The 23rd AIM International Workshop

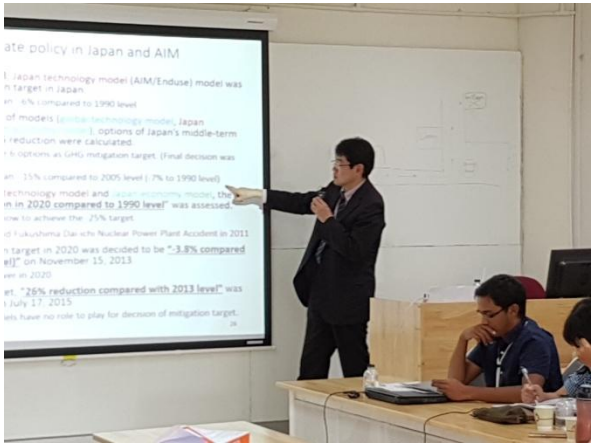
November 27-28, 2017
National Institute for Environmental Studies, Tsukuba, Japan

Thailand's NDC and AIM

Bundit Limmeechokchai

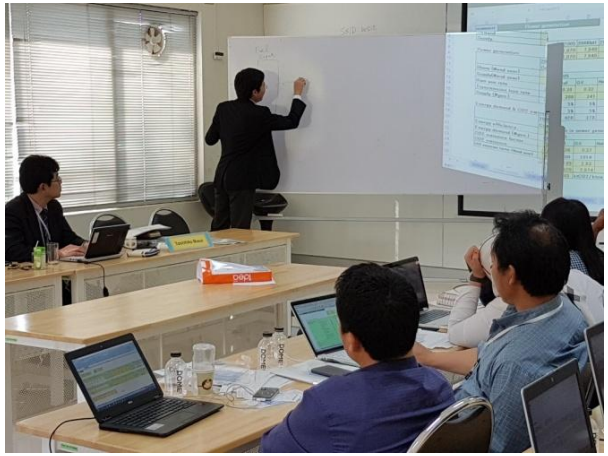
Sirindhorn International Institute of Technology

Thammasat University, Thailand


ate policy in Japan and AIM


SIIT
IGES
AIM Training Workshop
SIIT-TU, Thailand
January 30 - February 1, 2017


AIM Training Workshop




Climate Change Master Plan
2015-2050
CCMP Vision : 2050
Thailand becomes a Climate Change Resilient and Low-carbon Development Society Following Sustainable Development Pathway"
Approved by the Cabinet on July 14th 2015

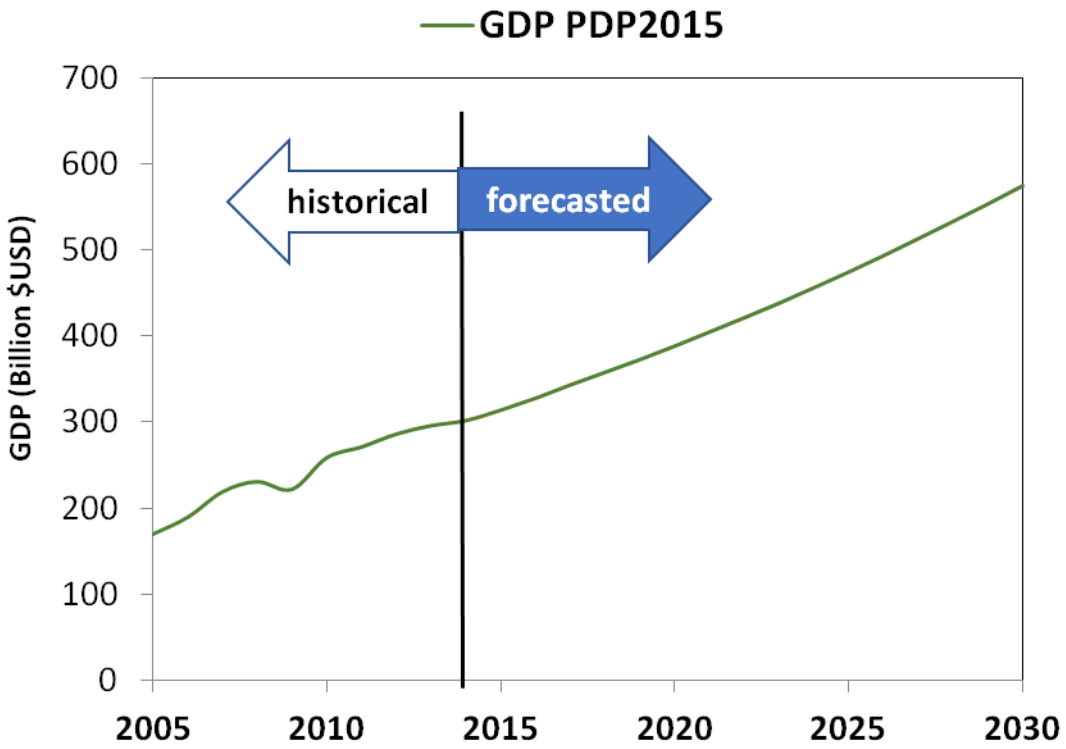

This building was donated by
The Federation of Thai Industries and Keidanren

Long-Term Economic Growth (2015-2036)

Year	2015	2016	2017	2018	2019	2020	2021	2022
GDP	4.0	4.4	4.7	4.3	4.1	4.2	4.2	4.1

Year	2023	2024	2025	2026	2027	2028	2029	2030
GDP	4.0	4.1	4.0	4.0	4.0	3.9	3.8	3.8

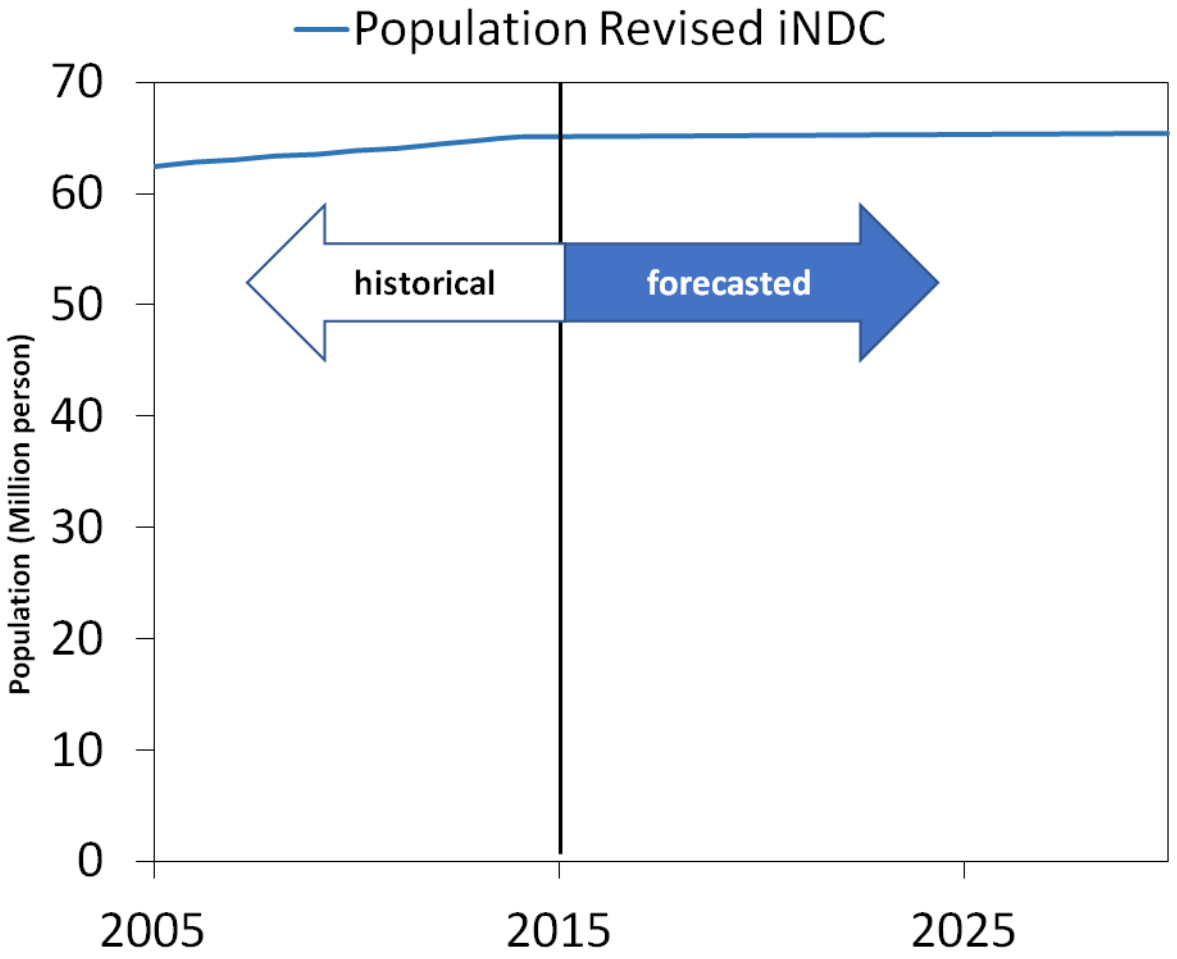
Source: PDP2015



Population Forecast

Population Assumption

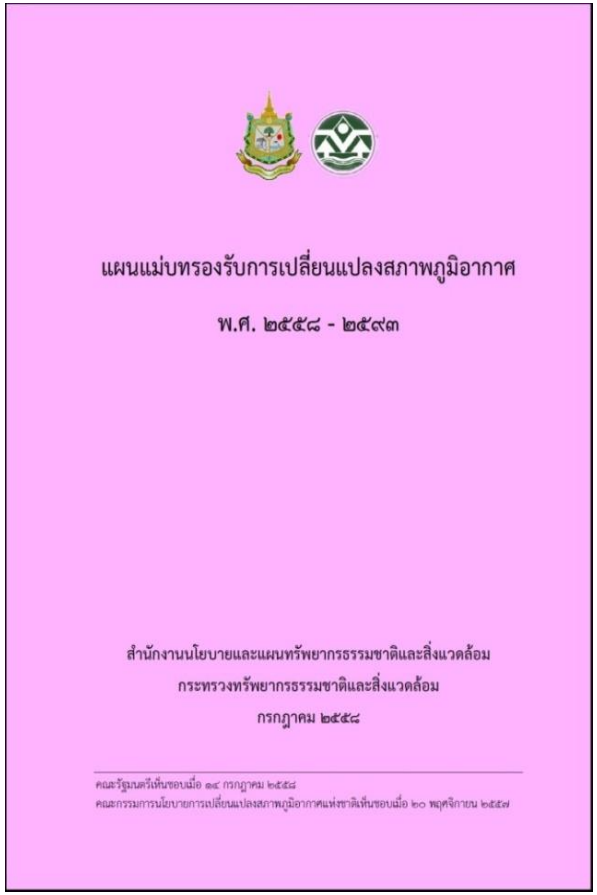
- **PDP2015:** 0.03% per annum



Thailand's Climate Change Master Plan 2050

Vision

"Thailand can achieve adaptation to climate change and will be a low carbon society in sustainable approach"



แผนแม่บทรองรับการเปลี่ยนแปลงสภาพภูมิอากาศ

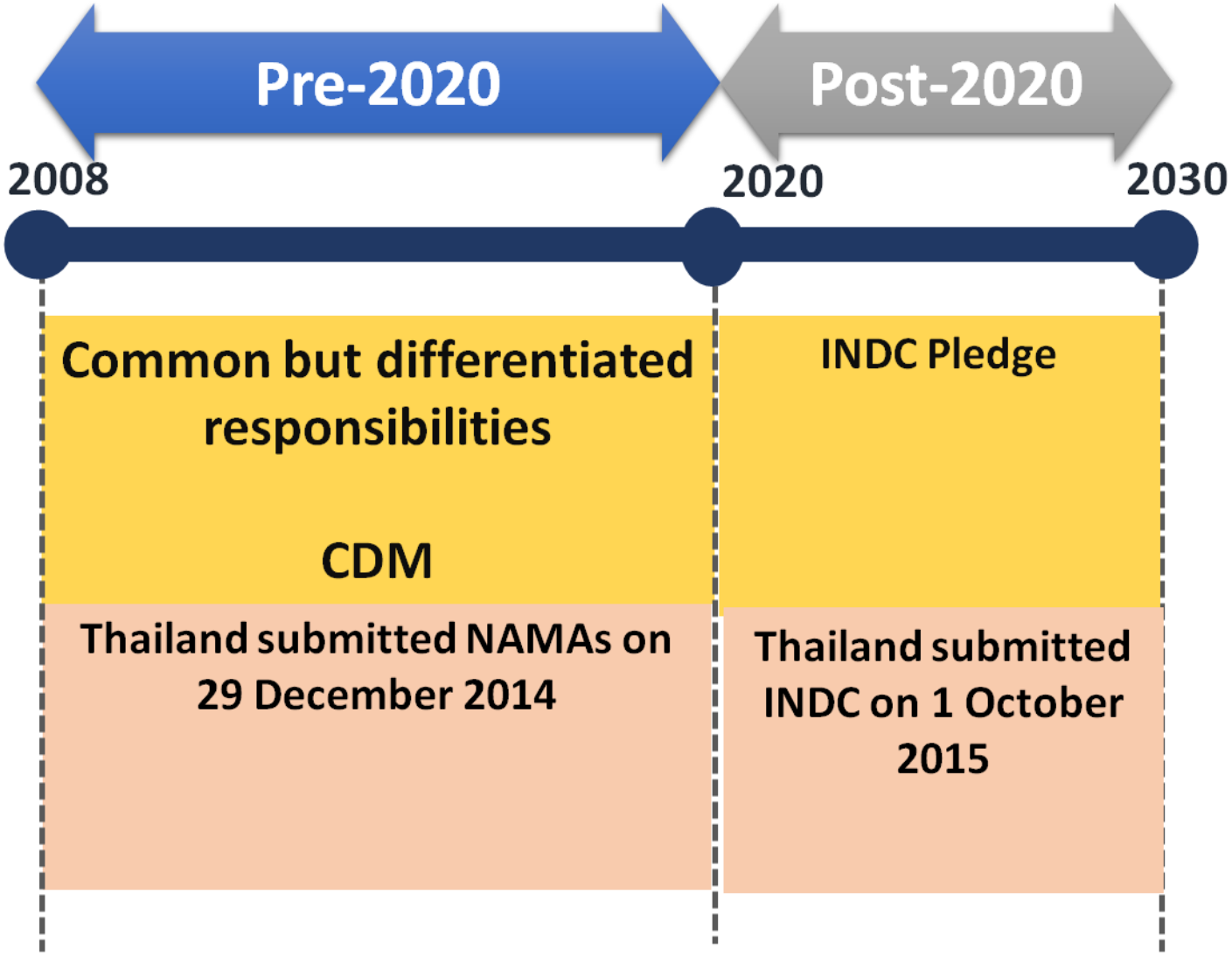
พ.ศ. ๒๕๕๘ - ๒๕๙๓

สำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม
กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม
กรกฎาคม ๒๕๕๘

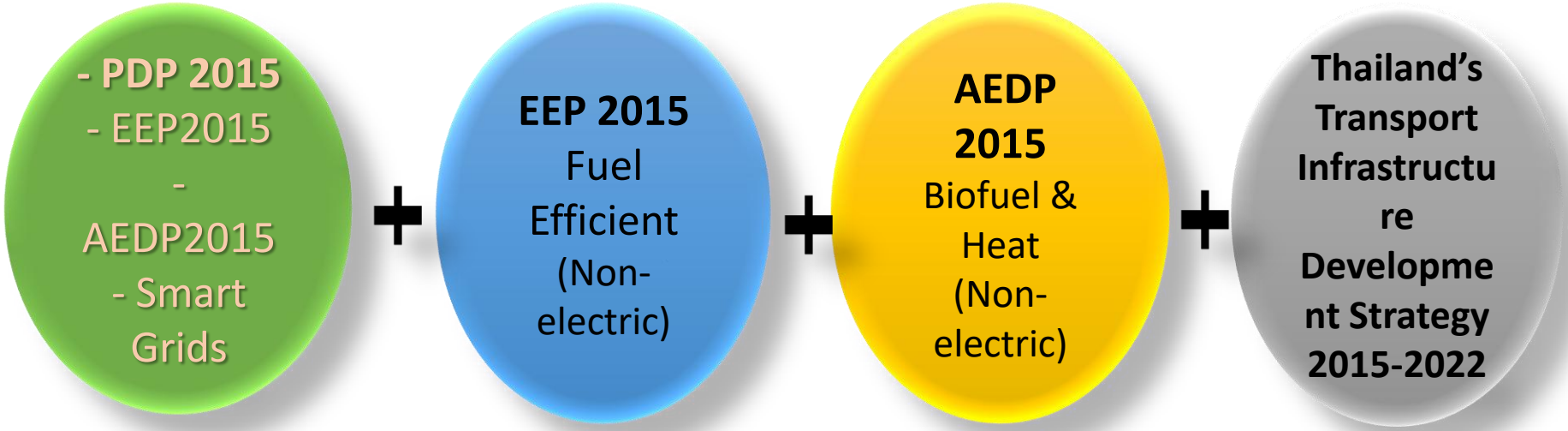
คณะรัฐมนตรีเห็นชอบเมื่อ ๑๔ กรกฎาคม ๒๕๕๘
คณะกรรมการนโยบายการเปลี่ยนแปลงสภาพภูมิอากาศแห่งชาติเห็นชอบเมื่อ ๒๐ พฤศจิกายน ๒๕๕๗

Approved by Cabinet on 14 July 2015

Thailand CO_2 emission targets



Innovation of Thailand's INDC – 2030 Mitigation Potential



Thailand Power Development Plan 2015-2036 (PDP2015)

- 3.94% of the average GDP growth rate (2014-2036), was estimated by NESDB
- **0.03% of the average population growth**
- 89,672 GWh was saved by EEDP in 2036
- 19,634 MW was set for the renewable energy development target by AEDP in 2036
- The power demand from BTS sky train, MRT train, and 10 mass rapid transit projects in Bangkok was included except those of the unclear high speed train projects.
- **Thailand smart grid master plan was included supporting the renewable energy sites**

Source: Thailand Power Development Plan 2015 (English Version)

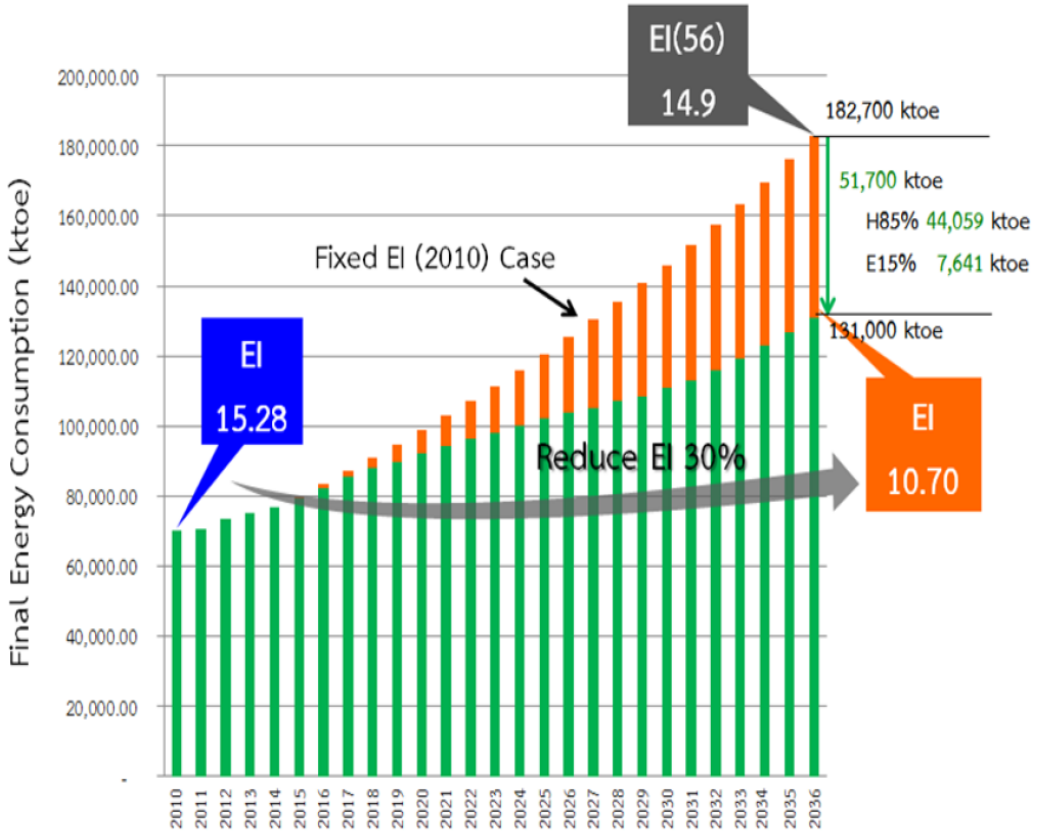
The Estimated Fuel Requirement for The PDP2015

Fuel types	2014	2026		2036	
	(%)	Installed capacity (MW)	(%)	Installed capacity (MW)	(%)
Import	7	6,421	10-15	12,347	15-20
Clean Coal & Lignite	20	6,480	20-25	8,133	20-25
Renewable Energy (include Hydro)	8	15,654	10-20	20,279	15-20
Natural Gas	64	33,362	45-50	26,298	30-40
Nuclear	-		-	2,000	0-5
Diesel and Fuel oil	1	342	-	1,277	-
Total		**62,260**		**70,335**	

Source: Thailand Power Development Plan 2015 (English Version)

Energy Efficiency Plan: EEP2015

- **PDP2015 already included the electricity demand from EEP**
- **30% energy intensity reduction in 2030 compared to 2010**



Final Energy Consumption Target by EEP

Source: Thailand Power Development Plan 2015 (English Version)

Electricity Savings in EEP2015

- **89,672 GWh of electricity can be saved by 2036**

SECTOR	Electricity Reduction Target (GWh)				
	2016	2021	2026	2031	2036
Industry	2,174	9,420	17,497	22,845	31,843
Commercial	853	5,156	12,687	22,406	37,052
Residential and agriculture	395	1,914	4,877	8,760	13,633
Government buildings	302	1,713	2,960	4,683	7,144
Total	**3,724**	**18,203**	**28,021**	**58,694**	**89,672**

Source: Thailand Power Development Plan 2015 (English Version)

Alternative Energy Development Plan: AEDP2015

Fuel type	2014 (MW)	2036 (MW)
1 Municipal Solid Waste	65.72	500.00
2 Industrial Waste	-	50.00
3 Biomass	2,451.82	5,570.00
4 Biogas (Waste Water/Waste)	311.50	600.00
5. Small Hydro	142.01	376.00
6 Biogas (Energy Crops)	-	680.00
7 Wind	224.47	3,002.00
8 Solar	1,298.51	6,000.00
9 Large hydro	-	2,906.40
Total Installed Capacity (MW)	**4,494.03**	**19,684.40**
Total Electricity Generation (GWh)	**17,217**	**65,588.07**
Total Electricity Demand (GWh)	174,467	326,119.00
Generated Electricity Ratio by RE (%)	**9.87**	**20.11**

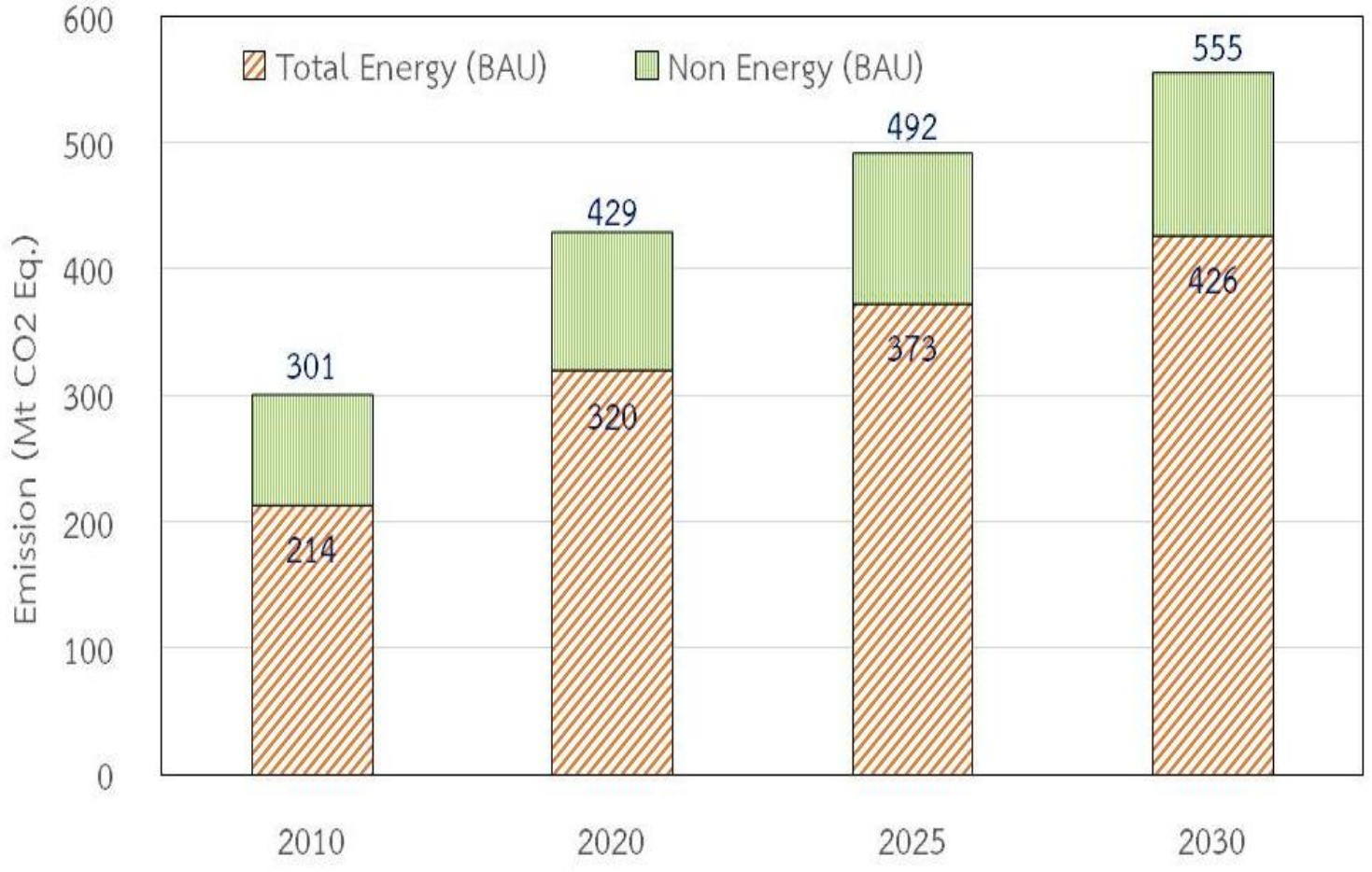
Alternative Energy Development Plan: AEDP2015

Fuel type	2014		2036	
	ML/day	ktoe	ML/day	ktoe
1.Biodiesel	2.89	909.28	14.00	4,404.82
2. Ethanol	3.21	872.88	11.30	2,103.50
3. Pyrolysis	-	-	0.53	170.87
4. Compressed Biogas (ton/day)	-	-	4,800.00	2,023.24
5. Other Renewable Energy	-	-	-	10.00
Total (ktoe)		**1,782.16**		**8,712.43**
Total Bio-fuel in Transport Sector		26,801.00		34,798.00
Bio-fuel Ratio in Transport Sector		**6.65**		**25.04**

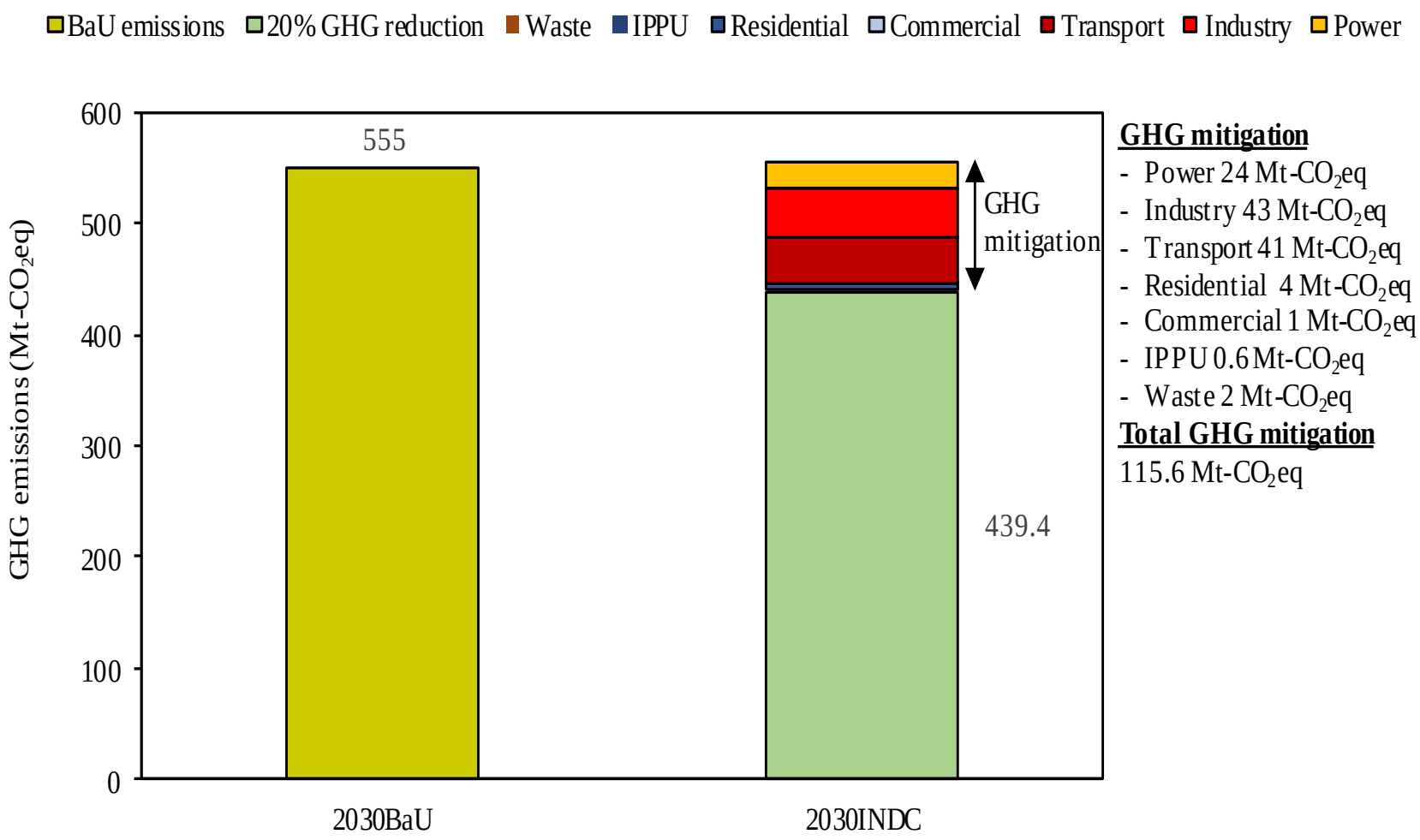
PM applauds 2030 Agenda, pledges word towards a sustainable Thailand including INDC 2030, UN NY, 30 Sept 2015

"... On Thailand's part, we reaffirm our Commitment under the **Intended Nationally Determined Contributions (INDCs)** to reduce our GHG emissions **between 20 and 25% by 2030**"...

Thailand's INDC
Economy-wide GHG Emissions in 2030



GHG reduction target in NDC Roadmap



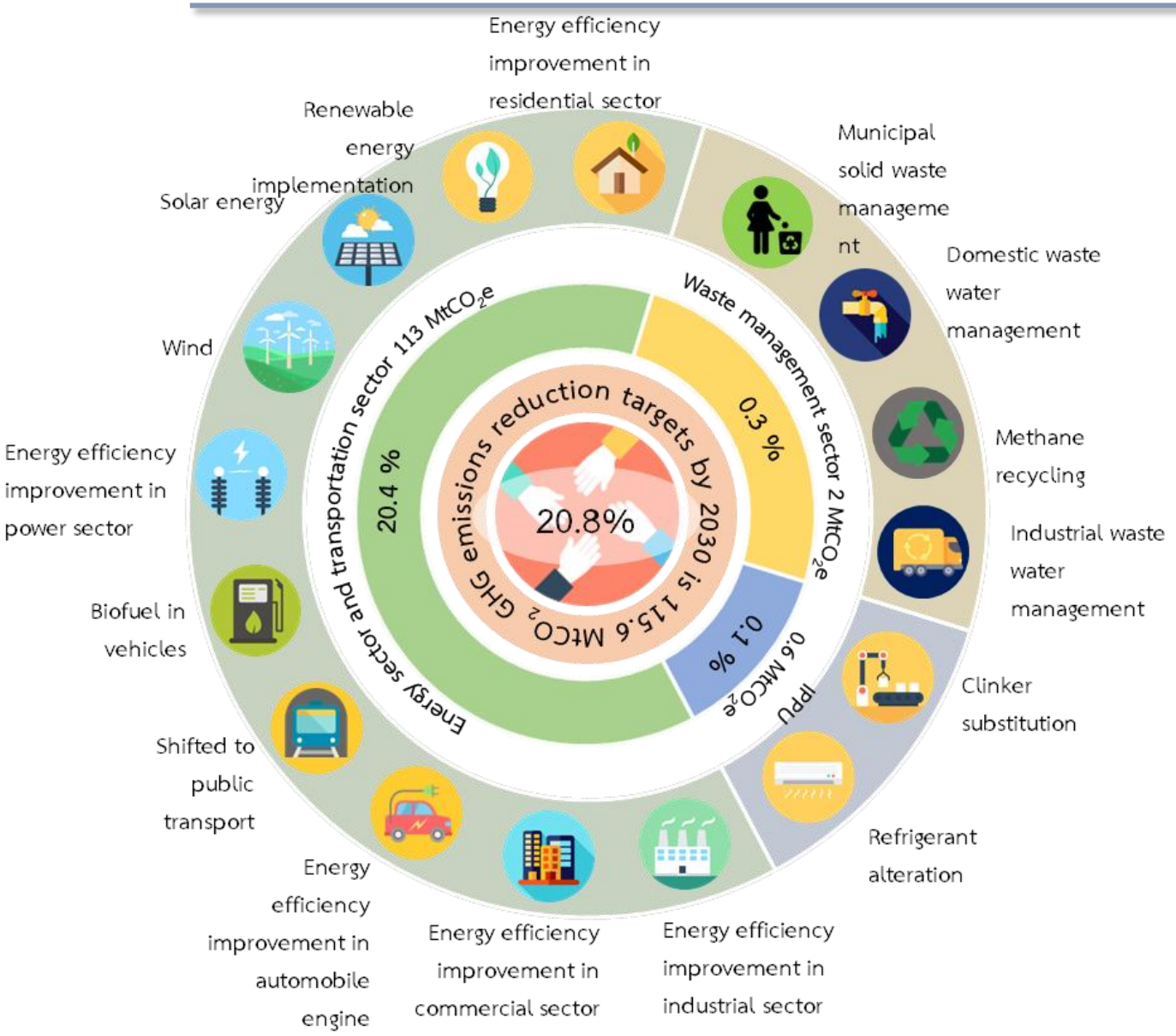
GHG mitigation

- Power 24 Mt-CO_2eq
- Industry 43 Mt-CO_2eq
- Transport 41 Mt-CO_2eq
- Residential 4 Mt-CO_2eq
- Commercial 1 Mt-CO_2eq
- IPPU 0.6 Mt-CO_2eq
- Waste 2 Mt-CO_2eq

Total GHG mitigation

115.6 Mt-CO_2eq

Thailand's NDC Roadmap 2030



Integrated Plans

- AEDP2015-2036
- EEP2015-2036
- PDP2015-2036
- Smart Grid (2015-2026)
- Transport Infrastructure Development Plan 2030
- Green Industry 2021
- Waste MP 2016-2021
- Invir Quality Improvement Plan 2017-2021
- RAC NAMA

CMs in Energy sector and Transport Sector

Unit: Mt-CO_2e

Measure	2020	2025	2030	
Electricity generation sector	14.62	20.71	24.00	
1. Energy efficiency improvement	2.87	5.84	6.00	4.3%
2. Implementation and deployment of renewable energy (e.g. biomass, ground-mounted solar farm, wind, MSW, hydropower)	11.75	14.87	18.00	
Residential sector	1.63	2.82	4.00	
3. Energy efficiency improvement (e.g. lighting and cooling system etc.)	1.19	2.06	2.79	0.7%
4. Renewable energy and alternative energy deployment	0.44	0.76	1.21	
Commercial sector	0.19	0.56	1.00	
5. Energy efficiency improvement (e.g. heating system and cooling system etc.)	0.19	0.56	1.00	0.2%
Manufacturing industrial sector	13.82	27.92	43.00	
6. Energy efficiency improvement (e.g. heating system, cooling system etc.)	2.38	8.27	11.00	7.4%
7. Renewable energy and alternative energy deployment (e.g. solar rooftop)	11.45	19.65	32.00	
Transport sector	9.37	23.83	41.00	
8. Energy efficiency improvement (e.g. engines efficiency improvement)	7.08	18.02	31.00	7.8%
9. Biofuel used in vehicles	2.28	5.81	10.00	
20.4% Total	39.63	75.83	113.00	

CMs in Waste sector

Unit: Mt-CO_2e

Measure	2020	2025	2030	
Municipal Solid Waste (MSW) management	0.36	0.79	1.30	0.2 %
10. MSW reduction				
Waste water management	0.20	0.43	0.70	0.1%
11. Collect methane gas from industrial waste water to increase biogas capacity				
12. Other Industrial waste water management				
13. Domestic waste water management				
0.3% Total	**0.56**	**1.22**	**2.00**	

CMs in Industrial Processes and Product Use (IPPU)

Unit: Mt-CO_2e

Measure	2020	2025	2030
IPPU	**0.06**	**0.30**	**0.60**
14. Clinker substitution (Clinker to cement ratio)	0.00	0.15	0.30
15. Refrigerant substitution/alteration	0.06	0.15	0.30
0.1% Total	**0.06**	**0.15**	**0.30**

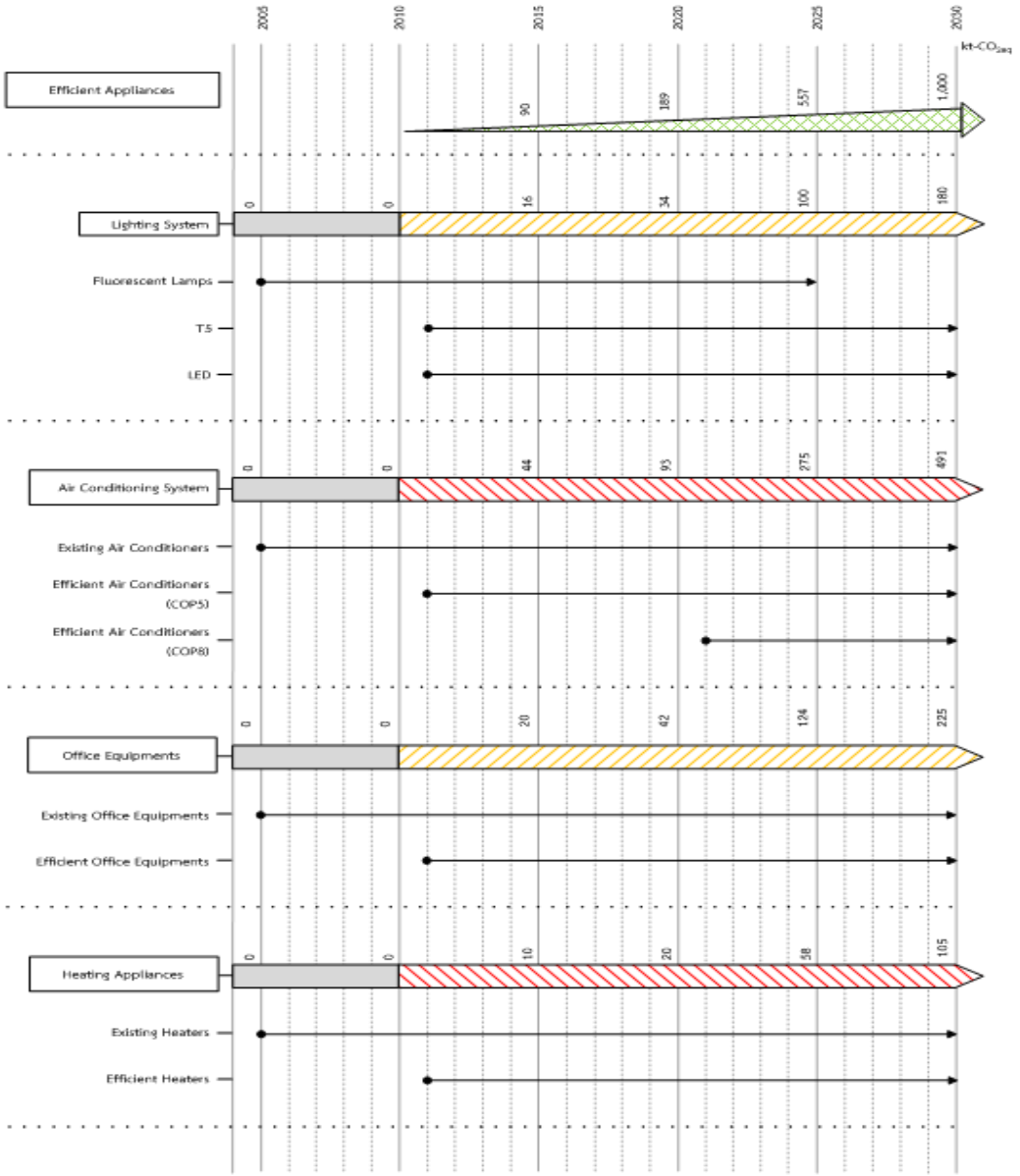
0.1%

AIM/Enduse Analyses: Thailand's NDC Roadmap

NDC Roadmap in Buildings

Energy Efficiency Measures

EE

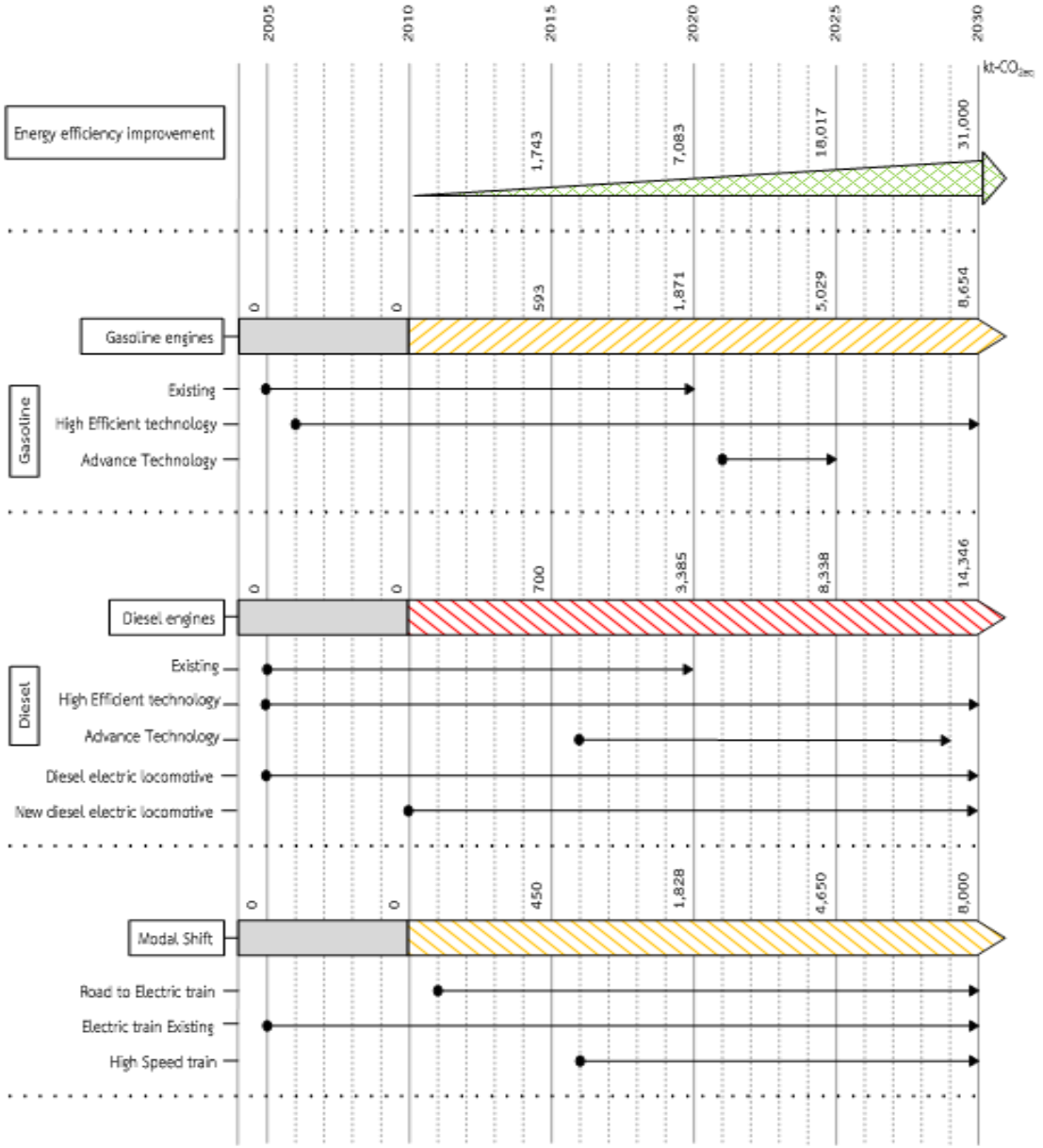


AIM/Enduse Analyses: Thailand's NDC Roadmap

NDC Roadmap in Transport

Energy Efficiency Measures

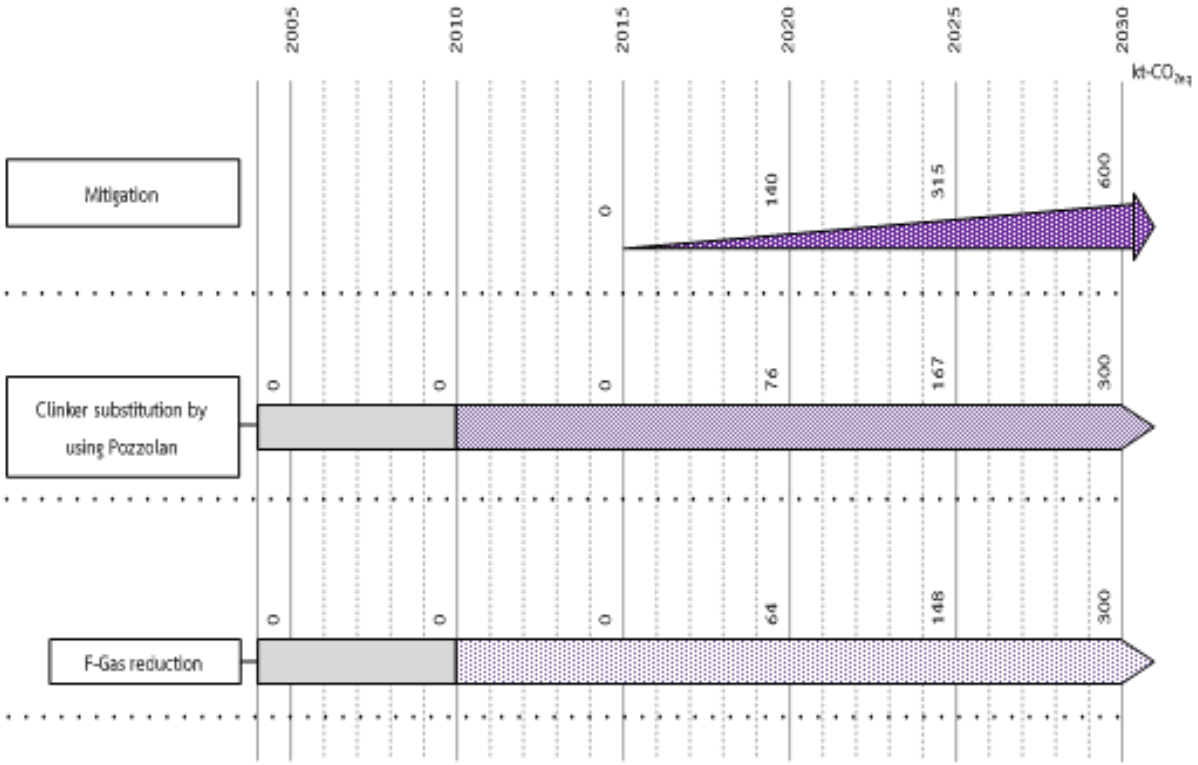
EE



AIM/Enduse Analyses: Thailand's NDC Roadmap

NDC Roadmap in IPPU Sector

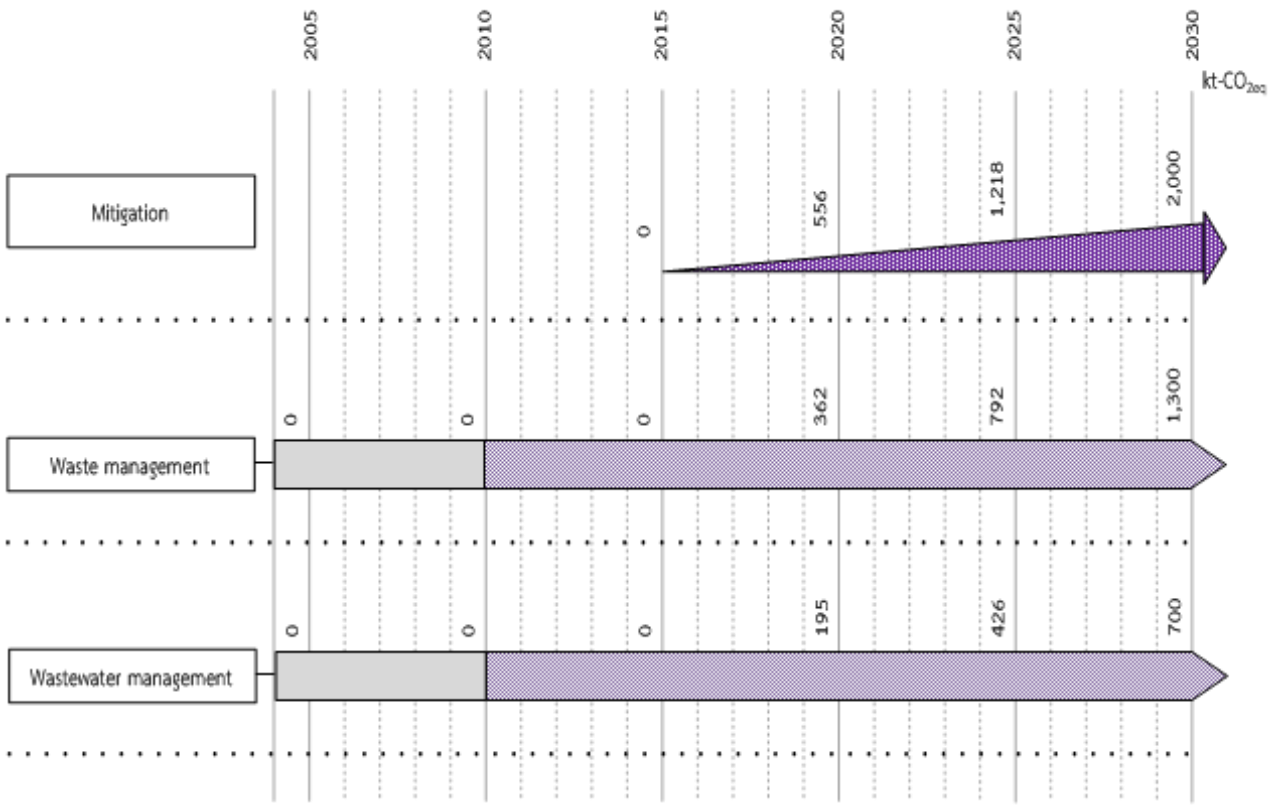
Material Substitution Measures



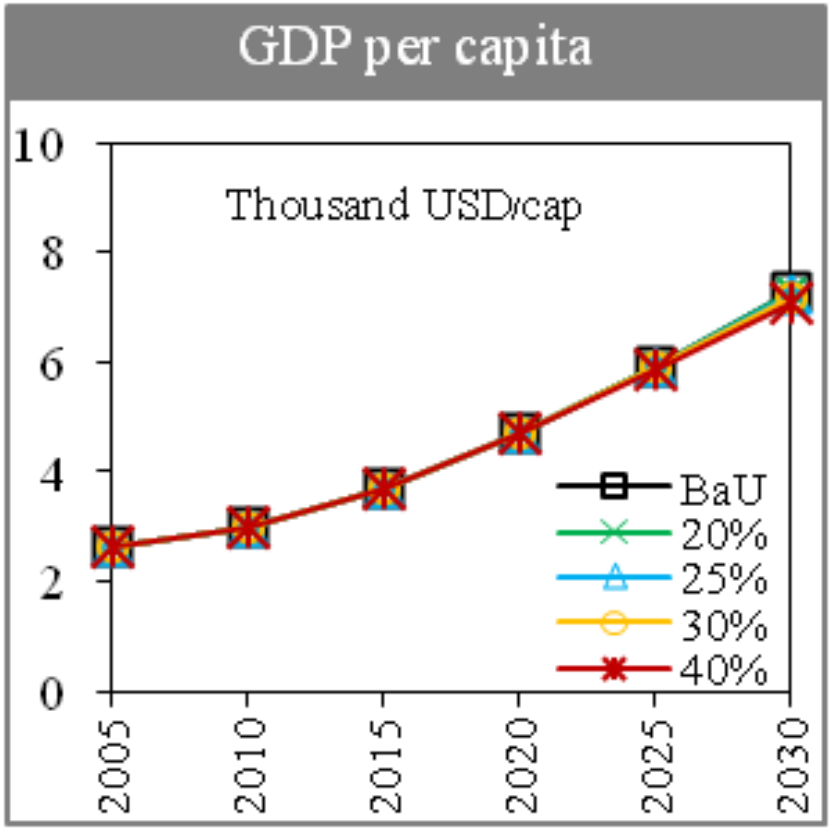
AIM/Enduse Analyses: Thailand's NDC Roadmap

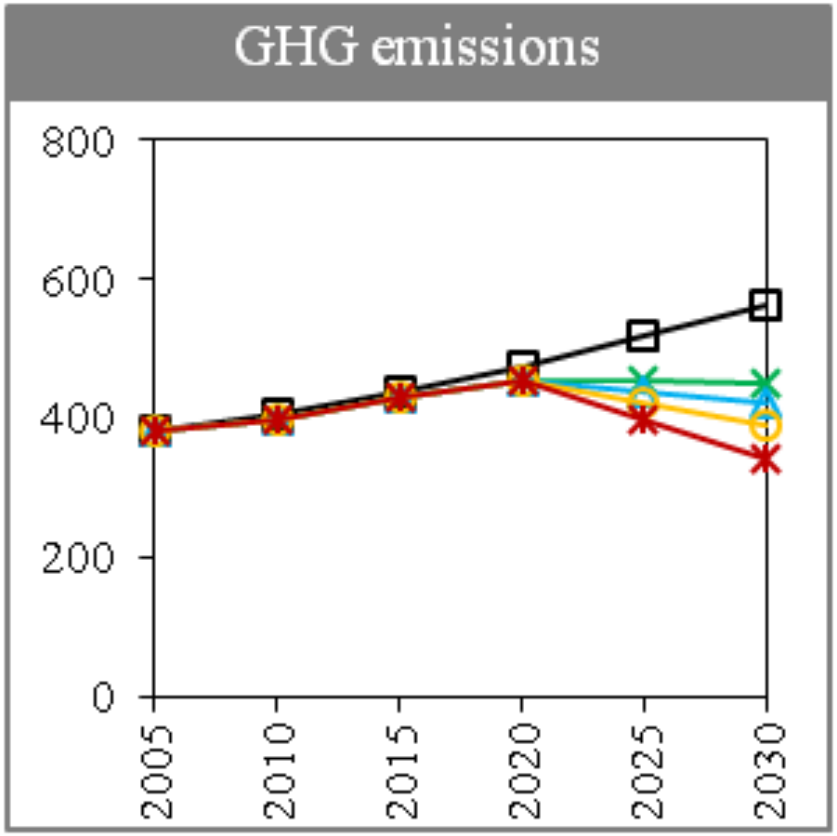
NDC Roadmap in Waste Sector

Management Measures

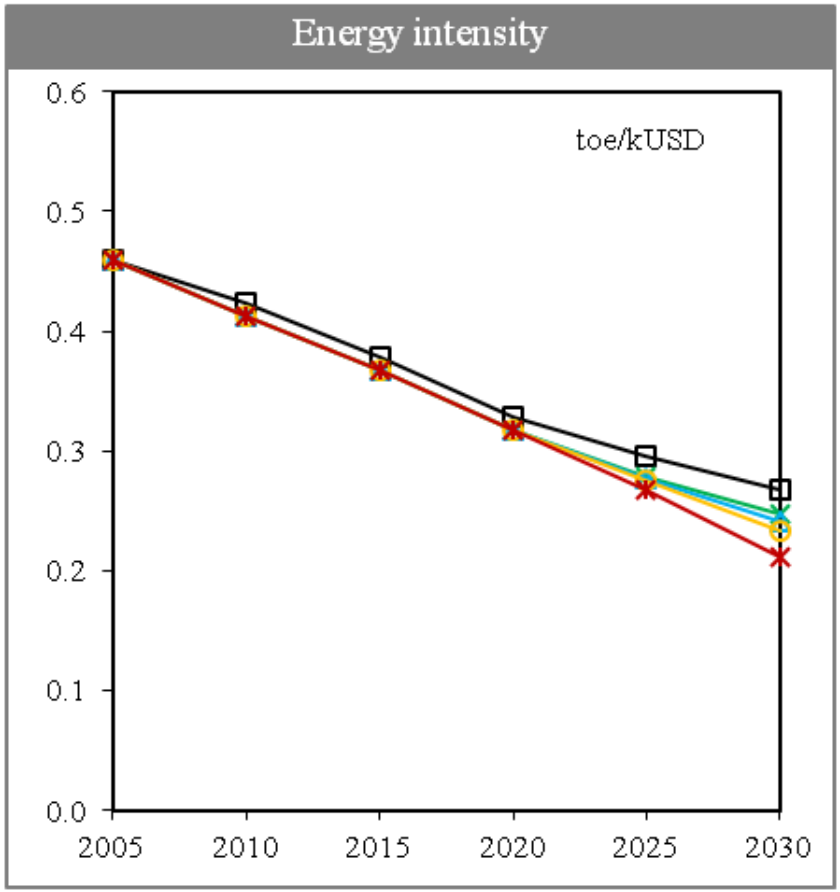


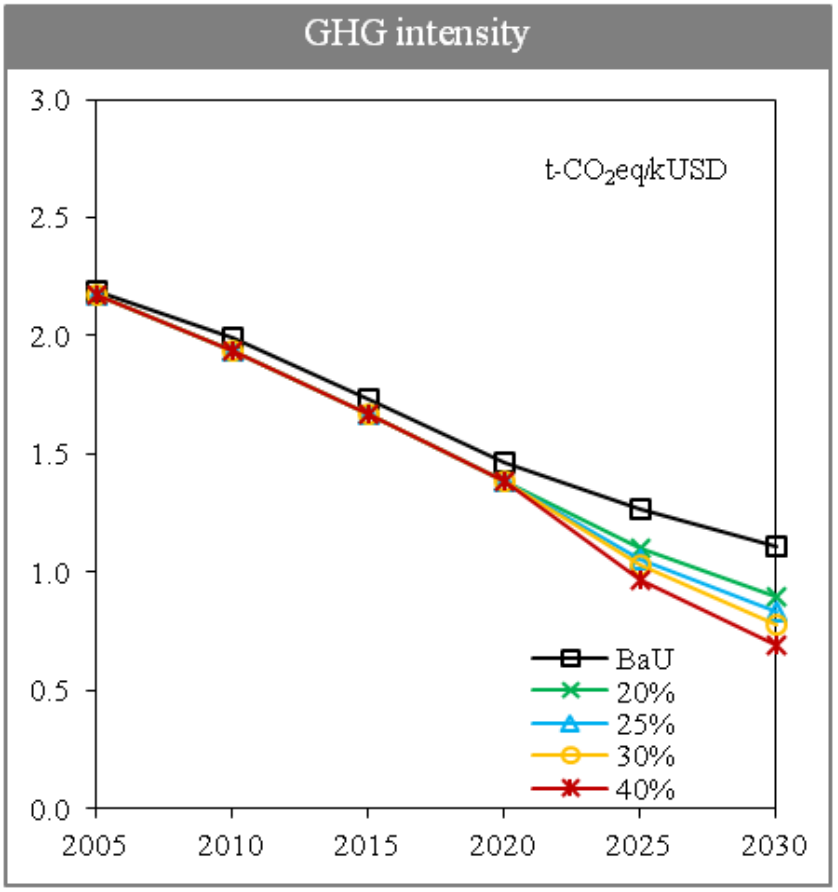
AIM/CGE Analyses:
Effects of GHG mitigation targets on per capita GDP and GHG emissions



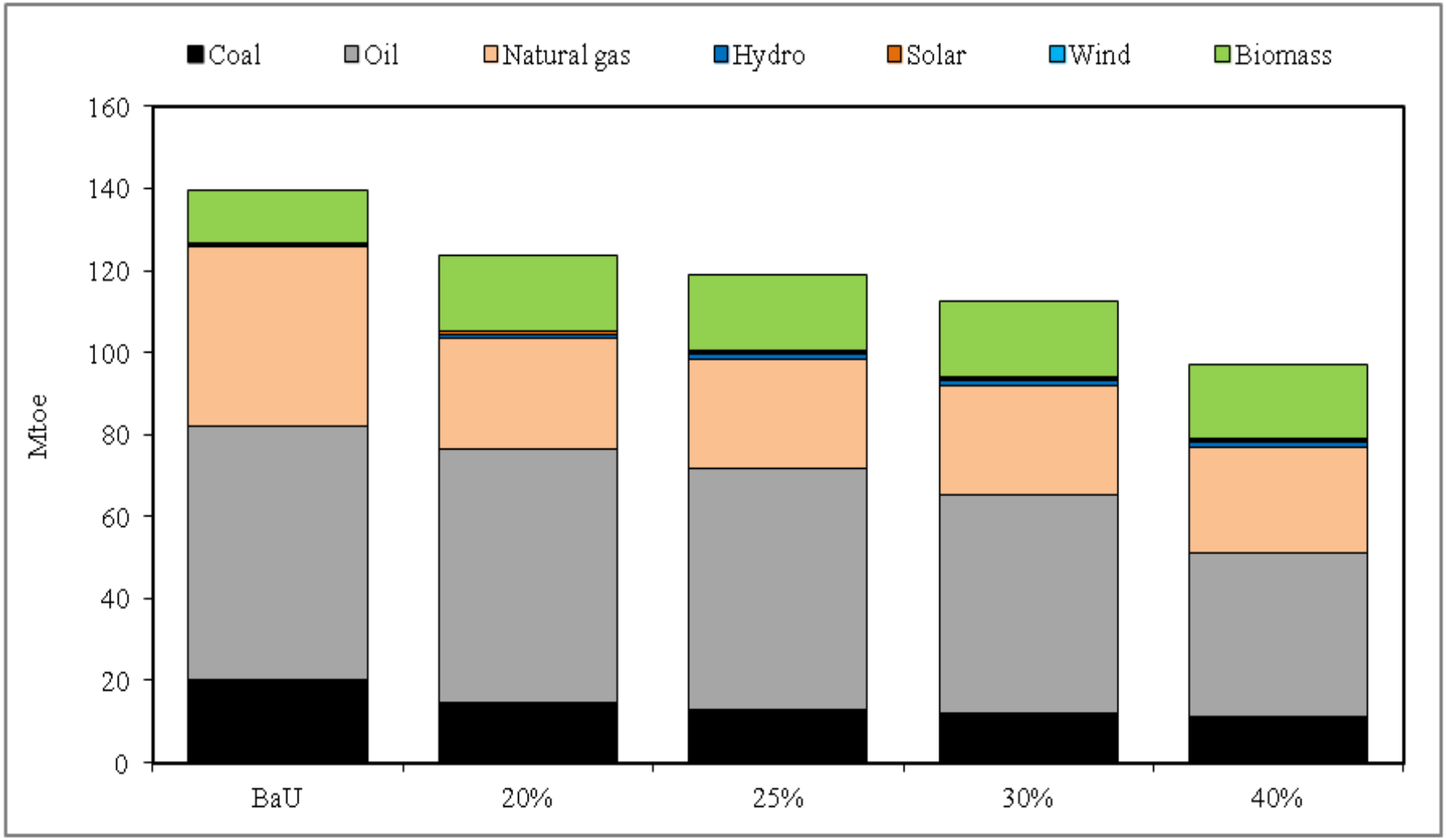


AIM/CGE Analyses:
Effects of GHG mitigation targets on Energy Intensity and GHG Intensity

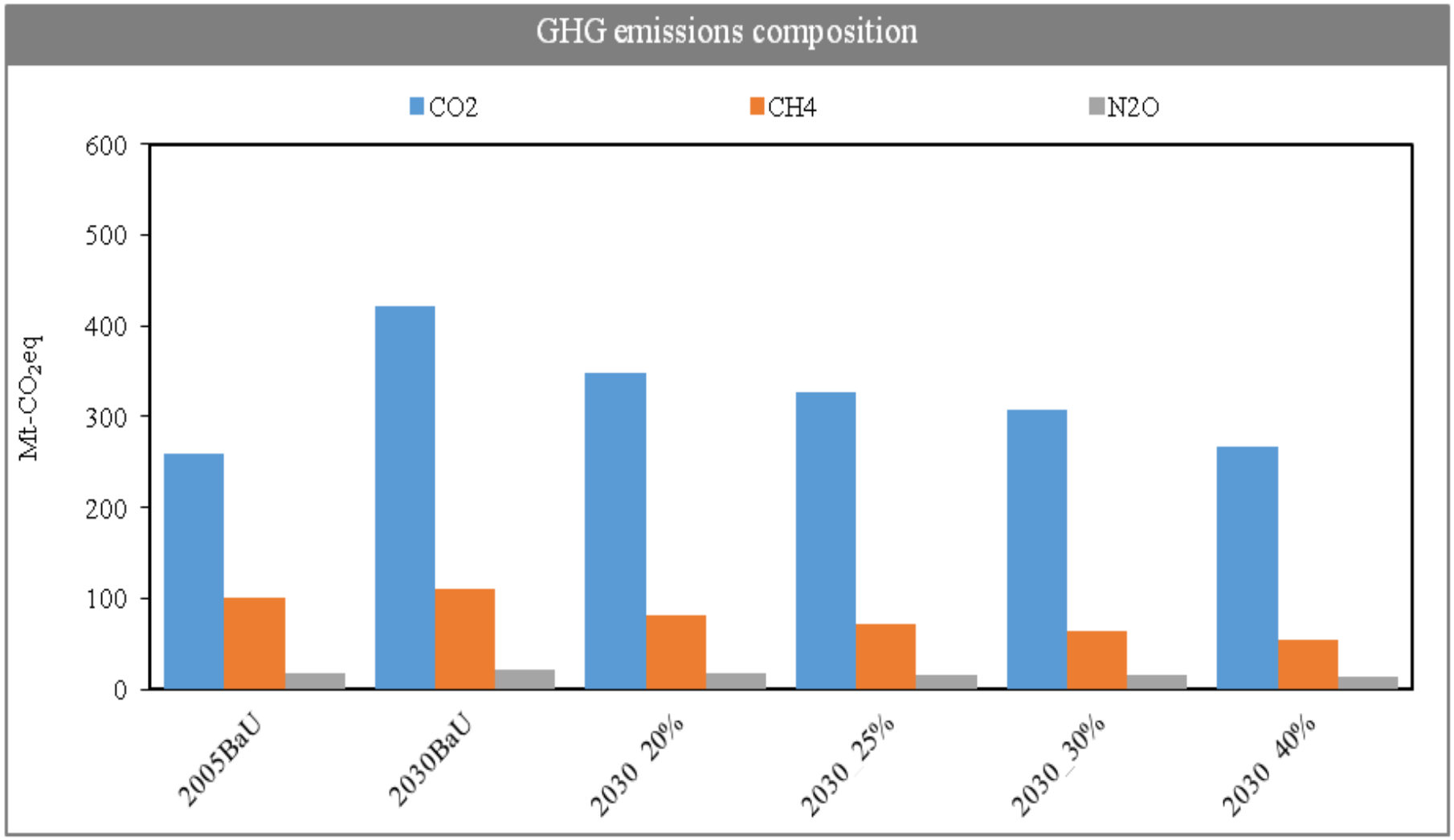




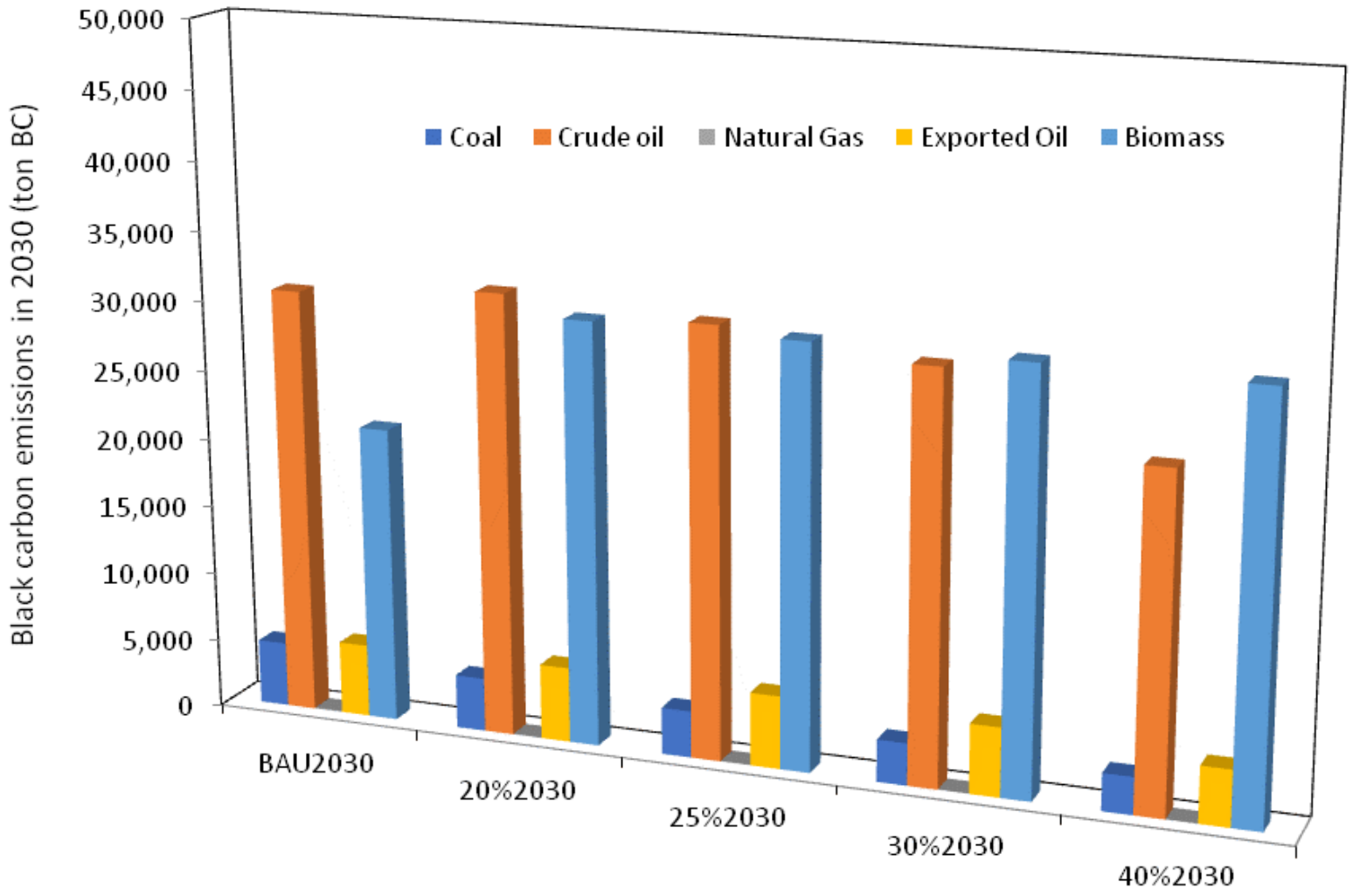
AIM/CGE Analyses:
Effects of GHG mitigation targets on Energy Mix



AIM/CGE Analyses:
Effects of GHG mitigation targets on GHG Composition



AIM/CGE Analyses:
Co-benefits of GHG mitigation targets
Black Carbon in 2030



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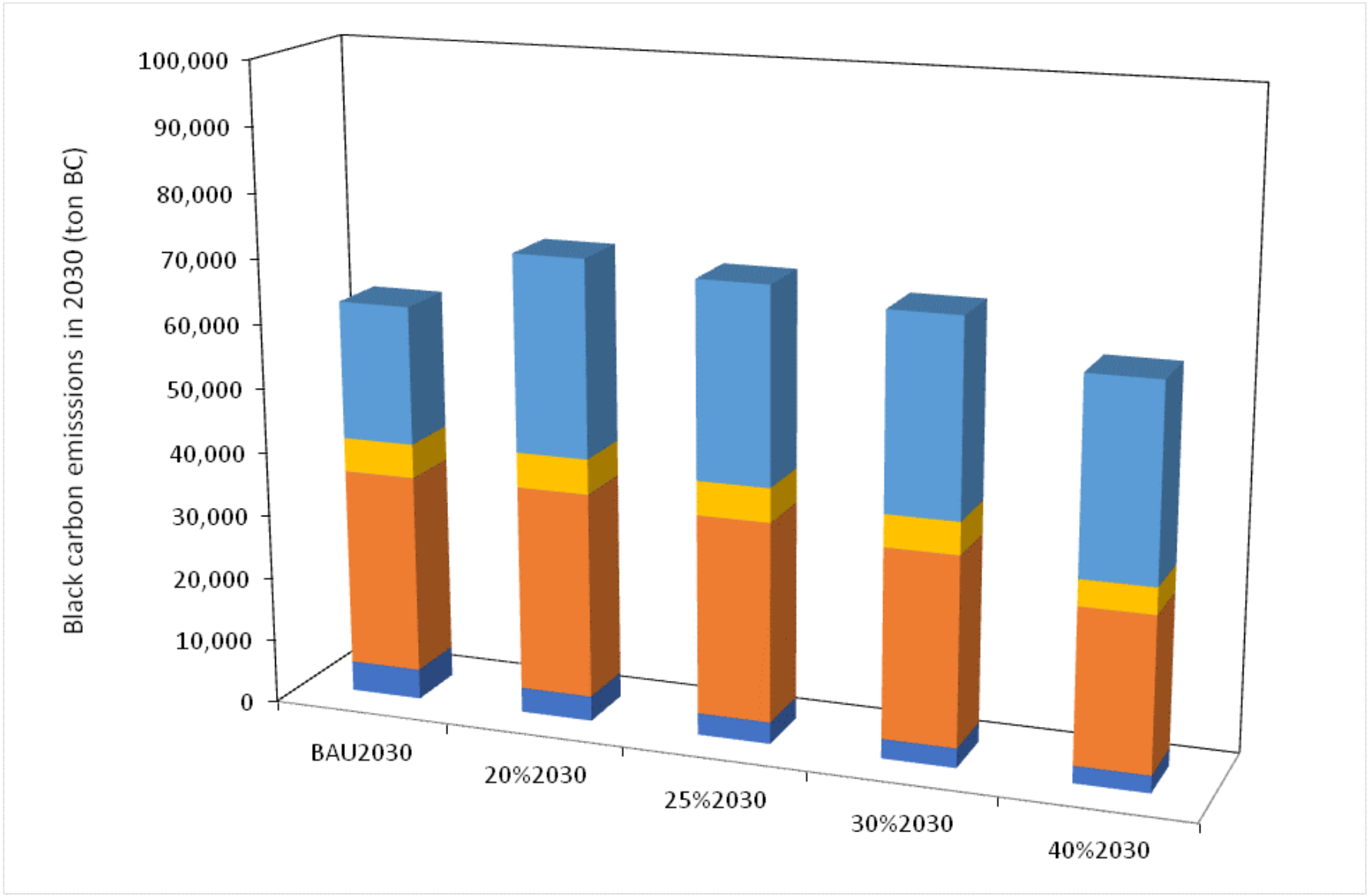
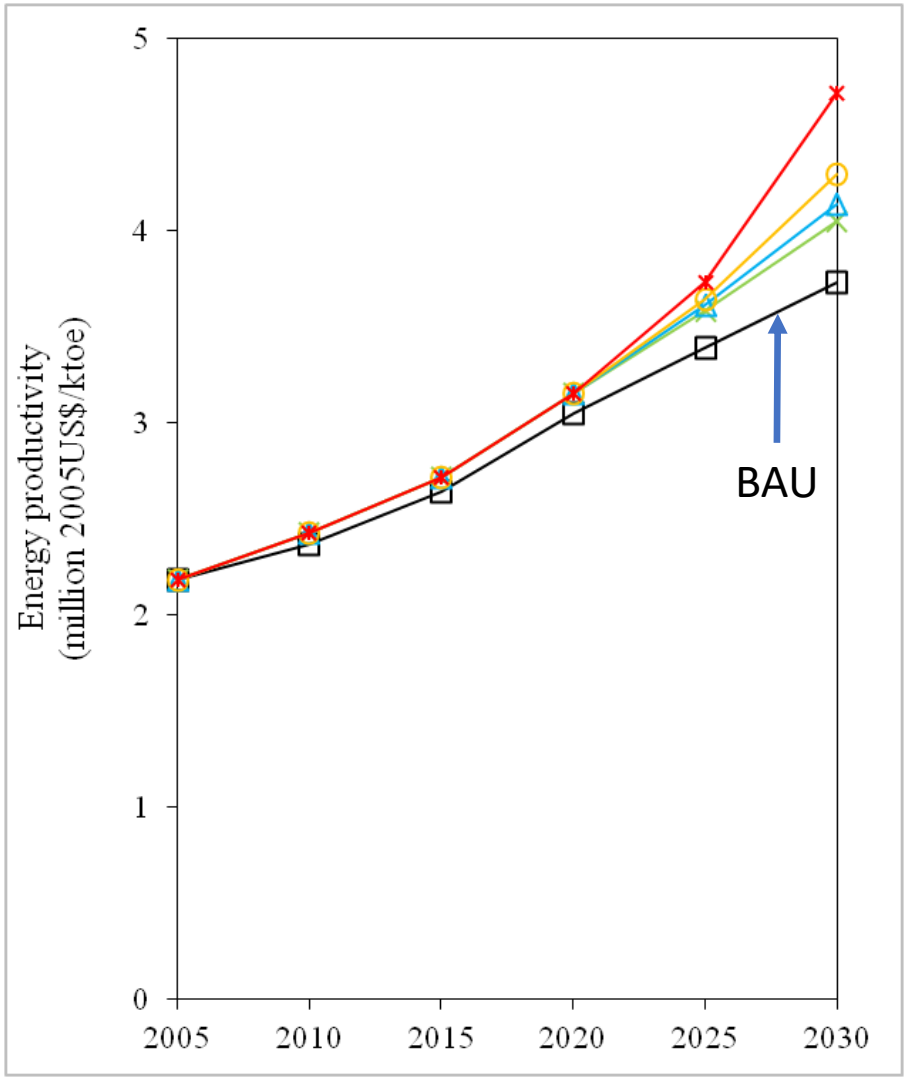
Co-benefits of GHG mitigation targets
Black Carbon in 2030



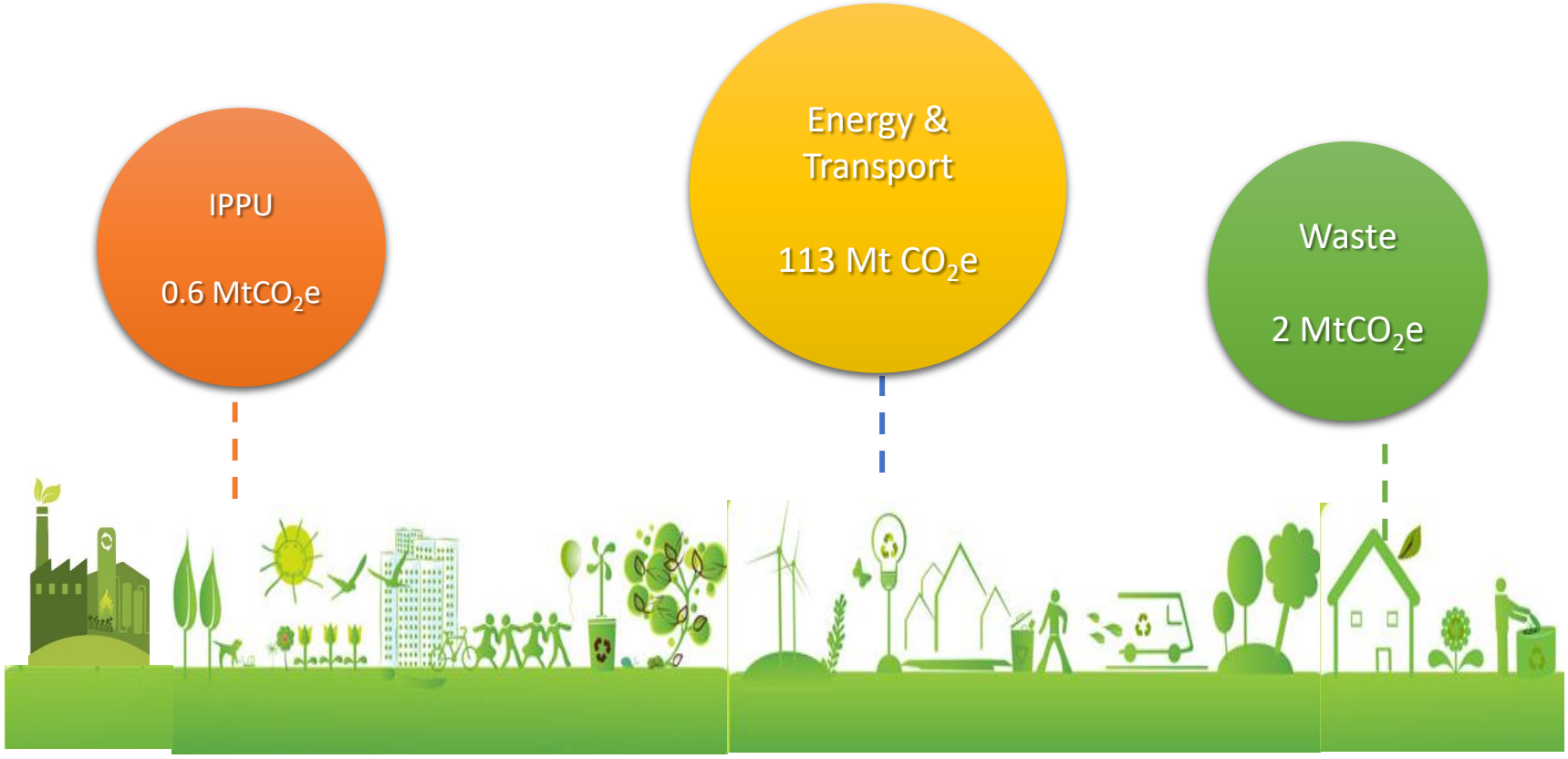
Energy Productivity (GDP/ktoe)

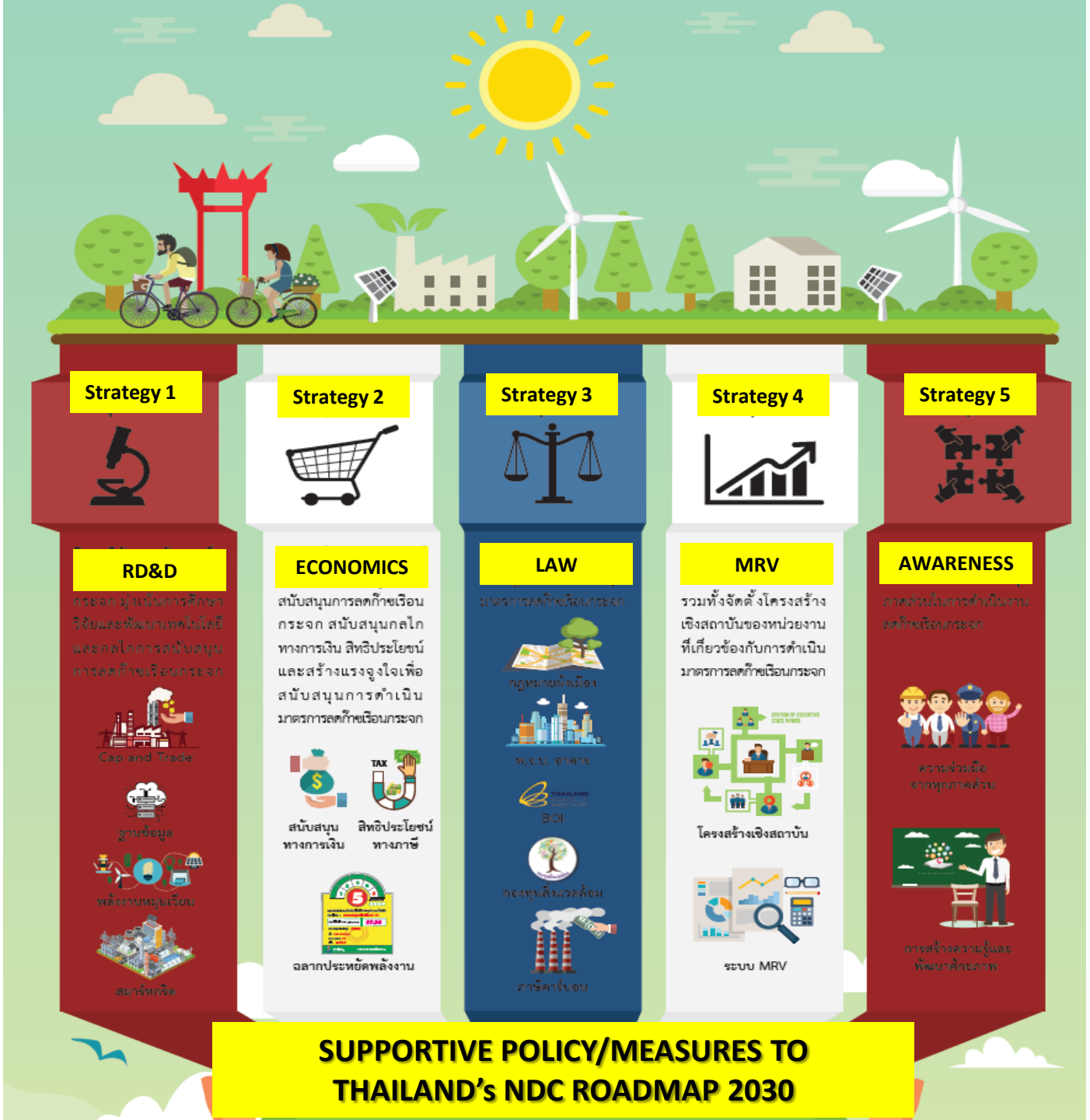


Unit: million 2005 US$/ktoe

	2005	2010	2015	2020	2025	2030
BaU	2.18	2.36	2.64	3.05	3.39	3.73
20%	2.18	2.43	2.72	3.15	3.58	4.05
25%	2.18	2.43	2.72	3.15	3.61	4.14
30%	2.18	2.43	2.72	3.15	3.64	4.29
40%	2.18	2.43	2.72	3.15	3.73	4.72

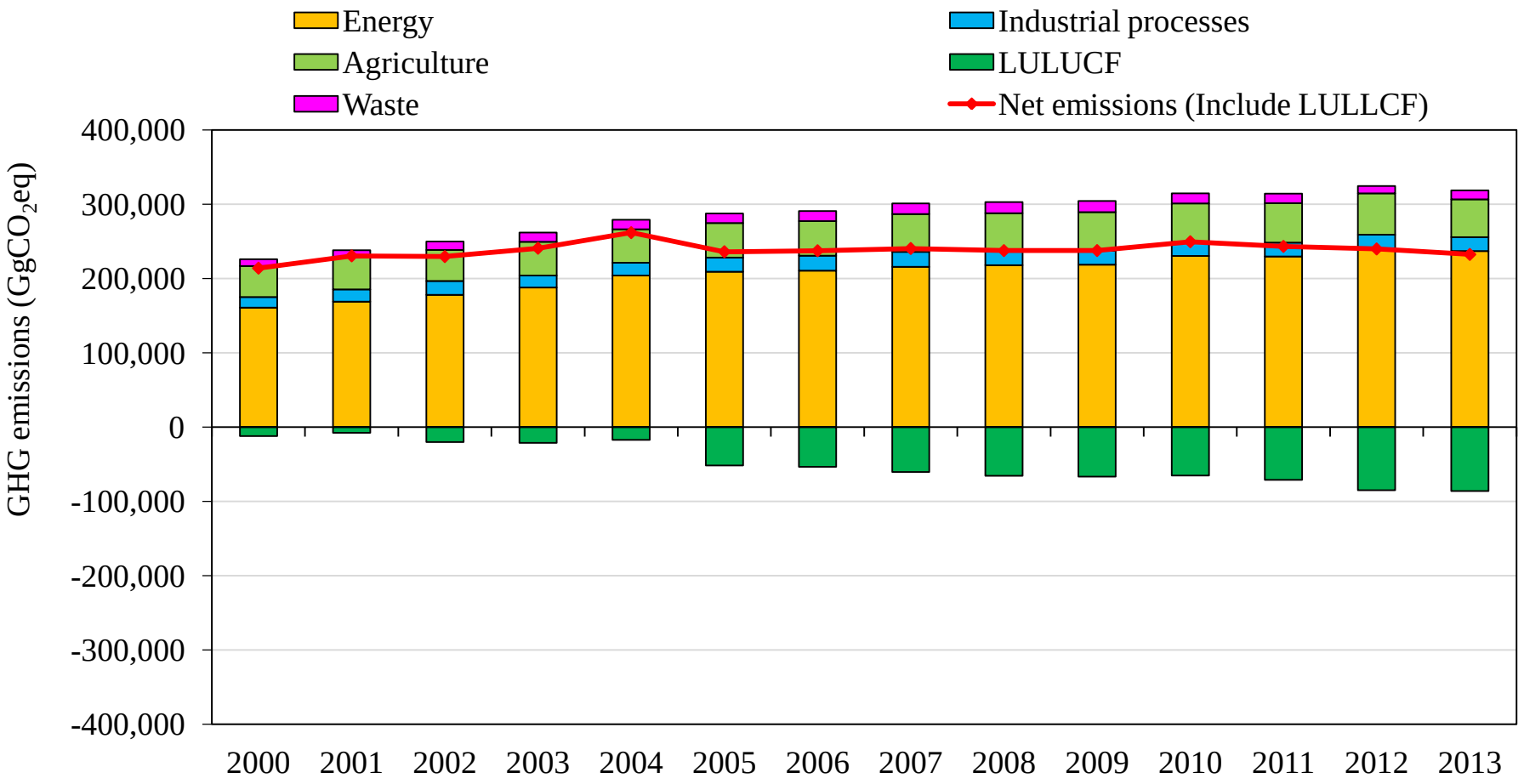
Thailand's NDC





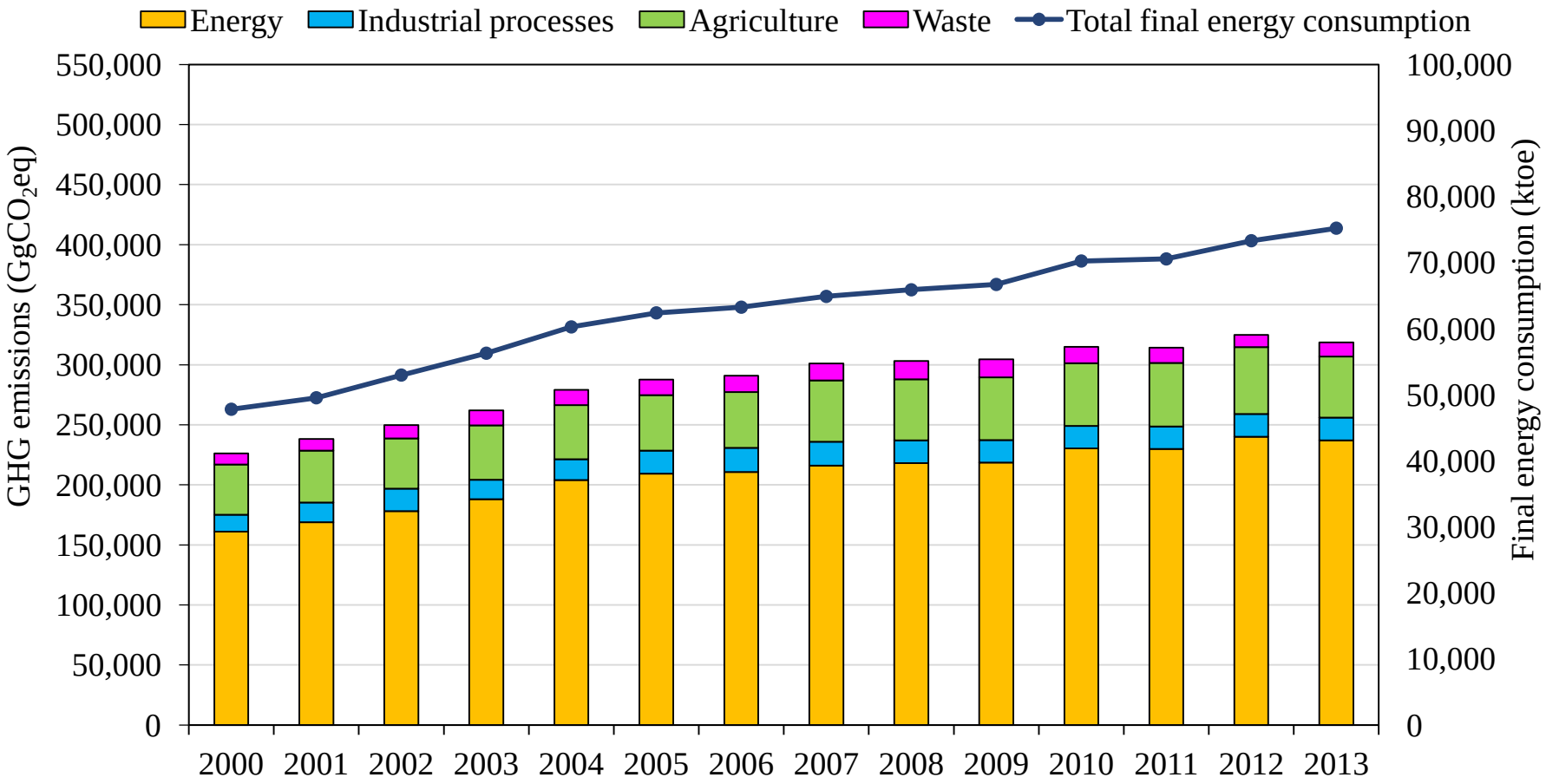
SUPPORTIVE POLICY/MEASURES TO THAILAND's NDC ROADMAP 2030

Thailand BUR2 (GHG Inventory)



Source: Thailand BUR1 (UNFCCC, 2017)

CO_2 emissions are decoupled from TFEC THAILAND

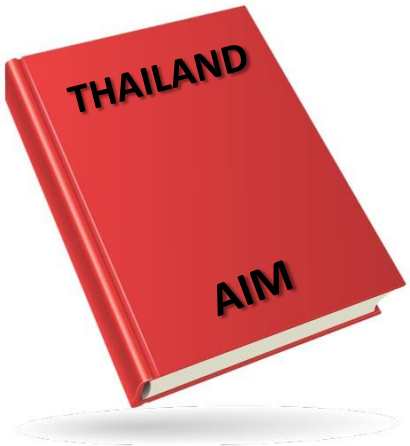


Thailand's National Communication (TNC) & AIM

CHAPTER 3

MITIGATION MEASURES

As mentioned, both Thailand's NAMAs and Thailand's NDC were developed on the basis of **Business-as usual (BAU)** (Figure 3.1). The BAU scenario was created by using the Asia-Pacific Integrated Assessment Model (AIM). The AIM model has been developed by the collaboration between the National Institute for Environmental Studies (NIES) Japan, Kyoto University, the Mizuho Information & Research Institute, and other Asian researchers including Thailand. The AIM model also focuses on relevant policies to support low-carbon pathways.



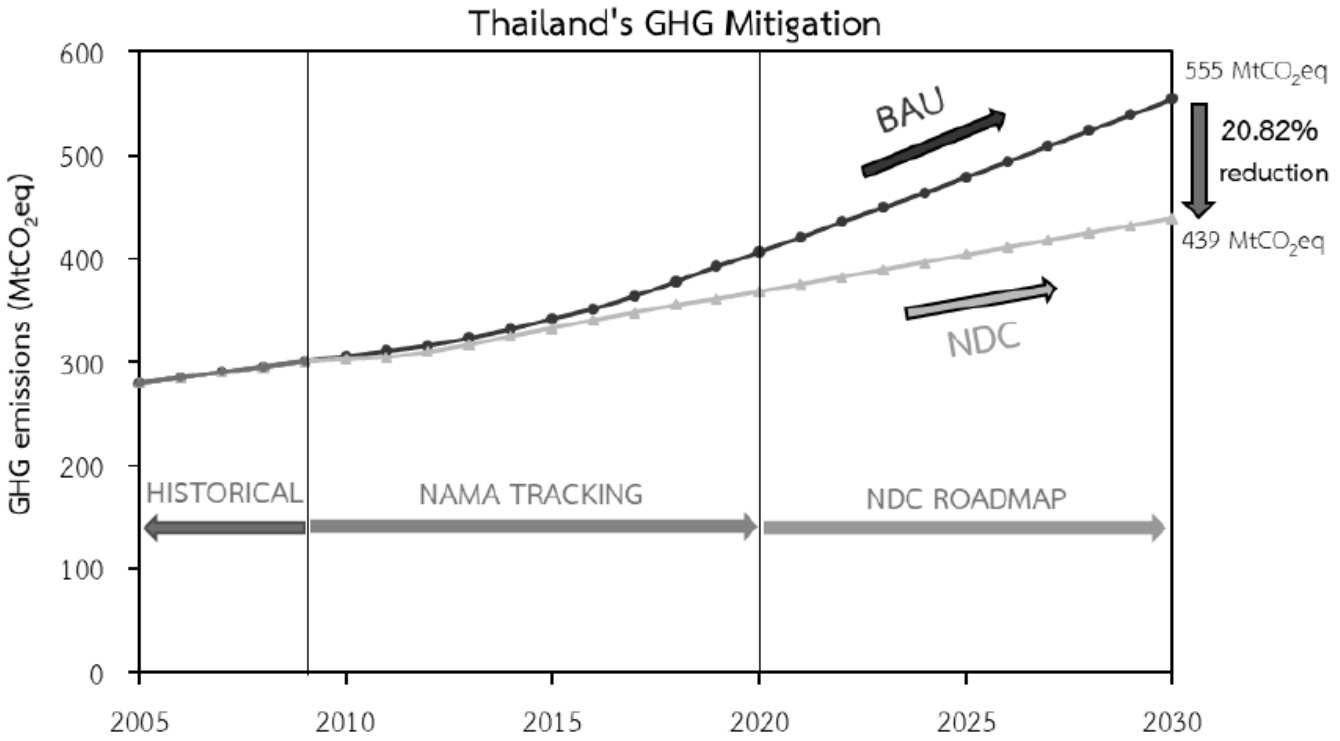


Figure 3.1 Thailand's GHG mitigation: NAMA 2020 and NDC 2030.

Renewable Energy 114 (2017) 1294–1305

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Renewable energy achievements in CO_2 mitigation in Thailand's NDCs

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Sustainable Energy Technologies and Assessments 21 (2017) 121–141

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Assessment of long-term low emission power generation in Sri Lanka and Thailand

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2017 International Conference on Alternative Energy in Developing Countries and Emerging Economies

CO_2 Reduction Perspective in Thailand's Transport sector towards 2030

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Electric and Biogas Stoves as Options for Cooking in Nepal and Thailand

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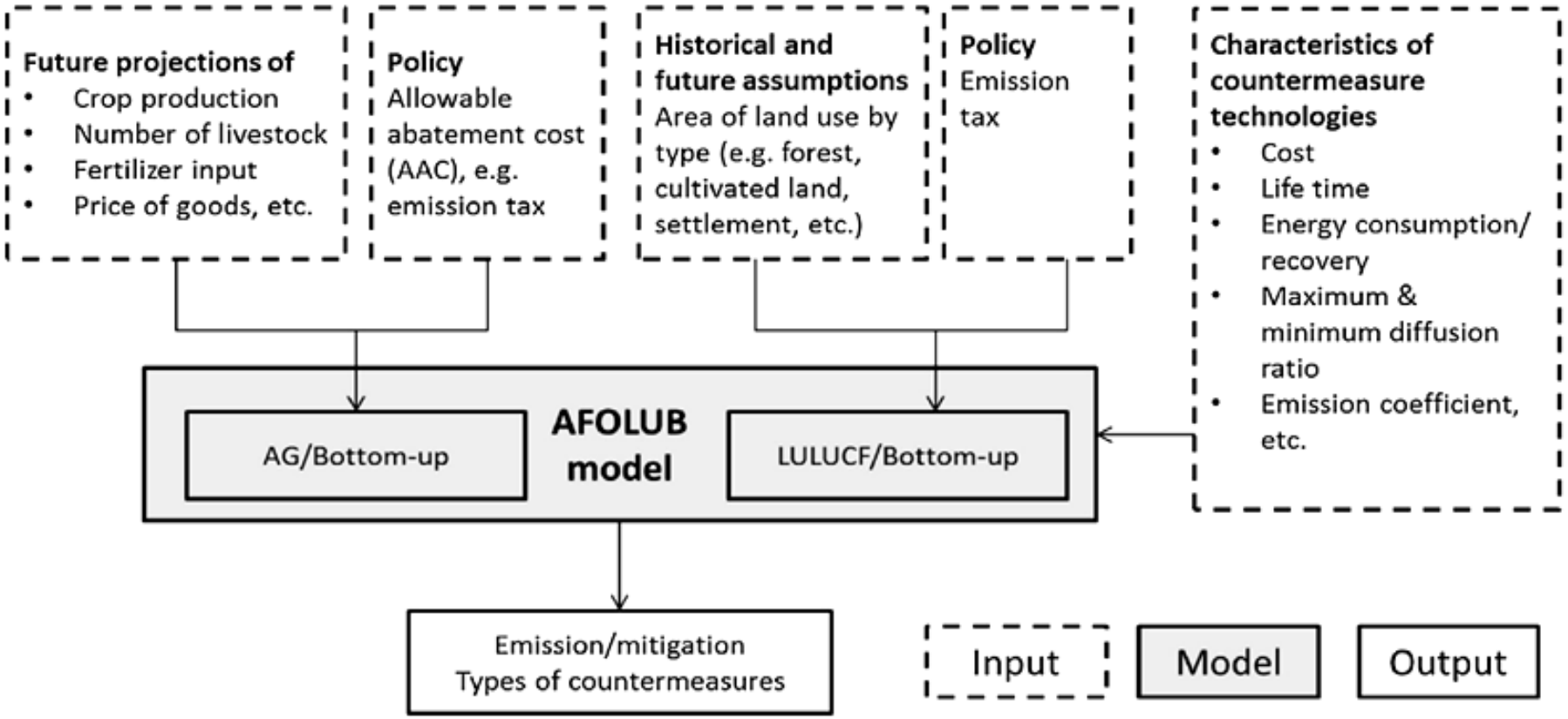
Development of Nepal & Thailand's AFOLU



Input and Output of AFOLU model (Hasegawa and Matsuoka, 2012).

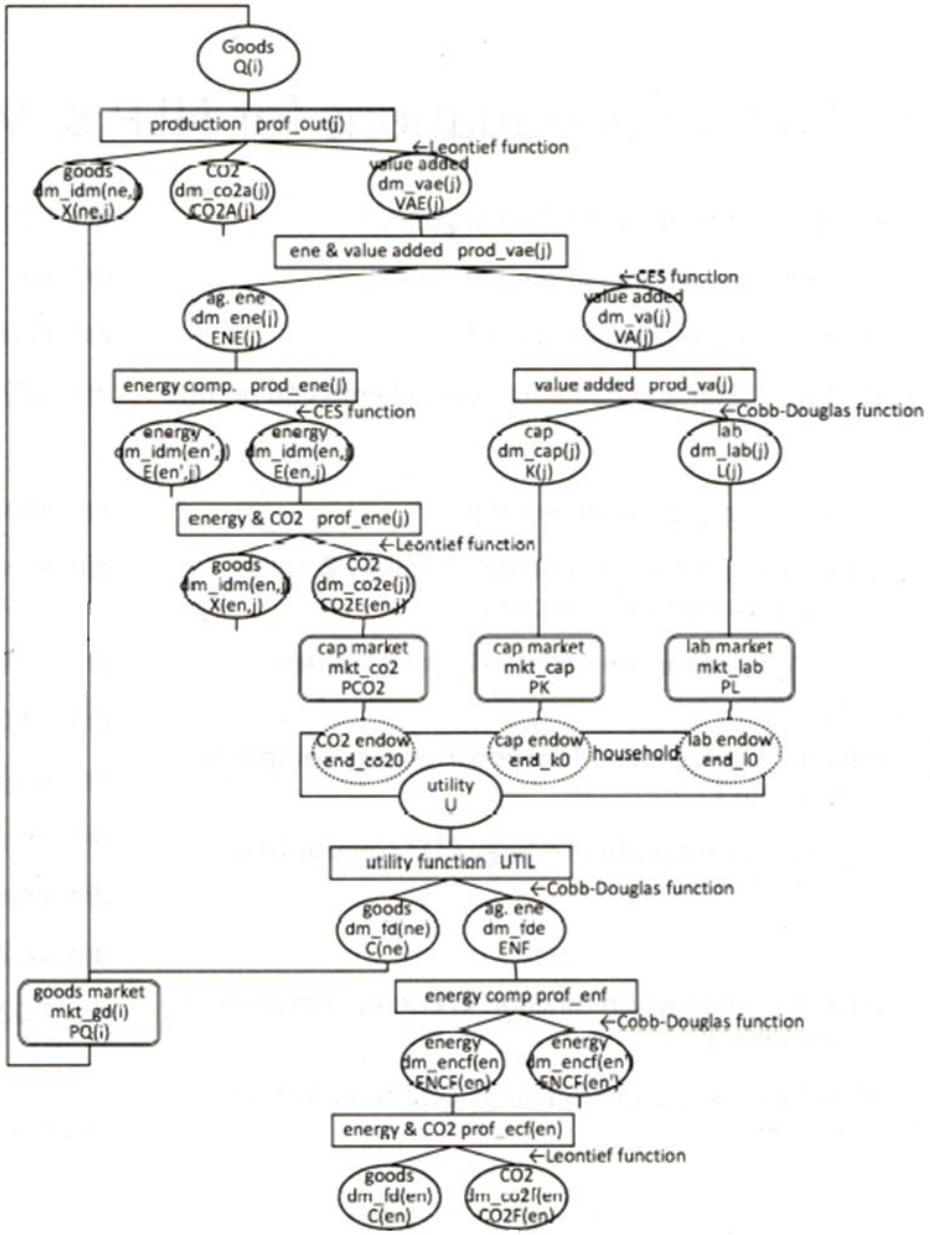
Development of Thailand's AFOLU

Highlighted Countermeasures in Thailand's AFOLU

A. Enteric Fermentation	B. Manure management (CH4)	C. Manure Management (N2O)	D. Rice cultivation	E. Agricultural soils	F. Field burning of agriculture residues	G. Carbon sequestration in croplands
1.Improve feed 2. Improve dietary additives 3. Improve breeds with high productivity or with reduced CH4 emission 4. Microbial technology	1. Good practices in solid manure storage/management systems 2. Anaerobic digester replacing uncovered lagoon 3. Dietary additives 4. Good practices in wet/slurry manure management	1 Improve in animal efficiency 2. Good practices in manure storage 3. Improve feed/diet for lower N excreta	1 Water management 1.2 Mid season drainage 1.2 Alternative wetting and drying (AWD) 1.3 multiple /intermittent drainage 2. Applied appropriate rate and form of organic materials and good practices in rice cultivation 4. Application of sulfate fertilizers 5. Improve breeds with high productivity or reduced CH4 emission	1 Appropriate fertilizer application 1.1. Appropriate fertilizer application for site-specific nutrient management (SSNM) 1.2. Appropriate fertilzer application for good agricultural practice 2. Application of urease inhibitors and nitrification inhibitors, slow release fertilizers 3. Improve crop productivity and improve nutrient (N) use efficiency by crop variety	1. Sequestration in woody plants 2. Reduce or prevent burning of agricultural residues in the field	1. Enhance C input in croplands 2. Increase crop residue uses 3. Reduce C loss from croplands

Source: ONEP (2017)

Flow Diagram of Nepal & Thailand's CGE



Definition of Variables

Q(i) production of goods i
C(i) final consumption of goods i
X(i,j) intermediate inputs i in sector j
K(j) capital input in sector j
L(j) labor input in sector j
VA(j) value added in sector j
VAE(j) energy & value added composite in sector j
ENE(j) energy composite in sector j
E(i,j) energy CO2 composit in sector j
CO2E(en,j) CO2 from energy in sector j
CO2A(j) CO2 from activity in sector j

ENF energy composite in household
ENCF(i) energy CO2 composite in household
CO2F(en) CO2 from energy in household

mkt_gd(i) market equilibrium of goods i
mkt_cap market equilibrium of capital
mkt_lab market equilibrium of labor
mkt_CO2 market equilibrium of CO2 emission permit

prof_out(j) zero profit in sector j
prod_vae(j) production function in energy & value added composite of sector j
prod_va(j) production function in value added of sector j
prod_ene(j) production function in energy composite of sector j
prof_ec(en,j) zero profit in energy CO2 composite in sector j

prod_enf production function in energy composite in household
prof_ecf(en) zero profit in energy CO2 composite in household

PQ(i) price of goods i
PK rent (price of capital)
PL wage (price of labor)
PCO2 price of CO2
PVA(j) price of value added in sector j
PVAE(j) price of energy & value added composite in sector j
PENE(j) price of energy composite in sector j
PE(i,j) price of energy CO2 composite in sector j
PENF price of energy CO2 composite in household
PECF(en) price of energy CO2 composite in household

M income
U utility

dm_fd(i) final demand
dm_fde final demand (energy)
dm_encf(en) energy-CO2 demand in household
dm_CO2f(en) CO2 emissions in household

dm_idm(i,j) non energy intermediate demand in sector j
dm_vae(j) energy & value added composite demand in sector j
dm_cap(j) capital demand in sector j
dm_lab(j) labor demand in sector j
dm_va(j) value added demand in sector j
dm_enc(j) energy (with CO2) demand in sector j
dm_ene(en,j) energy demand in sector j
dm_CO2E(en,j) CO2 emissions
dm_CO2A(j) CO2 emissions

income income balance
util utility

Source: Toshihiko Masui (NIES, 2017)

どうもありがとう

Thank You