

## Development of Low Carbon Society Scenarios for Asian Regions

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

YOKOHAMA JAPAN

24 July 2013

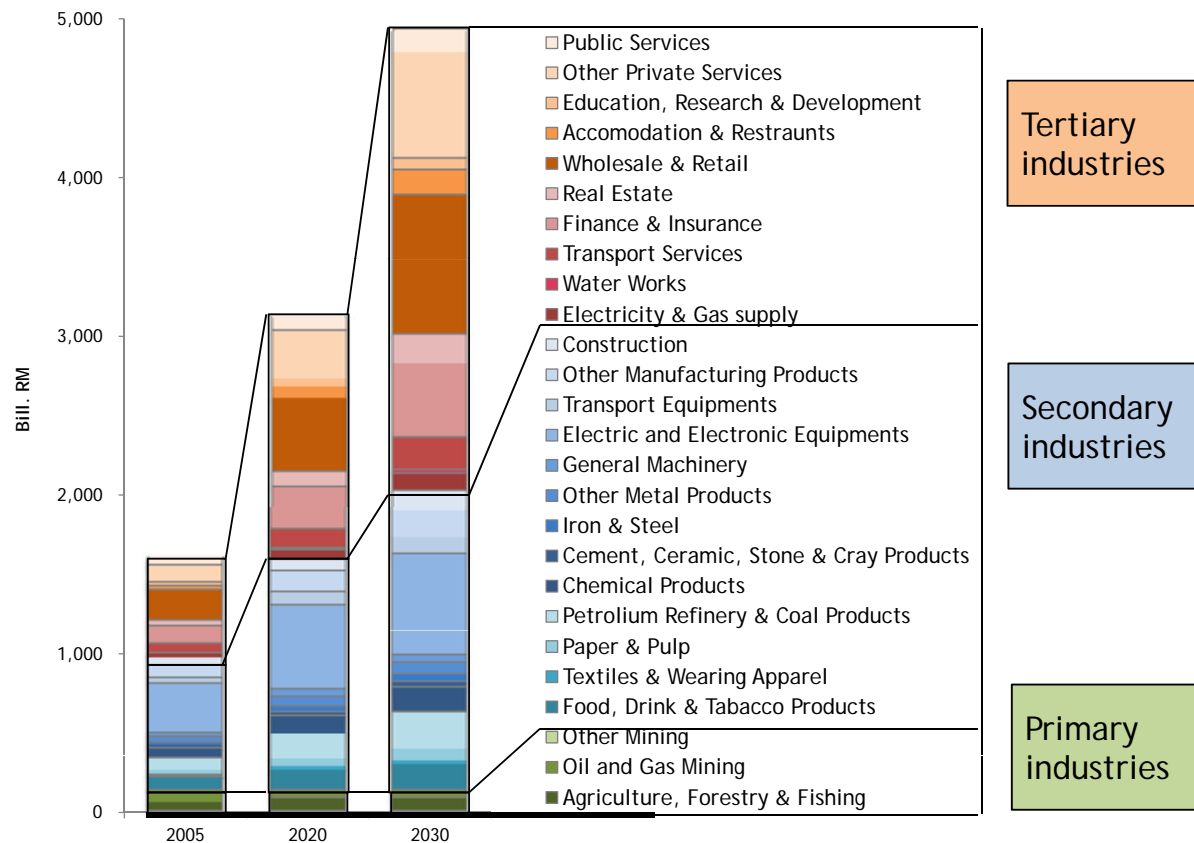
Ho Chin Siong (UTM) ,  
 Yuzuru Matsuoka and Kei Gomi (Kyoto University)  
 Junichi Fujino and Tomoko Hasegawa (NIES)

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	Million
Household	5.8	8.2	9.3	1.4	1.6	Million
GDP	509	996	1,601	2.0	3.1	Bill. RM
Per capita GDP	19.5	30.4	43.0	1.6	2.2	1000.RM
Gross output	1,604	3,135	4,929	2.0	3.1	Bill. RM
Primary	55	84	97	1.5	1.8	
Secondary	920	1,507	2,175	1.6	2.4	
Tertiary	629	1,544	2,657	2.5	4.2	
Passenger transport	169	315	359	1.9	2.1	Bill. pass-km
Freight transport	92	150	214	1.6	2.3	Bill. t-km

# Projected output by 26 sectors



3

## Mitigation options (1)

Share of energy efficient devices

	CM1	CM2
2020	40%	60%
2030	75%	85%

Conversion efficiency of power plant

		Coal	Oil	Gas	Hydro power	Solar & mini hydro	Biomass and other renewables	Nuclear
2005		24%	69%	39%	34%			
2020	BaU	32%	39%	39%	34%			
	CM1	36%	39%	43%	34%	100%	36%	
	CM2	39%	39%	47%	34%	100%	39%	
2030	BaU	32%	39%	39%	34%			
	CM1	39%	39%	47%	34%	100%	39%	100%
	CM2	42%	39%	51%	34%	100%	39%	100%

4

# Mitigation options (2)

## Renewable energy of power supply in CM scenarios

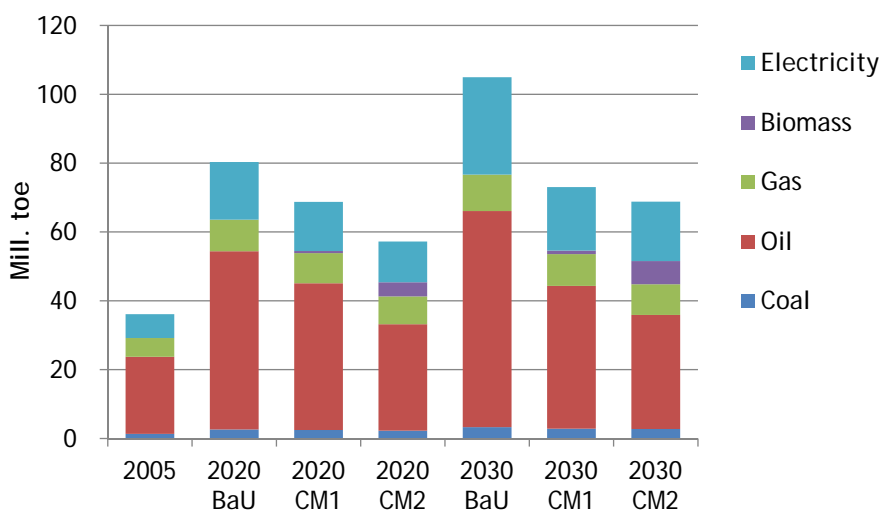
		Biomass	Biogas	Mini-hydro	Solar PV	Solid Waste	Total
CM1	2020	800	240	490	190	360	2080
	2030	1600	480	980	380	720	4160
CM2	2020	1600	480	980	380	720	4160
	2030	4000	1200	2450	950	1800	10400

## Share of bio diesel in transport fuel

	CM1	CM2
2020	2.0%	5.9%
2030	3.1%	7.8%

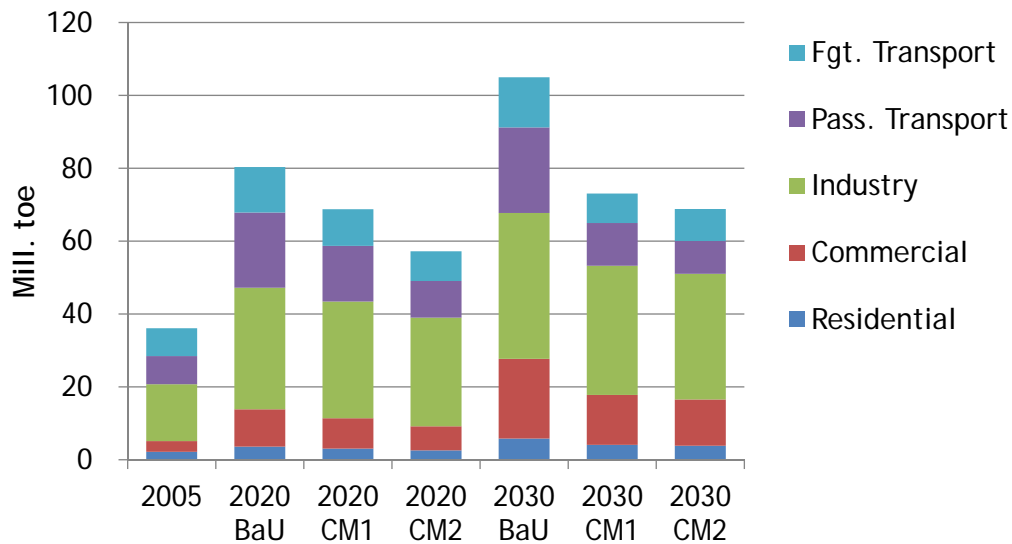
## Projected final energy demand by fuels

- Final energy demand by fuel in 2020BaU was fit to that of NC2
- **Oil has the largest share in all scenarios.**
- In 2030BaU scenario, final energy demand reaches 100 million toe.



## Projected final energy demand by sectors

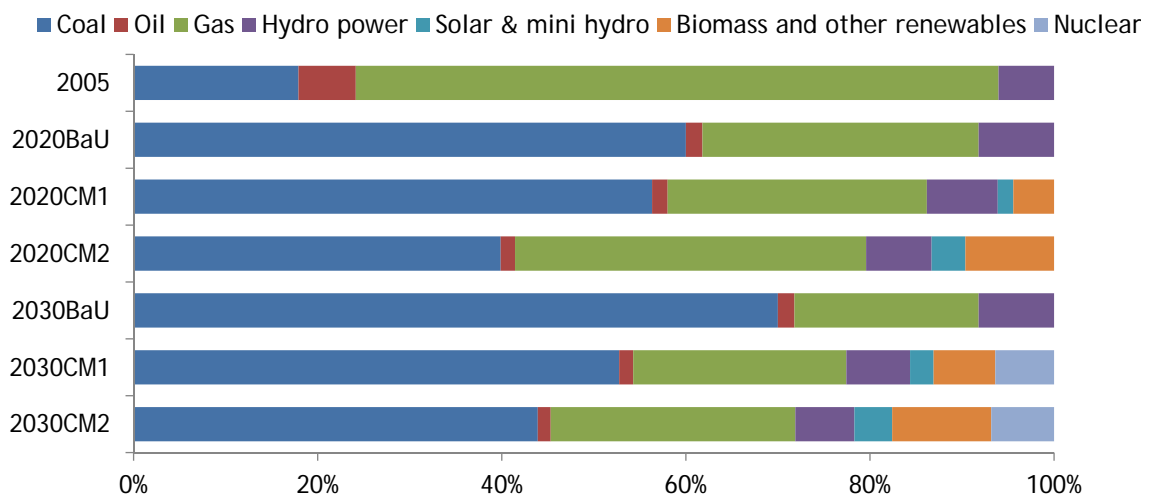
- Share of each sector is fit to NC2 in 2020BaU scenario
- The largest energy consumer is industry sector



7

## Projected energy mix of power supply

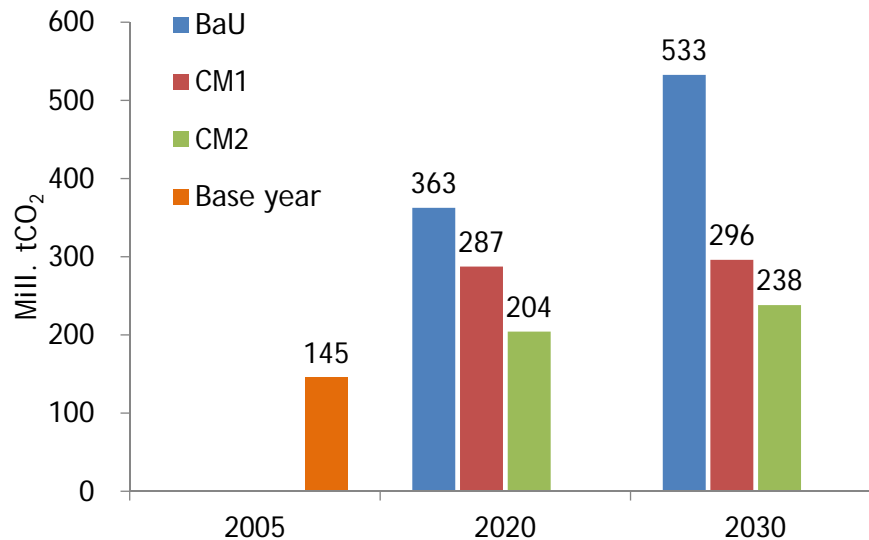
- Power supply mix is projected to fit **primary supply** of each type of energy in NC2
- Coal increase its share significantly in all scenarios
- In 2030CM scenario, share of renewable energies reaches nearly 20%.



8

# Projected CO<sub>2</sub> emissions

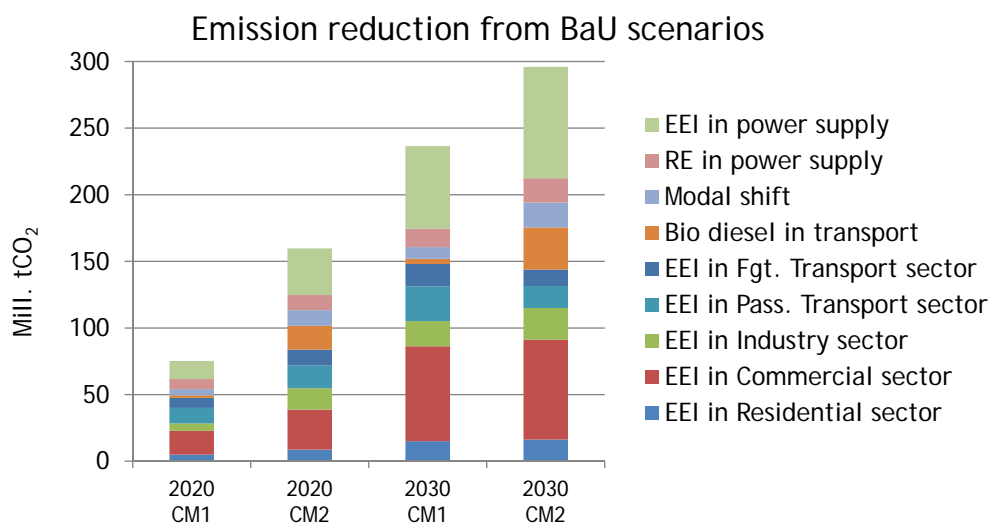
- In 2020BaU, CO<sub>2</sub> emission doubled from 2005, and tripled in 2030BaU.
- In CM1 scenario, it was reduced by 21%(2020) and 44%(2030) from BaU scenarios.
- In CM2 scenario, it was reduced by 44%(2020) and 55% (2030) from BaU scenarios.



9

## 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

10

# Scenarios and Mitigation options

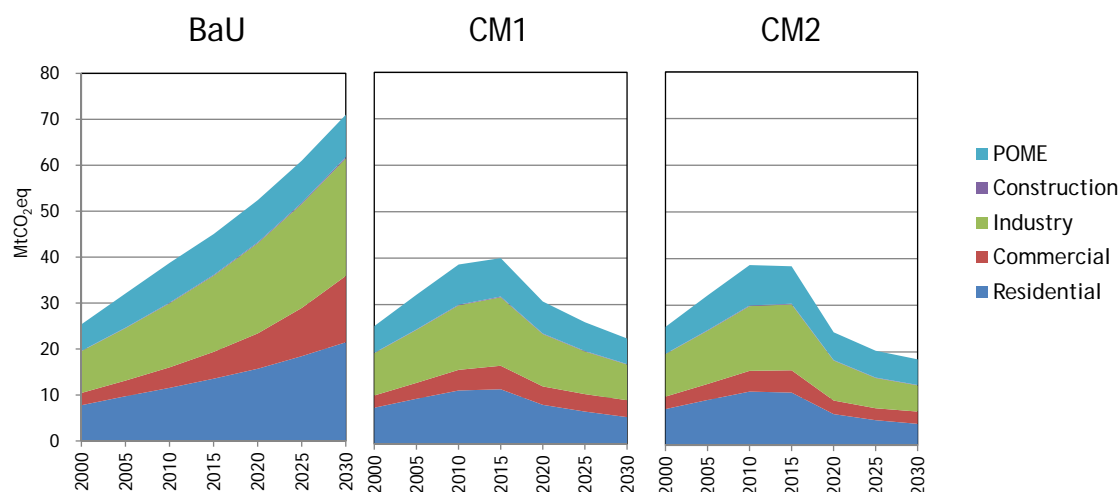
- **BaU:** Without measures to reduce GHG emission.
- **CM1:** Scenario 2 in NC2. With mitigation options
- **CM2:** More intensive implementation of mitigation options than CM1

		Baseline	CM1	CM2
Recycling	2020	5.5%	40%	55%
	2030	5.5%	50%	60%
Incineration	2020	0.0%	10%	15%
	2030	0.0%	20%	20%
Composting	2020	2.2%	15%	15%
	2030	2.2%	25%	25%
CH4 recovery	2020	0%	25%	35%
	2030	0%	40%	40%

11

## Projected GHG emissions (waste)

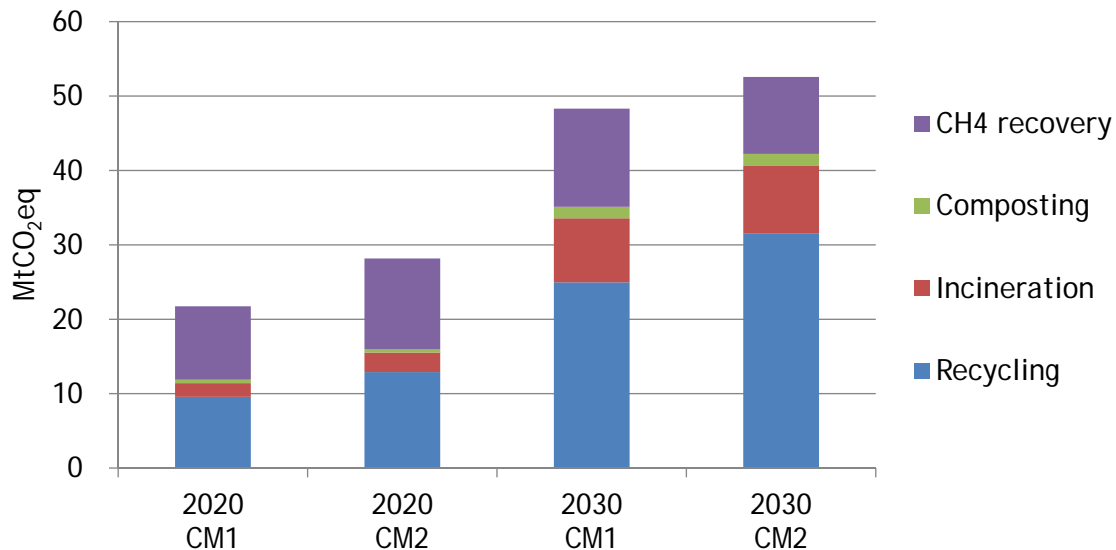
- In BaU, GHG emission increased more than 2 times in 2020 and 2.8 times in 2030
- In CM1, emission was reduced by 41% (2020) and 68% (2030) from BaU
- In CM2, emission was reduced by 54% (2020) and 74% (2030) from BaU



12

# 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.



13

# 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

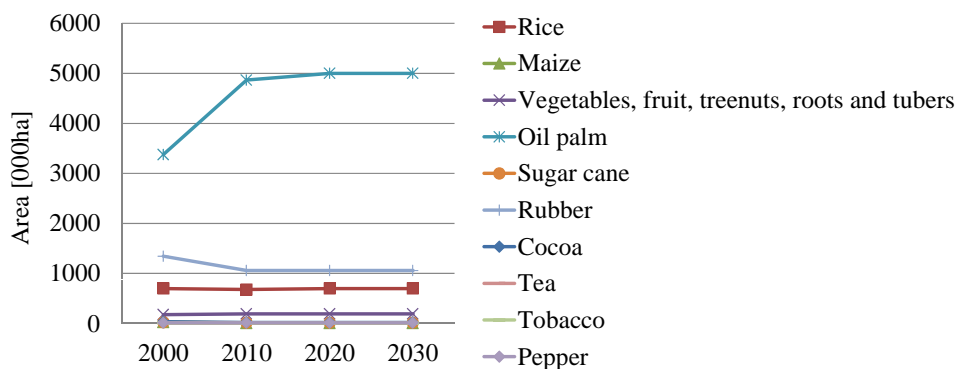
- Cost
- Reduction effect
- Life time/ project period
- Diffusion ratio
- Energy consumption and recovery

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

14

# Scenario: Harvested area of crops

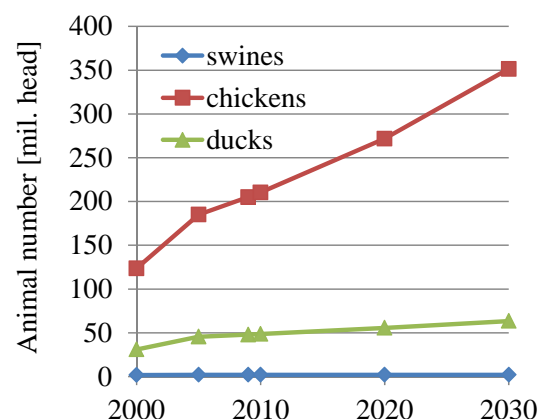
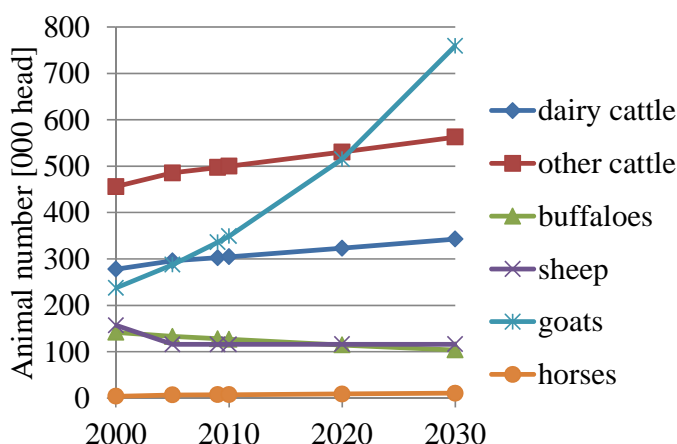
- Total croplands: 9.8 mil. ha in 2000 → 11.3mil.ha in 2030
- Yield: 2.5 times from 2000 to 2030 (Hasegawa, 2011)
- Oil palm area is increasing up to 5 mil. ha by 2020 (Wicke et al., 2011).
- Other crops: Extrapolation from 2005 to 2030 using growth ratio from 2005 to 2009
- Fertilizer per area is set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



15

# Scenario: livestock animals

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

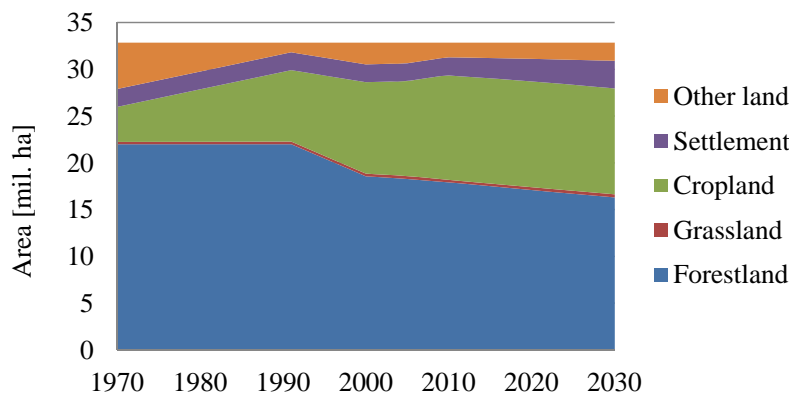


16



## Scenario: land use and land use change

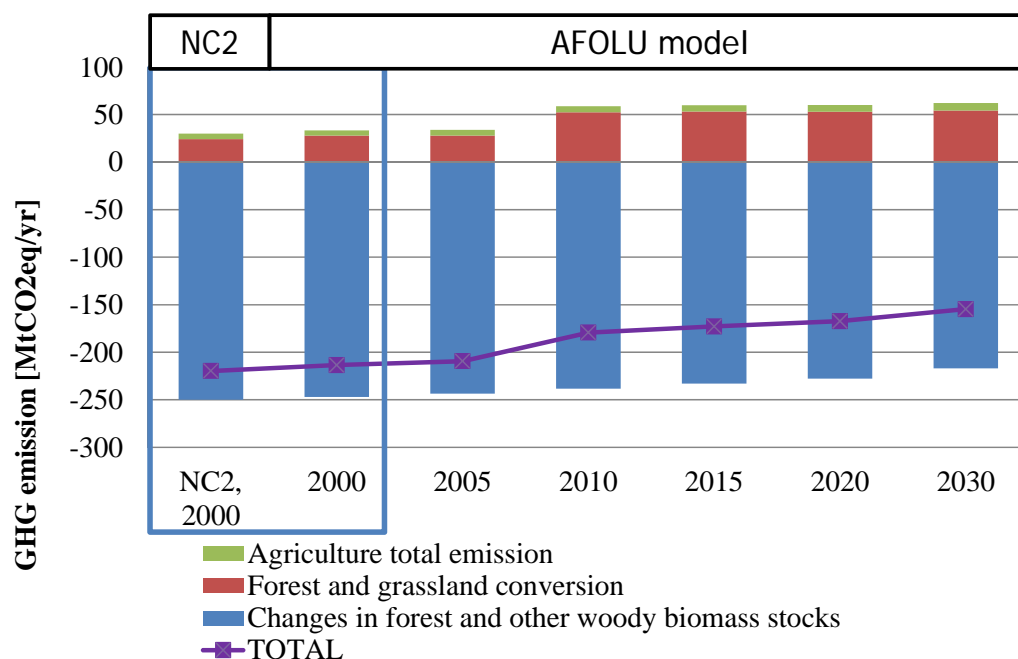
- *Forestland*: NC2 for 2000, 2005, 2009, 2010 and 2020
- *Grassland*: FAOSTAT(2011)
- *Cropland* is total harvested area of crops
- A ratio of *settlements* to total country area:
  - 5.8% in 2008 → 7.3% in 2020 (NPP2)
- *Other land* : Total Land area - others



17

## Total GHG emissions in BaU in AFOLU sectors

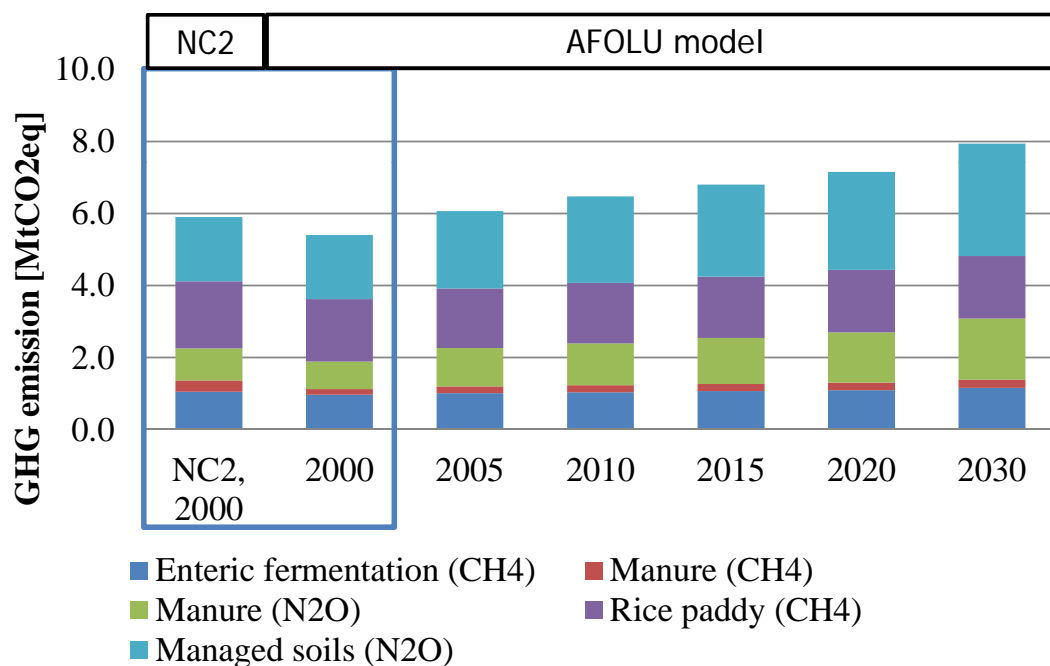
Our results is similar with NC2 estimates



18

# GHG emissions in Agriculture in BaU case

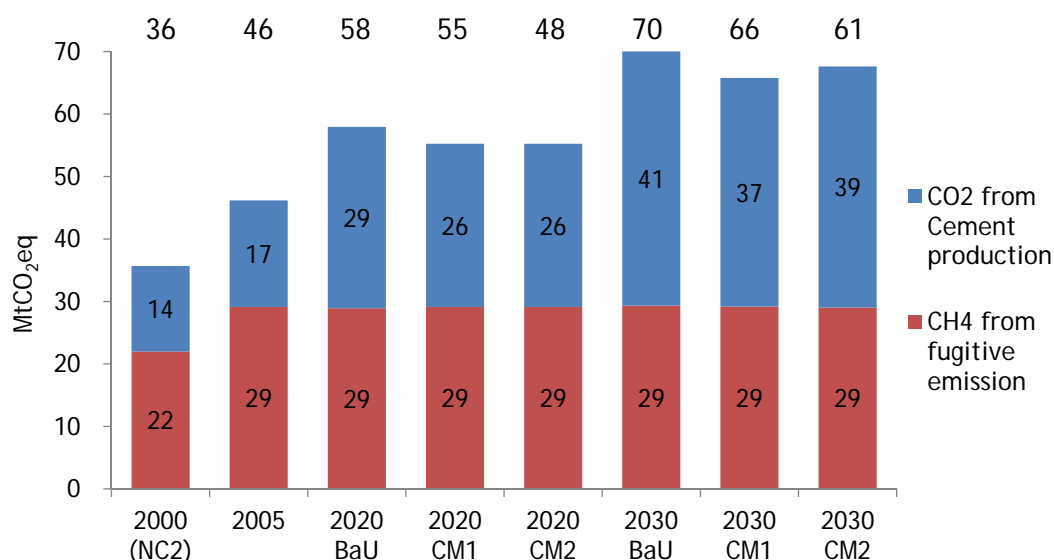
Our results is similar with NC2 estimates



19

## GHG emissions from other emission sources

- In future scenarios, CO<sub>2</sub> emission from cement was increased because of more demand of cement for construction.
- CH<sub>4</sub> emission from natural gas is almost constant because of assumption of natural gas primary production.



20

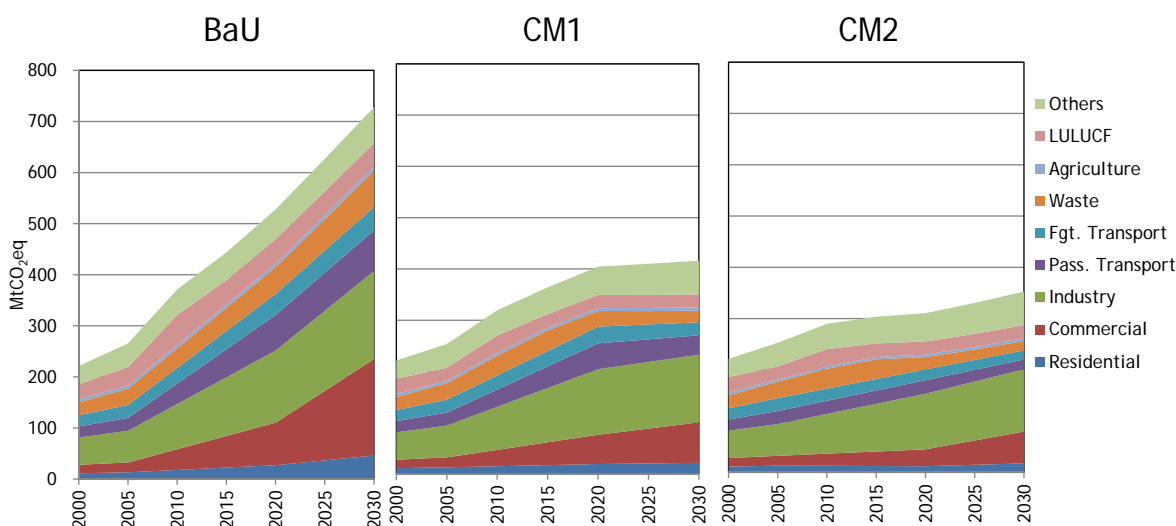
# Summary of mitigation options

	2020		2030	
	CM1	CM2	CM1	CM2
Diffusion of energy efficient devices	40%	70%	75%	85%
EEl 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 CH <sub>4</sub> from waste management	25%	35%	40%	40%
Reduction rate of CO <sub>2</sub> emissions from cement production process	10%	10%	10%	10%
Mitigations in AFOLU sectors	<10USD/kt CO <sub>2</sub> eq	<100USD/k tCO <sub>2</sub> eq	<10USD/kt CO <sub>2</sub> eq	<100USD/k tCO <sub>2</sub> eq

21

## GHG emissions

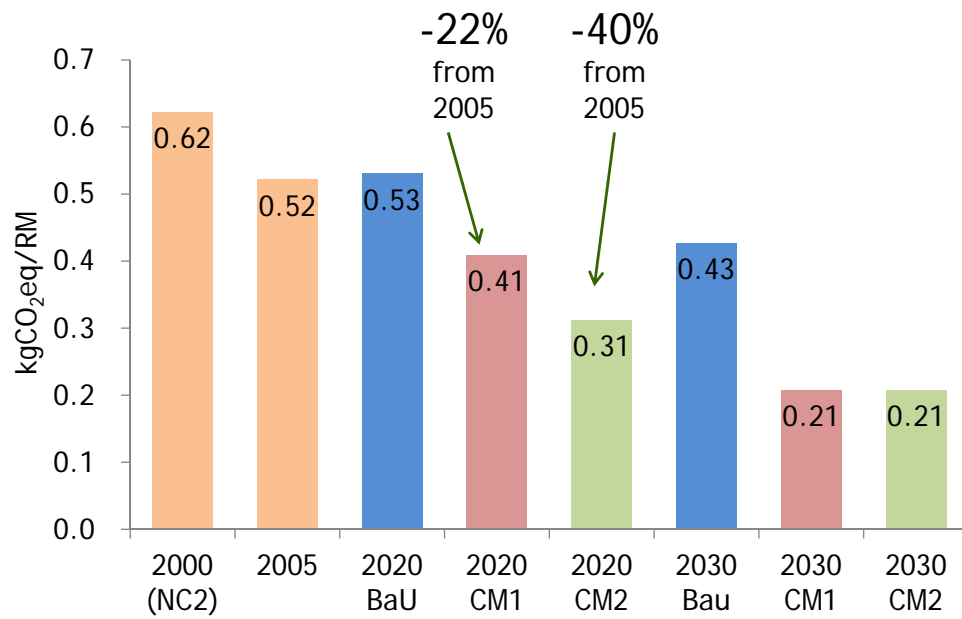
- Energy has the largest contribution in both scenarios in all years.
- In BaU scenario, GHG emission increased by 99% (2020) and 174% (2030) from 2005
- In CM1 scenario, it was reduced by 22% (2020) and 42% (2030) from BaU, in CM2, 41% (2020) and 52% (2030).



Periods between projected years were interpolated linearly.

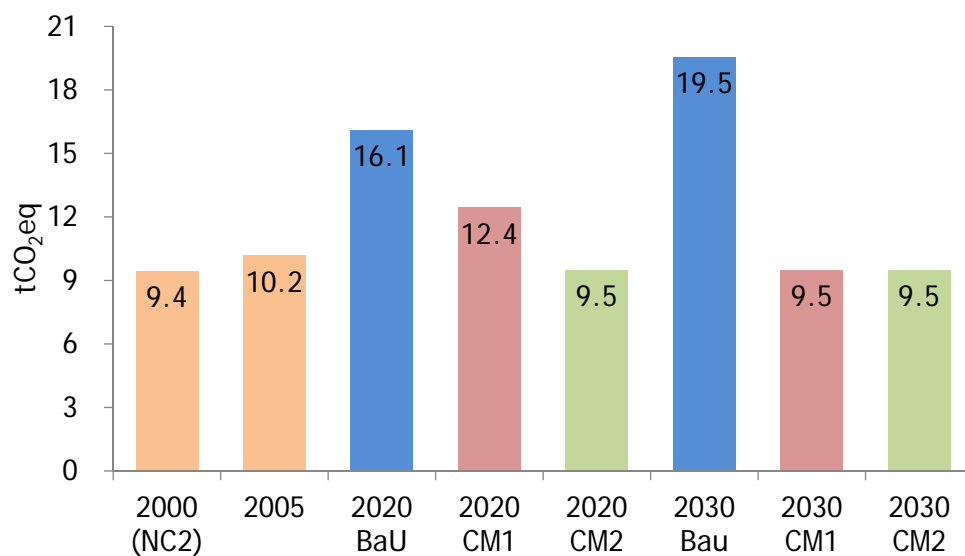
22

## Emission intensity (GHG emission per GDP)



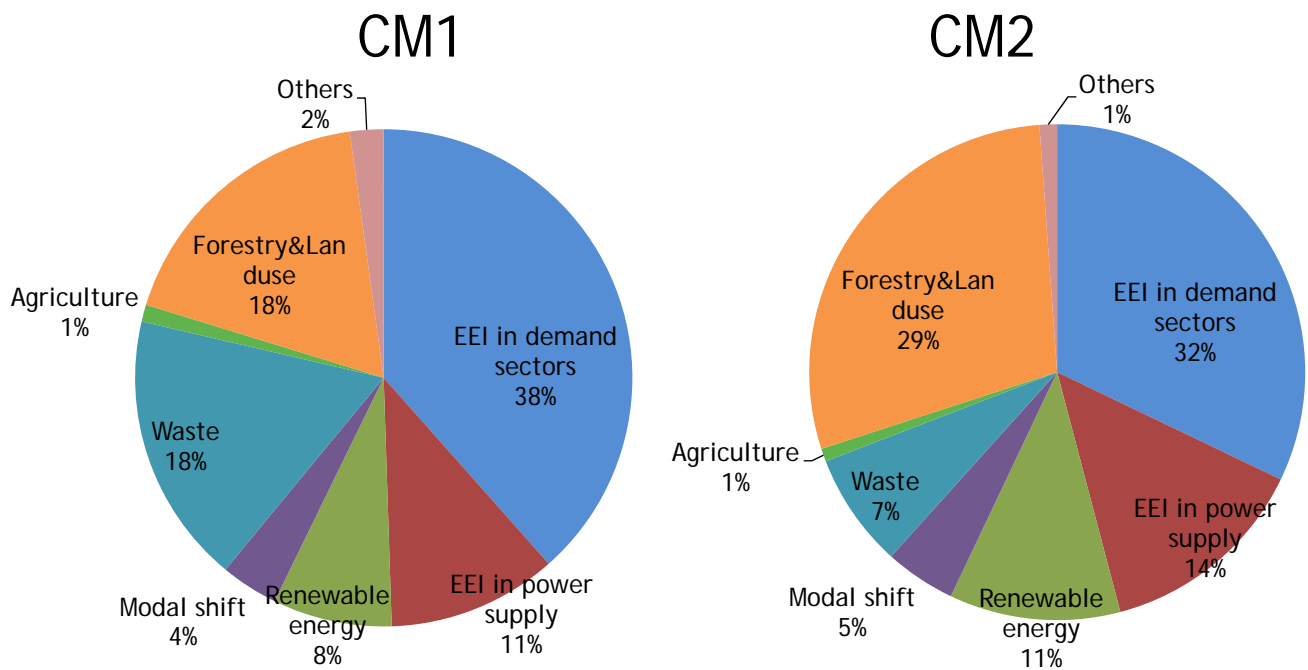
23

## Per capita GHG emission



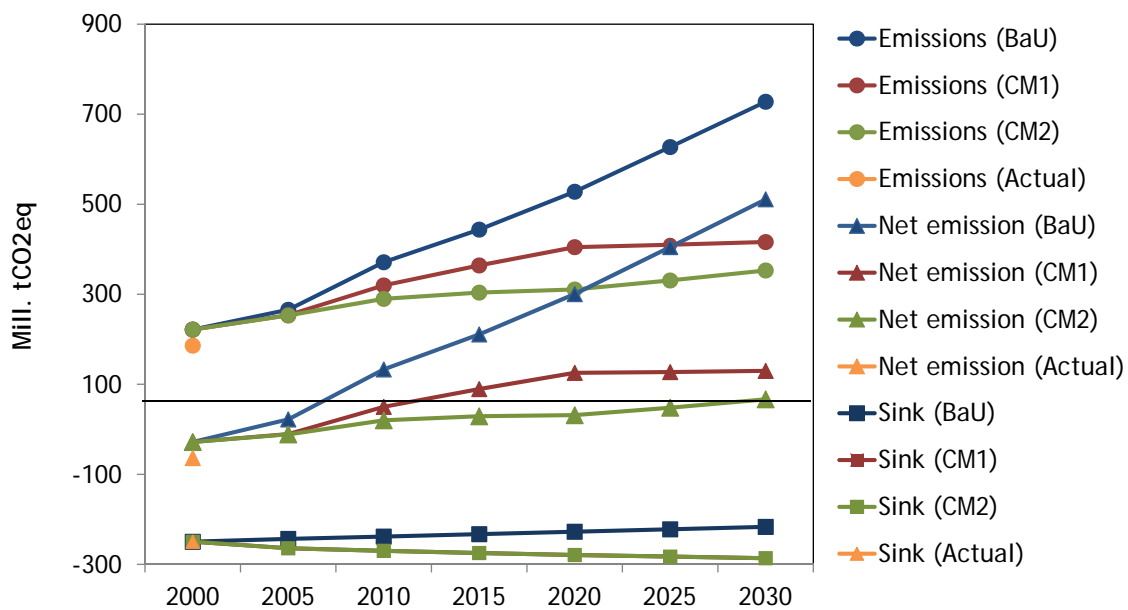
24

# Contribution to emission reduction in 2020



25

# Emissions, sink, and net emissions



26

# Conclusion

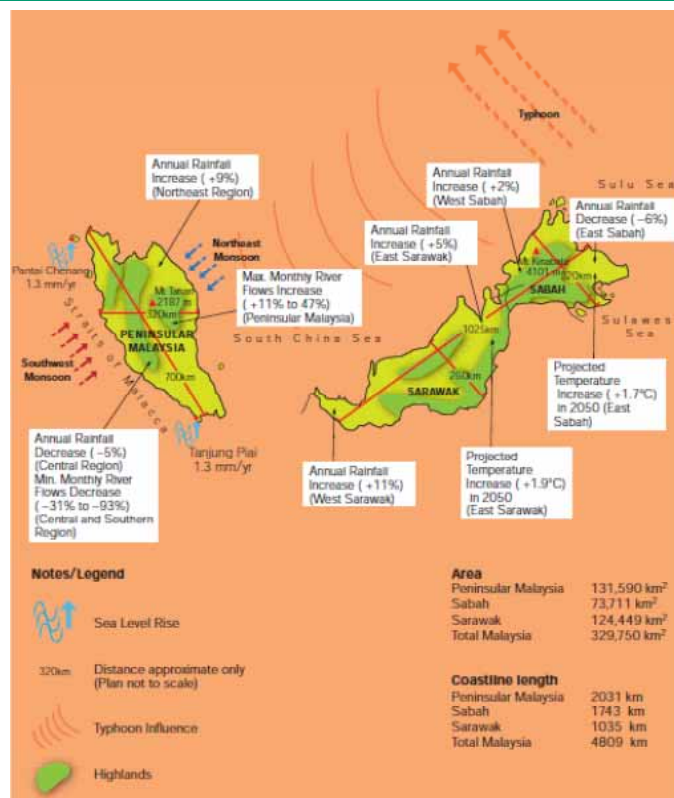
- Target GHGs are: CO<sub>2</sub> from energy use, CO<sub>2</sub> and CH<sub>4</sub> from waste management, CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O in AFOLU sectors
- Modeling result showed that in 2020BaU scenario, GHG emission was doubled from 2005.
- In Countermeasure scenario, GHG emission 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.

27

## Climatic Pattern and Projected changes - Adaptation measures are also important to reduce the impact.

### Impact and Vulnerability on

- 1) Water resources
  - a) Irrigation and Water supply
  - b) Flood and Erosion
- 2) Agriculture (pdt fall)
  - a) Oil palm
  - b) Rice
  - c) Rubber
  - d) cocoa
- 3) Agriculture and Biodiversity
  - a) Mangrove swamp
  - b) Montane forest
  - c) Biodiversity
- 4) Coastal and marine
  - a) Sea level rise
  - b) increase frequency and duration of storms.
- 5) Public health
  - a) malaria



Source : NC2 Malaysia ( 2011)

28



# Thank you for your attention!

Thank You Terima Kasih 谢谢 धन्यवाद ありがとう