International Research Network for Low Carbon Societies and Low Carbon Asia Research Network

Development of Low Carbon Society Scenarios for Asian Regions

DEVELOPING MALAYSIA's LOW CARBON SOCIETY (LCS) VISION 2020 and 2030

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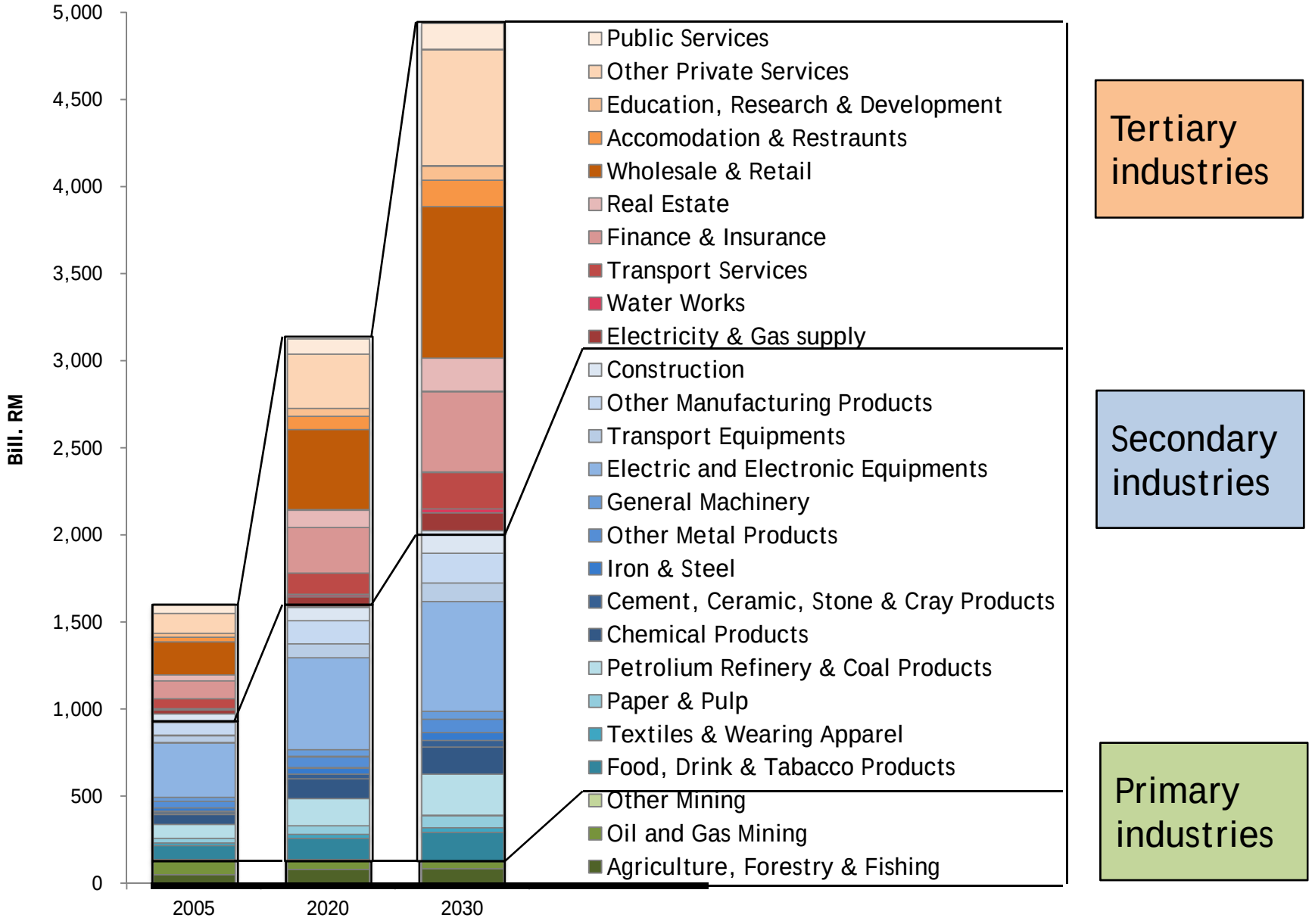
Ho Chin Siong (UTM) ,
Yuzuru Matsuoka and Kei Gomi (Kyoto University)
Junichi Fujino and Tomoko Hasegawa (NIES)

Email: ho@utm.my/ csho59@yahoo.com

Results of main variables

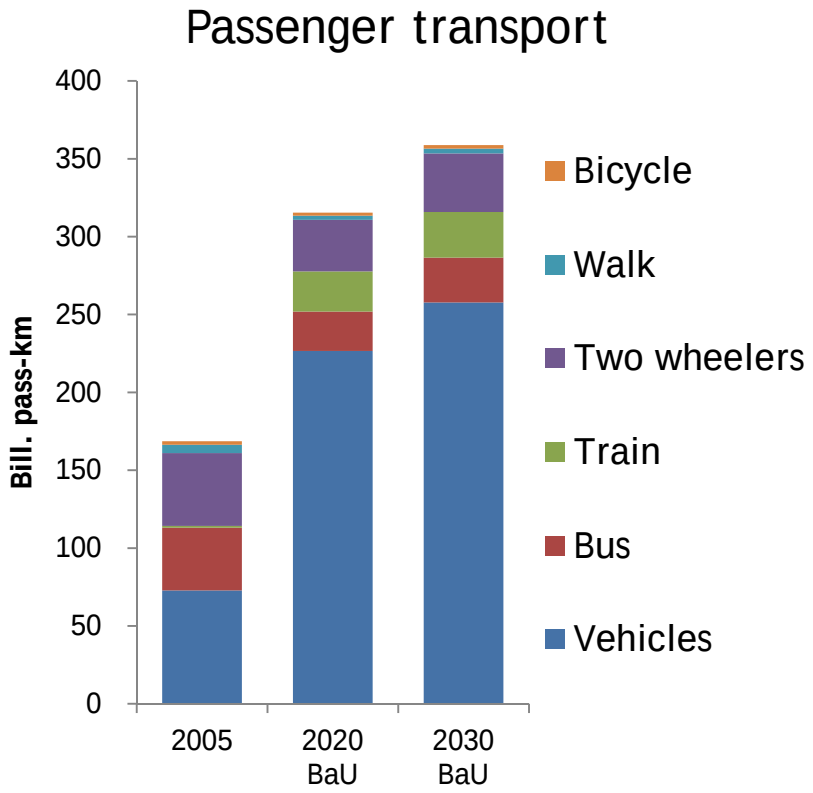
	2005	2020	2030	2020 /2005	2030 /2005	
Population	26.1	32.8	37.3	1.3	1.4	Mil
Household	5.8	8.2	9.3	1.4	1.6	Mil
GDP	509	996	1,601	2.0	3.1	BilRM
Per capita GDP	19.5	30.4	43.0	1.6	2.2	'000
Gross output	1,604	3,135	4,929	2.0	3.1	B RM
Passenger transport	169	315	359	1.9	2.1	Bil. pss-km
Freight transport	92	150	214	1.6	2.3	Bt-km

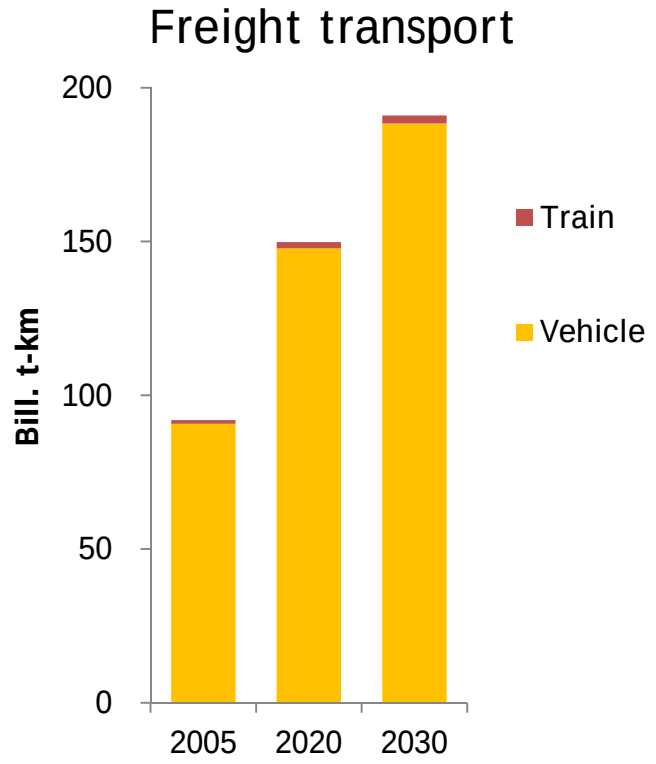
Projected output by 26 sectors



Projected transport volume

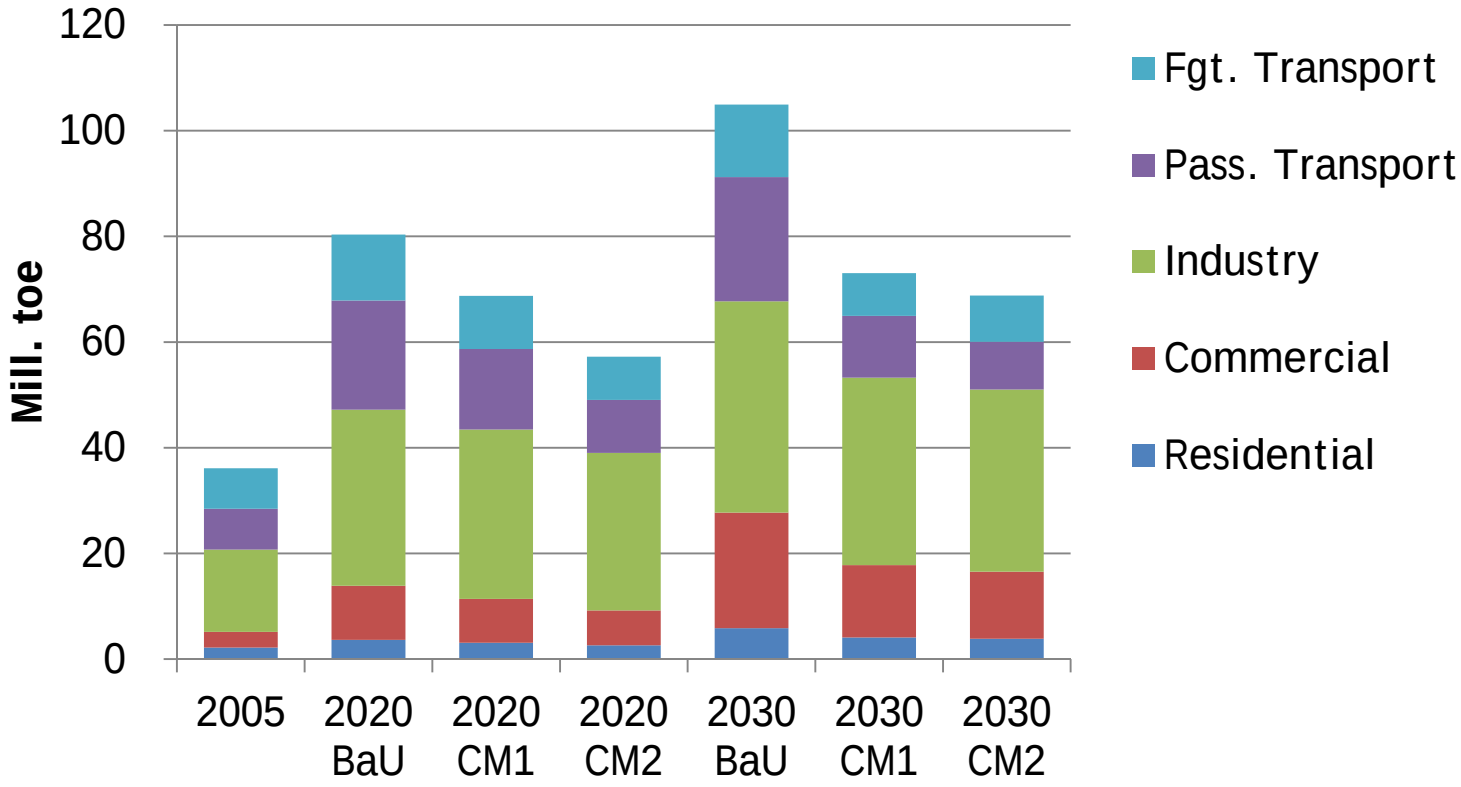
- Both **modal share and transport volume** of **private vehicle** increase in 2020
- Freight **transport volume** increases proportionally with growth of **secondary industries**





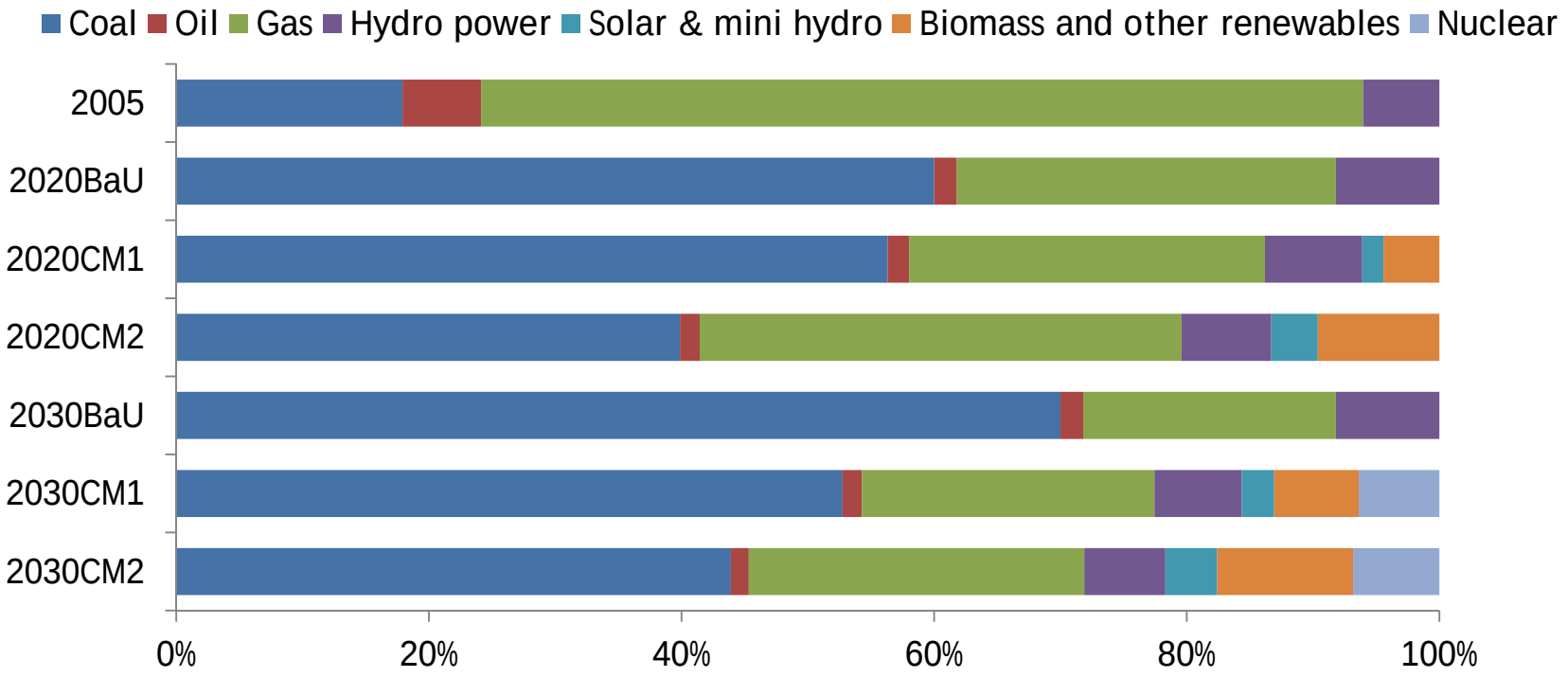
Projected final energy demand by sectors

- Share of each sector is fit to NC2 in 2020BaU scenario
- The largest energy consumer is industry sector



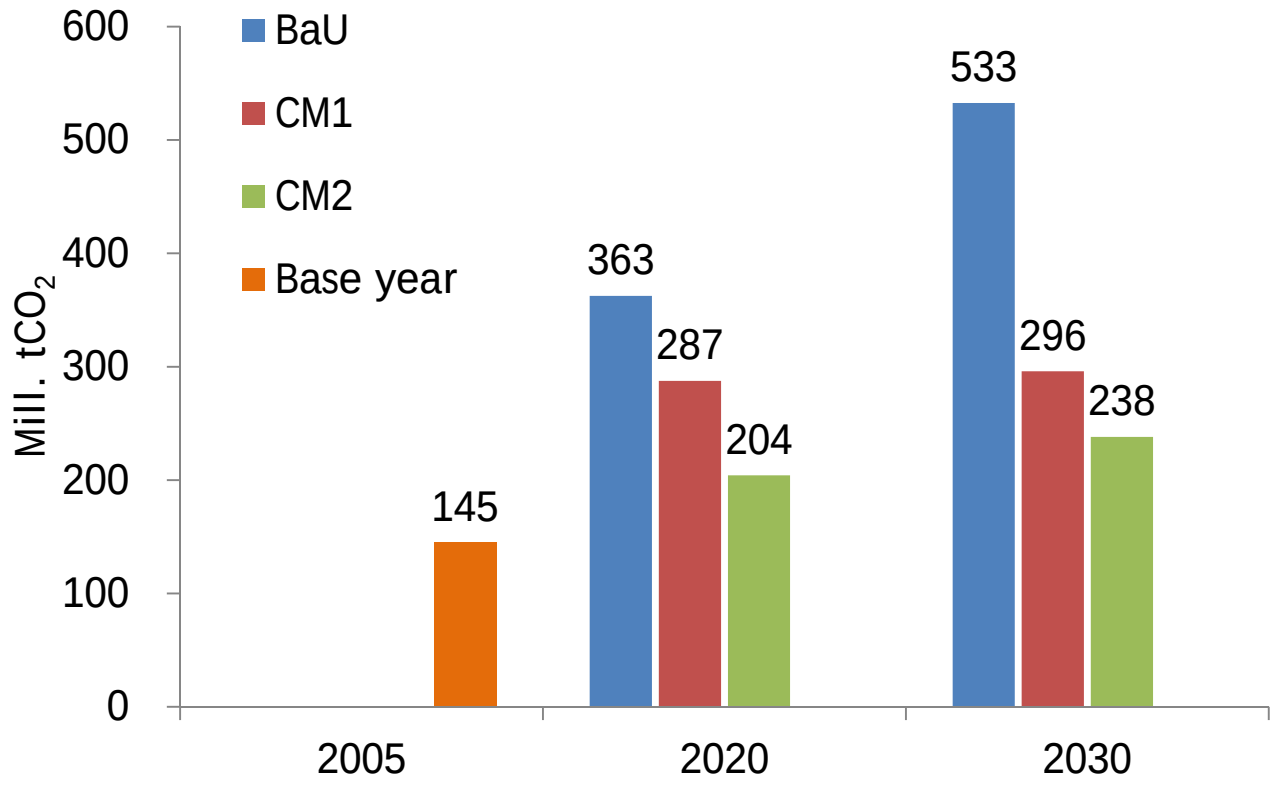
Projected energy mix of power supply

- Power supply mix is projected to fit **primary supply** of each type of energy in **NC2**
- Coal increase its share significantly in all scenarios
- In 2030CM scenario, share of **renewable energies** reaches **nearly 20%.**



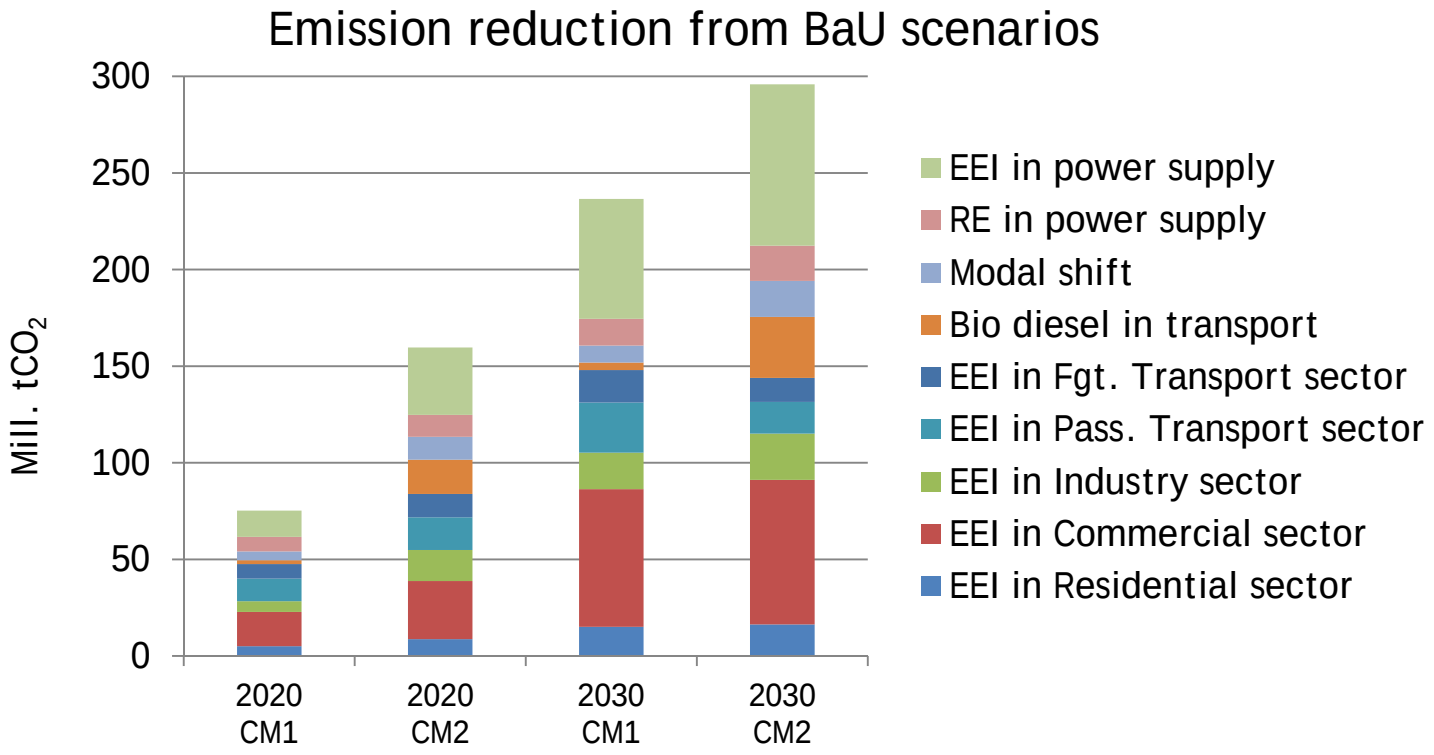
Projected CO_2 emissions

- In 2020BaU, CO_2 emission doubled from 2005, and tripled in 2030BaU.
- In CM1 scenario, it was reduced by 21%(2020) and 44%(2030) from BaU scenarios.
- In CM2 scenario, it was reduced by 44%(2020) and 55% (2030) from BaU scenarios.



Contribution of mitigation options

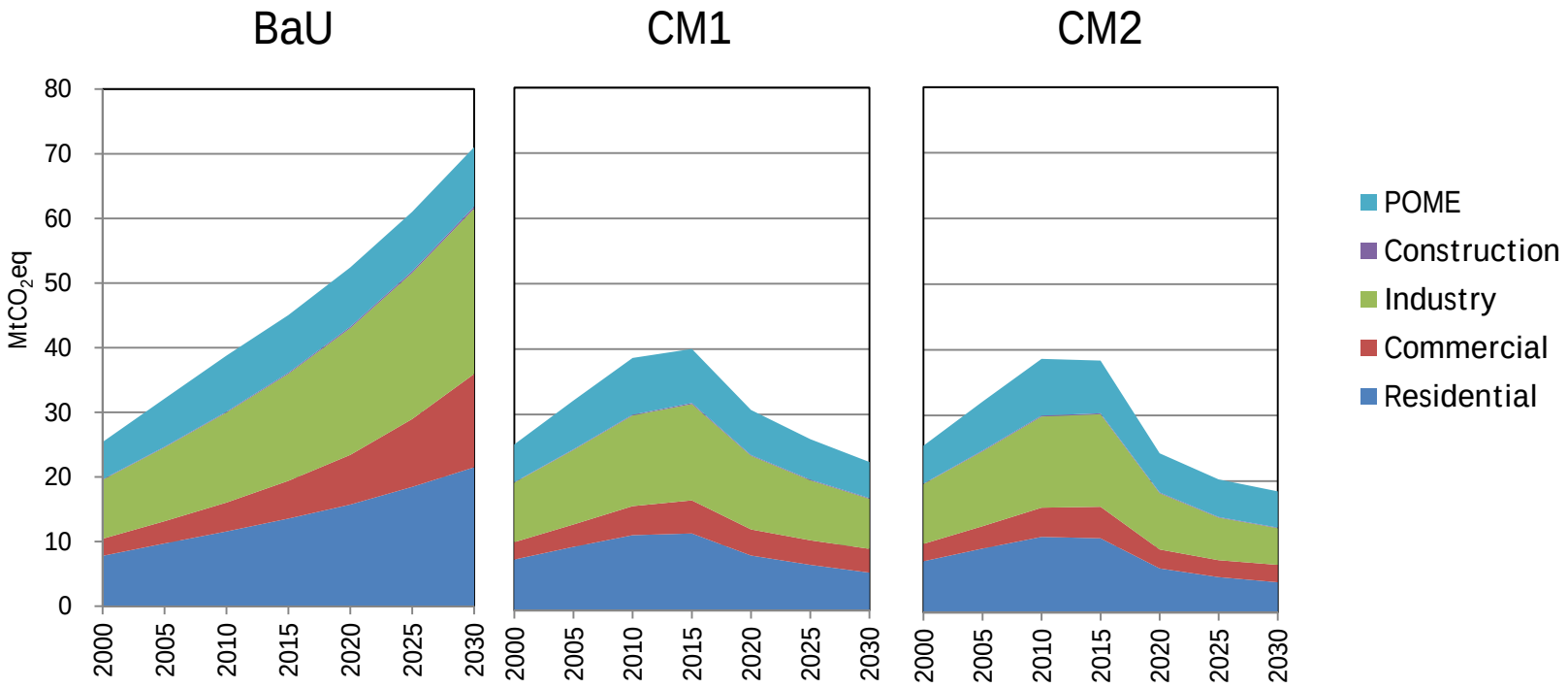
- Both in 2020CM and 2030CM, **energy efficiency improvement** of **commercial sector** has the largest share.
- In 2030CM, **energy efficiency improvement** in **power supply** is second largest.



EEI: energy efficiency improvement

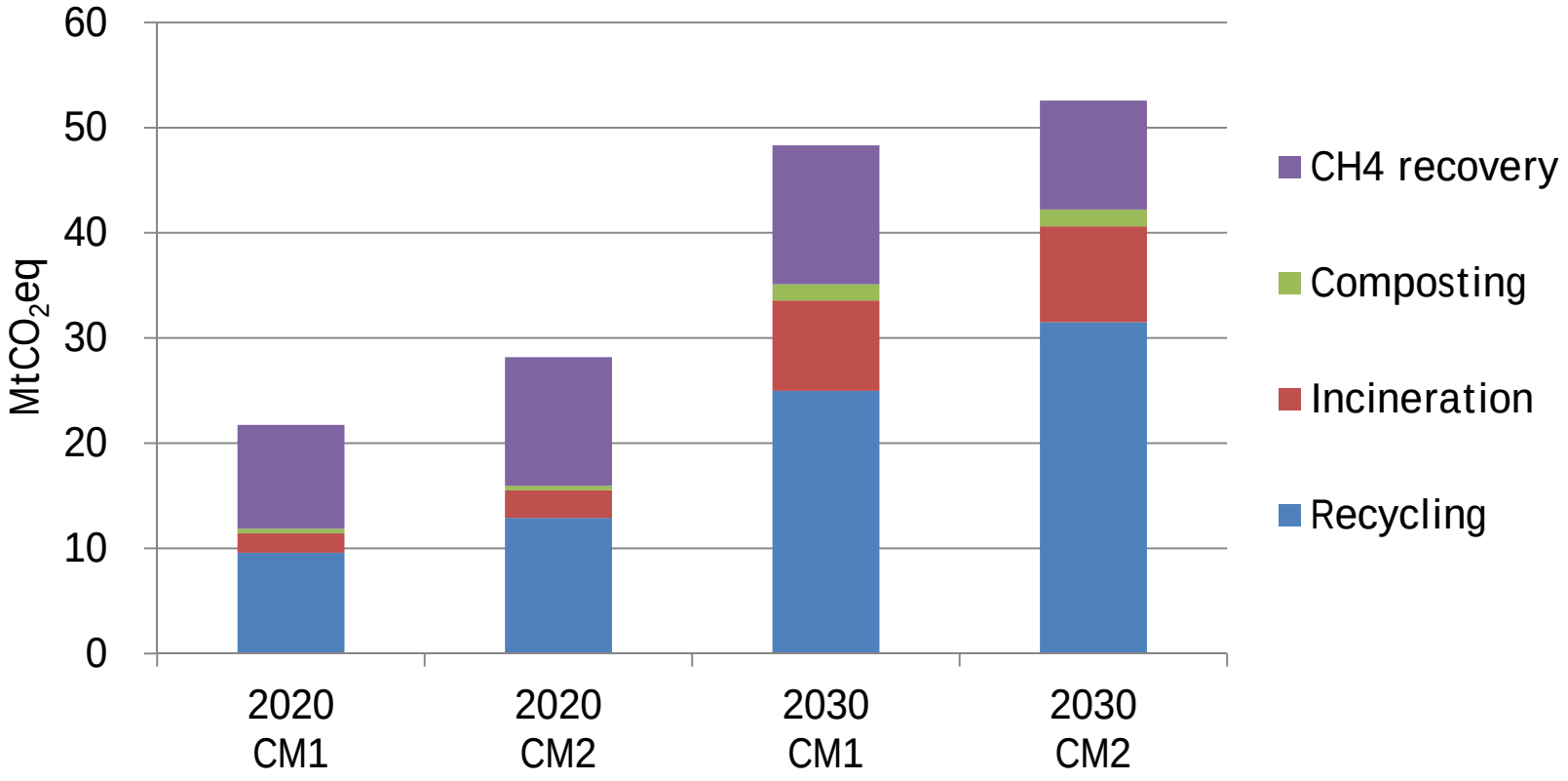
Projected GHG emissions (waste)

- In BaU, GHG emission increased more than 2 times in 2020 and 2.8 times in 2030
- In CM1, emission was reduced by 41% (2020) and 68% (2030) from BaU
- In CM2, emission was reduced by 54% (2020) and 74% (2030) from BaU



Contribution of mitigation options

- In S1, CH4 recovery shows the largest contribution
- In S2, recycling is the largest and CH4 recovery is less than S1 because of less CH4 generation resulted from other mitigation options.



Input & output of AFOLU model

Input → AFOLU Emission model → Output

List of Countermeasure
Characteristics of Countermeasure
Scenario of;
- Crop production
- Number of Livestock animals
- Land-use change
- Fertilizer input
- Wood production etc.
- Price of Commodity and Energy
- Yield of crops and Carcass weight of animals
- Production system

Policy;
- GHG emission tax rate
- Energy tax rate
- Subsidy

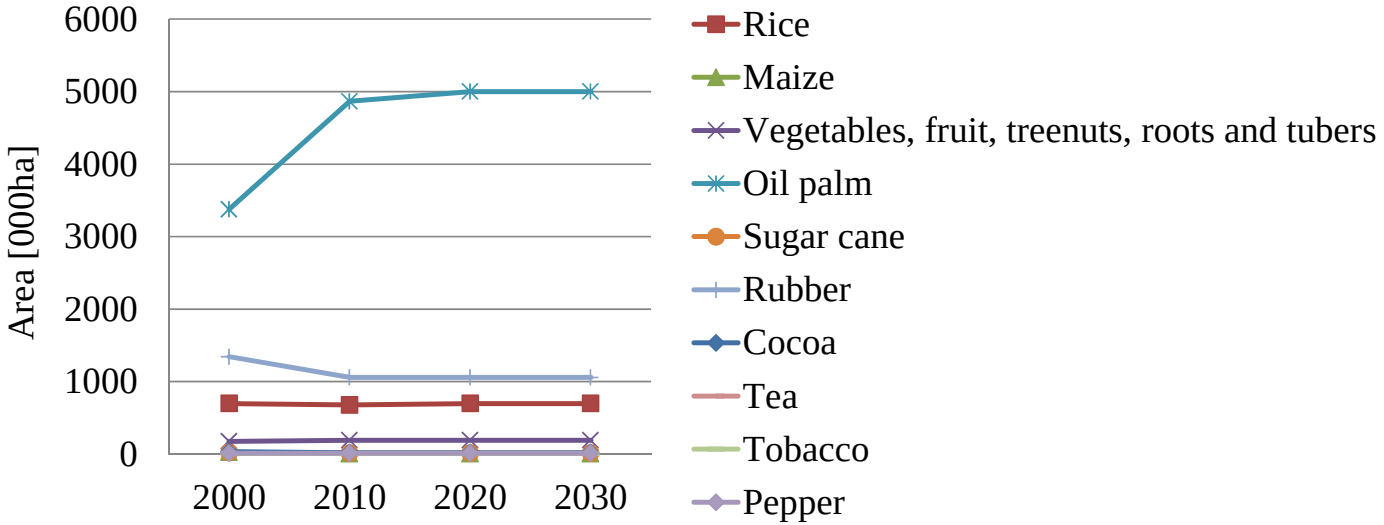
Emission/ Mitigation
Types of countermeasures

- Cost
- Reduction effect
- Life time/ project period
- Diffusion ratio
- Energy consumption and recovery

- Feeding system of livestock
- Manure management system
- Share ratio of irrigation and rain fed area

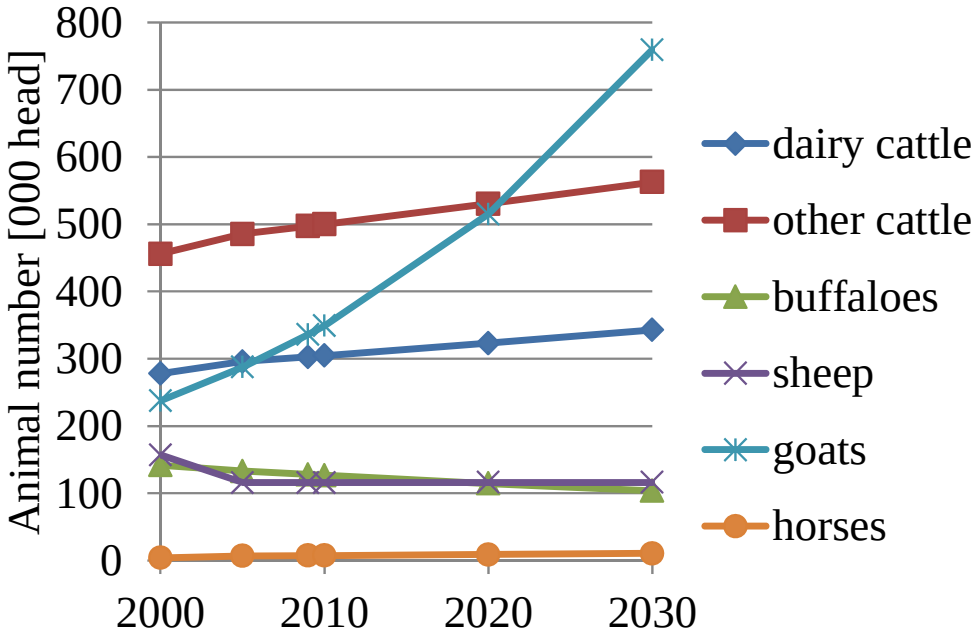
Scenario: Harvested area of crops

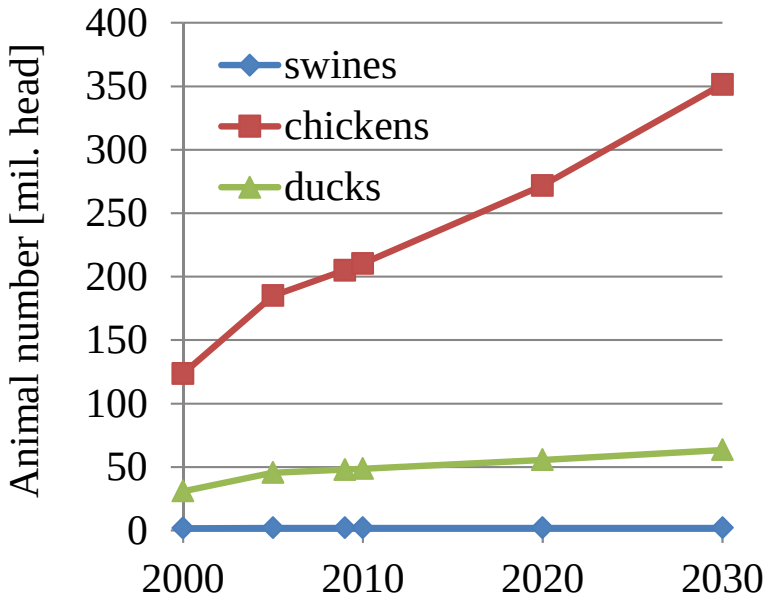
- Total croplands: 9.8 mil. ha in 2000 → 11.3mil.ha in 2030
- Yield: 2.5 times from 2000 to 2030 (Hasegawa, 2011)
- Oil palm area is increasing up to 5 mil. ha by 2020 (Wicke et al., 2011).
- Other crops: Extrapolation from 2005 to 2030 using growth ratio from 2005 to 2009
- Fertilizer per area is set based on yield
  - Yield may change depending on Fertilizer input



Scenario: livestock animals

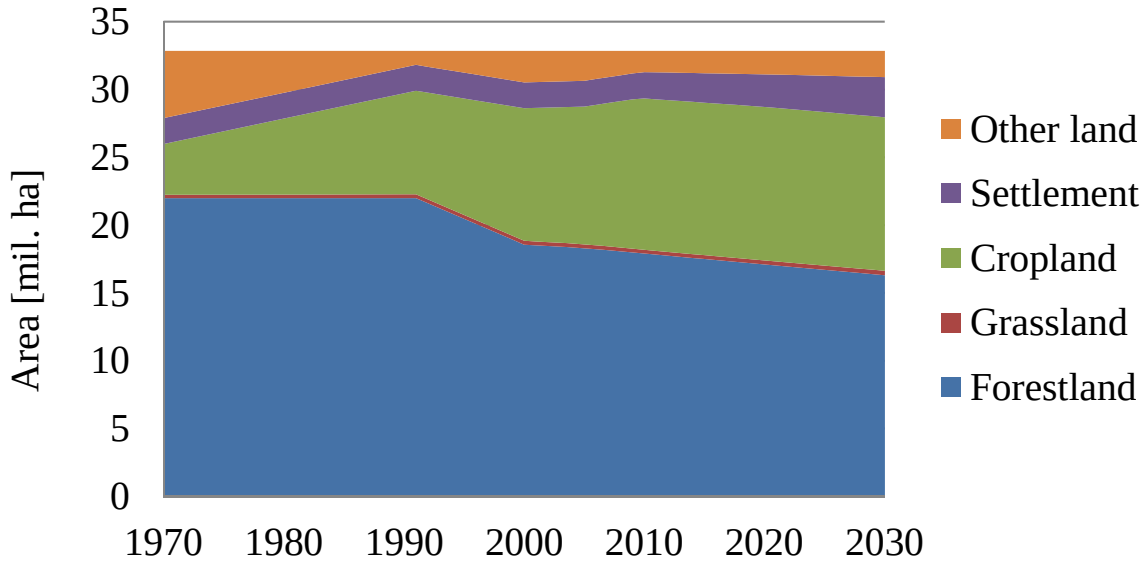
- Base year: NC2
- 2009 (the latest data): FAOSTAT
- 2010 to 2030: increase at ratios in 2005 to 2009





Scenario: land use and land use change

- *Forestland:* NC2 for 2000, 2005, 2009, 2010 and 2020
- *Grassland:* FAOSTAT(2011)
- *Cropland* is total harvested area of crops
- A ratio of *settlements* to total country area:
  - 5.8% in 2008 → 7.3% in 2020 (NPP2)
- *Otherland* : Total Land area – others



Findings from AFOLU model

AFOLU model was applied in Malaysia and estimates GHG emissions and mitigations in AFOLU sectors.

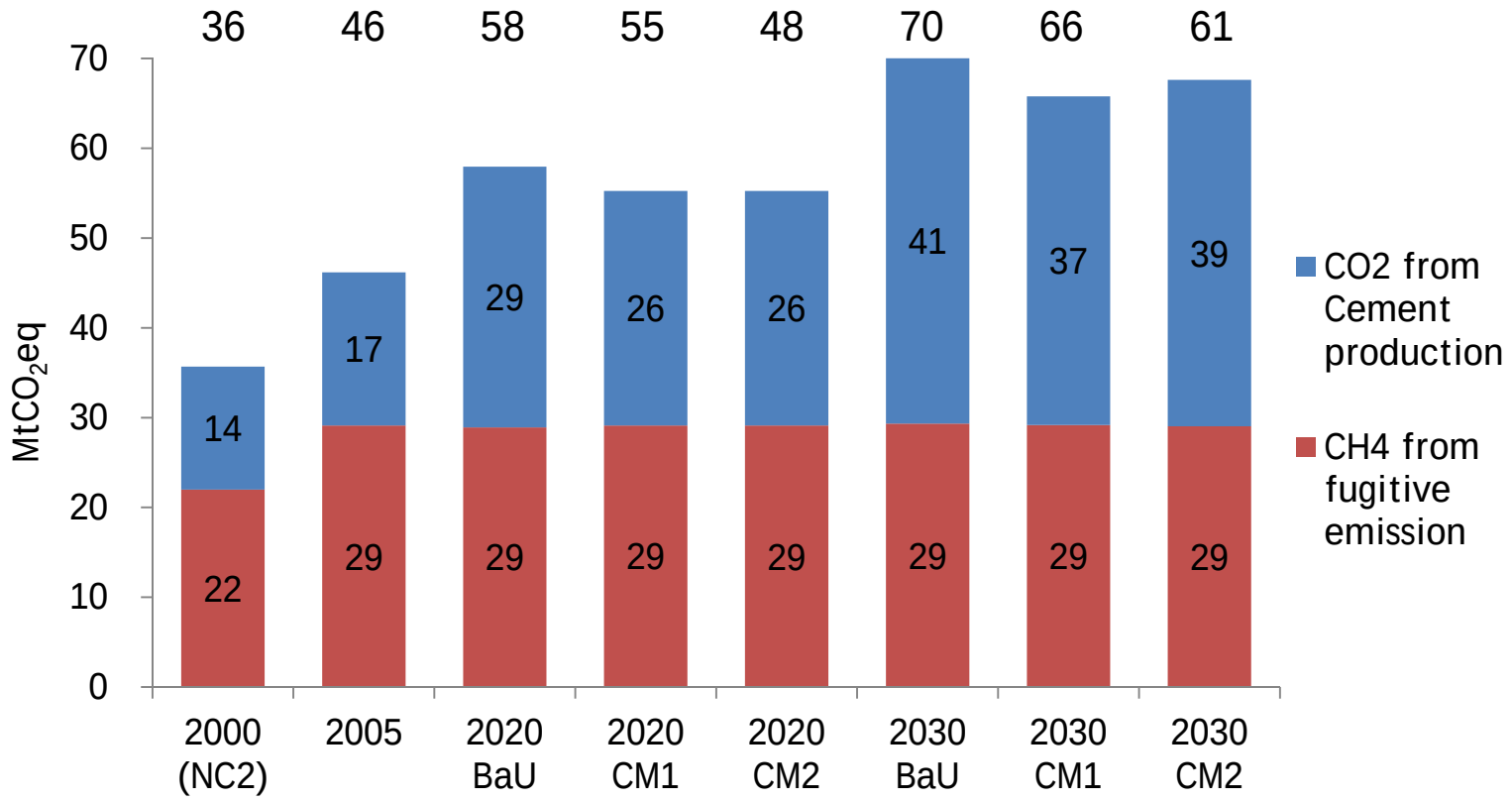
Sectors	BaU emissions		Mitigation Potential	
[MtCO2eq/yr]	2020	2030	2020	2030
Agriculture	7.2	7.9	1.4	1.4
LULUCF	-174	-163	75	91
Total	-167	-155	77	93

- Countermeasures which have high mitigation potential;
  - **Midseason drainage** for Agriculture.
  - **Reduce impact logging** for LULUCF.

* Malaysia NC2, Chap.3, p38, Fig3.4 & Table3.5 *BaU case*

GHG emissions from other emission sources

- In future scenarios, CO2 emission from cement was increased because of more demand of cement for construction.
- CH4 emission from natural gas is almost constant because of assumption of natural gas primary production.



Integration

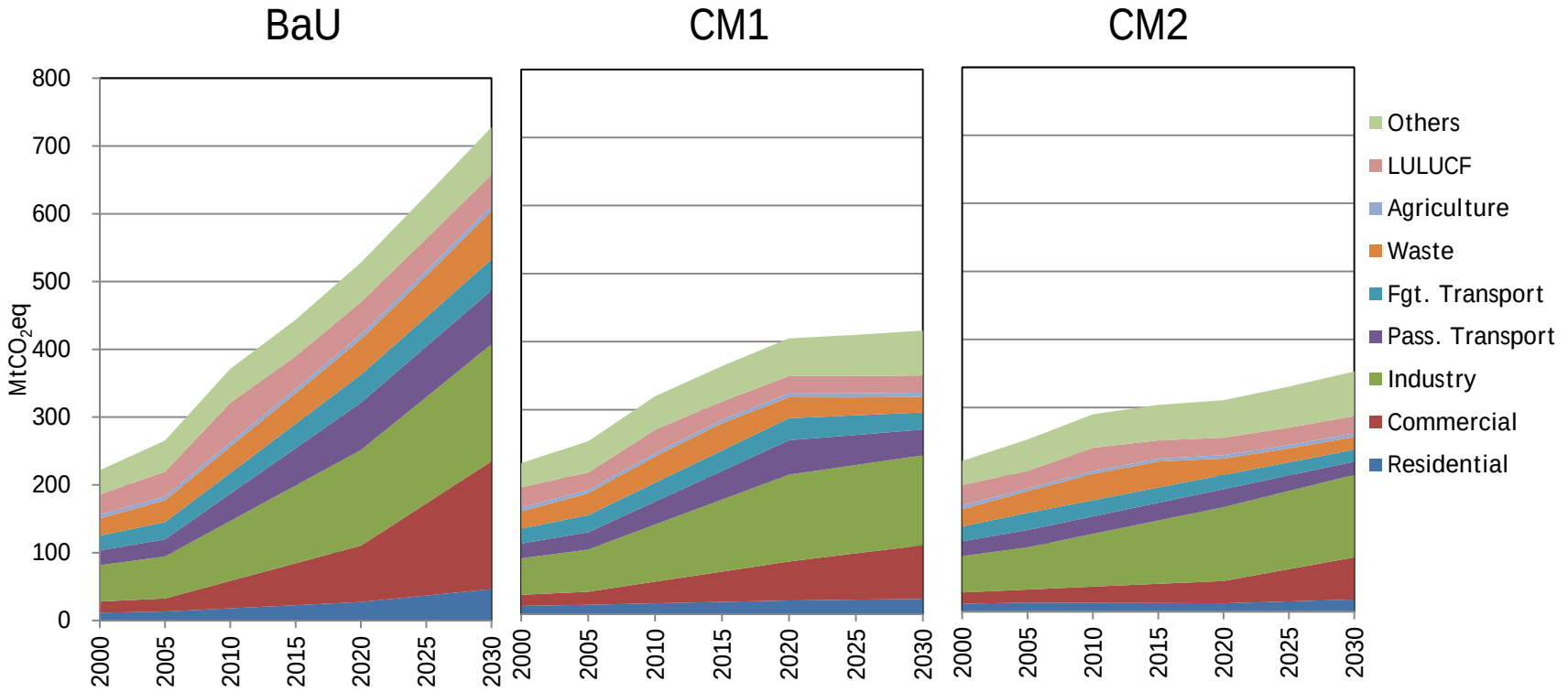
- Combining all three sectors: Energy, Waste AFOLU and other emission sources
- For AFOLU sectors, @<10USD/tCO2eq case was applied both for CM1 and CM2 scenarios.

Summary of mitigation options

	2020		2030	
	CM1	CM2	CM1	CM2
Diffusion of energy efficient devices	40%	70%	75%	85%
EEI rate from BaU of thermal power plants	10%	21%	20%	30%
Modal shift from passenger cars	10%	22%	20%	40%
Share of bio diesel in transport	2%	6%	3%	8%
Capacity of RE power plant (MW)	2080	4160	4160	10400
Recycling rate of solid waste	40%	55%	50%	60%
Incineration rate of solid waste	10%	15%	20%	20%
Recovery rate of CH4 from waste management	25%	35%	40%	40%
Reduction rate of CO2 emissions from cement production process	10%	10%	10%	10%
Mitigations in AFOLU sectors	<10USD/kt CO2eq	<100USD/k tCO2eq	<10USD/kt CO2eq	<100USD/k tCO2eq

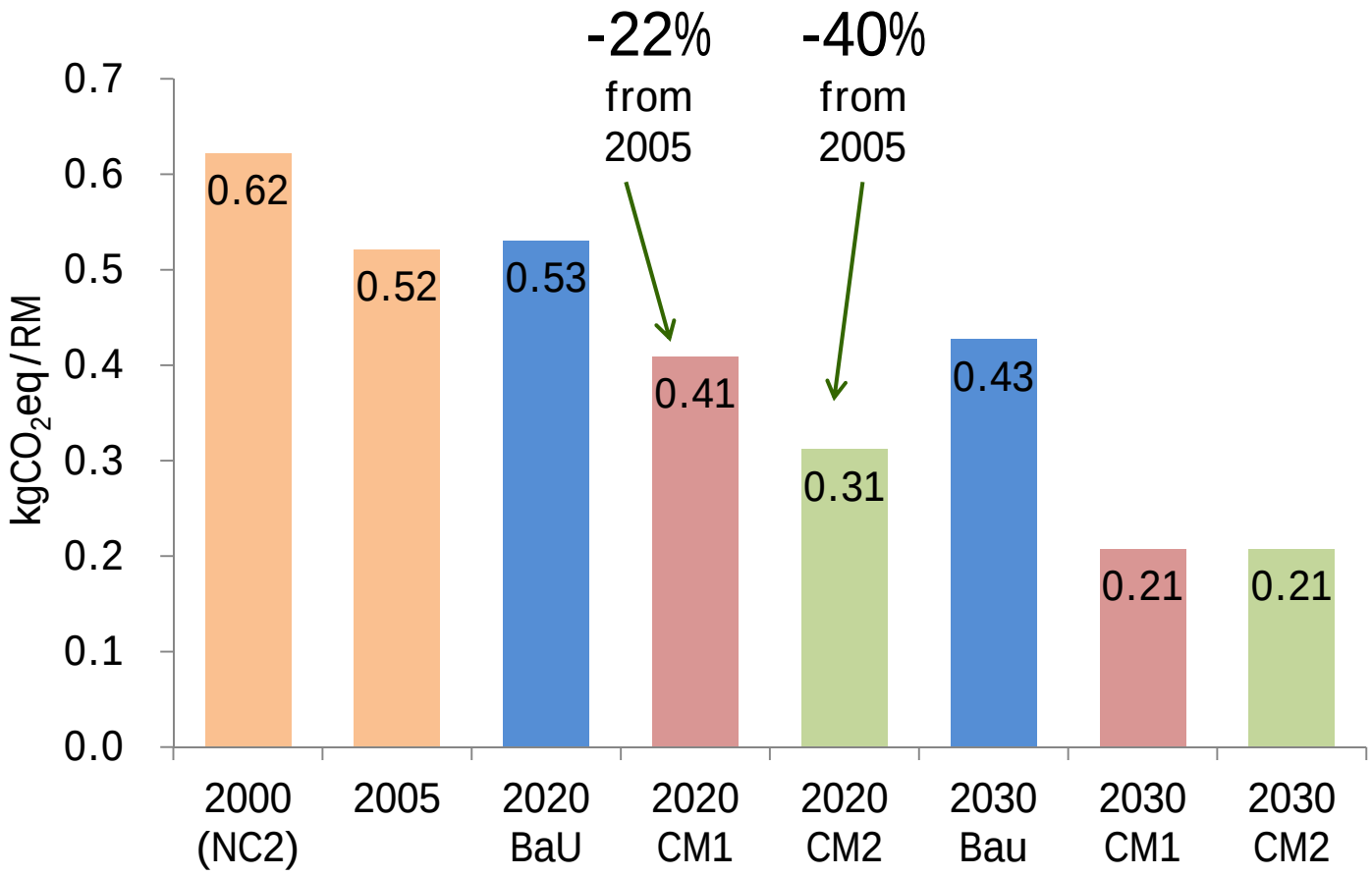
GHG emissions

- Energy has the largest contribution in both scenarios in all years.
- In BaU scenario, GHG emission increased by 99% (2020) and 174% (2030) from 2005
- In CM1 scenario, it was reduced by 22% (2020) and 42% (2030) from BaU, in CM2, 41% (2020) and 52% (2030).

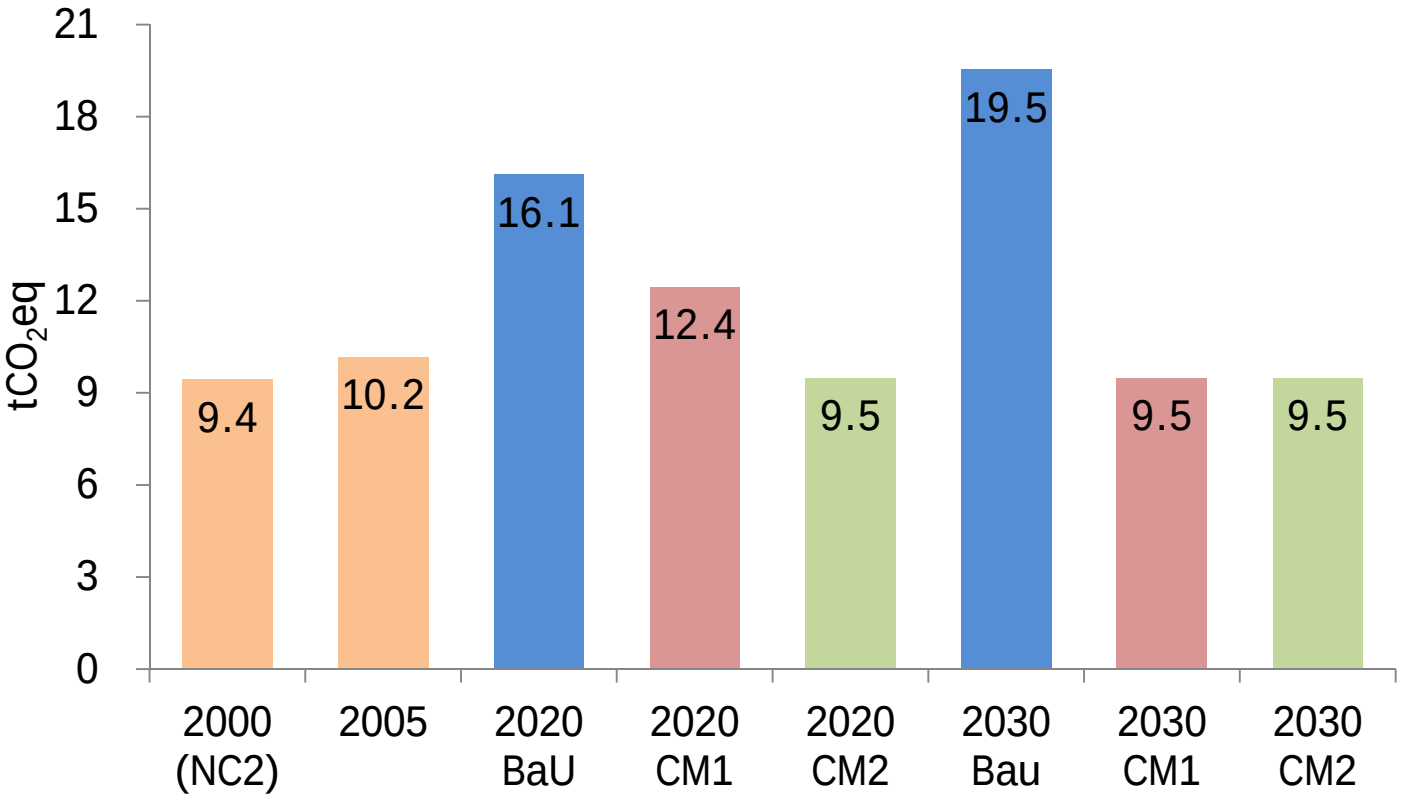


Periods between projected years were interpolated linearly.

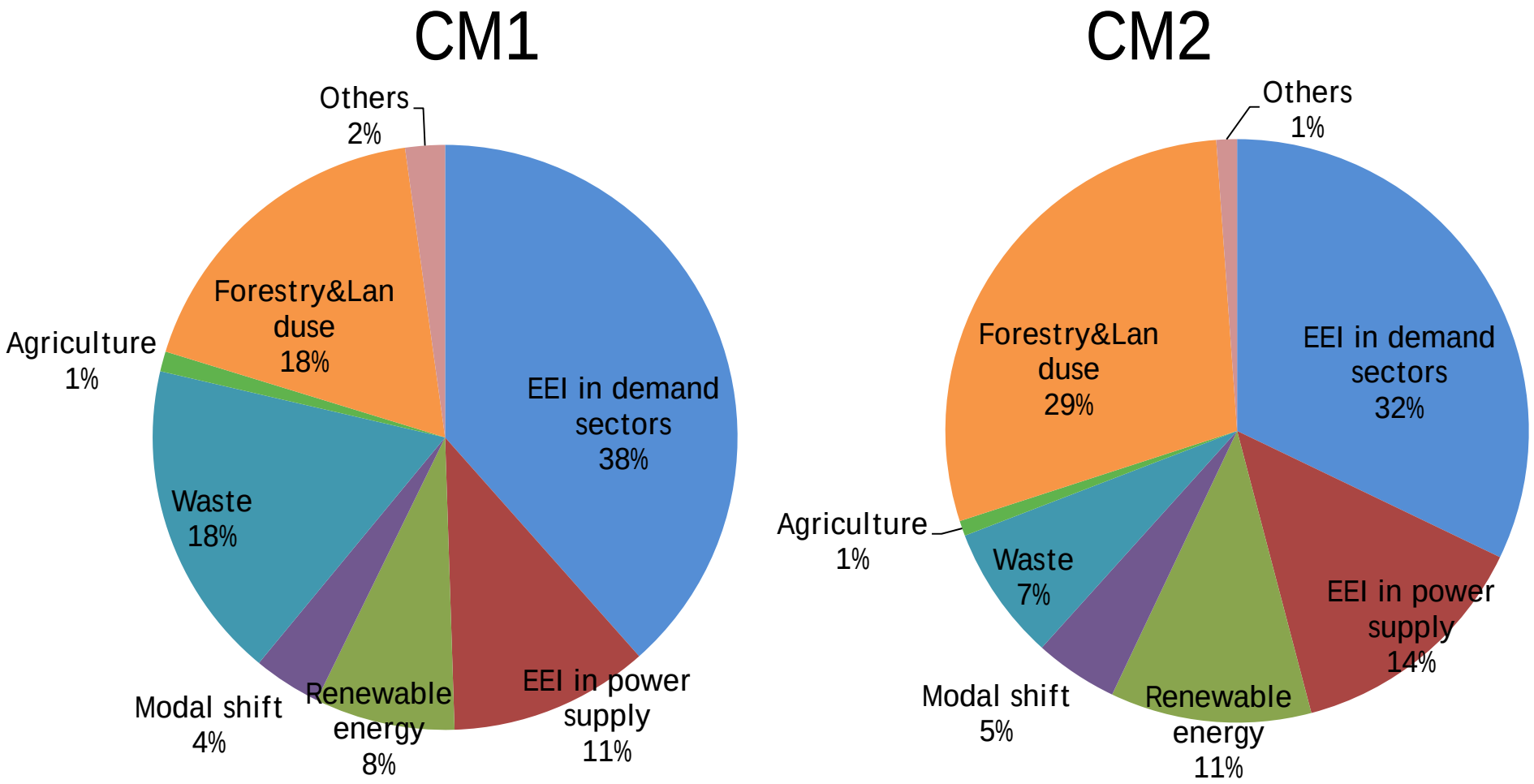
Emission intensity (GHG emission per GDP)



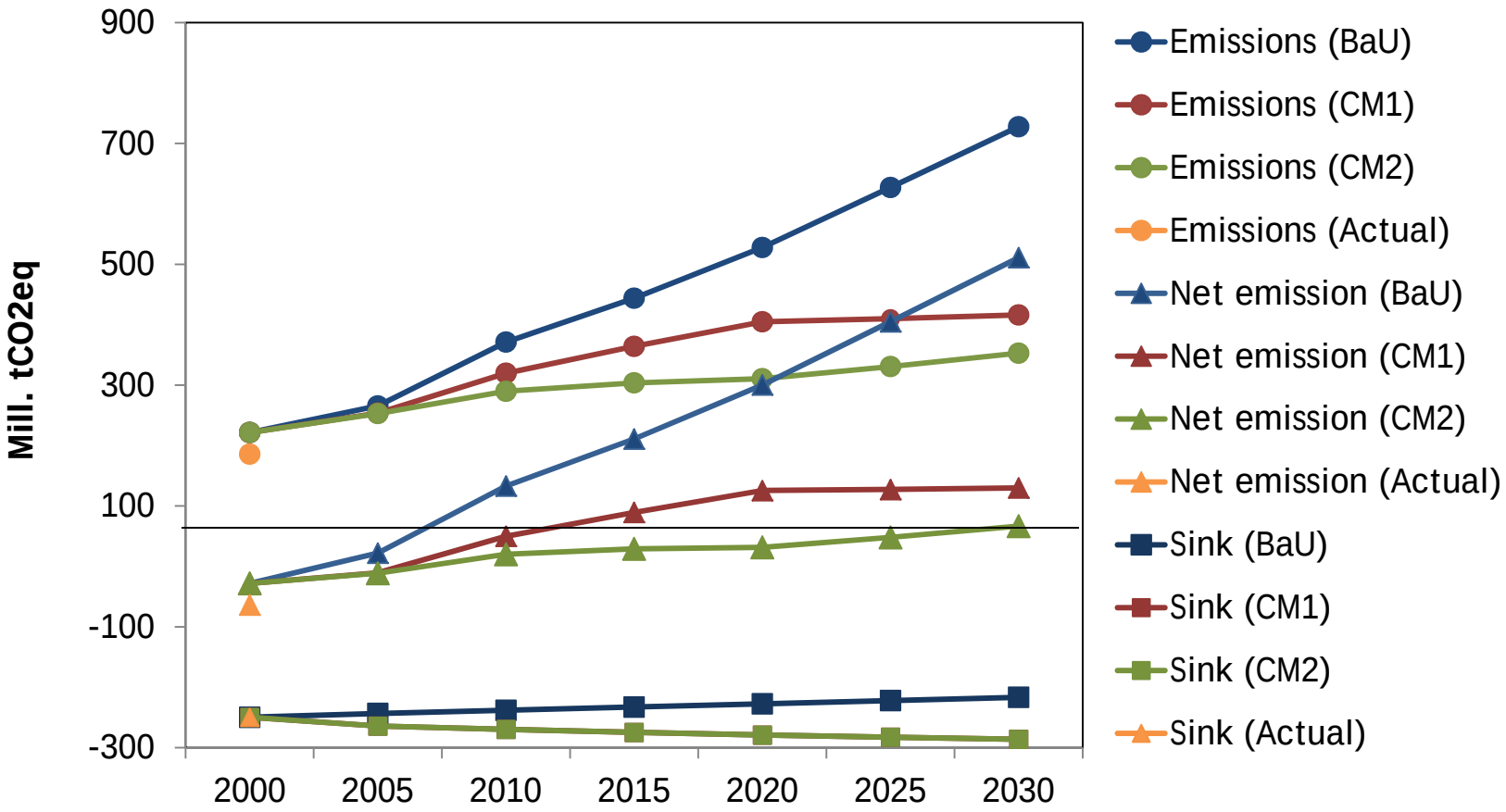
Per capita GHG emission



Contribution to emission reduction in 2020



Emissions, sink, and net emissions



Conclusion

- Target GHGs are: CO_2 from energy use, CO_2 and CH_4 from waste management, CO_2, CH_4 and N2O in AFOLU sectors
- Modeling result showed that in 2020BaU scenario, GHG emission was doubled from 2005.
- In Countermeasure scenario, GHG emission intensity was reduced by 23% from 2005 in 2020CM1 and 40% from 2005 In 2020CM2 scenario.
- In order to achieve -40% target of emission reduction, more intensive implementation is needed especially in energy sector.
- It is important to note that climate resilient policy strategy is based on balanced development whereby measures need to be balanced with Malaysia's need to continue to grow to increase its per-capita productivity and income, eradicate poverty and raise living standards.
- Apart from mitigation measures, Malaysia also focuses on adaptation effort that builds resilience against potential impacts.