Effects of carbon taxes for selected CO_2 stabilization targets on the Thai energy system

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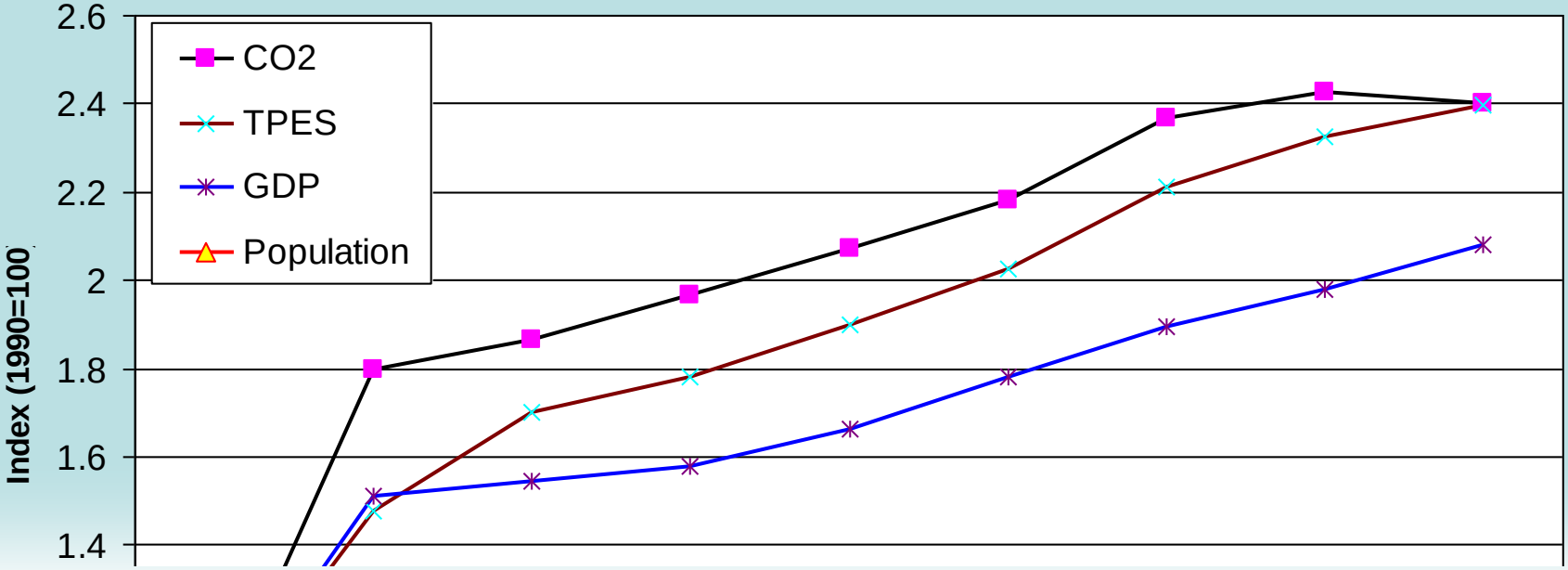
Presentation Outline

- ✓ Background
- ✓ CO_2 emission, energy mix, technology mix,
  - Base case analysis
  - CO2 Stabilization target carbon tax scenario analysis
- ✓ Co-benefits
- ✓ Concluding remarks

CO_2, TPES, GDP and Population Growth during 1990-2006



AAGR (2001-2006):

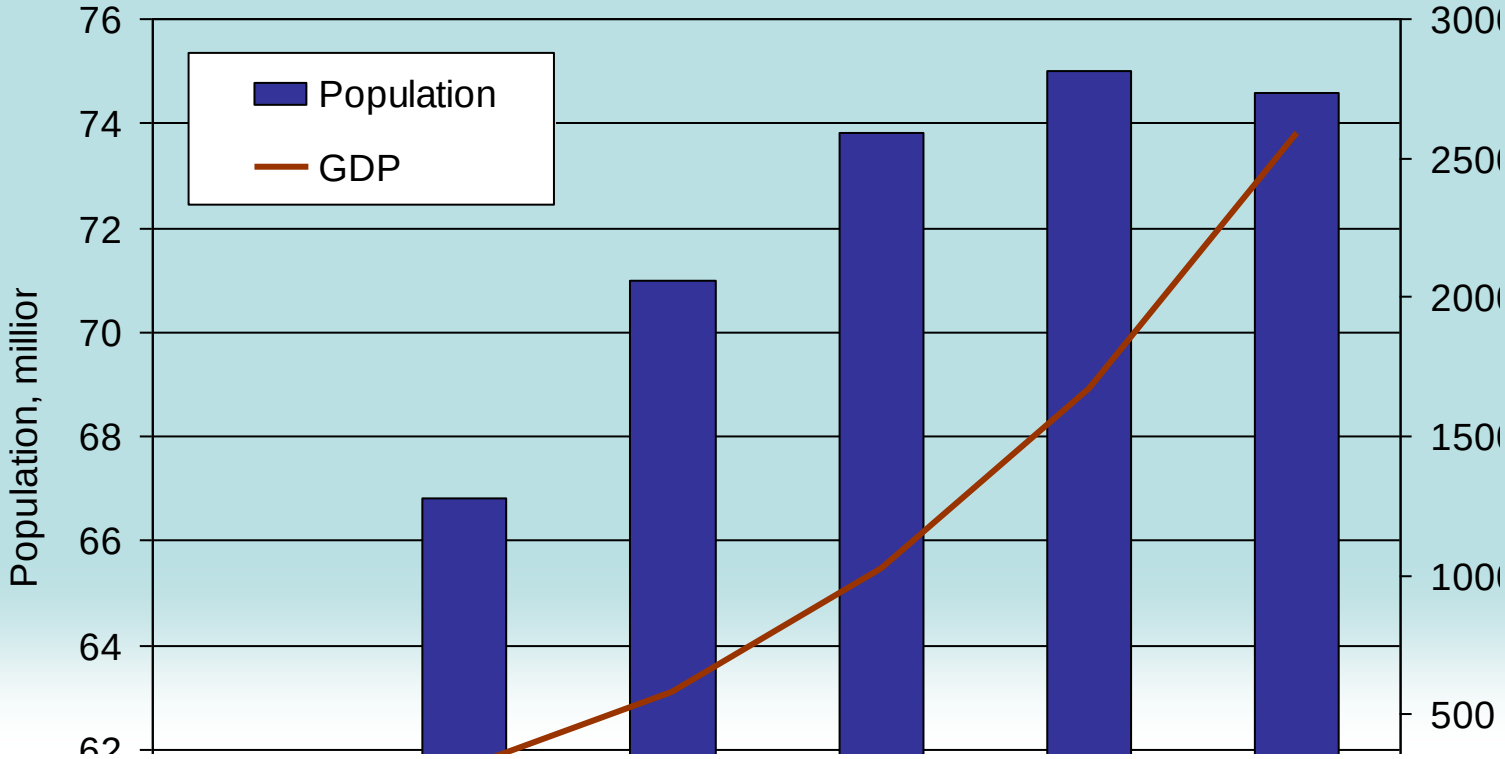
CO_2: 4.35% Population: 1.02%

TPES: 5.91% GDP: 5.07%

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

Base Case Analysis

GDP and Population during 2005-2050



CAGR (2000-2050):

Population: 0.4%

GDP: 5.6%

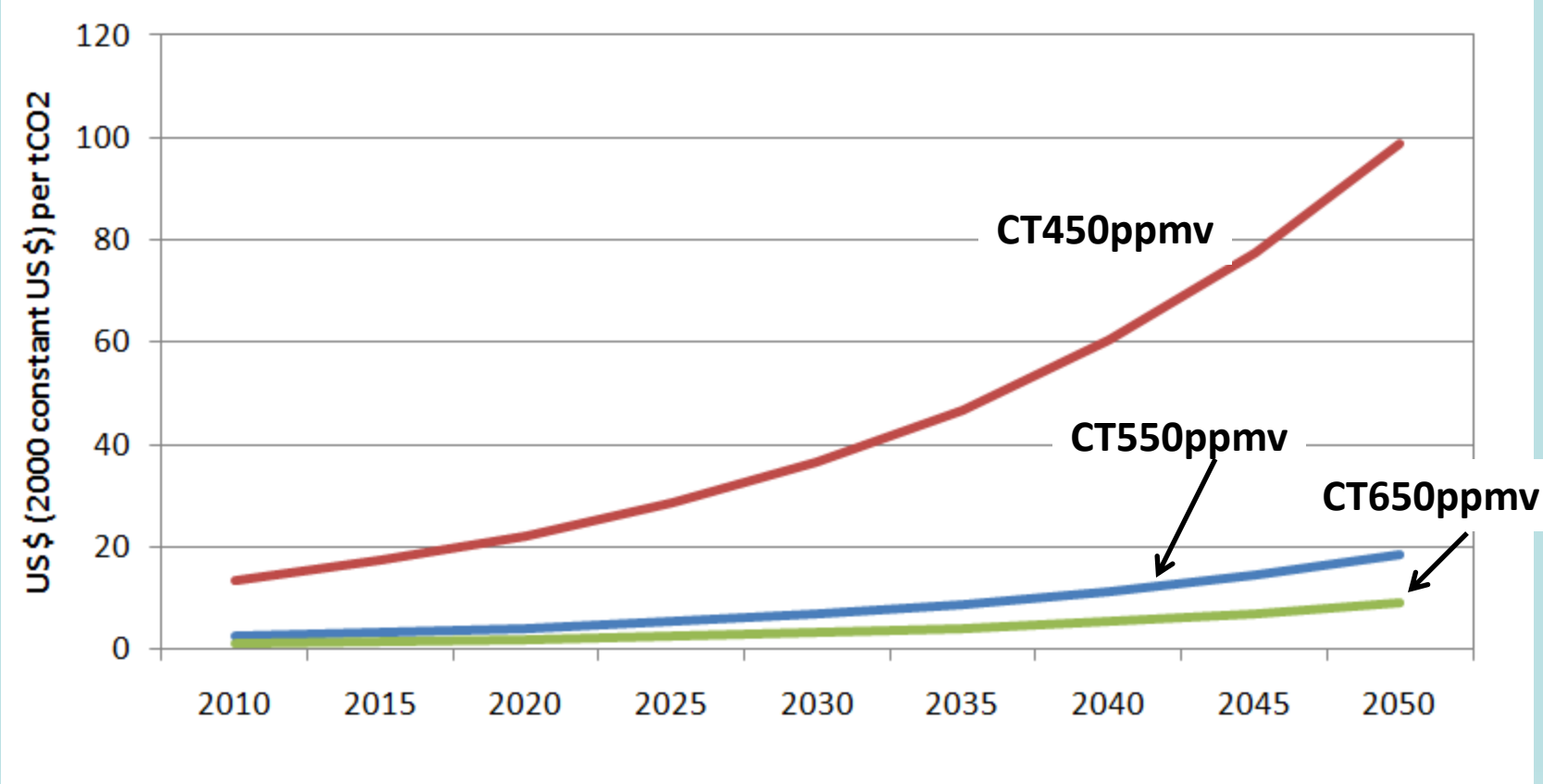
Sources: TDRI, 2004; UN, 2006

Base case assumptions

- 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 onward.
- 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.
- Learning effects (Solar, Wind, CCTs, biomass power generation technologies), Autonomous energy efficiency improvement (AEEI) in conversion and demand technologies.

CO2 Stabilization Carbon Tax Case Analysis

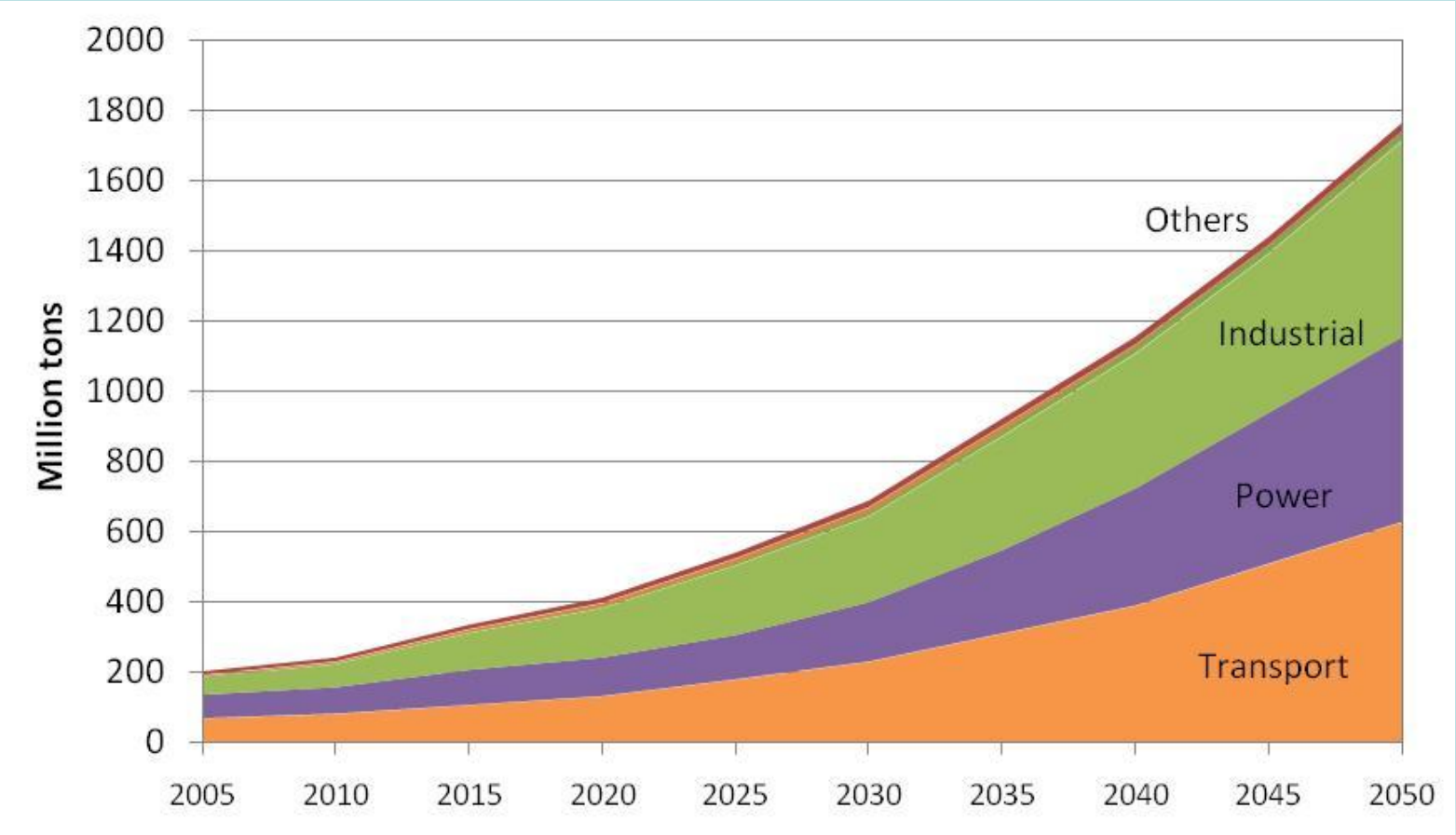
Carbon tax profile in the selected CO2 stabilization scenarios by 2100



- **Based on the MiniCAM model output for India and the other South and East Asian countries**

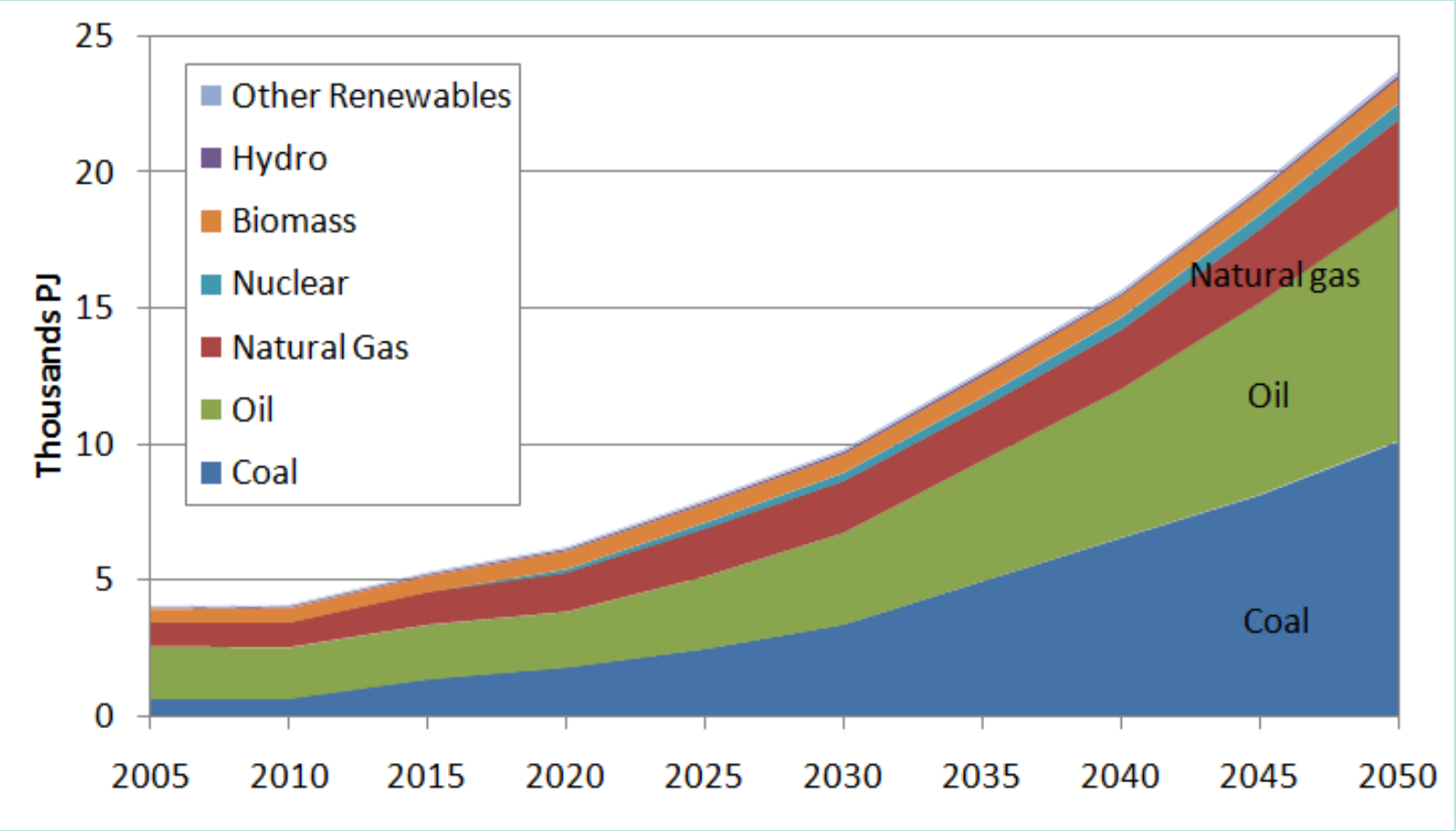
Source: Edmonds et al. (2008) and personal communication with Jae Edmonds

Base case CO2 emissions during 2005-2050



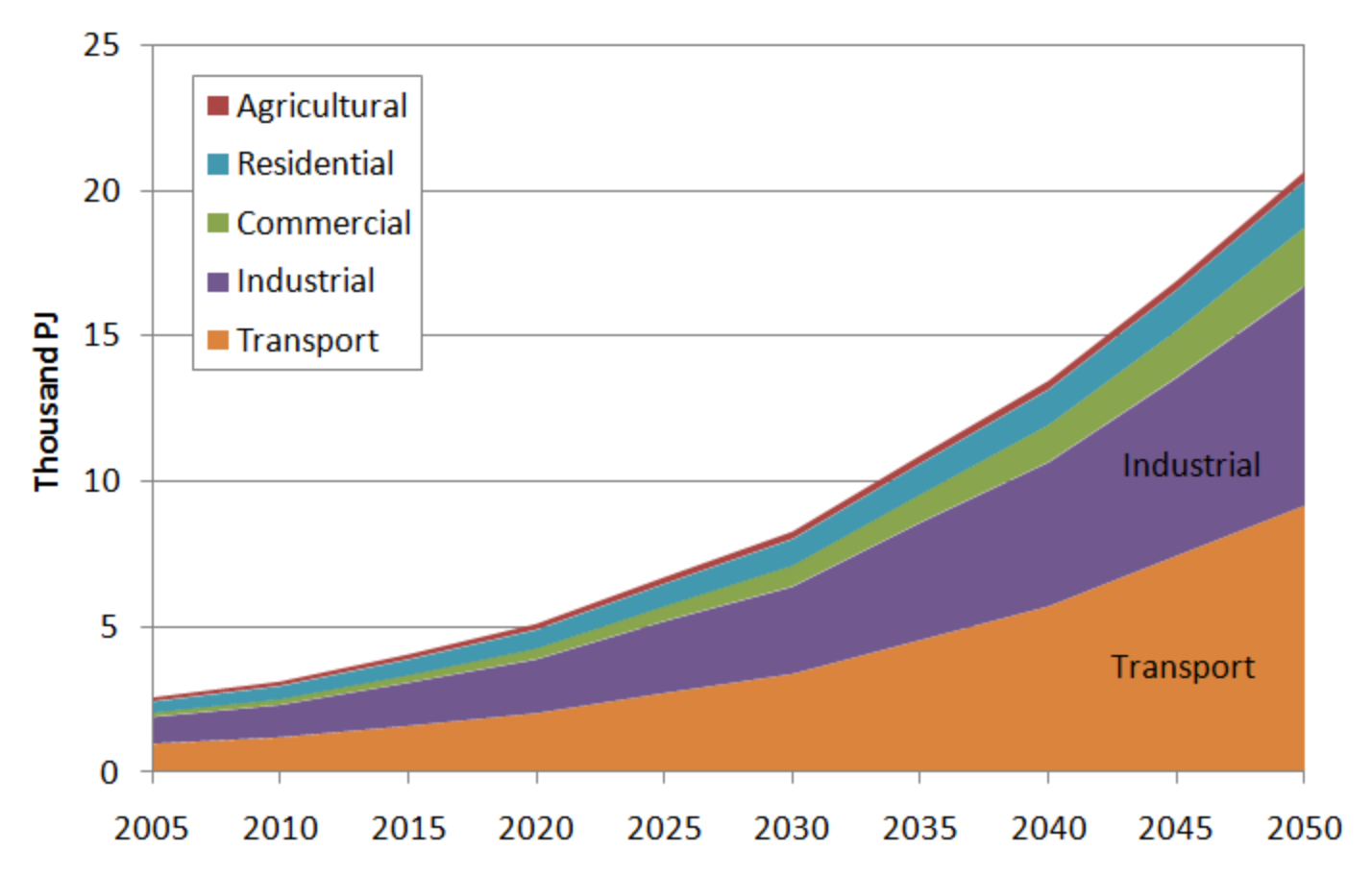
- **Total CO_2 emissions increase by over 7 folds in the base case, i.e. from 203 million ton in 2005 to 1,766 million ton by 2050**
- The base case emissions includes LR and AEEI: without LR and AEEI, the total CO2 emissions would have been 7% higher.

Primary energy requirement in the Base case



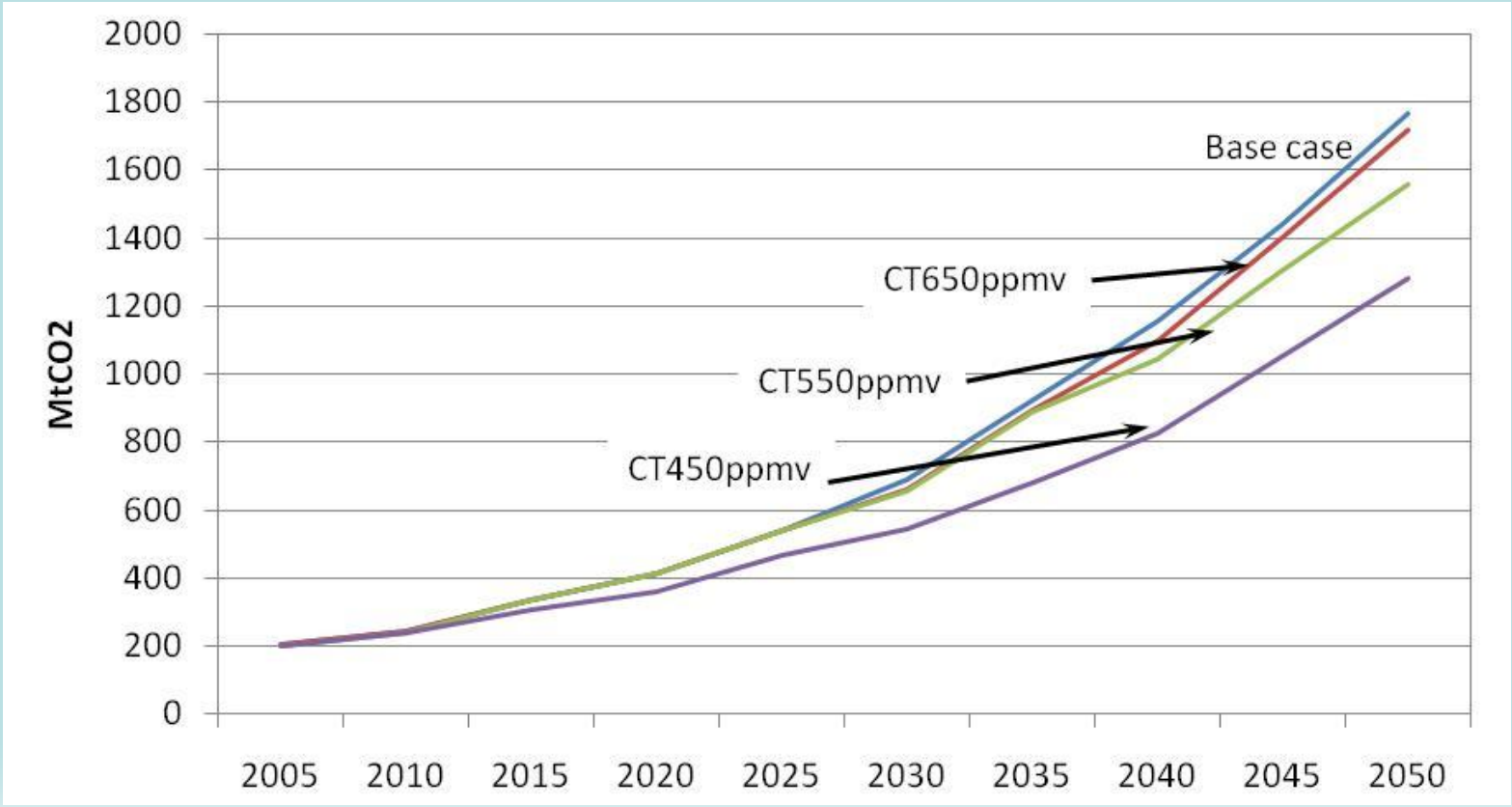
- TPES is found to increase by nearly 5 folds from 4,026 PJ to 23,688 during the period.
- The combined share of coal, oil and natural gas increases from 86% in 2005 to 93% by 2050; The share of coal (mainly imported) increases from 16% to 43% during the period;
- Also the share of the total imported energy in TPES would increase from 53% in 2005 to 92% by 2050.

Final energy demand in the Base case



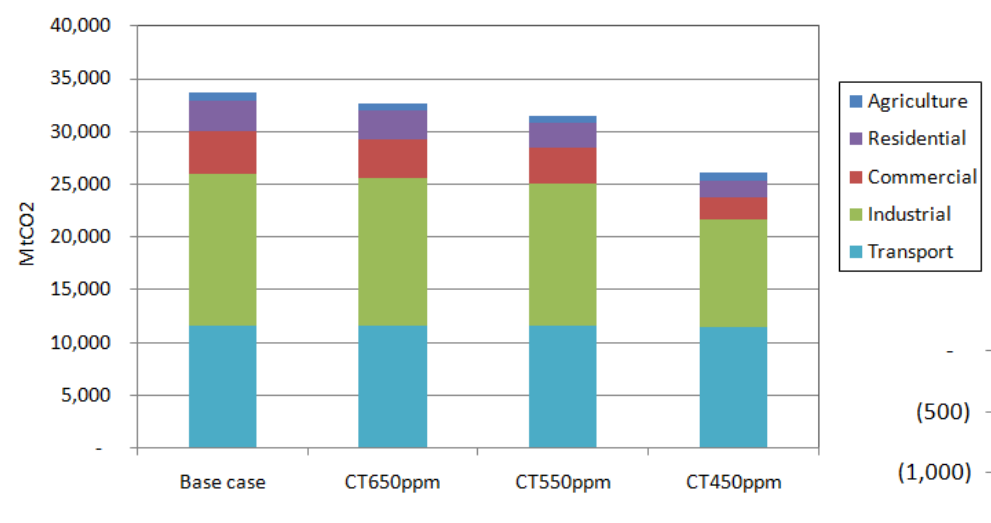
- TFEC would grow by more than 7 folds (i.e., from 2,568 PJ in 2005 to 20,633 PJ in 2050).
- Industrial and transport sectors together, would account for 74% of TFEC in 2005 and their share would grow to 81% by 2050.

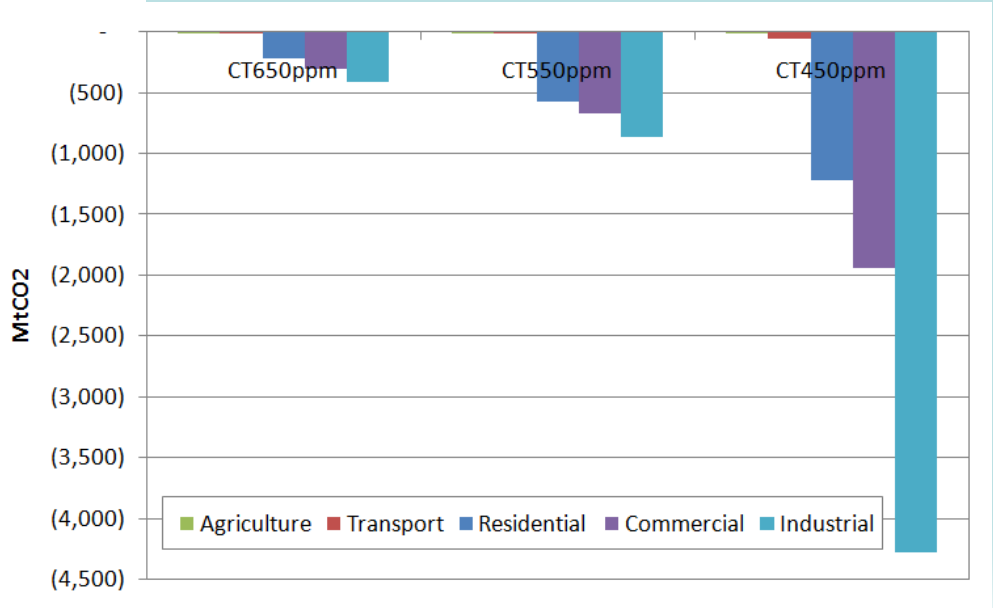
CO_2 emission profiles in the selected scenarios



- **The total cumulative CO_2 emission would decrease by 3%, 6% and 22% under CT650ppmv, CT550ppmv and CT450ppmv respectively from the base case during 2005-2050.**

Sectoral CO2 emission reductions in the selected scenarios

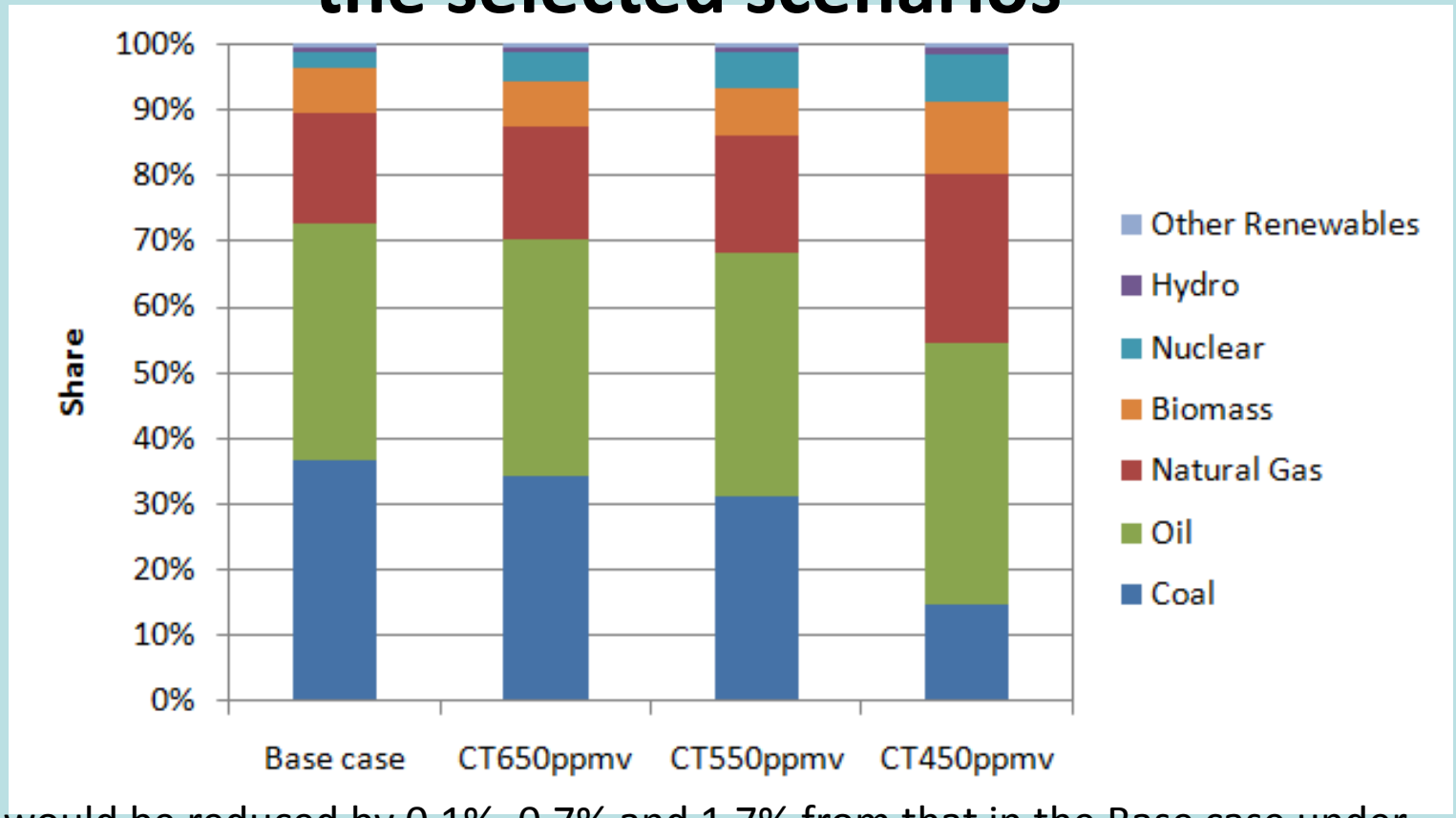




- ✓ **Sectoral share in CO2 reduction in CT650ppmv – CT450ppmv***
  - Industrial sector: 44 – 57%
  - Commercial sector: 33 – 26%
  - Residential sector: 23 – 16%
  - Transport and Agricultural Sector: not significant

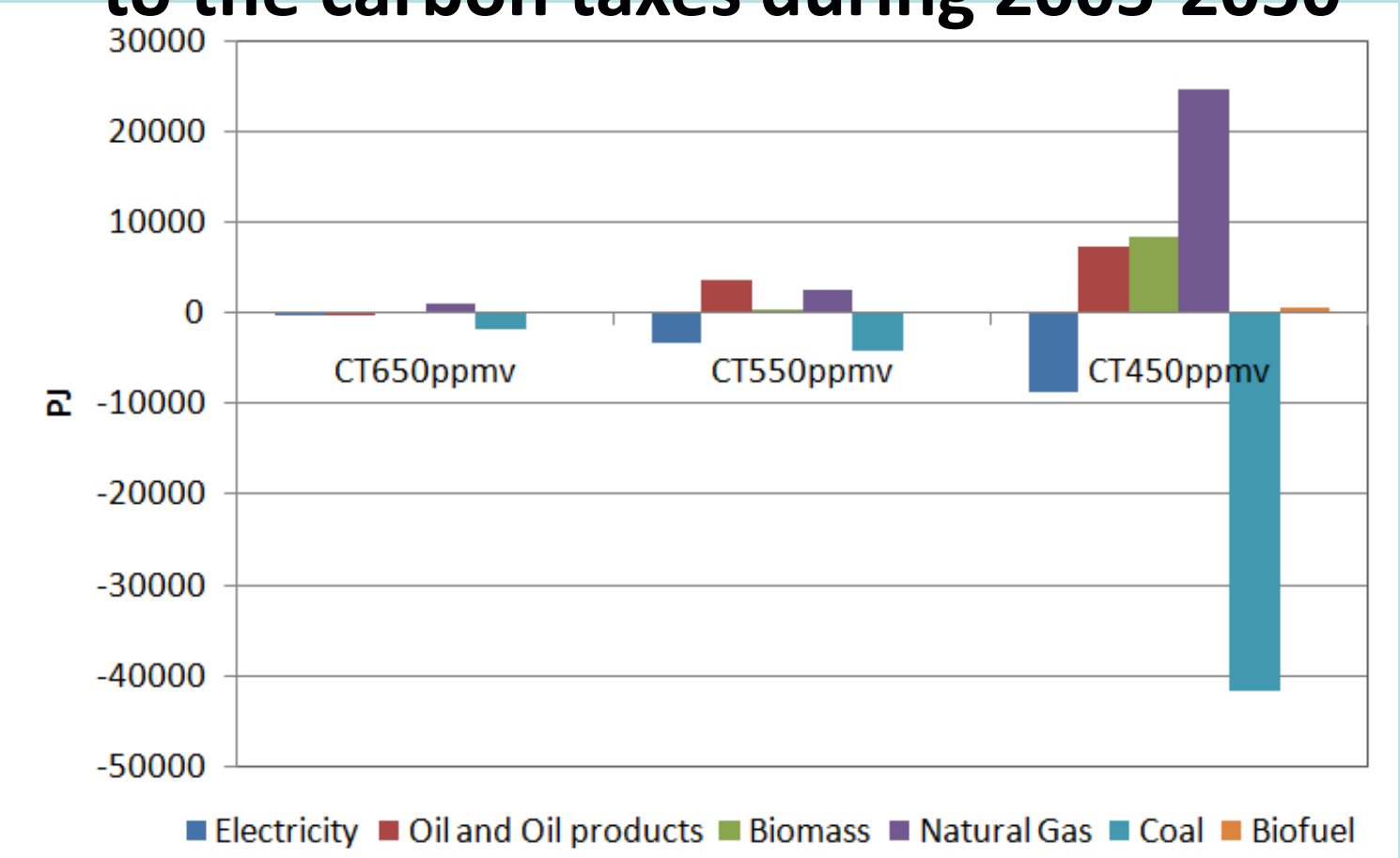
  * including emissions related to power generation
- ✓ **More than 70% of the CO2 reduction would take place in Power sector in all the selected scenarios.**

Total primary energy supply mix in the selected scenarios



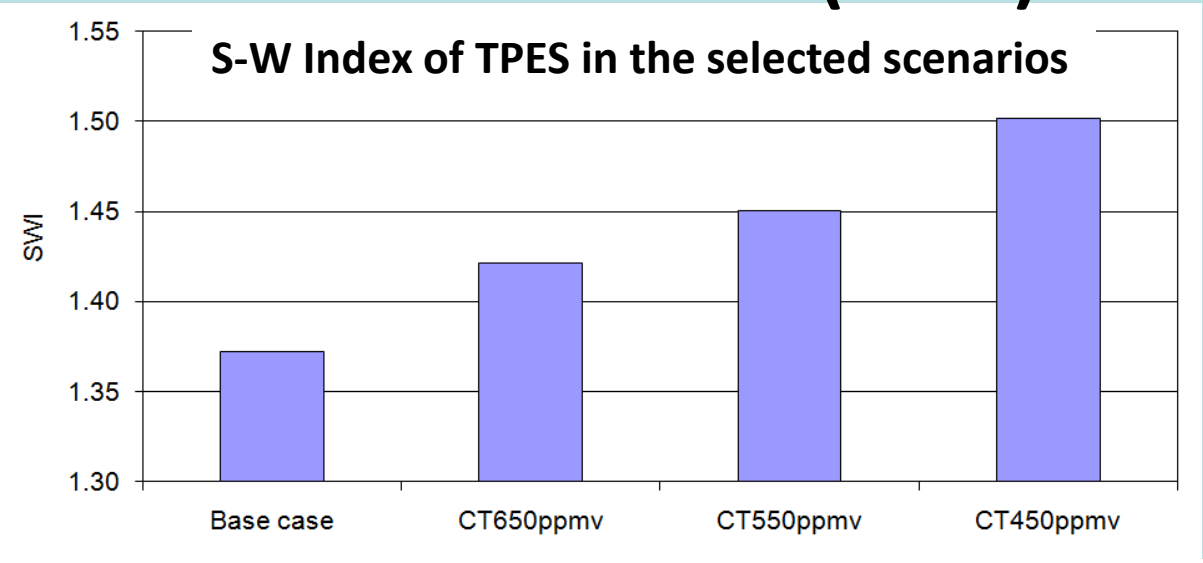
- TPES would be reduced by 0.1%, 0.7% and 1.7% from that in the Base case under CT650ppmv, CT550ppmv and CT450ppmv respectively during 2005-2050.
- The share of coal is found to decrease from 37% in the base case to 34%, 31% and 15% in CT650ppmv, CT550ppmv and CT450ppmv respectively .
- The share of natural gas would increase from 17% in the base case to 18% and 26% in CT550ppmv and CT450ppmv respectively. However, the carbon tax for CT650ppmv has no significant effect on the share of natural gas.

Effects on total final energy consumption due to the carbon taxes during 2005-2050



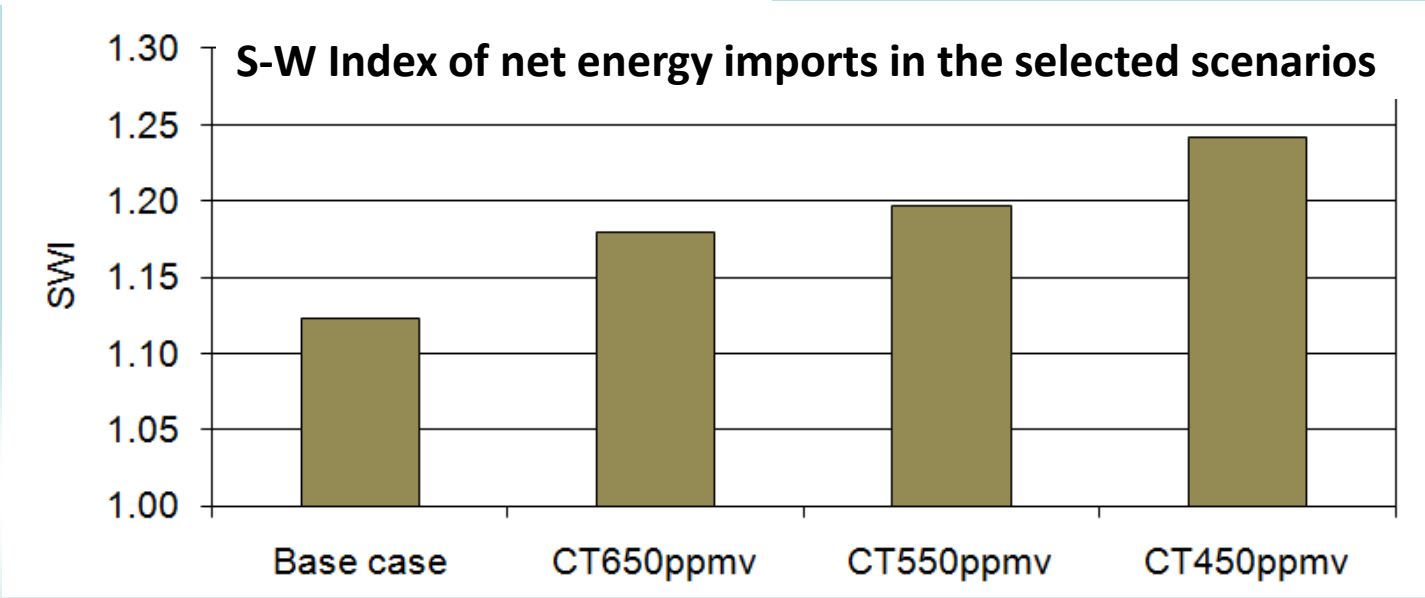
- TFEC would decrease by more than 9 thousand PJ under CT450ppmv; by over 1 thousand in CT650ppmv and CT550ppmv cases.
- The share of coal would decrease from 25% in the Base case to 15% in CT450ppmv and the share of natural gas would increase from 9% in the Base case to 15% in CT450ppmv.
- The share of oil would increase from that in the Base case as a result of increase in the use of bio-fuel in the transport sector.

Diversification in total primary energy supply (TPES)

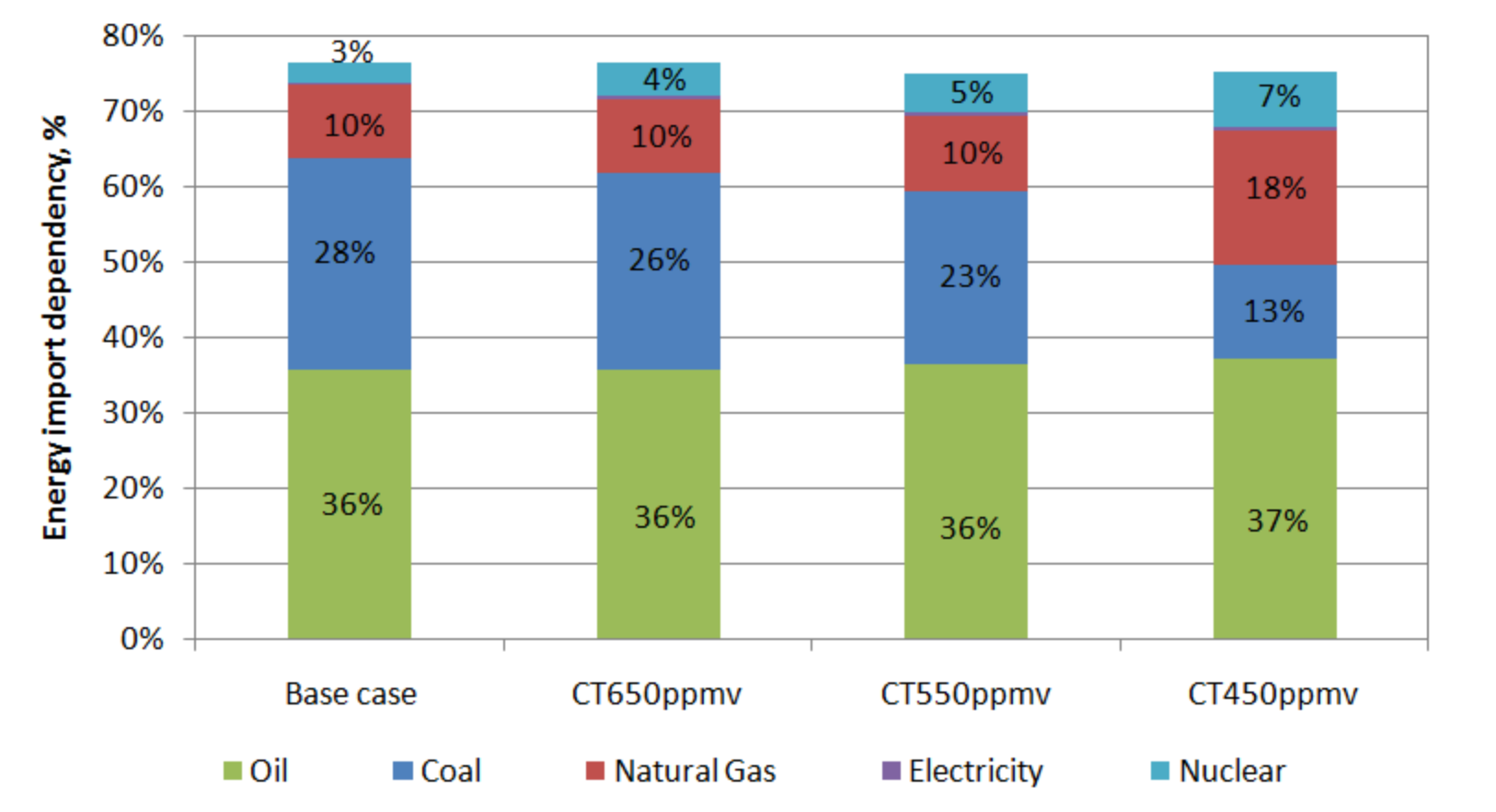


- The diversification increases with the selected level of carbon taxes.
- However, an optimum S-W index would have been 1.95 for the 7 fuel types considered.
- Coal import decreases; natural gas and nuclear import increases.

- Also the diversification of net energy imports would increase with the increment of the selected carbon taxes.

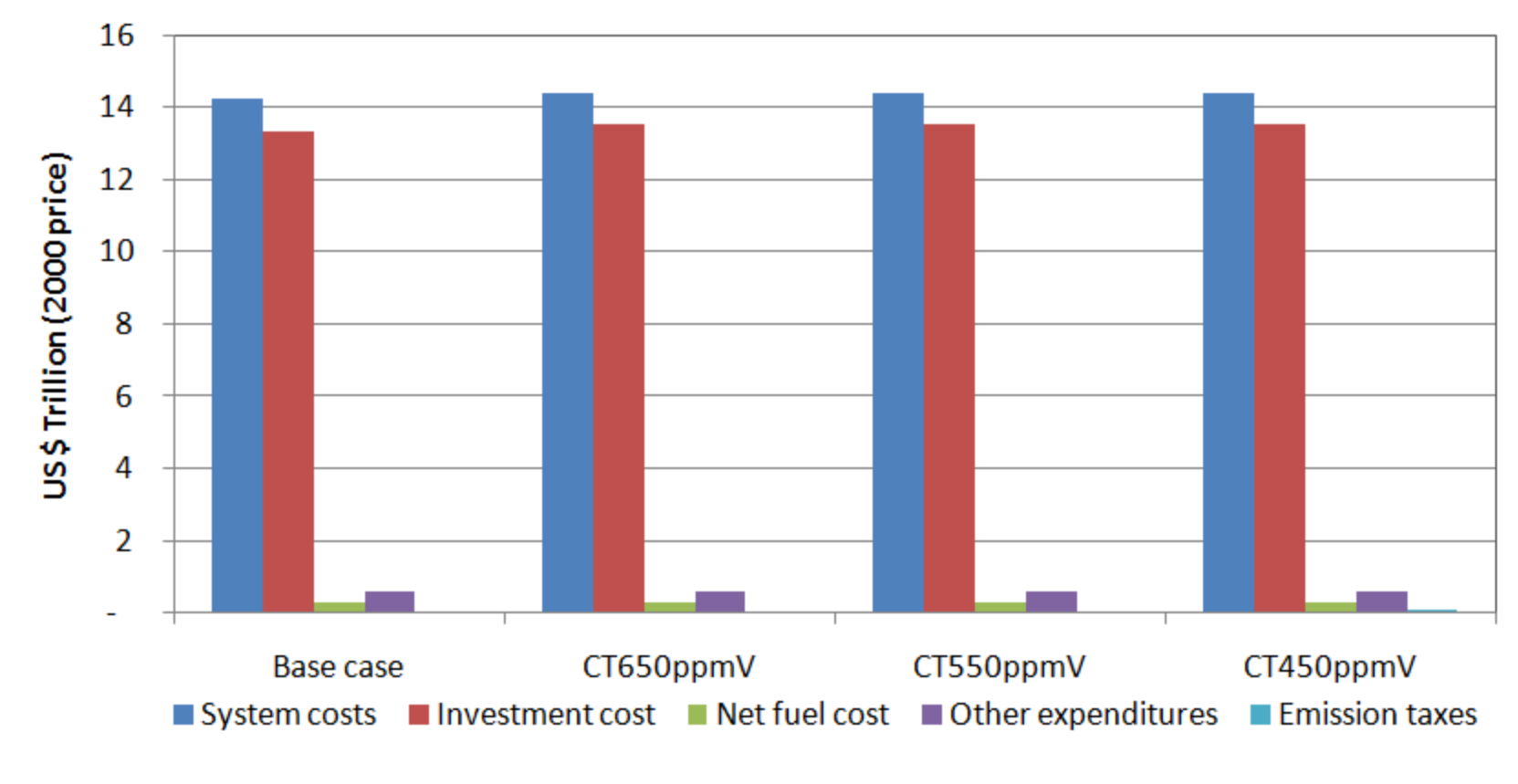


Effects on energy import dependency during 2005-2050 in the selected cases.



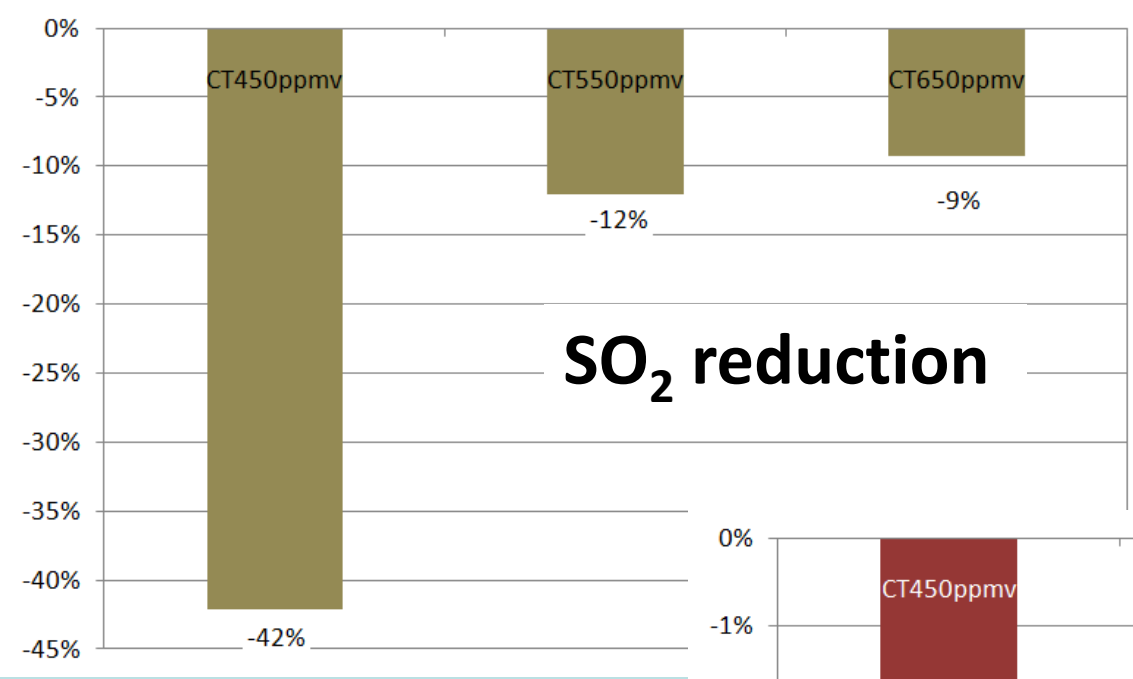
- No significant effect on energy import dependency (EID) under the selected carbon taxes during 2005-2050.
- However, the cumulative energy imports during the period would be lower than that in the base case.
- Import of coal would significantly decrease while natural gas and nuclear fuel imports would significantly increase.

Different cost associated to the selected scenarios.



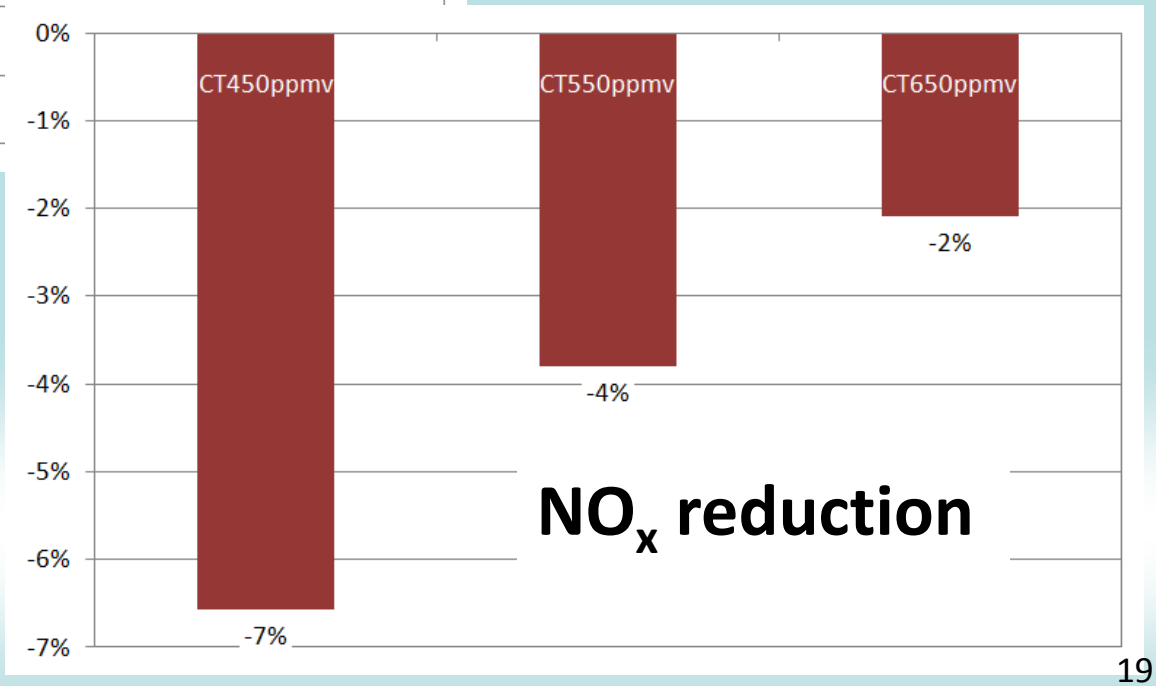
- Total system cost net of carbon tax revenue would increase by 1.08%, 1.08% and 1.14% in CT650ppmv, CT550ppmv and CT450ppmv respectively from that in the base case.

Reduction of SO_2 and NO_x as co-benefits in the selected scenarios.



- SO_2 reduction would be about 9%, 12% and 42% in CT650ppmv, CT550ppmv and CT450ppmv respectively from that in the Base case.

- NOx reduction would be about 2%, 4% and 7% in CT650ppmv, CT550ppmv and CT450ppmv respectively from that in the Base case.



Concluding remarks

- With the introduction of carbon tax, the total cumulative CO_2 emission during the planning horizon would be reduced by 3% under CT650ppmv, 6% under CT550ppmv and 22% under CT450ppmv as compared to the base case emission. Mostly CO2 reduction would come from the reduction in the coal use in the power sector.

- The power sector would account for more than 70% of the total cumulative CO2 emission reduction under all the selected cases.

- Primary energy requirement would be reduced and there would be an improvement in the diversification of primary energy requirement in the selected carbon tax cases as compared to the Base case.

- The level of final energy demand would decrease by more than 9 thousand PJ under CT450ppmv during 2005-2050 whereas the total final energy consumption would be reduced by over 1 thousand in rest of the two cases.