Effects of Carbon Tax on Energy System Development and Environment : Cases of Indonesia and Thailand

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Presentation outline

- Introduction
- Primary Energy Supply & Emissions
- Effect of C-tax on Energy Supply & Emissions
- Changes in other Indicators

I. AIM Related Activities during 2005/06

AIM Related Activities during 2005/06

- Updating AIM/ Enduse model of Thailand
  - Extension of the planning horizon to 2050
  - Revision of the transport sector (included new technologies)
  - Revised emission factors (IPCC revised guidelines and RAINSASIA)
  - Modifications on the methodology to forecast service demand
  - Revision of fuel prices
  - Efficiency improvement of devices

- Multi-gas emissions inventory of Thailand
  - Type of gases: CO_2, NO_x, N_2O, CH_4 & CO.
  - Source and sink categories: energy use, fugitive emissions, industrial processes, agriculture and waste.
  - Planning horizon: 2000-2035.

AIM Related Activities during 2005/06

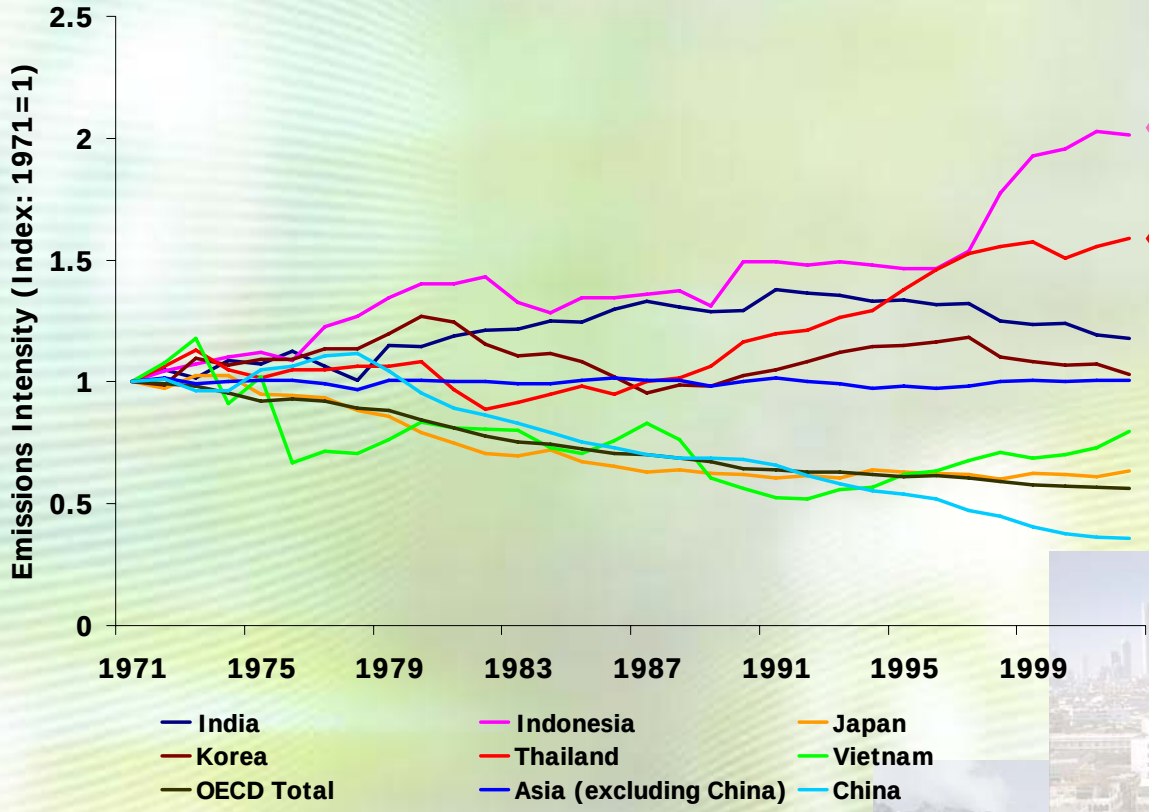
- **AIM/ Air: Bangkok**
  - Data collection (on going)
  - Development of the node-link matrix for Bangkok city
  - Estimation of emissions from each line source

- **AIM/ Enduse – Cambodia & Nepal:**
  - Data collection (ongoing)

- **AIM/ Enduse – Indonesia:**
  - Updating energy devices data
  - Revisions to fuel prices
  - Revised emission factors (IPCC revised guidelines and RAINSASIA)
  - Modifications on the methodology to forecast service demand
  - Analysis of carbon tax scenarios

II. Effects of Carbon Tax on energy System Development and Environment : Cases of Indonesia and Thailand

CO_2 Intensity (CO_2 per GDP_{MER})



Indonesia

Thailand

Source: IEA, 2004

- CO_2 intensity has been increasing in the past three decades in Indonesia and Thailand.

Economy, energy use and CO_2 emissions in Thailand, Indonesia and selected countries of the world (2002)

Indicators	Thailand	Philippines	Indonesia	OECD	World
Population (million)	62	80	212	1145	6195
GDP/capita (constant 1995 US$)	3,000	1,209	1,060	24834	5701
TPES/capita (kgoe)	1,344	526	736	4668	1675
CO_2 emissions (million tons)	179	70	303	12,554	24,101
CO_2 intensity (kg CO_2 per 1995 US$)	0.97	0.72	1.35	0.44	0.68
Net energy import (% of commercial energy use)*	47	53	-54	-	-

* Data for 2001

Source: WDI (2004) and IEA (2004)

In Thailand,

- **GDP/capita and TPES/capita is higher compared to Indonesia but lower compared to industrialized nations.**
- **CO_2 emissions and CO_2 intensity is lower compared to Indonesia but higher compared to industrialized nations.**

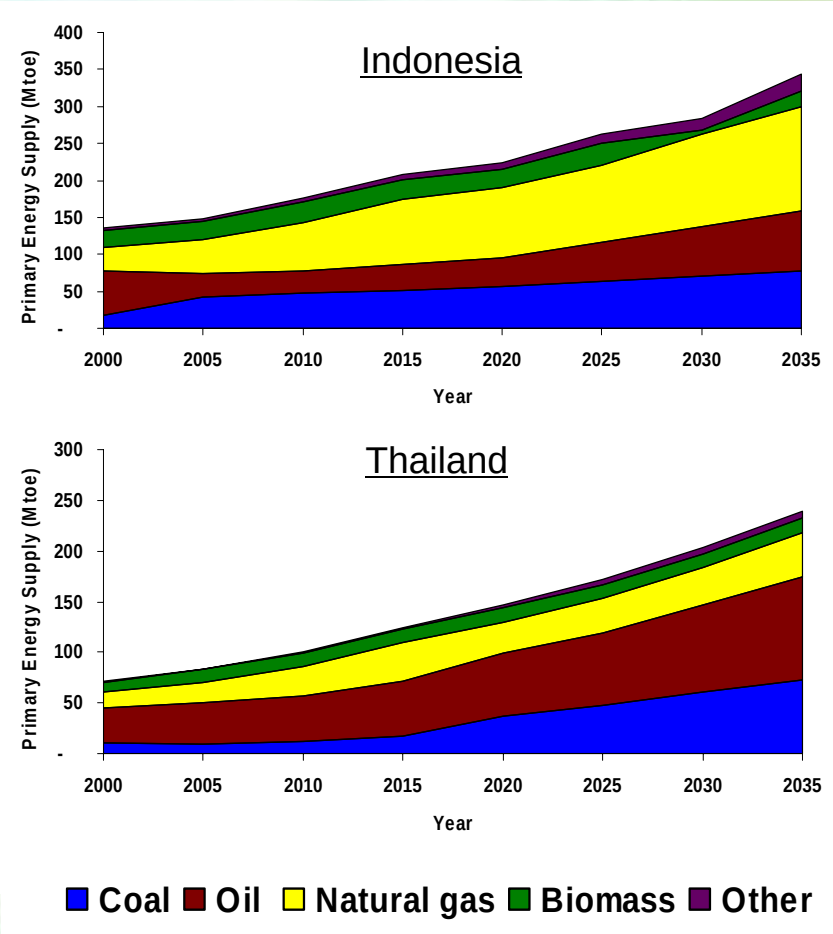
Introduction

- Study period:
  - 2000 to 2035

- Scenarios considered:
  - Base Case
  - Carbon Tax: US $ 10, 30, 50, 100 & 200 /tC (CT10, CT30, CT50, CT100 & CT200)

- Tax is considered from 2013 onwards.

Total Primary Energy Supply (TPES)
Base case



- TPES :

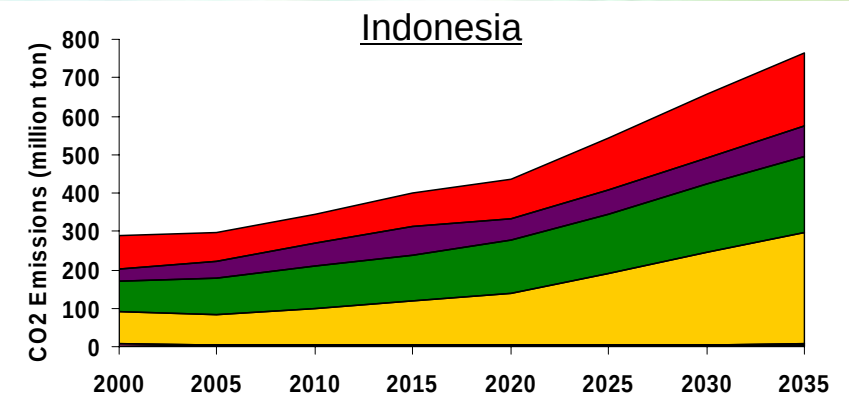
  From 2000 to 2035,
  - Indonesia: 135 to 343 Mtoe (2.5 times)
    AAGR: 2.9%
  - Thailand: 71 to 239 Mtoe (3.5 times)
    AAGR: 3.5%

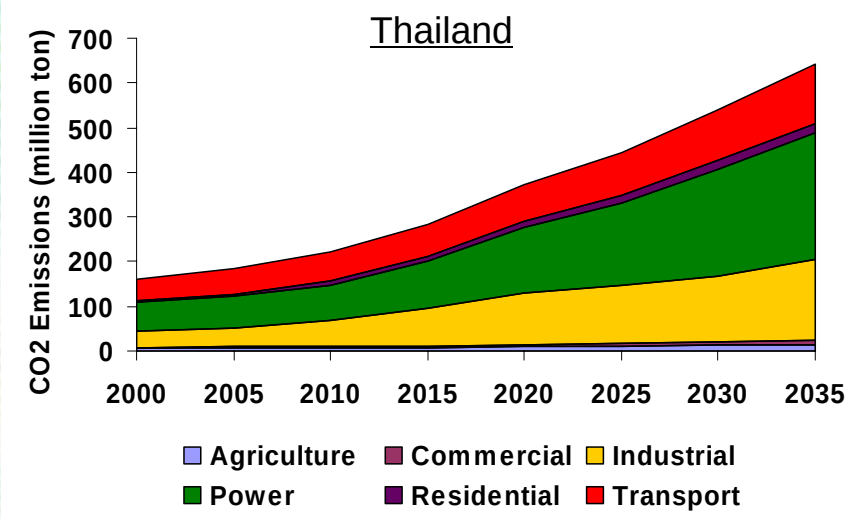
- Changes in fuel shares: (From 2000 to 2035)

  Indonesia:
  - Oil ↓ 45 to 24%
  - Coal ↑ 13 to 23%
  - Natural gas ↑ 23 to 41%
  - Biomass ↓ 17 to 6%

  Thailand:
  - Oil ↓ 49 to 43%
  - Coal ↑ 14 to 30%
  - Natural gas ↓ 22 to 19%
  - Biomass ↓ 14 to 6%

Total CO_2 Emissions
Base case





Indonesia:

- 288 million ton (2000)
- 763 million ton (2035) (< 3 times)

- AAGR during 2000-2035: 2.8%

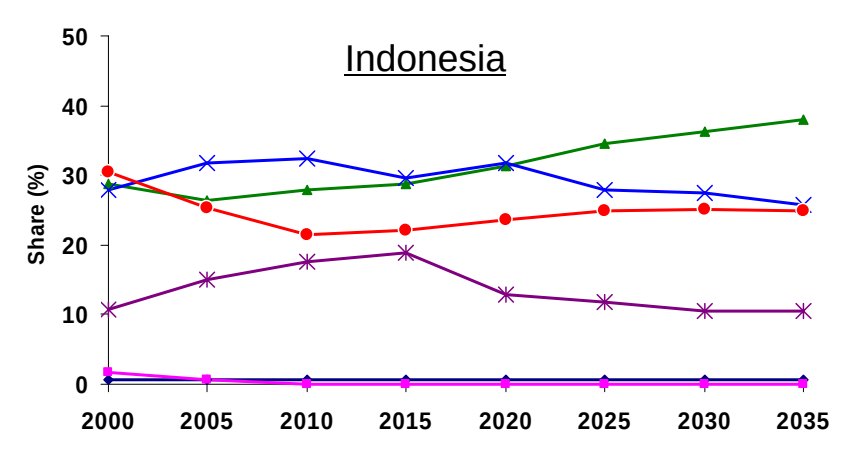
Thailand:

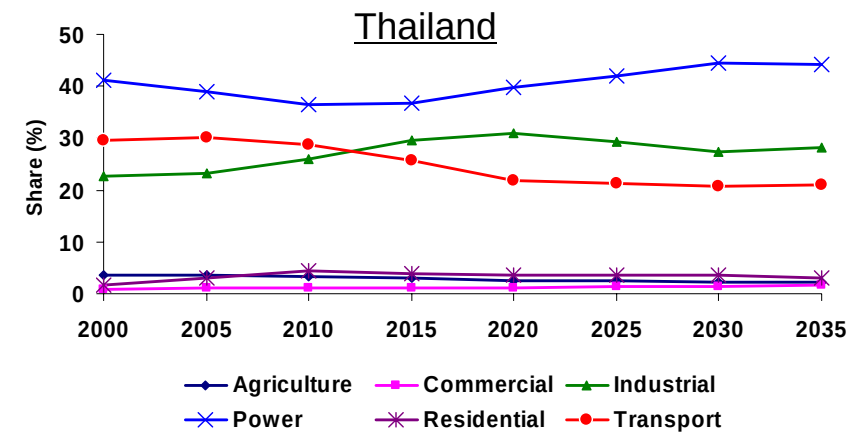
- 161 million ton (2000)
- 641 million ton (2035) (4 times)

- AAGR during 2000-2035: 3.9%

Sectoral Shares in Total CO_2 Emissions

Base case





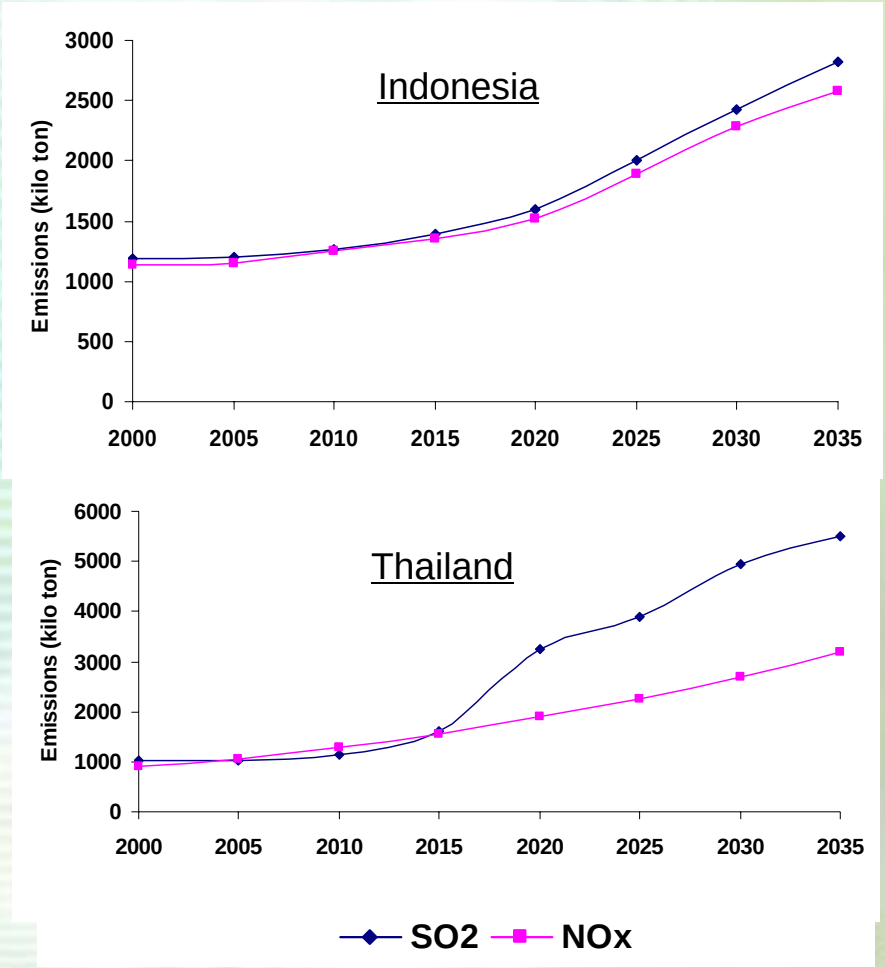
Indonesia:

- Sectoral shares from 2000 to 2035:
  - Power: ↓ 28 to 26%
  - Transport: ↓ 30 to 25%
  - Industrial: ↑ 29 to 38%
- Industry becomes largest and power becomes second largest in 2035

Thailand:

- Sectoral shares from 2000 to 2035:
  - Power: ↑ 41 to 44%
  - Transport: ↓ 30 to 21%
  - Industrial: ↑ 23 to 28%
- Power sector becomes largest and Industry becomes second largest in 2035

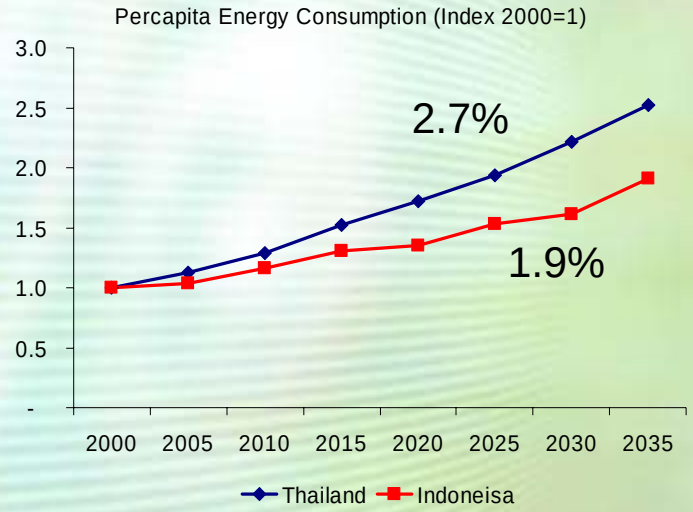
SO_2 & NO_x Emissions
Base case

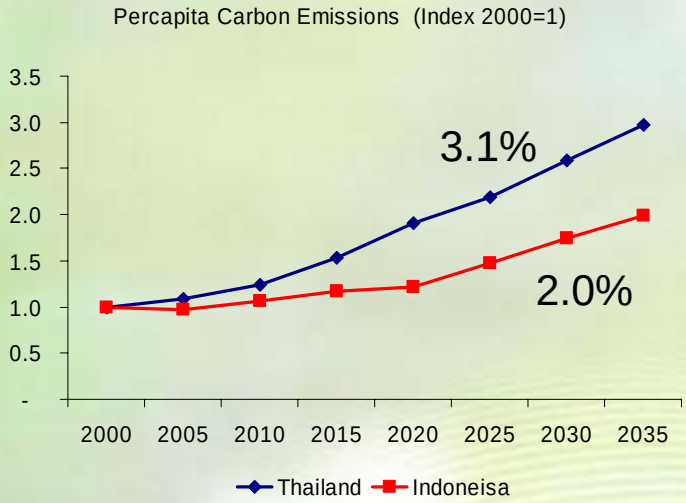


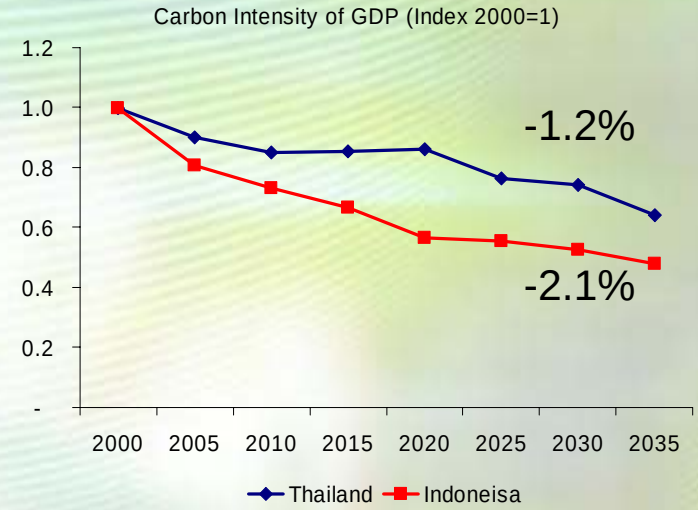
- SO_2 emissions :
  From 2000 to 2035 (AAGR),
  - Indonesia: 2.6%
  - Thailand: 4.9%
- NO_X emissions:
  From 2000 to 2035 (AAGR),
  - Indonesia: 2.5%
  - Thailand: 3.7%
- Thailand has higher AAGR of SO2 & NOx emissions during 2000-2035.
- In Thailand large increase in SO_2 emissions because of increase in coal use.

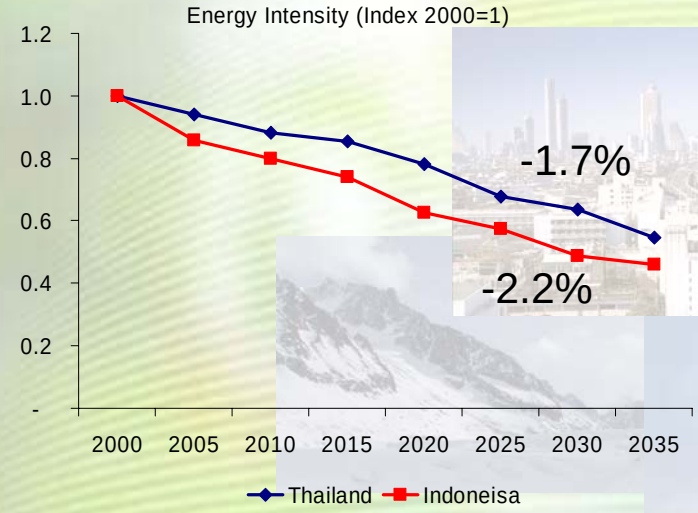
Selected Indicators

Base case

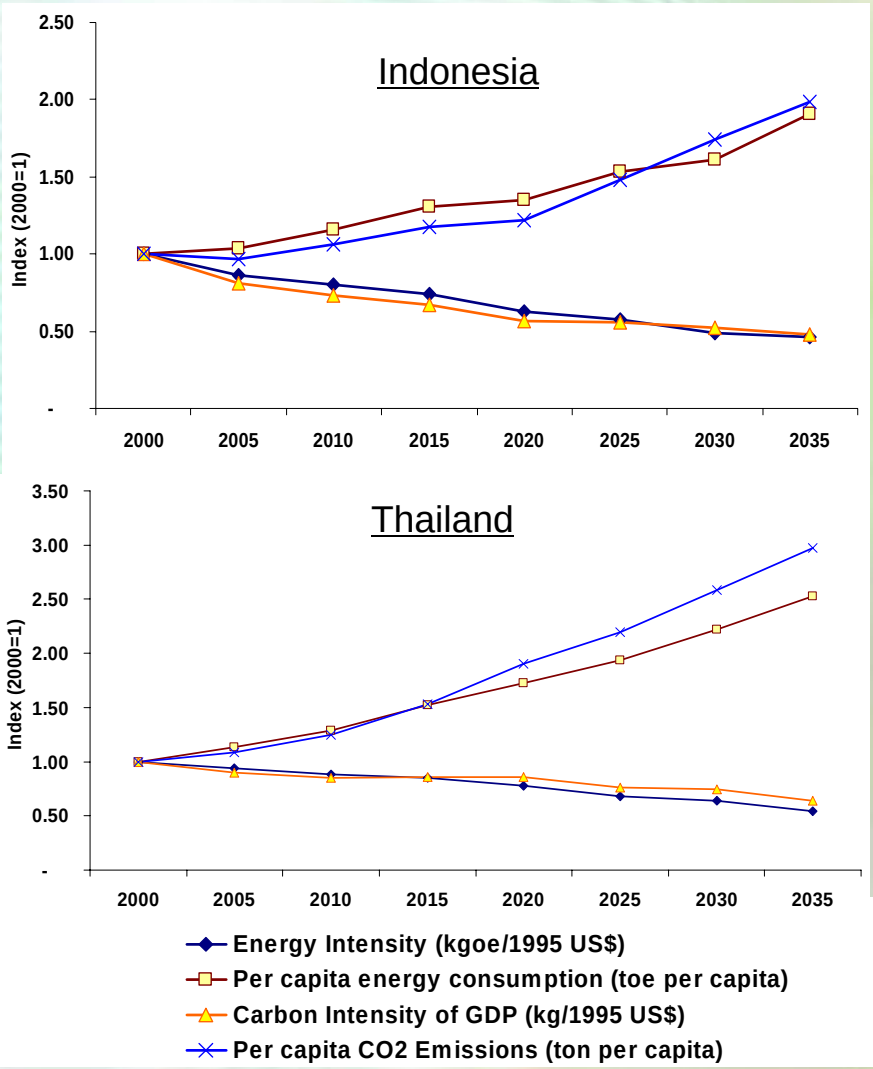








Other Indicators



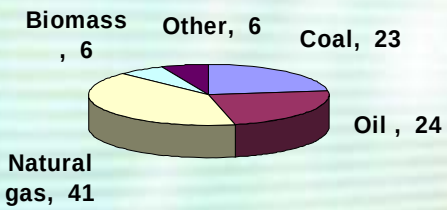
From 2000-2035,

- Per capita CO2 Emissions (ton):
  - Indonesia: 1.36 to 2.71
  - Thailand: 2.63 to 7.82
- Energy Intensity of GDP at MER (kgoe/1995 US$):
  - Indonesia: 0.65 0.30
  - Thailand: 0.59 to 0.32
- Carbon Intensity of GDP at MER (kg/1995 US$):
  - Indonesia: 1.38 to 0.66
  - Thailand: 1.34 to 0.86
- Carbon Intensity of Energy (ton/toe):
  - Indonesia: 2.14 to 2.22
  - Thailand: 2.28 to 2.69

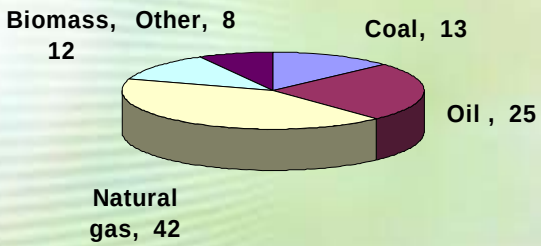
Total Primary Energy Supply
Carbon Tax Case

Indonesia

Base case

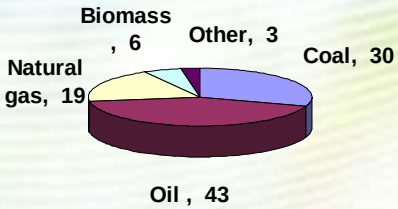


CT200

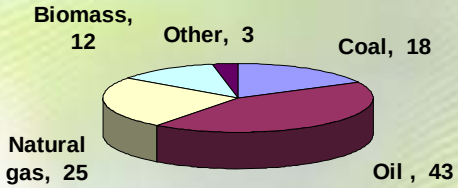


Thailand

Base case



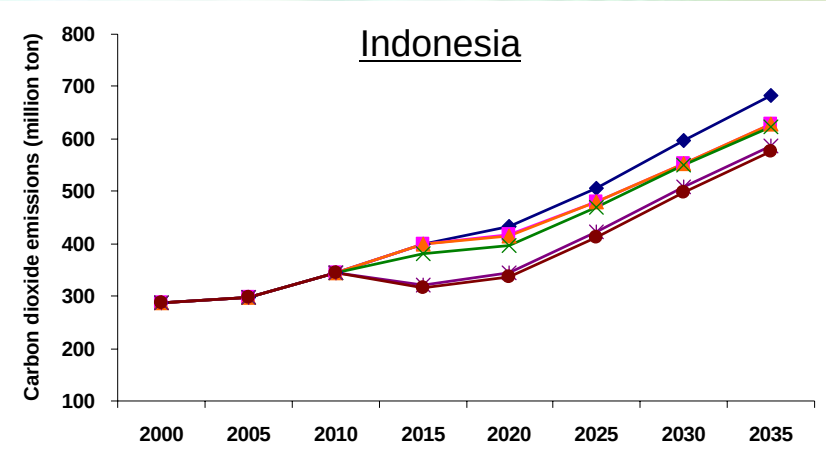
CT200

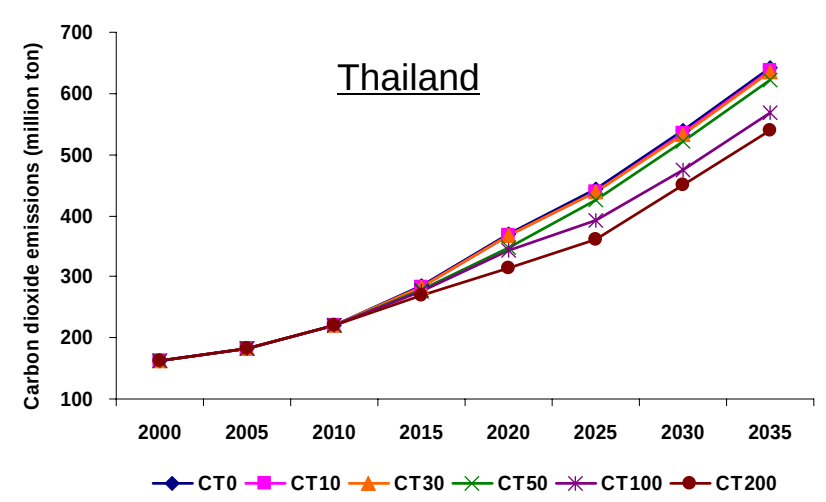


In 2035, CT200 compared to base case,

- Indonesia
  - Coal: ↓ 23 to 13%
  - Oil: ↑ 24 to 25%
  - Natural gas: ↑ 41 to 42%
  - Biomass: ↑ 6 to 12%
  - Other (hydro, geo) ↑ 6 to 8%
- Thailand
  - Coal: ↓ 30 to 18%
  - Oil: 43% unchg.
  - Natural gas: ↑ 19 to 25%
  - Biomass: ↑ 6 to 12%
  - Other 3% unchg.
- Coal is substituted by biomass and natural gas in CT200 case.

Reduction in CO_2 Emissions
Carbon Tax Case



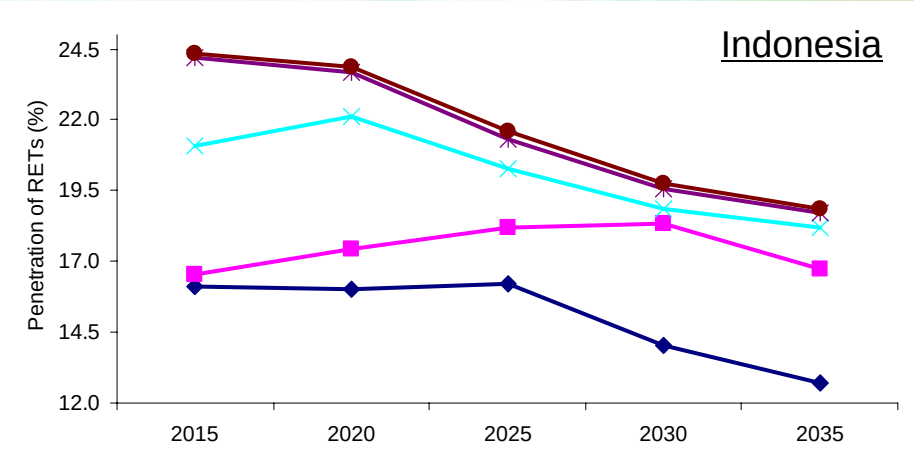


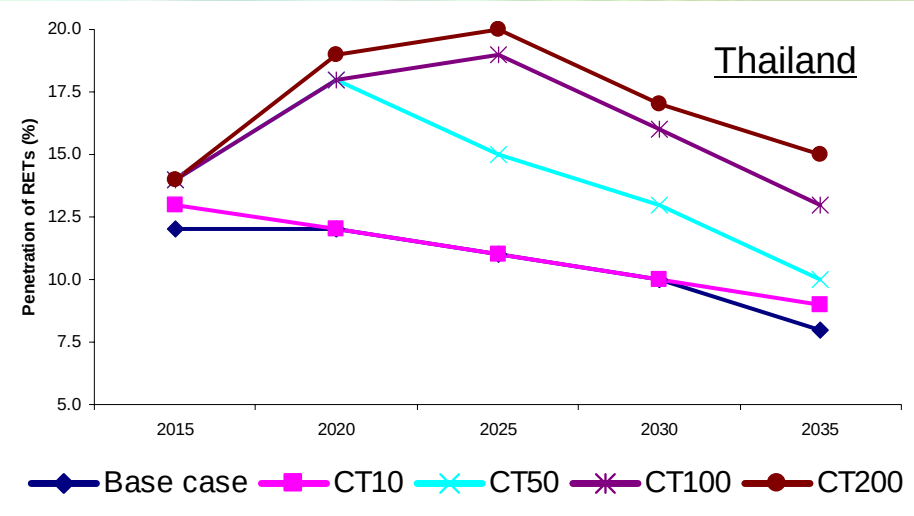
- Reduction of CO_2 compared to base case in 2035 (%),

	Indonesia	Thailand
CT50	10	3
CT100	16	11
CT200	19	16

Share of Renewable Energy Technologies

Carbon Tax Case





Indonesia:

- RETs Share in 2035:
  - Base case: 13%
  - Under CT200: 19%
- At CT200, RETs selected are biomass and geothermal.

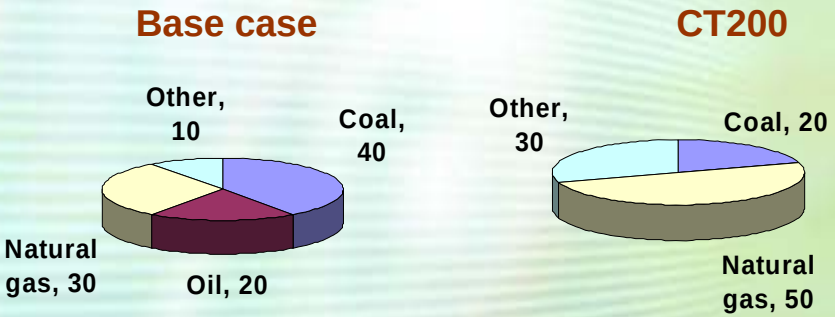
Thailand:

- RETs Share in 2035:
  - Base case: 8%
  - Under CT200: 15%
- Decline in % RETs in base case because of the limitation in agricultural residue availability.
- At CT200, biomass for power generation and biofuels for transport are selected.

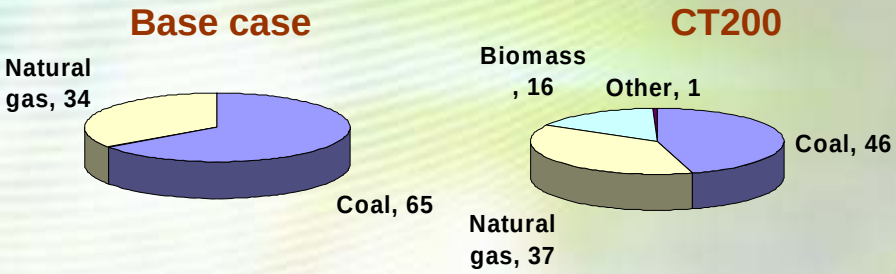
Energy Mix in Power Generation

Carbon Tax Case

Indonesia



Thailand



In 2035, CT200 compared to base case,

- Indonesia
  - Coal: 40 to 20% ⬇
  - Oil: 20 to 0% ⬇
  - Natural gas: 30 to 50% ⬆
  - Other: 10 to 30% ⬆

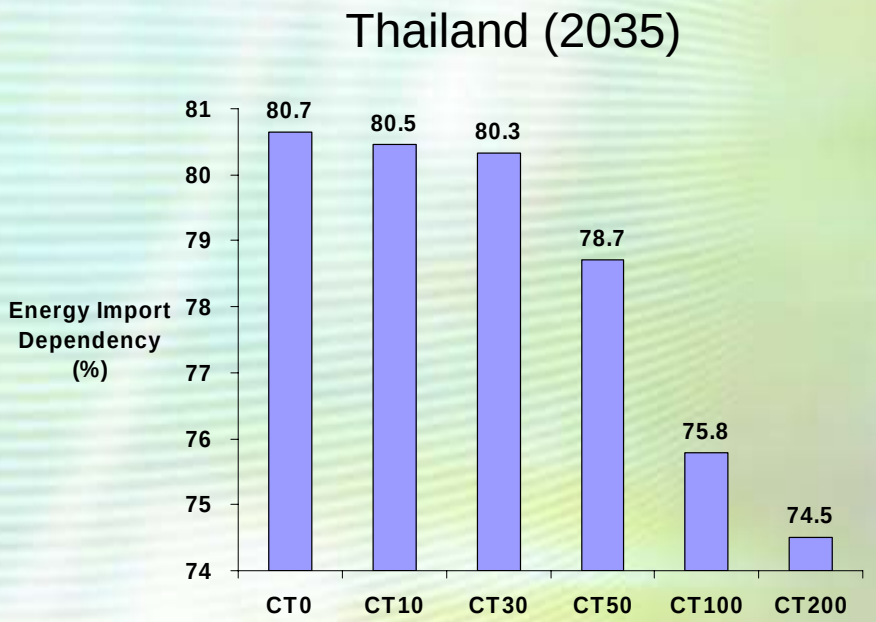
Other technologies are biomass, geothermal & nuclear

Coal and oil is substituted by natural gas, biomass, geothermal and nuclear.

- Thailand
  - Coal: 65 to 46% ⬇
  - Natural gas: 34 to 37% ⬆
  - Biomass: 0 to 17% ⬆

Coal is substituted by biomass and natural gas.

Energy Import Dependency (EID)
Carbon Tax Case



- EID:
  Base case: 80.7%
  CT200: 74.5%
- Reduction in EID due to increased use of biomass for power generation.
- Total plantation biomass potential (15 Mtoe) is used at CT200.

Conclusions

- Carbon tax could reduce CO_2 emissions up to 19% in Indonesia and 16% in Thailand by 2035.

- Carbon tax results in increasing the share of RETs in both countries
  - Indonesia – 13% in base case to 19% in CT200 in 2035
  - Thailand - 8% in base case to 15% in CT200 in 2035

- RETs selected in Carbon tax cases:
  - Indonesia – biomass & geothermal
  - Thailand – biomass, wind & biofuel

- Carbon tax reduce EID in Thailand by 81% in base case to 74% in CT200 by 2035.

THANK YOU