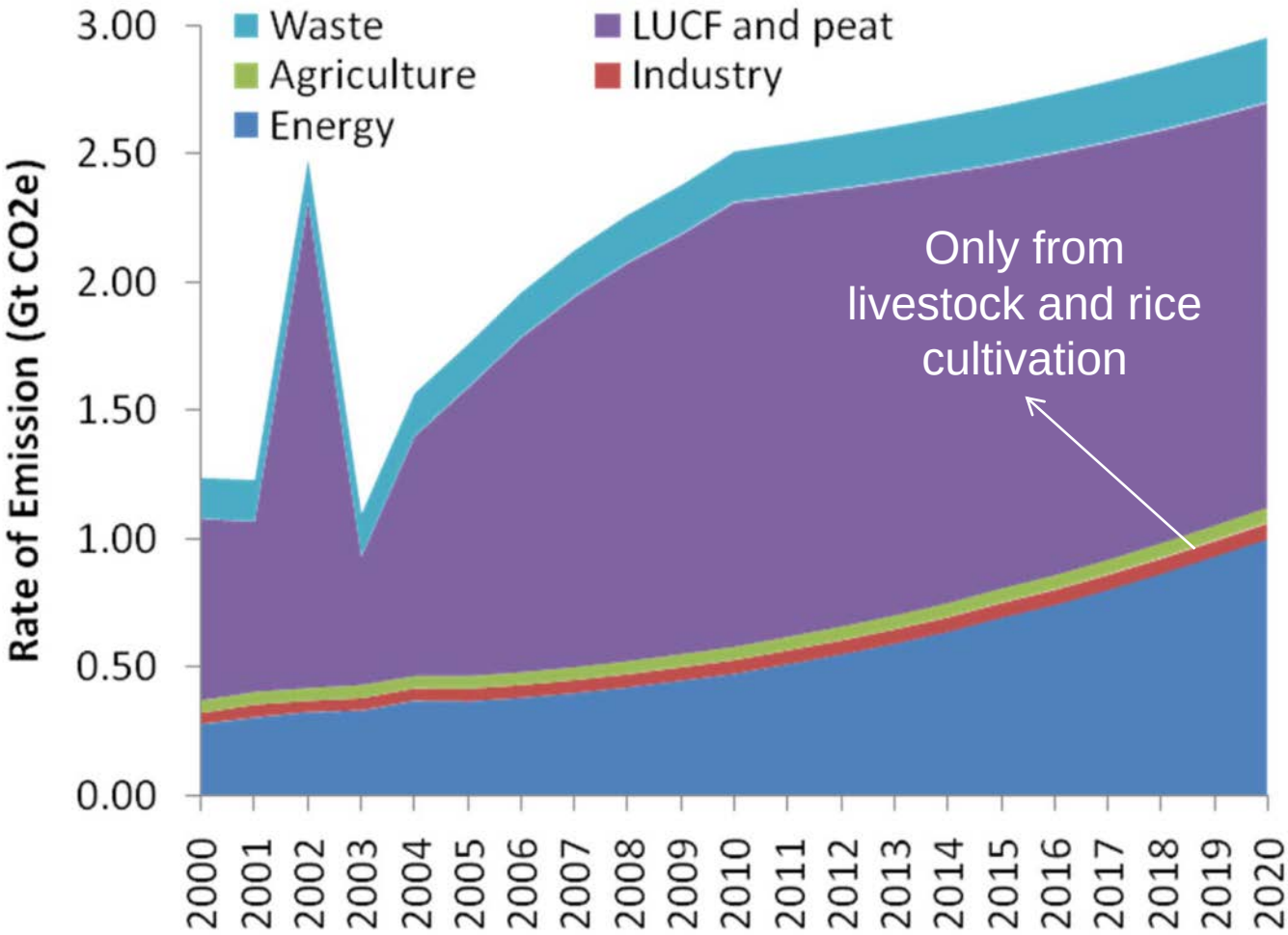
LOW CARBON DEVELOPMENT: INDONESIA

Rizaldi Boer
Center for Climate Risk and Opportunity Management
Bogor Agriculture University-INDONESIA
and
Retno Gumilang Gelang
Center for Research on Energy Policy
Institut Teknologi Bandung-INDONESIA
CREP ITB

Background

- LCD is relatively new in Indonesia → Current GOI plans are not developed to achieve LCD but in lined with and supportive to LCD.
- Indonesia is the world's 10 largest GHG emitters:1,377 MTon CO2eq (2000) and 1,991 MTon CO2-eq (2005) → growth rate 5.7%/year;
- About half the total national emission was from LULUCF and peat fire, while energy is the second with contribution of about 20%
- 'Non-binding' GHG reduction target of 26% lower than baseline of 2020 (domestic budget) and further increased to 41% (international support); GHG reduction primarily will be achieved through forestry (include peat emissions), followed by energy, waste, industry sectors.
- Indonesia is developing National Action Plan on GHG Reduction (2010-2020).

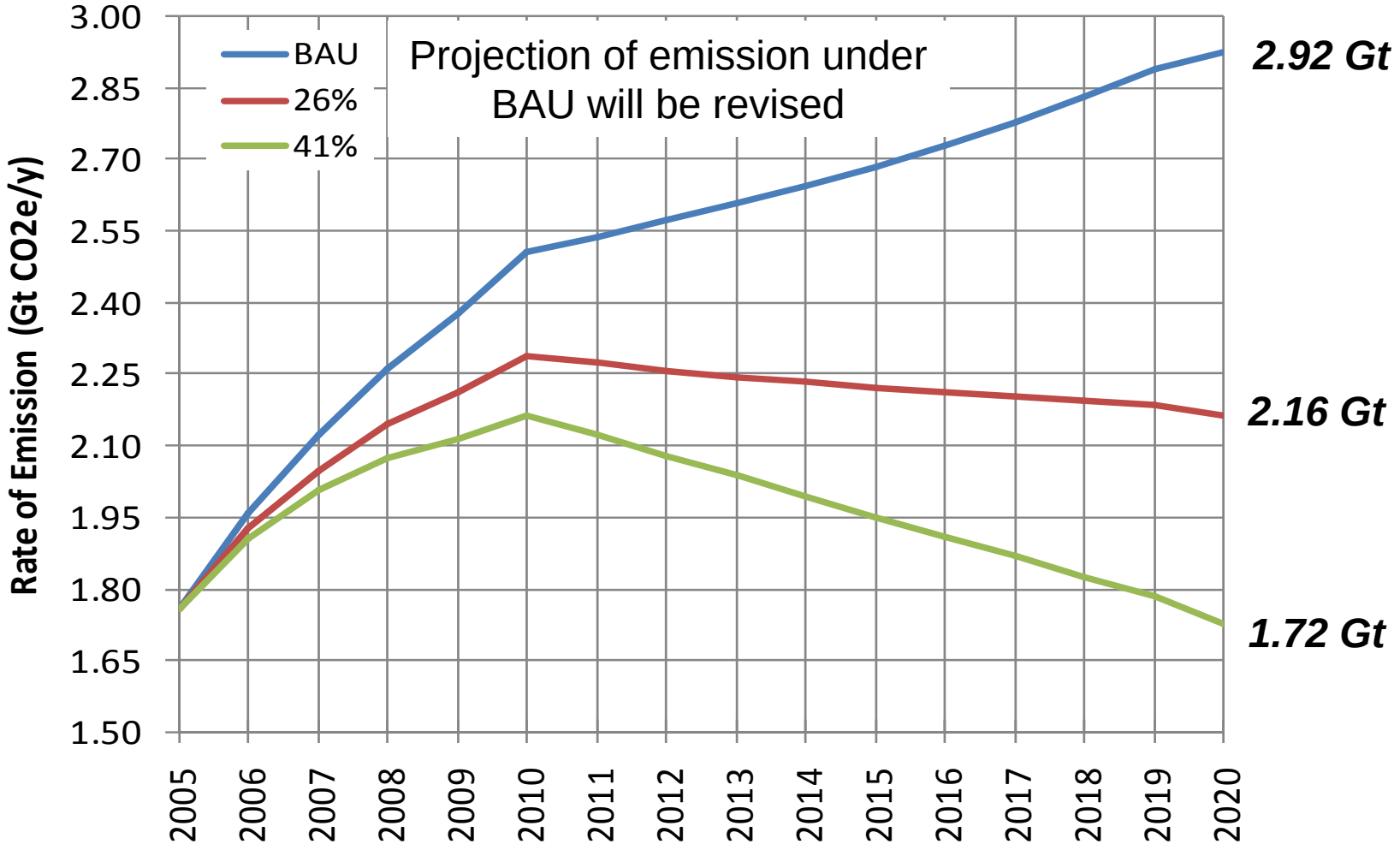
Background: Historical Emission & BAU Projection



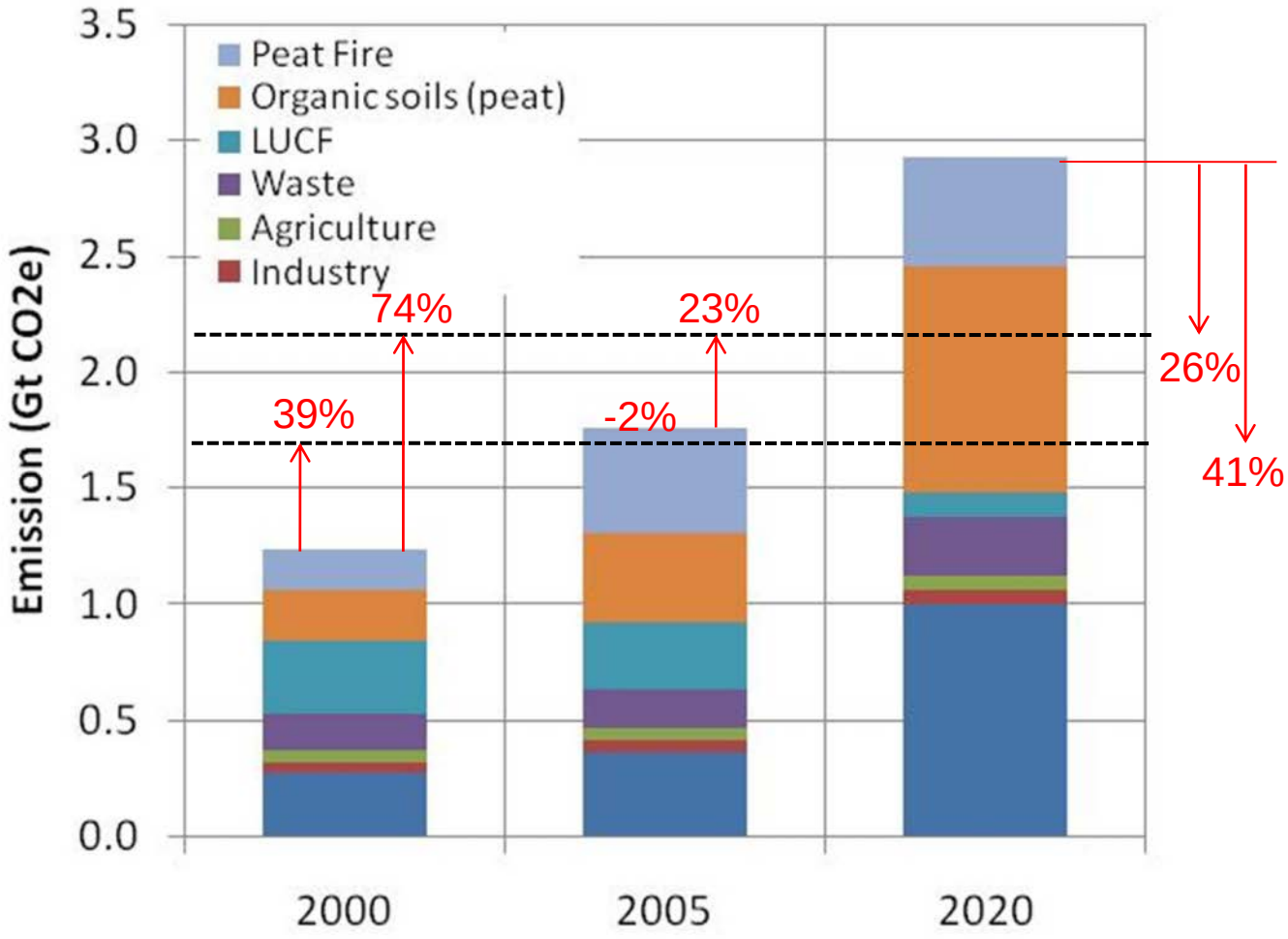
Source: SNC (2010)

Projection of emission under BAU until 2020, LULUCF and peat land is still the major source of GHG emission. However after 2020, energy sector might take over the LULUCF position as the major source of the GHG emission

BAU Projection has been adopted by GoI in defining the 26% and 41% ERT. By 2020, ERT through unilateral actions will be 26% of the BAU 2020 emission rate and additional 15% ER is targeted through supported actions



Rate of Emission under BAU



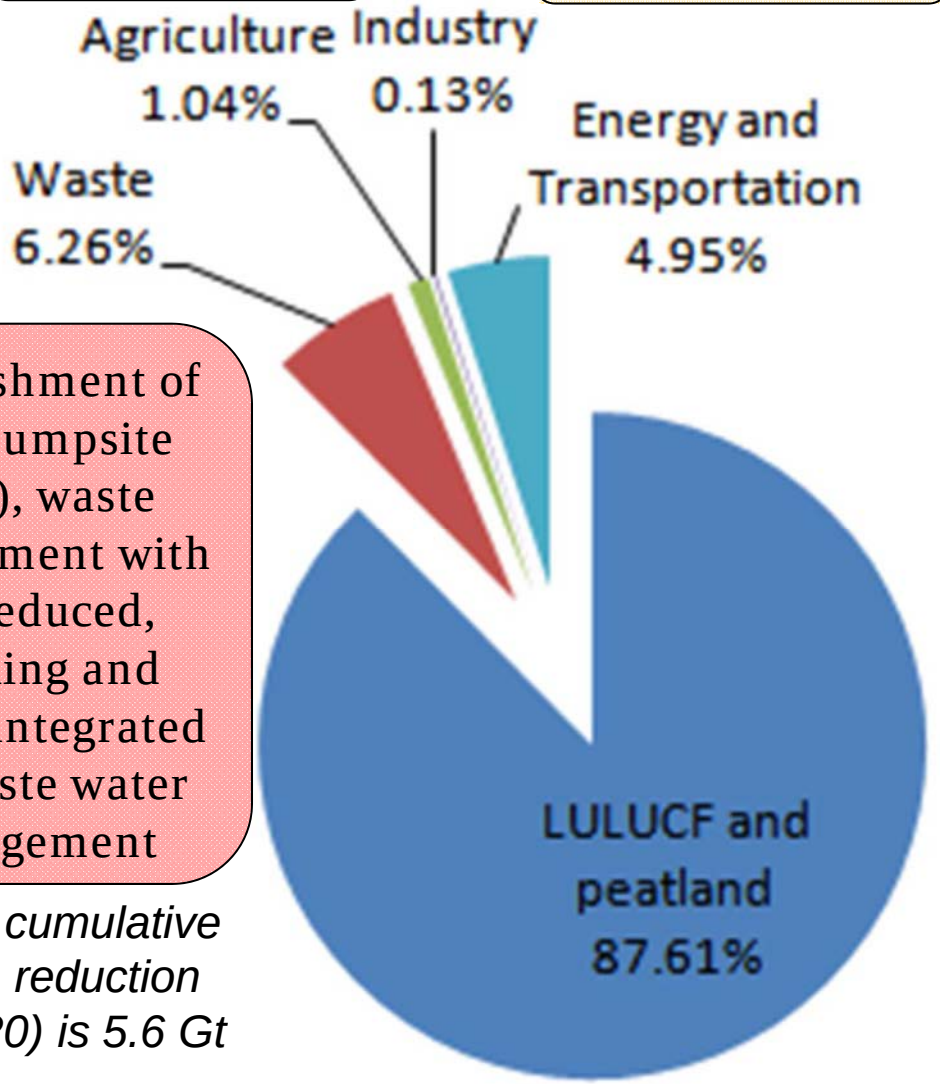
With 26% ERT, the expected emission in 2020 will be 74% above the 2000 Emission level or 23% above the 2005 emission level,
while with 41% ERT, , the expected emission in 2020 will be 39% above 2000 Emission level or 2% below the 2005 emission level

Source: Based on SNC (2010)

Sectors contribution to the 26% ERT

Introduction of LEV, WUE etc.

Energy efficiency, the use of RE etc



Use of biofuel, engine with improved energy efficiency, improve public transportation and road, *demand side management*, *energy* efficiency, development of renewable energy

Establishment of final dumpsite (TPA), waste management with 3R (reduced, recycling and reuse), integrated city waste water management

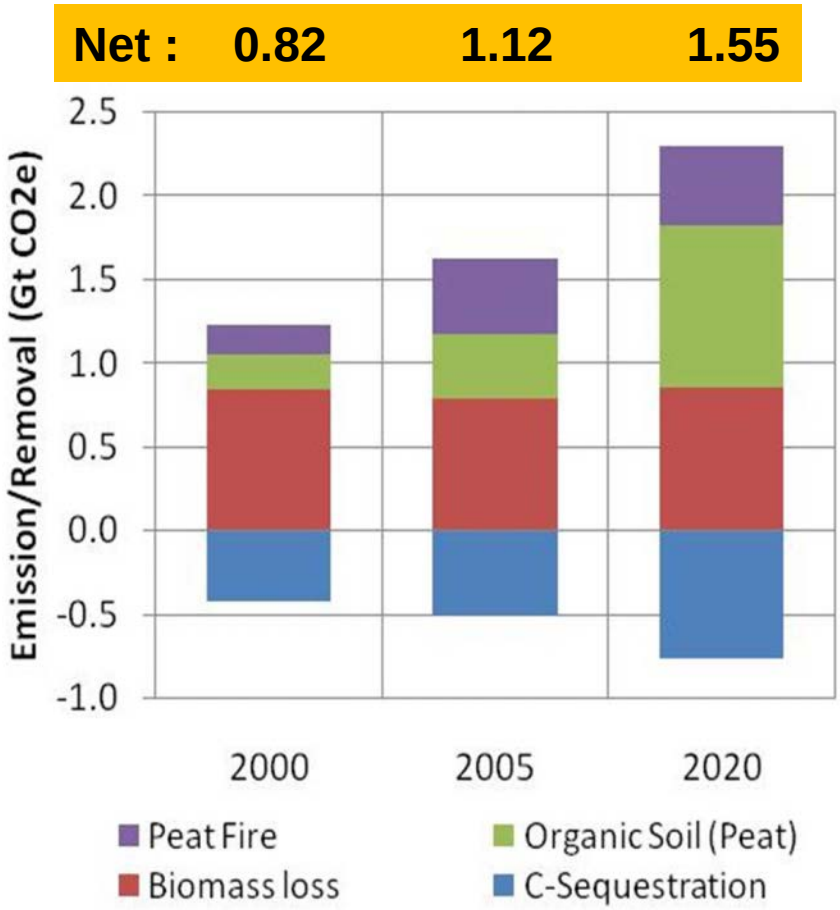
Peat/forest fire management, improving water management on peat, land and forest rehabilitations, combating illegal logging, reducing deforestation and community empowerment

Expected cumulative emission reduction (2005-2020) is 5.6 Gt

Forestry: 53.8%
~ 1.56 Gt CO_{2e}

BAU Emission from Forestry Sector in the SNC

- Emission from biomass removal similar to historical emission 0.898 Gt CO_2 per year (from MoFor, 2009).
- Emission from peat fire taken from van der Werf *et al.* (2008)
- Emission from peat (average over 2006-2025, with assumption that all forest in peatland outside forest area and inside convertible forest will be converted and in non-convertible forest follows historical rate, based on Bappenas 2009)
- Rate of sequestration occurs as a result of:
  - regeneration of secondary forests (5.32 tCO_2/ha),
  - tree planting (36.7 tCO_2/ha), Rate of tree planting between 1996 and 2006 was 198 thousand ha/year.
  - Regrowth of woody vegetation (13.5 tCO_2/ha).



Source: SNC, 2010

Emission projection under BAU and Mitigation scenarios developed by Policy Working Group on Forestry (for the Minister of Forestry-Pokja Kebijakan-Kementrian Kehutanan, 2010)

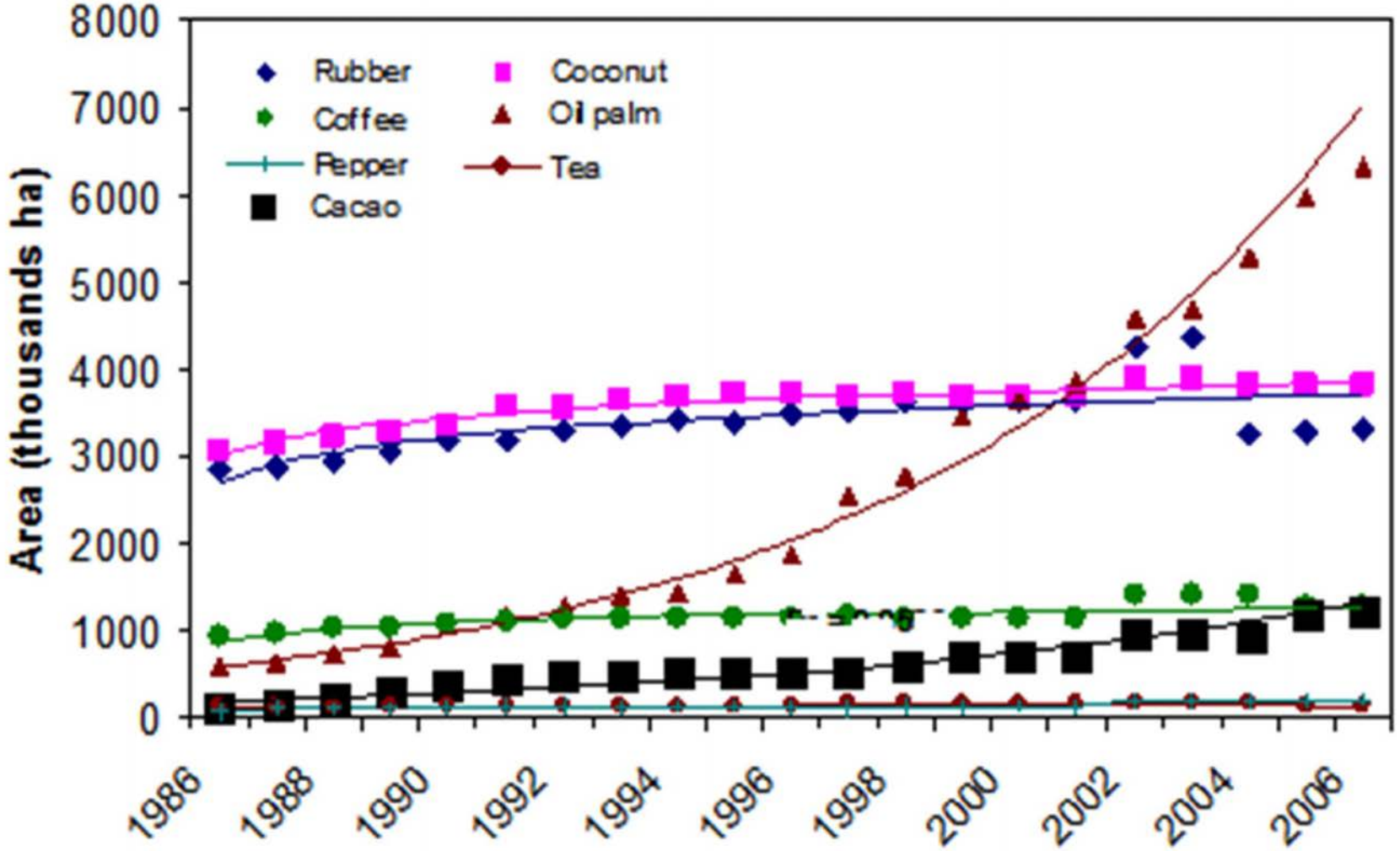
Indonesian Land Cover in 2007

Source: Baplan, 2008

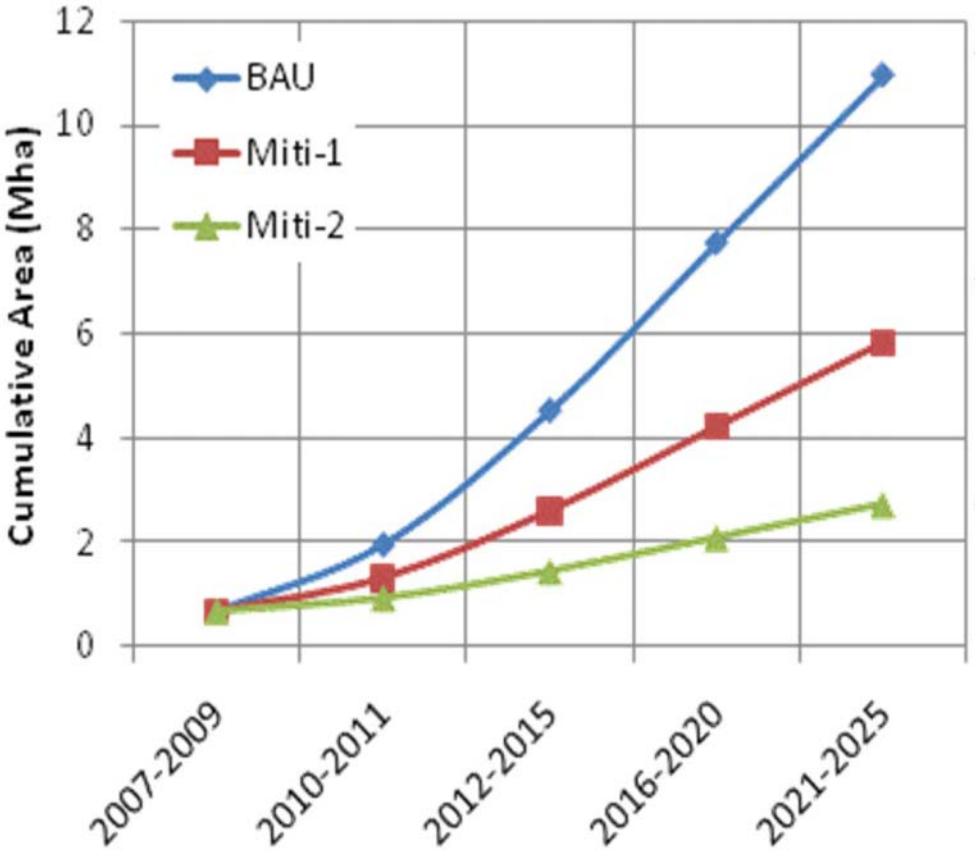
Land cover condition	Conserva-tion Forest	Protec-tion Forest	Produc-tion Forest	Con-vertible Forest	Non-Forest Area
Forested	14,365	22,102	38,805	10,693	7,960
Non-Forested	4,009	5,622	18,404	11,057	44,163
Unidentified	1,502	2,328	3,706	981	2,216
Total	19,876	30,052	60,915	22,732	54,339

Government Plans are to have permanent agriculture land for food crops of 15 Mha (additional 7 Mha is required) and thus forest areas available for agriculture plantation and other non forest activities will be about 15 Mha.

Use of lands for agriculture plantations in Indonesia (1986-2009)

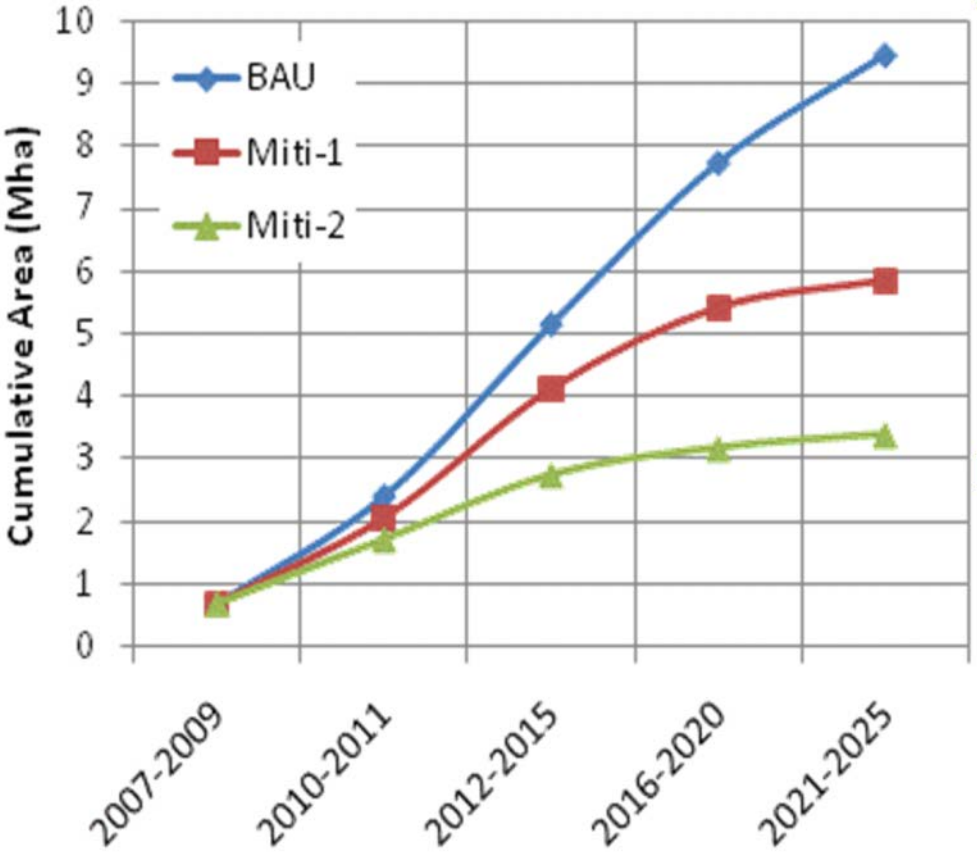


Planned Deforestation Scenario (only on Convertible Forest called HPK)



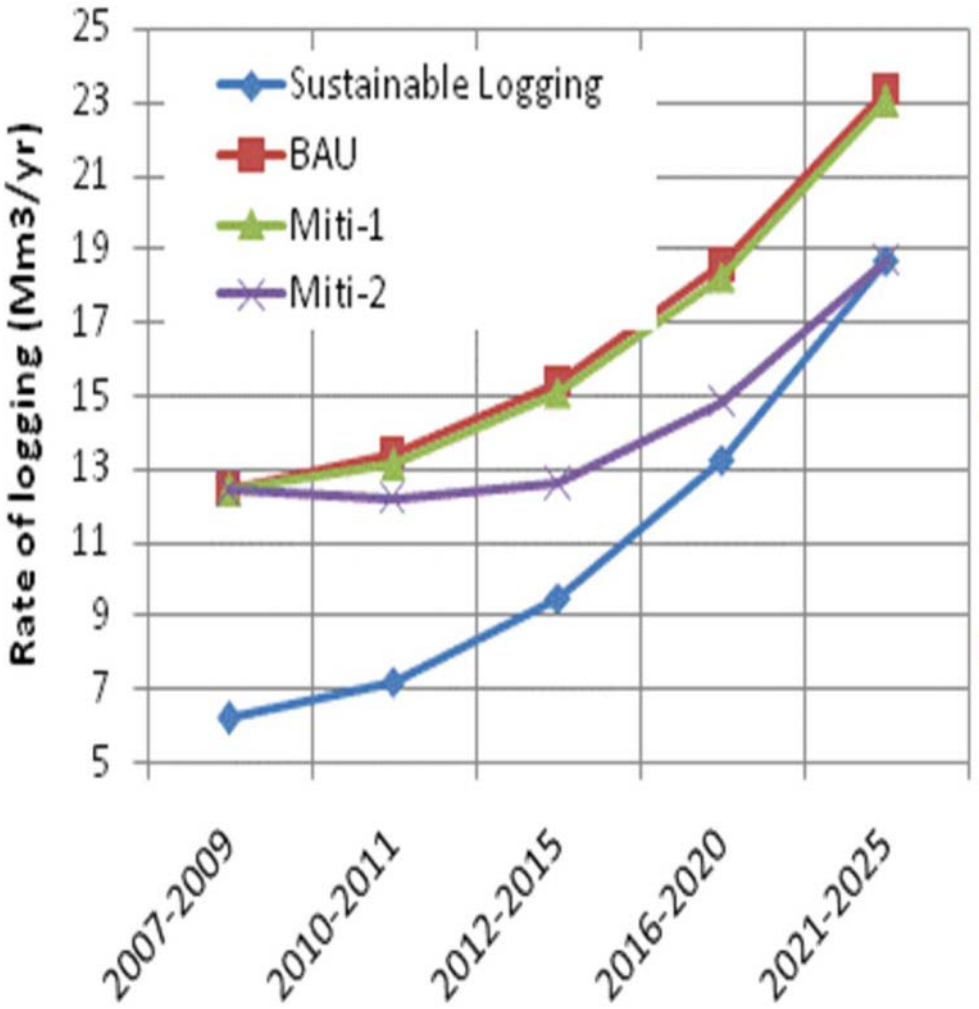
- BAU: All HPK will be converted for non-forest activities irrespective of forested or non-forested until 2025
- Mitigation: Forested HPK will be maintained as forest area (Miti1: 50% and Miti2: 75%)
- Supporting Regulations PP. 10/2010 and PP11/2010; National forest policy for avoiding deforestation; establishment of forest management unit (FMU)

Unplanned Deforestation Scenario



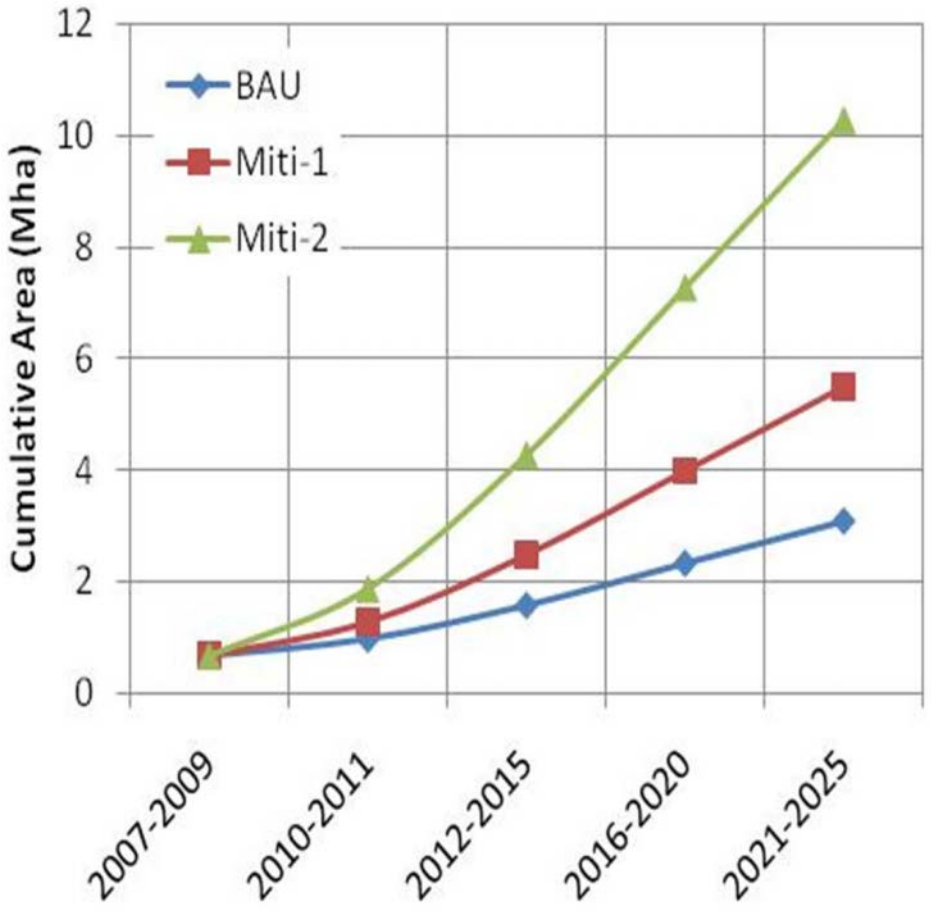
- BAU: Following historical deforestation rate that occurred between 2000-2006 (contribute to about 79% of total deforestasi rate) ~ 210 FMU. Need to have 700 KPH
- Mitigation: Depend on the successfulness of establishing FMU, Human resources and fund
  - Miti1: same as BAU and FMUs function effectively,
  - Miti2: All FMUs established

Forest Degradation due to logging Scenario



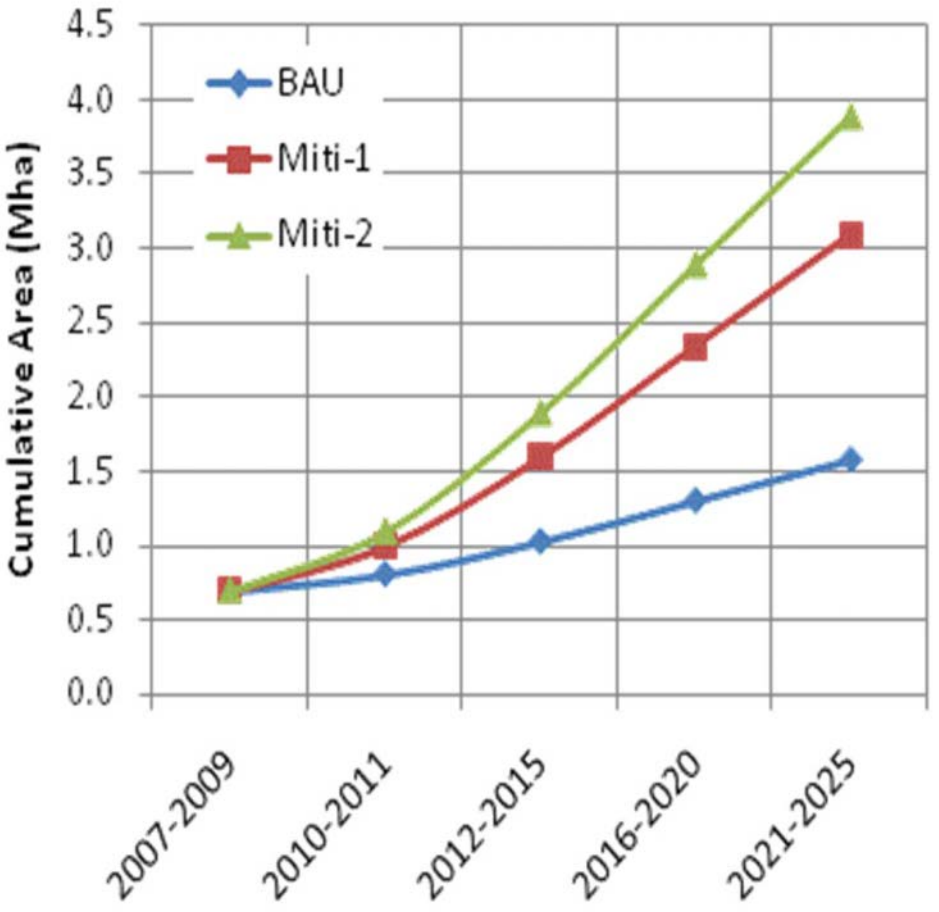
- Assumption:
  - Historically, amount of illegal logging is the same as legal logging
  - Rate of from illegal logging decrease linearly with the establishment of FMU
- BAU: Amount of logged wood decrease slightly following the FMU establishment
- Mitigation: Depend on the successfulness of establishing FMU, Human resources and fund
  - Miti1: same as BAU but FMUs function effectively,
  - Miti2: All FMUs established

Industrial Timber Plantation Establishment Scenario



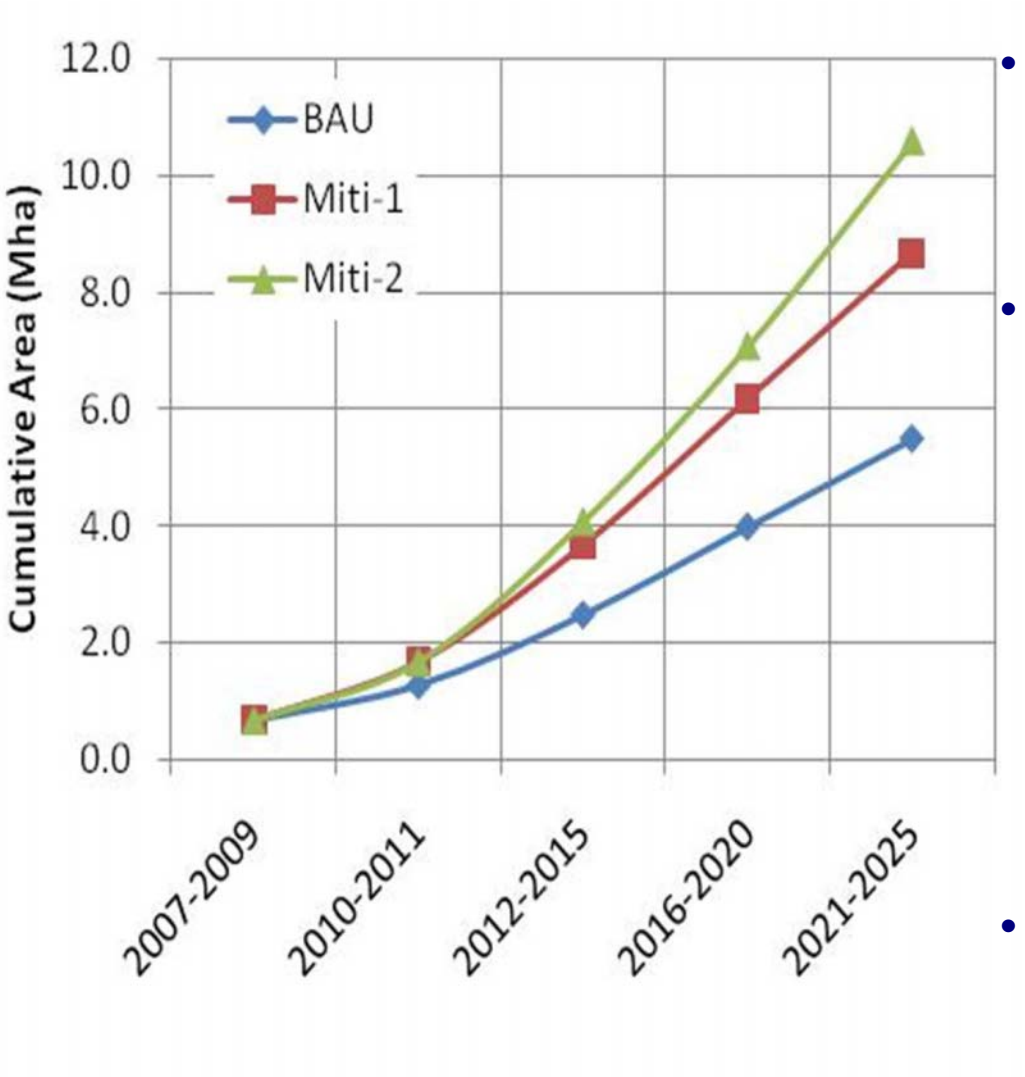
- BAU: Rate of timber plantation establishment followed historical rate (at present total timber plantation is about 4.8 Mha)
- Mitigation:
  - Miti1: New timber plantation establishment is to meet the target of10 Mha (Government scenario)
  - Miti2: New timber plantation establishment is set up to make Indonesia as the 3rd largest timber producer countries in the world, APHI scenario)
- Assumption: land tenure solved and climate for investment good

Community based-Timber Plantation Establishment Scenario



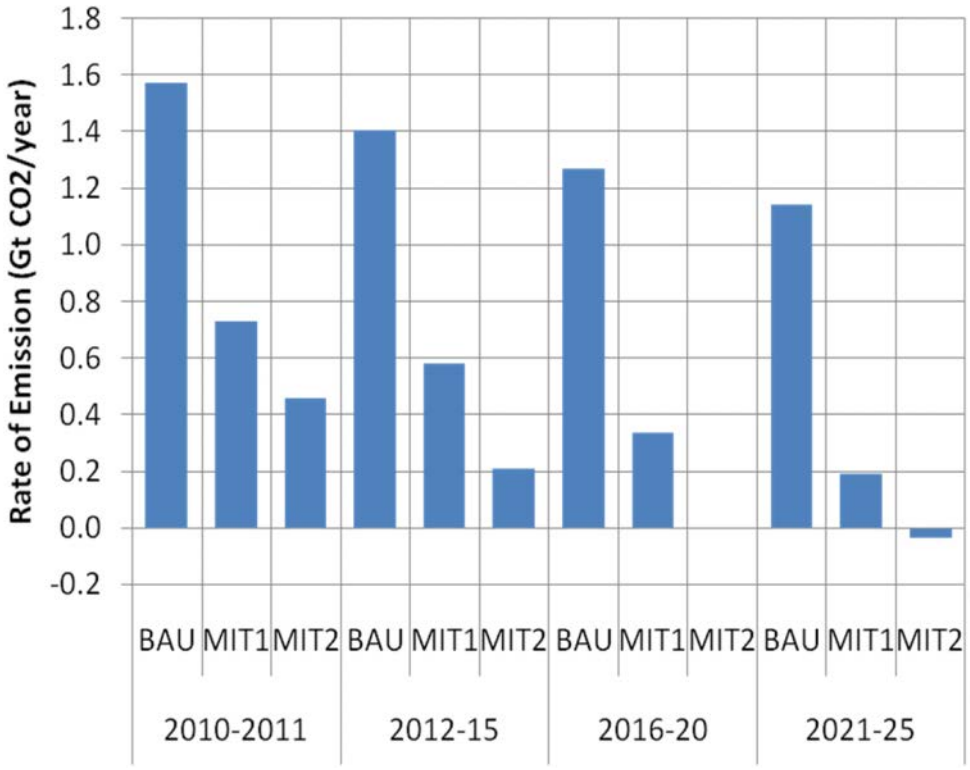
- BAU: Rate of timber plantation establishment followed historical rate
- Mitigation:
  - Miti1: Rate of planting meets part of the government target considering the biophysical feasibility of lands for the timber plantation
  - Miti2: Rate of planting meets the government target
- Assumption: land tenure solved and climate for investment good

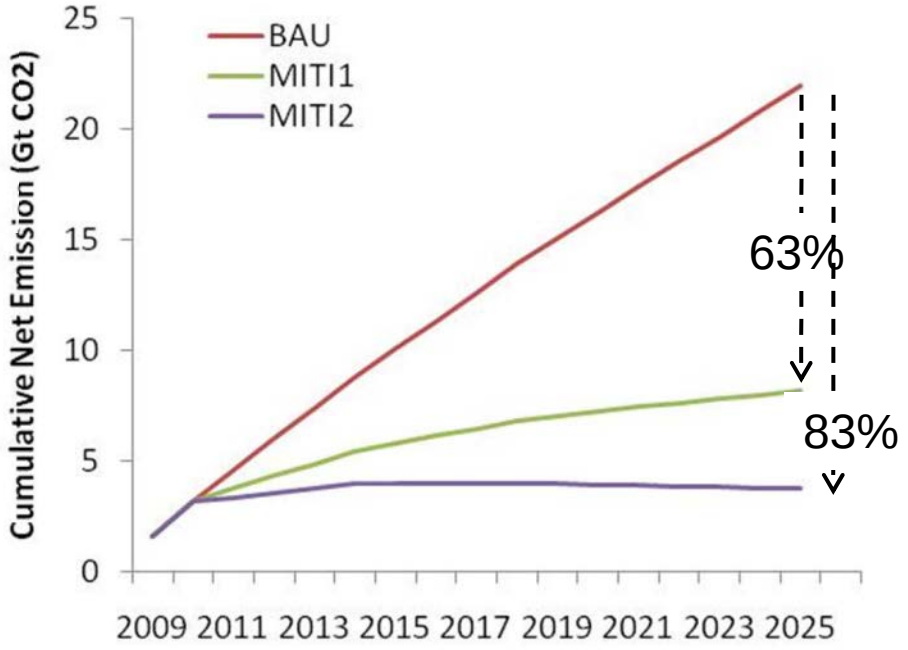
Rate of planting for Land Rehabilitation program



- BAU: Rate of planting and survival rate followed historical condition
- Mitigation: Meet the government target and the survival rate increase following the successfulness of FMU establishment
  - Miti1: same as BAU but FMUs function effectively,
  - Miti2: All FMUs established
- Assumption: Institution work well, good seedling, fund available and good extension services

Emission Projection from LULUCF





Concluding Remarks

- LULUCF and peat land can contribute significantly to the reduction of the GHG emissions
- Conditions:
  - Establishment of FMU should be accelerated. Available budget may be enough only for Budget available for this only for 30%
  - Land tenure
  - Climate investment
  - Financial support for communities-forest-based-activities and extension services

Low Carbon Development Strategy Toward 2050 in Indonesian Energy Sector

Overview of Energy Sector and GHG Emissions

Energy and GHG Emissions Projections (BAU)

Future Visions for Achieving LCDS Toward 2050

Indonesian LCD Strategy in Energy Sector:

It is not to achieve a certain target (i.e. world's target on GHG emission reduction); it is more to explore various possibilities of the Future Economic Development in a Low-carbon Way

Overview of Energy Sector and GHG Emissions

- Energy consumption grows 5.45 %/year (2000-2005) at population growth 1.05%, energy elasticity 1.2, GDP growth 4.95% - 5.5%.
- The objective of energy development is energy supply security.
- Energy development is guided by 'energy supply security' concern; energy investments is based on least cost and resources availability and are not related to climate change mitigation
- Fossil fuels 90% in national energy mix, in which oil accounts to 51%; GHG increases 5%/year
- There is potential to reduce GHG by deplyoment of renewable energy.
- Indonesia relies on imported technology in all sectors. Current energy technologies are generally still inefficient, there are rooms for improvements on technology efficiency.

Energy Resource Potential of Indonesia, 2008

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
Coal Bed Methane	453 TCF	-	-	-

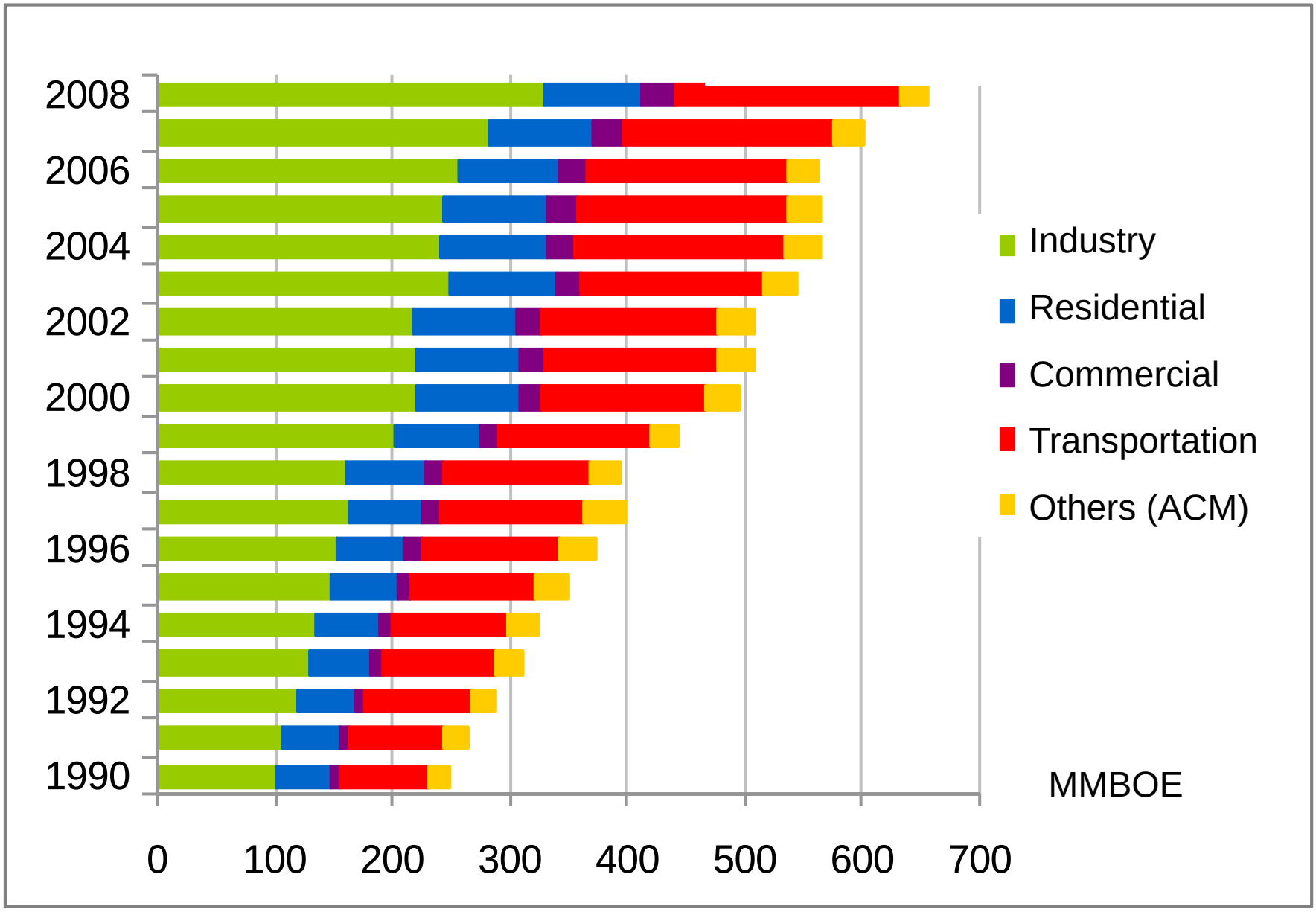
(*) assuming no new discovery; (**) including Cepu Block

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

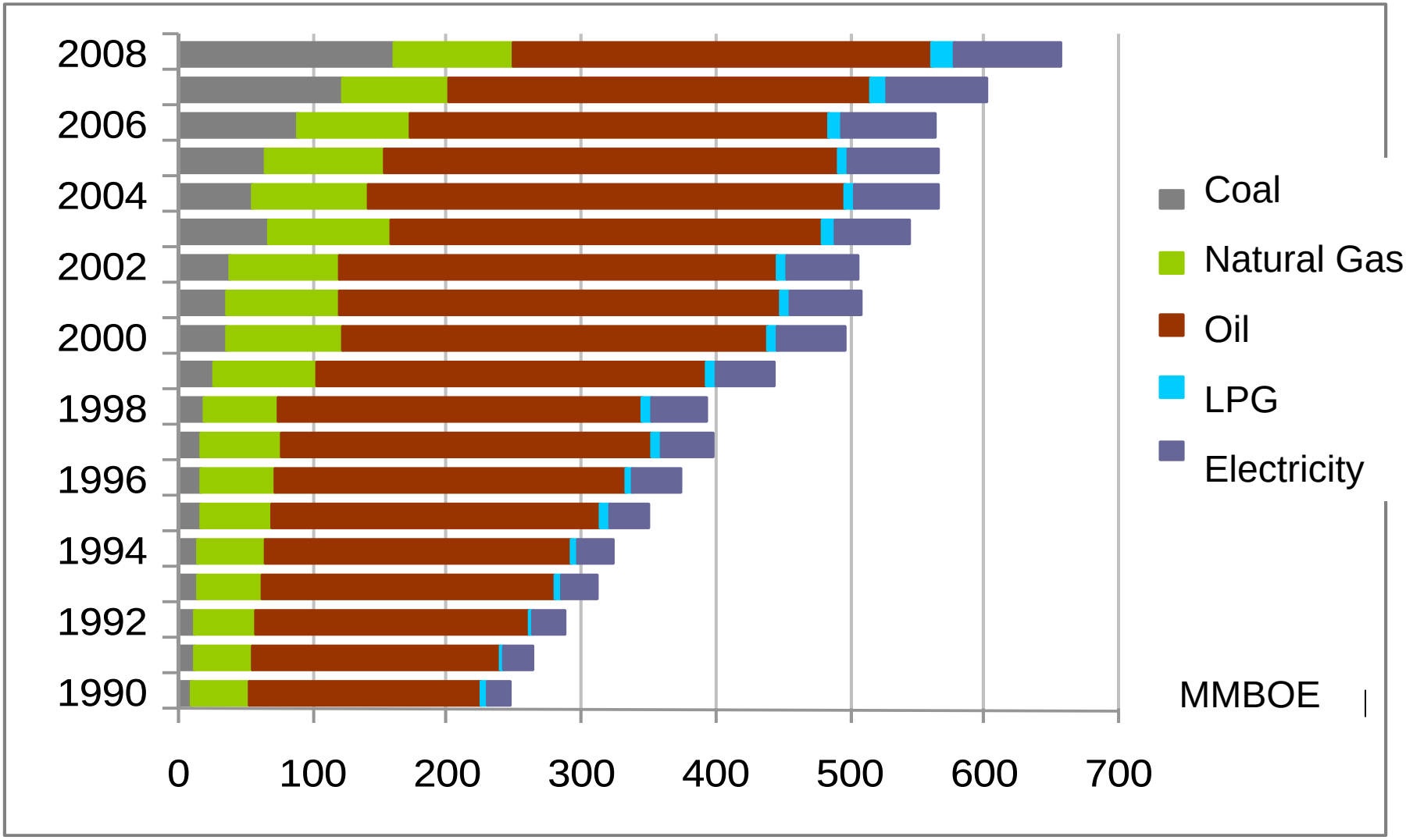
***) Only at Kalan – West Kalimantan

Source: Data and Information Center, MEMR, 2009

Final Energy Demand by Sector



Final Energy Demand by Type of Energy



VISIONS

Three conditions are used to figure the direction of future socio economic visions for achieving LCS goals toward 2050

- BAU assumes existing society orientation will continue until 2050.
- Two countermeasures assume that there will be changes in society orientation in the future, namely:
  - Moderate economic growth, which assumes that the society behavior is depicted as calmer, slower, nature oriented ones.
  - High economic growth conditions assumes that the society is depicted as more active, quick changing, and technology oriented. This scenario has two long-term objectives: realizing full socio-economic potential of the country and creating a sustainable LCS.

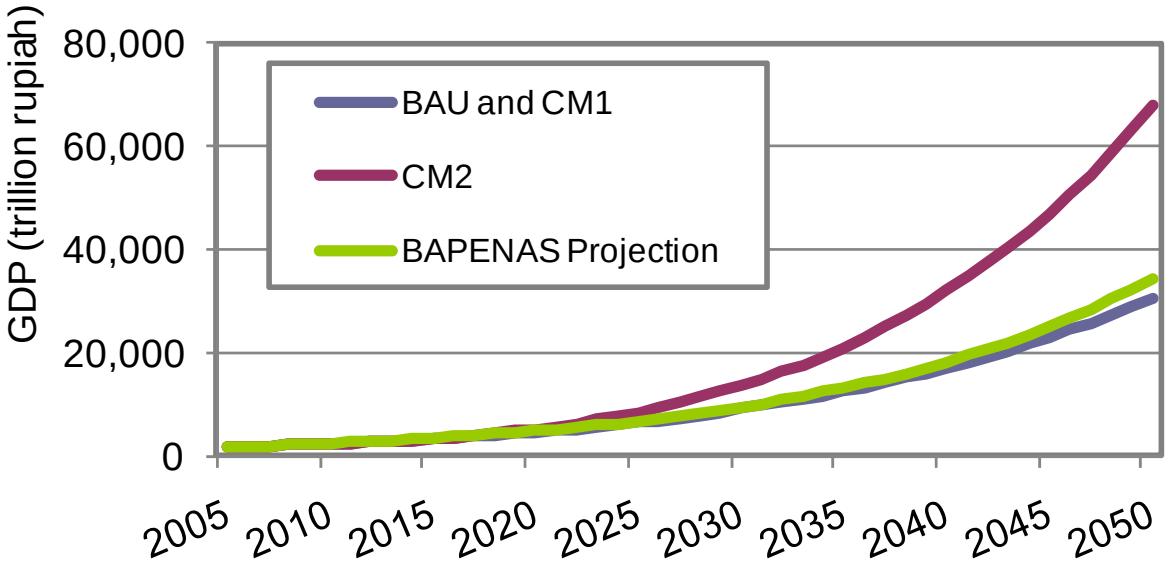
Development scenarios to 2050 with respect to LCDS

Particular interest: socio-economic, energy use, and associated emission level

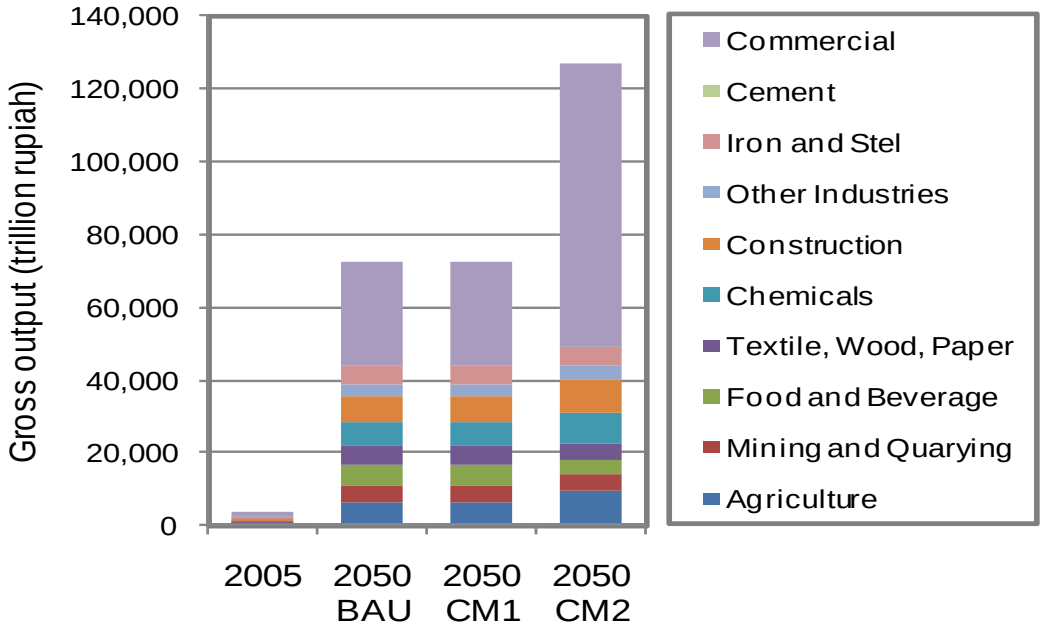
- Base year: 2005
- Projection 2050
  - BaU (moderate scenario): current socio-economic development, society behavior, energy systems/structure will continue until 2050;
  - CM1 (moderate scenario): economic growth is similar with BAU, more energy efficient and lower carbon emitting energy technology compared to BAU, slight change in society behavior (depicted as calmer, slower, and nature oriented)
  - CM2 (high scenario): high economic growth, very energy efficient, lower carbon emitting technology, much better energy related infrastructure compared to BAU, with society behavior depicted as active, quick changing, and technology oriented

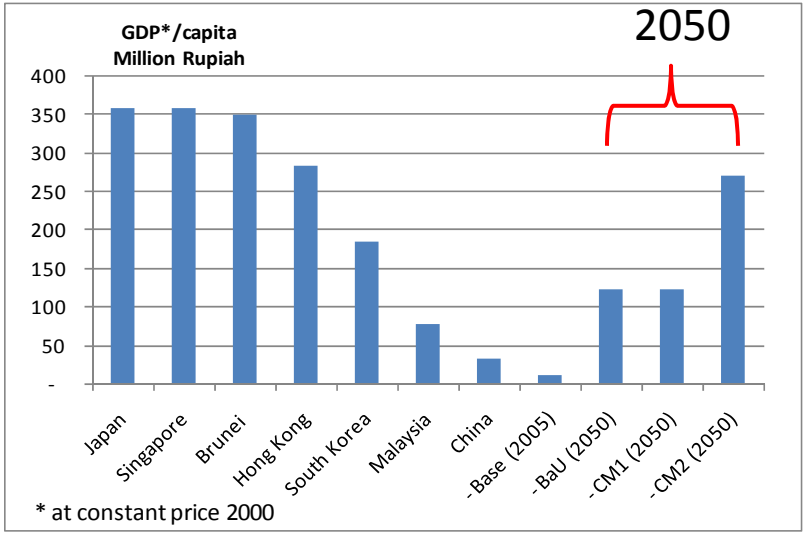
Estimated socio economic indicators in the base year (2005) and the target year(2050)

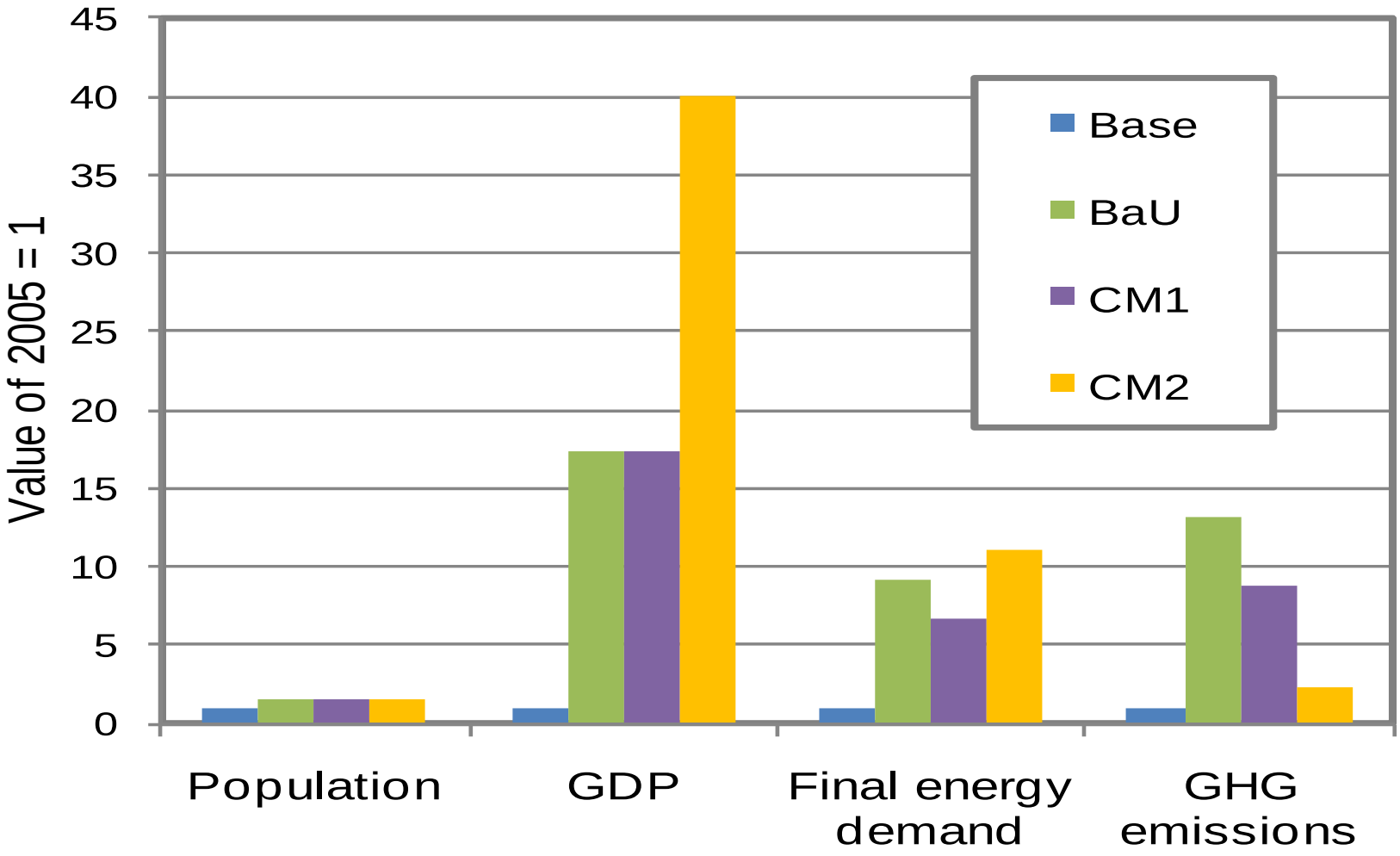
Socio Economic Parameter	2005	2050			2050/2005		
		BaU	CM1	CM2	BaU	CM1	CM2
Population, Million	219	327	327	327	1.5	1.5	1.5
No. of households. Million	60	89	89	109	1.5	1.5	1.8
GDP, trillion rupiah	1,787	36,998	36,998	68,252	20.7	20.7	38.2
GDP per capita, million rupiah	8.2	113	113	209	13.9	13.9	25.6
Gross output, trillion rupiah	3,533	72,406	72,406	126,791	20.5	20.5	35.9
Primary	329	6,516	6,516	9,610	19.8	19.8	29.2
Secondary	1,953	37,505	37,505	39,625	19.2	19.2	20.3
Tertiary	1,251	28,384	28,384	77,556	22.7	22.7	62.0
P-transport demand, billion psg km	1,763	3,407	2,965	2,195	1.9	1.7	1.2
F-transport demand, million ton km	1.07	20.64	20.64	23.08	19.3	19.3	21.6



Change in GDP structure toward tertiary industry



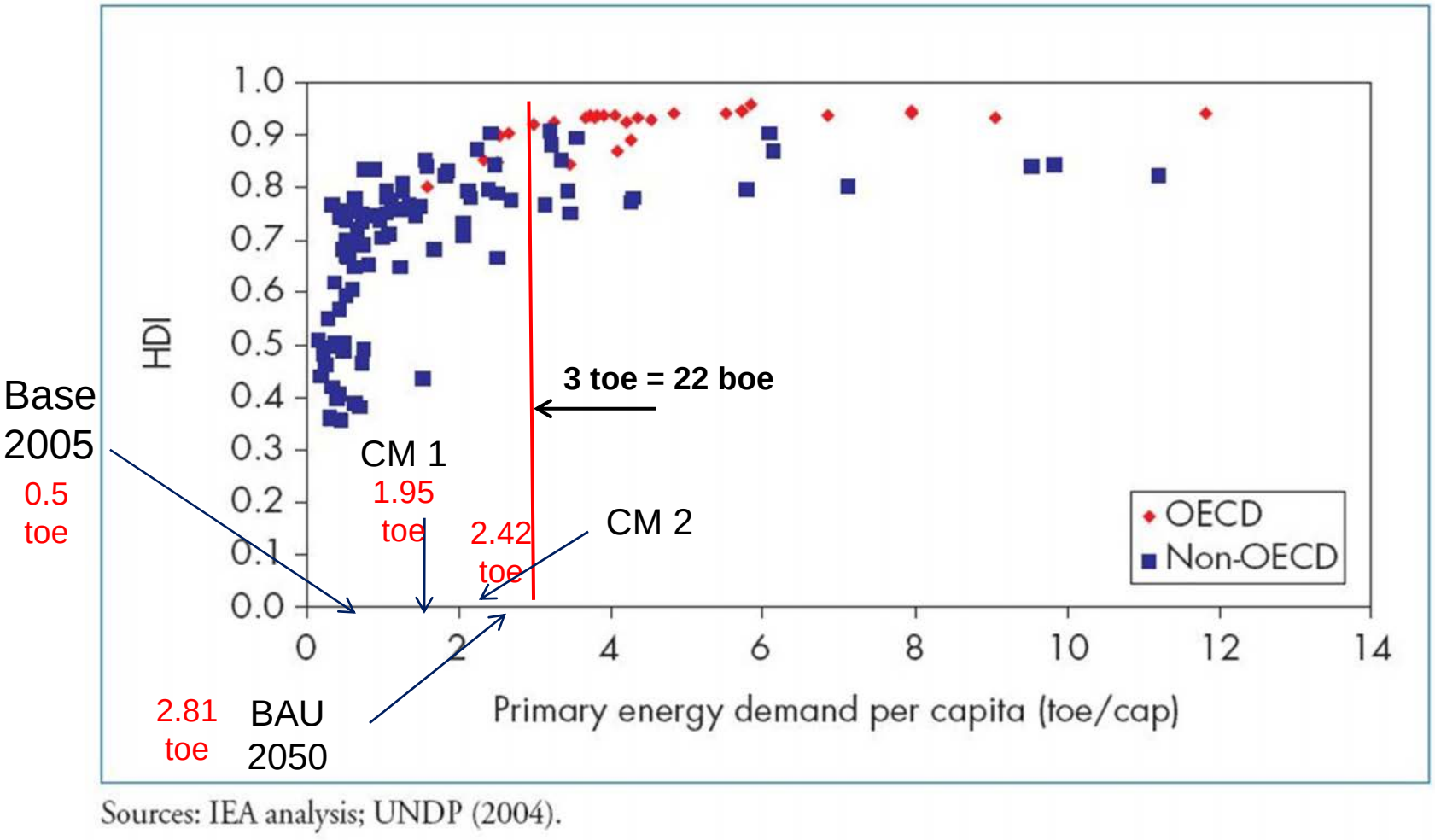



45
40
35
30
25
20
15
10
5
0
Value of 2005 = 1
Base
BaU
CM1
CM2
Population
GDP
Final energy demand
GHG emissions

Estimation result of base year (2005) and target year (2050)

Energy Emission Parameter	2005 Base	2050		
		BaU	CM1	CM2
Energy Demand, ktoe				
Passenger Transport	17,798	41,406	12,543	9,244
Freight Transport	6,562	126,510	45,623	42,056
Residential	42,832	69,761	38,710	66,971
Industry	39,224	569,325	471,039	543,266
Commercial	3,704	111,952	68,039	129,068
Total	110,120	918,953	635,954	790,605
Energy demand per capita, toe	0.50	2.81	1.95	2.42
Energy intensity, toe/million rupiah	61.6	24.8	17.2	11.6
CO_2 Emissions				
Total, million ton-C*	81	1,184	617	183
Per capita, ton-C	0.37	3.62	1.89	0.56
Total, million ton-CO_2	299	4,341	2,263	670
Per capita, ton-CO_2	1.4	13.3	6.9	2.0
Annual GDP Growth rate	-	6.9%	6.9%	8.3%
Annual energy demand growth rate	-	4.8%	4.0%	4.5%
Energy elasticity	-	0.70	0.57	0.54

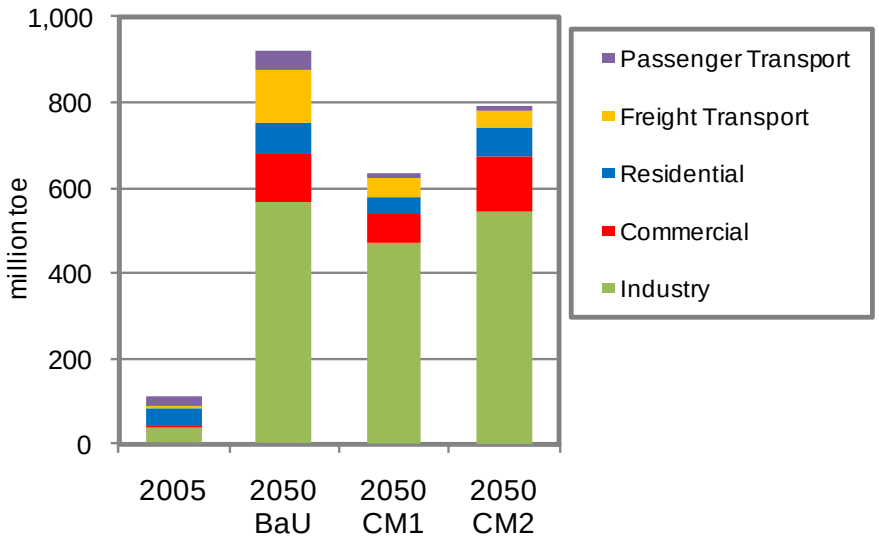
HDI (~ life expectancy at birth + adult literacy & school enrolment + GNP per capita at PPP) versus Primary Energy Demand per Capita (2002) in tonnes of oil equivalent (toe) pa [1 toe pa = 1.33 kWs]



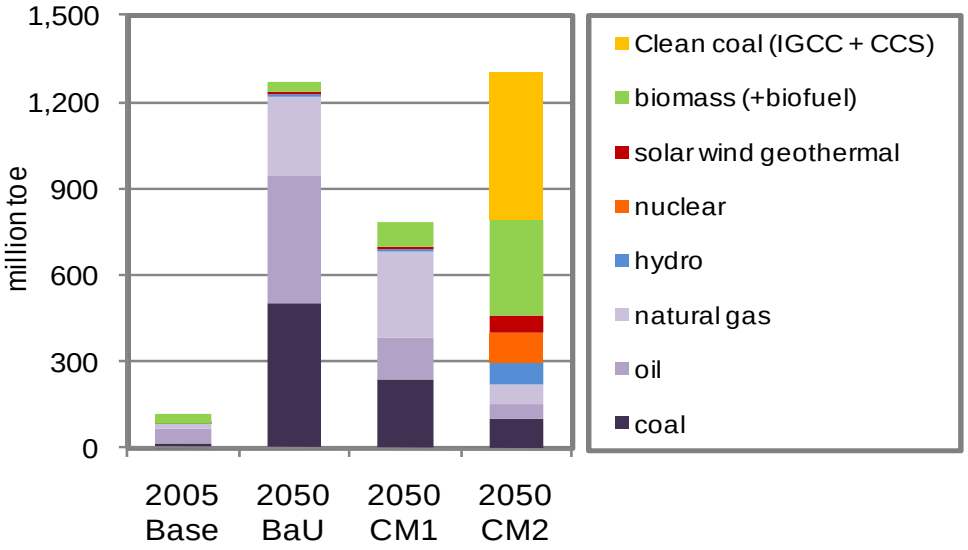
Sources: IEA analysis; UNDP (2004).

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

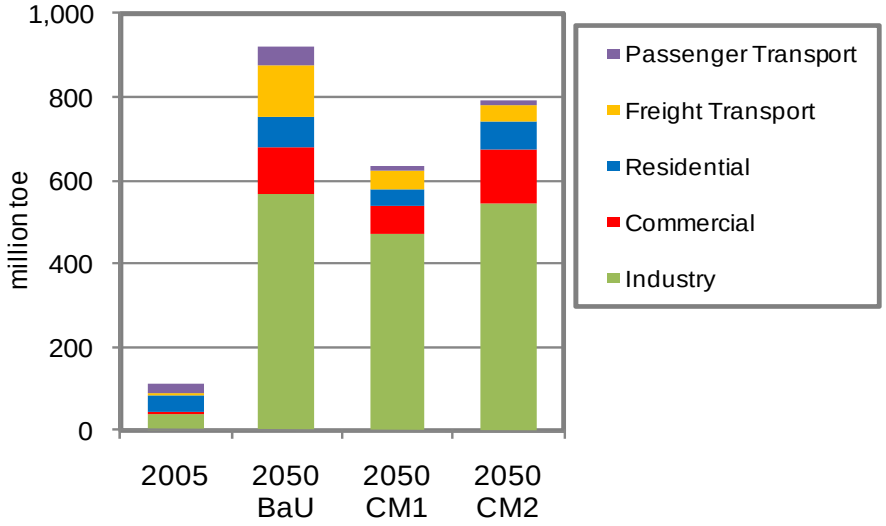
3 toe = 22 boe



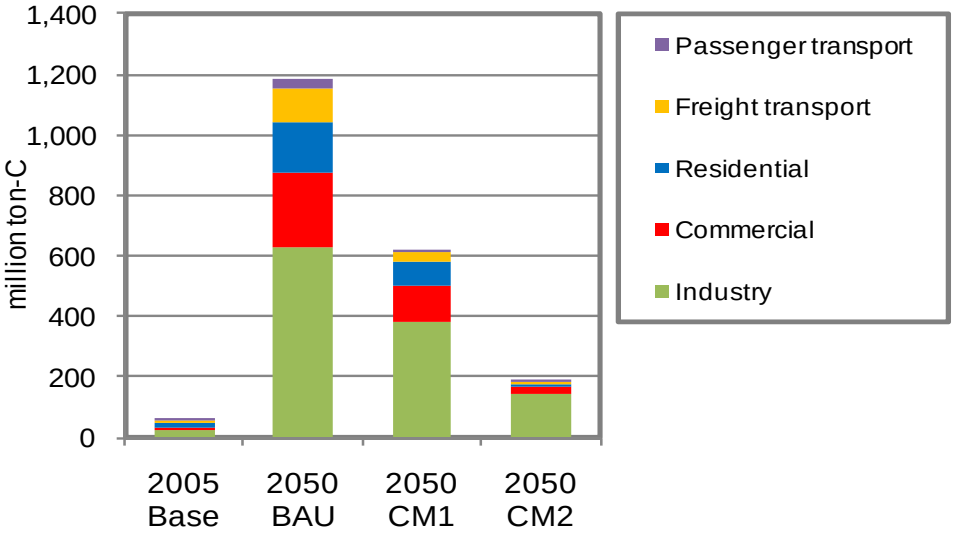
Primary energy demand by sector



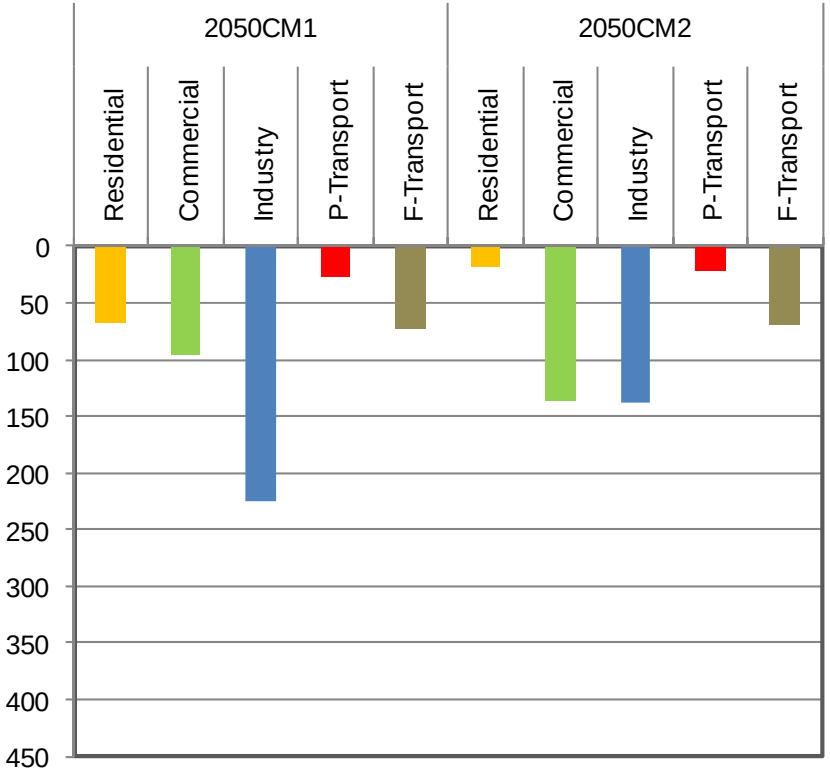
Final energy demand by type of energy



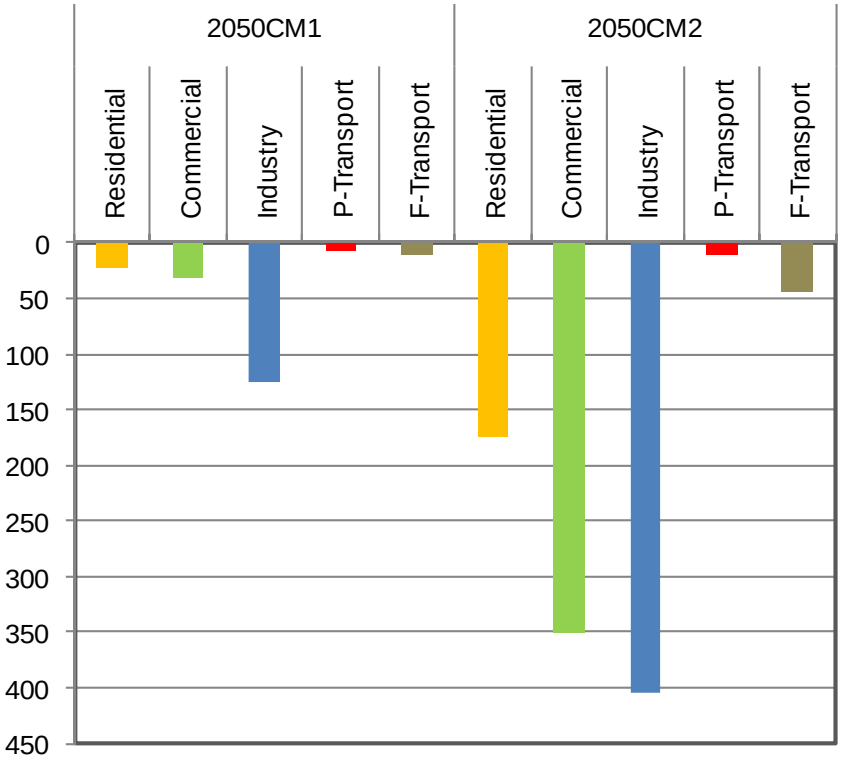
Final energy demand by sector



CO_2 emissions by sector, million ton C



Potential of GHG emission reduction of demand side by energy demand sector



Potential of GHG emission reduction of supply side by energy demand sector

MITIGATION STRATEGIES

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

Impact = Population × Affluence × Technology

CO_2 Emissions = Population × (GDP/Population) × (Energy/GDP) × (CO_2 /Energy)

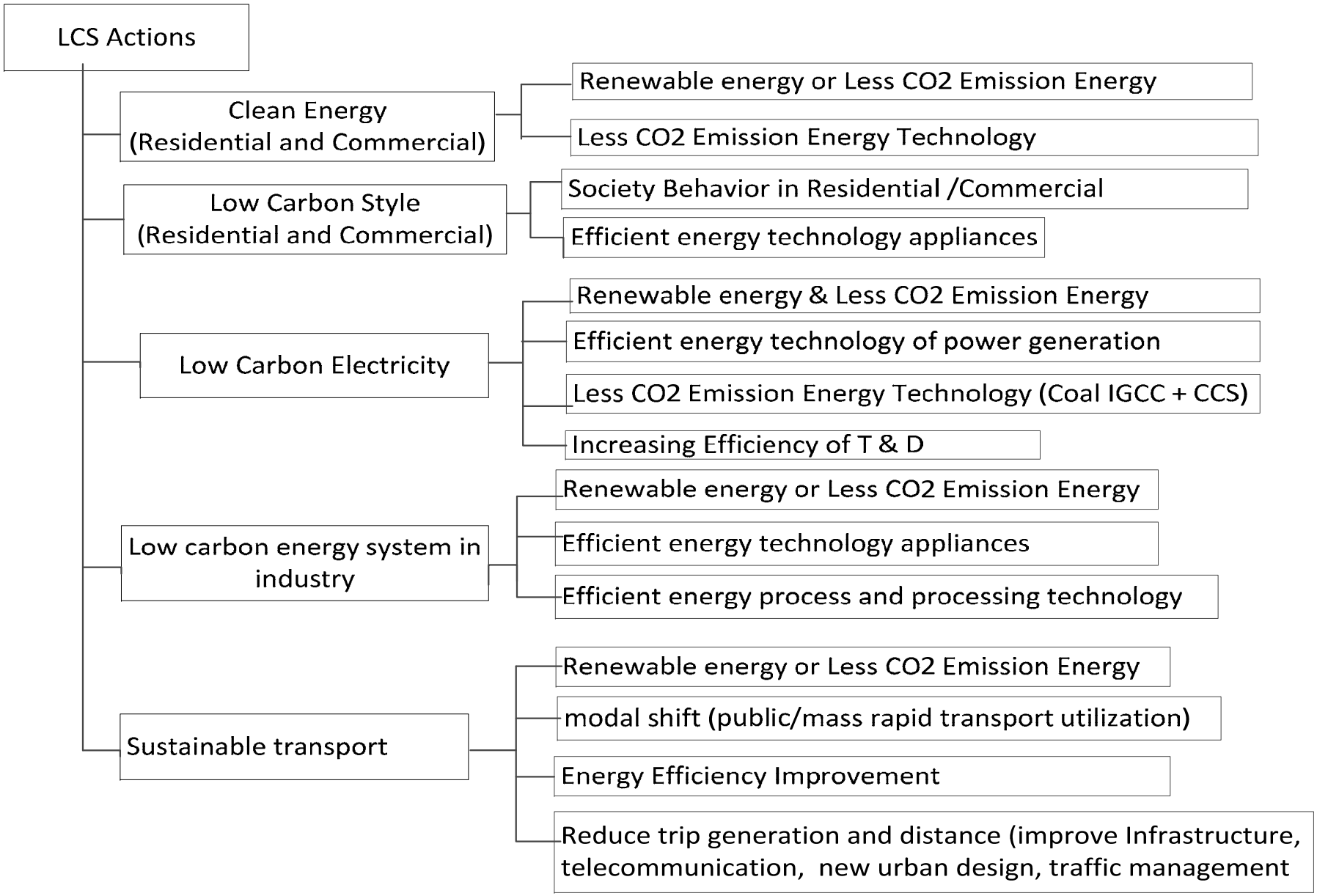
(“Kaya” multiplicative identity)

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

Energy Efficient

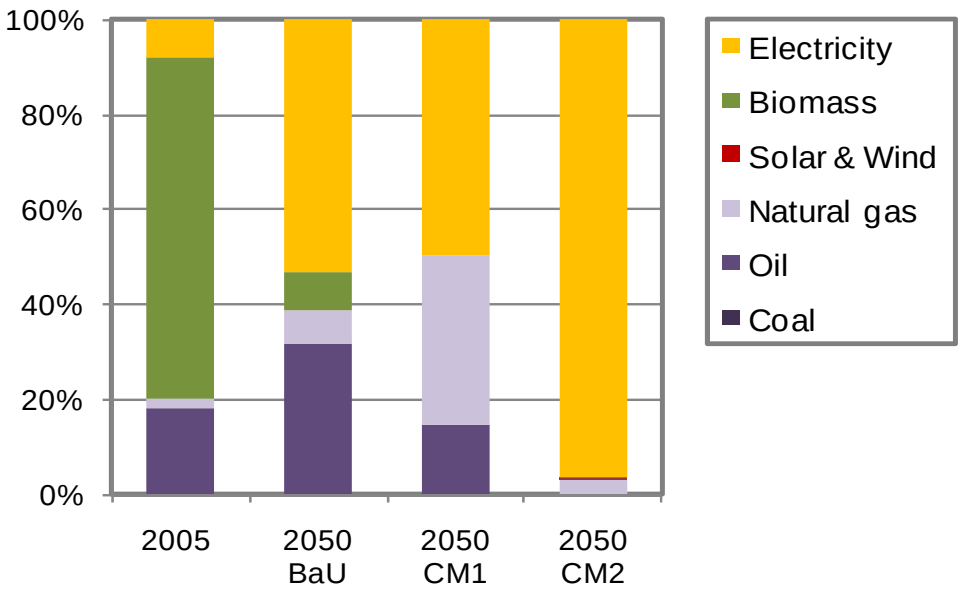
Clean Energy and Technology

Climate Change Mitigation Acions are to reduce Nett GHG Emisions

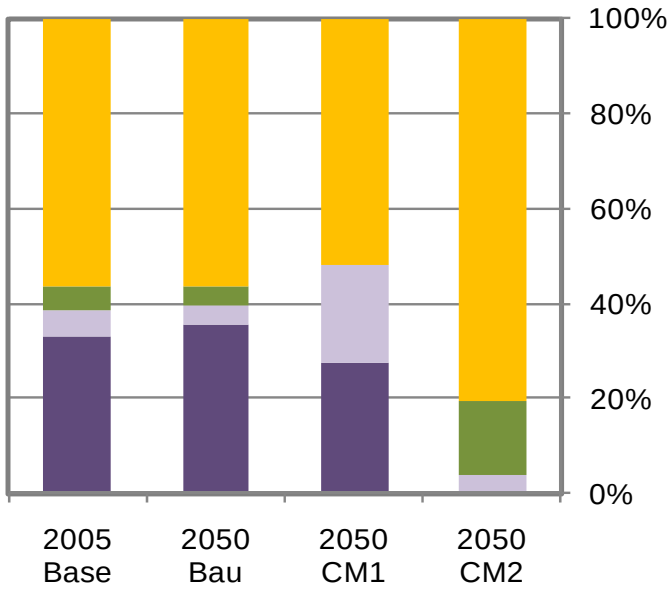

LCS Actions
Clean Energy (Residential and Commercial)
Renewable energy or Less CO2 Emission Energy
Less CO2 Emission Energy Technology
Low Carbon Style (Residential and Commercial)
Society Behavior in Residential /Commercial
Efficient energy technology appliances
Low Carbon Electricity
Renewable energy & Less CO2 Emission Energy
Efficient energy technology of power generation
Less CO2 Emission Energy Technology (Coal IGCC + CCS)
Increasing Efficiency of T & D
Low carbon energy system in industry
Renewable energy or Less CO2 Emission Energy
Efficient energy technology appliances
Efficient energy process and processing technology
Sustainable transport
Renewable energy or Less CO2 Emission Energy
modal shift (public/mass rapid transport utilization)
Energy Efficiency Improvement
Reduce trip generation and distance (improve Infrastructure, telecommunication, new urban design, traffic management

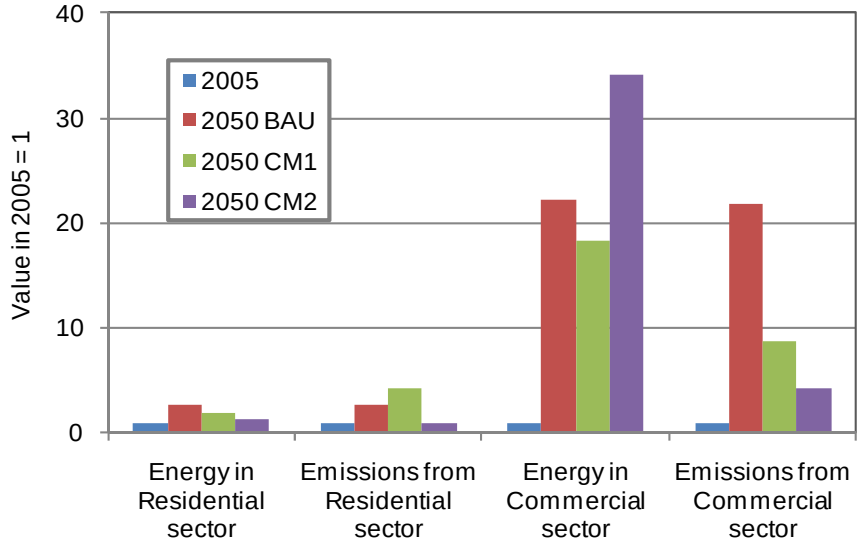
Action 1 Clean Energy: Increase share of renewable/less carbon emitting fuels

(a) Residential sector

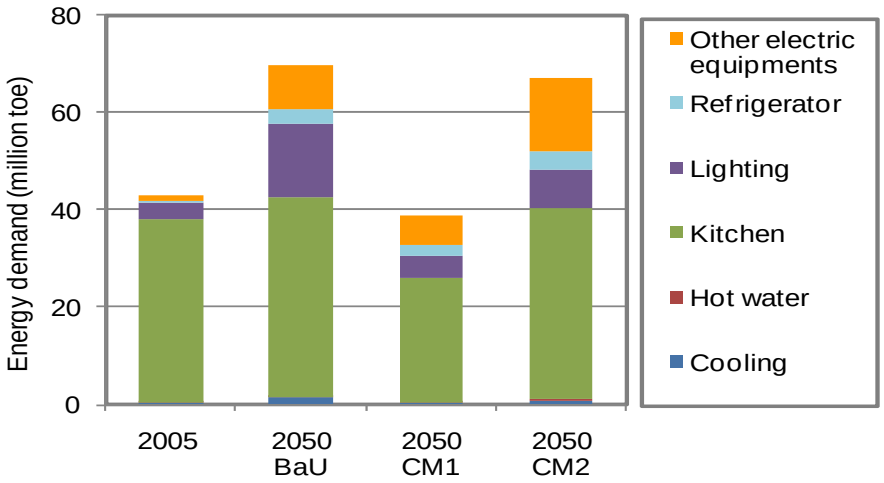


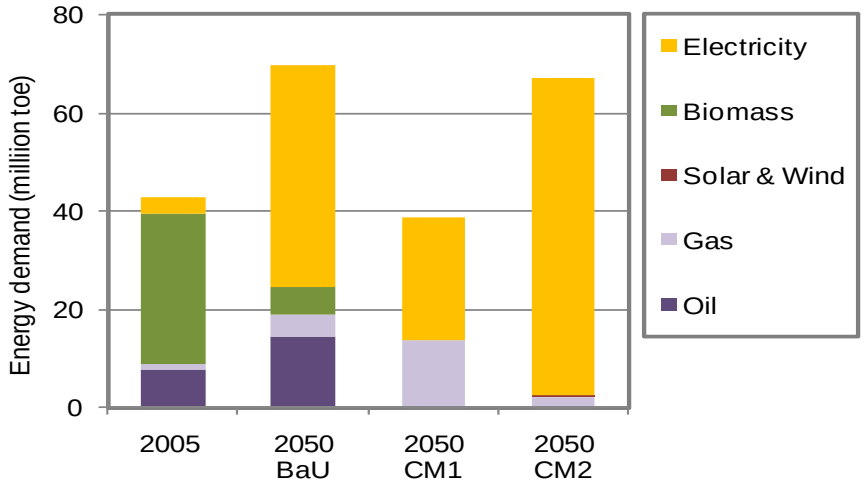
(b) Commercial sector



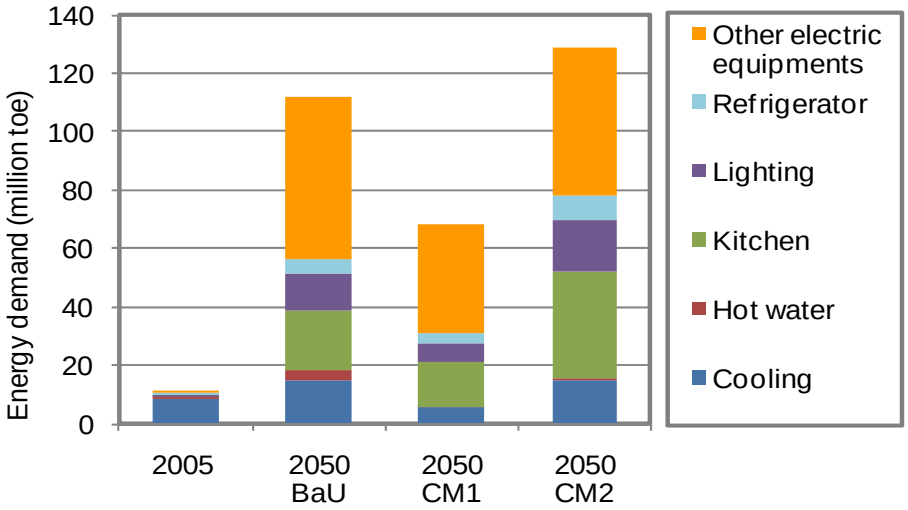


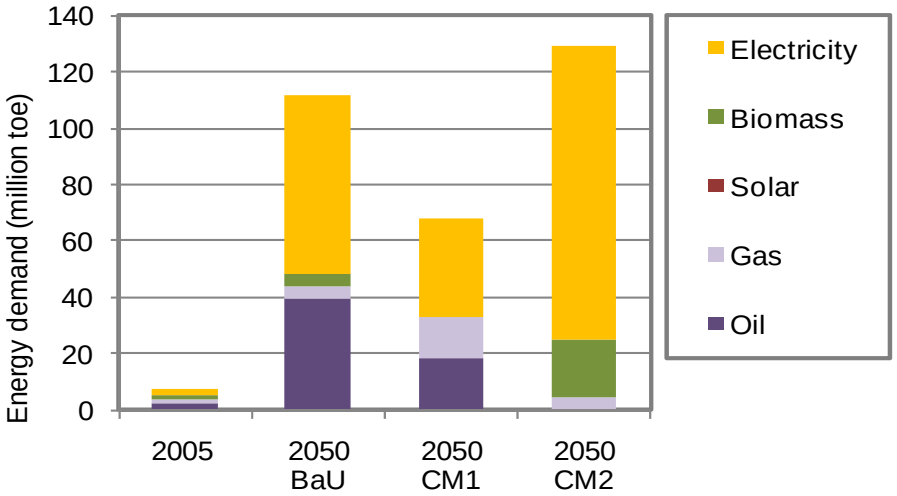
Action 2 Low Carbon Lifestyle





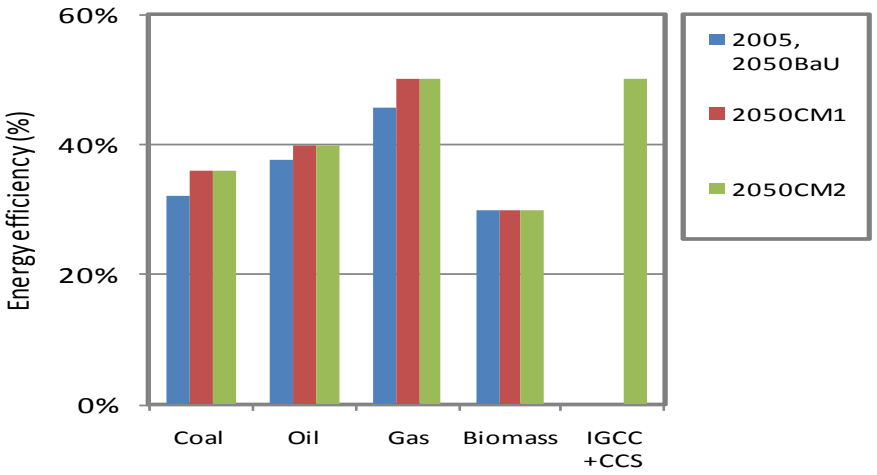
Final energy demand by service (left) and by fuel (right) in residential sector



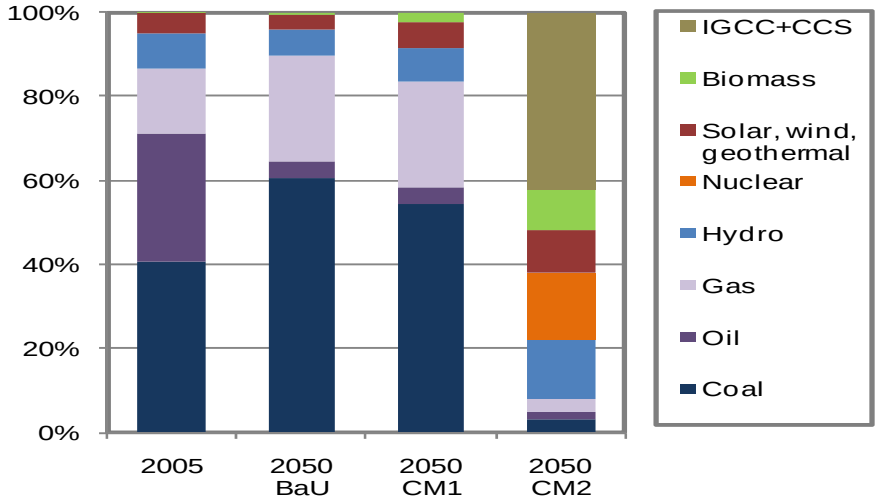


Final energy demand by service (left) and by fuel (right) in commercial sector

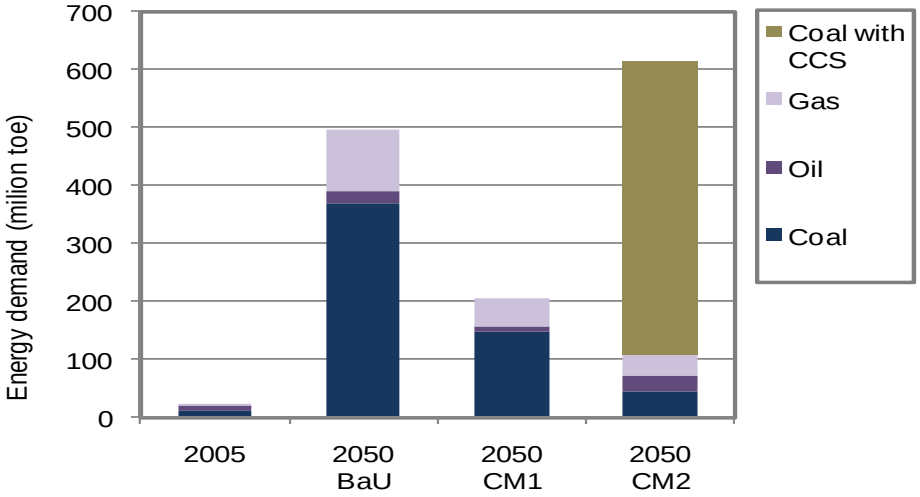
Action3: Low Carbon Electricity

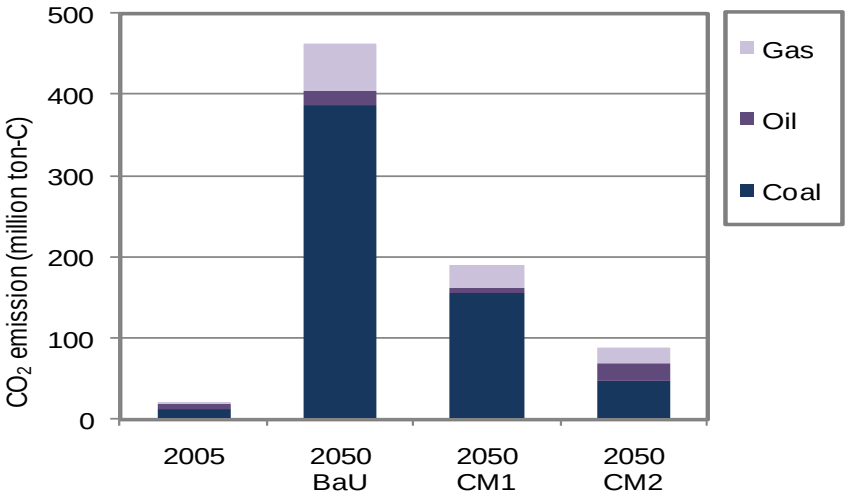


Energy efficiency level of power generation in each scenario



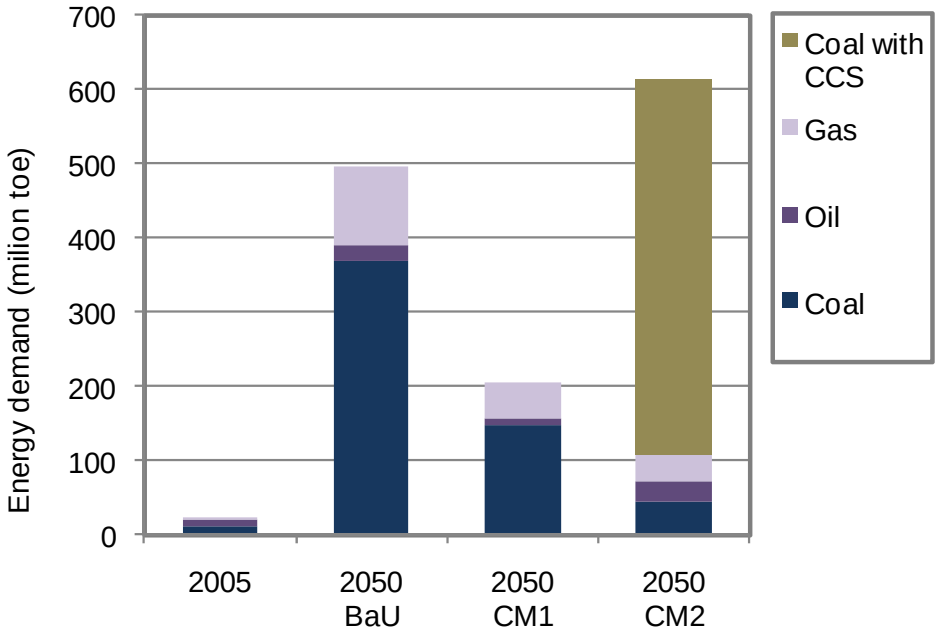
Share of power supply by energy type in each scenario

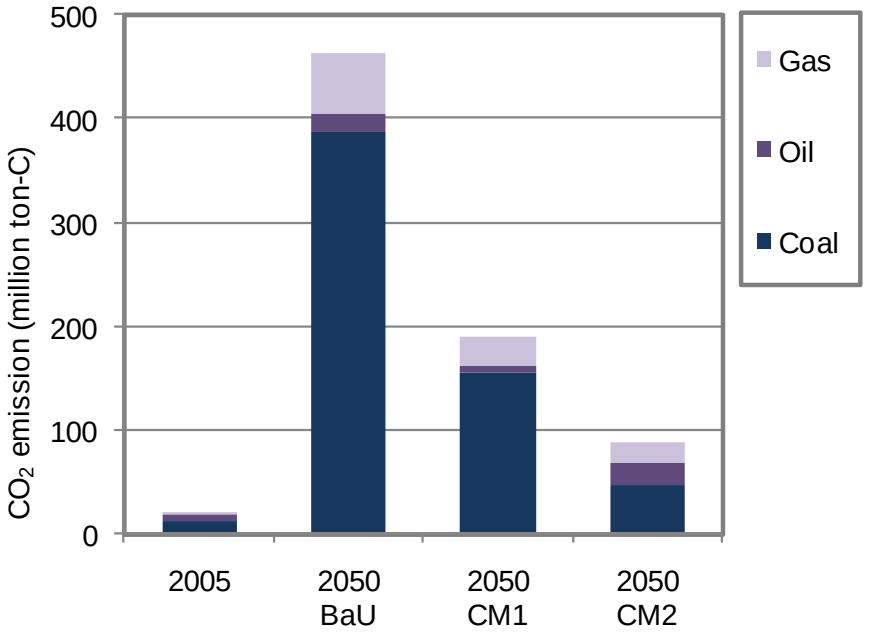




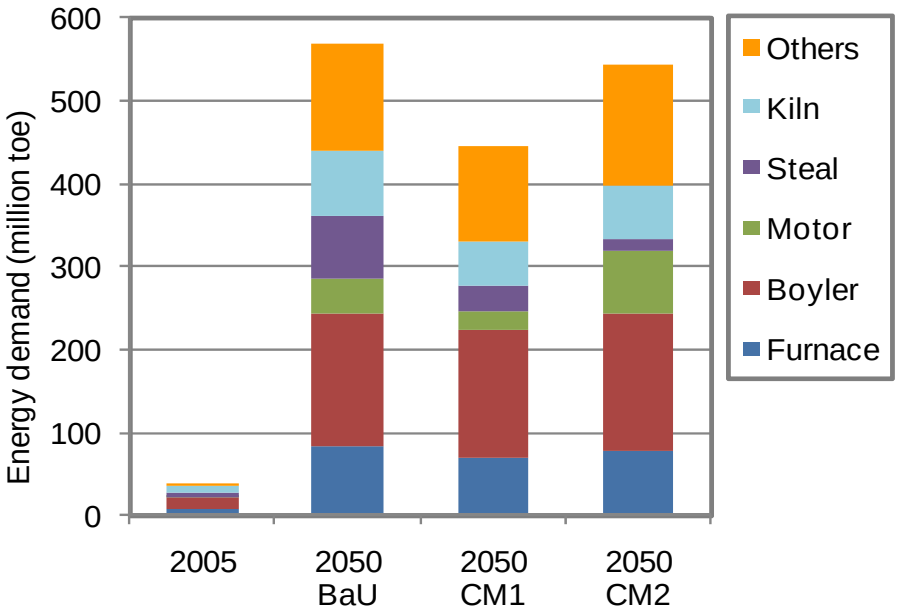
Fuel consumption and CO_2 emission of power generation sector in each scenario

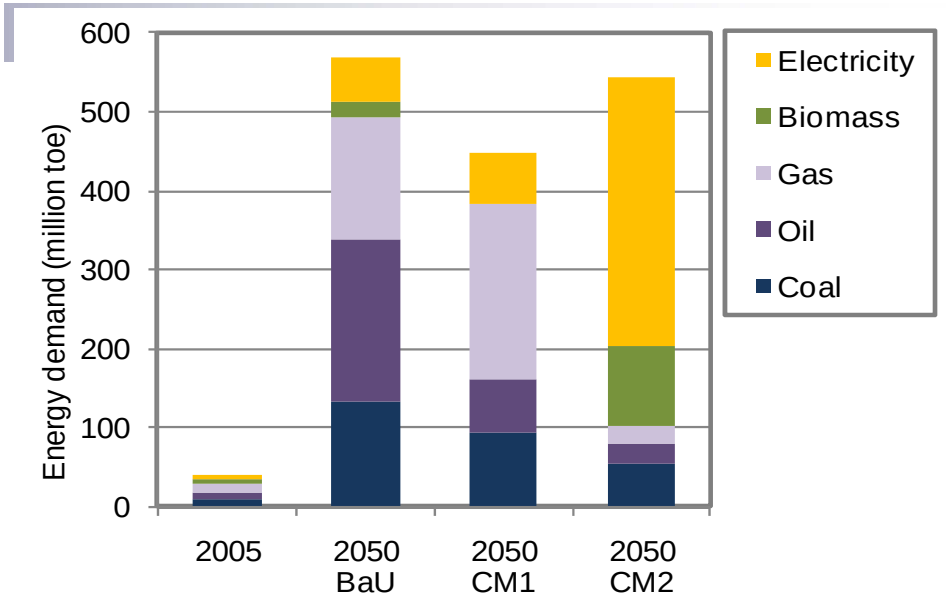
Action 4: Low Carbon Energy System in Industry



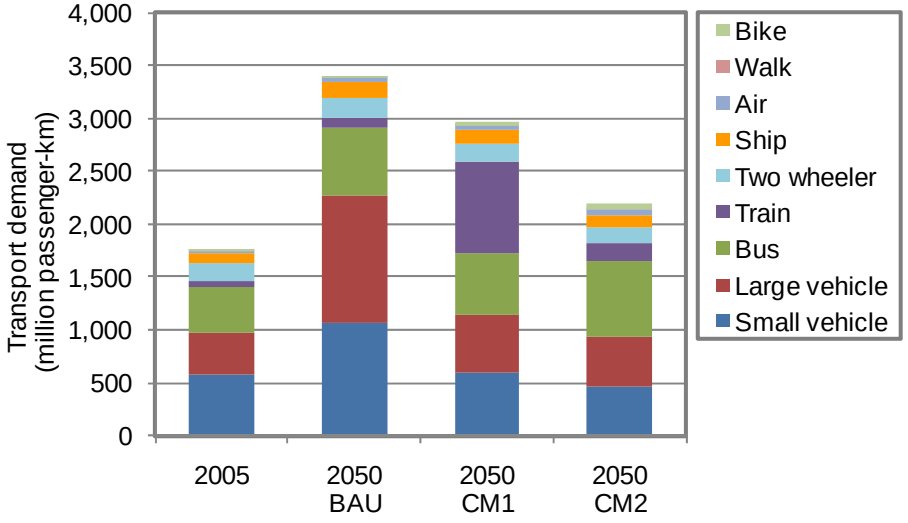


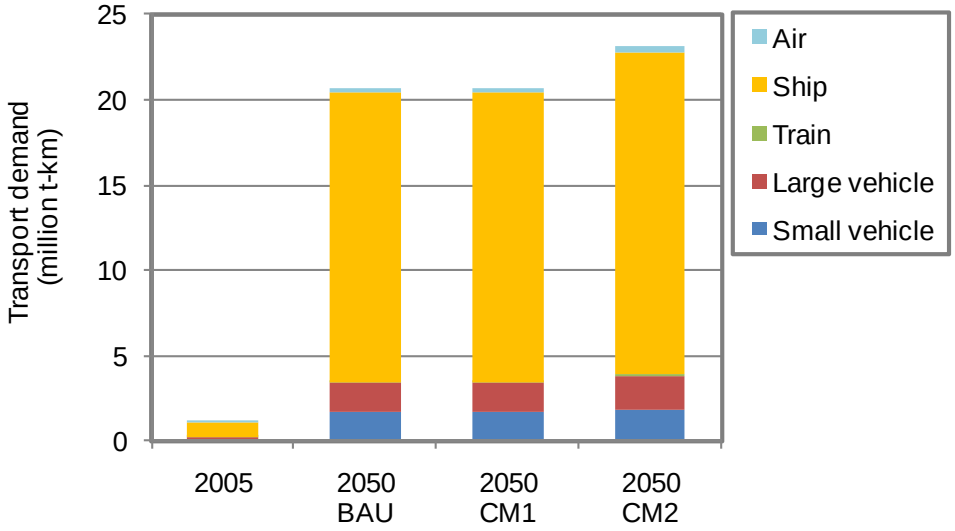
Fuel consumption and CO_2 emission of power generation sector in each scenario





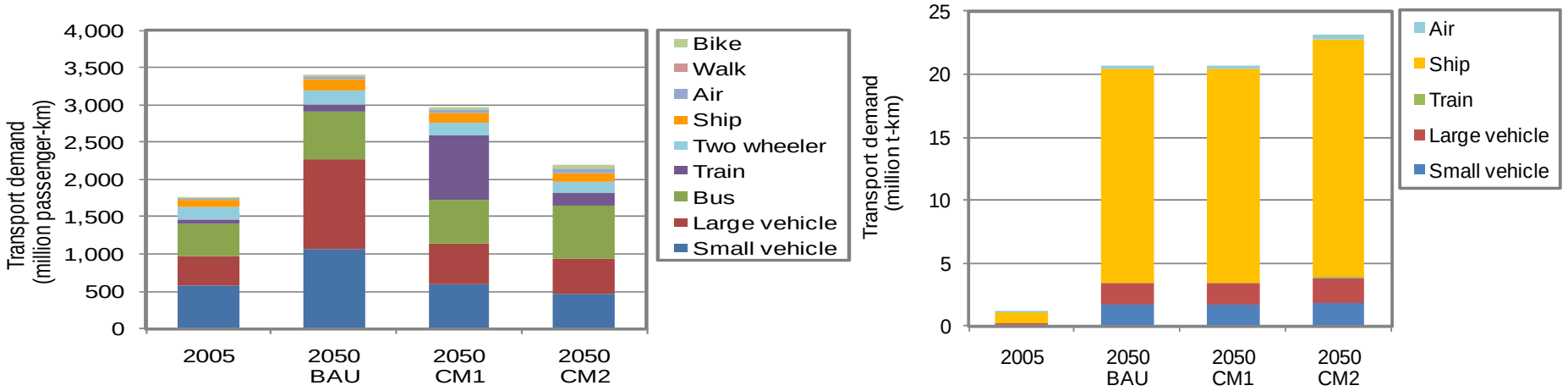
Energy demand in Industry by energy service and by type of fuel



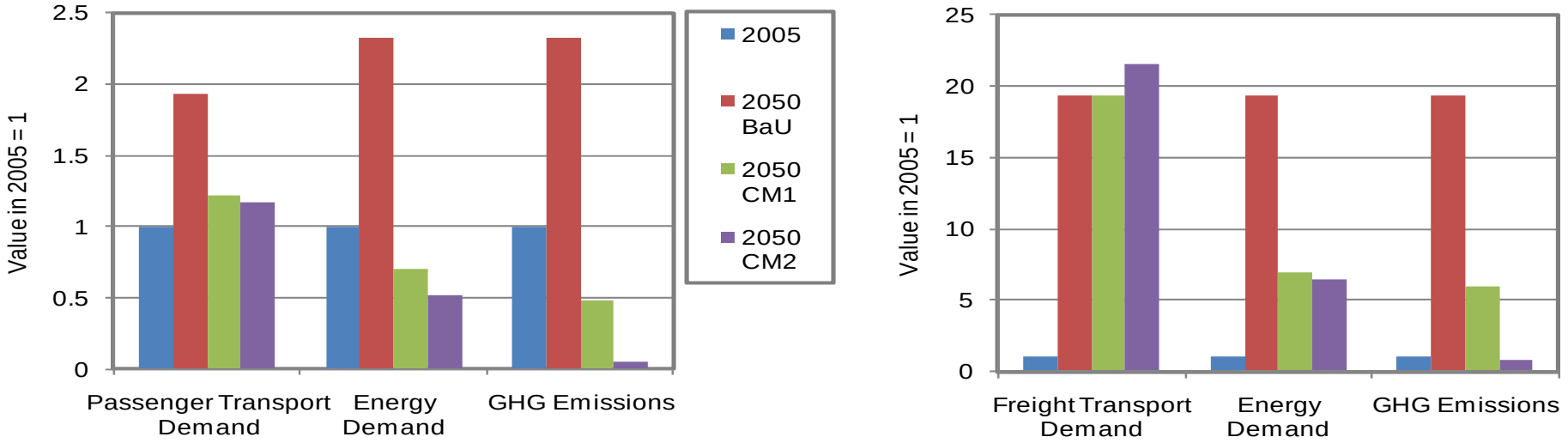


Transport demand by transport mode in passenger (right) and freight (left) transport

Action 5: Sustainable Transport



Transport demand by transport mode in passenger (right) and freight (left) transport



Effect of passenger and freight transport demand to energy demand and CO_2 emissions

Policies and Regulations

- There are numerous energy-climate policy initiatives, regulations, and actions in energy sector that could result in CO_2 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 CO_2 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 five major 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 Presidential Regulation 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 power plant, transportation, 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 CO_2 emissions generation.

Conclusion

- If current economic growth and society behavior continues until 2050 in the BaU scenario, energy demand will increase 8.2 times and the associated emissions will increase 12.5 times (compared to 2005 levels).
- Moderate economic growth, with current policies/regulations on efficiency efforts will lead to 33% energy conservation and 53% emissions avoidance, both compared to the Bau levels
  - Low energy conservation and emissions avoidance due to moderate economic growth will limit efforts in improving energy efficiency and investment in infrastructures related to energy supply – demand
- High economic, high energy demand, high emissions reduction
- LCS achievable in terms of emissions avoidance without sacrificing high economic development
- Requirement to achieve LCS (CM2) is high economic development that make investment in better infrastructure (with efficient and low carbon emitting energy systems) possible

THANK YOU

Dr. Takuro Kobashi
Institute for Global Environmental Strategies (IGES) - Japan

Prof Dr. Yuzuru Matsuoka and Dr. Kei Gomi
Kyoto University – Japan

Dr. Tomoki Ehara
Mizuho Information & Research Institute - Japan

Dr. Mikiko Kainuma and Dr Junichiro Fujino
National Institute for Environmental Studies (NIES) – Japan

Dr. Ucok Siagian
Institut Teknologi Bandung (ITB) - Indonesia

Dr. Toni Bakhtiar and Indra, MT
Institut Pertanian Bogor (IPB) - Indonesia