

Technology Options for Achieving Low Carbon Energy in Indonesia

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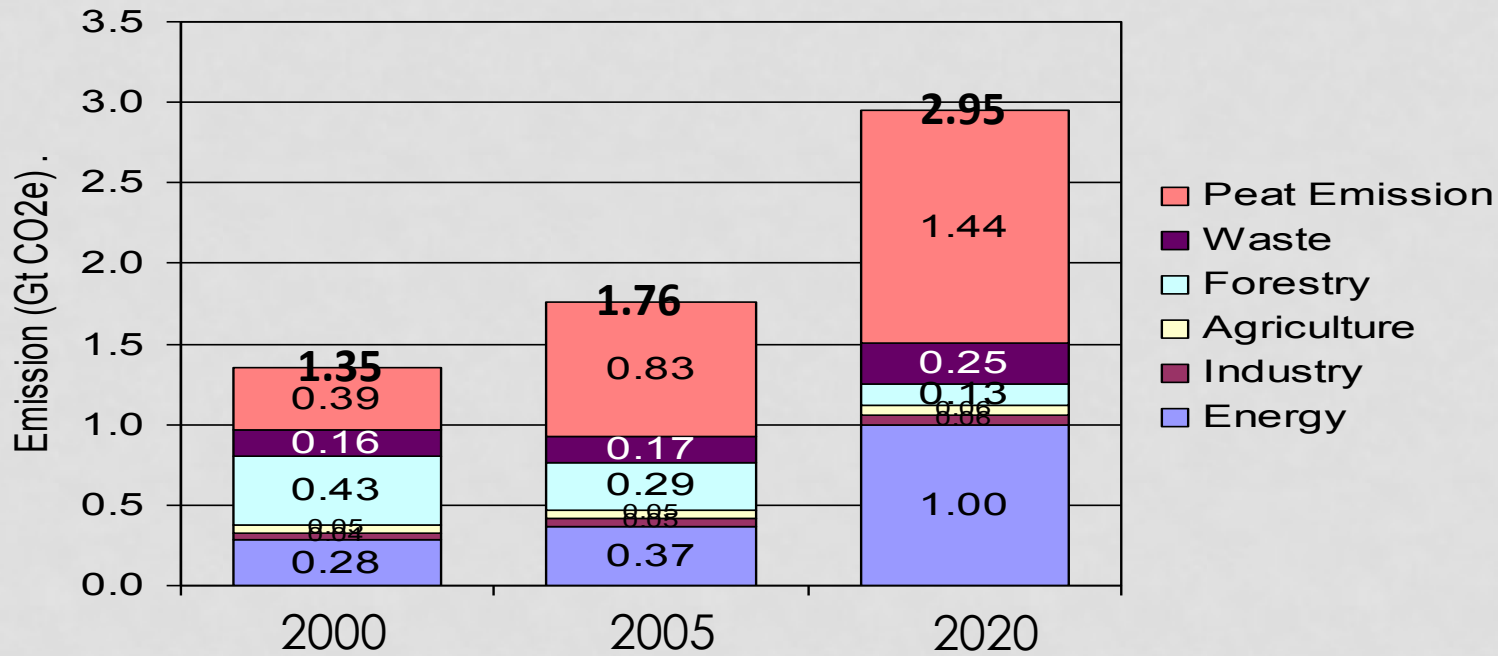
Outline

1. Introduction
2. Energy Sector and GHG Emissions and It's Projection
3. Power Supply Mix and Transportation Scenarios
4. GHG Emission Level and Mitigation Actions

1. INTRODUCTION

- LCD is long term vision (2050) of economic development in a low-carbon way → challenge for achieving LCD is now in a global mainstream;
- Particular emphasis in short-term (2020) is to address options for achieving GHG reduction target (National Action Plan) up to 26% below the baseline with domestic budget and further up to 41% with international support. Supported by PerPres No. 61/2011 (National Action Plan for Mitigation Action) and PerPres 71/2011 (GHG Inventory), regulation for MRV is under preparation
- Energy sector is 2nd contributor of national GHG emission, particularly CO₂ emission after AFOLU (agriculture, forestry, and land use). CO₂ energy sector increased: 369,800 ton (2005) to 392,820 ton (2010)
- LCD is relatively new in Indonesia; current government plans on energy are not developed to achieve LCD, but still inline with/supportive to LCD. Current energy supply mix: share of renewable less carbon emitting energy is still low, RE (6.1%), oil (44.34%), gas 43.30 %, coal 24.43%.
- LCD strategy is not to achieve world's target on carbon intensity level; it is more to explore possibilities of the future development in a low-carbon way.

GHG Emissions, Ton CO₂-eq per year



Sector	2000	2001	2002	2003	2004	2005	Growth, %/yr
Energy	280,938	306,774	327,911	333,950	372,123	369,800	5.7
Industry	42,814	49,810	43,716	46,118	47,971	48,733	2.6
Agriculture	75,420	77,501	77,030	79,829	77,863	80,179	1.1
Waste	157,328	160,818	162,800	164,074	165,799	166,831	1.2
LUCF	649,254	560,546	1,287,495	345,489	617,423	674,828*	Fluctuated
Peat Fire ¹	172,000	194,000	678,000	246,000	440,000	451,000	Fluctuated
Total (+LUCF)	1,377,753	1,349,449	2,576,952	1,215,460	1,721,179	1,991,371	Fluctuated
Total w/o LUCF	556,499	594,903	611,457	623,971	663,756	665,544	3.2

CO2 EMISSIONS INTENSITY OF ENERGY SECTOR

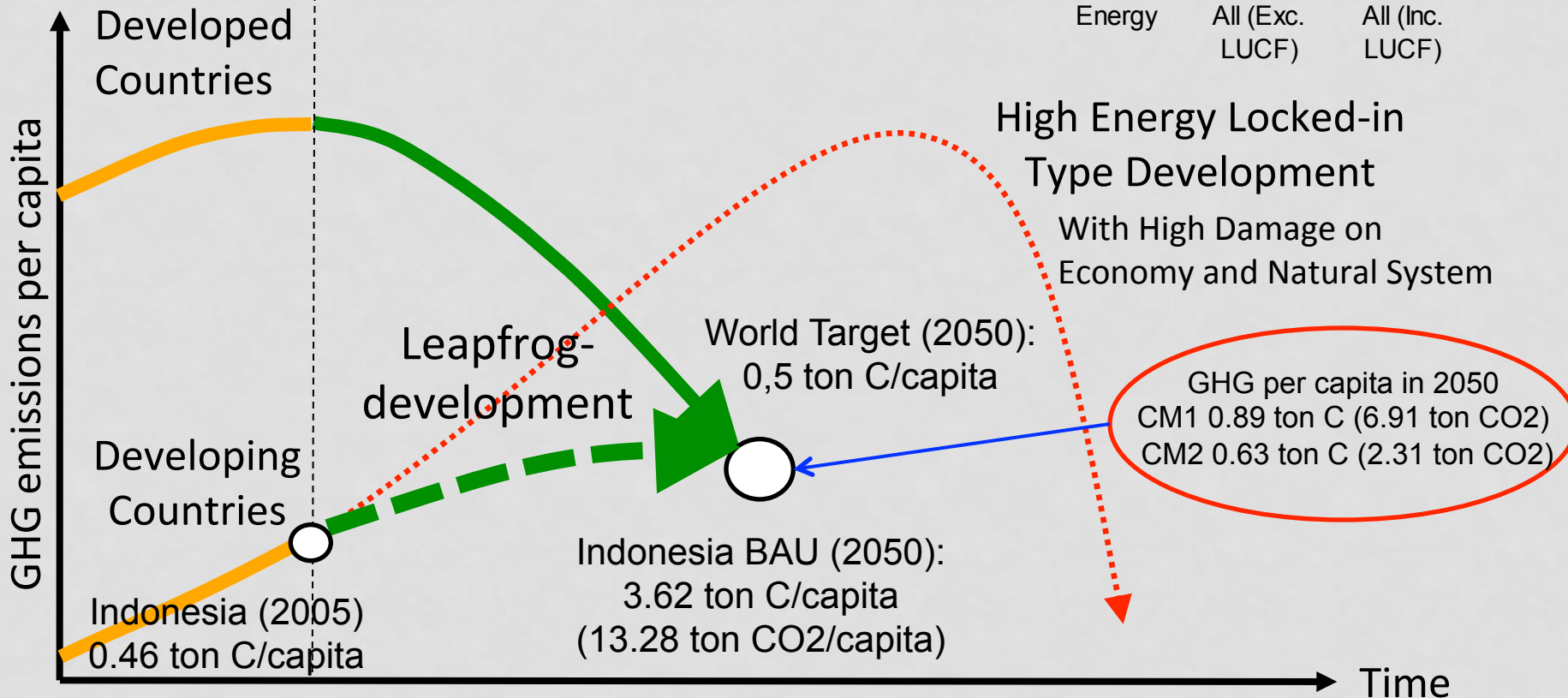
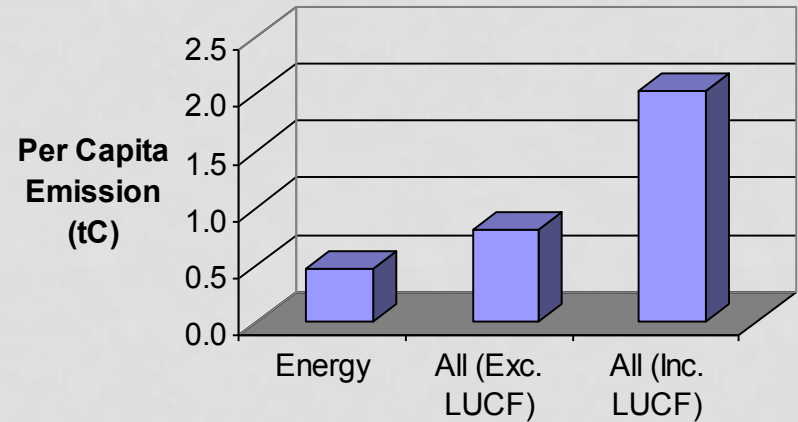
International (2005), Ton C/capita

-Japan, UK, Germany 2.5

-US 5.5; Canada 4.2

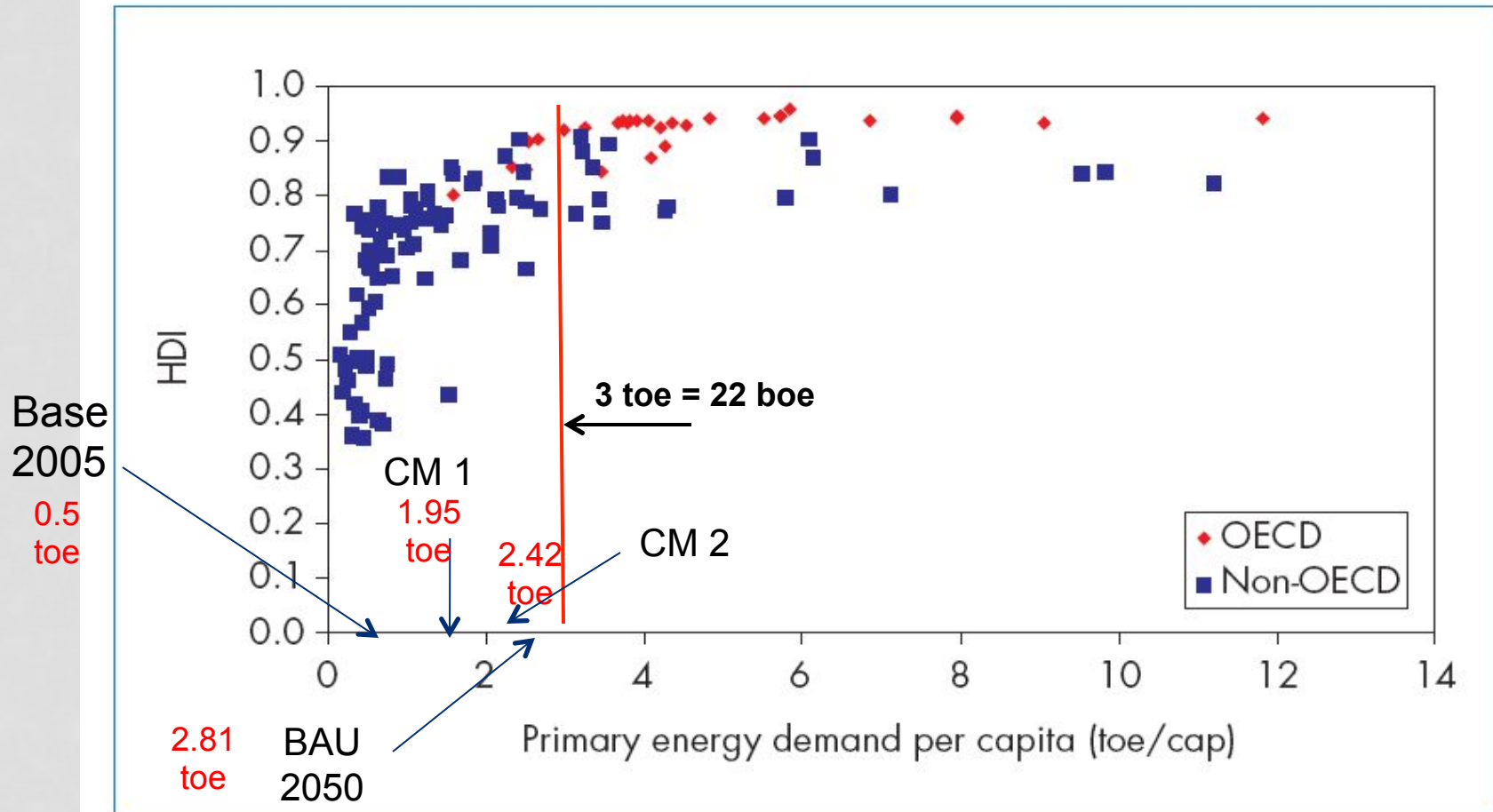
-India 0.3; China 0,6

-World (average) 1.0 – 1.1



Emission/capita from energy [Source: AIM training WS Asian LCDS Study , 2010]

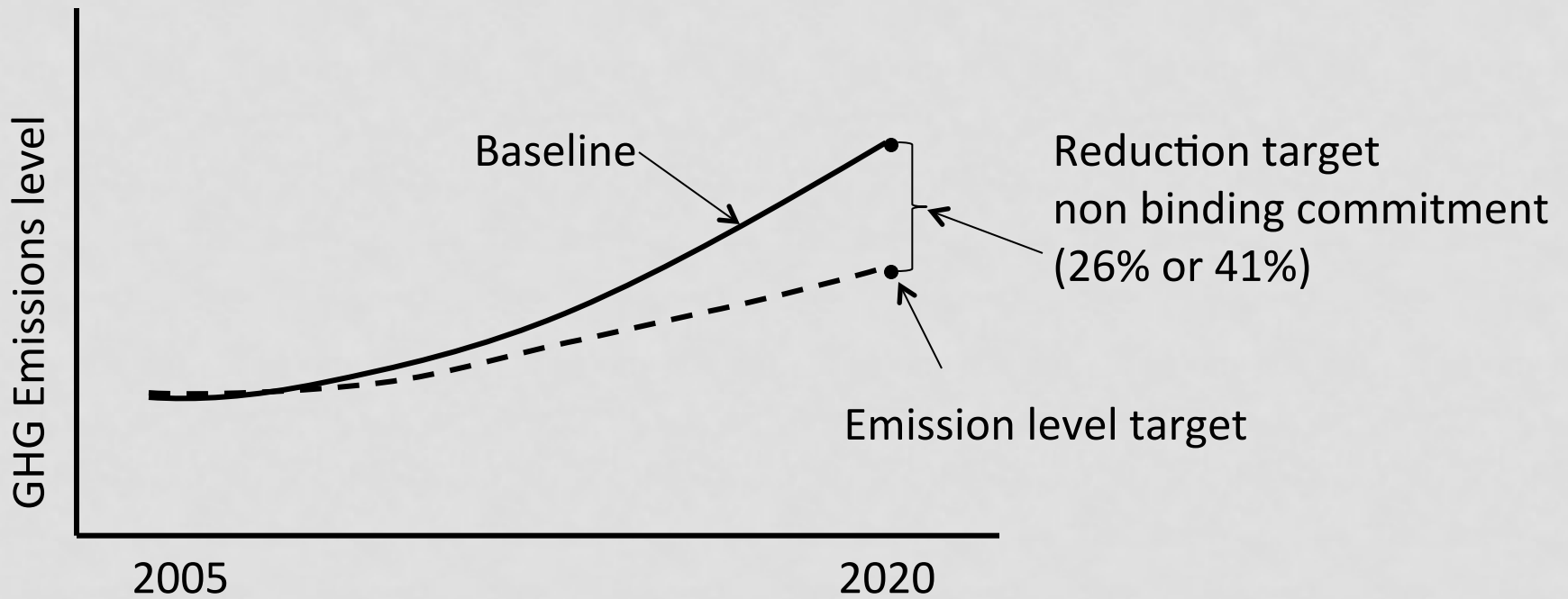
HDI (~ LIFE EXPECTANCY AT BIRTH + ADULT LITERACY & SCHOOL ENROLMENT + GNP PER CAPITA AT PPP) VERSUS PRIMARY ENERGY DEMAND PER CAPITA (2002) IN TONNES OF OIL EQUIVALENT (TOE) PA [1 TOE PA = 1.33 KWS]



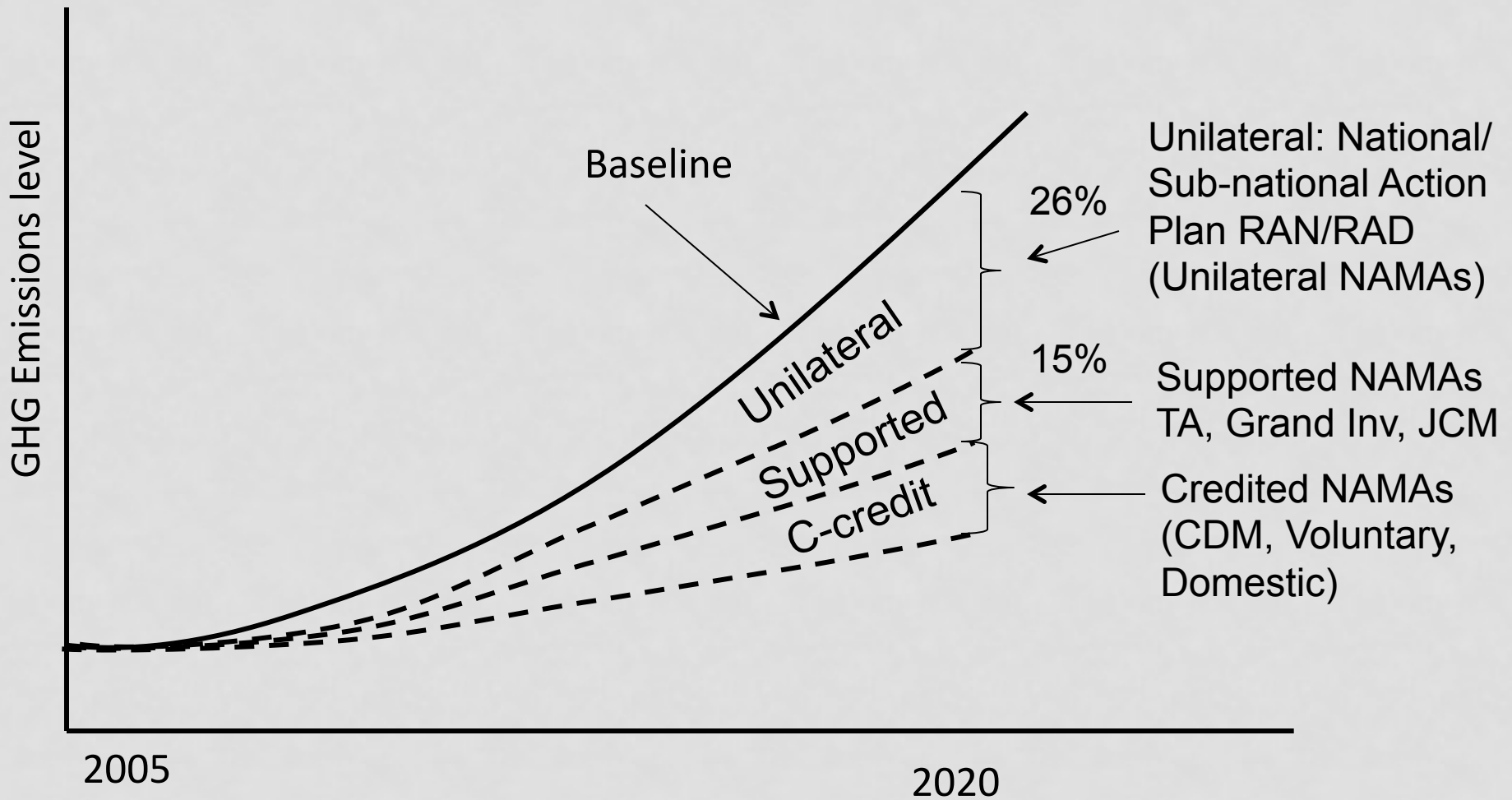
Sources: IEA analysis; UNDP (2004).

Note: shoulder in HDI vs energy-use curve at ~ 3 toe pa [= 4.0 kW] per capita

3 toe = 22 boe



Sector	Emission Reduction (Giga ton CO2e)		Total (41 %)
	26%	15%	
Forestry and Peatland	0.672	0.367	1.039
Waste	0.048	0.030	0.078
Agriculture	0.008	0.003	0.011
Industry	0.001	0.004	0.005
Energy	0.038	0.018	0.056
Total	0.767	0.422	1.189



Unilateral: domestic budget (national/sub-national budget, private business, community, CSR, GoI just released stimulus and incentive for industry who wants to reduce GHG emission)

Domestic C-credit: Carbon Nusantara

Several intangible program: green industry, green building, proper, international GIR, ISO, etc.

2. ENERGY SECTOR AND GHG EMISSION

NATIONAL CIRCUMTANCE



Electricity Grid Connected: northern and southern part of Sumatera Island, Jawa-Madura Bali (JAMALI), East Kalimantan, Sulawesi

Energy Resource Potential of Indonesia

Fossil Energy	Resources	Reserves (Proven + Possible)	Annual Production	R/P, year (*)
Oil	56.6 BBarels	8.2BBarels (**)	357 MBarels	23
Natural Gas	334.5 TCF	170 TCF	2.7 TSCF	63
Coal	104.8 Btons	18.8 Btons	229.2 Mtons	82
<i>Coal Bed Methane</i>	453 TCF	-	-	-

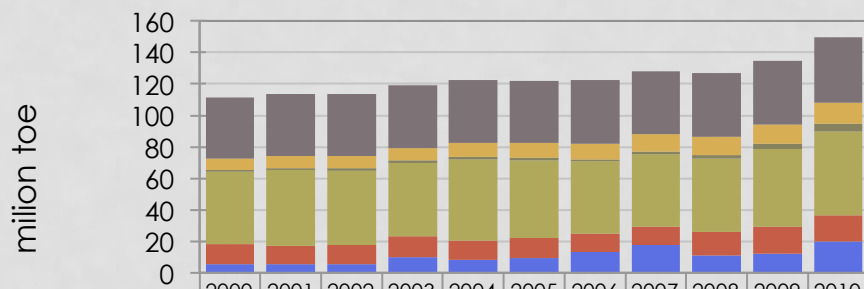
(*) assuming no new discovery; (**) including Cepu Block

New and Renewable Energy	Resources	Installed Capacity
Hydro	75.670 MW	4.200 MW
Geothermal	27.510 MW	1.052 MW
Mini/Micro Hydro	500 MW	86,1 MW
Biomass	49.810 MW	445 MW
Solar Energy	4,80 kWh/m ² /day	12,1 MW
Wind Energy	9.290 MW	1,1 MW
Uranium (***)	3 GW for 11 years*) (e.q. 24,112 ton)	30 MW

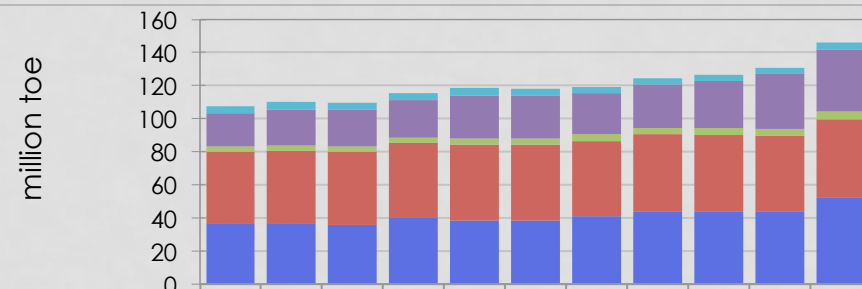
***) Only at Kalan – West Kalimantan

Current Condition of Energy Sector in Indonesia

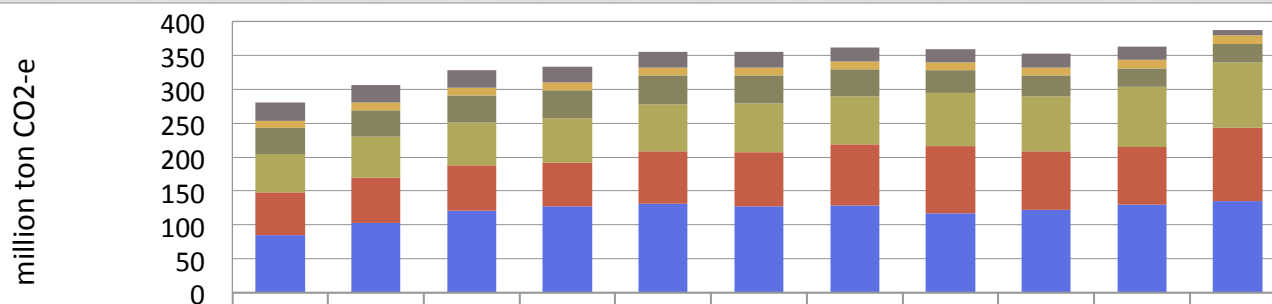
Final Energy Consumption



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
■ Biomass*(residential)	39.28	39.27	39.45	39.71	39.68	39.43	40.34	40.17	40.57	40.76	42.11
■ Electricity	7.09	7.57	7.80	8.10	8.96	9.58	10.08	10.86	11.55	12.05	13.19
■ LPG	1.21	1.21	1.28	1.28	1.34	1.23	1.37	1.60	2.29	3.69	4.74
■ Fuel	46.03	47.92	47.48	46.92	51.73	49.40	45.54	45.88	46.86	49.10	53.07
■ Gas	12.73	12.01	11.81	13.18	12.48	12.65	12.15	11.71	14.93	17.24	16.83
■ Coal	5.28	5.42	5.66	9.98	8.09	9.61	13.01	17.81	10.96	12.09	19.98

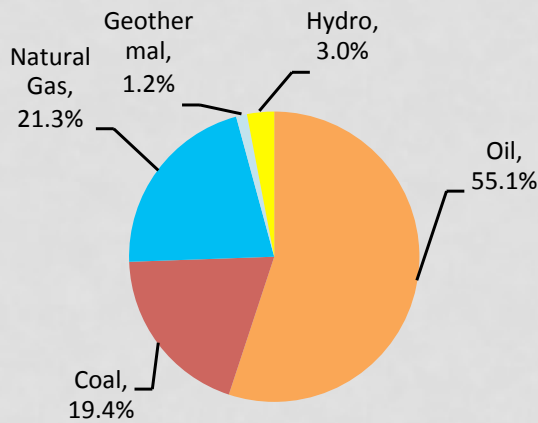


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
■ ACM & others	4.27	4.47	4.38	4.15	4.63	4.25	3.79	3.64	3.63	3.84	4.20
■ Transportation	20.32	21.65	22.12	22.81	26.04	26.05	24.84	26.16	28.75	32.96	37.35
■ Commercial	3.02	3.13	3.18	3.27	3.71	3.83	3.82	4.07	4.27	4.44	4.77
■ Household	43.30	44.00	44.24	45.12	45.86	45.81	45.66	46.62	46.25	45.96	47.52
■ Industry	36.78	36.82	35.79	40.20	38.44	38.35	40.91	43.90	43.73	43.45	51.94

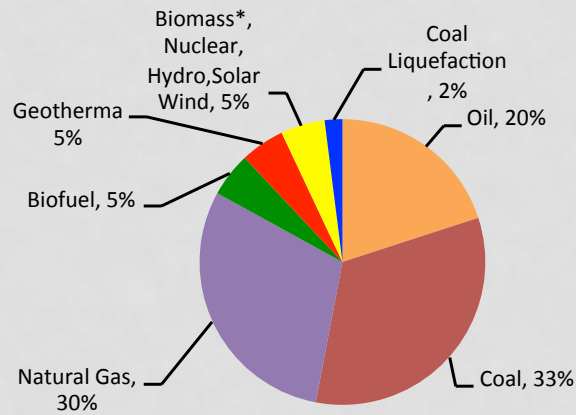


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
■ Fugitive	27	26	25	24	23	22	22	20	20	20	8
■ Non-specified	11	11	12	12	12	12	11	11	12	12	13
■ Residential	38	39	41	42	42	41	40	34	31	28	26
■ Transportation	57	60	62	65	70	73	71	79	81	89	96
■ Industry	64	68	68	65	76	79	90	99	87	85	109
■ Energy productions	84	102	120	127	132	127	129	117	122	129	135

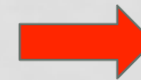
*Residential include biomass



2005



Target 2025 – PerPres 5/2006



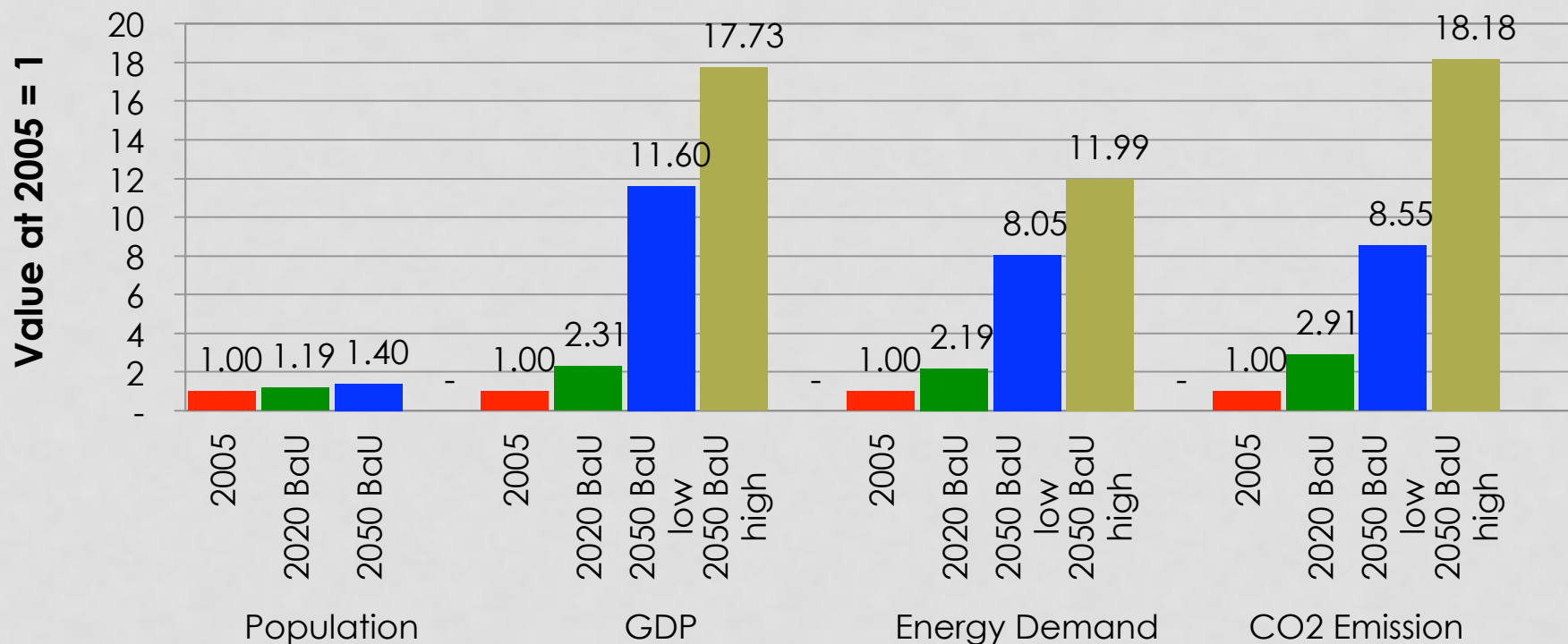
**Increase
New-Renewable
Energy to 34%**

**KEN (National
Energy Policy)**

*excluding residential biomass

- New-RE increased from 4.5% (2005) to 25% (2025) is positive to GHG mitigations; coal increases from 19.4% (200) to 33% (2025) will negatively affect to mitigations; Supportive plan: increasing new-renewable up to 34%
- Potential reduction: deployment of renewable and less carbon emitting energy
- Indonesia relies on imported technology in all sectors, in which energy technologies are still inefficient, there are rooms for improvements.

GHG EMISSION PROJECTION



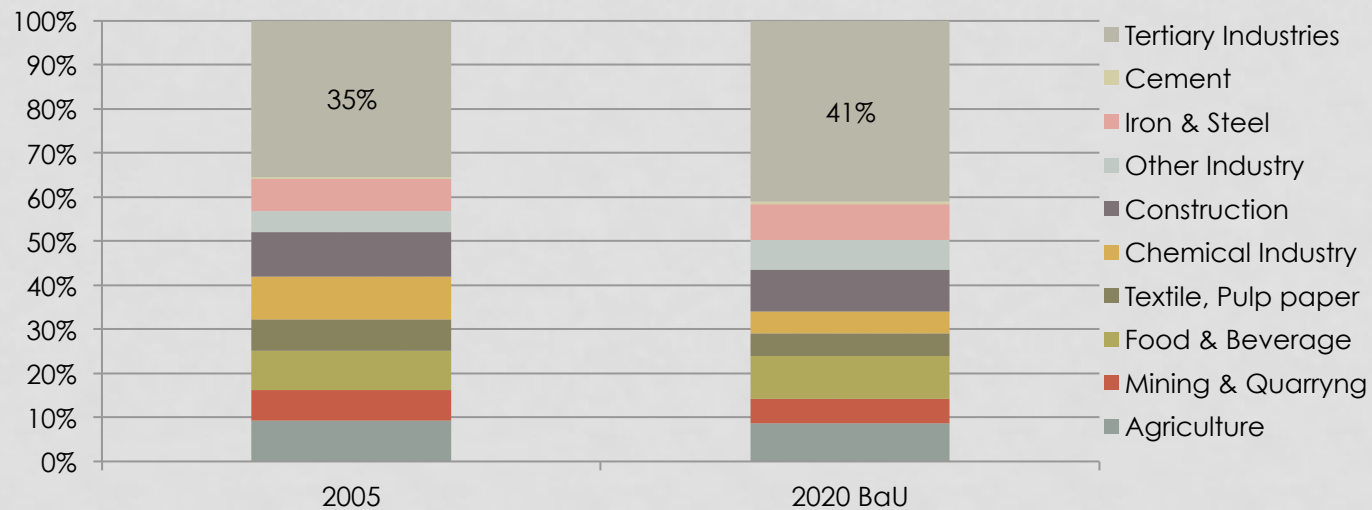
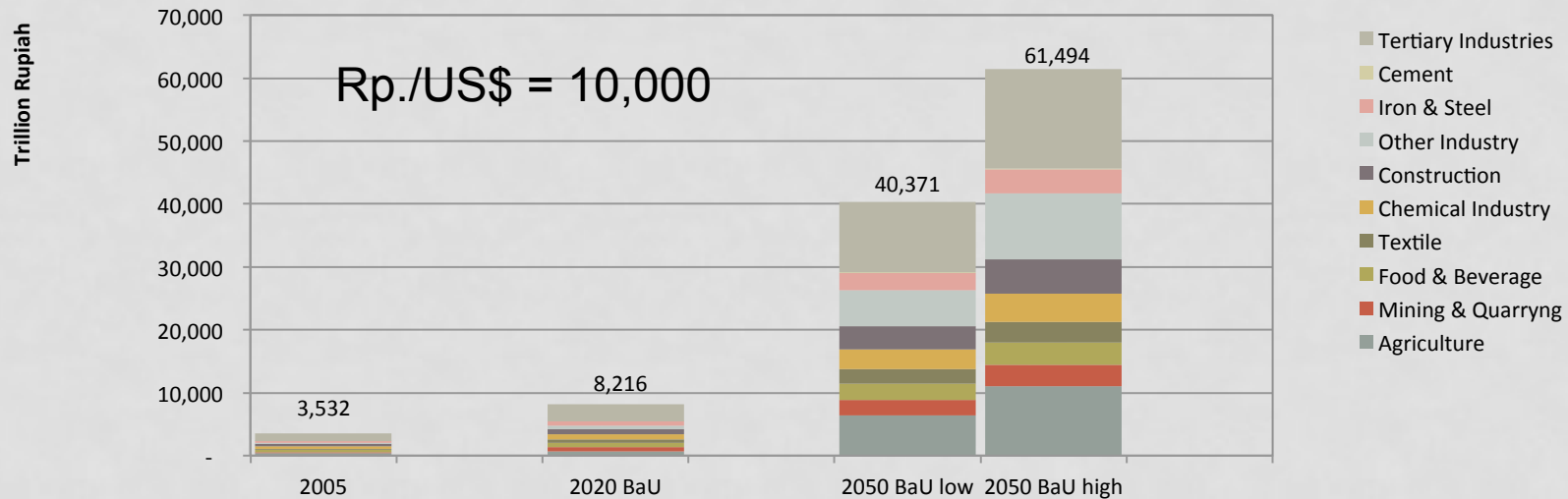
- **Baseline scenario:**

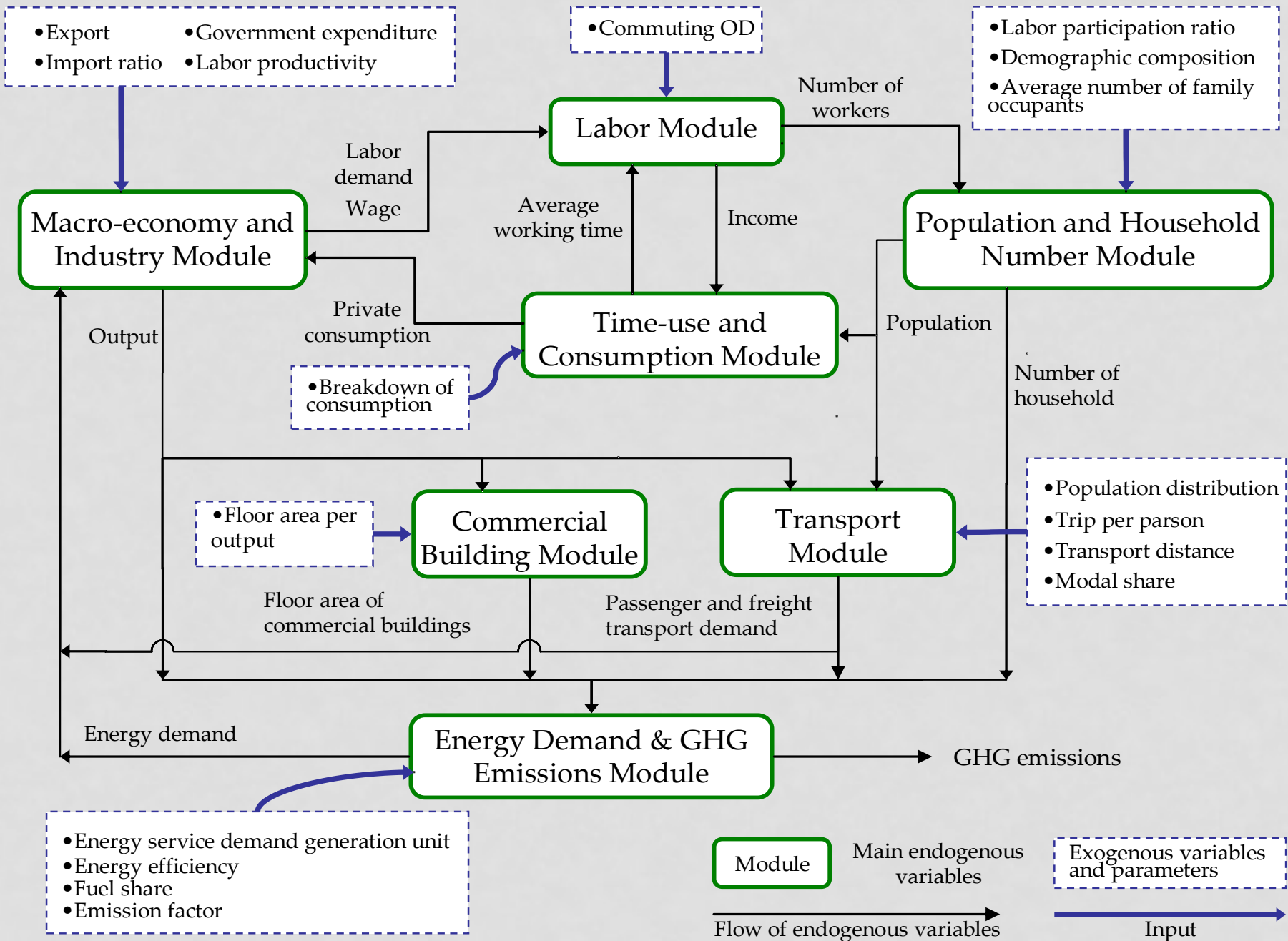
Projection of GHG emission under expected socio-economic development in Indonesia without additional countermeasures to reduce GHG from energy.

- **Counter Measure (CM) scenario:**

Introduction of low-carbon measures which are already available. Assumptions are based on the official target (RAN-GRK, reduce 38 MtCO₂ in energy sector).

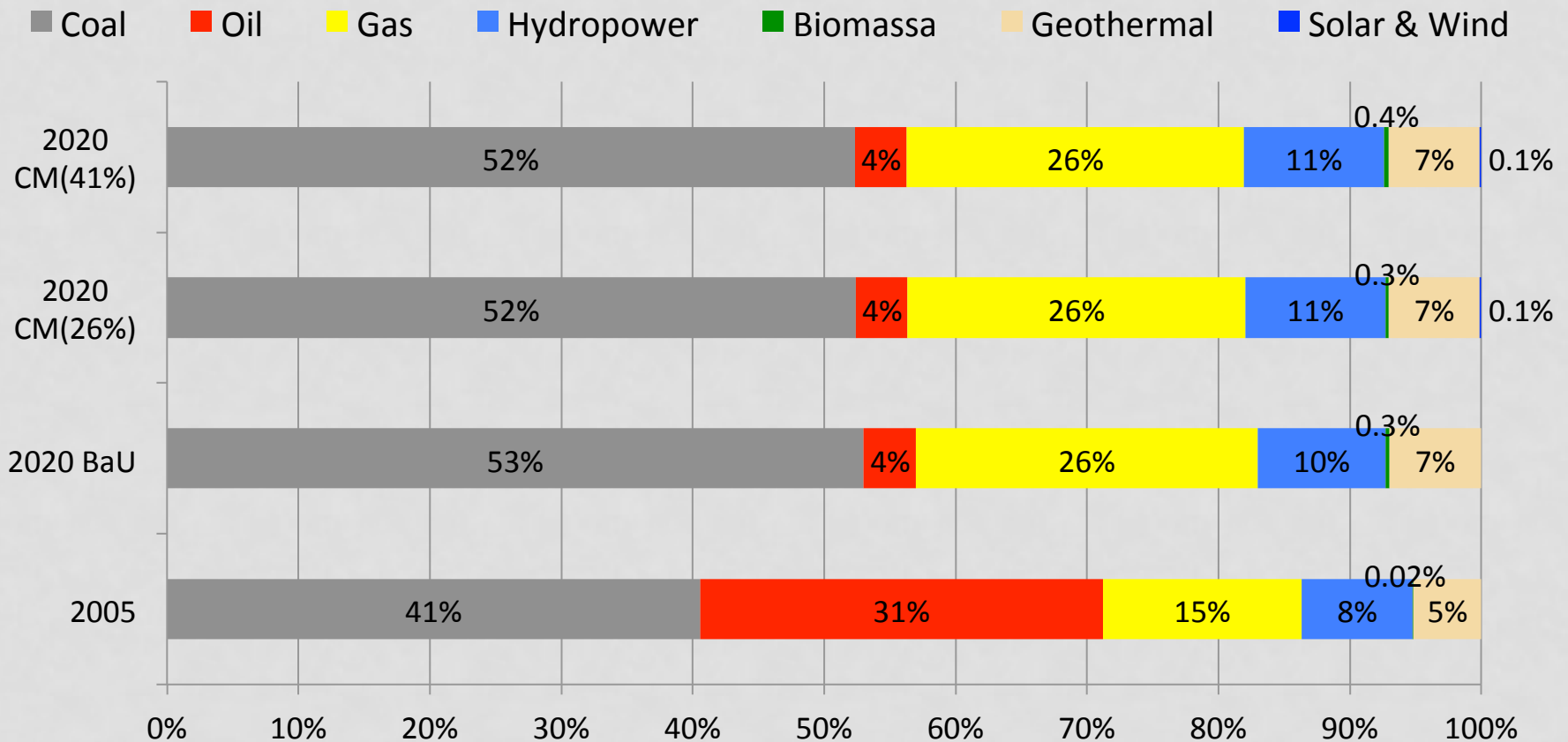
GROSS OUTPUT OF PRODUCTION SECTOR

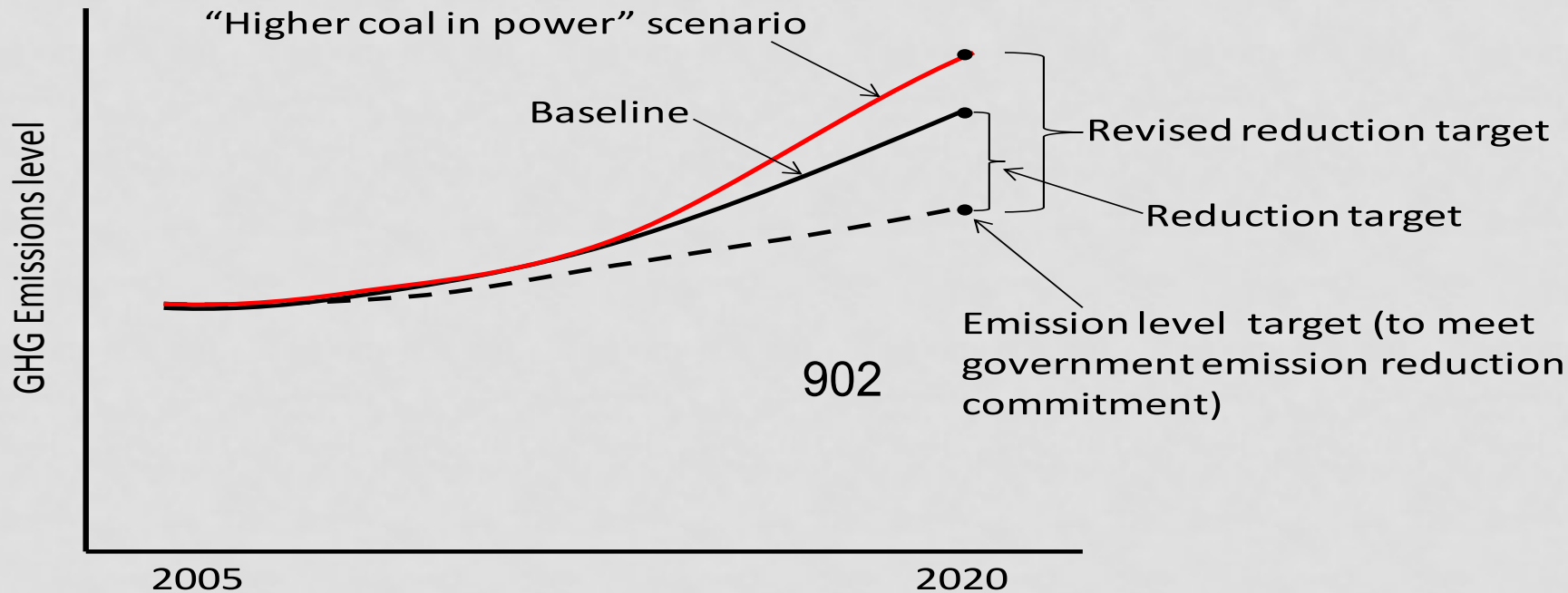




3. POWER SUPPLY MIX AND TRANSPORTATION SCENARIOS

ENERGY SUPPLY MIX IN POWER GENERATION





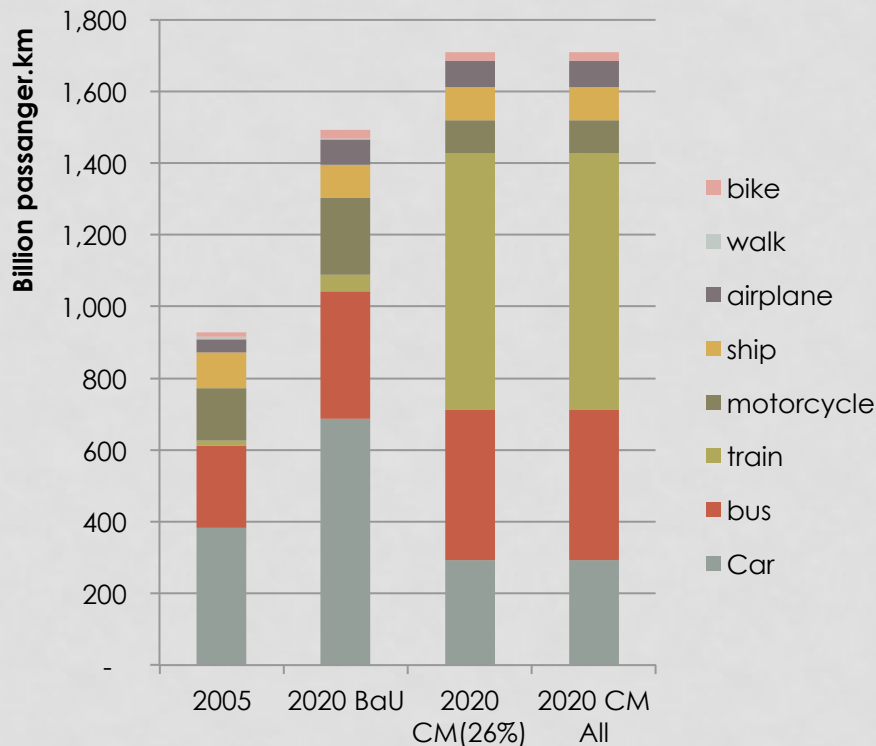
Type of energy	Base year 2005	RUPTL 2009-2018	Revised PLN plan*
Coal	40.7%	53%	65%
Oil	30.6%	4%	3%
Natural gas	15.1%	26%	20%
hydro	8.4%	10%	5%
geothermal	5.2%	7%	7%

RUPTL 2009 - 2018	Coal	Oil	Natural Gas	Hydropower	Biomass	Geothermal
Efficiency	28%	33%	38%	18%	29%	16%
Transportation Loss	12.1%	12.1%	12.1%	12.1%	12.1%	12.1%
Share	53.0%	4.0%	26.0%	9.7%	0.3%	7.0%

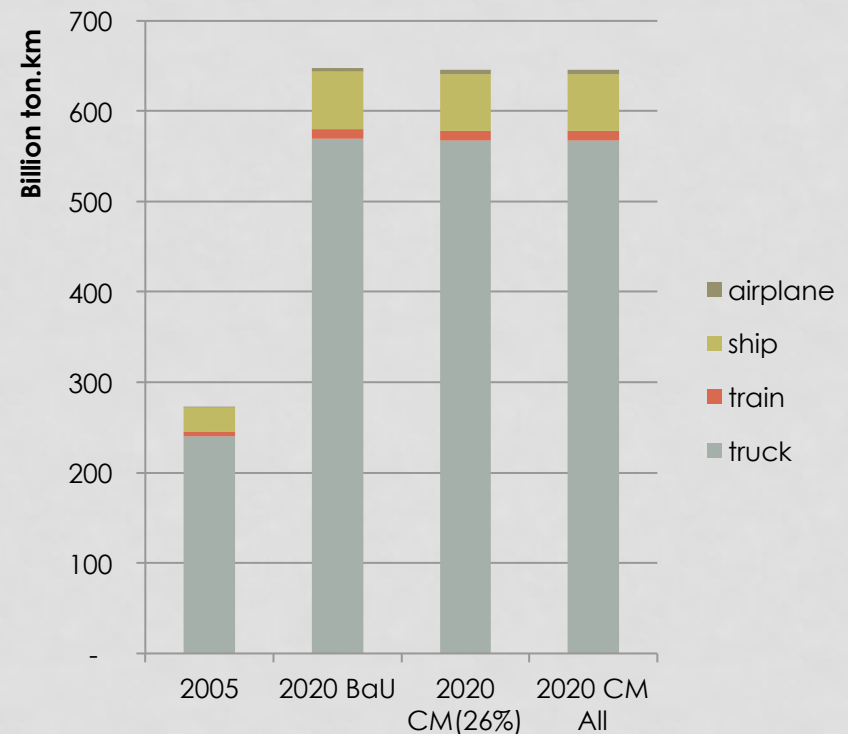
PROJECTED TRANSPORT VOLUME

- Both modal share and transport volume of private vehicle increase in 2020 Baseline.
- In 2020 CM, it is assumed that share of train increases volume of train become larger.
- Freight transport volume increases proportionally with growth of secondary industries.

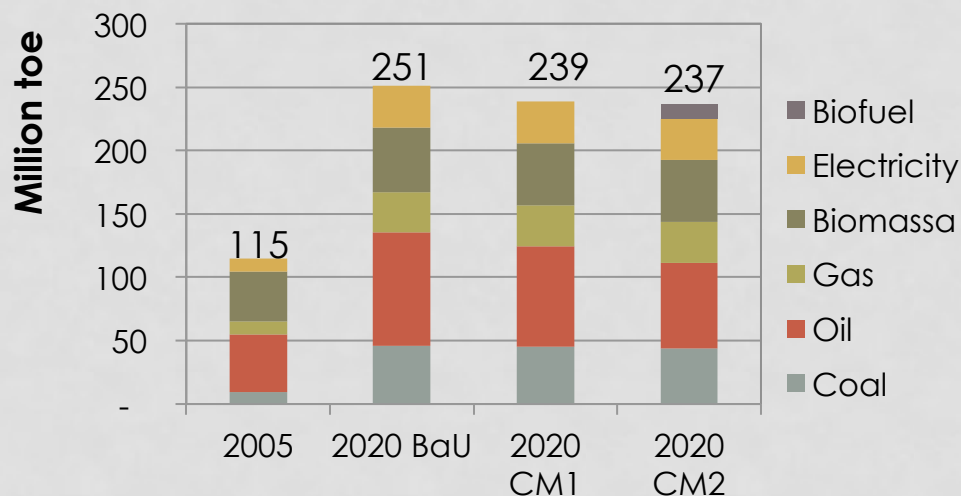
Passenger transport



Freight transport



FINAL ENERGY DEMAND PROJECTION (2020)



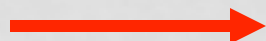
By Fuel



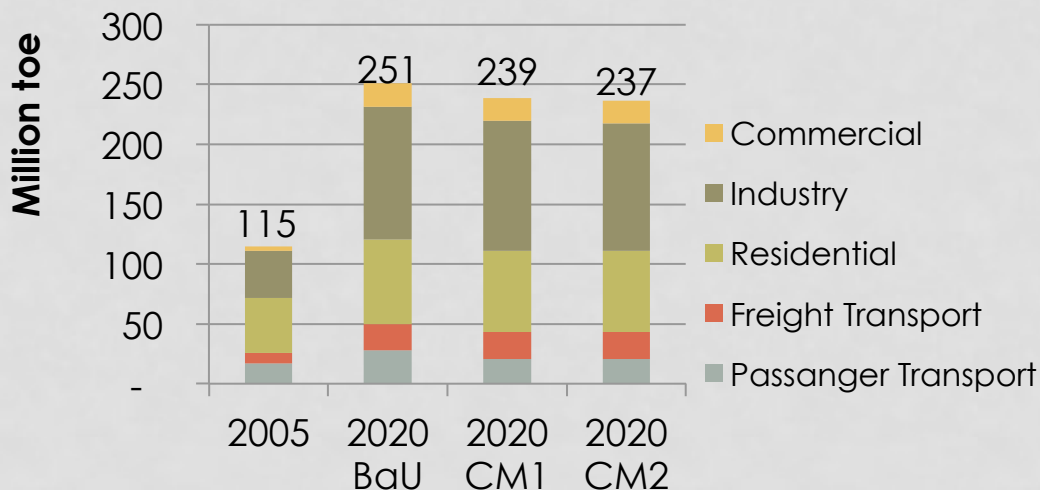
Difficult in moving away from oil

Biomass is used in rural residential

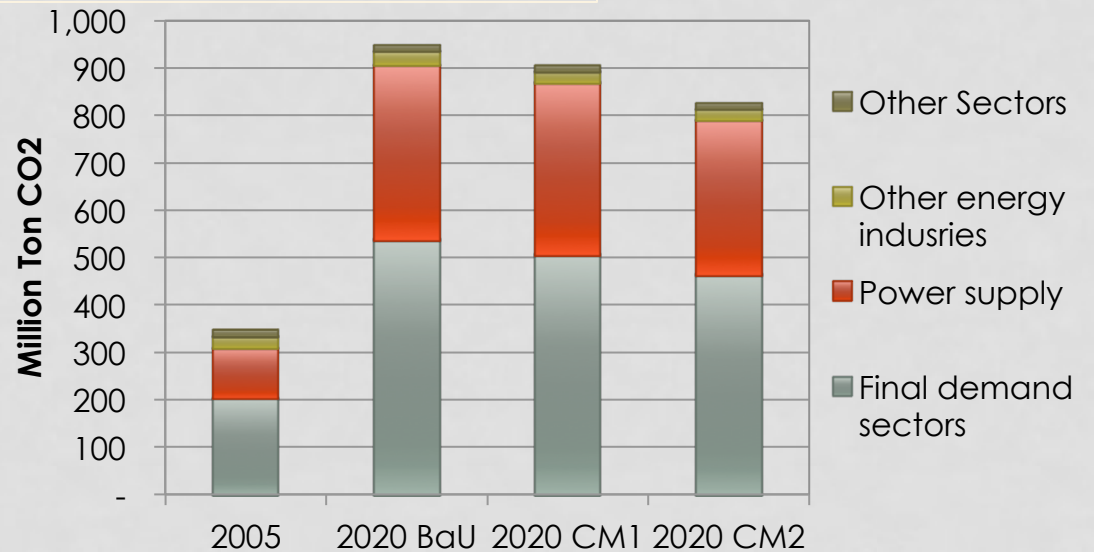
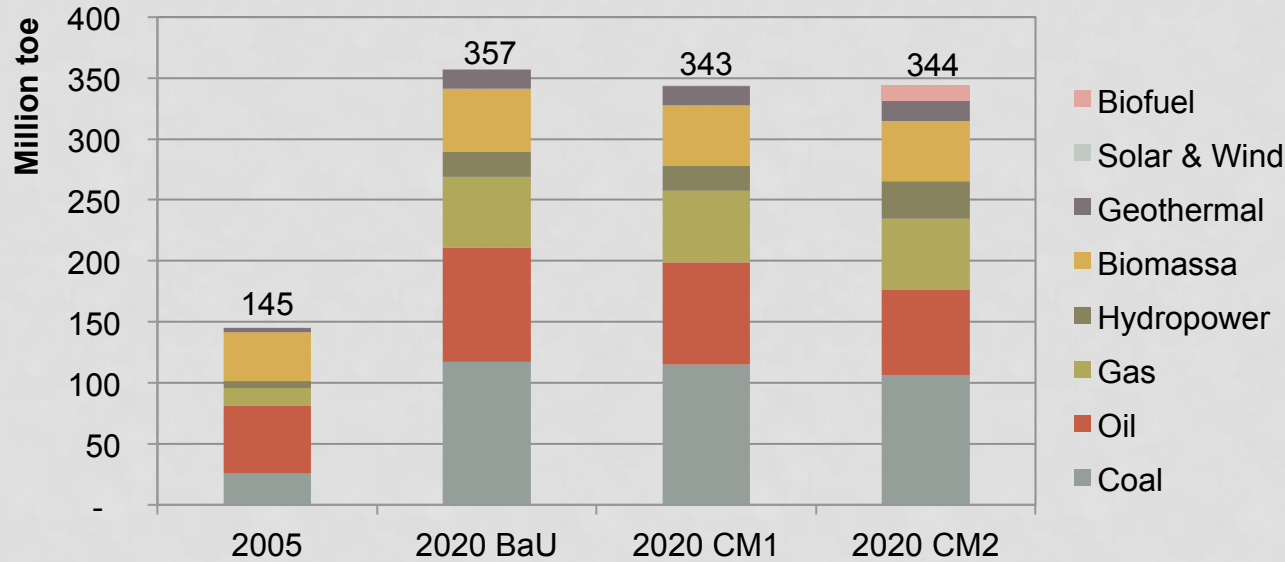
By Sector



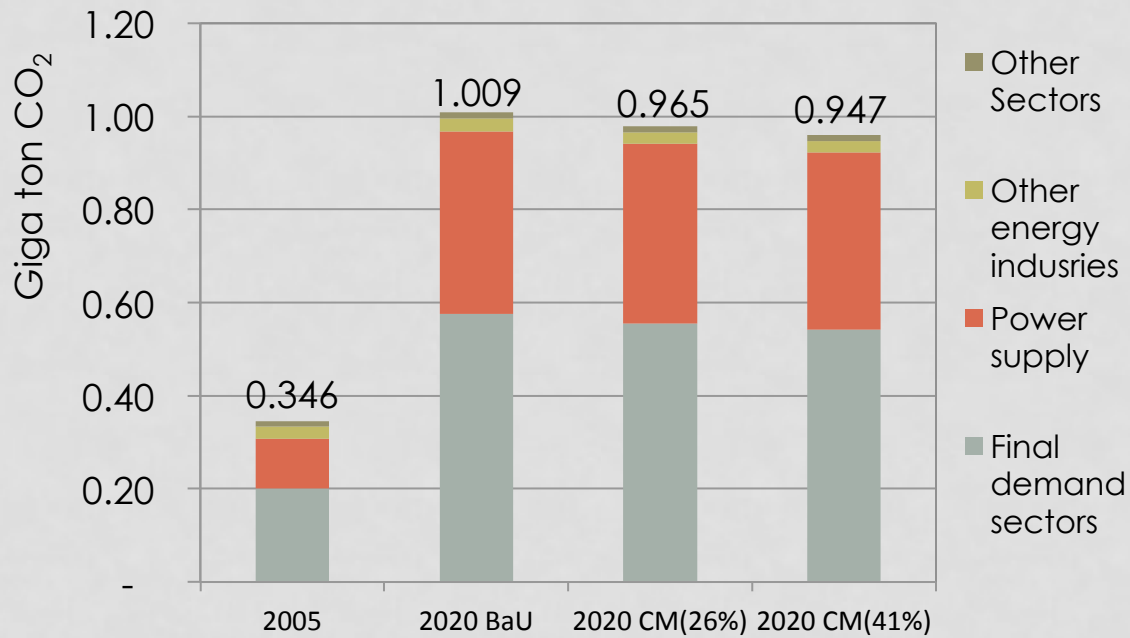
Industrial sector is main consumer



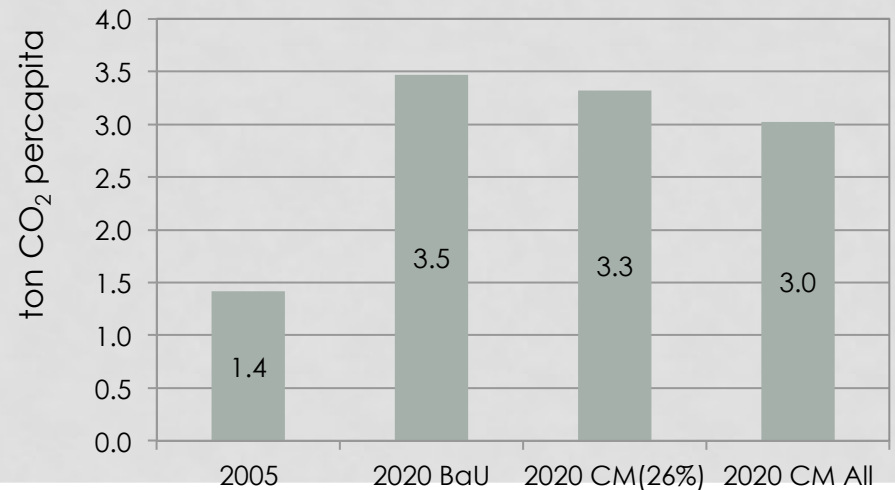
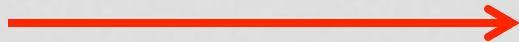
PRIMARY ENERGY SUPPLY AND CO2 PROJECTION (2020)



4. GHG EMISSION LEVEL AND MITIGATION ACTIONS



CO₂ emission intensity



Drivers of GHG Emissions can be identified from “IPAT identity”:

$$\text{Impact} = \text{Population} \times \text{Affluence} \times \text{Technology}$$

$$\text{CO}_2 \text{ Emissions} = \text{Population} \times (\text{GDP}/\text{Population}) \times (\text{Energy}/\text{GDP}) \times (\text{CO}_2/\text{Energy})$$

(“Kaya” multiplicative identity)

$$\text{Net } C = P \left(\frac{\text{GDP}}{P} \right) \left(\frac{E}{\text{GDP}} \right) \left(\frac{C}{E} \right) - S$$

↓ ↓

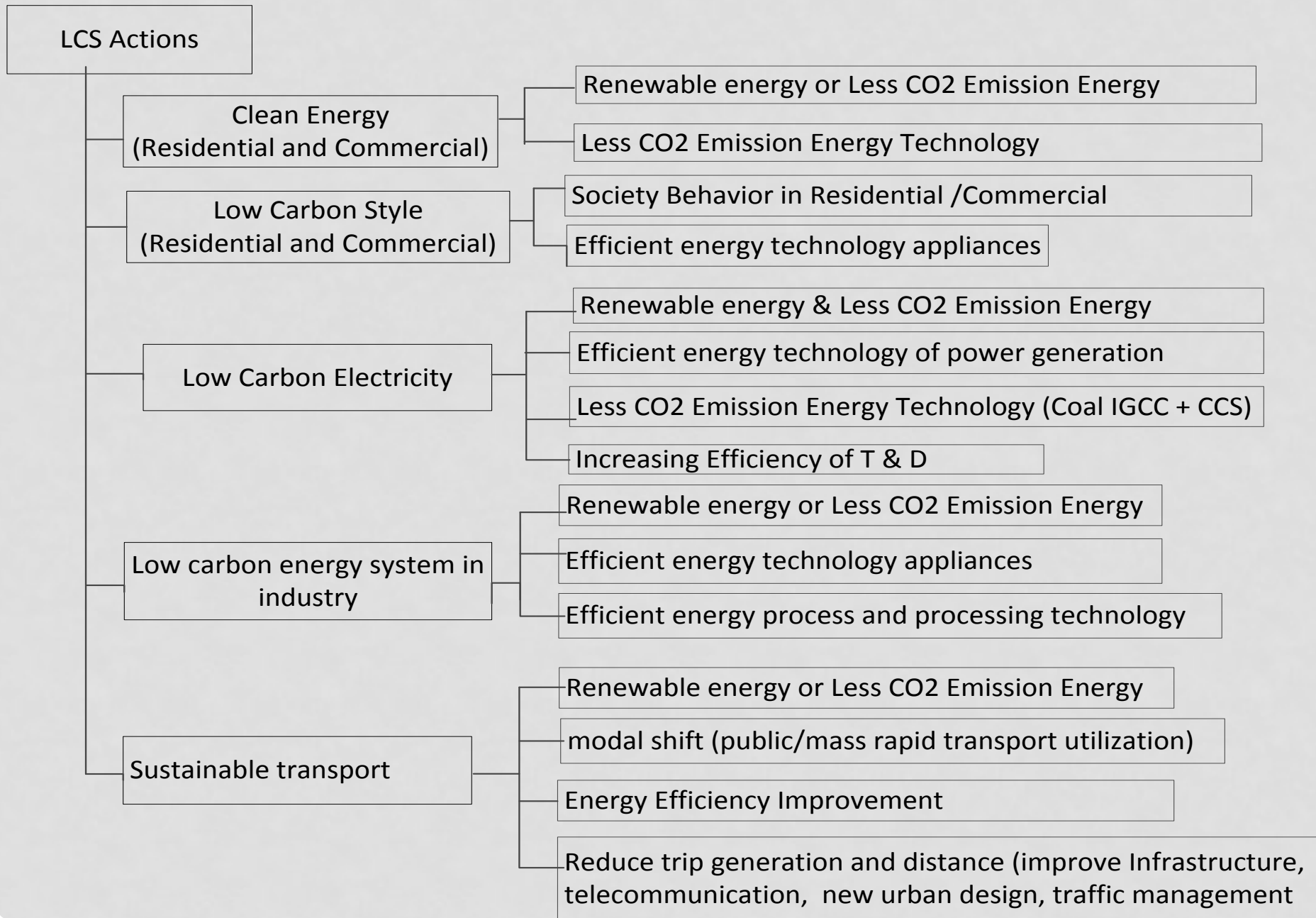
Energy Clean Energy
Efficient and
 Technology

Climate Change Mitigation Actions are to reduce Net GHG Emissions

MITIGATION STRATEGIES

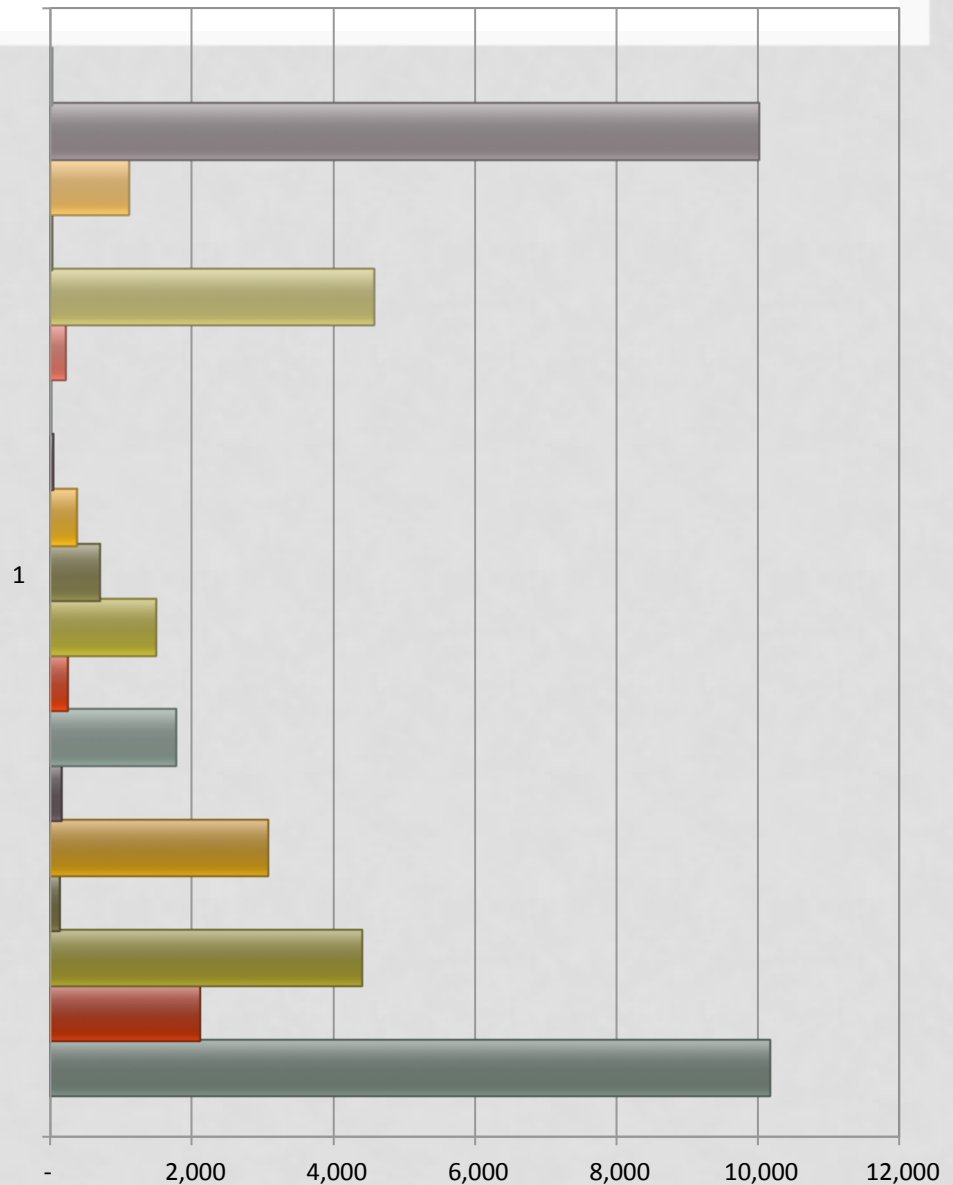
- **Clean Energy:** renewable/less carbon emitting energy and technology in residential/commercial;
- **Low Carbon Lifestyle:** efficiency improvement through appliances technology and society behavior in residential/commercial;
- **Low Carbon Electricity:** more renewable energy, efficient power generation (pulverized to sub-critical, supercritical, and integrated gasification combined cycle (IGCC) equipped with carbon capture and storage (CCS), and decreasing losses in T&D of electricity grids;
- **Low Carbon Fuels Industry:** energy shift (toward renewable and less carbon emitting fuels), efficiency improvement of industrial processes, equipment, and appliances;
- **Sustainable transport:** transport mode shift (more mass rapid transport), fuel shift (to renewable/ less carbon emitting fuels), reducing trip generation & trip distance (improvement infrastructure, telecommunication, information access), traffic management, efficiency improvement.

LOW CARBON DEVELOPMENT STRATEGIES

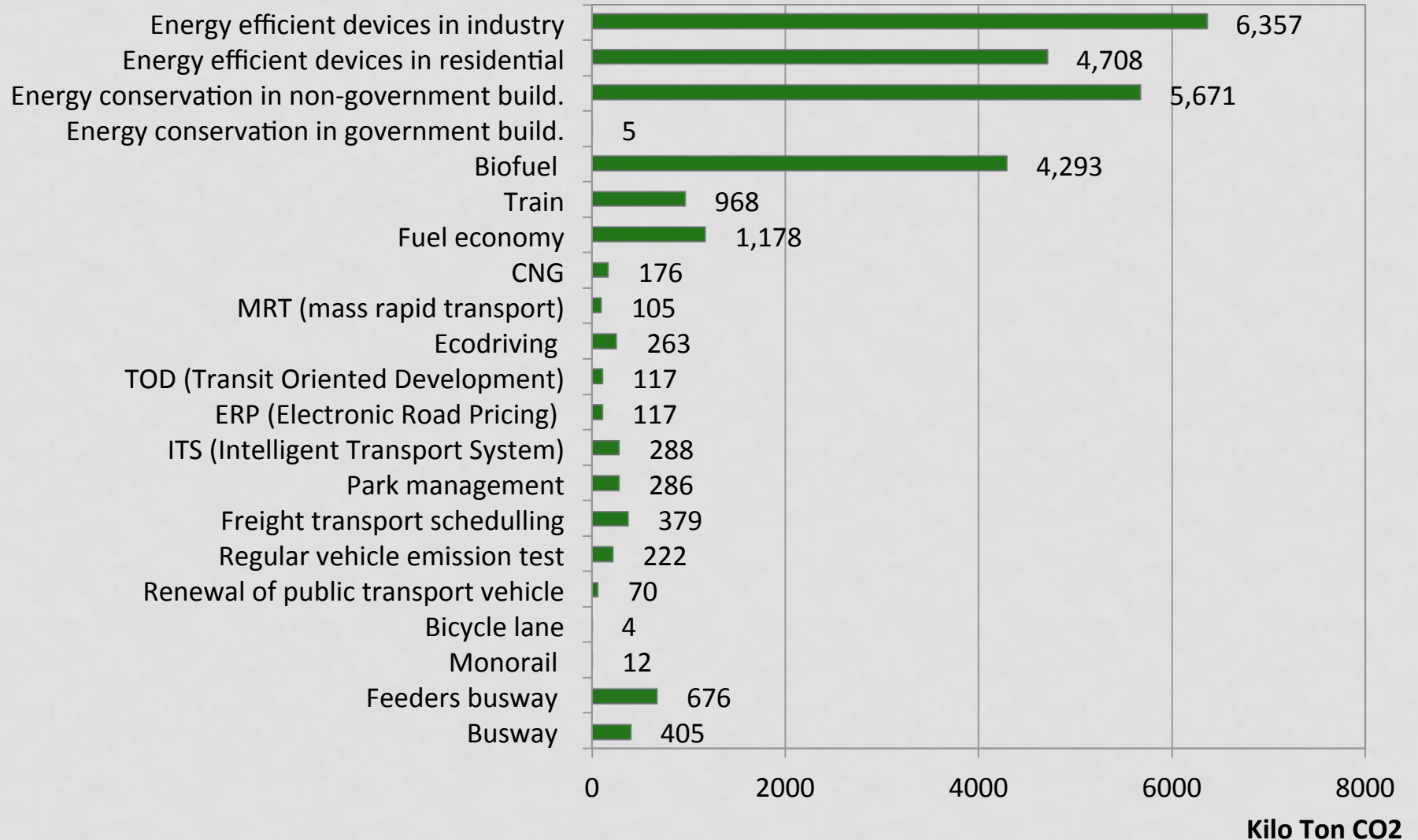


NATIONAL MITIGATION ACTION PLAN (RAN GRK)

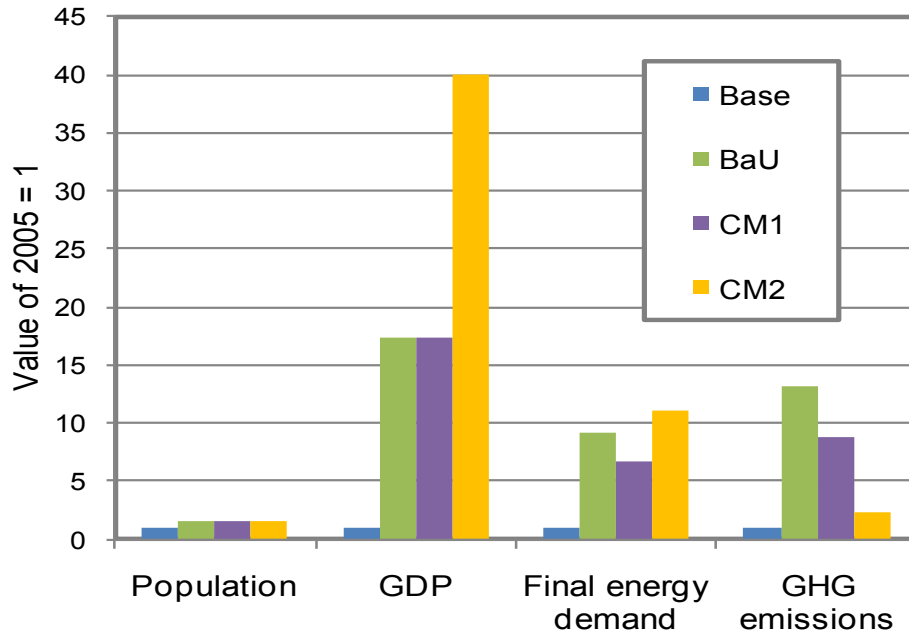
- Fugitive reduction through LPG production in Oil and Gas Field
- Eff. Energy Technology in Residential (7.9 + 13.53 millions kWh)
- Increase energy efficiency in road transport
- Increase share of MRT
- Increase share of Train
- Modal shift from Private Vehicle to walk and bicycle
- EcoDriving (Eff. Energy)
- Fuel substitute
- Use more efficient car and bus
- Increase share of BRT
- Modal Shift (Private to MRT)
- ITS (Efficiency Energy in transport) and Modal Shift (Private to MRT) 2
- ITS (Efficiency Energy in transport) and Modal Shift (Private to MRT) 1
- Natural gas for city gas (94500 residential)
- Use gas fuel in city public transportation
- Biogas (10000 unit + 21400 unit)
- Renewable Energy Implementation
- Energy conservation Community/Private (1303 buildings&industries)
- Energy management 200 companies (Intensive Energy)



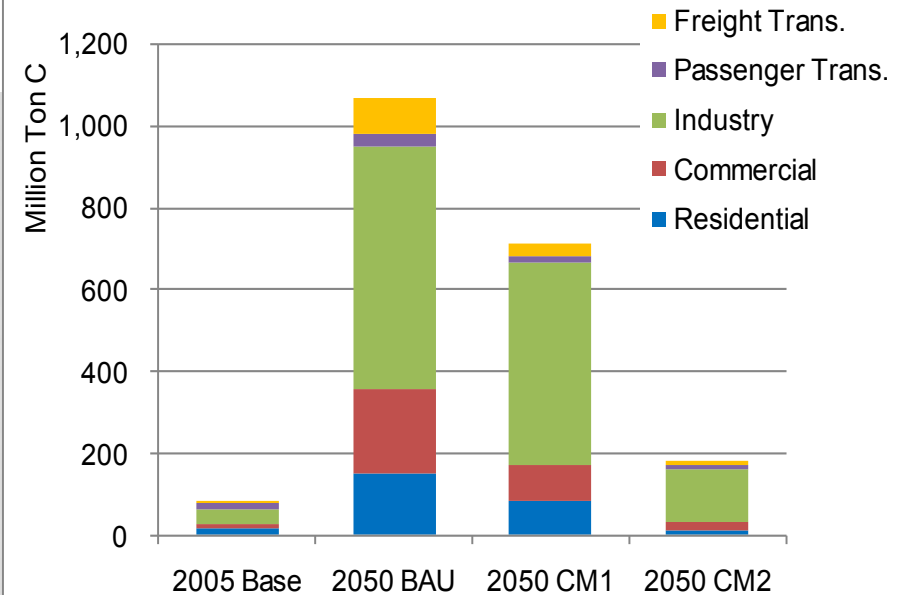
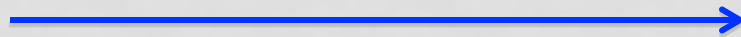
SUB-NATIONAL ACTION PLAN (RAD) FOR GREATER JAKARTA

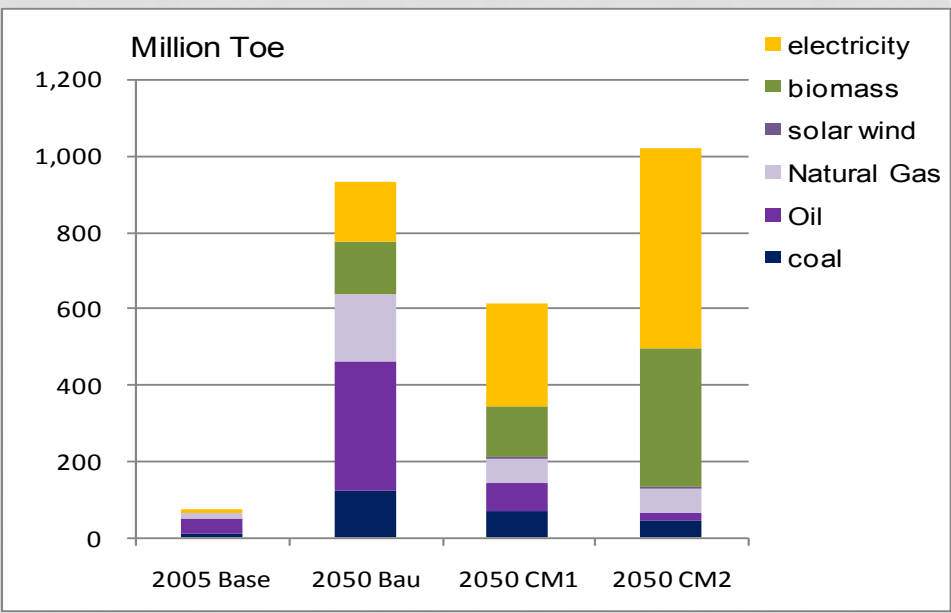
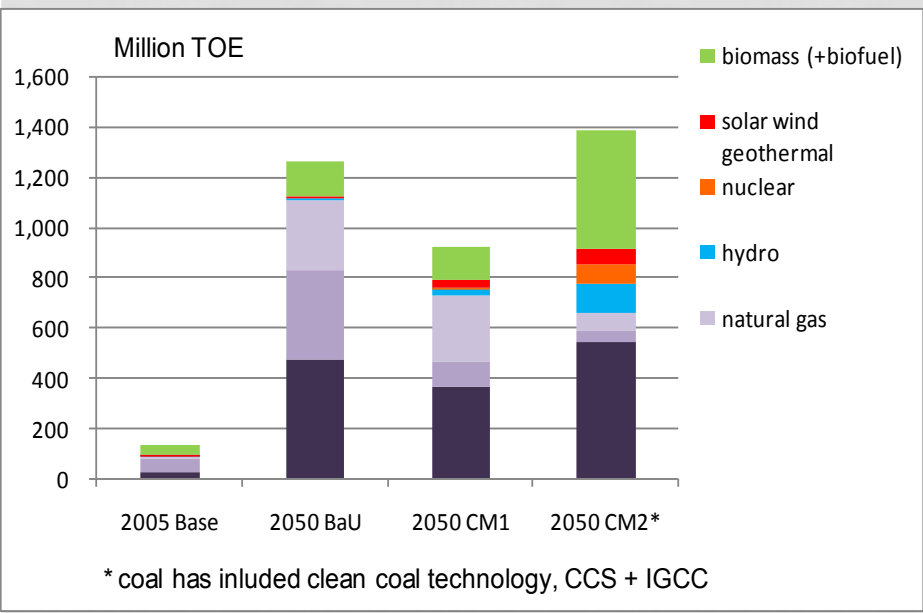


Socio-economy, energy, and CO2 for each development scenario



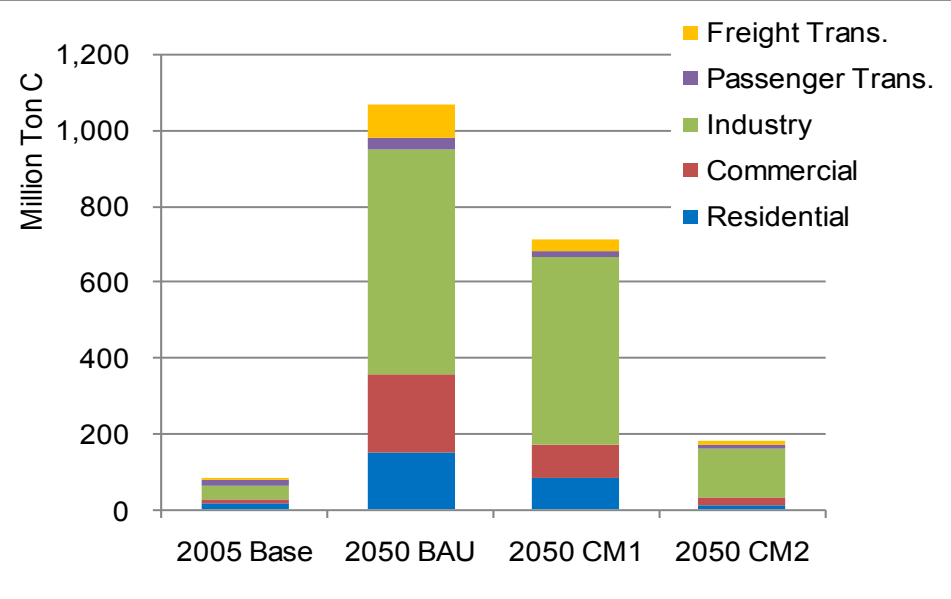
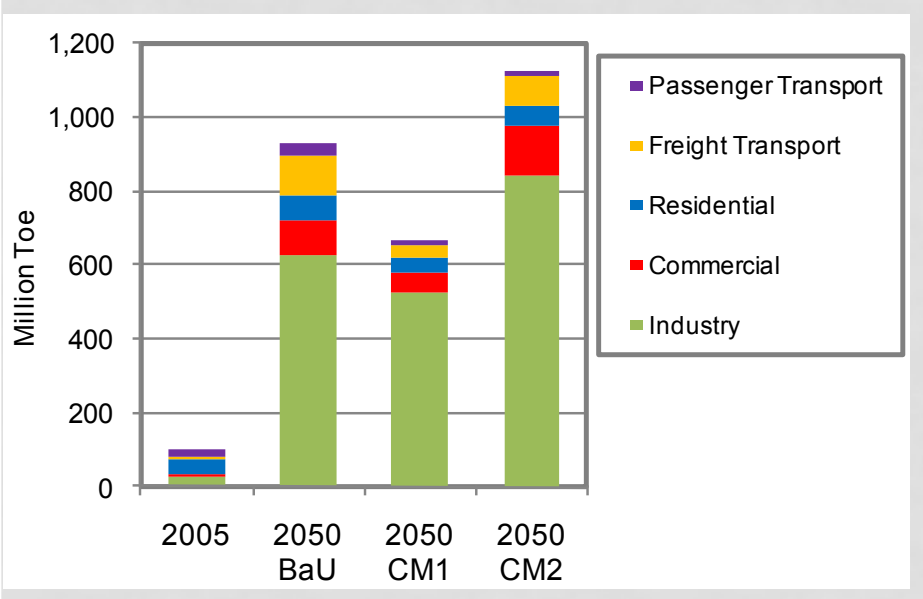
CO₂ emissions by sector, million ton C





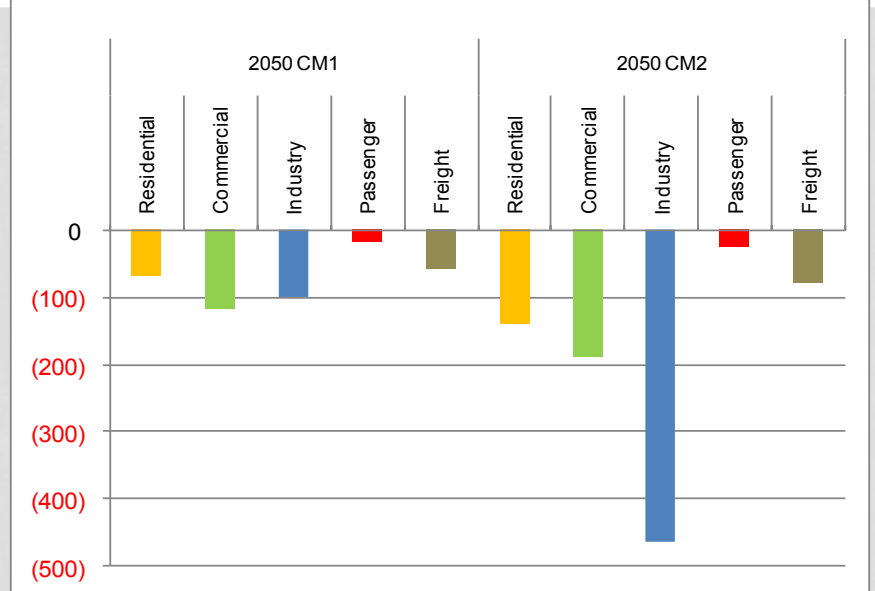
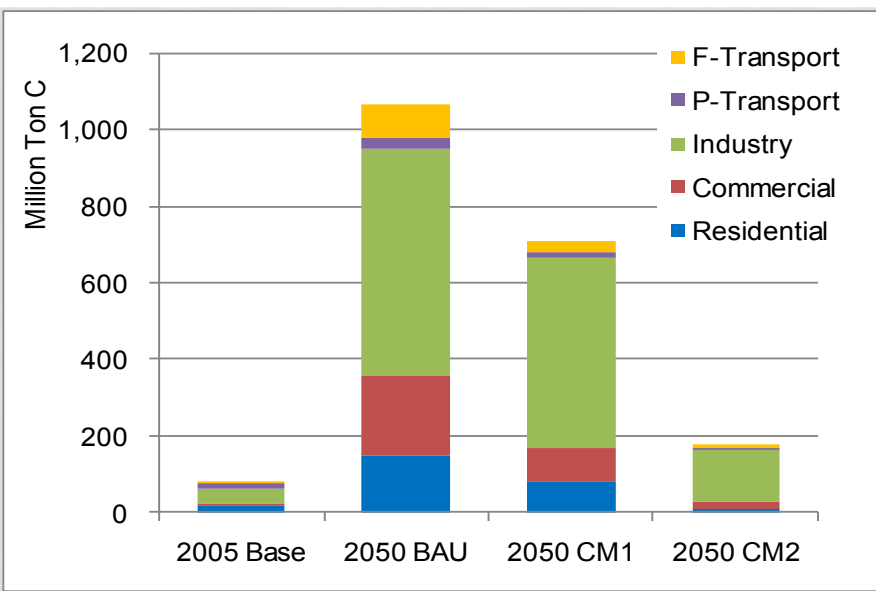
Primary energy demand by type of energy

Final energy demand by type of energy

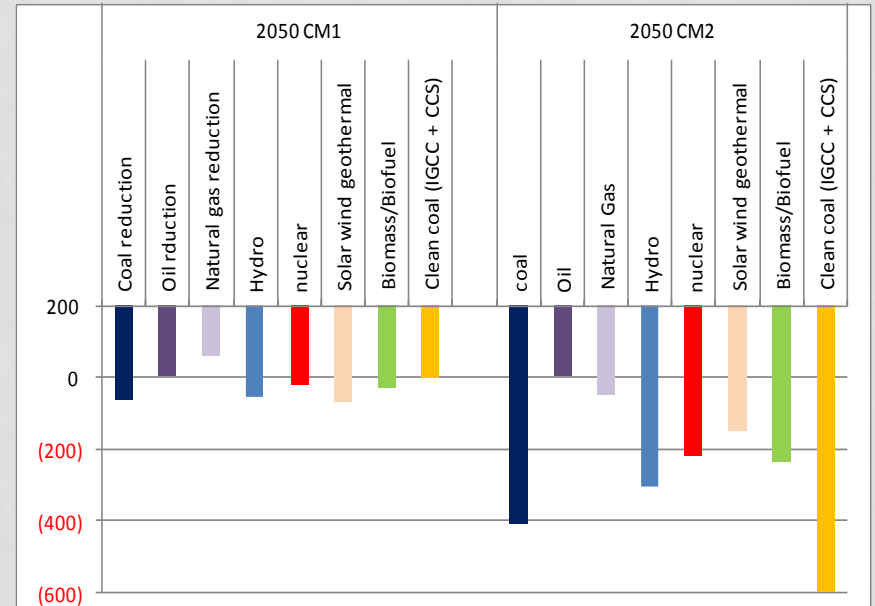
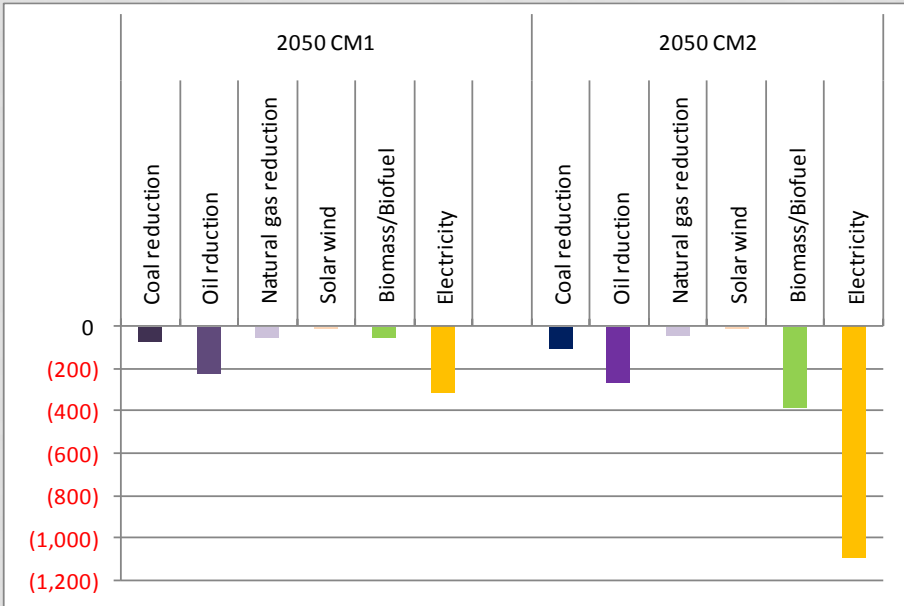


Final energy demand by sector

CO₂ emissions by sector, million ton C



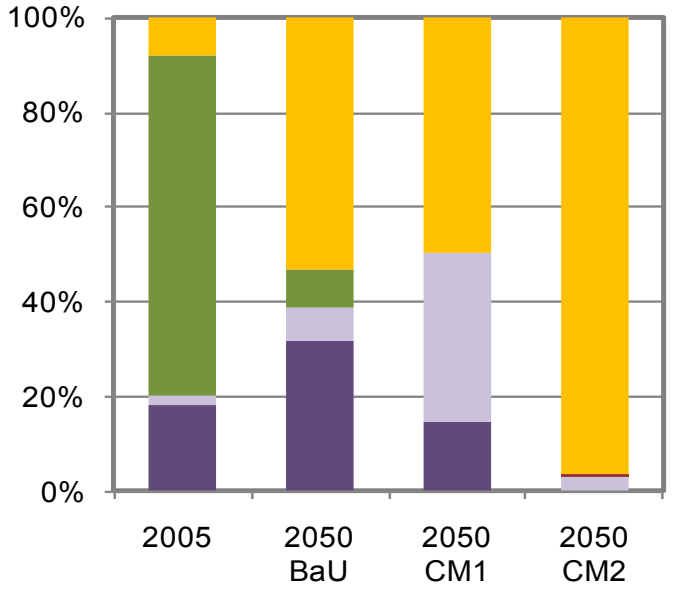
CO2 emission generation in demand side of energy system and reduction potential



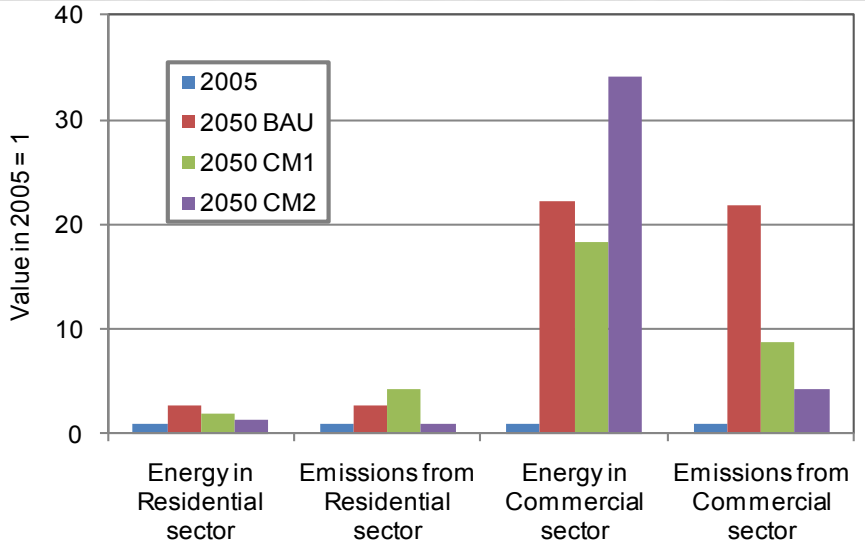
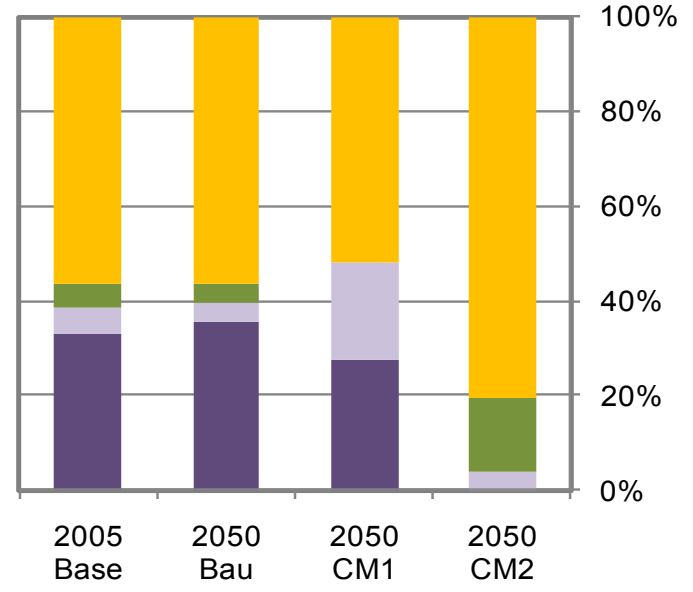
Emissions reduction potential in demand side and supply side (power sector)

Action 1 Clean Energy: Increase share of renewable/less carbon emitting fuels

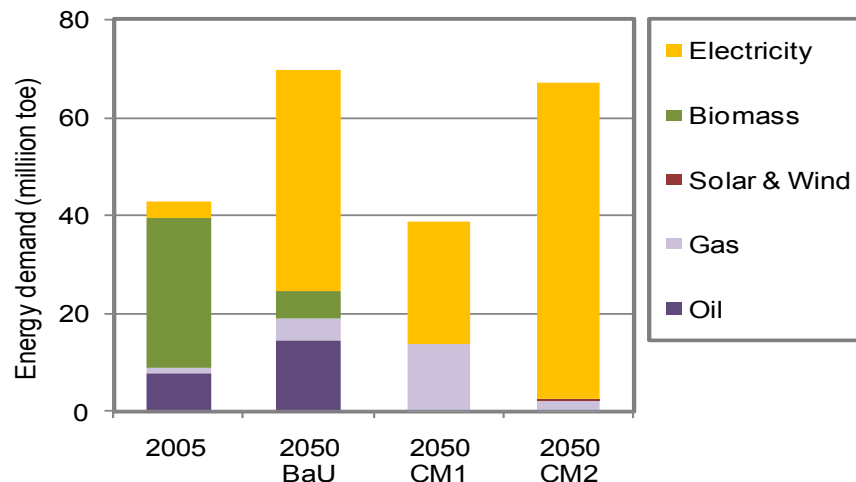
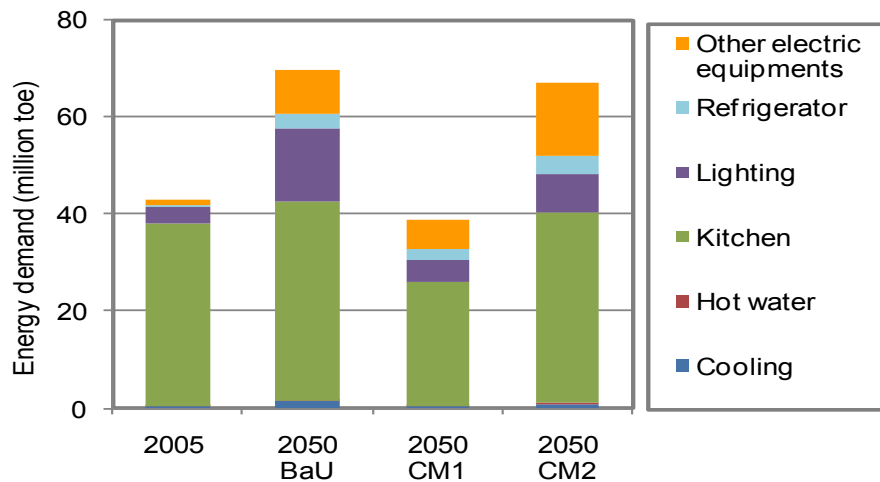
(a) Residential sector



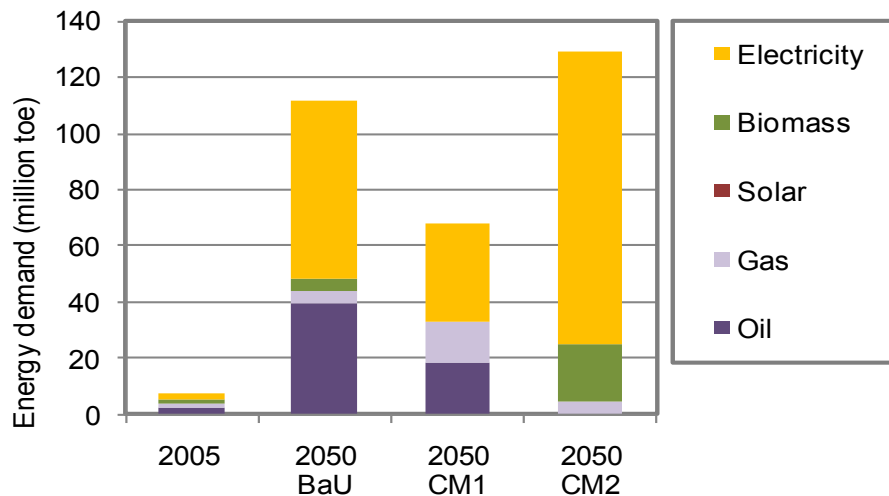
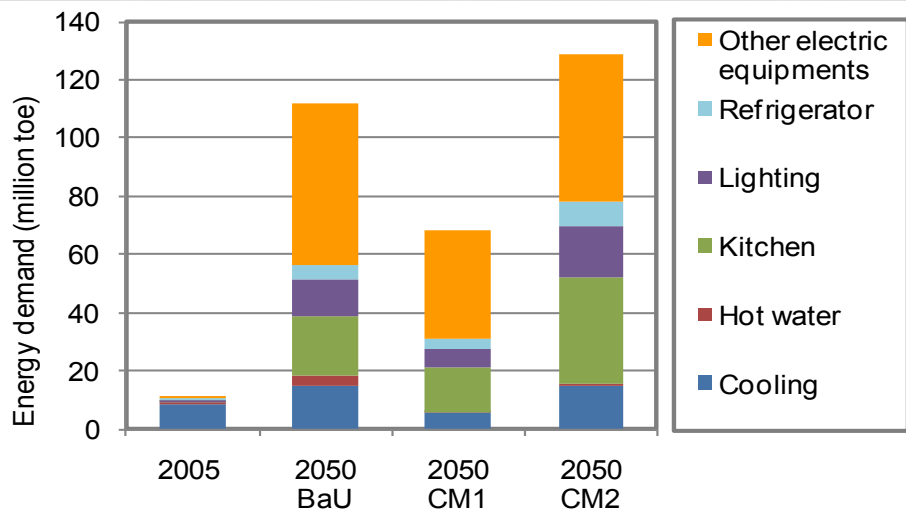
(b) Commercial sector



Action 2 Low Carbon Lifestyle:

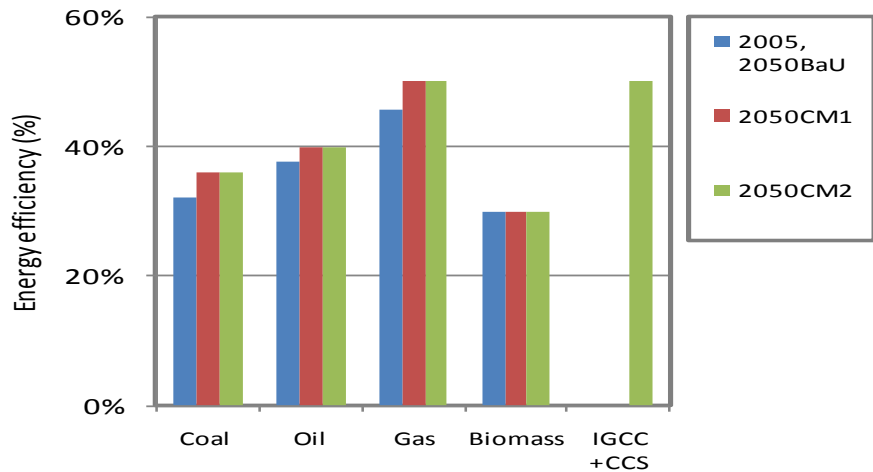


Final energy demand by service (left) and by fuel (right) in residential sector

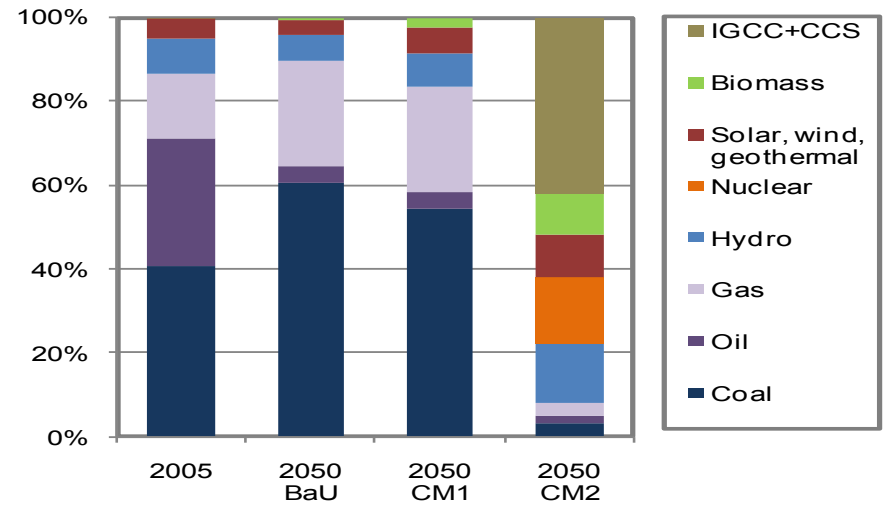


Final energy demand by service (left) and by fuel (right) in commercial sector

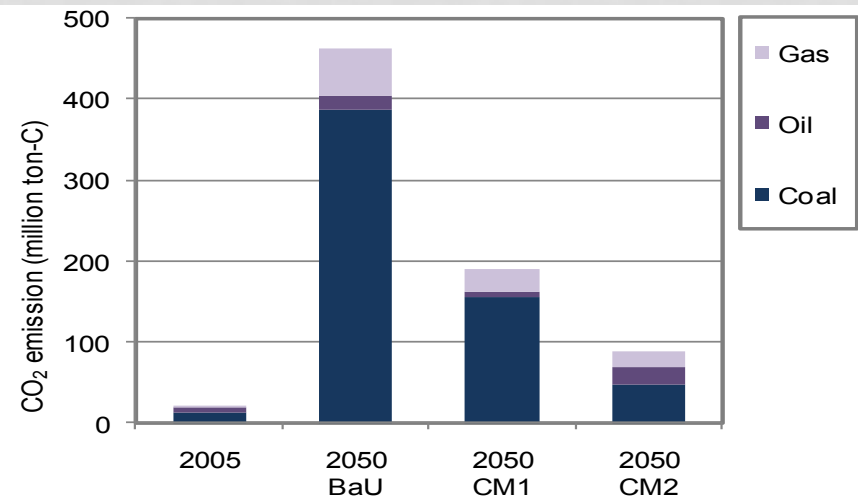
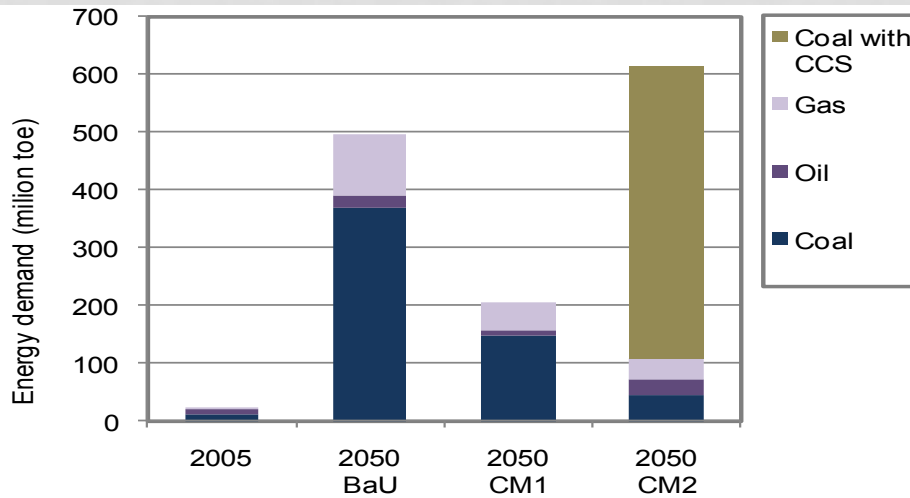
Action3: Low Carbon Electricity



Energy efficiency level of power generation in each scenario

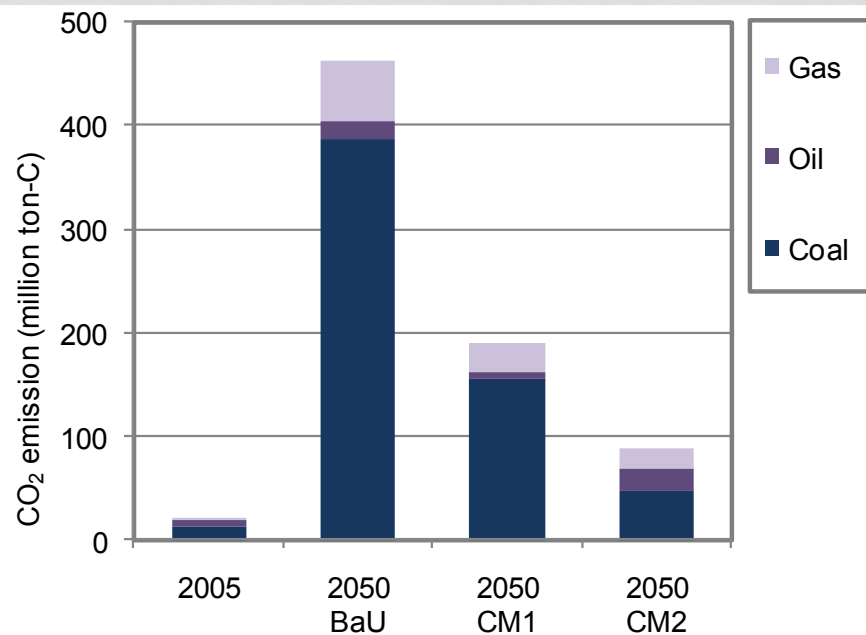
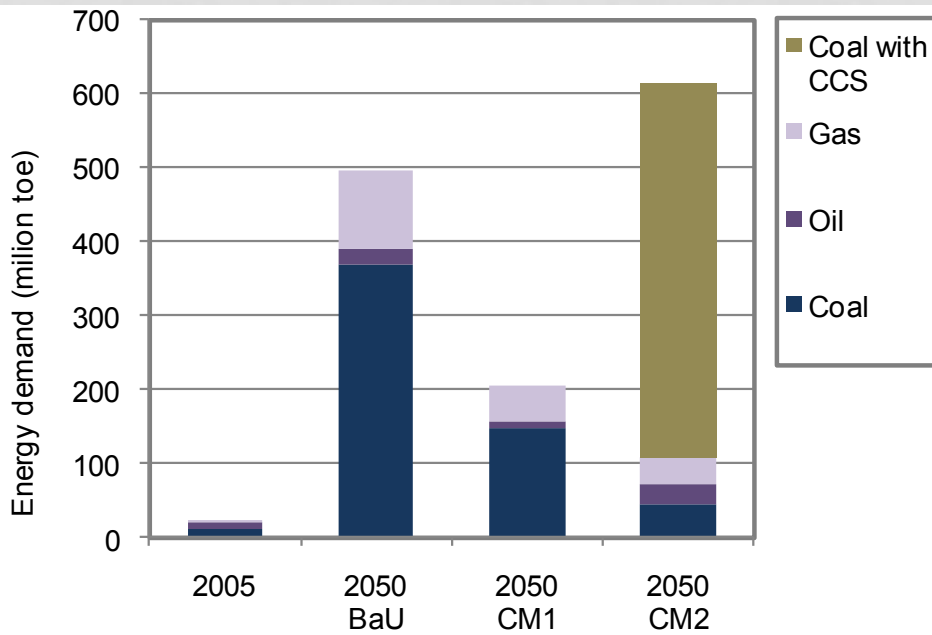


Share of power supply by energy type in each scenario



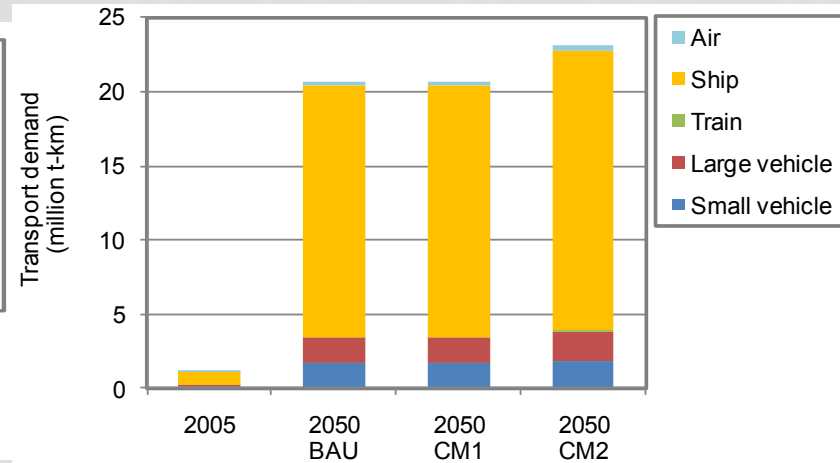
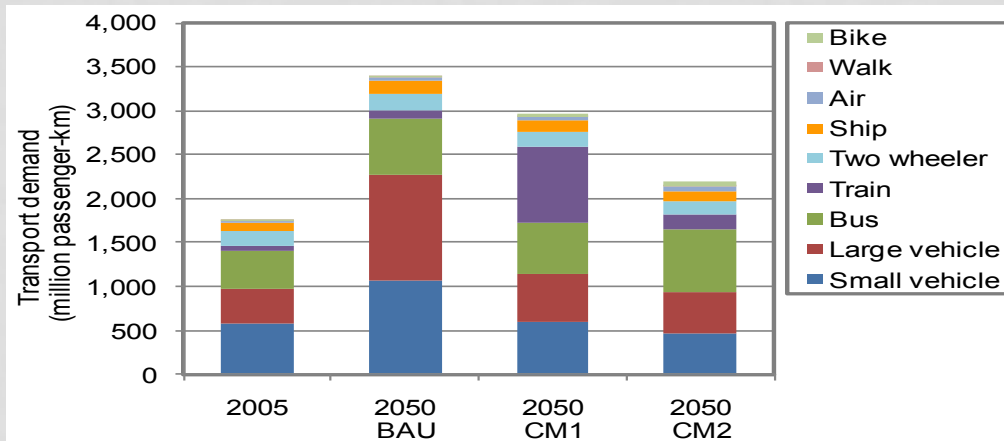
Fuel consumption and CO₂ emission of power generation sector in each scenario

ACTION 4: LOW CARBON ENERGY SUPPLY

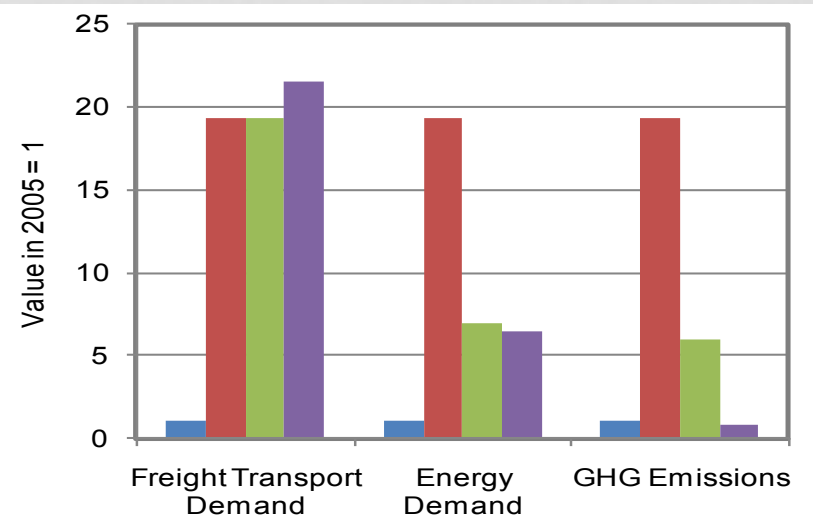
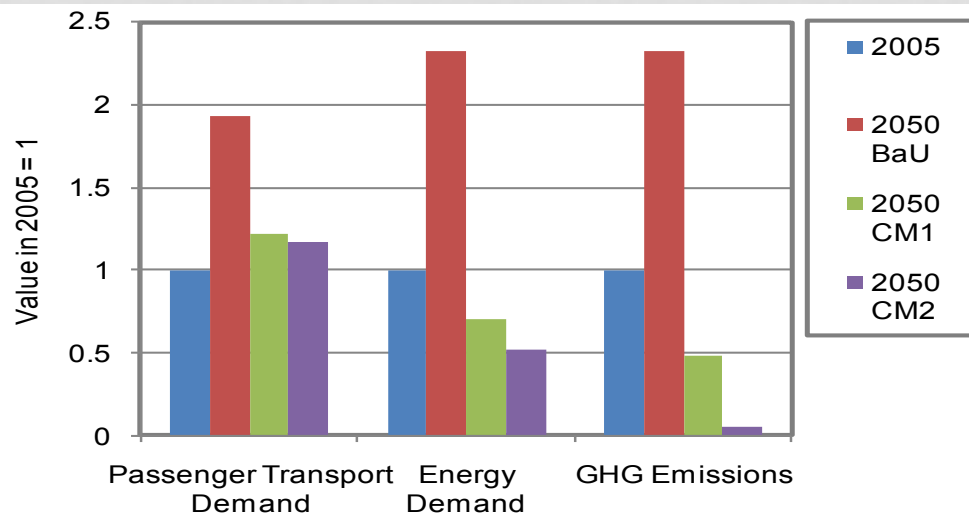


Fuel consumption and CO₂ emission of power generation sector in each scenario

ACTION 5: SUSTAINABLE TRANSPORT



Transport demand by transport mode in (a) passenger transport & (b) freight transport



Effect of passenger and freight transport demand to energy demand and CO₂ emissions

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POLICIES AND REGULATIONS

- There are numerous energy-climate policy initiatives, regulations, and actions in energy sector that could result in CO₂ emission reduction.
- The latest policy initiative is non-binding emission reduction target of 26% lower than baseline in 2020 using domestic budget and further increased to 41% with international support.
- To implement non-binding commitment, GOI prepares National Actions Plan 2010 -2020 to Reduce CO₂ Emissions.
- In addition to the policy initiatives, most actions plan developed for achieving the LCS target will still need policy measures to support the implementations of these actions:

Policy measures to support the implementations of these actions:

- a. Increasing share of new/renewable energy and less carbon emitting fuels (include less carbon emitting technology) in energy supply mix to support implementation of PerPres No. 5/2006.
- b. On-going programs considered to meet energy supply mix target are power generation crash program I and II (which include clean coal and geothermal), kerosene to LPG, mandatory of bio-fuel utilization in transport, power, and industry (MEMR 32/2008);
- c. Increasing share of new/renewable (hydro, geothermal) and oil switch to natural gas as stated in the National Plan of Electricity Development (RUPTL) PLN 2008 - 2018;
- d. Regulations that lead to the formulation of national master plan on energy efficiency;
- e. Policies to support MRT development, diversification of fuels (CNG/LPG, bio-fuel, electricity) in transportation, and emissions monitoring and control of local emission and combustion efficiency that has implication to the CO₂ emissions generation.