Carbon dioxide and Green fuel from biomass

- byproducts from agricultural activities such as corn steve
- Waste treatment
- Biomass from microalgae
The Greening of Synfuels

An old, dirty technology to make transportation fuels from coal could fight global warming, say proponents. The trick is using more biomass and burying the carbon dioxide that's generated.

It’s a gas. Traditional synfuels plants take coal and turn it into syngas. The gas is then catalyzed into various liquid fuels. Proposed plants would also store underground the CO₂ that is created. Greater reliance on biomass would make the process more carbon friendly.

- Board ENERGY (Vancouver, Washington US) — 5 × 10⁹ $ plant in Wellsville OHIO → 50,000 barrels/day of diesel
- RENTECH Inc (Los Angeles, California US) — 2011 – Natchez, Mississippi → 30,000 barrels/day of fuel

Financial limit: cost of a barrel of oil ≥ 50 $
Decarbonized synfuels and electricity from coal + biomass with CCS

E.D.Larson, G.Fiorese, G.Liu, R.H.Williams, T.G.Kreutz, S.Consonni  
energy environ.sci.2010, 3, 28-42

Goal: coproduction Fisher Tropsch liquid (FTL) fuels and electricity from co-feed of biomass and coal with CCS

- Modelling of supply systems from corn stover or mixed grass

Energy content: coal: 30.506 MJ/Kg_{HHV}
  corn stover: 17.415 MJ/Kg_{HHV}

Energy per delivered tonne: MJ/dry T
  corn stover: 1.14 MJ/dT

( fertilizer include) 167 Kg co2/dT
average cost 66$/dT or 3.8$/ GJ_{HHV}

Oil price breakeven 72$/barrel

CLT plant for a 50000 bbl/day of FTL

*Biomass feed stock cost: 3.8$/GJ_{HHV}
In Illinois for 1 million Tons/Year of corn stover

*Coal cost (Illinois): 1.44$/GJ_{HHV} ($
2007) or 37$/T coal

19.650 T/day coal

3805 dT/day biomass or 9% of FTL

C input (feedstock) 161 KgC/second
*C in FTL ( liquid fuel): 24.3%
*C stored as CO2: 51.3% or 1087 T/H

Injection of 2500 T/day of CO2

Electricity sale price
60$/MWh + 636 kg CO2/MWh

Cost of GHG: 20$/T; IEA estimate 2030: 120$/T
Optimisation of greenfuel from coal and biomass

- Synfuel price breakeven $72$/barrel (2010)
- For a mixture of 91% coal and 9% of biomass (corn stover)

- E.D.Larson, G.Fiorese, G.Liu, R.H. Williams, T.G. Kreutz, S.Consonni
- energy environ.sci.2010,3,28-42
- Princeton University/Politecnico de Milano/Beijing University
L'envelop des matières premières agricoles se poursuit

**Le blé à Paris**
Cours en euros par tonne

280 240 200 160 120 6 juin 4 juin 2011 2010

229,50

**Le colza à Paris**
Cours en euros par tonne

300 400 500 6 juin 4 juin 2011 2010

465,75

**Le maïs à Chicago**
Cours en dollars par boisseau

3 4 5 6 7 4 juin 5 juin 2011 2010

7,46*

*En séance

**Le café robusta à Londres**
Cours en dollars par tonne

3 4 5 6 7 1200 1400 1600 1800 2000 2200 2400 4 juin 6 juin 2011 2010

2,404

Source et photos : Bloomberg
Biodiesel from microalgae

Vegetal oil production $d=0.912\text{kg/l}$

**Chemical transformation**: $\rightarrow$ Energy efficiency: 10 photons per CO2

Trans esterification $\rightarrow$ methyl ester $d=0.864$ : Triglyceride + 6 CH3OH = 3 methyl ester

**energy storage from sun light: max10%**

* Oil content in dry algae 20% to 50%, 80% ex: Nitzschia sp 45% to 50%
  Botryococcus braunus 29% to 75%

*comparison*

*colza* 1g/m2.day 1190l/ha

* palm oil 5690l/ha

* sugar cane 10g/m2.day

*algae* 50g/m2.day 136900l/ha (max)

1 Kg of bioalgea = 1.8 Kg of CO2

**algae oil cost:** 1.4 to 2.6$\text{/l}$ and may be 5$\text{/l}$

*Shell exits algae venture with Cellana*  CEN 7/feb/2011)

European Parlement STOA 22/3/2011)

EMRS/UPMC