

The Strategies of TEPA for Climate Change and the Role of MARKAL Model

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Outline

- ◆ Introduction of Taiwan
- ◆ GHG Emissions
- ◆ Future Emission Projection
- ◆ Post-Kyoto Target Simulation
- ◆ Actions for Climate Change
- ◆ Conclusions



Introduction of Taiwan

◆ Population:

- Taiwan's population exceeded 22.6 million in 2003;
- The population density: 624 persons / square km., **the second highest in the world.**

◆ Economic Development

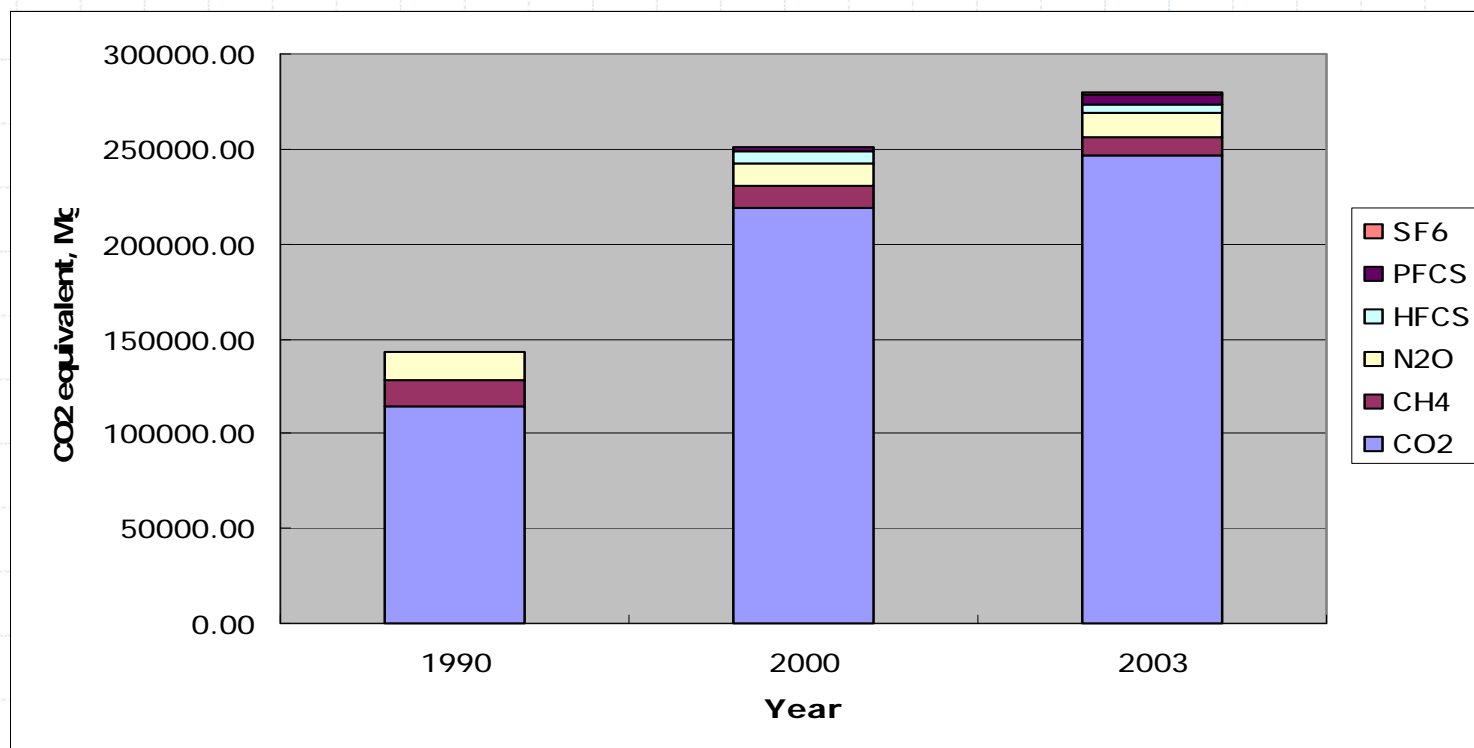
- During the past twenty years, Taiwan's economic transition **from labor-intensive to technology- and capital-intensive** industries has created further changes in production ratios for our economic sectors.
- **Per capita GDP increased from USD 2,344 in 1980 to USD 13,139 in 2003.**
- Per capita energy consumption
 - ◆ Increased from 1,677 liters of oil equivalent in 1980 to 4,593 liters in 2003
 - ◆ **The annual average growth rate was 4.6%**





Greenhouse Gas Emissions

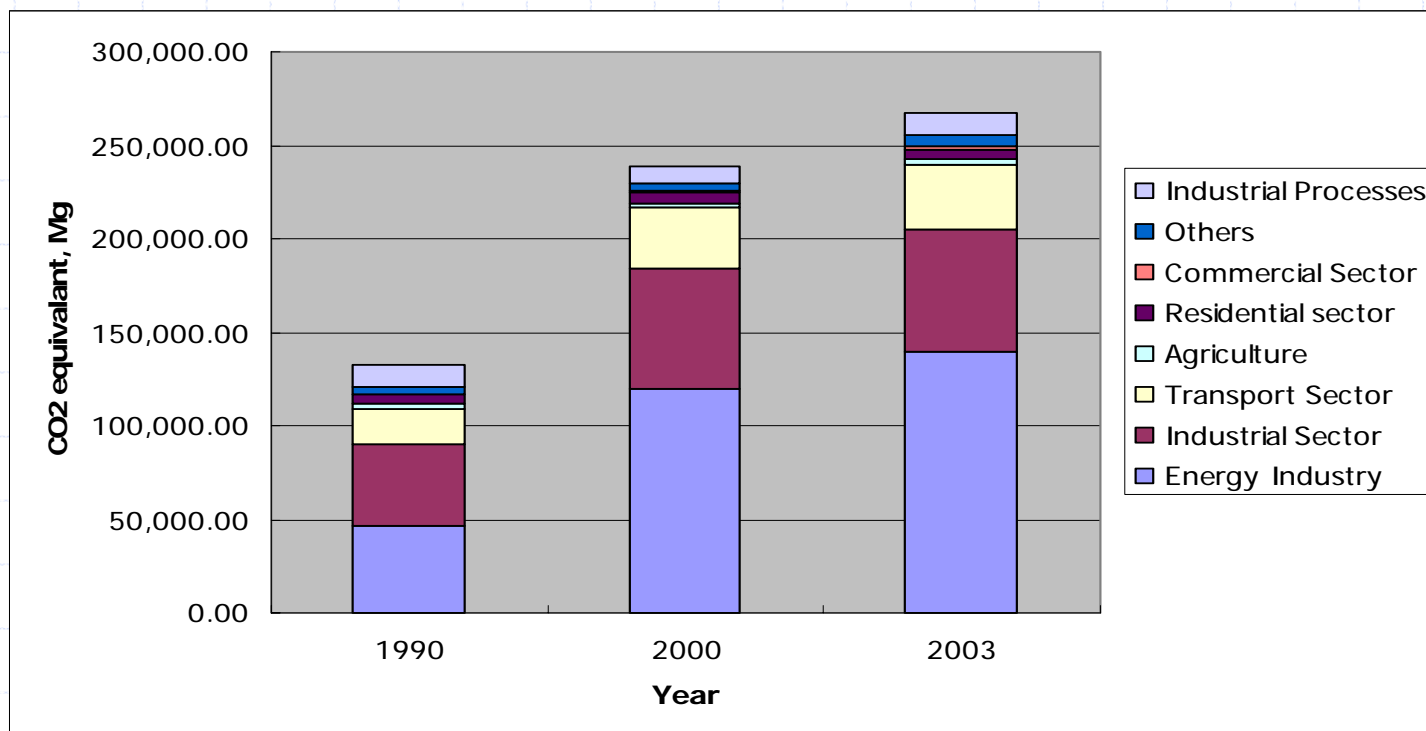
- ◆ Emission trend of six major GHGs.
- ◆ Rapid economic growth and higher energy consumption have significantly increased our greenhouse emissions, which have almost doubled in the past decade.
- ◆ **CO₂ emission makes up over 85% of total emissions**





Carbon Dioxide Emissions

- ◆ Taiwan's CO₂ emission trend by sector:
 - Energy and Industrial sectors make up most of the CO₂ emissions.
 - Emissions from the transport sector growing rapidly, which is a trend also seen in many developed countries





Energy/Economy/CO₂ Comparison

Taiwan ranks near the top 20s in total emissions, per capita emissions, as well as GDP and per capita GDP, carbon and energy intensity are relatively close to the global average

	Taiwan			Global	OECD	Japan	Korea	Germany
	Y2002	Rank	Share (%)					
Total Emission^a (Mton CO ₂)	231.42	22	0.96	24,101.83	12,554.03	1,206.91	451.55	837.53
Per Capita Emission (ton CO ₂)	10.31	21		3.89	10.96	9.47	9.48	10.15
Population (Million)	22.45	46	0.36	6,195.66	1,145.06	127.44	47.64	82.48
GDP^b (billion USD)	408.61	18	0.94	43,413.48	25,374.85	3,042.31	718.00	1,938.16
Per Capita GDP^b (USD)	18201	26		7,007.00	22,160.00	23,872.00	15,071.00	23,499.00
Energy Supply (10 ¹⁵ Joule)	3,917.86	22	0.90	434,439.90	223,814.50	21,642.71	8,520.06	14,501.05
Per Capita Energy Consumption (10 ⁹ Joule)	174.50	27		70.10	195.50	169.80	178.80	175.80
Carbon Intensity^b (kg CO ₂ /USD)	0.57	48		0.56	0.49	0.40	0.63	0.43
kg CO₂/10⁹ Joule	59.07	33		55.48	56.09	55.77	53.00	57.76

Remarks : a. CO₂ from the international sea-lane transportation is not included.

b. This is based on "purchase power parity" and 1995 USD.

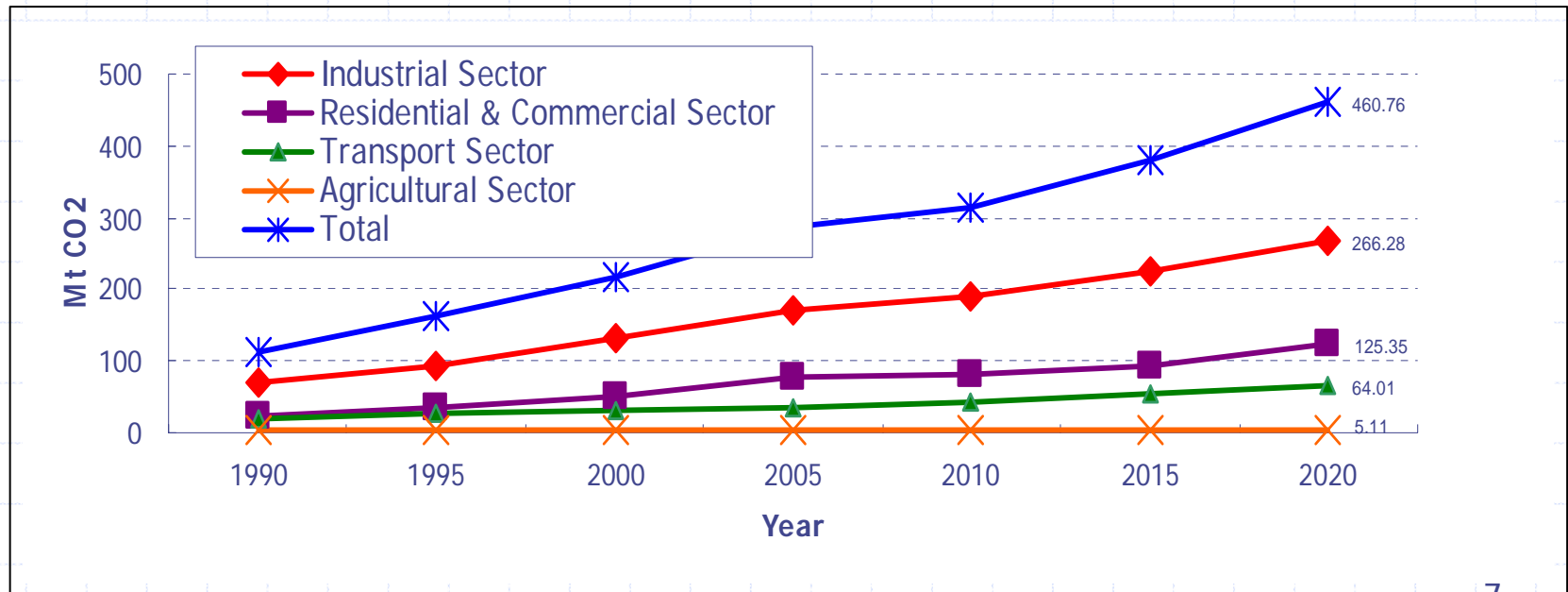
c. CO₂ emission is calculated based on the sector approach.

Source : CO₂ Emissions from Fuel Combustion – 1971-2002, IEA , 2004.



Future CO₂ Emission Trend

- ◆ According to TAIWAN-MARKAL model calculations, based on current social and economic forecasts, i.e. business as usual (BAU) scenario, **CO₂ emissions from fuel combustion will increase from 113Mt in 1990 to 461Mt in 2020**, in which the industrial sector would still be the main source. Meanwhile, **emissions from residential, commercial and transport sectors would grow rapidly.**





Post-Kyoto Target Simulation

- ◆ **Ambiguous position of Taiwan in the UNFCCC**
 - Taiwan is not a member of the United Nations and cannot sign the UNFCCC or Kyoto Protocol. However, we are willing to take on a fair responsibility to reduce GHG emissions.
 - Kyoto Protocol does not set reduction targets for non-Annex I countries. However, newly industrialized countries might face pressure to take on reduction targets in the post-Kyoto period.
- ◆ **High GHG reduction cost**
 - TEPA has used the Taiwan-MARKAL model to evaluate several Post-Kyoto Target Simulations, including Kyoto-style Scenario and GHG Intensity Scenarios.
 - The results showed that the reduction cost is high.



Post-Kyoto Target Simulation

◆ Kyoto-style Scenario

- Tentative reduction target of the National Energy Conference (set in 1998)
 - ◆ **By 2020, reduce GHG emissions to 2000 level** (total emission=223 million tons; per capita emission=10 tons)
 - ◆ Under current measures to reduce GHG emissions, by 2020, total emission is projected to reach 345 million tons, with per capita emission at about 13 tons.
 - ◆ If the National Energy Conference Target is to be achieved, **accumulated energy conservation must achieve 43%, GDP would decline by 9%, compared with 1998 level.**
 - ◆ **Marginal reduction cost would reach USD₁₉₉₁ 207/ ton CO₂**



Post-Kyoto Target Simulation

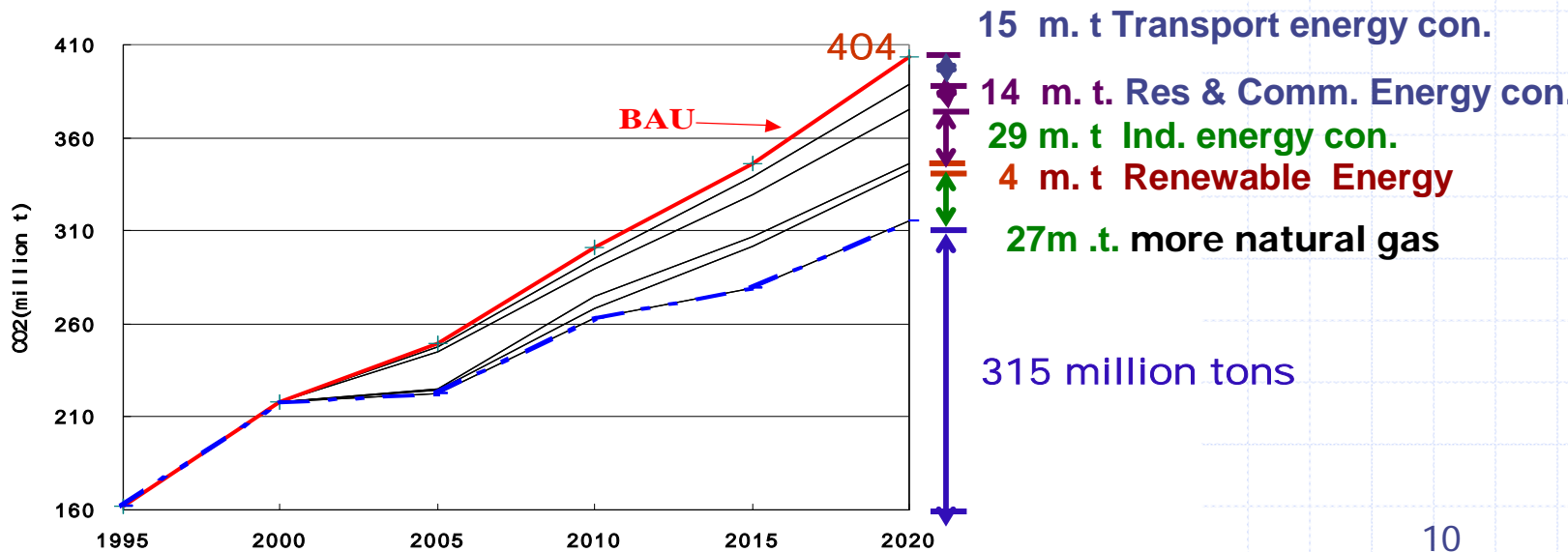
◆ Kyoto-style Scenario

◆ Reducing 20% in 2020 compared with BAU

- ◆ Total emission in 2020 would reach 315 million tons
- ◆ Per capita emission would be 13 tons, compared to project OECD level of 14 tons

◆ Taiwan would need to reduce 89 million tons in 2020, of which 58 millions tons would come from energy conservation, 5 millions tons from renewable energy, and 27million tons from change in energy structure.

◆ Marginal reduction cost would be USD₁₉₉₁ 101/ton CO₂

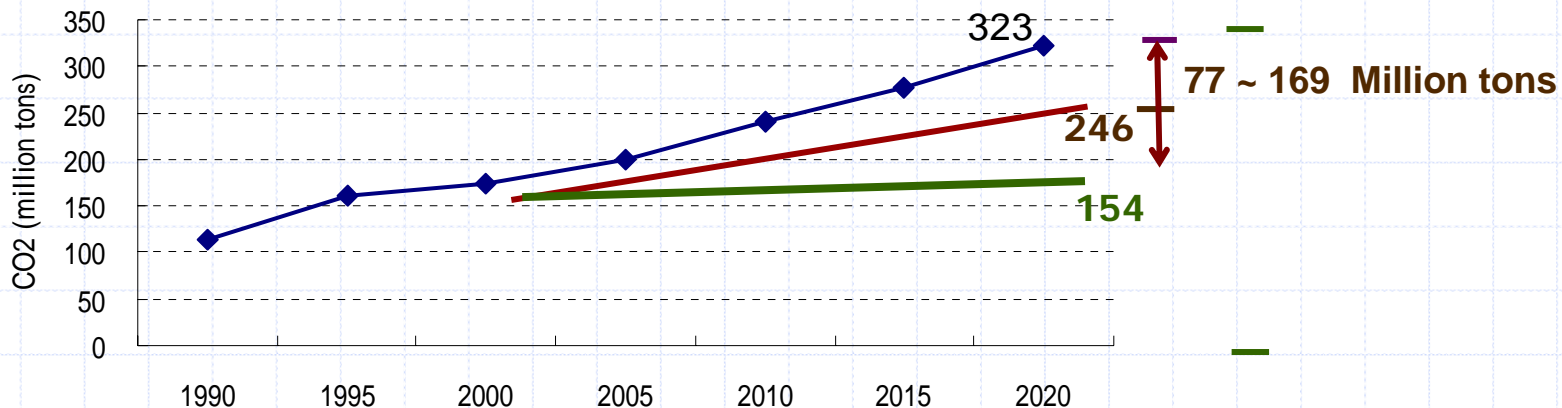




Post-Kyoto Target Simulation

◆ GHG Intensity Scenarios

- Germany Model: To stabilize GHG concentration at 450ppm by 2100, GHG intensity must be reduced by 2-4% between 2013-2020
- Taiwan's total emissions in 2020 would need to be reduced by 77~169 million tons (19%-41.7% reduction) compared to BAU.
- Per capita emission in 2020 would be 9.4-13.1 ton/CO₂, which is compared to BAU .
- Marginal reduction cost would be USD₁₉₉₁ 101/ ton CO_{2o}



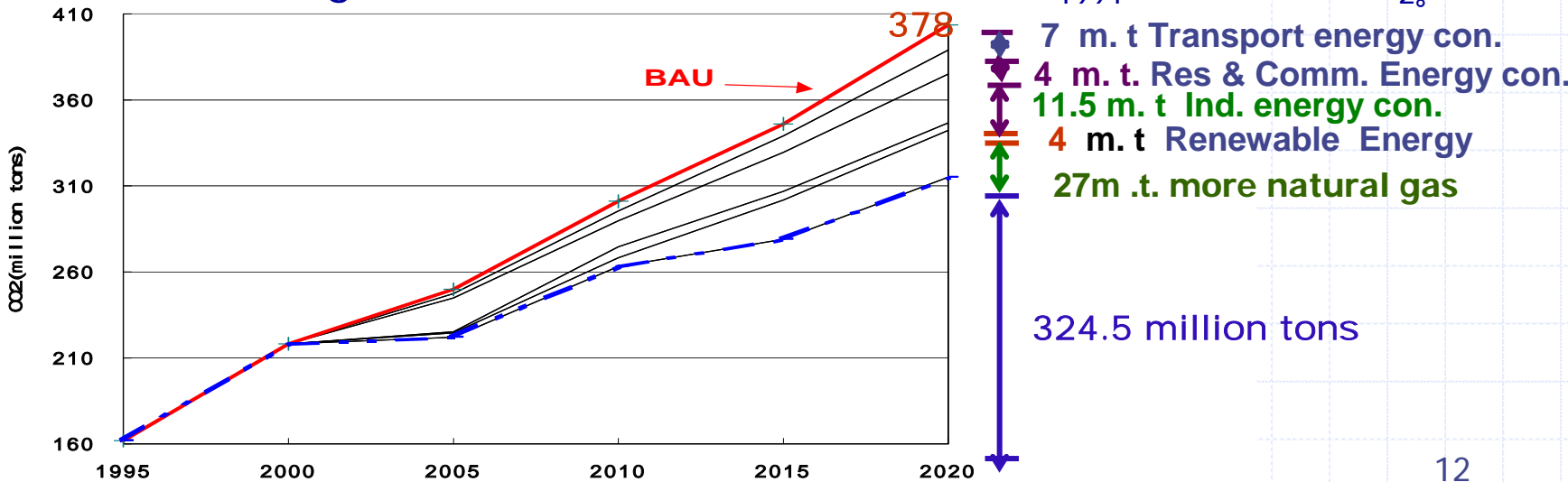


Post-Kyoto Target Simulation

◆ GHG Intensity Scenarios

■ Argentina Model:

- ◆ Reducing emissions by 14% in 2020 compared to BAU, with a reduction amount of 53.5 million tons, with 22.5 million tons from energy conservation, 4 million tons from renewable energy, and 27 million tons from energy structure change.
- ◆ Per capita emission would be 13 tons
- ◆ Marginal reduction cost would be USD₁₉₉₁ 23.2/ton CO₂.



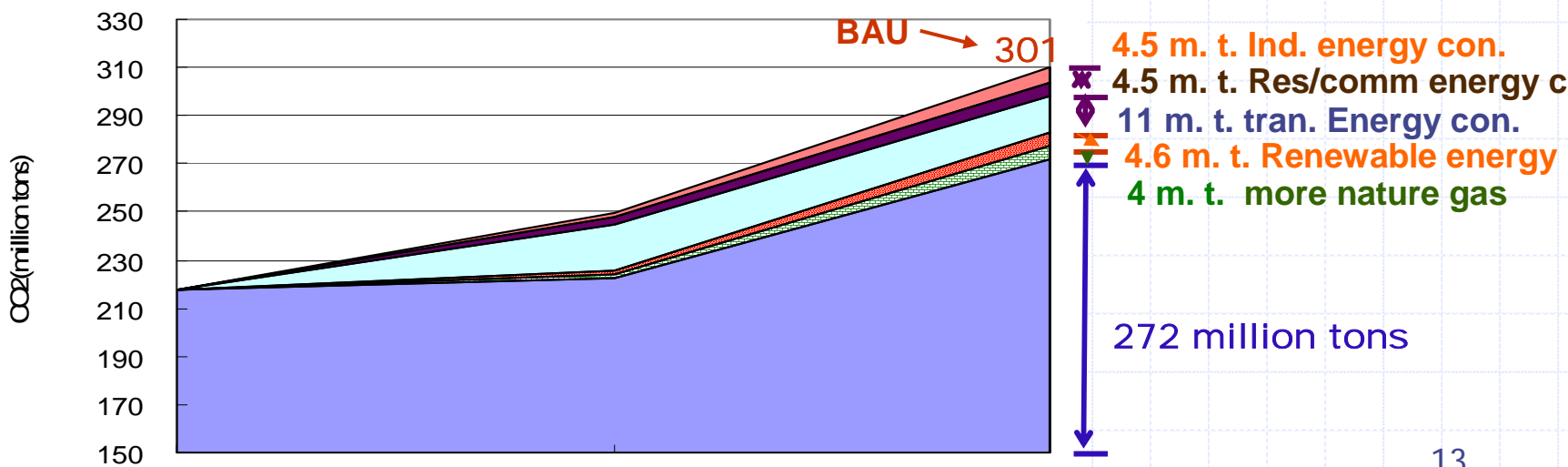


Post-Kyoto Target Simulation

◆ GHG Intensity Scenarios

■ U.S. Model

- ◆ Reducing CO₂ intensity by 18% in 2010 compared to BAU. Per capita emission in 2010 would be 11.4 ton/CO₂
- ◆ Marginal reduction cost would be USD₁₉₉₁ 41/ ton CO₂: it is between 0.77-96.2 USD/ton CO₂ for Annex B countries.





Post-Kyoto Target Simulation

◆ Simulation results of emission reduction scenarios

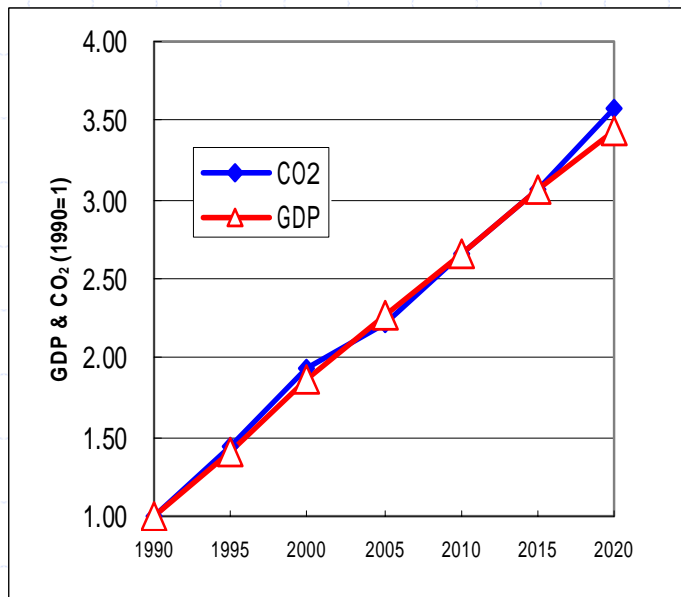
Reduction Scenarios	Reduction Target	Reduction Rate	Marginal Reduction Cost
To continue Kyoto Protocol scenario	<i>Tentative reduction target of National Energy Conference</i> Per capita emission in 2020: 10 ton/CO ₂	35%	US\$ ₁₉₉₁ 207/ ton CO ₂
	Per capita emission in 2020: 13 ton/CO ₂	20%	US\$ ₁₉₉₁ 101/ ton CO ₂
GHG Intensity Scenarios	<i>Germany Model</i> Per capita emission in 2020: 9.4~13.1 ton/CO ₂	19%~41.7%	US\$ ₁₉₉₁ 101/ ton CO ₂ (Reduction rate: 19%)
	<i>Argentina Model</i> Per capita emission in 2020: 12.7 ton/CO ₂	14%	US\$₁₉₉₁ 23.2/ ton CO₂
	<i>U.S. Model</i> Per capita emission in 2010: 11.4 ton/CO ₂	18%	US\$₁₉₉₁ 41/ ton CO₂ (Cost at 2010)



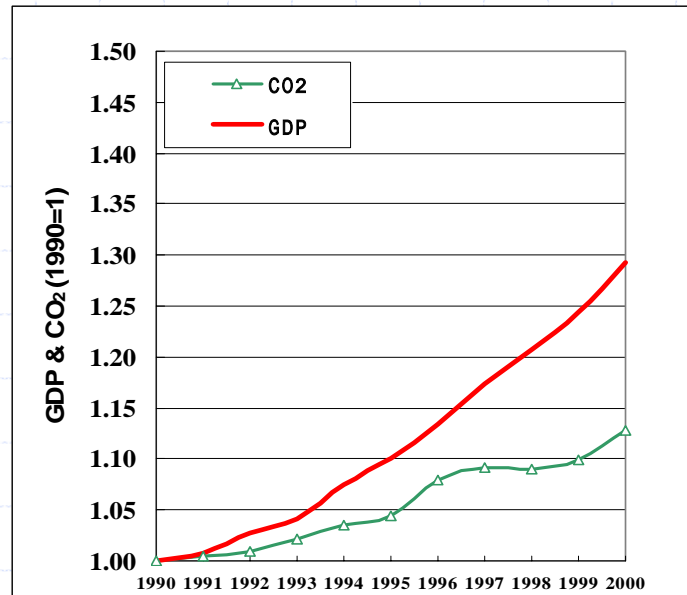


Challenges Facing Taiwan

Taiwan



OECD Countries



- Developed countries (OECD countries) have started adjusting industrial structures since 1970s toward high value-added, low energy intensive industrial structure accompanied by adopting low carbon energy, with the aim of maintaining high economic growth while stabilizing CO₂ emissions;
- Taiwan is similar to other developing countries, CO₂ emission is coupled with economic growth, even until 2020, if doing as usual.



Ongoing Actions for Climate Change

- ◆ Promoting voluntary industrial GHGs reduction and establishing GHGs Inventory System.
 - TEPA started assisting industries to inventory GHG emissions and will establish a registration system.
 - Taiwan TFT LCD Association (TTLA) and Taiwan Semiconductor Industry Association (TSIA) have committed to the reduction of PFCs emissions. TEPA has signed a MOU on voluntary PFCs emission reduction with TTLA in 2004.
- ◆ Compiling National Communication.
 - Taiwan started drafting the National Communication from 1998 and has completed the first draft in 2000.



Ongoing Actions for Climate Change

- ◆ Promoting renewable energy development and energy efficiency.
 - Encouraging landfill gas power generation.
 - Encouraging and subsidizing clean energy project, such “Bio-diesel pilot project”
 - Promoting “Energy Star Labeling System”
- ◆ Conducting climate change impact assessment and preparing adaptation strategies



Actions in response to Kyoto Protocol

- ◆ Establishing inter-ministerial “Climate Change and Kyoto Protocol Task Force”:
 - Strategic Planning and International Negotiation Group
 - Sector Reduction Planning Group
 - Economic Impact Adaptation and Incentive Planning Group
 - Scientific Research, Education and Promotion Group
 - Meanwhile, we will also apply TAIWAN-MARKAL and other models to assess the cost and effectiveness of a various of emission reduction strategies.
- ◆ Contriving “Greenhouse Gases Reduction Program”
 - Design Taiwan climate change strategies through intra-governmental cooperation and private sector’s involvement to prepare for future international actions.



Actions in response to Kyoto Protocol

- ◆ Legislating “Greenhouse Gases Control Act”:
 - Responsibilities of government, business and citizens for GHGs reduction;
 - Control strategies;
 - Education and promotion.
- ◆ Continuing GHGs reduction measures for existing and newly established emission sources
 - Furthering the works on establishing GHGs Inventory System and advancing industry voluntary GHGs reduction.
 - Including GHG emission evaluation in the environmental impact assessment for significant projects and requiring the investors to provide a reduction plan for GHGs and other pollutants.



Conclusions

- ◆ Taiwan is underway to reduce GHG emissions and to pursue sustainable development.
- ◆ Taiwan has re-evaluated its energy and industrial policies and also promoted various "no-regret" measures.
- ◆ With the aim of evaluating future GHGs reduction strategies, we strive to improve energy efficiency, adjust industry structure toward less energy intensive industries, promote new and renewable energy.
- ◆ Taiwan expect to cooperate with the international community to reduce emissions of greenhouse gases.



Thank you for your attention