MOEA

Perspective on a Hydrogen Economy in Taiwan

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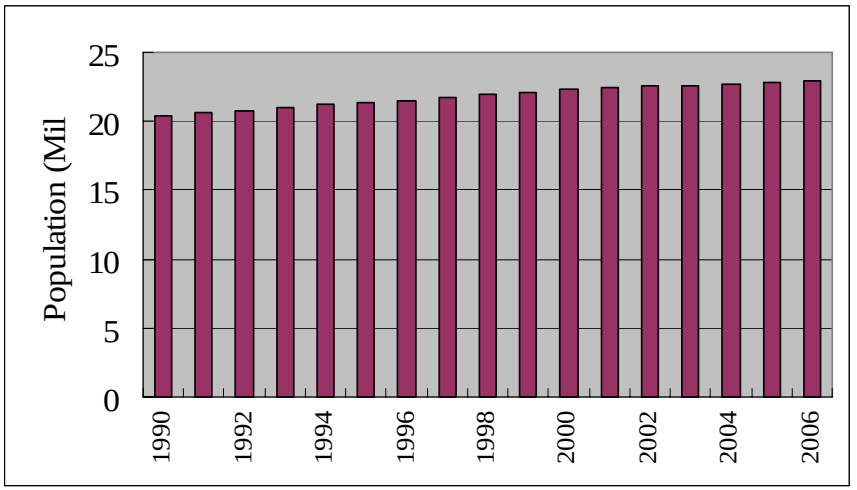
Taiwan - Formosa

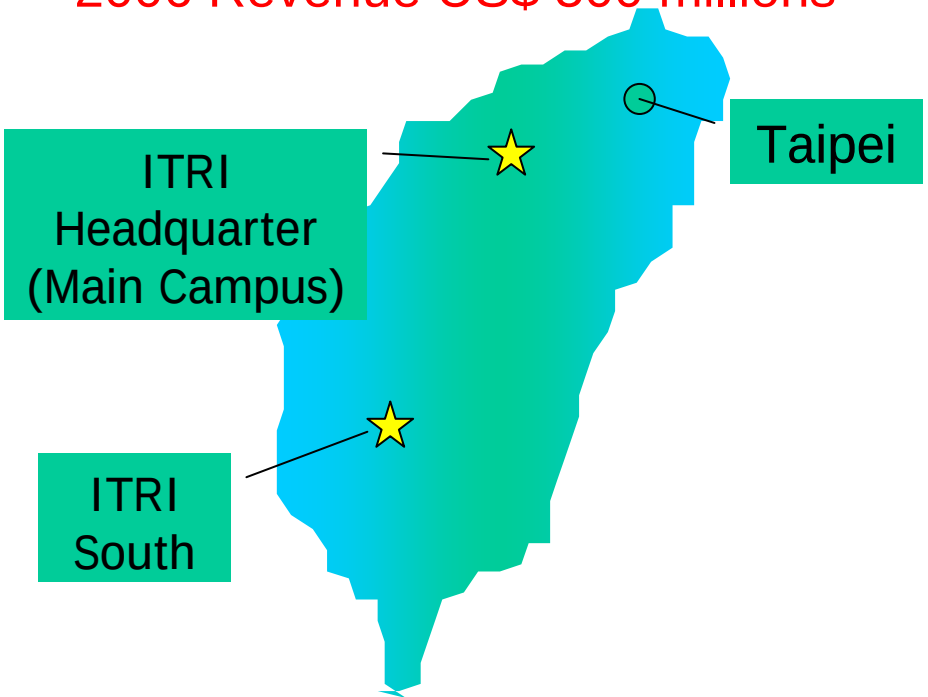
CAPITAL: Taipei
SYSTEM OF GOVERNMENT:
Multiparty Republic
AREA: 36,174 Sq km (13,967 Sq Mi)
ESTIMATED 2007 POPULATION:
23 millions



ITRI Profile

Industrial Technology Research Institute

- Founded in 1973 by the government
- A non-profit R&D organization
- Over 6,000 employees
- 2006 Revenue US$ 500 millions



6 Core Laboratories

- Biomedical Engineering
- Electronics and Optoelectronics
- Energy and Environment
- Information and Communications
- Material and Chemical Research
- Mechanical and Systems

5 Focus Centers

- Display Technology
- Medical Electronics and Devices
- Photovoltaics Technology
- RFID Technology
- SoC Technology

ITRI

Industrial Technology Research Institute







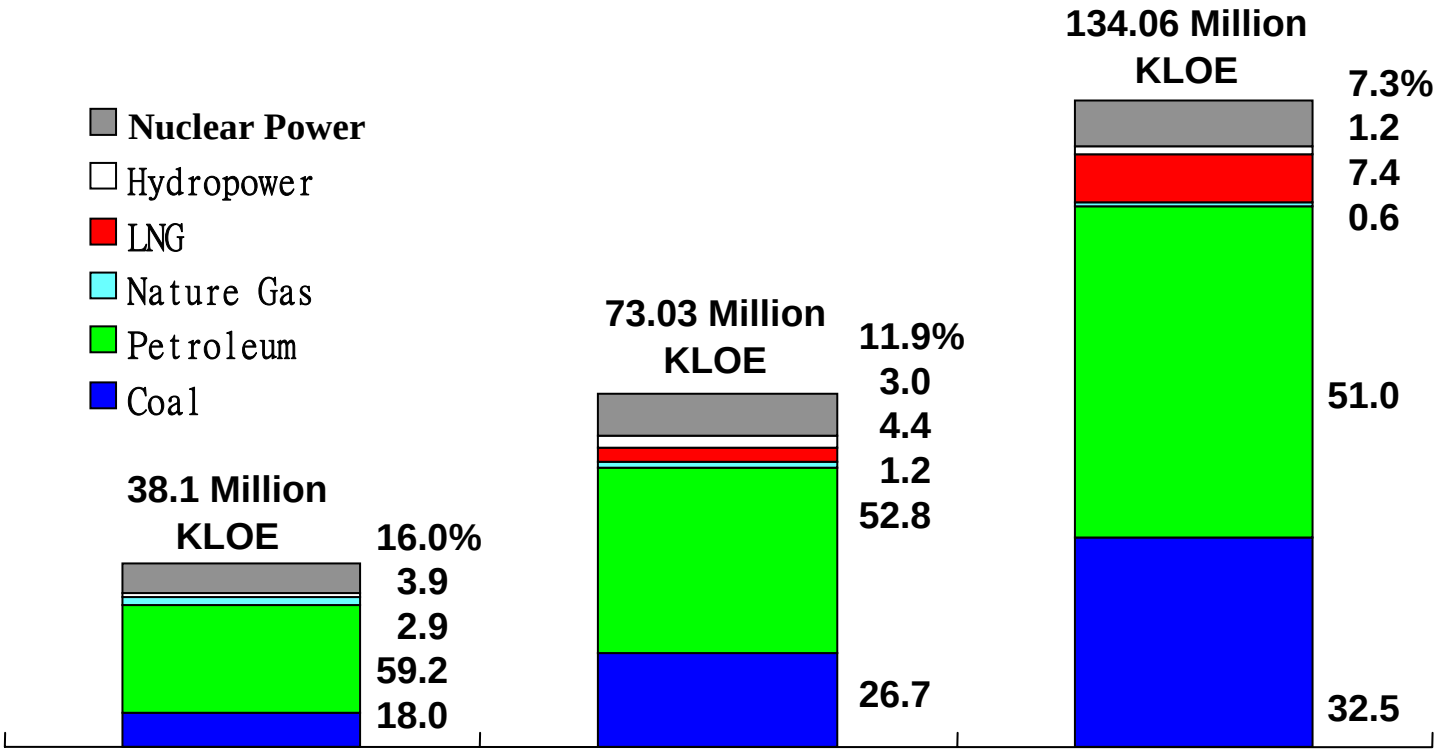


R&D Staff：6,000　　Total Patents：7,230

Ph. D.：　900　　Start-Ups Co.s：　135

Structure of Energy Supply in Taiwan

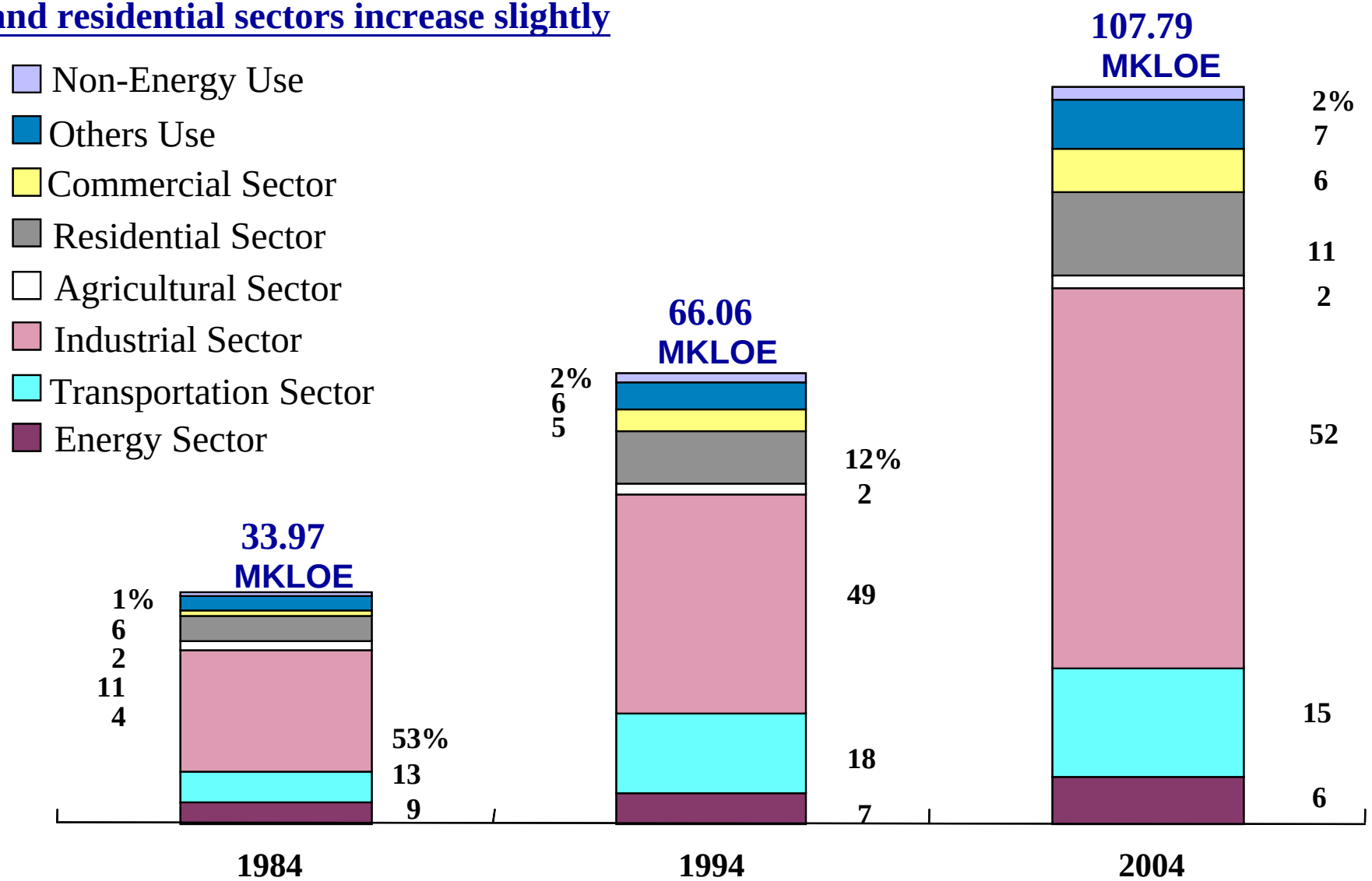
- Due to the shortage of indigenous energy, more than 97.9% of energy is imported.
- Imported crude oil is the major portion of energy supply and 76.7% of it is from the Middle East.
- During 1984~2004, average annual growth rate of energy supply is 6.4%



Dependence of imported energy： 1984 88.8% → 1994 95.3% → 2004 97.9%

Structure of Energy Consumption (by Sector)

↓**The shares of energy consumption in commercial and residential sectors increase slightly**



The Push for Renewable Energy

	2004	2010	2020
	Accumulated Capacity (MW)	Accumulated Capacity (MW)	Accumulated Capacity (MW)
Hydro	191.1	216.8	250
Wind	1.25	215.9	250
Photovoltaic	0.0561	2.1	40~70
Geothermal	0	5	10
Biomass	56.169	74.1	100
Total	248.58	513.9	650~680
Total Share of Renewable Generation	**5.72%**	**10%**	**12%**

Investment in H_2 Technological Researches

- Government spending in hydrogen researches amounts to 20% of the total government investment in energy researches.

	2003	2004	2005	2006
Public Budget	NT$ 250 M (US$ 7.6 M)	NT$ 260 M (US$ 8.1 M)	NT$ 350 M (US$ 11.1 M)	NT$ 400 M (US$ 12.1 M)
Private Investment	NT$ 100 M (US$ 3 M)	NT$ 100 M (US$ 3 M)	NT$ 100 M (US$ 3.1 M)	NT$ 120 M (US$ 3.6 M)
Total	NT$ 350 M (US$ 10.6 M)	NT$ 360 M (US$ 11.1 M)	NT$ 450 M (US$ 14.2 M)	NT$ 520 M (US$ 15.8 M)

Hydrogen Subsidiary Program

- Part of the Renewable Energy Development Act
- Currently under public review and pending for congressional approval
- Scheduled to be effective in 2008
- Tentative program contents
  - Subsidy for fuel cell generation system with and without reformers
  - Subsidy for hydrogen production system using renewable energy sources

ITRI PEMFC & H_2 Technology Development II

Hydrogen Infrastructure Technology Development

Distributed Hydrogen Production(H_2>10 Nm^3/hr @ η_{th} > 80%, FER) and Storage(> 4wt% material-based) Technology, and Analysis and Modeling of H_2 Economy

☆ Hydrogen Production/Storage

- Improvement of fossil-based reformation technologies & energy system
- Pre-study of long-term, advanced H_2 production/storage technologies
- Domestic hydrogen resources projection a priori

☆ H_2 Economy Evolution & System Demonstrations

- Establishment of H_2-economy modeling capability
- Laws & regulations adaptation and adoption
- Hydrogen energy system demonstrations

2005	2006	2007	2008
US$ 5 M	5.3 M	6.7 M	(7.5 M)

PEMFC Applications Development

Small Stationary PEMFC System Applications and Development (η_{th} > 70%, Durability > 2500 hrs)

☆ System Durability Improvement & Cost Reduction

- High performance stationary/portable system development
- Key components commercialization
- High performance NG/MeOH/LPG reformer development

☆ PEMFC Applications & Demonstrations

- Alliance/partnership, education and training
- Laws & regulations adaptation and adoption
- Hydrogen energy system integration and demonstrations

Hydrogen Energy Technology Demonstration and Applications

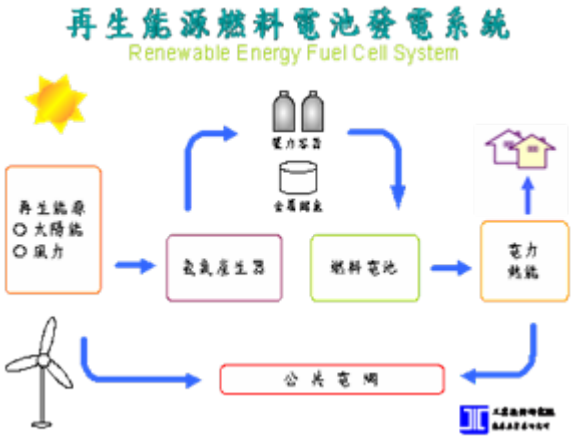
Establishment of a Hydrogen Infrastructure and Fuel Cell Demo and Testing Station by 2008

Demonstration of a PEMFC System Integrated with Renewable Energy by 2007

PEMFC CHP System Demonstration and Field Trials

PEMFC CHP Stationary System Demo & Durability Test

Renewable+Electrolyzer+H_2 storage & FC System Demo (20kW Grid Connected)

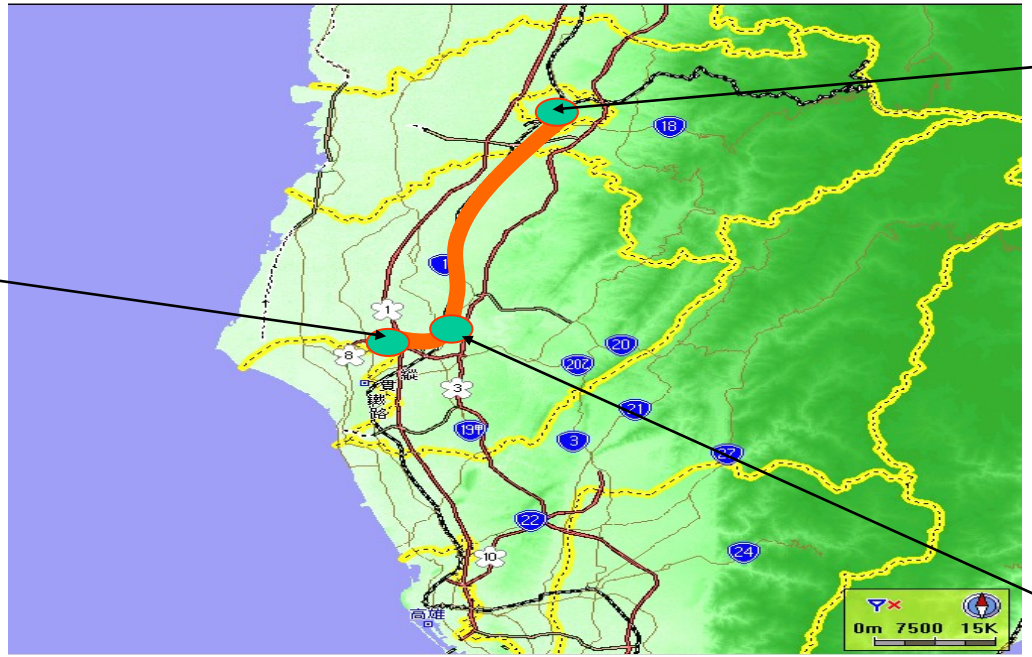


H_2 infrastructure & fuel cells technology test center and the first hydrogen fueling station in Taiwan at ITRI southern Campus (2007-2010)

A Mini-hydrogen Corridor Concept (2008-2010)

Refining & Manufacturing Research Institute

Southern Taiwan Science Park



ITRI Southern Campus

Fuel Cell Bus & Car

Hydrogen Fueling Station

Summary of Current Status

- Both the government and the industry are investing heavily in H_2 R&D, seeking opportunities to play a role in the future hydrogen economic development.
- Significant progress has been made for PEMFC CHP stationary system development in Taiwan and small scale field demonstrations are underway.
- There is a substantial long-term resource commitment from public sector to hydrogen technology R&D and subsidiary program.
- A complete roadmap toward hydrogen economy transition is not yet finalized.

Chances and Challenges

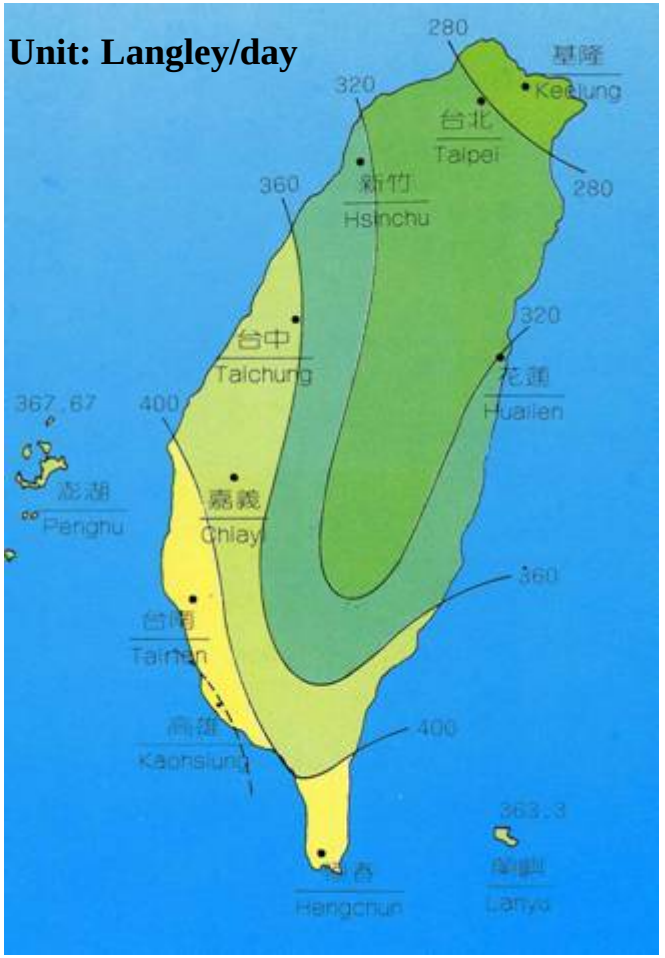
- Lack of indigenous resources creates a strong demand for an energy policy that will enhance energy security.
- However, hydrogen economy modeling for the best scenarios is required before a transition roadmap would be accepted by the policy makers.
- International cooperation, e.g. IEA and IPHE, on hydrogen economy modeling, demonstrations, public education, and standards & codes will cut cost and accelerate early markets development and the hydrogen transition in Taiwan.

Chances and Challenges (continued)

- The wide spread deployment of natural gas pipelines currently in Taiwan makes distributed and on-site hydrogen production from natural gas reforming the most feasible solution in the early transition.
- High cost is the major hurdle to the adoption of FC and H_2 energy by the general public.
- Taiwan's manufacturing and system integration capability can help to reduce the cost dramatically, by actively participating in the international development and establishing a global production chain.

Perspective on a Renewable Hydrogen Economy

- **Short of indigenous energy ?**
  - The amount of solar energy reaching the land of Taiwan every year is **2.0×10^8 TJ**
- **Hydrogen or Bio-ethanol ?**
- **Stationary or Transportation ?**



Thank you for your attention

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Sponsored by the Bureau of Energy/Ministry of Economic Affairs/Taiwan