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# **Low Carbon Scenarios: Case of Thailand**

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# Brief Background on Thailand

- **Location:**
  - Area of 513,115 km<sup>2</sup> and extends about 1,620 km from north to south and 775 kilometres from east to west.
- **Population:** 65 million (2007)
- **Population Density:** 128 people/km<sup>2</sup>
- **GDP:** US\$ 245 billion in 2007
- **GDP per capita:** US \$ 3,740 (year 2007)
- 2<sup>nd</sup> largest economy in the ASEAN

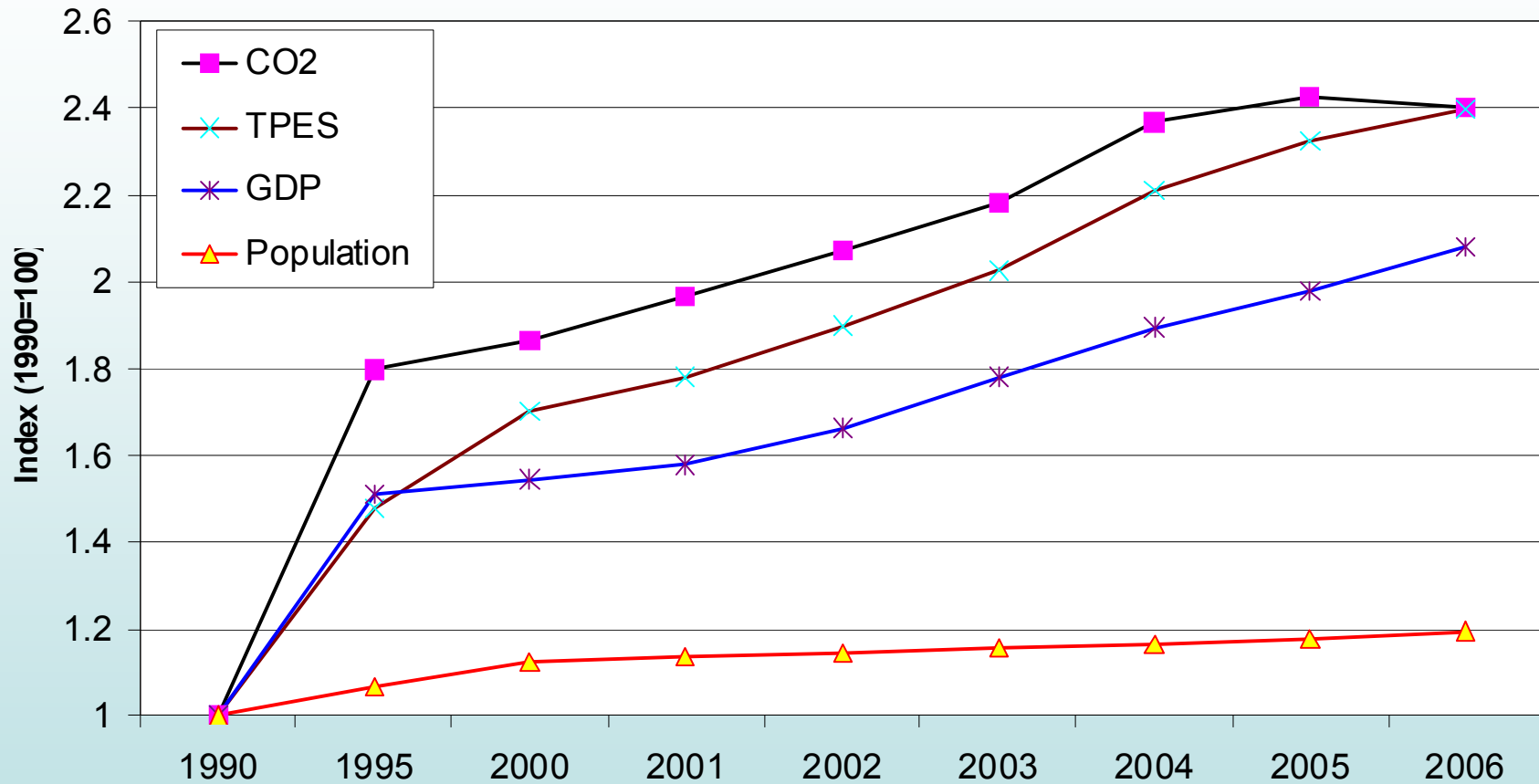
Source: ASEAN Secretariat, 2007



# Energy, Economic and Carbon Growth Evolutions during 1990-2006

- Decoupling of energy and economy (similarly CO<sub>2</sub> and economy) yet to be realized.
- Index (2006/1990) of:
  - GDP: 2.2
  - Total primary energy supply: 2.4
  - CO<sub>2</sub> emission: 2.4
  - Population: 1.2

# CO<sub>2</sub>, TPES, GDP and Population Growth during 1990-2006

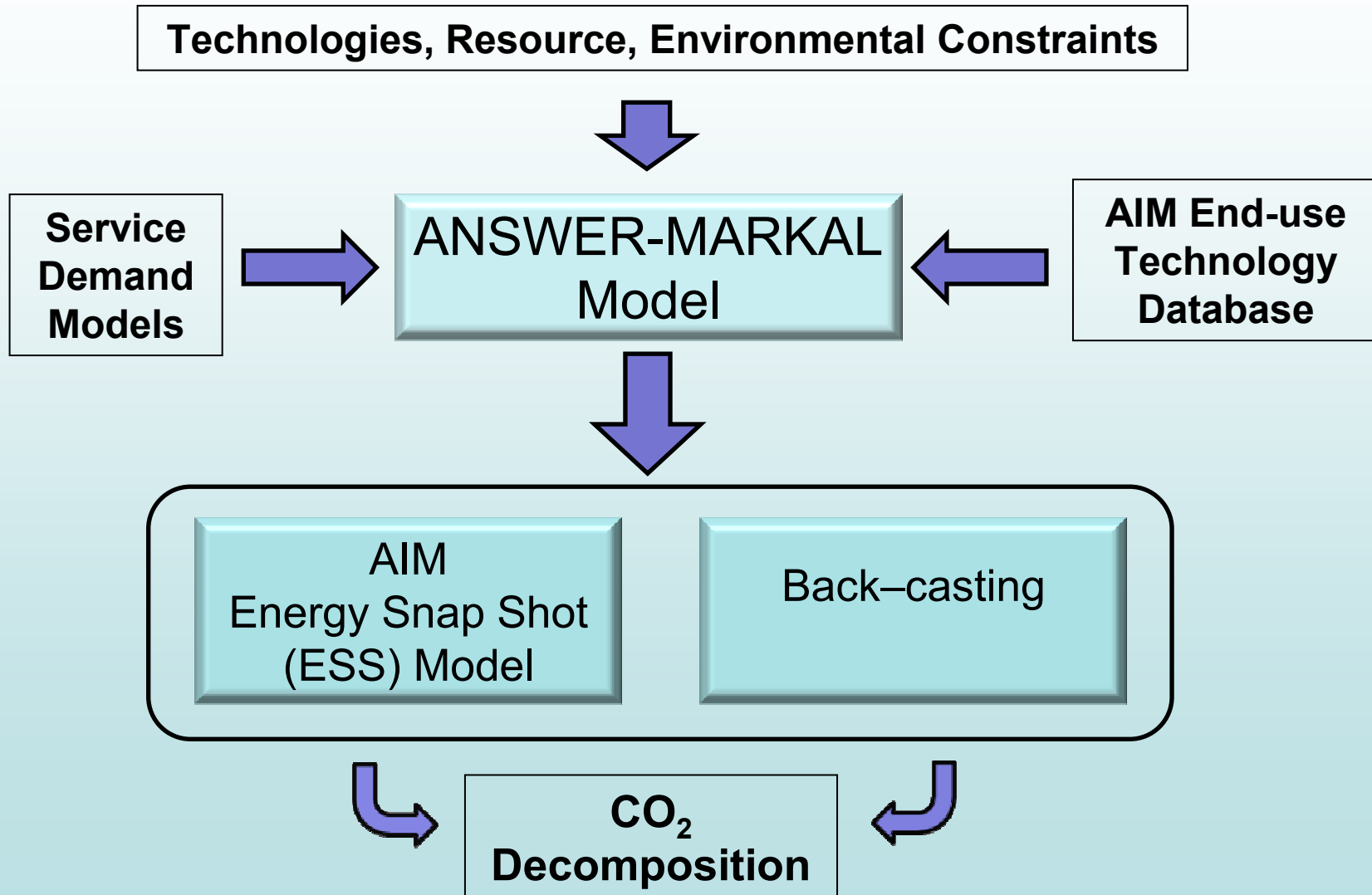


## AAGR (2001-2006):

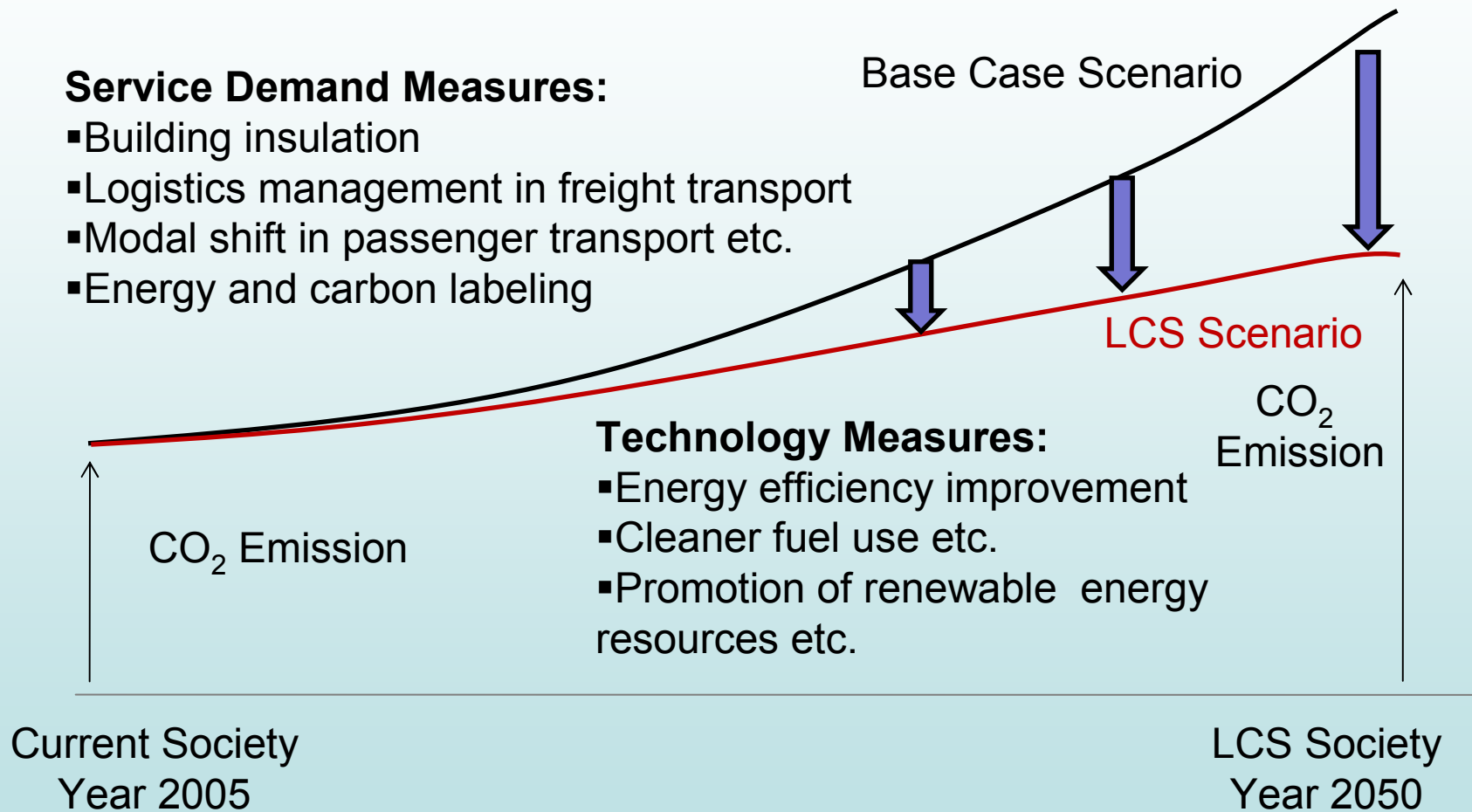
CO <sub>2</sub> : 4.35%	Population: 1.02%
TPES: 5.91%	GDP: 5.07%

Source: DEDE, 2006, IMF, 2008, IEA, 2007 and 2008

# LCS Modeling Framework



# Concept of low carbon society scenario in the study



# Scenario Description

## 1) Base Case Scenario (Business as Usual)

- Growth (CAGR): GDP (5.6%), population (0.4%) during 2000-2050
- No CO2 Reduction policy.

## 2) Moderate CO2 Reduction Scenario (LCS20)

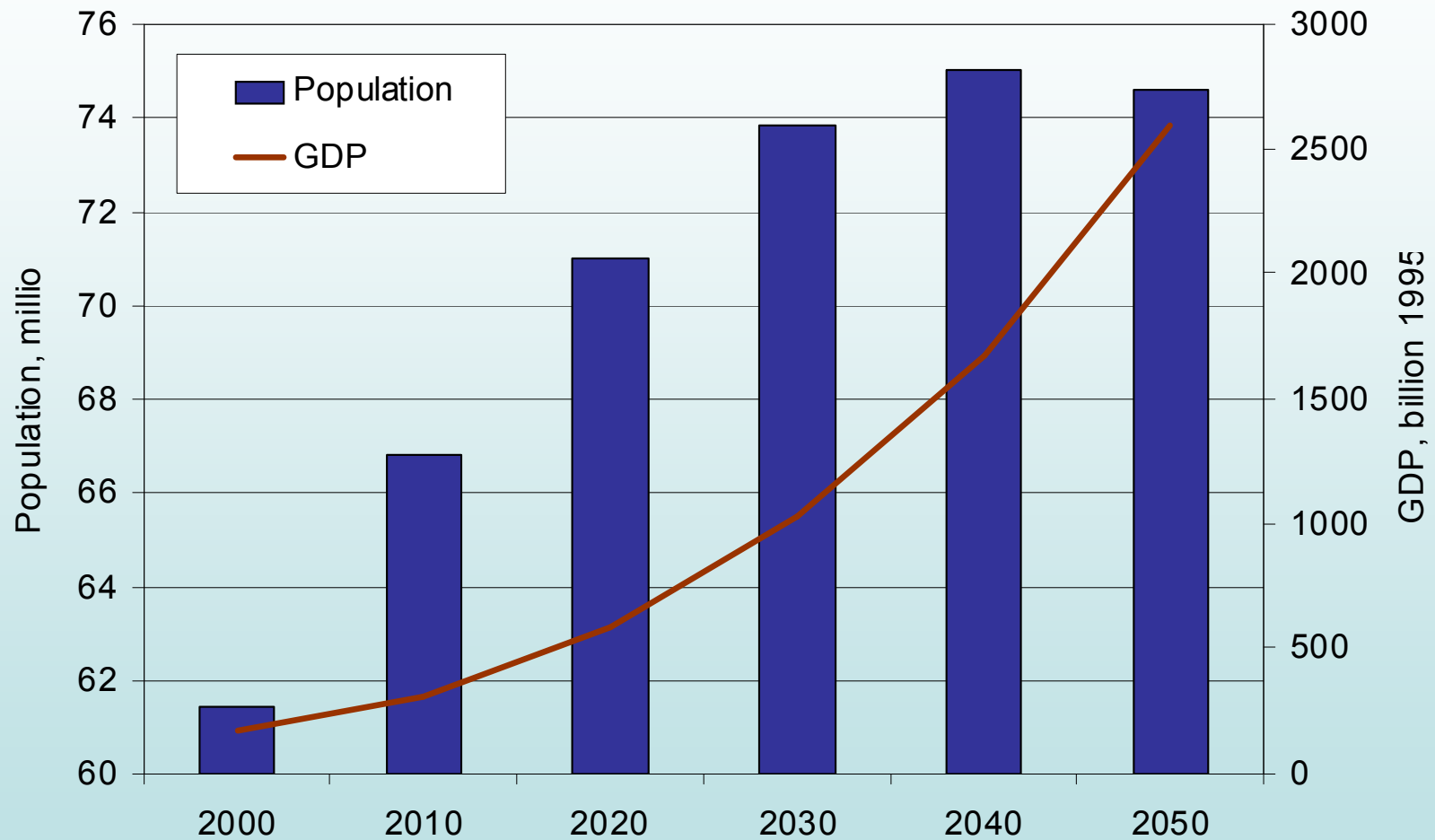
- Least cost measures targeting cumulative CO2 reduction of 20% during 2000-2050
- The target corresponding to cumulative CO2 reduction to be achieved by gradually increasing carbon tax from US\$10/tCO2 in 2015 to \$100/tCO2 in 2050 in Thailand.

## 3) Accelerated CO2 Reduction Scenario (LCS50)

- Cumulative CO2 reduction 50% from the base case emissions during 2005-2050
- Comprehensive technological measures

# Base Case Description(1)

## GDP and Population growth



CAGR (2000-2050):

Population: 0.4%

GDP: 5.6%

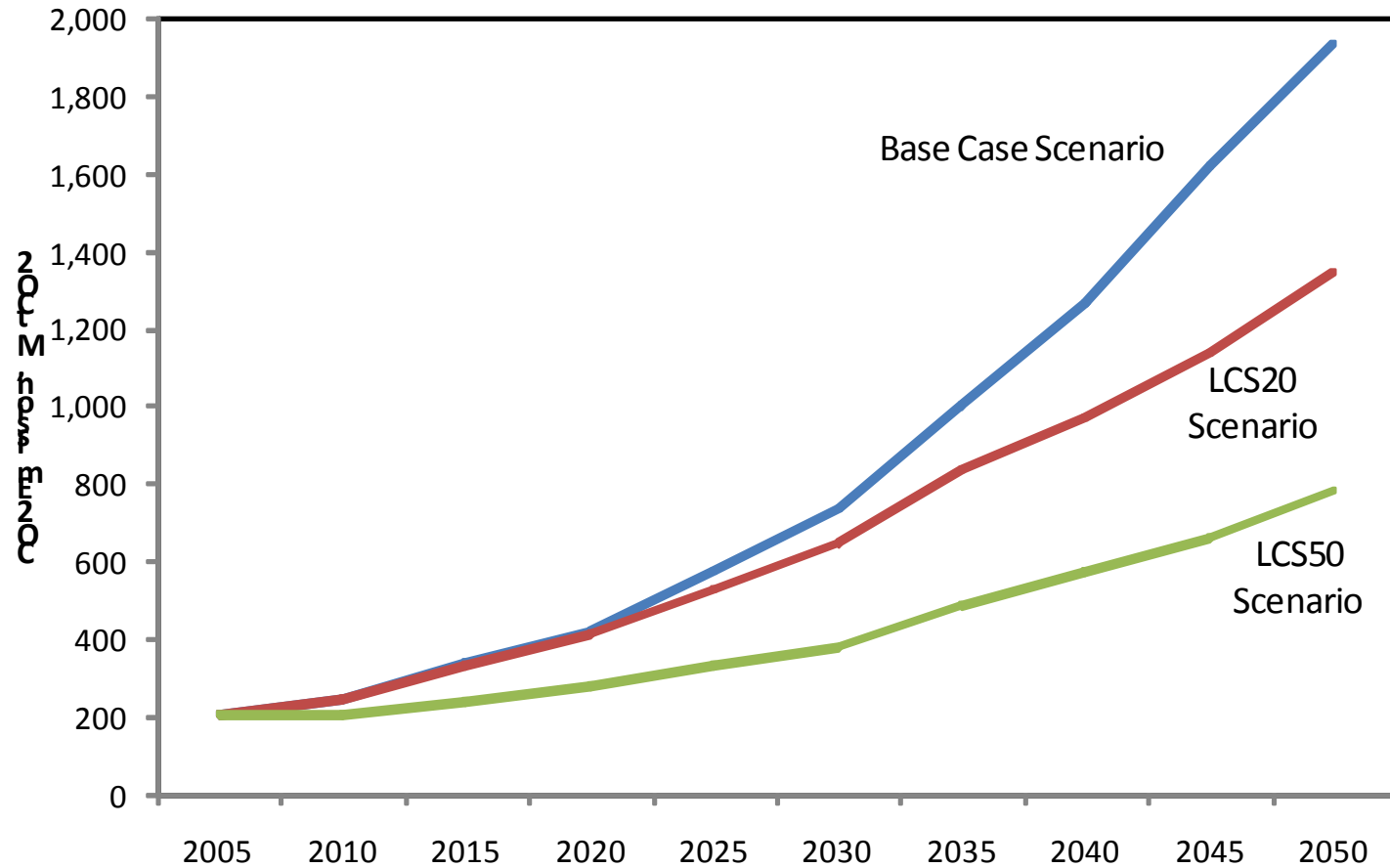
Sources: TDRI, 2004; UN, 2006



## Base Case Description (2)

- No greenhouse gas (GHG) mitigation policy intervention.
- Nuclear power option from 2020 onwards (EGAT, 2008).
- Minimum daily limits on ethanol and biodiesel use in the transport sector by 2015 (EPPO, 2006):
  - 3 million liters (ethanol)
  - 4 million liters (biodiesel)
- Maximum availability of biofuel feed-stocks from 2015 onwards:
  - 64,000 kilo tons (for ethanol)
  - 2,550 kilo tons (for biodiesel)(DEDE, 2006a and 2006b).
- Emerging technologies considered from 2020 include:
  - plug-in hybrid and fuel cell vehicles;
  - and CCS in power generation.

## CO<sub>2</sub> emission profiles during 2005-2050 in selected scenarios



- ❑ In LCS20, most CO<sub>2</sub> reduction measures would start 2020 onwards.
- ❑ In LCS50, the CO<sub>2</sub> reduction need to start much earlier.

# How much CO<sub>2</sub> reduction in year 2050 compared to that in base case?

Increase in CO<sub>2</sub> emission in 2050 compared to year 2005  
CO<sub>2</sub> emission:

❑ Base case: 8 times.

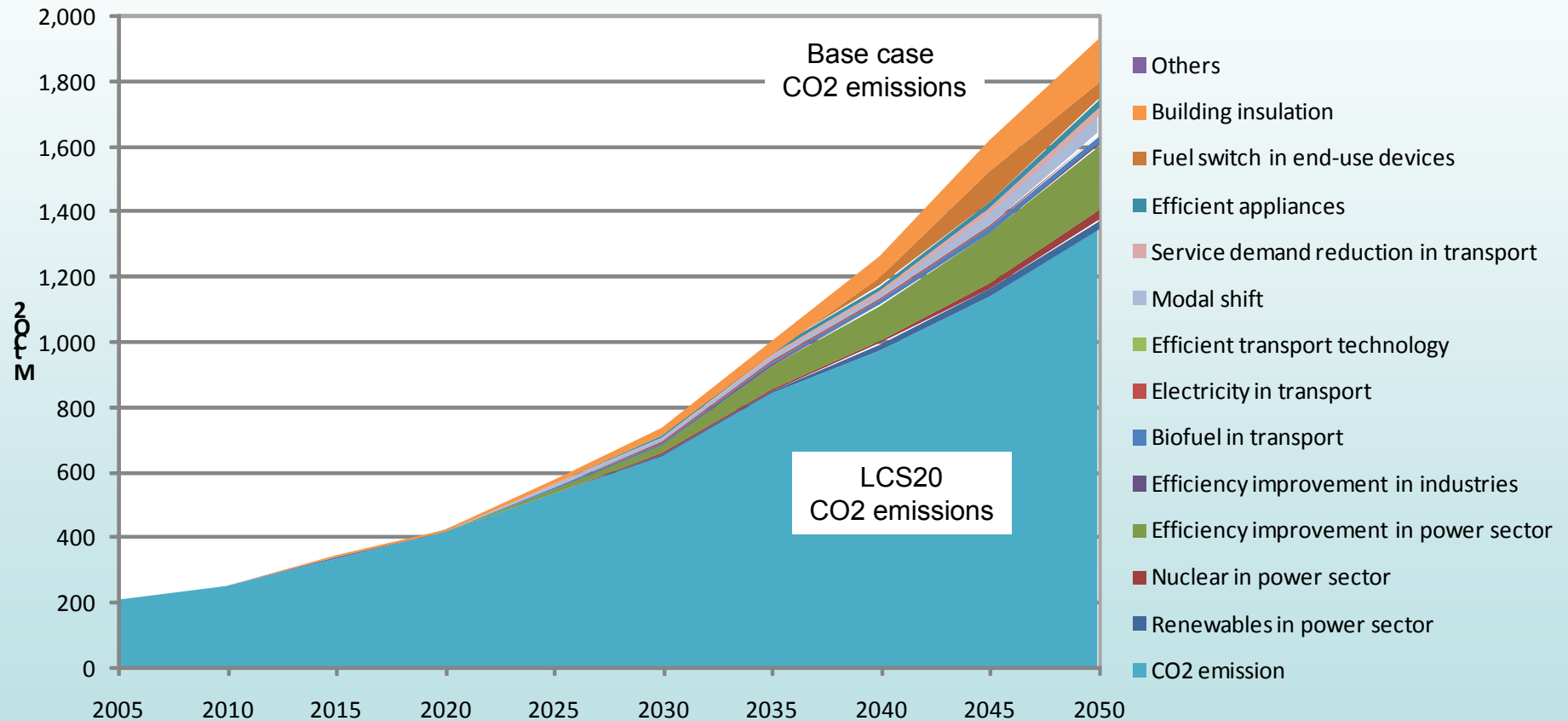
❑ LCS20: 5 times.

✓ i.e. over 30% CO<sub>2</sub> reduction compared to year 2050 base case emissions.

❑ LCS50: 2 times.

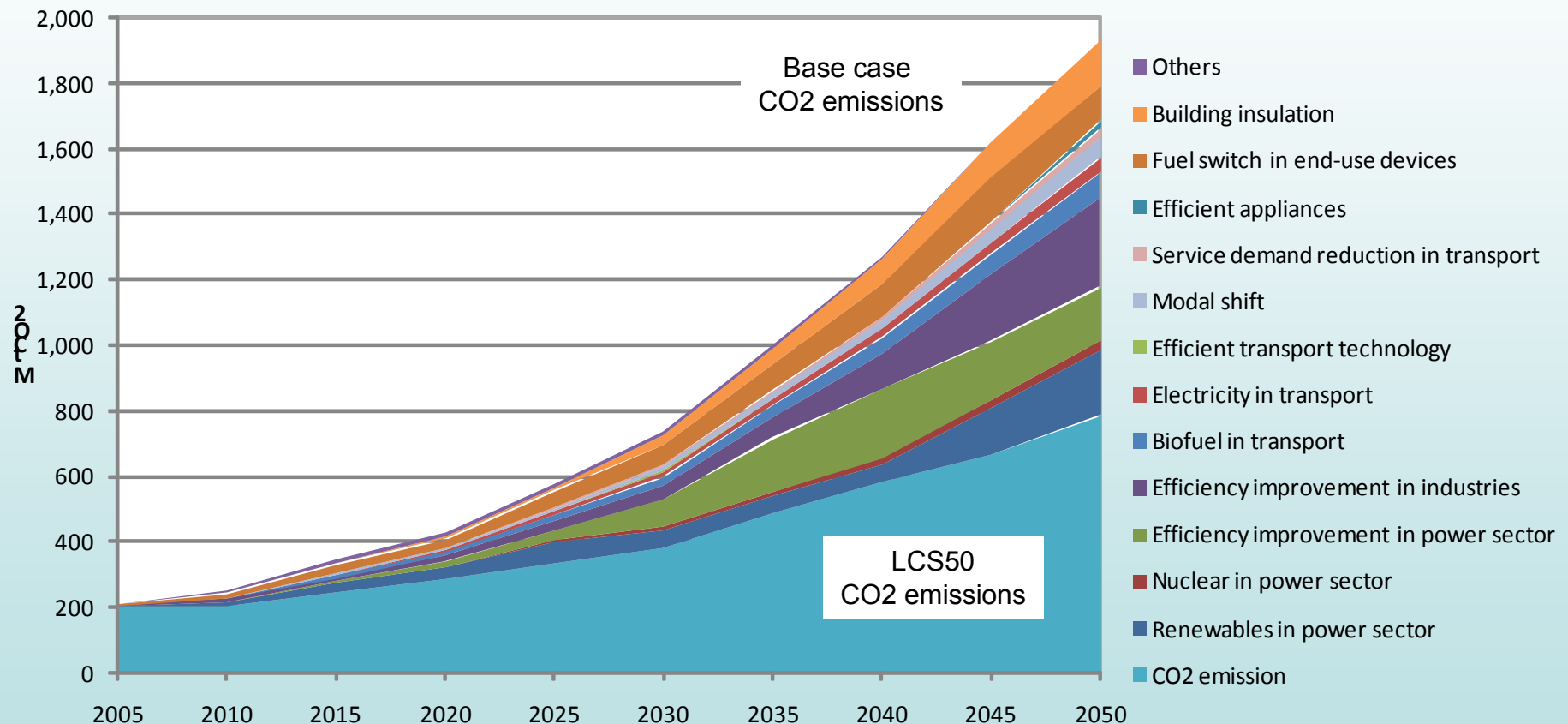
✓ i.e. about 60% CO<sub>2</sub> reduction compared to year 2050 base case emissions.

# Contribution of different measures in CO<sub>2</sub> reduction in LCS20 during 2005-2050



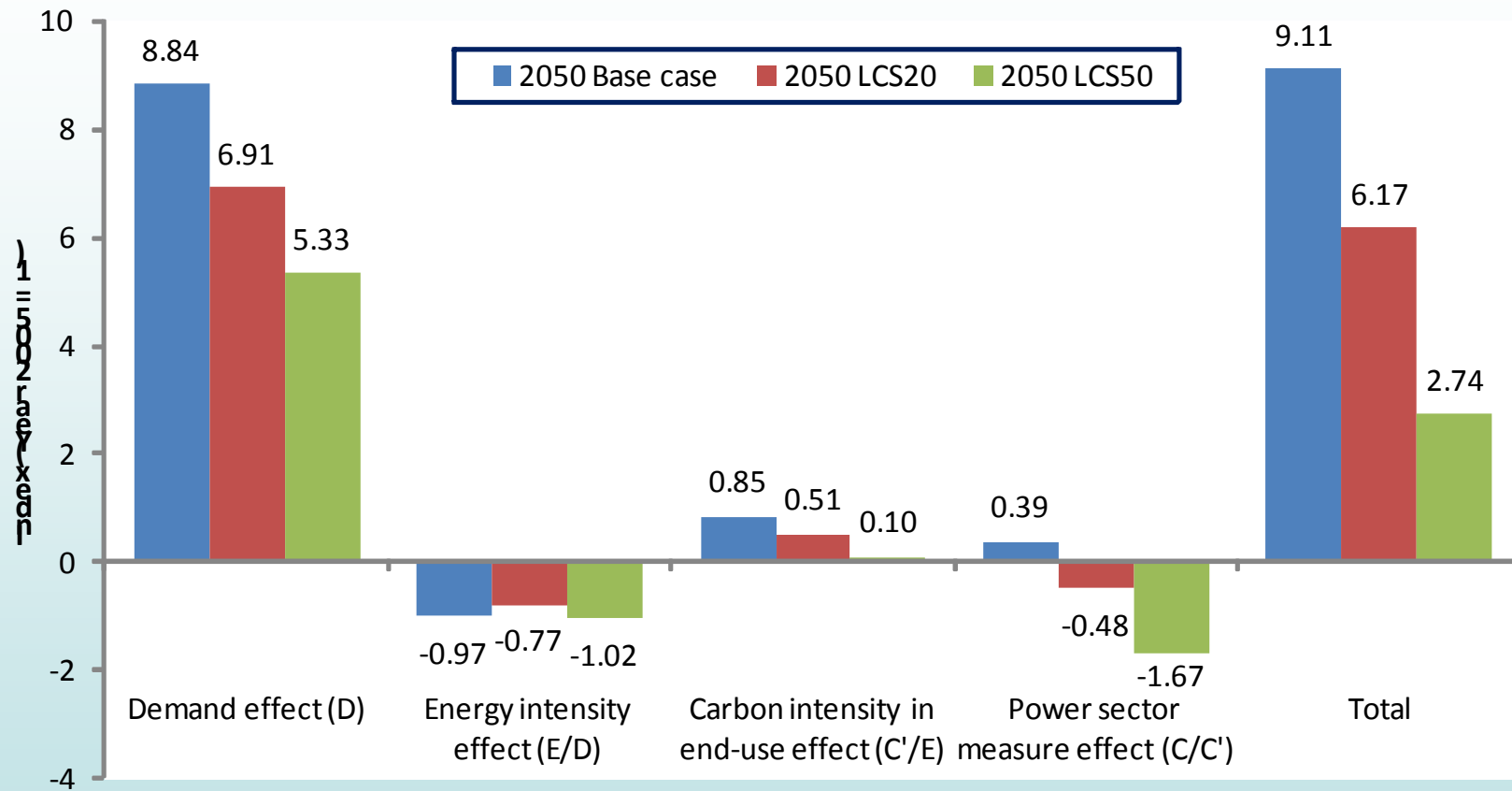
- Efficiency improvement in the power sector and building insulation: Two largest contributors

# Contribution of different measures in CO<sub>2</sub> reduction in LCS50 during 2005-2050



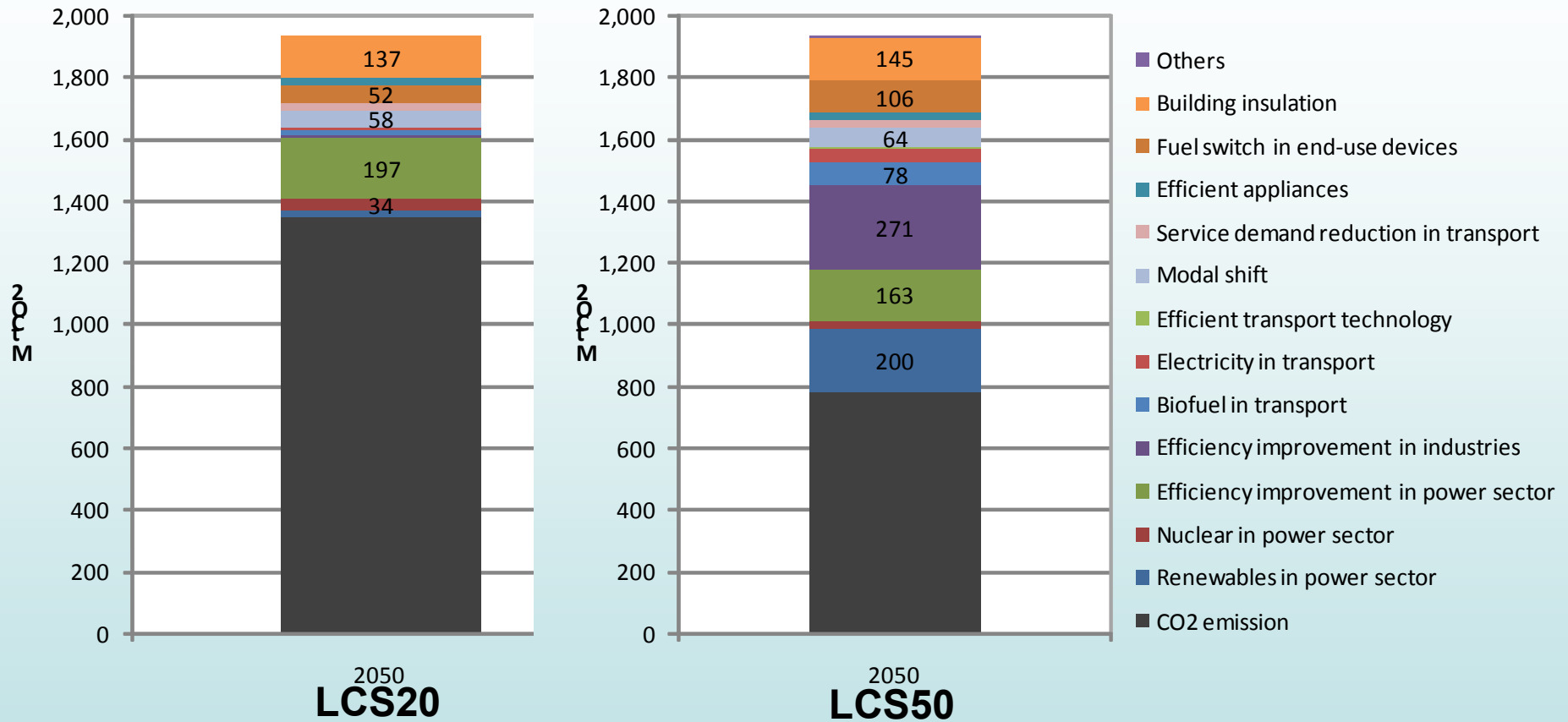
- Efficiency improvement in power generation – the largest contributor followed by EI industries (steel and cement), RE based power, fuel switching in end use, building insulation, biofuels etc.

# Factors behind the increase in CO<sub>2</sub> emission in 2050 in selected cases



- Demand effect (DE) is predominant in all cases. DE supported by Carbon intensity effect .
- Energy efficiency effect and power sector measures acting against the increase.

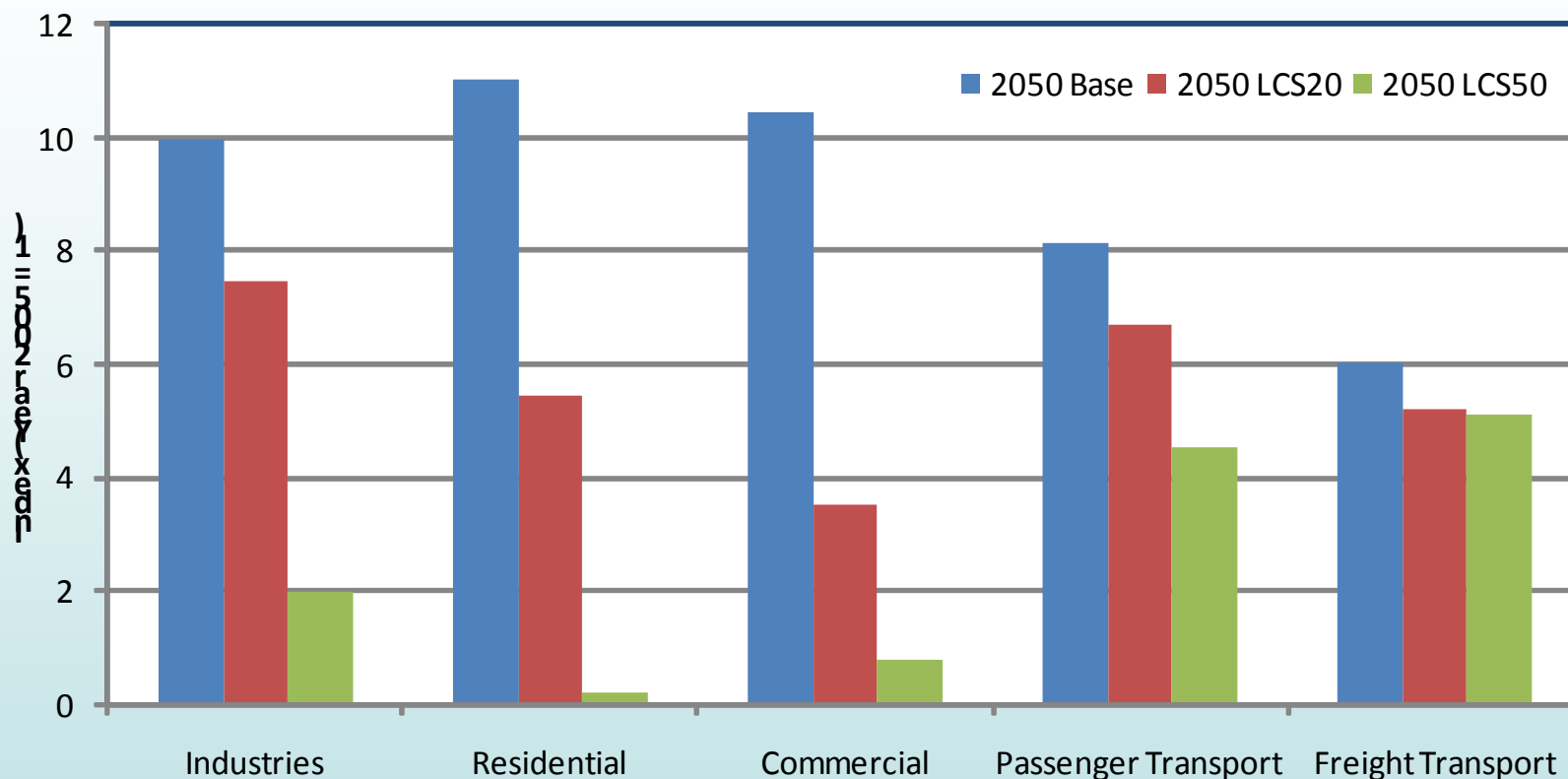
# Contributions of CO<sub>2</sub> reduction measures in year 2050 in LCS cases



- Efficiency Improvement in Power Sector
- Building Insulation
- Fuel Switch
- Modal shift

- Efficiency Improvement in Industries
- Renewables in Power Generation
- Efficiency Improvement in Power Sector
- Building Insulation
- Fuel switch in demand side
- Biofuel in transport
- Modal shift

## Sectoral CO2 emission in 2050 in selected cases

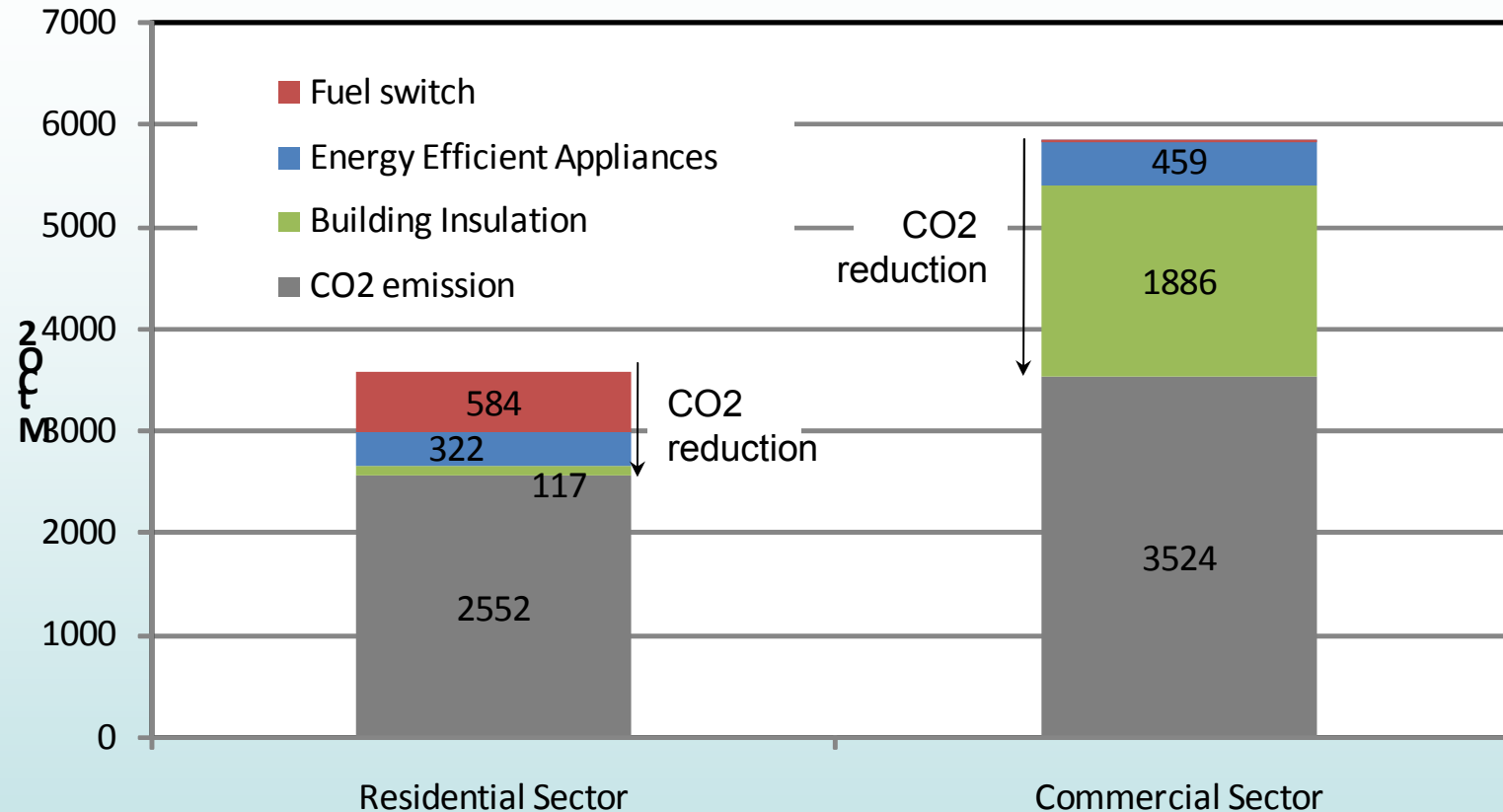


In terms of change in CO2 emission (%) in the economic sectors:

- The residential and commercial sector would have higher contribution in CO2 reduction in both scenarios followed by industries.
- Transport will have a lower contribution in CO2 reduction in both scenarios.



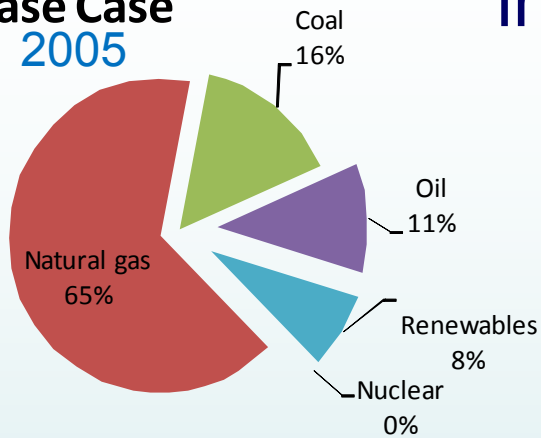
## Changes in Residential and Commercial sector emission in the selected cases in LCS20 during 2005-2050



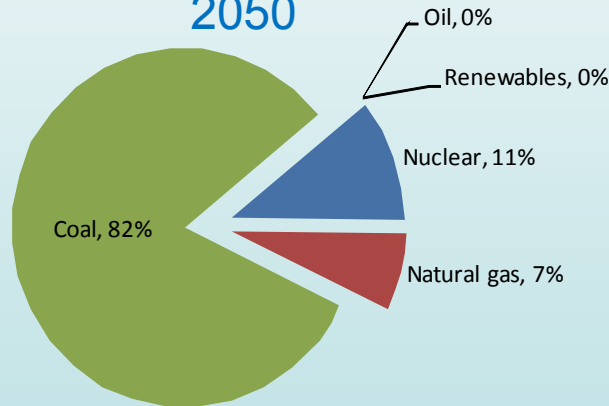
- During 2005-2050, in the residential and commercial Sector during 2005-2050, CO2 emission reduction (including CO2 reduction associated with electricity use) of about 30% and 40% of total CO2 emission from the respective sectors in the base case would be achieved in LCS20.
- Together Res. and Com. sectors contribute about 9% of total reduction from base case emissions.

# Power generation in year 2005 and 2050 in the selected cases

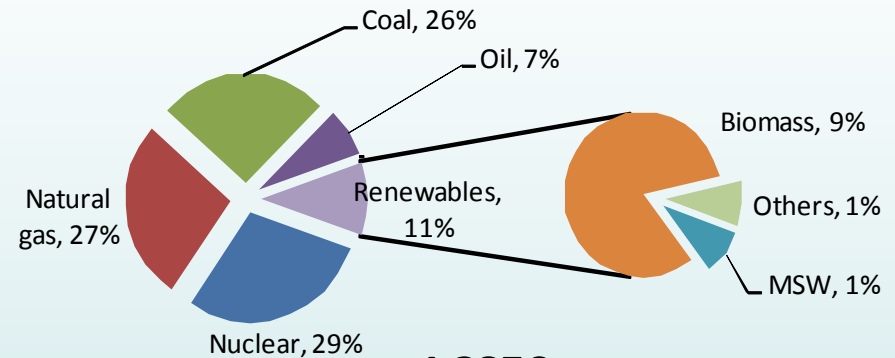
**Base Case  
2005**



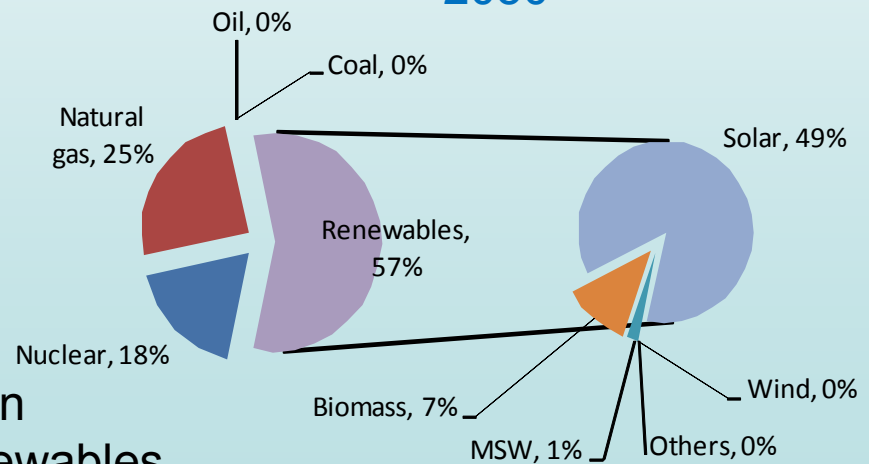
**Base case  
2050**



**LCS20  
2050**

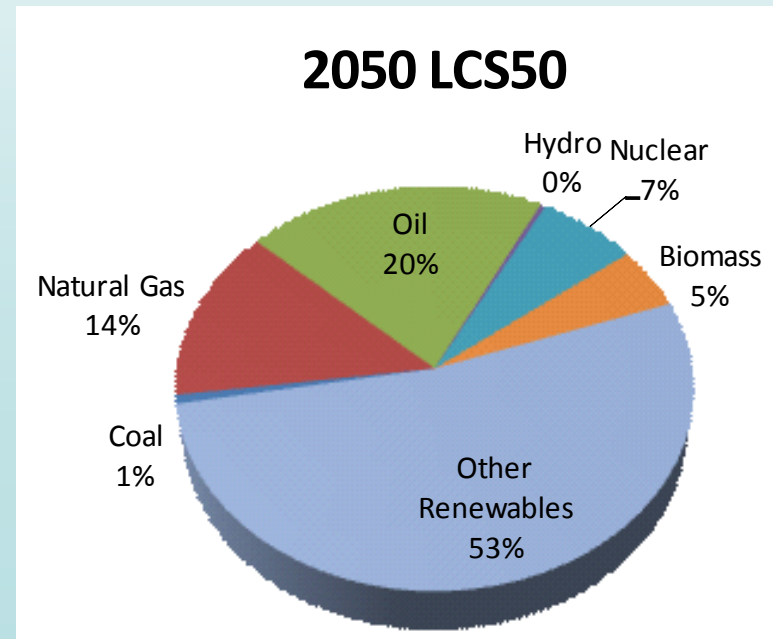
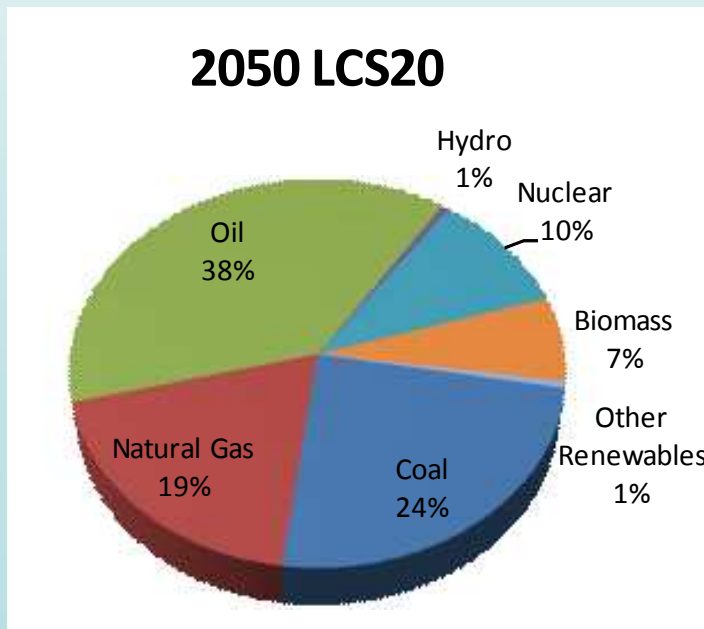
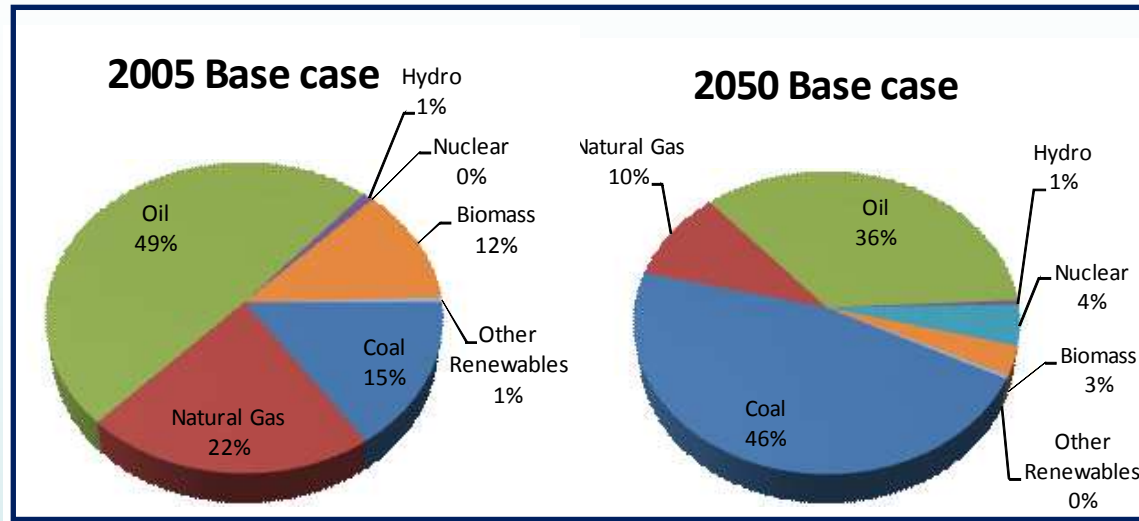


**LCS50  
2050**

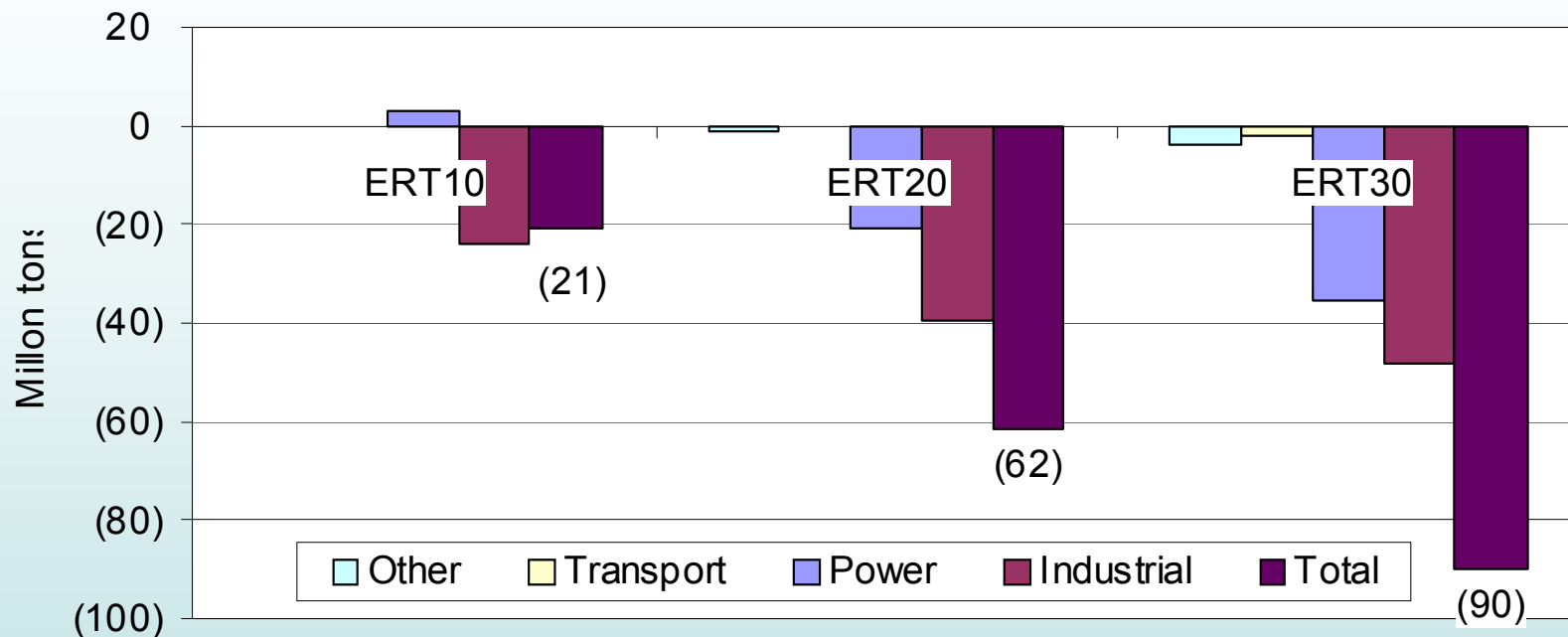


- **Base case** : Coal dominated
- **LCS20** : Diversified power generation (increase in the share of renewables in power generation)
- **LCS50** : Dominated by renewables

# Structure of primary energy requirement in the selected cases

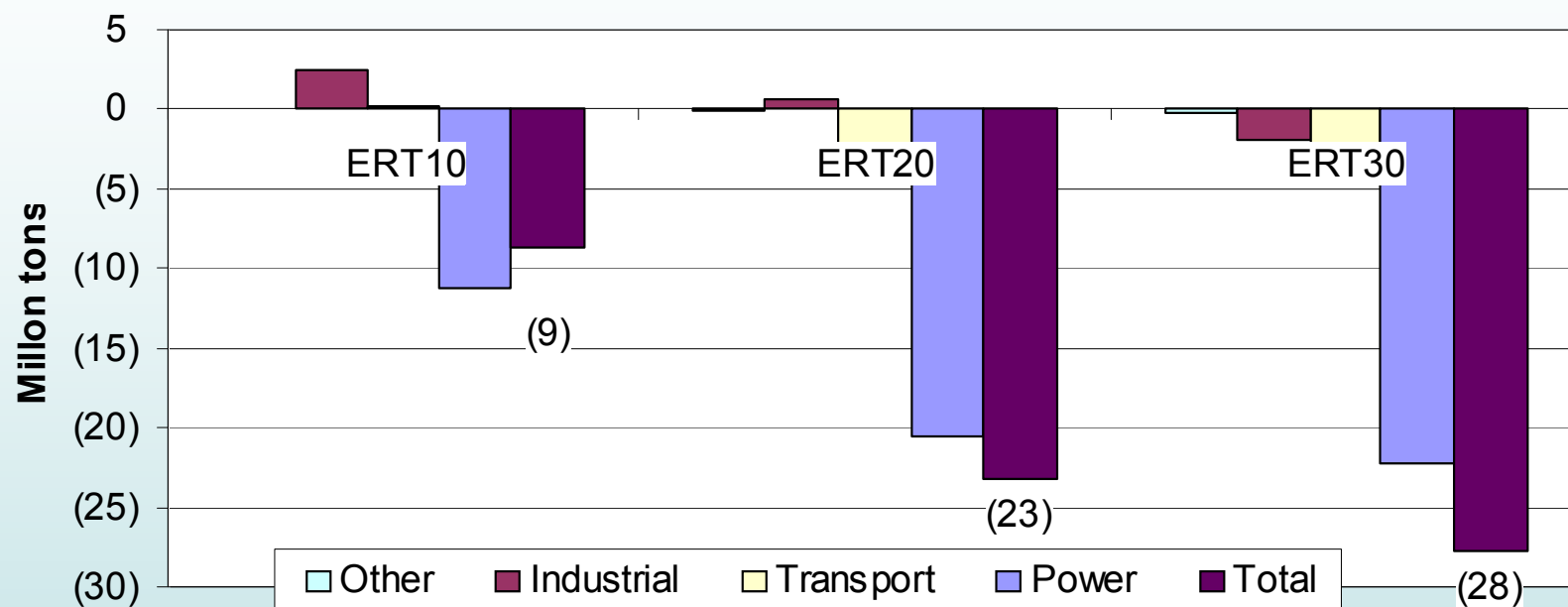


## How much co-benefit in terms of SO<sub>2</sub> reduction?



- SO<sub>2</sub> reductions of 10%, 28% and 41% from the base case value under ERT10, ERT20 and ERT30.
- The highest SO<sub>2</sub> reduction (over 54%) from the industrial sector followed by the power sector.

## How much co-benefit in terms of NO<sub>x</sub> reduction?



- % reduction of NO<sub>x</sub> relatively lower than % reduction of SO<sub>2</sub> emission.
- NO<sub>x</sub> reduction of 2%, 6% and 7% of from the base case value under ERT10, ERT20 and ERT30 respectively.
- The highest NO<sub>x</sub> reduction (over 80%) would take place in the power sector followed by the transport sector.

# Measures to achieve low carbon society during 2005-2050

## Cleaner Fuel Use and Environment Friendly Public Transport System

### Use of non-motorized transport systems

- shift to non-motorized transport

### Master plan for compact cities

- Lowers travel demand

### Public transport friendly design of cities and transport system

- modal shift, higher use of Mass Rapid Transits

### Use of clean fuel and efficient vehicles

- improving efficiency and lowering carbon intensity of energy use in transport; promoting biofuels.

## Energy Efficiency Improvements (End Use and Industrial Production)

### Labeling on electrical appliances

### Energy auditing – promoting use of efficient technology in industries

### Carbon emission labeling of industrial products

- Promoting use of low carbon products.

## Low Carbon Electricity Generation

### Efficient and cleaner power generation

- Promoting natural gas based advanced combined cycle power plants

### Renewable Portfolio Standard (RPS)

- Biomass based power
- Solar based power

### Nuclear power generation

### Natural gas use in electricity generation

## Building Insulation in Residential and Commercial Sector

### Building codes

- Regulatory measures to lower energy use

### Financial incentives through Energy Conservation Fund

### Public awareness campaign

- to promote voluntary measures

# Some Environment Friendly Policies in Thailand (1)

## Policies in Transport Sector

- To substitute 10% of diesel use with bio-diesel by 2012.
- Utilization of E10 Gasohol from one million liters per day in 2006 to 3 million liters of ethanol per day by 2011.
- Retail price incentive for ethanol and biodiesel fuels.
- Subsidy for vehicles to convert to CNG.
- Substitution of existing diesel-run trains with electric trains
- Expansion of mass rapid transit (MRTs) in cities (7 lines from existing 2 lines)

## Some Environment Friendly Policies in Thailand (2)

### Power Sector Policies

- ❑ Ministerial guidelines to reduce GHG emission per unit of energy use by 20% to major power and oil companies (MOE, 2008).
- ❑ Small Power Producer and Very Small Power Producer Policy
  - Feed in tariff for Renewable Power Generation, Soft loan, Tax Incentive
- ❑ Renewable Portfolio Standard (RPS)
  - now changed to VSPPs and SPPs.
- ❑ Nuclear power proposed in Power Development Plan (Revised 2008)(EGAT, 2008)
  - 2000 MW each in Years 2020 and 2021
- ❑ Promotion of clean coal technologies.



# Some Environment Friendly Policies in Thailand (3)

## Industrial and Residential Sector Policies

- ❑ Energy efficiency improvement programs
  - Demand Side Management in residential, commercial and industrial sectors
    - ❑ Promotion of high efficiency motors
- ❑ Energy Conservation fund for supporting energy audit and efficiency improvement measures.
- ❑ Building Energy Codes for designated factories.
- ❑ Energy efficiency labeling of appliances
  - On voluntary basis for refrigerators, air conditioners, fluorescent lamp ballasts, compact fluorescent lamps (CFLs), electric fans and rice cookers.

## Concluding and final remarks

- ❑ Power sector measures play the largest role in CO<sub>2</sub> reductions.
  - ❑ Efficiency improvement in the power sector would be the largest contributor to CO<sub>2</sub> reductions.
- ❑ Higher CO<sub>2</sub> reduction (i.e., in LCS50) requires substantial renewable based power generation, particularly from solar.
- ❑ Building insulation in residential and commercial sectors would have a significant role in the CO<sub>2</sub> reduction, if emissions from power generation are allocated to the final demand sectors.
- ❑ In LCS50, efficiency improvement in steel and cement industries becomes important as well.
- ❑ Travel demand measures necessary to have significant contribution from the transport sector.

# Thank you

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