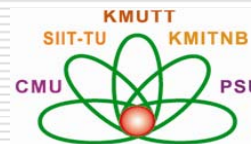
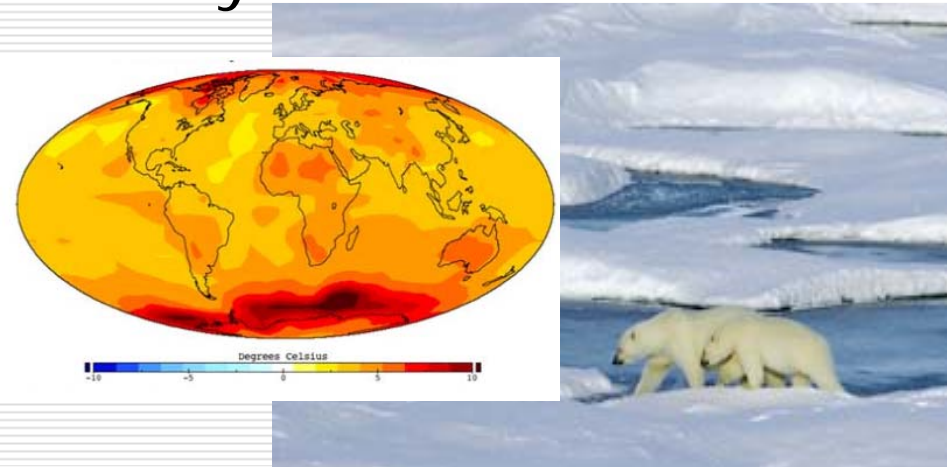


# Thailand's Energy Options for a Low Carbon Economy

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Franco – Thai Seminar on  
Technological and Infrastructural Challenges for  
Building a Low Carbon Economy  
8 October 2009

Bundit Fungtammasan  
JGSEE



**JGSEE**  
The Joint Graduate School of Energy and Environment

# Scope

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- ❑ Thailand's CO<sub>2</sub> emission situation
- ❑ Energy and climate security challenges
- ❑ Recent policies and measures to reduce energy – related CO<sub>2</sub>
- ❑ Future CO<sub>2</sub> emission trends and mitigation potentials
- ❑ Key success factors for realizing the potentials

# Acknowledgement

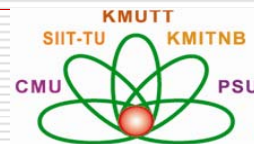
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- Dr Suvit Tia, KMUTT
  - Dr Bundit Limmeechokchai, SIIT
  - Dr Chumnong Sorapipatana, JGSEE
  - Dr Athikom Bangviwat, JGSEE
  - Dr Nattapong Chayawatho
- 
- TRF, EPPO, for project support
  - DEDE for use of data

# Thailand's CO<sub>2</sub> Emission Situation

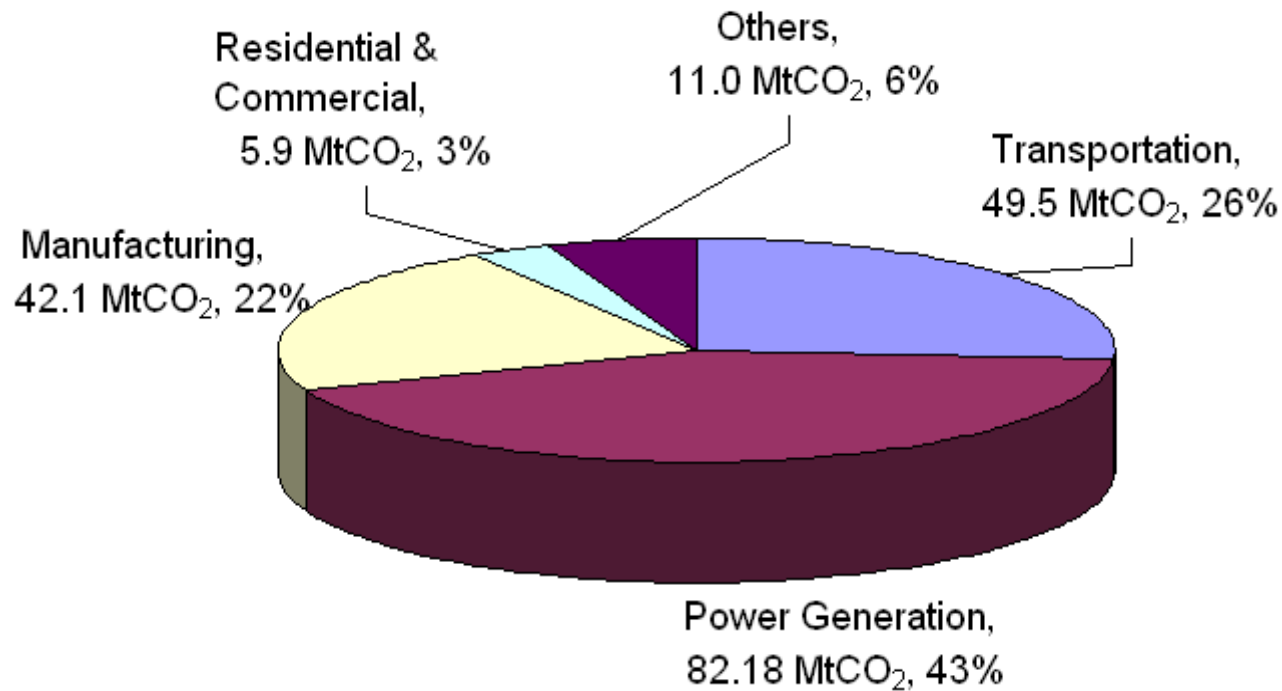
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- Emission in the energy sector
- Key drivers for emission increase
- Thailand's emission relative to other countries



# CO<sub>2</sub> Emission in the Energy Sector, 2007

Energy related emission accounts for roughly 2/3 of total, or 202 MtCO<sub>2-eq</sub> in 2007

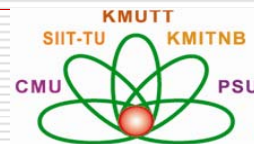


Source: Adapted from DEDE Energy Situation Report, Thailand

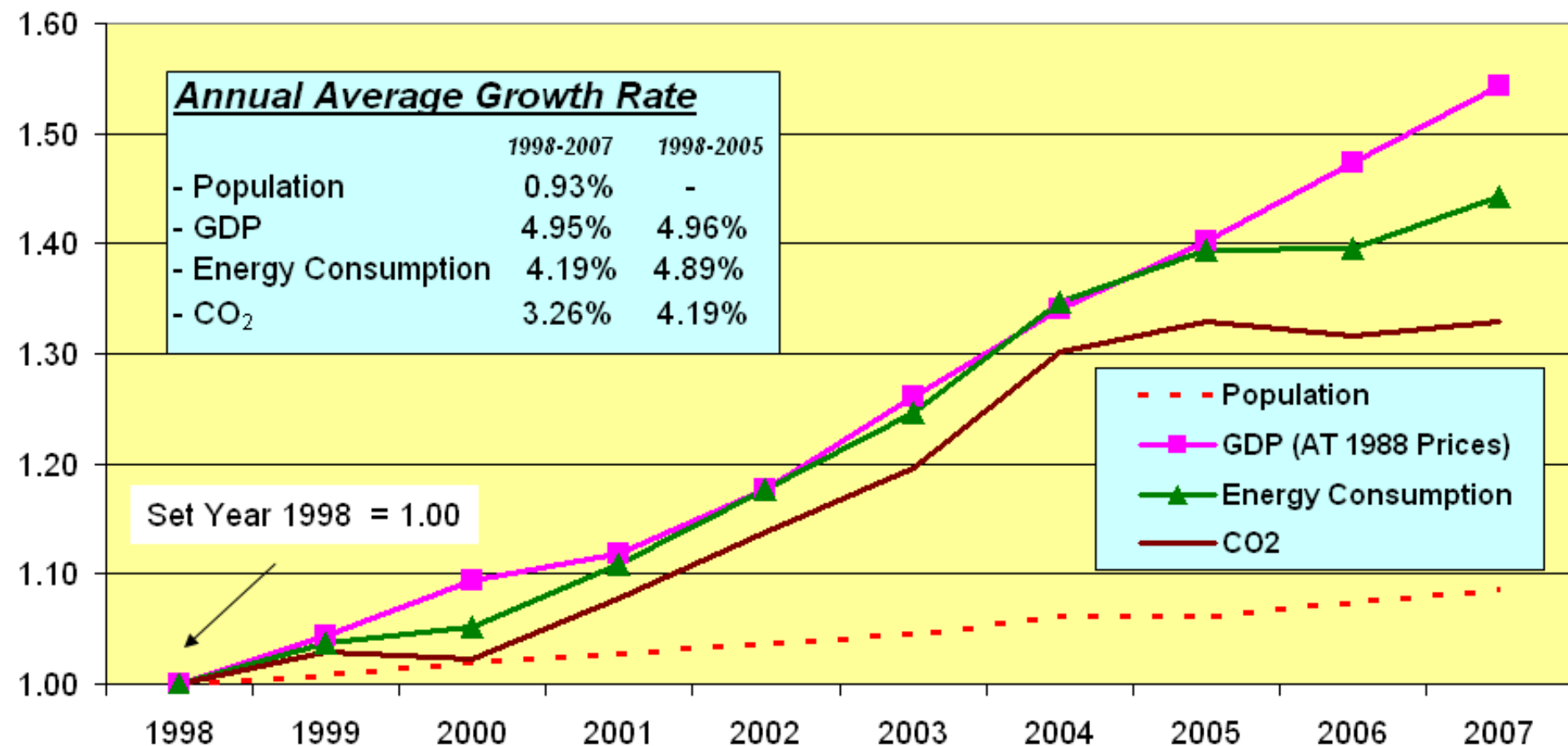
# Key Drivers for Emission Increase

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- Population
- Economics
- Energy consumption
- Energy resource
- Technology

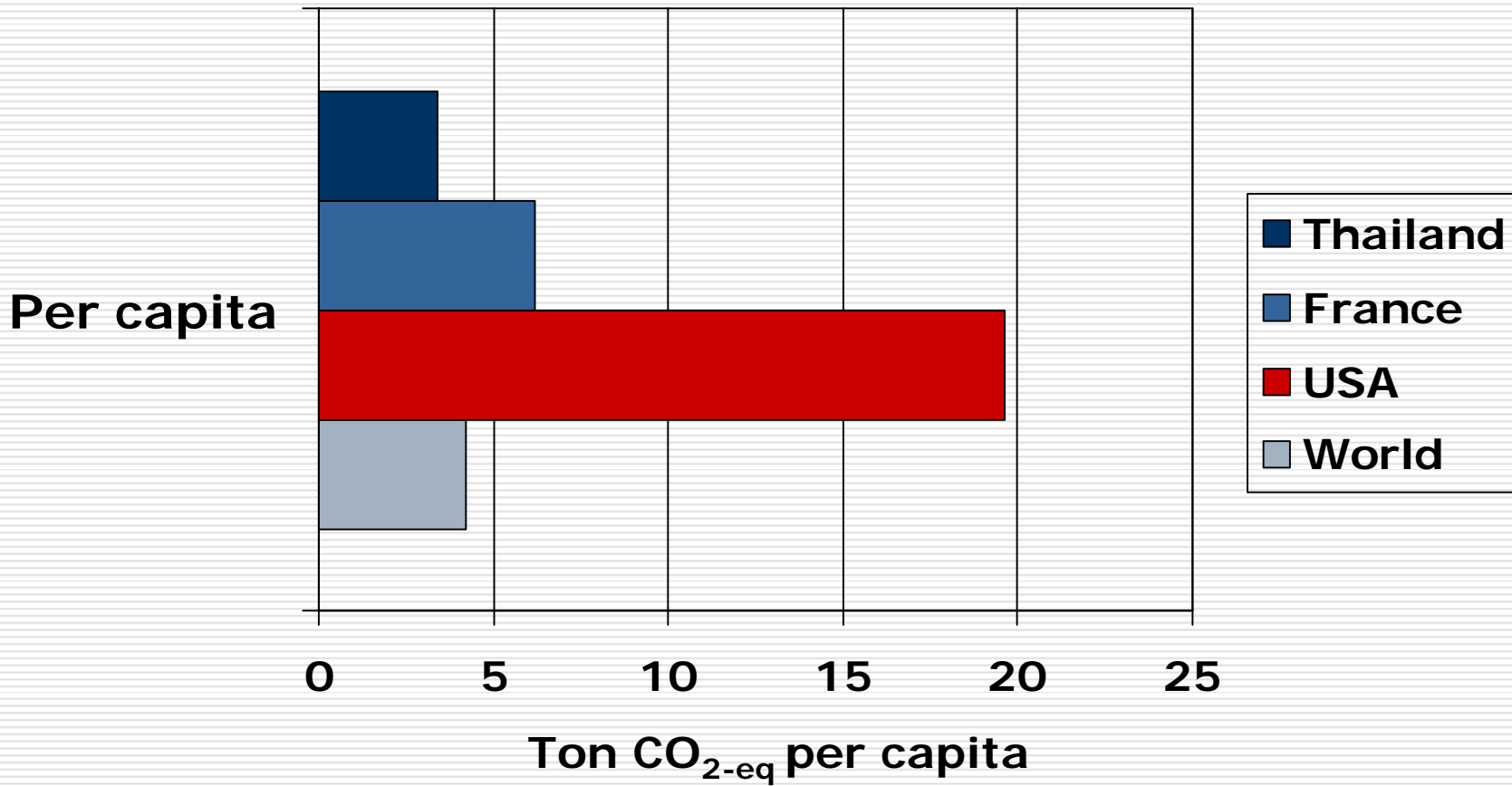


# Population, GDP, Energy Consumption and CO<sub>2</sub> Trends in Thailand 1998 - 2007

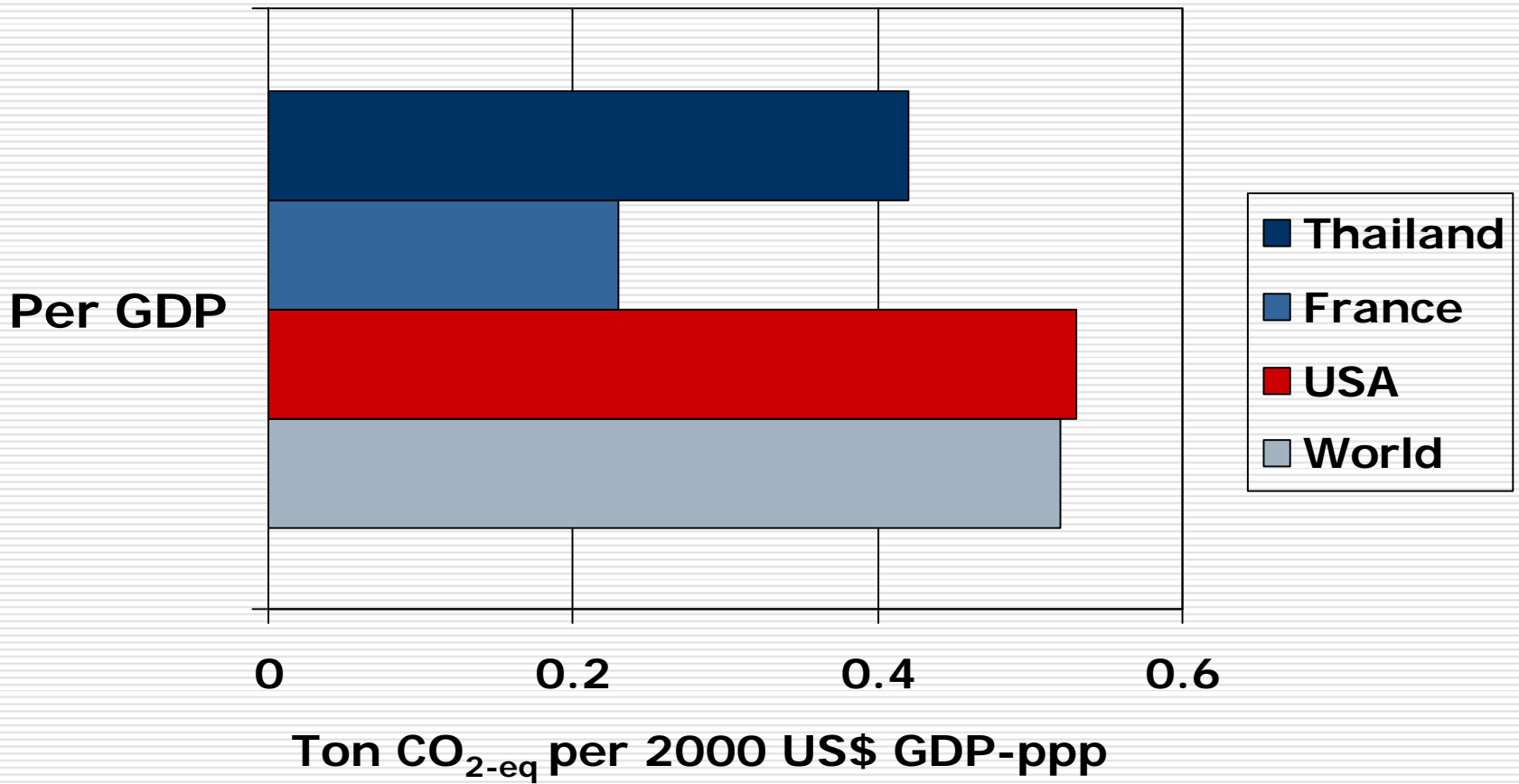


Source: Derived from DEDE report, Thailand and UN

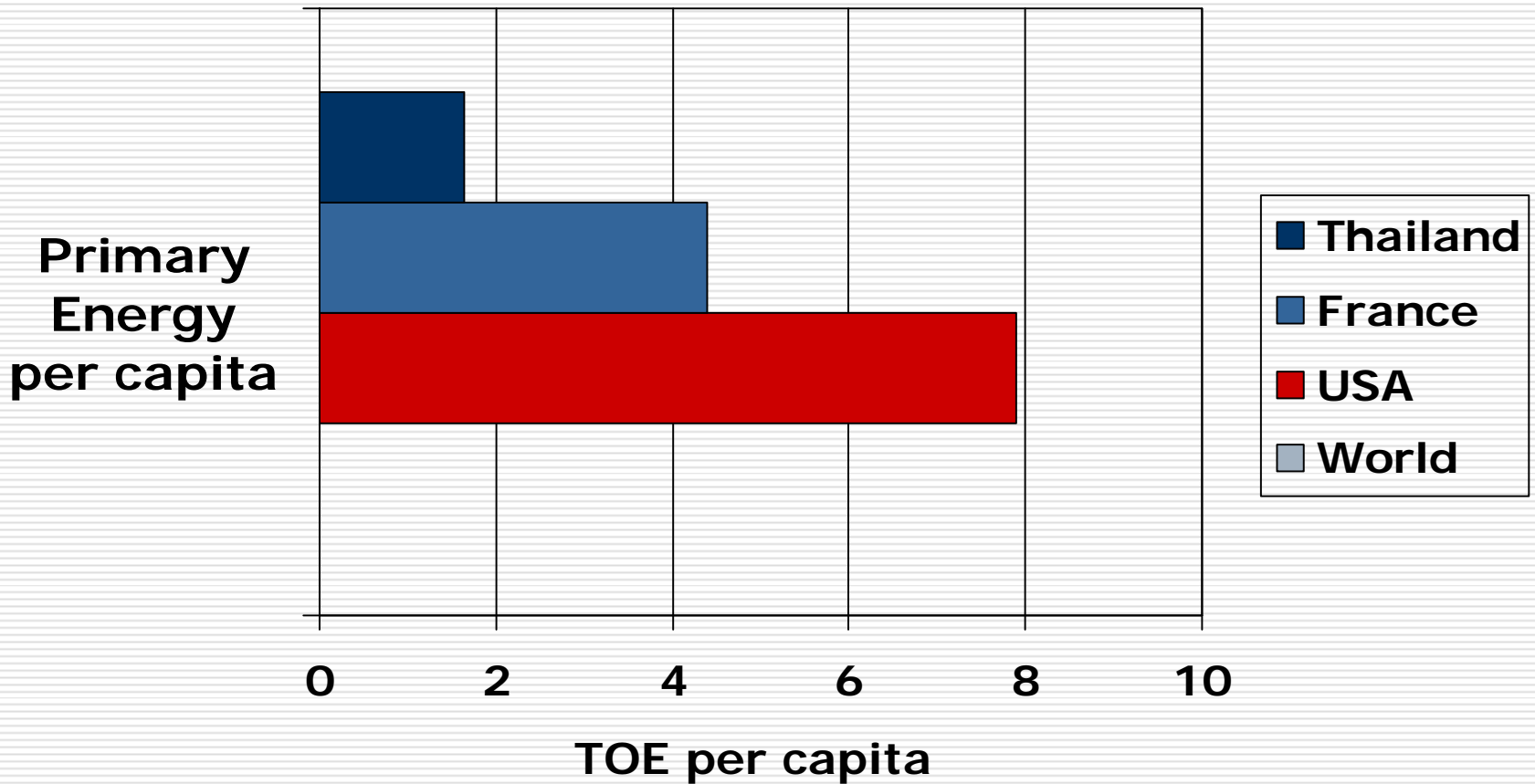
# Thailand's Emission Relative to Others



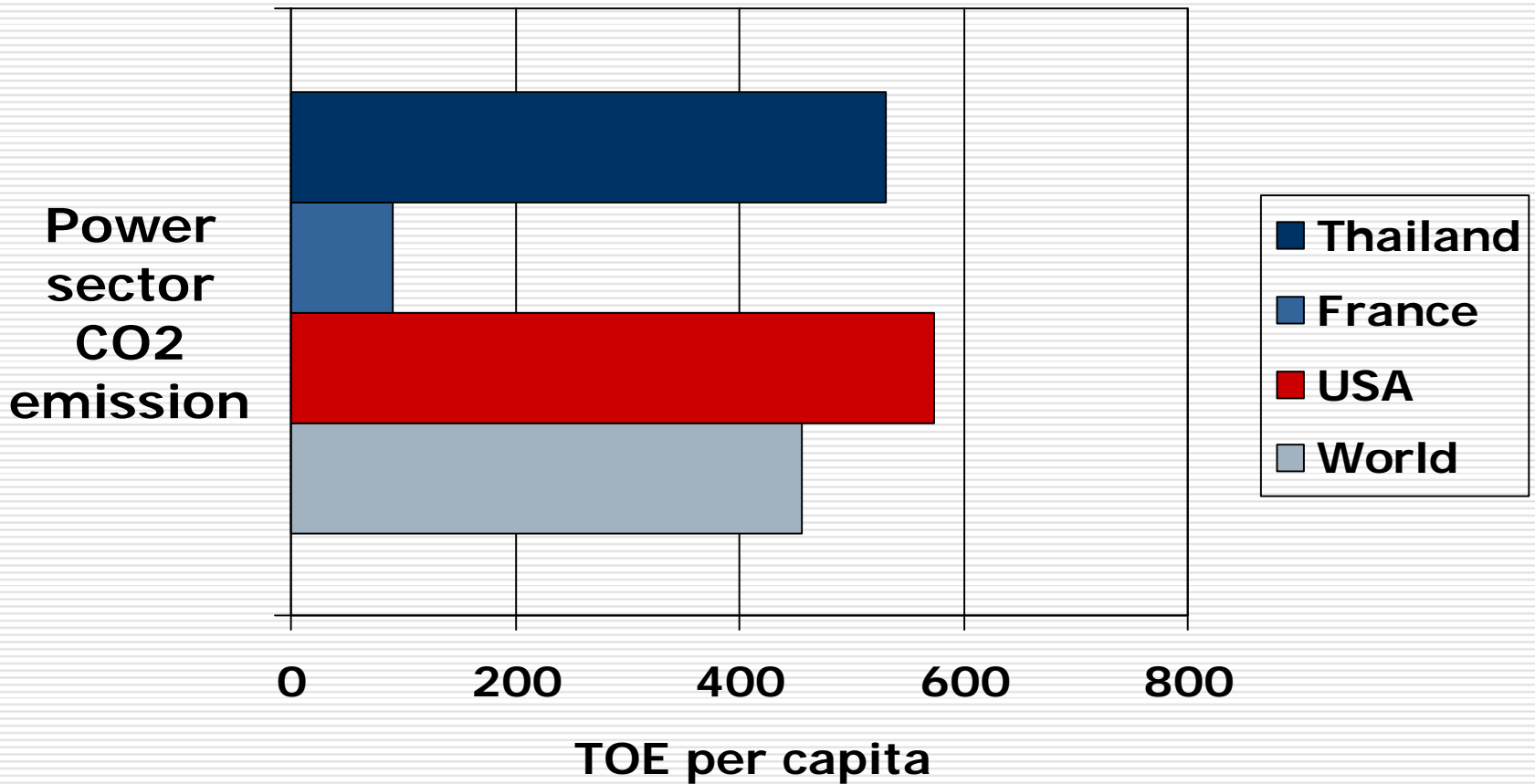
# Thailand's Emission Relative to Others



# Thailand's Emission Relative to Others



# Thailand's Emission Relative to Others



# Thailand's Emission Relative to Others

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## Implications

- ❑ Energy, and hence CO<sub>2</sub> per capita likely to increase to attain better quality of life
- ❑ Energy efficiency can be improved
- ❑ CO<sub>2</sub> emission per kWh, especially in the power sector, can be reduced

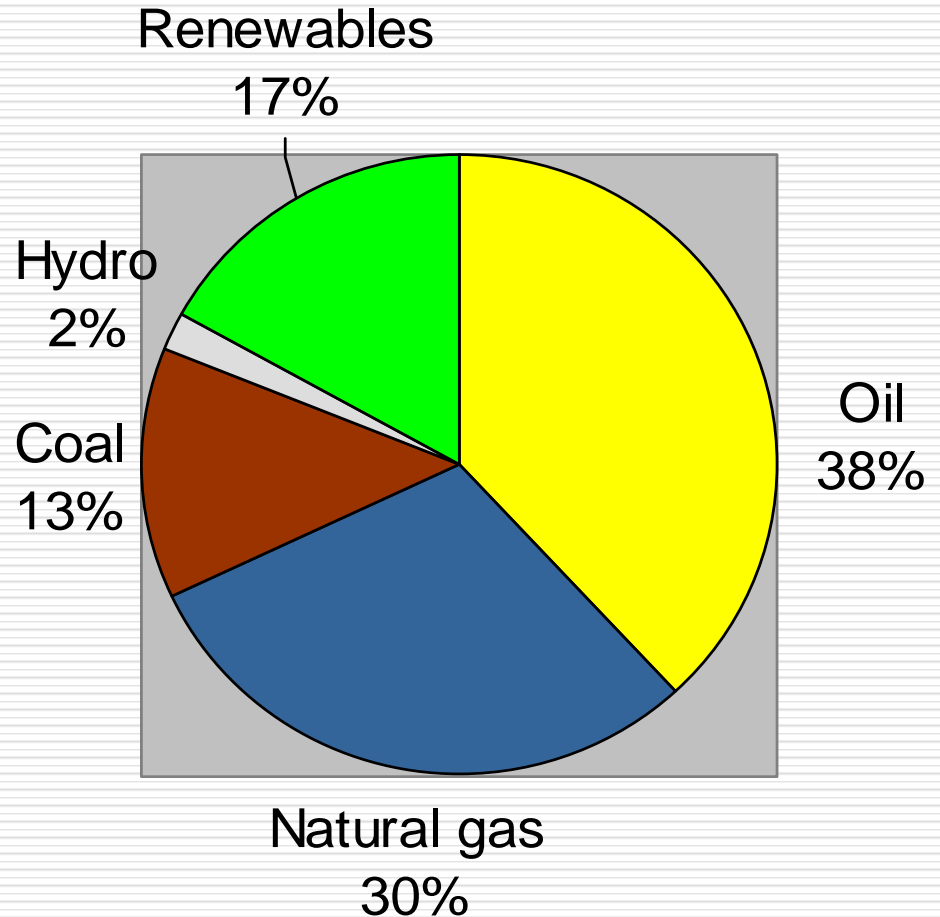
# Energy and Climate Security Challenges

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- ❑ Energy supply mix
- ❑ Energy consumption pattern
- ❑ Critical security issues

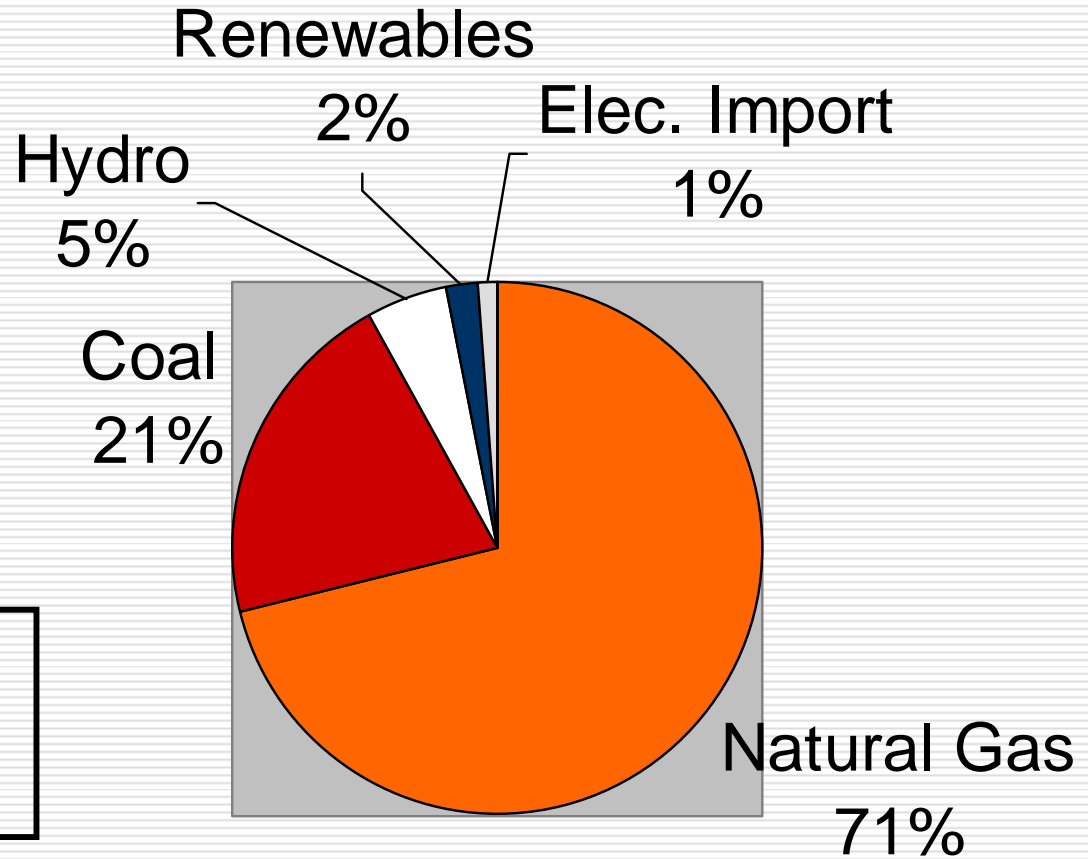
# Primary Energy Supply Mix 2007

Total PES: 107 Mtoe  
Fossil: 81%  
New Renewables  
(minus fuelwood):  
~ 6 %



Source: Adapted from DEDE 2007

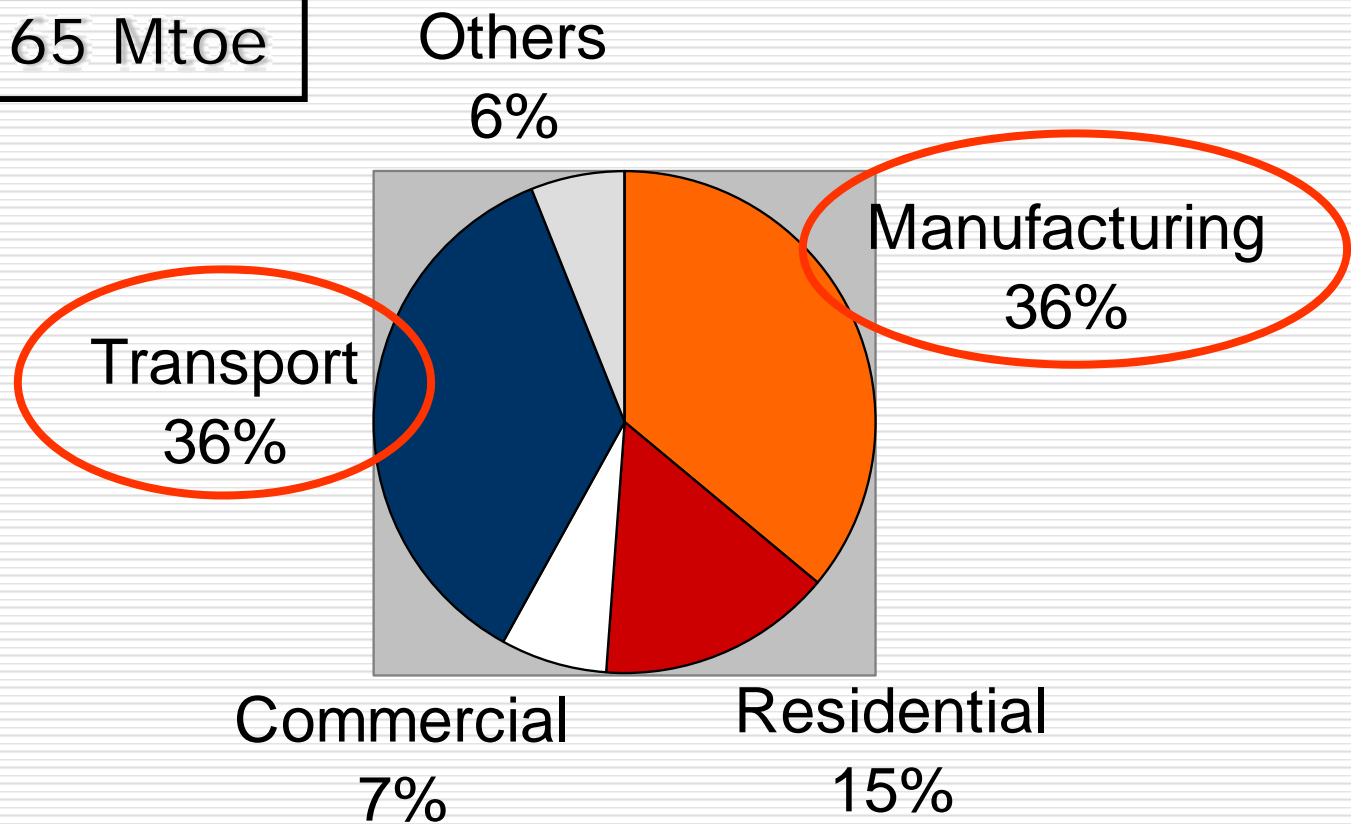
# Electricity Supply by Energy Type (present)



Total generation:  
143 GWh  
Fossil: 93%

# Final Energy Consumption by Sector 2007

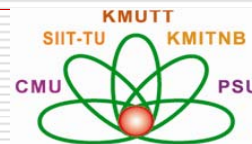
Total FEC: 65 Mtoe



# Critical Security Issues

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- ❑ High import dependence (>50%)
- ❑ Heavy reliance on natural gas for power generation
- ❑ Domestic energy resource limited: gas to run dry in 26 years
- ❑ Fossil dominance: 93% for power, 81% for energy
- ❑ High proportion of energy consumption transport sector (road transport)
- ❑ Barriers on large scale hydro, coal, and nuclear



# Recent Policies and Measures to Reduce Energy-related CO<sub>2</sub>

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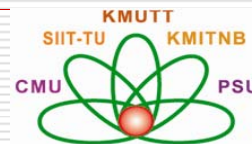
A number of recent policy initiatives, though aimed at boosting energy security, has helped, or will help, reduce carbon emission:

- Renewable energy for power generation
- Alternative fuels for transport
- Nuclear power
- Energy efficiency

# Renewable Energy for Power Generation

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- ❑ Energy Conservation Promotion Act 1992, setting up of Energy Conservation Promotion Fund
- ❑ Subsidies for SPPs and VSPPs using renewables and co-generation using other type of fuels
- ❑ “Adders” on top of regular tariffs (2007) for electricity produced from renewables and sold to grid
- ❑ Revolving fund, particularly for biogas, ESCO  
Venture capital



# Renewable Energy for Power Generation

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- ❑ Board of Investment privileges (tax holiday, etc)
- ❑ Promotion of CDM, setting up of TGO in 2008, following National Strategic Plan for Climate Change (2008)
- ❑ “15 – year Alternative Energy Development Plan” targets 12% renewable energy, including 2% renewable electricity, by 2022

# Present and Future Contribution of Renewable Electricity (MW)

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Source	2008	2022
Solar	32	500
Wind	1	700
Small hydro	50	320
Biomass	1,597	3,700
Biogas	29	120
MSW	5	160
<b>Total</b>	<b>1,714</b>	<b>5,500</b>

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Source: DEDE 2009

# Alternative fuels for transport

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- Ethanol
- Biodiesel
- Natural gas for vehicles

# Policies on Biofuels

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- ❑ Biofuel industry development policy introduced in 2000
- ❑ Market: E10 in 2003, E20 since 2007, E85 in 2008 but still lacks infrastructure and flexible fuel vehicles (FFVs)
- ❑ Production:
  - 1 million liters per day in 2008 (from molasses, though potential exists for cassava)
  - palm biodiesel reached 1.4 ml/d



# Policies on Biofuels

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- ❑ Fuel mandates: B2 (2% biodiesel) enforced in April 2008, ethanol blend has NOT yet been mandated
  - ❑ Pricing and subsidy: retail gasohol priced substantially lower than gasoline, and subsidies and tax incentives for refineries (fuel blenders)
-

# Natural Gas for Vehicles

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- ❑ Embarked on Natural Gas for Vehicles (NGV) Program in 2003
  - ❑ Subsidies and loans for conversion kits, tax reductions for dedicated and retrofit CNG vehicles, and subsidies for natural gas fuel (half of gasoline)
  - ❑ Rapid surge during high oil price period: from 1,500 vehicles in 2003 to more than 120,000 in November 2008
  - ❑ Target for 2023: 470,000 vehicles
-

# Policies on Nuclear Power

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- ❑ Incorporated in the present Power Development Plan (PDP 2007, Revision 2)
  - ❑ 4,000 MW initially planned but 2,000 MW to be installed by 2021, out of 30,000 MW new capacities to be added
  - ❑ Currently under feasibility study and site selection
  - ❑ Decision to build (or not to build) by 2011
-

# Measures on Energy Efficiency

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- ❑ Following Energy Conservation Promotion Act, mandated designated large energy consumers in building and industry sectors to audit and set targets for energy conservation
  - ❑ Carried out a successful DSM program: labeling of electric appliances
  - ❑ Import duty reduction for energy saving equipment, tax rebates, revolving fund for low interest loans, ESCO fund
  - ❑ Building energy code
  - ❑ Set 20% energy consumption reduction target for industry and commercial sector by 2011
-

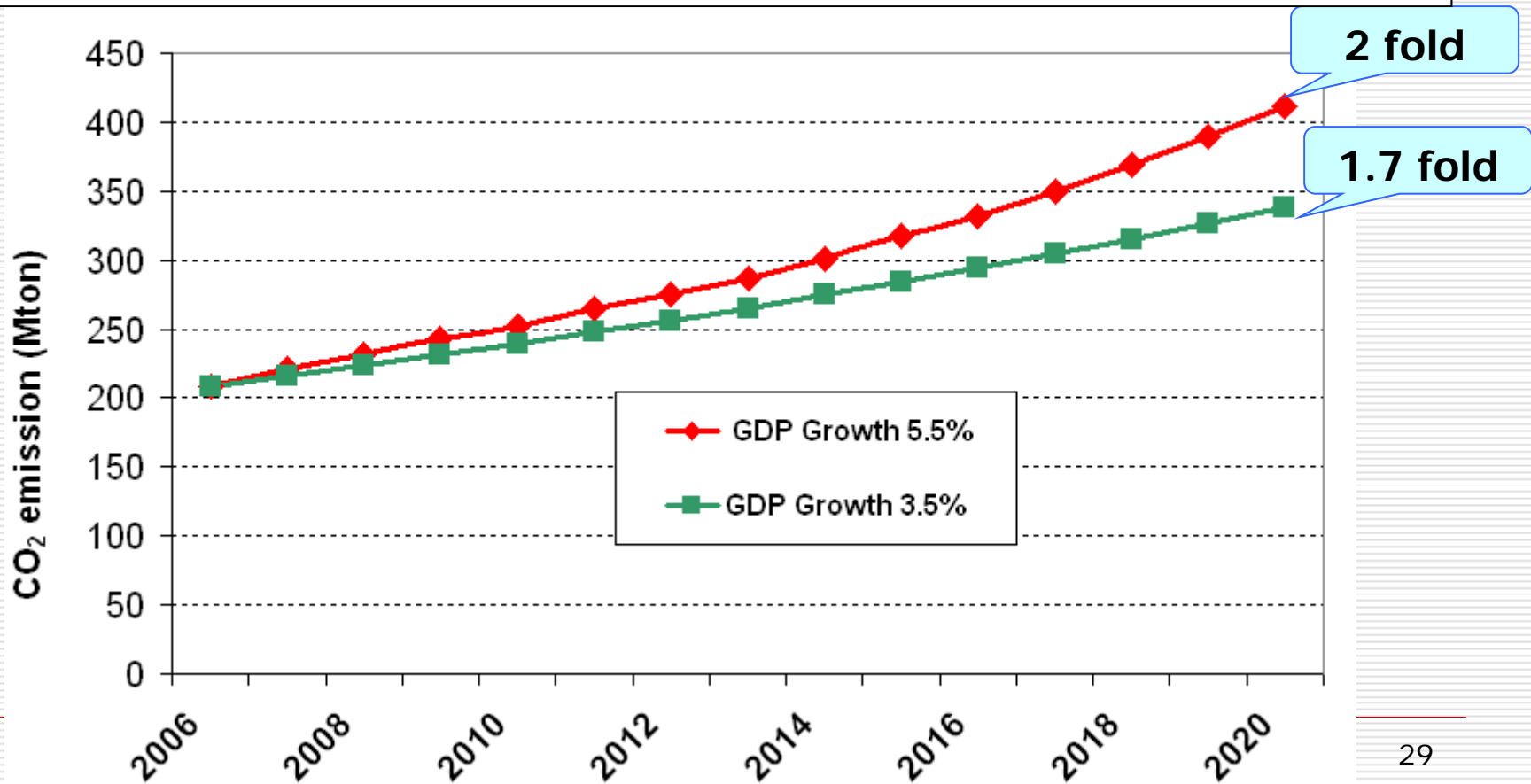
# Future CO<sub>2</sub> Emission Trends and Mitigation Potential

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- CO<sub>2</sub> emission scenarios in 2020
- Mitigation potentials
- Mitigation options and costs

# Projected Total Energy-related CO<sub>2</sub> Emission Scenarios to 2020

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II



# Thailand's CO<sub>2</sub> emissions reduction scenarios

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- Possible criteria for allocation of national emissions reduction responsibilities (under international negotiation):
    - Annual CO<sub>2</sub> emission per capita
    - Annual per GDP (PPP) CO<sub>2</sub> emission
    - Current CO<sub>2</sub> emission
    - Past (accumulated) CO<sub>2</sub> emission
-

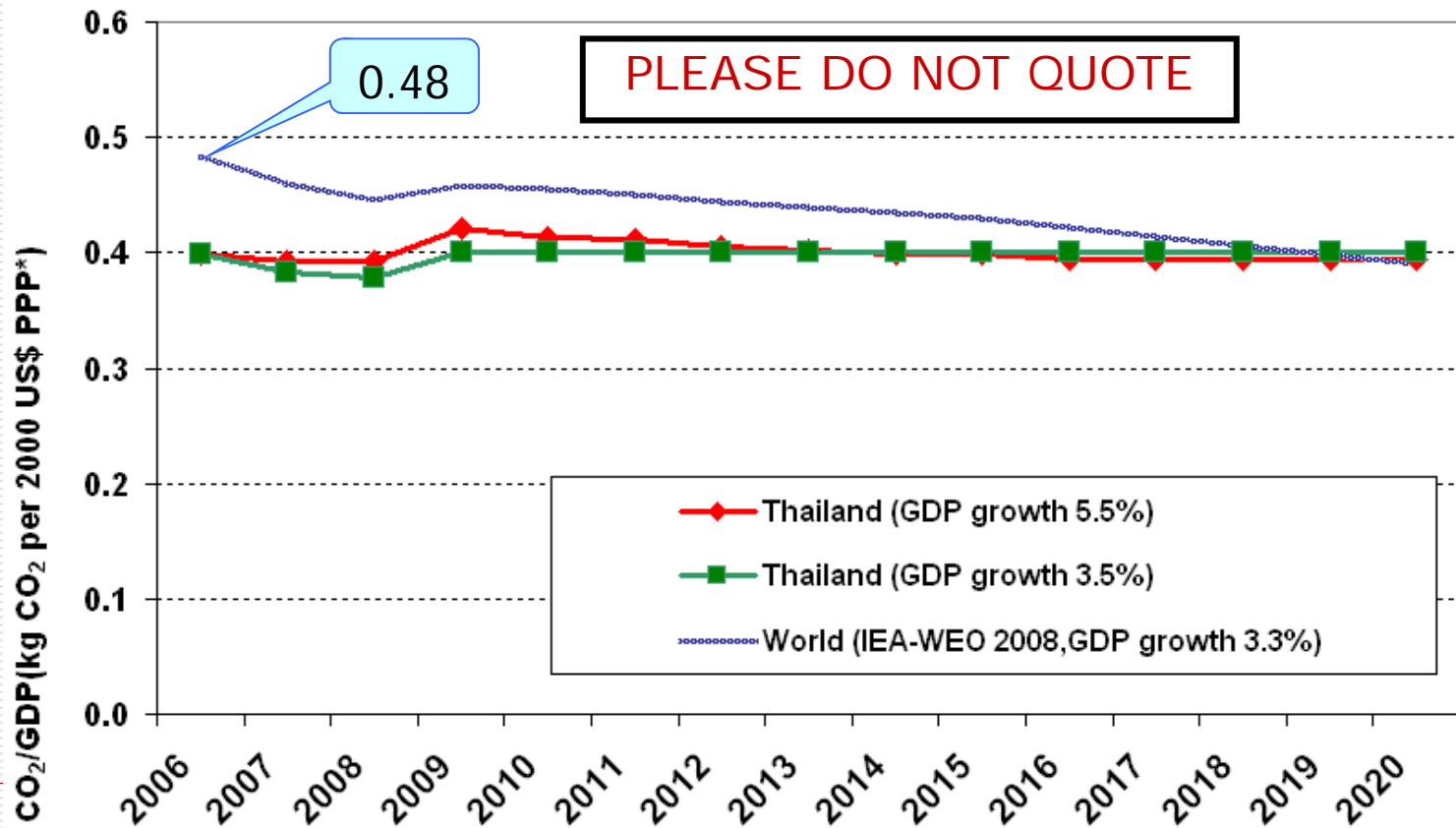
# Projected CO<sub>2</sub> Emission per Capita to 2020

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II



# Projected CO<sub>2</sub> Emission per GDP to 2020

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II



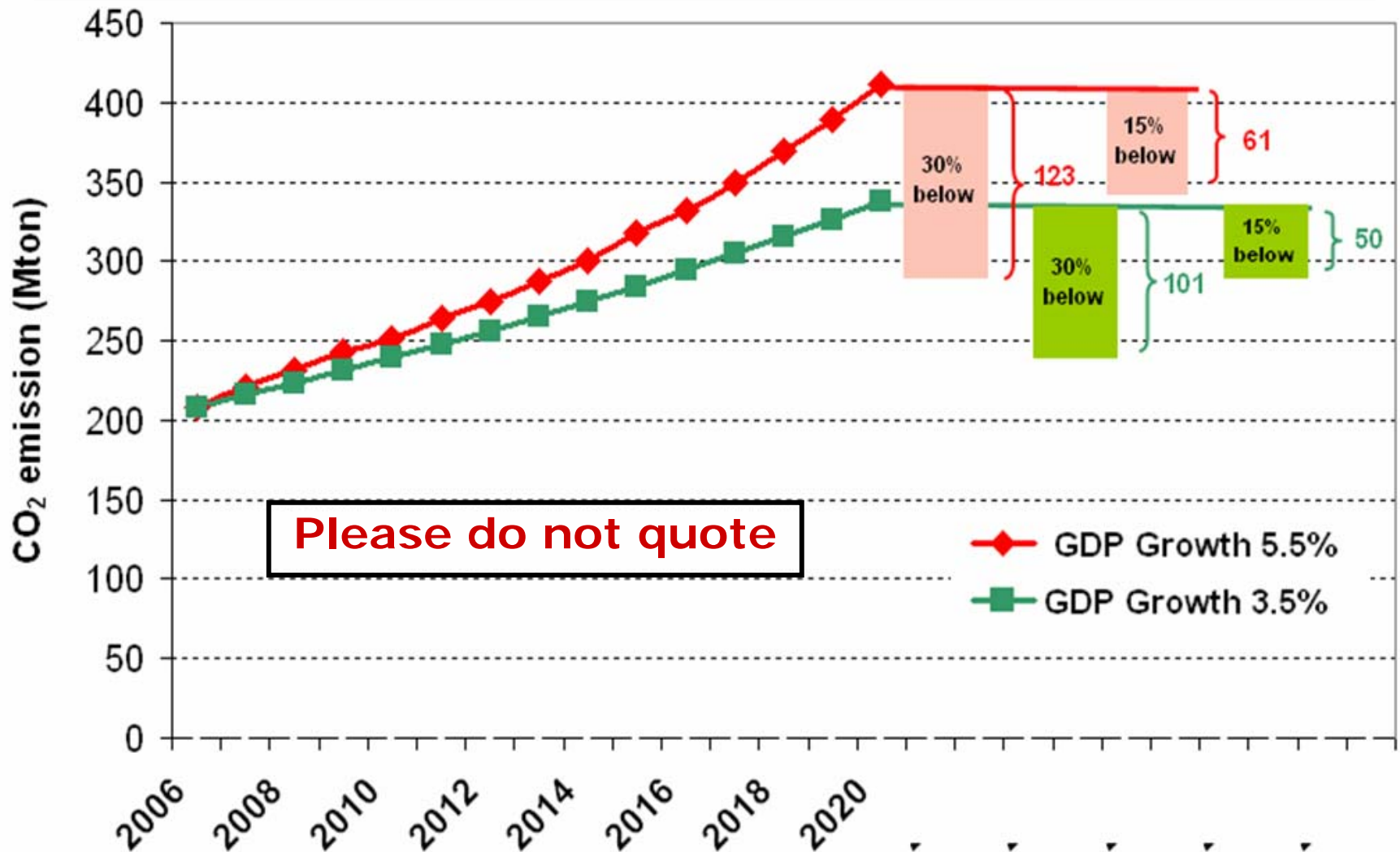
# Thailand's CO<sub>2</sub> emissions reduction scenarios

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- Recent study by JGSEE & partners shows 4 scenarios based on expected range of reductions for developing countries, i.e. 15 – 30% below BAU levels in 2020
    - **Scenario 1:** high GDP growth (5.5%), high commitment (30% below BAU)
    - **Scenario 2:** low GDP growth (3.5%), high commitment (30% below BAU)
    - **Scenario 3:** high GDP growth (5.5%), low commitment (15% below BAU)
    - **Scenario 4:** low GDP growth (3.5%), low commitment (15% below BAU)
-

# Thailand's CO<sub>2</sub> emissions reduction scenarios

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II



# Thailand's CO<sub>2</sub> emissions reduction scenarios

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## Implications

- ❑ 15 – 20% below BUA: 50 – 80 Mt reduction needed
- ❑ 15 – 30% below BAU: 50 – 120 Mt reduction needed

## Key question

- ❑ Which option at what cost?
-

# Near-term CO<sub>2</sub> Mitigation Options

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- ❑ Energy efficiency improvement “the low-hanging fruit”
    - Power generation, transmission and distribution
    - Transportation, industry, commercial & residential
  - ❑ Renewable Energy
    - Heat & power
    - Fuel for transport
  - ❑ Clean coal technology
-

# Longer-term CO<sub>2</sub> Mitigation Options

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- Nuclear
  - Carbon capture and sequestration (CCS)
-

# Selected Cross-cutting Energy Efficiency Technology Options

Energy Efficient Technologies / Appliances		
Industry	Commercial/Residential	Transport
Motor	T5 lamp	Eco car
Air compressor	Compact fluorescence (CFL)	Hybrid car
Chiller	Air conditioner	
Furnace	Charcoal stove	
Arc furnace	LPG stove	
Boiler		

# Estimated CO<sub>2</sub> Mitigation Potentials\*

Source: Adapted from JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phases I & II

Technology	Potential in 2020 (MtCO <sub>2</sub> - <sub>eq</sub> )
EE - key cross-cutting technologies (30% of assessed potential)	13
EE Building energy code (2016)	3
EE Combined heat & power (NG based, 50% of assessed potential)	4
RE - Biofuels (100% of target)	10
RE - heat (80% of assessed potential)	19
RE - electricity (80% of assessed potential)	13
<b>Total</b>	<b>62</b>

*EE: Energy Efficiency*

*RE: Renewable Energy*

# Estimated CO<sub>2</sub> Mitigation Potentials\*

Source: Adapted from JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phases I & II

\*Estimates up to 2020 have not taken into account:

- process-specific efficiency improvement
- Power sector efficiency improvement
- Modal change in transport sector
- NGV
- Nuclear

# Prioritizing Mitigation Options

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II

- ❑ Based on marginal cost per unit of CO<sub>2</sub> avoided and total CO<sub>2</sub> that could be avoided over a period of time (Example)

Marginal cost (US\$/tCO <sub>2</sub> )	Technology Options in descending order of total CO <sub>2</sub> avoided
▪ <0	Eco-car, boiler, motor, furnace, biogas air-con.(comm.), T5(comm.), air-con.(res.), LPG stove, CFL(comm.), air-con (comm.), CLF(res.), T5(res.), chiller and arc-furnace
▪ 50 - 100	Biomass, Ethanol, Biodiesel
▪ >100	Hybrid-car, MSW, Hydro, Wind and PV

Source: JGSEE-KMUTT-SIIT, 2009, Energy policy research report Phase II

# Key Success Factors for Realizing Mitigation Potentials

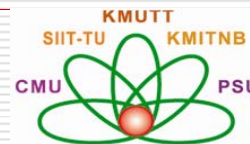
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- ❑ Energy efficiency improvement
- ❑ Decarbonizing the transport sector
- ❑ Decarbonizing power supply

# Energy efficiency in industry and commercial/residential sectors

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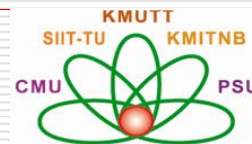
- ❑ Reinforce demand side management: upgrade energy efficiency labels, expedite enforcement of Minimum Energy Performance Standards (MEPS) of appliances and equipment
- ❑ Expedite enforcement of building energy code
- ❑ Adequate investment in gas pipeline network for CHP (integrate with pipeline for NGV to reduce cost)
- ❑ Systematic upgrading of process specific technologies for energy-intensive industries



# Decarbonizing the transport sector

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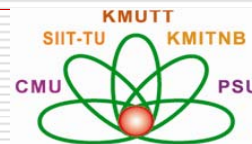
- ❑ Ensure adequate feedstock supply for biofuel production: increase energy crop yield by deploying modern biotechnology and good agricultural practices, avoiding food security and water footprint issues
- ❑ Consistent policies on promoting local production of eco-cars, and small sized hybrids
- ❑ Impose emission tax and/or other financial instruments, such as carbon surcharge, to cause consumer behaviour change
- ❑ Investment in the transport systems: mass transit and rail system



# Decarbonizing the power sector

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- Efficiency upgrade for older plants
- Adequate “adders” for renewable resources that are not yet competitive, e.g. rice straw, empty fruit bunch (palm oil production), eco hydropower (run-of-river, up to 25 MW)
- Impose financial instruments, such as carbon surcharge, to render low carbon technology options more cost competitive, consumer behavior change



# Conclusions

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- ❑ Estimated CO<sub>2</sub> mitigation potentials on the borderline of meeting 15 – 20%-below-BAU scenario in 2020
- ❑ Have to ensure that key success factors are in place
- ❑ Choice of mitigation options must be based on sound criteria
- ❑ Energy efficiency is obviously the lower cost option but requires significant promotional effort

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**Thank you for your kind attention**

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