



經濟部能源局

Bureau of Energy, Ministry of Economic Affairs

Analysis of Taiwan's Future Energy Structure under the Clean Energy Development Goals

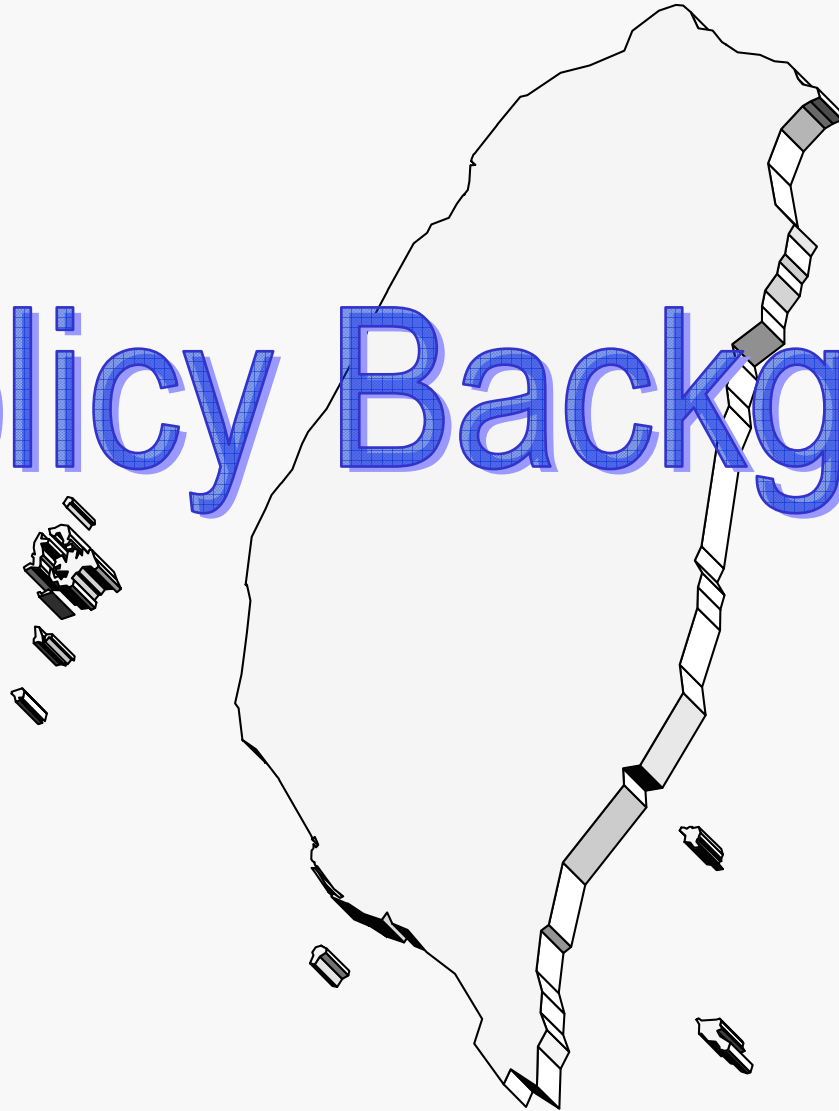
**Bureau of Energy,
Ministry of Economic Affairs**

5 April, 2005

Outline

- Policy Background
- Current Energy Situation in Taiwan
- Modeling Tool and Policy Scenarios
- Analysis Results

Policy Background





■ 「National Energy Conference」 in 1998

In response to the international appeal on greenhouse gas emission reduction through Kyoto Protocol, A National Energy Conference was held in Taipei. The weight of renewable energy in electricity capacity was set as 1 to 3% in 2020.

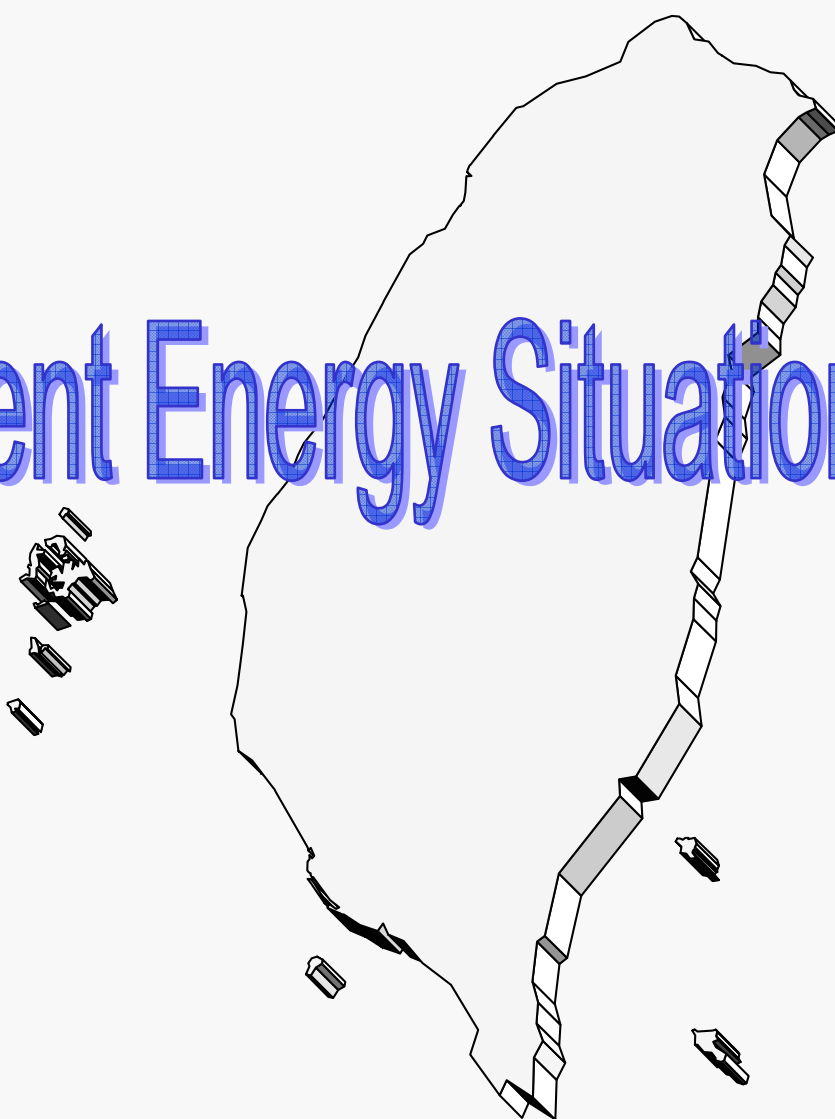
■ 「New and clean energy research development plan」 in 1999

「National energy conference action plan」 and 「New and clean energy research development plan」 were completed in 1999, by which the renewable energy development potential assessment and other measures are reinforced.

■ National Nuclear-Free Homeland Conference」 in 2003

Clean energy is the major element in both “nuclear-free homeland” and “Kyoto protocol”, Taiwan’s short-term goals focus on wind power generation. Geothermal, biomass and small hydro will also be promoted. The renewable energy in electricity capacity is set as 5,139MW in 2010 and 6,500MW in 2020. The import volume of LNG will reach 1000 MT in 2010 and 1300MT in 2020.

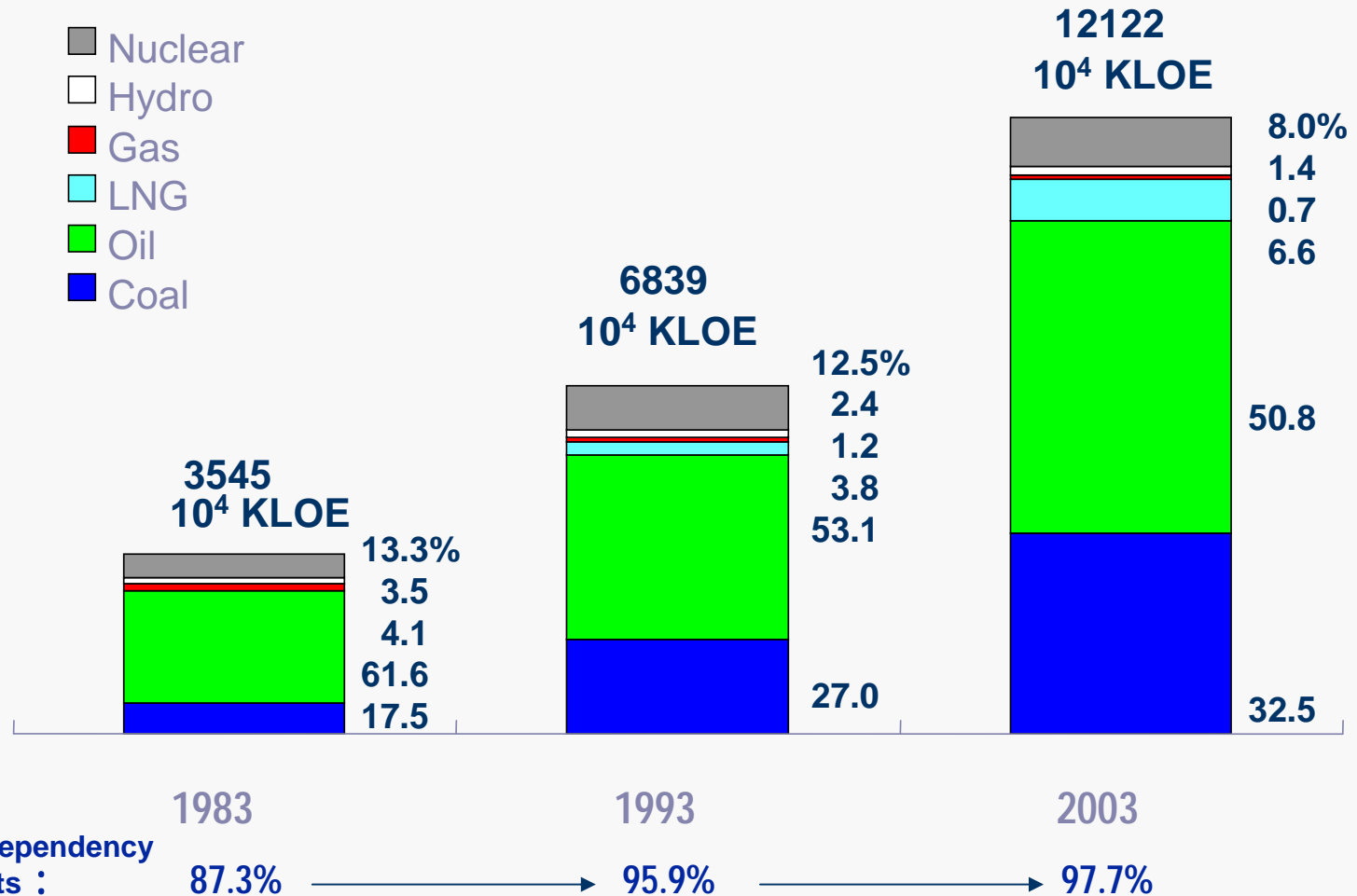
Current Energy Situation in Taiwan



Energy Supply Structure

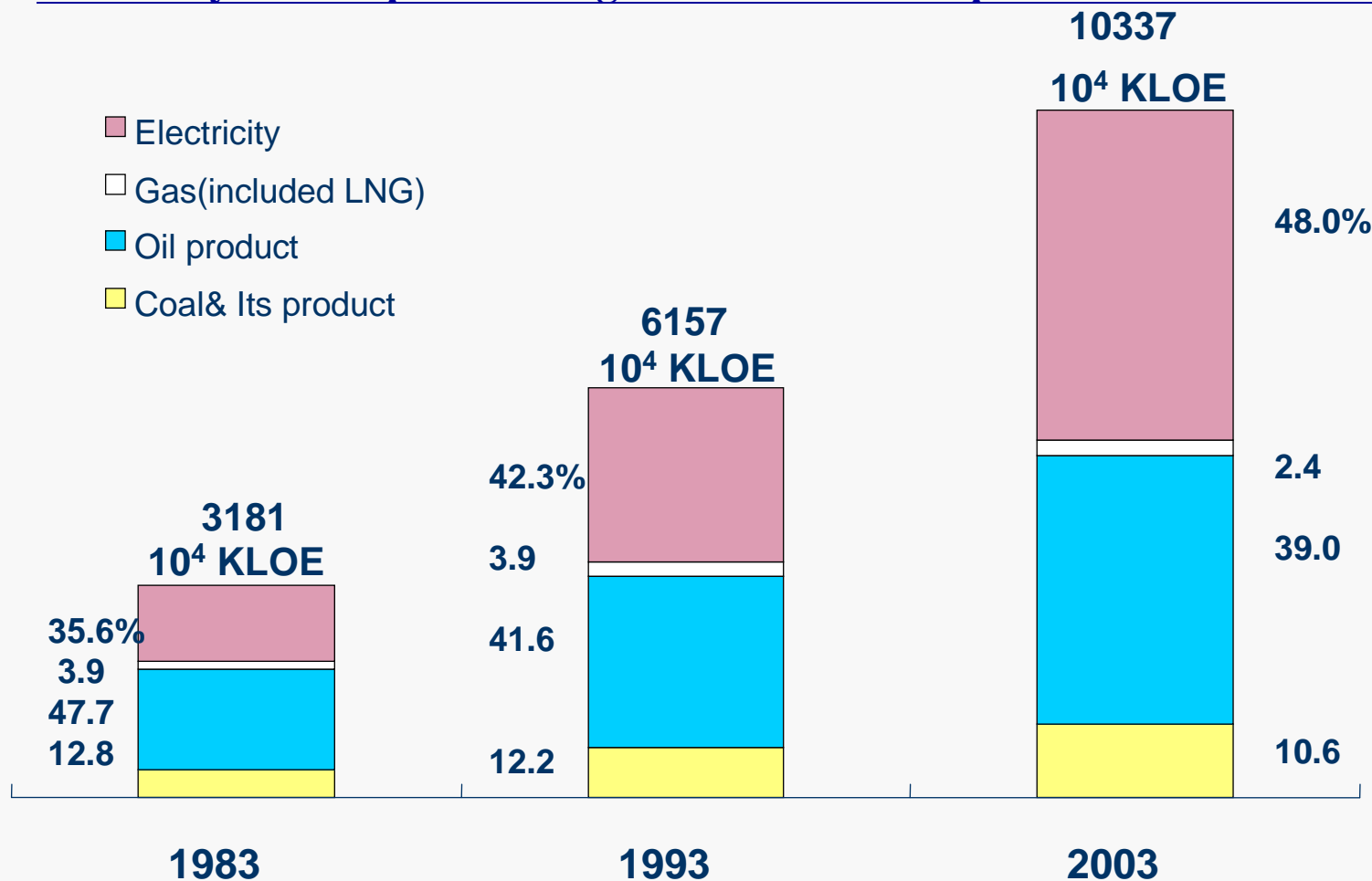
☒ Very limited indigenous energy resources, 97.7% rely on import

☒ Average annual growth rate for energy supply was 6.3% from 1983 to 2003



Energy Consumption Structure

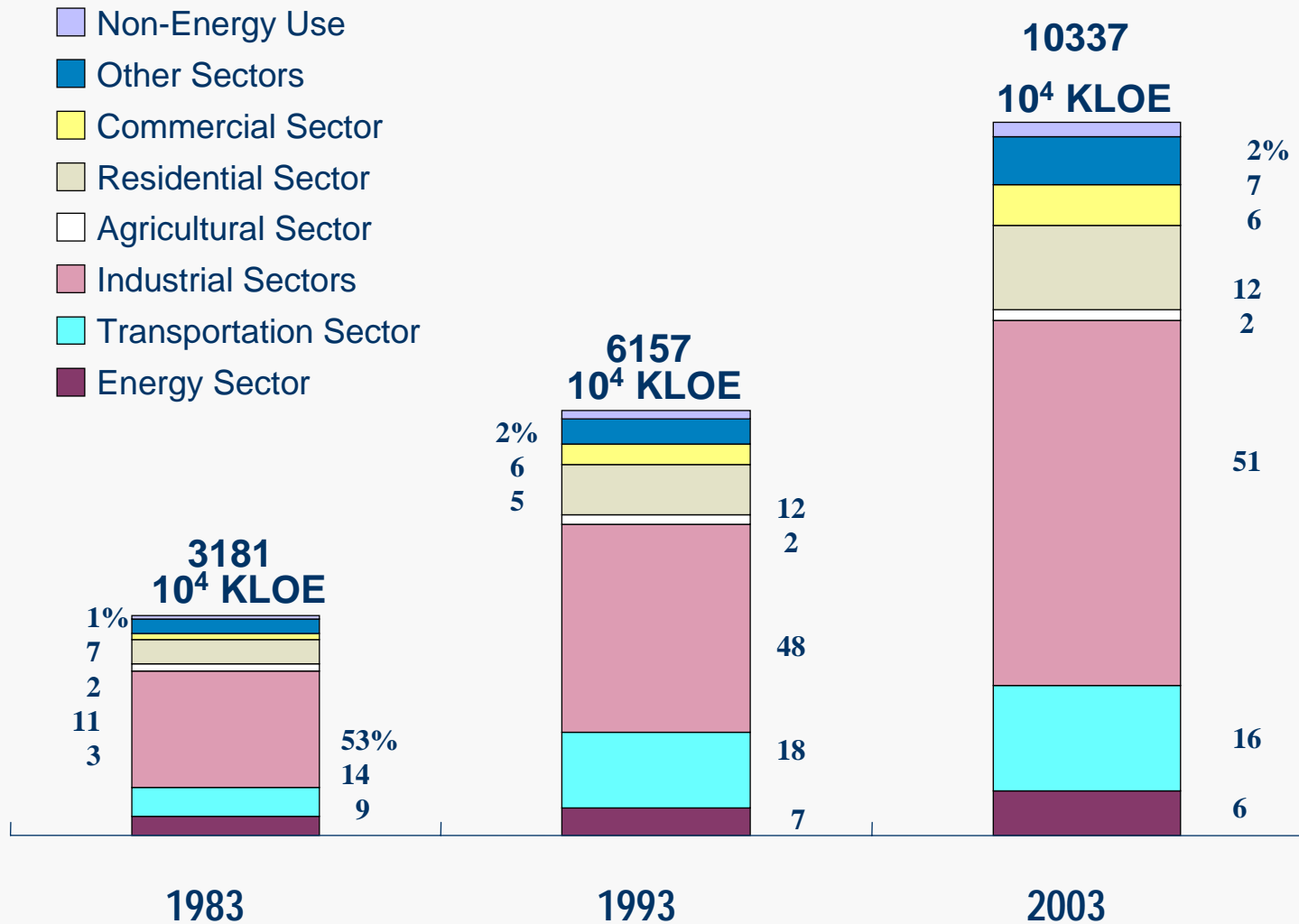
- ⊠ Average annual growth rate for energy consumption was **6.1%** from 1983 to 2003, average GDP growth was **5% annually**
- ⊠ Electricity consumption ratio grows as oil consumption ratio decreased yearly



*Electricity includes coal, oil, gas, hydro, nuclear, and renewable energy

Energy consumption structure by sector

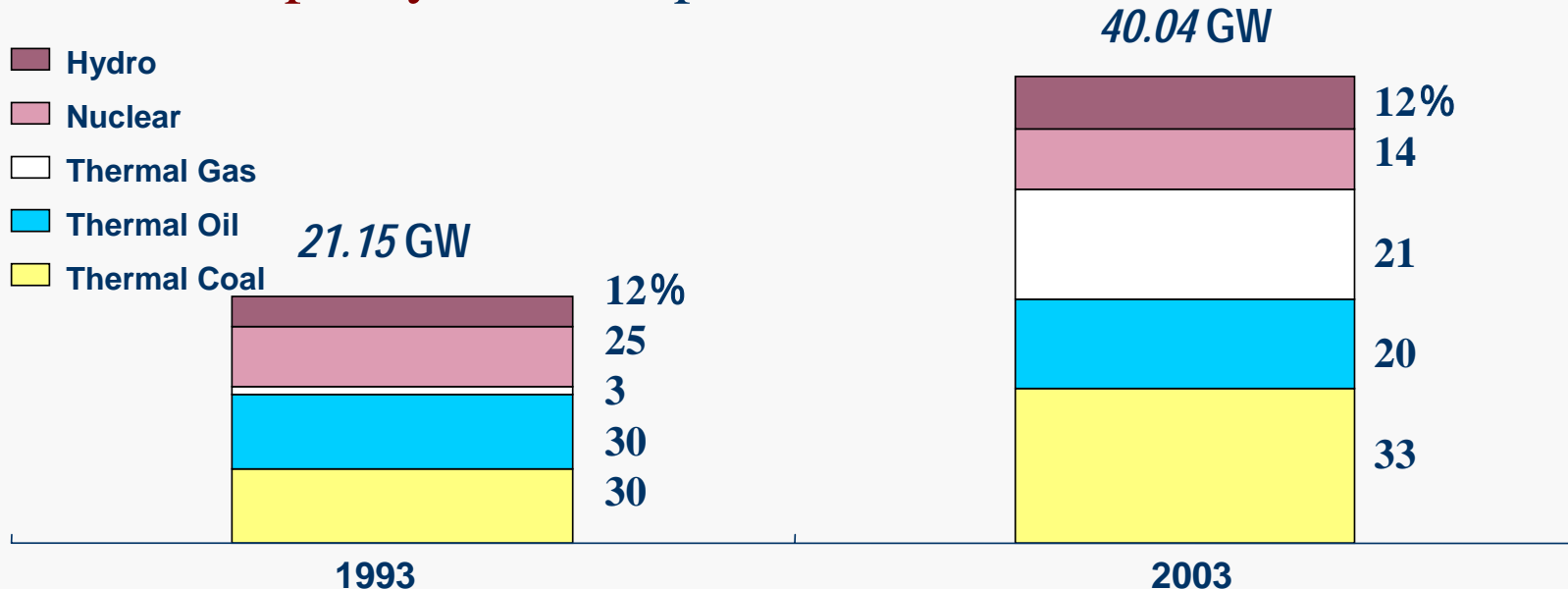
✉ Industrial and residential sectors are increasing by ratio



Electricity Installed Capacity Ratio

Average annual growth rate in 1993-2003

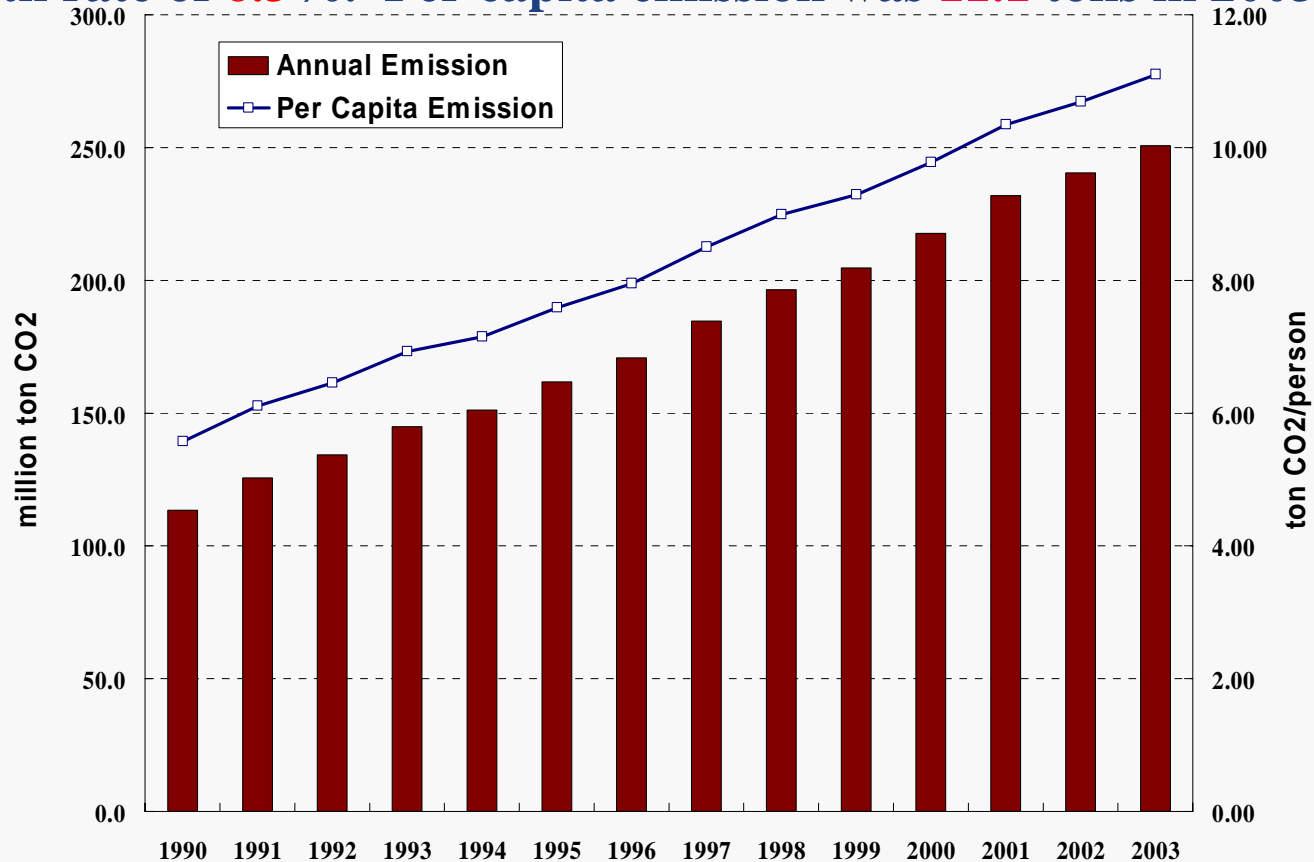
➤ Total capacity : **3.2%** , peak load : **5%**



Items	Year	1998	1999	2000	2001	2002	2003
Taiwan Power Installed Capacity(GW)		26.43	27.03	27.13	27.44	27.31	28.53
Independent Power Producers Installed Capacity(GW)		---	1.20	2.25	2.70	4.60	5.76
Cogeneration Installed Capacity(GW)		2.85	3.22	4.64	4.96	5.89	5.75
Percent Reserve Margin(%)		7.7	12.5	12.6	13.2	16.0	14.6

CO₂ emission from energy use: supply side

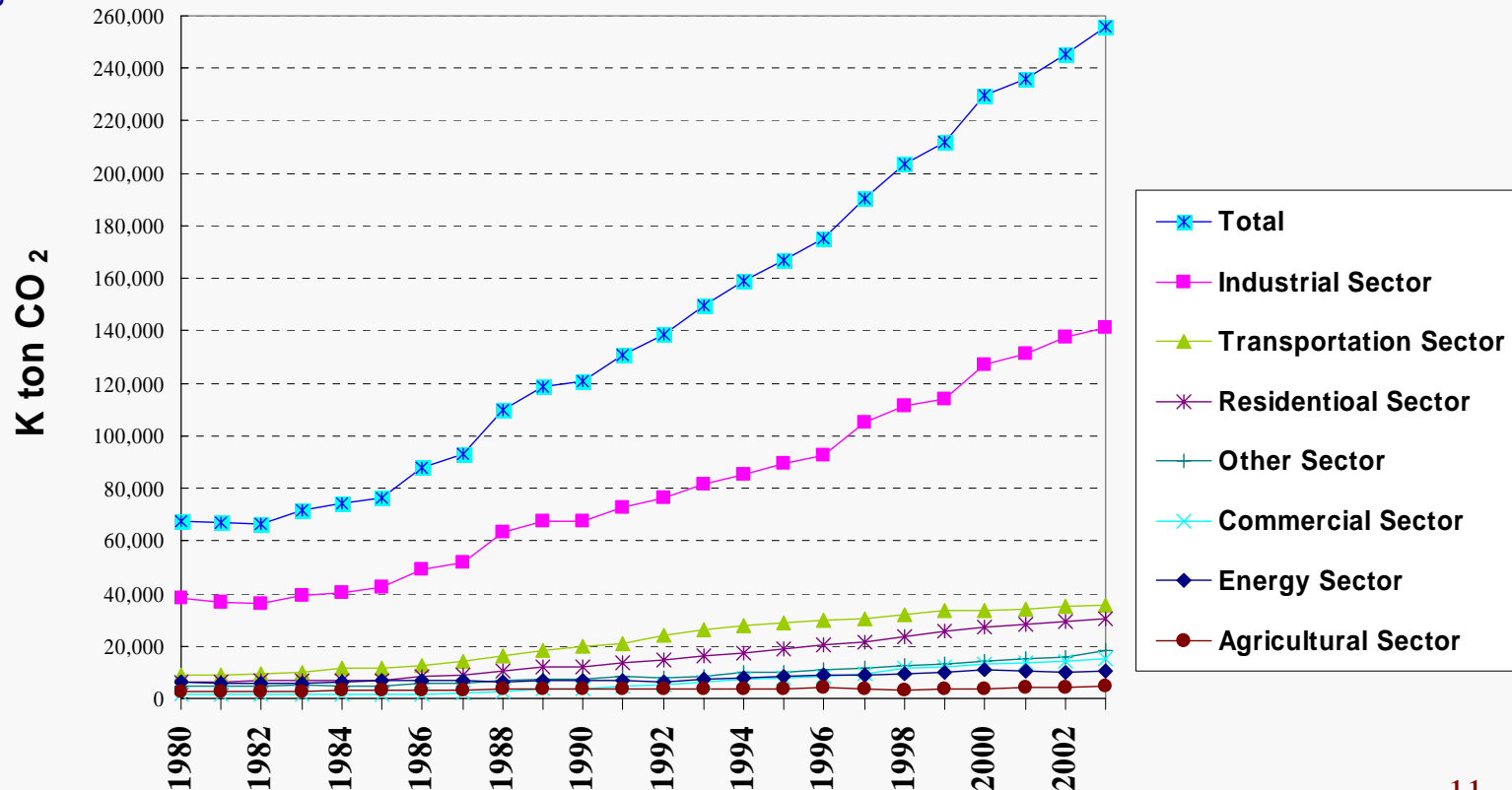
CO₂ emission by energy supply sector was **113.431** million tons in 1990, , grew to **250.902** million tons in 2003, with average annual growth rate of **6.3%**. Per capita emission was **11.1** tons in 2003



CO₂ emission from energy use: demand side

■ CO₂ emission from final consumption is 255,983 thousand tons in 2003, **industrial sector (55.2 %)** is the largest emitter, followed by transportation (13.8 %), household (11.9 %), others (7.2 %), and commercial (6.0 %)

■ In industrial sector, the emission ratio by sub-category are steel (27%), oil-chemical (16%), electrical (10%), textile (6%), cement (5%), and pulp/paper (4%)。



Modeling Tool and Policy Scenarios



Modeling Tool

☞ Taiwan MARKAL energy engineering model was applied to study the impacts of the clear energy development policy.

➤ Standard MARKAL was introduced by Bureau of Energy, MOEA, in 1994.

➤ MARKAL-MACRO was established under the assistance of Brookhaven National Laboratory, USA, in 1995

➤ Scope of Application

❖ Future energy supply planning

❖ CO₂ emission target planning

❖ Cost-effective energy policy planning

Policy Scenario

■ Clean Energy Target

■ LNG

➤ Future LNG demand will increase from 6.13MT in 2003, to 7.87MT in 2005, 10MT in 2010, and 13 MT in 2020.

■ Electricity from Renewable Energy

➤ **Renewable energy installed capacity: 5,139MW in 2010, 6,500MW in 2020** (see Attachment 1)。

■ Energy Efficiency Target:

- Energy efficiency indicator calculated using energy productivity will increase by 28% in 2020 from 1997。

■ Electric Power Development:

- Before 2014, according to long-term electric power development plan by Taiwan Power Company (June 2003 version): Coal-fired generation will increase by 2397MW in 2001-2005 by 8800MW in 2010-2015; gas-fired generation will increase by 8730MW in 2006-2010. Existing nuclear power plants will be in operation for a limit of 40 years, and the new 4th nuclear power plant will start commercial operation in 2008

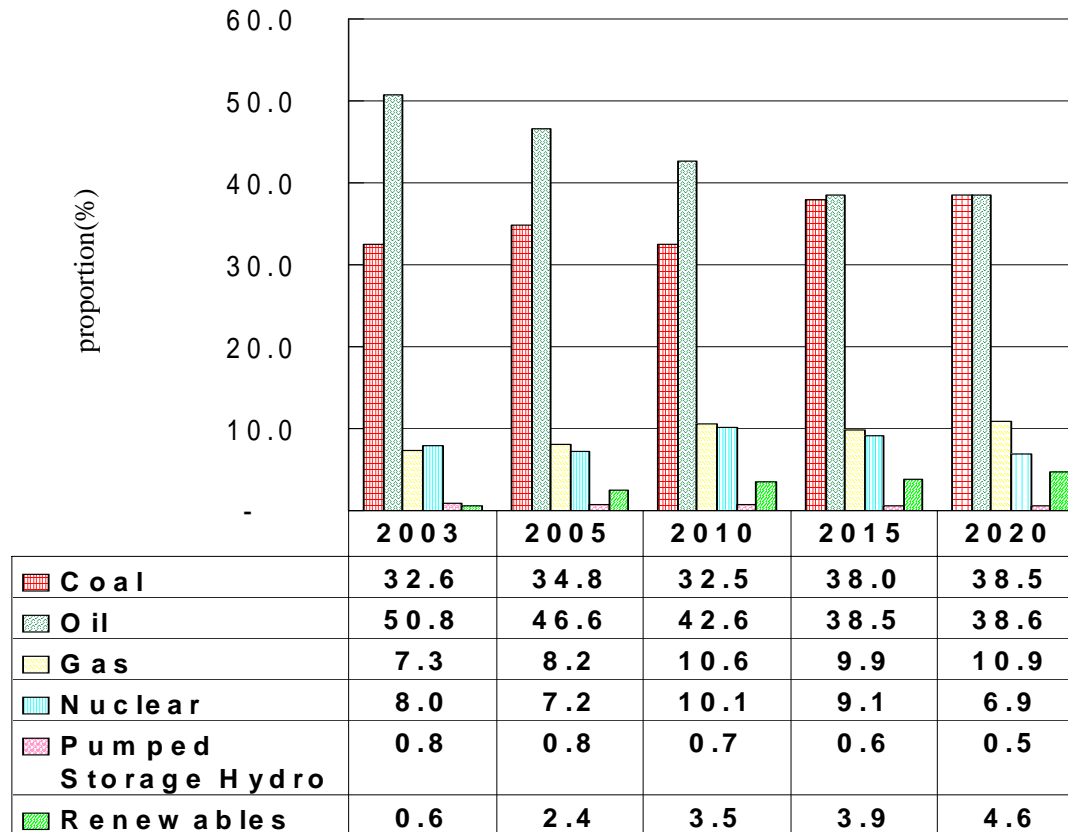
Analysis Results



Future Energy Supply Structure

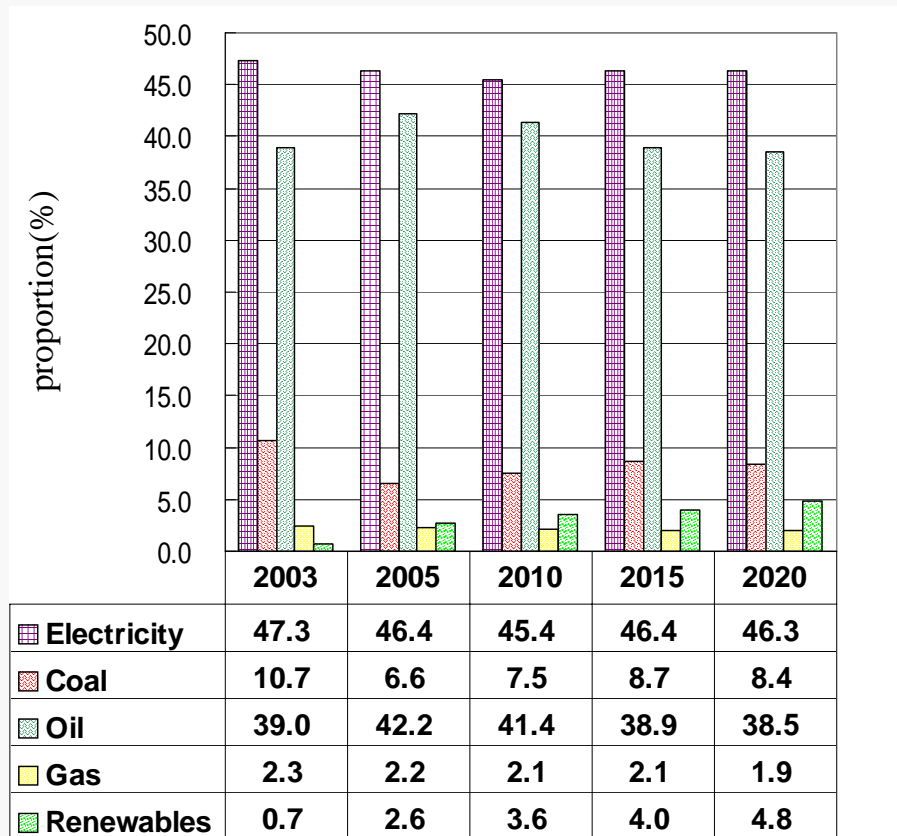
Due to increased LNG supply, its ratio will reach 10.6% in 2010, and about 10.9% in 2020
 Raising renewable energy target, its primary energy ratio will increase from 0.6% in 2003, to 3.5% in 2010, and 4.6% in 2020.

4th nuclear power plant begins commercial operation in 2008, causing the ratio of coal to drop to 32.5% in 2010. However, since the increase of LNG is limited, the ratio of coal will slowly incre



Future Energy Consumption Structure

In 2010, due to raising of the renewable energy target, renewable energy will replace part of the traditional fossil fuel generation. However, since renewable energy will increase the cost of power generation, energy demand will turn to the cheaper coal, thus raising the ratio of coal.



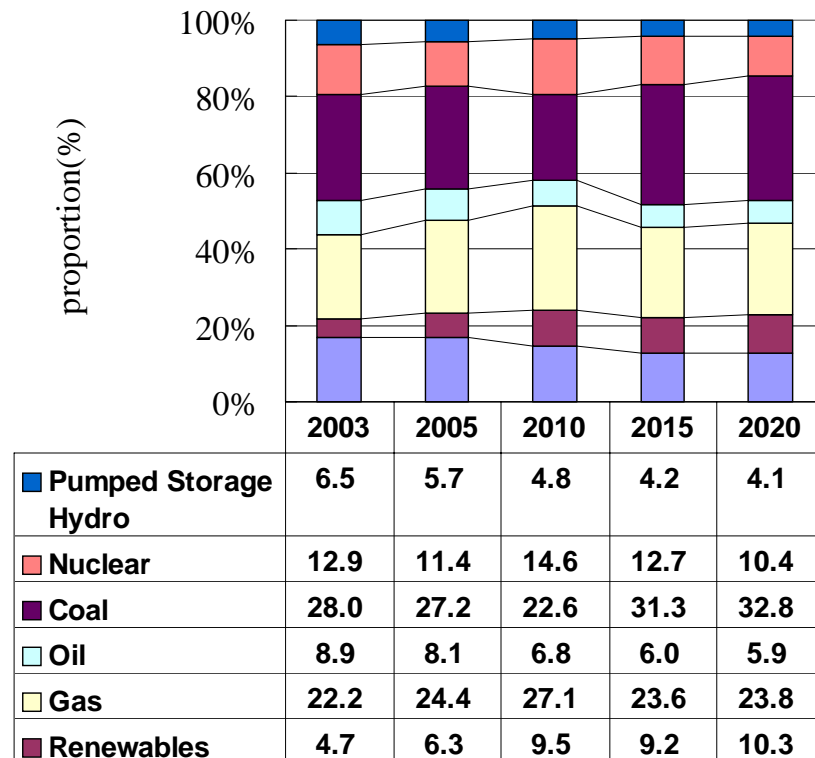
Note: Electricity does not include renewable energy generation

Ratio of Future Electricity Installed Capacity

Gas-fired generation will reach 27.1% in 2010 as LNG increases continuously its import volume.

Coal-fired generation will decrease to 22.6% in 2010 as the 4th nuclear power plant starts commercial operation, but will be up again to 32.8% in 2020 due to limited growth of gas-fired and nuclear.

Renewable energy is expected to reach 9.5% in 2010, and 10.3% in 2020 by the intensive development goal by the government.

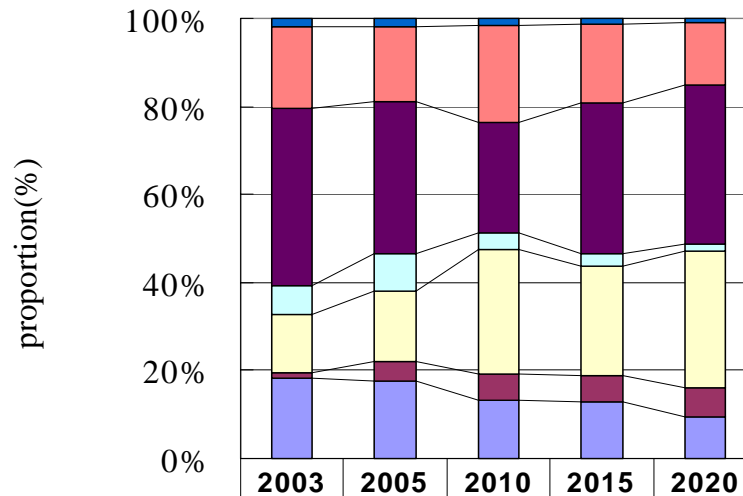


Ratio of Future Power Generation

Gas-fired generation will reach 31.2% in 2020 as LNG increases continuously its import volume.

Coal-fired generation will decrease to 25.2% in 2010 as the 4th nuclear power plant starts commercial operation, but will be up again to 36.1% in 2020.

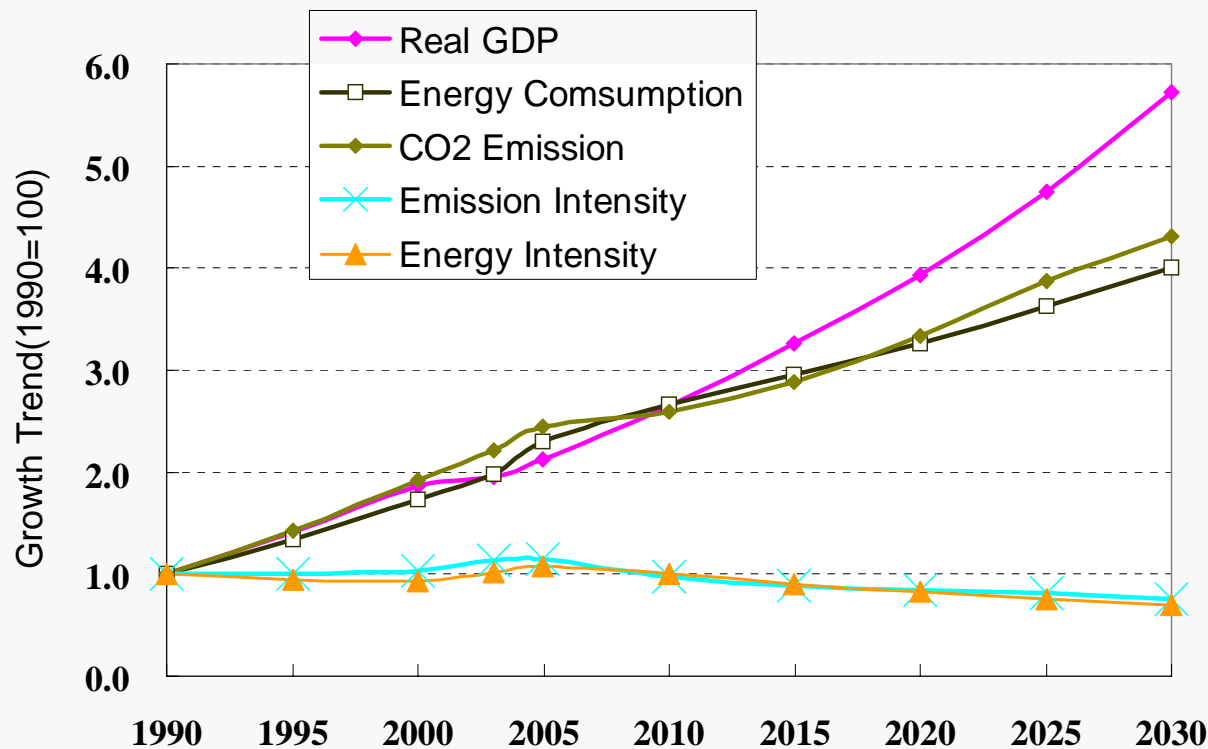
Renewable energy is 6.5% in 2020 due to its lower capacity factor.



■ Pumped Storage Hydro	1.8	1.9	1.5	1.2	1.1
■ Nuclear	18.6	17.0	21.9	18.0	13.9
■ Thermal Coal	40.2	34.7	25.2	34.4	36.1
■ Thermal Oil	6.7	8.4	3.8	2.8	1.6
■ Thermal Gas	13.1	15.9	28.3	24.9	31.2
■ Renewables	1.5	4.4	6.1	5.9	6.5
■ Cogeneration	18.1	17.7	13.2	12.8	9.6

CO₂ Emission from Fuel Combustion

Under the scenario of actively promoting renewable energy, increasing natural gas imports, and improving energy efficiency, the annual CO₂ emission growth rate will be lower to 2.8% from 2000 to 2020, and the emission intensity and energy intensity will also be improved, thus reduced 22% and 13%, respectively.





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Thank You for your attention!

Attachment 1: Renewable Energy Generation Targets

Unit: MW

technological items year	Total installed capacity target			
	2000	2005	2010	2020
Conventional hydro	1,963.0	2,168.2	2,300.0	2,500.0
wind	309.8	2,159.0	2,180.0	2,200.0
geothermal	1.0	21.0	100.0	300.0
photovoltaic	5.0	50.0	100.0	150.0
biomass steam turbine	479.0	553.0	553.0	553.0
methane steam turbine	24.6	29.0	36.0	43.0
municipal solid waste electricity	67.4	159.0	456.0	754.0
Total	2,849.8	5,139.0	5,725.0	6,500.0

