

Agrion - Paris, 28 November, 2007



Coal-To-Liquids

Serge Périneau, World CTL Conference
Word-CTL2008.com

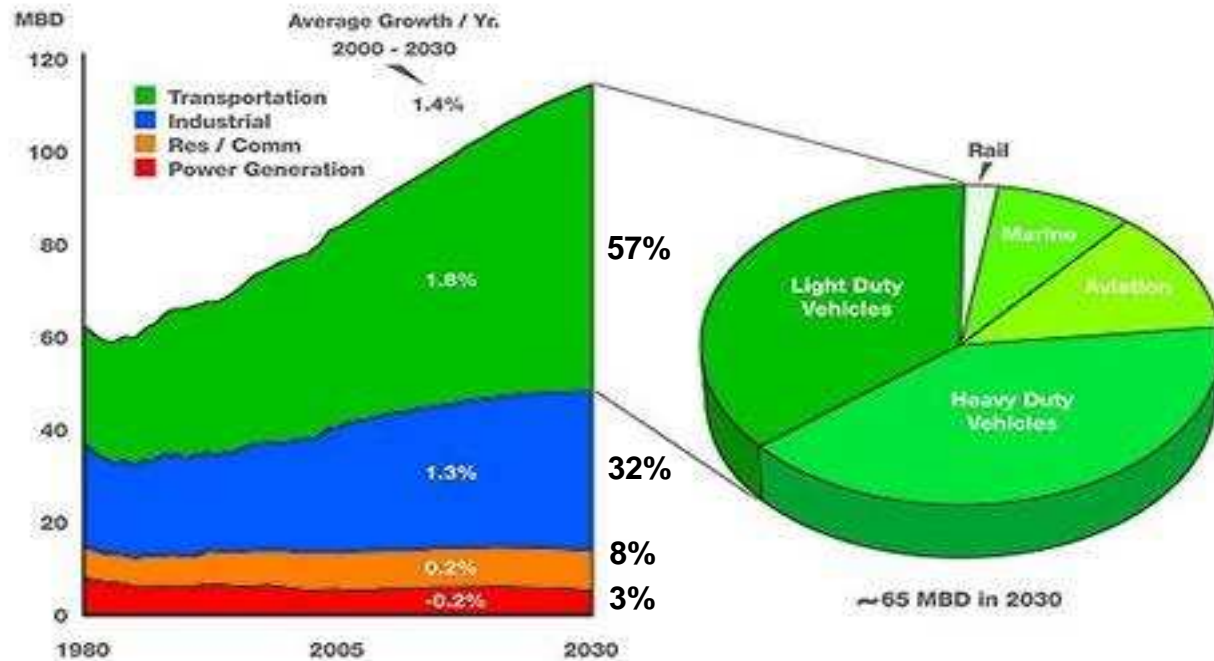
Summary



- **Geostrategic Approach**
- **Technology**
- **Economics**
- **Environment**
- **Conclusion**

Strong growth of the world demand in liquid hydrocarbons

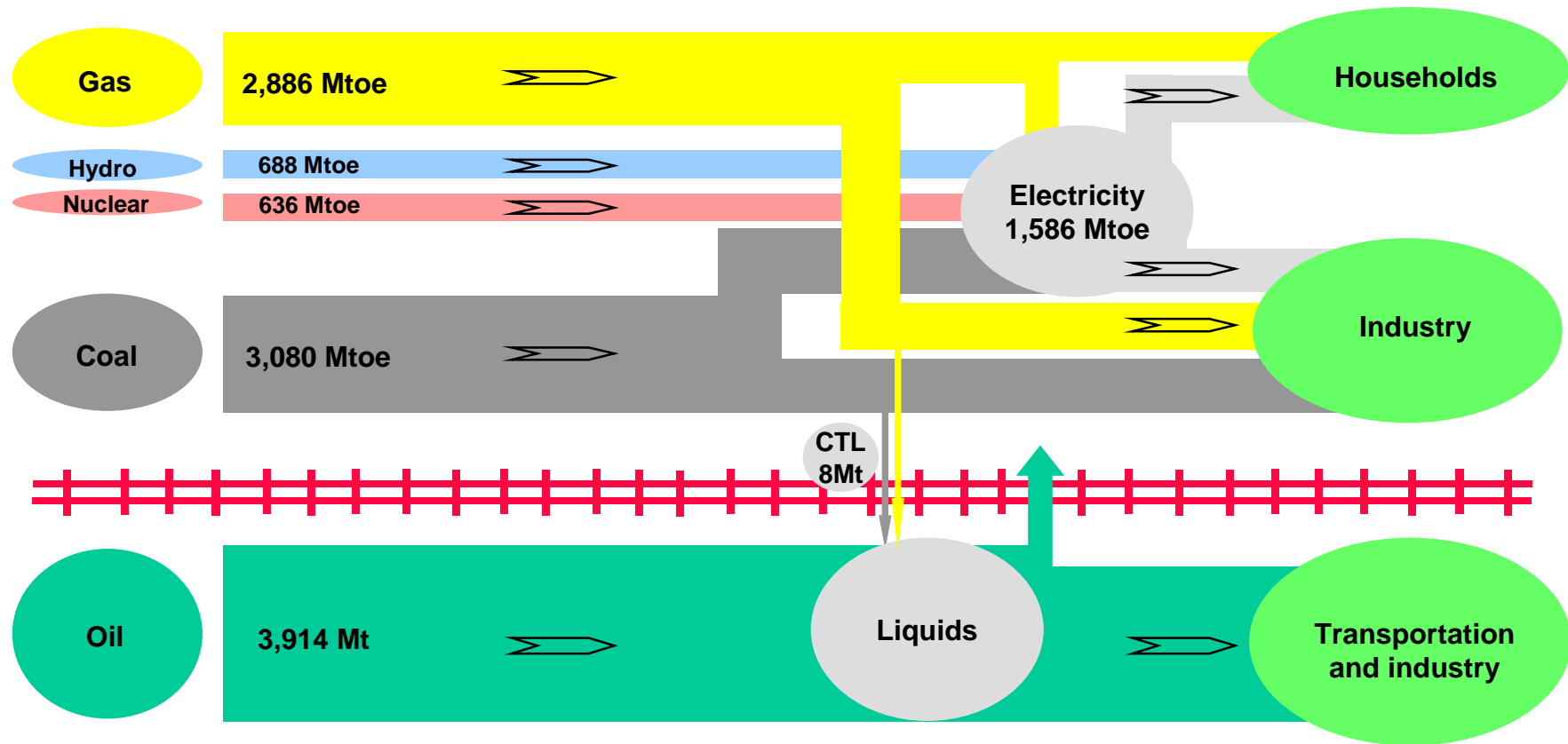
Global Liquids Demand by Sector



Source: ExxonMobil Energy Outlook 2007

A single source for the production of Liquids

Energy flows in 2006 (world):

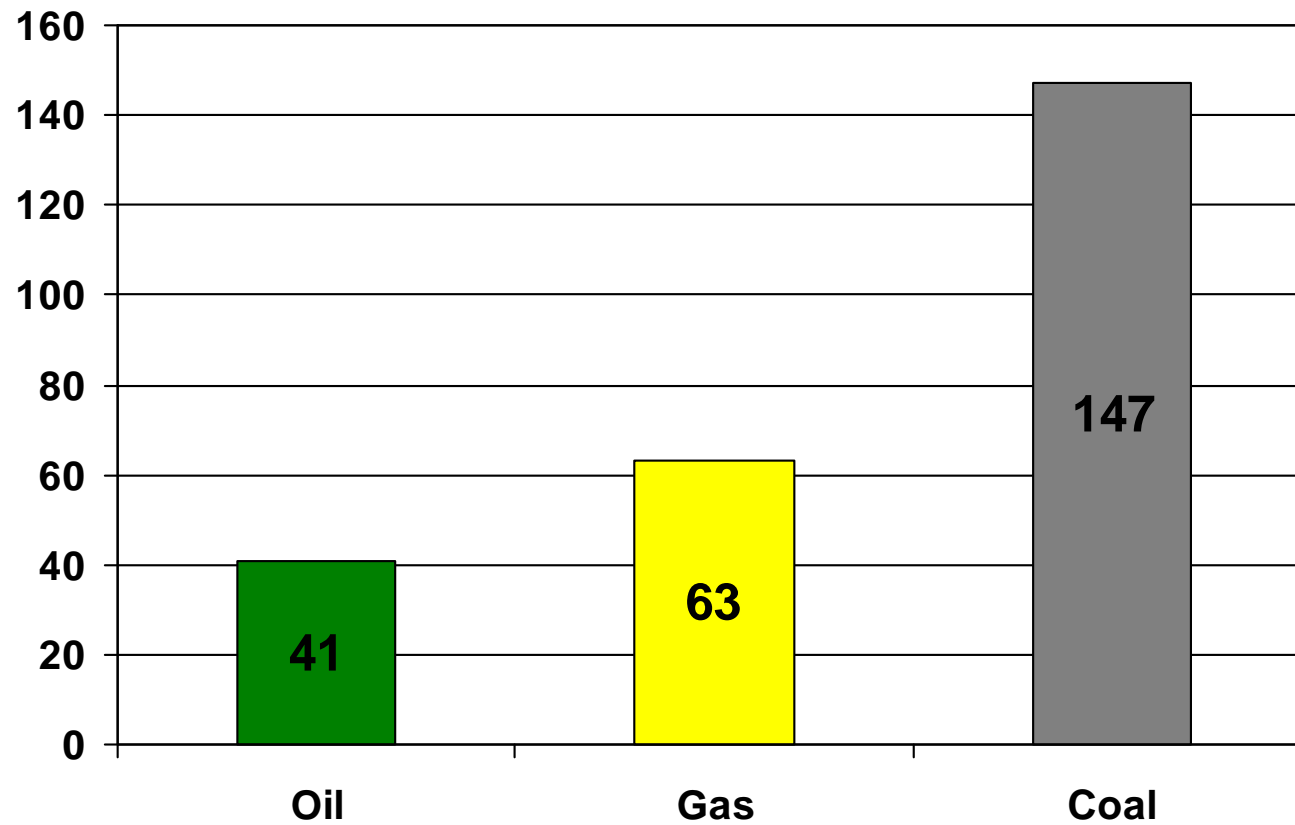


Source: BP Statistical Review 2007

Crude reserves limited to a few decades



Number of years of crude reserves, compared with other fossil energies



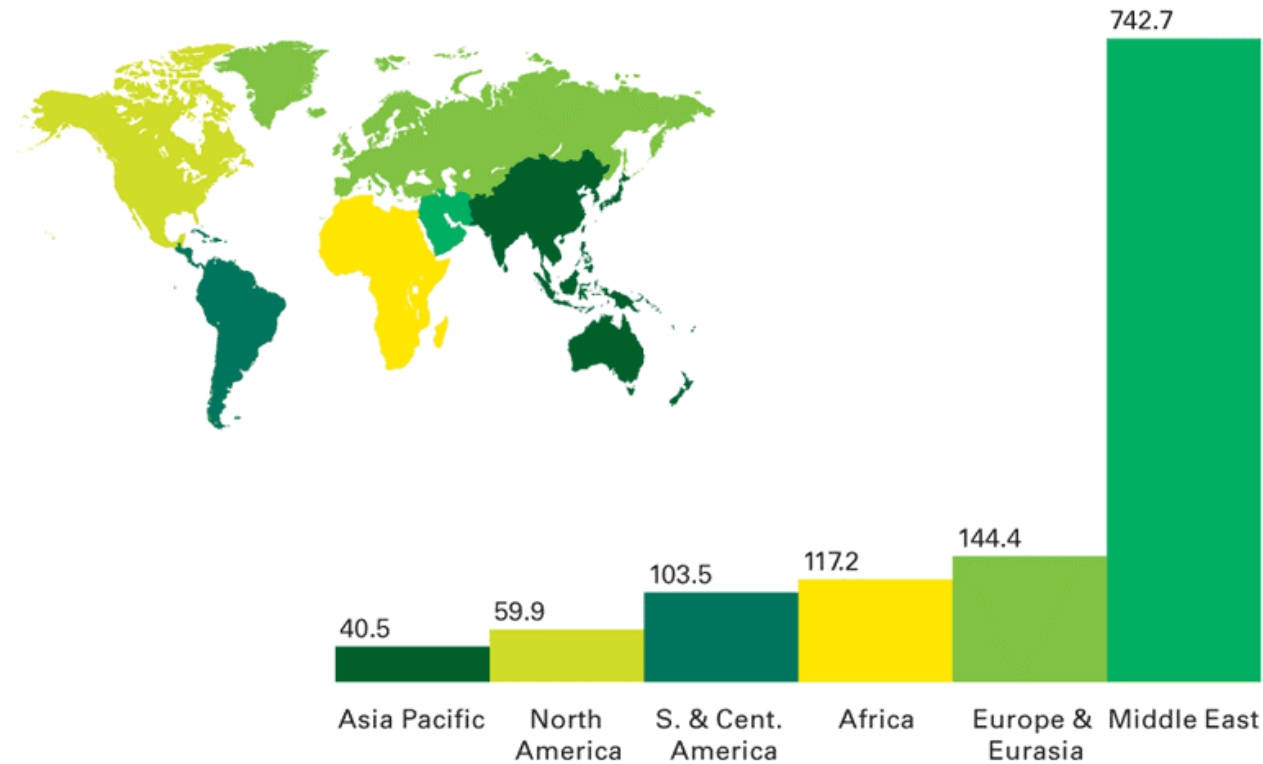
Source: BP Statistical Review 2007

Crude reserves located in countries with low consumption



Reserves are concentrated in the Middle East

Proved reserves at end 2006
Thousand million barrels



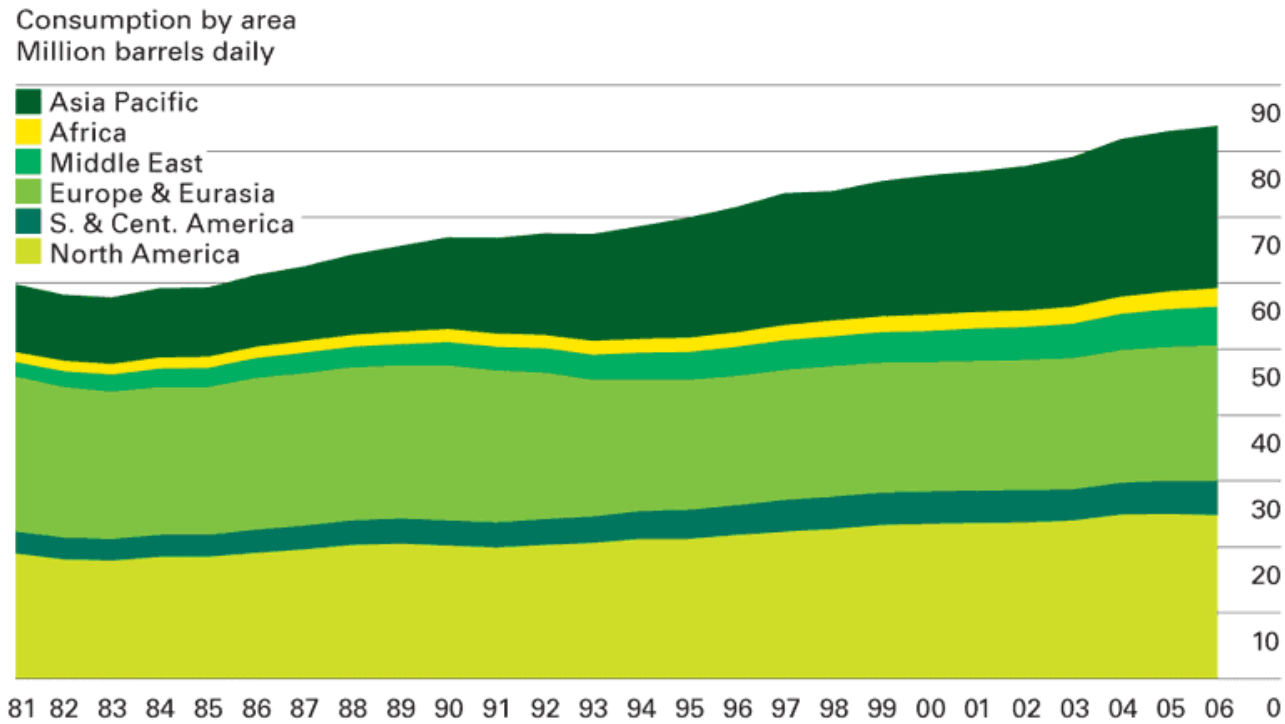
Middle East, Russia, Venezuela, Kazakhstan, Libya and Nigeria account for 84% of oil reserves.

Source: BP Statistical Review 2007

Consumption areas different from major reserves locations



North America, Western Europe and Asia-Pacific account for 76% of consumption.



World oil consumption rose by just under 650,000b/d in 2006, about half the 10-year average. OECD consumption fell by 400,000b/d, the biggest decline since 1983. Oil consumption growth was above average in China and oil-exporting countries.

(Middle East, Russia, Venezuela, Kazakhstan, Libya and Nigeria account for 84% of oil reserves).

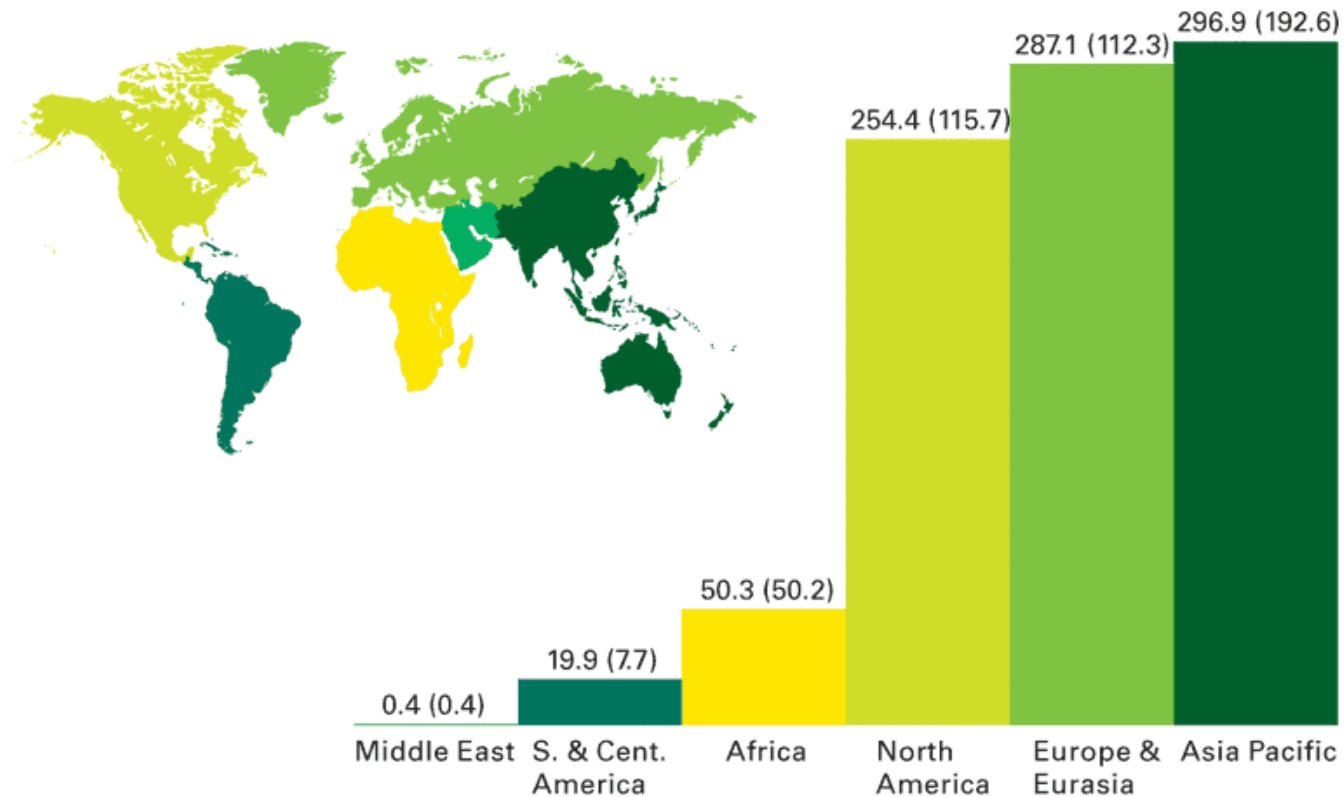
Source: BP Statistical Review 2007

Coal reserves geographically better distributed

Coal reserves are closer to consumption areas

Proved reserves at end 2006

Thousand million tonnes (share of anthracite and bituminous coal is shown in brackets)



USA, Russia, China, India, Australia et South Africa account for 81% of coal reserves.

Source: BP Statistical Review 2007

Advantages of CTL



Six strong arguments:

- Large coal reserves;
- Reserves close to consumption areas;
- High price and volatility of crude oil;
- Coal energy less expensive, often proprietary;
- Technical feasibility established (South Africa);
- Support of national authorities in several important countries (USA, China, South Africa).

CTL advantages illustrated by facts

- **South Africa**
 - 30% of liquid hydrocarbons produced from coal.
- **USA**
 - Tests of synthetic jet fuel completed by the US Airforce on B52 aircraft, ongoing on C17;
 - Tests to be completed on the whole fleet by 2011.
- **China**
 - First commercial CTL unit onstream in 2008;
 - CTL option proposed to the students of the China University of Petroleum.
- **More than 30 projects worldwide.**



Advantages of CTL



Six strong arguments:

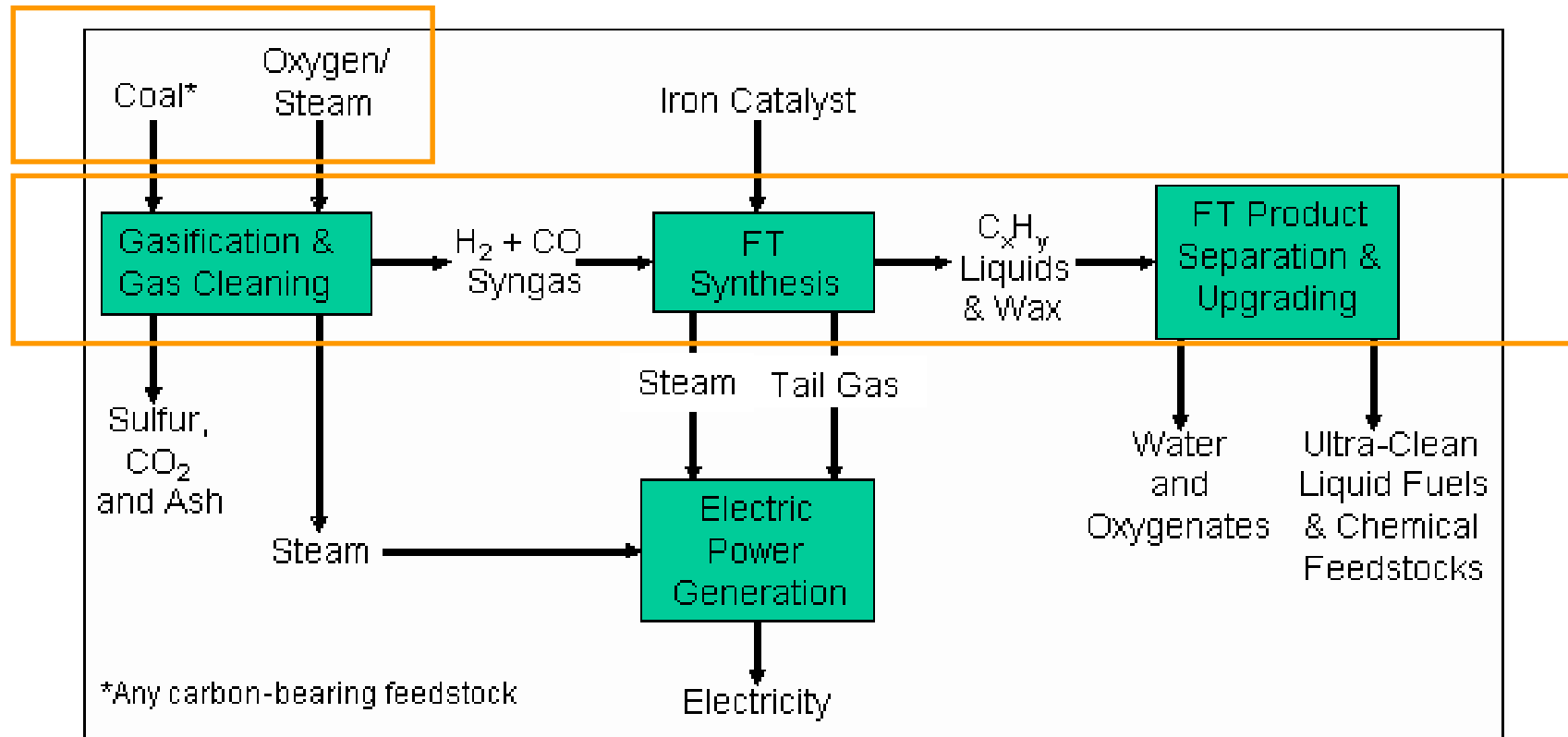
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BUT four issues:

- Limited commercial experience;
- Very high level of capital expenditure needs (G\$, G€);
- Risks associated to the volatility of crude oil and coal prices;
- CO2 emissions.

Technology: Indirect route

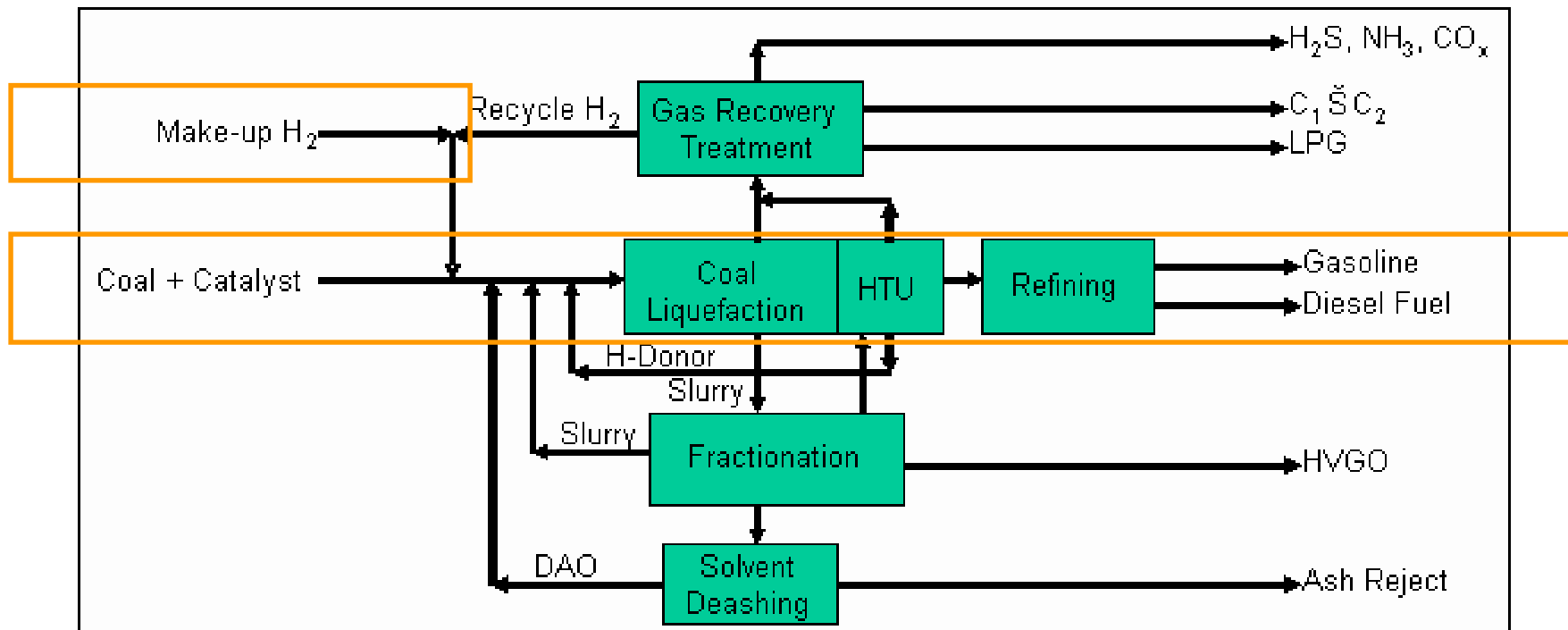
Coal + oxygen → CO + hydrogen → liquid hydrocarbons



- Technology provided by **Rentech, Sasol, Syntroleum**, gasification providers;
- Three plants in operation within **Sasol (South Africa)**.

Technology: Direct route

Coal + hydrogen → liquid hydrocarbons



- Technology provided by Axens, Headwaters/HTI, NEDO;
- First commercial unit: start up in 2008 in China.

Economics: key figures



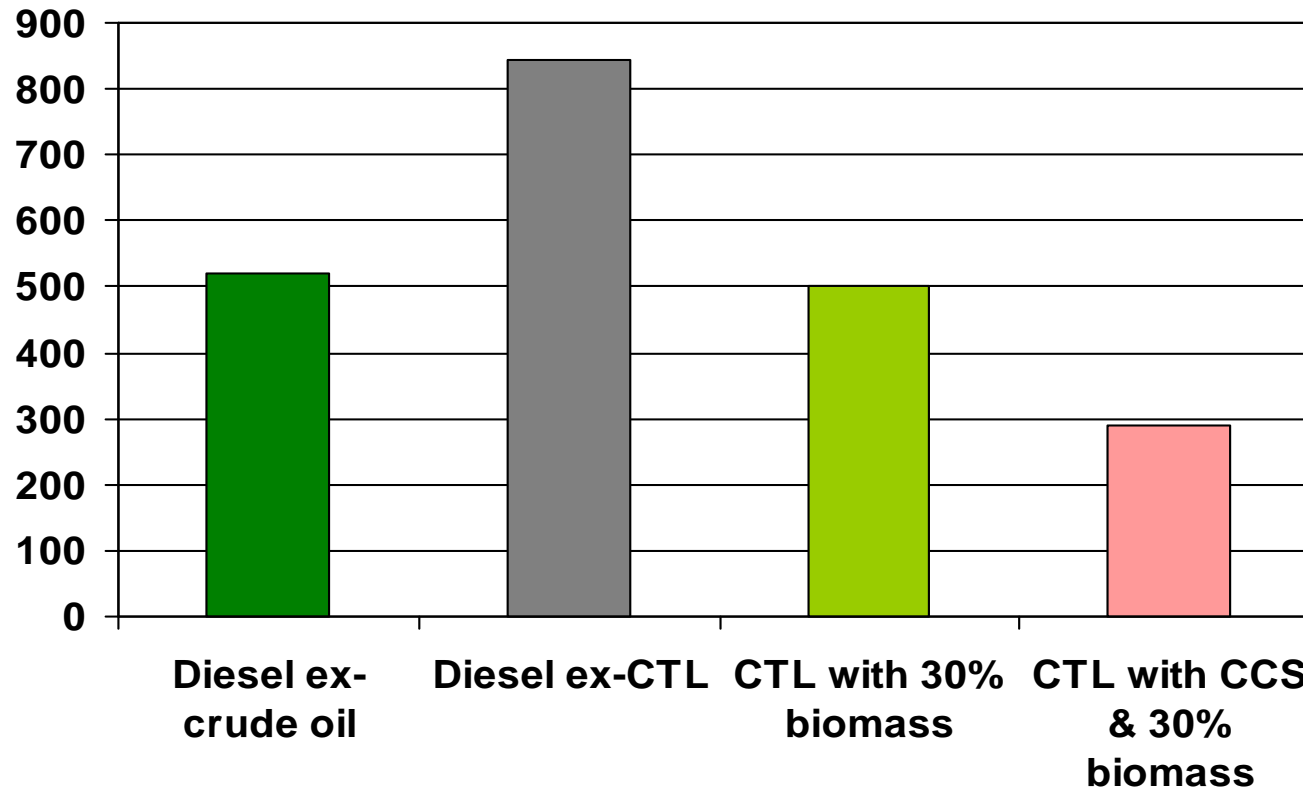
- **Capital expenditure:**
 - Estimated 60 to 100 \$/bpd, CCS excluded;
 - Sasol recommendation: minimum 50,000 bpd capacities.
- **Profitability:**
 - Breakeven generally expressed as « equivalent crude price »;
 - Large range of breakevens announced;
 - Important impact of the cost of capital, the prices of coal and crude oil, and the tax policies;
 - No publication on CTL take CCS into account.

Environment: 1. Greenhouse effect



“Coal” involves “more CO2 production than other fossils fuels”.

Grams of CO2 equivalent per mile (« Well-to-Wheels ») :

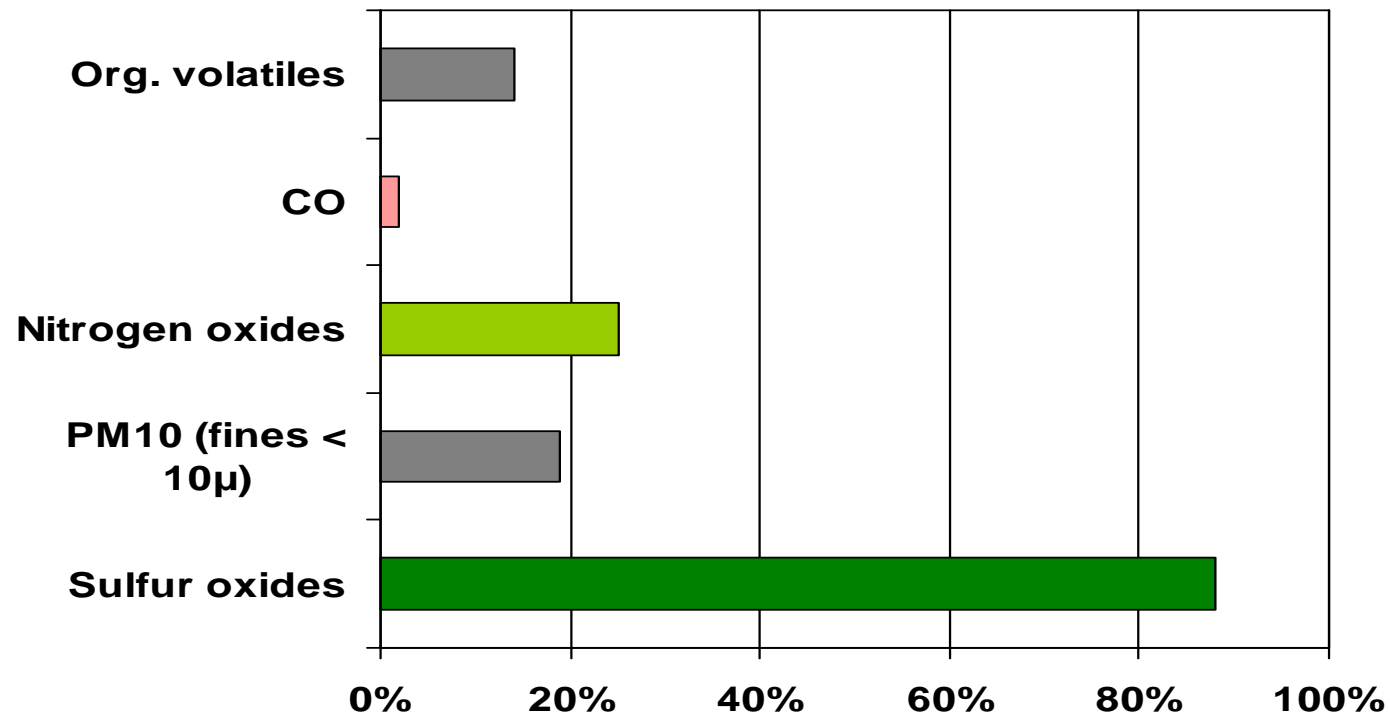


Source: Idaho Natinal laboratory

Environment: 2. Advantages of synthetic fuels

Ex-CTL hydrocarbons are synthetic products, with a higher purity.

Reduction of emissions compared to conventional diesel:



Source: Idaho Natinal laboratory

Conclusion

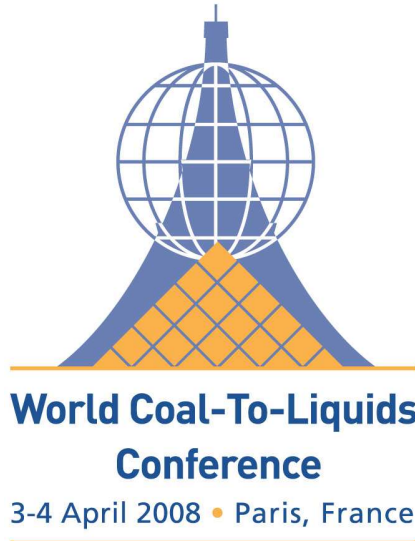


- CTL can increase the energy security of several countries.
- The industry lacks additional commercial references, namely for the Direct route.
- Economics have to be better evaluated.
- Environment is a major issue. Technologies of CCS are getting improved... and will need financing.
- *These issues will be debated during the first world conference on CTL in Paris on 3 & 4 April, 2008:*

World CTL 2008



Agrion - Paris, 28 november, 2008



Thanks!

www.world-CTL2008.com