Indonesia's mitigation potential project: energy sector

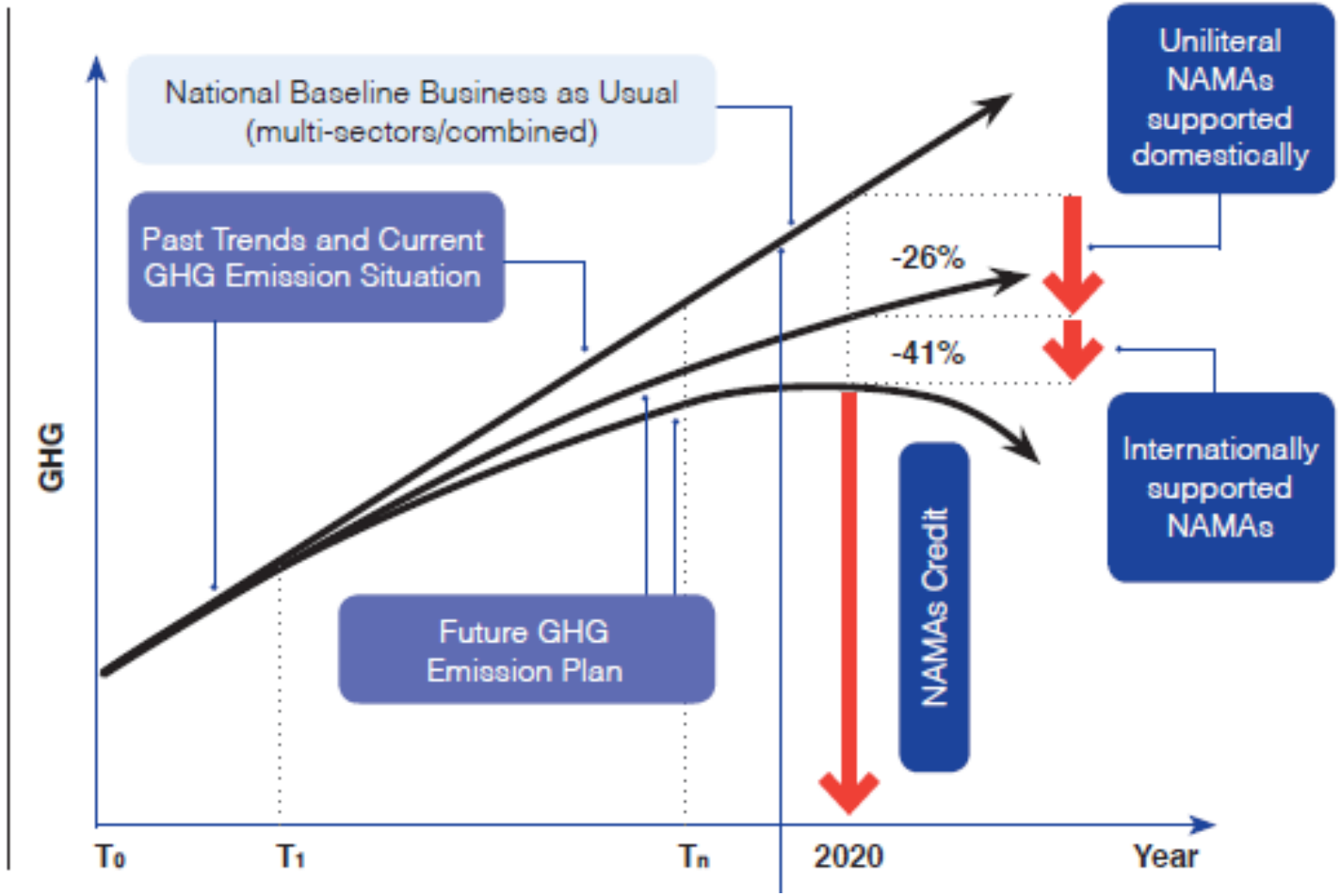
Rohmadi Ridlo
The Agency for the Assessment and Application of Technology (BPPT)
Indonesia

IPCC Expert Meeting on
Application of 2006 IPCC Guidelines to Other Areas
July 1-3, 2014, Sofia, Bulgaria

Outline

- Indonesia's GHG emissions reduction target by 2020
- Indonesia’s GHG Emission from Energy Sector
- Mitigation potential project: energy sector
- Calculation of GHG emission reduction
- Potential Emission Reduction

Indonesian GHG Emission Reduction Target in 2020



Source: Guideline for Implementing Green House Gas Emission Reduction Action Plan

GHG Emission Reduction Targets by Sector in 2020

Sector	GHG emission reduction target (Gton CO2e)		Action plan
	26%	41%	
Forestry and Peatlands	0.672	1.039	Forest and land fire control, network system management & water management, Forestry & land rehabilitation, (HTI (Industrial Plantation Forest), HR (Community Forest), Illegal logging eradication, Deforestation prevention, Community empowerment
Agriculture	0.008	0.011	Introduction of low-emission paddy varities, irriagation water efficiency, organic fertilizer use
Energy and Transportation	0.036	0.056	More efficient technologies for energy conversion and utilization, new or improved technologies for utilizing alternative energy sources with lower or no GHG emissions (such as natural gas and renewables), etc.
Industry	0.001	0.005	Energy efficiency, use of renewable energy, etc
Wastes	0.048	0.078	Use of final landfill, waste management by 3R and urban integrated waste water management
Total	0.767	1.189	

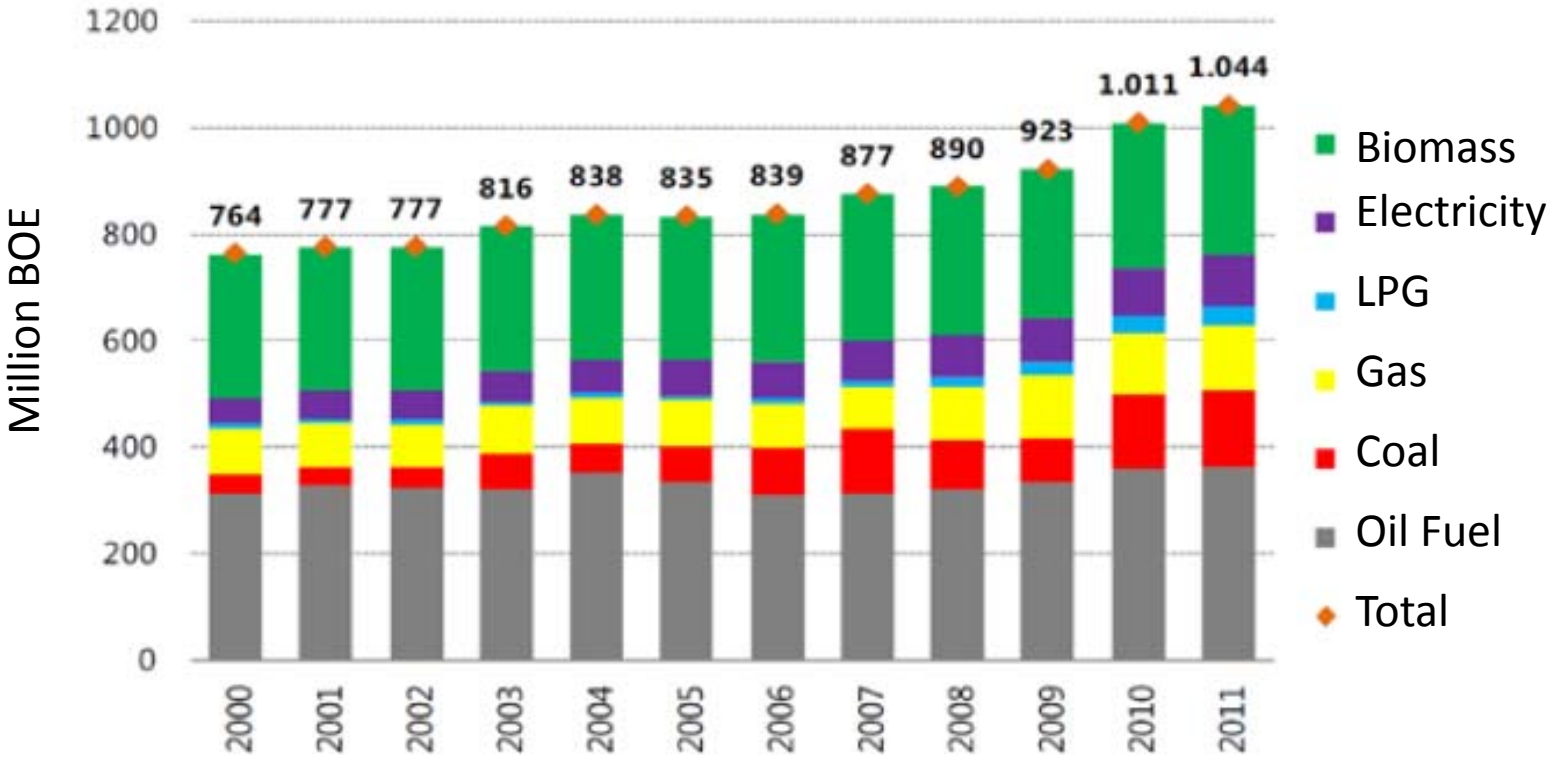
Policies, Actions and Instruments for the Energy Sector

- To orient the energy system towards low-carbon energy sources,
- To develop and spread low-carbon and carbon-free energy technologies,
- To promote increased efficiency in energy production (supply side) and energy use (demand side),
- Efficient transmission and distribution systems, and
- To revise related policies and regulatory frameworks to draw more investment into the energy sector, including innovative financing that creates synergy between financial sources to stimulate the flow of investment in energy

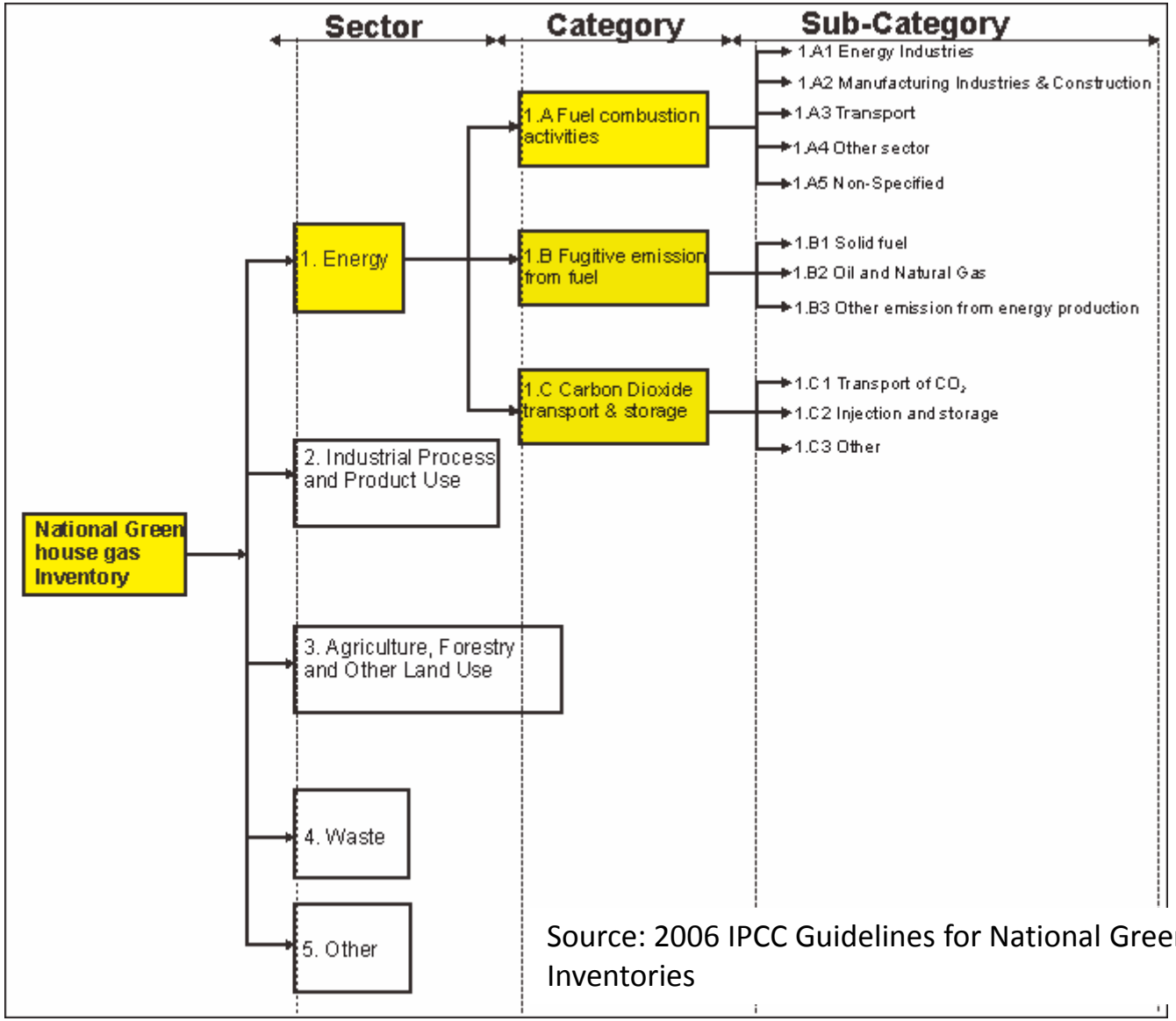
Potential Mitigation Action Scenarios

Scenario	
Zero-Carbon Technologies and Greater Renewable Energy Role	• To improve the roles of geothermal and renewable resources, based on national potential availability mapping • Individual biomass burning, or combined burning based on national potential availability mapping.
Low-carbon technologies, Fuel Conversion and Increased Efficiency	• Power plant with supercritical and ultra-critical coal as fuel; more advanced use of clean coal technologies, integrated gasification combination circle (IGCC) • Revitalization and modernization of existing electric plants to improve efficiency level, operational performance and capacity • Support clean fuel in an effort to convert from fossil fuel with high emission factor to fuel whose carbon emission factor is low. • Improved integrated distribution of plant system including distribution and transmission of asset management system. • Put high temperature superconductors into strong power tools that improve efficiency, system capacity, reliability and safety. • Use of end-side intervention: energy efficiency for housing, commercial consumers and the public
New technologies	Introduction to new power plant technologies including CCS technology

Final Energy Consumption by Type



Main categories of emissions by sources



Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

GHG Estimation Calculation

General Equation

$$Emission = \sum_{abcd} (EF_{abcd} * Activities_{abcd})$$

Emission	:	Total emission
EF	:	Emission Factor (Mass per unit aactivities in g/km, g/L atau g/joule
Activities	:	Average Activities (fuel consumption or VKT) Liter/year or km/year
a	:	Type of fuel (gasoline, diesel)
b	:	Type of vehicle (passenger car, bus, taxsi dll)
c	:	Emission control
d	:	Road type or speeds and other

Fugitive Emission calculation
Coal Mine

The fundamental equation to be used in estimating emissions from surface mining is follow:

CH_4 emissions = Surface mining emissions of CH_4 + Post-mining emission of CH_4

Surface mining emissions of CH_4	**Post-mining emission of CH_4**
CH4 Emission = CH4 Emission Factor * Surface Coal Production * Conversion Factor	CH4 Emission = CH4 Emission Factor * Surface Coal Production * Conversion Factor
Methane Emissions (Gg year^{-1}) CH4 Emission Factor = 1.2 m^3 tonne^{-1} Conversion Factor: 0.67 * 10^{-6} Gg m^{-3}	Methane Emissions (Gg year^{-1}) CH4 Emission Factor = 0.1 m^3 tonne^{-1} Conversion Factor: 0.67 * 10^{-6} Gg m^{-3}

Fugitive Emissions From Oil And Natural Gas Systems

$$E_{\text{gas, industy segment}} = A_{\text{industry segment}} \times EF_{\text{gas, industry segment}}$$

Where:

$E_{gas,industry\ segement}$ = Annual emissions (Gg)

$EF_{gas,industry\ segement}$ = emission factor (Gg/unit of activity),

$A_{industry\ segement}$ = activity value (units of activity)

Emission Factors For Fugitive Emissions From Oil And Gas Operations In Developing Countries And Countries With Economies In Transition

Source of Emission	Oil Production (Gg 10^3 m^3)				Natural Gas Production (Gg 10^6 m^3)		
	Location	CH_4	CO_2	N_2O	CH_4	CO_2	N_2O
Fugitive	Land	0,03	0,0022	-	0,0122	$9,7 \times 10^{-5}$	-
	Offshore	$5,9 \times 10^{-7}$	$4,3 \times 10^{-8}$	-			
Flaring		$3,0 \times 10^{-5}$	0,0485	$7,6 \times 10^{-7}$	$8,8 \times 10^{-7}$	0,0014	$2,5 \times 10^{-8}$
Venting		$8,55 \times 10^{-4}$	$1,13 \times 10^{-4}$	-	-	-	-

GHG Emission from Household (example calculation)

Sector	**Energy**								
Category	**Fuel combustion activities**								
Category Code	**1A (4 a&b) other sector: combustion in the residential, commercial/institutional**								
Sheet	**1 of 1 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)**								
	Energy consumption			**CO_2**		**CH_4**		**N_2O**	
Province	A	B	C	D	E	F	G	H	I
North Sumatera	Consumption	Conversion Factor[(b)]	Consumption	CO_2 Emission Factor	CO_2 Emissions	CH_4 Emission Factor	CH_4 Emissions	N_2O Emission Factor	N_2OEmissions
2007	((Gg)	(TJ/Gg)	(TJ)	(kg CO_2/TJ)	(Gg CO_2)	(kg CH_4/TJ)	(Gg CH_4)	(kg N_2O /TJ)	(Gg N_2O)
			C=A*B		**E=C*D/10^6**		**G=C*F/10^6**		**I=C*H/10^6**
Liquid fuels									
Motor Gasoline	0	44.3	0	69,300	0	**10**	0	**0.6**	0
Jet Kerosene	0	44.1	0	71,500	0	**10**	0	**0.6**	0
Other Kerosene	546	43.8	23,899	71,900	1,718	**10**	0.24	**0.6**	0.01
Gas / Diesel Oil	0	43	0	74,100	0	**10**	0	**0.6**	0
Residual Fuel Oil	0	40.4	0	77,400	0	**10**	0	**0.6**	0
LPG	48	47.3	2,248	63,100	142	**5**	0.01	**0.1**	0.00
Solid fuels									
Sub-bituminous coal	0	18.9	0	96,100	0	**300**	0	**1.5**	0
Natural gas									
Natural Gas (Dry)	24.06	48	1,154.96	56,100	64.79	**5**	0.01	**0.1**	0.00
Biomass				**Information Items[b]**					
Wood / Wood Waste	0	15.6	0			**300**	0	**4**	0
Other Primary Solid Biomass	10,707	11.6	124,202			**300**	37.26	**4**	0.50
				Total	**1,924.94**	**Total**	**37.52**	**Total**	**0.51**

Emission from Industrial

Sector	**Energy**								
Category	**Fuel combustion activities**								
Category Code	**1A2 (industries) Manufacturing industries and construction**								
Sheet	**1 of 1 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)**								
	Energy consumption			**CO_2**		**CH_4**		**N_2O**	
Province **Papua 2007**	A Consumption (Gg)	B Conversion Factor[(b)] (TJ/Gg)	C Consumption (TJ)	D CO_2 Emission Factor (kg CO_2/TJ)	E CO_2 Emissions (Gg CO_2)	F CH_4 Emission Factor (kg CH_4/TJ)	G CH_4 Emissions (Gg CH_4)	H N_2O Emission Factor (kg N_2O /TJ)	I N_2OEmissions (Gg N_2O)
			C=A*B		**E=C*D/10^6**		**G=C*F/10^6**		**I=C*H/10^6**
Liquid fuels									
Motor Gasoline	0	44.3	-	69,300	-	3	-	0.6	-
Jet Kerosene	0	44.1	-	71,500	-	3	-	0.6	-
Other Kerosene	2	43.8	102	71,900	7	3	0.00	0.6	0.00
Gas / Diesel Oil	179	43	7,716	74,100	572	3	0.02	0.6	0.00
Residual Fuel Oil	0	40.4	-	77,400	-	3	-	0.6	-
LPG	0	47.3	-	63,100	-	1	-	0.1	-
Solid fuels									
Sub-bituminous coal	0	18.9	-	96,100	-	10	-	1.5	-
Natural gas									
Natural Gas (Dry)	-	48	-	56,100	-	1	-	0.1	-
Biomass				**Information Items[b]**					
Wood / Wood Waste	0	15.6	-			30	-	4	-
Other Primary Solid Biomass	78	11.6	909			30	0.03	4	0.00
				Total	**579**	**Total**	**0.05**	**Total**	**0.01**

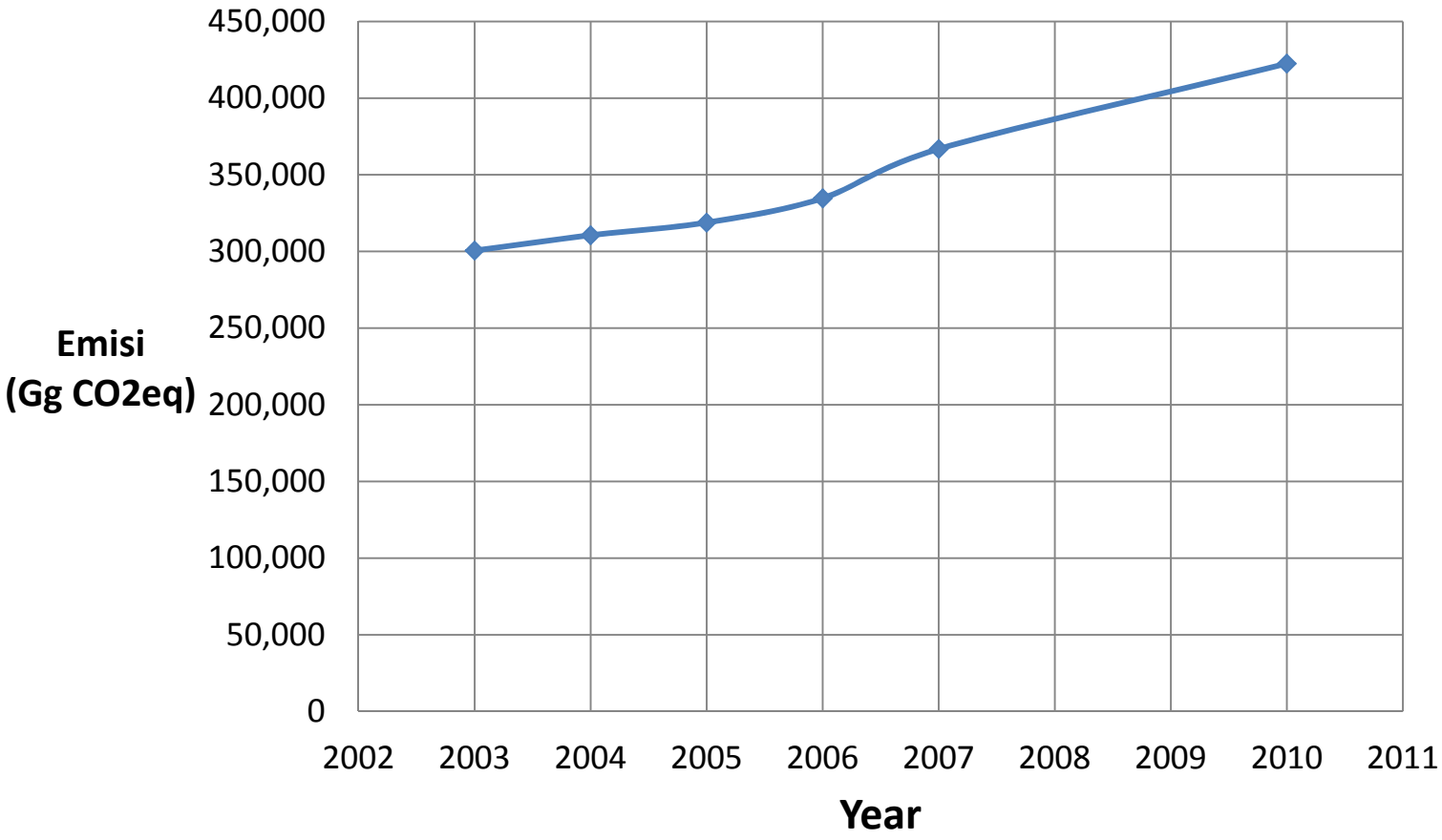
GHG Emission from Electricity (example calculation)

Sector	**Energy**								
Category	**Fuel combustion activities**								
Category Code	**1A 1 (Energy combustion in energy industries)**								
Sheet	**1 of 1 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)**								
	Energy consumption			**CO_2**		**CH_4**		**N_2O**	
Province	A	B	C	D	E	F	G	H	I
Papua	Consumption	Conversion Factor[(b)]	Consumption	CO_2 Emission Factor	CO_2 Emissions	CH_4 Emission Factor	CH_4 Emissions	N_2O Emission Factor	N_2OEmissions
2007	(Gg)	(TJ/Gg)	(TJ)	(kg CO_2/TJ)	(Gg CO_2)	(kg CH_4/TJ)	(Gg CH_4)	(kg N_2O /TJ)	(Gg N_2O)
			C=A*B		**E=C*D/10^6**		**G=C*F/10^6**		**I=C*H/10^6**
Liquid fuels									
Motor Gasoline	0	44.3	0	69,300	0	3	0	**0.6**	0
Jet Kerosene	0	44.1	0	71,500	0	3	0	**0.6**	0
Gas / Diesel Oil (ADO)	112	43	4,822	74,100	357	3	0.01	**0.6**	0.00
Gas / Diesel Oil (IDO)	0	43	0	74,100	0	3	-	**0.6**	-
Residual Fuel Oil	0	40.4	0	77,400	0	3	-	**0.6**	-
LPG	0	47.3	0	63,100	0	1	0	**0.1**	0
Solid fuels									
Sub-bituminous coal	720	18.9	13,608	96,100	1,308	**1**	0.01	**1.5**	0.02
Natural gas									
Natural Gas (Dry)	-	48	0	56,100	0	**1**	-	**0.1**	-
Biomass				**Information Items[b]**					
Wood / Wood Waste	0	15.6	0			**30**	0	**4**	0
Other Primary Solid Biomass	0	11.6	0			**30**	0	**4**	0
				Total	**1,665.04**	**Total**	**0.03**	**Total**	**0.02**

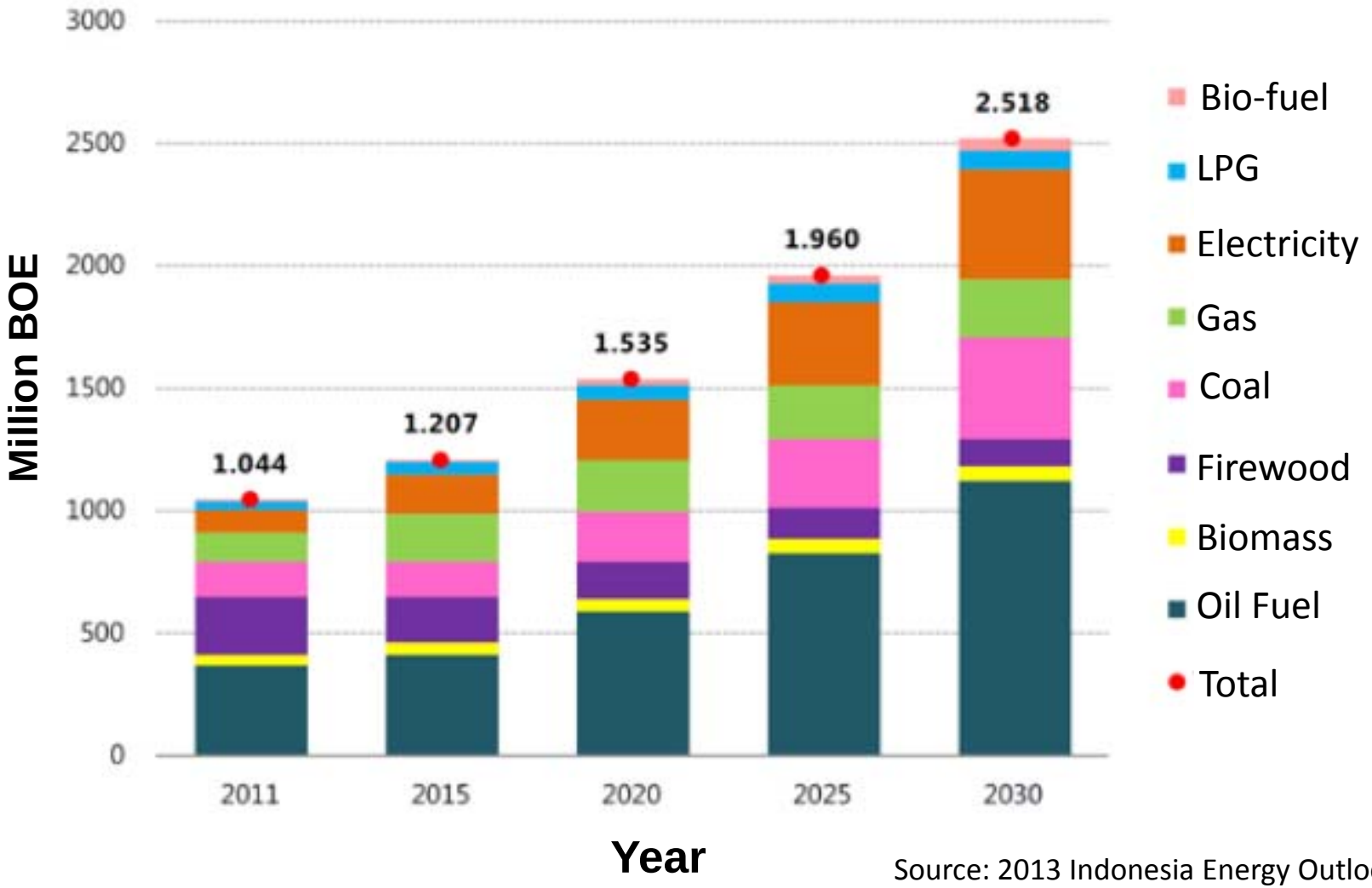
GHG Emission from Transportation (example calculation)

Sector	**Energy**								
Category	**Mobile combustion activities**								
Category Code	**1A 3 (Transportasi)**								
Sheet	**1 of 1 (CO_2, CH_4 and N_2O from fuel combustion by source categories – Tier 1)**								
	Energy consumption			**CO_2**		**CH_4**		**N_2O**	
Province	A	B	C	D	E	F	G	H	I
Papua	Consumption	Conversion Factor[(b)]	Consumption	CO_2 Emission Factor	CO_2 Emissions	CH_4 Emission Factor	CH_4 Emissions	N_2O Emission Factor	N_2OEmissions
2007	(Mass, Volume or Energy unit)	(TJ/unit)	(TJ)	(kg CO_2/TJ)	(Gg CO_2)	(kg CH_4/TJ)	(Gg CH_4)	(kg N_2O /TJ)	(Gg N_2O)
			C=A*B		**E=C*D/10^6**		**G=C*F/10^6**		**I=C*H/10^6**
Liquid fuels									
Motor Gasoline	106	44.3	4,681	69,300	324	**33**	0.15	**3.2**	0.01
Jet Kerosene	48	44.1	2,103	71,500	150	**0.5**	0.00	**2**	0.00
Other Kerosene	0	43.8	0	71,900	0		-		-
Gas / Diesel Oil	43	43	1,855	74,100	137	**3.9**	0.01	**3.9**	0.01
Residual Fuel Oil	0	40.4	0	77,400	0	**7**	-	**2**	-
LPG	0	47.3	0	63,100	0	**62**	-	**0.2**	-
Solid fuels									
Sub-bituminous coal	0	18.9	0	96,100	0	**1**	0	**1.5**	0
Natural gas									
Natural Gas (Dry)	0	48	0	56,100	0	**1**	0	**0.1**	0
Biomass				**Information Items[b]**					
Wood / Wood Waste	0	15.6	0			**30**	0	**4**	0
Other Primary Solid Biomass	0	11.6	0			**30**	0	**4**	0
				Total	**612.18**	**Total**	**0.16**	**Total**	**0.03**

Indonesia's GHG Emission from Energy Sector (Gg CO2e)

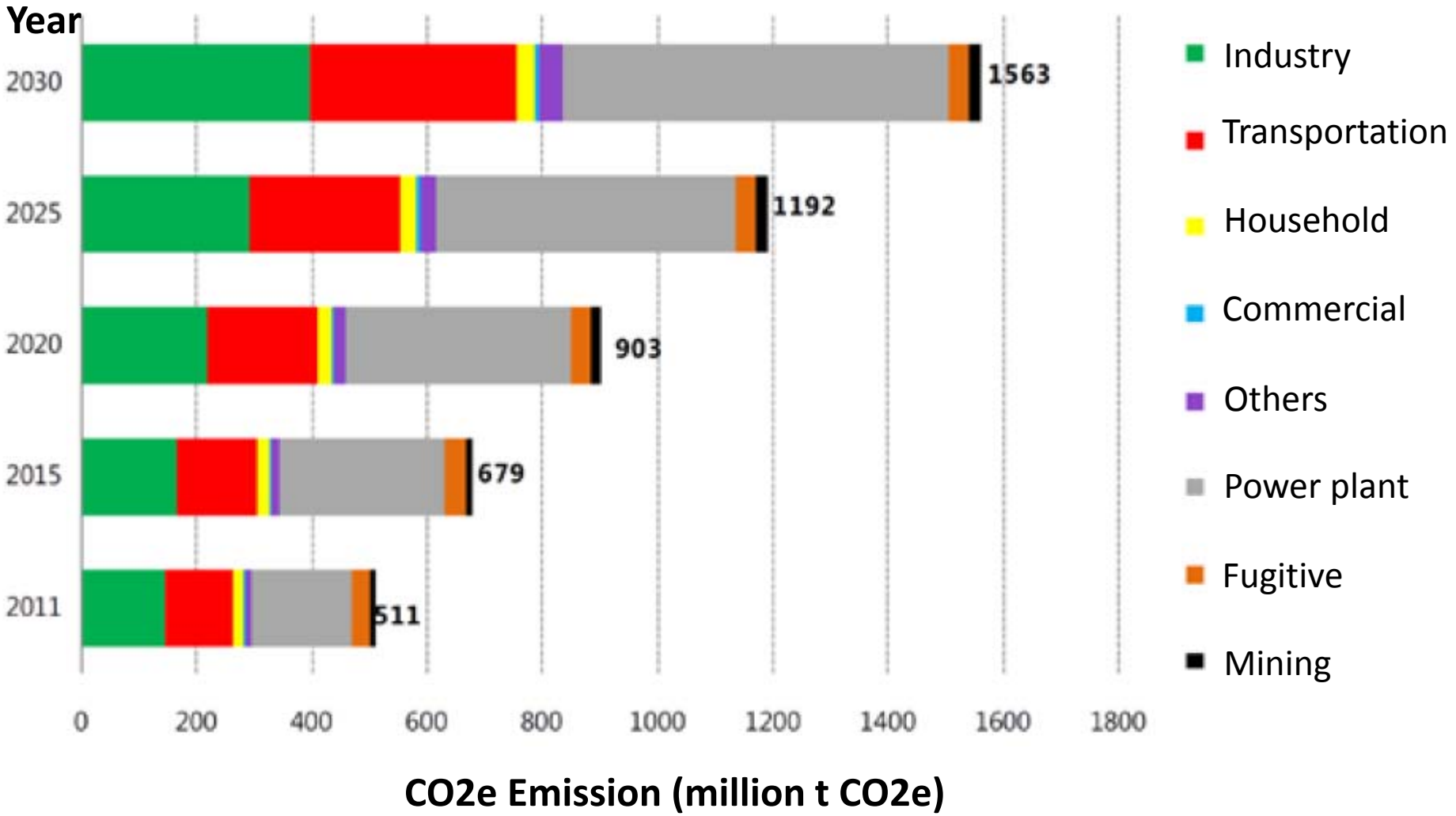


The Projection of Total Final Energy Demand by Fuel Type



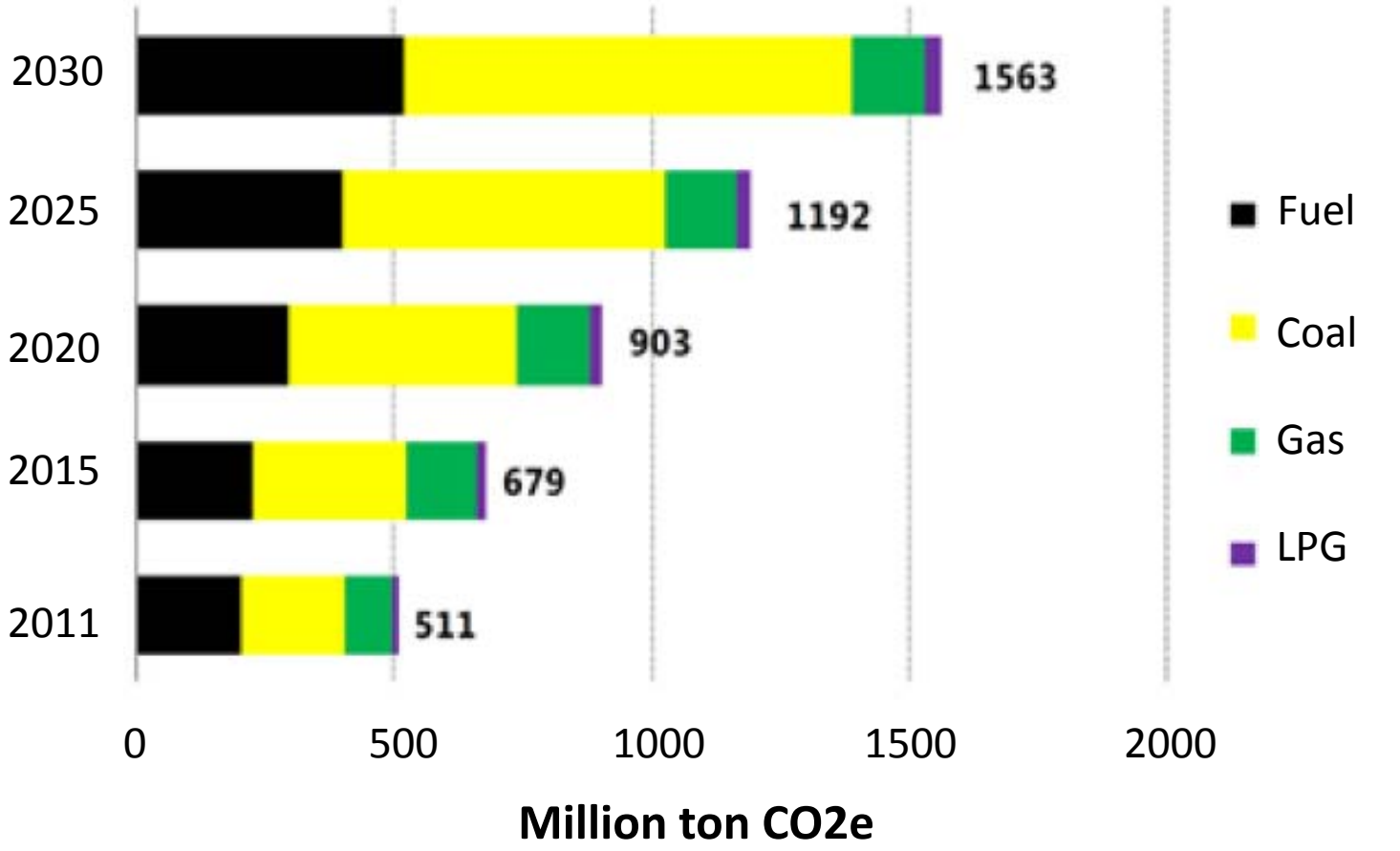
Source: 2013 Indonesia Energy Outlook

CO2e Emission Projection on Demand Sector of Final Energy



Source: 2013 Indonesia Energy Outlook

Projection of CO2e Emission Based On Type Of Final Energy Use



Source: 2013 Indonesia Energy Outlook

National Action Plan for Greenhouse Gas Emission Reduction in Energy Sector

- Energy conservation in buildings and industry,
- Efficient technology for household appliances,
- Power generation using renewable (geothermal, biomass, hydropower etc.) or low carbon energy sources (fuel switching oil to gas)
- Low-carbon technologies (such as power plant with supercritical and ultra-critical coal as fuel),
- Public transport advancement,
- Management and engineering of traffic,
- Transportation demand management (TDM)

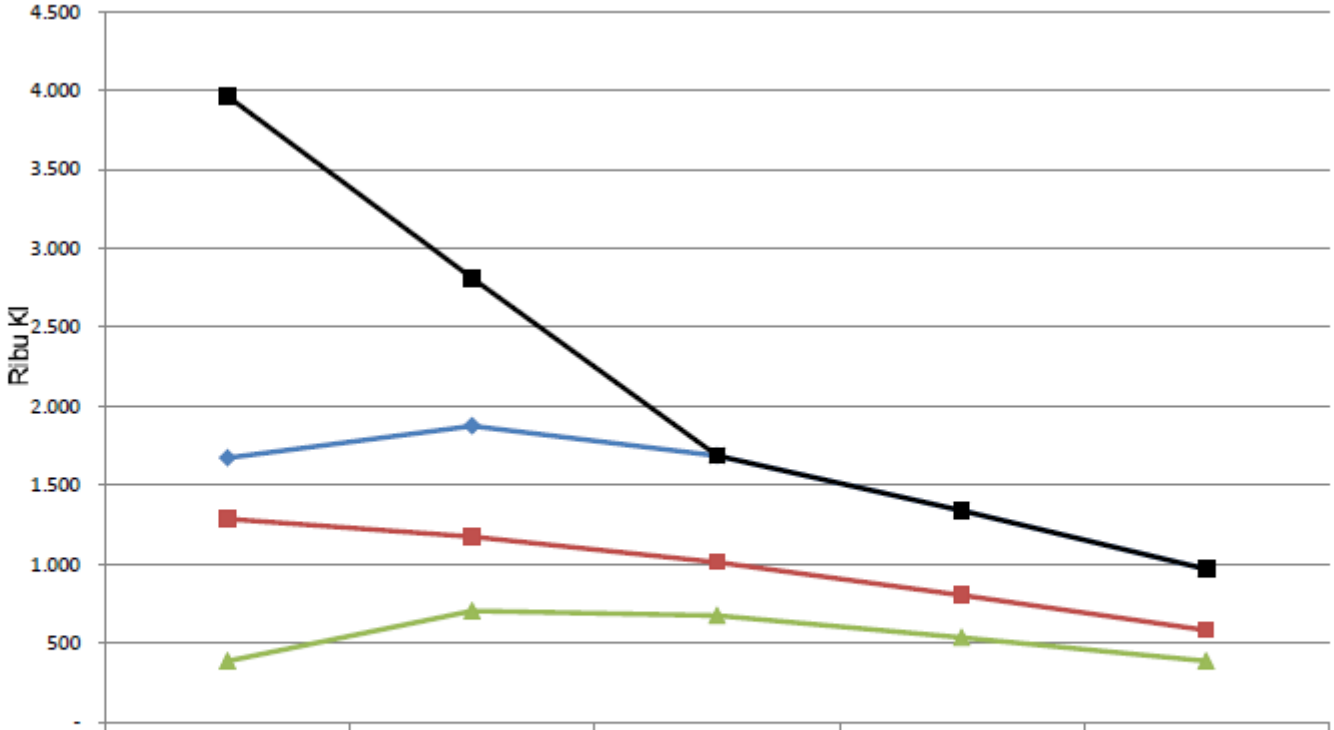
Total Power Development Plan in Indonesia (MW)

No	Kind of Power Plant	Capacity (MW)							
		2015	2016	2017	2018	2019	2020	2021	2022
1	Geothermal	30	85	580	495	1645	635	625	705
2	Biomass	15	20	30	40	50	50	50	50
3	Minihydro	96	149	237	192	186	156	190	200
4	Hydropower	45	10	341	284	386	671	1,173	824
5	Solar	75	54	36	60	75	75	75	75
6	Wind	50	20	20	20	30	40	50	50
7	Bio fuel*	400	500	500	600	600	600	600	600
8	Supercritical & ultra supercritical coal-fired power plant		2000	1800	1000	1320	4000	2000	1000

*High Speed Diesel consumption will be replaced by biofuel

BIOFUEL PLAN

Year 2016: 50% of HSD consumption will be replaced by biofuel



	2014	2015	2016	2017	2018
Total Nabati	1.674	1.875	1.687	1.339	968
Total Biodiesel	1.287	1.172	1.012	803	581
Total OLEIN	386	703	675	536	387
Total HSD	3.962	2.813	1.687	1.339	968

Emissions Reduction Calculations

$ER_y = BE_y – PE_y - L_y$

where:

ER_y Emissions reduction in year ‘y’ (tCO2e / year)

PE_y Baseline emissions in year ‘y’ (tCO2e / year)

BE_y Project emissions in year ‘y’ (tCO2e / year)

L_y Leakage emissions in year ‘y’ (tCO2e / year)

Baseline Emissions

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$

$EG_{PJ,y}$ Electricity supplied by the project activity to the grid (MWh)

$EF_{grid,CM,y}$ Combined Margin CO2 emission factor for grid connected power generation in year ‘y’ calculated using the latest version of the Tool to calculate the emission factor for an electricity system

Emission Reduction from Geothermal Power Plant

Item									
Baseline emissions	Unit	2015	2016	2017	2018	2019	2020	2021	2022
Installed capacity	MW	30	85	580	495	1645	635	625	705
Capacity factor	%	88%	88%	88%	88%	88%	88%	88%	88%
Expected gross generation	MWh	231,264	655,248	4,471,104	3,815,856	12,680,976	4,895,088	4,818,000	5,434,704
Auxiliary loss	%	5%	5%	5%	5%	5%	5%	5%	5%
Expected net electricity deliver to grid	MWh	219,701	622,486	4,247,549	3,625,063	12,046,927	4,650,334	4,577,100	5,162,969
Baseline emission factor	t CO2/ MWh	0.741	0.741	0.741	0.741	0.741	0.741	0.741	0.741
Baseline emissions	t CO2	162,798	461,262	3,147,434	2,686,172	8,926,773	3,445,897	3,391,631	3,825,760
Project emissions									
Steam flow rate/year	t	3,836,880	10,871,160	74,179,680	63,308,520	210,388,920	81,213,960	79,935,000	90,166,680
NCG content in steam	% weight	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
CO2 content in steam	% weight	93%	93%	93%	93%	93%	93%	93%	93%
Project emissions		10,990	31,139	212,480	181,341	602,638	232,629	228,966	258,273
Emission Reductions	**t CO2 eq/year**	**151,808**	**430,122**	**2,934,953**	**2,504,831**	**8,324,135**	**3,213,268**	**3,162,665**	**3,567,486**

Note: Emission factor is assumed to be the same (Jawa Bali grid)
Steam flow rate: based on Lahendong I records

Emission Reduction from Biomass Power Plant

Item									
Baseline emissions	Unit	2015	2016	2017	2018	2019	2020	2021	2022
Installed capacity	MW	15	20	30	40	50	50	50	50
Capacity factor	%	80%	80%	80%	80%	80%	80%	80%	80%
Expected gross generation	MWh	105,120	140,160	210,240	280,320	350,400	350,400	350,400	350,400
Auxiliary loss	%	10%	10%	10%	10%	10%	10%	10%	10%
Expected net electricity deliver to grid	MWh	94,608	126,144	189,216	252,288	315,360	315,360	315,360	315,360
Baseline emission factor	t CO2/ MWh	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748
Baseline emissions	t CO2	70,767	94,356	141,534	188,711	235,889	235,889	235,889	235,889
Project emissions									
Project emissions		0	0	0	0	0	0	0	0
Project Leakage		0	0	0	0	0	0	0	0
Emission Reductions	**t CO2 eq/year**	**70,767**	**94,356**	**141,534**	**188,711**	**235,889**	**235,889**	**235,889**	**235,889**

Assumption: The project does not co-fire fossil fuels therefore there are no project emissions as per AMSI.D.

Emission Reduction from Hydro Power Plant

Item									
Baseline emissions	Unit	2015	2016	2017	2018	2019	2020	2021	2022
Installed capacity	MW	141	159	578	476	572	827	1363	1024
Capacity factor	%	80%	80%	80%	80%	80%	80%	80%	80%
Expected gross generation	MWh	988,128	1,114,272	4,050,624	3,335,808	4,008,576	5,795,616	9,551,904	7,176,192
Auxiliary loss	%	2%	2%	2%	2%	2%	2%	2%	2%
Expected net electricity deliver to grid	MWh	973,306	1,097,558	3,989,865	3,285,771	3,948,447	5,708,682	9,408,625	7,068,549
Baseline emission factor	t CO2/ MWh	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.748
Baseline emissions	t CO2	728,033	820,973	2,984,419	2,457,757	2,953,439	4,270,094	7,037,652	5,287,275
Project emissions									
Project emissions		0	0	0	0	0	0	0	0
Emission Reductions	**t CO2 eq**	**728,033**	**820,973**	**2,984,419**	**2,457,757**	**2,953,439**	**4,270,094**	**7,037,652**	**5,287,275**

Emission Reduction from Solar PV Power Project

Item									
Baseline emissions	Unit	2015	2016	2017	2018	2019	2020	2021	2022
Installed capacity	MW	75	54	36	60	75	75	75	75
Capacity factor	%	17%	17%	17%	17%	17%	17%	17%	17%
Expected gross generation	MWh	111,690	80,417	53,611	89,352	111,690	111,690	111,690	111,690
Auxiliary loss	%	0%	0%	0%	0%	0%	0%	0%	0%
Expected net electricity deliver to grid	MWh	111,690	80,417	53,611	89,352	111,690	111,690	111,690	111,690
Baseline emission factor	t CO2/ MWh	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Baseline emissions	t CO2	89,352	64,333	42,889	71,482	89,352	89,352	89,352	89,352
Project emissions									
Project emissions		0	0	0	0	0	0	0	0
Project Leakage		0	0	0	0	0	0	0	0
Emission Reductions	**t CO2 eq/year**	**89,352**	**64,333**	**42,889**	**71,482**	**89,352**	**89,352**	**89,352**	**89,352**

Emission Reduction from Wind Power Project

Item									
Baseline emissions	Unit	2015	2016	2017	2018	2019	2020	2021	2022
Installed capacity	MW	50	20	20	20	30	40	50	50
Capacity factor	%	20%	20%	20%	20%	20%	20%	20%	20%
Expected gross generation	MWh	87,600	35,040	35,040	35,040	52,560	70,080	87,600	87,600
Auxiliary loss	%	0%	0%	0%	0%	0%	0%	0%	0%
Expected net electricity deliver to grid	MWh	87,600	35,040	35,040	35,040	52,560	70,080	87,600	87,600
Baseline emission factor	t CO2/ MWh	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Baseline emissions	t CO2	70,080	28,032	28,032	28,032	42,048	56,064	70,080	70,080
Project emissions									
Project emissions		0	0	0	0	0	0	0	0
Project Leakage		0	0	0	0	0	0	0	0
Emission Reductions	**t CO2 eq/year**	**70,080**	**28,032**	**28,032**	**28,032**	**42,048**	**56,064**	**70,080**	**70,080**

Emission Reduction from Supercritical Coal Fired Power Plant

Parameter Item	Unit	Value	Data Source
(1) Install Capacity of the project	MW	2000	
(2) Annual Power Generation Hours of the project	Hour	5500	
(3) Self-consumed-Electricity Rate of the power plant	%	6.20%	
(4) Coal Consumption per kWh for Power Generation of the project	kg/MWh	283	
(5) NCV of stand coal equivellent	MJ/tce	29271	
(6) NCV of Coal of the project	MJ/ton	23420	
(7) Carbon Content in Coal of the project	%	61.45%	
(1) Calculation of Emission Factor of Option I			
$EF_{FF,BL,CO2,y}$	tCO2/GJ	0.0946	Table 1.4 , 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Emission Factor of Coal of the project	tCO2/GJ	0.0962069	Calculating Process-data
$EF_{FF,PJ,CO2,y}$	tCO2/GJ	0.0962	Rounded Data
Coal Consumption per kWh for Power Generation of 2*600MW sub-critical coal-fired power generation technology	kg/MWh	330	
Self-consumed-Electricity Rate	%	6.20%	
Coal Consumption per kWh for Power Supplied to Grid of 2*600MW sub-critical coal-fired power generation technology	kg/MWh	351.81237	Calculating Process-data
Energy efficiency of 2*600MW sub-critical coal-fired power generation technology	%	34.9586%	Calculating Process-data
ηBL	%	34.96%	
Emission Factor of Option I	tCO2/MWh	0.9741	Calculating Result

Emission Reduction from Supercritical Coal Fired Power Plant-2

Parameter Item	Unit	Value	Data Source
(2) Emission Factor of Option II			
Average emission factor for the top 15% performing power plants	tCO2/MWh	0.9	Assumption
(3)Baseline Emission Factor	tCO2/MWh	0.9	Calculating Result
(4)Baseline Emission	tCO2	9,286,200	Calculating Result
Project Emission			
(1) Consumption of stand coal equivellent	tce	3,113,000	Calculating Process-data
(2) Consumption of Coal used in the project	tce	3,890,718	Calculating Process-data
(3) Consumption of Coal used in the project	tce	3,890,718	
(4) Emission Factor of Coal of the project	tCO2/GJ	0.0962069	Calculating Process-data
(5) Emission Factor of Coal of the project	tCO2/GJ	0.0962	
(6) CO2 emission coefficient (COEF)	tCO2/ton	2.253004	Calculating Process-data
(7) COEF	tCO2/ton	2.253004	
(8) Project Emission	tCO2/y	8,765,803	Calculating Process-data
(1) Baseline Emission	tCO2/y	9,286,200	
(2) Project Emission	tCO2/y	8,765,803	
(3) Leakage	tCO2/y	-	Methodology of ACM0013
(4) Emission Reduction	tCO2/y	520.397	

Potential Emission Reduction (tCO2e)

No	Kind of Power Plant	Emission Reduction (tCO2e)							
		2015	2016	2017	2018	2019	2020	2021	2022
1	Geothermal	151,808	430,122	2,934,953	2,504,831	8,324,135	3,213,268	3,162,665	3,567,486
2	Biomass	70,767	94,356	141,534	188,711	235,889	235,889	235,889	235,889
3	Minihydro	545,250	663,556	1,346,086	1,090,500	1,056,422	886,032	1,079,141	1,135,938
4	Hydropower	255,586	44,534	1,936,774	1,613,032	2,192,360	3,811,072	6,662,276	4,680,064
5	Solar	89,352	64,333	42,889	71,482	89,352	89,352	89,352	89,352
6	Wind	70,080	28,032	28,032	28,032	42,048	56,064	70,080	70,080
7	Bio fuel	233,671	186,937	186,937	155,781	155,781	155,781	155,781	155,781
8	Ultra-Supercritical coal-fired power plant	-	520,397	468,357	260,198	343,462	1,040,794	520,397	260,198
Total		1,416,514	2,032,267	7,085,562	5,912,567	12,439,449	9,488,252	11,975,581	10,194,788
Emission Reduction/y		1,416,514	3,448,781	10,534,343	16,446,910	28,886,359	38,374,611	50,350,192	60,544,980

GHG Emission Reduction Target in 2020: 36-56 million tCO2e

Recommendation

- The need to improve the quality of the emission factors for the Indonesia energy sector
- The need to conduct further studies on developing local EF
- Improve database in the related institutions

Thank you for your attention

Rohmadi Ridlo
Email: rridlo@yahoo.com
Email: rridlo@gmail.com
Mobile ph: +628128507523