

# *Low-Carbon Society Vision 2030*

## *Thailand*

**Bundit Limmeechokchai**

**Sirindhorn International Institute of Technology  
Thammasat University**

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# ASIA-PACIFIC INTEGRATED MODEL (AIM)

## Bottom-up approach

### AIM/ExSS Model

- ❑ *This tool can assess energy balance and CO<sub>2</sub> emissions among sectors simultaneously.*
- ❑ *This is a snapshot tool at a certain point (but not optimization model).*

### AIM/Enduse Model

- ❑ This model can assess individual technologies under the detail technology selection framework.
- ❑ This model is partial equilibrium model on energy.

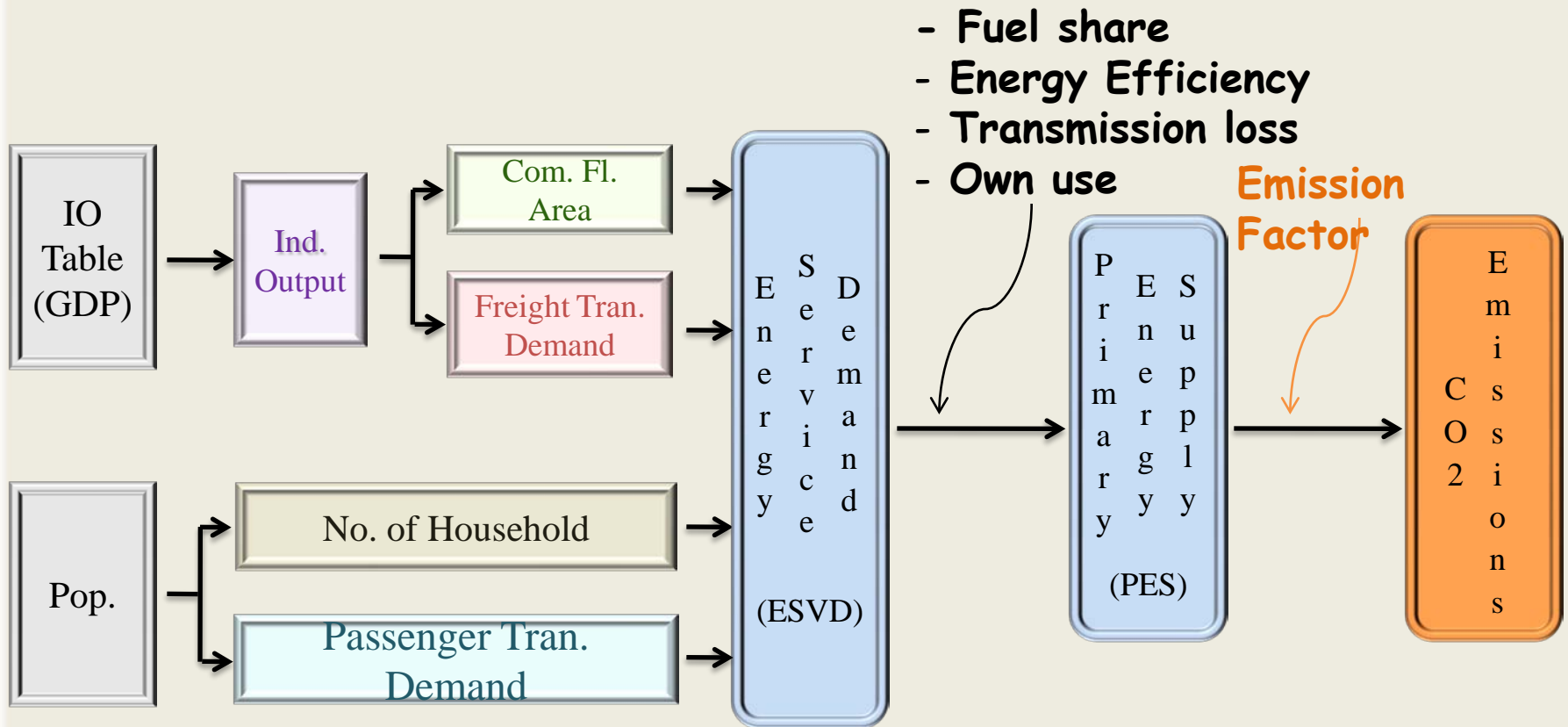
## Top-down approach

### AIM/CGE Model

- ❑ This model draws the balanced macro economy, based on social condition such as population, technology and preference, and countermeasure.
- ❑ This model is a general equilibrium model.

# EXSS BASIC CONCEPT

- Tool for socio-economic indicators and environmental load emissions

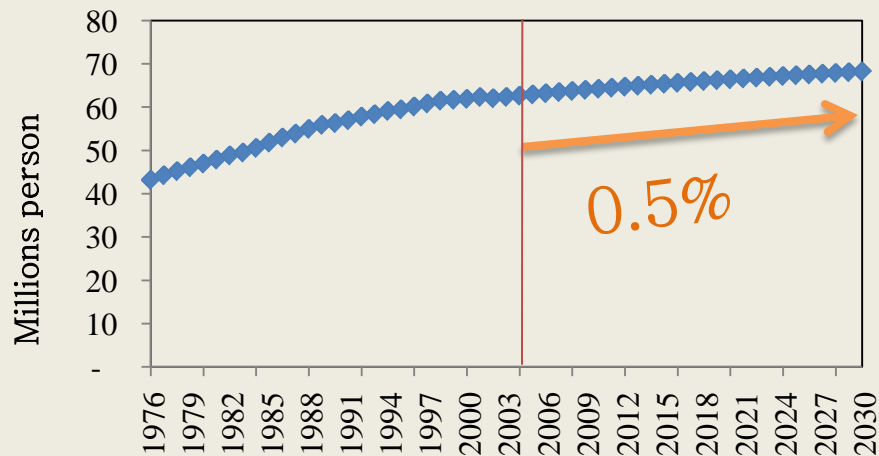


# INTRODUCTION

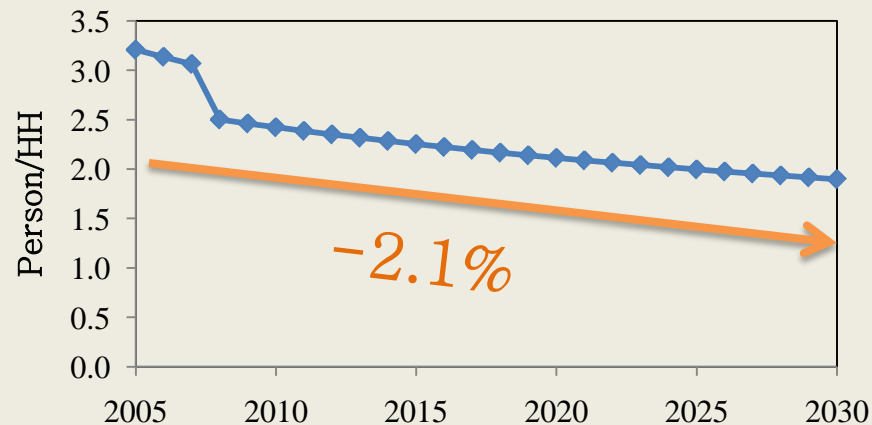
- ❑ LCS is a concept referring to an economy which has a minimal output of GHG emissions into biosphere.
- ❑ To propose for avoid catastrophic climate change, and precursor to zero carbon society and renewable-energy economy.
- ❑ To discuss the possibility of developing a Thailand's low-carbon society.
- ❑ To create awareness among Thailand's authorities, government, stakeholders, and communities for urgent and decisive actions to be taken to realize a robust growth and low-carbon Thailand.

# QUANTITATIVE ASSUMPTIONS

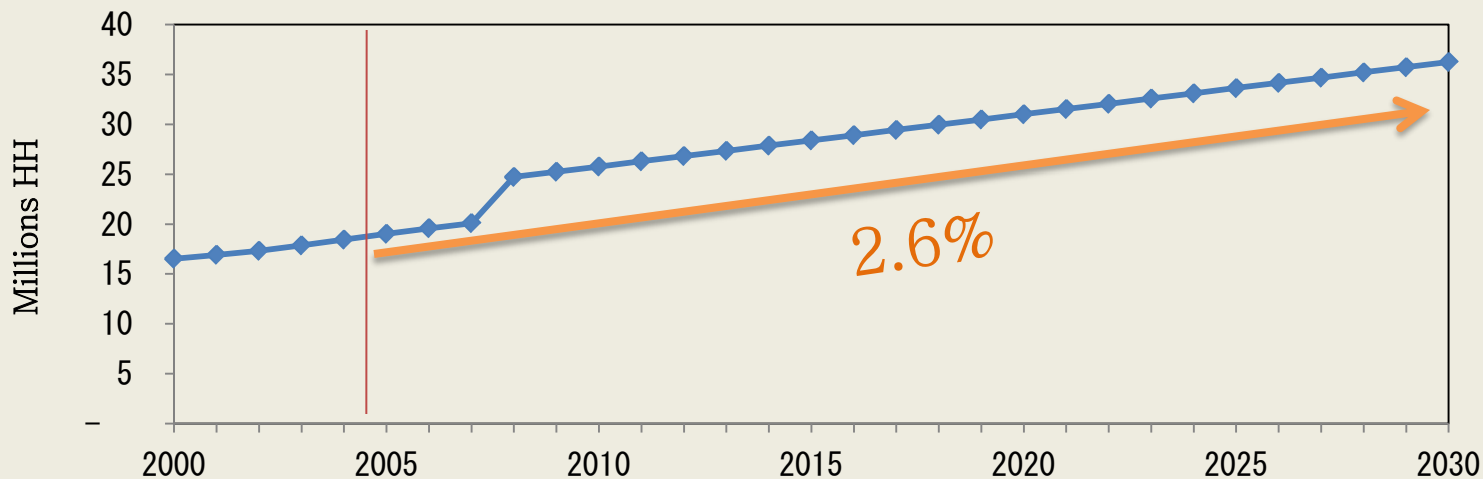
## Population



## HH size

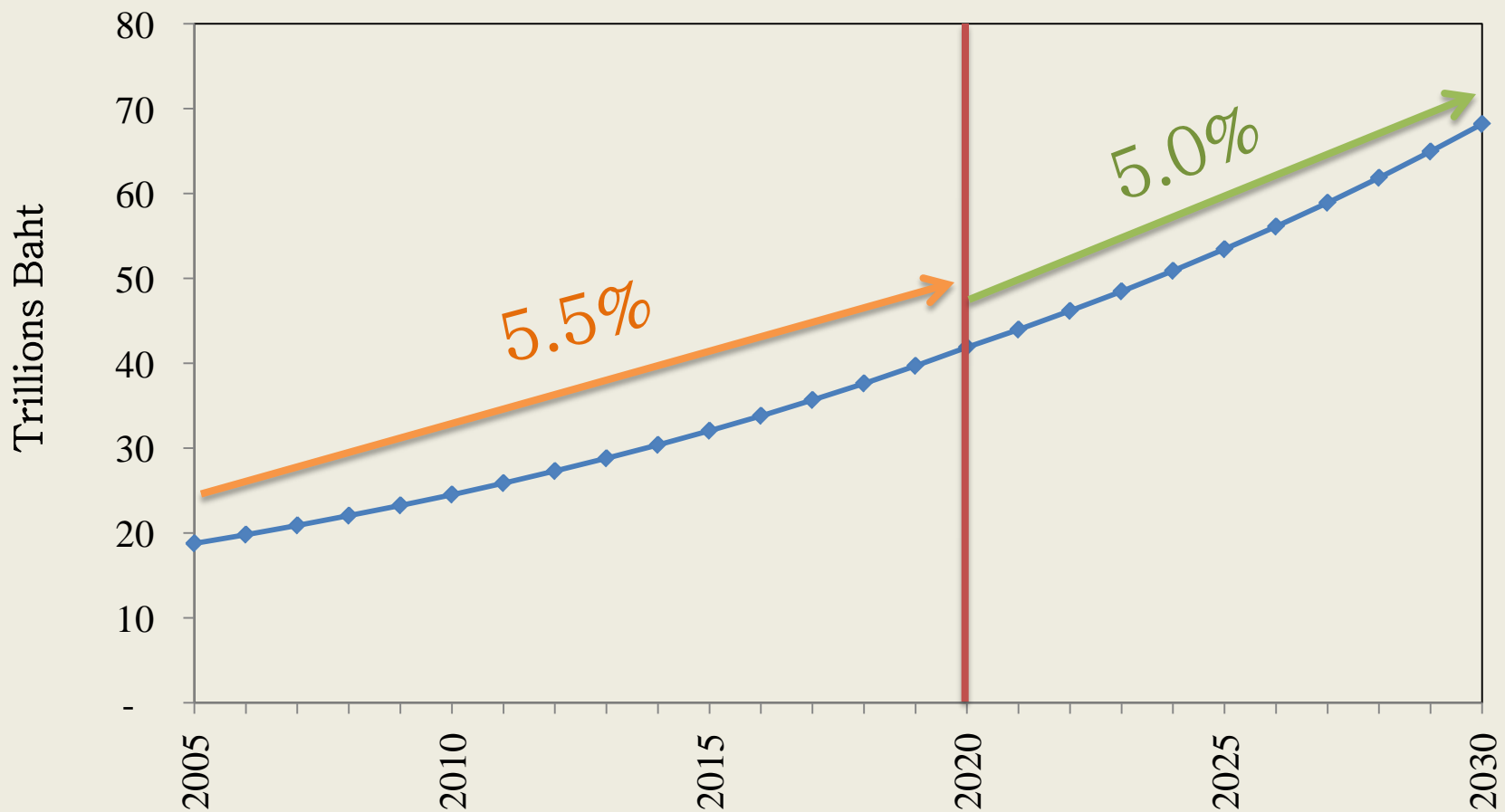


## No. of HH



# QUANTITATIVE ASSUMPTIONS

## Gross Domestic Product (GDP)



# ESTIMATED SOCIO-ECONOMIC INDICATORS

	2005		2030
	60,991,000	0.49%	68,815,004
Population			36,265,390
No. of HH	19,016,784		30,802,306
GDP (mil Baht)	8,016,595		68,456,651
Gross output (mil Baht)	18,755,884	3.9%	2,801,864
Primary industry (mil Baht)	1,116,621	6.4%	38,008,931
Secondary industry (mil Baht)	11,453,496		27,645,856
Tertiary industry (mil Baht)	6,185,767		394
Remarks: Primary industry	→ Agriculture, Mining, and Construction		216,088
Secondary industry	→ Textiles, Food & beverage, Chemical, Metallic, Non-metallic, and Others		191,520
Tertiary industry	→ Service sector		188,524
Floor-space for commercial (mil m <sup>2</sup> )			589,859
Passenger transport demand (mil p-km)			
Freight transport demand (mil t-km)			

- NESDB  
- DOPA

- NESDB

- TTP  
- DCA  
- DLT

- ENERGY DEMAND IN 2030 BAU
- ENERGY DEMAND IN 2030 CM

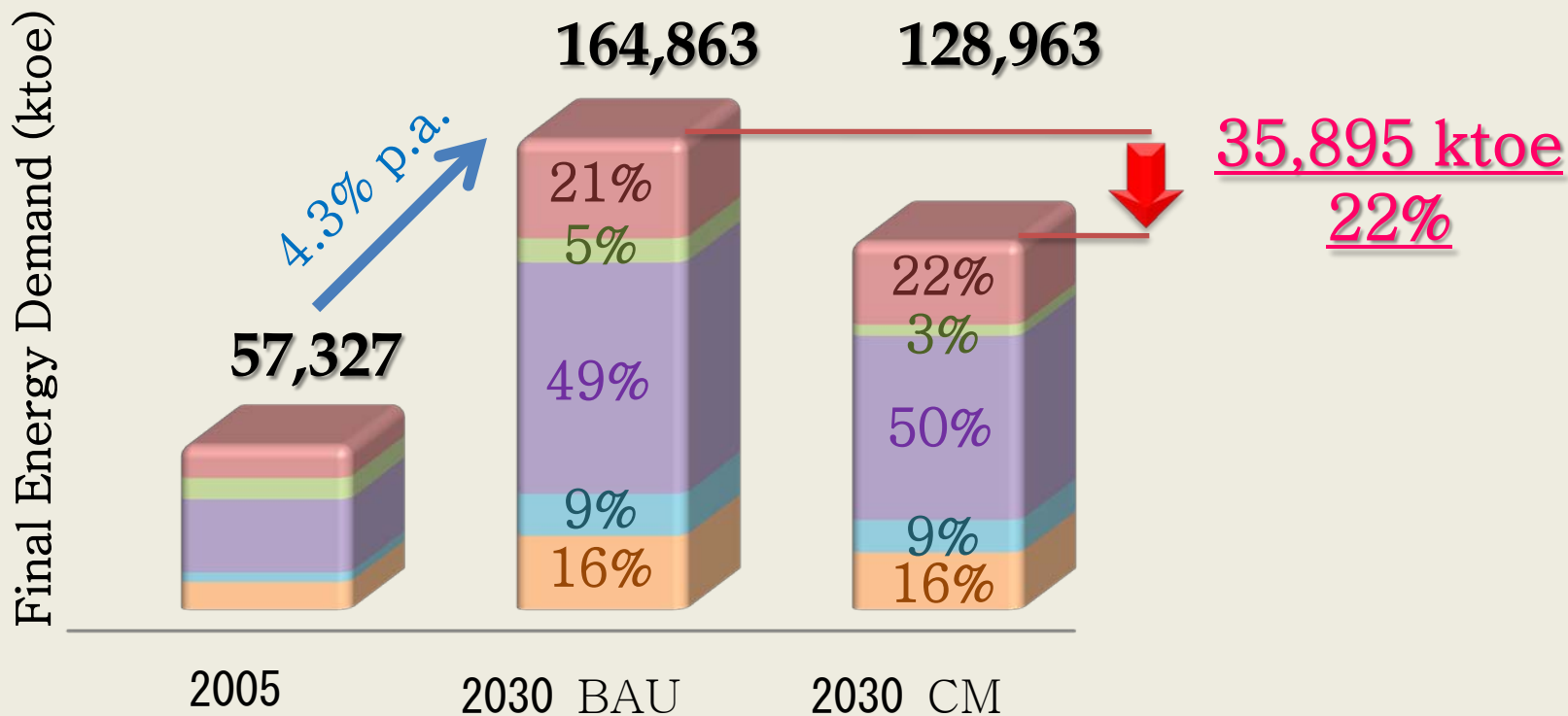
ONLY COST-EFFECTIVE ENERGY SAVINGS AND CO<sub>2</sub> MITIGATION OPTIONS.

CO<sub>2</sub> MITIGATION MEASURES IN 2030CM MUST BE COMPLIED WITH NATIONAL CONSTRAINTS.



# ENERGY DEMAND

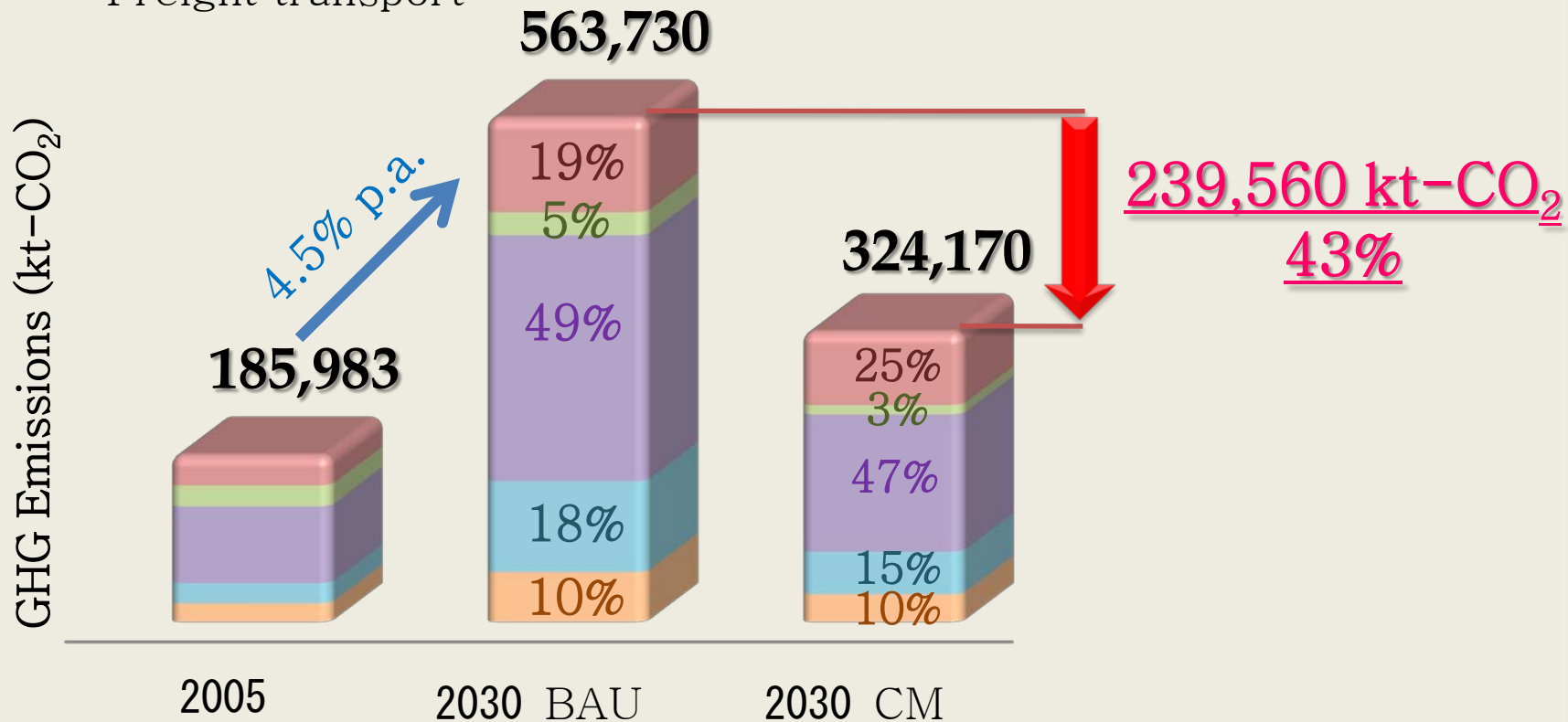
- Residential
- Commercial
- Industry
- Passenger transport
- Freight transport



Remarks: BAU is Business as Usual  
CM is Countermeasure

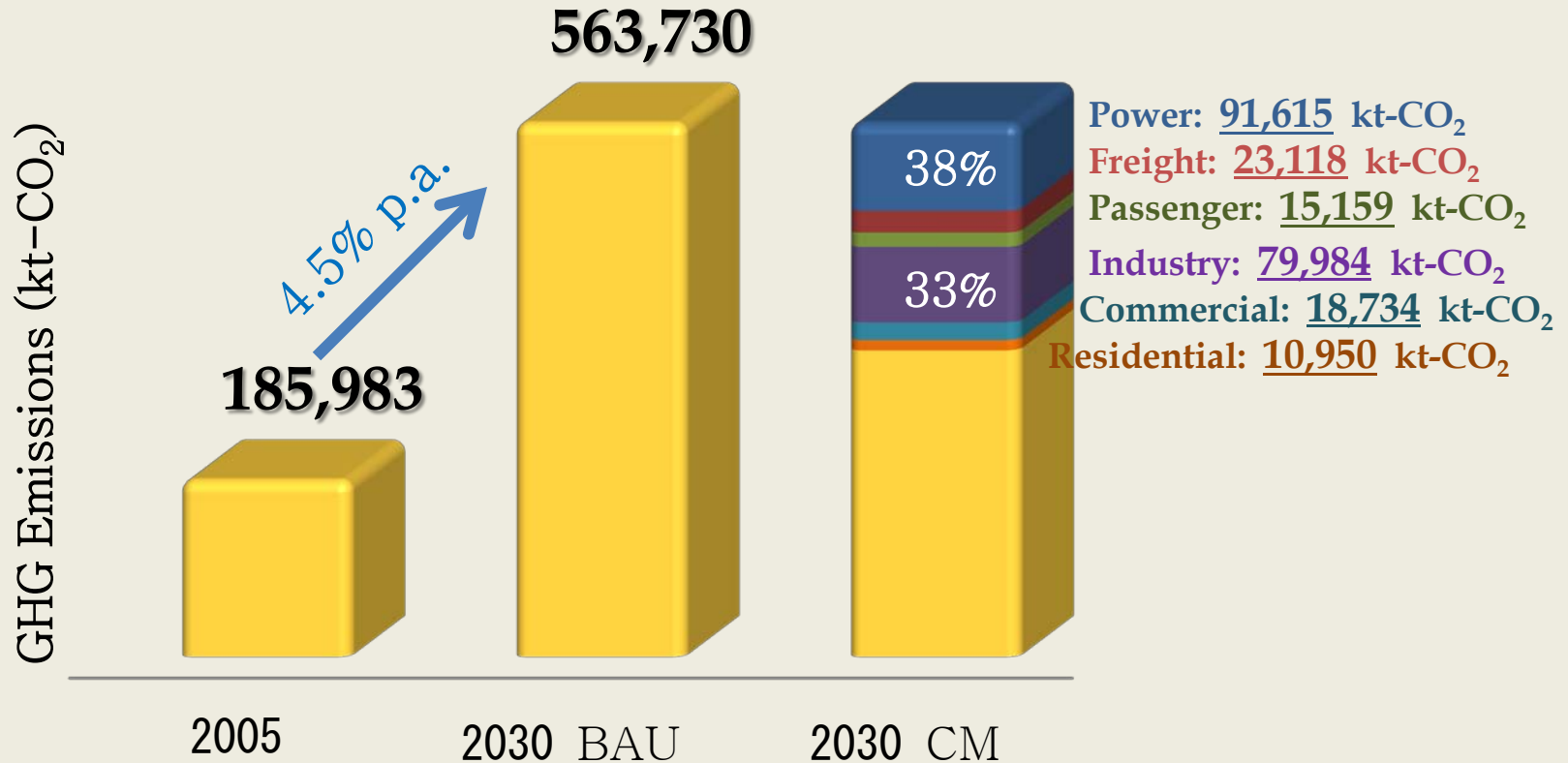
# GHG EMISSIONS

- Residential
- Commercial
- Industry
- Passenger transport
- Freight transport



Remarks: BAU is Business as Usual  
CM is Countermeasure

# GHG EMISSIONS/REDUCTIONS



Remarks: BAU is Business as Usual  
CM is Countermeasure

# MEASURES

## POWER GENERATION

- Efficiency improvement in the Power generation sector
  - T&D loss will improve to be 5%.
  - Technology transfer: New power plant technology will be added such as IGCC and CCGT → Eff. Improve to be 48% and 56%.
  - Fuel switching: Increasing share of RE and NE in PDP 2010.

Fuel type	Share in 2030 BAU	Share in 2030 CM
Natural gas	71.4	39.0
Oil	6.6	-
Coal	15.1	23.6
Hydro	4.4	20.5
Nuclear	-	11.2
Renewable energy	2.5	5.7

# MEASURES

## RESIDENTIAL

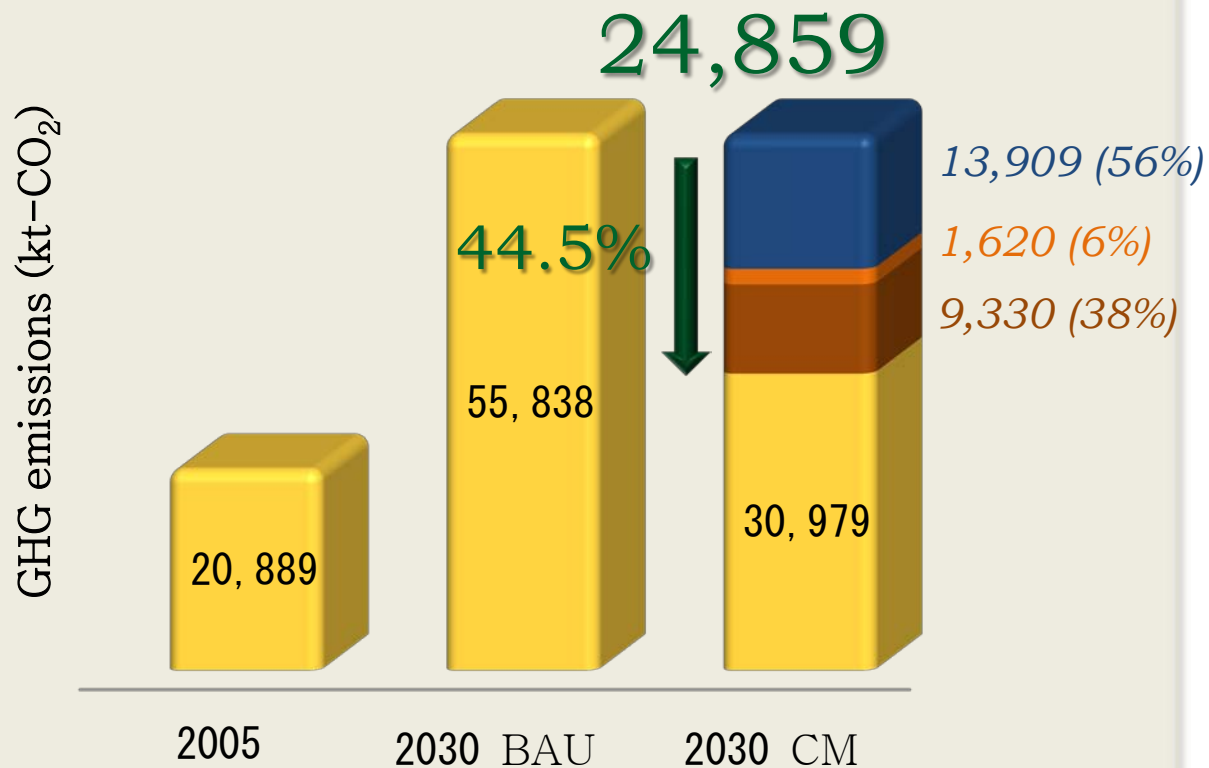
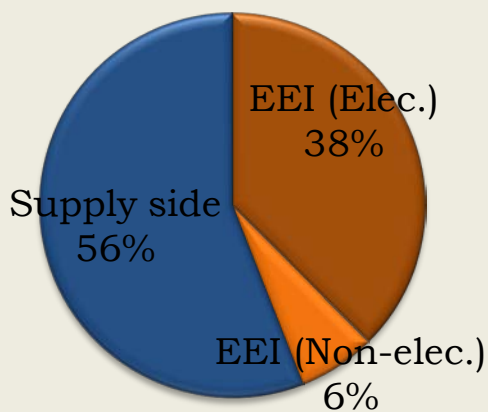
- ❑ Energy efficiency improvement in Households (Electric)
  - *Efficiency improvement by 30%*
  - *Penetration rates up to 100% in 2030*
  
- ❑ Energy efficiency improvement in Households (Non-electric)
  - *Efficiency improvement*
    - *by 30% in wood stove*
    - *by 5% in LPG stove*
  - *Penetration rates up to 100% in 2030*



Ref: Thailand Research Fund. 2007. Research Programme on Policy Research for Promoting the Development and Utilization of Renewable Energy and the Improvement of Energy Efficiency in Thailand.

# MEASURES

## RESIDENTIAL



- GHG emissions
- EEI (electrical app.)
- EEI (non electrical app.)
- EEI (power sector)

# MEASURES

## COMMERCIAL

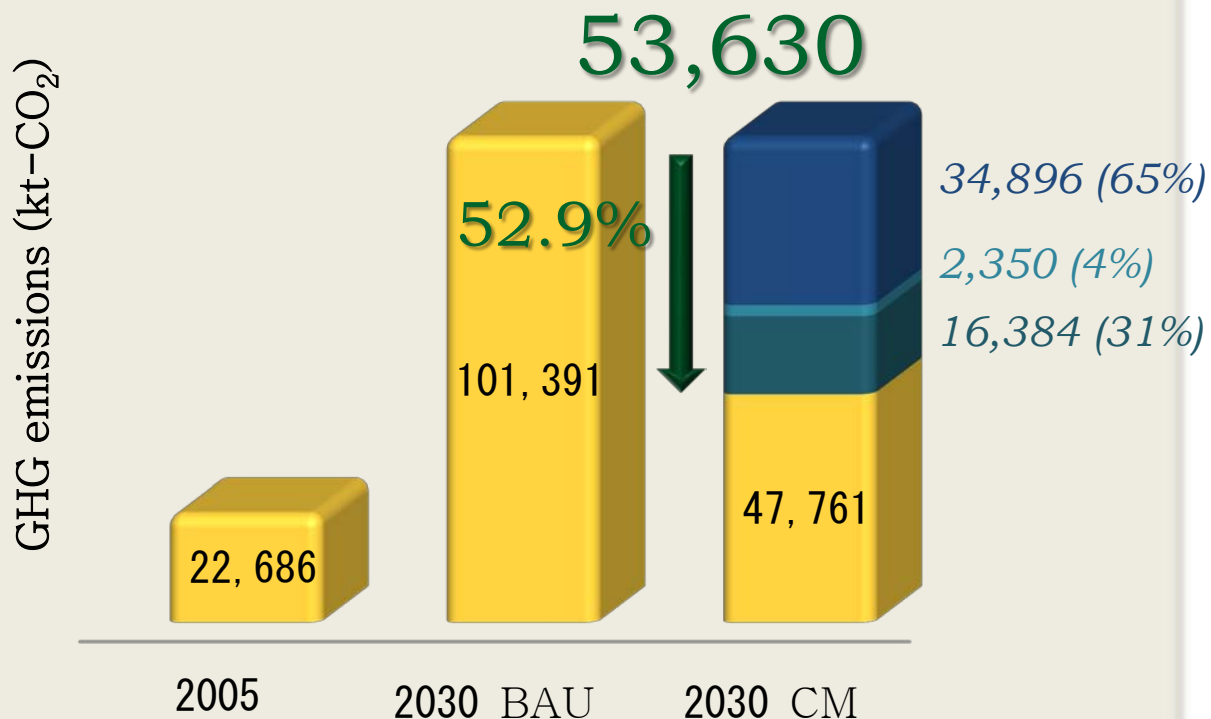
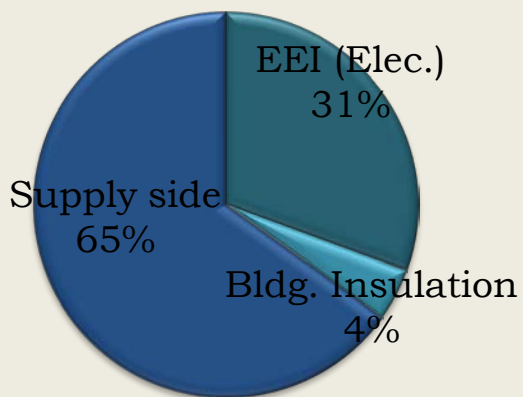
- Energy efficiency improvement in Buildings
  - *Efficiency improvement by 30%*
  - *Penetration rates up to 100% in 2030*
  
- Energy efficiency improvement in Buildings (Building Codes)
  - *Building insulation*
  - *Building envelope*
  - *Penetration rates up to 100% in 2030*



Ref: Thailand Research Fund. 2007. Research Programme on Policy Research for Promoting the Development and Utilization of Renewable Energy and the Improvement of Energy Efficiency in Thailand.

# MEASURES

## COMMERCIAL



- GHG emissions
- EEI (electrical app.)
- Building insulation
- EEI (power sector)



# MEASURES

## INDUSTRY

□ Energy efficiency improvement in Industry (Electric)

▪ *Efficiency improvement*

System	Motor	Others	Lighting
EEI	10%	20%	30%

▪ *Penetration rates up to 100% in 2030*

□ Energy efficiency improvement in Industry (Non-electric)

▪ *Efficiency improvement by 30%*

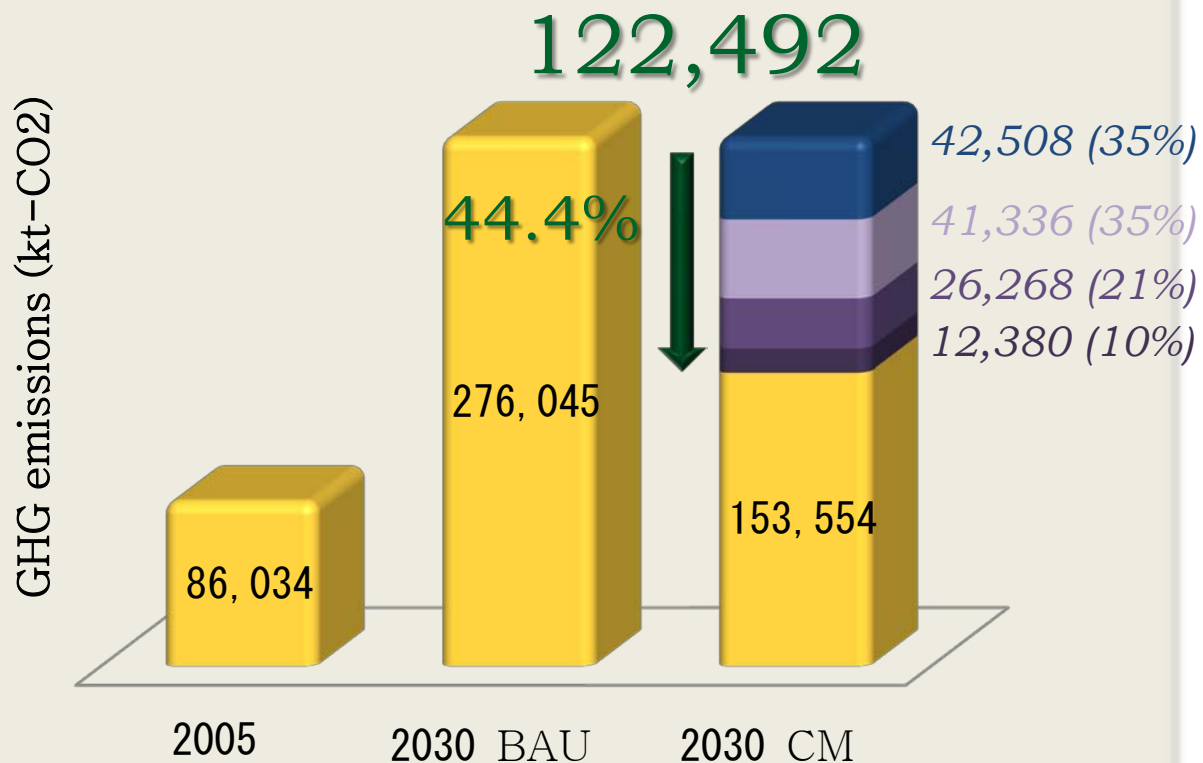
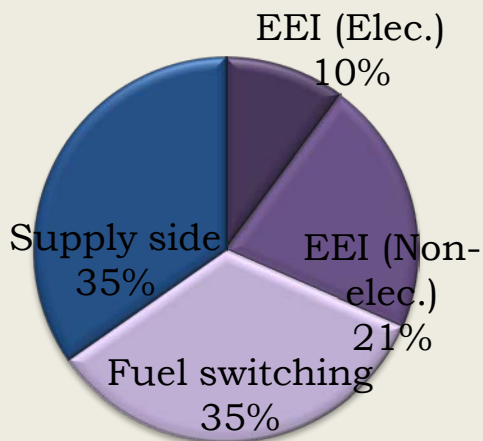
□ Fuel switching in Industry

▪ *Reduce the penetration level in coal and oil by 50%*

▪ *Replace the penetration level remaining in biomass and LPG.*

# MEASURES

## INDUSTRY



- GHG emissions
- EEI (non electrical app.)
- EEI (power sector)
- EEI (electrical app.)
- Fuel switching

# MEASURES

## TRANSPORTATION

- ❑ Fuel economy improvement (FEI) in Transport sector
  - *Efficiency improvement by 30% in*
  - *Penetration rates up to 100% in 2030*
  
- ❑ Travel demand management (TDM) in Transport sector
  - *Efficiency improvement by 7.38%*
  - *Using (eco-driving, bus priority, and non-motorized transport)*

Ref: Pongthanaisawan, J. 2007. Road transport energy demand analysis and energy saving potentials in Thailand. Asian Journal of Energy and Environment

Kuwattanachai, N. 2009. Hybrid and Electric cars. TRF Newsletter.

# MEASURES

## TRANSPORTATION



- ❑ Fuel switching in Transport sector
  - CNG engines will increase by 20% in 2030
  - Hybrid engines can save energy consumption by 30%

- ❑ Modal shift in Transport sector



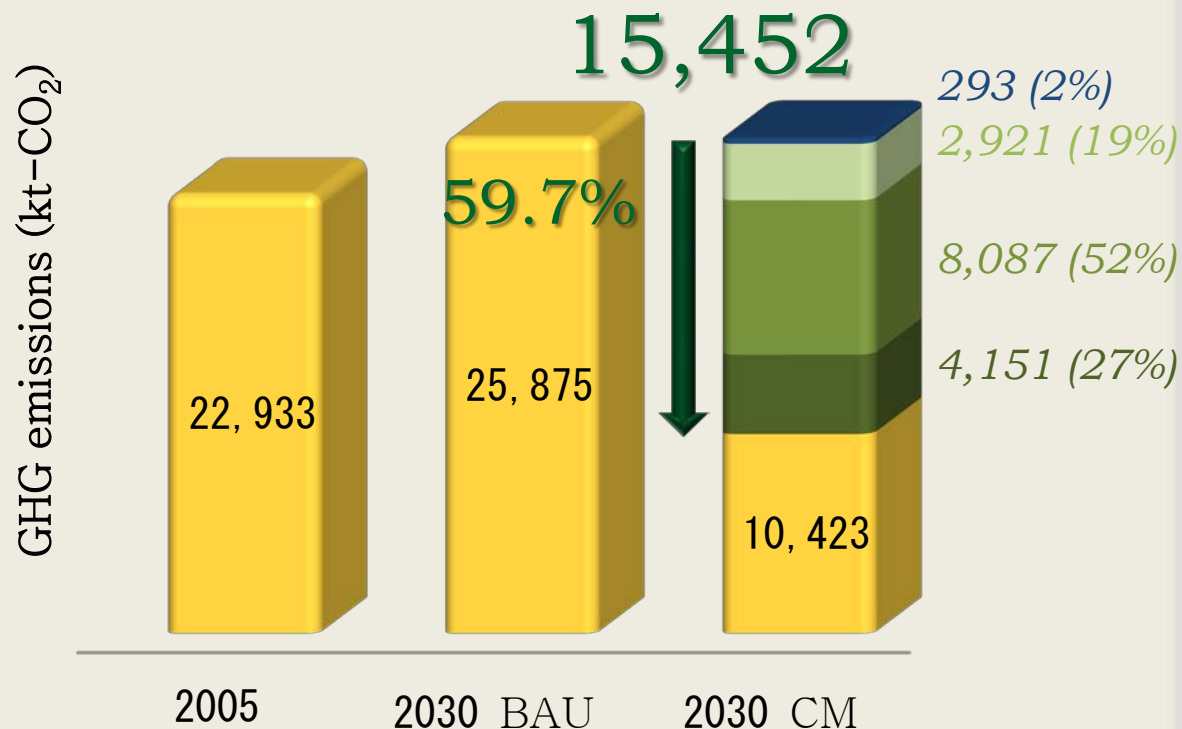
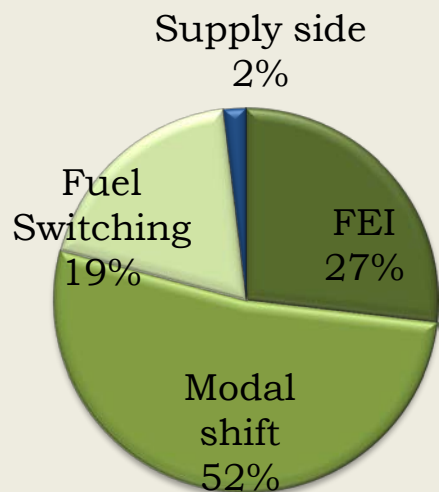
		SV	LV	Bus	Motor bike	Bike	Walk	Train	Plane	Ship
Passenger	2005	24.3	6.7	42.3	14.6	0.8	10.7	0.2	0.4	-
	2030	15.0	5.0	20.0	10.0	12.8	25.0	12.0	0.2	-
Freight	2005	2.2	80.8					2.3	0.02	14.8
	2030	2.2	58.2	-	-	-	-	24.9	0.02	14.8

Ref: Pongthanaisawan, J. 2007. Road transport energy demand analysis and energy saving potentials in Thailand. Asian Journal of Energy and Environment

Kuwattanachai, N. 2009. Hybrid and Electric cars. TRF Newsletter.

# MEASURES

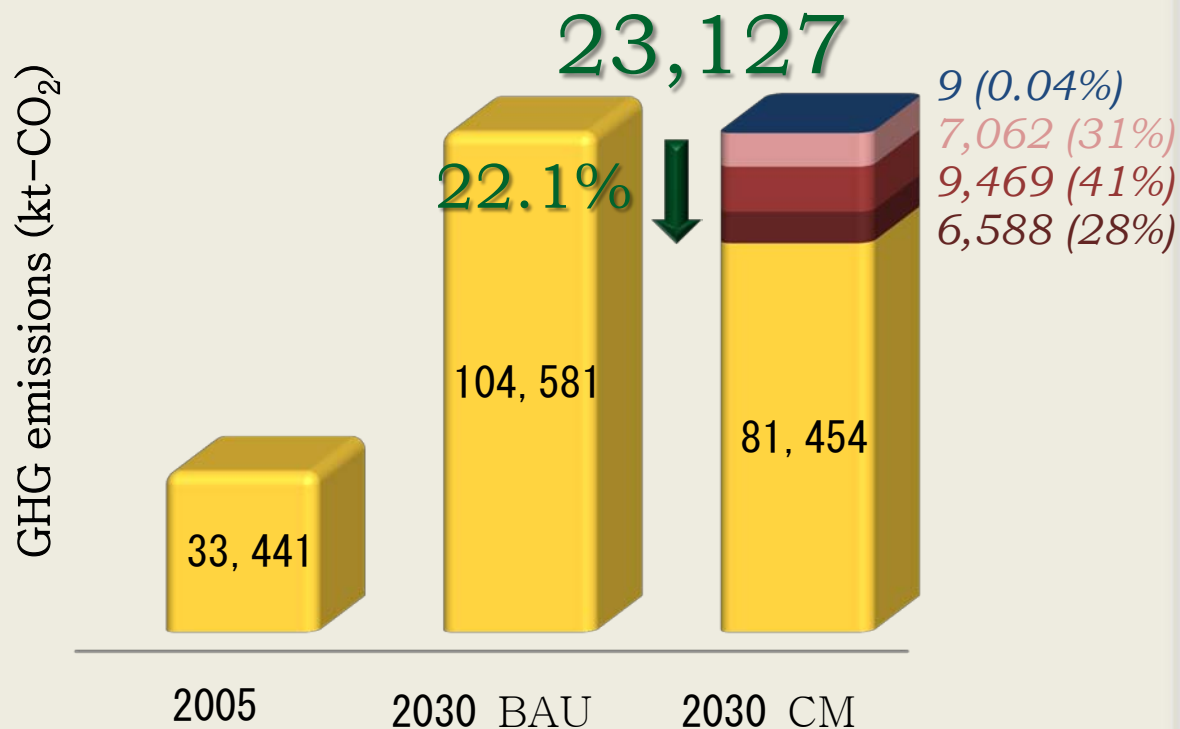
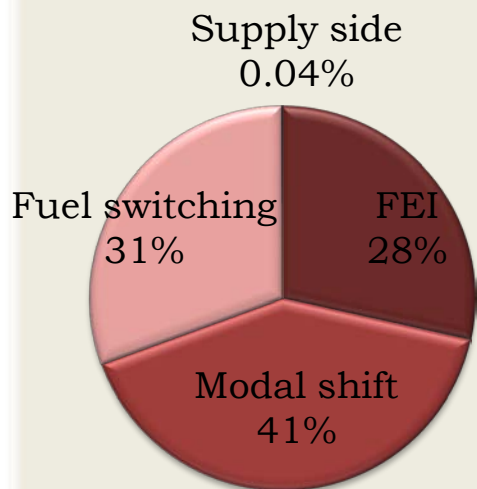
## PASSENGER TRANSPORT



- GHG emissions
- FEI
- Modal shift
- Fuel switching
- EEI (power sector)

# MEASURES

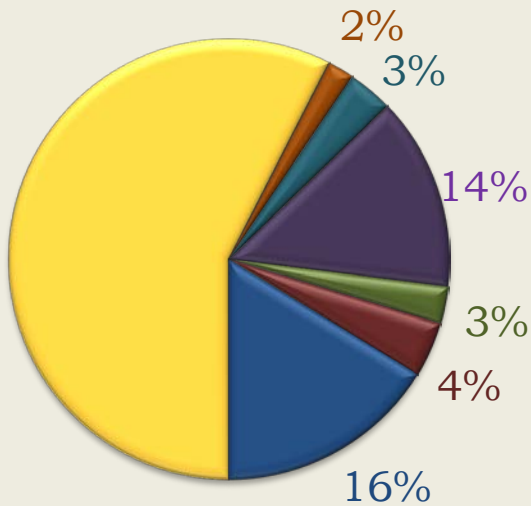
## FREIGHT TRANSPORT



- GHG emissions
- FEI
- Modal shift
- Fuel switching
- EEI (power sector)

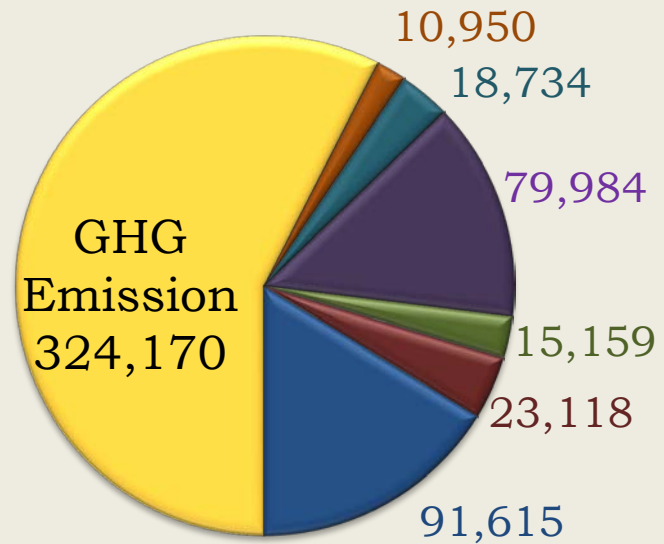
# GHG EMISSIONS/REDUCTION

**TOTAL**



- GHG emissions
- Residential
- Commercial
- Industry
- Passenger transport
- Freight transport
- Power generation

**GHG REDUCTION:  
239,560 KT-CO<sub>2</sub>**



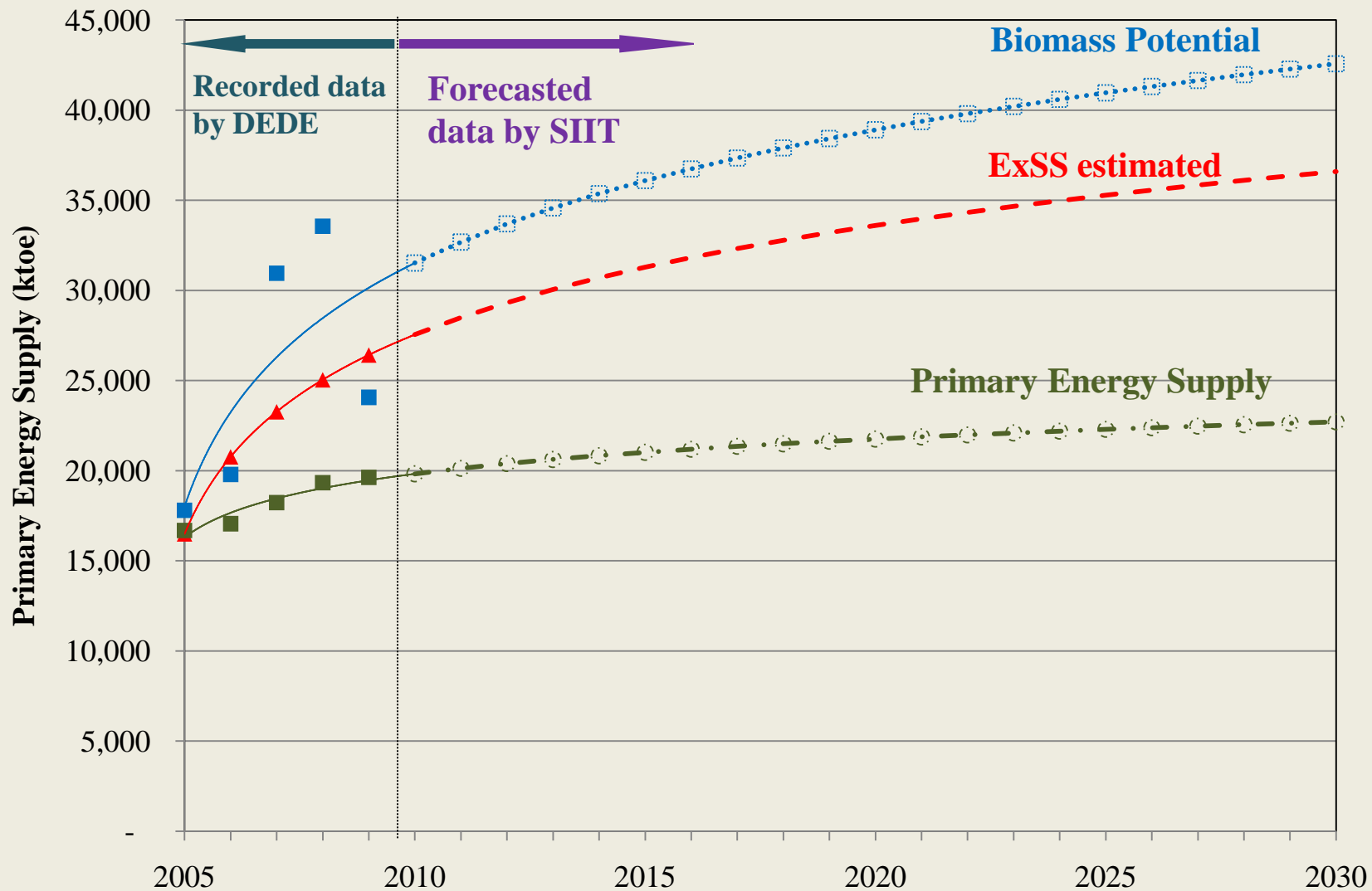
Unit: kt-CO<sub>2</sub>

# SUMMARY OF GHG MITIGATION MEASURES

Action	GHG Reduction (kt-CO <sub>2</sub> )	(%)
<b>1. Energy efficiency improvement (EEI) in households</b>	10,950	4.6%
- EEI in electric devices	9,330	3.9%
- EEI in non-electric devices	1,620	0.7%
<b>2. Energy efficiency improvement in buildings</b>	16,384	6.8%
<b>3. Building codes</b>	2,350	1.0%
<b>4. Energy efficiency improvement in industries</b>	38,648	16.1%
- EEI in electric devices	12,380	5.1%
- EEI in non-electric devices	26,268	11.0%
<b>5. Fuel switching in industry</b>	<b>41,336</b>	<b>17.3%</b>
<b>6. Fuel economy improvement in transportation</b>	10,739	4.5%
- Passenger transport	4,151	1.7%
- Freight transport	6,588	2.8%
<b>7. Fuel switching in transportation</b>	9,983	4.2%
- Passenger transport	2,921	1.2%
- Freight transport	7,062	3.0%
<b>8. Modal shift in transportation</b>	17,556	7.3%
- Passenger transport	8,087	3.3%
- Freight transport	9,469	4.0%
<b>9. Efficiency improvement and fuel switching in the power sector</b>	<b>91,614</b>	<b>38.2%</b>
<b>Total GHG mitigation in 2030</b>	<b>239,560</b>	<b>100.0%</b>
<b>Total GHG emissions in the 2030 BAU scenario</b>	<b>563,730 kt-CO<sub>2</sub></b>	
<b>Total GHG emissions in the 2030 CM scenario</b>	<b>324,170 kt-CO<sub>2</sub></b>	



# RENEWABLE POTENTIALS



# RENEWABLE POTENTIALS

Energy type	Potential	Existing		2008-2011			2023-2030		
<b>Electricity</b>	<b>MW</b>	<b>MW</b>	<b>GWh</b>	<b>MW</b>	<b>GWh</b>	<b>ktoe</b>	<b>MW</b>	<b>GWh</b>	<b>ktoe</b>
Solar	50,000	38.6	46	55	66	6	600	720	67.2
Wind	1,600	5.13	10	115	231	13	960	1,934	106.8
Small hydro	700	67	293	165	722	43	390	1,708	102
Biomass	4,400	1,644	11,521	2,800	19,622	1,463	4,400	30,835	2,319
Biogas	190	79.6	573	60	432	27	144	1,036	64.8
Waste	400	5.6	44.8	78	624	35	192	1,536	86.4
<b>Total</b>	<b>57,290</b>	<b>1,840</b>	<b>12,487.8</b>	<b>3,273</b>	<b>21,697</b>	<b>1,587</b>	<b>6,686</b>	<b>37,769</b>	<b>2,746</b>
<b>Thermal</b>	<b>ktoe</b>	<b>ktoe</b>				<b>ktoe</b>			<b>ktoe</b>
Solar	154	0.5				5			45.6
Biomass	7,400	3,071				3,660			7,400
Biogas	600	201				470			600
Waste		1.09				15			42
<b>Total</b>	<b>8,154</b>	<b>3,273</b>				<b>4,150</b>			<b>8,088</b>
<b>Bioenergy</b>	<b>ML/day</b>	<b>ML/day</b>		<b>ML/day</b>		<b>ktoe</b>	<b>ML/day</b>		<b>ktoe</b>
Ethanol	3.00	1.24		3.00		805	10.8		2,936
Biodiesel	4.20	1.56		3.00		950	5.40		1,698
<b>Total</b>	<b>7.20</b>	<b>2.80</b>		<b>6.00</b>		<b>1755</b>	<b>16.20</b>		<b>4,634</b>
Required energy (ktoe)		66,248				70,300			112,868
Required renewable energy		4,237				7,492			15,468
RE share (%)		6.4%				10.6%			13.7%
NGV (M.cu./Day)		147		393.0		3,469	800		7,064
Alternative energy used (ktoe)						10,961			22,532
AE share (%)						16.6%			19.96%

## CONCLUSIONS

- The GHG emissions in 2030 BAU scenario without mitigation measures will increase to 563,730 kt-CO<sub>2</sub>.
- Energy saving can be decreased by 35,895 ktoe or 21.8% in 2030CM.
- By adopting measures, GHG emissions can be decreased to 324,170 kt-CO<sub>2</sub> or by 42.5%.
- If those policies are planned in early stage, Thailand will be able to develop not only as a premier growth center but also serve as a model for LCS.
- However, to increase more energy savings and CO<sub>2</sub> mitigation, leapfrogging technologies are needed under appropriate mechanism.

# ACKNOWLEDGEMENTS

- ❑ Sirindhorn International Institute of Technology, Thammasat University (SIIT-TU)
- ❑ Asian Institute of Technology (AIT)
- ❑ National Institute for Environmental Studies (NIES), Japan
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- ❑ Mizuho Information and Research Institute, Japan
- ❑ Asia Pacific Integrated Model (AIM)

# THE END