



COP24 side event

Energy 24 Congress

Panel discussion:

How the Climate Challenge and Energy Policy can drive innovation

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Production of major fuels and chemical raw material in the world



**CRUDE OIL PRODUCTION: DAILY 94 M BARRELS, 204 B GJ ANNUALLY (11.473 USD/GJ)
(PRICE: 11,4 USD /GJ PEAK 2X)**

**NATURAL GAS PRODUCTION: 3500 B M³ 184 B GJ
(3 USD/GJ(US), 5.7 USD GJ EU, 9.52 USD/GJ CHINA, PEAK 2 X)**

COAL PRODUCTION 8 B TONNES ~119 B GJ

**GERMAN OPEN PIT < 2,30 USD/GJ , 2.9 USD/GJ POLISH UNDERGROUND
2.8 USD/GJ ARA, 3.3 USD/GJ CHINA)(PEAK 1,5 X)**

RENEWABLE ENERGY RESOURCES: ESTIMATED 76 B GJ (~15% OF THE TOTAL)

**AROUND 80-90% MONOPOLY REGARDING HYDROCARBONS
COMMERCIAL TRADE AND COMMERCIAL PRICES**

**LESS THAN 40% MONOPOLY REGARDING COAL
COMMERCIAL TRADE IS LOW AND PRODUCER PRICES DOMINATE**

RENEWABLES EQUIPMENT PRODUCERS (AVAILIBILTY SUN:15 % WIND 21 %)

CONCENTRATION



Comparison of Coal production prices in the world

Coal prices	USD/GJ	Correction for the energy efficiency gas/coal 55/43% 1,27 x	Price of natural gas USD/GJ /LNG ca. +70%/
USA Powder River Wyoming	0,4722	0,6	3(102 USD/1000 m3)
USA Illinois	1,372	1,74	3
USA Northern Appalache	1,638	2,08	3
USA Rocky mountains	1,638	2,08	3
USA Middle Appalache	1,638	2,08	3
China Shenhua at mine mouth	1,375	1,746	9,5(324 USD/1000 m3)
China Shenhua transported	2,06	2,61	9,5
China CECO purchase	3,41	(4,33) + only for chemicals	9,5
India	0,44	0,56	4,55
Europe ARA	3,71	7,71	6 (22 Euro/MWh)
Europe German open pit	1,72- 2,3	2,18- 2,92	6
Europe Polish deep mine	2,9	3,68	6 + no public data available
Hungarian open pit	< 2,29	< 2,90	6+ no public data available
Hungarian deep mine new opening estimate	3,44- 4,60	4,367- 5,84	6 + no public data available
Australia Victoria open pit	0,44	0,56	4,55

For all industrial units as required:

- Electric energy supply
- Water supply/Water treatment
- Catalyser supply

Unused carbonium sources

- Agricultural biomass
- Sewage sludge
- Manure
- Waste
- Coal
- CO₂

Unused energy and water sources

- Power plant/industrial waste heat
- Solar/wind/geothermal energy
- Rivers
- Off-peak electricity

Preparation plant

- Separation/Concentration
- Cutting/Grinding
- Homogenisation
- Watering/Drying
- Torrefaction
- Bacteria/enzymes

Energy use / storage

- Heat storage, heat pumps, ORC
- CHP
- Thermal max
- Hydropower use
- Accumulator farms

Electric energy
District heating
Agriculture

Processing plants

Production of chemical products

- Gasification, CO₂ sequest, crude gas cleaning
- Crude oil cleaning with solvent procedure
- Synthesis procedure

Bacteria/enzyme processing

- Biogas production, CO₂ sequestration

CO₂ utilisation

- Chemical processing
- Fireproof material cells

H₂ production, O₂ production

- Hydrolisis
- Natural gas decompos.
- Carbon reduction
- Air decomposition

Waste material, slag use

- Chemically bound construction material
- Chemical extraction

Energy use

- Renewables, collectors
- Catalytic oxidation

MeOH, Further chemical compounds
Sulfur,
Soil improving Fertiliser

Biogas

Polyols,
Hydrocarbons

H₂, O₂, N₂
H₂ chemical storage

Construction material, Rare Earth Element



Clean coal technologies and their possible application in existing infrastructure

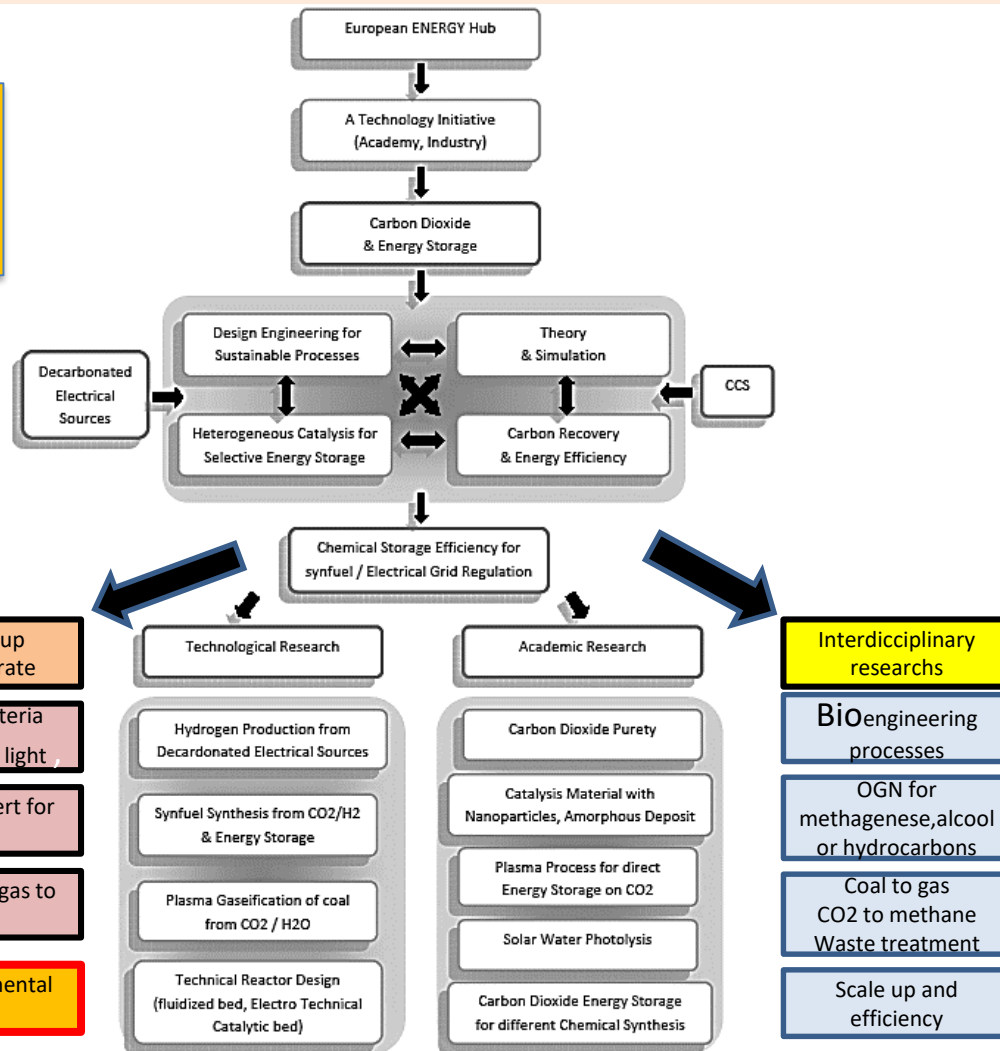


- All technologies of coal use either as material direct dissolution or indirect gasification with subsequent cleaning and transformation
- Also technologies for CO₂ capture and sequestration CCS or reuse CCR
- Selected technologies of the toolbox can be used to clean coal retrofit of existing infrastructure, hence strategy for CTC and coal to power overlapping
- Example: Gasification outside of the existing boiler than catalytic glowing of the gas instead of burning and transformation of the CO₂ in the exhaust with the help of waste heat into alcohols (common research areas)



E-MRS research strategy (source : presentation of Prof Jacques Amouroux)

**European strategy for
A multicultural
research**



bioIndustrial scale up
For CO2 to CH4 hydrate

Sea water ,cyanobacteria
,iron catalyst ,and sun light

Heat and mass transfert for
CO2 reduction

Specific process from gas to
solid (hydrate)

Patents and environmental
strategy



CO₂ separation and Capture

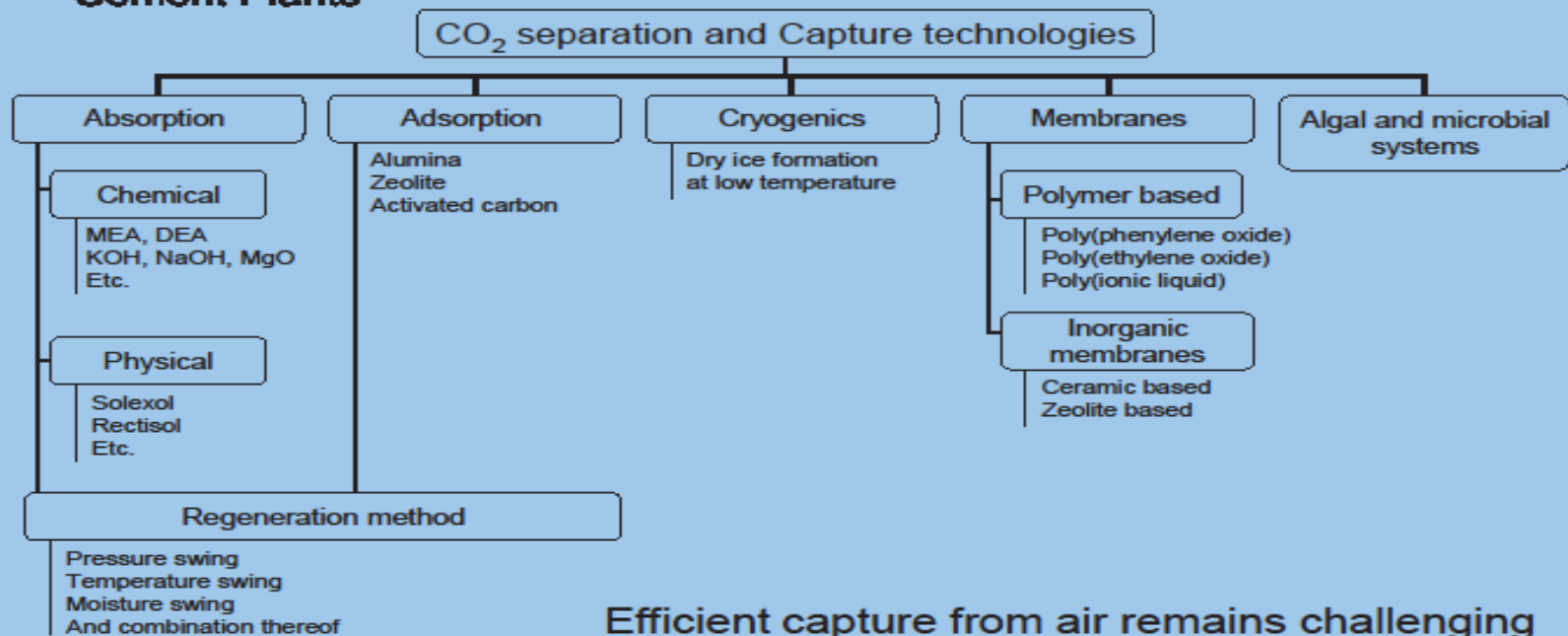
(source :Prof. Suriya Prakesh)



Sources of CO₂

Geothermal Vents
Fermentation Processes
Natural Gas Wells
Cement Plants

Fossil Fuel Burning Power Plants
Aluminum Plants
Air Itself



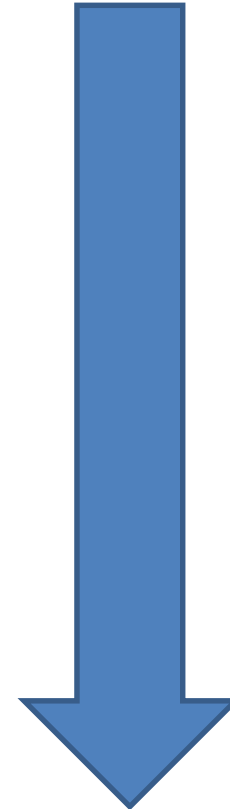
CO₂ utilisation roadmap

(from the presentation of Prof. Denis Clodic and others)



State of the art

- **Overarching issues**
 - - CO₂ purity
 - -High value products
- **Direct valorization**
 - E O R
 - Mineralization
- **Chemical transformation**
 - Biogas dry reforming of CO₂ and CH₄
- **Biological routes**
 - Cyanobacteria and microalgae
- **Photo-electrochemistry**
 - H₂ generation by water Photo-electrolysis
 - Joint CO₂ and H₂O Photo-reduction



Blue Sky



Direct and indirect GHG emissions from fossil fuels
 Germany has 2,8 % share in worldwide GHG emission
 if the USA would reduce its per head GHG emissions to the present German level
 7,2 % could be saved

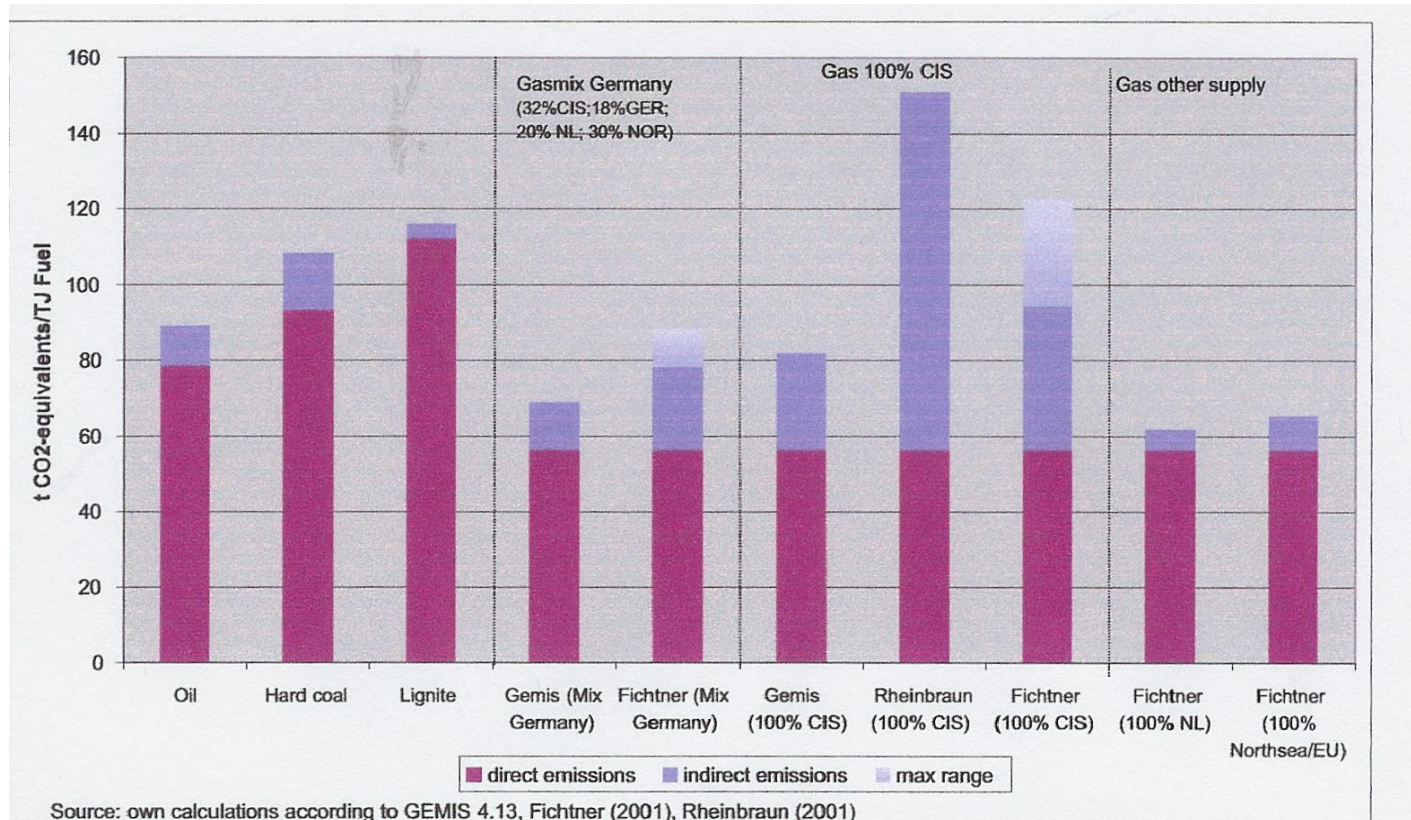


Fig. 2: Direct and indirect GHG-emissions (in CO₂-equivalents) of different fuel-types in comparison with the emissions from the natural gas life cycle under different assumptions and LCA's





The role of the media

- Soren Kierkegaard:
- „There are two ways to be fooled:
- One is to believe what isn't true, the other one is to refuse to accept what is true.”
- Mark Twain:
- „ It is easier to fool people, than to convince them, that have been fooled.”
- The media influences people , people influence politics
- Certain interest groups buy themselves media influence





Thank you for the attention

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