A BRIEF OVERVIEW ON COAL LIQUEFACTION IN INDONESIA

Lokakarya Energi Baru dan Terbarukan
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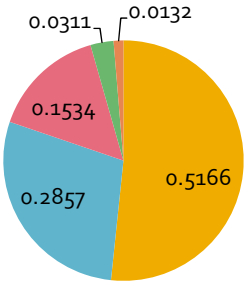
INDONESIA ENERGY MIX - 2025

NRE

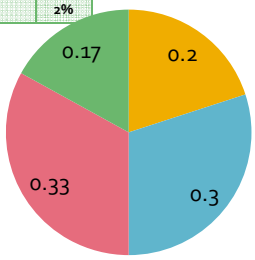
Biofuels	5%
Geothermal	5%
Solar, Wind, Nuclear	5%
Liquified Coal	2%

2005



Oil
Gas
Coal
Hydro
Geothermal

2025



Oil
Gas
Coal
others

(NRE)

(Source: MEMR, 2007)

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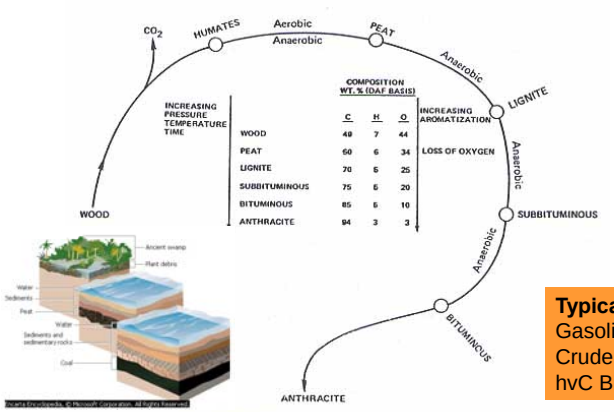
COAL

- an organic rocklike natural product
- a result of decay and maturation of floral remains
- a fossil fuel originated from plant material
- one of hydrocarbon resources of the earth



changes in C and H composition

Typical H/C ratio

Gasoline	1.95
Crude oil	1.82
hvC Bituminous coal	0.76

COALIFICATION PROCESS (Speight, 1994)

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SIMPLIFIED CLASSIFICATION OF HYDROCARBON RESOURCES

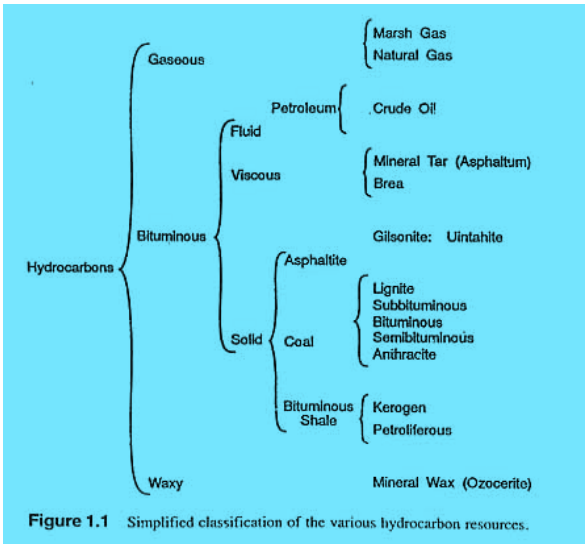

Figure 1.1 Simplified classification of the various hydrocarbon resources.

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ATOMIC H TO C RATIO OF VARIOUS FUELS

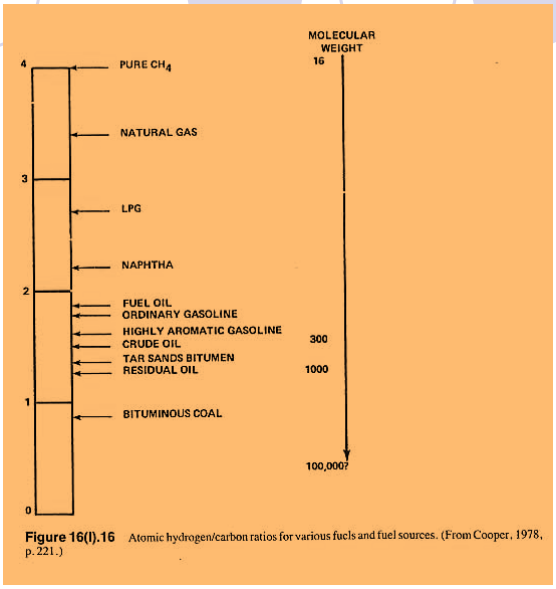

Figure 16(I).16 Atomic hydrogen/carbon ratios for various fuels and fuel sources. (From Cooper, 1978, p. 221.)

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WORLD COAL RESERVES (mineable), PRODUCTION (Indonesia) AND WORLD EXPORTS

Country	Mineable reserve, million tons (% world)
USA	246,643 (27.1)
Russia	157,010 (17.3)
China	114,500 (12.6)
India	92,445 (10.2)
Australia	78,500 (8.6)
South Africa	48,750 (5.4)
Poland	14,000 (1.5)
Canada	6,578 (0.7)
Indonesia	***4,968 (0.5)***

Country	Export (2003), million tons	Export (2004), Million tons
Australia	238.1	247.6
Indonesia	***107.8***	***131.4***
China	103.4	95.5
South Africa	78.7	74.9
South Americas	57.8	65.9
Russia	41.0	55.7
USA	43.0	48.0
Canada	27.7	28.8
Poland	16.4	16.3

Year	Production	Domestic Use	Export
2005	152.7	41.3	107.1
2006	178.2	39.3	129.5
2007 (Aug)	83.4	19.9	69.3

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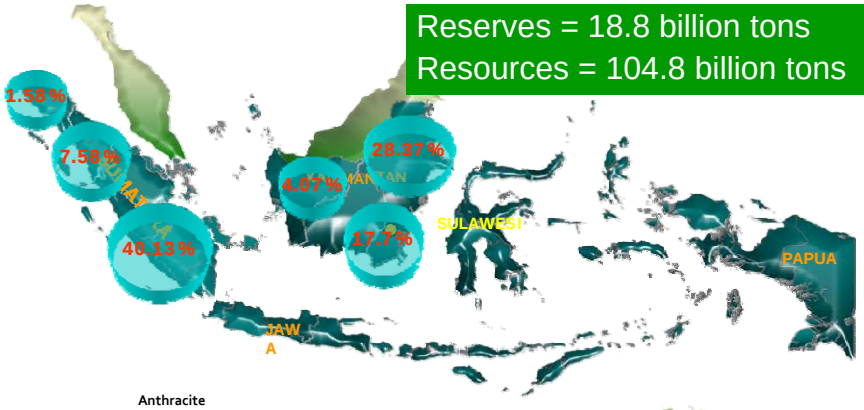
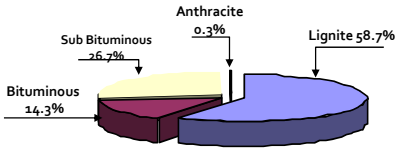
INDONESIA COAL DEPOSIT DISTRIBUTION (MEMR, 2008)

Reserves = 18.8 billion tons
Resources = 104.8 billion tons





DIRECT COAL COMBUSTION

- conversion from chemical energy to thermal energy
- oldest technology of coal utilization
- oxidation by air
- used in a range of application
- majority of consumable energy to the world
- creates environmental problems

What makes coal "unclean" ?
- Coal is mostly carbon
- Coal contains sulfur and nitrogen
- Coal contains ash
- Coal contains other materials

$2\ C_{coal} + O_2 \rightarrow 2\ CO$
$2\ CO + O_2 \rightarrow 2\ CO_2$
$C_{coal} + O_2 \rightarrow CO_2$
$S_{coal} + O_2 \rightarrow SO_x$
$N_{coal} + O_2 \rightarrow NO_x$

coal particle size

fixed bed	cm
fluidized bed	mm
pulverized bed	μm

POWER PLANT

process performance in an environmentally acceptable manner

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INDIRECT COAL COMBUSTION

solid

GASIFICATION (CTG)

- Solid to gas containing mainly CO and H2 (synthesis gas) that produces less emission than coal if burnt. Gas can be distributed to end users.
- Ash and unwanted materials can be contained at gasification plant site.

gas

LIQUEFACTION

- Direct (e.g. BCL, NEDO):
  Coal to liquid fuel (CTL) equivalent to crude petroleum oil or end petroleum products (refinery).
- Indirect (e.g. Sasol):
  Via gasification (e.g. Lurgi) to produce synthesis gas and subsequent conversion of gas to liquid fuel (GTL) (e.g. Fischer -Tropsch).
- Biological (research)

liquid

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THERMAL CONVERSION

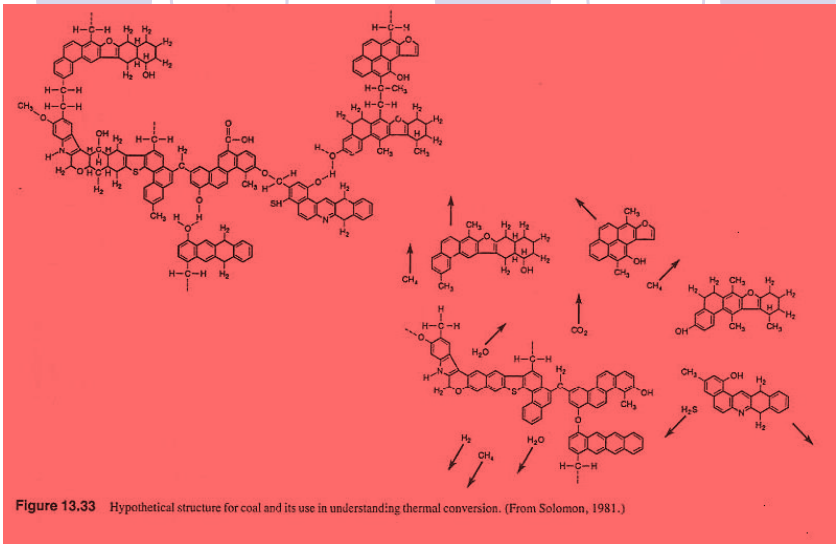

Figure 13.33 Hypothetical structure for coal and its use in understanding thermal conversion. (From Solomon, 1981.)

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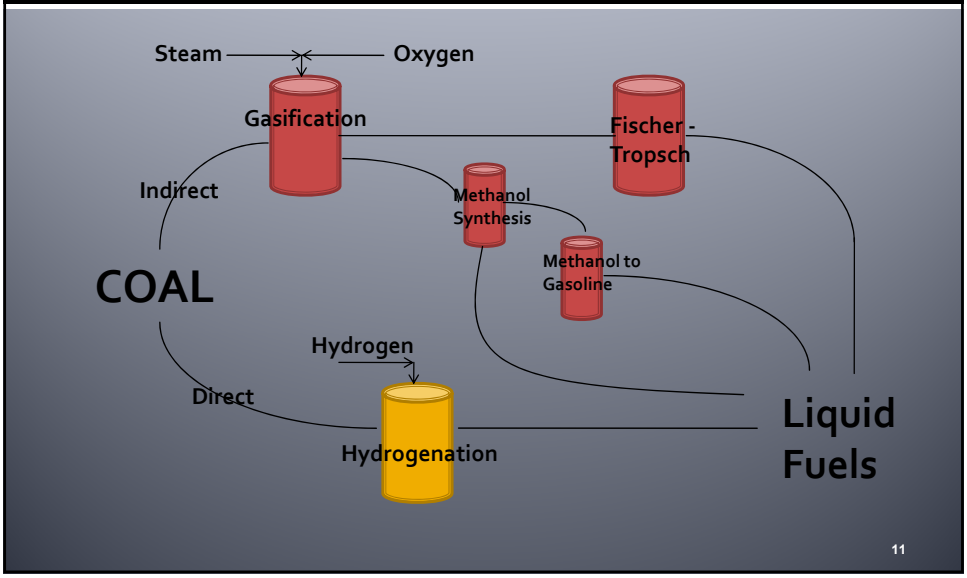
LIQUEFACTION



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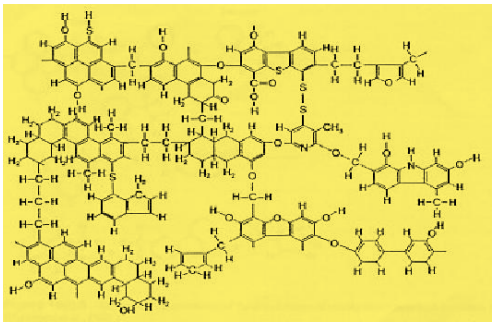
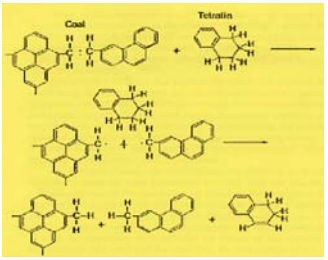
CHEMISTRY OF COAL LIQUEFACTION (DIRECT)





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COAL LIQUEFACTION PLANT PROJECTS

(US DOE, 2007)

Country	Owner/Developer	Capacity (bpd)	Status
South Africa	Sasol	150,000	Operational
China	Shenhua	20,000 (initially)	Construction Operational in 2007–2008
China	Lu'an Group	~3,000–4,000	Construction
China	Yankuang	40,000 (initially) 180,000 planned	Construction
China	Sasol JV (2 studies)	80,000 (each plant)	Planning
China	Shell/Shenhua	70,000–80,000	Planning
China	Headwaters/UK Race Investment	Two 700-bpd demo plants	Planning
Australia	Anglo American/Shell	60,000	Planning
Australia	Altona Resources plc, Jacobs Consultancy, MineConsult	45,000	Planning
Philippines	Headwaters	50,000	Planning
New Zealand	L&M Group	50,000	Planning

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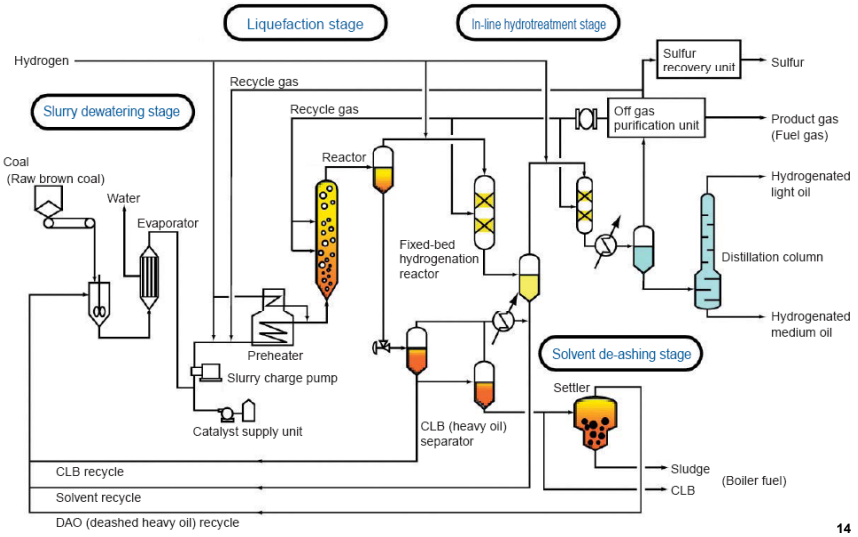
BROWN COAL LIQUEFACTION (DIRECT COAL LIQUEFACTION)



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BCL PROCESS STAGES

- Slurry dewatering stage
  - Where water is efficiently removed from low-rank coal.
- Liquefaction stage
  - Where liquefied oil production yield is increased by using a highly active limonite catalyst and bottom recycling technology.
- Inline hydrotreatment stage
  - Where the heteroatoms (sulfur-containing compounds, nitrogen-containing compounds, etc.) in the coal liquefied oil are removed to obtain high quality gasoline, diesel oil, and other light fractions.
- Solvent de-ashing stage
  - Where the ash in coal and the added catalysts are efficiently discharged from the process.

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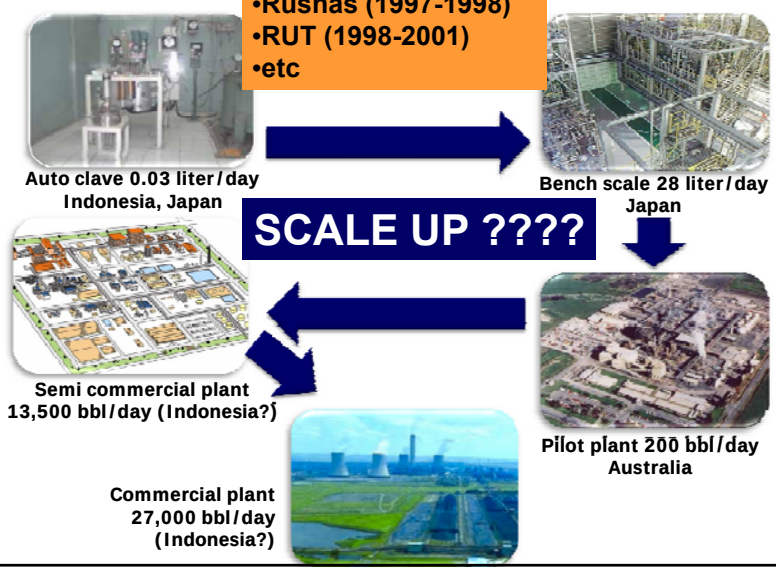
BCL TECHNOLOGY R & D

(MEMR, 2008)



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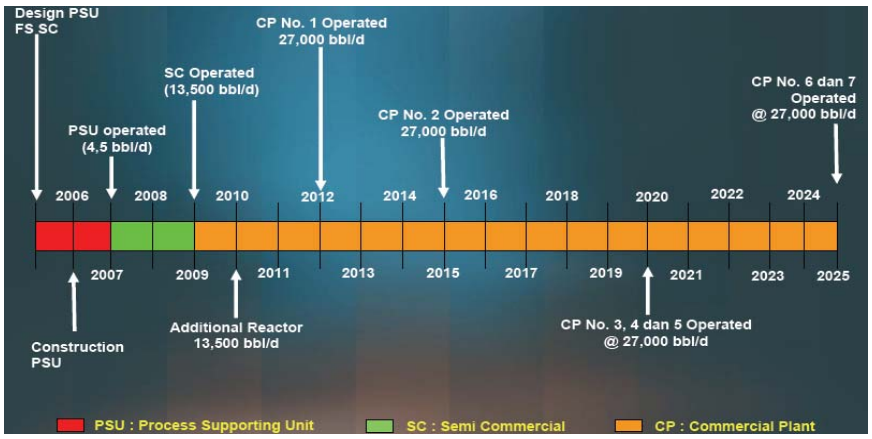
ROAD MAP TO BCL PROCESS IN INDONESIA

(MEMR, 2006)



Cancelled !!!

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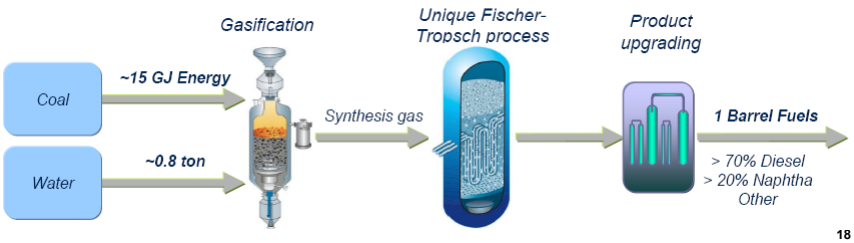
INDIRECT COAL LIQUEFACTION

- **Gasification of to produce 'syngas'.**
- **Fischer – Tropsch for conversion of gas to liquid.**
- **SASOL.**



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GASIFICATION

Partial oxidation of coal to produce gaseous fuel frequently referred to as producer gas

OXYGEN/AIR
$C_{coal} + 1/2\ O_2 \rightarrow CO$

CARBON DIOXIDE
$C_{coal} + CO_2 \rightarrow CO$

STEAM
$C_{coal} + H_2O \rightarrow CO + H_2$

HYDROGEN
$C_{coal} + 2H_2 \rightarrow CH_4$

Energy and Chemicals

synthesis gas (CO and H_2) ►►► CHEMICALS
(methanol, ammonia, etc)

→ **potential**

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GASIFICATION

conversion of coal to produce combustible gases

REACTIONS

- $2\ C + O_2 \rightarrow 2\ CO$
- $C + O_2 \rightarrow CO_2$
- $C + CO_2 \rightarrow 2\ CO$ (Boudoard's reaction)
- $CO + H_2O \rightarrow CO_2 + H_2$ (*shift reaction*)
- $C + H_2O \rightarrow CO + H_2$ (*water gas reaction*)
- $C + 2\ H_2 \rightarrow CH_4$
- $2\ H_2 + O_2 \rightarrow 2\ H_2O$
- $CO + 2\ H_2 \rightarrow CH_3OH$
- $CO + 3\ H_2 \rightarrow CH_4 + H_2O$ (*methanation reaction*)
- $CO_2 + 4\ H_2 \rightarrow CH_4 + 2\ H_2O$
- $C + 2\ H_2O \rightarrow 2\ H_2 + CO_2$
- $2\ C + H_2 \rightarrow C_2H_2$
- $CH_4 + 2\ H_2O \rightarrow CO_2 + 4\ H_2$

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SASOL FOR CTL IN INDONESIA

- Capacity 39 million tons/year lignite for 80,000 bpd
- Planned 200,000 bpd in 2025 (2% of energy mix)
- Estimated 2 billion tons in 40 years
- Sumatera Bagian Selatan

MOST RECENT NEWS
SASOL FOR CTL IN INDONESIA

Selasa, 18/1/2011 11:25 WIB

RI Kehilangan Investasi Rp 90 Triliun dari Sasol

Suhendra - detikFinance

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Foto: dok. detikFinance

Jakarta - Kepala Badan Koordinasi Penanaman Modal (BKPM) Gita Wirjawan mengatakan rencana investasi pencairan batubara atau Coal to Liquid (CTL) oleh Sasol Synfuels International (Sasol) asal Afrika Selatan dipastikan batal. Indonesia kehilangan peluang investasi mahabesar senilai US$ 10 miliar atau Rp 90 triliun.

Gita menjelaskan ini dikarenakan pihak PT Bukit Asam (BA) tak mampu memenuhi kebutuhan pasokan batubara dari rencana investasi Sasol di Indonesia. Dengan tak terjaminnya pasokan batubara yang memadai maka investasi Sasol sulit terealisasi.

"Kemungkinan besar gagal, tanya dirutnya (PT Bukit Asam)," kata Gita di kantornya, Jakarta, Selasa (18/1/2011).

Menurut Gita, jaminan pasokan batubara untuk rencana investasi Sasol menjadi kunci realisasi investasi CTL di Indonesia. Namun apa daya pihak PT BA selaku mitra Sasol tak mampu menyanggupi kebutuhan batubara.

"Karena BA mengambil sikap tidak bisa memasok. Selama tak ada batubara tak bisa," kata Gita.

Sebelumnya Dirut PTBA Sukrisno mengaku sulit untuk memenuhi pasokan batubara yang diminta South African Synthetic Oil Ltd (Sasol), sebesar 2 miliar ton. Pasalnya hasil produksi PTBA hanya 1,6 miliar ton dan ini pun telah dialokasikan ke beberapa pembeli dalam bentuk komitmen pasokan.

(hen/dnl)

BIOLOGICAL CONVERSION BY BIOSOLUBILIZATION

- On going work by a research team (Pingkan Aditiawati, Dwiwahju Sasongko, Dea Indriani Astuti, Irawan Sugoro)
- Lignite solubilization by indigeneous microbes (Stranas, 2010-2012)
  - Isolation of microbes
  - Selection of microbes
  - Optimization of lignite biosolubilization

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END

"The left side of your brain is good at math and science. The right side is creative and playful. You'll get a raise as soon as you have the right side surgically removed."

Thank you for your attention

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