Some Results of Emission Modeling Studies on Thailand and Indonesia

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Outline

1. AIM related activities at AIT
2. Multi-gas emissions inventory of Thailand
3. Effects of CO_2 emissions reduction target on energy development and environment in Indonesia
4. Concluding remarks

AIM related activities during 2006/07

AIM Related Activities during 2006/07

- AIM/ Enduse model of Thailand and extension of the planning horizon to 2050 under four scenarios.
  - Updating the database
- Multi-gas emissions inventory development of Thailand
  - draft report completed
- AIM/ Enduse Model – Indonesia
  - Analysis of CO_2 emission reduction targets
- AIM/CGE modeling of Thailand
  - Analysis on effects of energy tax (ongoing)
- ESS Analysis for Thailand (preliminary version)
- AIM/ Air analysis of Bangkok (ongoing)
- Preparation of Database for **AIM/Enduse–Cambodia**- ongoing

Multi-gas Emissions Inventory Development for Thailand

Introduction

- Background:
  - First official GHGs emission inventory was carried out in 1990.
  - Thailand submitted initial national communication to UNFCCC on November 2000. This initial communication documents the 1994 inventory of GHGs in Thailand based on revised IPCC Guidelines (1996).

- Outline of the present study:
  - CO_2 and non-CO_2 GHGs (NCGGs)
  - GHG emissions source and sink categories:
    - Energy use
    - Industrial processes
    - Agriculture
    - Land use change and forestry
    - Waste
  - Planning horizon: 2000-2035

Approach used

- Energy related emissions based on basic energy output from AIM/Enduse model and revised IPCC guidelines (1996)

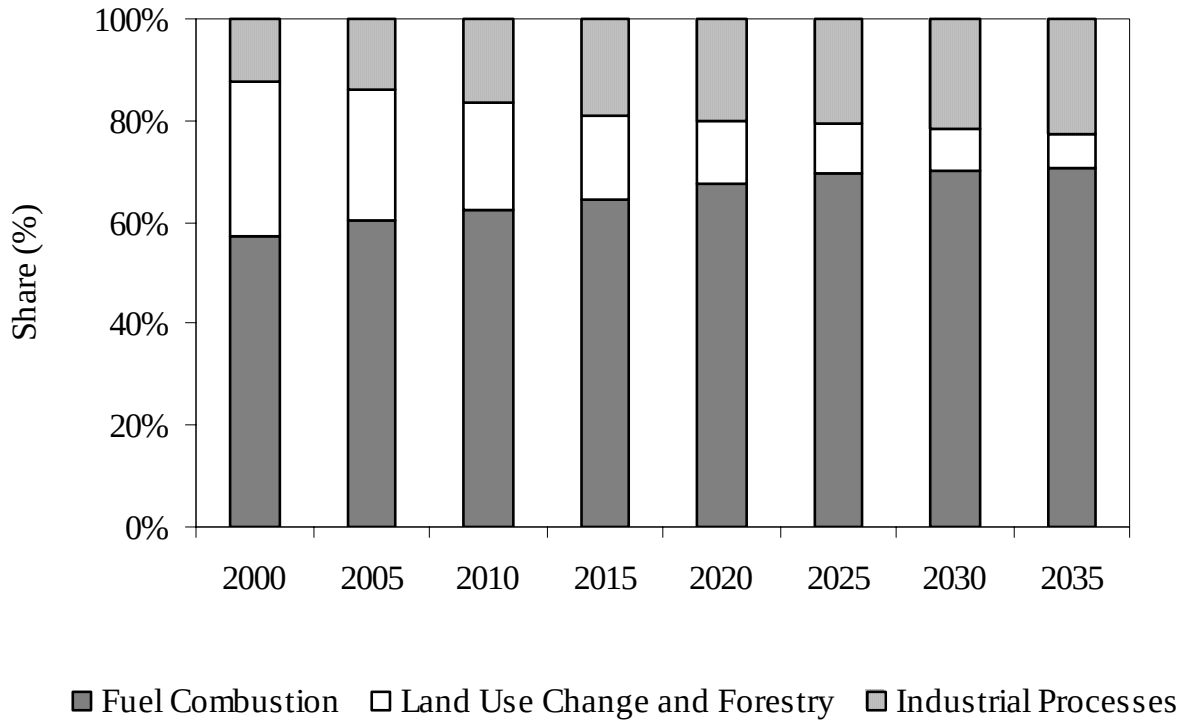
- Emissions from Non-energy sources based on data/assessment on level of agricultural activities, livestock population, land use, change in forest cover etc and relevant emission factors

Estimated GHG Emissions during 2000-2035 (in CO2 eq.)

Pollutant	2000		2015		2025		2035	
	Kt	%	kt	%	kt	%	kt	%
CO_2	276,655	66	486,099	73	670,287	79	1,224,436	83
CH_4	127,972	30	159,321	24	187,634	19	219,811	15
N_2O	15,688	4	18,648	3	20,720	2	22,496	2
CO_2 equivalent GHG	**420,315**		**664,068**		**985,512**		**1,466,743**	

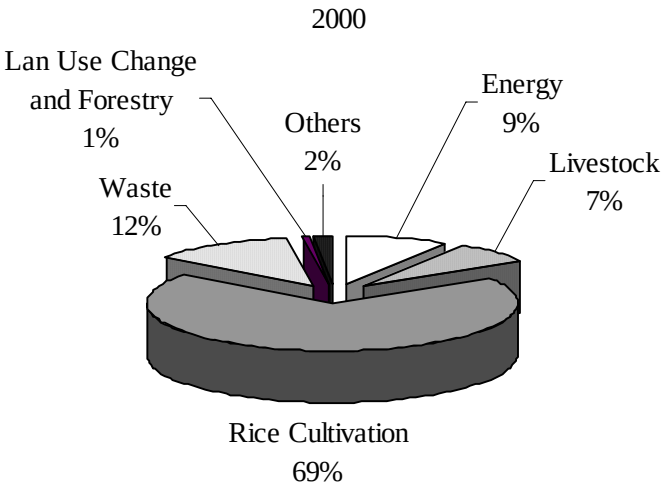
- Changes in shares of GHG emissions (between 2000 and 2035):
  - CO_2: 66% to 83% ↑
  - CH_4: 30% to 15% ↓
  - N_2O: 4% to 2% ↓
- CO_2 equivalent GHG:
  - 420 million ton (2000) to 1,467 million (2035) ~ 3.5 times increase
  - AAGR 3.6%
- Among the sources of GHG emissions, energy use is estimated to account for 57% of total GHG emissions in 2035 as compared to 55% in 2000.

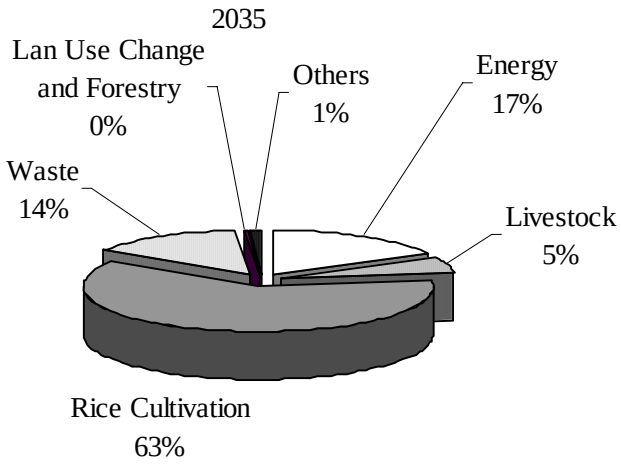
CO_2 Emission from Fuel Combustion, LUCF and Industrial Processes



- **Changes in shares of CO_2 emissions from 2000 to 2035:**
  - ❑ **Fuel combustion:** **57% to 72%** ↑
  - ❑ **Land use change and forestry:** **30% to 6%** ↓
  - ❑ **Industrial processes:** **13% to 22%** ↑

Methane Emission during 2000-2035



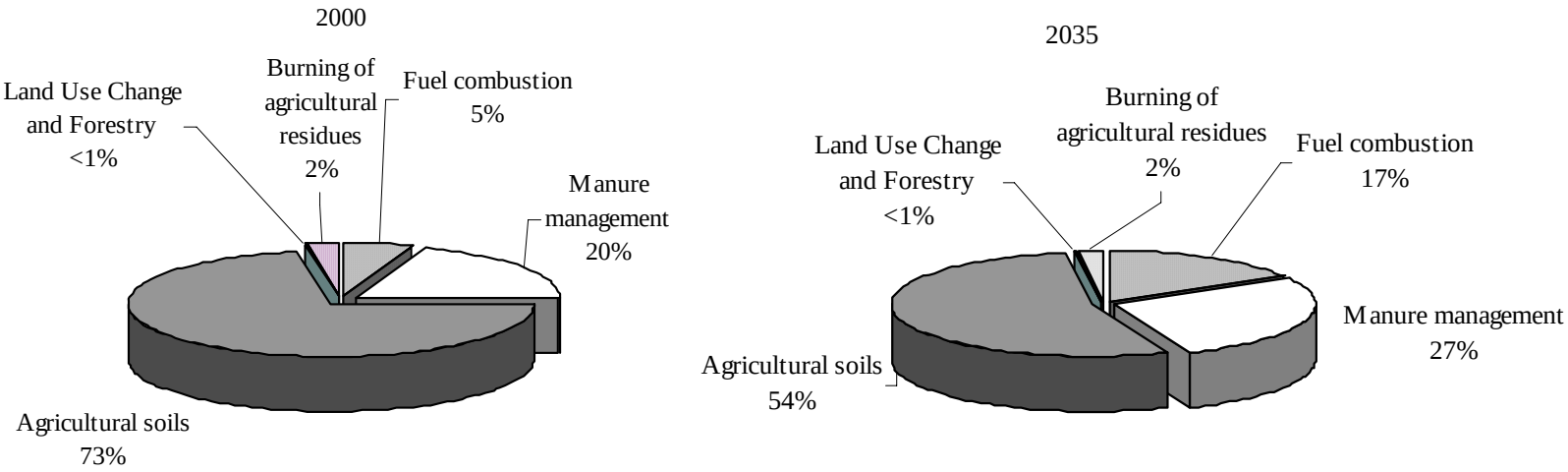


- **AAGR during 2000-2035: 1.6%**
- **Changes in shares of methane emission by source during 2000 to 2035 (%):**

Rice cultivation	**69 to 63 ↓**	**Energy**	**9 to 17 ↑**
Waste	**12 to 14 ↑**	**Livestock**	**7 to 5 ↓**

- **Rice cultivation to account for around two-thirds of methane emissions.**
- **Increasing share of energy use and waste in methane emissions.**

Nitrous Oxide Emission during 2000-2035



- **AAGR during 2000-2035: 1.1%**
- **Changes in shares of N_2O emission by source from 2000 to 2035 (%):**
  - **Agricultural soil** **73 to 54** ↓
  - **Fuel combustion** **5 to 17** ↑
  - **Manure management** **20 to 27** ↑
- **Agricultural soil is the largest contributor to N_2O emission.**
- **The shares of fuel combustion and manure management are to increase in the future.**

Energy & Environmental Implications of CO_2 Emission Reduction Targets in Indonesia

Outline

- Introduction
- Base case results
- Implications of CO2 reduction
  - Power sector
- Co-benefit of CO_2 Emission Reduction Target
- Conclusion

GDP, Total Primary Energy Supply and CO_2 Emissions in 2002 in Indonesia

(IEA, 2004)

- Population (million): 212
- GDP (billion 95 US$ MER): 224
- Total Primary Energy Supply (Mtoe): 156
- CO_2 emissions (Mton): 303
- Emission Intensity CO_2/GDP (kg CO2/95 US$_{MER}$): 1.35
- Energy Intensity TPES/GDP (toe/1000US$_{MER}$): 0.70

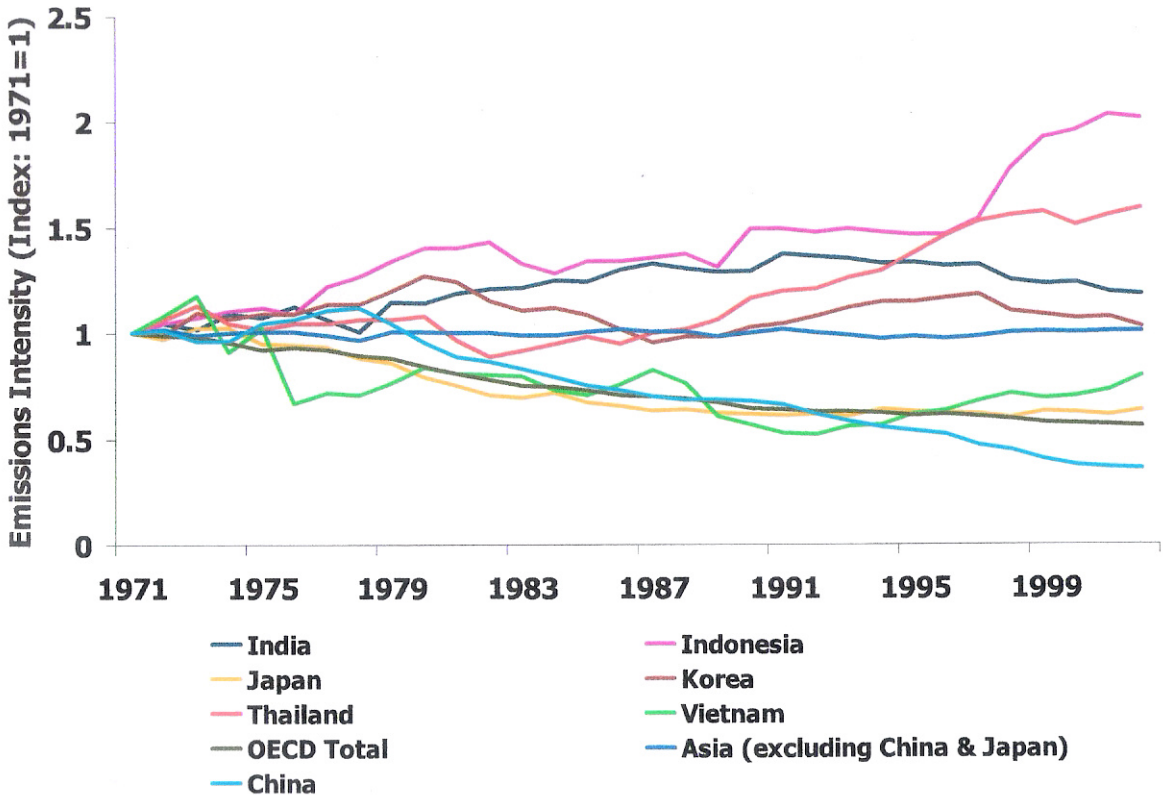
Growth of GDP, Energy Use and CO2 emissions in Indonesia

AAGR (1991-2000):

- CO2 emission = 7.3%
- GDP constant price 1993 = 4.4%
- TPES = 4.7%
- Final Energy Consumption = 6.4%
- Electricity Generation = 8.3%

CO2 emission growing much faster than GDP and TPES.

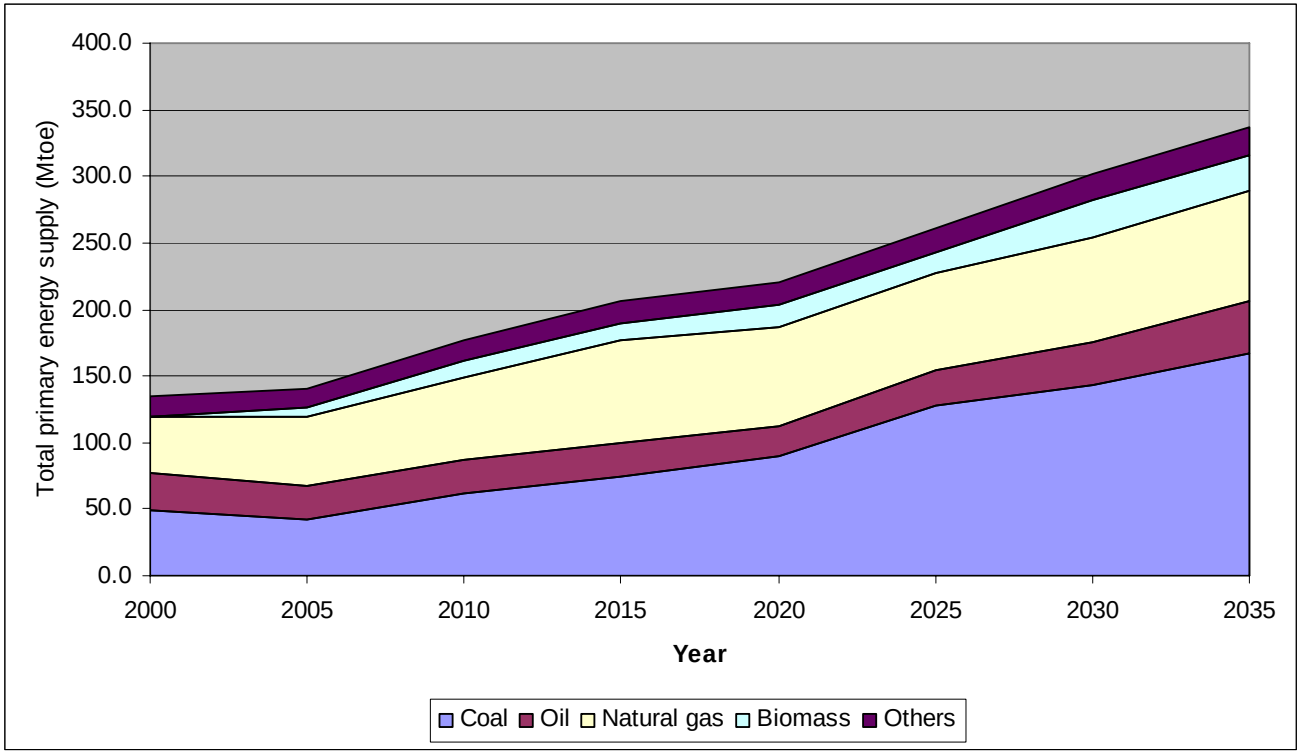
Rapidly growing Indonesian CO_2 Intensity (CO_2 per GDP_{MER})



Source: IEA, 2004

- Period of ER Target Study:
  - 2000 to 2035
- Scenarios considered:
  - Base Case
  - CO_2 emission reduction: 5%, 10%, 20%, 30% (ER_5, ER_10, ER_20, ER_30)
- CO_2 emission reduction is considered from 2013, which is considered as the second commitment period.

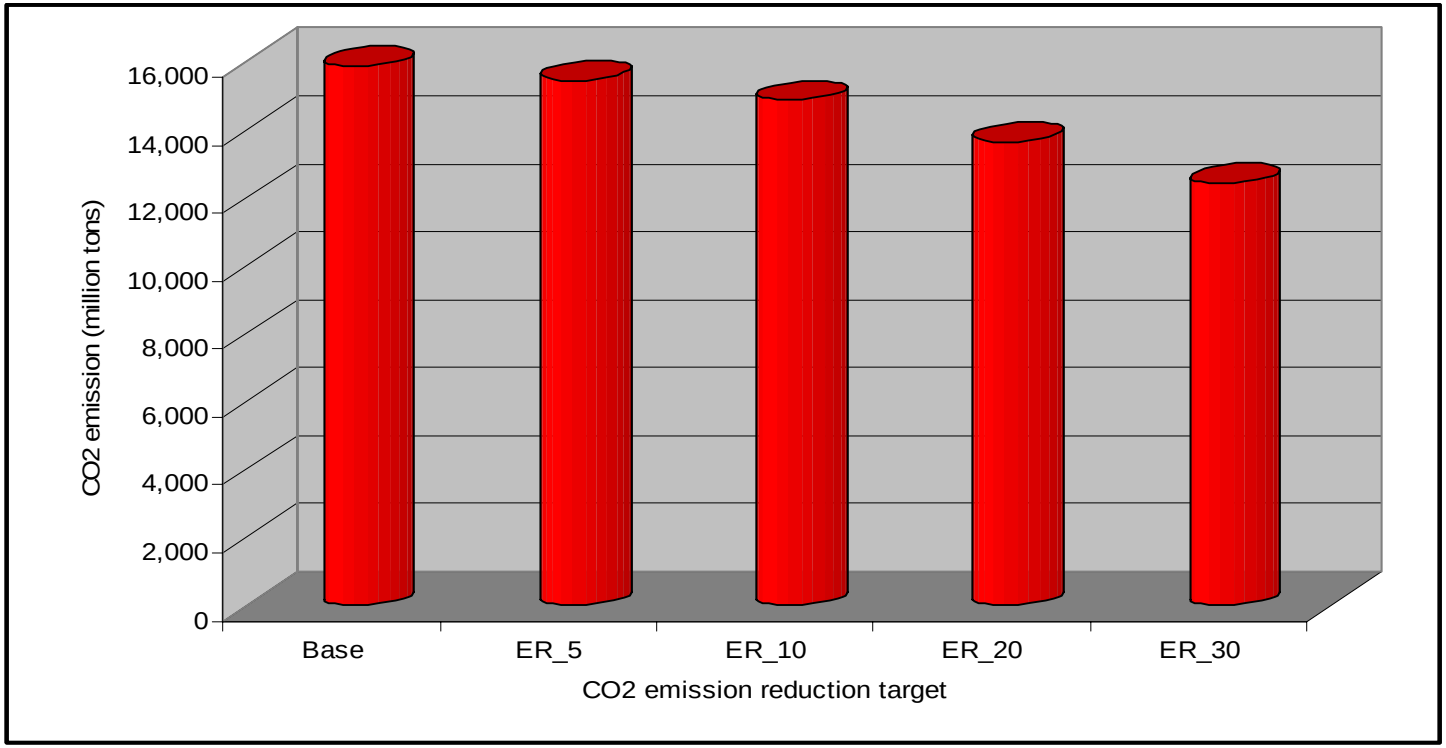
Base Case Primary Energy Supply During 2000-2035



Note: Others include hydro and geothermal

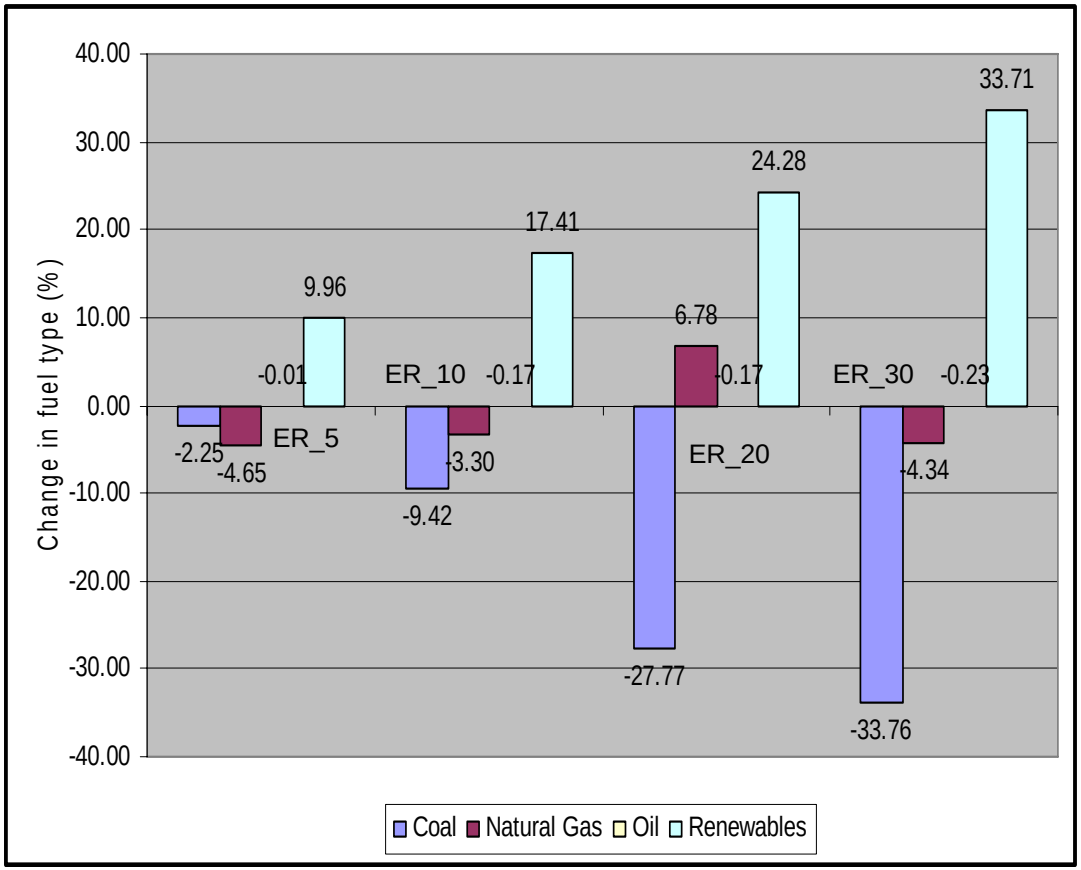
- Coal: 36.5% in 2000 to 49.8% in 2035
- Oil: 21.1% in 2000 to 11.5% in 2035
- Natural gas: 30.9% in 2000 to 24.6% in 2035
- Renewables:1.1% in 2000 to 8.2% in 2035

Total CO_2 Emission During 2000-2035 at Selected CO_2 Emission Reduction Targets



Cumulative CO2 emission during 2000-2035 to decrease from about 15,000 Mt to about 12,000Mt in ER_30 case.

Changes in Primary Energy-Mix under CO_2 Emissions Reduction Cases during 2000-2035



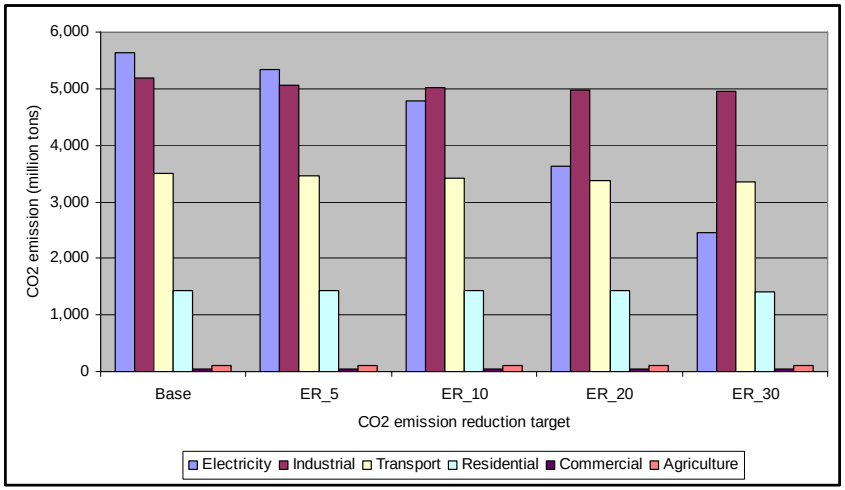
- Coal decreases by 33.4% at ER_30
- Natural gas decreases by 4.3% at ER_30
- Oil decreases by 0.2% at ER_30
- Renewables increase by 33.7% at ER_30

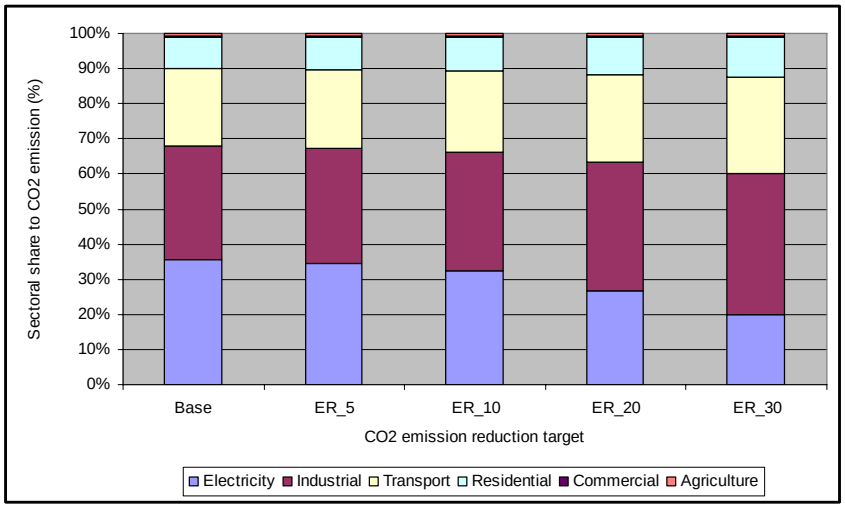
Note: Renewables include biomass, geothermal, wind, solar

"+" means the energy increases compared to the Base case

"-" means the energy decreases compared to the Base case

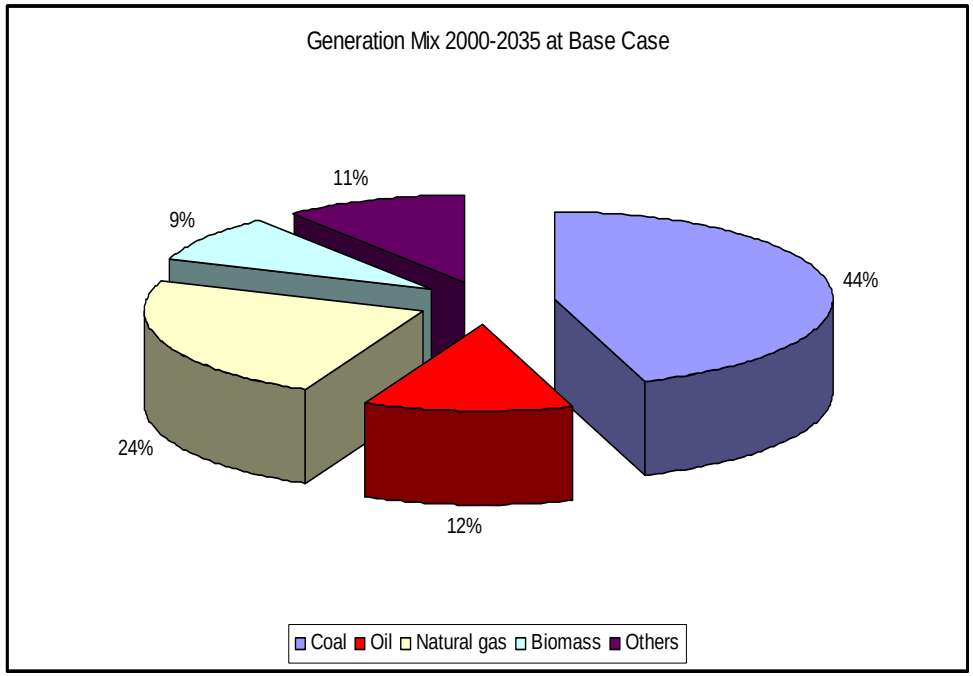
Sectoral Shares in CO_2 Emission during 2000-2035





- At Base case and ER_5, the CO_2 emission is mostly from the electricity sector (in the range 34 to 36%).
- At ER_10 and higher, CO_2 emission is mostly from the industrial sector (in the range 33 to 41%)

Generation Mix During 2000-2035 at Base Case and ER_30



Decrease in

Coal: 44% (Base) to 30% (ER_30)

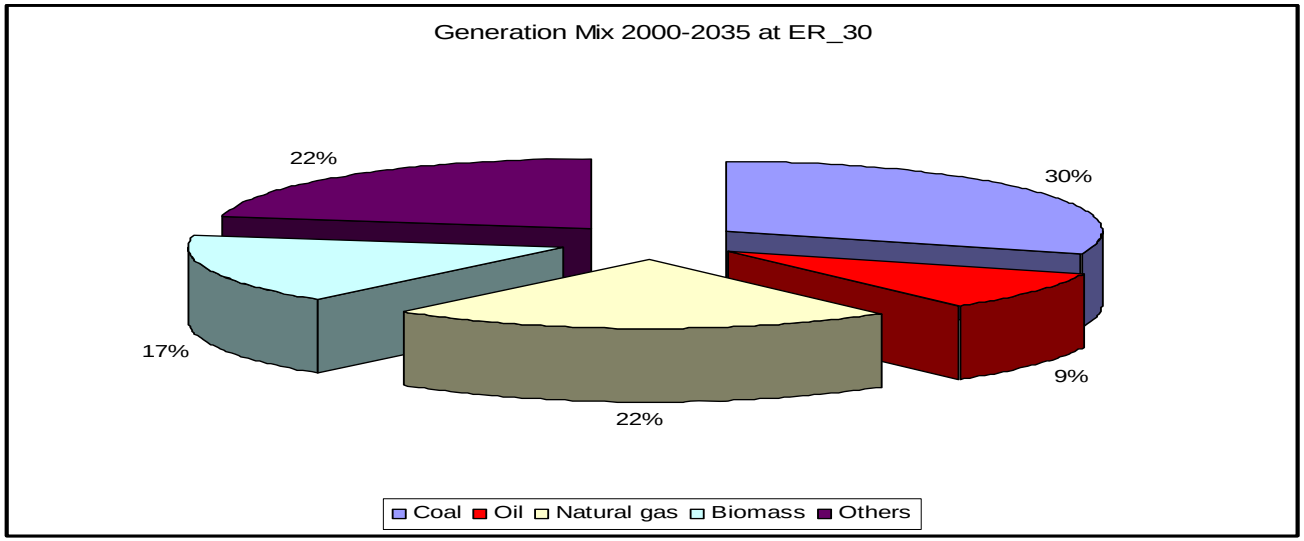
Oil: 12% (Base) to 9% (ER_30)

Natural Gas: 24% (Base) to 22% (ER_30)

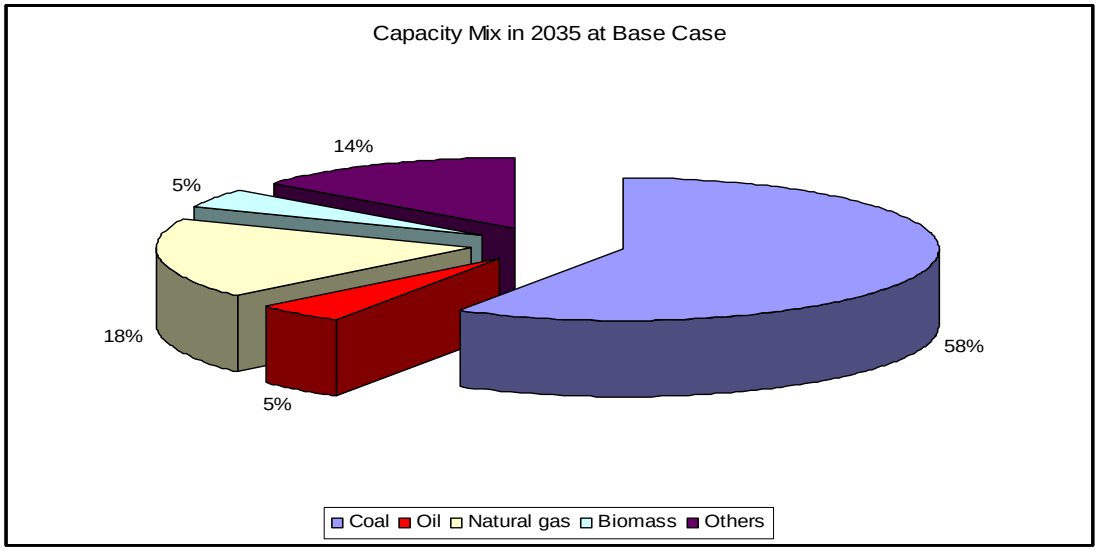
Increase in

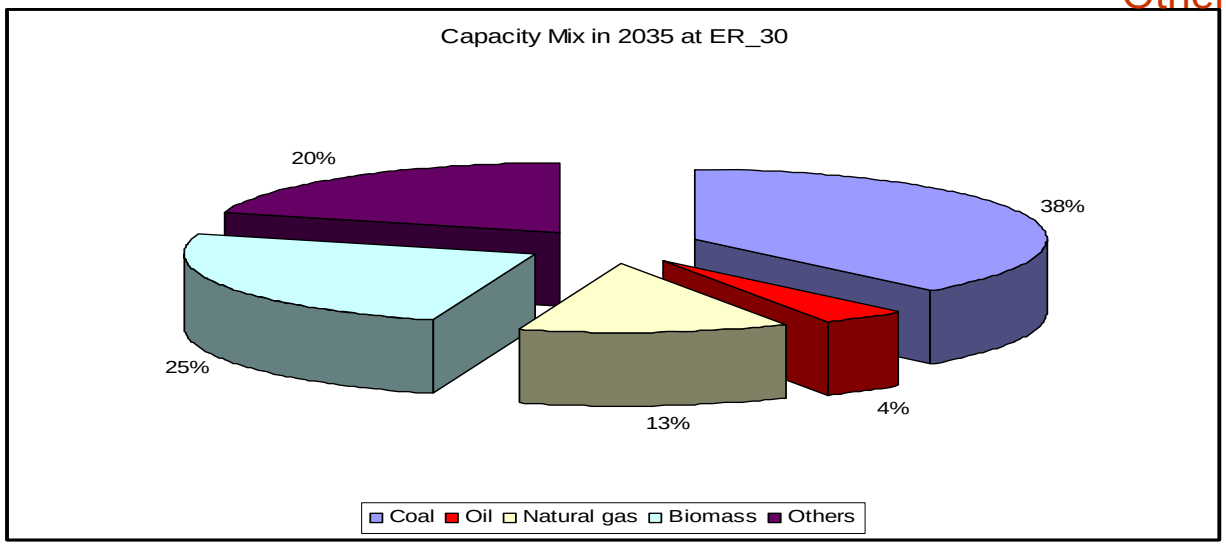
Biomass: 9% (Base) to 17% ER_30)

Others: 11% (base) to 22% (ER_30)



Power Generation Capacity Mix in 2035 at Base Case and ER_30





Decrease in

Coal: 58% (Base) to 38% (ER_30)

Oil : 5% (Base) to 4% (ER_30)

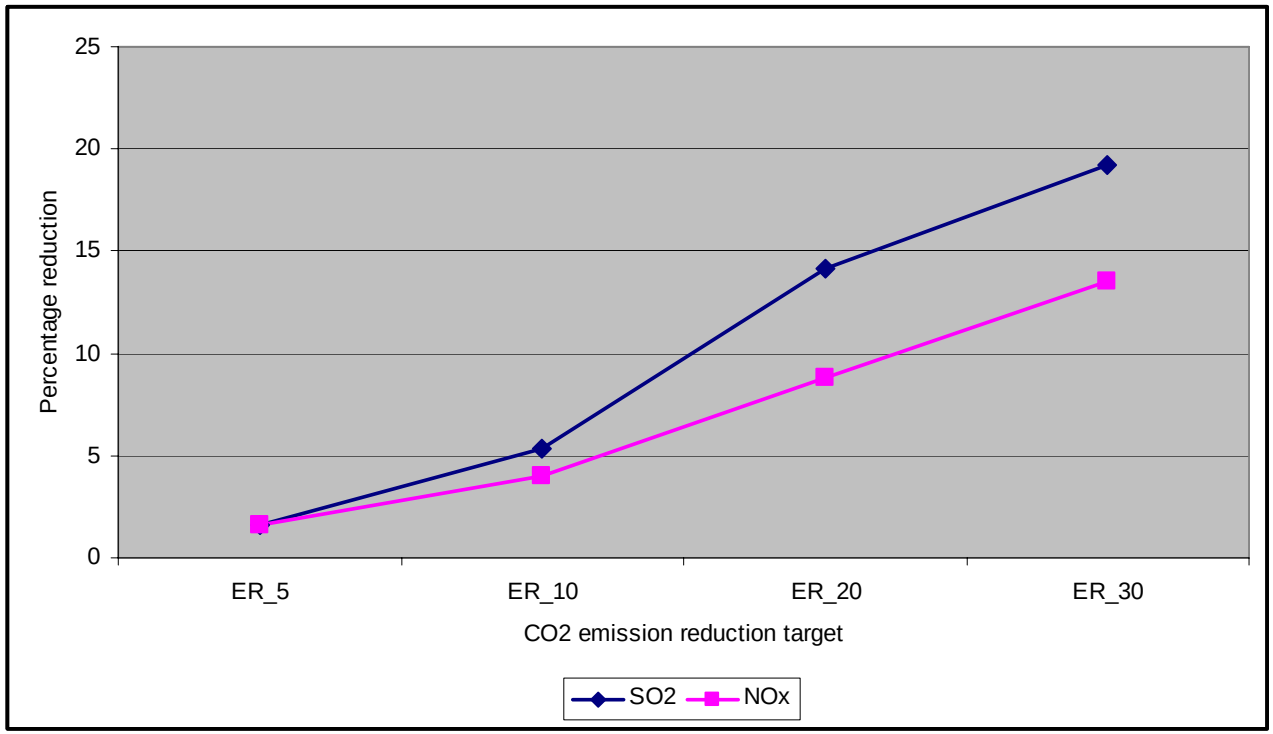
Natural Gas:18% (Base) to 13% (ER_30)

Increase in

Biomass: 5% (Base) to 25% (ER_30)

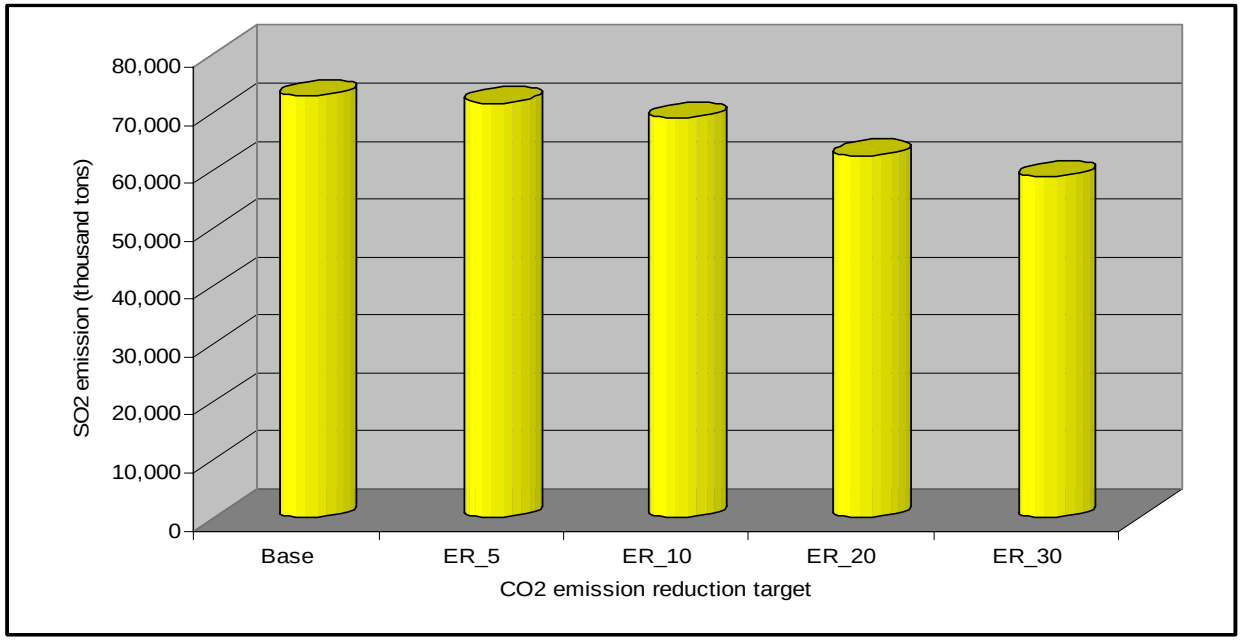
Others: 14% (Base) to 20% (ER_30)

Co-Benefit of CO_2 Emission Reduction Target to Local Pollutant Emissions



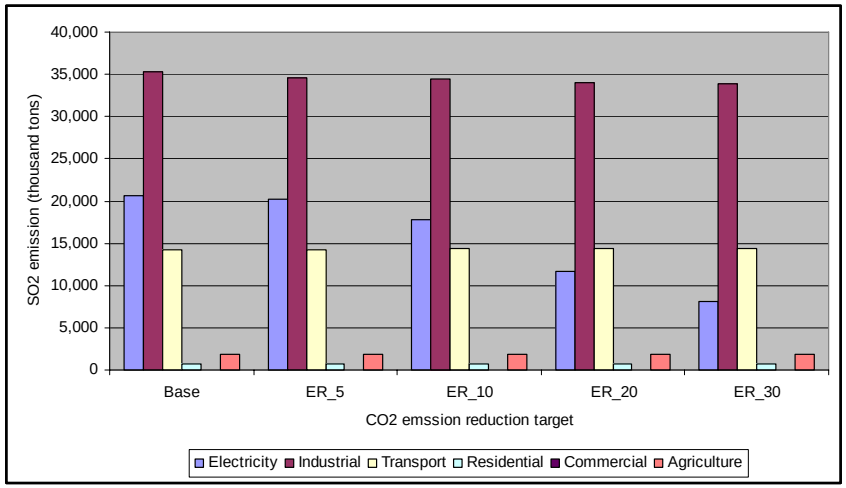
- SO_2 emission would be reduced by 1.6% at ER_5 and 19.2% at ER_30.
- NO_x emission would be reduced by 1.64% at ER_5 and 13.6% at ER_30.

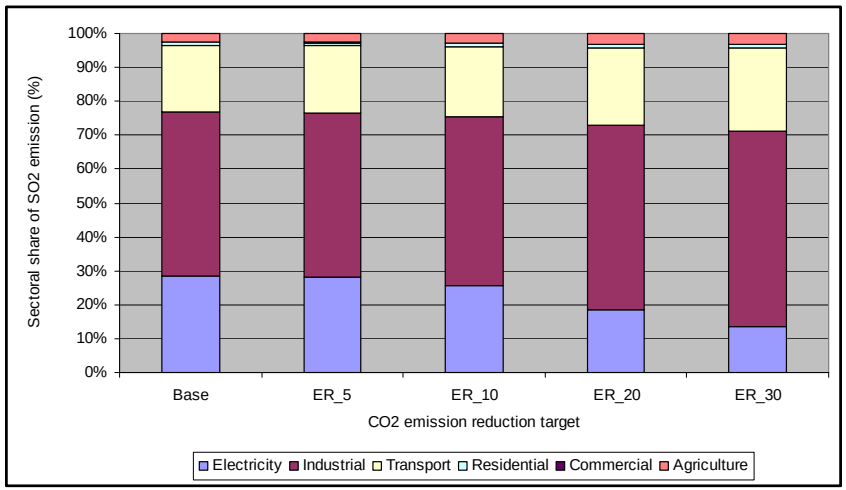
Total SO_2 Emission During 2000-2035 at Selected CO_2 Emission Reduction Targets



Total SO_2 emission during 2000-2035 in ER_30 case would be about 20% less than that at the Base case

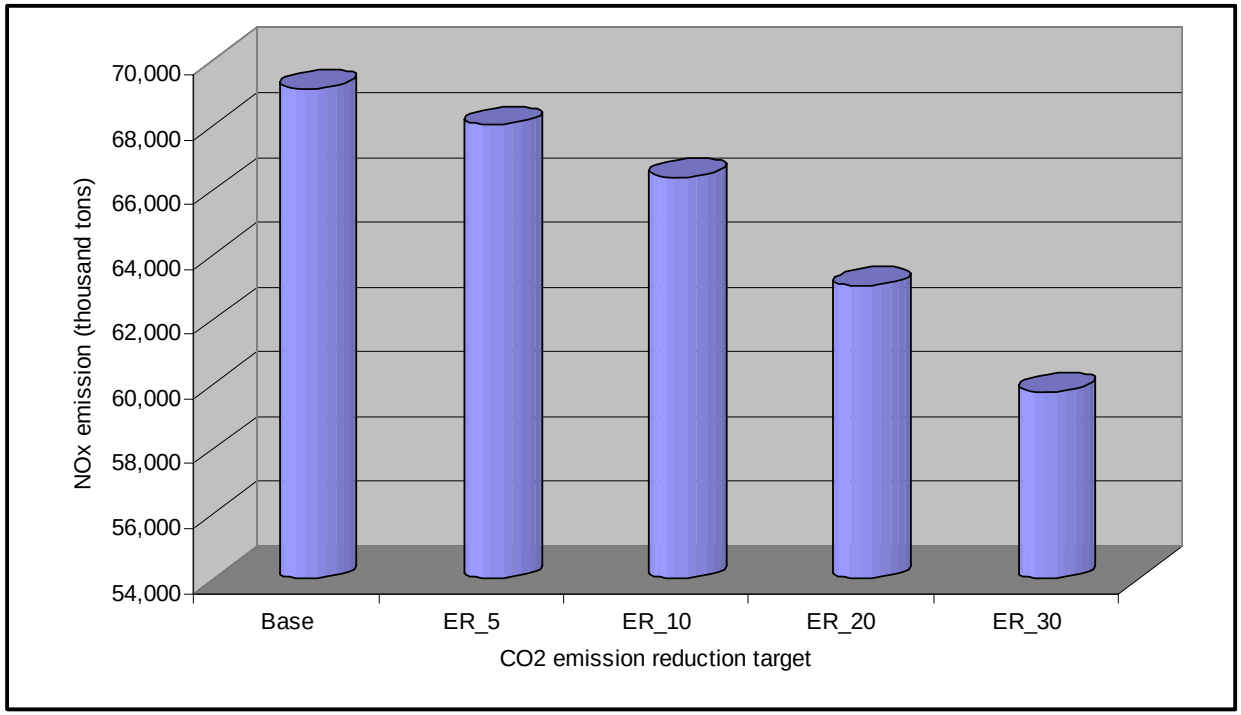
Sectoral Shares in SO_2 Emission During 2000-2035





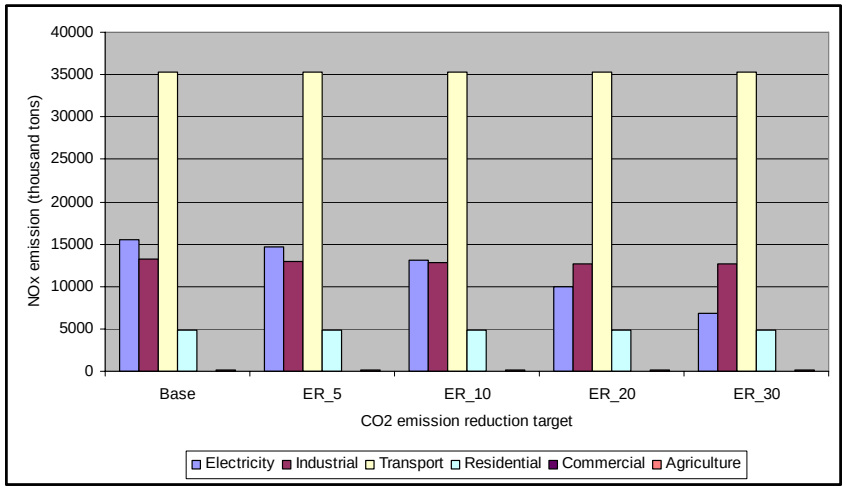
- The highest SO2 emission during 2000-2035 would be from the industrial sector, i.e., in the range 48 to 58%
- At ER_5 and ER_10, the share of SO2 emission from the electricity sector is higher than that from the transport sector. At ER_20 and higher, transport sector share exceeds the power sector share.

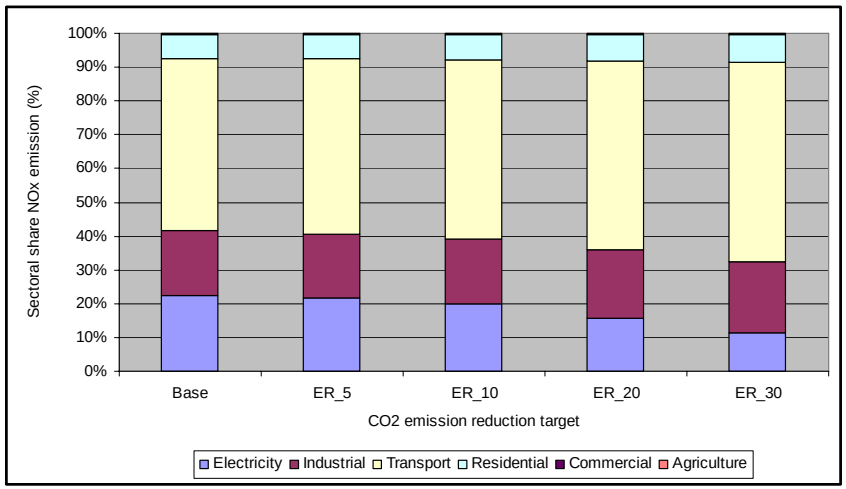
Total NO_x Emission During 2000-2035 at Selected CO_2 Emission Reduction Targets



Total NO_x emission during 2000-2035 in ER_30 case would be about 14% below that in the Base case

Sectoral Shares in NO_x Emission During 2000-2035





- Transport sector contributes the most, i.e. in the range 51 to 60%
- At ER_5 and ER_10, the share of NOx emission from the electricity sector would be higher than that from the industrial sector.
- At ER_20 and ER_30, transport sector share is higher.

Recent Energy and Environmental Policy Developments in Indonesia

National Energy Policy

- Based on President Regulation No. 5/2006 on National Energy Policy, the target on energy mix by 2025 is as follows:
  - Oil share less than 20%
  - Natural gas share above 30%
  - Coal share of is more than 33%
  - Biofuels' share more than 5%
  - Geothermal energy share more than 5%
  - The share of new and renewable energy (biomass, nuclear, small scale hydro, solar, wind) is more than 5%
  - The share of liquified coal is more than 2%

DSM Policy

- DSM programs in Indonesia have been implemented based on President Decree No. 43/1991 about Energy Conservation and Energy and Mining Minister Decree No. 100.K/148/M.PE/1995 about National Energy Conservation Plan
- DSM policies include peak clipping-, load shifting- and energy conservation policies

Policies in Transport

- Based on Local Government Policy, monorail will be built in Jakarta
- The bus way in Jakarta will be expanded

Conclusions

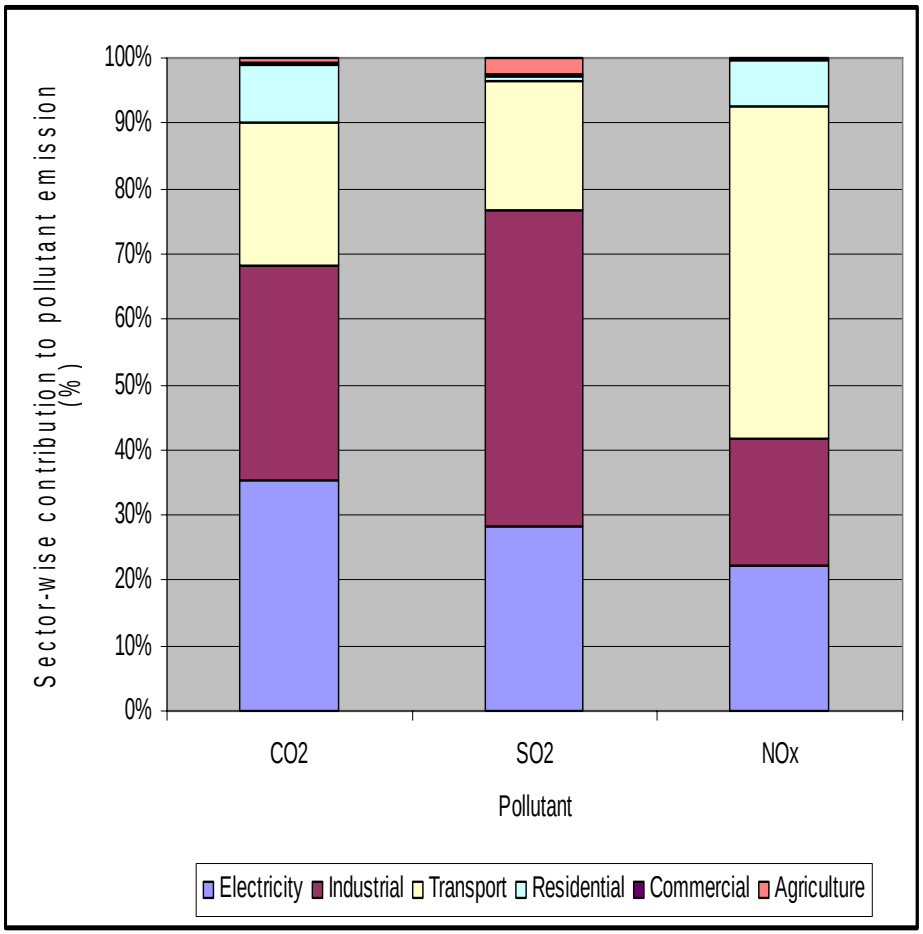
- At Base case and ER_5 case, the power sector is the largest contributor to CO_2 emission (34 to 36%) in Indonesia. At higher ER targets cases, the industrial sector becomes the largest contributor to CO_2 emission (in the range 33 to 41%).
- The CO_2 emission reduction from the is mainly due to:
  - fuel shifting to renewable energy, clean coal technologies and the use of CCS in the power sector .
  - fuel shifting from oil to gas in the industrial sector
  - fuel shifting from oil to gas and electric vehicles in the transport sector
- The CO_2 emission reduction from the residential sector would happen only at ER_30 i.e. fuel shifting from gas and electric cooker

Conclusions (contd)

- Co-benefit of CO_2 emission reduction target:
  - Total SO_2 emission during 2000-2035 under ER_30 would be about 20% lower than that in the Base case
  - Total NOx emission during 2000-2035 under ER_30 would be about 14% lower than that in the Base case

THANK YOU

Sectoral Contributions to Pollutants Emissions in Base Case during 2000-2035



CO2:

Electricity sector has highest share (35.5%), followed by industry sector (32.3%) and transport sector(22.0%)

SO2:

Industry sector share (48.5%) the highest, followed by electricity (28.3%) and transport (19.6%) sectors.

NOx:

Transport sector share (51.1%) the highest, followed by electricity (22.3%) and industry (19.2%) sectors.