Development of
Low Carbon Society Scenarios for Asian Regions

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Low carbon Society Blueprint and Roadmap towards Low Carbon Iskandar Malaysia 2025

Ho Chin Siong, Kei Gomi, Yuzuru Matsuoka, and Fujino Junichi

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

01 Introduction

Development of Low Carbon Society Scenarios for Asian Regions

Research Team: Universiti Teknologi Malaysia (UTM), Kyoto University (KU), Okayama University (OU), National Institute for Environmental Studies (NIES)

Joint Coordinating Committee: Iskandar Regional Development Authority (IRDA), Federal Department of Town and Country Planning (JPBD), Malaysia Green Technology Corporation (MGTC)

Sponsorship: Japan International Cooperation Agency (JICA) , Japan Science and Technology (JST)

Period: 2011 - 2016

Research Output:

I. **Methodology** to create LCS scenarios which is appropriate for Malaysia is developed.

II**. LCS scenarios** are created and utilized **for policy development** in IM.

III. **Co-benefit of LCS policies** on air pollution and on recycling-based society is quantified in IM

IV. **Organizational arrangement of UTM** to conduct trainings on LCS scenarios for Malaysia and Asian countries is consolidated, and a network for LCS in Asia is established

02 Background

Iskandar Malaysia: Key Challenges

Size: 2,216.3 km²

Population: 1.3 mil. (2005) I 3.0 mil. (2025)

GDP: 35.7 bil. RM (2005) I 141.4 bil. RM (2025)

Issues

_ Rapid urbanization and industrialization

_ Relatively high carbon intensity dependence on fossil fuel

_ High private car ownership

_ Low density development and urban sprawl

_ Low efficiency appliances

Government Policy Directions

_ National Green Technology Policy

_ National Policy on Climate Change

_ National Renewable Energy Policy and Action Plan

_ National Policy on the Environment

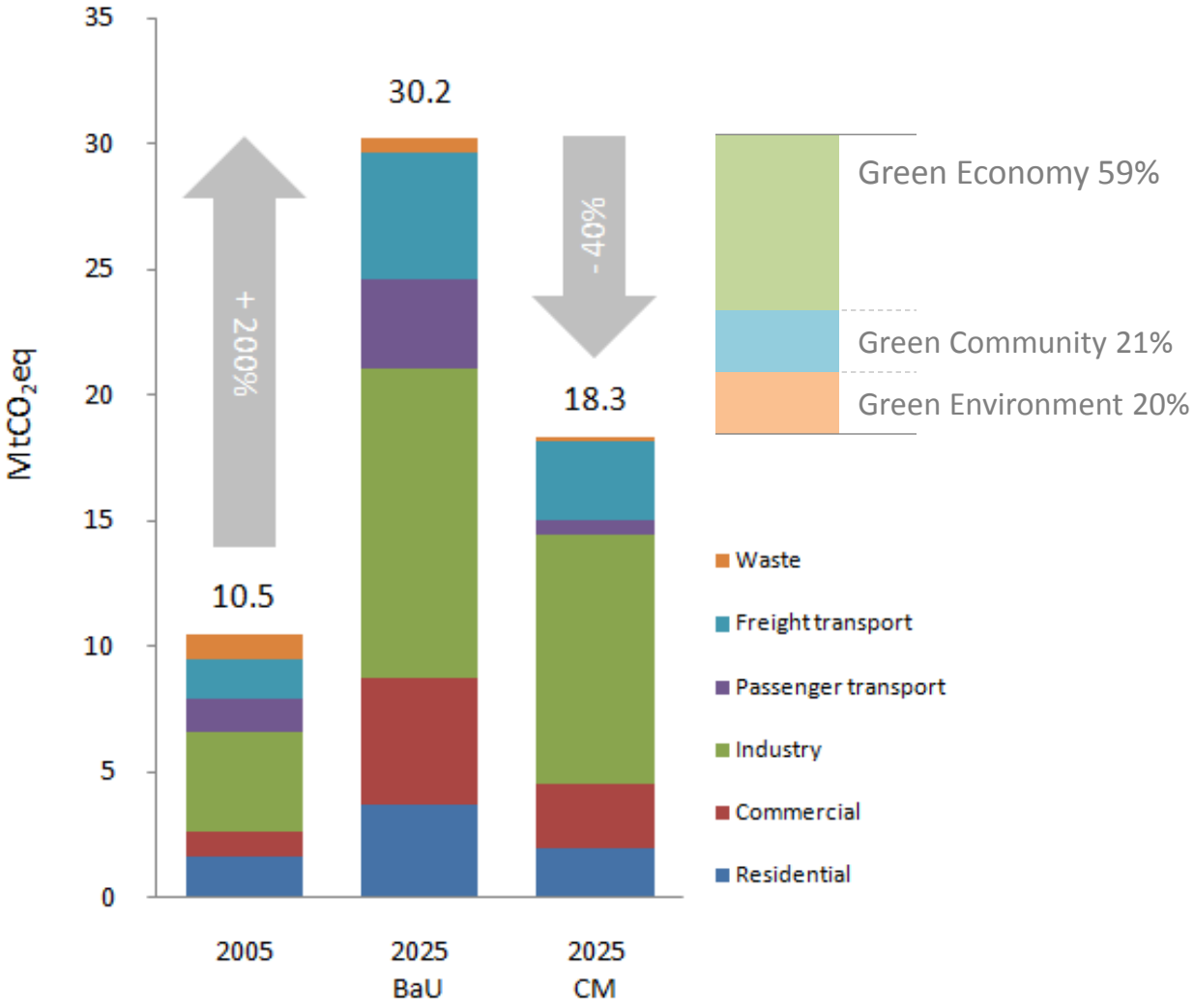
_ 10th Malaysia Plan

_ Green Neighborhood Planning Guideline

_Low Carbon Cities Framework and Assessment System

04 Potential Mitigation Options for Iskandar Malaysia

Green Economy, Green Community and Green Environment



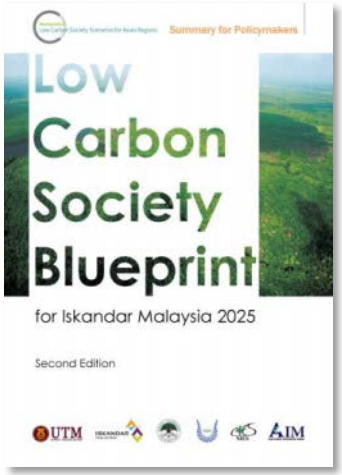
04 Potential Mitigation Options for Iskandar Malaysia

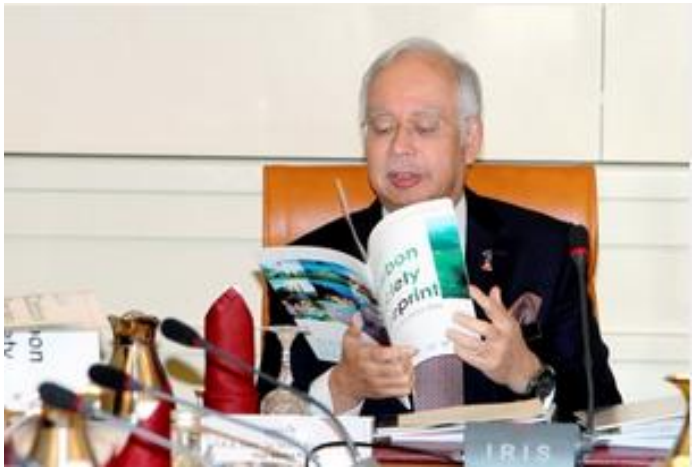
12 Actions Towards Low Carbon Future

Mitigation Options	CO2 Reduction	%
Green Economy	**7,401**	**59%**
Action 1 Integrated Green Transportation	1,916	15%
Action 2 Green Industry	1,085	9%
Action 3 Low Carbon Urban Governance**	-	-
Action 4 Green Building and Construction	1,338	11%
Action 5 Green Energy System and Renewable Energy	3,061	24%
Green Community	**2,557**	**21%**
Action 6 Low Carbon Lifestyle	2,557	21%
Action 7 Community Engagement and Consensus Building**	-	-
Green Environment	**2,510**	**20%**
Action 8 Walkable, Safe and Livable City Design	264	2%
Action 9 Smart Urban Growth	1,214	10%
Action 10 Green and Blue Infrastructure and Rural Resources	620	5%
Action 11 Sustainable Waste Management	412	3%
Action 12 Clean Air Environment**	-	-
Total	12,467**	100%

01 Introduction

After the Low Carbon Society Blueprint – What's Next?





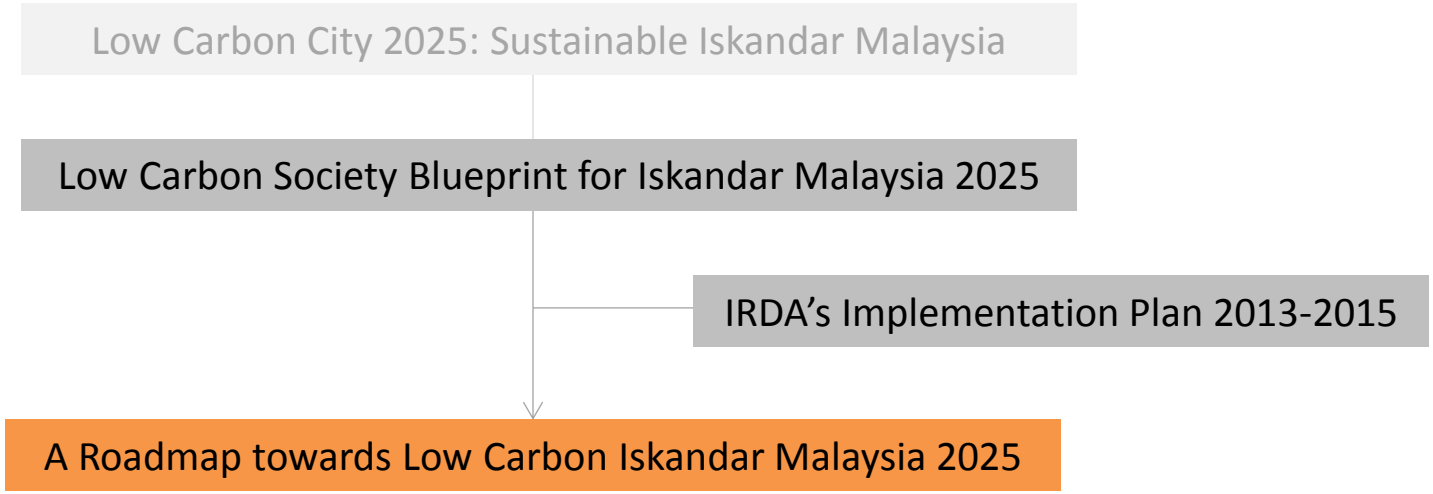
The *Low Carbon Society Blueprint for Iskandar Malaysia 2025*, officially launched by the Prime Minister of Malaysia and adopted by the Iskandar Regional Development Authority (IRDA) in 2012, sets a target for 50% carbon intensity reduction in 2025 as compared to the 2005 level and recommends a total of 283 strategic policies towards minimizing carbon emissions in Iskandar Malaysia (IM).

Taking the blueprint into the implementation phase poses several questions:

Which policies should come first?
How long should the implementation period be?
When should these policies be implemented?
Who are the potential implementation agencies involved with these policies?

01 Introduction

A Roadmap towards Low Carbon Iskandar Malaysia 2025



This roadmap has been formulated to serve as a **complementary document** to the blueprint. It provides **a pathway to guide the implementation of policy** actions proposed in the blueprint by **outlining implementation programmes** according to the **given priority, timeline and related implementation agencies, including the 10 implementation plans that IRDA has identified for 2013-2015 period.**

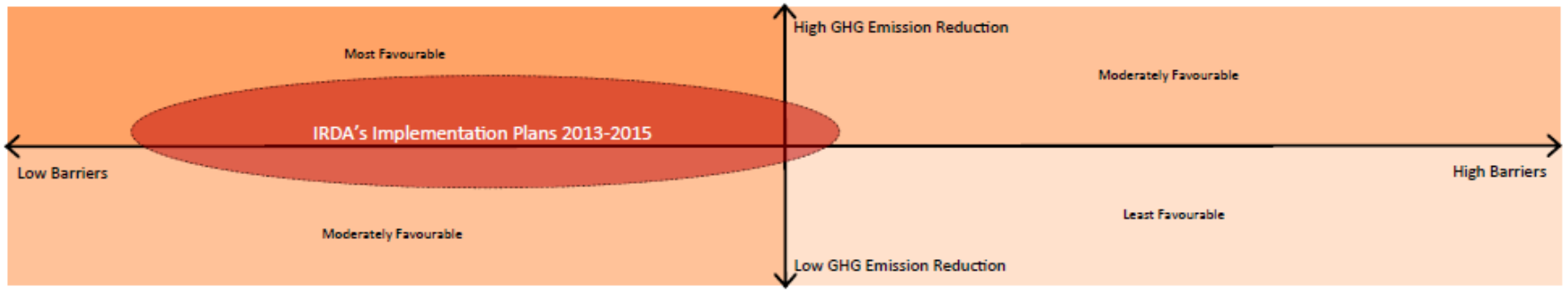
01 Introduction

LCS Blueprint , IRDA's Implementation Plan and LCS Roadmap

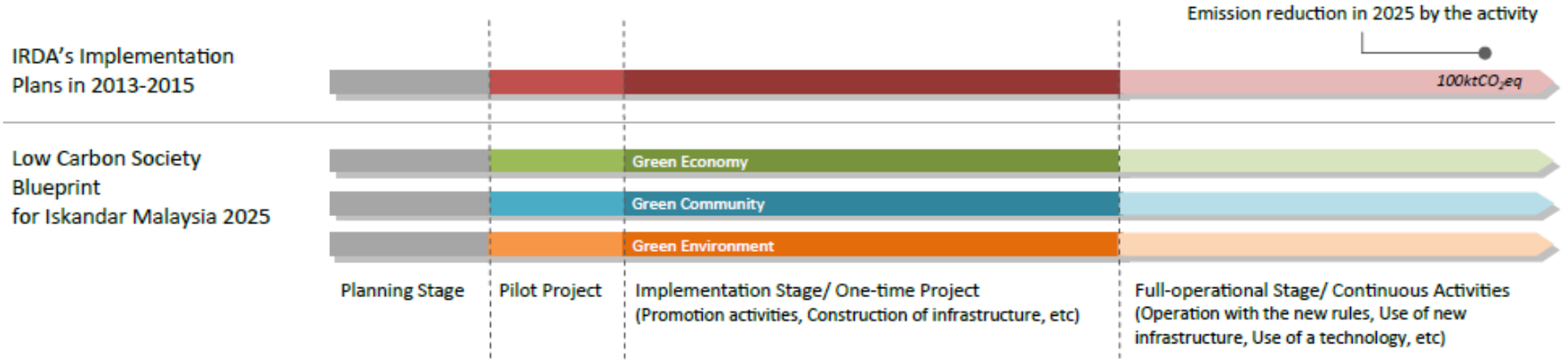
	12 Actions in the *Low Carbon Society Blueprint for Iskandar Malaysia 2025* / IRDA's Implementation Plan 2013-2015	Specific Action-based Projects							Special Projects		
		GI-1 Green Economy Guidelines for IM	GI-2 Portal on Green Technology for Iskandar Malaysia	GB-1 GAIA (Green Accord Initiative Award)	GT-1 Mobility Management System	LL-1 Eco-Life Challenge Schools Project	RR-1 Trees for Urban Parks/ Forests	RR-7 Responsible Tourism and Biodiversity Conservation	Bukit Batu Eco-Community	Low Carbon Village Felda Taib Andak	*Nafas Baru* Pasir Gudang - Clean and Healthy City
Green Economy	Action 1 Integrated Green Transportation (GT)				●				○		○
	Action 2 Green Industry (GI)	●	●								
	Action 3 Low Carbon Urban Governance (LG)										
	Action 4 Green Building and Construction (GB)			●							
	Action 5 Green Energy System and Renewable Energy (GE)			●					○		
Green Community	Action 6 Low Carbon Lifestyle (LL)					●			○	○	○
	Action 7 Community Engagement and Consensus Building (CC)										
Green Environment	Action 8 Walkable, Safe and Livable City Design (WC)										
	Action 9 Smart Urban Growth (SG)										
	Action 10 Green and Blue Infrastructure and Rural Resources (RR)						●	●		○	
	Action 11 Sustainable Waste Management (WM)								○		○
	Action 12 Clean Air Environment (CA)								○	○	○

01 Introduction

Rationales & Guide to Reading Timeline Diagram

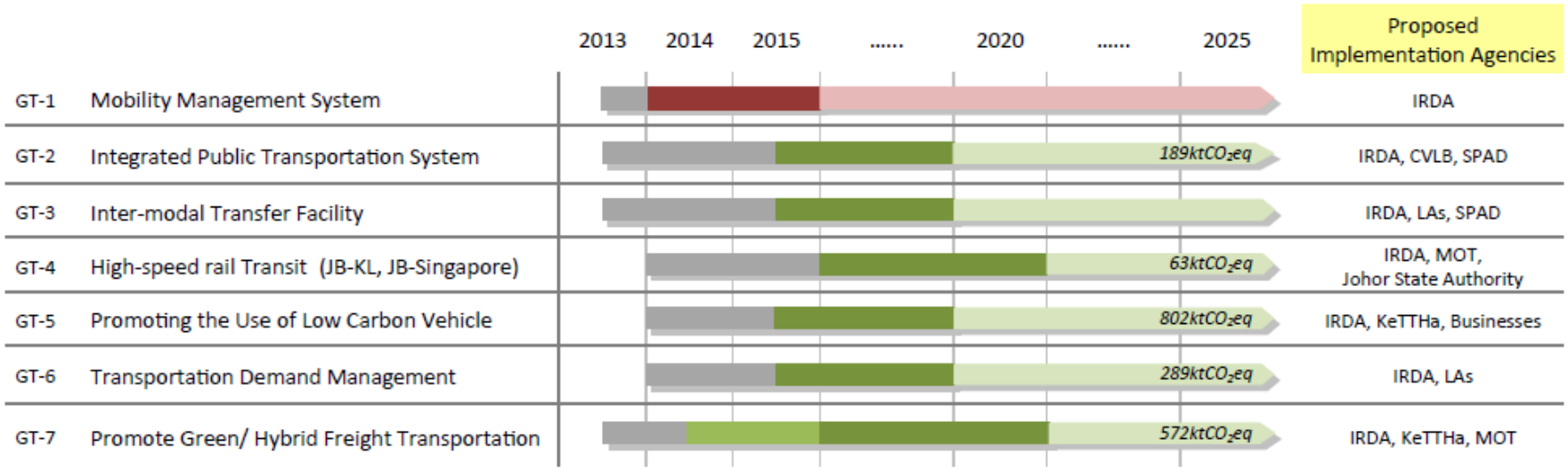


A good roadmap is characterized by well justified phasing of projects. Priority projects would be those that have relatively low barriers but high GHG reduction impacts (see diagram). Implementation barriers include cost, human capital, institution and legislation framework, societies readiness (stakeholder acceptance) and technology availability.



02 A Roadmap towards Low Carbon Iskandar Malaysia

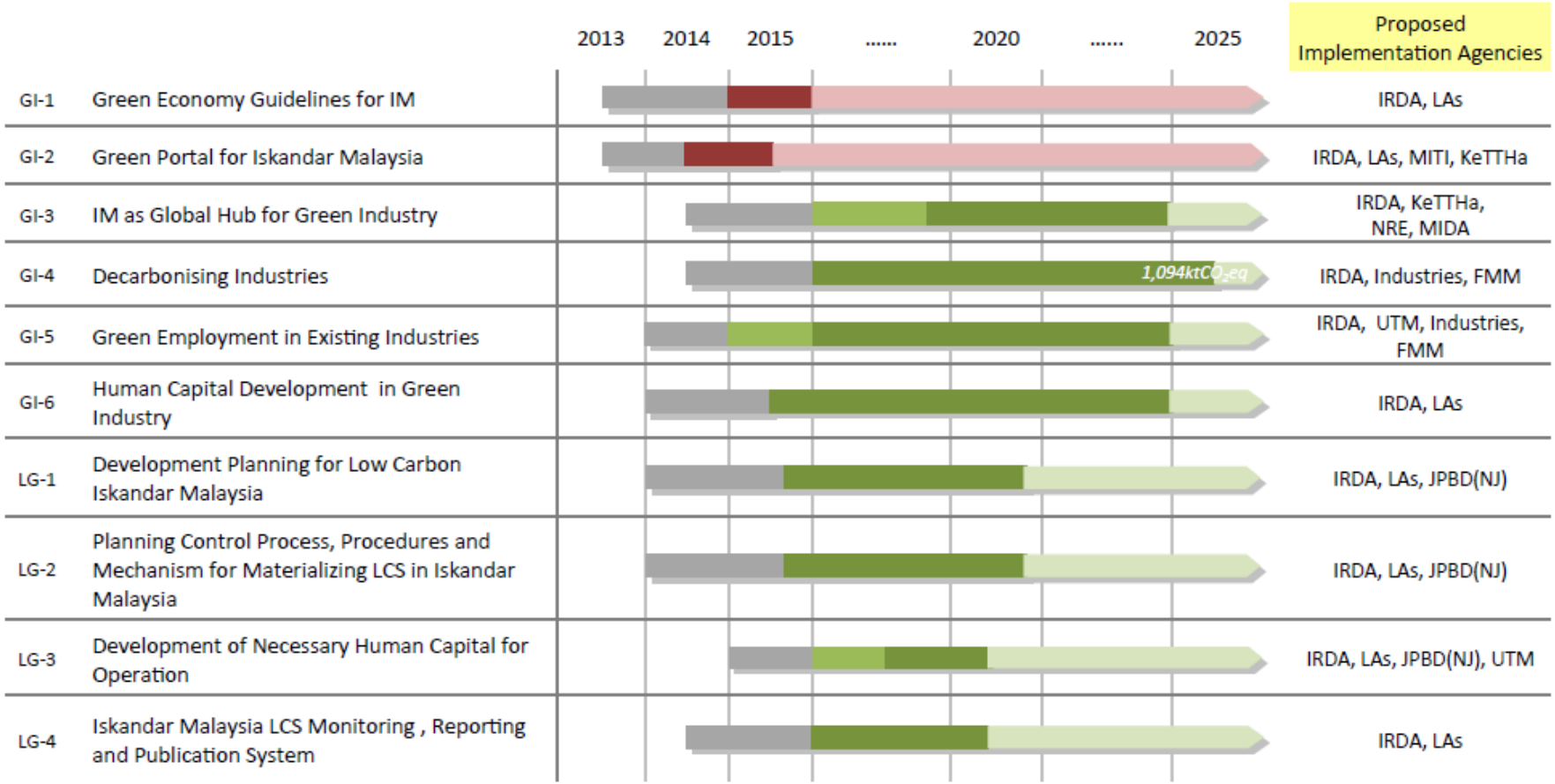
Green Transportation (GT)



Action 1 “Green Transportation” (GT) and Mobility Management System (GT-1), IRDA’s Implementation Plan are covered.

02 A Roadmap towards Low Carbon Iskandar Malaysia

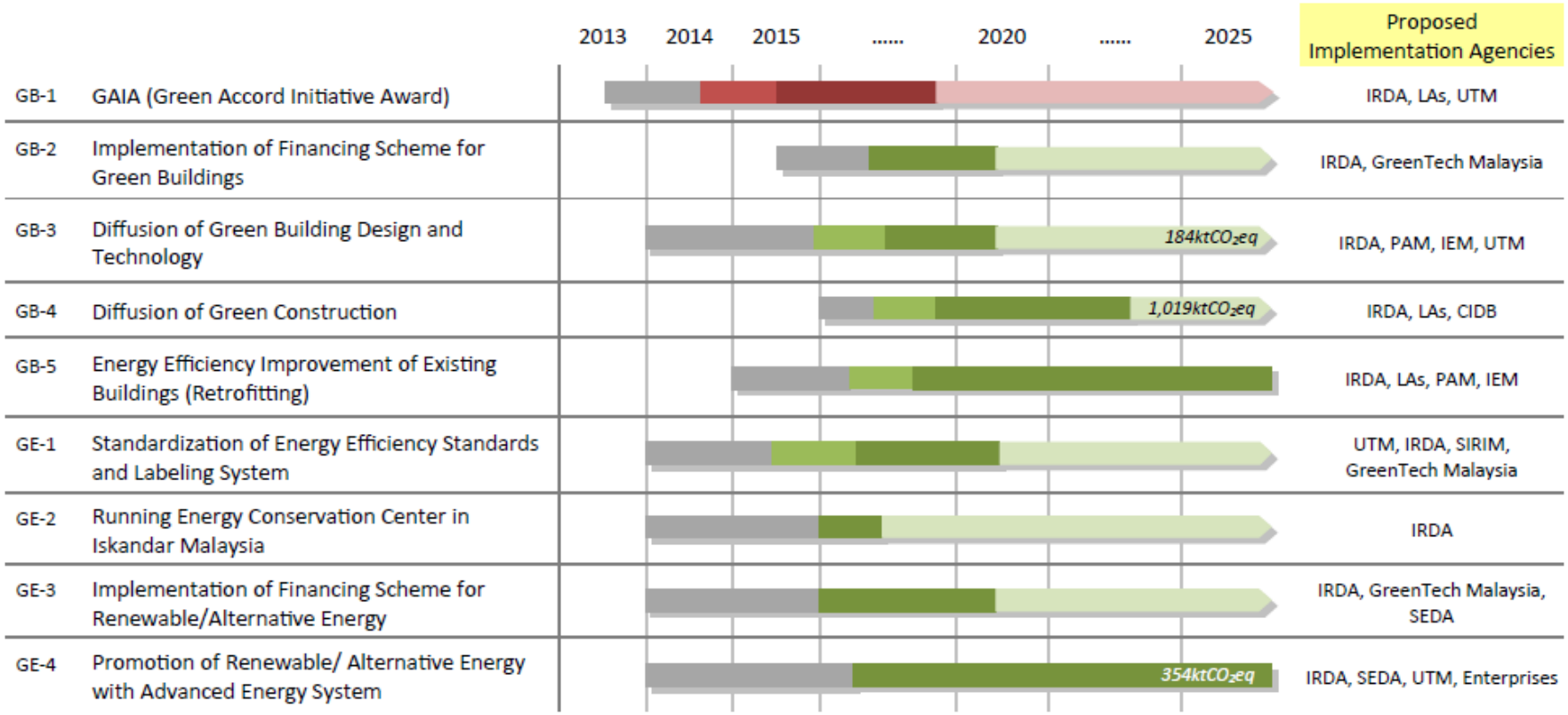
Green Industry and Low Carbon Urban Governance (GI, GL)



Action 2 “Green Industry” (GI) and Action 3 “Low Carbon Urban Governance” (LG), IRDA’s Implementation Plans; Green Economy Guidelines for IM (GI-1) and Green Portal for Iskandar Malaysia (GI-2) are covered.

02 A Roadmap towards Low Carbon Iskandar Malaysia

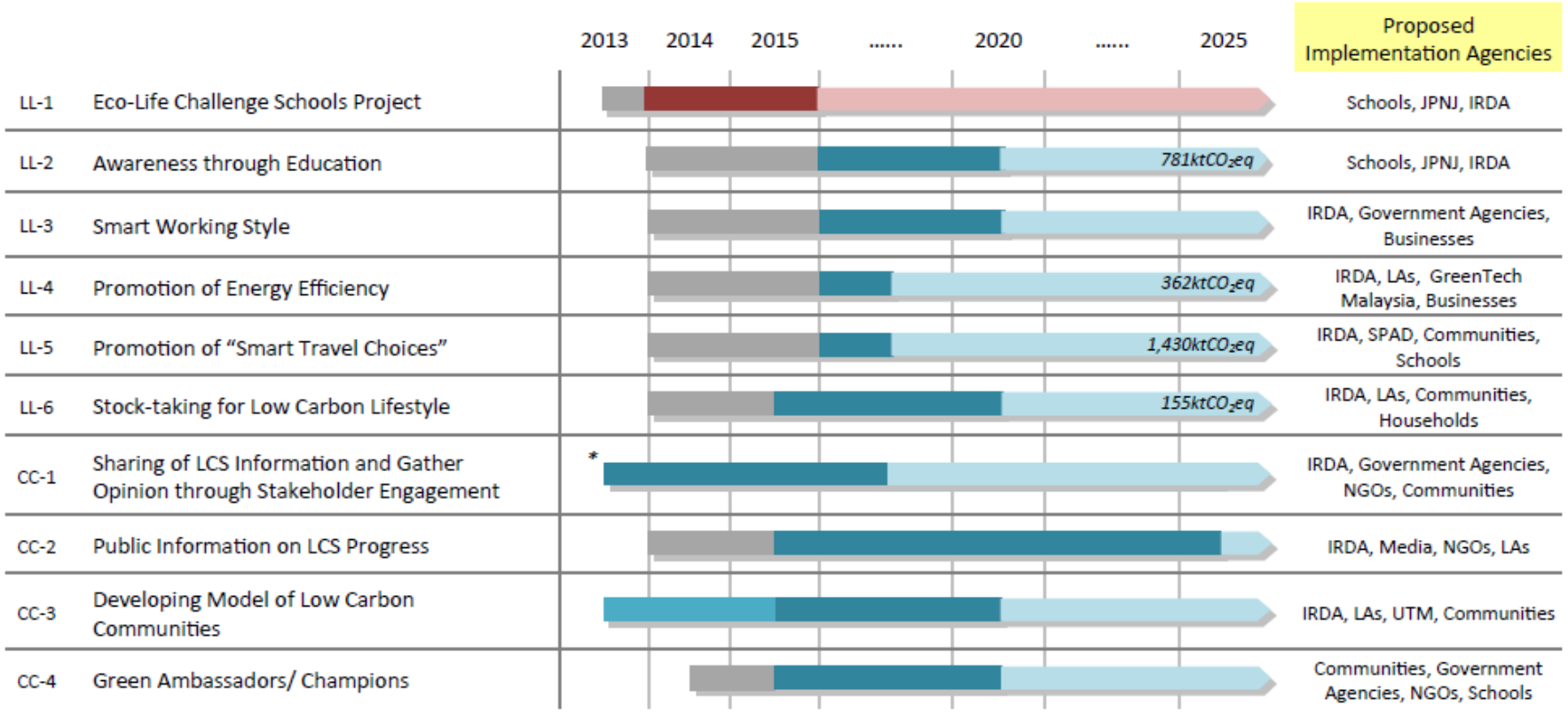
Green Building and Energy System (GB, GE)



This section describes implementation of Action 4 “Green Building and Construction” (GB) and Action 5 “Green Energy System and Renewa-ble Energy” (GE) with IRDA’s implementation plan of GAIA (Green Accord Initiative Award) (GB-1).

02 A Roadmap towards Low Carbon Iskandar Malaysia

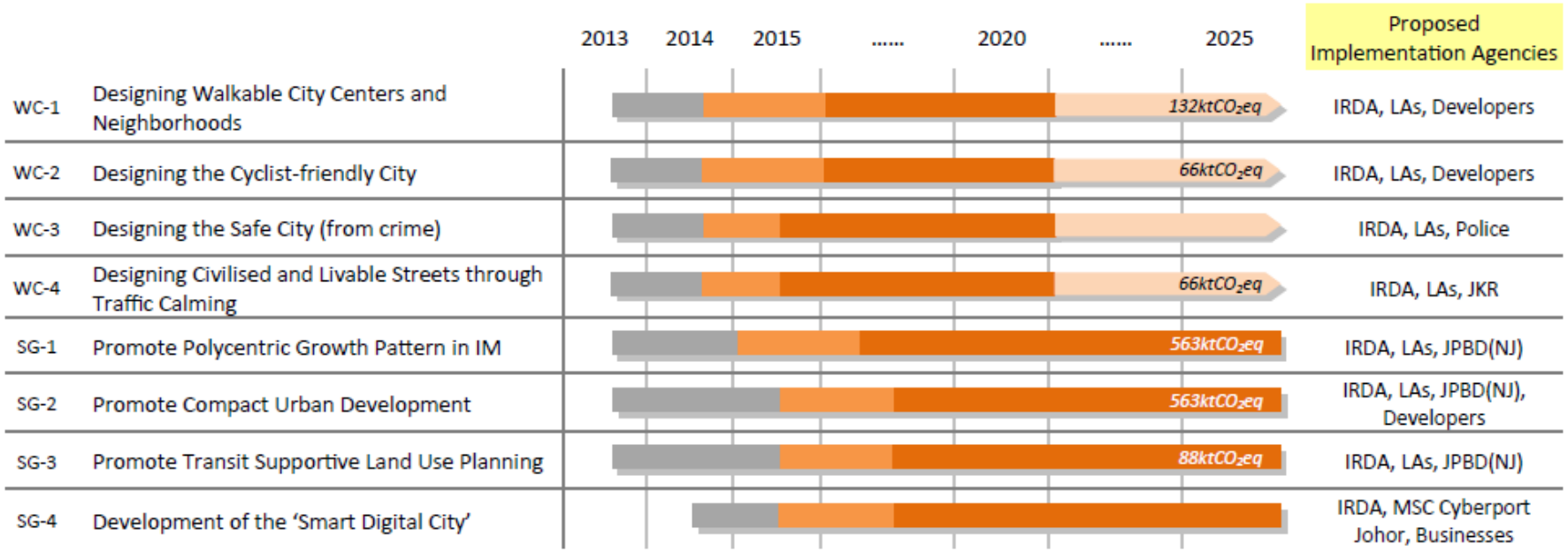
Green Community (LL, CC)



This section describes implementation of Action 6 "Low Carbon Lifestyle" (LL) and Action 7 "Community Engagement and Consensus Building" (CC) with IRDA's Implementation Plan, Eco-Life Challenge Schools Project (LL-1).

02 A Roadmap towards Low Carbon Iskandar Malaysia

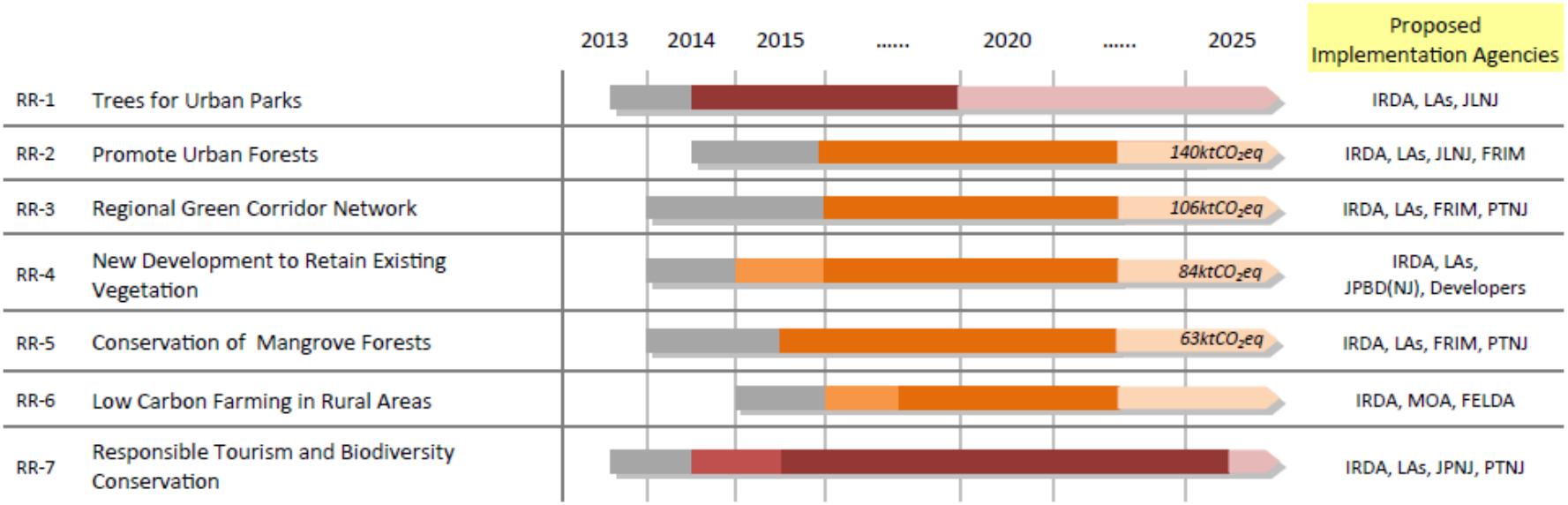
Green Urban Design (WC, SG)



Action 8 "Walkable, Safe and Livable City Design" (WC) and Action 9 "Smart Urban Growth" (SG) are covered.

02 A Roadmap towards Low Carbon Iskandar Malaysia

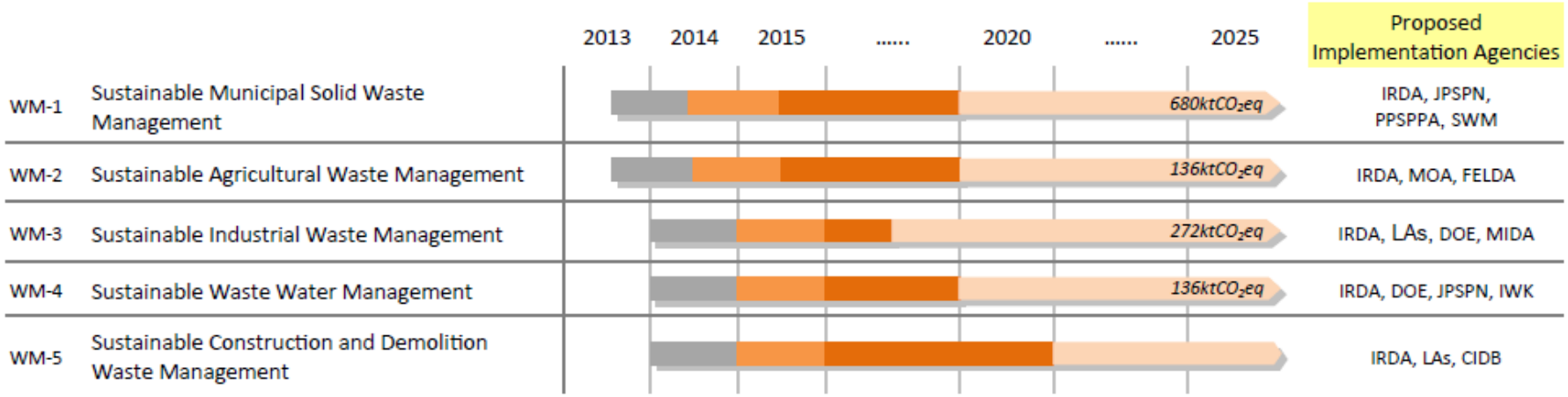
Green and Blue Infrastructure & Responsible Tourism (WC, SG)



This section describes implementation of Action 10 “Green and Blue Infrastructure and Rural Resources” (RR) with IRDA’s Implementation Plans; Trees for Urban Parks (RR-1) and Responsible Tourism and Biodiversity Conservation (RR-7).

02 A Roadmap towards Low Carbon Iskandar Malaysia

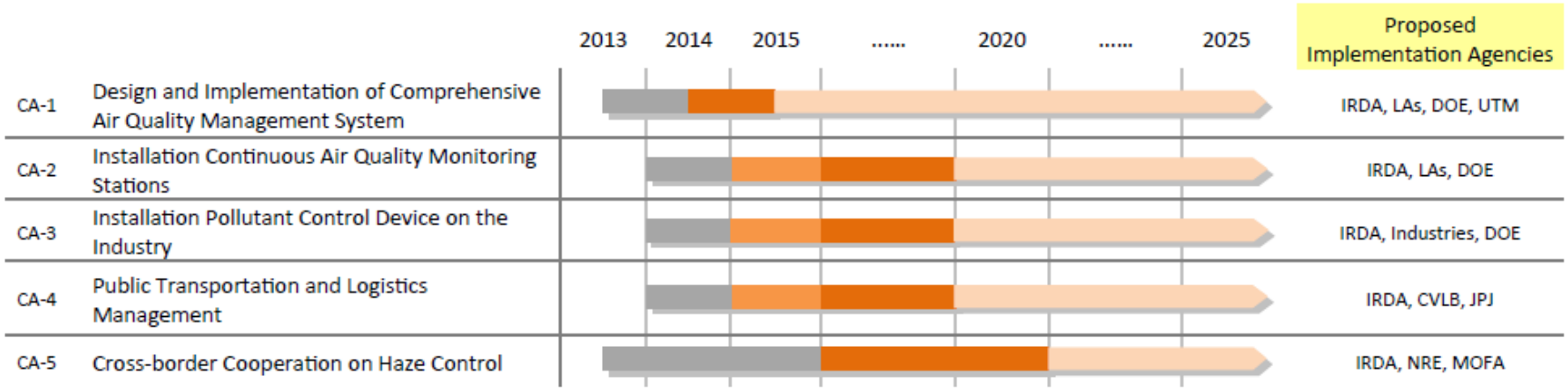
Sustainable Waste Management (WM)



This section covers Action 11 “Sustainable Waste Management” (WM) that includes five sub-actions which cover waste from five different sectors - municipal (household and commercial), agriculture, industry, waste water, and construction and demolition.

02 A Roadmap towards Low Carbon Iskandar Malaysia

Clean Air Environment (CA)



Action 12 “Clean Air Environment” (CA) is covered. The main contents are establishment of comprehensive air quality management system, installation of air quality monitoring station and pollutant emission control device in the industry sector. Green passenger and freight transportation are also considered. Cross-border cooperation to avoid regional haze pollution from open biomass burning is tightened.

Launching of the Iskandar Malaysia:
Actions for a Low Carbon Future

ISKANDAR REGIONAL DEVELOPMENT AUTHORITY

Malaysia Launching: 06 Nov 2013 at Parliament
Global launching: 15 November 2013, COP19 Warsaw Poland

05 Conclusion

The Way Forward

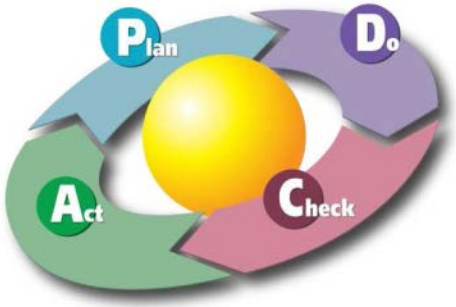
Quantification from LCS modeling assist **better understanding** on impact of proposed actions, sub actions and programs.

Good **baseline study, consensus building and low carbon blueprint plan** will help to develop an **integrated climate resilient , Low carbon framework** for a city or region.

Green cities or Local carbon cities need to have a **LOW CARBON SOCIETIES mindset**/ behavior and **Joint effort** between different professions (Planners, architect, engineer and related environmental profession)

Important to have a Asian (eg IGES & AIM workshop) **and International platform** for **research collaboration** between researchers in LCS as well as **capacity building opportunities.**

Explore PDCA cycle for LCS implementation



03 The Way Forward

Future Plan

As the present roadmap is a preliminary work, most of them are in need for further studies to complete full report of LCS Roadmap. (E.g. specific programmes, timeline, GHG emission reduction by program, implementation agencies, stakeholders, etc.)

Detail works by every research group for the full report LCS roadmap:

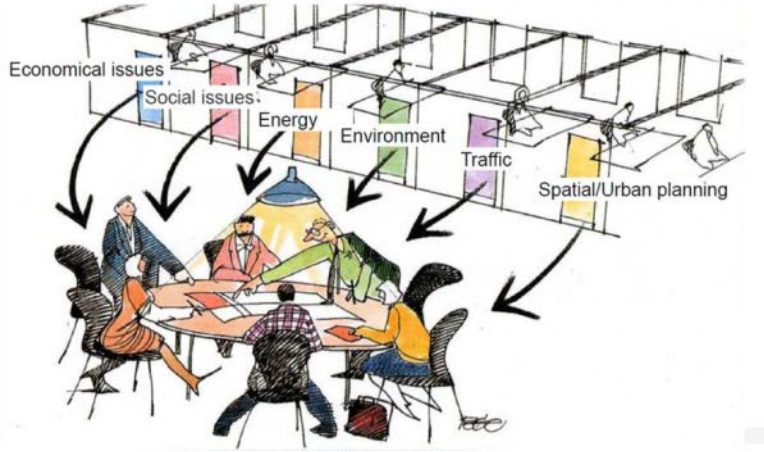
i. Scenario integration and Land Use Planning
_ Green Industry (GI), Low Carbon Urban Governance (LG), Green Building (GB), Green Urban Design (WC, SG)

ii. Consensus Building and Education
_Green Community (LL, CC)

iii. Energy System
_Green Energy System (GE)

iv. Solid Waste Management
_Sustainable Waste Management (WM)

v. Air Quality and Transportation
_Green Transportation (GT), Clean Air Environment (CA)



Developing Malaysia LCS vision in 2020 and 2030 for Energy, Waste and AFOLU sectors

Unversiti Teknologi Malaysia
Ho Chin Siong

Kyoto University, Japan
Yuzuru MATSUOKA
Kei GOMI
Janice Simson
Yuri HAYASHI
Phubalan Karunakaran

National Institute for Environmental Studies, Japan
Mikiko KAINUMA
Junichi FUJINO
Shuichi ASHINA
Tomoko HASEGAWA
Maiko SUDA
Miho KAMEI

Approach/Methodology

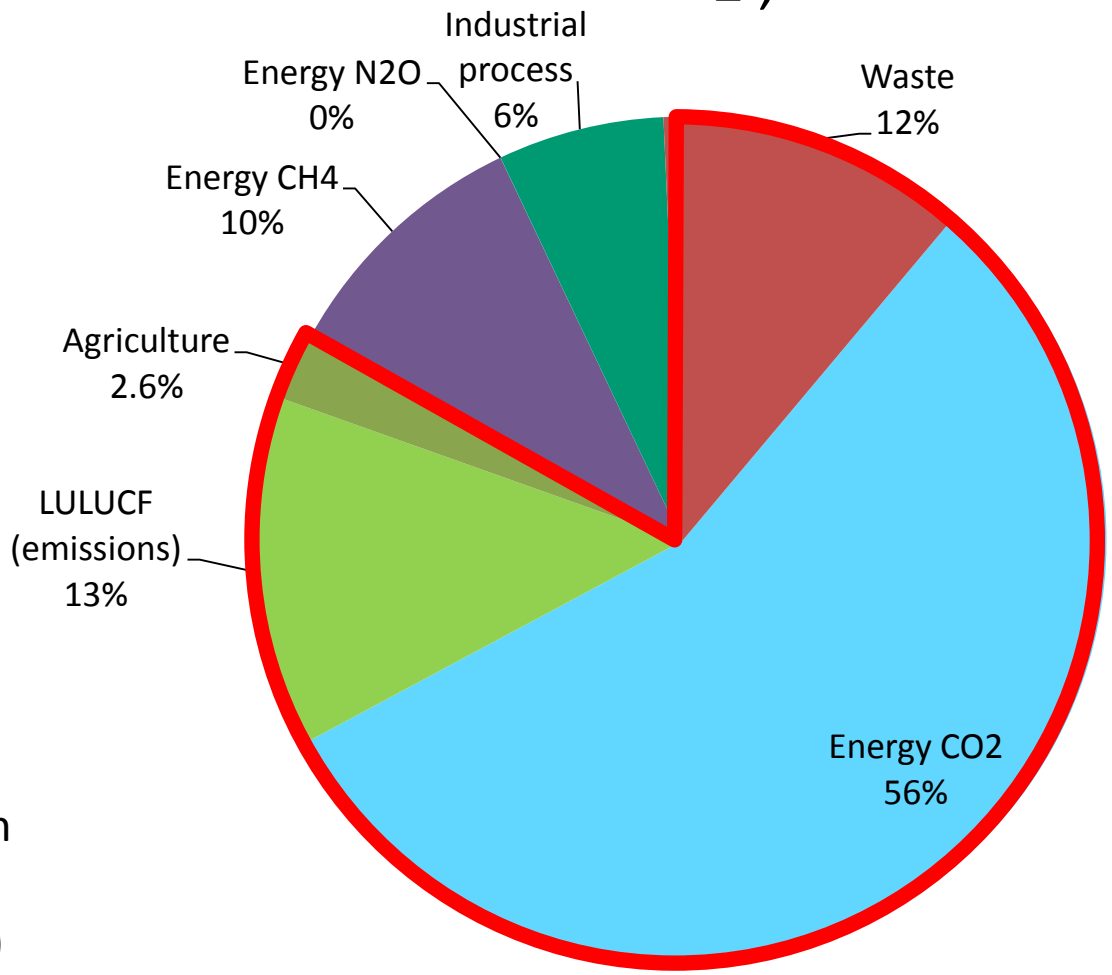
- Main Findings are based on **quantitative estimation tools - Extended Snapshot Tool (ExSS) and AFOLU model.**

- Major assumption and data are based on **Malaysia Second National Communication (NC2) 2011** submitted to the UNFCCC

- Two mitigation scenarios were developed: CM1 and CM2

- Research Findings adopted **Low-carbon society (LCS) scenario in 2020** and supported with **more quantitative socio-economic scenarios and mitigation option details.**

Target gas: Energy CO_2 , Waste, AFOLU



Covers 84% of total emissions in 2000

GHG Emission Composition in 2000 (Source : NC2)

CONTENT

Part I: Socio-economic scenario in 2020 and 2030

Part II: Energy

Part III: Waste

Part IV: Agriculture, forestry and other land use

Part V: Integration

Part I: Socio-economic scenario

Procedure

1. Data collection & estimation in the base year (2005)

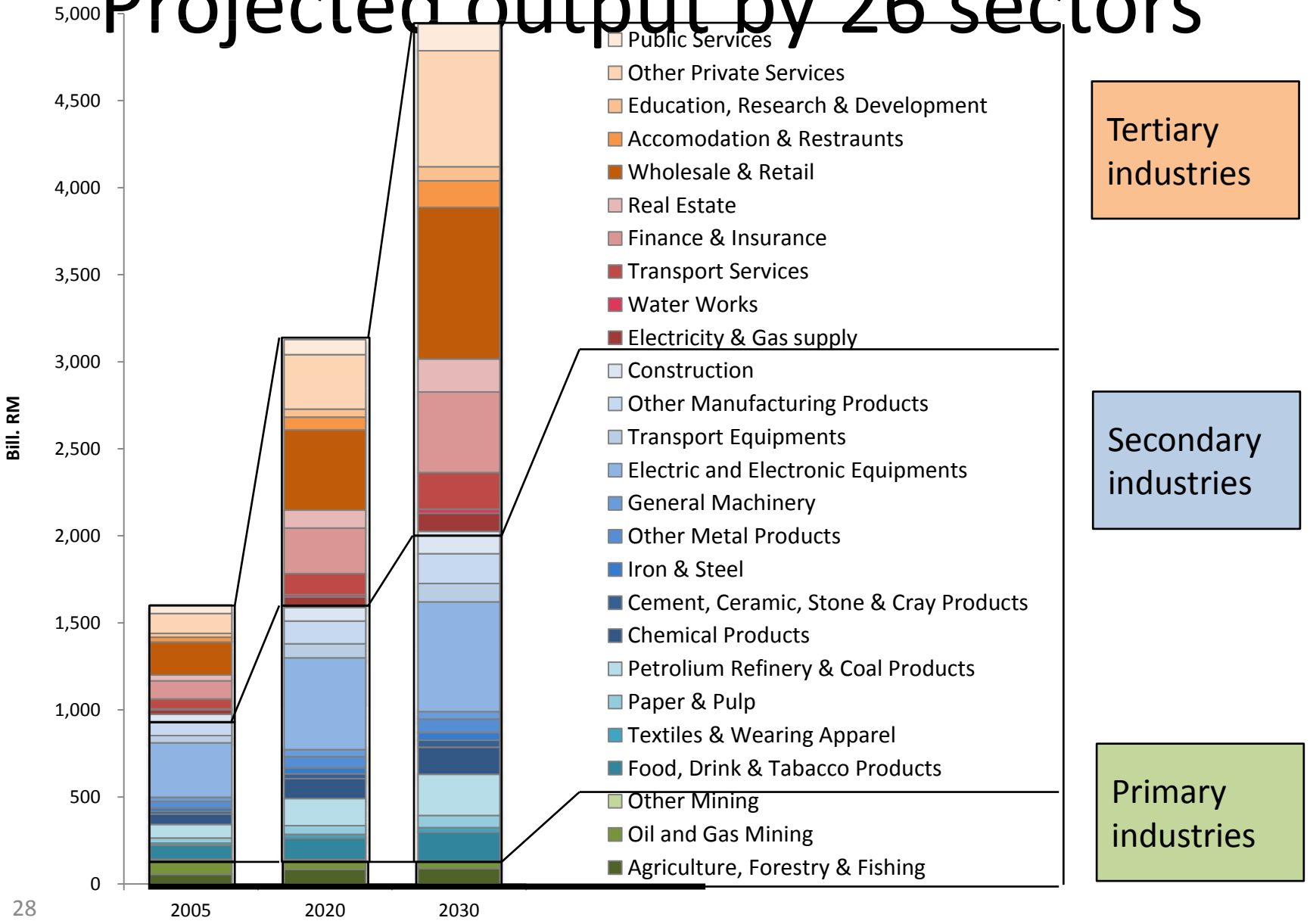
2. Construct future socio-economic scenario in 2020 based on the New Economic Model (NEM) and NC2 using ExSS

3. Construct future socio-economic scenario in 2030 based on extrapolation of the scenario in 2020 and UN population projections using ExSS

Results of main variables

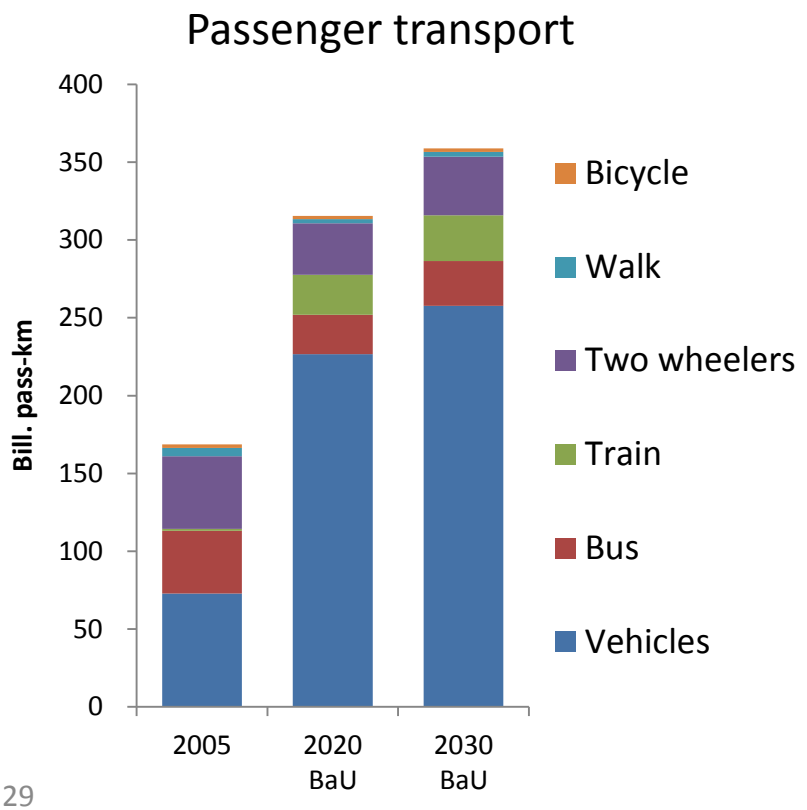
	2005	2020	2030	2020 /2005	2030 /2005	
Population	26.1	32.8	37.3	1.3	1.4	Million
Household	5.8	8.2	9.3	1.4	1.6	Million
GDP	509	996	1,601	2.0	3.1	Bill. RM
Per capita GDP	19.5	30.4	43.0	1.6	2.2	1000.RM
Gross output	1,604	3,135	4,929	2.0	3.1	Bill. RM
Primary	55	84	97	1.5	1.8	
Secondary	920	1,507	2,175	1.6	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

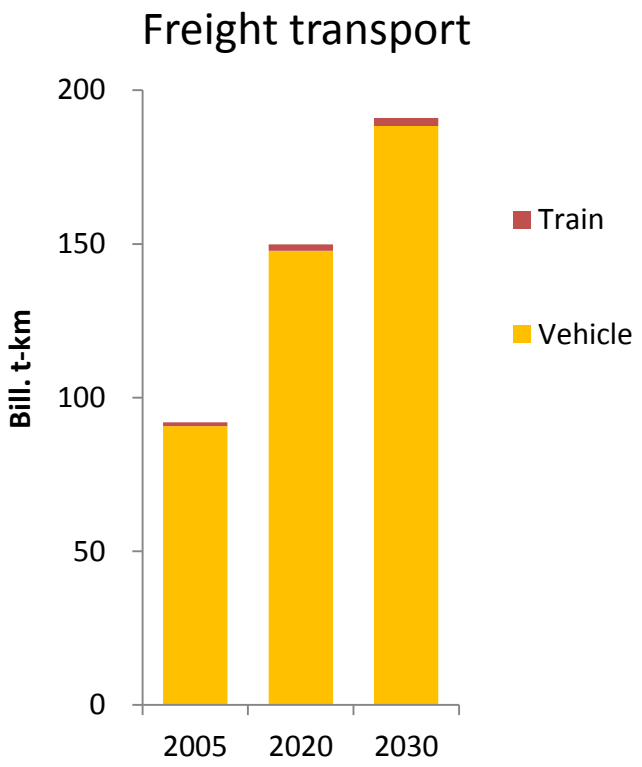
Projected output by 26 sectors



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**





Part II: Energy demand and CO_2 emissions

Procedure

1. Data collection of energy demand and supply

2. To project 2020BaU (Business as usual) energy demand and CO_2 emissions based on assumptions in NC2

3. To develop 2 mitigation scenarios

   CM1: With mitigation options outlined in NC2 and additional options

   CM2 : With more intensive introduction of mitigation options than CM2 which achieves -40% target in 2020

4. To develop 2030BaU and 2030CM1, 2030CM2 scenarios as extension of 2020 scenarios

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%

Mitigation options (2)

Renewable energy of power supply in CM scenarios

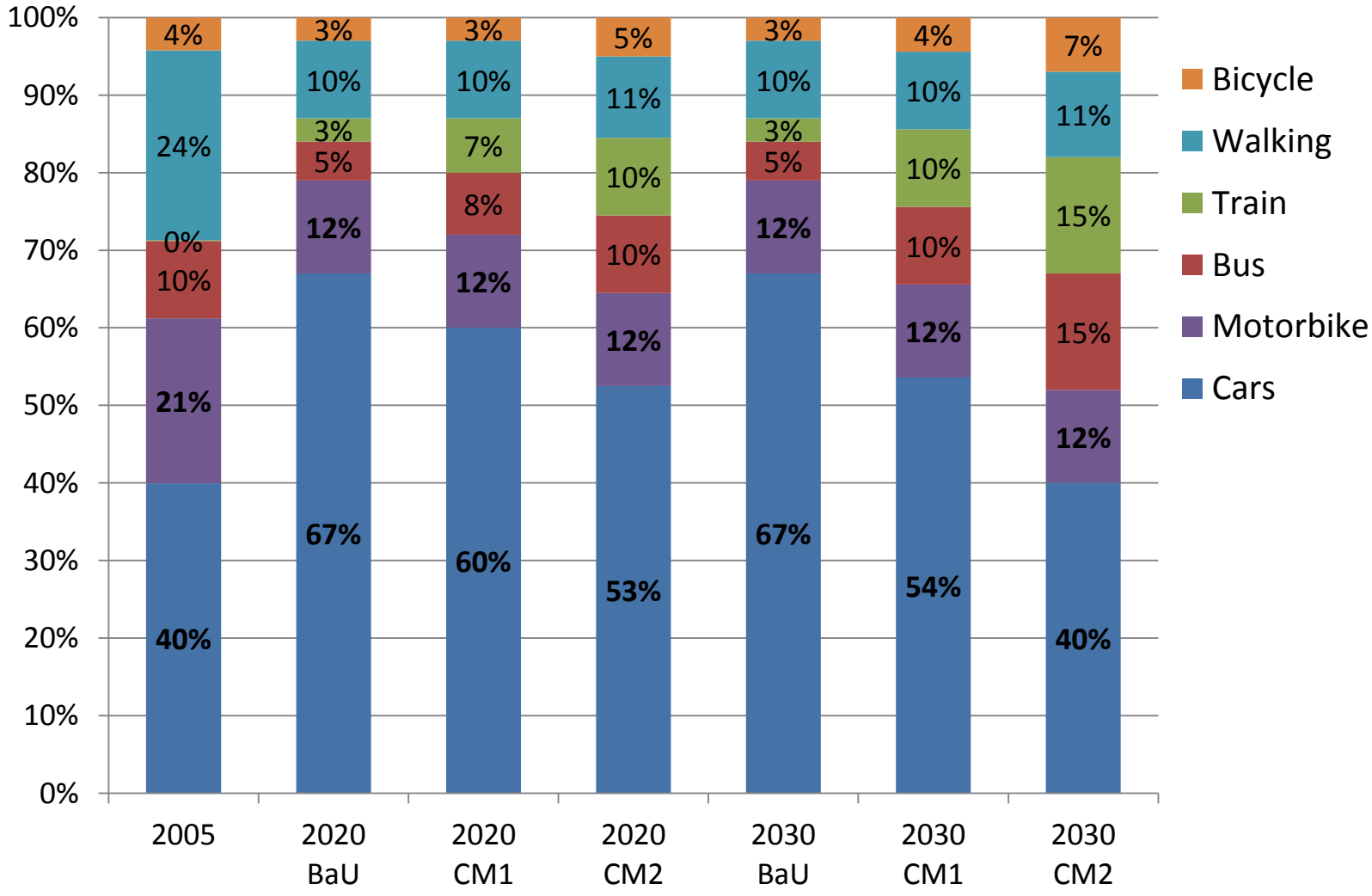
		Biomass	Biogas	Mini-hydro	Solar PV	Solid Waste	Total
CM1	2020	800	240	490	190	360	2080
	2030	1600	480	980	380	720	4160
CM2	2020	1600	480	980	380	720	4160
	2030	4000	1200	2450	950	1800	10400

Share of bio diesel in transport fuel

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

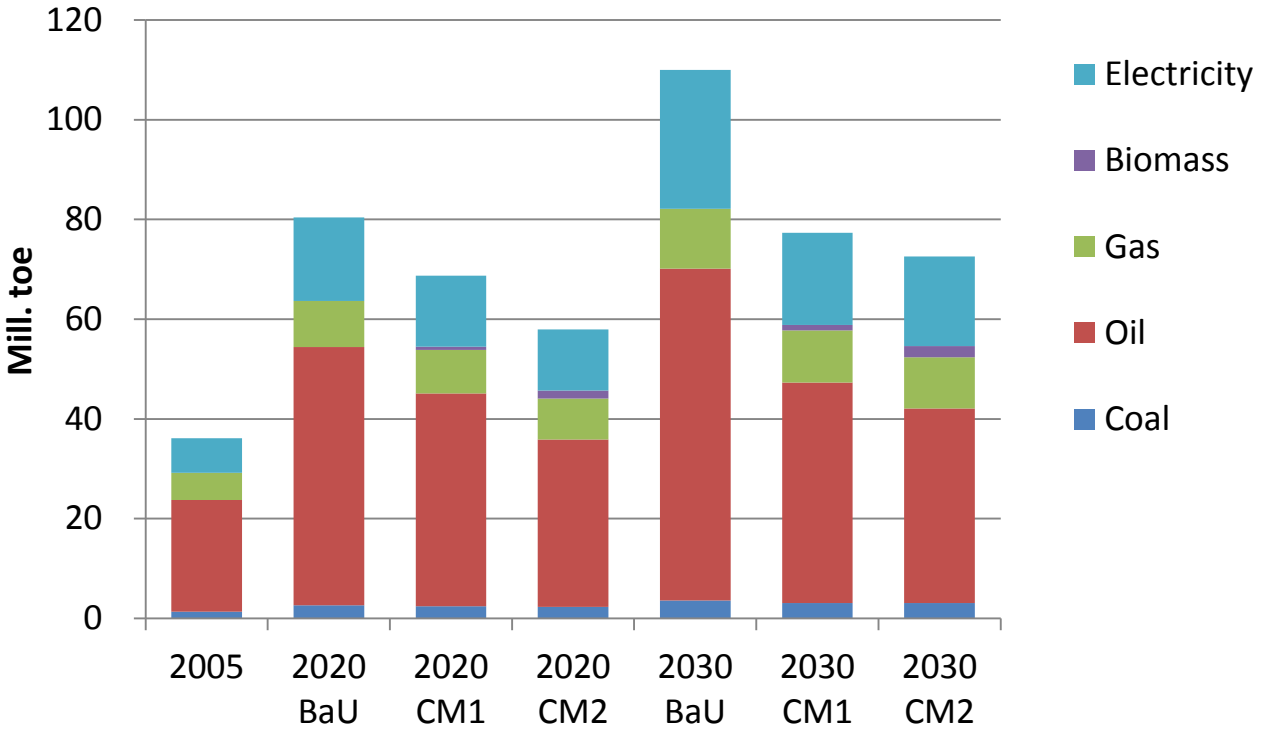
Mitigation options (3)

Modal share of passenger transport



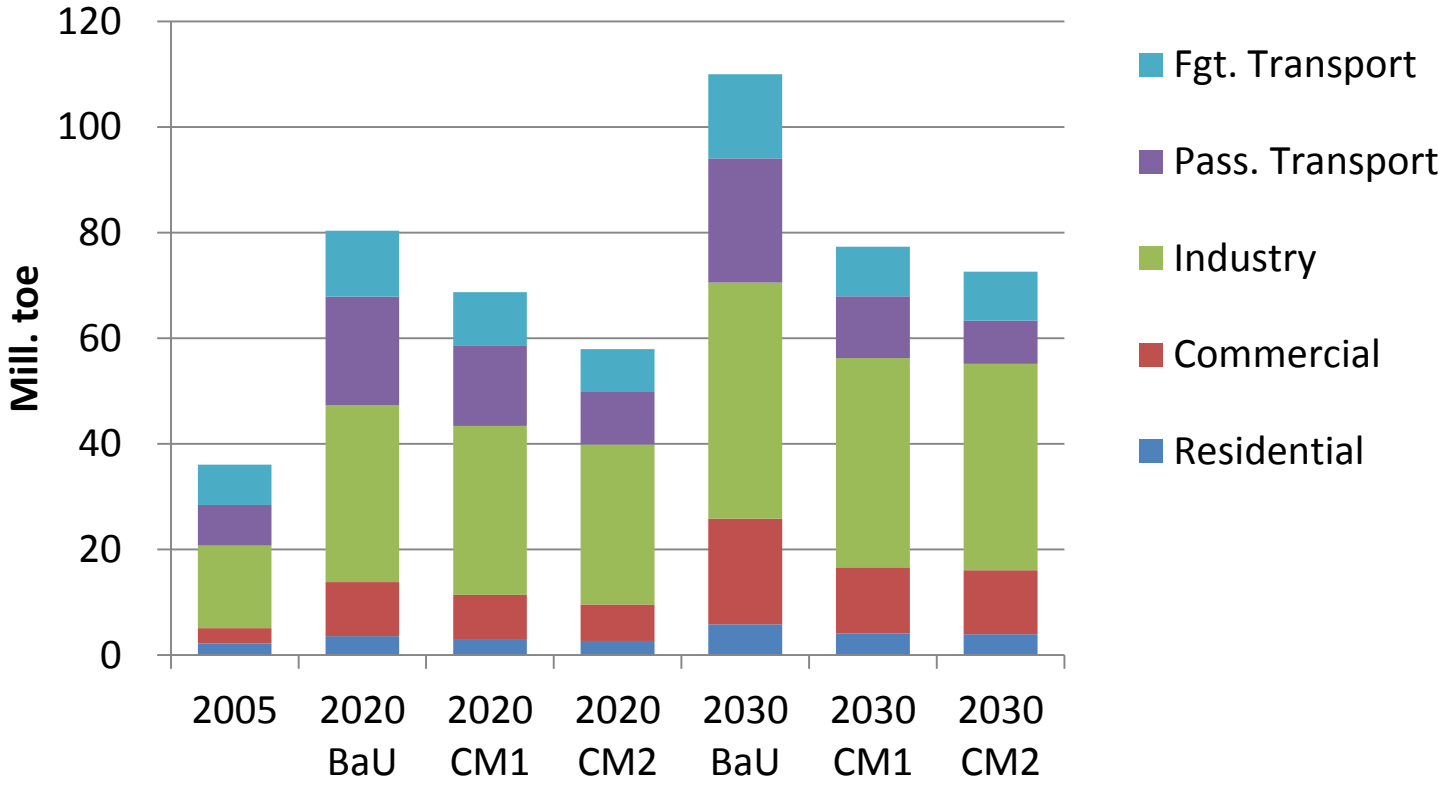
Projected final energy demand by fuels

- 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.



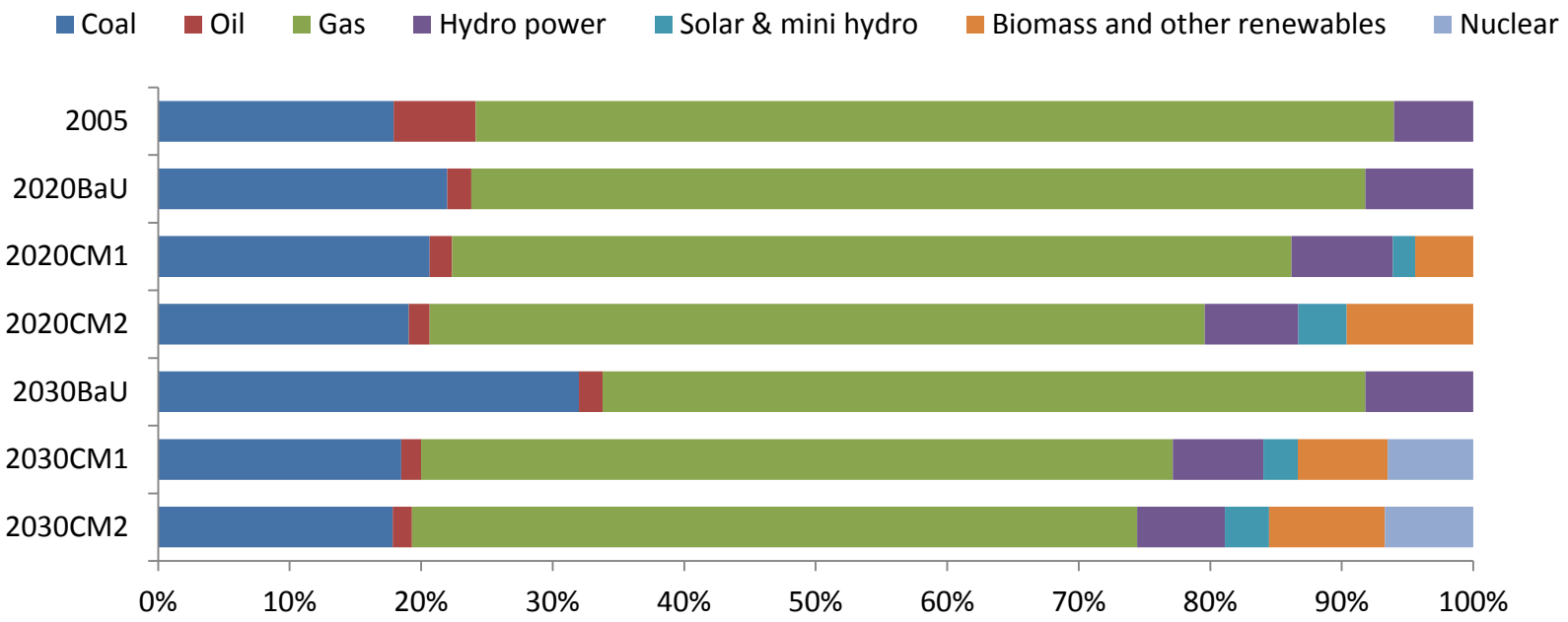
Projected final energy demand by sectors

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



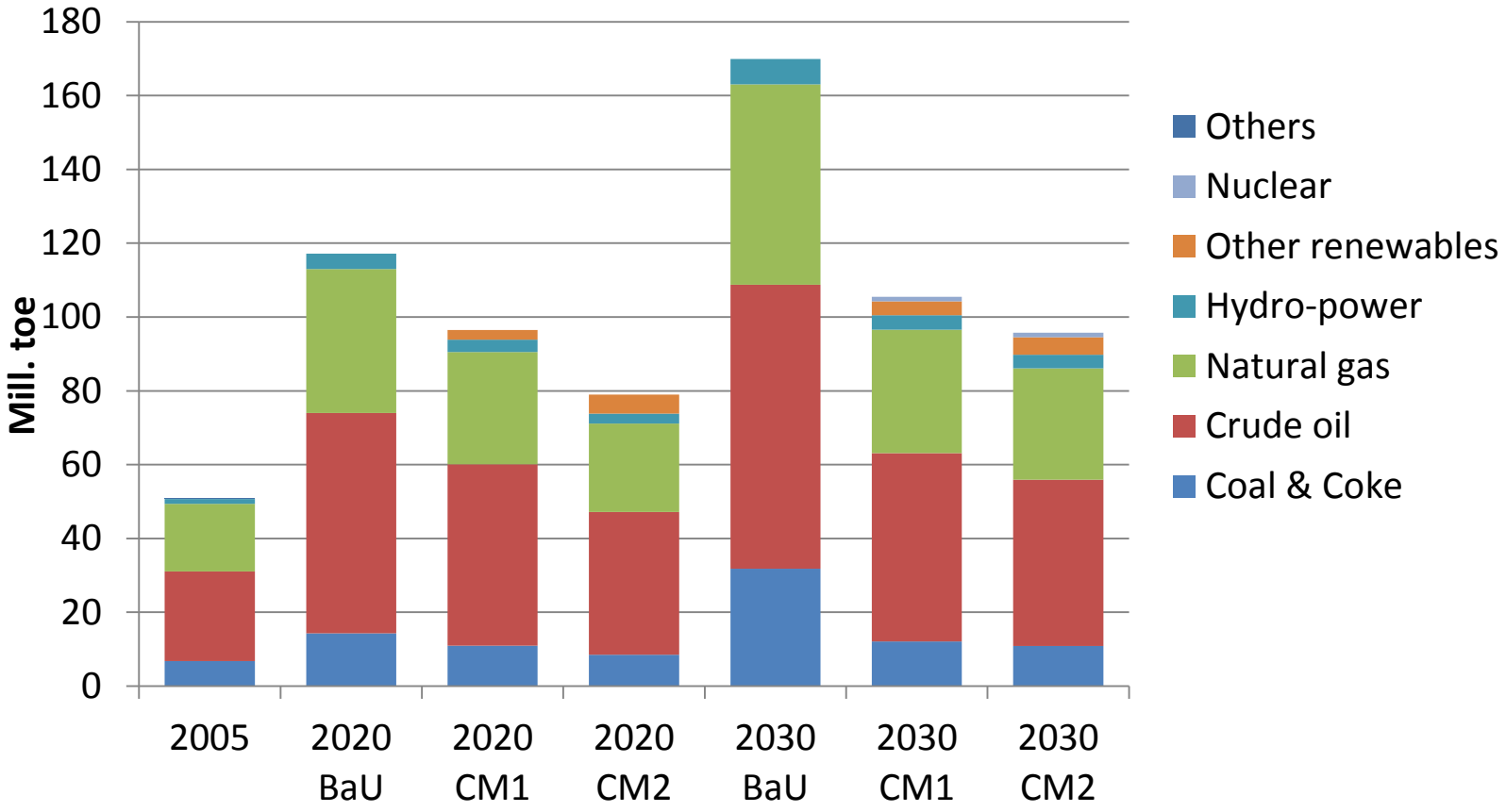
Projected energy mix of power supply

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



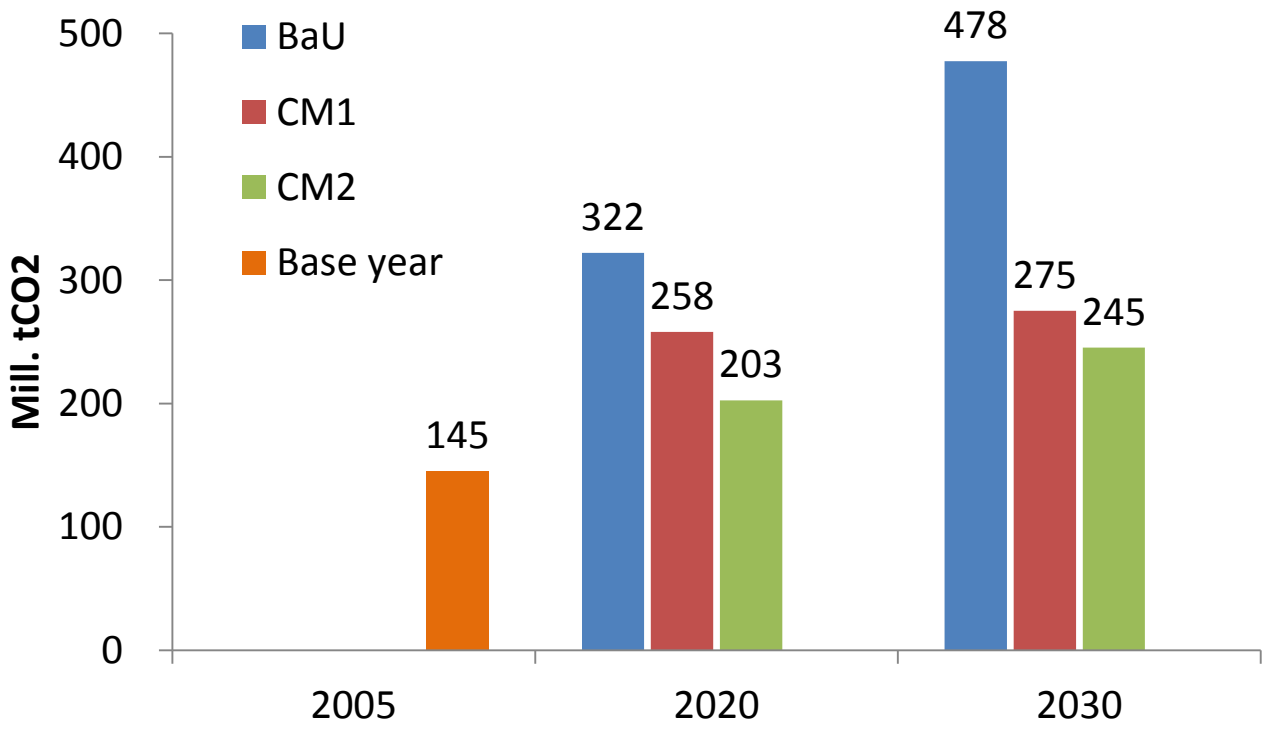
Projected primary energy supply

- In 2030BaU, total **primary energy supply** increased more than **3 times of 2005**
- Most of the fuels are increased proportionally



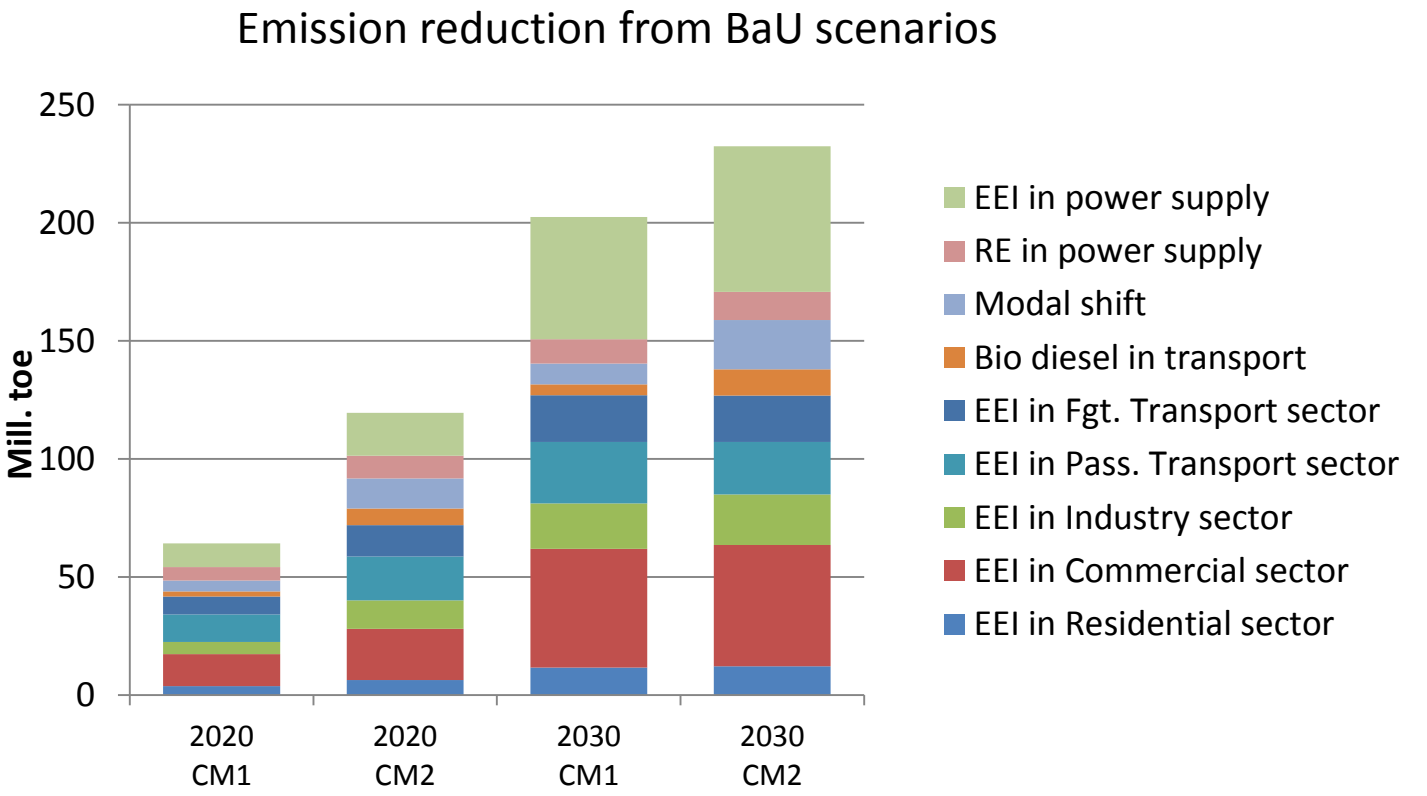
Projected CO_2 emissions

- In 2020BaU, CO_2 emission doubled from 2005, and tripled in 2030BaU.
- In CM1 scenario, it was reduced by 20% and 42% from BaU scenarios.
- In CM2 scenario, it was reduced by 42% and 49% 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

Part III: Waste

Procedure

1. Data collection of waste generation and parameters in 1970-2005

2. Projecting waste generation in BaU scenario and GHG emissions in 2005-2030

3. Developing two countermeasure scenario (CM1 and CM2) with mitigation options outlined in NC2

Scope

- Solid waste (SW) management
  - CH_4 emission from landfill
  - CO_2 emission from incineration of fossil carbon
- Waste water
  - CH_4 emission from palm oil mill effluent (POME)

Assumptions of SW generation

- Since NC2 give waste generation in several years* from 2000 to 2020, it was extended for 1970 to 2030.

  *2001,2005,2007,2020

- 1970 to 1999: Based on reported value of MSW generation and composition in Malaysia.

- 2021 to 2030:
  - Municipal solid waste of residential sector: Extrapolation of per capita waste generation using linear regression from 2000 to 2010
  - Municipal solid waste of commercial sector and Industrial waste: Assuming same per output generation and

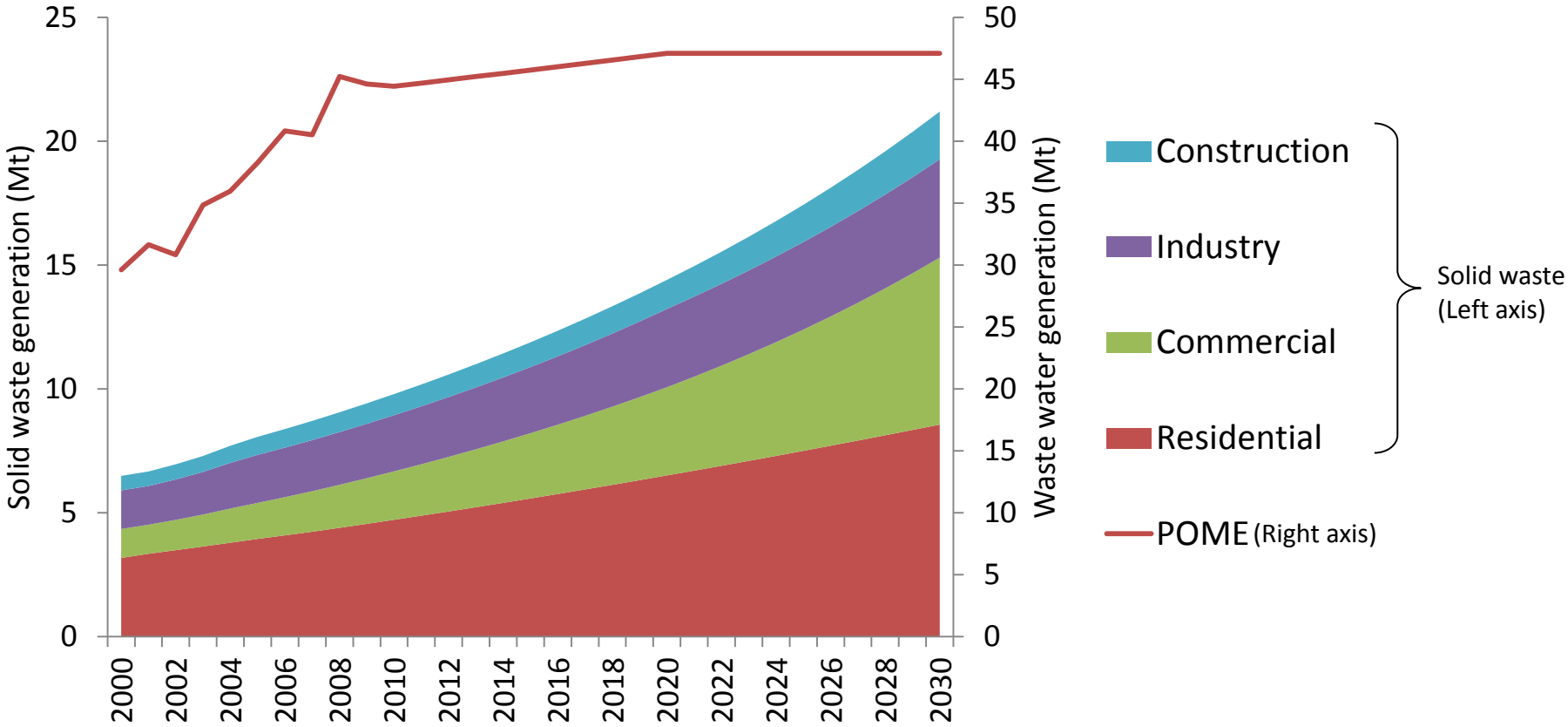
Scenarios and Mitigation options

- **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%

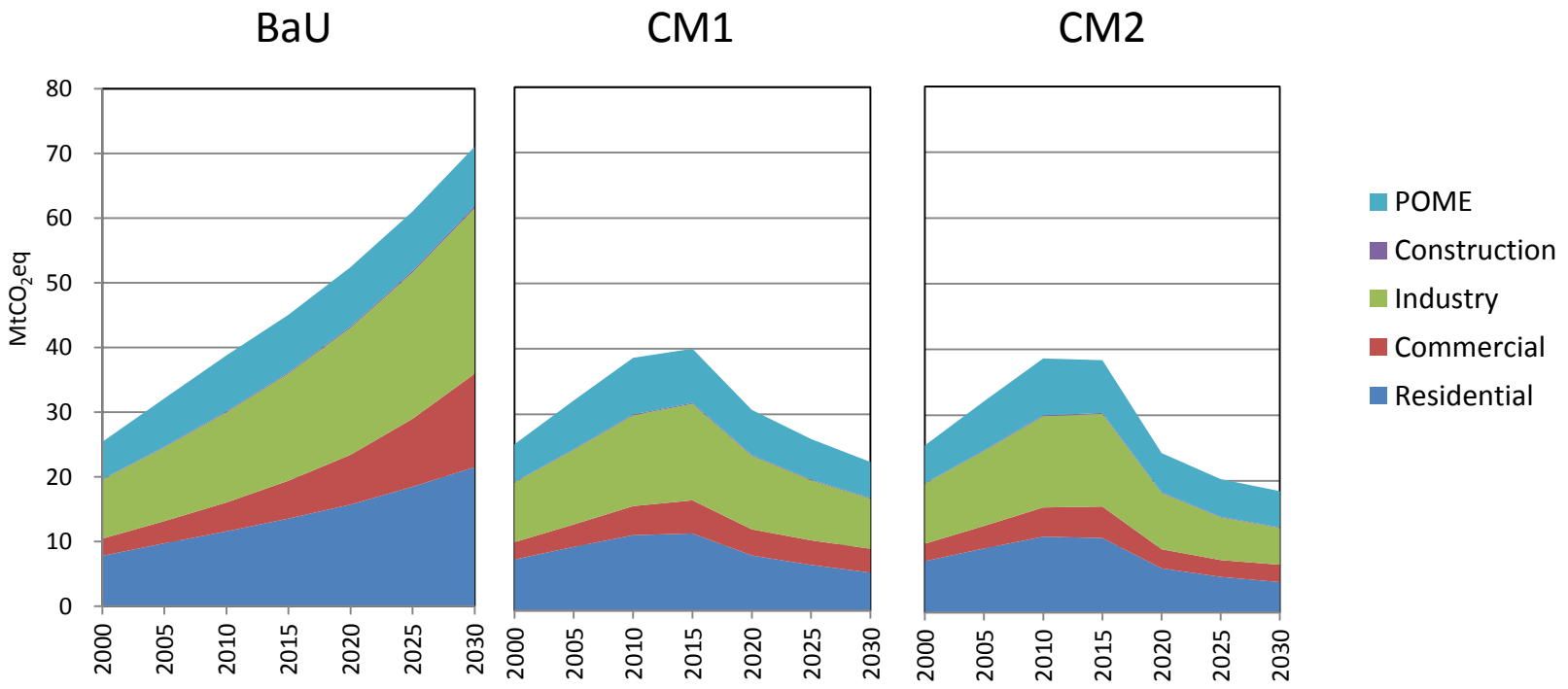
Projected waste generation

- SW generation is increased by 25% in 2020 and 39% in 2030 from 2007.



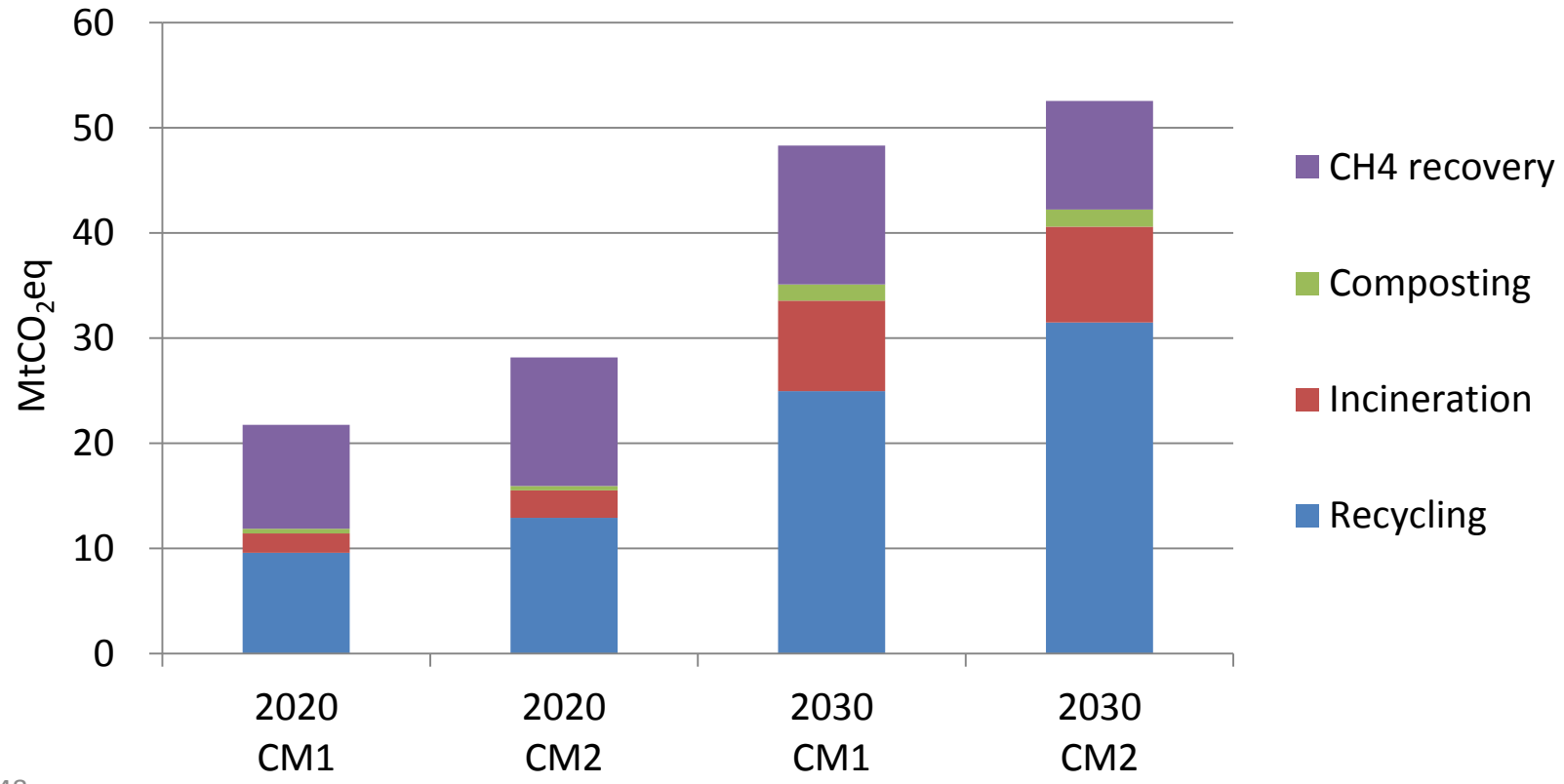
Projected GHG emissions

- 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.



Part IV: Agriculture, forestry and other land use

Framework

- Country: Malaysia
- Sectors:
  - Agriculture
  - Forestry and Other Land-Use (LULUCF)
- Year: 2000-2030
  - Agriculture; 5 year step, FOLU; 1 year step
- Target GHGs: CO_2, CH_4, N_2O
- Case:
  - BaU: no countermeasure
  - CM: reduction measures applied under several carbon taxes
- Activities: Crops, Livestock Animal and Land-Use change excluding fire and disturbance of land.

  (Future activity data is from literature. So ExSS-AFOLU is not applied in this preliminary application)

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

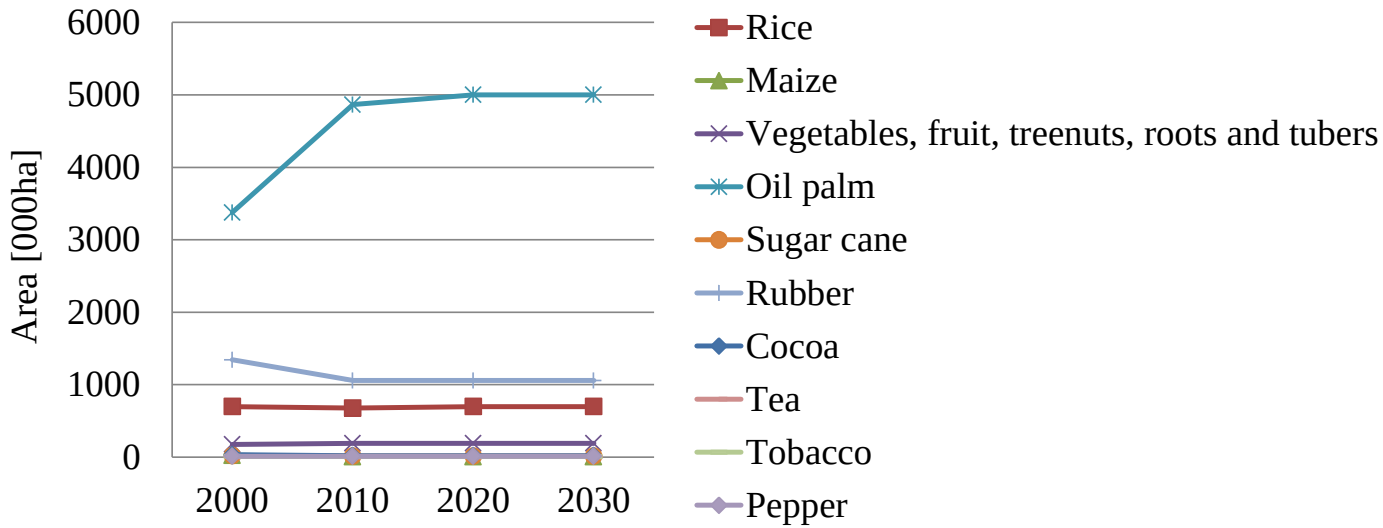
Emission/ Mitigation
Types of countermeasures

- 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

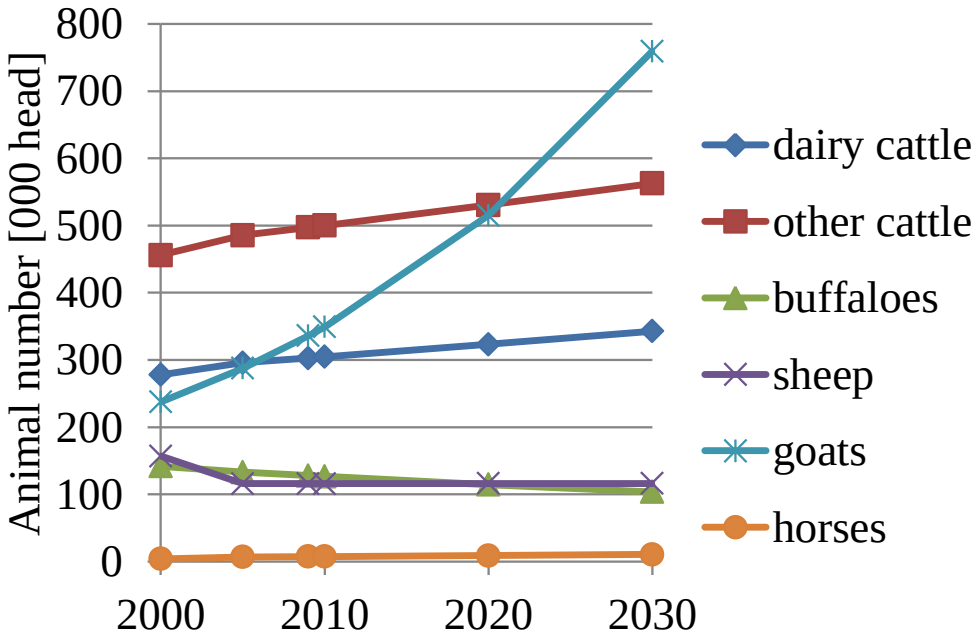
Scenario: Harvested area of crops

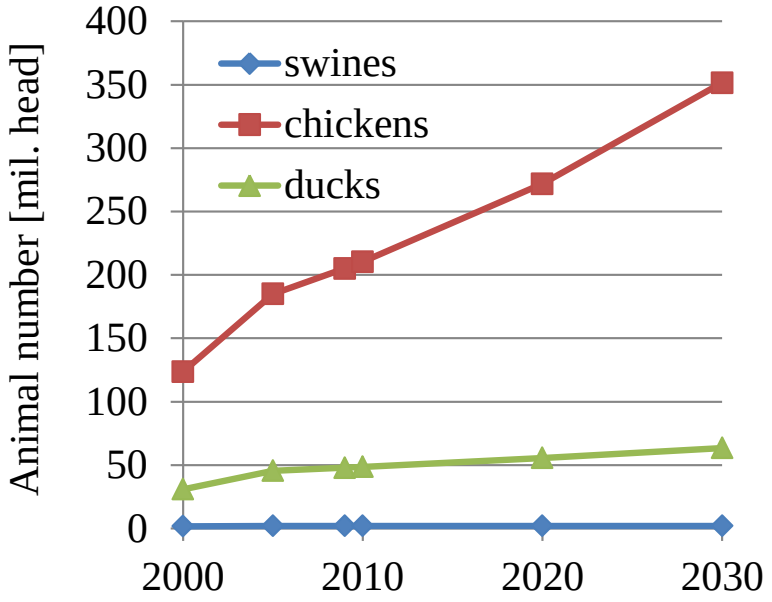
- Total croplands: 9.8 mil. ha in 2000 → 11.3mil.ha in 2030
- Yield: 2.5 times from 2000 to 2030 (Hasegawa, 2011)
- Oil palm area is increasing up to 5 mil. ha by 2020 (Wicke et al., 2011).
- Other crops: Extrapolation from 2005 to 2030 using growth ratio from 2005 to 2009
- Fertilizer per area is set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



Scenario: livestock animals

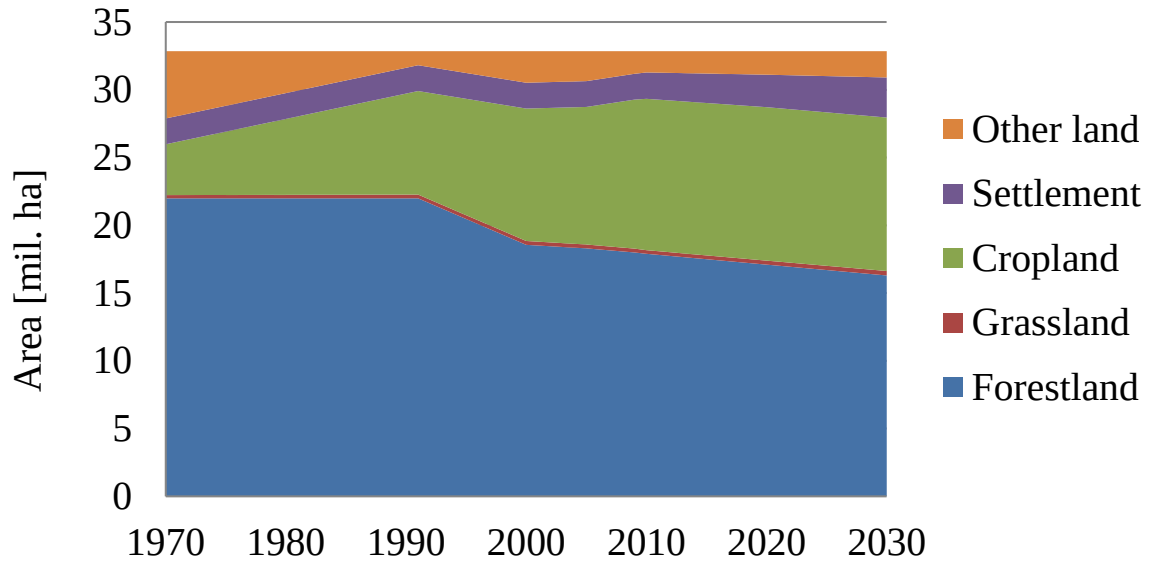
- Base year: NC2
- 2009 (the latest data): FAOSTAT
- 2010 to 2030: increase at ratios in 2005 to 2009





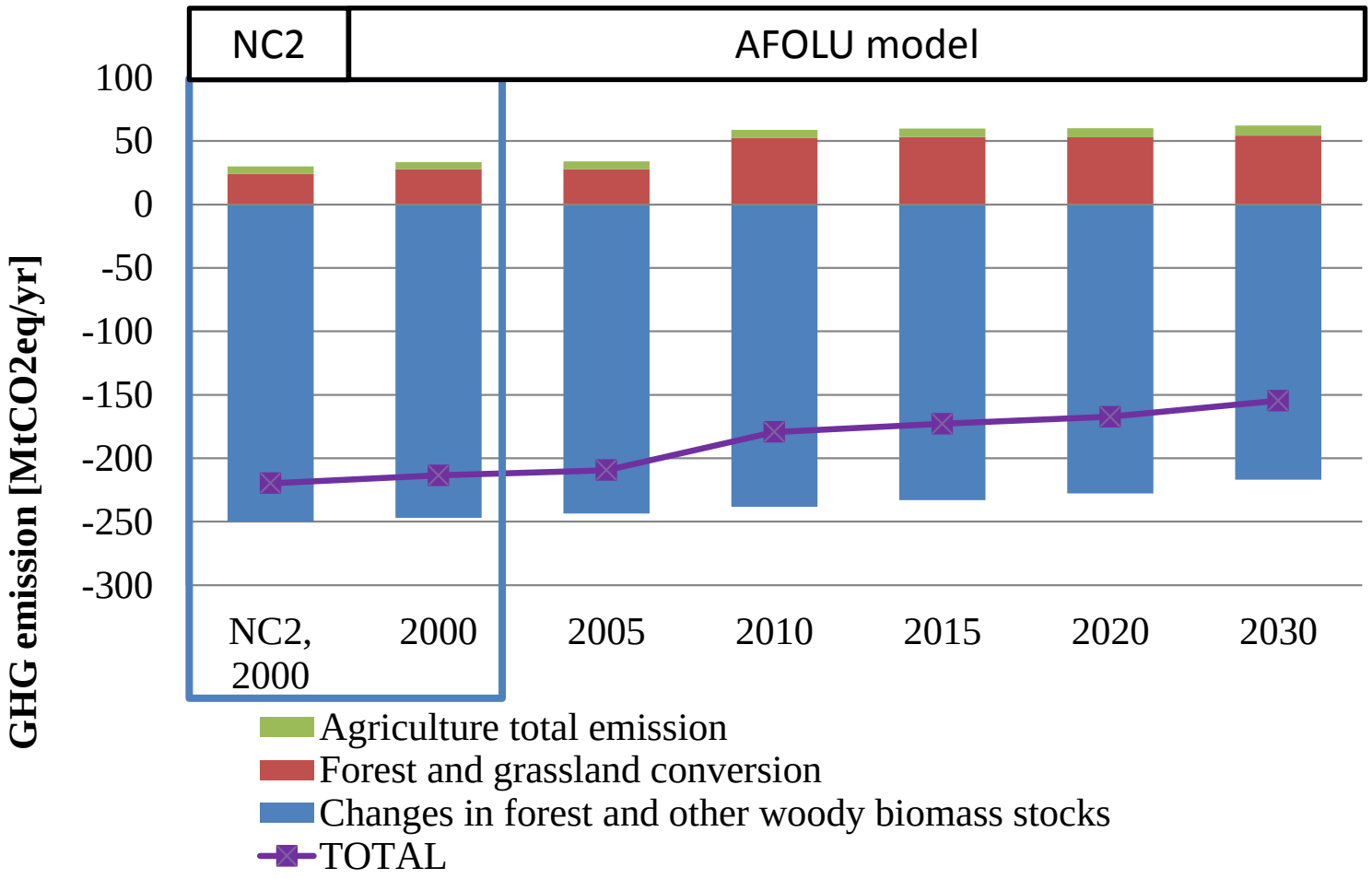
Scenario: land use and land use change

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



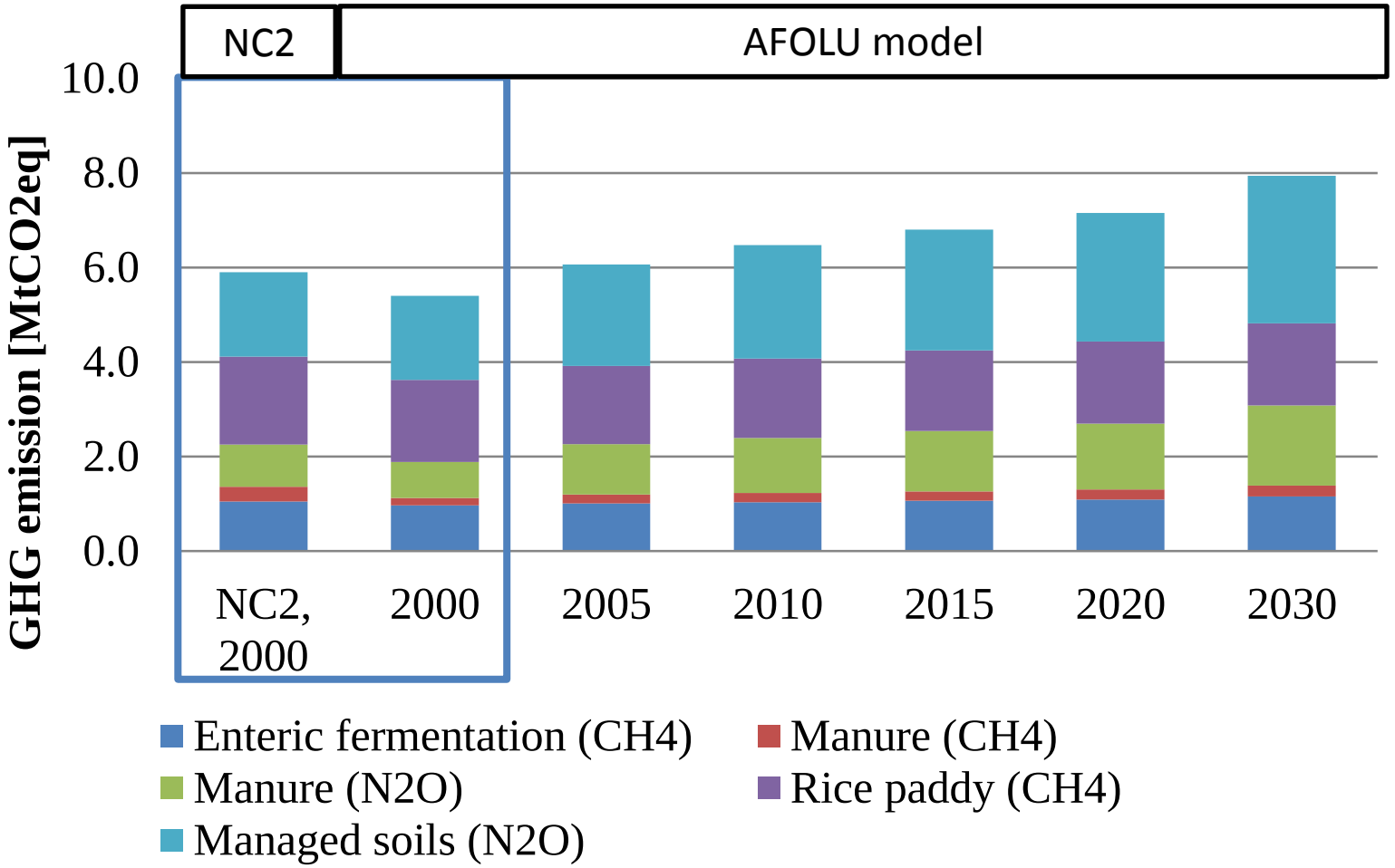
Total GHG emissions in BaU in AFOLU sectors

Our results is similar with NC2 estimates

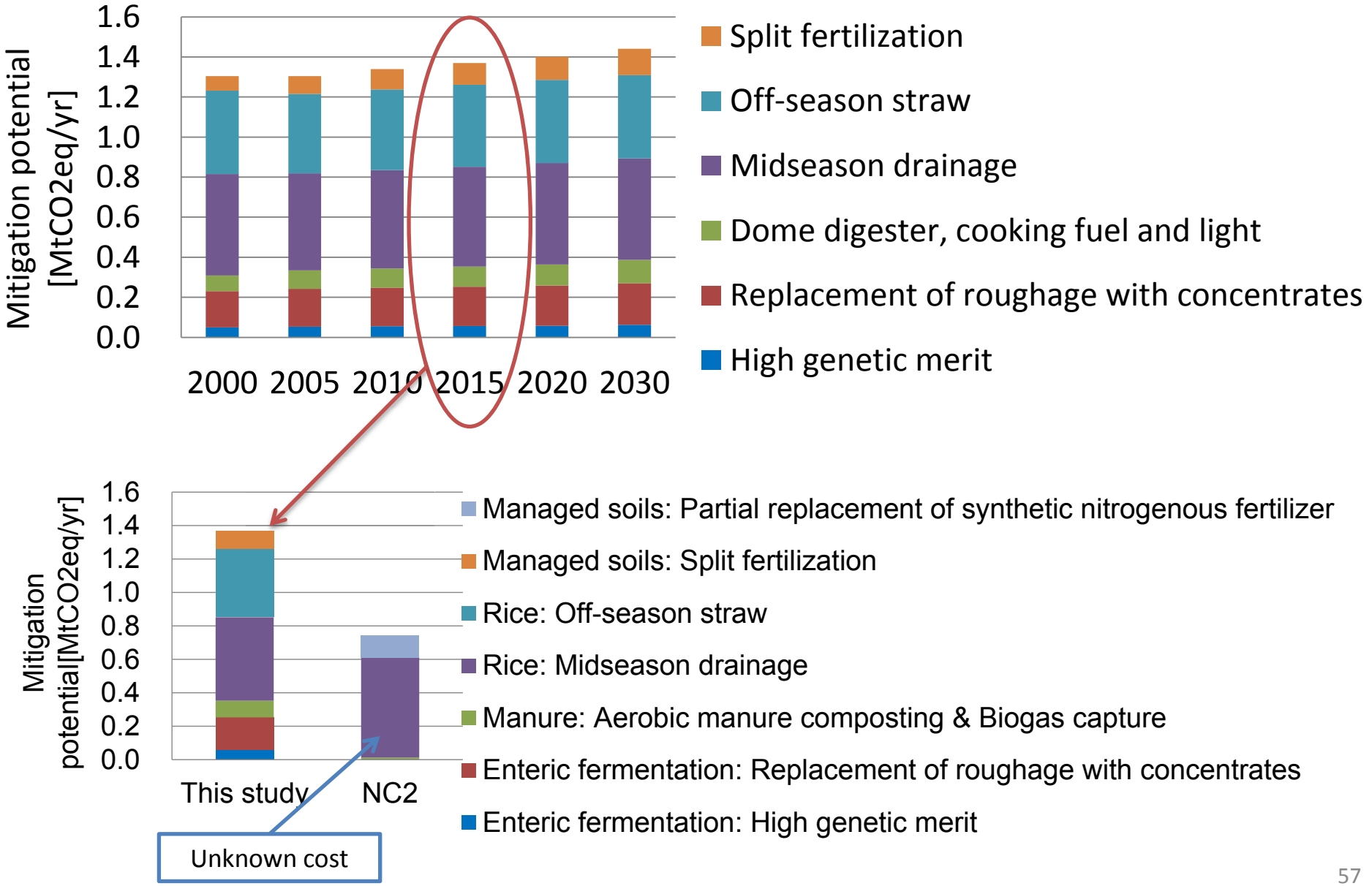


GHG emissions in Agriculture in BaU case

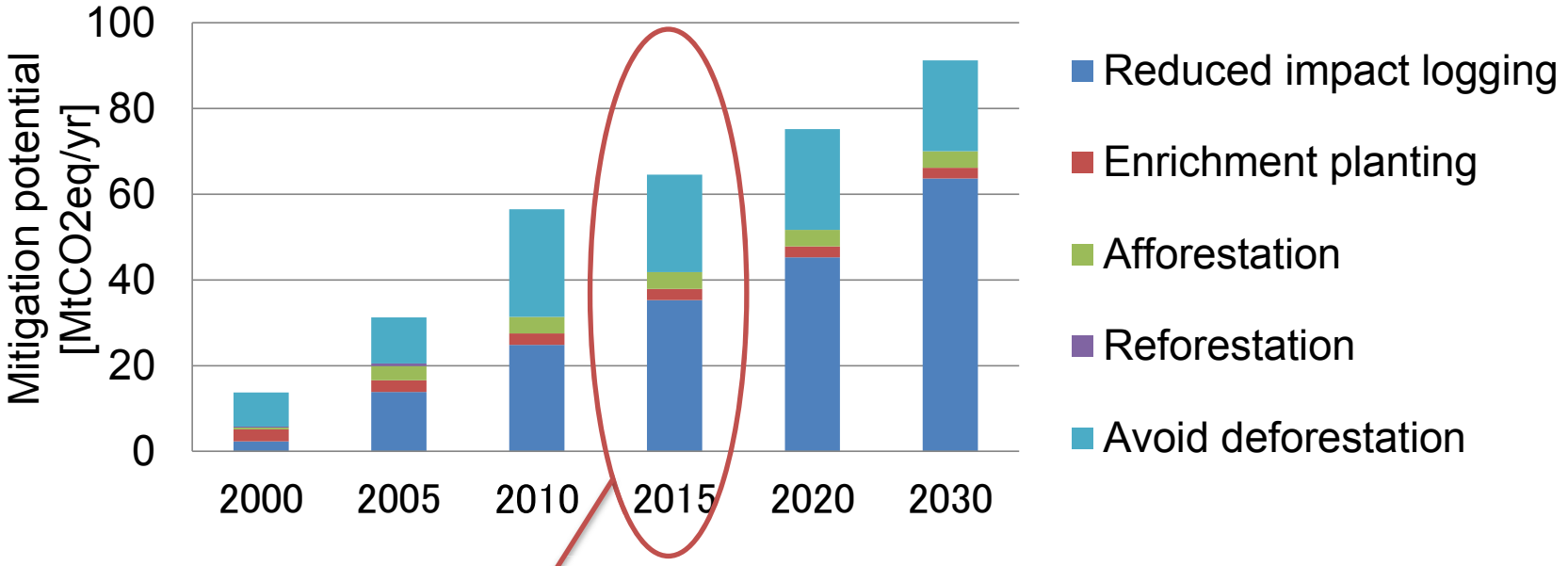
Our results is similar with NC2 estimates

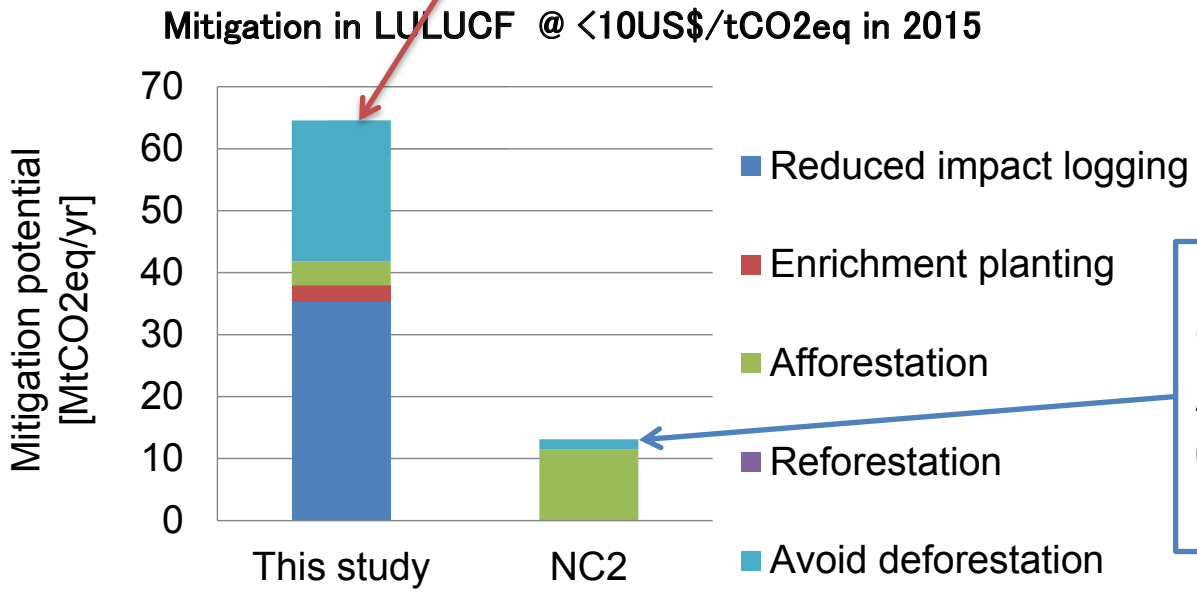


Mitigations in agriculture @<10USD/tCO2eq



Mitigations in LULUCF @<10USD/tCO2eq





Plantation;
9.5US$/tCO2
Avoid deforestation;
0.002US$/tCO2
(1RM=0.32US$)

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*

Part V: Integration

Integration

- Combining all three sectors: Energy, Waste and AFOLU

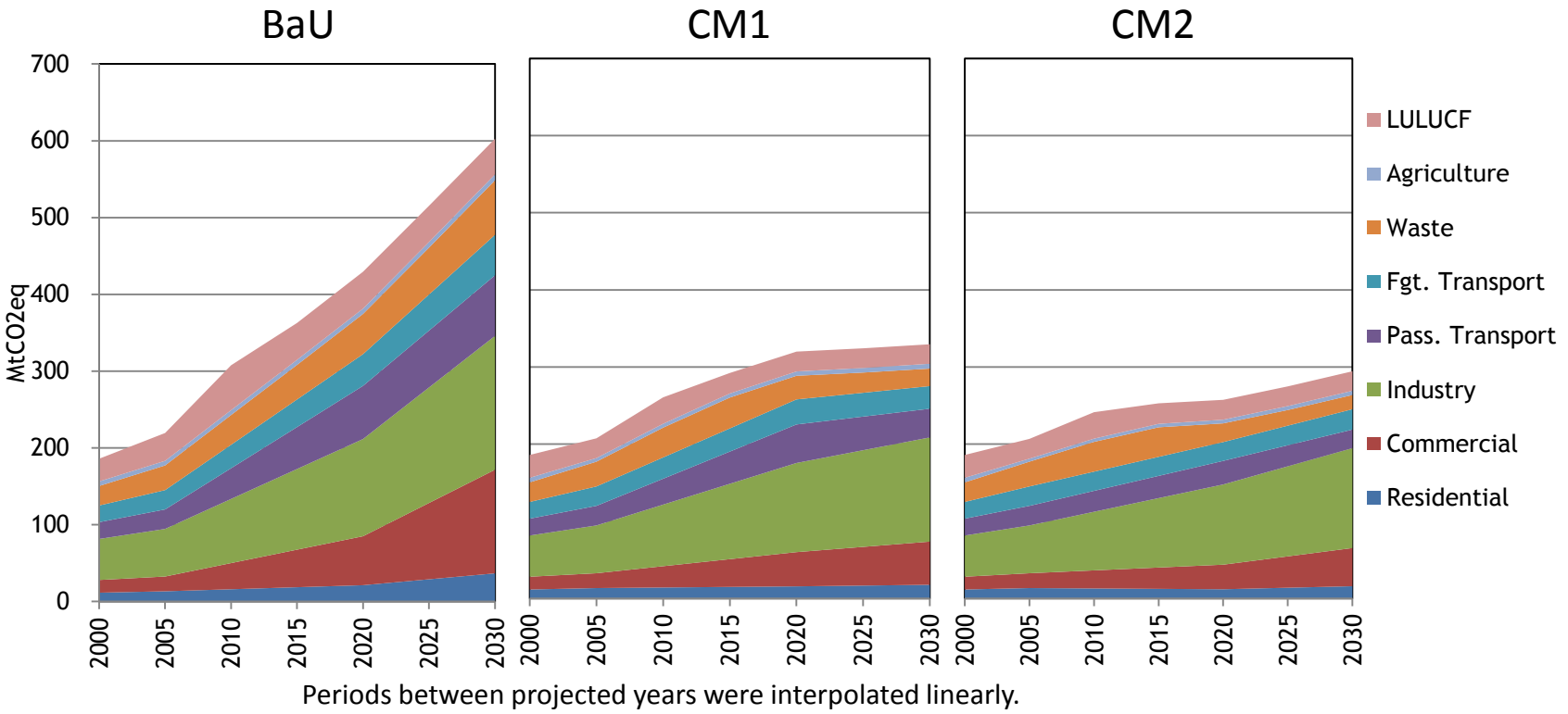
- For AFOLU sectors, @<10USD/tCO2eq case was applied both for CM1 and CM2 scenarios.

Summary of mitigation options

	2020		2030	
	CM1	CM2	CM1	CM2
Diffusion of energy efficient devices	40%	60%	75%	85%
EEI rate from BaU of thermal power plants	10%	20%	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%
Mitigations in AFOLU sectors*	<10USD/ktCO2eq			

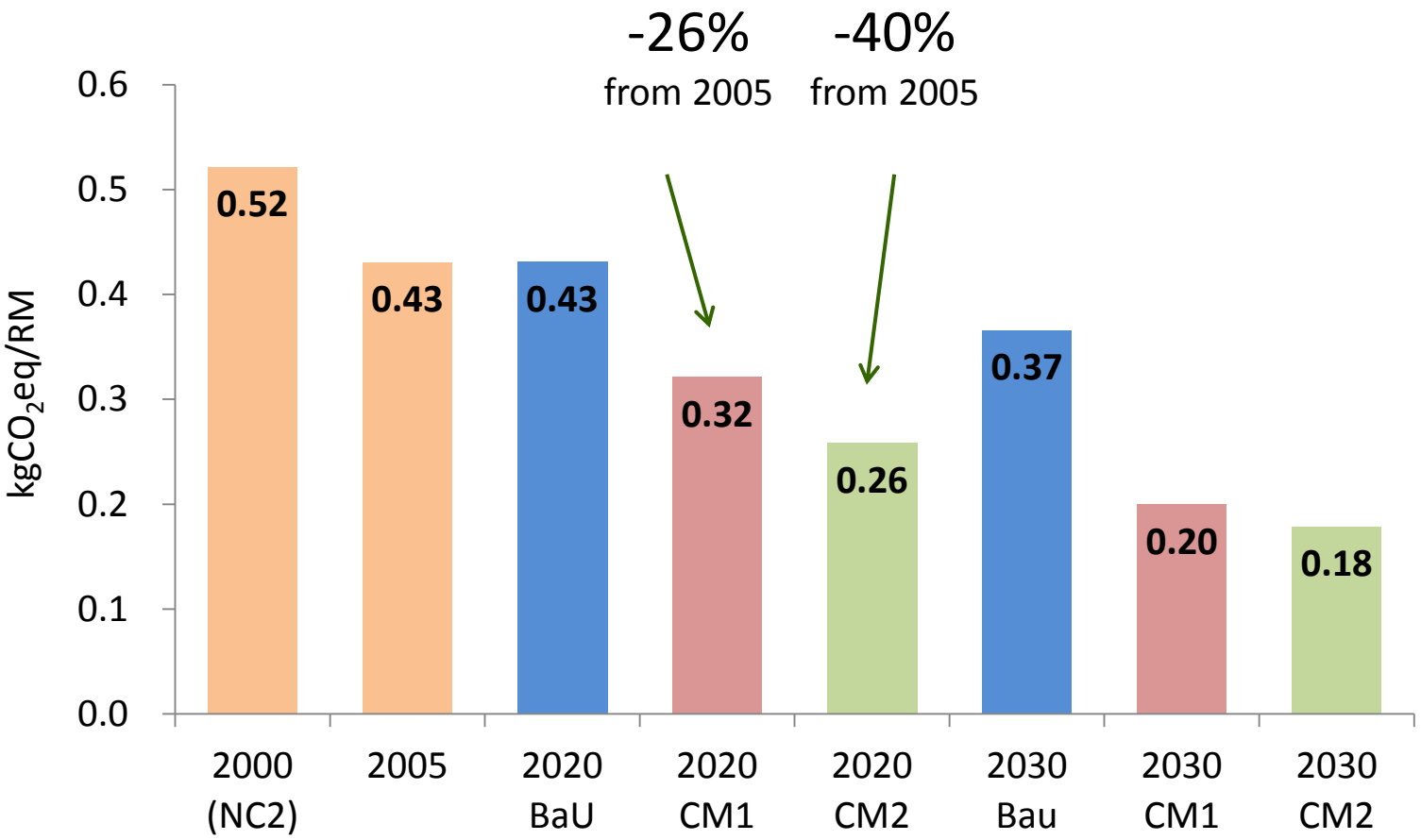
GHG emissions (Energy, Waste and AFOLU)

- Energy has the largest contribution in both scenarios in all years.
- In BaU scenario, GHG emission increased by 96% (2020) and 175% (2030) from 2005
- In CM1 scenario, it was reduced by 26% (2020) and 45% (2030) from BaU, in CM2, 40% (2020) and 51% (2030).

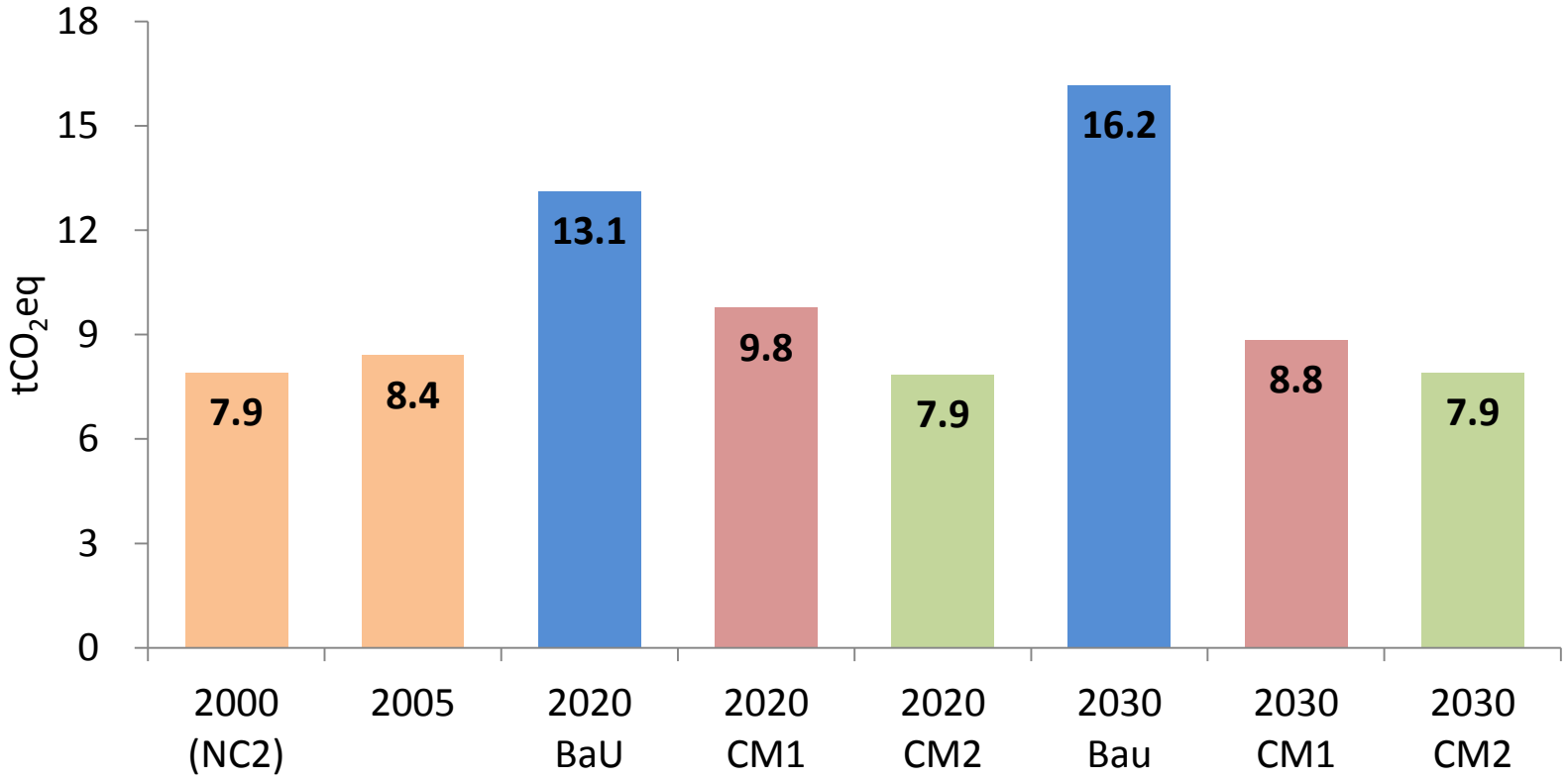


Periods between projected years were interpolated linearly.

Emission intensity (GHG emission per GDP)

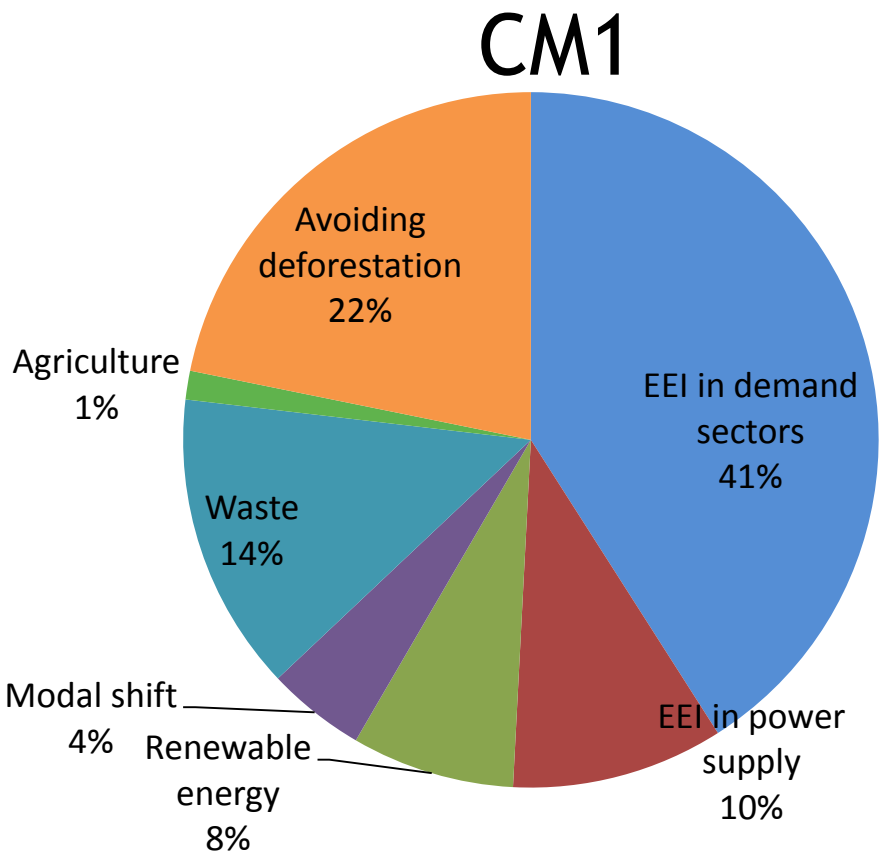


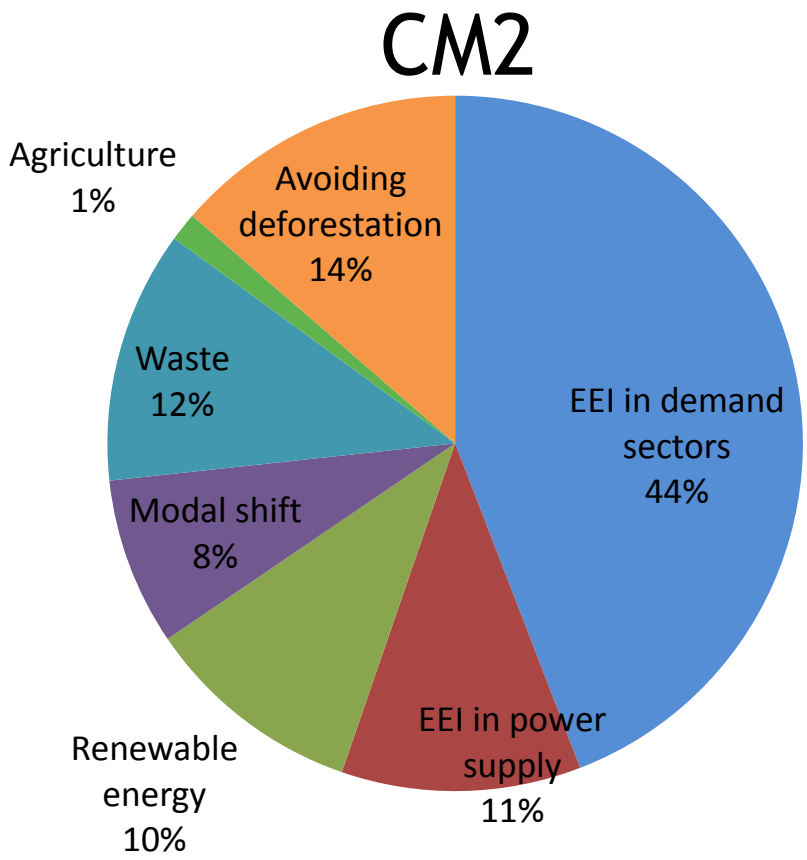
Per capita GHG emission



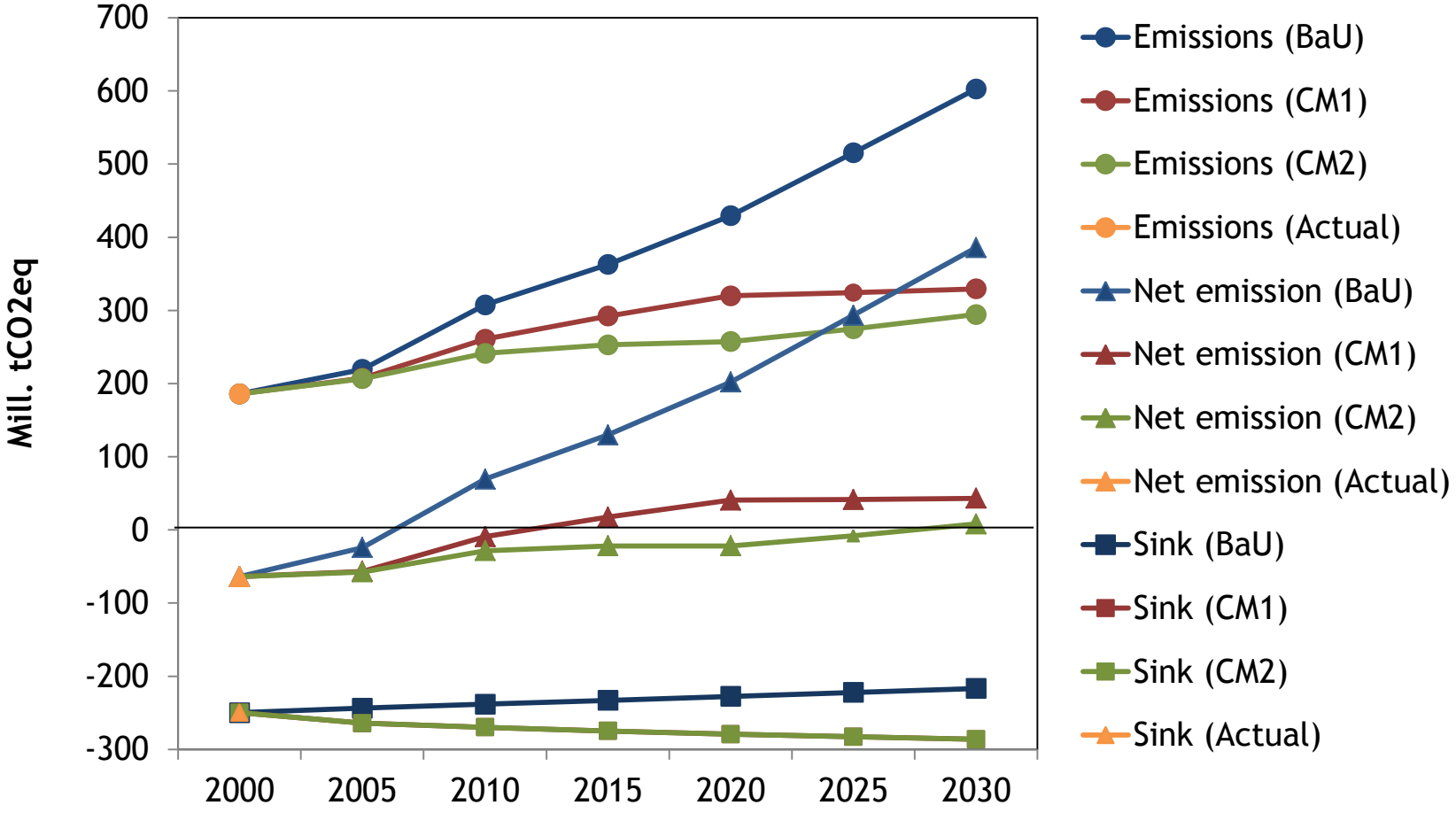
Contribution to emission reduction in 2020

- In order to achieve -40% target in 2020, more contribution of EEI, renewable energy and modal shift is required.





Emissions, sink, and net emissions



Conclusion

- Using ExSS and AIM/AFOLU model, Malaysia LCS scenarios in 2020 and 2030 were projected.
- 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
- In 2020BaU scenario, GHG emission was doubled from 2005.
- In 2020CM1 scenario, GHG emission intensity was reduced by 26% from 2005.
- In 2020CM2 scenario, GHG emission intensity was reduced by 40% from 2005.
- In order to achieve -40% target of emission reduction, more intensive implementation is needed especially in energy sector.

Thank you for your attention!

Thank You Terima Kasih 谢谢 धन्यवाद ありがとう