The 19th AIM International Workshop

Thailand LCS Scenarios towards 2050: The LCS Roadmap and Peak CO_2

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NIES, Japan

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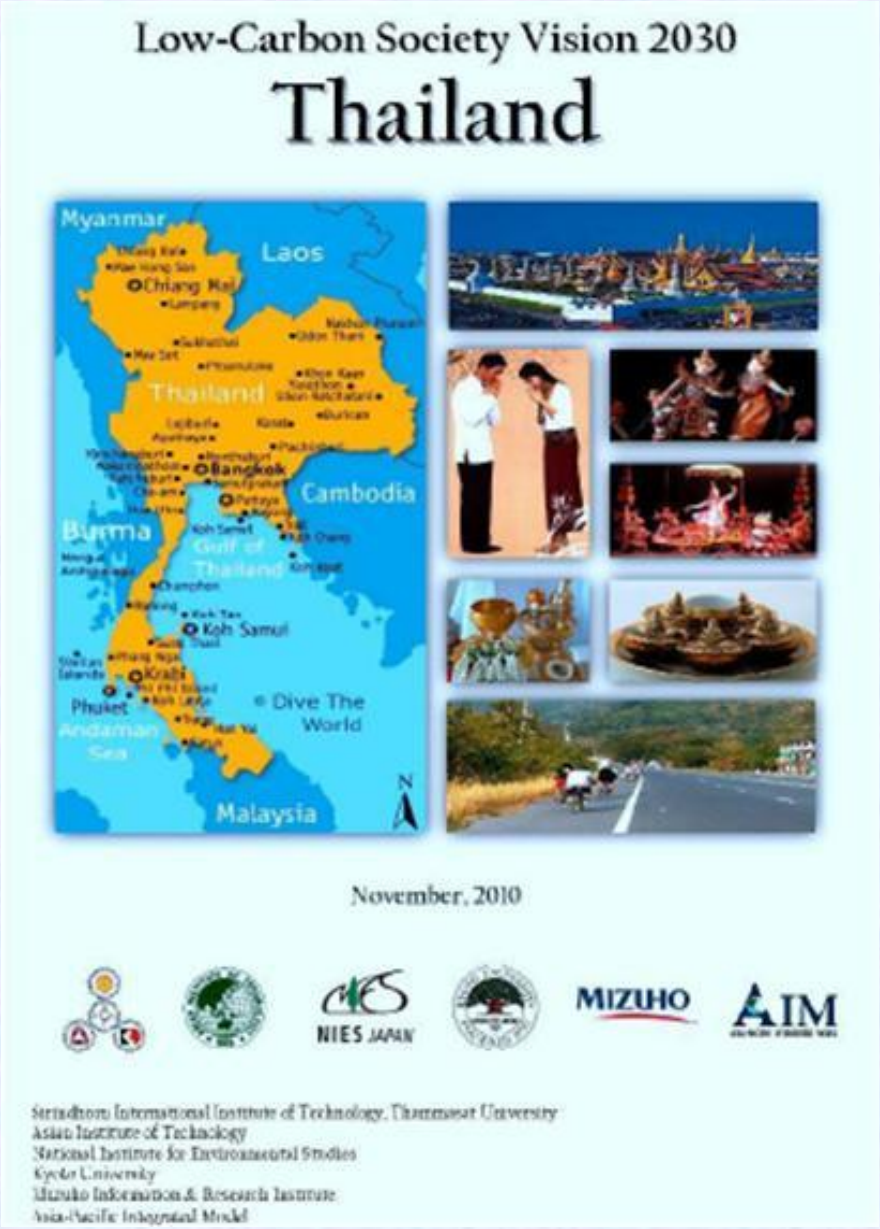
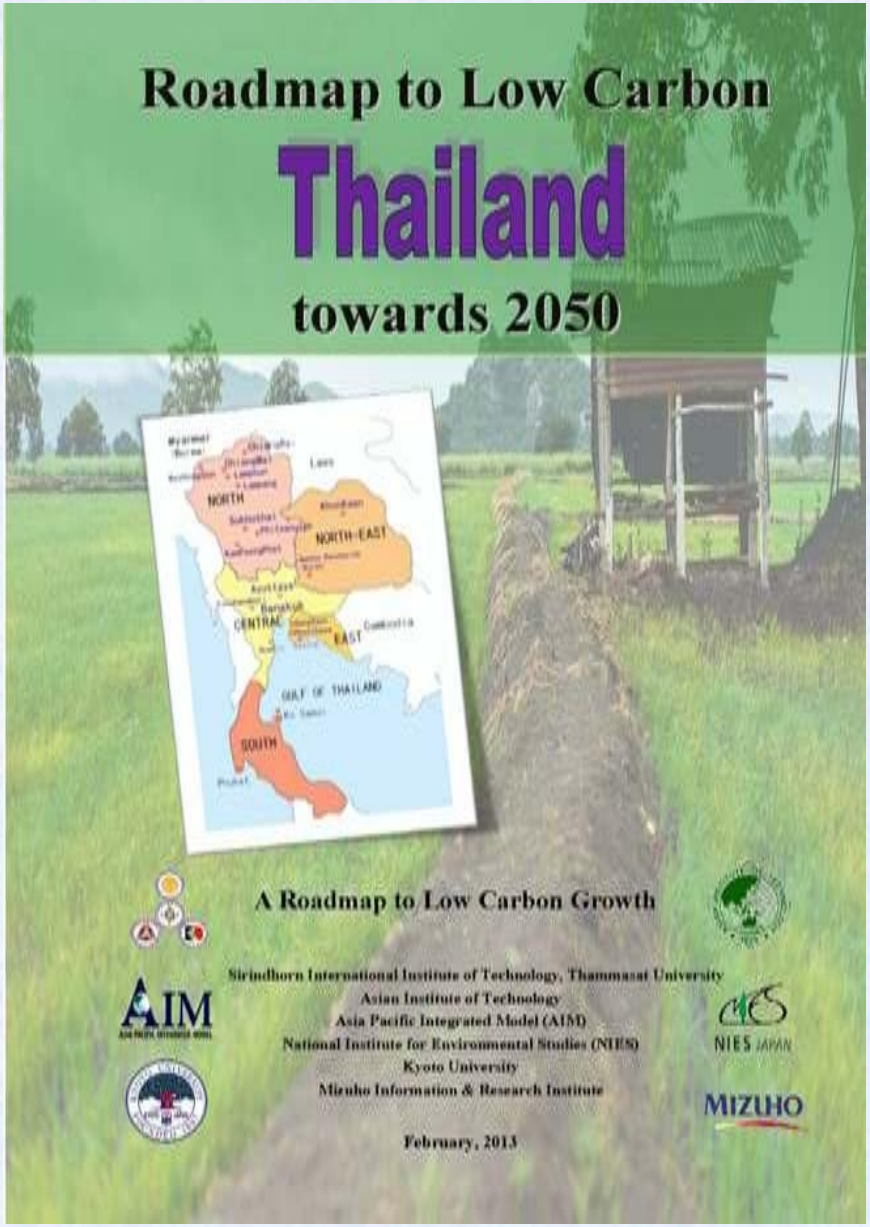


1st LCS Scenario by AIM/ExSS



2nd LCS Roadmap by AIM/Enduse

Objectives

- Appropriate CO_2 reduction target in 2020
  (Thailand's NAMA has been studied for CO_2 mitigation in a range of 7-20%)

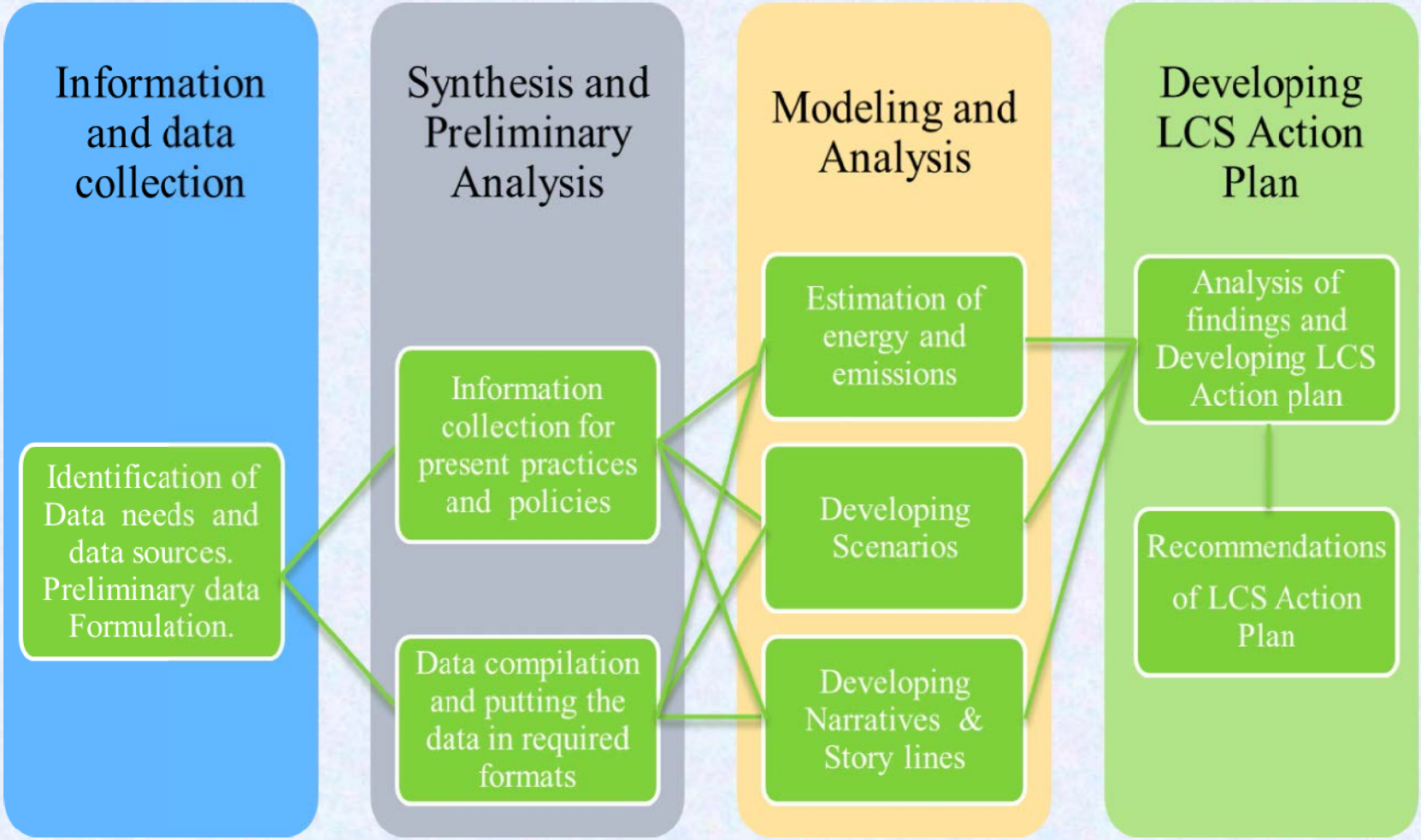
- LCS Roadmap to Low Carbon Thailand 2050
  (CO_2 mitigation upto 29.2%)

- Peak CO_2 Scenario within 2050 for Thailand
  (CO_2 mitigation upto 48.3%)

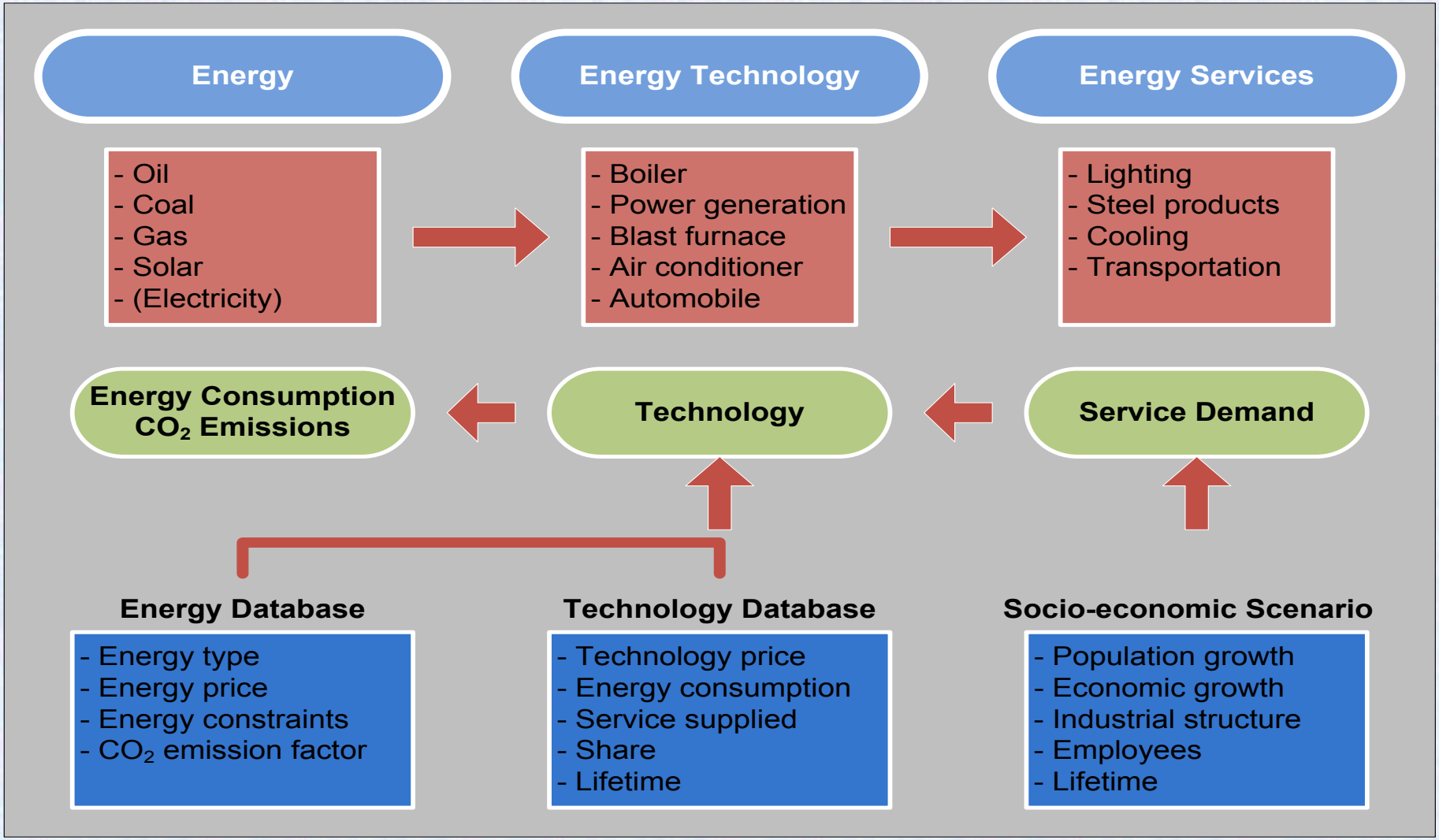
Thailand's NAMAs

- **Thailand's Nationally Appropriate Mitigation Actions (NAMAs) has been proposed for CO_2 mitigation in a range of 7-20% (7% for unilateral/domestic and 13% for international supported according to their abatement costs).**
- **In Thailand NAMAs, only cost effective actions are proposed (IRR > 10%, Payback period < 4 years).**
- **Without M R V, 20% mitigation target in 2020 cannot be achieved.**
- **For NAMAs 2020, LCS roadmap 2050, and peak scenarios, AIM/Enduse has been used in analyses.**

Methodology (LCS Action Plan)

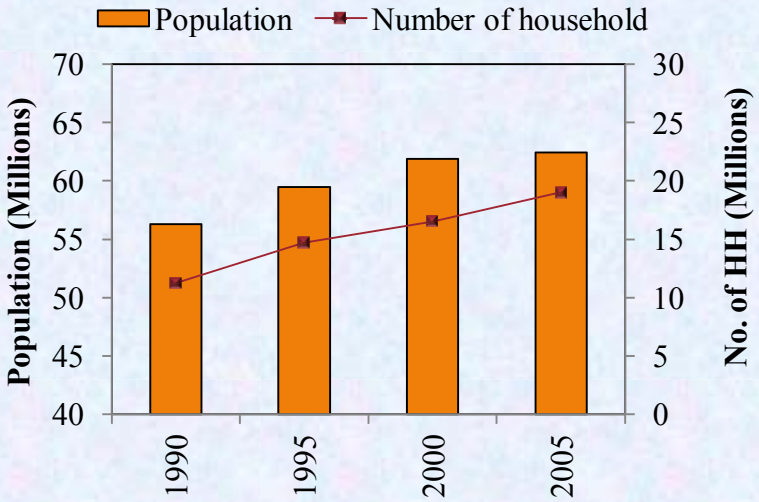


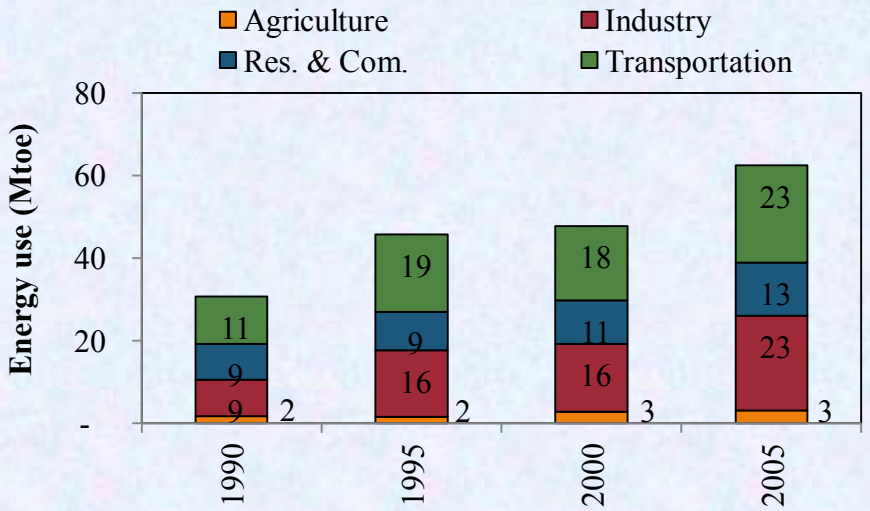
Methodology (AIM/Enduse), NIES

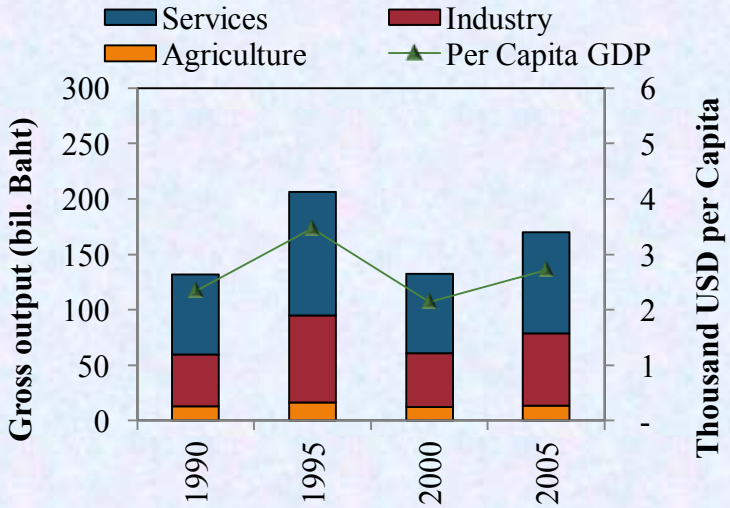


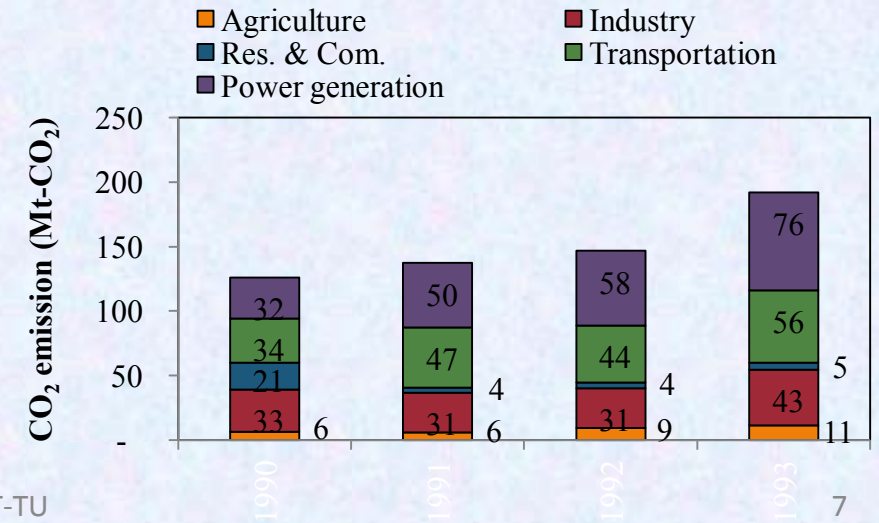
National Circumstance 1990-2005

Population, GDP, Energy, CO_2 emissions







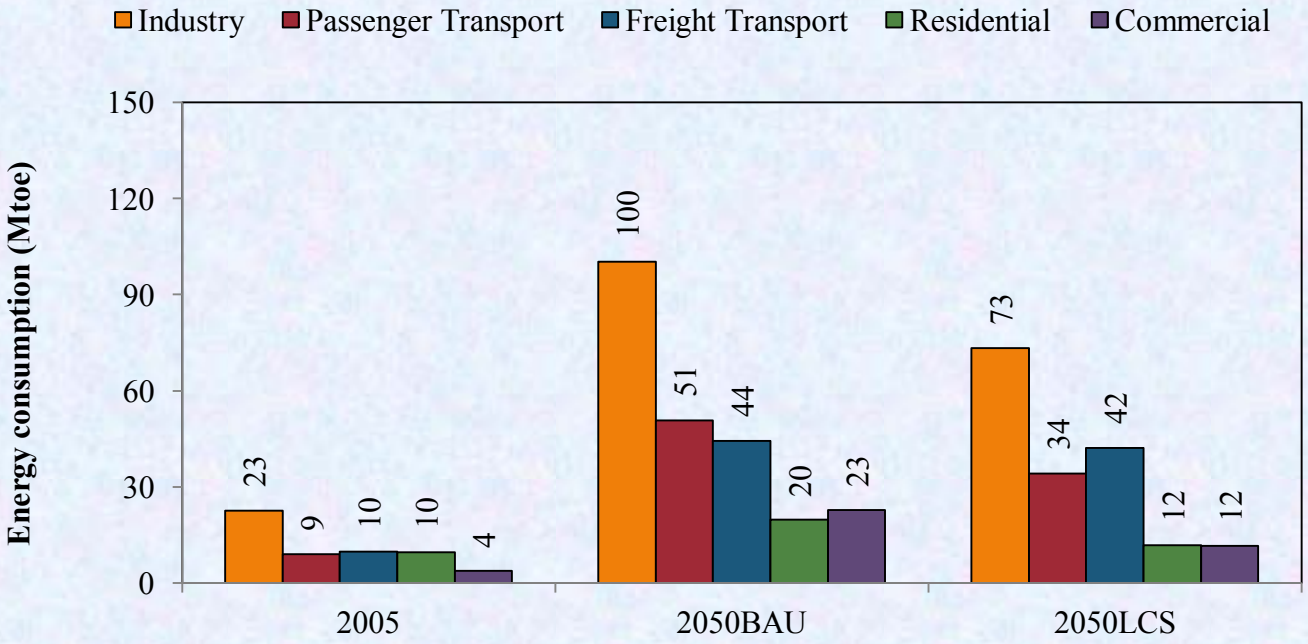


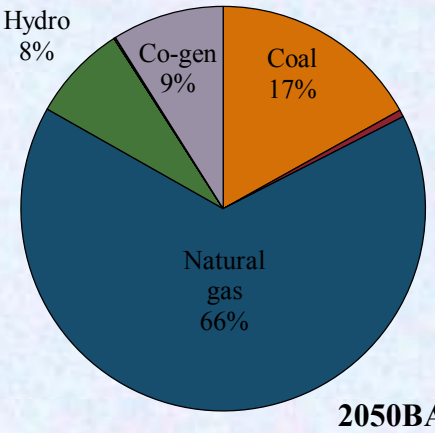
Demographic and Economic Assumptions in 2050

Average population growth	Historical data (2006–2011) 0.51% p.a. increase (2012–2050)
Number of household	Historical data (2006–2011) 2.89% p.a. increase (2012–2050)
Floor space	4.02% p.a. increase
Gross Domestic Products (GDP)	Historical data (2006–2010) Follows PDP2010 (2011–2023) 3.92 p.a. increase (2024–2050)
GDP share by industry	Primary industry (9.68%) Secondary industry (37.37%) Tertiary industry (52.95%)
Modal share of passenger transport	Road (97.69%), Rail (0.25%), Air (2.06%)
Modal share of freight transport	Road (6.39%), Rail (0.01%), Water (91.85%), Air (1.76%)

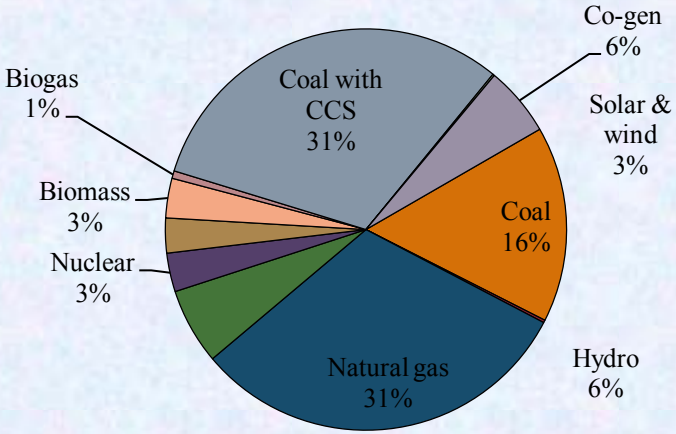
Socio-economic indicators	2005	2050	2050/2005
Population (Person)	62,418,054	78,071,984	1.25
No. of Households	19,016,784	67,478,570	3.55
GDP (Million USD)	169,870	1,247,449	7.34
Gross output (Million USD)	407,157	2,939,643	7.23
Primary industry	43,286	284,499	6.57
Secondary industry	146,182	1,098,631	7.52
Tertiary industry	217,689	1,556,506	7.15
Per capita GDP (USD/Capita)	2,721	15,978	5.87
Floor space for commercial (Million m^2)	88	519	5.90
Passenger transport demand (Million passenger-km)	361,819	1,201,951	3.32
Freight transport demand (Million tone-km)	1,826,631	9,701,505	5.31

Energy Demand in 2050 (LCS)





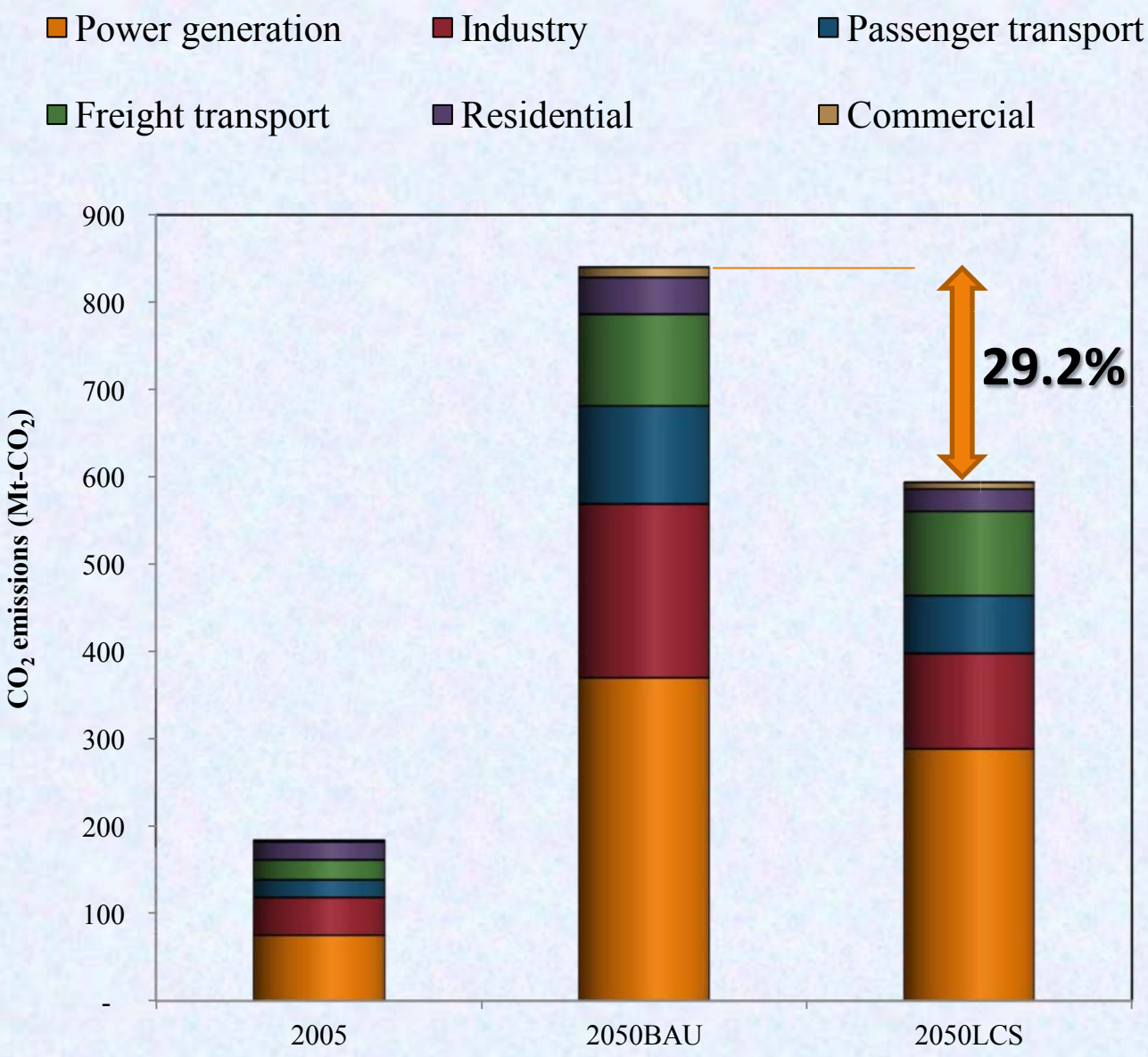
2050BAU



2050CM

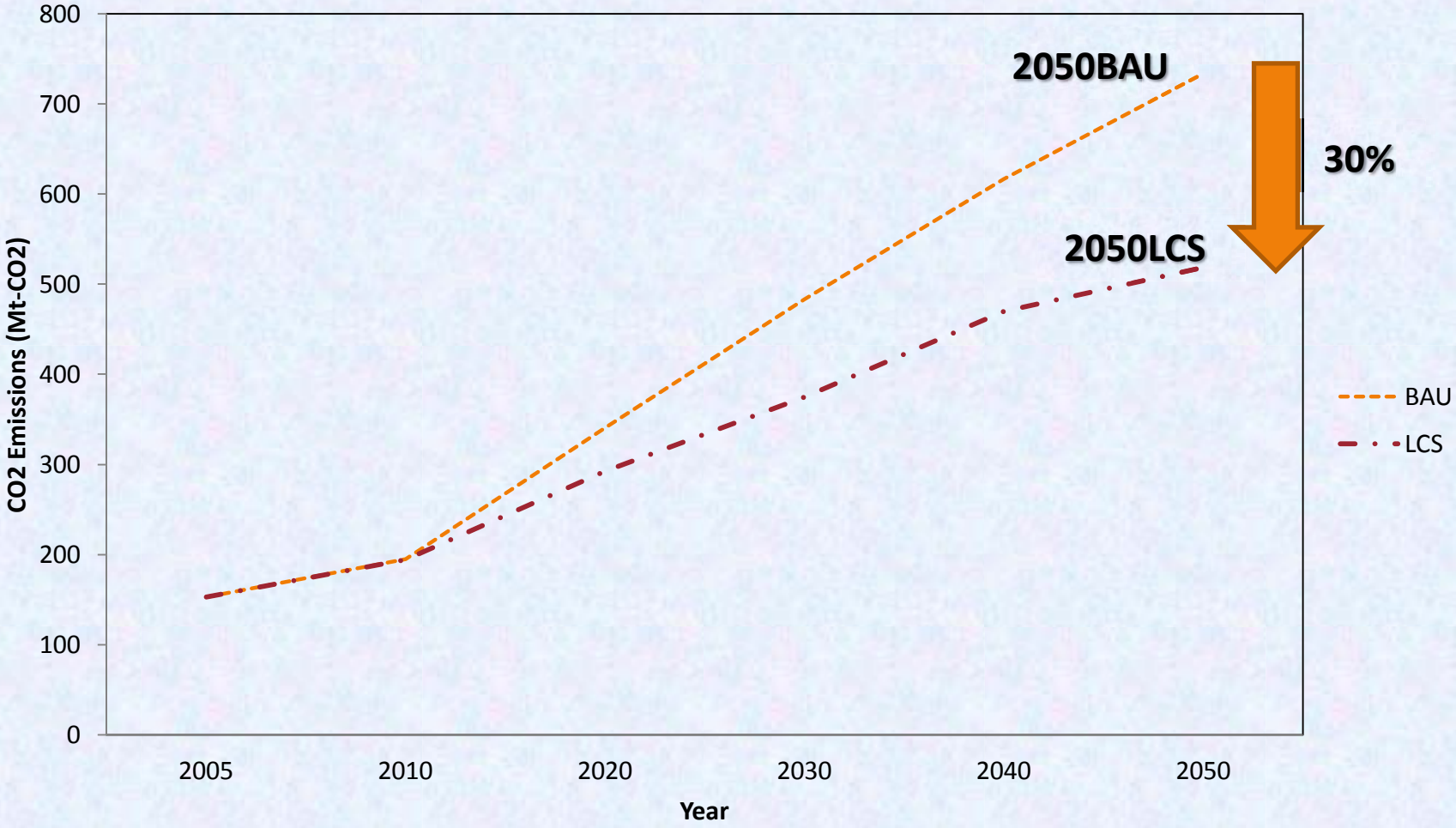
Primary Energy Demand by fuel type in 2050

GHG Emissions in 2050 (LCS)



- In the 2050BAU scenario, the GHG emissions would increase to 769.9 Mt-CO_2.
- That is 4.6 times higher than the base year 2005.
- According to the proposed LCS roadmap for sustainable Thailand towards 2050, and by adopting the selected feasible GHG mitigation measures available by 2020, 2030 and 2050, the GHG emissions in the 2050LCS scenario can be decreased by approximately 29.2% to 551.6 Mt-CO_2.
- However, the **Thailand's LCS roadmap, which is based on selected feasible GHG mitigation measures, could not achieve the 2 degree target.**

Total GHG Emissions 2005-2050 (LCS)



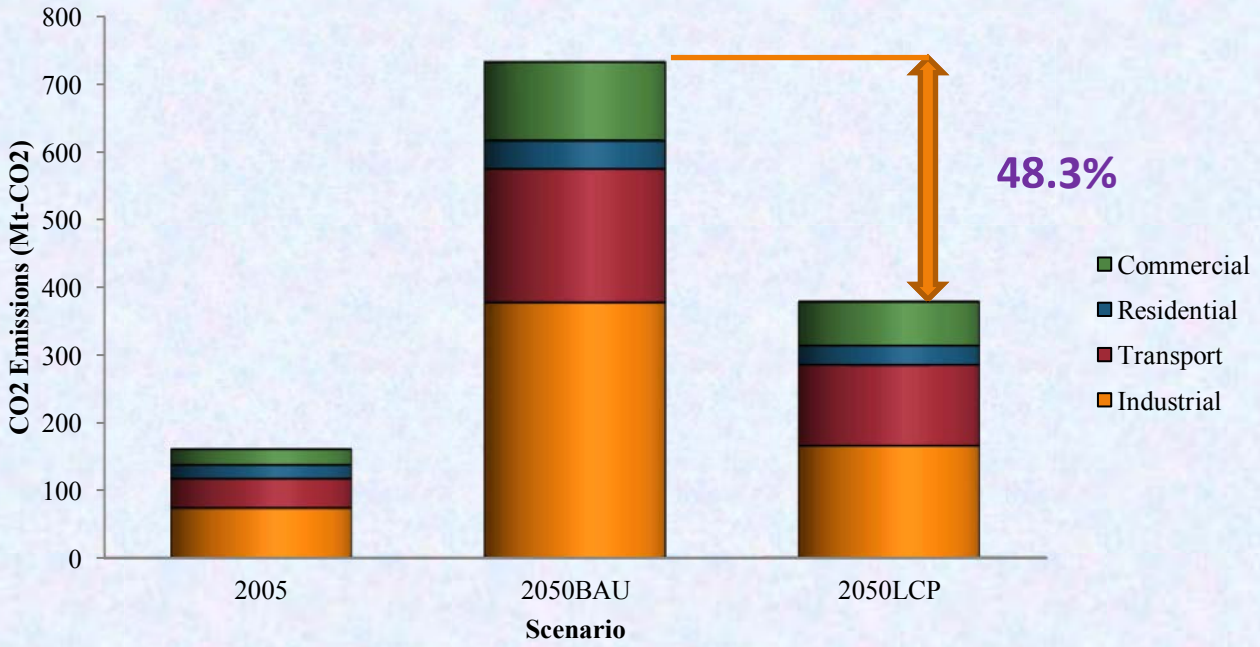
Peak CO_2 Scenario

- Therefore, rigorous LCS actions to achieve the peak CO_2 target within 2050 are proposed.
- Results from analyses show that Thailand could meet the peak CO_2 emissions during 2040 - 2045 at 393 Mt-CO_2 emissions.
- The peak CO_2 scenario shows that CO_2 can be reduced by approximately **48.3% from 770 to 393 Mt-CO_2.**

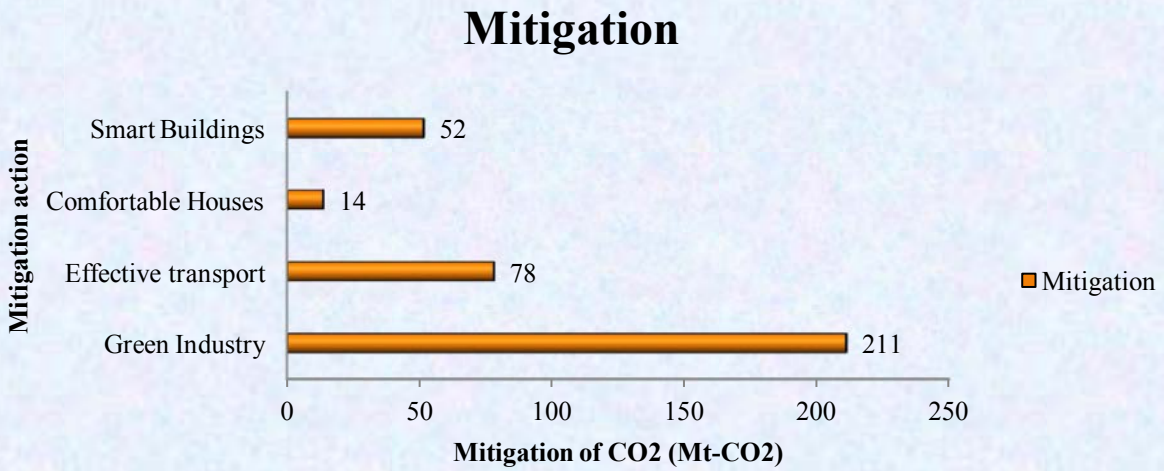
What are LCS Actions in the Peak Scenario ?

- **LCS Actions include both supply-side and demand-side actions such as increasing the use of carbon capture storage (CCS) in power generation and industries, more utilization of bio-fuels, renewable energy (RE), promoting modal shift in transportation, and increasing energy efficiency (EE) in buildings and industries.**

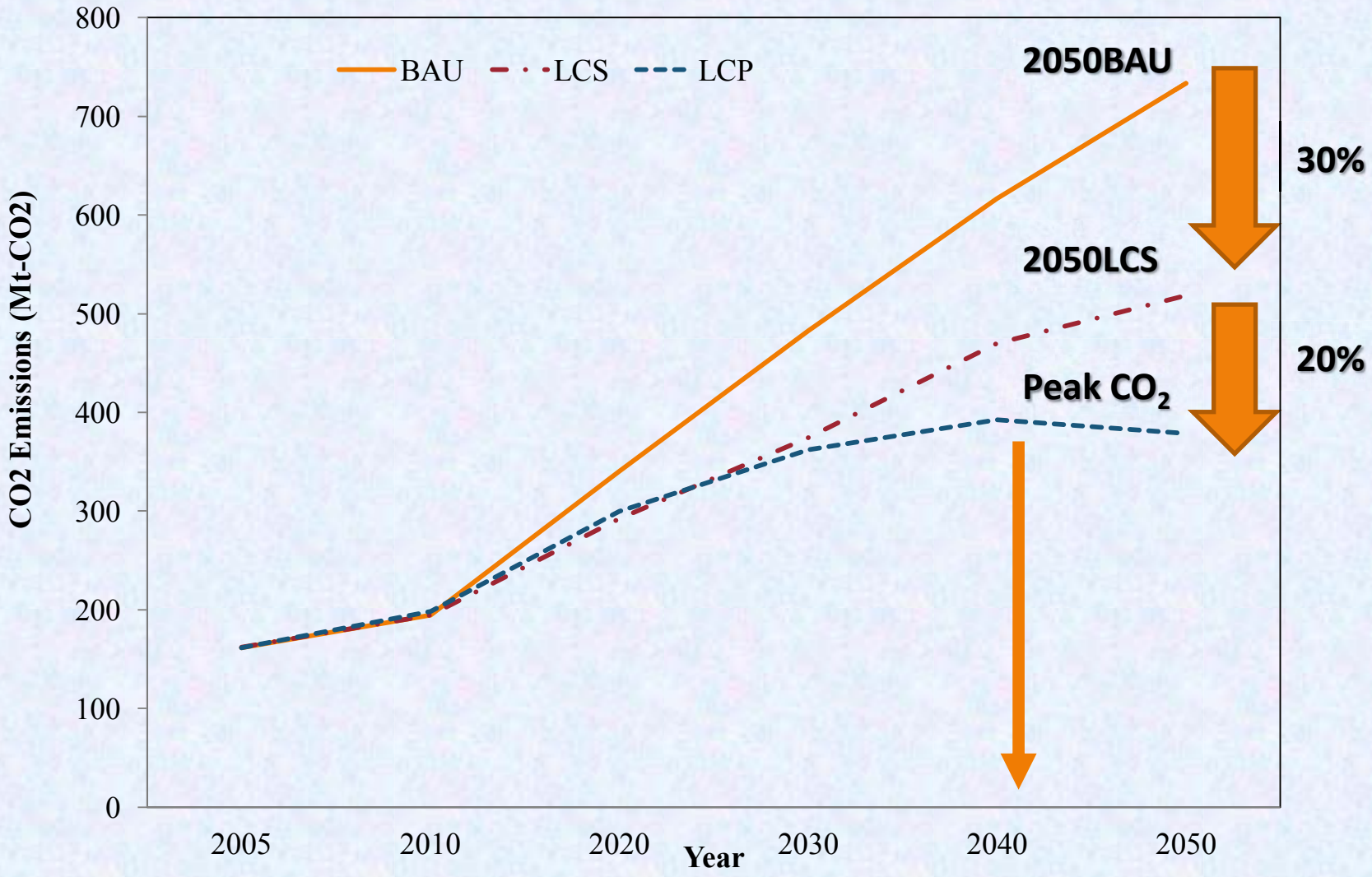
GHG Emissions in 2050 (Peak CO_2)



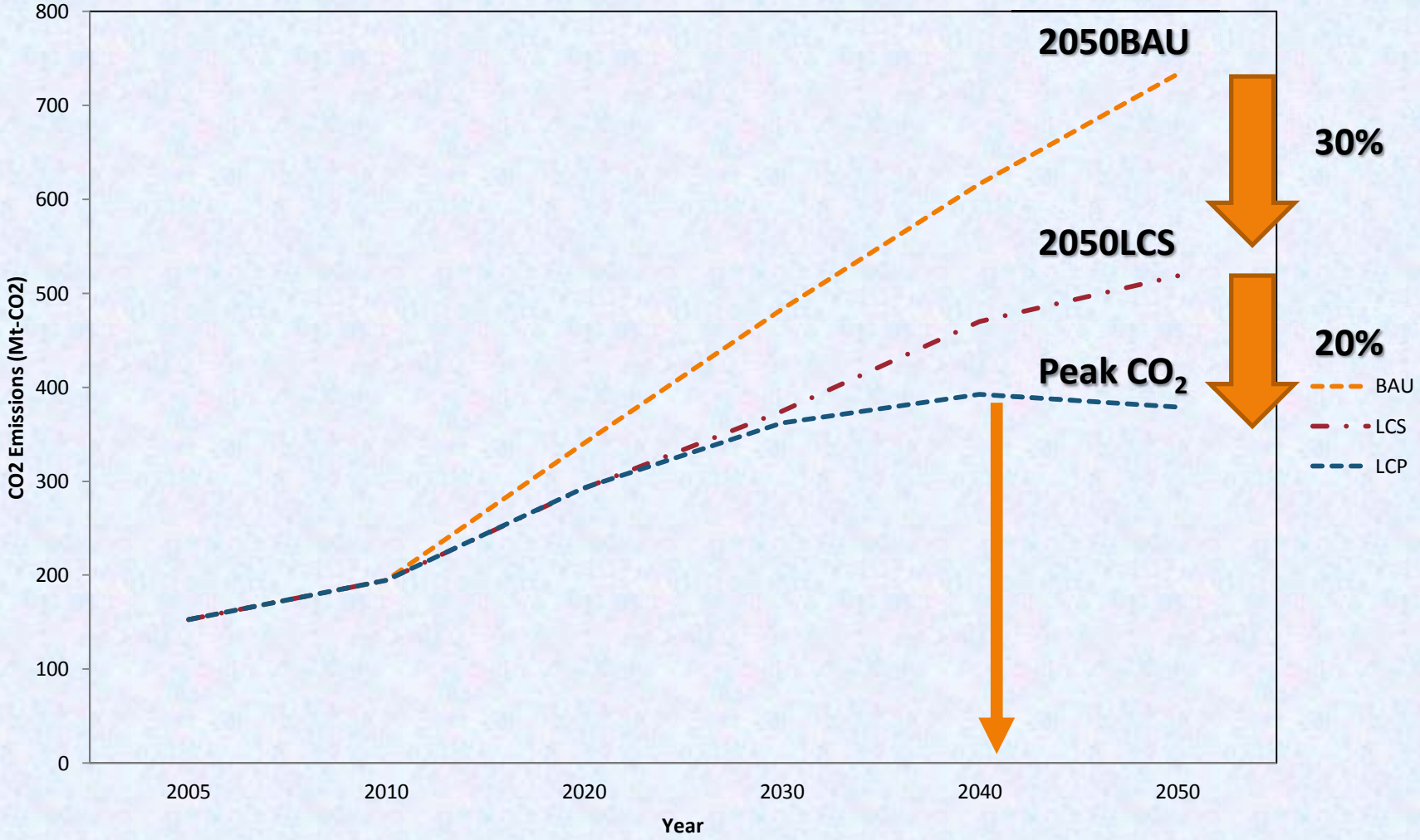
GHG Mitigation by 2050 (Peak CO_2)



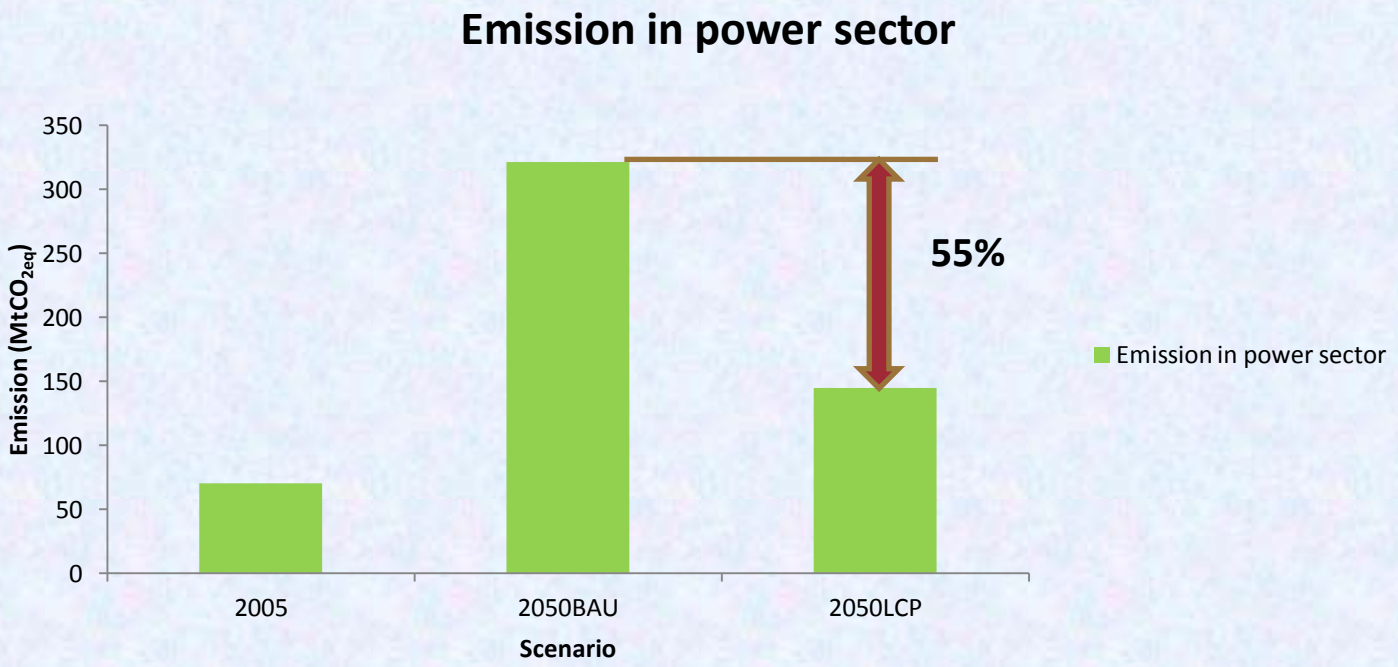
Total GHG Emissions 2005-2050 (Peak CO_2)



Total GHG Emissions 2005-2050 (Peak CO_2)

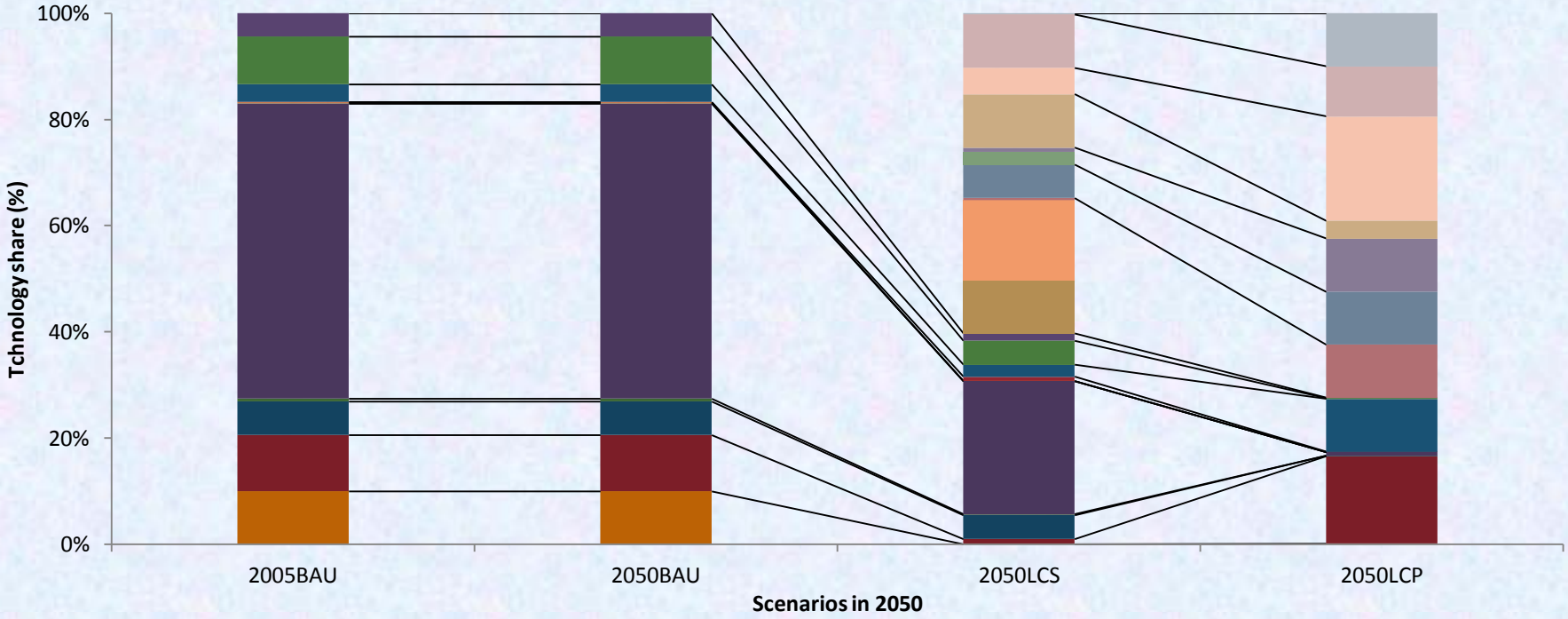


GHG Emissions in 2050 (Power Sector) (Peak CO_2)



Low Carbon Peak
Action 1:
Clean Power

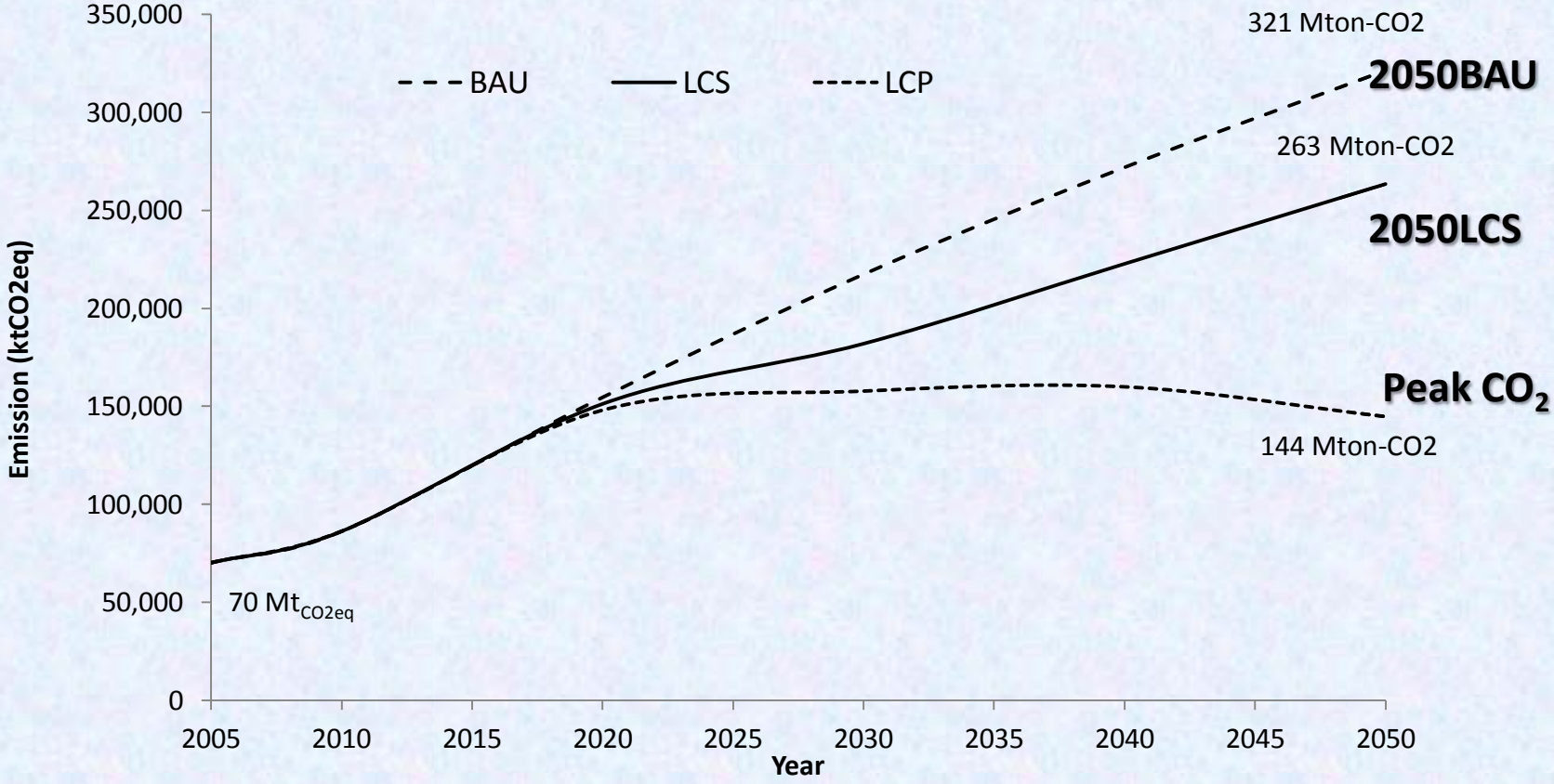
- Conventional thermal PP by natural gas
- Conventional thermal PP by lignite
- Conventional thermal PP by coal
- Conventional thermal PP by fuel oil
- Conventional combined cycled PP by natural gas
- Conventional gas turbine PP by natural gas
- Conventional gas turbine PP by diesel
- Conventional biogas PP
- Hydro PP
- Conventional congeneration PP
- Import power
- IGCC
- Supercritical PP
- Wind power
- Biomass PP
- Nuclear PP
- Solar PV
- Thermal PP with CCS by coal
- IGCC with CCS
- Supercritical PP with CCS
- Municiple waste PP



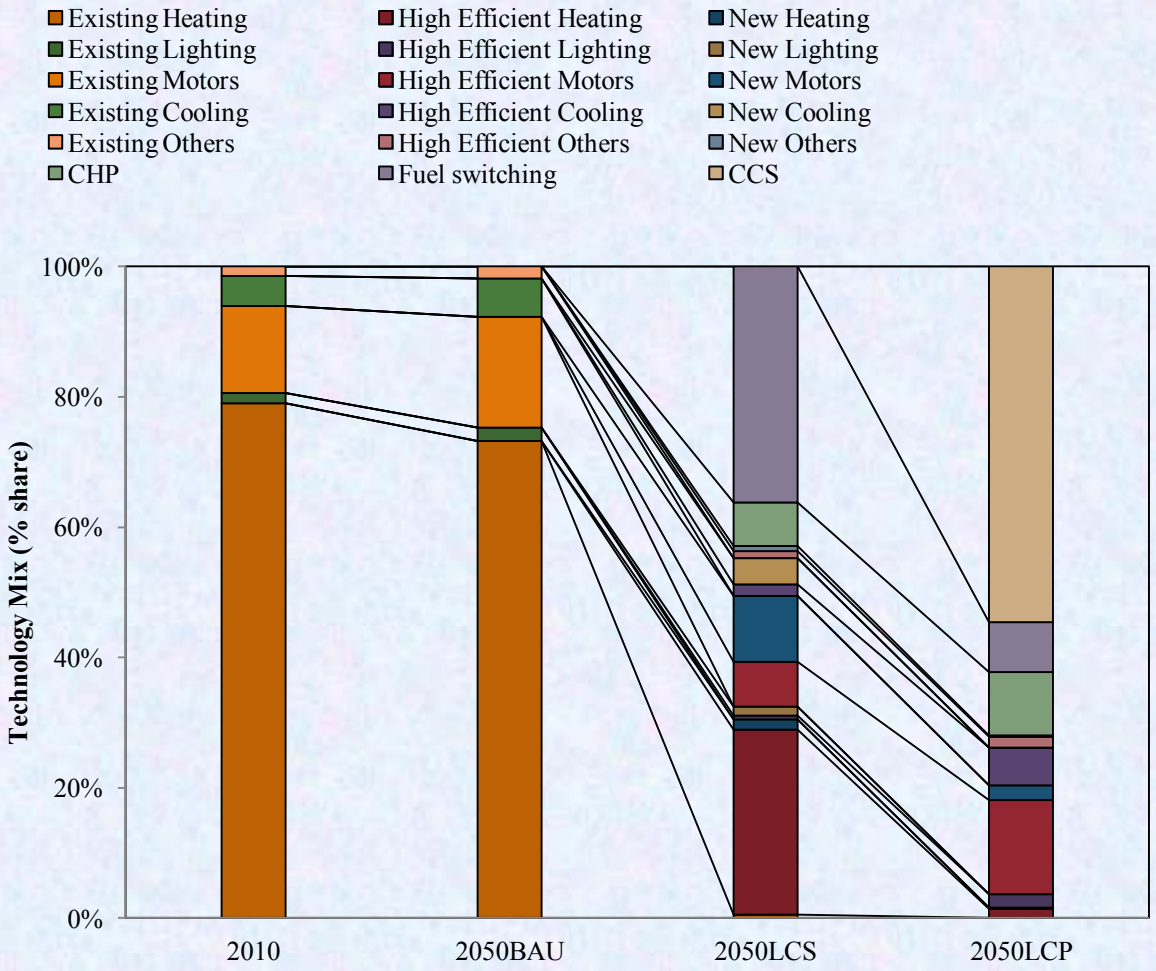
Low Carbon Peak
Action 1: Clean Power

		2010	2020	2030	2040	2050
1	Wind Power					
2	Nuclear Technology					
3	Solar PV					
4	Municipal Waste Power Plant					
5	Thermal Power Plant with CCS					
6	IGCC with CCS					
7	Supercritical Power Plant with CCS					

Low Carbon Peak
Action 1:
Clean Power



Low Carbon Peak
Action 2: GREEN INDUSTRY



Highlighted LCS Actions in 2050 Peak Scenario

Efficiency improvement
- Heating efficiency improvement
- Electrical efficiency improvement

CCS

CHP

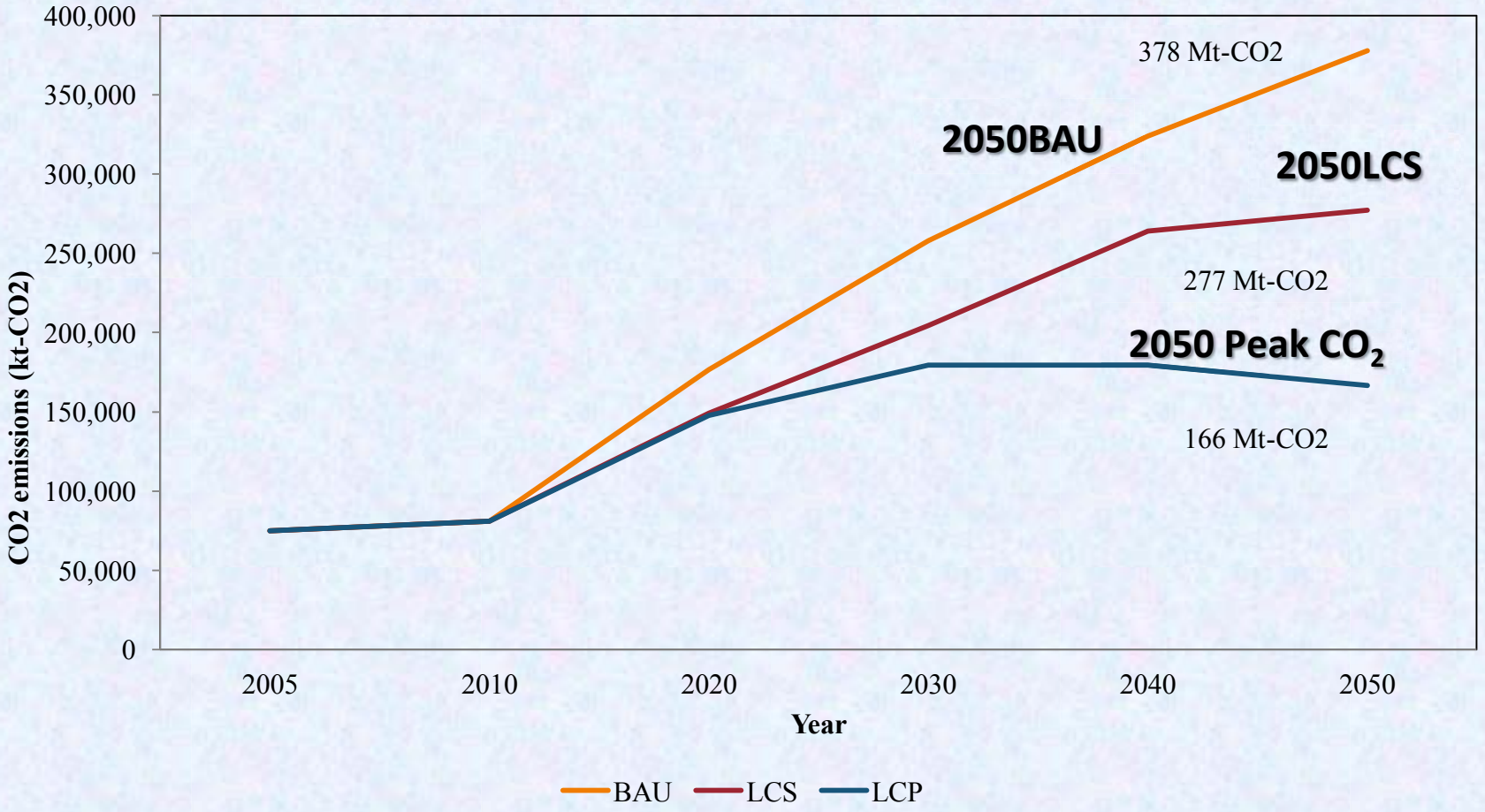
2nd and 3rd Generation Biomass

Advanced technologies
- Heating advanced technologies
- Advanced electrical technologies

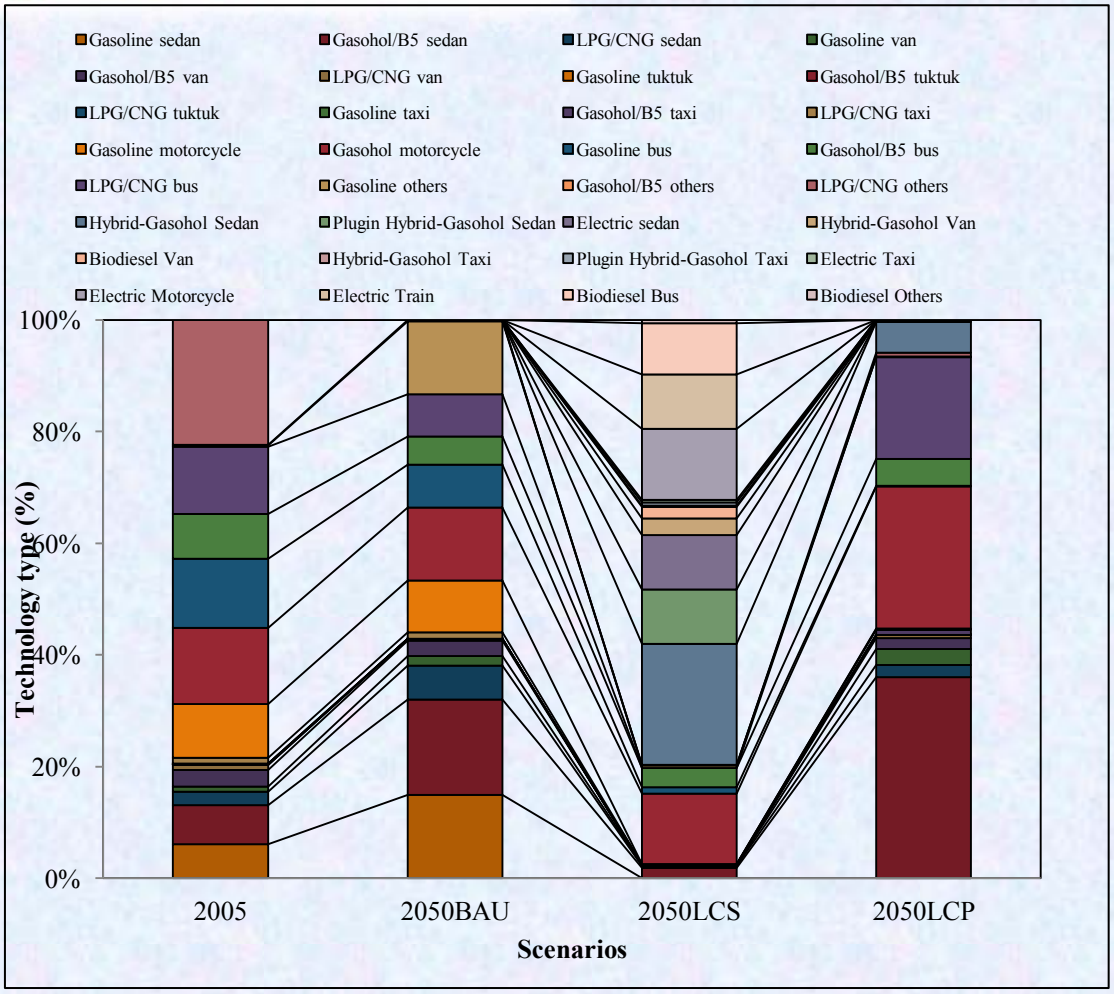
Low Carbon Peak
Action 2: GREEN INDUSTRY

		2010	2015	2020	...	2045	2050
1	Efficient Heating						
2	Advanced Technology in Heating						
3	New Heating						
4	High Efficient Lighting						
5	New Lighting						
6	High Efficient Motors						
7	New Motors						
8	High Efficient Cooling						
9	New Cooling						
10	High Efficient Others						
11	New Others						
12	CHP						
13	Fuel Switching						
14	CCS						

Low Carbon Peak
Action 2: GREEN INDUSTRY



Low Carbon Peak
Action 3: Smart Passenger Transport



Highlighted LCS Actions in 2050 Peak Scenario

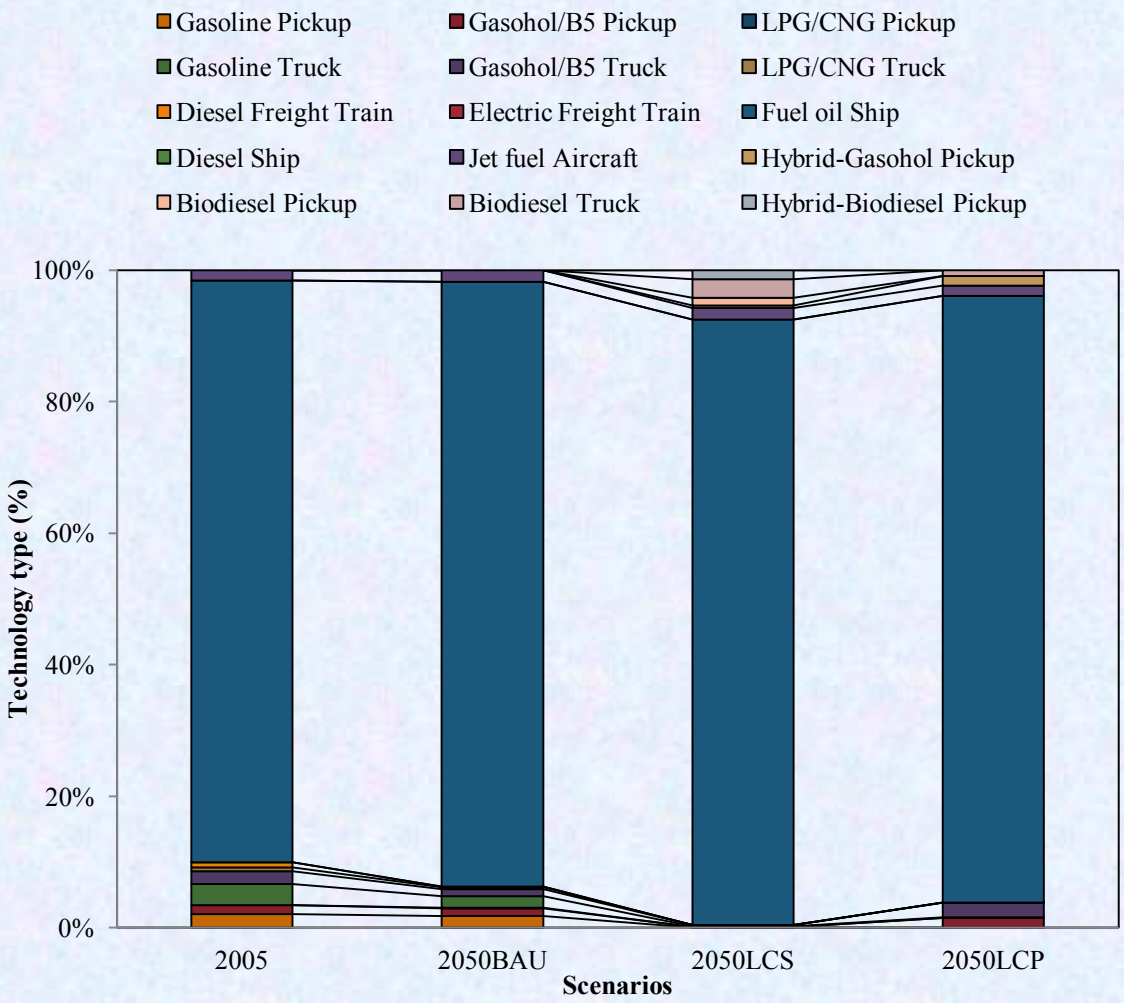
Bus sector by each technology
- Modal shift to electric train
- Fuel switching (E85, LPG,CNG)

Motorcycle
-Gasohol

Passenger
- Hybrid (battery)
-Fuel switching (E85, LPG,CNG)

Sedan
- Hybrid (battery)
- Plug-in hybrid
- EV
- Fuel switching (E85, LPG,CNG)

Low Carbon Peak
Action 4: Effective Freight Transport



Highlighted LCS Actions in 2050 Peak Scenario

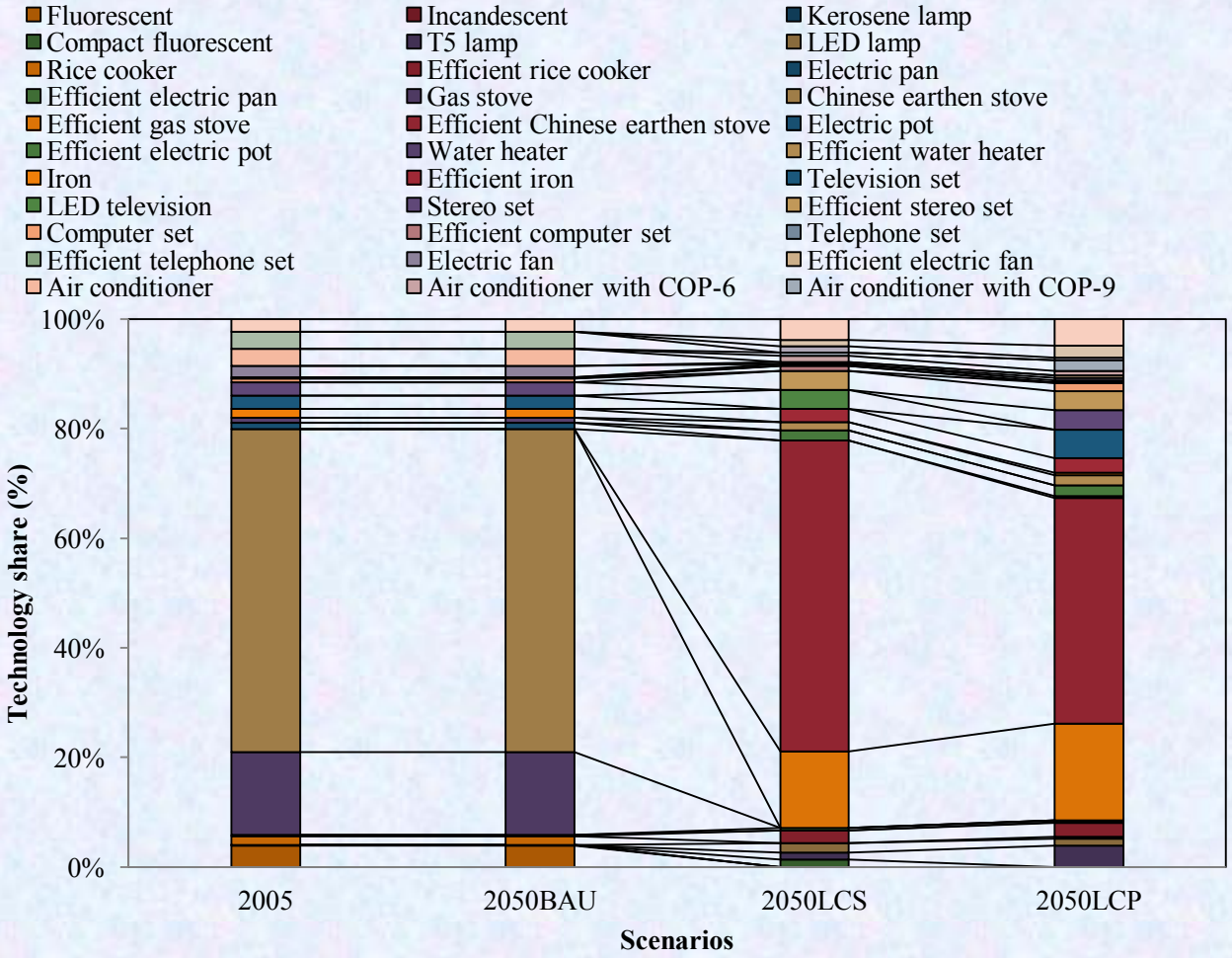
Pickup
- Diesel Hybrid (battery)
- Gasoline Hybrid (battery)
- 2nd generation bio-fuel (B10, B20)
- Fuel switching (E85, LPG,CNG)

Truck
-Second generation bio-fuel (B10, B20)
- Modal shift to Rail

Low Carbon Peak
Action 4: Effective Transport

		2010	2020	2030	2040	2050
1	Gasohol/ B5 sedan					
2	LPG/ CNG sedan					
3	Gasohol/ B5 van					
4	Gasohol/ B5 tuktuk					
5	Gasohol/ B5 taxi					
6	LPG/ CNG taxi					
7	Gasohol Motorcycle					
8	Gasohol/ B5 bus					
9	Gasohol/ B5 others					
10	Hybrid-Gasohol Taxi					
11	Electric Train					
12	Gasohol/ B5 pickup					
13	Electric Freight Train					
14	Hybrid-Gasohol Pickup					
15	Biodiesel Pickup					
16	Biodiesel Truck					

Low Carbon Peak
Action 5:
Thai Style Comfortable Houses



Highlighted LCS Actions in 2050 Peak Scenario

Cooking
- Higher efficiency stove
- Renewable stove

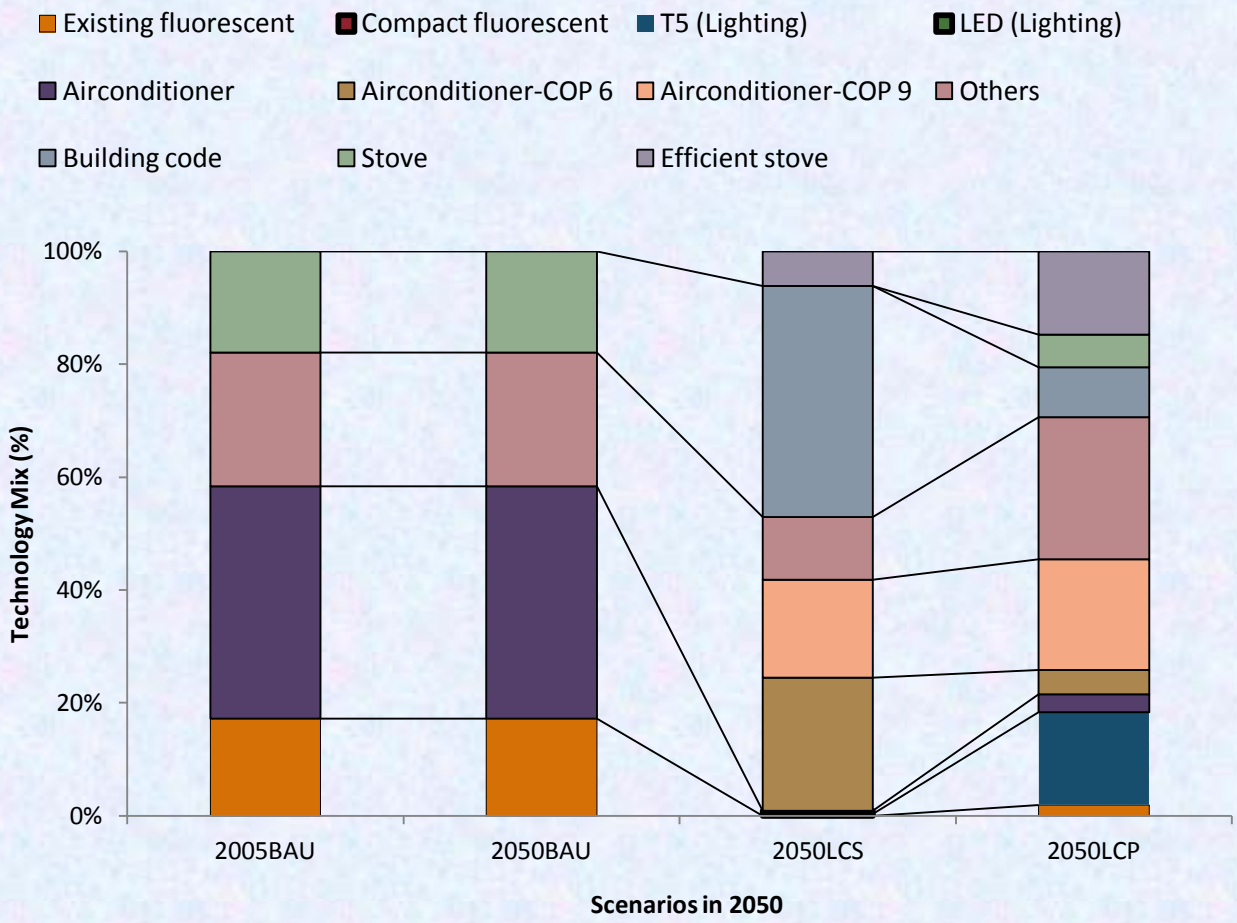
Lighting
- T5
- LED Lamp
- Compact Fluorescent

Cooling
- A/C and refrigerator COP6
- A/C and refrigerator COP9
- New Building codes

Low Carbon Peak
Action 5:
Thai Style Comfortable Houses

		2020	2030	2040	2050
1	T5 lamp				
2	LED lamp				
3	Efficient Appliances				
4	Advanced Air-conditioners				
5	Advance Refrigerators				

Low Carbon Peak
Action 6:
Modern Buildings



Highlighted LCS Actions in 2050 Peak Scenario

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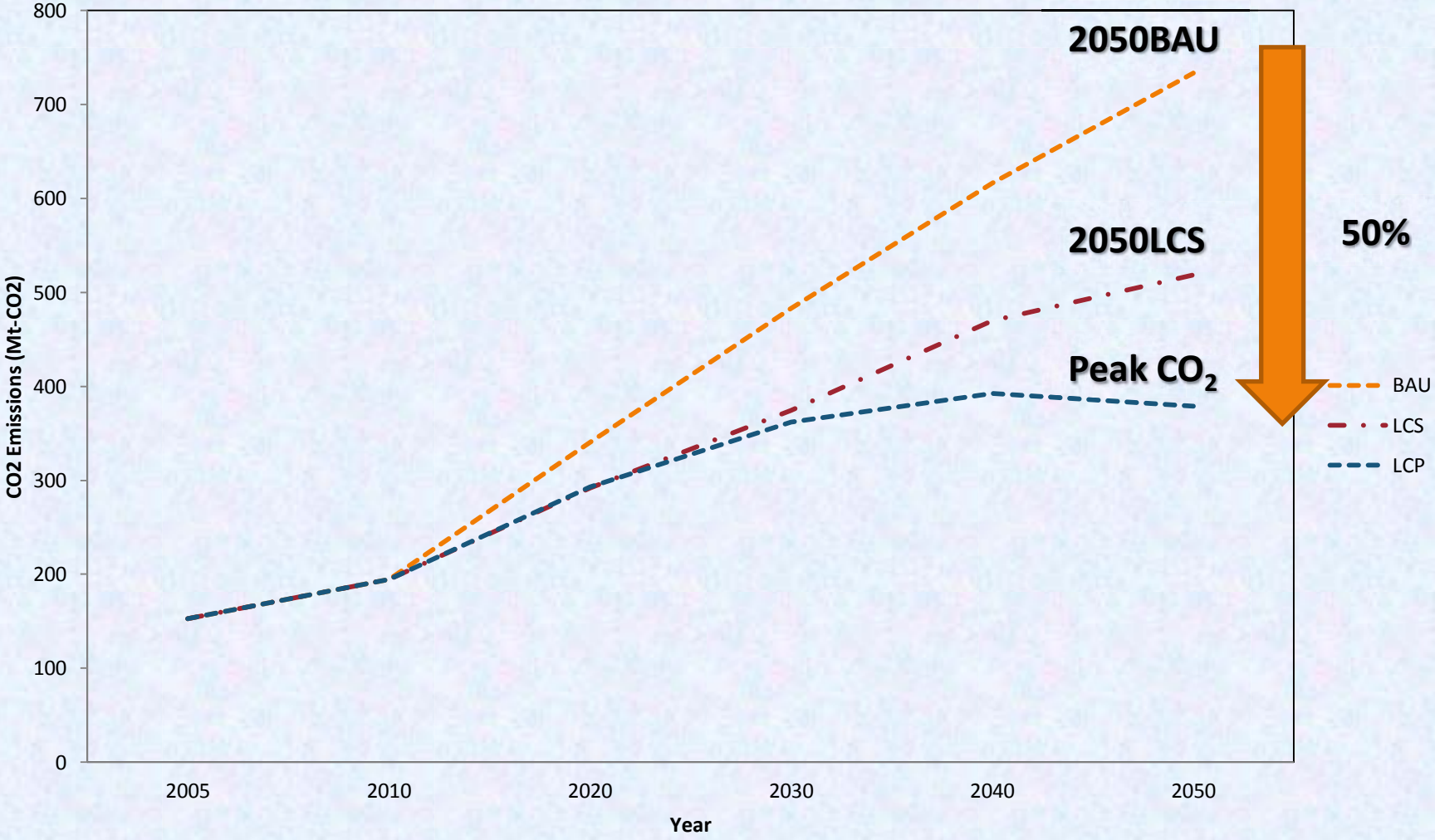
Lighting
- T5
- LED Lamp
- Compact Fluorescent

Cooling
- A/C and refrigerator COP6
- A/C and refrigerator COP9
- New Building codes

Low Carbon Peak
Action 6:
Modern Buildings

		2010	2015	2020	...	2045	2050
1	T5 Lamp						
2	Building Code						
3	Efficient Stove						
4	Air conditioner with COP-6						
5	Air conditioner with COP-9						
6	Efficient other equipment						

Total GHG Emissions 2005-2050 (Peak CO_2)



Conclusions

- In 2050, these CO_2 CMs will result in **Transformational Changes** in not only supply side but also demand side while **Thailand's NAMA will not** result in such changes.
- To achieve **Peak target**, Thailand needs, i) LCS **Capacity Building**, ii) sustainable **Feed-in Tariff scheme** for renewable electricity, iii) enforcement of **Energy Efficiency laws,** iv) **Co-funding** of the LCS Actions in both **demand side** and **clean supply side**.
- This **Peak target** can not be achieved **if they are not planned & implemented in the early stage**.
- In addition, **M R V** of LCS actions are of necessity.

Selected LCS publication between Thailand and AIM Teams

Panida Thepkhun, Bundit Limmeechokchai, Shinichiro Fujimori, Toshihiko Masui, and Ram M Shrestha (2013), "Thailand's Low-Carbon Scenario 2050: The AIM/CGE analyses of CO_2 mitigation measures", ***Energy Policy,*** Vol.62, 2013.

Sujeetha Selvakkumaran, Bundit Limmeechokchai, Toshihiko Masui, Tatsuya Hanaoka and Yuzuru Matsuoka, "Low Carbon Society Scenario 2050 in Thai Industrial Sector", ***The 26th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems,*** July 16-19, 2013, Guilin, China, and selected for publication in ***Energy Conversion and Management.***

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Pornphimol Winyuchakrit1, Bundit Limmeechokchai1, Yuzuru Matsuoka, Kei Gomi, Mikiko Kainuma, Junichi Fujino and Maiko Suda (2011), "Thailand's Low-Carbon Scenario 2030: Analyses of Demand Side CO_2 Mitigation Options", ***Energy for Sustainable Development*****, 15,** 2011.

どうもありがとう

Thank You

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