# -7- (2) Carbon dioxide to liquid: methanol

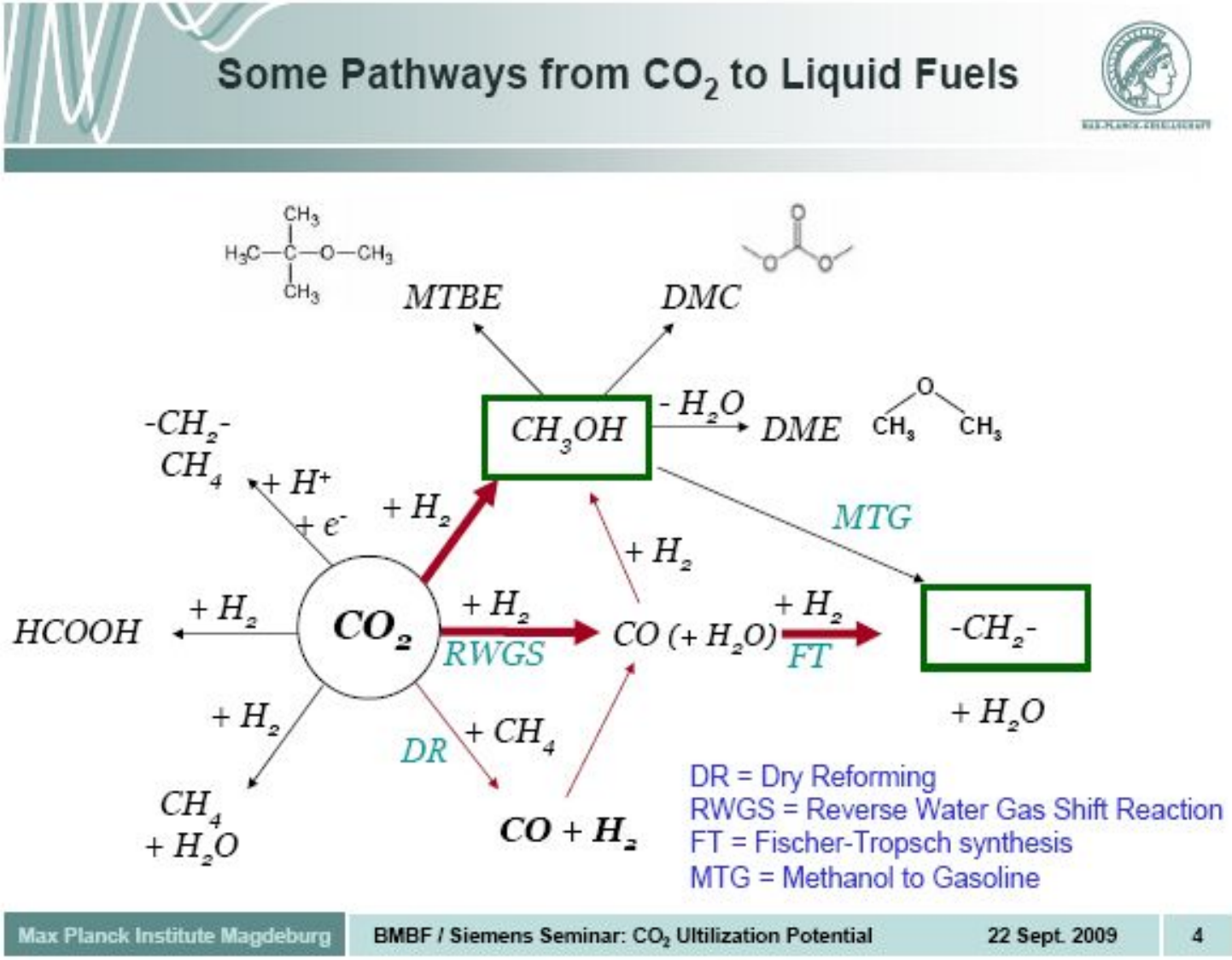
chemical reactions and energy storage

1) CO2 to methanol (gas to liquid)or
   22.4l=32cm3 305 euros/T

2)Methanol to olefine technology (polymer)

3) Methanol to DME additif for MON (motor octane number)

4) Methanol for proteines extraction from the micoalgea




DME= dimethyl ether
MTBE=methyl tributhyl ether
DMC=dimethylcarbonate
HCOOH=formic acid

# Methanol synthesis

- From specific catalytic reactor :
- $CO_2+H_2$ → $CH_3OH+H_2O$
- for olefine production
- for substitut to oil
- for energy storage
- Usual catalyst:$Cu/ZnO/Al_2O_3$ (300°C-70 Bar)

- Professor A Keinneman Strasbourg

## About Mitsui Chemicals

Mitsui Chemicals, one of Japan's leading chemical companies and a member of the Mitsui Group, was established in 1997 through the merger of Mitsui Petrochemical Industries and Mitsui Toatsu Chemicals. Our innovative technologies and materials are widely used in the automotive, electronic, information technology, energy-related, and packaging industries. The Group counts approximately 100 consolidated subsidiaries worldwide and has 12,824 employees. Annual net sales are ¥1,487 billion.

## Together with Stakeholders and Society

Mitsui Chemicals is committed to earning the trust of all stakeholders and society as a good global citizen dedicated to protecting the natural environment and contributing to the well-being of all. We believe our commercial activities must be in harmony with the global environment and we are determined to be a company of which our employees can be rightly proud.

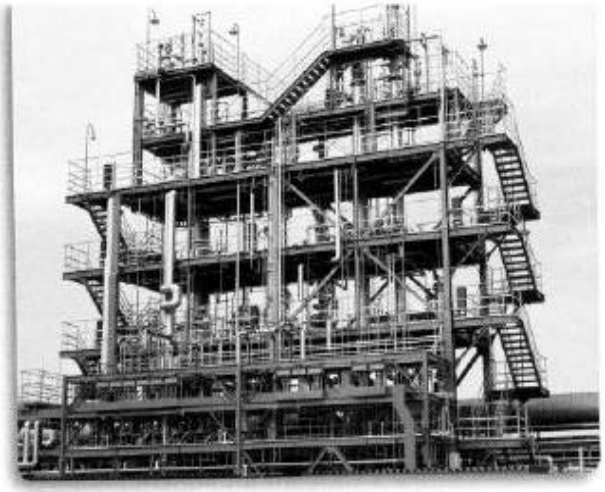
## Exciting New Technology

Through world-class innovative technology, Mitsui Chemicals has found ways to protect natural resources and the environment while enriching the lives of people around the world. One example of this is our high-activity catalysts, which are used in the process of making methanol from $CO_2$ and $H_2$. Development of this technology is progressing well and when perfected the process will contribute greatly to reducing greenhouse gases by separating, and chemically immobilizing, $CO_2$ contained in factory emissions.

## Aiming to be the Global Leader

Mitsui Chemicals aims to be the global top performer in not only social accountability and protection of the natural environment but also in its already strong product lineups. Currently, we boast a product portfolio with many products that have leading market shares in global and Asian markets. We will continue to strengthen our business in products with competitive advantage while aiming at a global top position in core business areas.

As part of our effort to strengthen our overseas operations, we decided to join hands with Sinopec in China to form an equally owned joint venture. The first step in this undertaking took shape as a bisphenol A plant where commercial operations began last year. Our expansion in the growing Chinese market will be further strengthened by the construction of a production facility for phenol where we will realize an integrated production system for phenol and bisphenol A. These efforts will strengthen our international competitiveness and pave our way to becoming the world's leading provider of phenol.



$CO_2$-methanol plant.

**CO2-methanol plant**

We also commenced commercial operation at our production base in India last June. Mitsui Chemicals is currently the world's second-largest provider of polypropylene compounds. Our Indian production base will take us a step closer to becoming the top global provider in these compounds.

In June this year, we will establish yet another overseas base. Brazil is the world's sixth-largest automobile producer. Our operations there will not only strengthen our position in polypropylene compounds, but will also expand the market for our high-performance resin, Admer.

## Strengthening Our Position

Despite volatile business conditions over the past year, we have been successful in strengthening our operations using unique technology to create original products that are not only without competition but also able to reduce our dependence on fossil fuels and lessen our impact on the natural environment. While we will continue to intensify our business competitiveness around the world, Mitsui Chemicals will always place priority on its responsibility to the environment and society. We invite you to share our dream to make the world a better place through the innovations of chemistry.

Mitsui Chemicals



**chemical week may 3,2010**



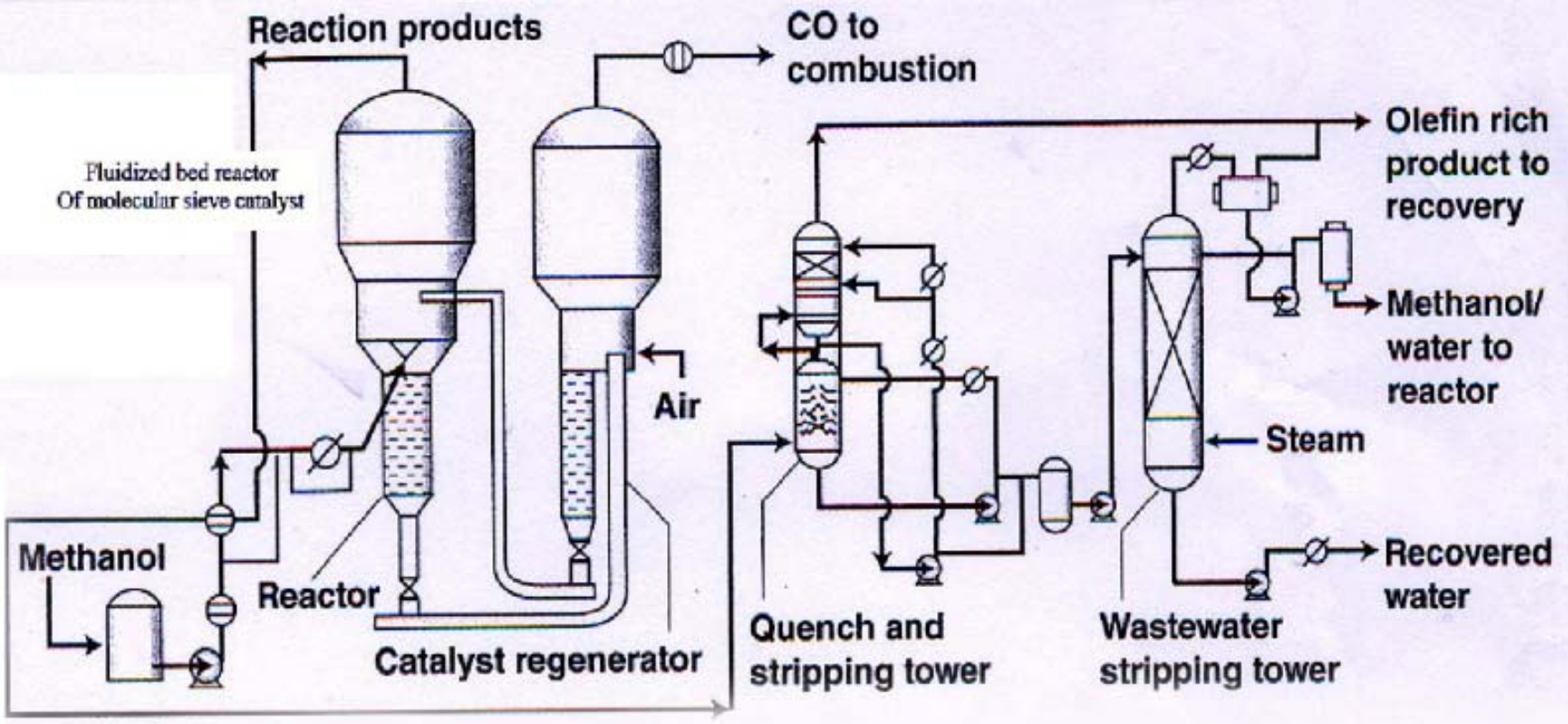
- **new technology:making methanol from CO2 and H2 with high activity catalysts**

# Economical evaluation CCS for a 900 MW coal fired power plant and energy storage

- 90% plant factor CO2 rate=611T/h
- = 4.82 10 $^{6}TCO^{2}/y$
- Carbone production =1.30 $10^{6}T/y$
- Assumption $H_2$ from $CH_4$ = 2.82 $10^{6}$ T/y
- Total carbone product =2.03 $10^{6}T/y$
- Methanol product =3.16 $10^{6}T/y$
- **Plant investment = 961 $10^{6}$$**
- **green house gas carbon dioxide mitigation M. M. Halmann ,M. Steinberg Lewis Publishers 1999 NY**

# Commercialization is set for a methanol to olefins technology

Edited by Gerald Ondrey | Chemical Engineering January 2009 p13 | January 2009




Technical data

From CH3OH……ethylene

Propylene

Few butene

1-2% coke

55% H2O

propylene ratio :----------=0.8to1.2 ethylene

Economic data Naphta price 375$/T

CH3OH 340$/T

**600.000T/Y**

**Dalian university China**

**CO2 to:polymer production**

## Industrial plant for coal gazeification MTO complex (Shenhua Baotou Coal Chemicals Co. China)

- Size 1.6 $10^6$T/year of $CH_3OH \rightarrow$ 6000.000 T/year $C_2H_4$, $C_3H_6$
  (ethylene – propylene)

  Production expected 2010

- **Technical aspects**

  - DMTO process : $CH_3OH$ feed in fluidized bed reactor catalyst :
    molecular sieve

  - Technical data from $CH_3OH$

    Ethylene
    Propylene ratio $\frac{\text{propylene}}{\text{ethylene}}$ = 0.8 – 1.2
    Few butene
    1-2 % coke
    55 % $H_2O$

- **Patents and licence**

  → MTO process (methanol to olefine) – **Dalian Institute of Chemical Physics (China) Chinese Academy**

  → Licence and development

  Lumus Technology (Woodlands, Tex)
  SYN Energy Tech, Co. (Dalian China)