The Impacts of Climate Change on Energy Security of Taiwan

Dr. Chi-Yuan Liang
Minister without Portfolio
The Executive Yuan
Taiwan, R.O.C.

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Outline

I. Characteristics and Problems with Taiwan's Energy Structure

II. High CO2 emissions per Capita, CO2 Intensity and Energy Intensity

III. Ways To Improve Energy Security

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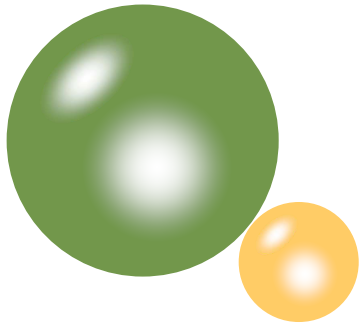
Characteristics and Problems with Taiwan's Energy Structure



Characteristics and Problems with Taiwan's Energy Structure

- Taiwan's energy structure is its high ratio of imported energy and high energy concentration rate.
- Compared with nine other major countries around the world (see Figure 1), Taiwan's ratio of imported energy was 99.32% in 2007; thus it ranked first among the ten countries.
- The energy concentration rate was 61.4%, which was second only to the PRC (see Figure 2).
- Due to high imported energy ratio, Taiwan's energy security is exposed to high risks.

Figure 1 Imported Energy Ratio (2007)

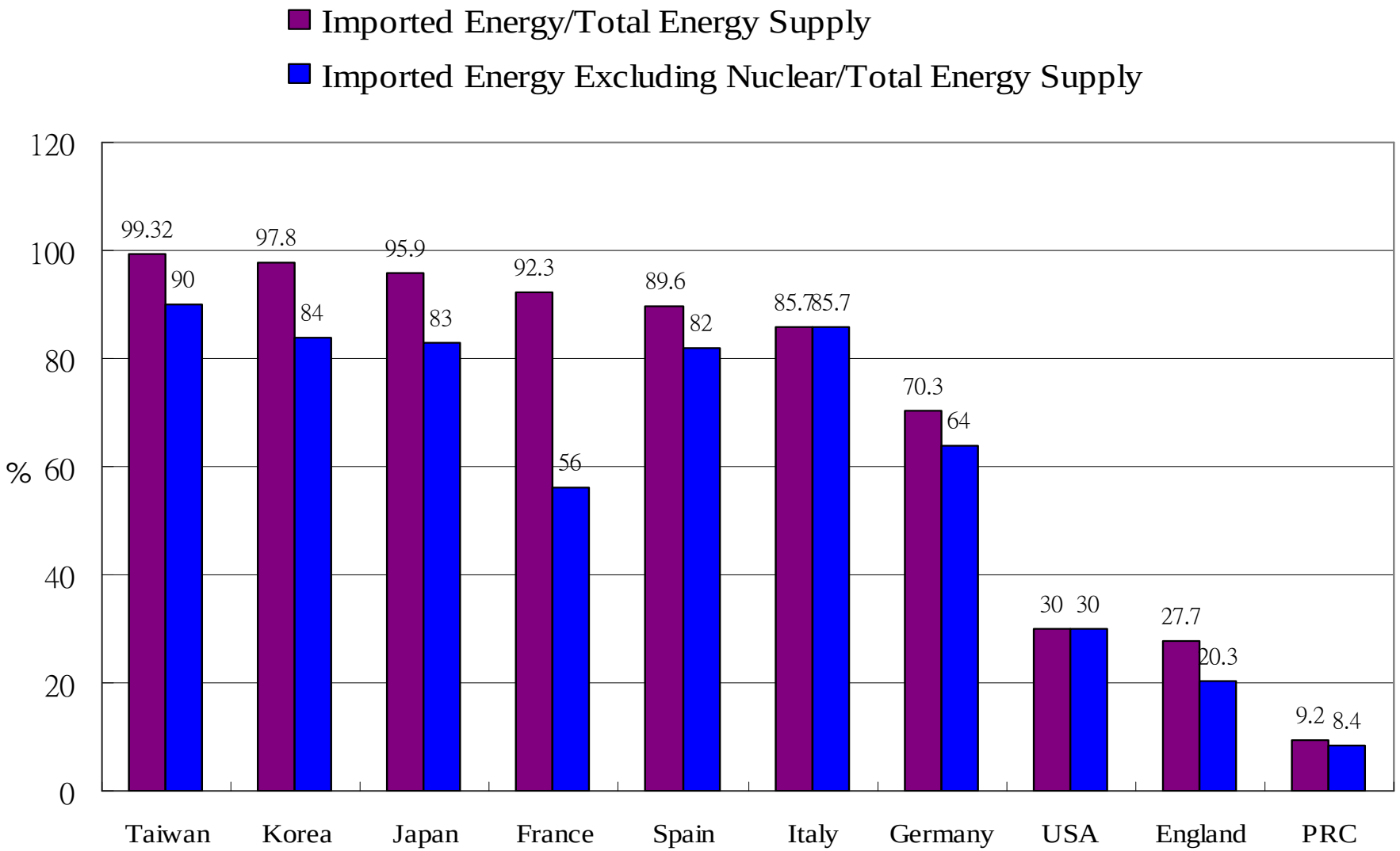
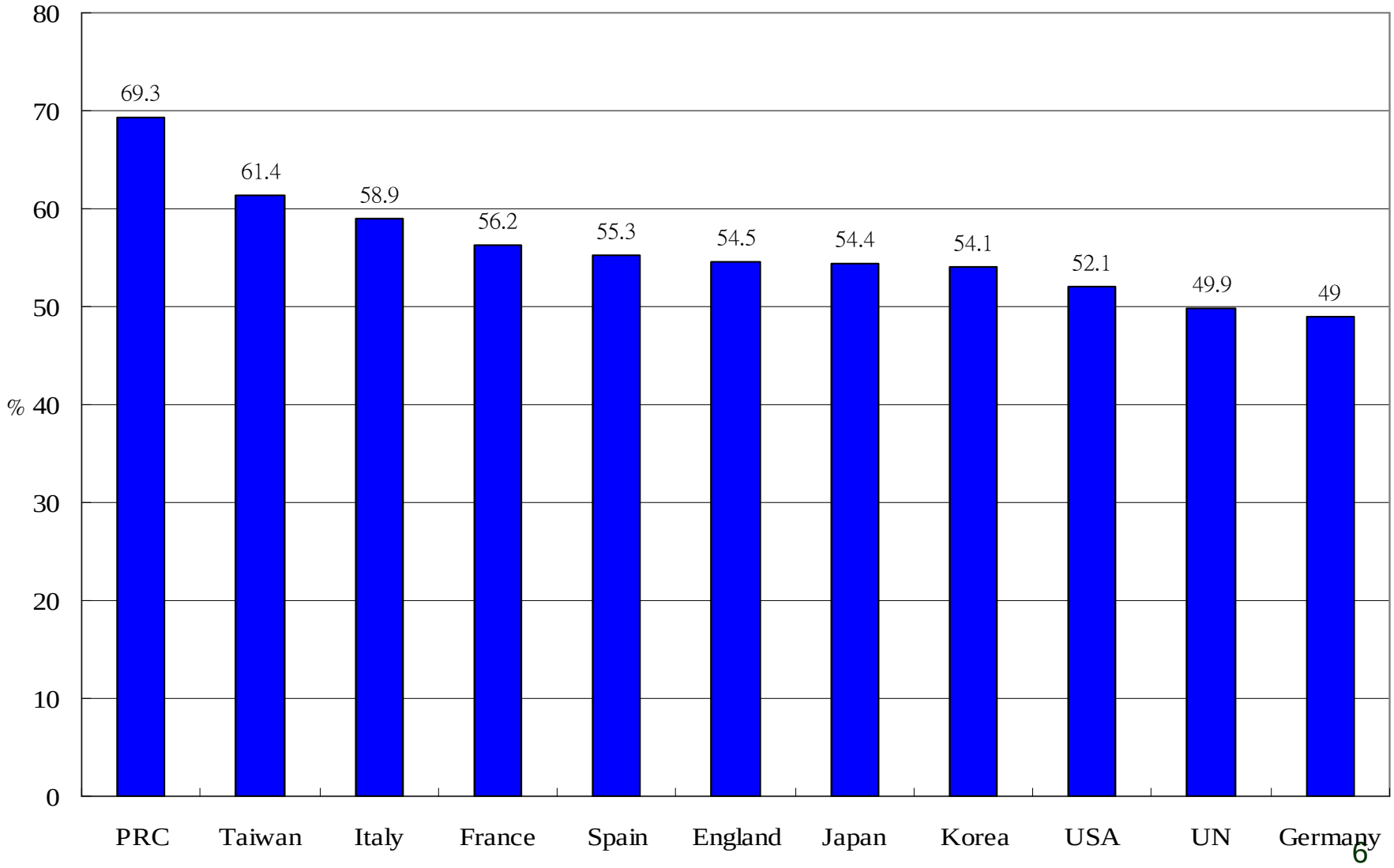


Figure 2 Energy Concentration Rate (2007)



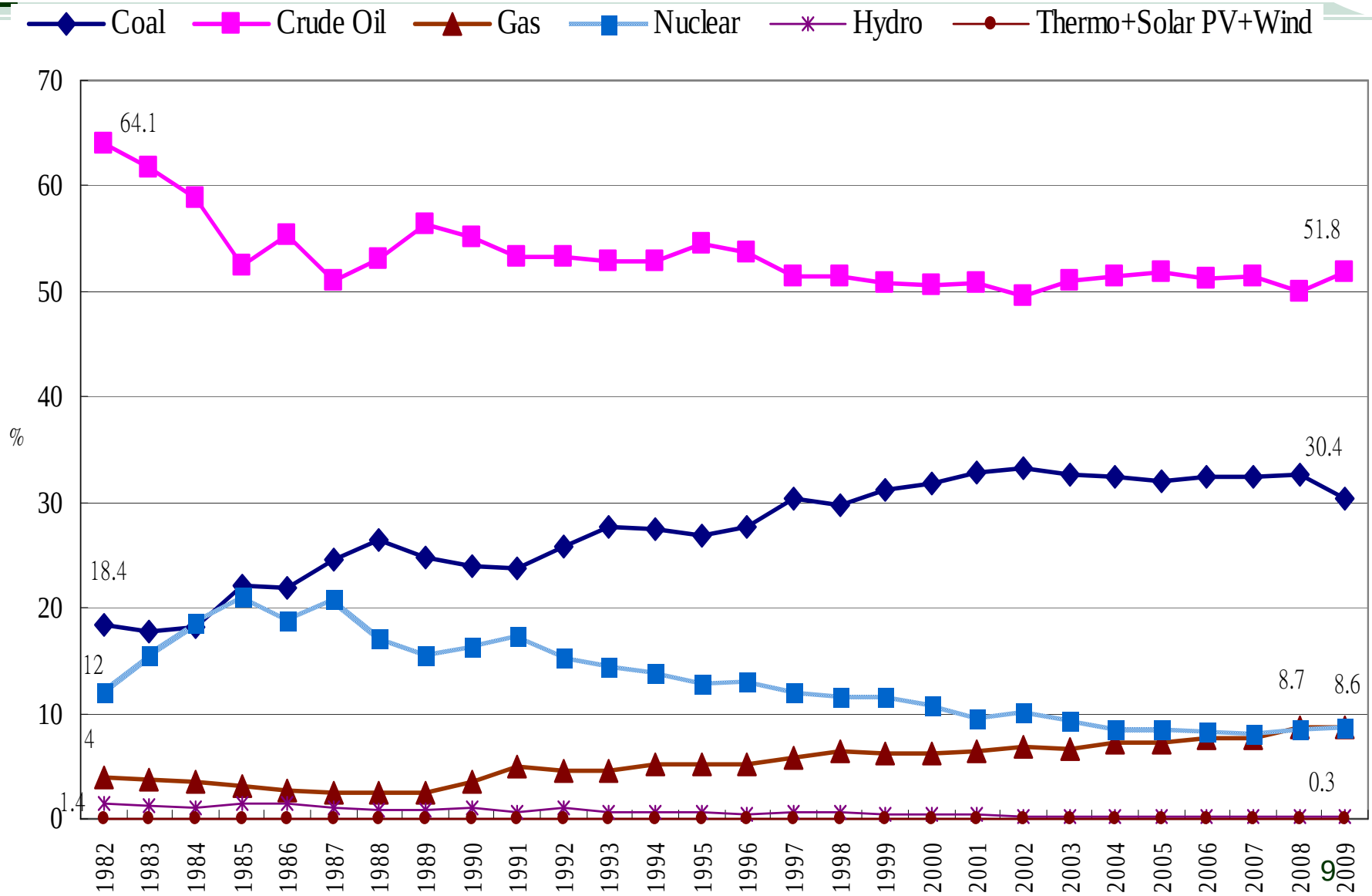
Characteristics and Problems with Taiwan's Energy Structure

- Another characteristic of Taiwan's energy supply is that it mainly consists of high-carbon energy.
- According to data from the Energy Bureau of the Ministry of Economic Affairs, coal and crude oil accounted for 30.45% and 51.82% of Taiwan's energy supply in 2009.
- Conversely, low-carbon energy, which includes hydro power, natural gas power, solar photovoltaic and thermal power, wind power and nuclear power, constituted in total less than 10%.

Characteristics and Problems with Taiwan's Energy Structure

- The share of energy derived from oil dropped from 64.16% in 1982 to 51.82% in 2009, oil is still the most important source of energy in Taiwan.
- Coal's energy share rose from 18.42% to 30.45% during the same period.
- Nuclear power accounted for 12.01% of Taiwan's energy supply in 1982 and almost caught up to coal's energy share (22.02%). After 1985, no more new nuclear plants were built, the ratio dropped steadily to 8.72% in 2009.
- The share of energy derived from natural gas increased from 4% in 1982 to 8.63% in 2009, and that of hydro power decreased from 1.4% to 0.26% (see Figure 3).

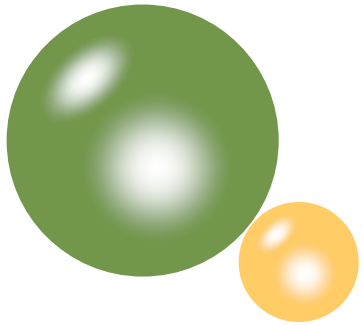
Figure 3 Structure of Energy Supply in Taiwan (1982-2009)



Characteristics and Problems with Taiwan's Energy Structure

- Overall, Taiwan's high-carbon energy (oil and coal) share decreased slightly from 82.58% in 1982 to 82.27% in 2009. Meanwhile, Taiwan's low-carbon energy ratio increased slightly from 17.42% to 17.73%.

High CO2 emissions per Capita, CO2 Intensity and Energy Intensity



CO_2 emissions and CO_2 emissions per capita

- CO_2 per capita is a convenient CO_2 emissions indicator for cross-country comparisons.
- When a country has high CO_2 per capita, this means that the economic behavior of its residents produces more CO_2 emissions and has a negative effect on the environment. It may also imply that the country uses too much high-carbon energy.
- The PRC and the United States were the greatest CO_2 emitters among the world's major countries in 2007.

CO_2 emissions and CO_2 emissions per capita

- Taiwan emitted 276 million tons of CO_2in 2007, ranked lowest among the major countries.
- But Taiwan's CO_2 per capita was 12.1 tons/person, second only to the United States (19.1).
- Taiwan has an export-oriented economy (accounted for 70% of Taiwan's GDP), high energy intensity, and energy consumption/GDP.
- If indirect net energy exports were excluded from domestic energy consumption, Taiwan's CO2 emissions per capita in 2007 would be 9.43 tonnes instead of 12.1 tonnes, ranked No.6 in ten countries.
- CO2 per capita increased between 1982 and 2007: Taiwan's overall economy consumed too much high carbon energy with low energy efficiency.

CO_2/GDP and Energy/GDP Ratios

- But from 2007 to 2008, CO_2 per capita decreased because of the financial tsunami and improvement in energy efficiency.
- CO_2 intensity and energy intensity are both indicators of a country's energy efficiency, referring to the total amount of CO_2 emitted or spend in a country per unit of GDP produced.
- PRC registered the highest CO_2/GDP ratio (2.52 kg/US$ 2000 prices) among the 10 major countries. Followed by Korea (0.69), Taiwan (0.66), and the United States (0.5).
- With PPP adjustment, the PRC still had the highest CO_2/GDP ratio (0.61). (see Figure 4 and Figure 5).

Figure 4 CO_2 Intensity (2009)

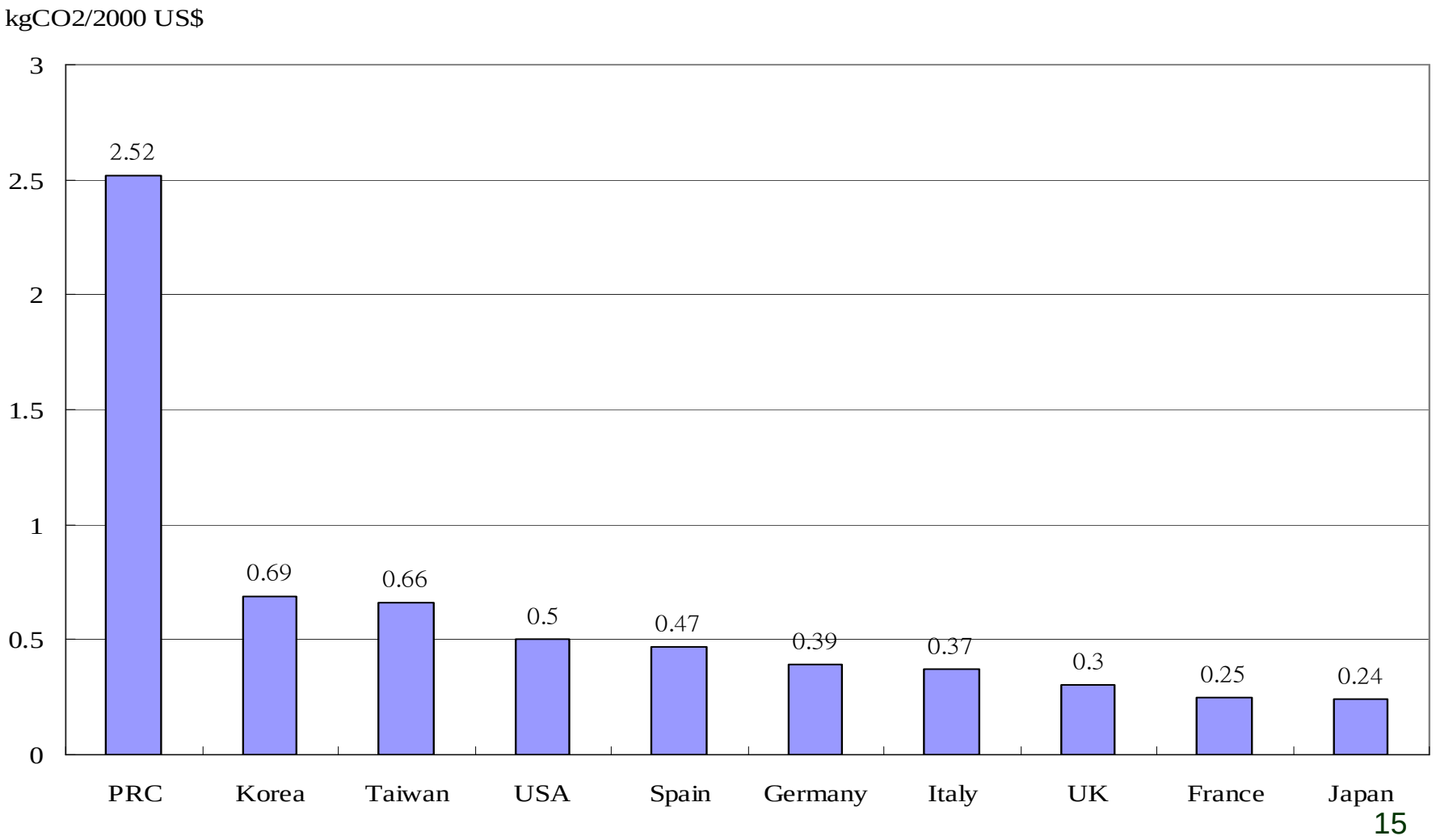
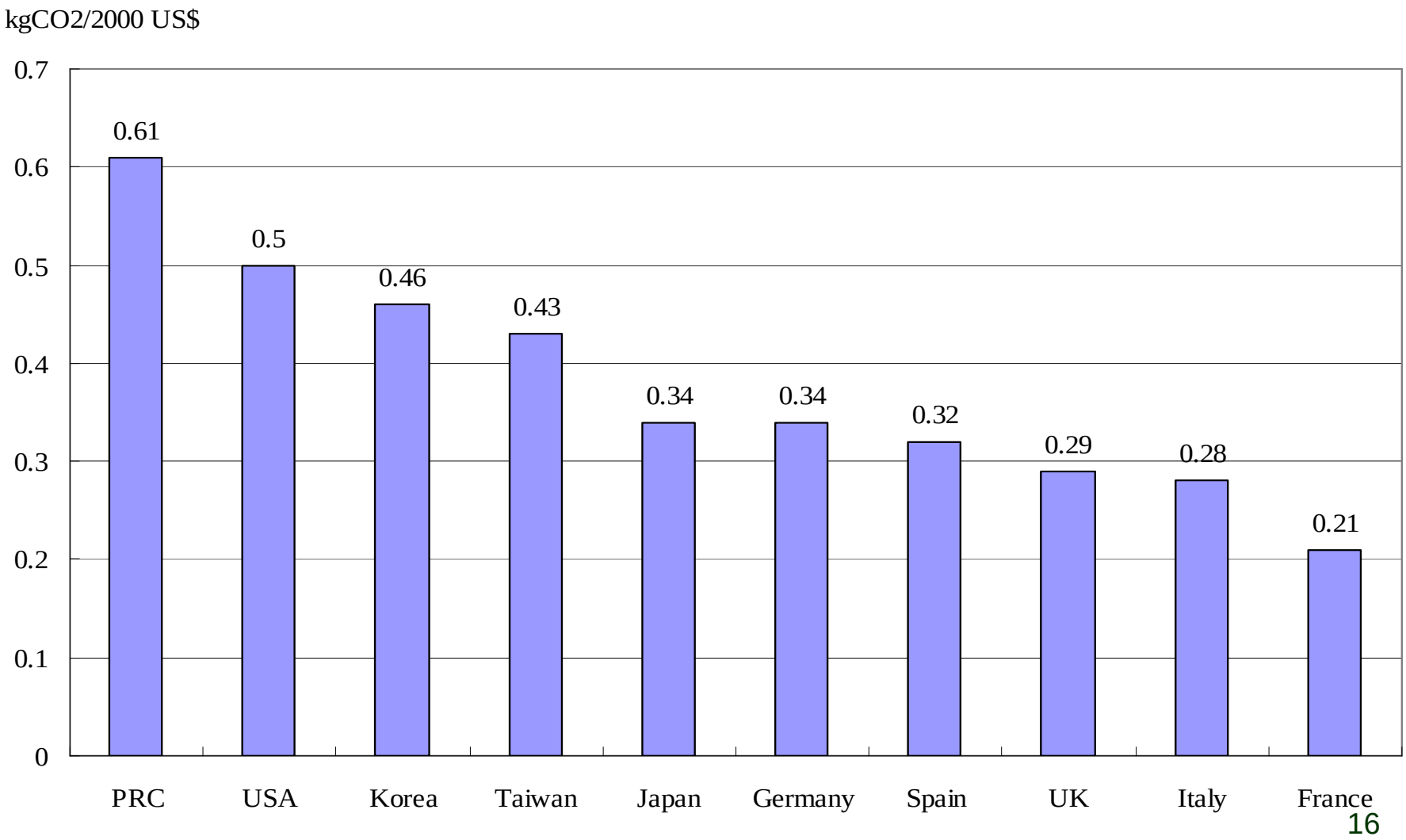


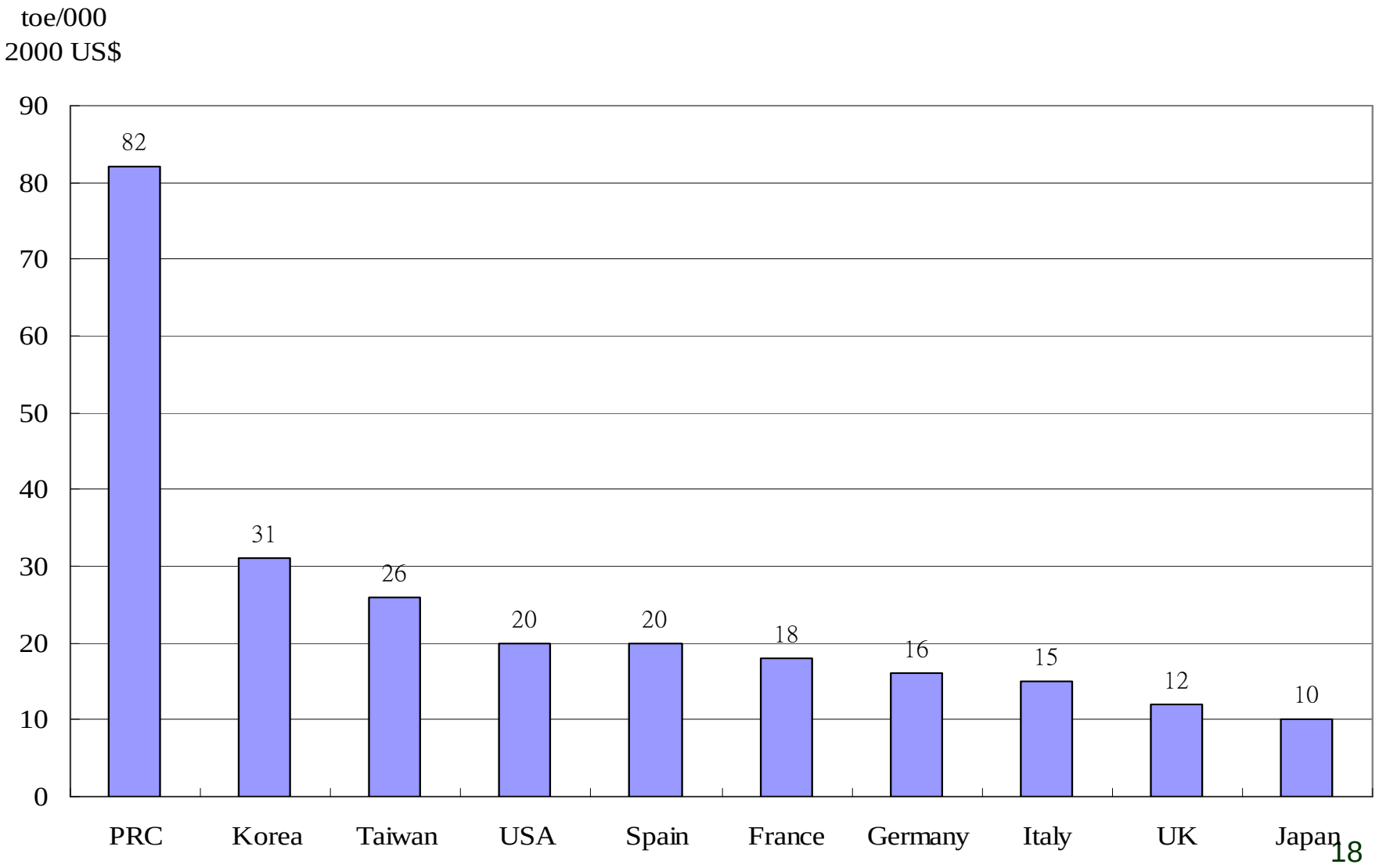
Figure 5 CO_2 Intensity (PPP adjusted) (2009)



CO_2/GDP and Energy/GDP Ratios

- Since CO_2 emissions mainly result from energy consumption, the national rankings of CO_2 intensity (see Figure 5) correlated highly with those of energy intensity (see Figure 6).
- During 1982-1999, Taiwan's CO_2 intensity and energy intensity both showed a decreasing trend: production of high value-added products and services.
- From 2000 to 2004, CO_2 intensity and energy intensity both worsened in Taiwan: energy-intensive industry rapidly expanded.
- After 2004, both indicators decreased continually due to the increases in energy prices authorized by government authorities.

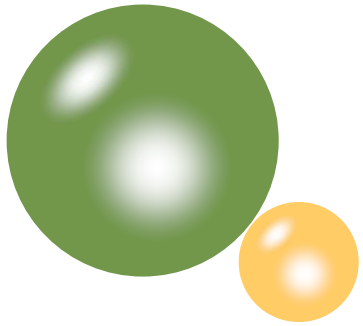
Figure 6 Energy Intensity (2009)



CO_2/GDP and Energy/GDP Ratios

- In conclusion, Taiwan's low energy security was due to high imported energy ratio and energy concentration rate.
- Taiwan also has relatively high CO_2 emissions per capita, CO_2 intensity and energy intensity.
- Facing climate change, Taiwan's energy security will become even worse.
- Fundamental changes are urgently needed!

Ways To Improve Energy Security



Ways To Improve Energy Security

1. The Plan of Renewable energy development from 2008 to 2025

- **The goal in 2025**

Hydro Power	**2,500 MW**
Wind Power	**2,520 MW**
Solar Power	**2,000 MW**
Biofuel Power	**1,400 MW**
Ocean Power	**200 MW**
Geothermal Power	**150 MW**
Hydrogen Power	**200 MW**

Ways To Improve Energy Security

- Taiwan has passed the "Renewable Energy Development Act" on July 8, 2009 to develop clean energy.
- However, we should note the following limitation of renewable energy development.

The limitation of renewable energy

1. more costly than the traditional fuels
2. unstable power supply
3. resource of renewable is limited in Taiwan
4. Hydro energy shares 0.3 percent of total energy supply only
5. High population Density (637 persons/km^2)
6. 2/3 of land is mountain area

Ways To Improve Energy Security

- Enhance the international competitiveness of Taiwan's Renewable Energy Industries.

R&D for renewable energy

To strengthen the R&D for renewable is essential to increase the long-term competitiveness of Taiwan's renewable energy industries.

Strong competitiveness in the ICT industry

The production values of 14 ICT products in Taiwan rank either No. 1 or No. 2 in the world. The productive values of LED chips and solar PV in Taiwan ranked No. 1 and No. 4, respectively, in the world in 2008.

Ways To Improve Energy Security

- On April 16, 2010, Taiwan's government promulgated the Industrial Innovation Bill and amended the Income Tax Bill, lowering the corporate income tax rate from 25% to 17%.
- Taiwan also signed the Economic Cooperation Framework Agreement (ECFA) with mainland China on June 29, 2010.
- Those will further increase the competitiveness of Taiwan's industries, including renewable energy industry.

Ways To Improve Energy Security

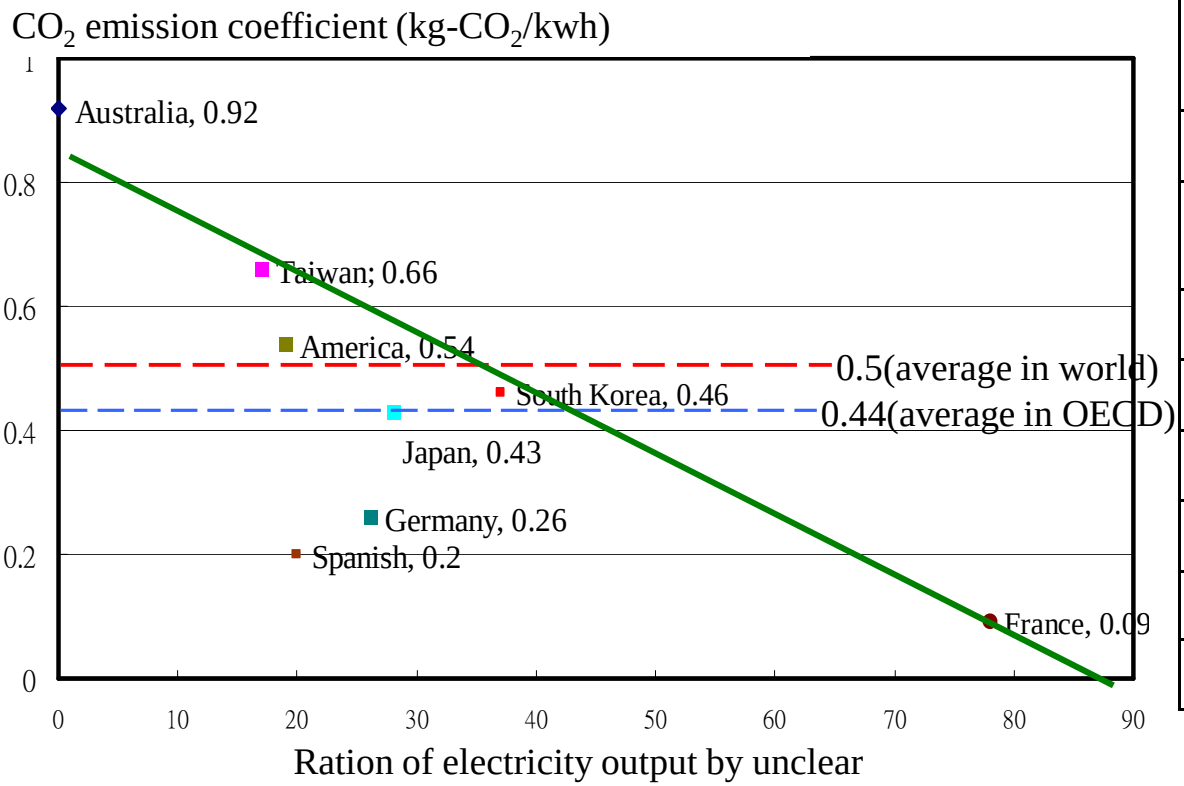
2. Reevaluate the "Nuclear Free Homeland" policy.

Reasons:

1. The electricity sector emits around 60% of CO_2 in Taiwan.
2. The CO_2 emission per kWh was 0.63 kilogram much higher than most of countries (for instance, U.S., Japan and Korea were 0.52, 0.42 and 0.44).
3. Risk of energy insecurity
4. Increase of fossil fuel cost
5. Nuclear free homeland policy has reversed in the world after the Kyoto protocol and oil price surge.

The electricity strategy of carbon reduction in OECD

CO_2 Emissions from Fuel Combustion (IEA,2009 edition)



Country	Nuclear	Renewable Energy (include Hydro-electricity)
France	**78**	**11(11)**
South Korea	**37**	**1(1)**
Japan	**28**	**10(9)**
Germany	**26**	**12(4)**
Spanish	**20**	**18(1)**
America	**19**	**10(7)**
Taiwan	**17**	**4(3)**
Australia	**0.0**	**7(6)**

- According to "Paradigm of carbon reduction in OECD" in 2006 (the CO_2 emission coefficient is lower than 0.44), in Germany, South Korea, Japan and Spanish, their ratios of non-carbon energy were 38%, and the CO_2 emission coefficient was 0.46~0.37, due their higher electronic supply by low-carbon energy.
- Developing renewable energy is not an easy job because of the geographical environment and climate. Taiwan will make the maximum ratio of electronic supply by renewable energy up to 8% in 2025.Besides, referring to the policies of above benchmark countries, Taiwan will increase nuclear power (up to 30%) and LNG electricity to make the CO_2 emission coefficient lower than 0.44, the paradigm of OECD.

Ways To Improve Energy Security

3. Adopt a rational energy pricing policy

- Taiwan's energy prices were one of the lowest countries in the world
- Since state-owned Chinese Petroleum Corporation and Taiwan Power Company enjoy monopolistic power in Taiwan's oil and electricity market, respectively, there are always pressures asking government to intervene the energy markets when import energy prices increase.
- The former government even strongly intervened the domestic energy market. The energy prices were 'frozen' when crude oil price increased from USD $80 to USD $147 per barrel during Nov. 2007-May 2008.

Ways To Improve Energy Security

- State-owned Chinese Petroleum Corporation and Taiwan Power Company lost NTD$120 billion and NTD$75 billion, respectively, in 2008
- Since June 2008, the new government has unfrozen the energy prices and adjusted upward: oil price by 15 percent, electricity by 25 percent and natural gas by 30%.
- As a result, under the new government, the energy intensity has decreased by 7 percent in the second half of 2008

Ways To Improve Energy Security

The tax revenue should be used

1. To reduce the personal and business income tax rate
2. replace the commodity tax, entertainment tax, stamp tax on automobiles, and cement and fuel taxes on automobiles
3. To lower the burden of social welfare (retirement fund and Medicare) of the employers
4. Subsidies of energy expenses to the low income families
5. To purchase CO_2 emission credits from abroad
6. To refund the enterprises with outperforming energy efficiency.

   Except item 6, the others are the consensus and resolution of National Energy Conference in 2009.

- **Ministry of Finance is drafting the "Energy Tax Bill" to reflect the external cost of CO_2 emission**

Ways To Improve Energy Security

4.Strengthen regulation of the energy efficiency rate

Several key recommendations for enhancing Taiwan's energy efficiency are suggested in the following.

A. Increase the minimum energy efficiency standards routinely and implement these standards effectively
B. Combine comparative labels for energy performance based on the concept behind Japan's Top Runner program
C. Replace typical light bulbs with high-efficiency light bulbs
D. Promote green building and enhance building insulation
E. Promote high-efficiency vehicles
F. Establish credits for early action programs in order to reward
G. industrial entities that achieve greenhouse gas reductions

Ways To Improve Energy Security

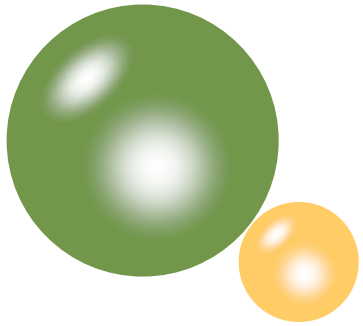
5. Reform the industrial structure

Taiwan's aforementioned energy prices are some of the lowest in the world and do not fully reflect internal and external costs. The price signal is too weak to provide sufficient incentive to reduce energy consumption and restructure industry.

To solve this problem, the government is planning to take the following measures:

- Promote less energy-intensive industries, such as the service, biotechnology and medical care industries.
- Demand that energy-intensive industries (such as the steel, cement, petroleum and chemical industries) provide CO2 offset plans when investing in new projects.

Conclusions



Conclusions

Taiwan's low energy security could be attributed to

- the lack of domestic energy resources
- high concentration of energy supply
- high CO2 emissions per KWh of generated electricity,
- high share of exports in GDP and low energy efficiency of the economy.

To improve the energy security of Taiwan, the government should:

- increase the use of low carbon energy, such as renewable energy, natural gas and nuclear power
- implement a rational energy pricing policy
- implement a carbon tax and green tax reform
- reform the industrial structure
- strengthen the energy efficiency regulation of all kinds of high energy-use products, vehicles and buildings.

Thank You