Thailand LCS Development and Co-benefits of Carbon Mitigation Strategies

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Part 2: Co-benefits of carbon emission mitigation targets

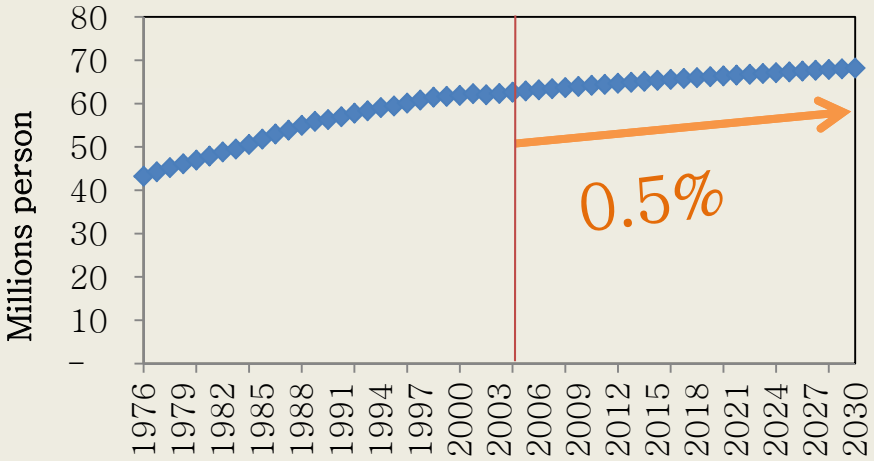
1. Thailand Low Carbon Scenario Development

THAILAND "LCS" STUDY OBJECTIVES

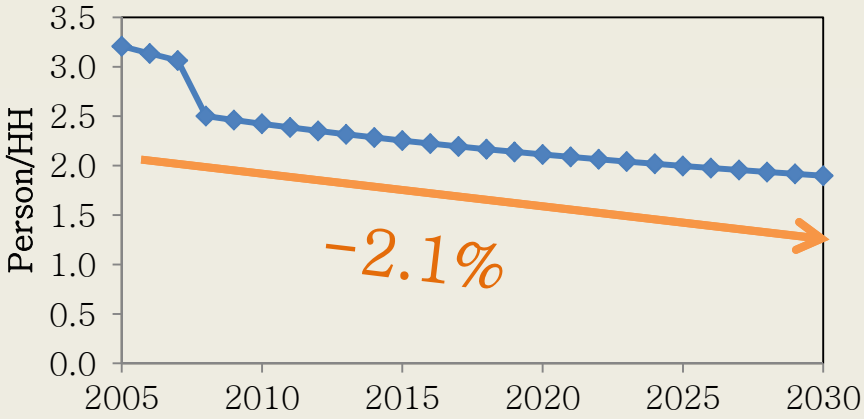
- To propose measures for avoiding climate change, and precursors to zero carbon society and renewable-energy economy.
- To discuss the possibility of developing a low-carbon society in Thailand.
- To create awareness among Thailand's authorities, government, stakeholders, and communities for low-carbon Thailand.

QUANTITATIVE ASSUMPTIONS

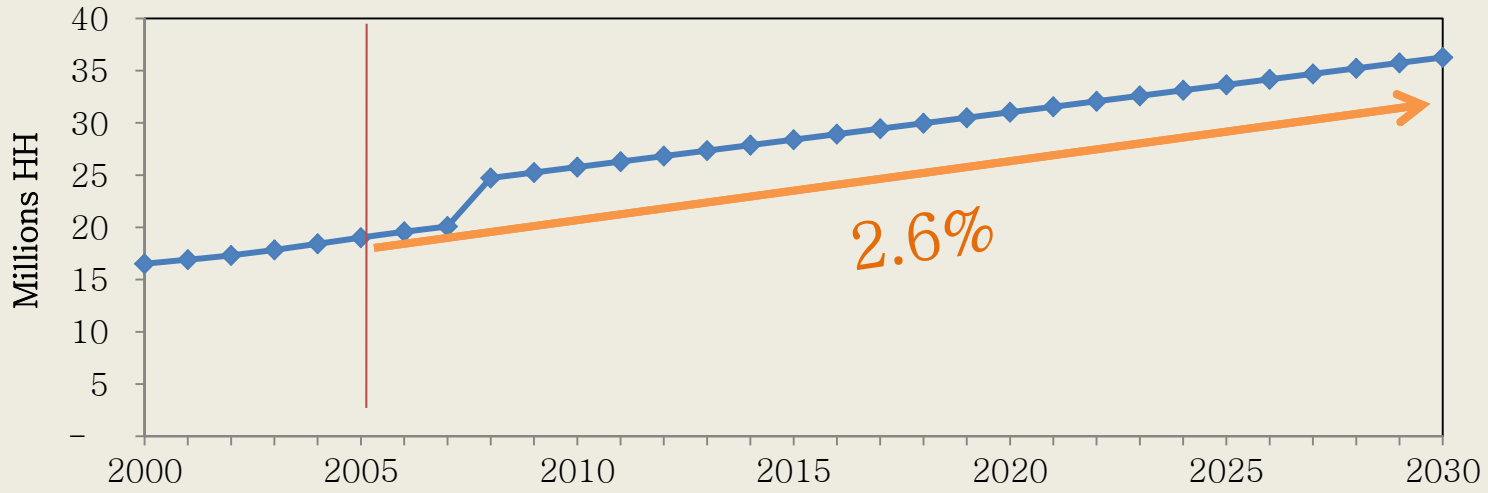
Population



HH size



No. of HH



ESTIMATED SOCIO-ECONOMIC INDICATORS

	2005		2030
Population	60,991,000	0.49% →	68,815,004
No. of HH	19,016,784	2.6 % →	36,265,390
GDP (mil Baht)	8,016,595	5.5- 5.0% →	30,802,306
Gross output (mil Baht)	18,755,884		68,456,651
Primary industry (mil Baht)	*1,116,621*	3.9% →	*2,801,864*
Secondary industry (mil Baht)	*11,453,496*	5.1% →	*38,008,931*
Tertiary industry (mil Baht)	*6,185,767*	6.4% →	*27,645,856*
Floor space for commercial (mil m^2)	88		394
Passenger transport demand (mil p-km)	191,520		216,088
Freight transport demand (mil t-km)	188,524		589,859

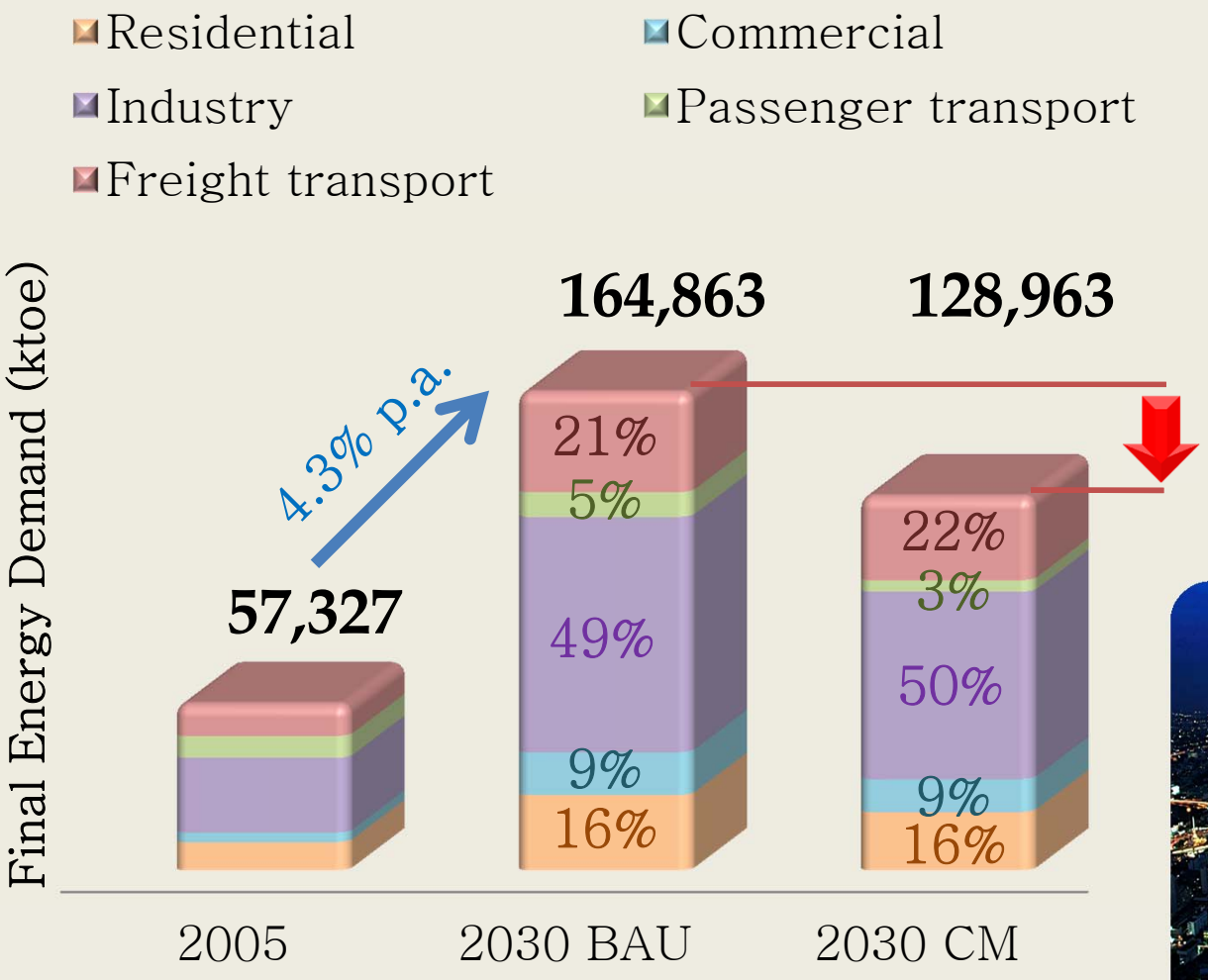
- NESDB
- DOPA

- NESDB

- TTP
- DCA
- DLT

Remarks: Primary industry → Agriculture, Mining, and Construction
Secondary industry → Textiles, Food & beverage, Chemical, Metallic, Non-metallic, and Others
Tertiary industry → Service sector

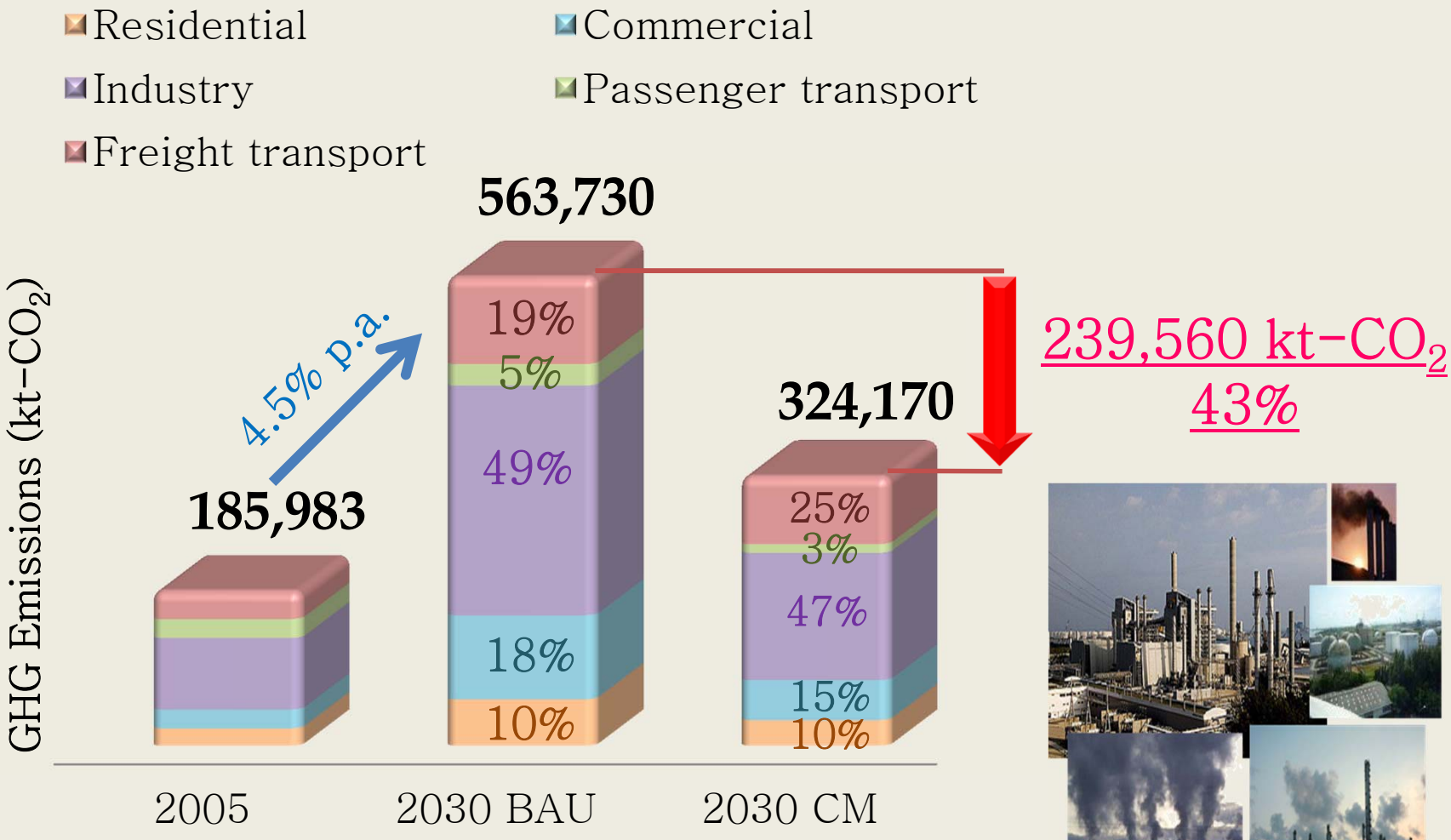
ENERGY DEMAND



35,895 ktoe
22%

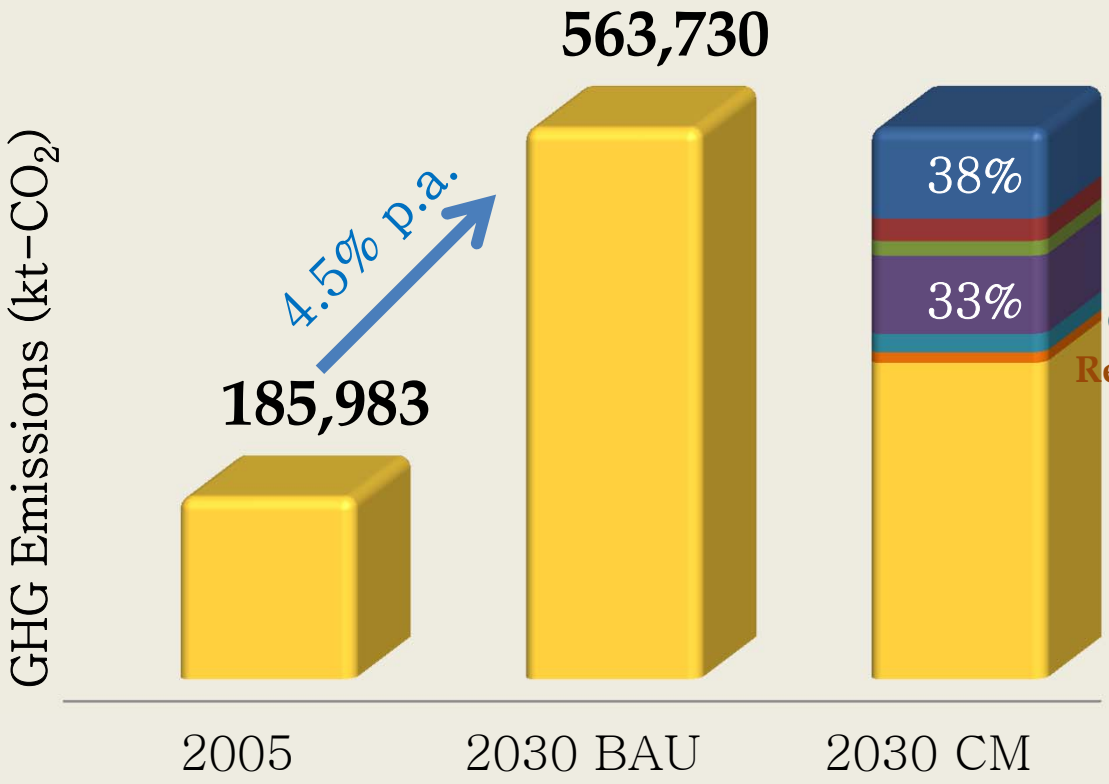
Remarks: BAU is Business as Usual
CM is Countermeasure

GHG EMISSIONS



Remarks: BAU is Business as Usual
CM is Countermeasure

GHG EMISSIONS/REDUCTIONS



Power: 91,615 kt-CO_2
Freight: 23,118 kt-CO_2
Passenger: 15,159 kt-CO_2
Industry: 79,984 kt-CO_2
Commercial: 18,734 kt-CO_2
Residential: 10,950 kt-CO_2

Remarks: BAU is Business as Usual
CM is Countermeasure

MEASURES

POWER GENERATION

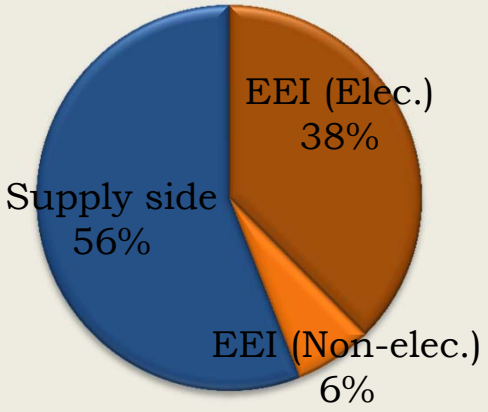
- Efficiency improvement in the *Power generation sector*
  - *T&D loss will improve to be 5%.*
  - *Technology transfer: New power plant technology will be added such as IGCC and CCGT → Eff. Improve to be 48% and 56%.*
  - *Fuel switching: Increasing share of RE and NE in PDP 2010.*

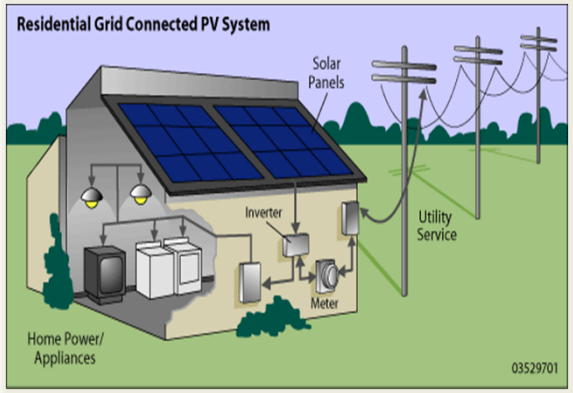
Fuel type	Share in 2030 BAU	Share in 2030 CM
Natural gas	71.4	39.0
Oil	6.6	-
Coal	15.1	23.6
Hydro	4.4	20.5
Nuclear	-	11.2
Renewable energy	2.5	5.7

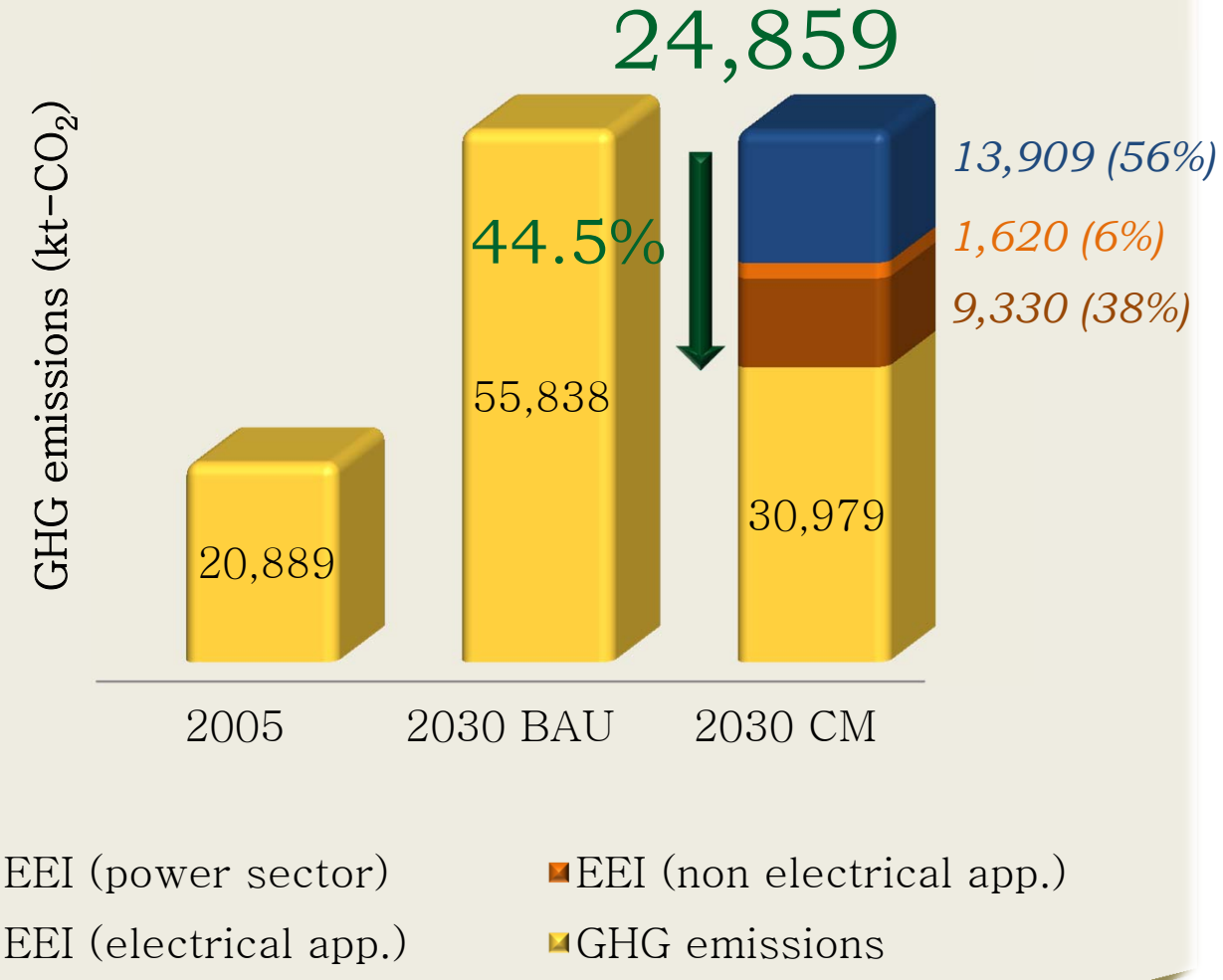
Ref: Thailand's Power Development Plan, PDP 2010.

MEASURES

RESIDENTIAL

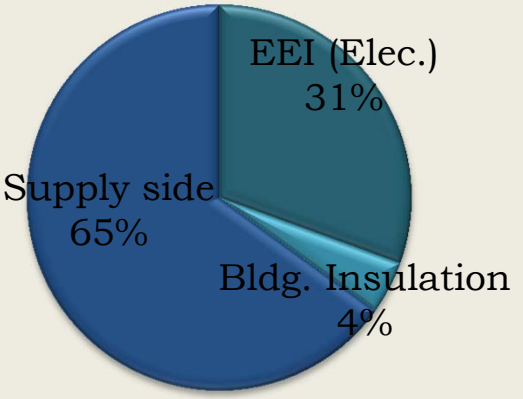


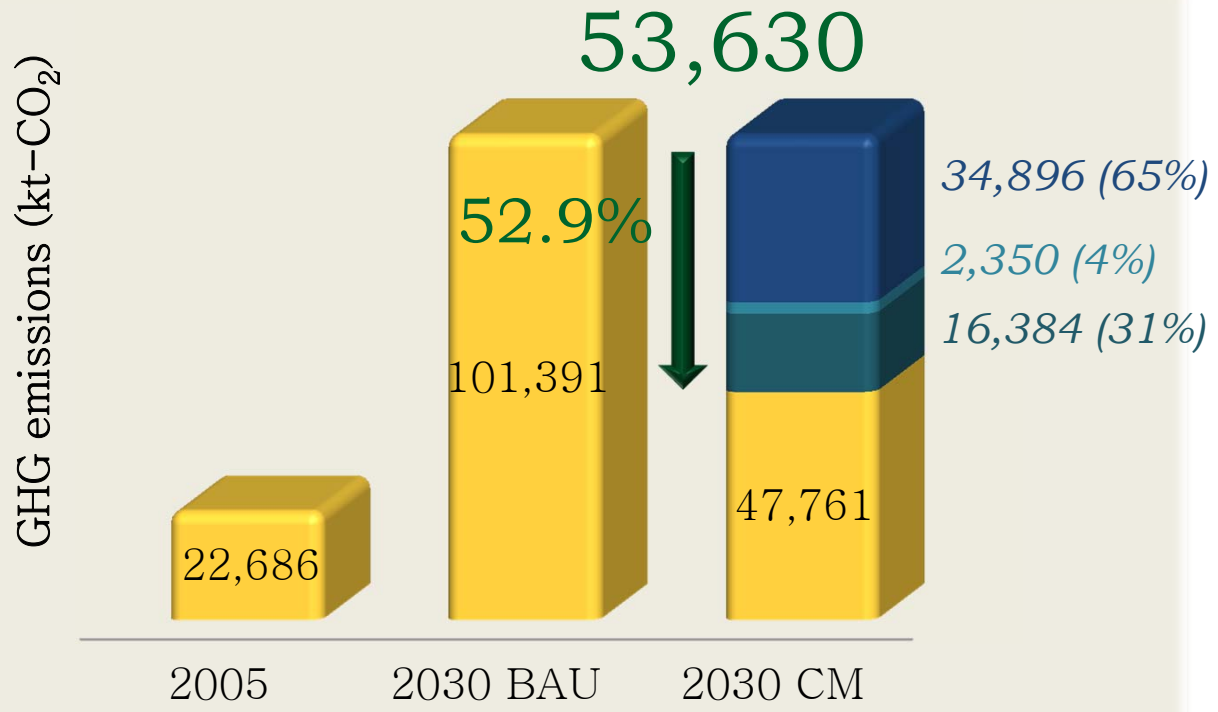




MEASURES

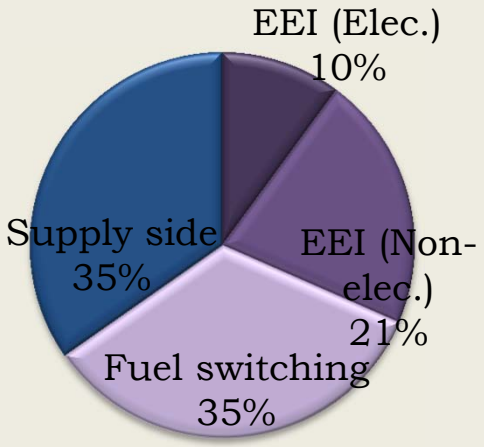
COMMERCIAL

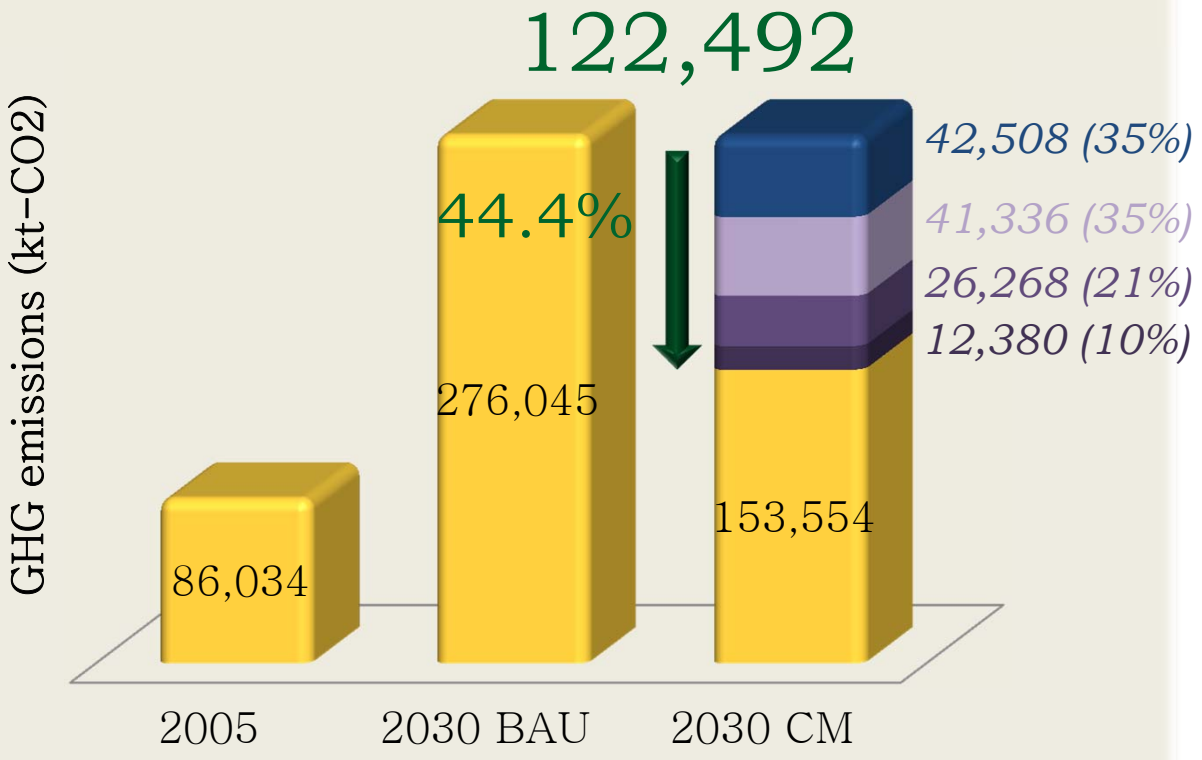




MEASURES

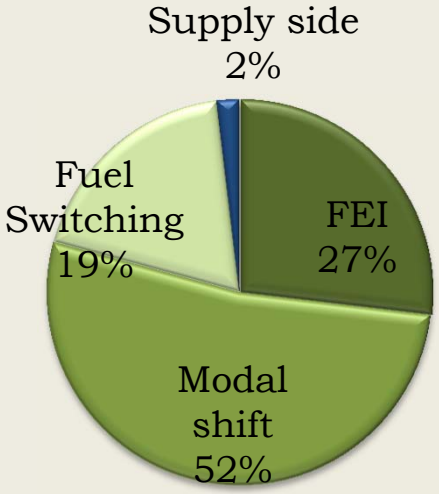
INDUSTRY

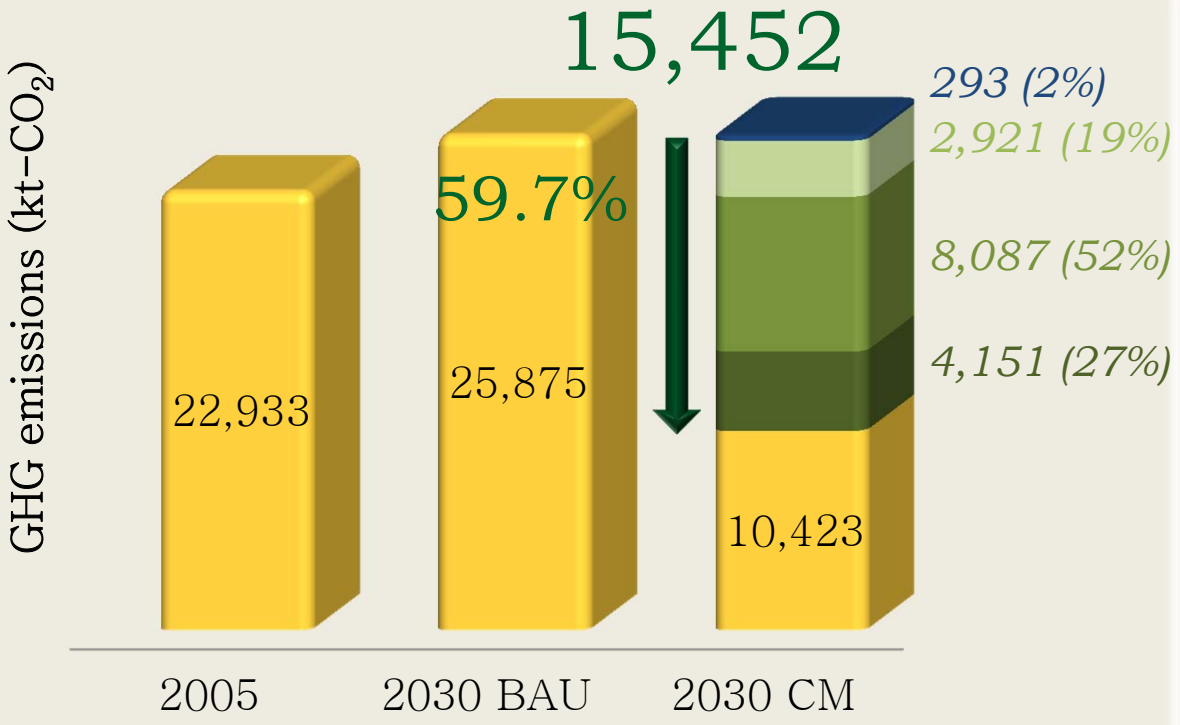




MEASURES

PASSENGER TRANSPORT





E20 20% Ethanol

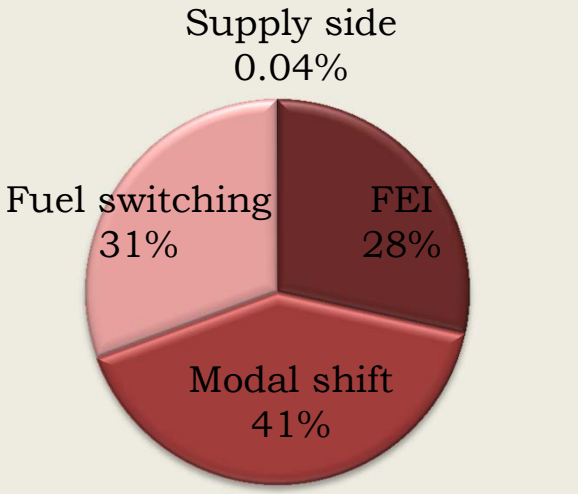
E85 ethanol FLEX-FUEL

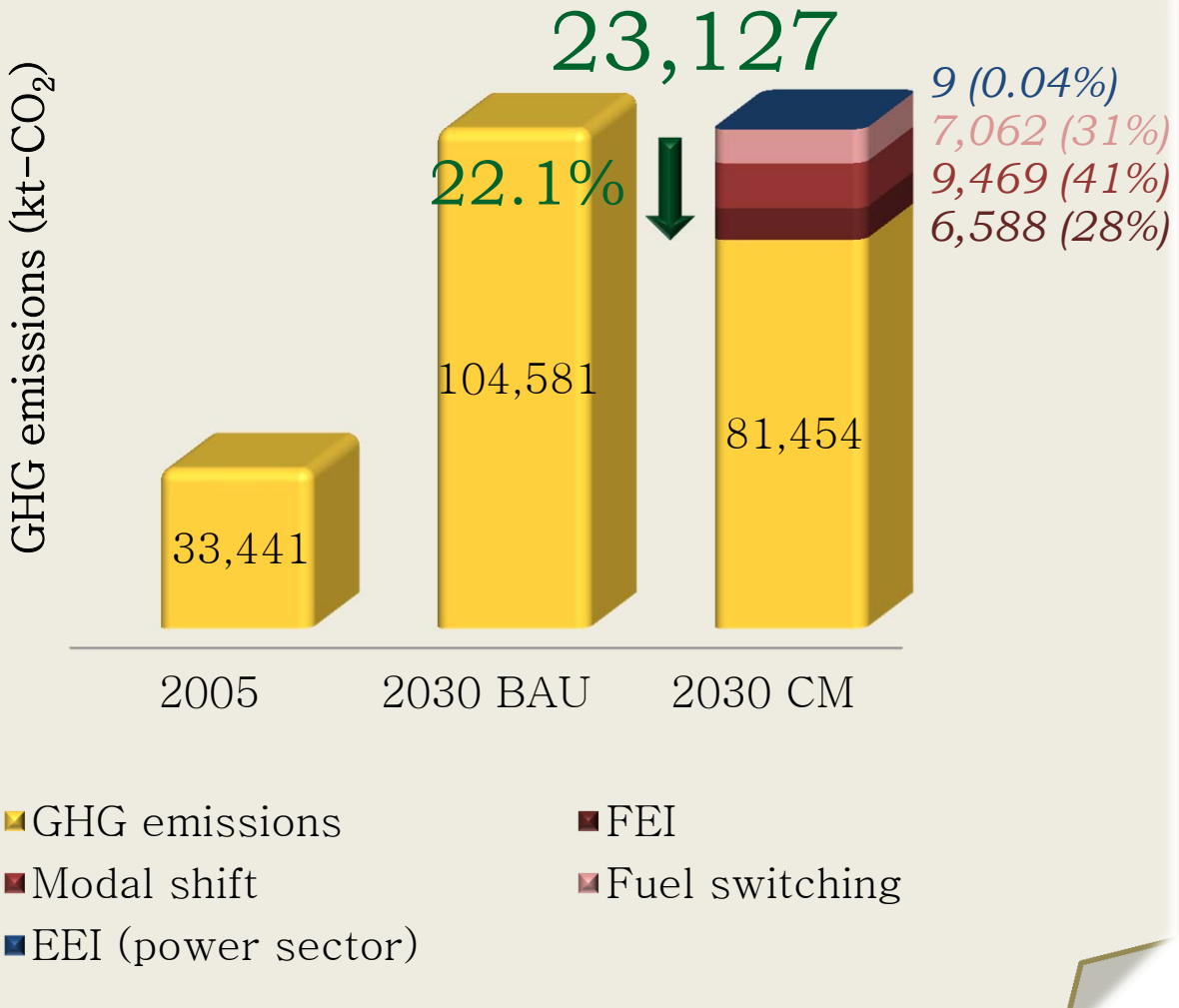
เพาเวอร์ B5

CNG

MEASURES

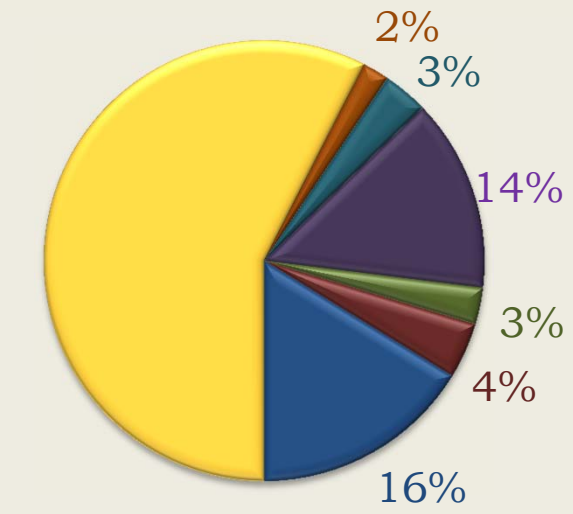
FREIGHT TRANSPORT



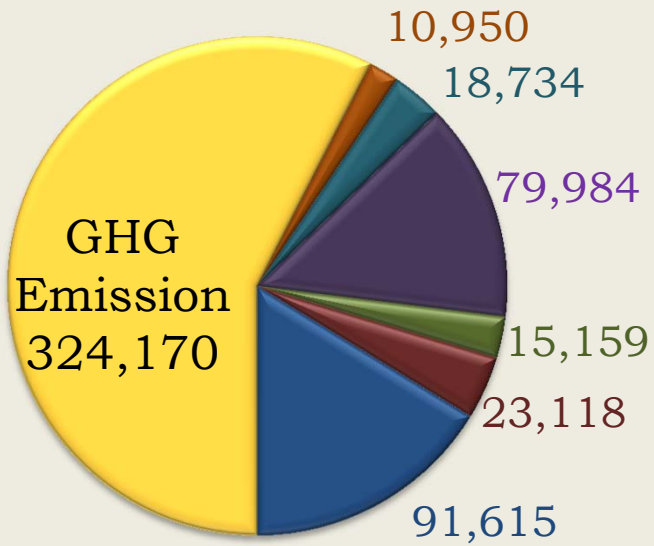


GHG EMISSIONS/REDUCTION

TOTAL



GHG REDUCTION: 239,560 KT-CO_2



Unit: kt-CO_2

SUMMARY OF GHG MITIGATION MEASURES

Action	GHG Reduction (kt-CO_2)	(%)
1. Energy efficiency improvement (EEI) in households	10,950	4.6%
- EEI in electric devices	9,330	3.9%
- EEI in non-electric devices	1,620	0.7%
2. Energy efficiency improvement in buildings	16,384	6.8%
3. Building codes	2,350	1.0%
4. Energy efficiency improvement in industries	38,648	16.1%
- EEI in electric devices	12,380	5.1%
- EEI in non-electric devices	26,268	11.0%
5. Fuel switching in industry	41,336	17.3%
6. Fuel economy improvement in transportation	10,739	4.5%
- Passenger transport	4,151	1.7%
- Freight transport	6,588	2.8%
7. Fuel switching in transportation	9,983	4.2%
- Passenger transport	2,921	1.2%
- Freight transport	7,062	3.0%
8. Modal shift in transportation	17,556	7.3%
- Passenger transport	8,087	3.3%
- Freight transport	9,469	4.0%
9. Efficiency improvement and fuel switching in the power sector	91,614	38.2%
Total GHG mitigation in 2030	239,560	100.0%

Total GHG emissions in the 2030 BAU scenario	563,730 kt-CO_2
Total GHG emissions in the 2030 CM scenario	324,170 kt-CO_2

CONCLUSIONS

- Energy saving can be decreased by 35,895 ktoe or 21.8% in 2030CM.
- The GHG emissions under the scenario without mitigation measures will increase to 563,730 kt-CO_2.
- By adopting measures, GHG emissions can be decreased to 324,170 kt-CO_2 or by 42.5%.
- If those policies are planned for early stage, Thailand will be able to develop not only as a premier growth center but also serve as a model for LCS.



Part 1: Co-benefits of carbon mitigation

Outline

- Description of scenarios
- CO2 emission in the base case
- Environmental co-benefits: Reduction of SO_2 and NOx emission
- Energy security – co-benefits
- Cost implications

Scenario Description

Base case and three emission reduction target scenarios as follows:

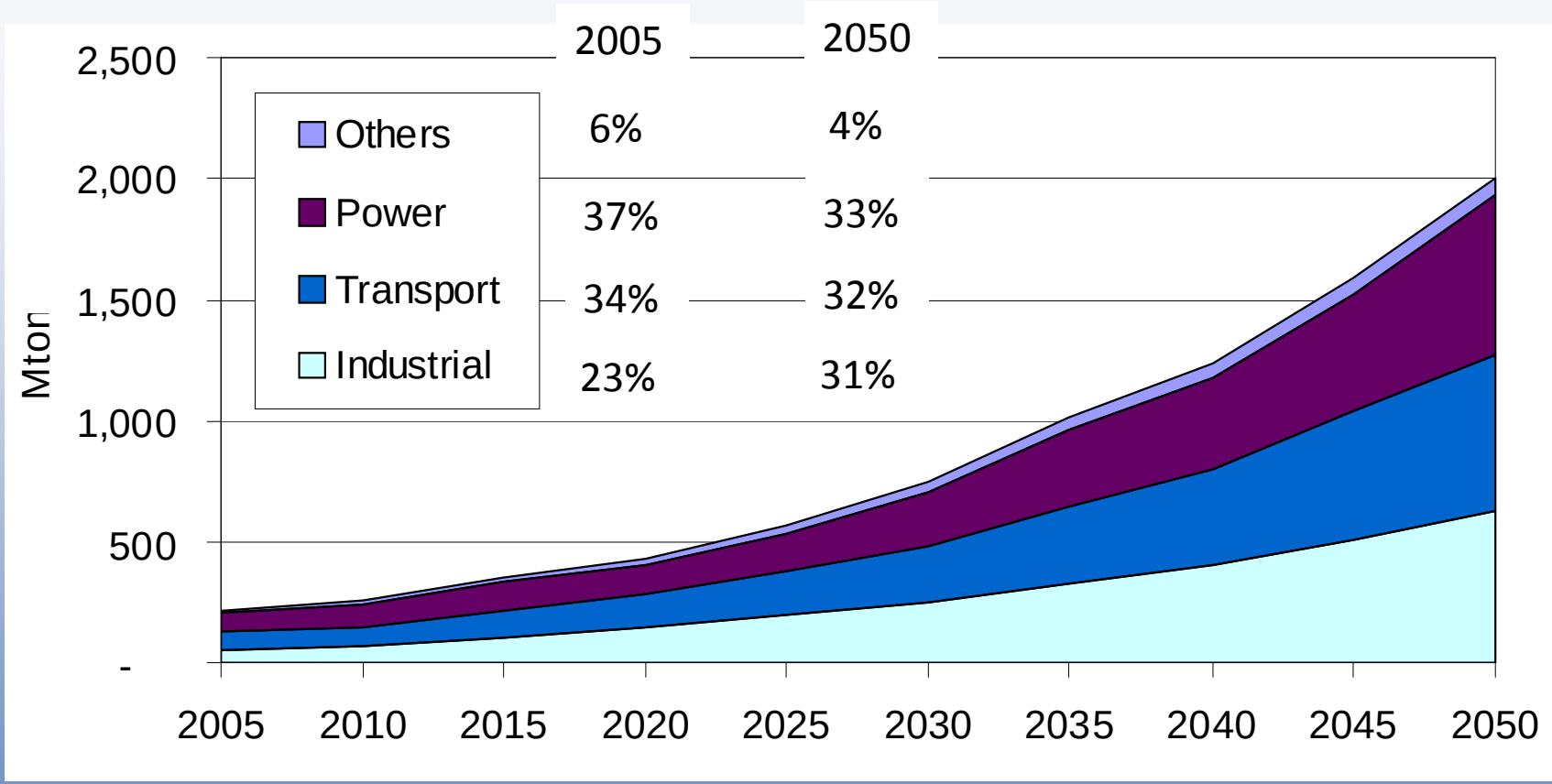
1) Base case
2) 10% Emission reduction target (ERT10)
3) 20% Emission reduction target (ERT20)
4) 30% Emission reduction target (ERT30)

- MARKAL modeling framework – the least cost optimization model is used for the analysis.
- All prices are given in US$ 2000 price.

Base Case Assumptions

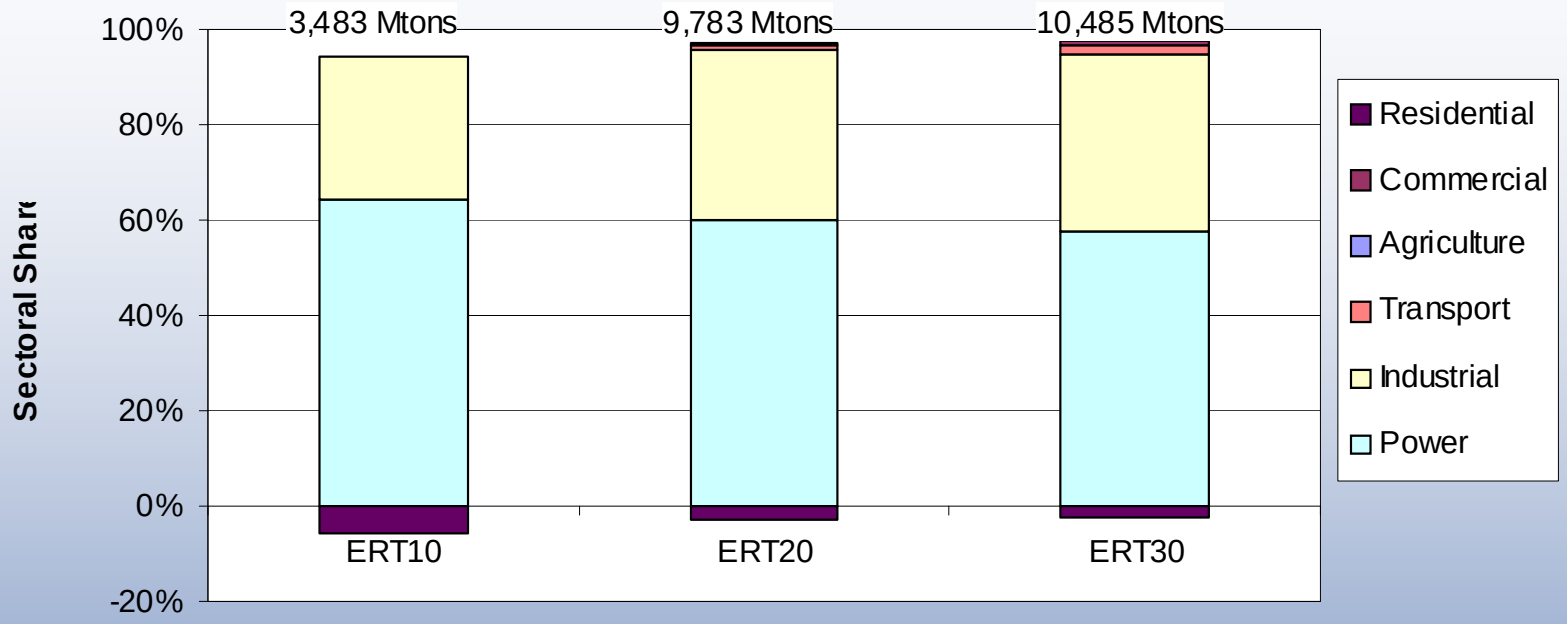
- CAGR (2000-2050): Population: 0.4%; GDP: 5.6%
- No greenhouse gas (GHG) mitigation policy intervention.
- Nuclear power generation would be introduced from 2020 onwards (2000 MW is proposed to be installed in 2020 and similarly in 2021 (EGAT, 2007)).
- Minimum of 3 million liters of ethanol per day and 4 million liters of biodiesel per day would be used by 2015 in the transport sector.
- 64,000 thousands tons of feedstock (e.g., cassava, molasses, sugarcane and others) for ethanol production and 2,550 thousands tons of oil seed (palm oil and coconuts) for biodiesel production would be available from 2015 onward during the planning horizon.
- Emerging technologies like hybrid vehicles are considered to be available from 2015 onward; fuel cell vehicles and power generation with carbon capture and storage technology are considered to be available from 2020 onward.
- Modal substitution between road transport and railways/MRT not considered.

CO_2 emission in the base case during 2005-2050



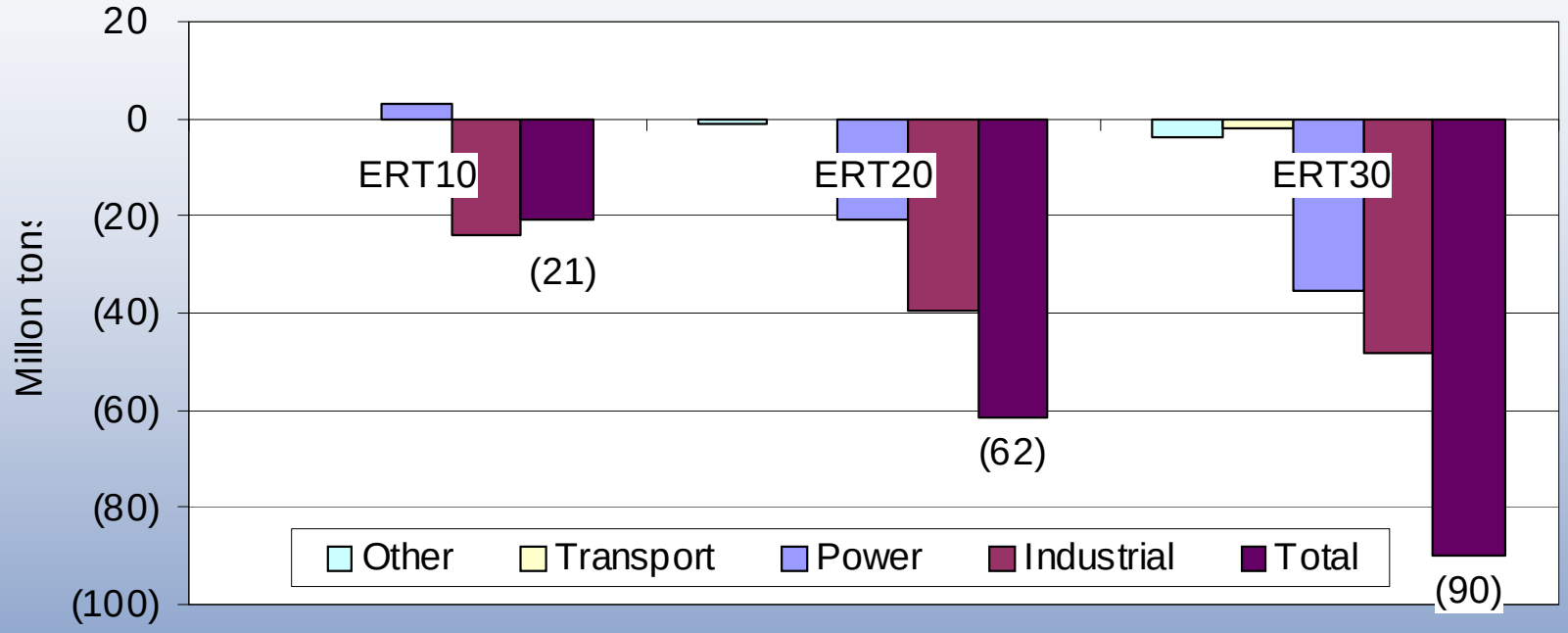
Total CO_2 emission would increase by more than 7 folds during 2005-2050 (AAGR 4%), i.e., 223 million tCO_2 in 2005 to 2,006 million tCO_2 in 2050.

Sectoral contributions to achieve the CO_2 emission reduction targets?



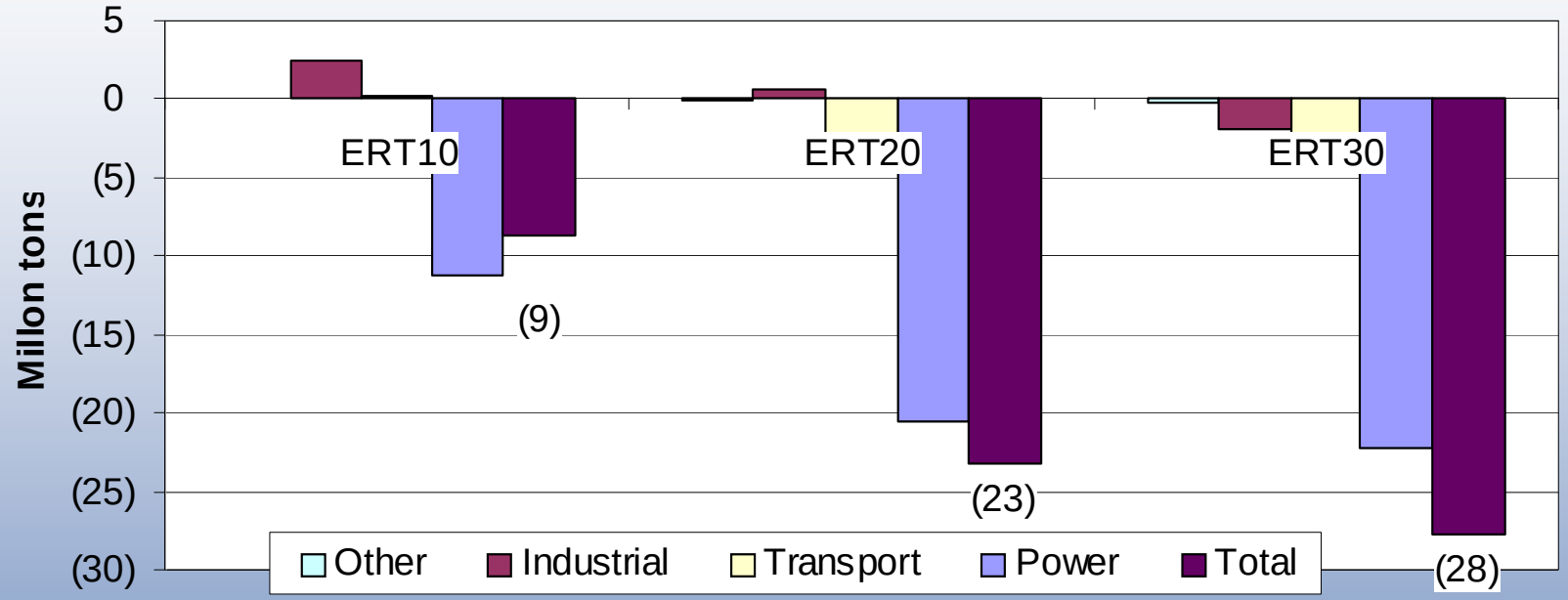
- Highest CO_2 emission reduction from the power sector, followed by the industrial and transport sectors.
- Over 73%, 64% and 61% of the total CO_2 emission reduction from the power sector in ERT10, ERT20 and ERT30 cases respectively.
- Major role of natural gas based advanced combined cycle power generation, carbon capture and storage (CCS) and nuclear based power generation in the power sector CO_2 emission reduction.
- Up to a maximum of 36% reduction from the base case emission could be feasible under the present framework.

Environmental co-benefits (1): Reduction in SO_2 emission



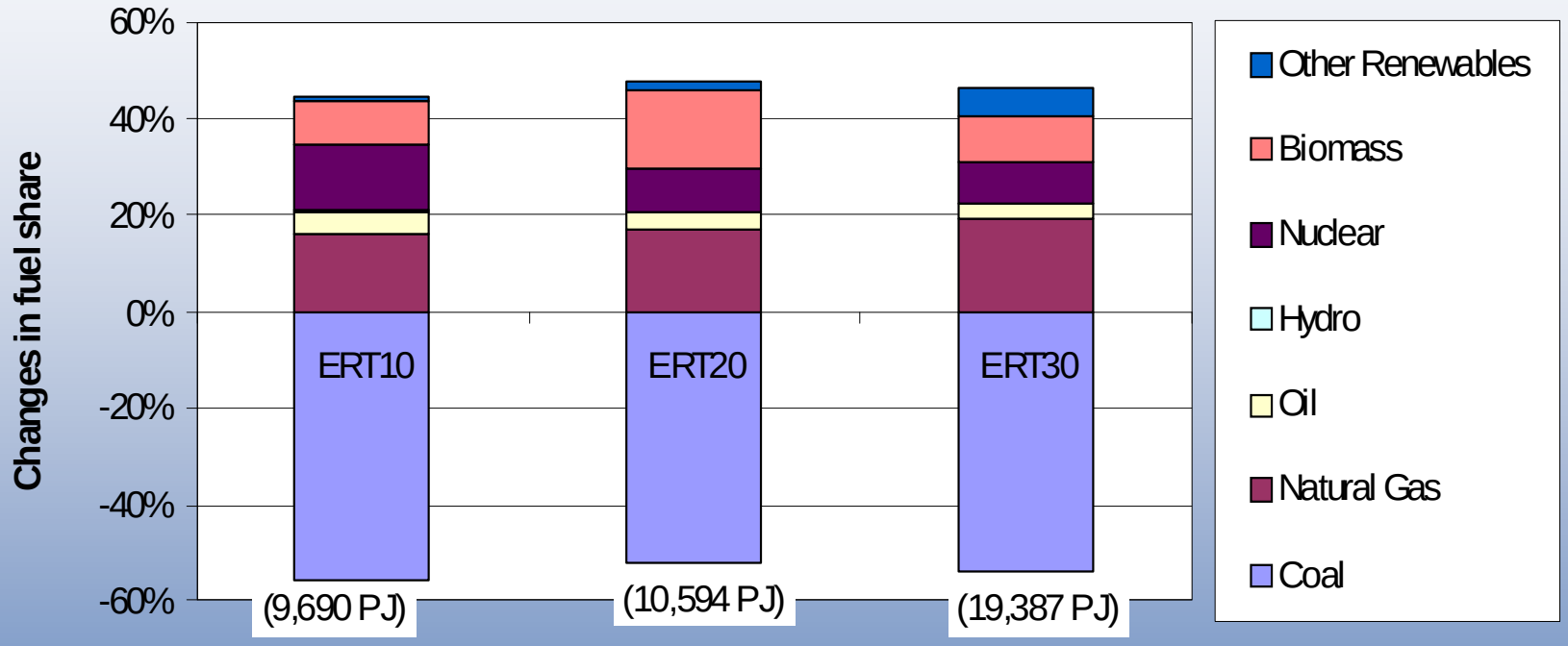
- SO2 reductions of 10%, 28% and 41% from the base case value under ERT10, ERT20 and ERT30.
- The highest SO2 reduction (over 54%) from the industrial sector followed by the power sector.

Environmental co-benefits (2): Reduction in NOx emission



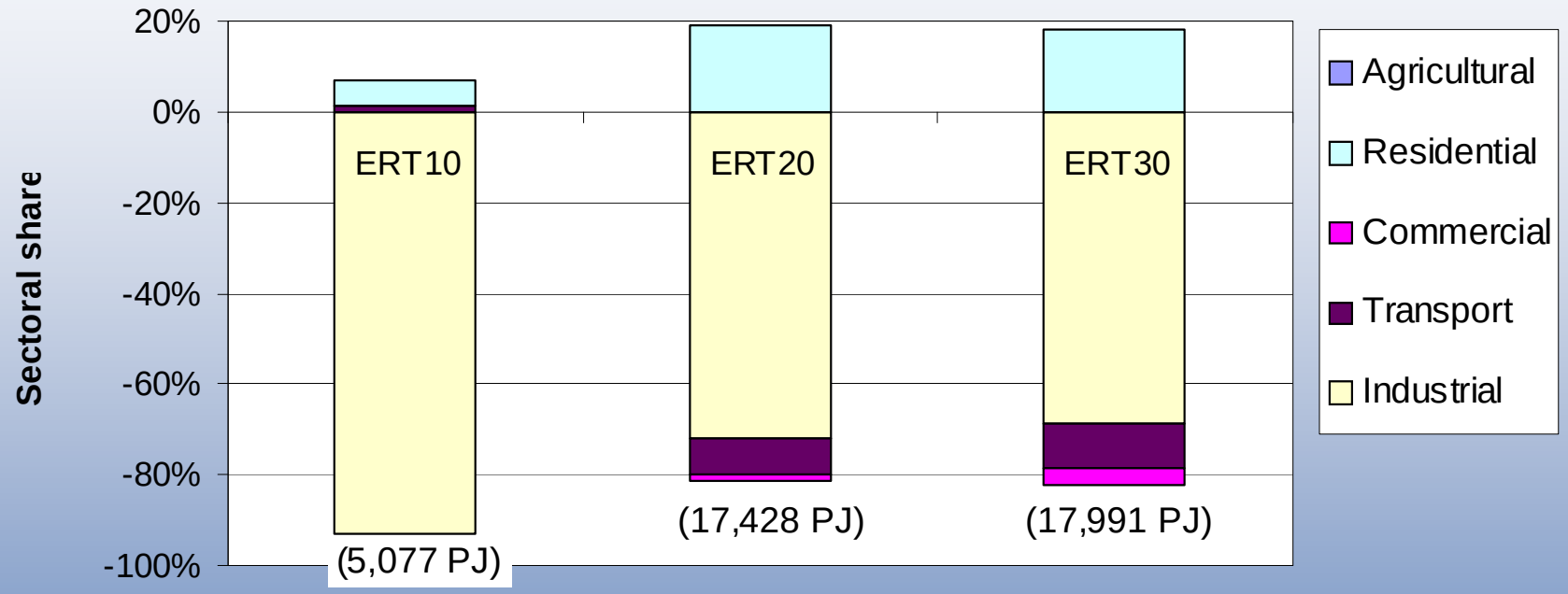
- % reduction of NOx relatively lower than that of SO_2 emission.
- NOx reduction of 2%, 6% and 7% of from the base case value under ERT10, ERT20 and ERT30 respectively.
- The highest NOx reduction (over 80%) would take place in the power sector followed by the transport sector.

Energy Co-benefit (1): Reduction in total primary energy requirement



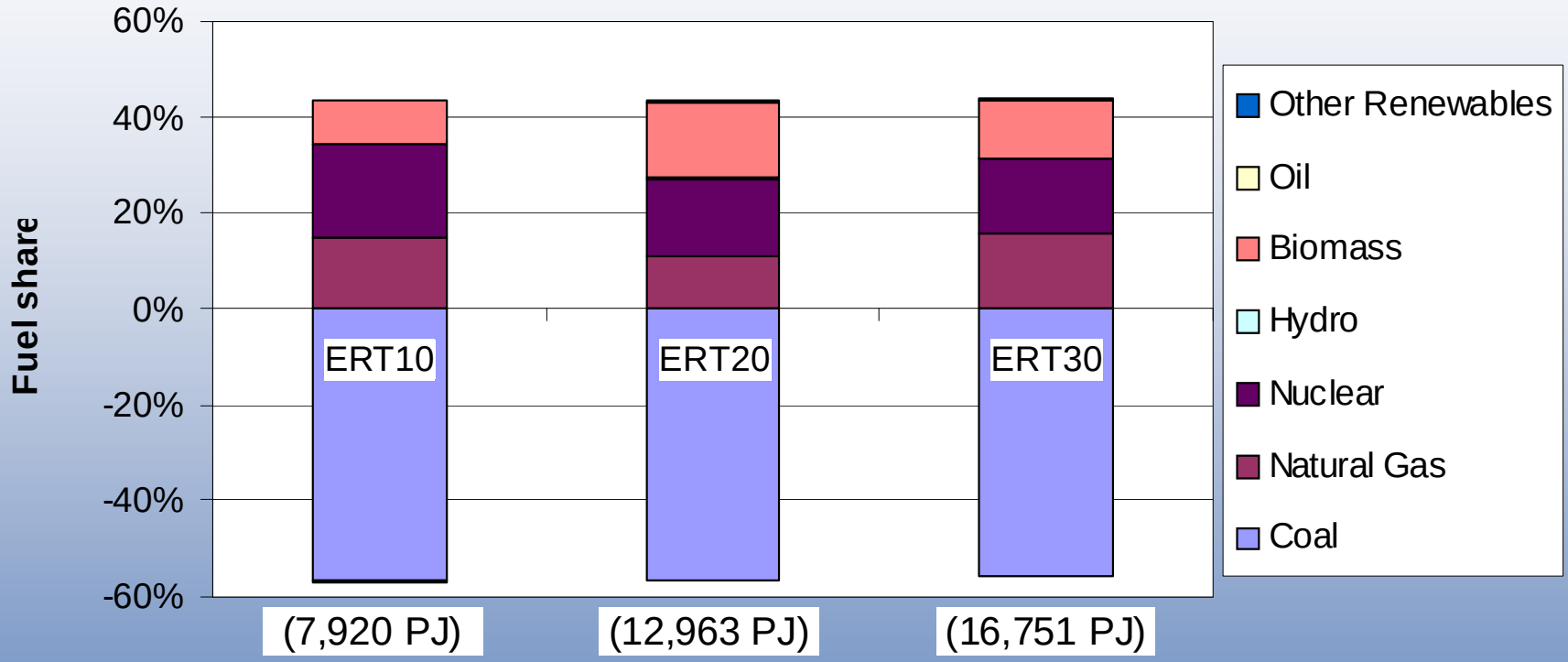
- Total primary energy requirement would decrease by 1.9%, 2.0% and 3.7% under ERT10, ERT20 and ERT30 respectively.
- Coal requirement would significantly decrease in all the cases.

Energy Co-benefit:
Reduction in final energy consumption



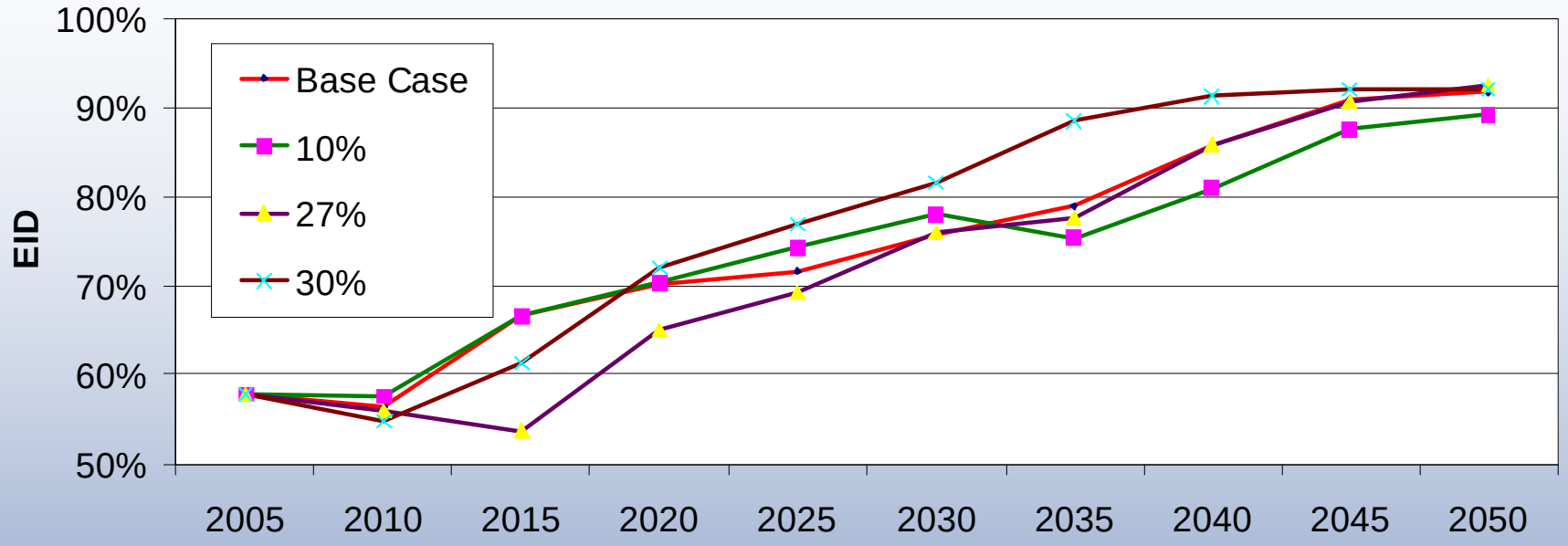
- Final energy demand would decrease by 1.2%, 4.2% and 4.3% under ERT10, ERT20 and ERT30 respectively.
- The industrial sector would gain most in terms of energy efficiency.

Energy Co-benefit:
Reduction in energy requirement for power generation



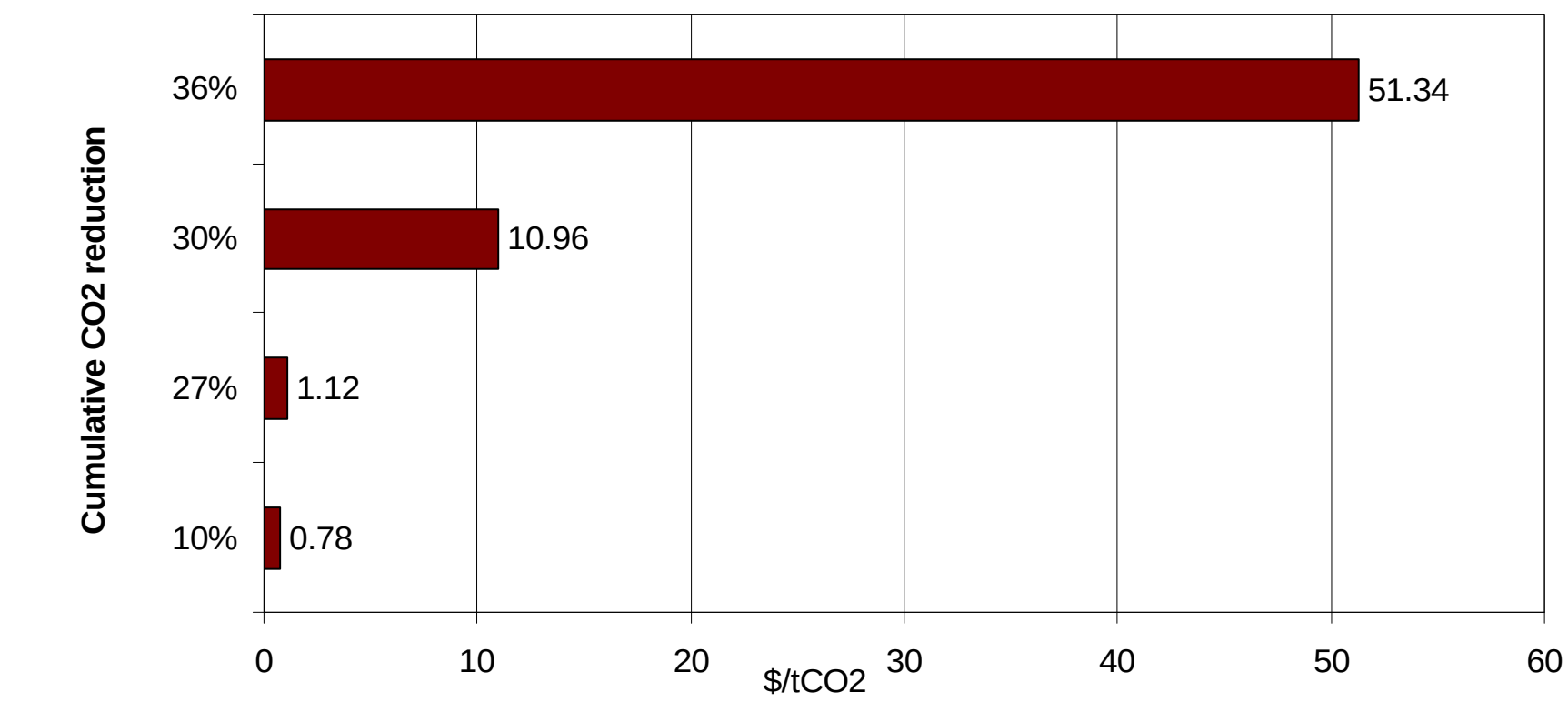
- Energy requirement in power generation would be reduced by 5.0%, 8.2% and 10.6% under ERT10, ERT20 and ERT30 respectively.

Energy security co-benefit



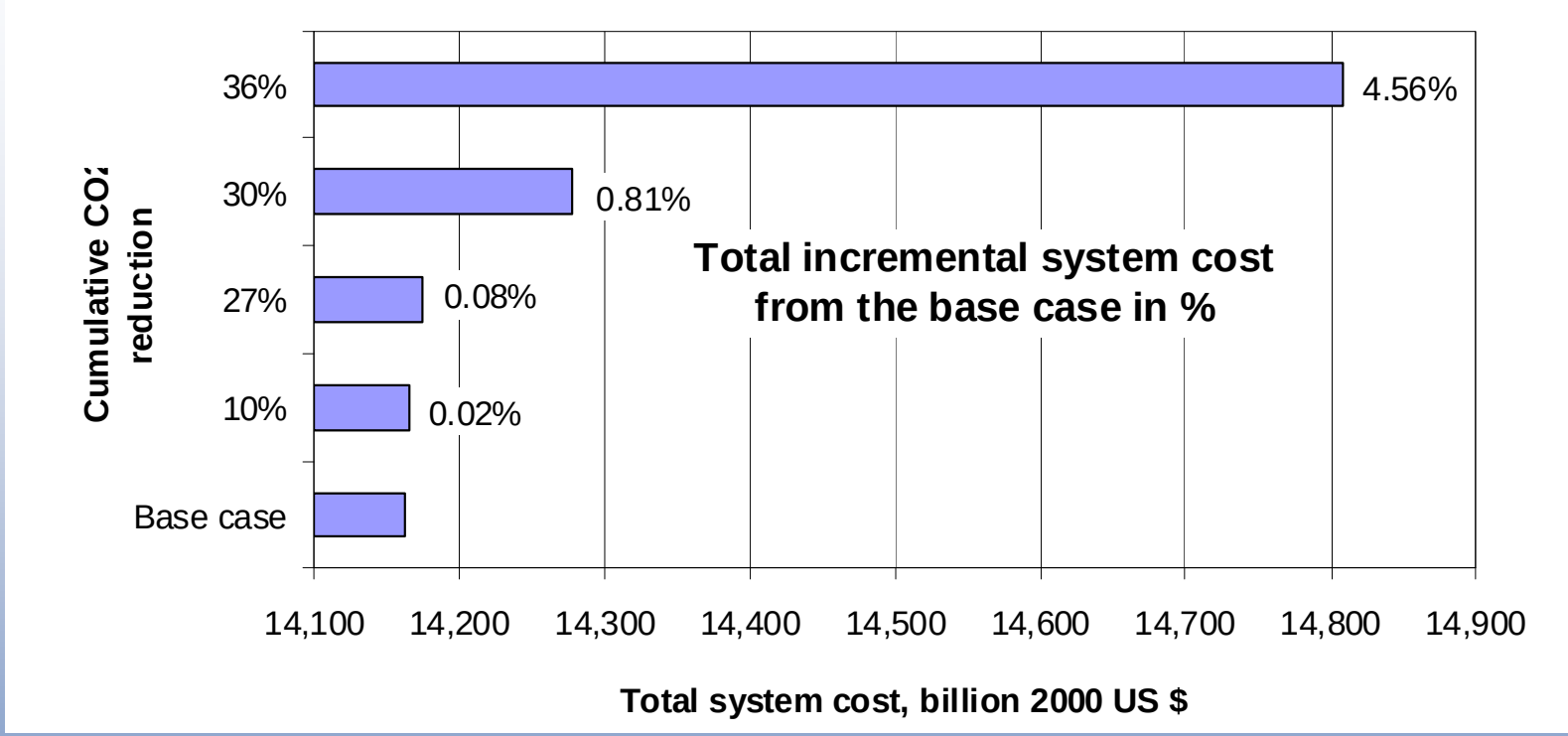
- TPES would be reduced by 1.9%, 2.0% and 3.7% under ERT10, ERT20 and ERT30 respectively.
- Cumulative energy import dependency (EID) in base case would be 80.6%. EID would decrease from the base case by 1.9% and 1.7% in ERT10 and ERT20. On the contrary, EID would increase by 2.9% in ERT30.
- The level of energy import dependency in year 2050 in ERT20 and ERT30 would be similar to that in the base case (i.e., 92%). In ERT10, EID would slightly decrease (to 89%) in 2050.

What would be the CO_2 abatement cost ($/t$CO_2$) under different ERTs?



- Up to 27% of the total CO_2 emission could be cost effectively mitigated at $ 1.12 per ton of CO_2.
- The cost for CO_2 abatement higher than 27% would be much higher and would increase from $ 10.96 to $ 51.34 for 30% to 36% emission reduction from the base case respectively.

How would the total cost increase with emission reduction?



- A maximum of 36% of CO_2 emission reduction would be possible from that in the base case as has been considered in the study (e.g., assuming there would be no modal shift to MRTs and electric railways, no reduction in service demand etc.).
- Total cost increases drastically for targets above 27% of emission reduction.



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