

# Implications of carbon reduction targets for energy systems development: Case of selected South East Asian countries

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10th AIM International Workshop  
10-12 March 2005  
Tsukuba, Japan



# Presentation Outline

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- AIM related activities at AIT
  
- Comparative analysis of selected South East Asian Countries on implications of carbon reduction targets in energy systems development
  - Introduction
  - Primary Energy Supply
  - Environmental Implications
  - Conclusions

# AIM related activities at AIT



# Models and countries covered

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- Types of models used:

- AIM/Enduse
- AIM/Local
- AIM/CGE

- Countries covered:

- Thailand
- Vietnam
- Sri Lanka
- Indonesia

# Issues Analyzed

AIM Models	Countries	Issues analyzed
I. Enduse	All	<p><b><i>For all countries (Indonesia, Sri Lanka, Thailand and Vietnam):</i></b></p> <p>Implications of CO<sub>2</sub> and SO<sub>2</sub> emission reduction targets</p> <p>Implications of carbon tax and sulfur tax</p> <p><b><i>Country Specific:</i></b></p> <p>Energy, environmental and cost implications of limitations on natural gas availability in Thailand</p> <p>Energy and environmental implications of biomass use for cooking and electricity generation in Sri Lanka</p> <p>Analysis of biofuel in transport sector in Thailand</p> <p>Analysis of selected policy issues in transport sector (ie. Emission charge) of Bangkok (For RISPO Project)</p>
II. Local	Thailand Vietnam	<p>Carbon tax and sulfur tax on energy systems</p> <p>CO<sub>2</sub> and SO<sub>2</sub> emission reduction targets</p>
III. CGE	Thailand	Implications of C-tax on Thai economy (Preliminary)

# Implications of carbon reduction targets for energy systems development



# Introduction

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- Countries covered:
    - Indonesia, Thailand and Vietnam
  
  - Study period:
    - 2000 to 2030
  
  - Scenarios considered:
    - Base Case
    - CO<sub>2</sub> Emissions Reduction Targets:
      - 5% (ER5)
      - 10% (ER10)
      - 15% (ER15)
- } Reduction from the base case during 2010-2030

# GDP, Total primary energy supply and CO<sub>2</sub> emissions of selected countries in 2002

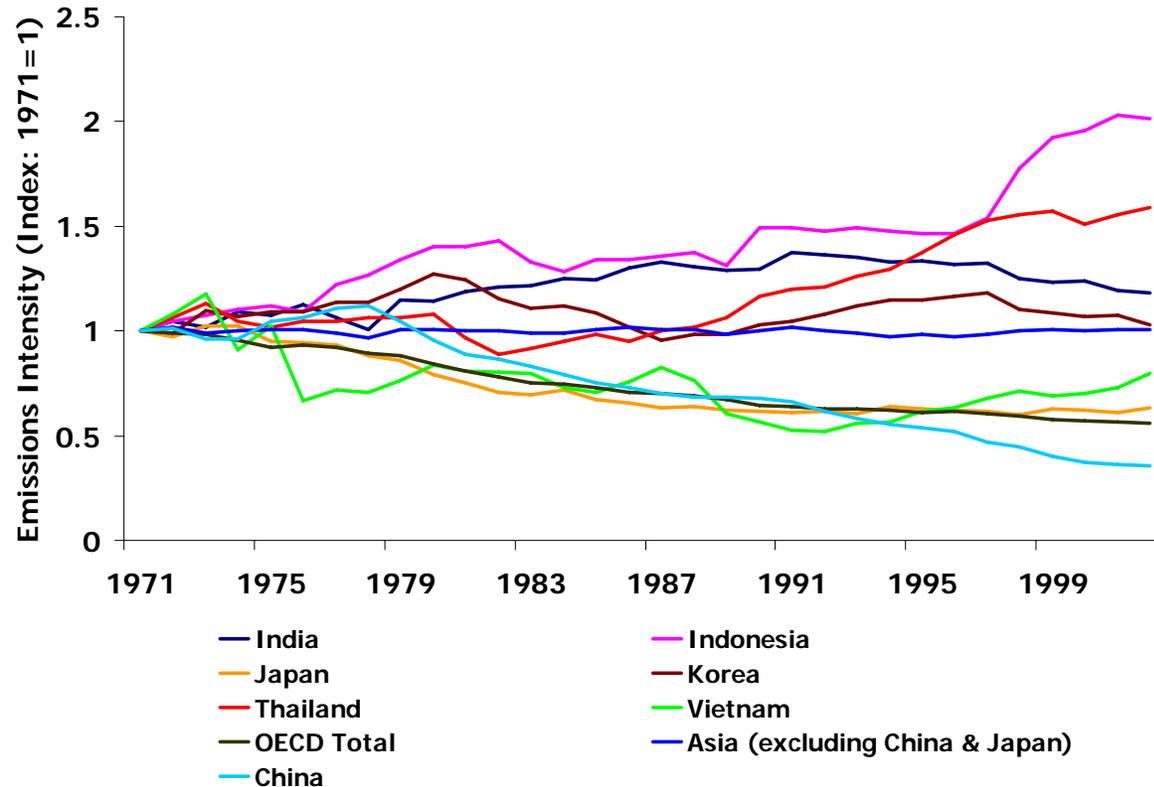
Country	Population (million)	GDP (billion 95US\$)	Total Primary Energy Supply (Mtoe)	CO <sub>2</sub> Emissions (Mton)	Emissions Intensity CO <sub>2</sub> /GDP (kg-CO <sub>2</sub> /95US\$)	Energy Intensity TPES/GDP (toe/1000 US\$)
Indonesia	212	224	156	303	1.35	0.70
Thailand	62	185	83	179	0.97	0.45
Vietnam	80	33	43	57	1.71	1.28
China	1280	1208	1229	3270	2.71	1.02
India	1049	517	538	1016	1.97	1.04
Japan	127	5715	517	1207	0.21	0.09
Korea	48	681	203	451	0.66	0.30
<b>Asia*</b>	<b>1988</b>	<b>1857</b>	<b>1184</b>	<b>2257</b>	<b>1.22</b>	<b>0.64</b>

\* Excludes China and Japan

Source: IEA, 2004

- Among the 3 South-East Asian countries under the study:
  - Emissions intensity is lowest in Thailand
  - Energy intensity is highest in Vietnam

# CO<sub>2</sub> Intensity (CO<sub>2</sub> per GDP<sub>MER</sub>)



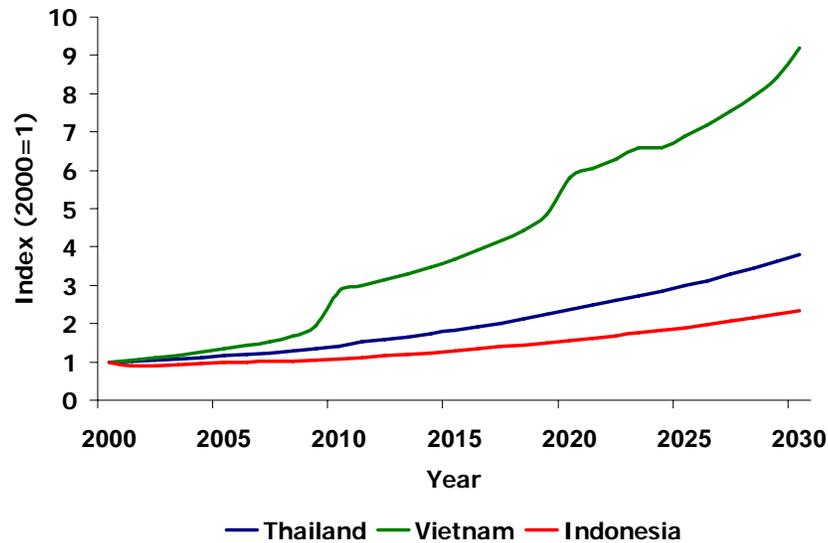
Source: IEA, 2004

- CO<sub>2</sub> intensity:
  - Relatively high in Indonesia and Thailand.
  - Increasing in all 3 countries (Indonesia, Thailand and Vietnam).

# I. Effects on Primary Energy Requirement



# Primary Energy Supply during 2000-2030 in the base case

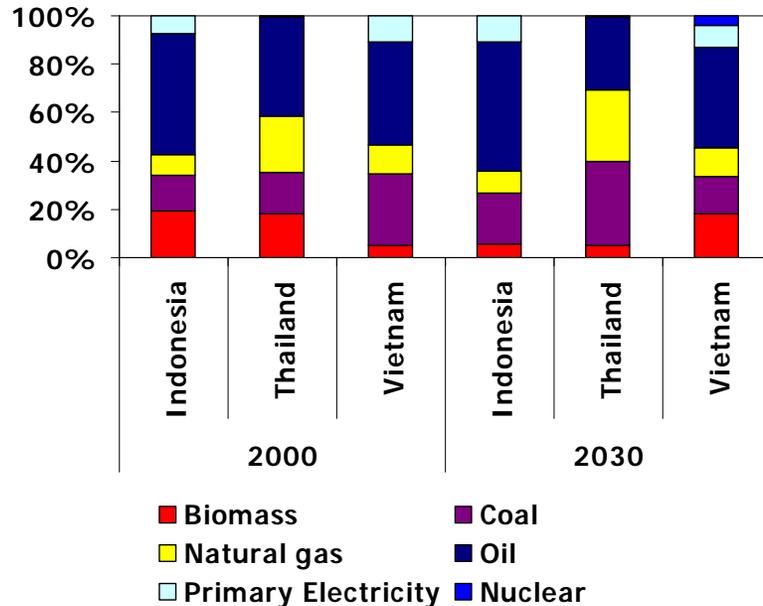


## Primary Energy Supply, Mtoe

	Y2000	Y2030
Indonesia:	118	276
Thailand:	66	251
Vietnam:	17	155

# Primary Energy Supply Structure in Base case

□ From 2000 to 2030:



Indonesia,

- Coal: ↑ 15 to 21%
- Nat.: gas ↑ 8.9 to 9.2%
- Oil: ↑ 50 to 53%
- Biomass: ↓ 19 to 6%

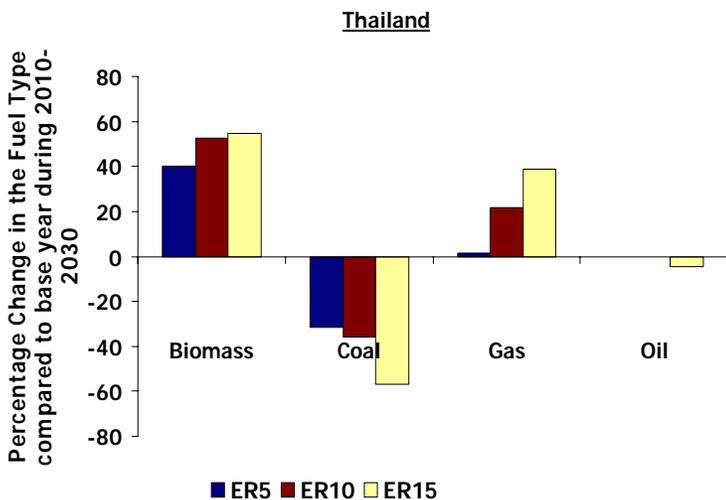
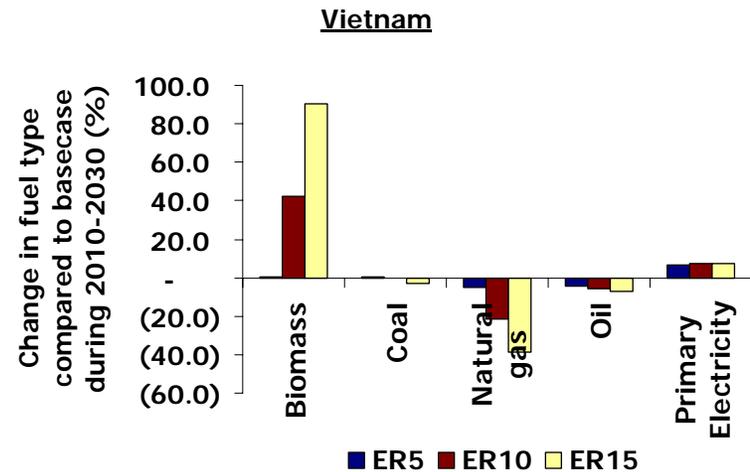
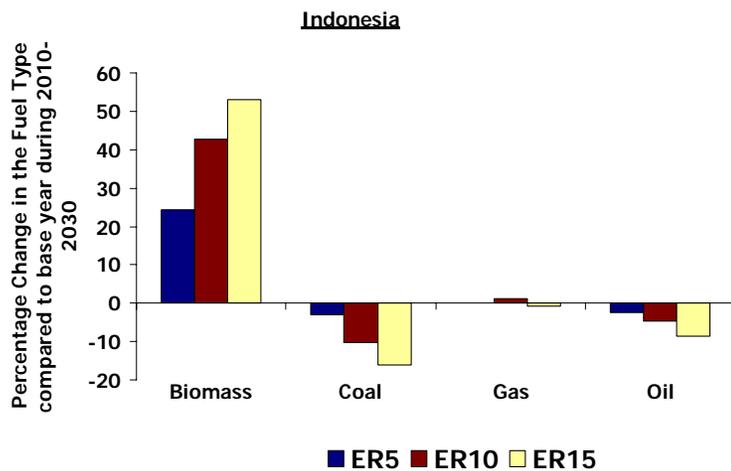
Thailand,

- Coal: ↑ 17 to 34%
- Nat. gas: ↑ 23 to 29%
- Biomass: ↓ 18 to 5%
- Oil: ↓ 41 to 30%

Vietnam,

- Biomass: ↑ 5 to 18 %
- Coal: ↓ 30 to 15%
- Oil: ↓ 43 to 41%
- Nat. gas remain constant at 12%

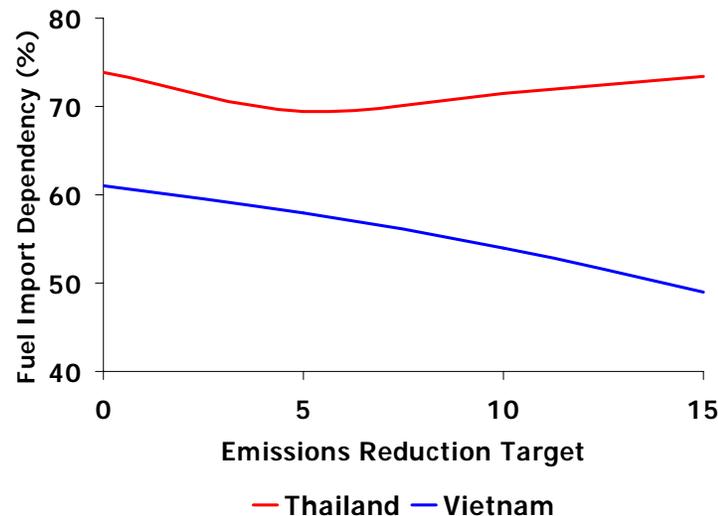
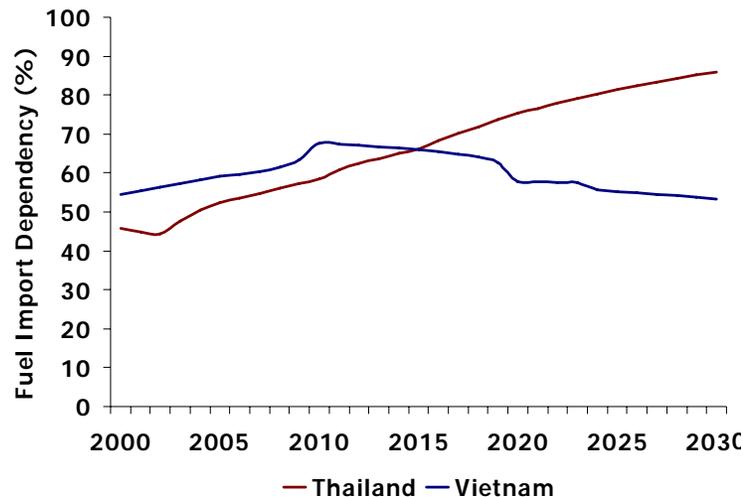
# Changes in Primary Energy Supply Structure due to Emission Reduction Targets



Fuel substitution in ER:

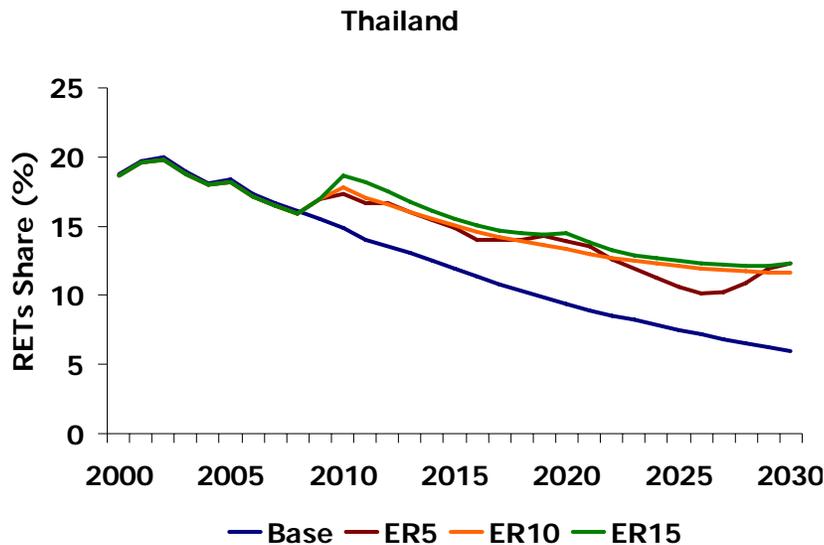
- Indonesia:  
Coal and oil to biomass and gas
- Thailand:  
ER5: coal to biomass  
ER10 & 15: coal to biomass & nat. gas
- Vietnam:  
ER5: oil, natural gas to primary electricity  
ER10 & 15: coal, oil, natural gas to biomass and primary electricity

# Energy Import Dependency (EID)



- There are no energy imports in Indonesia
- Base case:
  - EID increases rapidly from 46% in 2000 to 86% in 2030 Thailand due to growing energy demand and inadequate domestic resources.
- ER cases:
  - EID decreases from 74% in base case to 68% in ER5 in Thailand due to increased domestic biomass use and increases to 73% in ER15, due to increased use of imported natural gas.
  - EID decreases in Vietnam to 49% in ER15 due to increased use of biomass and primary electricity.

# Role of Renewable Energy Technologies in Thailand



- In base case, the share of Renewable Energy Technologies (RETs) will reduce from 20% in 2000 to 6% in 2030.
- In 2030, the RETS share increases from 6% in base case to about 12% in ER cases.
- The RETs share falls over time as agricultural residue available would be fully used.
- Plantation based biomass is also used in ER cases

# Role of Renewable Energy Technologies in Indonesia and Vietnam

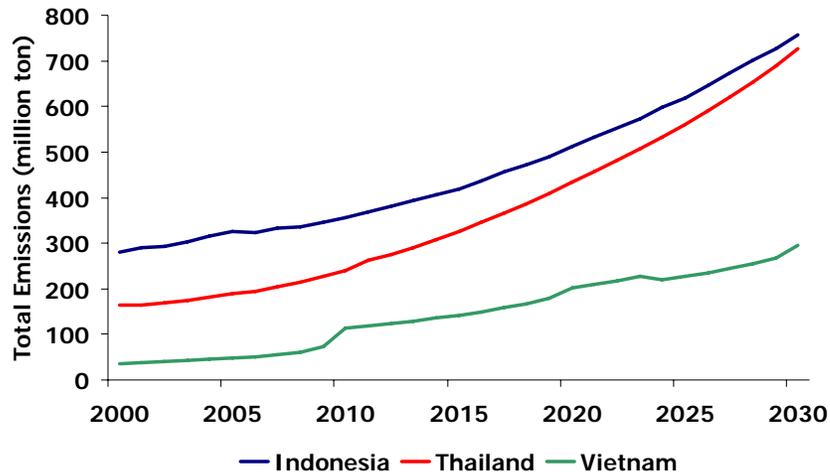
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- Vietnam RETs:
  - Increase from 16% in 2000 to 28% in 2030 in base case due to increase in hydro power generation.
  - Have an increasing contribution to ER
  - Plantation based biomass is selected
  
- Indonesia RETs:
  - Decrease from 19% in 2000 to 6% in 2030 in base case
  - Increase the RETs share from 6% in base case to 9% in ER15 in 2030).

## II. Environmental Implications



# CO<sub>2</sub> Emissions in Base case



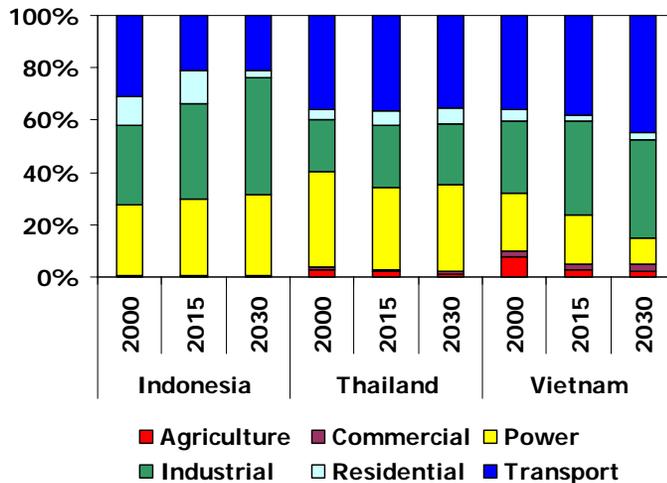
□ AAGR of CO<sub>2</sub> emissions during 2000–2030:

Indonesia: 3.5% (281 to 758 Mton)

Thailand: 5.1% (163 to 726 Mton)

Vietnam: 7.7% (13 to 121 Mton)

# Sectoral Contribution to CO<sub>2</sub> Emissions



□ From 2000 to 2030:

Indonesia,

- Power: ↑ 27 to 29%
- Industry: ↑ 31 to 36 %
- Transport: ↓ 31 to 21%

Thailand,

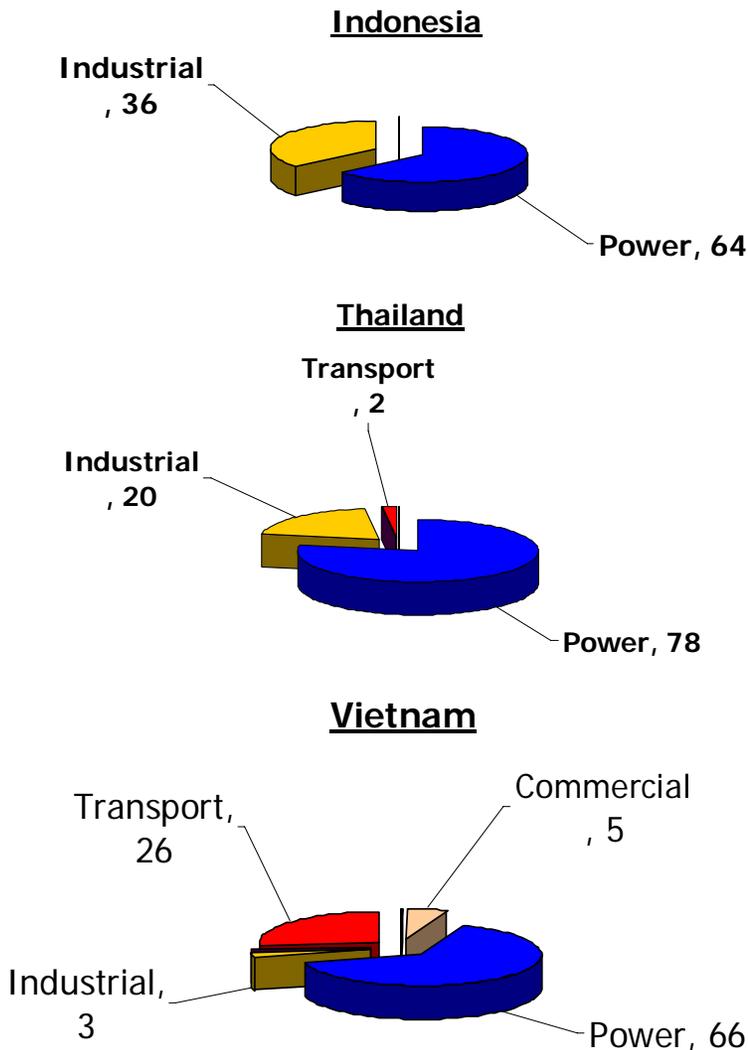
- Power: ↓ 36 to 31%
- Industry: ↑ 20 to 24%
- Transport: remain unchanged at 36%

Vietnam,

- Power: ↓ 22 to 19%
- Industry: ↑ 28 to 36%
- Transport: ↑ 36 to 38%

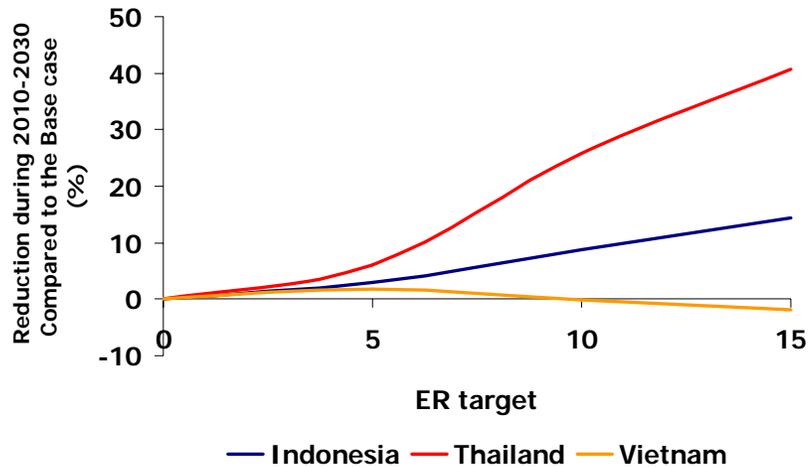
- Transport sector is the largest contributor in Thailand and Vietnam by 2030
- Similarly, Industry sector in Indonesia

# Sectoral Contribution to Cumulative CO<sub>2</sub> Emissions Reductions During 2000 - 2030



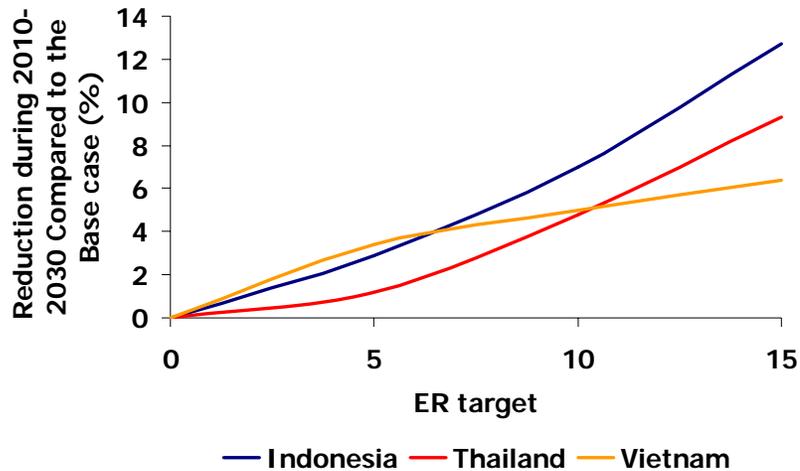
- Sectoral CO<sub>2</sub> reductions in ER15 compared to base case during 2010-2030 :
  - Indonesia: 64% from power & 36% from Industrial
  - Thailand: 78% from power, 20% from Industrial and 2% from transport
  - Vietnam: 66% from power, 26% from transport

# SO<sub>2</sub> reduction under CO<sub>2</sub> ER targets



- % SO<sub>2</sub> reduction largest in Thailand
- At ER15, SO<sub>2</sub> is reduced by 41% in Thailand and by 14% in Indonesia.

# NO<sub>x</sub> reduction under CO<sub>2</sub> ER targets



- Indonesia has highest NO<sub>x</sub> reduction at ER10 and ER15.
- At ER15 NO<sub>x</sub> was reduced by 13% in Indonesia, 9% in Thailand and 6% in Vietnam.

# Conclusions

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- ❑ Biomass produced on a sustainable basis play a key role in CO<sub>2</sub> emissions reduction in all 3 countries
- ❑ The power sector will have the highest contribution to ER in all 3 countries (78% in Thailand, 66% in Vietnam and 64% in Indonesia)
- ❑ Availability of biomass is found to limit its role at higher CO<sub>2</sub> reduction targets in Thailand
- ❑ SO<sub>2</sub> emissions fall significantly in CO<sub>2</sub> ER cases in Indonesia and Thailand
- ❑ Indonesia and Thailand would enjoy a higher percentage of NO<sub>x</sub> reduction than Vietnam at ER15

# Future AIM Activities at AIT

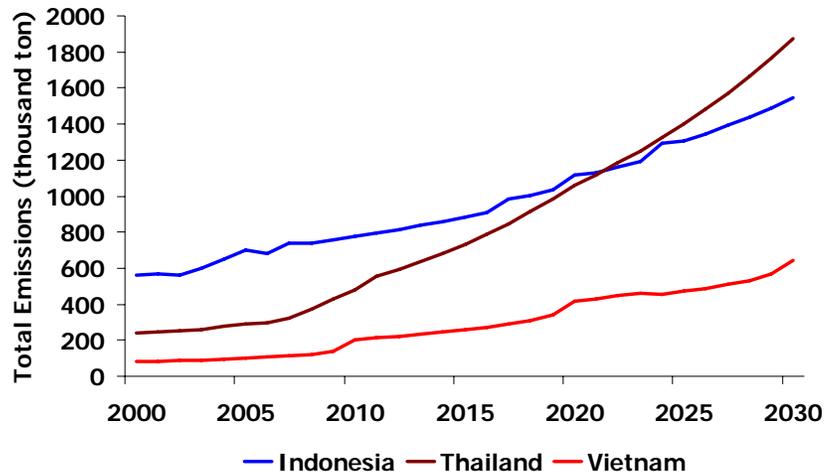
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- ❑ Multi gas emission inventory of Thailand
- ❑ AIM/Enduse Model development for Cambodia and Nepal
- ❑ AIM/Local Model development for Indonesia
- ❑ Refinement of AIM/CGE model for Thailand
- ❑ Dissemination of results

# END



# SO<sub>2</sub> Emissions in Base case



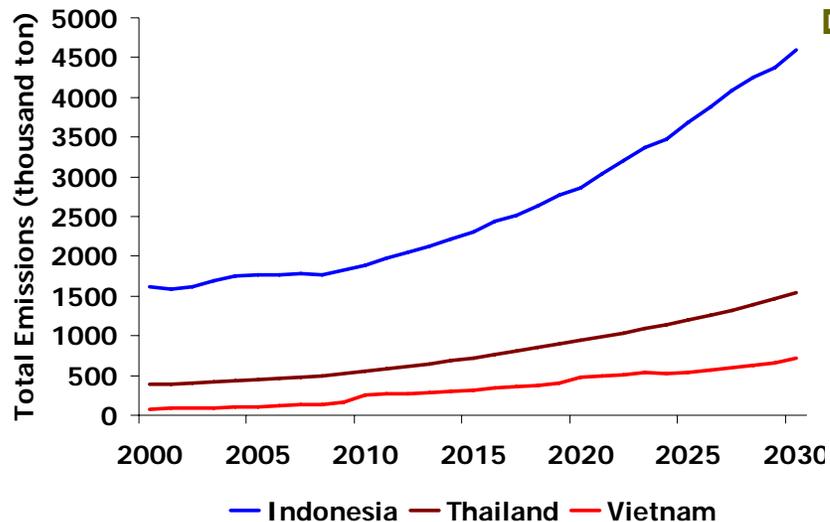
□ AAGR of SO<sub>2</sub> emissions during 2000 – 2030:

Indonesia: 559 to 1,543 kton (3.6%)

Thailand: 240 to 1,873 kton (7.1%)

Vietnam: 80 to 645 kton (7.5%)

# NO<sub>x</sub> Emissions in Base case



□ AAGR of NO<sub>x</sub> emissions during 2000 – 2030:

Indonesia: 1,614 to 4,598 (3.8%)

Thailand: 390 to 1538 kton (4.7%)

Vietnam: 80 to 722 kton (7.9%)