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Low-carbon energy development in Indonesia in alignment with its INDC by 2030

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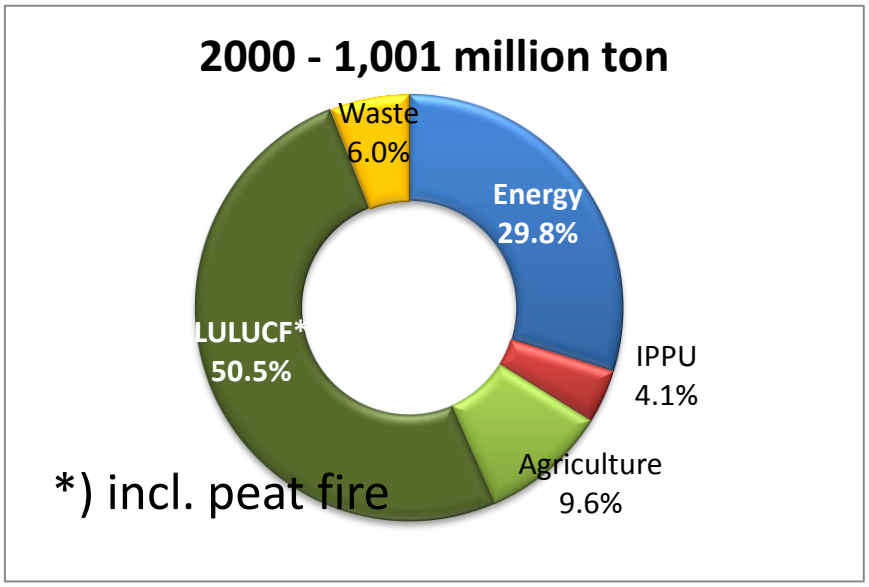
Retno G Dewi, Ucok Siagian, Bintang B Yuwono

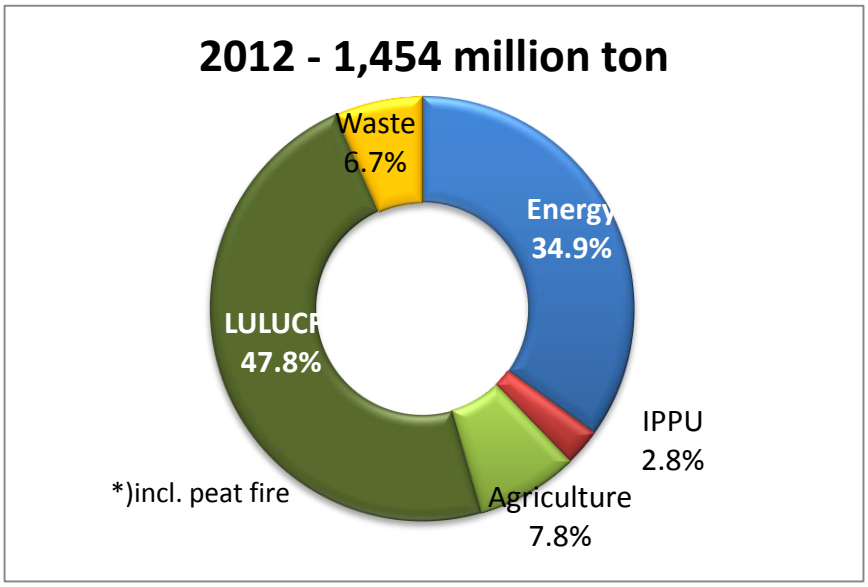
Center for Research on Energy Policy
INSTITUT TEKNOLOGI BANDUNG

OUTLINE

- Introduction: Importance of Energy Sector in Indonesian GHG Emissions
- Brief of Indonesia Modeling Activities Using AIM
- AIM CGE Energy Modeling: Low-carbon energy development in Indonesia in alignment with its INDC by 2030

PAST TREND OF GHG EMISSION



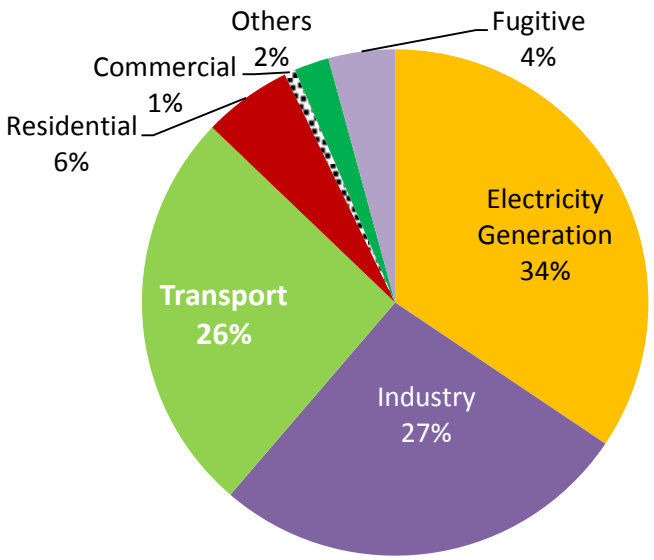


Sectors	Million ton CO2e		Percentage		Average annual growth
	2000	2012	2000	2012	
Energy	298	508	30	35	4.5%
IPPU	41	41	4	3	0.1%
Agriculture	96	113	10	8	1.3%
LULUCF *	505	695	51	48	2.7%
Waste	61	97	6	7	4.0%
Total	1,001	1,454			3.2%

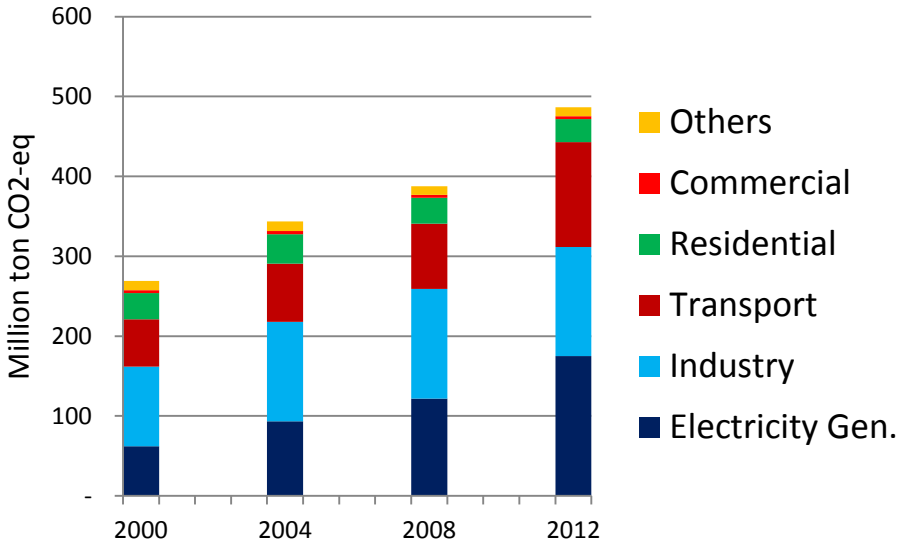
**) including peat fire*

Source: Indonesia 1st BUR, 2015

Breakdown of Energy Sector Emissions



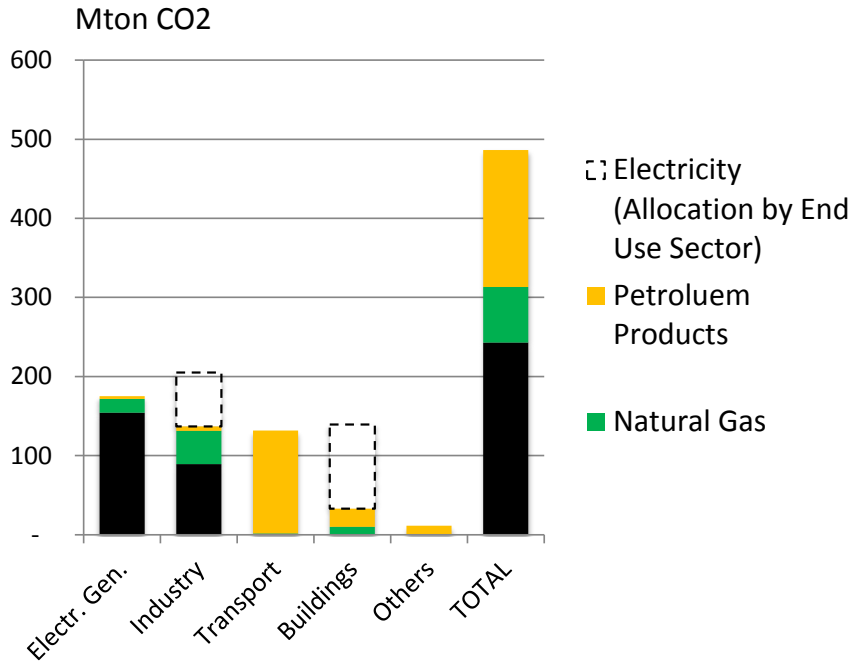
Energy 2012
508 mill ton



<u>Combustion Emissions</u>

Major sources: coal & oil used in power gen., industry, transport

End-use sector: 45% from fuel burning in industry;
Emissions from power generation is accounted by building (60%) and industry (40%) sectors.



Indonesia Energy Research Team in the AIM activities

Indonesia energy team is involved in the development of AIM in three models:

- AIM - ExSS Snapshot
- AIM - End-Use
- AIM - CGE

AIM-ExSS Snapshot

ExSS Snapshot model has been employed to develop three models:

- Low Carbon Development Path of Energy Sector Toward 2050 (publication)
- Low Carbon Development of Power Sector (to evaluate the impact of coal addition to power expansion plan by the state electric utility, submitted to National Council for Climate Change)
- Low Carbon Development in DKI Jakarta (submitted to DKI Jakarta Government and is being used in the re-evaluation of Jakarta's mitigation plan)
- Result of ExSS snapshot is used as the basis of End-Use modeling

AIM End-Use

In End-Use model, Indonesia energy team is involved in 4 sectors:

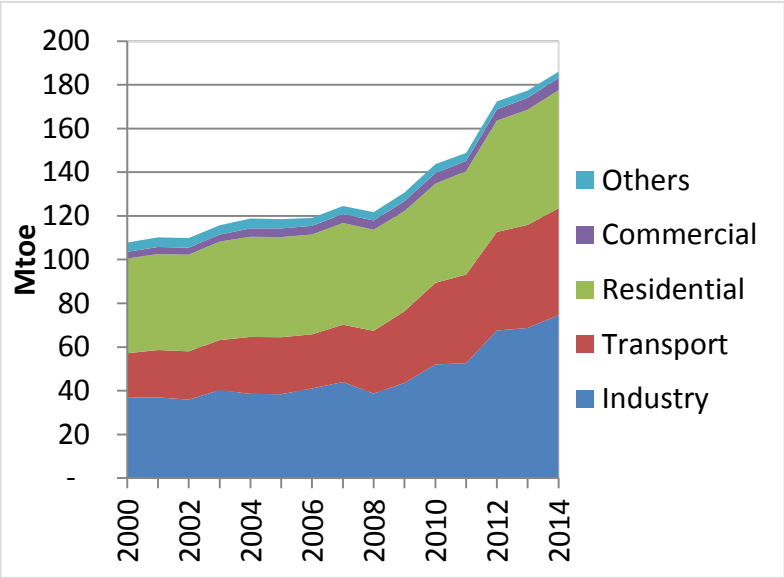
- Power
- Industry
- Transport and
- Residential and Commercial

AIM-CGE

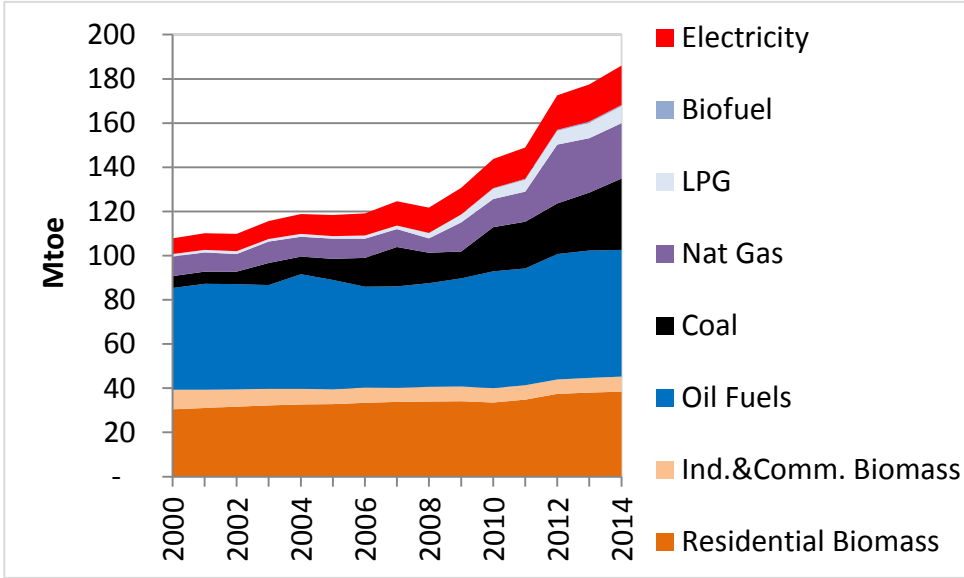
- AIM-CGE for Indonesia case combines energy sector with land based sector (agriculture and forestry)
- Most important feature of the model: to give answer to questions related to impact of mitigation actions to Indonesia economy (GDP).
- Currently the Indonesian model is still under development. The latest AIM training workshop has produced some preliminary results.
- AIM-CGE Energy is being used for analysis of low carbon in Indonesian energy sector NDC

RECENT ENERGY SITUATION

Final energy demands



by sector



by fuel type

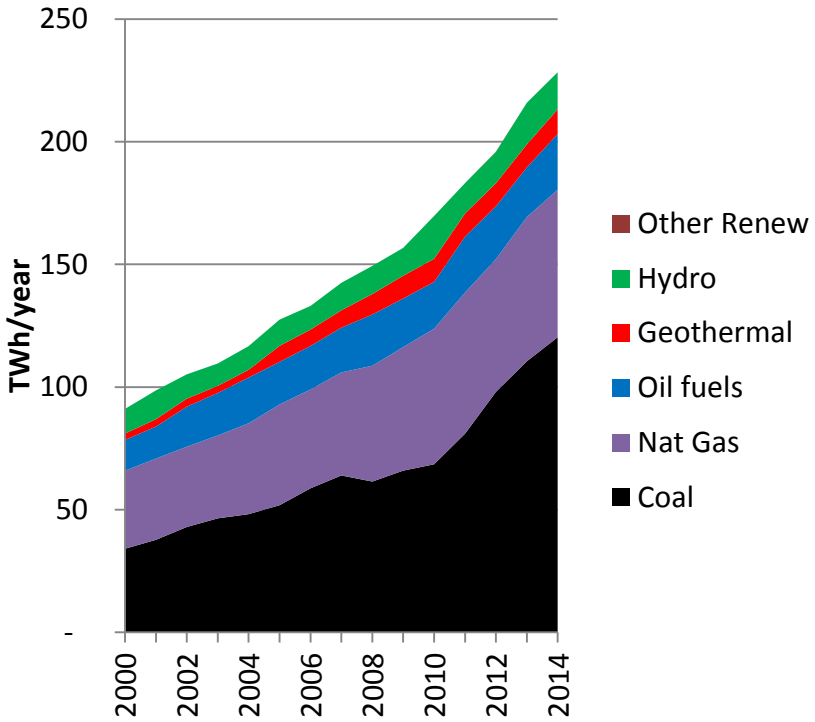
Average growth p.a.

Indust.	Transp.	Resid.	Comm.	Total
5.2%	6.5%	1.6%	4.5%	4.0%

Average growth p.a.

Coal	Nat Gas	LPG	Electr.	Total
10.8%	7.8%	14.0%	6.8%	4.0%

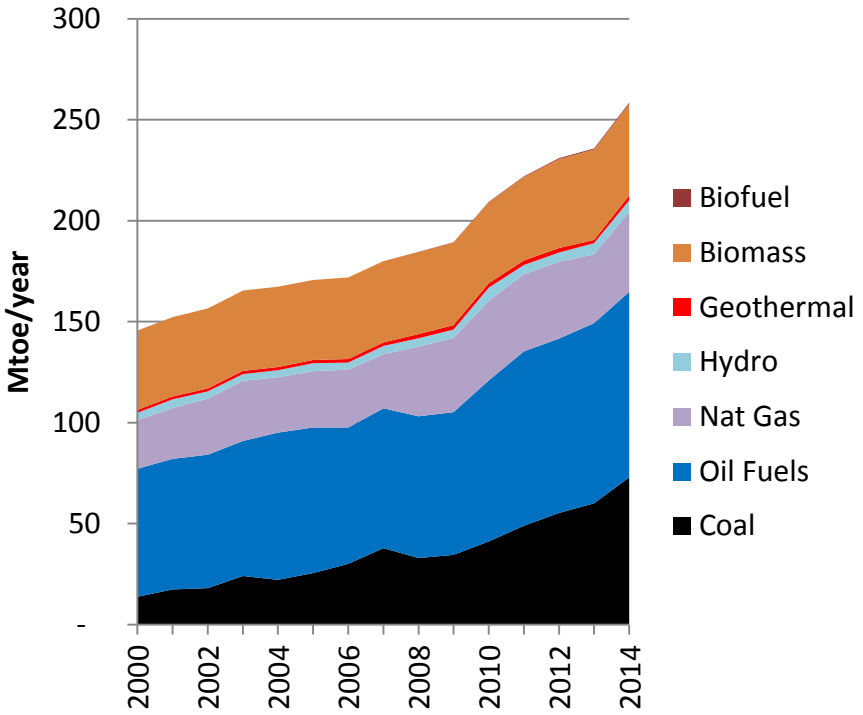
Power generation mix



Average growth p.a.

Coal	Nat Gas	Geoth.	Total
9.4%	4.6%	10.0%	6.8%

Primary energy supply



Average growth p.a.

Coal	Oil Fuels	Nat Gas	Hydro	Geo.	Total
12.7%	2.7%	3.6%	3.0%	3.8%	4.2%

INDONESIA NDC (Oct 2016)

Sector	GHG Emission Level 2010 (*)	GHG Emission Level 2030			GHG Emission Reduction			
		MTon CO2e			M Ton CO2e		% of Total BAU	
	MTon CO2e	BaU	CM1	CM2	CM1	CM2	CM1	CM2
Energy	453	1,669	1,355	1,271	314	398	11%	14%
Waste	88	296	285	270	11	26	0.38%	1%
IPPU	36.00	69.60	66.85	66.35	2.75	3.25	0.10%	0.11%
Agriculture	110.51	119.66	110.39	115.86	9.27	3.80	0.32%	0.13%
Forestry**	647	714	217	64	497	650	17%	23%
TOTAL	1,334	2,869	2,034	1,787	834	1,082	29%	38%

*including fugitive
** including peat fire

Key sectors of reduction: Forestry and Energy

AIM CGE Energy Modeling

Low-carbon energy development in Indonesia in alignment with its INDC by 2030

Drivers

Economic growth 5%, population growth: 1.1%

SCENARIOS

BAU: future Indonesian energy and emission trajectories where the development of the country continues on its present trajectory, without climate change mitigation actions.

CM1: development is linked with achieving its INDC target (i.e., a 29% reduction by 2030).

CM2: is the development scenario that targets greater emission reductions.

Power Sector:

The core of scenario setting is very closely related to the scenarios for the power sector.

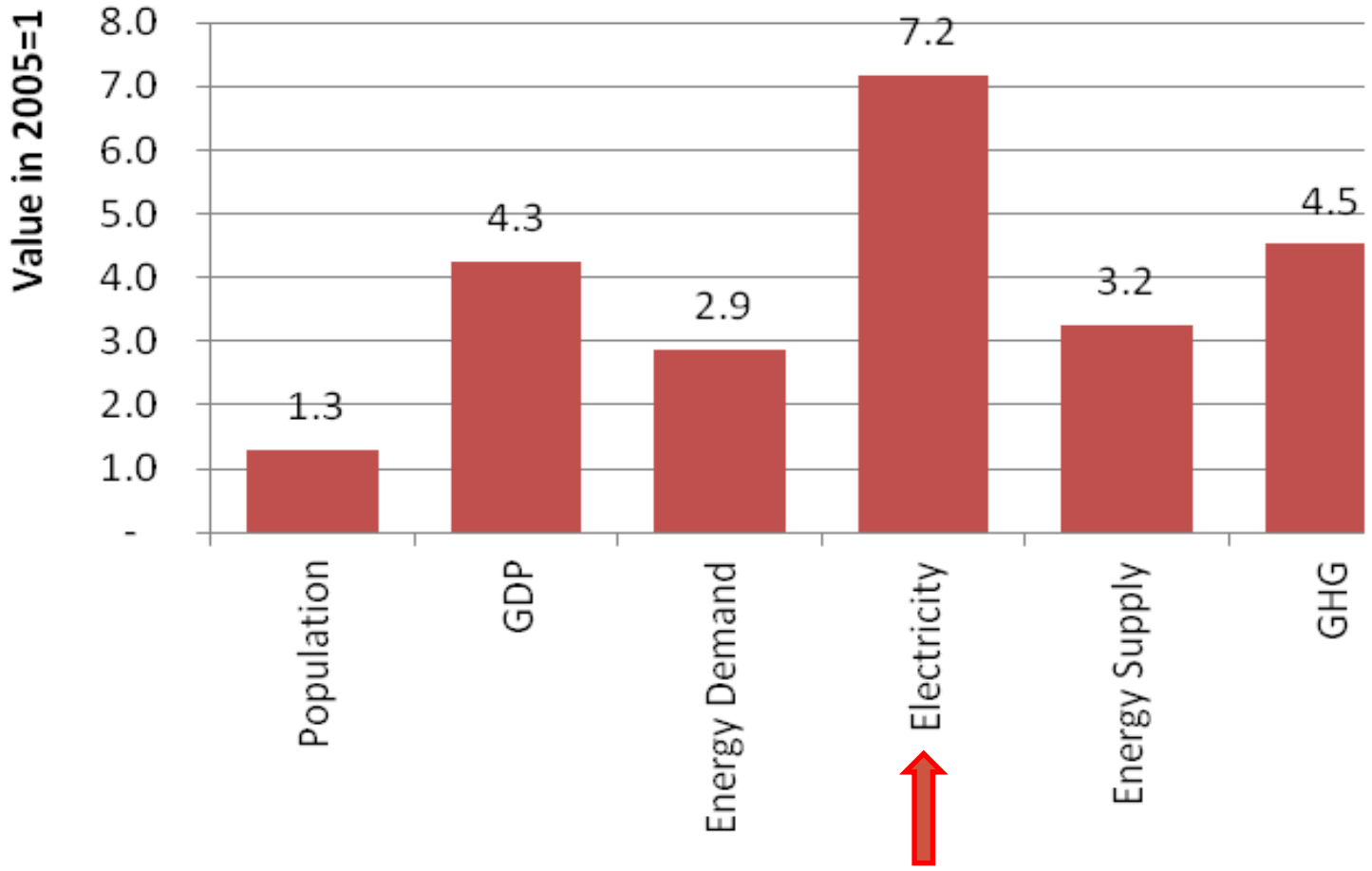
Generation mix is assumed to follow a utility expansion plan (RUPTL). Main feature: deployment of renewables to substitute for fossil fuels, particularly coal.

Other assumption: Future energy demand will be affected by assumed efficiency measures (exogenous).

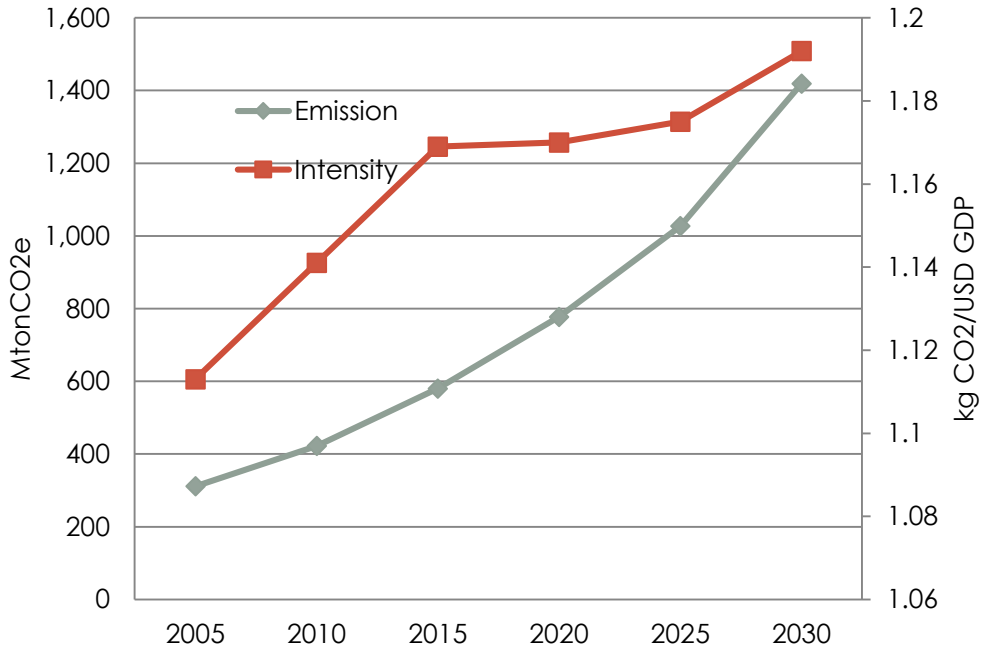
Power generation by fuel type for the three scenarios, in Ktoe/year

Power plant	Baseline		CM1		CM2	
	2020	2030	2020	2030	2020	2030
Coal	18, 346	54, 855	15, 102	37, 171	14, 277	33, 217
Oil	1, 226	492	1, 191	464	1, 165	443
Gas	8, 606	20, 535	8, 855	21, 742	8, 660	20, 795
Geothermal	851	863	2, 233	5, 946	2, 315	6, 394
Hydropower	1, 587	1, 610	3, 478	7, 732	3, 560	8, 102
Other RE	1, 098	2, 068	472	2, 896	195	1, 719
Total	31, 714	80, 423	31, 331	75, 950	30, 172	70, 670

Socio-economic factors, energy, and GHG emissions under the **Baseline scenario** in 2030 relative to 2005



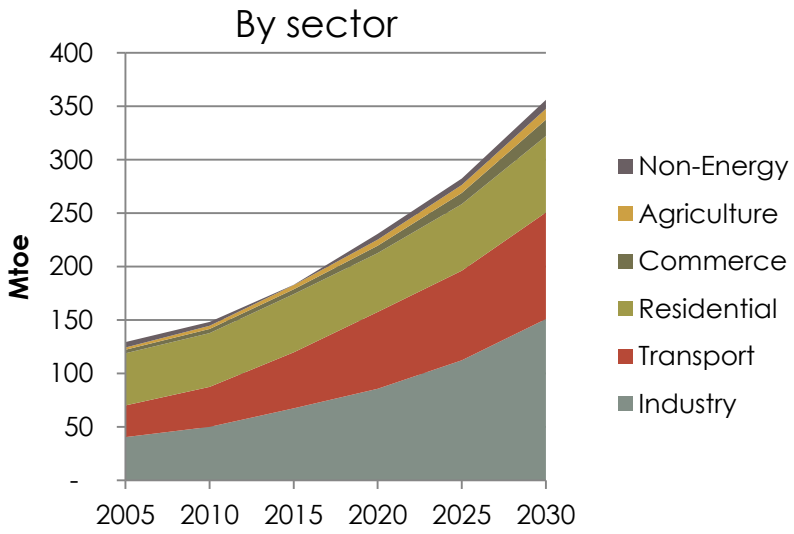
GHG emissions and emission intensity, Baseline scenario



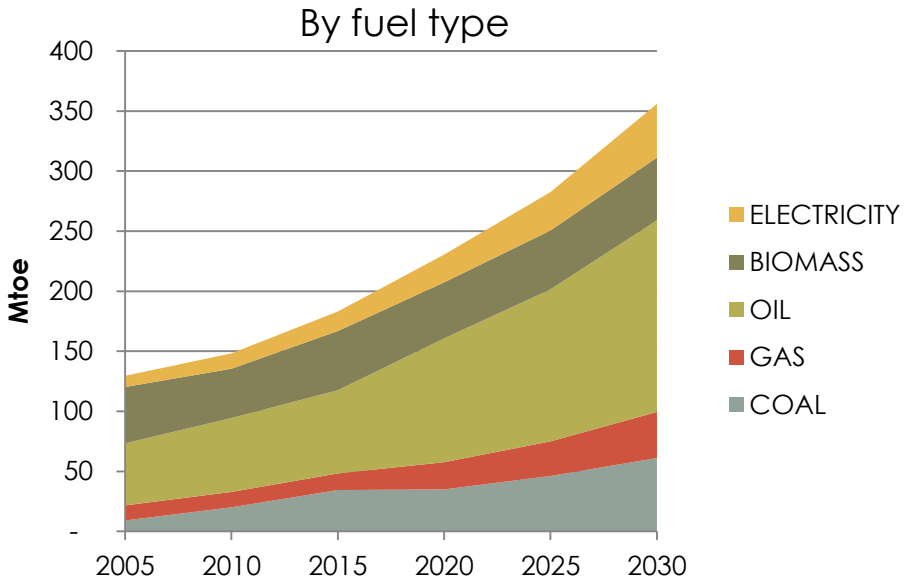
Indonesia is moving toward energy intensive industries

Baseline

Final energy demand

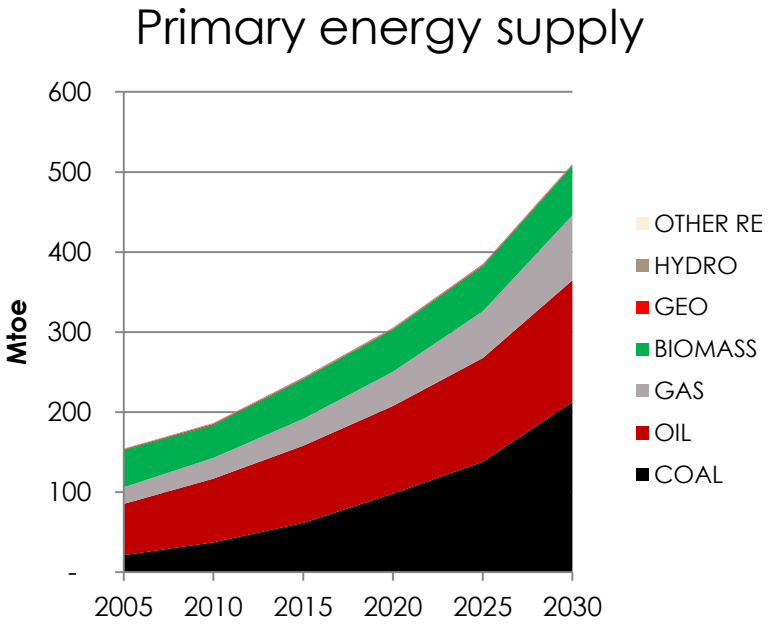


Dominant:
Industry and Transport

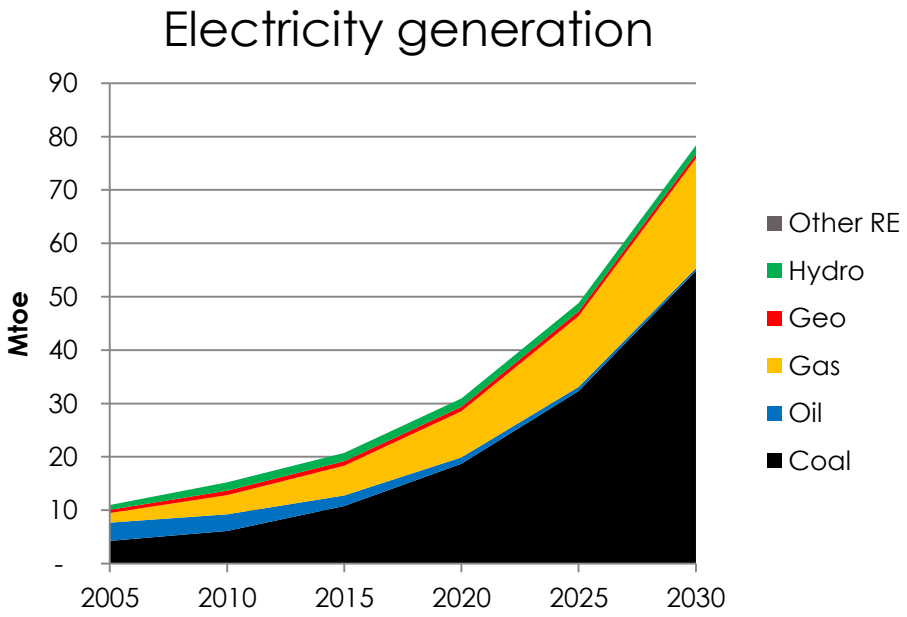


Dominant:
Oil and Coal

Baseline

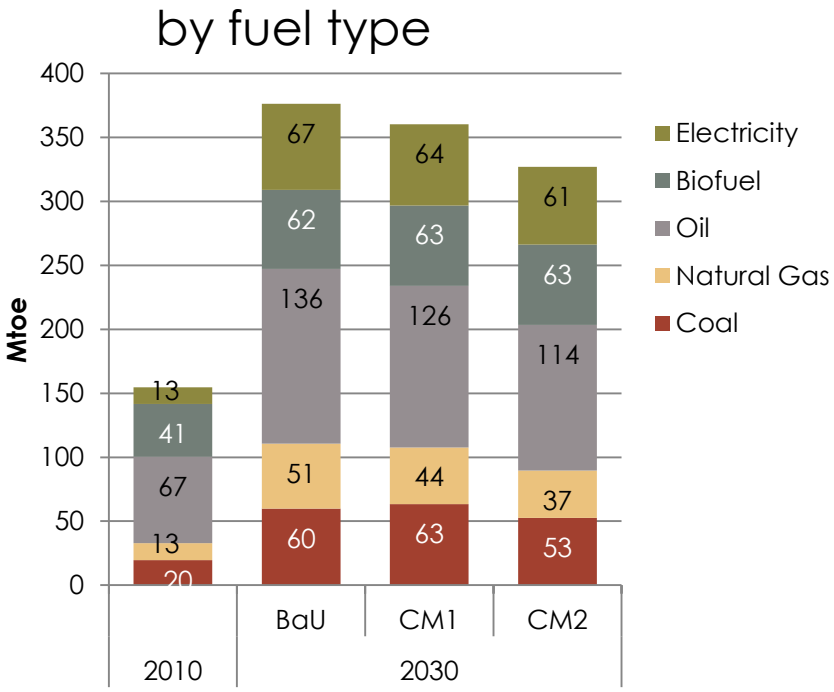


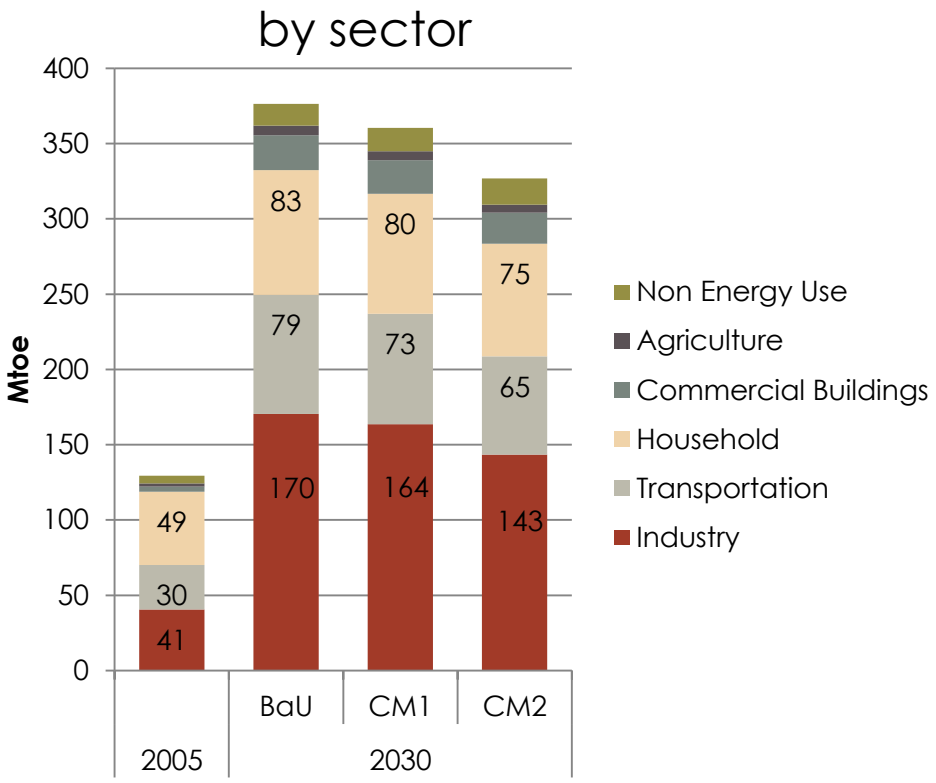
Dominant: Coal



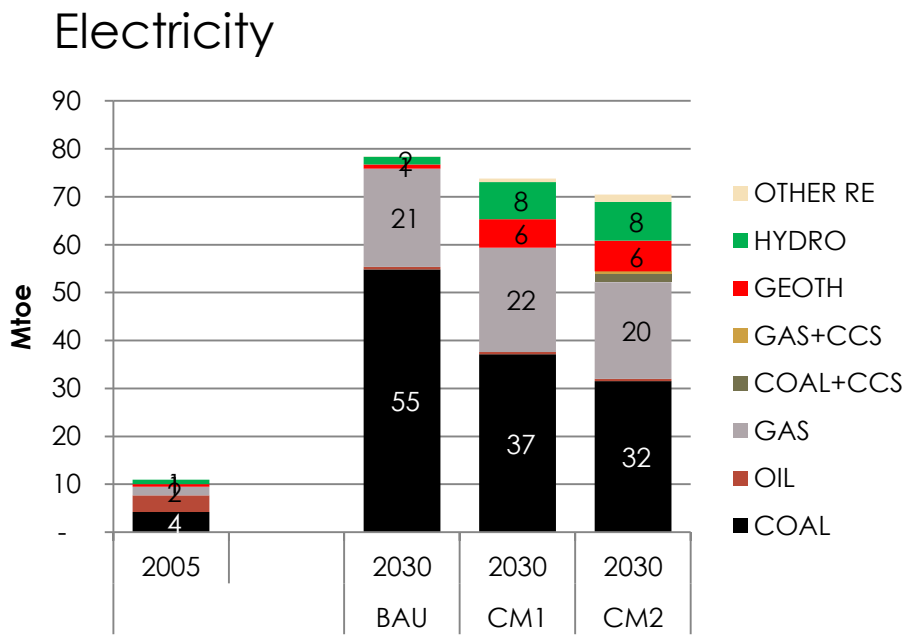
Dominant: Coal

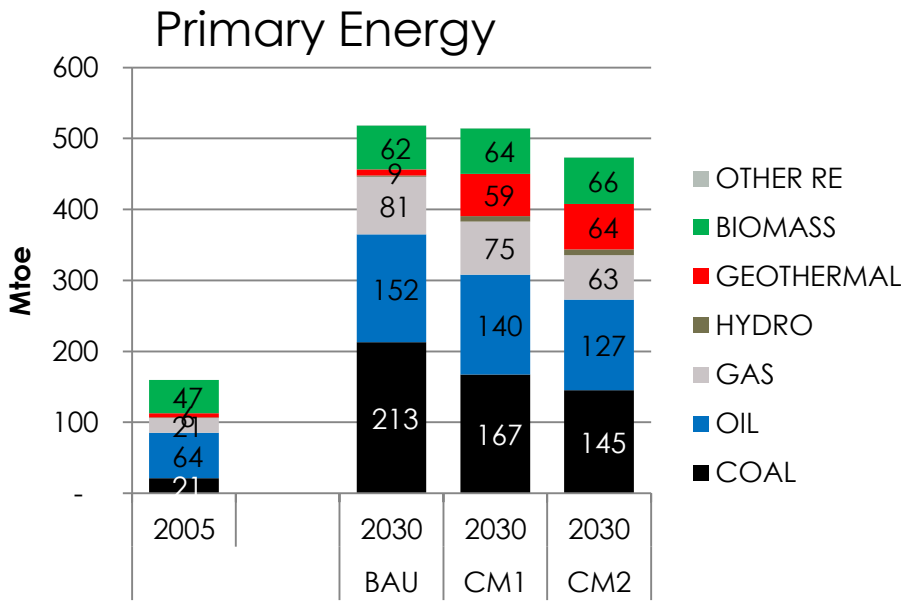
Reduction in final energy demands



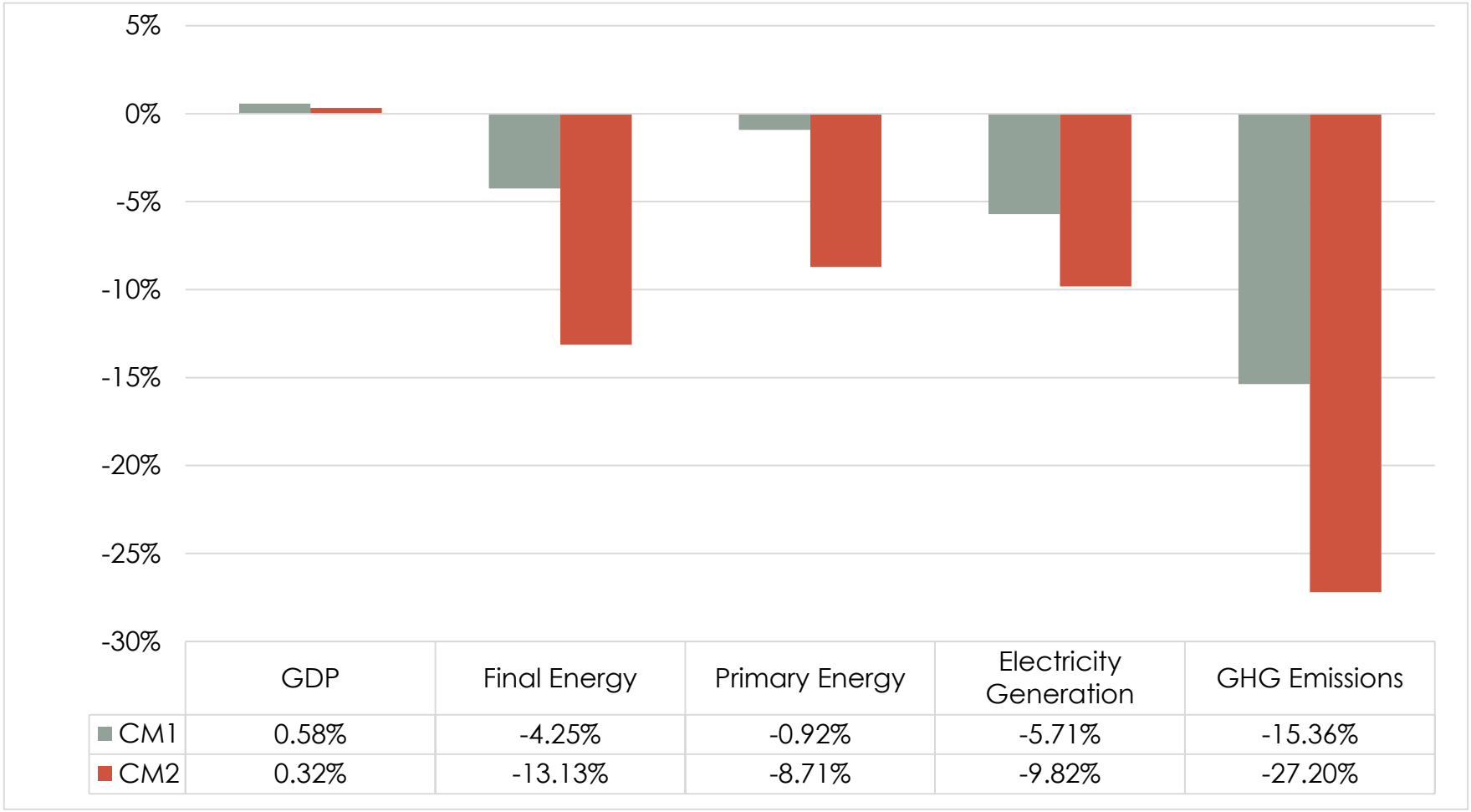


Changes in Energy Mix





Percent change in GHG emissions, energy, and GDP by 2030
(relative to Baseline values)



	GDP	Final Energy	Primary Energy	Electricity Generation	GHG Emissions
CM1	0.58%	-4.25%	-0.92%	-5.71%	-15.36%
CM2	0.32%	-13.13%	-8.71%	-9.82%	-27.20%

Mitigation cost
CM1: \$19 USD (2005)/tCO_2
CM2 : \$63 USD (2005)/tCO_2.

Impact to GDP

The GDP changes in both of the CM scenarios relative to Baseline are positive.

This is counter-intuitive to the expectations of a normal climate mitigation study.

The main factor generating these results is the combination of the assumptions for power generation and coal mining productivity.

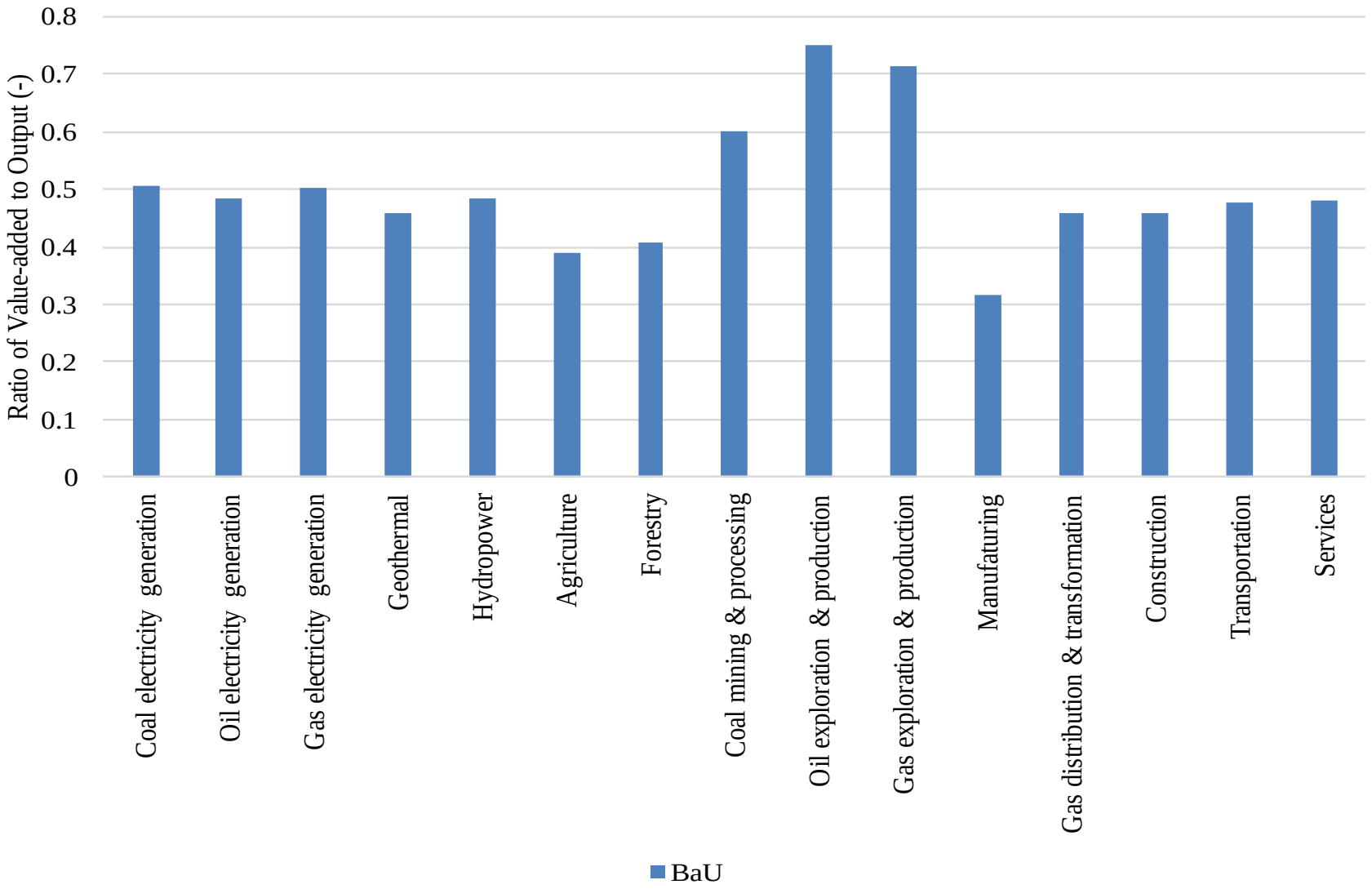
Power generation mix is fixed in this study (RUPTL): large increase in the use of coal in the Baseline scenario

However, the coal-mining sector has a high share in terms of value-added industries and represents a low-productivity sector. If coal use can be reduced in such mitigation scenarios, the total factor productivities can increase.

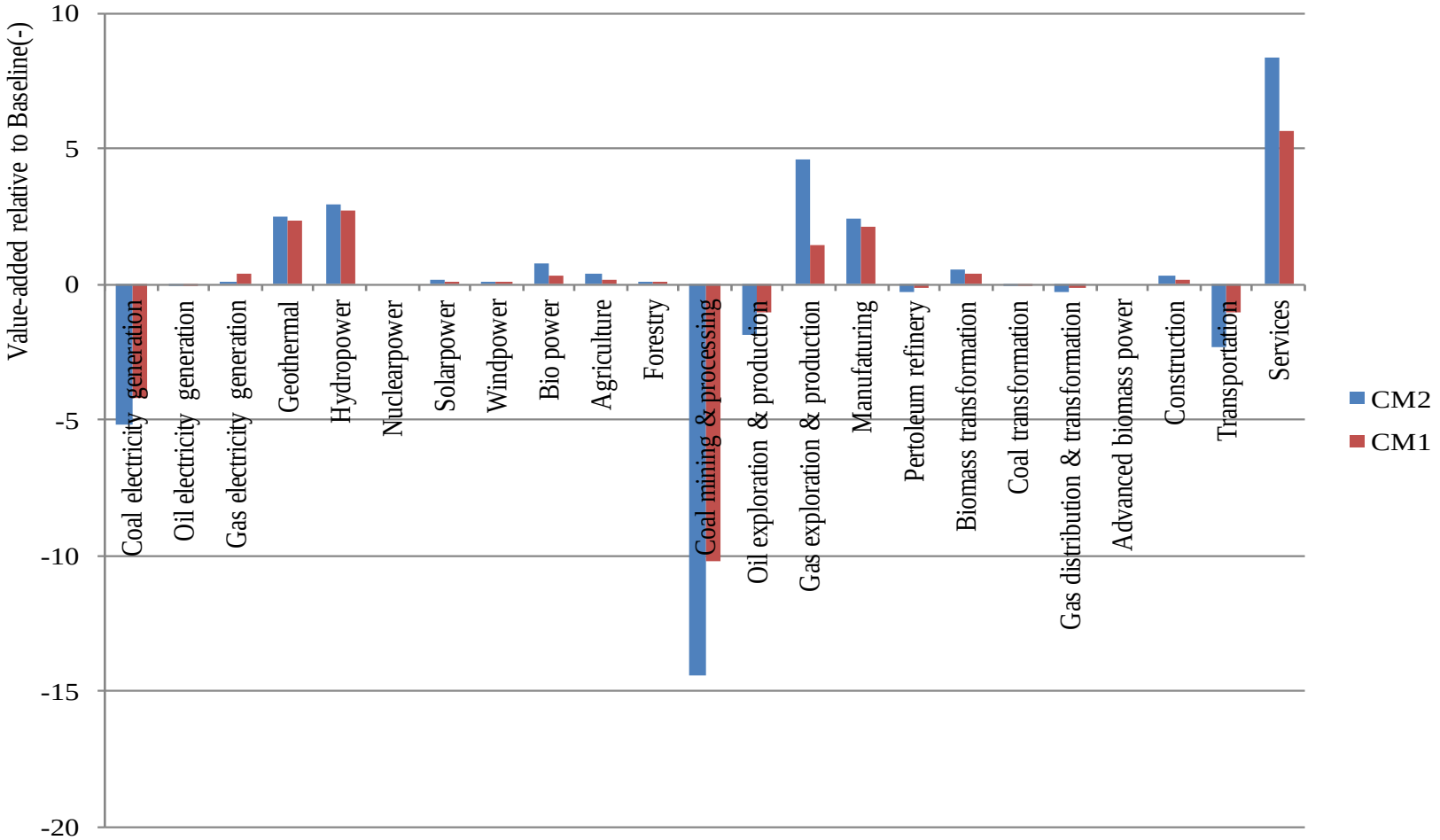
Coal-related industries induce negative impacts while renewable and service sectors induce positive impacts.

Notably, the results of our study imply that investments in low-carbon technologies are cancelled out by that factor.

Ratio of value-added to output



Ratio of value-added output relative to baseline



Coal related industry decrease
Increase in services, renewable related industries, gas, manufacturing

Concluding Remarks:

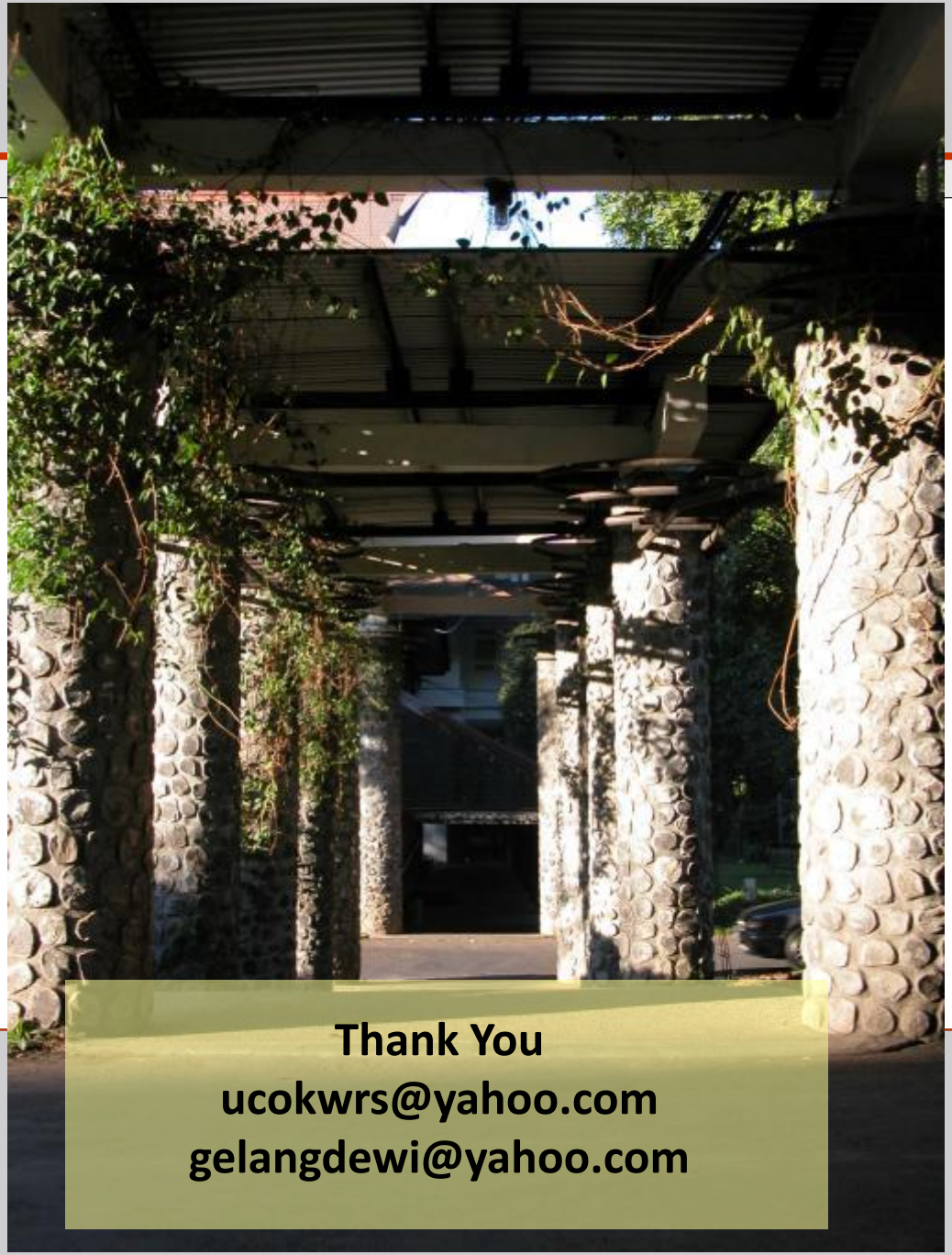
- CGE modeling provides insight into the role of a low-carbon energy system in terms of achieving Indonesia's GHG emissions reduction target.
- For moderate emission reduction target (CM1), implementation of energy efficiency measures combined with deployment of renewable energy would be sufficient.
- Electrification of end-user consumption is indicated by increases in the share of electricity in total energy consumption (CM1: 12.7% in 2030, BAU: 7.2% in 2030) plus increase renewable in power (4% in BAU vs 16% in CM1) reduces emission.
- CM2 needs more energy efficiency measures and deployment of renewables, coal + CCS power plants, more end-use electrification (17%). Renewables in the power mix increase to 22%, and 12% of coal power plants would be equipped with CCS systems.
- The emissions reductions that result from the mitigation actions in this modeling study are lower than Indonesia's energy sector emissions reduction targets (as proposed in the sectoral breakdown of Indonesia's INDC). The reason for this difference cannot be analyzed because the corresponding energy level and energy mix in 2030 are not provided in the INDC document.

Comparison Between Model Results (for NDC) and INDC

Scenario	NDC - Energy Sector			Present Study		
	Emission in 2030 $MtCO_2e$	Reduction from Baseline		Emission in 2030 $MtCO_2e$	Reduction from Baseline	
		$MtCO_2e$	%		$MtCO_2e$	%
Baseline	1444			1403		
Unconditional (CM1)	1191	253	17.5%	1193	216	15.4%
Conditional (CM2)	972	472	32.7%	1026	383	27.2%

Indonesia AIM energy team plans

- In the coming months, Indonesia climate change authority will prepare assessment and plans for Third National Communication and delineation of INDC.
- In addition, the energy authority will prepare the Master Plan of Indonesia Energy Development (derived from National Energy Policy Council Scenario), at the national and sub-National level
- Indonesia energy research team plans to contribute to those activities (through policy dialogues, focus group discussions) by using AIM approaches.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