



Environmental and energy implications of selected scenarios in Thailand

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Background

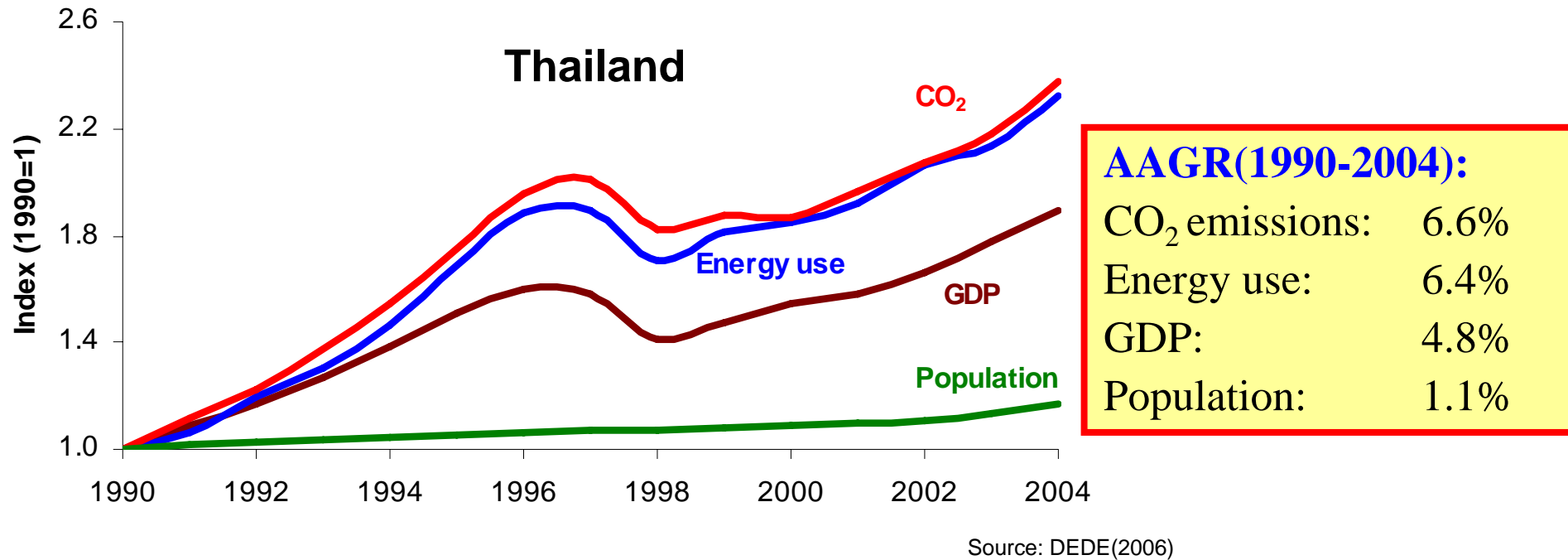
Selected Indicators (2002)

Country/region	GDP (billion 1995 US\$ using market exchange rate)	Total Primary Energy Supply (Mtoe)	CO2 emissions (Mt)	Population (million)
Vietnam	33	43	57	80
Philippines	97	42	70	80
Singapore	113	25	42	4
Malaysia	117	52	116	24
Thailand	185	83	179	62
Indonesia	224	156	303	212
India	517	538	1016	1049
South Korea	680	204	452	48
China	1209	1229	3271	1280
Asia (excluding China)	1857	1184	2257	1988
Japan	5715	517	1207	127
OECD	28435	5346	12554	1145
World	35318	10376	24102	6196

Source: IEA (2004)

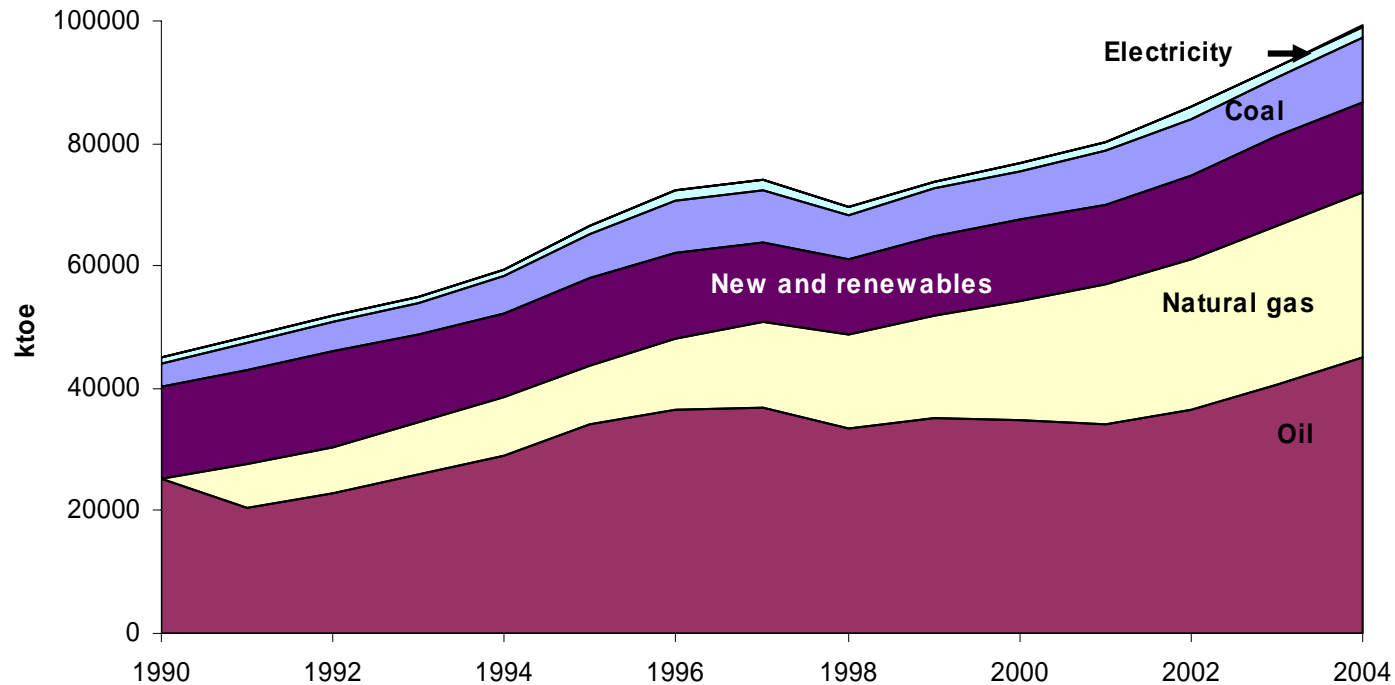
Thailand is the second largest economy in ASEAN.

Fast growing energy use, GDP and CO₂ emissions



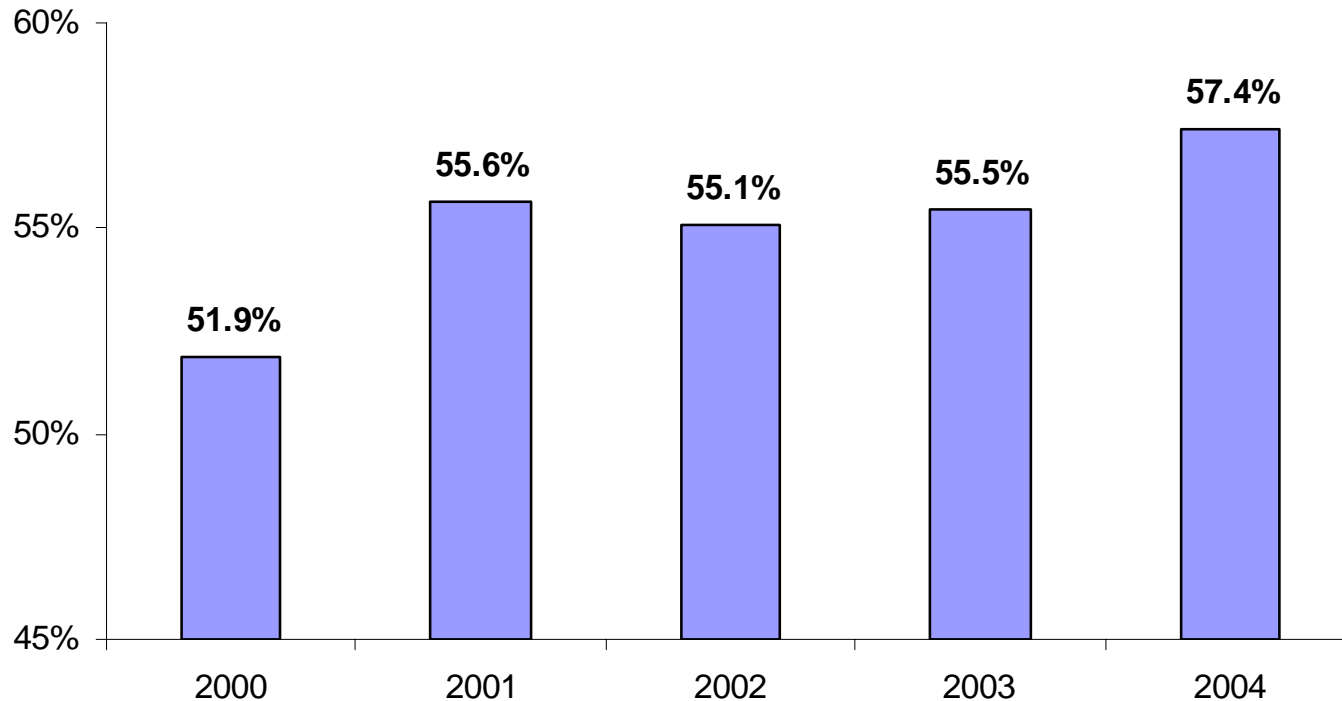
- Thailand is one of the fast growing economies in South-east Asia.
- Heavy and growing dependence on fossil fuels (share: 65% in 1990 and 83% in 2004)
- Per capita CO₂ emission **doubled during 1990-2004.**

Increasing share of fossil-fuels



- Total primary energy supply: 1990: 45 Mtoe 2004: 99 Mtoe
- Share of fossil fuels: 1990: 65% 2004: 83%

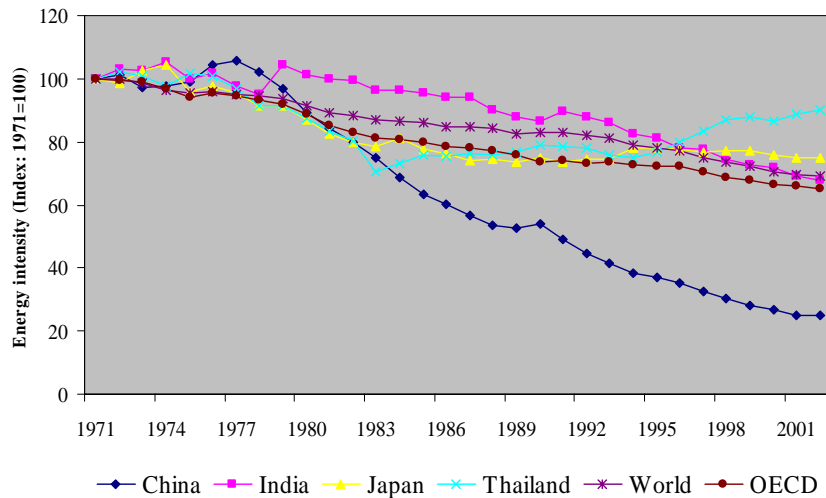
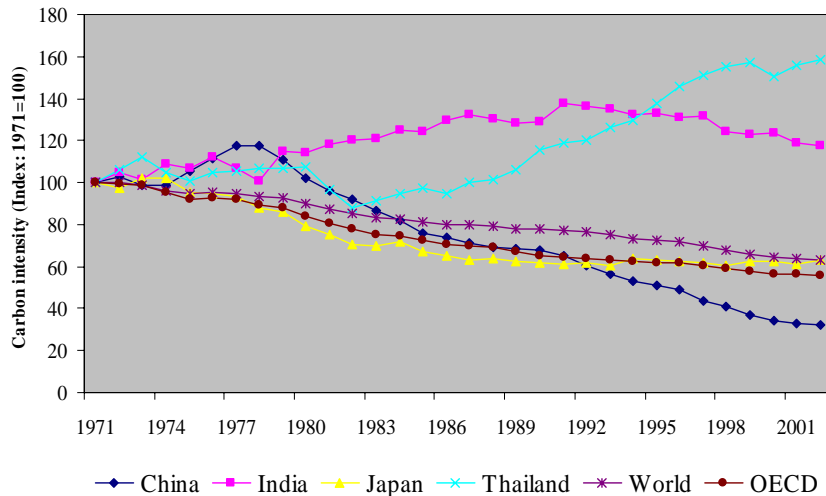
Increasing energy import dependency



Source: IEA (2004) and DEDE (2006)

- In last five years, **over 50%** of the total net energy requirement was imported.
- In 2005, energy import accounted for **9.6%** of total GDP (**US\$17billion**).

Increasing energy and carbon intensities




Country/ Region	2002		AAGR (1990-2002)	
	Energy intensity	Carbon intensity	Energy intensity	Carbon intensity
Japan	0.17	0.40	-0.0	0.2
OECD	0.21	0.49	-1.0	-1.3
World	0.24	0.56	-1.6	-1.7
Thailand	0.22	0.47	1.1	2.7
India	0.22	0.41	-2.0	-0.8
China	0.24	0.63	-6.3	-6.0

Note: Energy intensity is in kgoe/US\$ and carbon intensity is in kg of CO₂/US\$ using 1995 prices and PPP.

Source: IEA (2004)

- Both primary energy- and carbon-intensities in Thailand **increasing in recent years.**



Energy and emissions under selected Medium/long term scenarios

- Model Used: AIM/Enduse -Thailand
- Time horizon: 2000 – 2050
- No explicit climate intervention policies
- New and emerging technologies considered
- Key scenario drivers:
 - Economic growth
 - Population growth
 - energy efficiency improvements

Scenarios description

Scenario Description		Economy	Demography	Technology
TA1	Global market	High growth 2000-2020: 7.5% 2021-2050: 5.5%	Low population growth: 0.02% p.a	Energy efficiency improvement: 0.3% p.a
TA2	Dual track (Reference)	Moderate growth 2000-2020: 6% 2021-2050: 5%	High population growth: 0.74%	Energy efficiency improvement: 0.2% p.a
TB1	Sustainable development	Medium growth 2000-2020: 6.5% 2021-2050: 5.5%	Low population growth: 0.02%	Energy efficiency improvement: 0.4% p.a
TB2	Local stewardship	Low growth 2000-2020: 4% 2021-2050: 3%	Medium population growth: 0.39%	Energy efficiency improvement: 0.1% p.a

New Technologies Considered

They include:

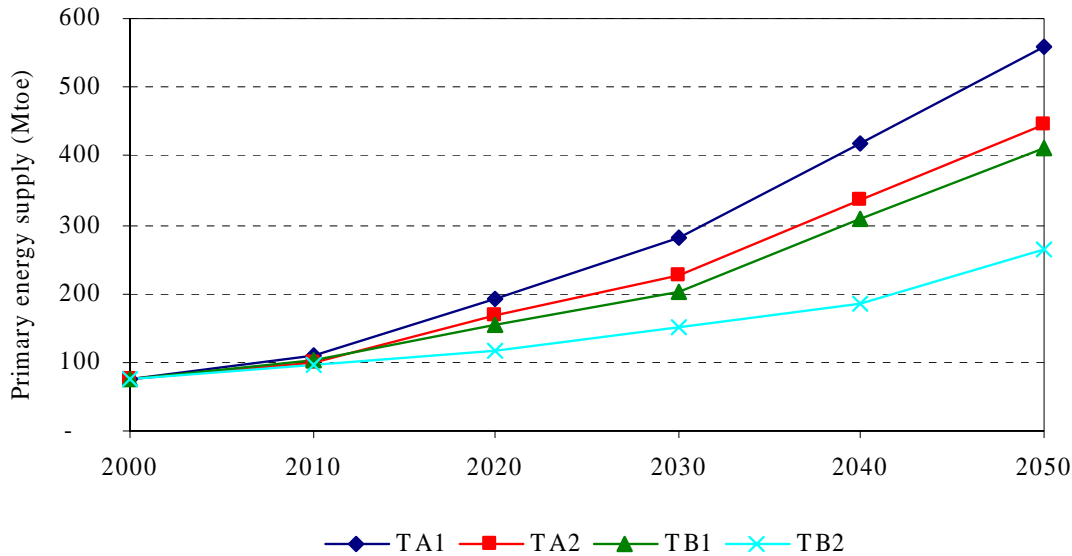
■ Power Sector

- Cleaner coal technologies with and w/o CCS
- RETs—BIGCC, solar, wind, geothermal, hydro, biogas, MSW
- CC

■ Transport Sector

- Biofuels (gasohol and biodiesel)
- Hybrid vehicles
- Fuel cell cars

Total energy requirements during 2000-2050, Mtoe



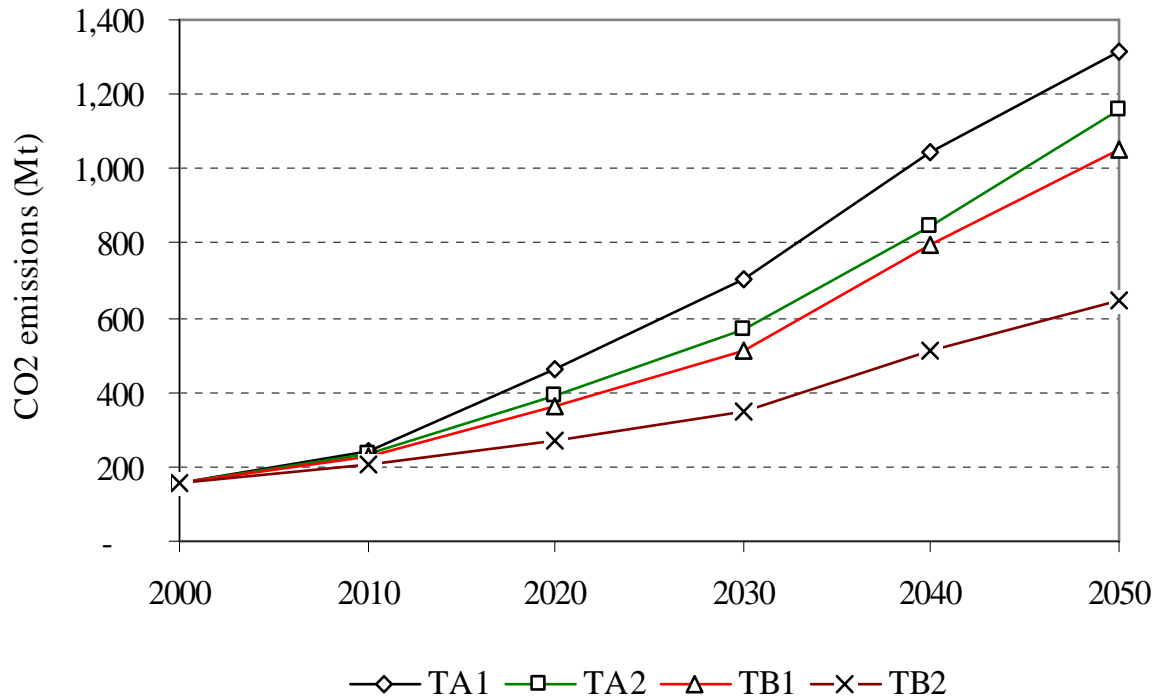
	AAGR (%)	Ratio 2050/2000
TA1	4.1	7.4
TA2	3.6	5.9
TB1	3.4	5.4
TB2	2.5	3.5

Dominance of fossil fuels in the primary energy mix:

2000: 81%

2050: 95% (Global market case (TA1)) to **87%** (Local stewardship (TB2))

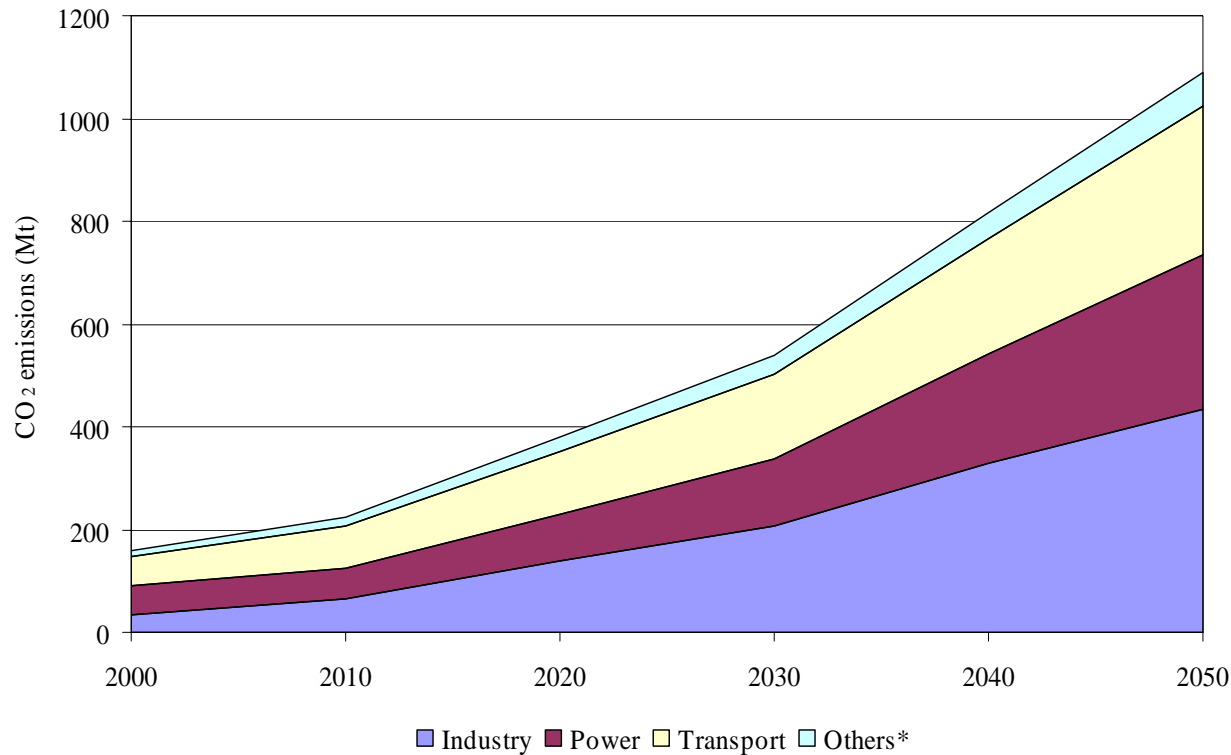
Energy related total CO₂ emissions, Mt



	AAGR (%)	Ratio 2050/2000
TA1	4.4	8.5
TA2	3.9	6.9
TB1	3.7	6.2
TB2	2.8	4.2

In the reference scenario (**TA2**), annual CO₂ emissions in 2050 (**1088 Mt**) would be **930 Mt** more than in 2000 (**158 Mt**).

Sectoral CO₂ emissions in reference scenario (TA2), Mt



During 2000 - 2050:

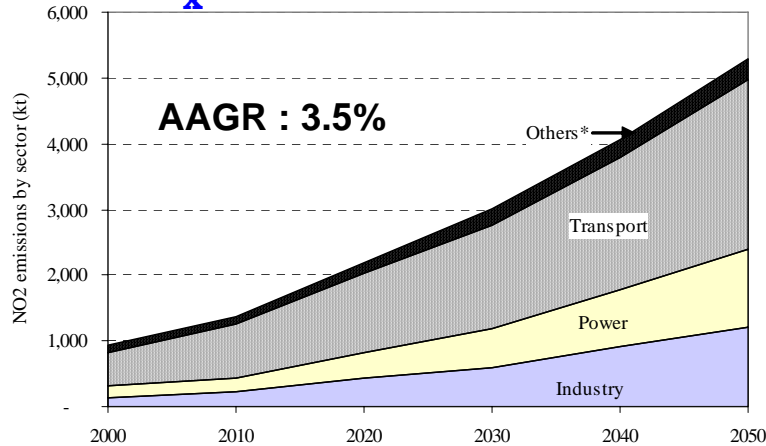
Power	: 37 to 28%	↓
Transport	: 35 to 27%	↓
Industry	: 21 to 40%	↑
Others	: 7 to 5%	↓

* Others includes residential, commercial and agriculture.

Industry sector - the largest contributor to total CO₂ emissions after 2020, followed by power, transport and others sectors.

NO_x and SO₂ emissions in reference scenario (TA2), kt

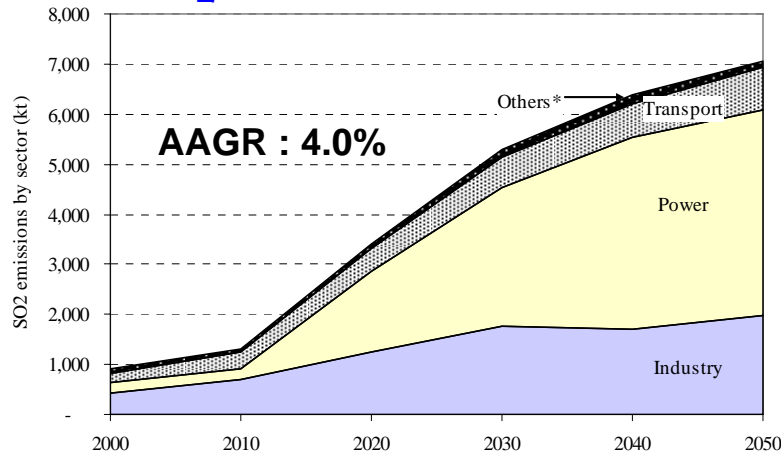
NO_x Emissions



In 2050:

- **NO_x: Transport** sector to contribute **51%** of total NO_x emissions, followed by industry, power and others.

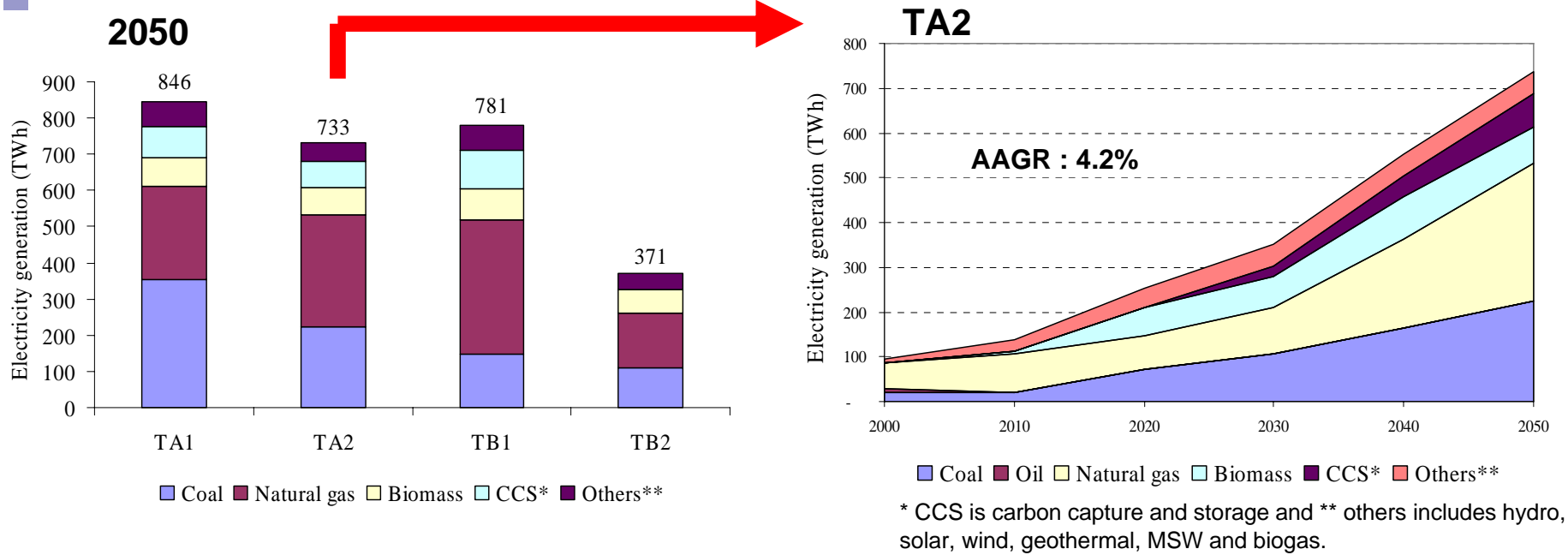
SO₂ Emissions



- **SO₂: Power** sector to contribute **53%** of total SO₂ emissions, followed by industry, transport and others.
- **Power** sector overtaking the **industry** sector after 2010.

* Others includes residential, commercial and agriculture.

Heavy dependence on fossil fuels for electricity generation to continue



- In 2050, **coal** and **natural gas** contribute more than **70%** of total electricity generation under all scenarios.
- In reference case:
 - **CCS technologies based electricity generation would be cost-effective after 2020.**
 - **Role of RETs remain low (7% in 2050) due to limited domestic resource availability and the high cost of PV and thermal based solar power generation.**



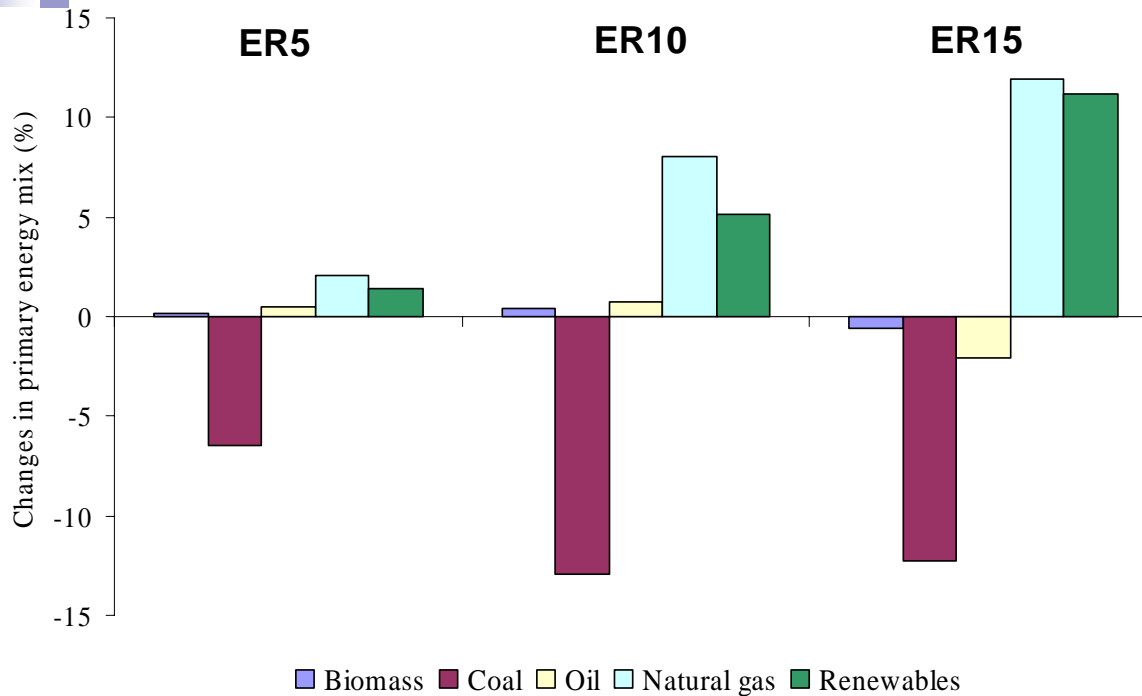
Effects of CO₂ emission reduction target (2000-2035)

Scenarios description

- Time horizon: 2000 – 2035
- Start year for CO₂ emission reduction: 2013 (Post-Kyoto)

Base case	Continuation of current economic, demographic and energy trends and policies and no mitigation policy.
Emission reduction targets	Reduction in CO ₂ emissions by at least 5%, 10% and 15% in each year, compared to base case emissions. <i>Denoted as ER5, ER10 and ER15 respectively.</i>

Changes in cumulative primary energy requirement by fuel types under ER cases (2013-2035), %

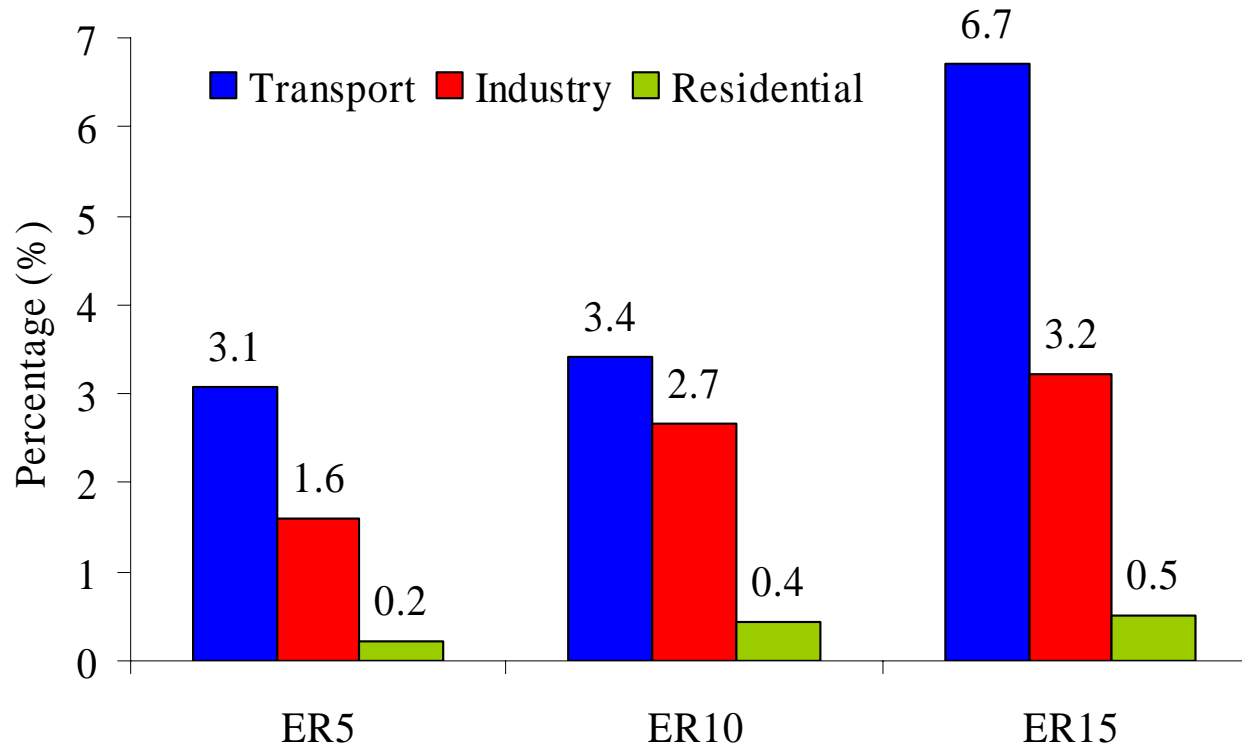


	ER5	ER10	ER15
Biomass	0.2	0.4	-0.6
Coal	-6.5	-12.9	-12.3
Oil	0.5	0.8	-2.1
Natural gas	2.1	8.0	11.9
Renewables	1.4	5.1	11.1



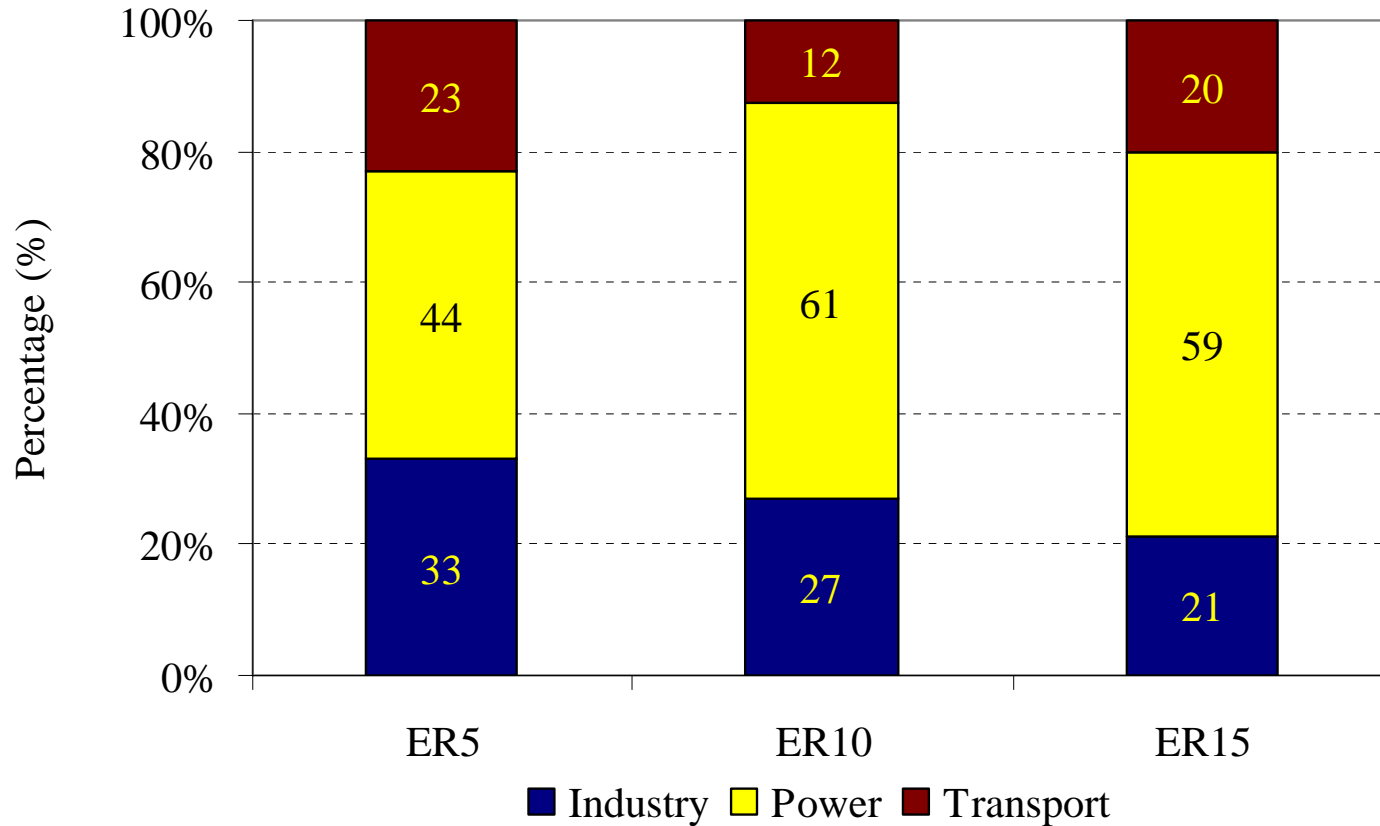
- **Coal use decreases and use of Natural gas and REs increase with ER targets.**
- **Reductions** in the **coal** use under ER15 about the same as under ER10 due to the selection of CCS coal based technologies in ER15.

Reduction in cumulative final energy demand under ER cases (2013-2035), %



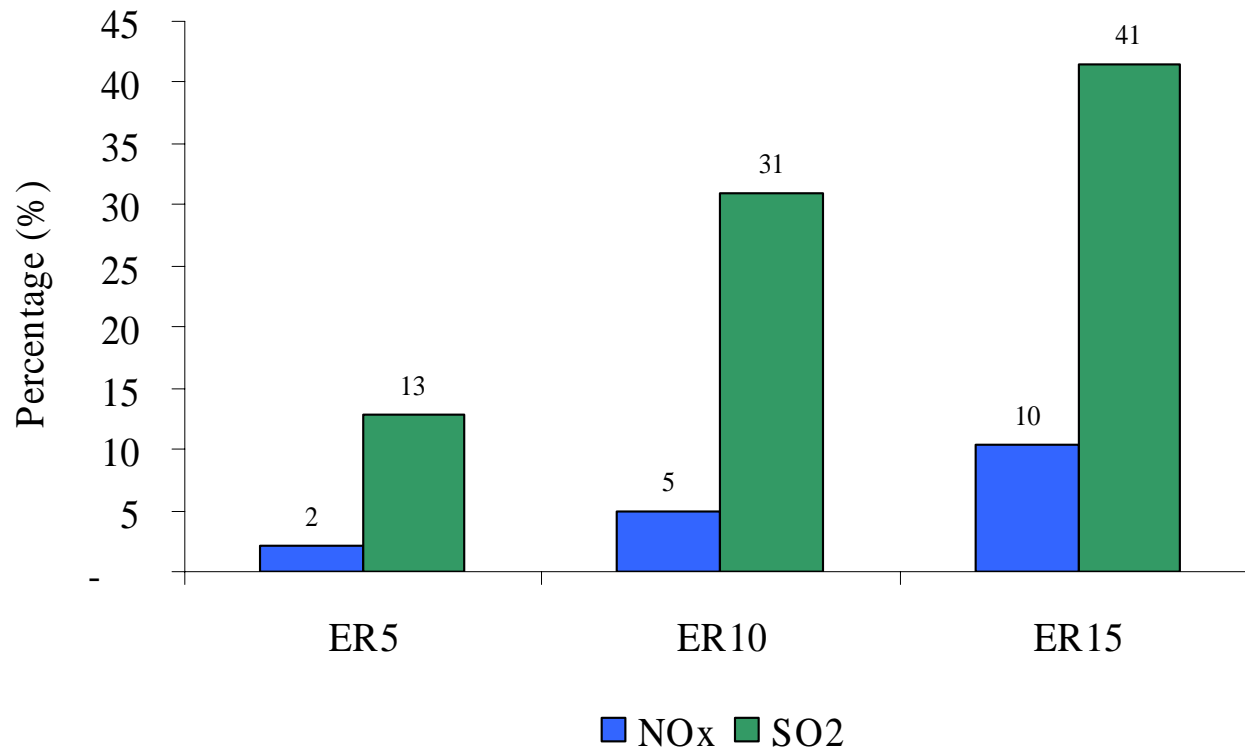
- **Total** cumulative final energy demand to decrease by **1.8%** in ER5 to **3.8%** in ER15 due to the use of more efficient technologies.
- **Highest % reduction in Transport** sector final energy demand, followed by reductions in industry and residential sectors.

Sector-wise contribution to cumulative CO₂ emission reduction under ER cases (2013-2035), %



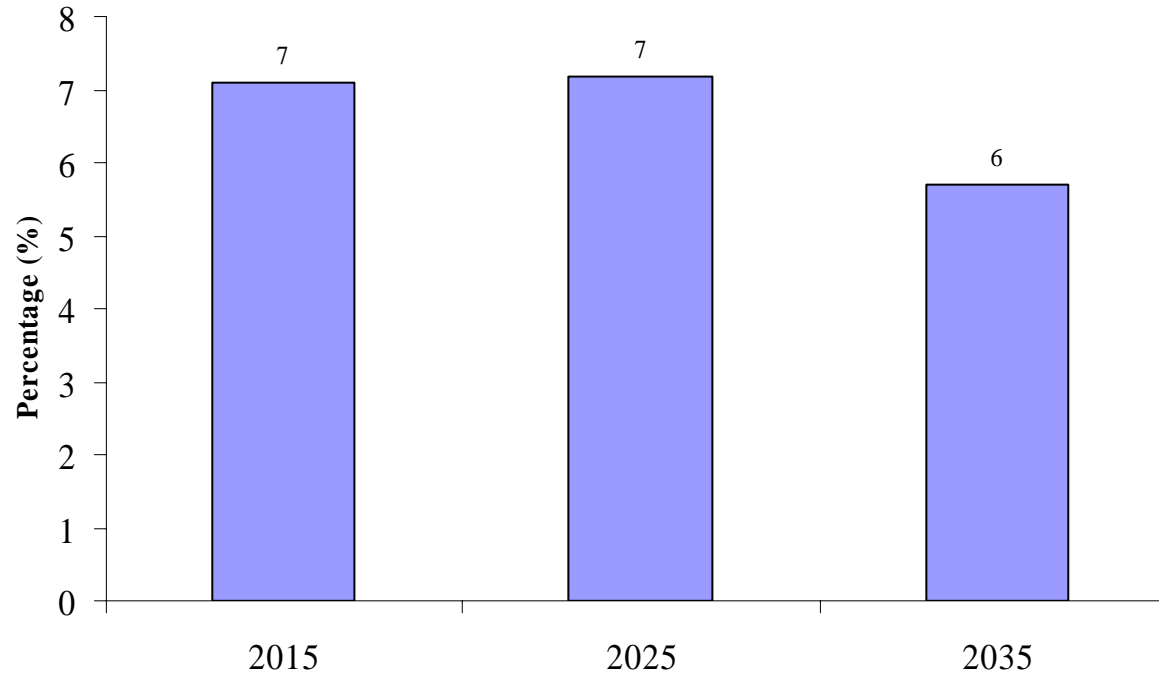
Power sector the largest contributor to the total CO₂ emission reduction.

Co-benefits under ER cases (2013-2035), %



- Under ER15, **SO₂** emission would be reduced by **41%**
- **NO_x** emission would be reduced by **10%**.

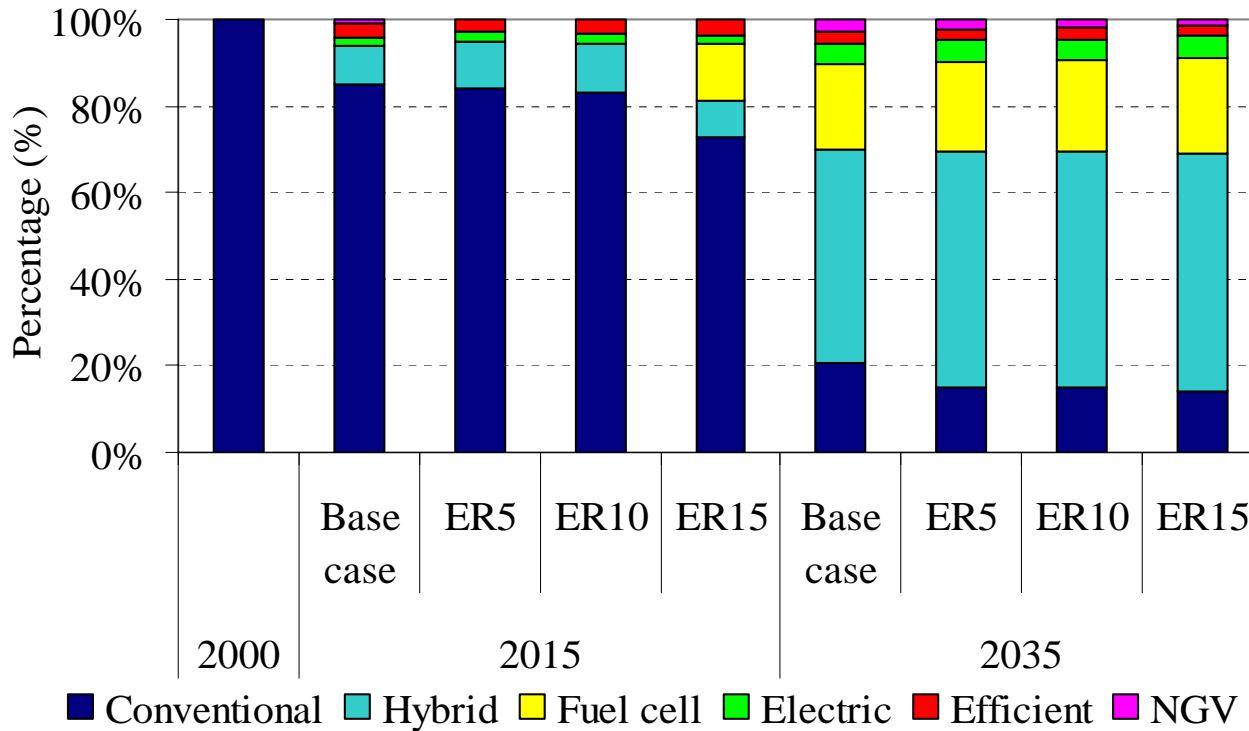
Role of biofuels in road-transport energy needs (Base case)



Biofuels (ethanol and biodiesel) would contribute about 6 to 7% of the road-transport energy needs.

No change in biofuel shares in ER cases due to limited domestic production potential.

Technology deployment in road transport in 2015 and 2035 under base case and ER cases, %



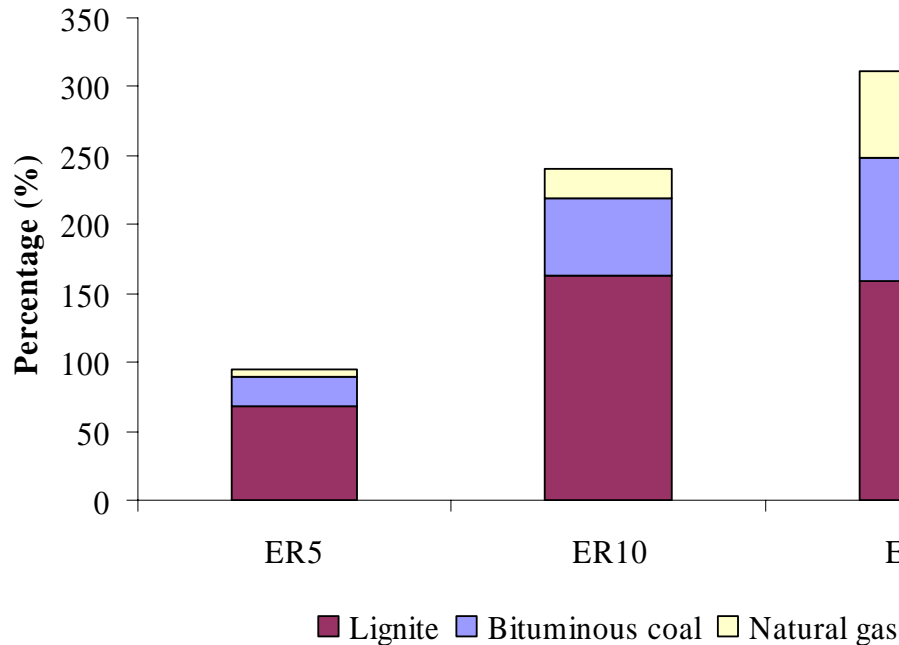
In 2035 (%):

	Base case	ER15
Conventional	21	14
Natural gas	3	1
Hybrid	49	55
Fuel cell	20	22



- Hybrid cars and fuel cell vehicles among the cost effective options under ER targets

Increase in CCS technology based electricity generation under ER cases (2013-2035)

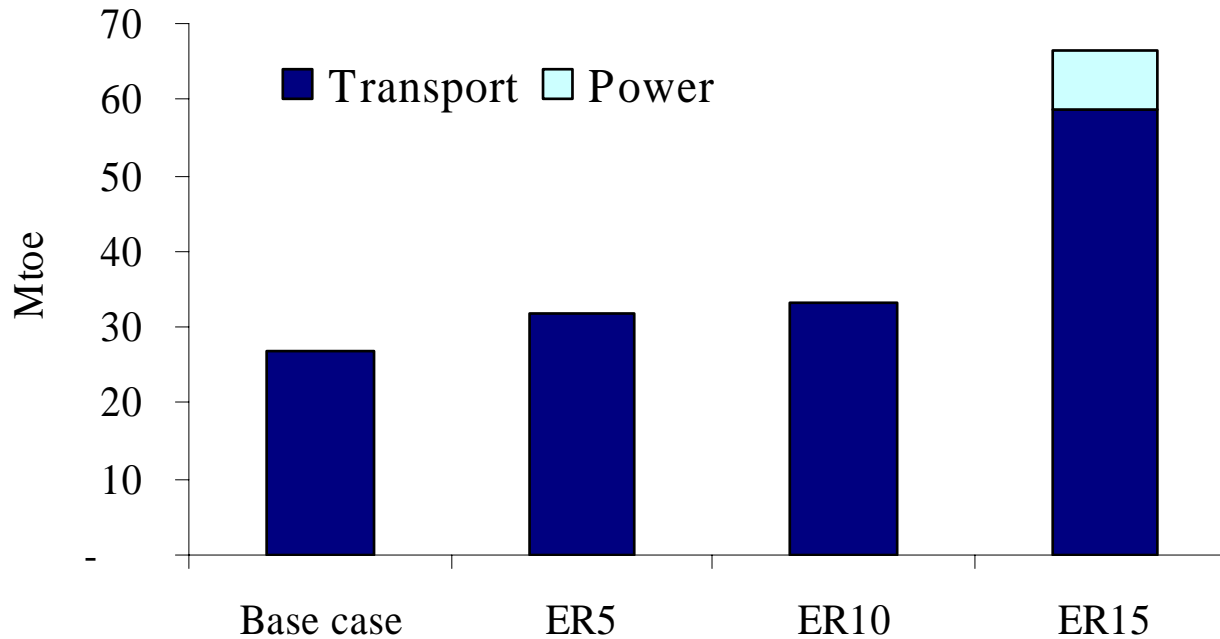


Power generation technologies with CCS considered:

Integrated gasification combined cycle (IGCC)	Lignite
	Bituminous coal
Pressurized fluidized bed combustion (PFBC)	Lignite
	Bituminous coal
Advanced combined cycle	Natural gas

- Significant increase in electricity generation from **CCS** based technologies in ER5, ER10 and ER15 cases (2, 5 and 6 times respectively of that in Base case).
- Largest % increase in power generation from **Lignite based CCS plant**.
- **Bituminous coal and natural gas** based CCS technologies play increasing role in electricity generation under higher ER targets.

Penetration of hydrogen based technologies under base case and ER cases (2013-2035), Mtoe



■ Percentage increase in the use of hydrogen energy in ER cases:

- ER5 18%
- ER10 23%
- ER15 147%

Thailand's RPS and biofuel targets

- To increase the contribution of commercial **renewable energy** to the total primary energy demand from **0.5%** in 2003 to **8%** by 2011 (**5% RPS for the power sector**);
- To produce/use biodiesel at the level of **8.5** million liter/day by **2012** and ethanol at the level of **3** million liter/day by **2011**.

Source: MOE, 2003

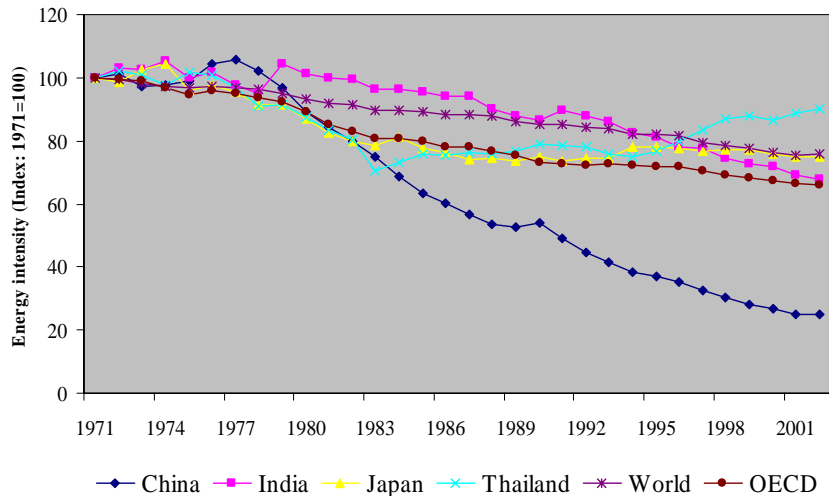
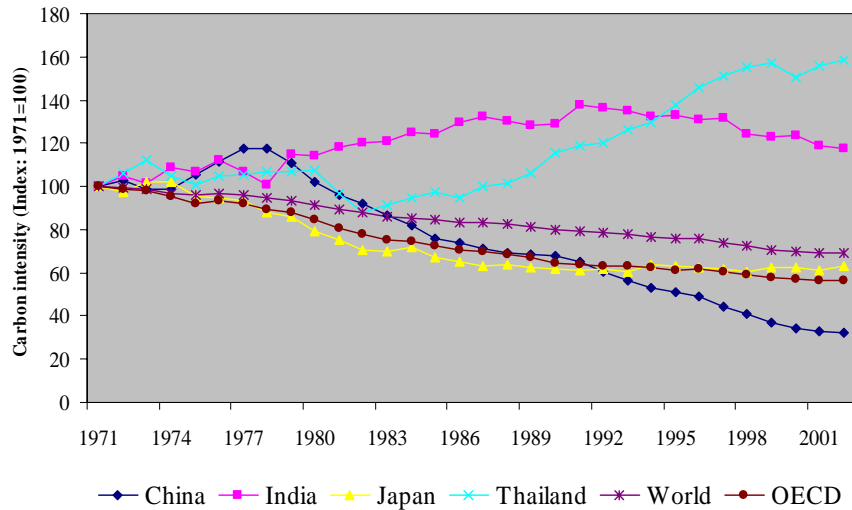
Concluding Remarks

- Fossil fuels would remain dominant energy source (95% in 2050 in the reference case).
- With ER targets
 - CCS technologies in power sector would play a significant role after 2020.
 - Hydrogen based electricity generation cost-effective in ER15 after 2030.
- Limited role of new and renewables (e.g., biomass, wind, geothermal and solar) due to limited domestic resource availability and/or high initial investment costs.
- Biofuels would make significant contribution to meeting road-transport energy needs (6-7%) with the present level of biofuels production potential.
- For sustainable energy future, additional options may have to be considered:
 - Use of nuclear energy
 - Land use change and increase in biofuels production
 - Energy efficiency improvements in building
 - Regional energy cooperation
 - Hydro import (Laos, Myanmar)
 - Natural gas import (Myanmar)?



THANK YOU.

Growth of CO₂ emission per unit of GDP_{MER} ("carbon intensity")



Country/ Region	2002		AAGR (1990-2002)	
	Energy intensity	Carbon intensity	Energy intensity	Carbon intensity
Japan	0.09	0.21	-0.0	0.2
OECD	0.19	0.44	-1.0	-1.3
World	0.29	0.68	-1.6	-1.7
Thailand	0.45	0.97	1.1	2.7
India	1.04	1.97	-2.0	-0.8
China	1.01	2.71	-6.3	-6.0

Source: IEA (2004)