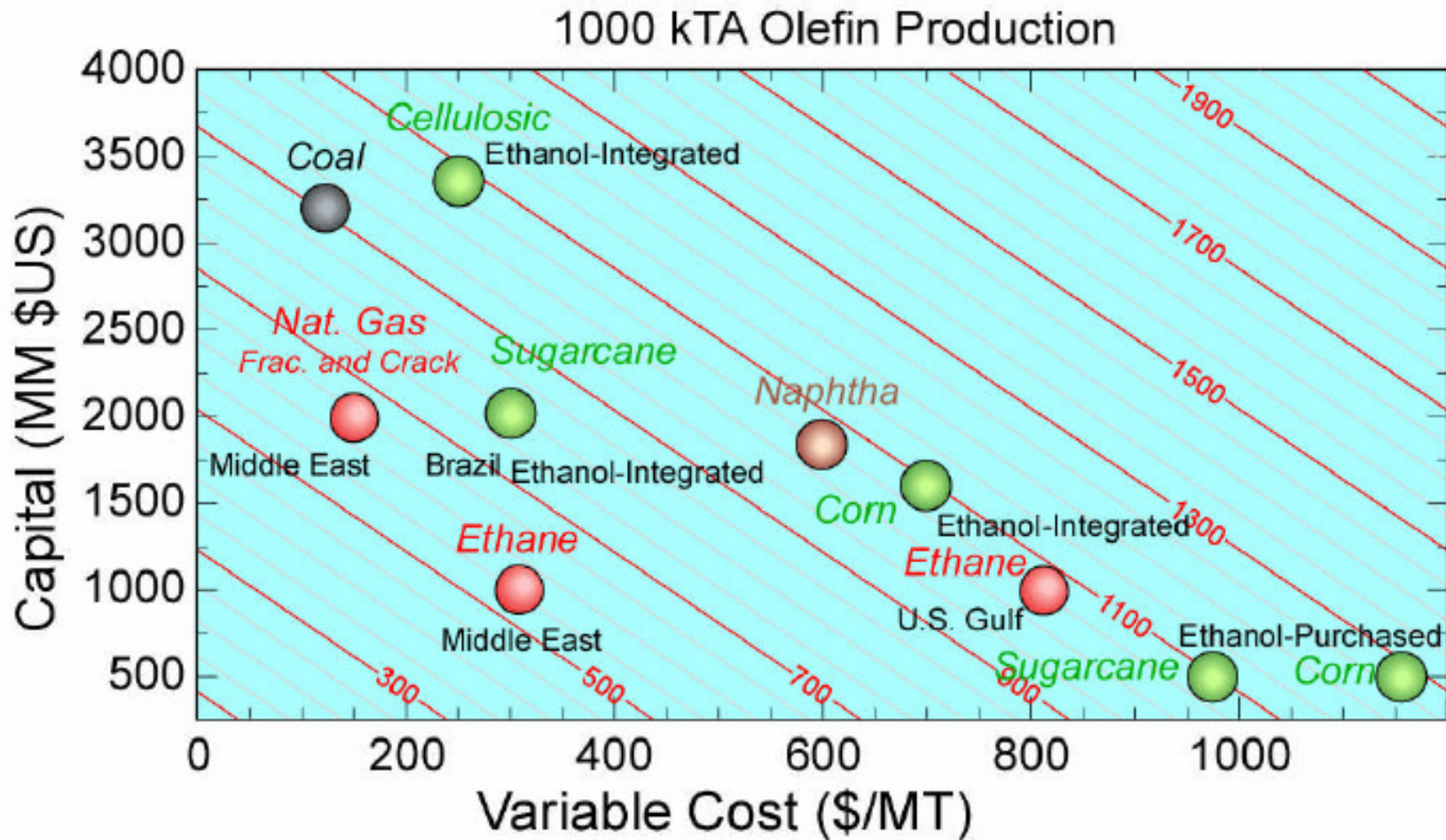
Ethylene is the organic chemical with largest production volume, ca 120 Mton/y (PE, vinyl chloride, styrene, ethylene oxide, .....), propylene is the seventh largest. There are several possible routes from renewable feed stocks:



## World outlook -- ethylene and PE

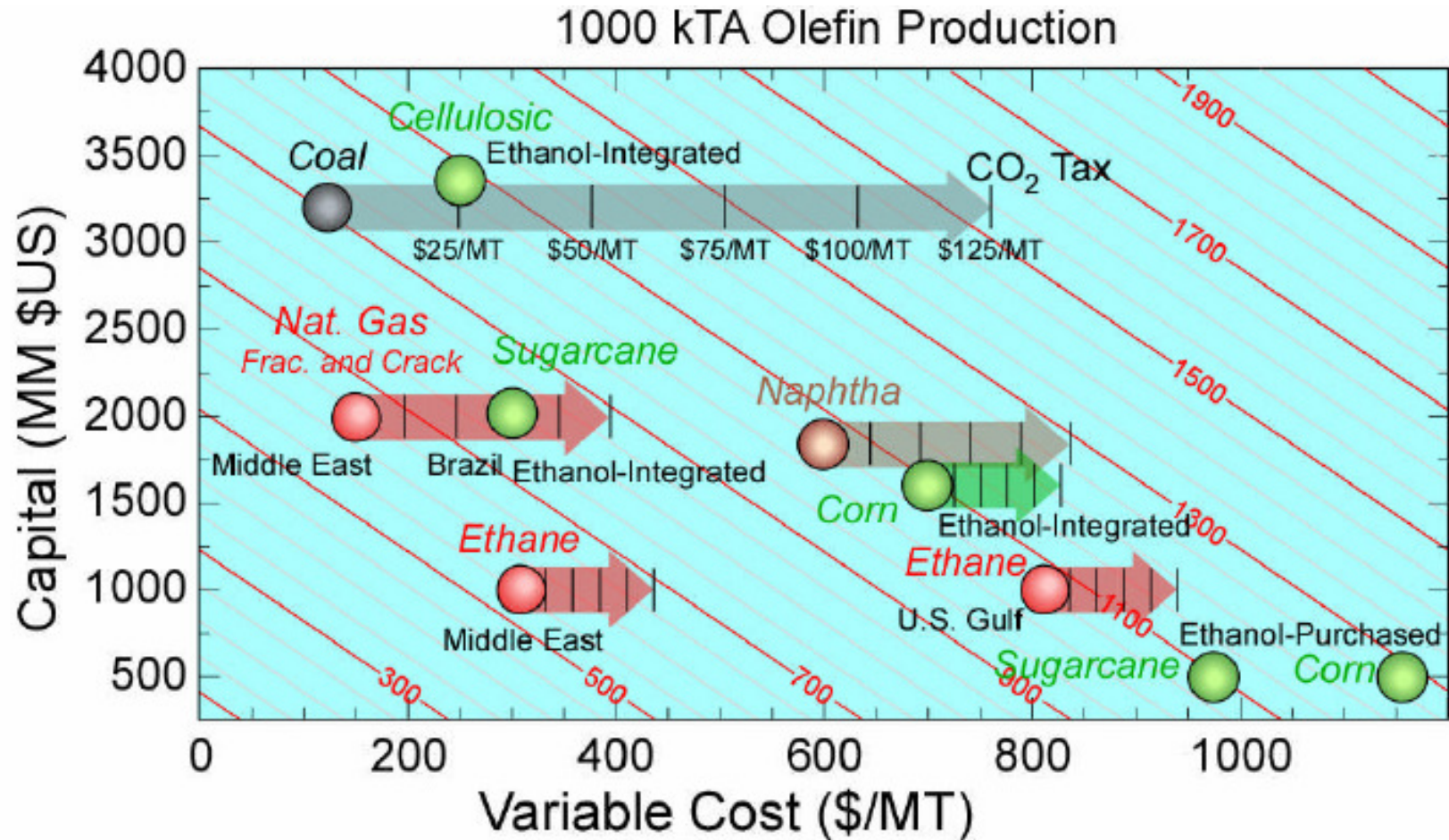
- Announced production of green ethylene
  - Braskem; 200 000 t/a, start 2010; 200 000 t/a planned start 2013
  - Crystalev + Dow; 350 000 t/y; planned start 2011
  - Solvay in Brasilia; 60 000 t/a; planned start 2010; for PVC
  - Songyuan Ji`an Biochemical; 300 000 t/a start ?
- Statement from Dow
  - 2020 the market share for bio-ethylene can be 12 % or ca 20 Mt/a
- Biomass Nippon Strategy
  - 2020 20% of all plastics must be renewable

# Production cost for ethylene



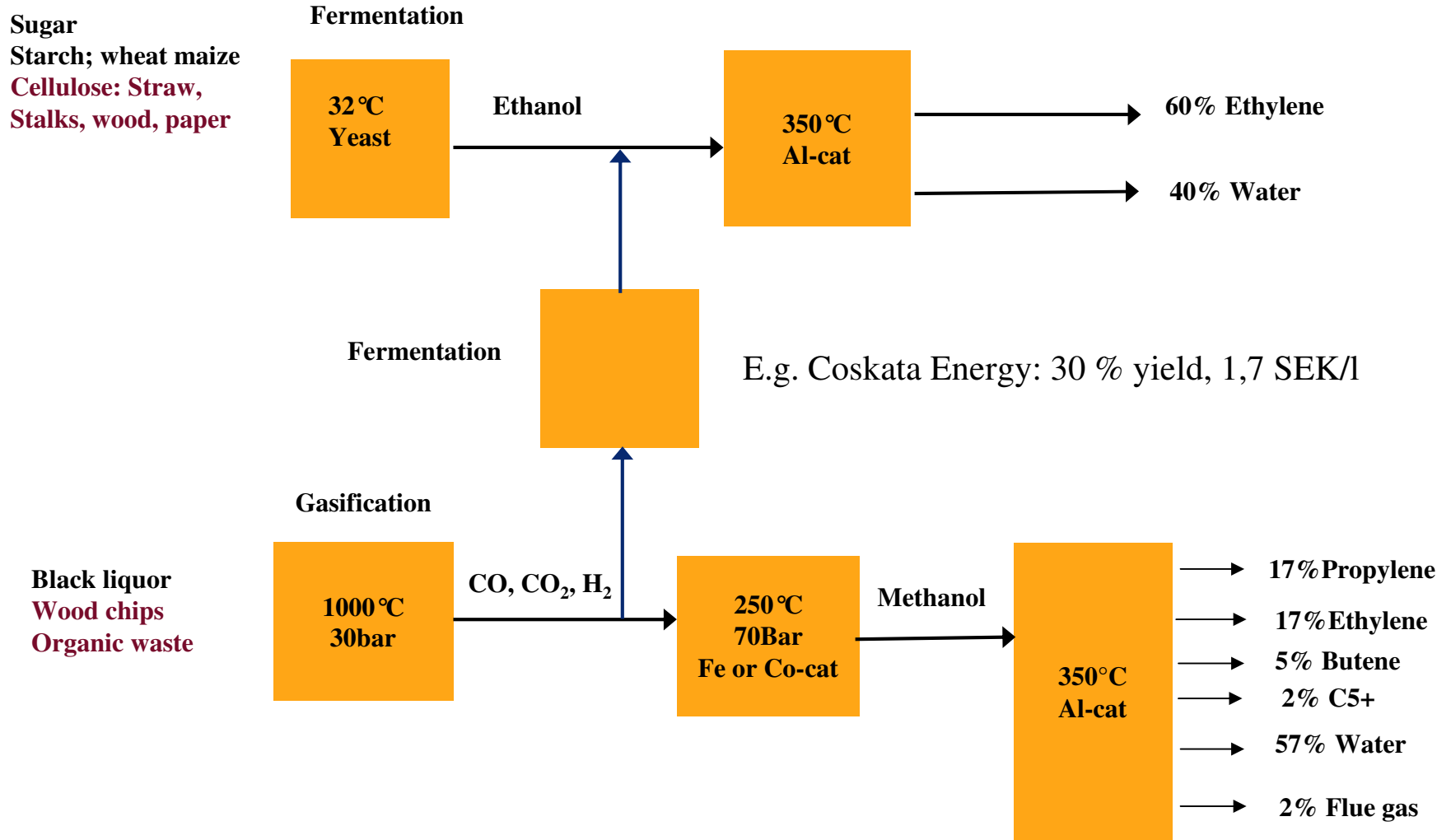
Chemical Engineering Progress; Mar 2008; 104, 3;  
 ABI/INFORM Trade & Industry, pg. S7

# Production cost for ethylene



Chemical Engineering Progress; Mar 2008; 104, 3;  
 ABI/INFORM Trade & Industry, pg. S7

# Production routes for renewable olefins



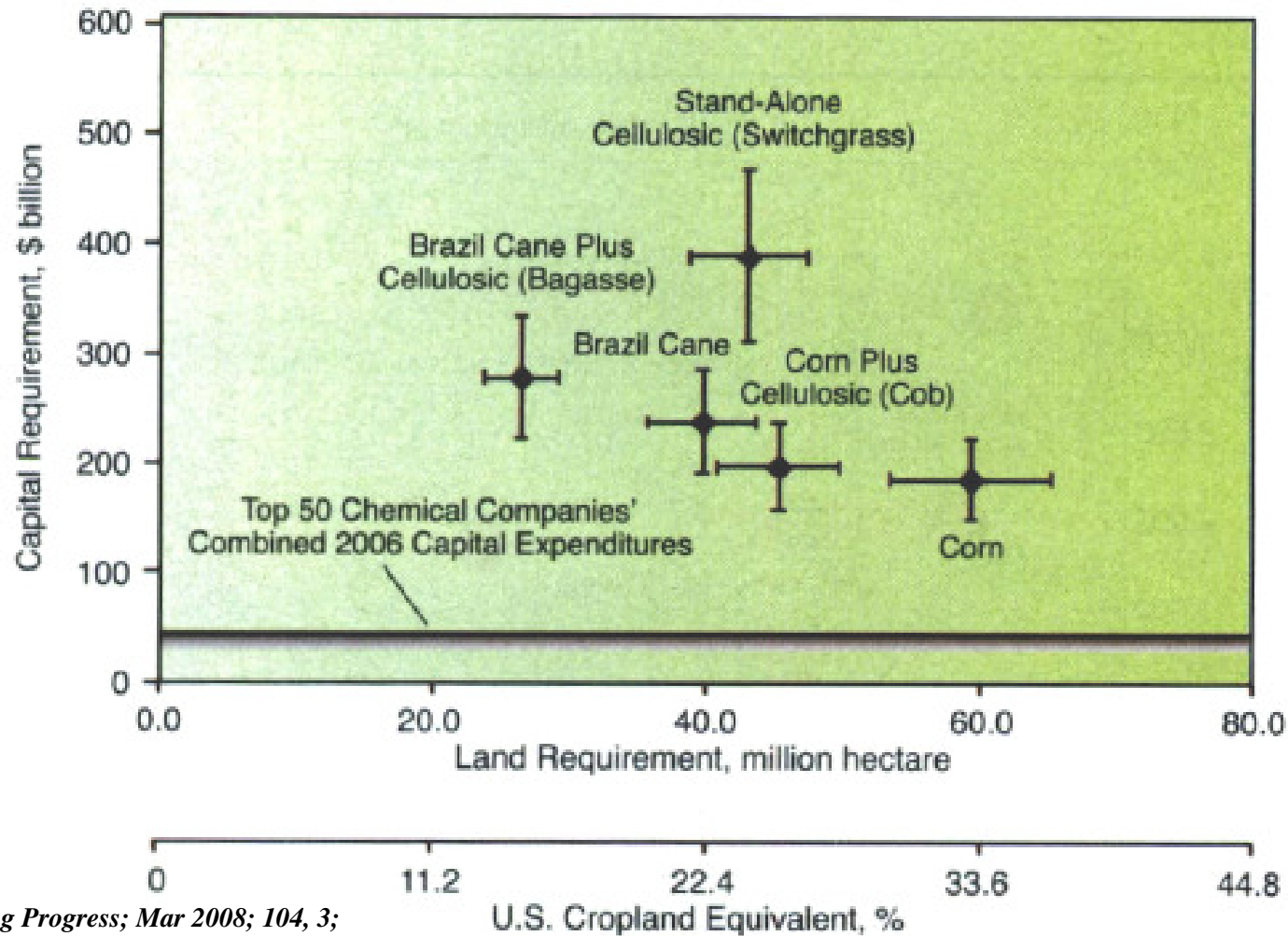
## Is a renewable feedstock sustainable?

- There are many possibilities to produce chemicals and polymers from renewable resources.

*but*

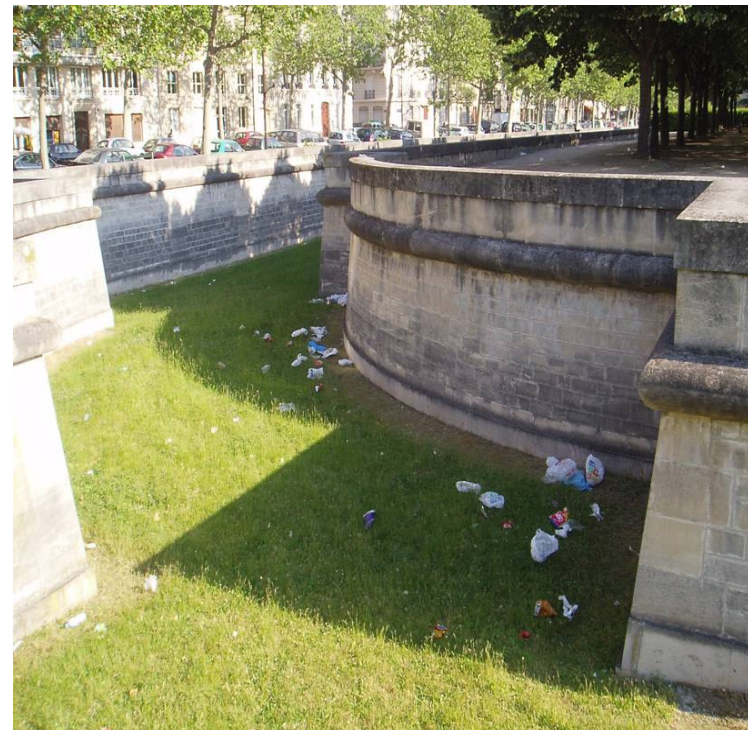
- The environmental impact of chemicals produced from renewable resources is not that small as assumed by many people.
- The use of renewable energy is a prerequisite .....
- There might be issues concerning land use with respect to food production and environmental effects, c.f. the debate about biofuels.

## Land and capital requirement to cover existing ethylene production



Chemical Engineering Progress; Mar 2008; 104, 3;  
 ABI/INFORM Trade & Industry, pg. S7

## Plastic bags -- environmental or symbolic issue?



## Biodegradable or not -- it depends

- *Waste system*  
land fill – energy recovery by incineration – compost
- *Human behaviour*  
will biodegradability lead to increased littering?
- *Material recycling*  
biodegradable polymers are less suited for recycling, if they are introduced to recycling systems low levels give decreased properties
- *Energy recovery*  
green PE can be energy recovered without any net addition of CO<sub>2</sub>
- *Composting*  
what is the value of the rest product?

## Message

I am personally convinced that polyethylene from renewable resources, green PE, is the best alternative for the plastic bags, also with respect to the environment. There are several arguments supporting this view:

1. LCA-analysis shows minimum effect for green PE.
2. The material is the same as ordinary PE - material recycling is OK.
3. Green PE can be energy recycled without net addition of CO<sub>2</sub>. The biomass is then used twice.
4. Producers of products, e.g. plastic bags, can use existing equipment and do not have to invest in new machinery.
5. It is possible to make green PE degradable if needed for specific applications.

