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#INOVASI INDONESIA

RECENT UPDATE OF INDUSTRIAL RESEARCH AND INNOVATION ON

SUBSTITUTION OF BIOMASS/FERMENTED MSW FOR COAL-FIRED INDUSTRIAL BOILER AND GASIFIER: THE STRATEGIC ENABLER KEY FOR DECARBONIZATION

ANGGORO TRI MURSITO
RESEARCH CENTER FOR MINING TECHNOLOGY
NATIONAL RESEARCH AND INNOVATION AGENCY (BRIN)

The 31st Clean Coal Day International Symposium (2022)

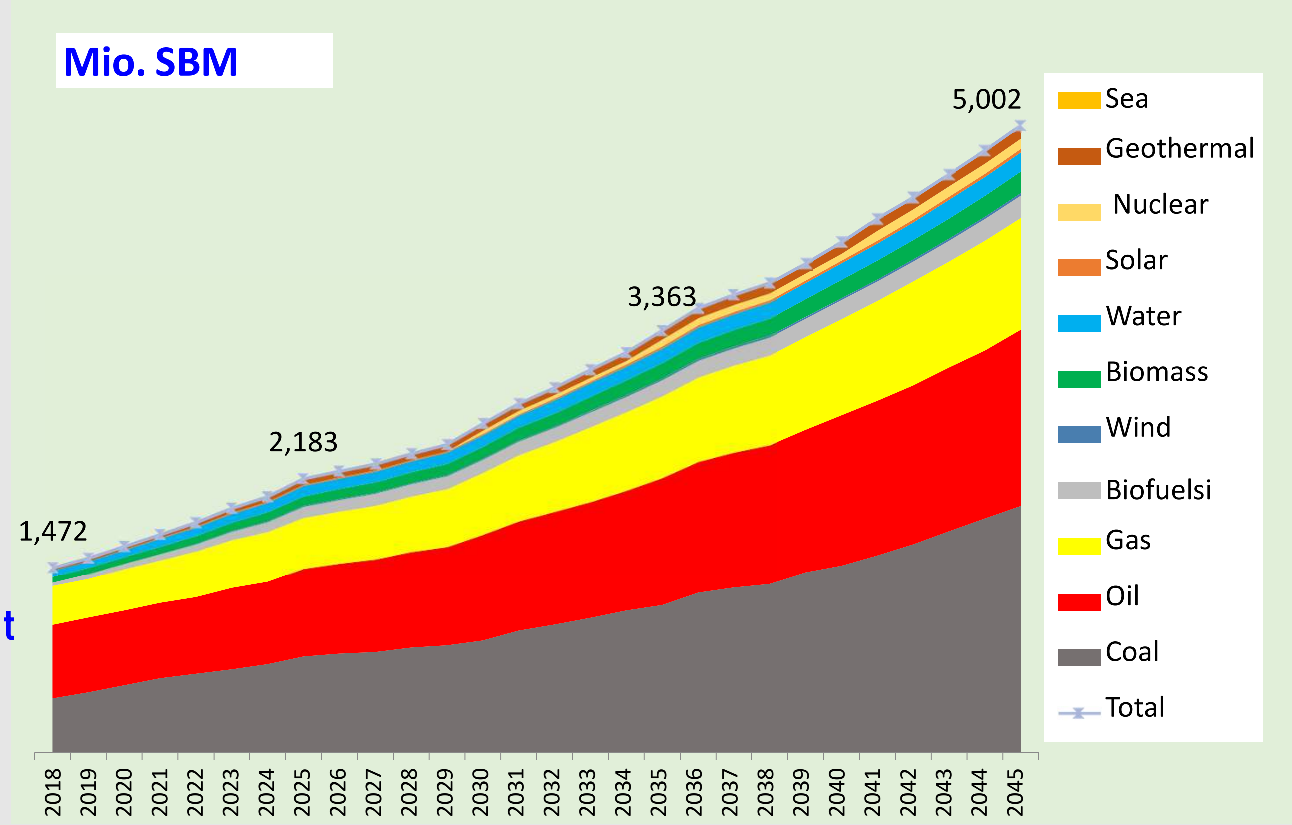
5th - 6th September, 2022

ENERGY SUPPLY PROJECTIONS AND CHALLENGES

The use of fossil energy (coal, oil, and gas) is still dominate in supply energy until 2045

In 2045, the share of fossil energy use will reach 85% (39% coal, 28% oil, and
gas 18%)

Fossil energy reserves are limited, it is necessary to prepare for the use of renewable energy that is cleaner and more sustainable



BPPT, Indonesian Energy Outlook

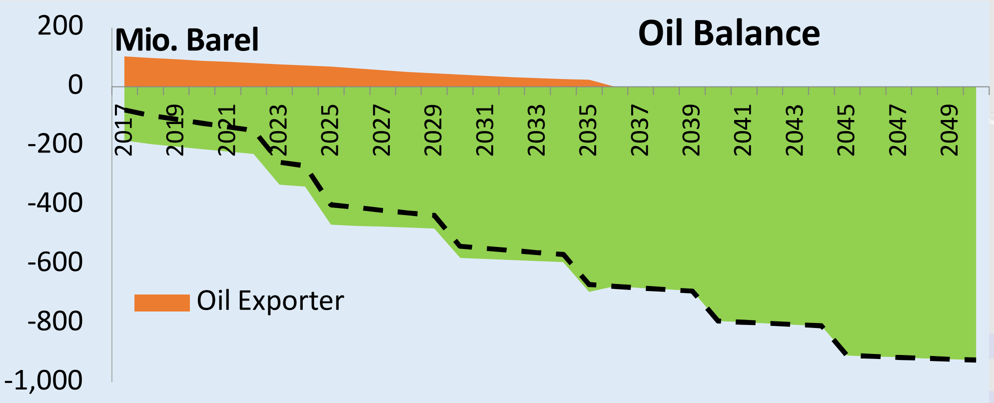
Dwianto, 2020

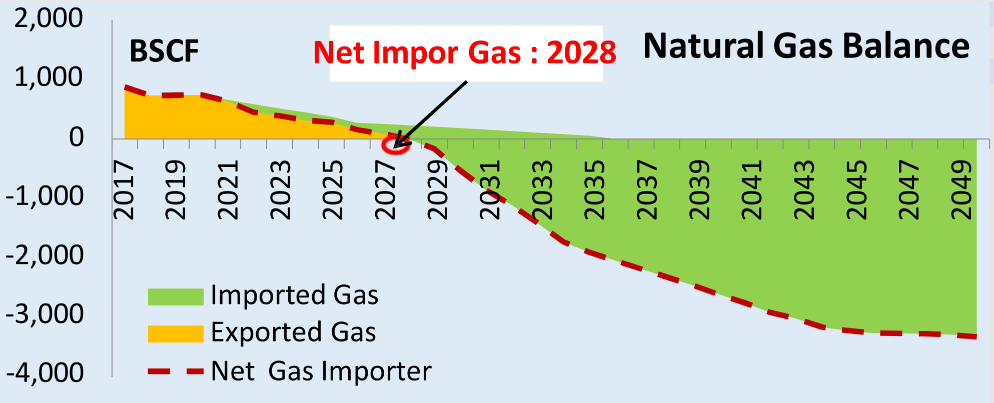
PROJECTIONS AND CHALLENGES
ENERGY SUPPLY

Petroleum: depleted reserves
- Already a Net Importer since 2004
- Decreased exploration
- Production decreases, consumption increases

Natural Gas: relatively clean fossil energy, however :
- Net Importer in 2028
- Non-conventional oil and gas exploration and exploitation is needed

Coal: the biggest CO2 emitter
- The main fuel in power plants (PLTU)
- Exports are always dominant (±70%)





Dwianto, 2020

INDONESIAN EFFORTS TO REDUCE GHG

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DAN INOVASI NASIONAL

PRESIDENT'S DIRECTIVE

UNFCCC - COP21, DECEMBER 2015

Reducing GHG emission for 29% (or **41%** by international assistance) by **2030** based on Nationally Determined Contribution **(NDC)**

STATE SPEECH, 16 AUGUST 2021

Transformasi towards New and Renewable Energy **(NRE), as well as the acceleration of a green technology-based economy**

LEADERS SUMMIT ON CLIMATE, APRIL 2021

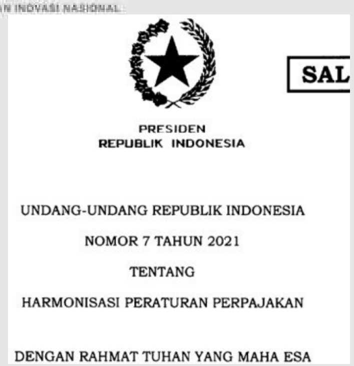
Unlocking **energy transition** investments through **the development of biofuels, lithium battery industry & electric vehicles**

COP 26, NOVEMBER 2021

Indonesia will be able to **contribute faster to the global Net-Zero Emissions** (**2060** or sooner)

Untung, 2022

EXISTING REGULATIONS FOR CARBON TAX



PRESIDEN
REPUBLIK INDONESIA

SAL

UNDANG-UNDANG REPUBLIK INDONESIA

NOMOR 7 TAHUN 2021

TENTANG

HARMONISASI PERATURAN PERPAJAKAN

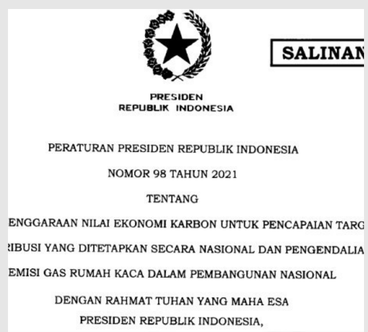
DENGAN RAHMAT TUHAN YANG MAHA ESA

Law No. 7/2021 about Harmonization of Tax Regulation (Carbon Tax)

- Currently formulating the draft of:
  - RPMK Tariff and DPP Carbon Tax
  -RPMK Procedure and Mechanism of Carbon Tax Implementation
  - RPP Carbon Roadmap

Presidential Regulation No. 98/2021 about Carbon Economic Value

- Current derivatives:
  -Ministry of Environment: 16 Ministerial Regulations and 15 Ministerial Decree
  - Regulation of Transparency in MRV, etc.
  -Sectoral regulation about mechanism of carbon trading and Upper Emission Level (BAE) of GHG



SALINAN

PRESIDEN
REPUBLIK INDONESIA

PERATURAN PRESIDEN REPUBLIK INDONESIA

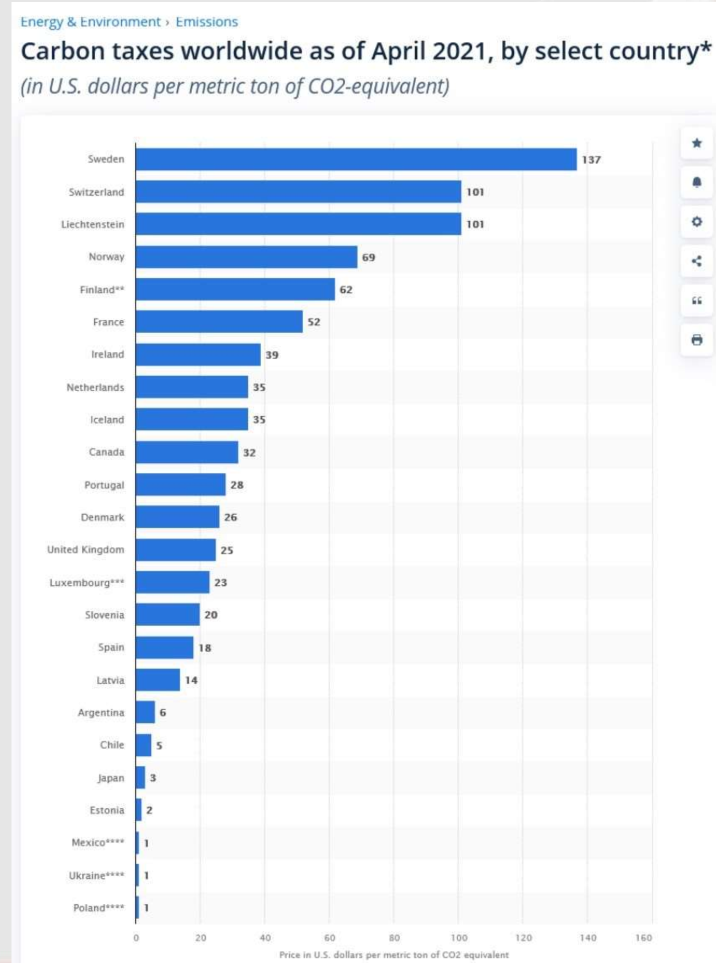
NOMOR 98 TAHUN 2021

TENTANG

ENGGARAAN NILAI EKONOMI KARBON UNTUK PENCAPAIAN TARG
IBUSI YANG DITETAPKAN SECARA NASIONAL DAN PENGENDALIA
EMISI GAS RUMAH KACA DALAM PEMBANGUNAN NASIONAL

DENGAN RAHMAT TUHAN YANG MAHA ESA

PRESIDEN REPUBLIK INDONESIA,



Source: ESDM, SKK Migas in Untung, 2022

EXISTING REGULATIONS FOR CCUS IN INDONESIA

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Clarification is needed for CCUS:

Re-assess and clarify on **PP 90/2010 and PP 27/2017** (and its derivatives) regarding contractors's earning (PSC Cost Recovery)

Bagian Kesatu
Penghasilan Bruto Kontraktor

Pasal 9

(1) Penghasilan bruto kontraktor terdiri atas:
a. penghasilan dalam rangka kontrak bagi hasil; atau
b. penghasilan dalam rangka kontrak jasa; dan
c. penghasilan lain di luar kontrak kerja sama.

Re-assess and clarify on **PP 53/2017** (and its derivatives) regarding contractors's earning (PSC Gross Split)

(3) Penghasilan lainnya selain dalam rangka bagi hasil Minyak dan Gas Bumi sebagaimana dimaksud pada ayat (1) huruf b terdiri atas:
a. penghasilan yang berasal dari *Uplift* atau imbalan lain yang sejenis;
b. penghasilan yang berasal dari pengalihan Partisipasi Interes (*Participating Interest*);
c. hasil penjualan produk sampingan dari Kegiatan Usaha Hulu; dan/atau
d. penghasilan lainnya yang memberikan tambahan kemampuan ekonomis.

Proposed position:

Major issues that will impact to the success of CCS/CCUS projects:

1. **Carbon Tax**
2. **Post-Operation Monitoring Cost**
3. **Interest Loan**

Inclusion of the above to the Petroleum Operation will significantly support the success of CCS/CCUS program

Permen ESDM re: CCS/CCUS is being finalized to capture and resolve the above issue

POLICY AND REGULATION IN ASEAN MEMBER COUNTRIES

	MALAYSIA	INDONESIA	VIETNAM	THAILAND	SINGAPORE	BRUNEI
International Climate Change Commitment (NDC)	✓ (45% reduction in GHG emission intensity of GDP by 2030)	✓ (29% reduction of GHG emissions by 2030)	✓ (8% reduction of GHG emissions by 2030)	✓ (20% reduction of GHG emissions by 2030)	✓ (Peak GHG emissions at 65 MtCO2e around 2030)	✓ (20% reduction of GHG emissions relative to BAU by 2030)
Net Zero Target	✓ (Pledge – 2050)	✓ (Proposed – 2060)	✓ (Pledge – 2050)	✓ (Pledge – 2050)	✓ (Policy – 2050)	✓ (Proposed – 2050)
Ratified party to International Marine Agreements	✓ (Limited to UNCLOS)	✓ (Limited to UNCLOS)	✓ (Limited to UNCLOS)	✓ (Limited to UNCLOS)	✓ (Limited to UNCLOS)	✓ (Limited to UNCLOS)
Domestic climate change and energy policies	✓	✓	✓	✓	✓	✓
CCS-specific domestic policies	✗	✓ National Action Plan recognizes role of CCS	✗	✓ Corporate tax exemptions	✓ EDB commitment MOU with Australia	✗
CCS-specific legal and regulatory framework	✓ (Under development)	✓ (Under development)	✗	✗	✗	✗
Existing legislation applicable to CCS operations	✓	✓	✓	✓	-	-

Source: Global CCS Institute in Untung, 2022

DECARBONIZATION EFFORTS ON ENERGY SECTOR

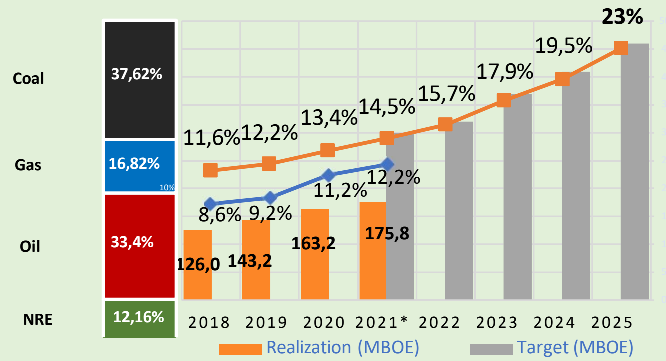
UTILIZING NRE POTENTIAL

ENERGY	POTENTIAL (GW)	UTILIZATION (MW)
SOLAR	3,295	217
HYDRO	95	6,637
BIOENERGY	57	2,284
WIND	155	154
GEOTHERMAL	24	2,293
OCEAN	60	0
TOTAL	3,686	11,585

Indonesia has **abundant**, **various**, and **spreading** NRE resource, Currently, **only 0.3% of the total potential has been utilized. The potential of new renewable energy is distributed as follows:**

- **Hydro** potential spreads all over Indonesia's areas.
- **Solar** potential spreads all over Indonesia's areas.
- **Wind** potential (>6 m/s) is particularly located in East Nusa Tenggara, South Kalimantan, West Java, NAD and Papua.
- **Ocean** energy potential particularly in Maluku, East Nusa Tenggara, West Nusa Tenggara and Bali.
- **Geothermal** potential spreads in ring of fire areas, including Sumatra, Java, Bali, Nusa Tenggara, Sulawesi, and Maluku.

NRE MIX TO 23% (2025)



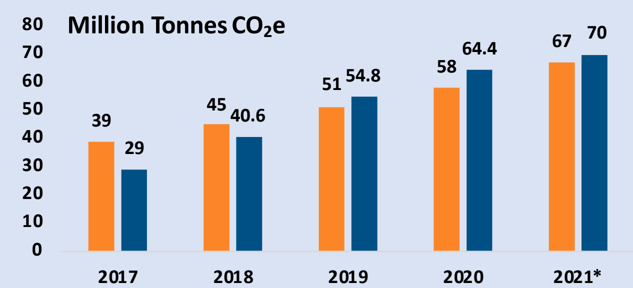
Acceleration Measures:

1. Completion of Pres. Reg. Draft on NRE Tariff
2. Implementation of Solar PV Rooftop
3. Mandatory Biofuel Utilization
4. Fiscal and Non-fiscal Incentives for NRE Projects
5. Ease of doing business
6. Stimulating demand towards electricity (EV, electric stove)

NDC TARGET (COP 21 & 26)

2030 NDC TARGET

No	Sector	2010 GHG Emission (Million Ton CO_2e)	GHG Emission by 2030			Reduction	
			BaU	CM1	CM2	CM1	CM2
1.	Energy	453.2	1,669	1,355	1,223	314	446
2.	Waste	88	296	285	256	11	40
3.	IPPU	36	70	66.85	66	3	3.25
4.	Agriculture	111	120	110	116	9	4
5.	Forestry	647	714	217	22	497	692
	TOTAL	1,334	2,869	2,034	1,683	834	1,185



Scenario Note: CM: Counter Measure; CM1: by own effort; CM2: by international assistance; IPPU: industrial processes and production use *in* Untung, 2022

ENERGY SECTOR EMISSION REDUCTION

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UU 16 / 2016 (NDC): Indonesia is committed to reduce GHG Emission by 29% in 2030 (up to 41% with international support).

No	Sector	GHG Emission Level 2010 (MTon CO2e)	GHG Emission Level 2030 (MTon CO2e)			GHG Emission Reduction (MTon CO2e)	
			BaU	CM1	CM2	CM1	CM2
1	**Energy***	**453.2**	**1,669**	**1,335**	**1,271**	**314**	**398**
2	Waste	88	296	285	270	11	26
3	IPPU	36	69.6	66.85	66.35	2.75	3.25
4	Agriculture	110.5	119.66	110.39	115.86	9	4
5	Forestry**	647	714	217	64	497	650
	TOTAL	**1,334**	**2,869**	**2,034**	**1,787**	**834**	**1,081**

* Including fugitive

**Including Peat fire

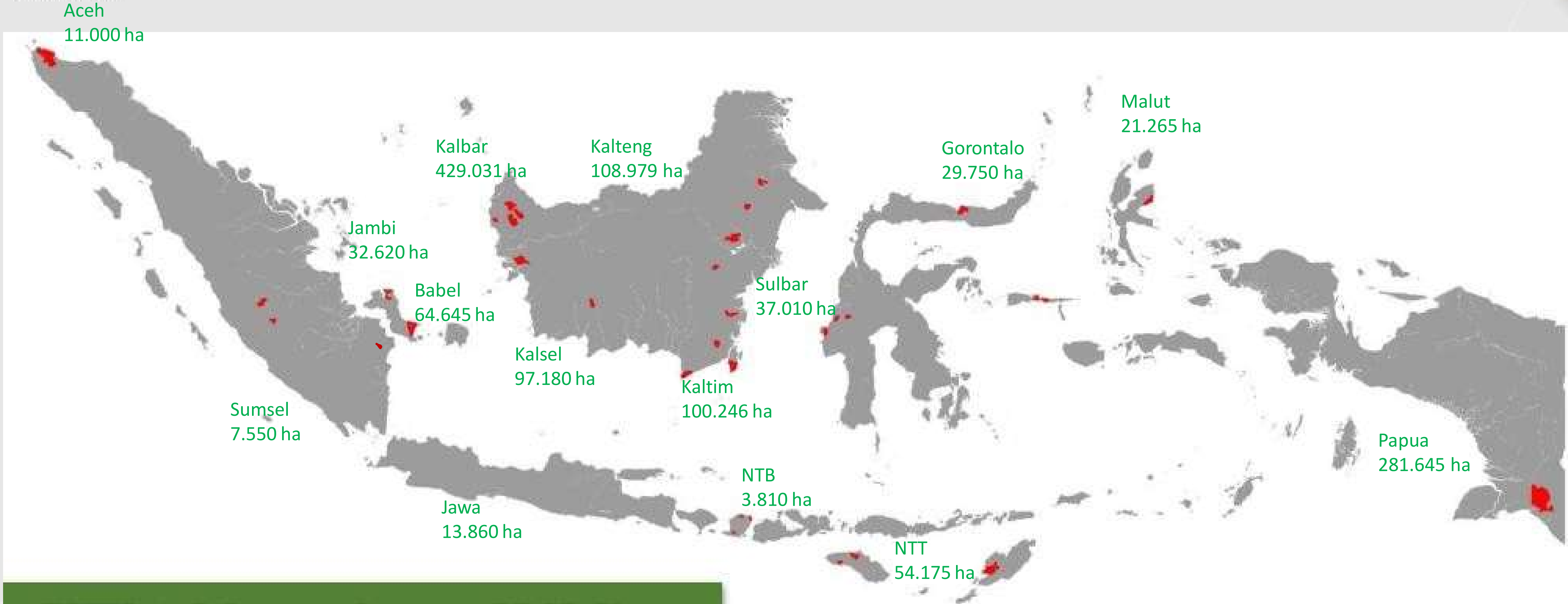
i 38% of emission reductions come from the energy sector

Notes: **CM1** = Counter Measure (*unconditional mitigation scenario*)
CM2 = Counter Measure (*conditional mitigation scenario*)

IPPU = Industrial Processes and Production Use
BECCS = Bioenergy with CCS
DDPP = Deep Decarbonization Pathway Program

Source: Bappenas, EBTKE in Untung, 2022

POTENTIAL FOREST ENERGY CROPS



Total area of potential energy plantation forest (HTE) = 1,292,766 ha Total business units committed to developing energy and bioenergy plantations = 32 business units

Keterangan:
= area HTE

Feedstocks : Cofiring

Household and similar household waste
- National waste generation in TPA reach 300 million tons/year
- Potential from around PLN's PLTU : ± 8,000 tons/day

Agricultural / Plantation Waste
- Potential from oil palm replanting: 55 M m3/year
- Potential of replanting rubber: 10 Million m3/year

Energy Crops
- The area of HTI that is ready for energy crops is ± 200 thousand Ha.
- Sub-optimal land area ± 2 million Ha.

Wood industry waste
The potential for sawdust waste in the sawmill industry is 18% of the raw material.

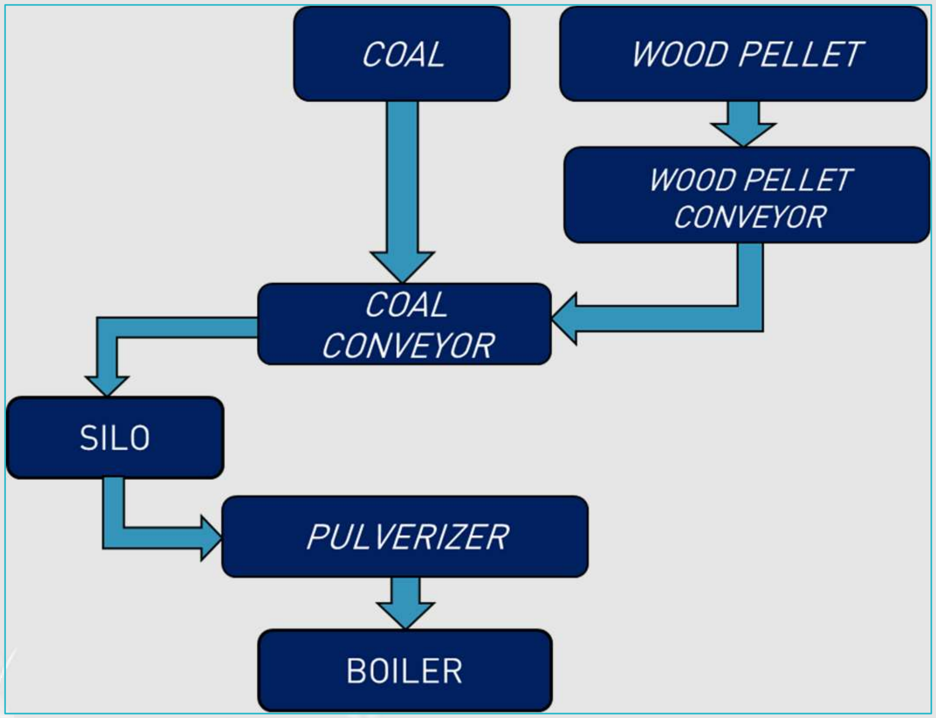
Sugiyanto, PJB- 2020

BIOMASS CO-FIRING - PLTU PAITON

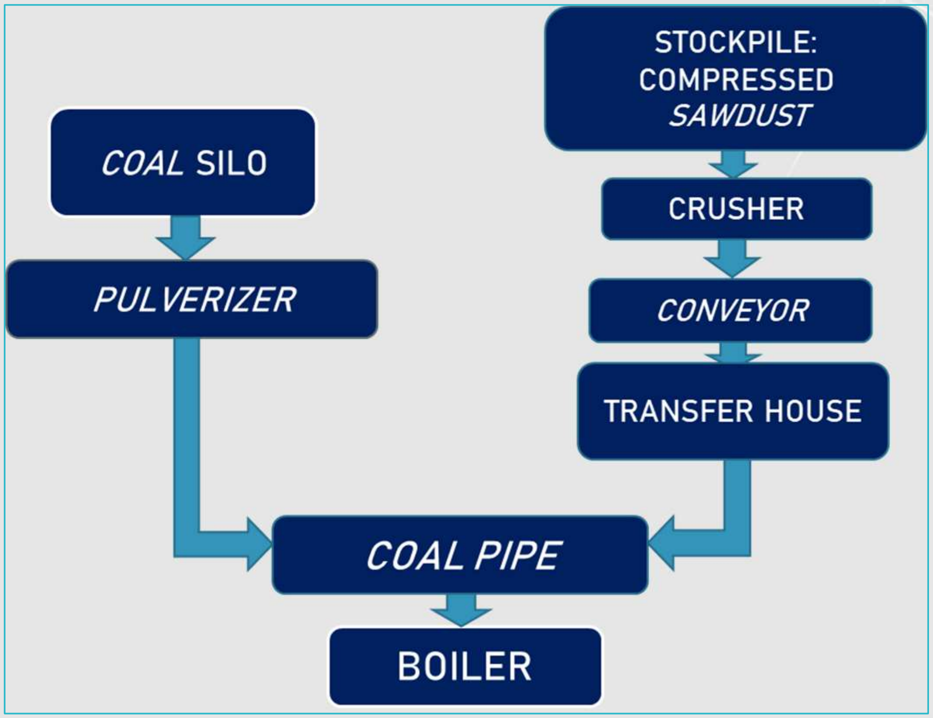
PJB – ITS Study : 2019

Co-firing Scenario

Ops. 1: Blending on Conveyor

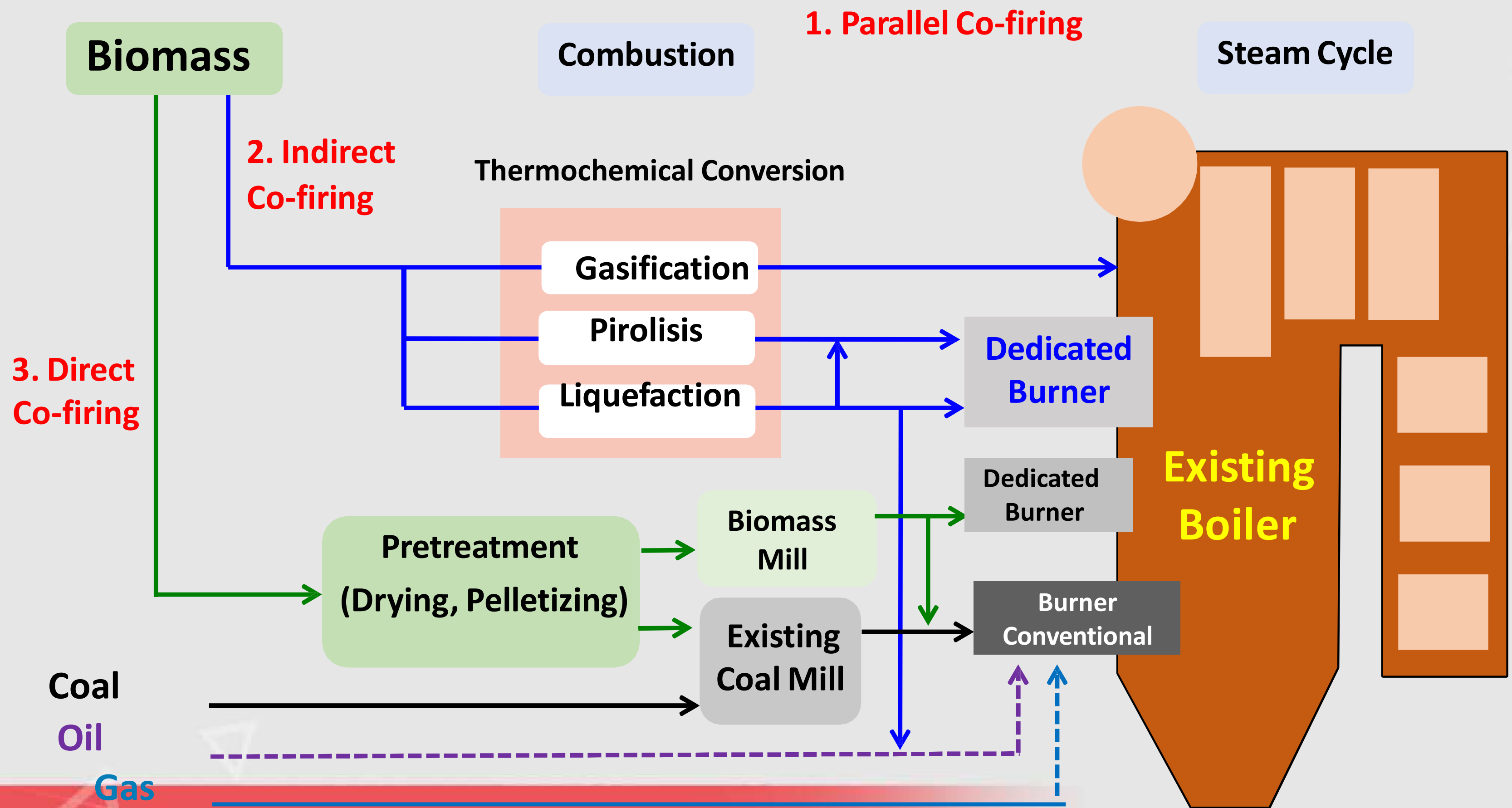


Ops. 2 – Tie in inside Coal pipe



Sugiyanto, PJB- 2020

SCENARIO : BIOMASS CO-FIRING (+COAL) TO CONVENTIONAL BOILER



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GREEN INDYSTRY : INDONESIA

PP 29/2018
Industry Empowerment:

Green Industry :

An industry which in its production process prioritizes efficiency and effectiveness in the use of resources in a sustainable manner so as to be able to harmonize industrial development with the preservation of environmental functions and can provide benefits to the community

- Raw Material and Energy
- Production Proces
- Product
- Enterprise Management
- Waste Treatment

- Used Efficiently and Effectively, Endeavor to Use:
  - Raw Material, Renewable Auxiliary
  - New Renewable Energy
- Production Process Performance Optimization
- Quality and Packaging Requirements
- Adoption of the Applicable Business Management System
- Using Effective Technology to Meet Environmental Quality Standards

Standarisasi dan Sertifikasi

Teknologi : Faktor Kunci

Dwianto, 2020

ASPECTS OF USE OF BIOMASS & MSW AS CO-FIRING FUEL

No.	Things to consider in the use of biomass fuel	Impact	Solution
1.	Dimension, Calorific Value, Density, Moisture Content, Ash Content, etc	Decreasing the Efficiency	Treatment/technology (chopping, pelletizing, carbonization etc.) to meet technical requirements
2.	Biomass-waste fuel contains alkali and chlorine. Alkalis can cause uncontrolled ash deposition on heat exchangers and ash handling surfaces. Chlorine at high temperatures can cause corrosion.	Occurrence of Slagging, Fouling and Corrosion	-Selection of wood type. -Technology is needed (Washing, Torefication) to remove/reduce the levels of alkali and chlorine and/or by limiting the percentage of the biomass mixture.
3.	Availability of feedstock, wood chip and wood pellet industry	Disruption of the supply of biomass fuel in the cofiring process	Adapted to the potential of biomass and production capacity of wood chips & wood pellets as needed
4.	Difference in energy density compared to coal	Biomass stock yard area needs, biomass transportation	Selection of the right technology and location for the preparation of biomass fuel

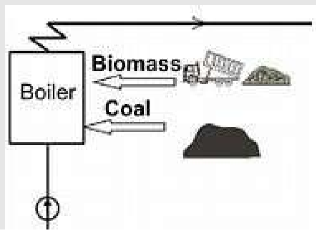
CO-FIRING TECHNOLOGY

Co-Firing

Is the combustion of 2 or more types of fuel from different materials in the same combustion system

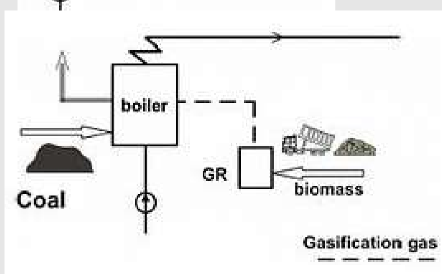
Direct Co-Firing

This is the cheapest and most commonly used option



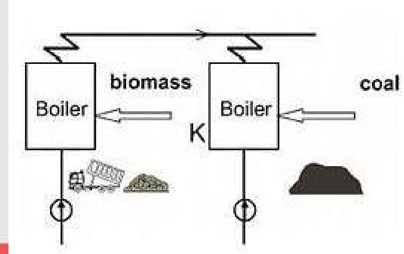
Indirect Co-Firing

Biomass is first gasified into fuel gas. More variety of biomass source options.



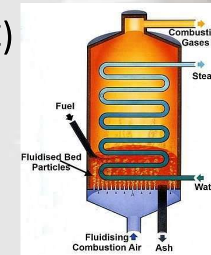
Pararel Co-Firing

Biomass is burned in a separate boiler. Popularly used in the Pulp and Paper industry.



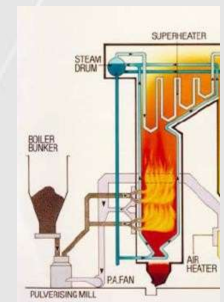
Combustor

1. Atmospheric Fluidised Bed Combustor (AFBC)



The combustion chamber has a bed which is usually made of sand which serves as a medium to maintain combustion at high temperatures at atmospheric pressure. This technology can anticipate diverse biomass sources.

2. Pressurised Fludized Bed Combustor (PFBC)

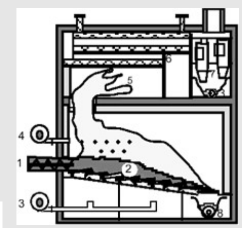


The technology is the same as AFBC in principle, the only difference lies in the combustion pressure which is higher than atmospheric pressure.

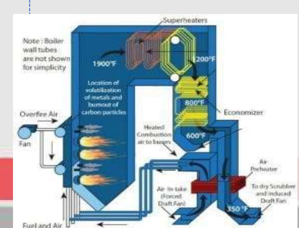
3. Pulverised Combustor

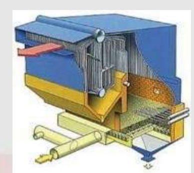
Before being injected into the combustion chamber, the biomass is first processed so that it reaches approximately < 1 mm.

4. Grate Combustor

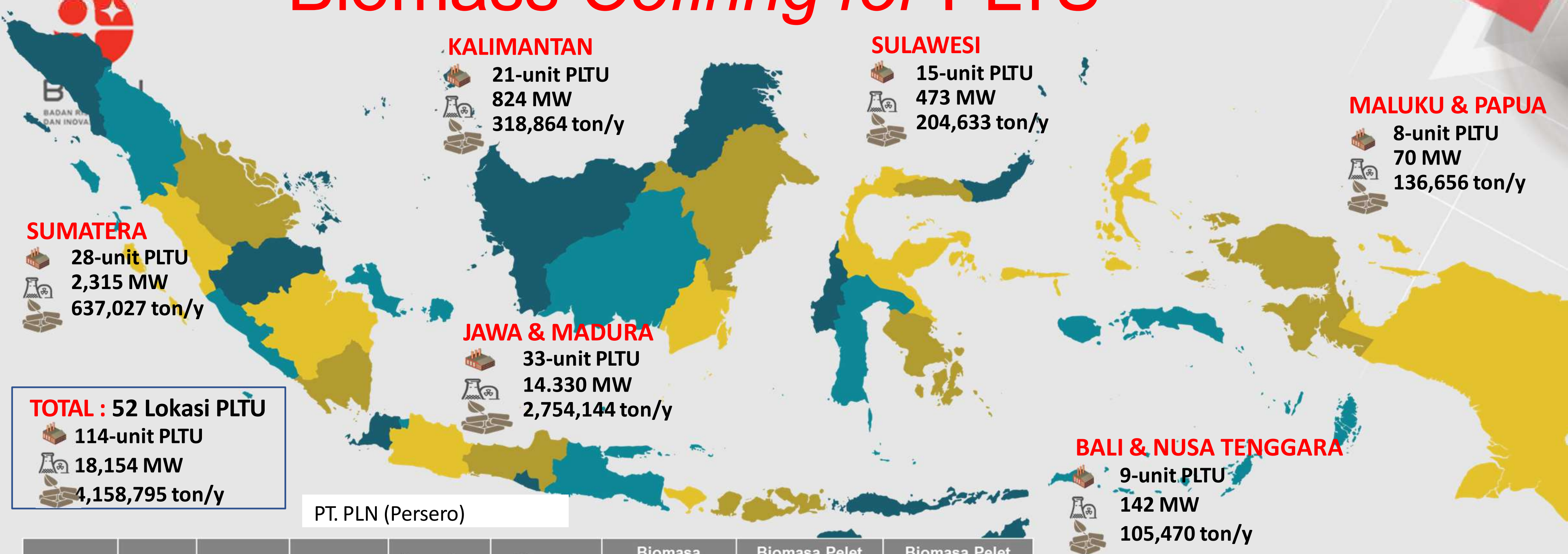


Biomass is directly burned, which is a technology that the simplest and the oldest.





Biomass *Cofiring for* PLTU



TOTAL : 52 Lokasi PLTU
114-unit PLTU
18,154 MW
4,158,795 ton/y

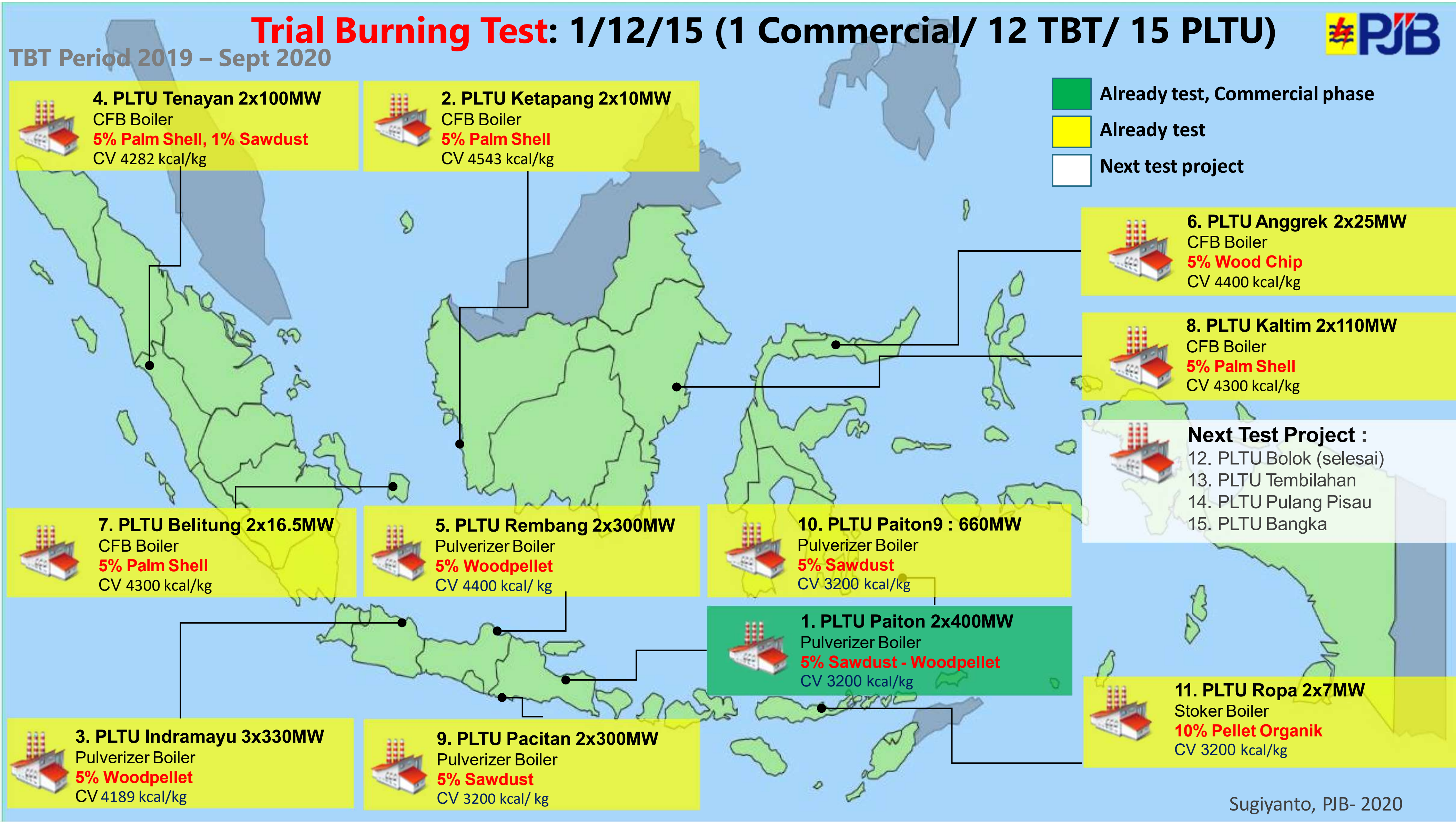
PT. PLN (Persero)

Tipe PLTU	Unit	MW	Ton/Jam	Persentase Biomasa	Biomasa (Ton/Hari)	Biomasa Wood Pellet (Ton/Tahun)	Biomasa Pelet Sampah (1%) (Ton/Hari)	Biomasa Pelet Sampah (1%) (Ton/Tahun)
PC	45	15.490,00	8.646,00	5%	10.375,20	3.029.558,40	2.075,04	605.911,68
CFB	39	2.435,00	1.813,00	5%	2.175,00	635.275,20	435,12	127.055,04
STOKER	30	229,00	234,00	30%	1.684,80	491.961,60	56,16	16,398.72
TOTAL	114	18.154,00	10.693,00		14.235,00	4.156.795,20	2.566,32	749.365,44

- Assuming 1 ton of waste pellets/RDF can be produced from 2-3 tons of waste (depending on its composition), the waste requirement for RDF in PLTU cofiring is ± 5.1 – 7.7 thousand tons/day (1% waste pellets).
- The potential for waste exceeds the need for RDF raw materials. However, further analysis is needed that takes into account distance and transportation costs

To meet the need for cofiring at PLN's PLTU, biomass pellets of 4.16-million tons/year are needed (biomass pellets 5%&30%); or

MSW pellets are 749-thousand tons/year (percentage of MSW pellets is 1%).


Trial Burning Test: 1/12/15 (1 Commercial/ 12 TBT/ 15 PLTU)
TBT Period 2019 – Sept 2020
PJB
Already test, Commercial phase
Already test
Next test project
4. PLTU Tenayan 2x100MW
CFB Boiler
5% Palm Shell, 1% Sawdust
CV 4282 kcal/kg
2. PLTU Ketapang 2x10MW
CFB Boiler
5% Palm Shell
CV 4543 kcal/kg
6. PLTU Anggrek 2x25MW
CFB Boiler
5% Wood Chip
CV 4400 kcal/kg
8. PLTU Kaltim 2x110MW
CFB Boiler
5% Palm Shell
CV 4300 kcal/kg
Next Test Project :
12. PLTU Bolok (selesai)
13. PLTU Tembilahan
14. PLTU Pulang Pisau
15. PLTU Bangka
7. PLTU Belitung 2x16.5MW
CFB Boiler
5% Palm Shell
CV 4300 kcal/kg
5. PLTU Rembang 2x300MW
Pulverizer Boiler
5% Woodpellet
CV 4400 kcal/ kg
10. PLTU Paiton9 : 660MW
Pulverizer Boiler
5% Sawdust
CV 3200 kcal/kg
1. PLTU Paiton 2x400MW
Pulverizer Boiler
5% Sawdust - Woodpellet
CV 3200 kcal/kg
11. PLTU Ropa 2x7MW
Stoker Boiler
10% Pellet Organik
CV 3200 kcal/kg
3. PLTU Indramayu 3x330MW
Pulverizer Boiler
5% Woodpellet
CV 4189 kcal/kg
9. PLTU Pacitan 2x300MW
Pulverizer Boiler
5% Sawdust
CV 3200 kcal/ kg
Sugiyanto, PJB- 2020

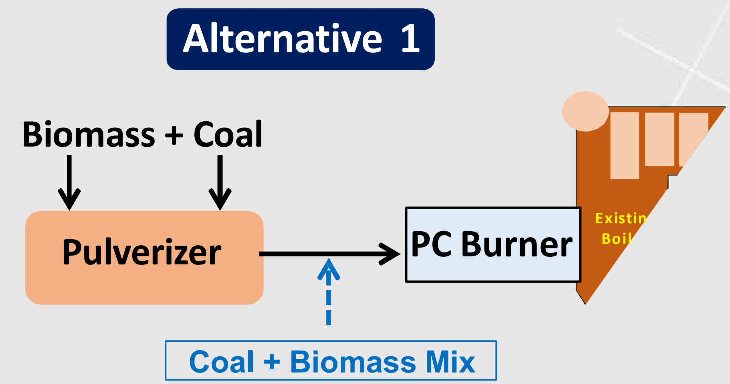
RESEARCH AND TECHNOLOGY SUPPORT IN IMPLEMENTATION OF BIOMASS CO-FIRING AT PLTU

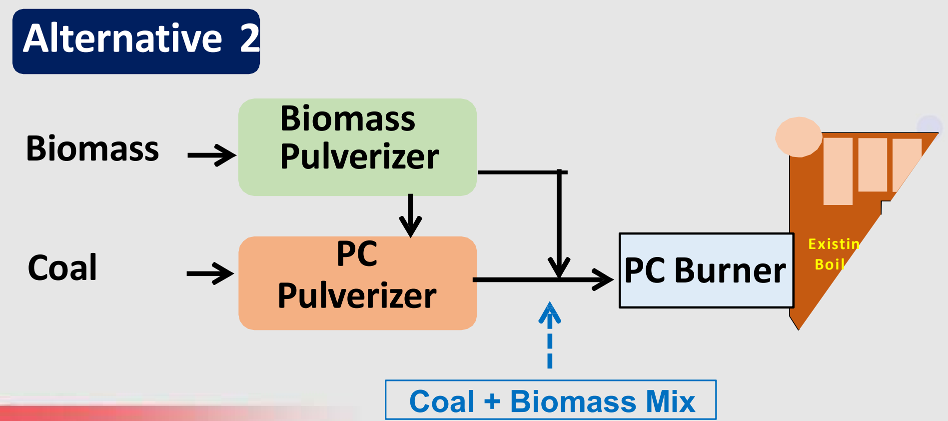
1 PROCESS SIMULATION FOR DIFFERENT TYPES OF BIOMASS

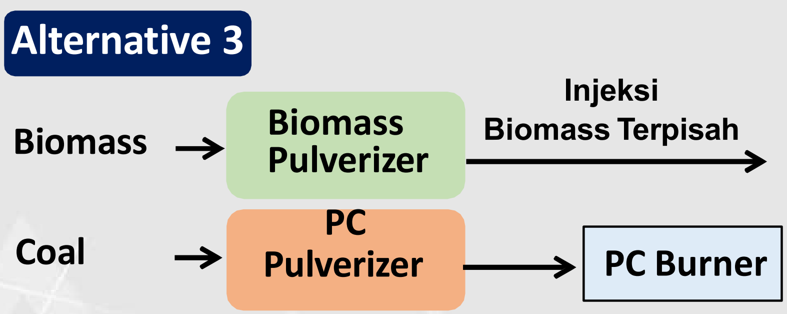
2 EXPERIMENT ON BENCH-SCALE:

- Co-firing: Fuel Blending
- SOx, NOx Emission Moniitoring

3 CFD SIMULATION (COMPUTATIONAL FLUID DYNAMIC)







Dwianto, 2020

RESEARCH AND TECHNOLOGY SUPPORT IN IMPLEMENTATION OF BIOMASS CO-FIRING AT PLTU

1-D FURNACE

COAL PREPARATION UNIT

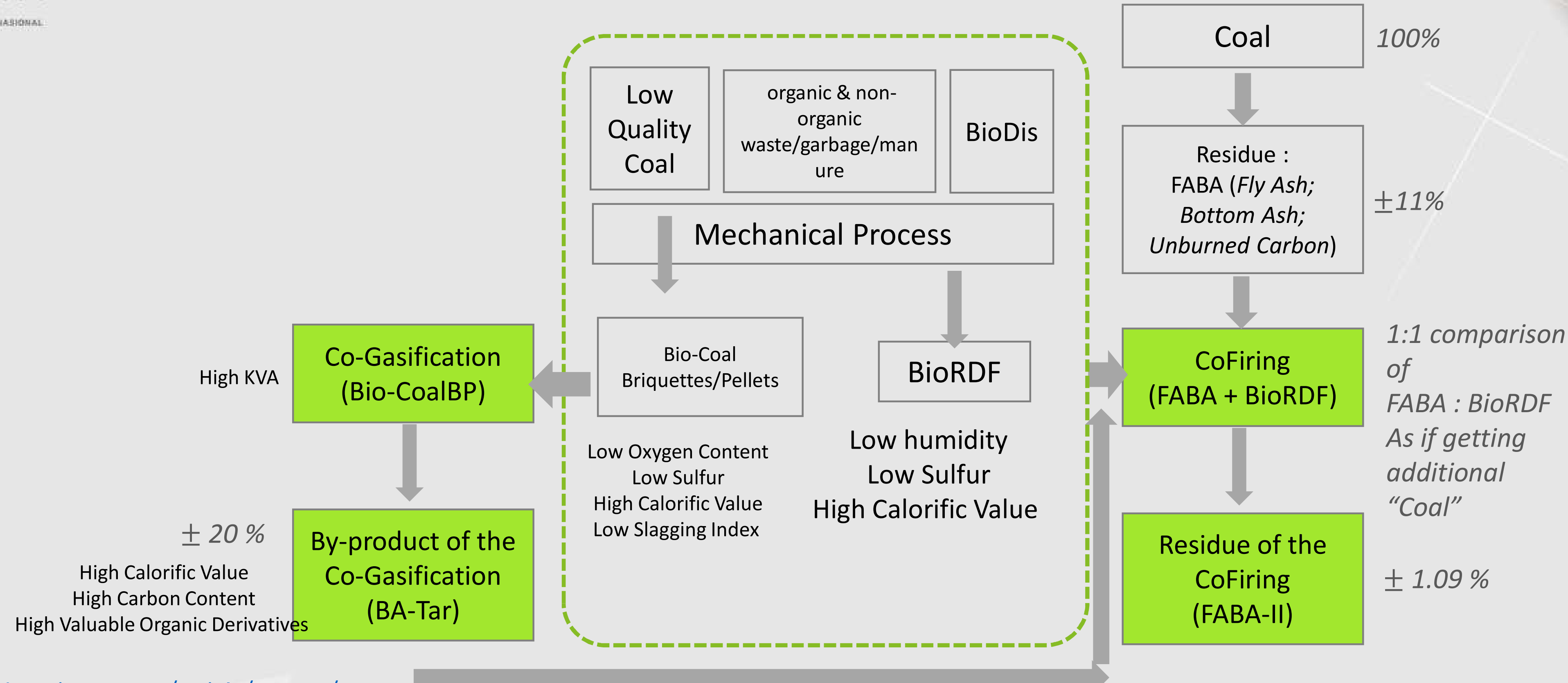
FASILITAS UJI : BOILER SIMULATOR

4 COMBUSTION CHARACTERIZATION

The occurrence of slagging, fouling, erosion and corrosion associated with the use of biomass co-firing.

Dwianto, 2020

BIOMASS-COAL FUEL (BCF)



https://link.springer.com/article/10.1007/s40789-020-00309-0
http://lipi.go.id/publikasi/paten-pellet-bio-batubara-terdesulfurisasi-dan-terdeoksigenasi-beserta-proses-pembuatannya/35237

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TYPICAL LARGE COAL POWER PLANT

Suralaya GBU Machine

Machine	Installed Capacity
Suralaya #1 SPP	400 MW
Suralaya #2 SPP	400 MW
Suralaya #3 SPP	400 MW
Suralaya #4 SPP	400 MW
Suralaya #5 SPP	600 MW
Suralaya #6 SPP	600 MW
Suralaya #7 SPP	600 MW

UNSUR OKSIDA	% BERAT
CaO	5,00
SiO_2	47,80
Al_2O_3	25,30
Fe_2O_3	16,00
MgO	2,70
P_2O_5	0,10
TiO_2	1,80
Na_2O	-
K_2O	0,80
SO_3	0,20

TYPICAL SMALL/MINE MOUTH COAL POWER PLANT






- Turbine 2x7 MW
- Maximum coal input capacity 70 T (8000 T/months)
- Average for 3 time/day in coal hopper (210 tons)
- About 1 kWh = 0.7 kg of coal (CV > 4500 kcal/kg) and 0.8 kg of coal (CV < 4500 kcal/kg)

> 4500 kcal/kg = 15% coal fly ash and 25% bottom ash

< 4500 kcal/kg = 50% coal fly ash and 10% bottom ash

IDENTIFIKASI BOILER

PT. Pulau Mas Texindo

PT. Gistex

IDENTIFIKASI BOILER

PT. Anggana Kurnia Putra

PT. Pan Asia Jaya Abadi

IDENTIFIKASI BOILER

PT. Dhanar Mas Concern

PT. Sipatex Putri Lestari

COAL BY-PRODUCT OBTAINED FROM TEXTILE INDUSTRY IN BANDUNG AND SURROUNDINGS

	Kab. Bandung	Cimahi	West Bandung
Coal	7200 Ton/day	3400 Ton/day	3600 Ton/day
Fly Ash	175.6 Ton/day	67.3 Ton/day	61.4 Ton/day
Bottom Ash	658.5 Ton/day	220.3 Ton/hari	299.5 Ton/day
Slag	43.9 Ton/day	18.4 Ton/day	19.5 Ton/day
Total	878 Ton/day	306 Ton/day	384 Ton/day
Number of coal-using factories	**141**	56	58

after Riadi, 2012

CHEMICAL COMPOSITION OF COAL FLY ASH

Chemical Composition of CFA	(% berat)		
	Kabupaten Bandung	Kota Cimahi	West Bandung
SiO_2	40.9	26 .1	28.1
Al_2O_3	9.4	14.3	11.1
Fe_2O_3	7.7	5.1	8.6
CaO	21.7	34.9	19.6
MgO	4.2	1.1	1.2
TiO_2	0.2	0.5	0.4
Na_2O	1.0	0.3	0.3
K_2O	1.3	1.0	1.1
P_2O_5	0.6	0.2	0.4
SO_3	1.2	3.2	5.6
Loss on ignition	**5.7**	**8.8**	**18.6**
%<75 microns	42	81	75

after Riadi, 2012

CHEMICAL COMPOSITION OF COAL BOTTOM ASH AND BOILER SLAG

Ash Type:	Bottom Ash					Boiler Slag		
Location	Kab. Bandung		Bandung Barat	Cimahi		Kab. Bandung	Bandung Barat	Cimahi
SiO2	35.6	21.1	24.9	35.4	47.6	38.9	43.6	30.5
Al2O3	17.3	14.7	18.9	14.3	12.9	21.9	22.7	13.8
FesO3	4.8	8.4	7.1	7.2	2.0	14.3	10.3	14.2
CaO	13.4	11.4	10.4	15.3	16.0	11.4	11.4	22.4
MgO	3.2	4.2	5.2	3.1	1.9	5.2	5.2	5.6
Na2O	1.0	0.5	0.8	1.0	0.6	0.7	1.2	1.7
K2O	0.3	0.2	0.2	-	0.1	0.1	0.1	1.1
LOI	**28.4**	**39.5**	**32.5**	**23.7**	**18.9**	**7.5**	**5.6**	**10.7**

after Riadi, 2012

PUSPA (MSW PROCESSING CENTER STUDY) KAB. BANDUNG

https://www.youtube.com/watch?v=mKstklzDb-U

PUSPA (MSW PROCESSING CENTER STUDY) KAB. BANDUNG

https://www.youtube.com/watch?v=mKstklzDb-U

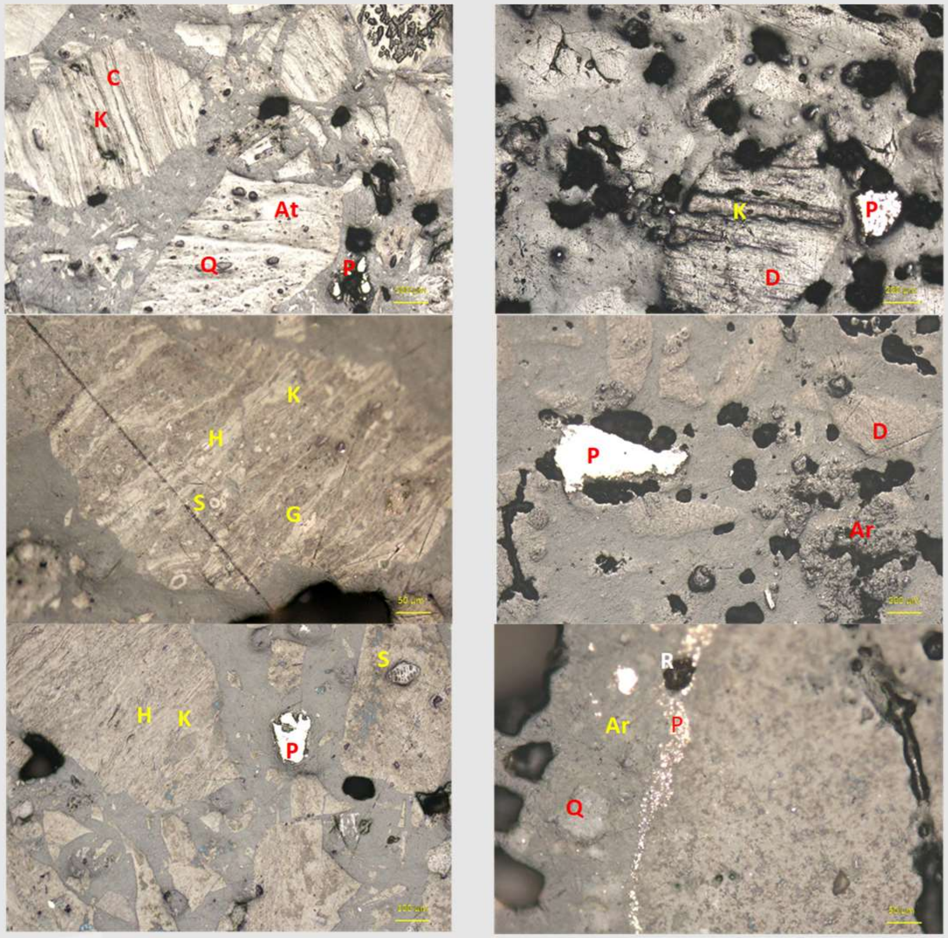
PUSPA (MSW PROCESSING CENTER STUDY) KOTA BANDUNG DAN DI WADUK SAGULING

https://www.youtube.com/watch?v=Dm0CIegUq5Q

PUSPA (MSW PROCESSING CENTER STUDY) KOTA BANDUNG DAN DI WADUK SAGULING

https://www.youtube.com/watch?v=Dm0CIegUq5Q

Under reflecting light microscope, the polished coal



Under reflecting light microscope, the polished coal samples showing P = pyrite; Ar = argilite; Q = quartz; S = sporinite; R = resinite; H = huminite; K = cutinite; G = gelinite; C = collotelinite; At = attrinite; D = densinite

https://link.springer.com/article/10.1007/s40789-020-00309-0

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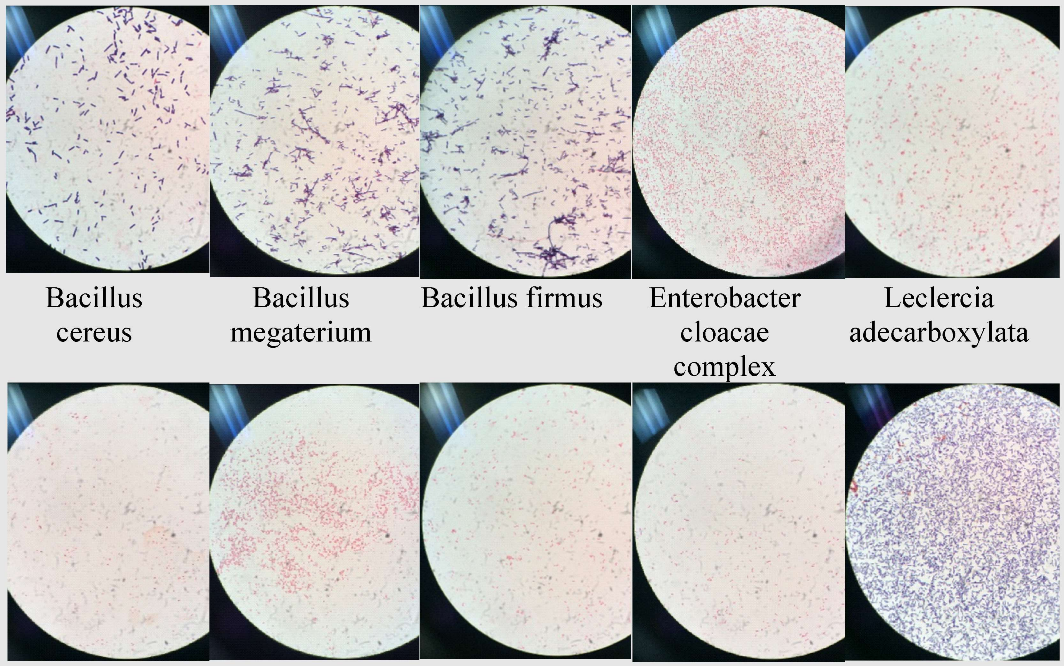
Selected gram-stained bacteria obtained from bio-coal briquettes product treated by Garant®

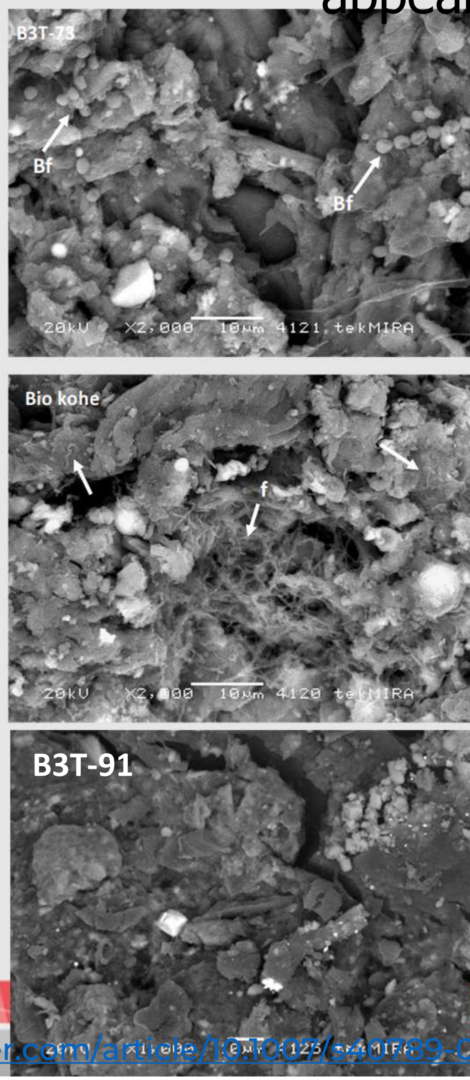


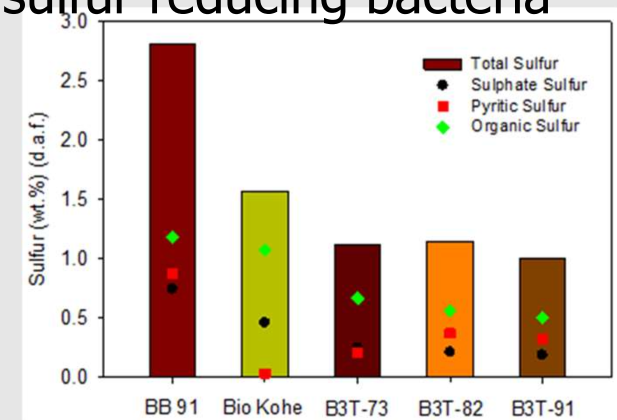
Bacillus cereus | Bacillus megaterium | Bacillus firmus | Enterobacter cloacae complex | Leclercia adecarboxylata

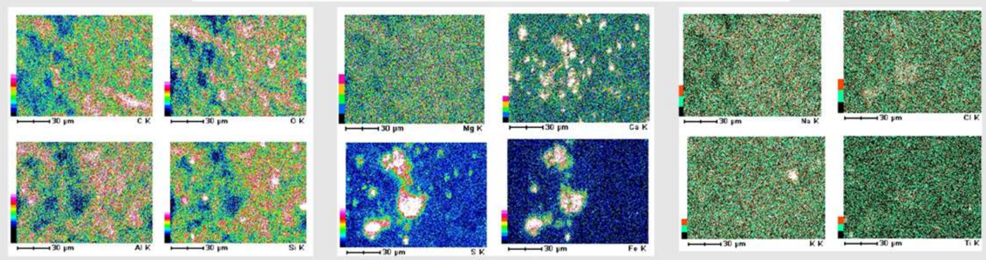
Klebsiella pneumoniae subsp. pneumoniae | Enterobacter ludwigii | Enterobacter cloacae complex | Escherichia coli | Bacillus licheniformis

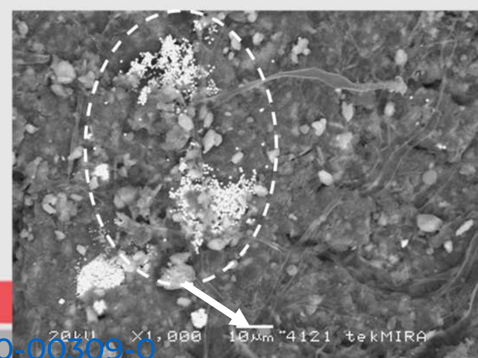
https://link.springer.com/article/10.1007/s40789-020-00309-0

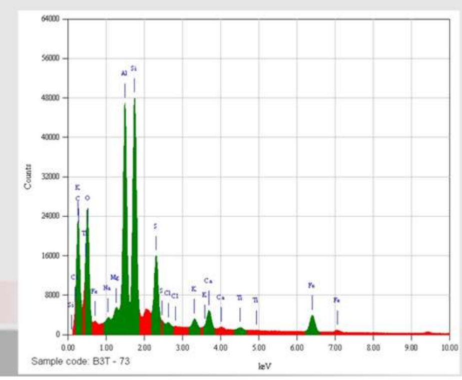
Selected figure of SEM-EDS obtained from B3T-73 sample as an indication of the appearance of sulfur reducing bacteria











https://link.springer.com/article/10.1007/s40789-020-00309-0

BIOLOGICAL WASTE WATER TREATMENT AT TEXTILE INDUSTRY IN KAB. BANDUNG

The BCFS production process at PT Gistex involves 6 workers who are divided into 2 shifts.

Each shift is 3 people so that production is carried out 24 hours in 1 day. from the results of monitoring the production of BCFS briquettes,

it can be concluded that the average production of BCFS briquettes produced on a pilot scale at PT. Gistex is 1 ton per day.

with a production of 1 ton per day, every day PT. Gistex consumes 300 Kg of biomass, 500 Kg of Bottom ash and 200 Kg of Sludge WWTP.

as for the addition of adhesive not more than 50 Kg per day.

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BCF PRODUCT

TM : 5.35
AC : 48.93
VM : 19.29
FC : 26.43
CV : 2953.18
TS : 0.70

TM : 6.79
AC : 35.72
VM : 22.54
FC : 34.95
CV : 3843
TS : 0.41

BCF Briquette

- Industrial Production
- TBT Test (Omnical and Oil Boiler)
- Increase in Combustion Efficiency (Om) (31 – 33%)
- Efficiency of wearing temperature 11%, 3%, and 2% (low water volume (5 m3 – 50 m3), medium (50 m3 – 80 m3), high (> 80 m3)(steam pressure 6-7 bar)(time increments of 6 to 26 seconds)
- Substitution ~12% (15% reduction)

TM : 5.79
AC : 47.82
VM : 28.23
FC : 18.17
CV : 2938.45
TS : 0.71

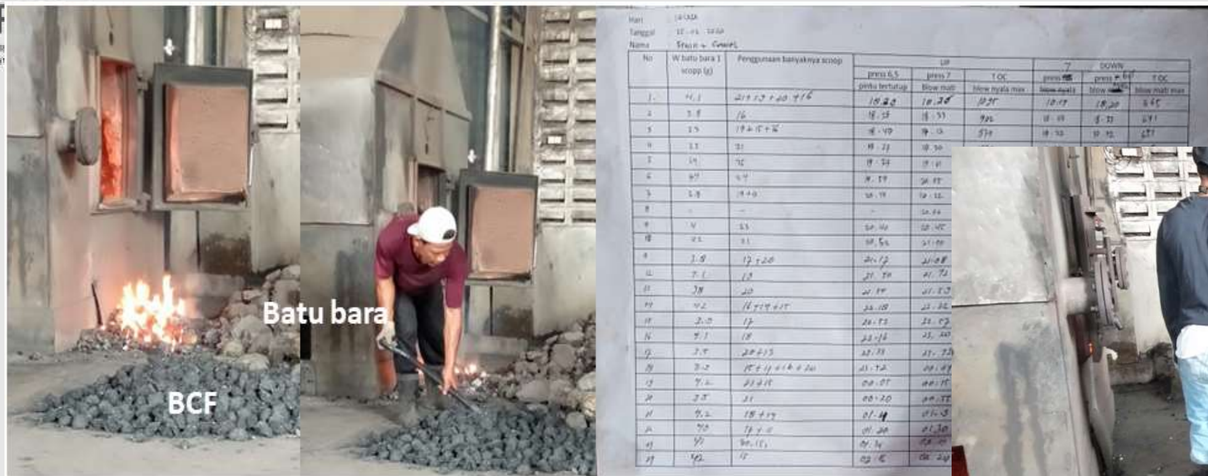
BCFS Briquette

- Industrial Production
- TBT Test (Omnical and Oil Boiler)
- Increase in Combustion Efficiency (Oil) (5.6 – 39.3%)
- Substitution ~12% (13% reduction)

BCF Pellet

- Produksi Industri
- Uji Pilot (Down Draft Gasifier), Syngas Fuel Internal Combustion Engines
- LHV Syngas (maks 6.08 MJ/m^3)

TRIAL BURNING TEST OF BCF FOR FIX BED BOILER (STEAM BOILER)



In data processing, it is divided into 3 conditions in the use of steam (amount of water entering the boiler), namely for production:

- **low (5 m3 – 50 m3),**
- **medium (50 m3 – 80 m3),**
- **height (> 80 m3).**

https://www.youtube.com/watch?v=ptB7Y-8I4sY

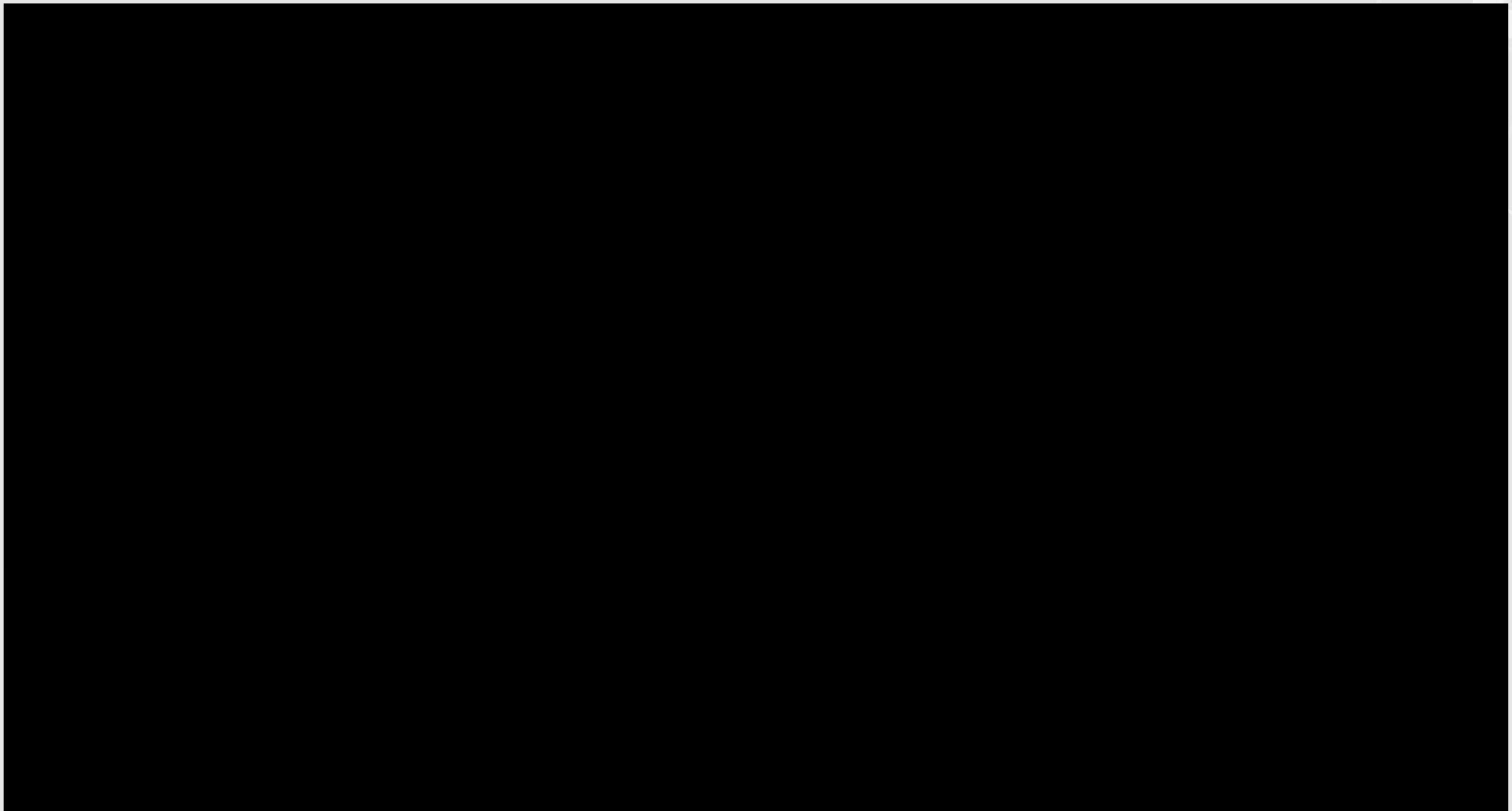
TRIAL BURNING TEST OF BCF FOR FIX BED BOILER (STEAM BOILER)

https://www.youtube.com/watch?v=ptB7Y-8I4sY

TRIAL BURNING TEST BCF ON FIX BED BOILER (STEAM BOILER)

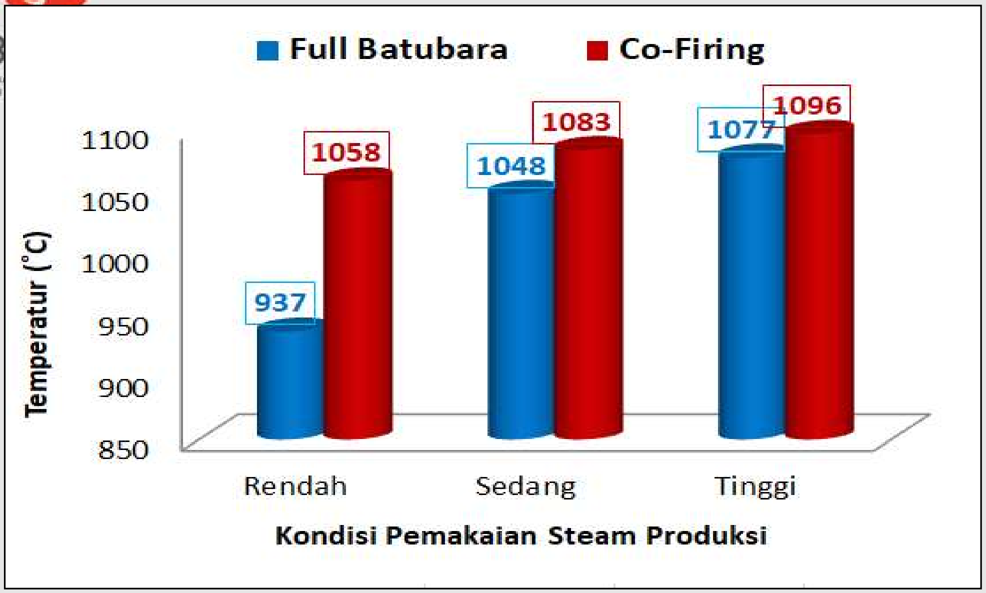
https://www.youtube.com/watch?v=7azFIkgDIh0

TRIAL BURNING TEST BCF ON FIX BED BOILER (STEAM BOILER)



https://www.youtube.com/watch?v=7azFIkgDIh0

TRIAL BURNING TEST BCF ON FIX BED BOILER (STEAM BOILER)



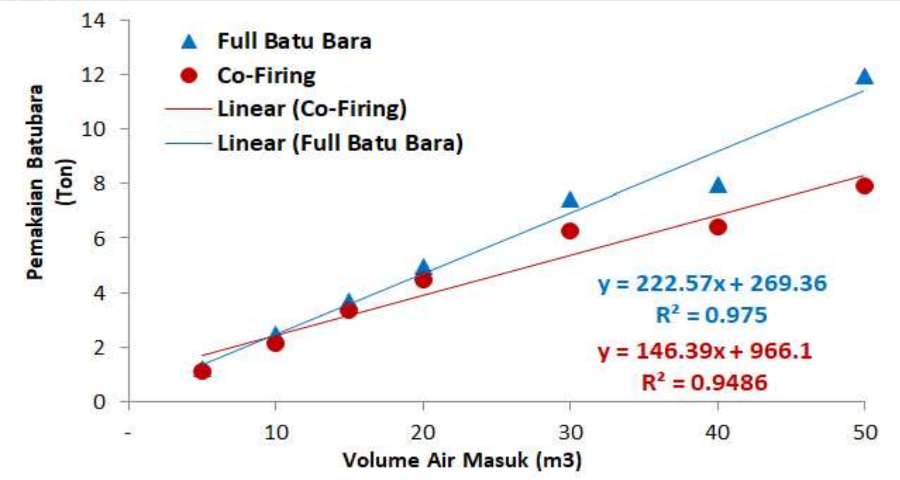
Efisensi TBT

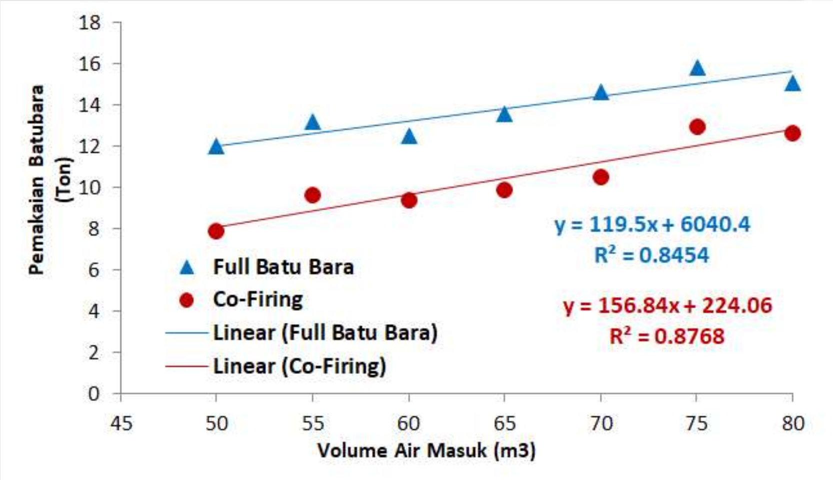
Efficiency of temperature increased : 11%, 3%, and 2% for low, medium, and high steam usage, respectively.

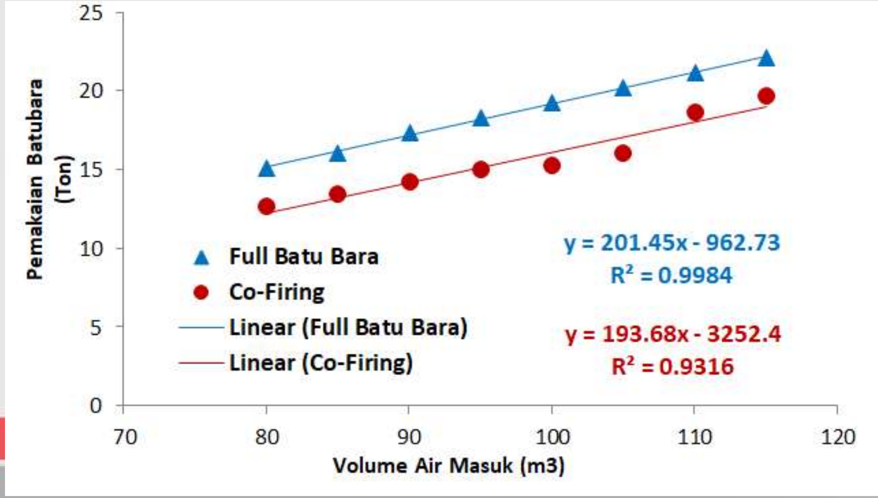
Efficiency of the time required for the boiler steam pressure to rise

Kondisi	Waktu Kenaikan 6 ke 7 bar (HH:MM)		
	Rendah	Sedang	Tinggi
Full Batubara	0:12	0:09	0:26
Batubara + 10-15% BCF	0:08	0:06	0:18
Kenaikan Efisiensi Pembakaran	**33%**	**33%**	**31%**

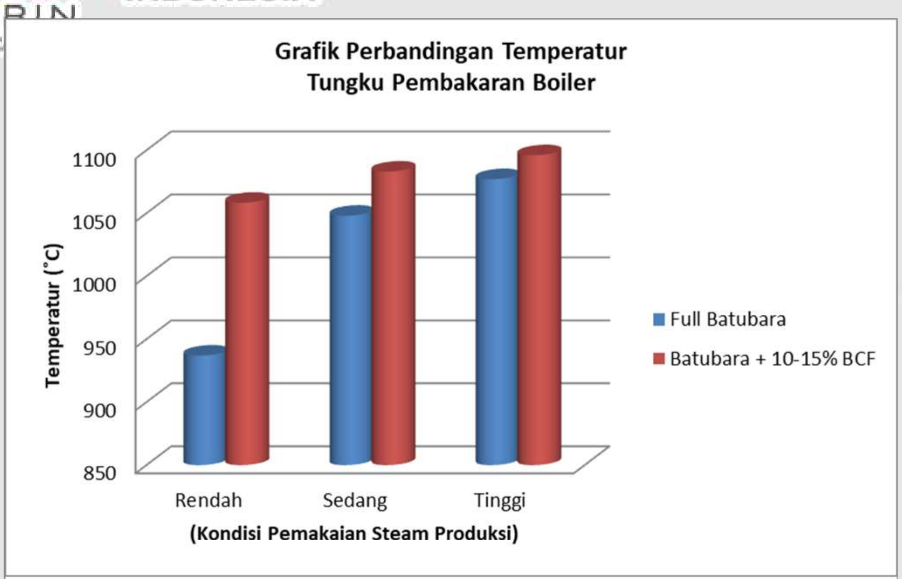
TOTAL COAL USE DURING TBT IN THREE CONDITIONS

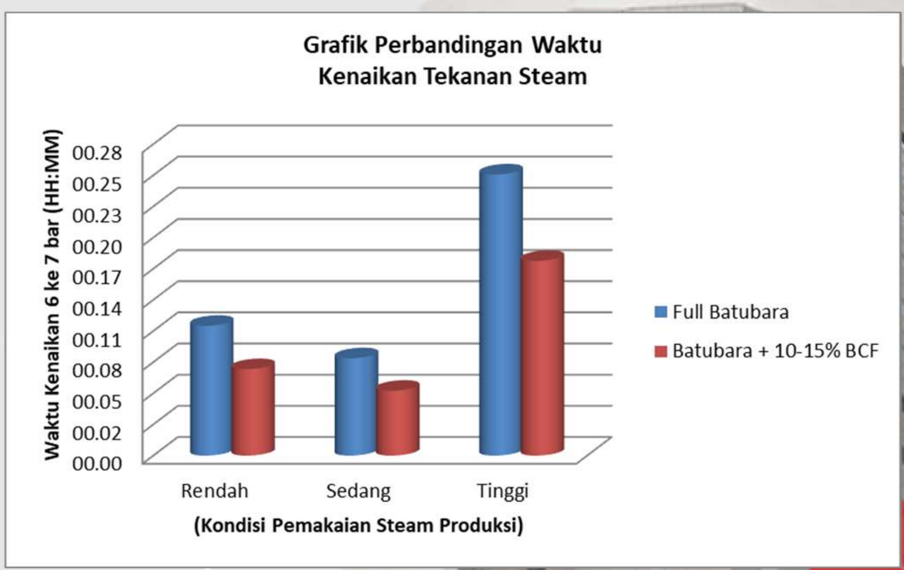


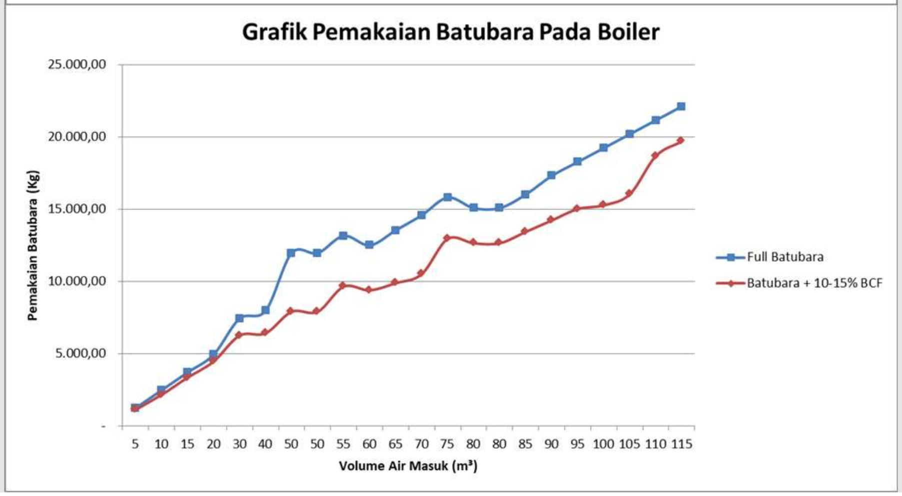




#INOVASI INDONESIA TRIAL BURNING TEST BCF ON FIX BED BOILER (STEAM BOILER)







- The boiler furnace temperature increased by 6% after 10 – 15% BCF was substituted.
- The time to increase the steam pressure from 6 to 7 bar is about 30% faster after substituting BCF by 10-15%
- Coal consumption decreased by 20% after BCF was substituted by 10-15%

HASIL UJI UDARA EMISI DAN AMBIENT

No	Parameter	Satuan	Baku Mutu	Hasil Pengujian [1]	Hasil Pengujian [2]	Metoda Acuan
	BUKAN LOGAM					
1	Ammonia (NH3)*	mg/Nm3	0.5	< 0.005	0.023	SBI 19-7117.6-2005
2	Gas Klorin (Cl2)*	mg/Nm3	10	< 0.0001	0.292	Kep.Ka.Bapedal No. Kep.205/BAPEDAL/07/1996
3	Hidrogen Klorida (HCl)*	mg/Nm3	5	2.18	3.82	SNI 19-7117.8-2005
4	Hidrogen Fluorida (HF)*	mg/Nm3	10	0.012	0.1812	SNI 19-7117.9-2006
5	Nitrogen Oksida (NO2)	mg/Nm3	1000	9.41	23	MP 03.25.06.3-2015 (Gas Analyzer)
6	Opasitas	%	35	< 20	< 20	MP 02.25.15.01-2015 (Opasitas Meter)
7	Partikel*	mg/Nm3	350	7.5	20.98	SBNI 19-1717.12-2005
8	Sulfur Dioksida (SO2)	mg/Nm3	800	7.85	18	MO 03.25.07.3-2015 (Gas Analyzer)
9	Total Sulfur Tereduksi (H2S)*	mg/Nm3	35	< 0.002	< 0.002	SNI 19-7117.7-2005
10	Laju Alir*	m3/s	-	4.8	4.9	
	LOGAM					
1	Air Raksa (Hg)	mg/Nm3	5	< 0.0002	0.0042	SNI 7117.20;2009
2	Arsen (As)	mg/Nm3	8	< 0.001	< 0.001	SNI 7117.20;2009
3	Antimon (Sb)	mg/Nm3	8	< 0.006	< 0.006	SNI 7117.20;2009
4	Kadmium (Cd)	mg/Nm3	8	< 0.012	< 0.012	SNI 7117.20;2009
5	Seng (Zn)	mg/Nm3	50	< 0.010	< 0.010	SNI 7117.20;2009
6	Timah Hitam (Pb)	mg/Nm3	12	< 0.034	< 0.034	SNI 7117.20;2009

BCF PELLET

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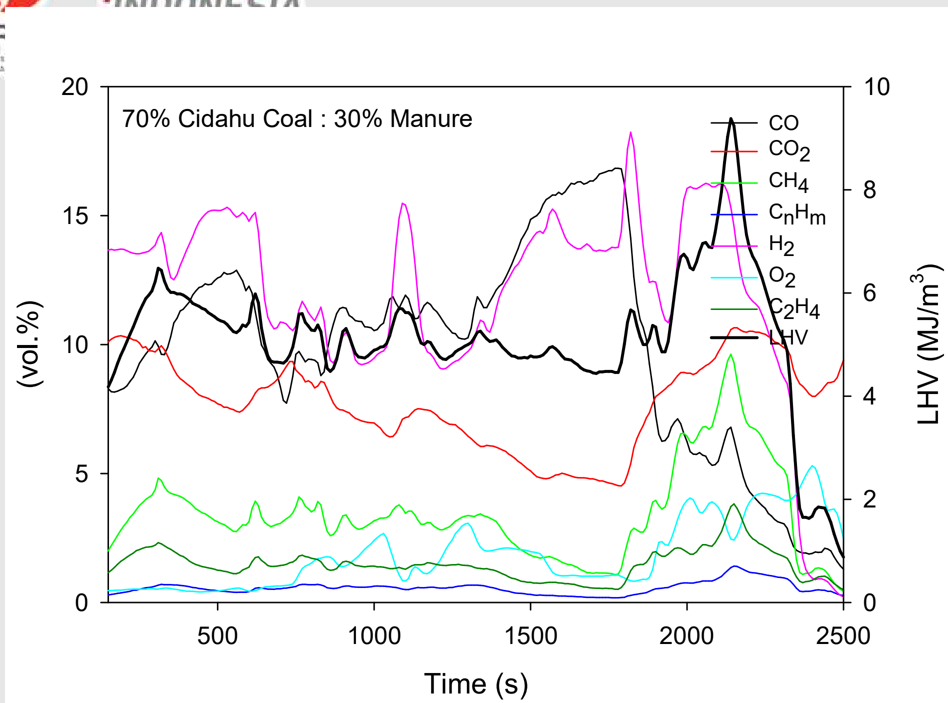
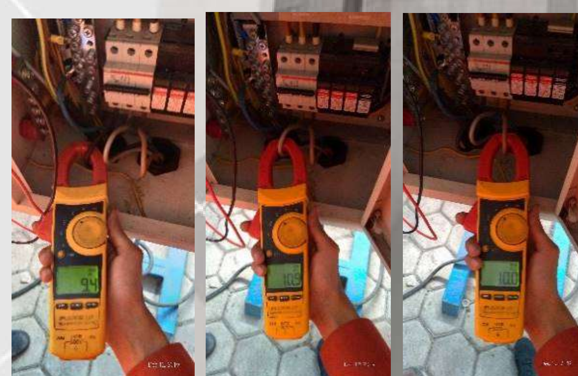
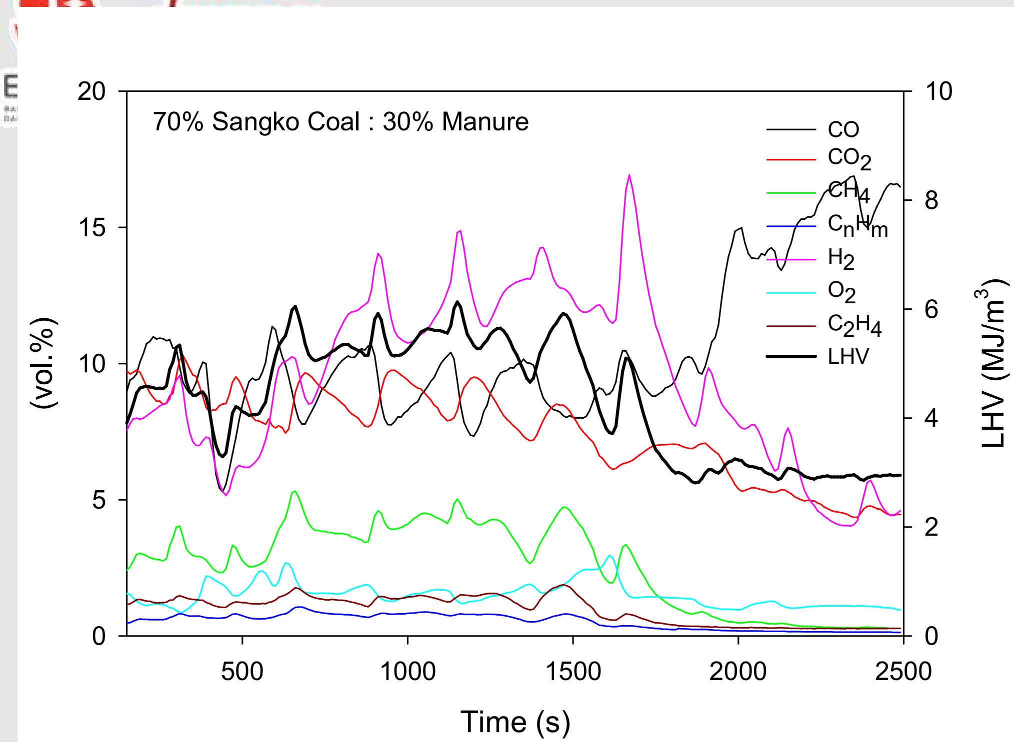
BIO-COAL PELLET GASIFICATION CYCLES

Properties	BBCM 73	BBSKM 73	BBSKB 73	BBSGM 73
Cycle analysis (min.)				
Fuel intake	0	0	0	0
Pre-heating	0	0	0	0
Flare starting	1	15	0	20
Engine starting	3	16	4	26
Engine on	3	16	4	26
Engine cut-off	27	22	16	28
Gasifier temperature (°C)				
Cyclone	386	414	282	294
Reduction	605	517	438	320
Filter	53	75	59	68
Combustion	336	573	436	443
Flow (SPLM)	1.76	229.21	1.33	14.31
Internal engine and output power				
Current phase (A)	9.4	8.9	8.5	6.4
R	10.9	9.1	10.4	8.5
S	10.0	9.0	9.4	7.5
T				
Voltage phase (Volt.)	282.2	357.0	338.9	336.9
RS	332.5	364.9	237.5	221.8
RT	364.3	365.5	287.4	297.6
ST				
Voltage phase (Volt.)	188.3	204.4	175.5	171.8
RN	196.9	202.1	135.5	135.5
RN	204.1	219.5	164.4	174.1
TN				





CO	9.89	%	CO2	9.55	%
CH4	4.3`	%	CnHm	0.69	%
H2	13.08	%	O2	0.56	%
C2H4	2.12	%	LHV	6.08	MJ/m 3
N2	59.80	%			





CO	9.09	%	CO2	10.08	%
CH4	3.21	%	CnHm	0.76	%
H2	8.13	%	O2	0.96	%
C2H4	1.39	%	LHV	4.68	MJ/m 3
N2	66.38	%			



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PATEN : S202105269; P00202005159 ; P00201804876
LISENSI : B-5546/II.8/KS/6/2022, 015-PKS/NJ/VI/2022
TRL : 7-9, B-427/V/KS.00.02/10/2021

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THANK YOU