

***International Conference
Governance on Green Energy and Carbon Reduction***

***Current Initiatives and Strategy
of Green Energy Development in Taiwan***

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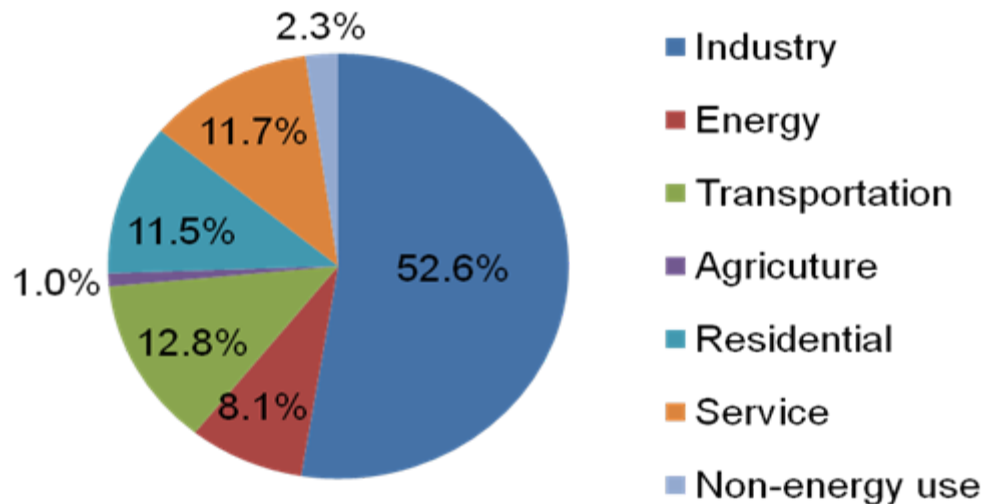


1. Challenges & Opportunities

Energy Situation of Taiwan

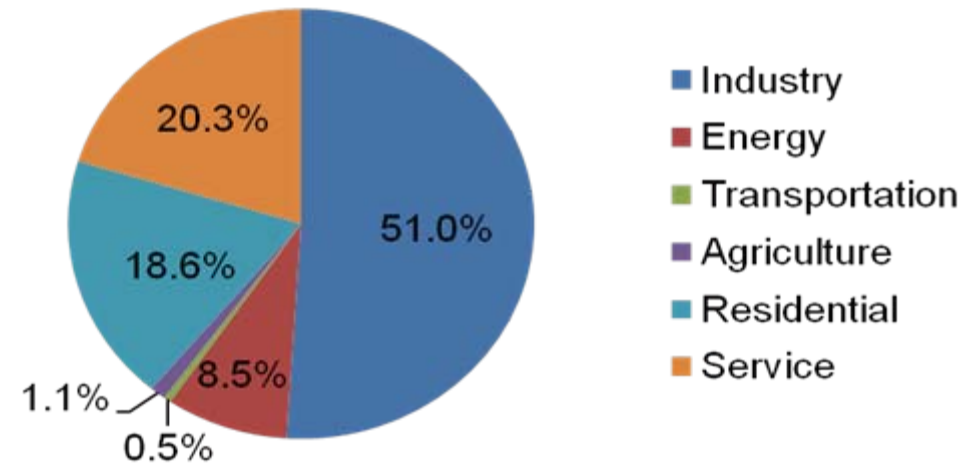
- In 2008, more than 99% of energy was imported, roughly 1% of global consumption.
- In terms of *final energy* consumption, the share of the industrial sector was 52.6%, the residential and service sectors 23.2% and the transportation sector 12.8%.
- In terms of *electricity* consumption, the share of the industrial sector was 51%, and the residential & service sectors 38.9% (the fastest growth rate).

Final energy consumption, 2008



Total: 117.7 million kLOE

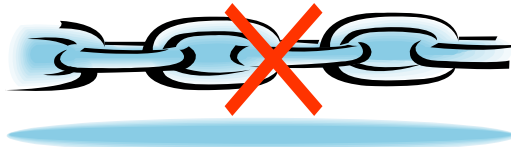
Total electricity consumption in 2008



Total: 229.8 billion kWh

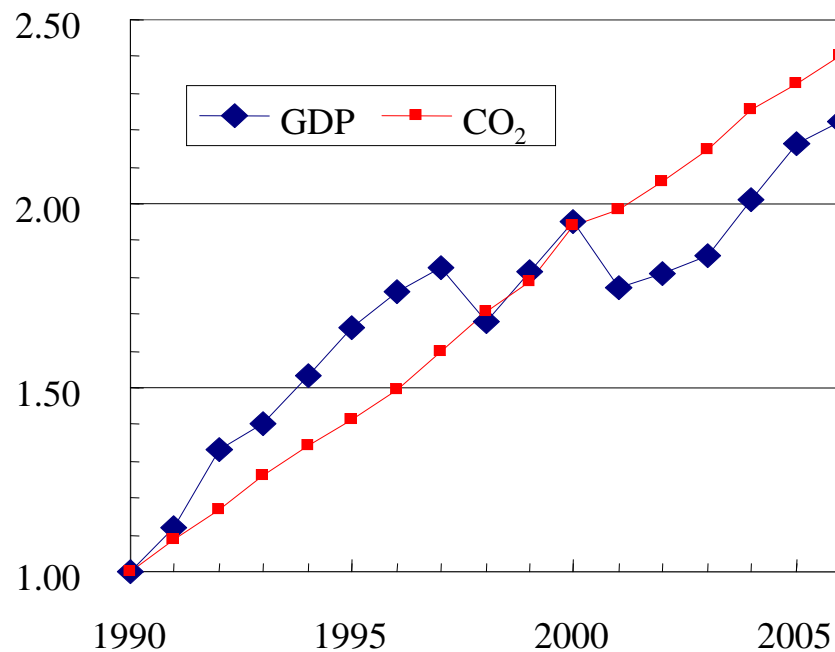
The Challenge – Energy Productivity & De-carbonization

CO₂ emission

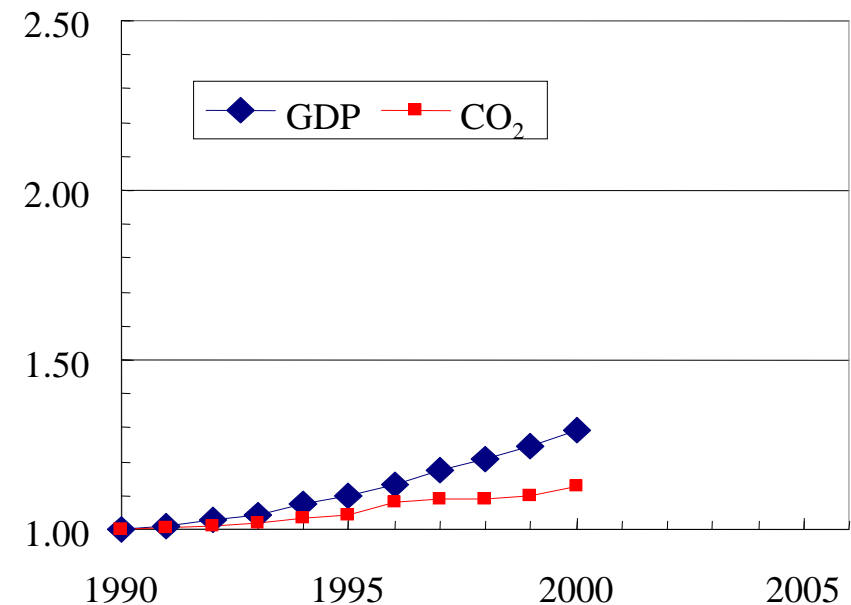


GDP growth

Taiwan



OECD countries



Base Year

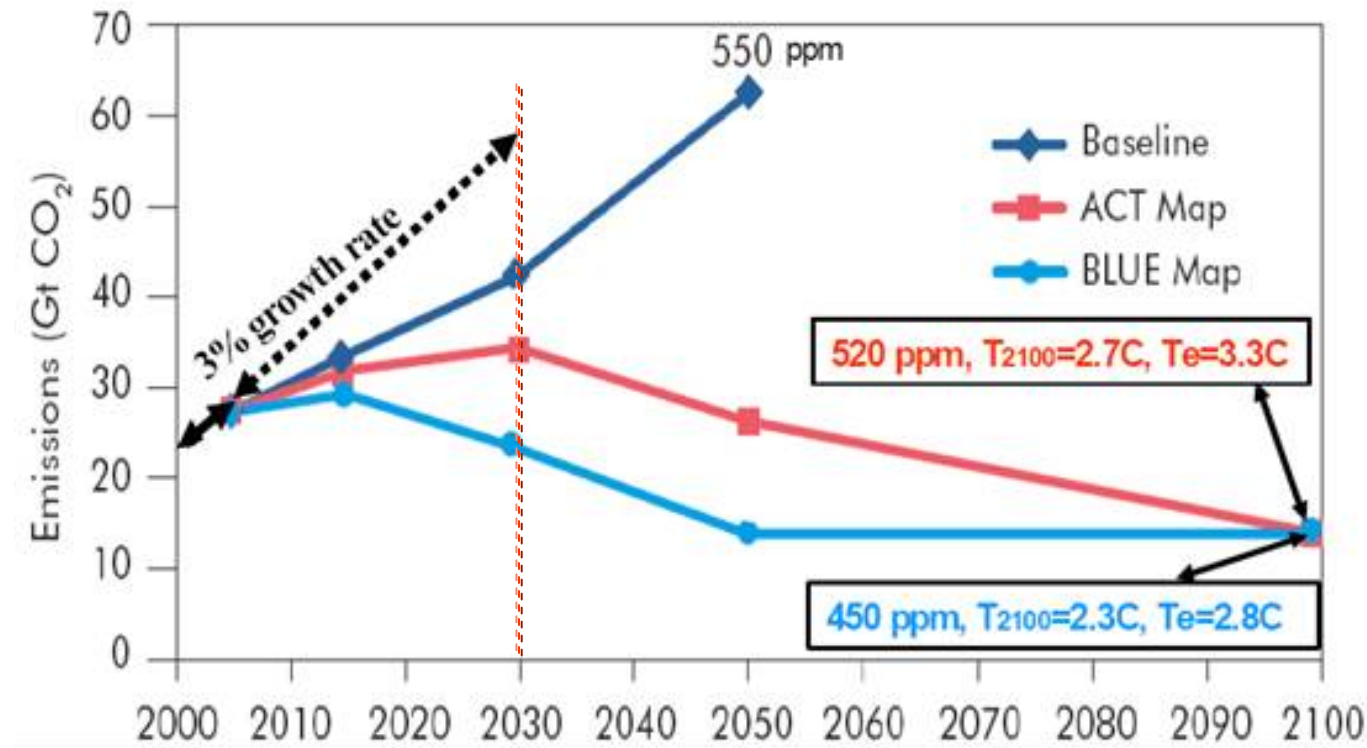
Year

Base Year

Year

The Global Challenge – Climate Change

- CO₂ emission **REDUCTION** (-1%~ -3%) must be achieved to minimize temp. rise
- New (breakthrough) technologies are expected to contribute by 45%~ 75%

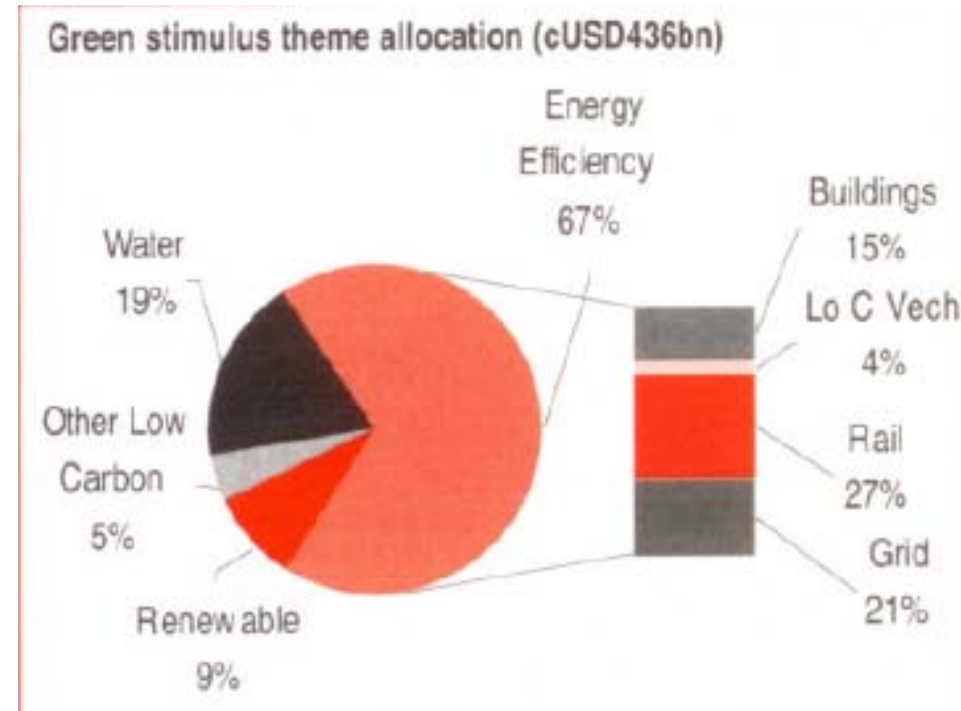
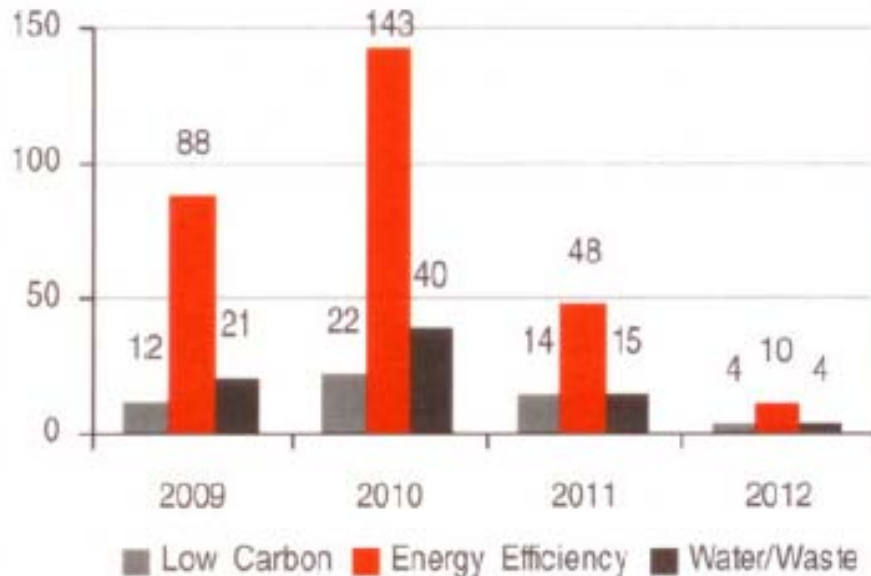


Sources: 1. Energy Technology Perspectives 2008, IEA
2. 2009 Annual Conference & Exhibition, AWMA

Global New Opportunities & Trends

- As governments struggle to revive their economies with stimulus packages, they are also seeking to lay the foundation for future growth, which is increasingly linked with
 - the climate change agenda
 - the low-carbon society

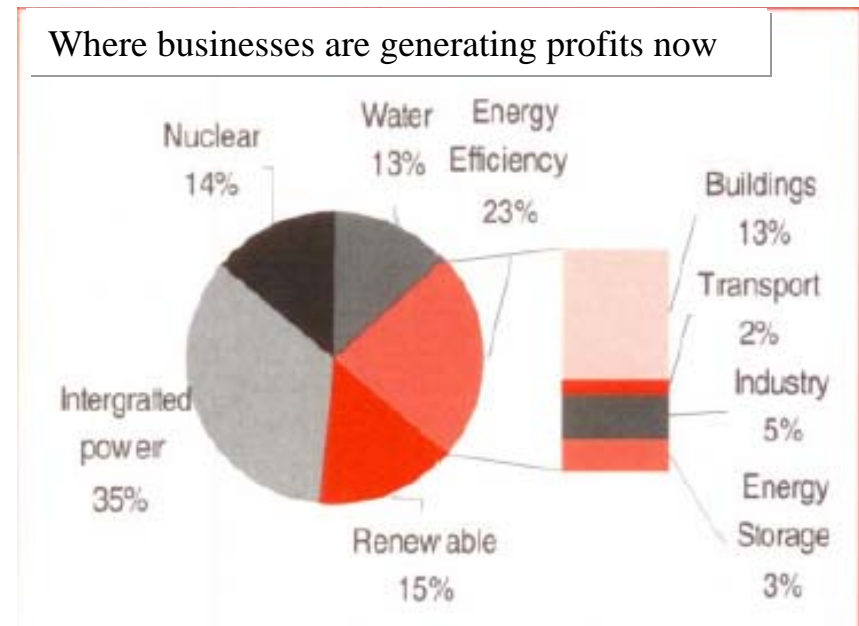
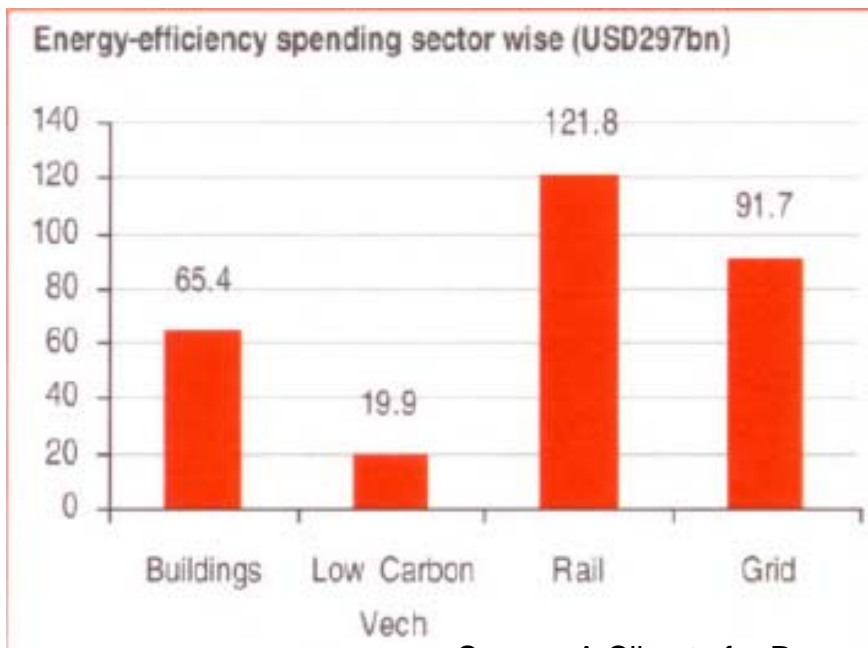
Estimated timing by theme (USDbn)



Source: A Climate for Recovery-the Color of Stimulus Goes Green, HSBC Global Research, Feb 2009

Global New Opportunities & Trends (cont'd)

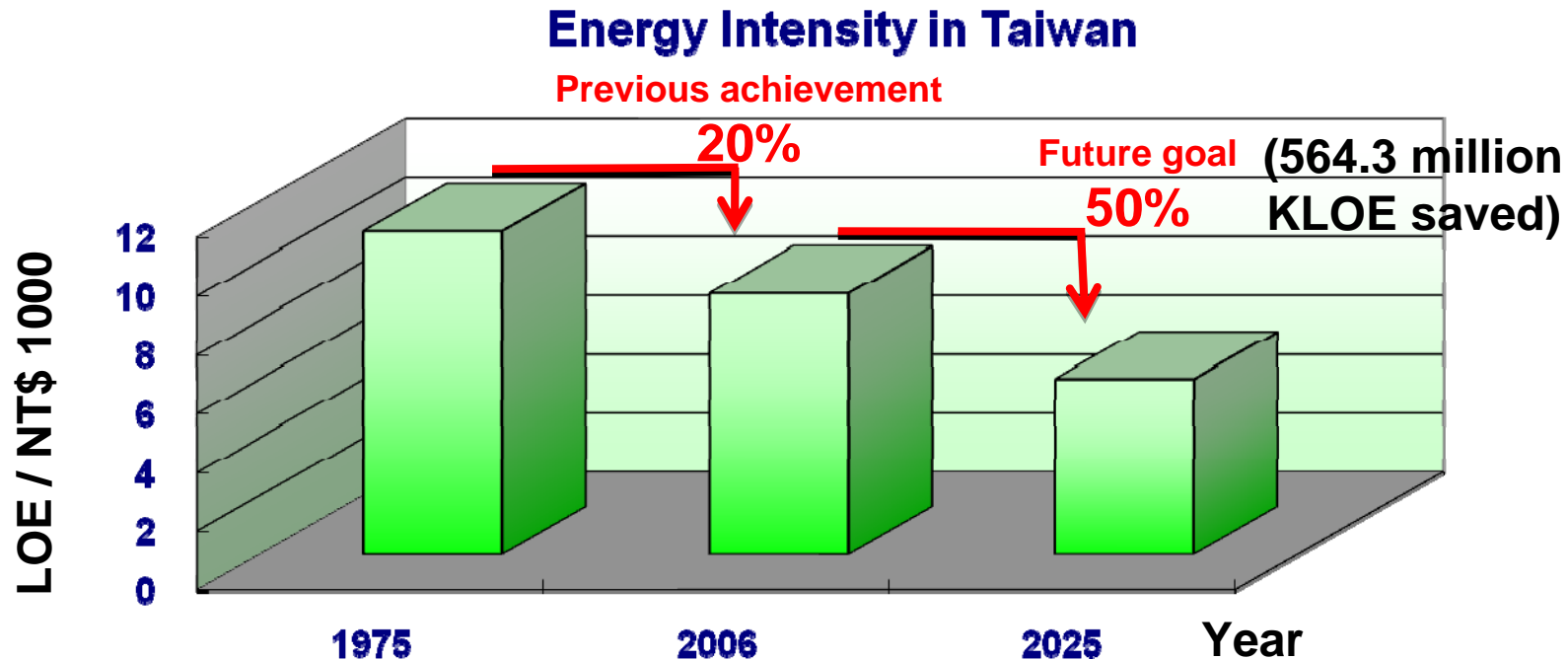
- The stimulus commitments are also using the green growth for domestic job creation to fulfill the important social need
- The fiscal packages also signal where future growth may be intensified and business opportunities created



Source: A Climate for Recovery-the Color of Stimulus Goes Green, HSBC Global Research, Feb 2009

The New Opportunity – Energy Efficiency

- The “low-hanging fruit” and no-regret policy of energy efficiency must be harvested and strengthened to buy time for transition

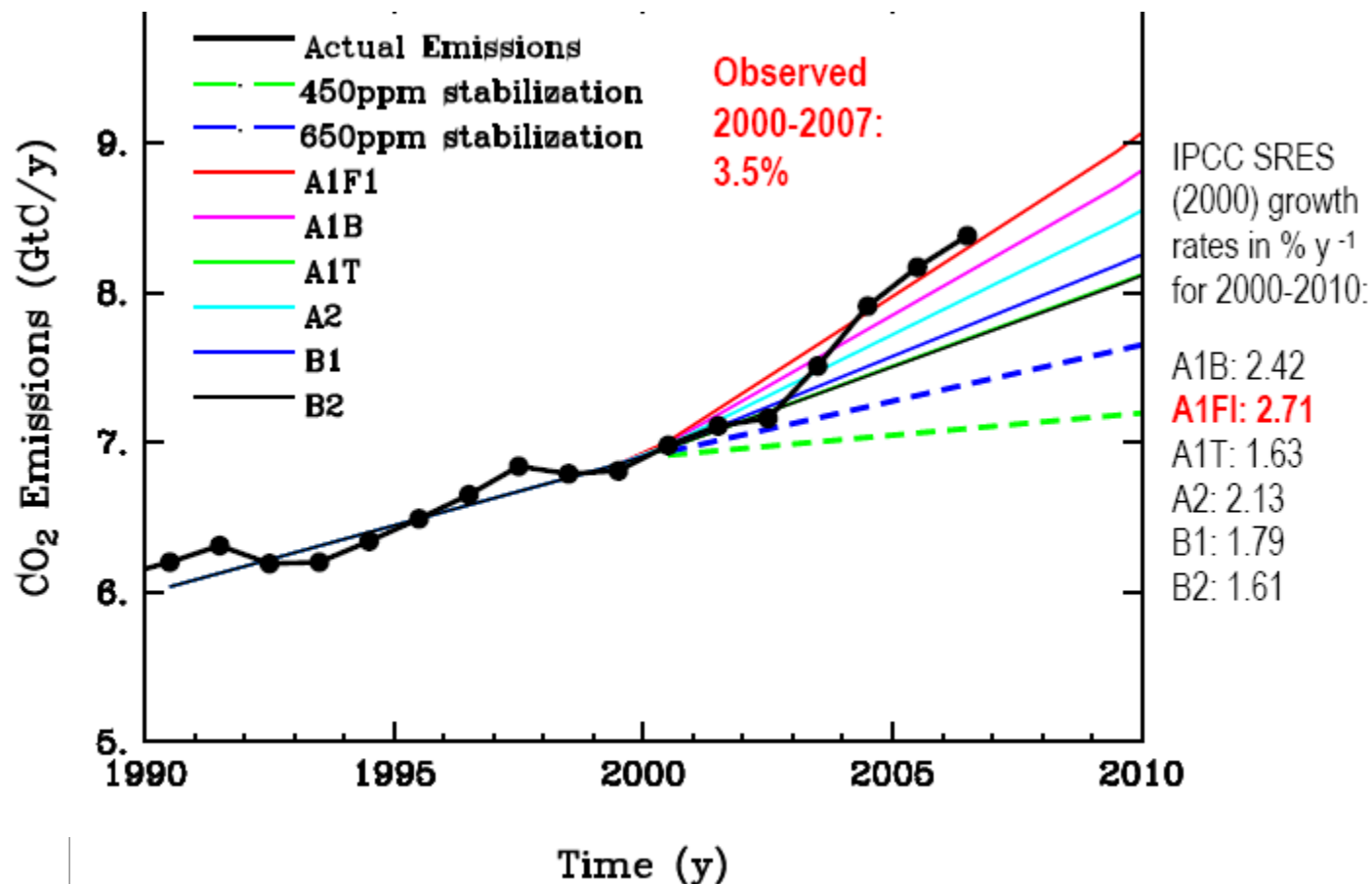


- For instance, Taipower rebates residential & public-sector customers for energy saving by up to 30% of electricity bills

- 39% of users qualified for the rebate July '08-June '09, 4.5 million MWh electricity saved relative to the last same period (equiv. 60% of annual consumption of Taipei City), more than 7700 Da-An Park's sequestration capacity (28.8 million tons CO₂)

The New Opportunity – Energy Efficiency

- Experience and evidence indicate efficiency alone is not enough
- Low-carbon technologies and, perhaps, life-style shifts along with macro economic adjustments are necessary to arrest the emission growth



The New Opportunity – Convergence of Green Tech & Low Carbon Society

Consensus agreement reached in the 2009 National Energy Conference for charting future energy policy and research & development priorities

■ Aim for a low-carbon society

- Reduce carbon emission to the level of 2008 during 2016 ~ 2020
- Reduce carbon emission to the level of 2000 by 2025 (close to IEA's "450 Policy" scenarios of 2030)
- Reduce the overall energy intensity by at least 2% annually for the next 8 years, and by 50% by 2025
- Increase the supply of low carbon energy to at least 55% of the power generation mix by 2025

■ Intensify public efforts

- Accelerate the deployment of renewable energy and improvement of energy efficiency
- Implement "Flagship Program of Green Energy Industry"
- Initiate the "National Energy R&D Program"
- Begin the low carbon community/city demonstration planning

Taiwan's Renewable Energy Development Act (REDA)

- **Approved by Legislative Yuan on 12 June, 2009**
- **Goal: 6,500~10,000 MW (new installation)**
- **Electricity utility companies are obliged to connect and purchase (with subsidy) renewable electricity, and contribute to the Renewable Energy Fund**
- **Feed-in tariffs of renewable electricity will be calculated every year**
- **Renewable powers in early stage of development and thermal utilization of renewable energy are eligible for subsidy**
- **New or refurbished public buildings and infrastructures must employ renewable energy**

2. Green Energy Technology & Industry Development



National Energy R&D Program (NEP) (1/2)

- **A program led by National Taiwan University along with other major academic institutes**
- **NT\$ 30B for FY2009~2013**
- **Aim to develop the fundamental energy science and technologies needed to achieve the policy goals of 3 E's**
- **Focus on four areas:**
 - **Energy technology policy**
 - **Energy conservation & carbon reduction**
 - **Energy technology**
 - **HR education & training**

National Energy R&D Program (NEP) (2/2)

Energy Conservation & Carbon Reduction

- clean coal & CCS
- HVAC
- green building
- transportation energy saving
- industrial energy saving
- lighting & appliances
- forestation
- smart grid
- AMI

Energy Technology

- solar energy
- wind power
- biomass
- ocean energy
- hydrogen energy
- nuclear energy
- geothermal energy

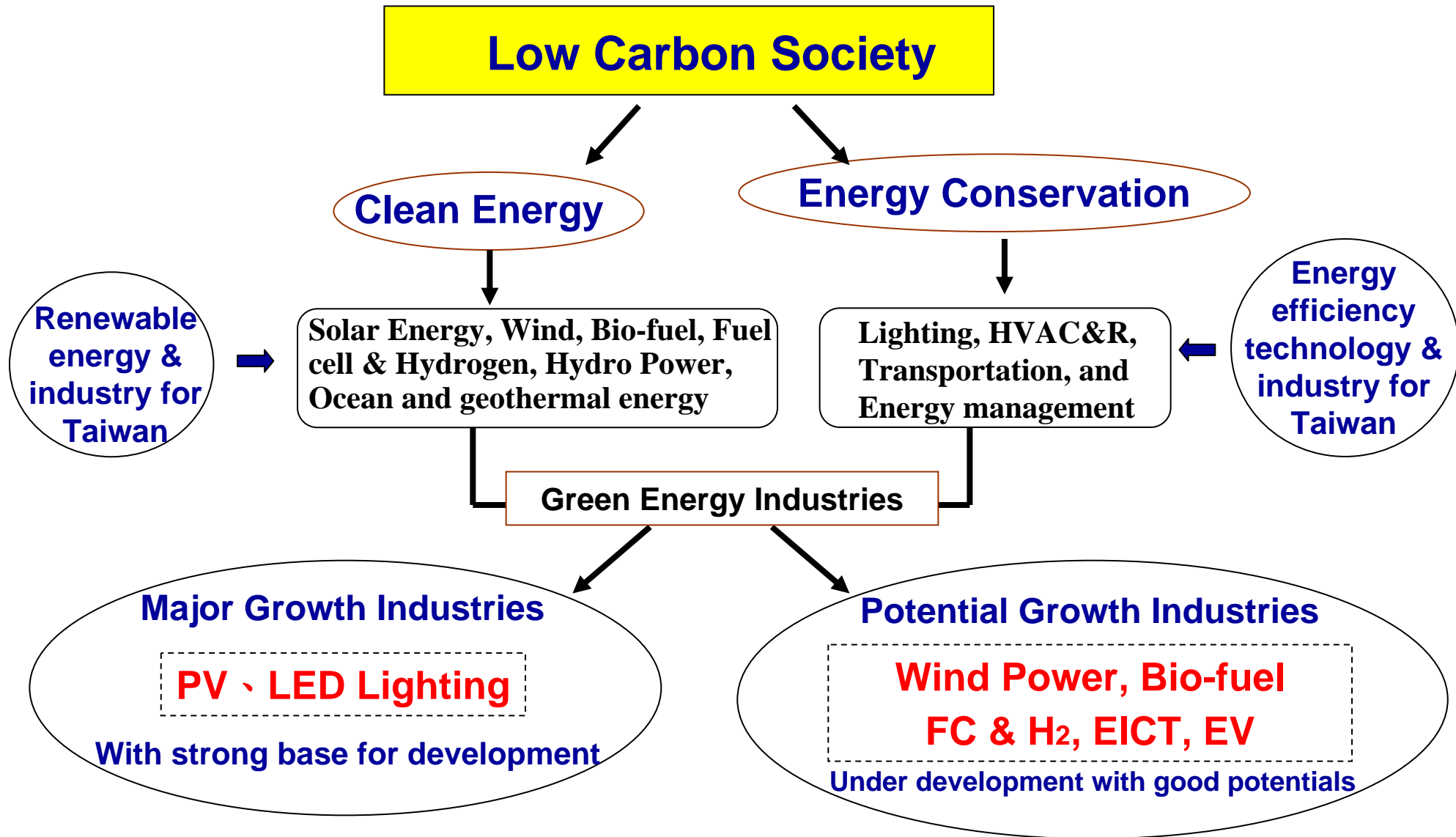
Energy Technology Policy

- energy conservation & carbon reduction
- new energy industry
- energy security

Education & Training

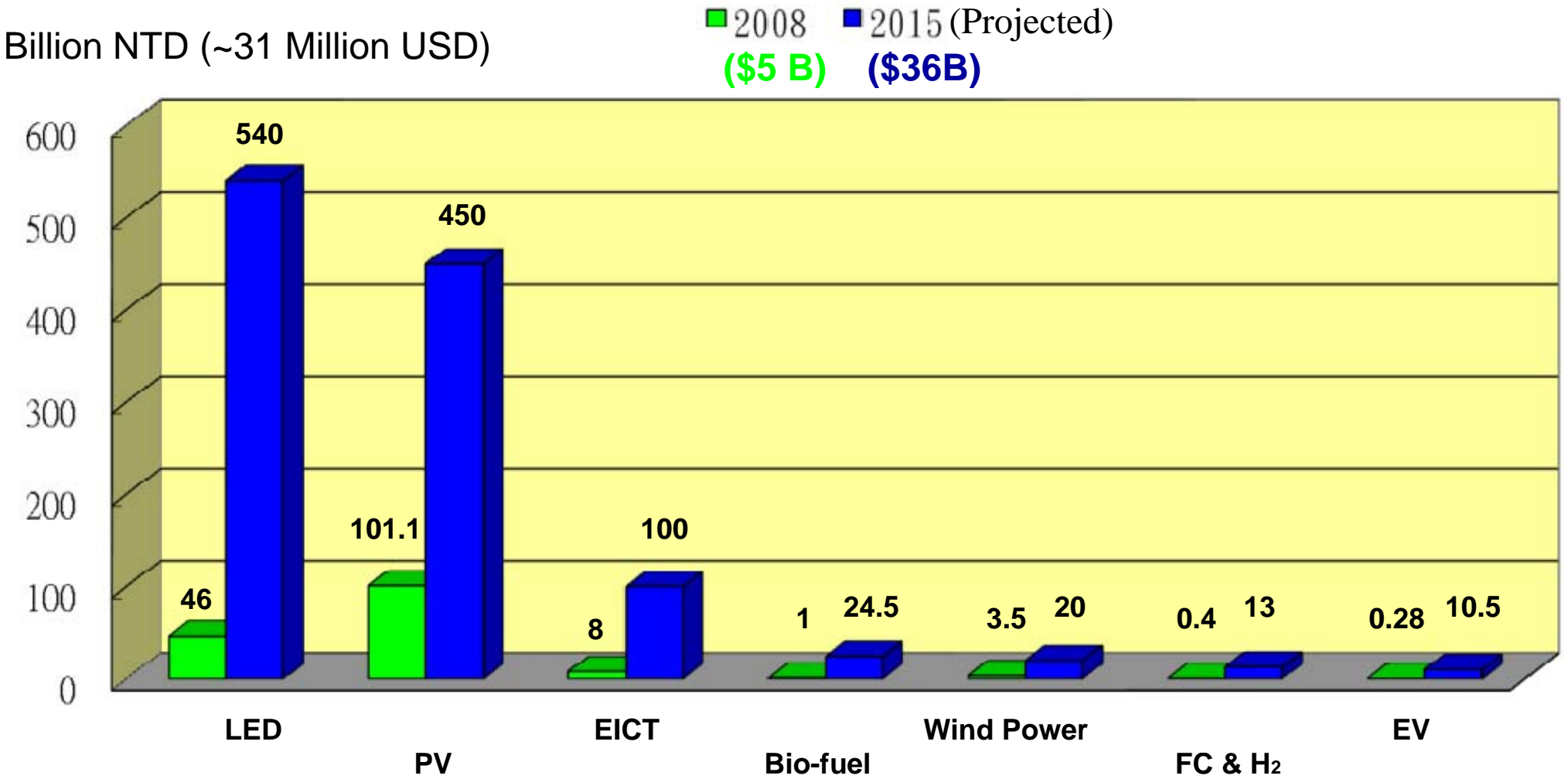
- research on teaching skills
- school education
- public awareness

Green Energy Industry Program (1/3)

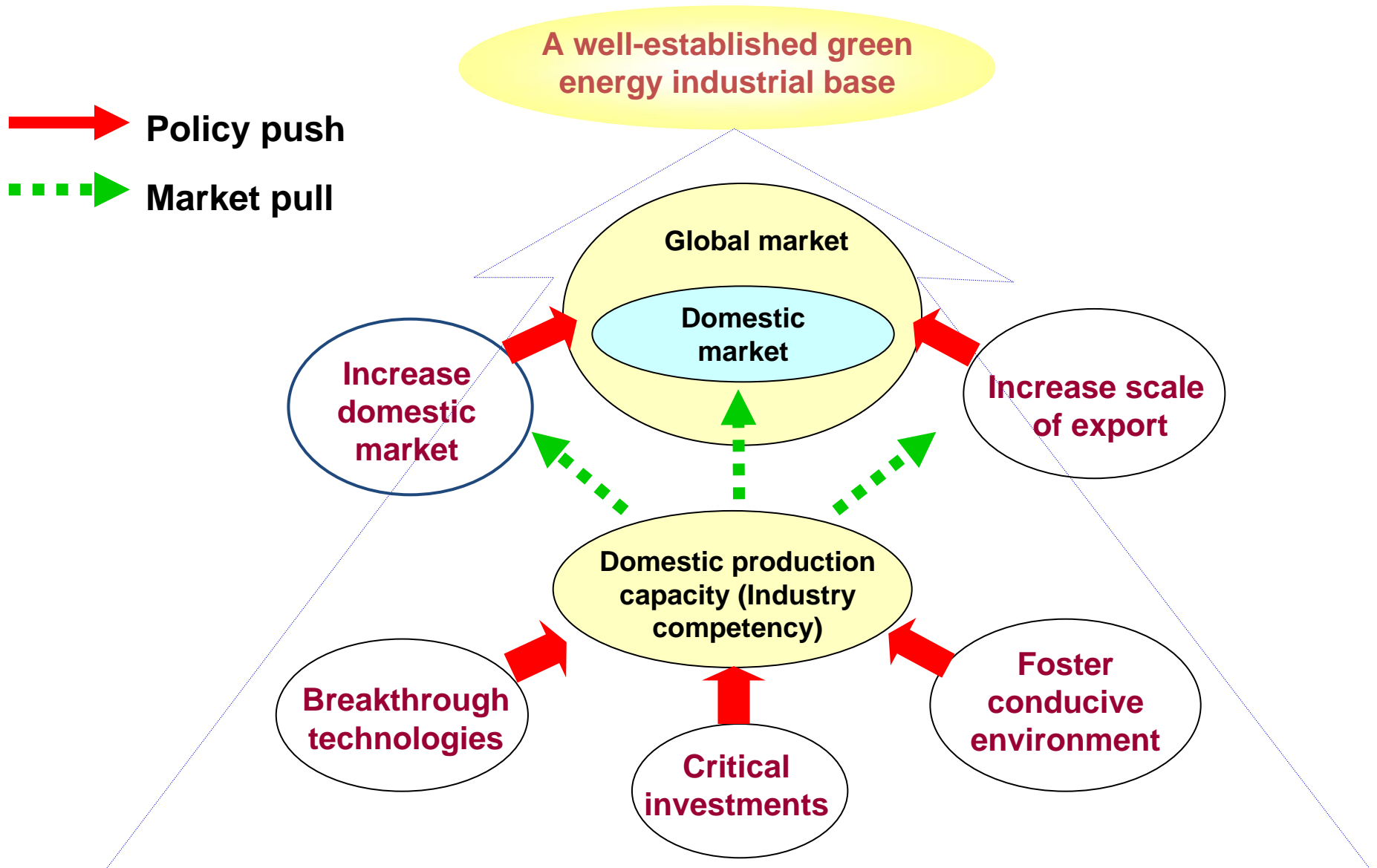


Green Energy Industry Program (2/3)

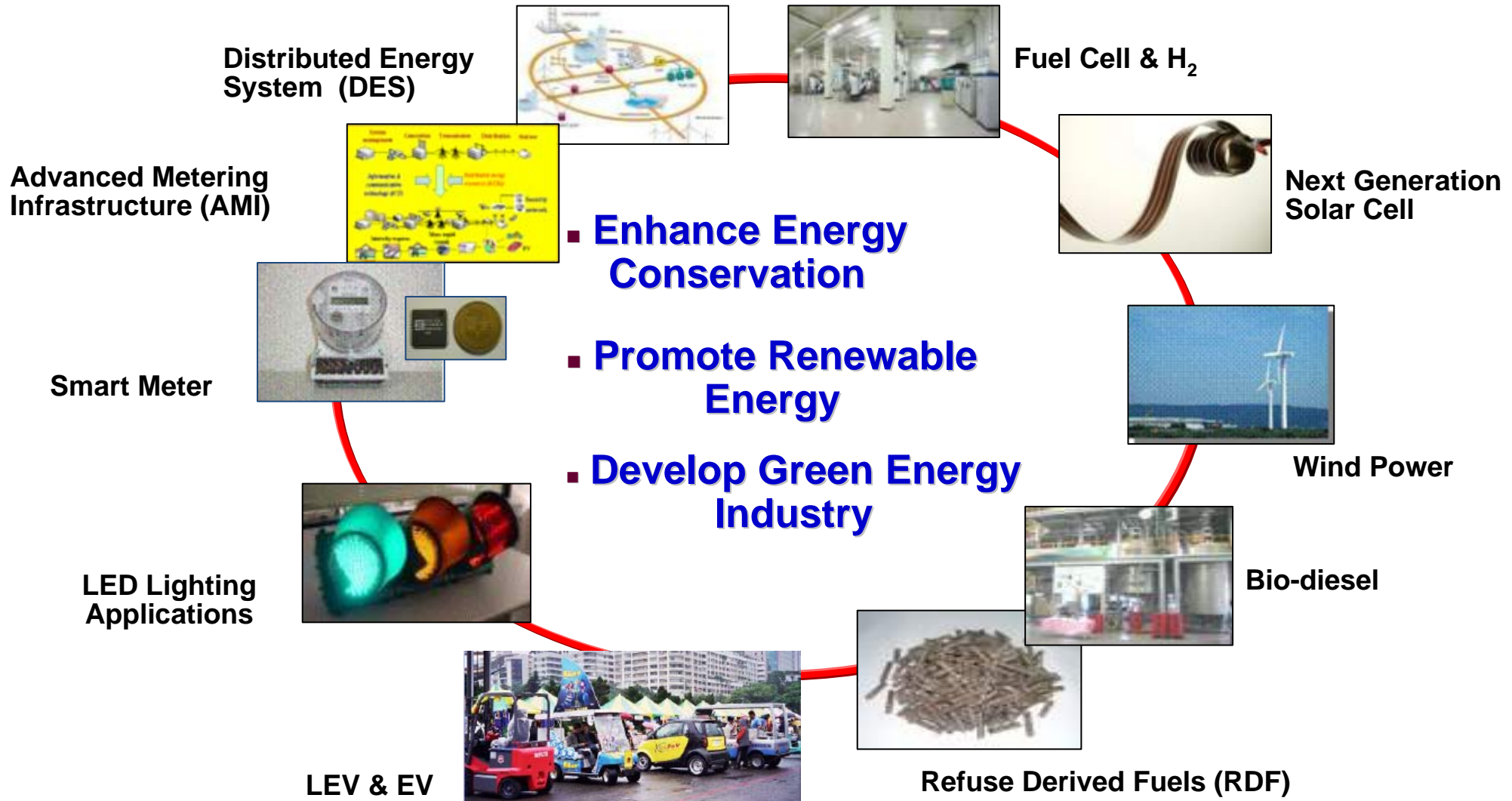
Approved by the Cabinet on April 23, 2009



Green Energy Industry Program (3/3)



Major Green Energy Industrial Development

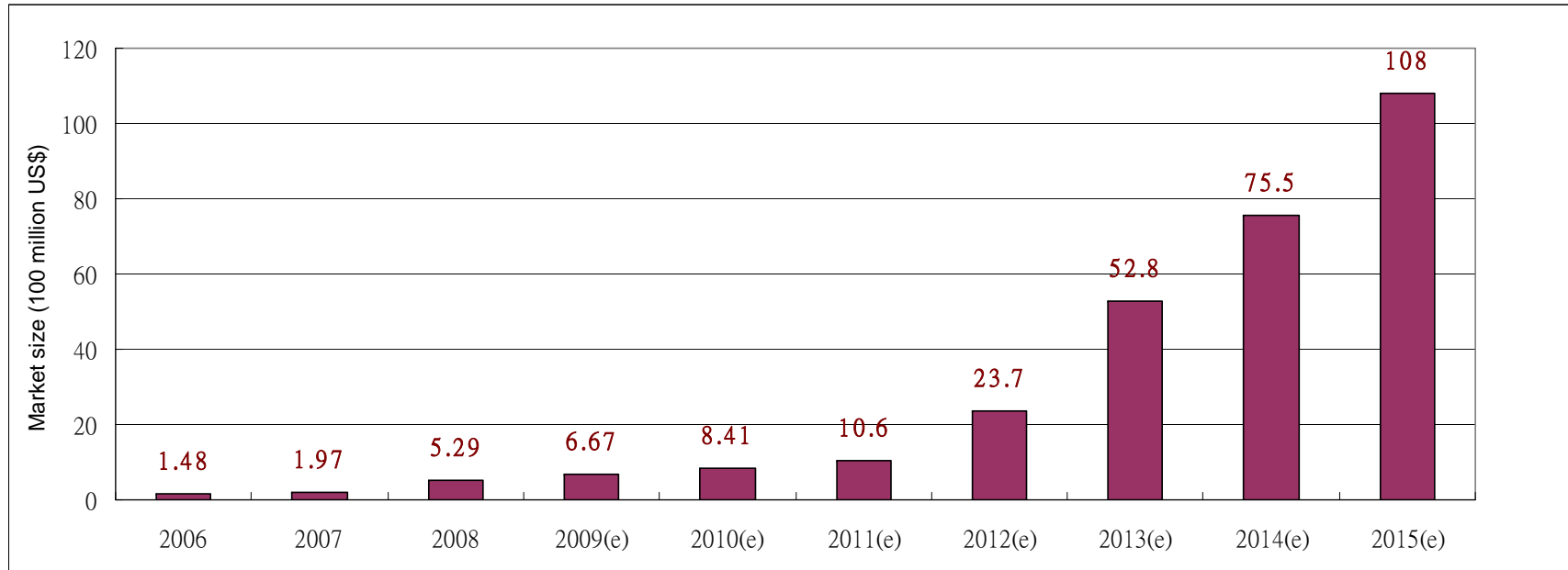


2A. Renewable Energy

- PV & Wind Power -

15-fold Growth Industry - BIPV+Energy Conservation

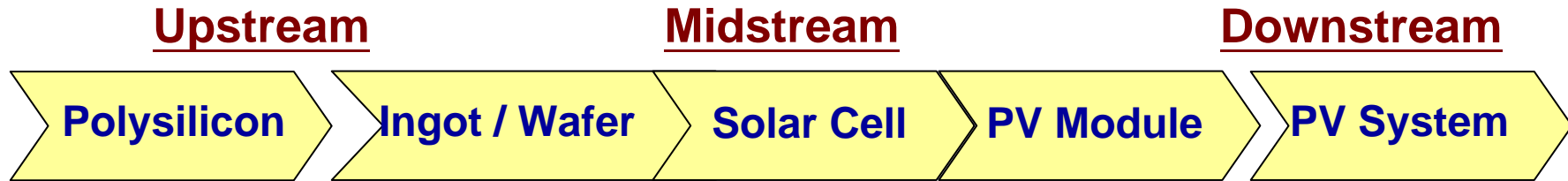
- Residential buildings consume 30% - 40% of global energy
- PVs and energy conservation in combination can make significant contribution to mitigate global warming
- NanoMarkets: *“The estimated growth rate for BIPV is more than 100% in the 2011 - 2013 period”*



BIPV is a large market that may eventually account for ~50% of the total area of installed PVB.P. Nelson, NREL

Sources: NanoMarkets, Frost & Sullivan, Lux Research and ITRI 2009/April

Development of PV Technology

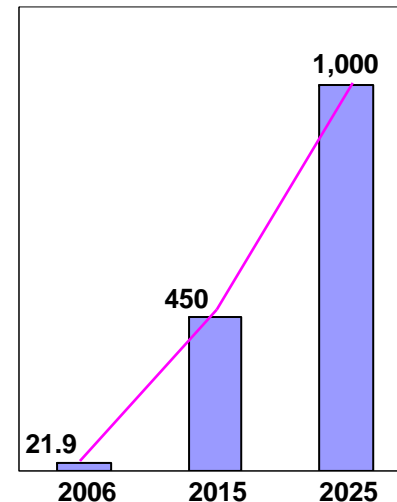


- PV production: >2.11 GWp in 2008 (25% share of world PV supply)
- Focus on next generation material and modules (CIGS thin film, Polymer, DSSC)

■ R&D Strategies:

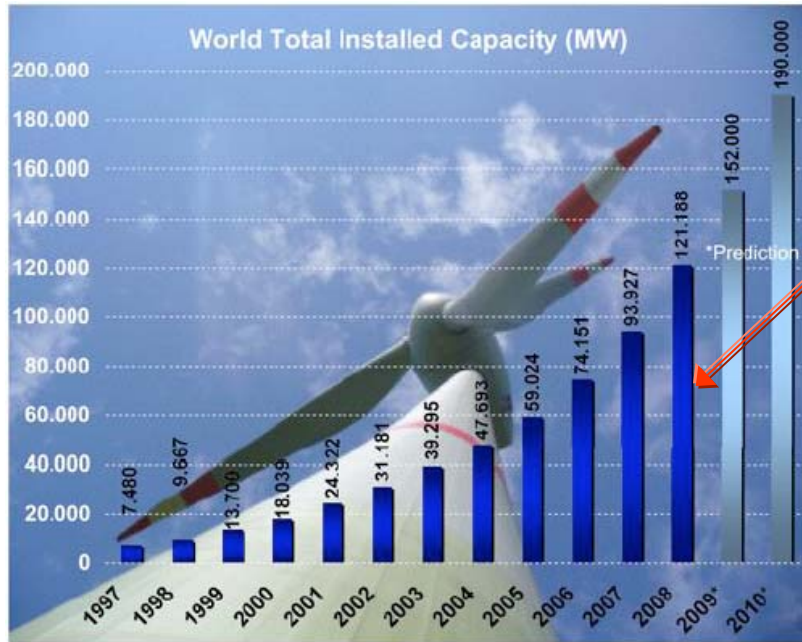
- Upstream poly-silicon raw material and purification technologies
- Module verification & validation technology
- Domestic equipment for mass production
- Develop the next generation solar cell

Domestic Annual Production (NT\$ B)



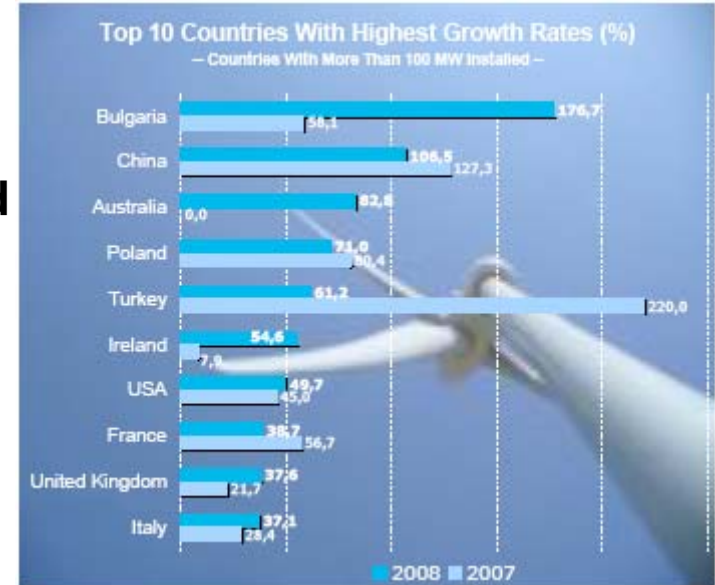
Motech
Eton
Gintech
Delsolar
Solartech
NSP
Mosel Votalic
Bigsun
Top Green
Ever Energy
Tainergy
Unitech
Sun Q
Sunrise Global Solar

Wind Power – the Major New Renewable Energy

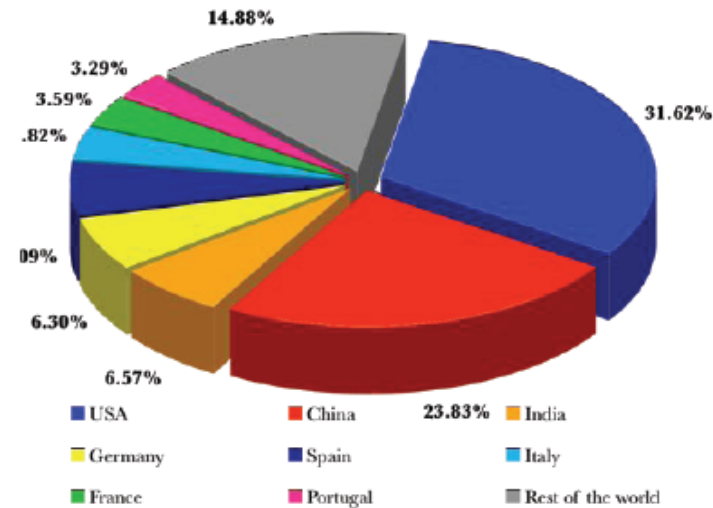
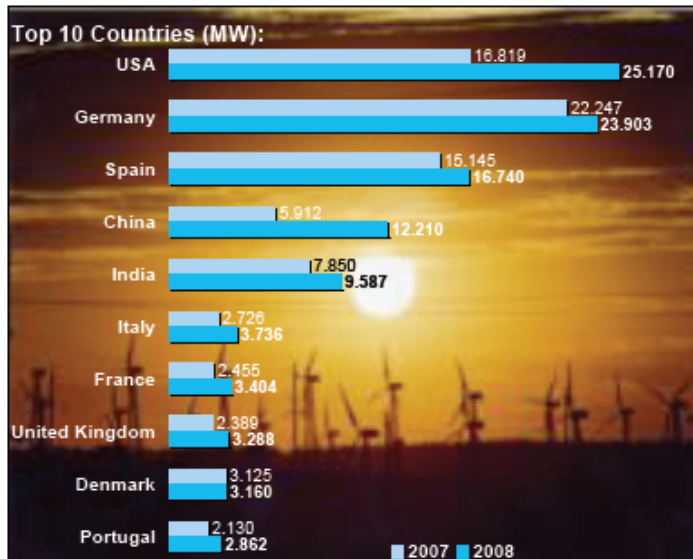


An increase of 29% and expected to continue in double digits still

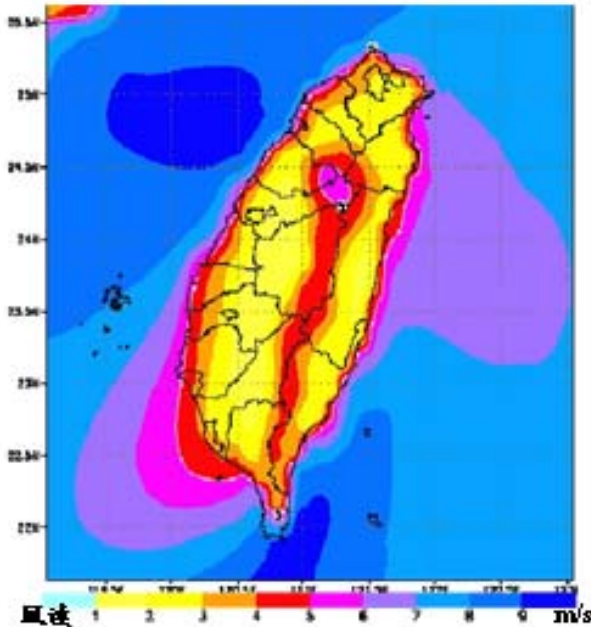
Source : WWEA(2009/02)



Country share of new installed capacity, 2008

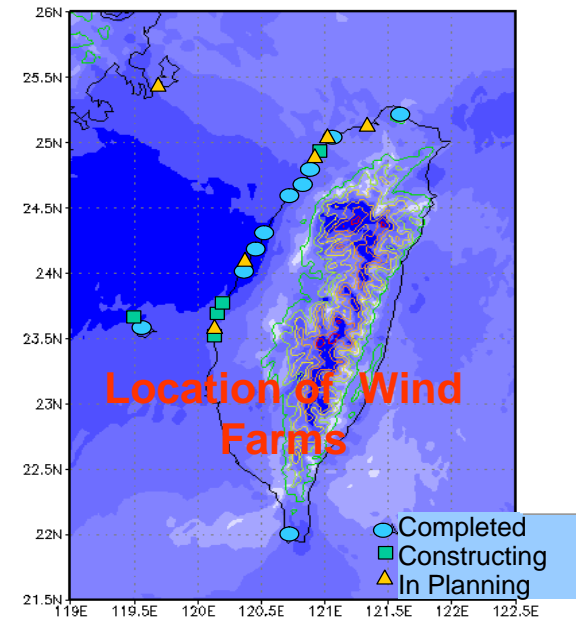


Development of Wind Power and Technology



Current Status (5/09)

- Installed capacity: 376 MW, with 198 installed wind turbines
- Electricity generated: around 940 GWh annually

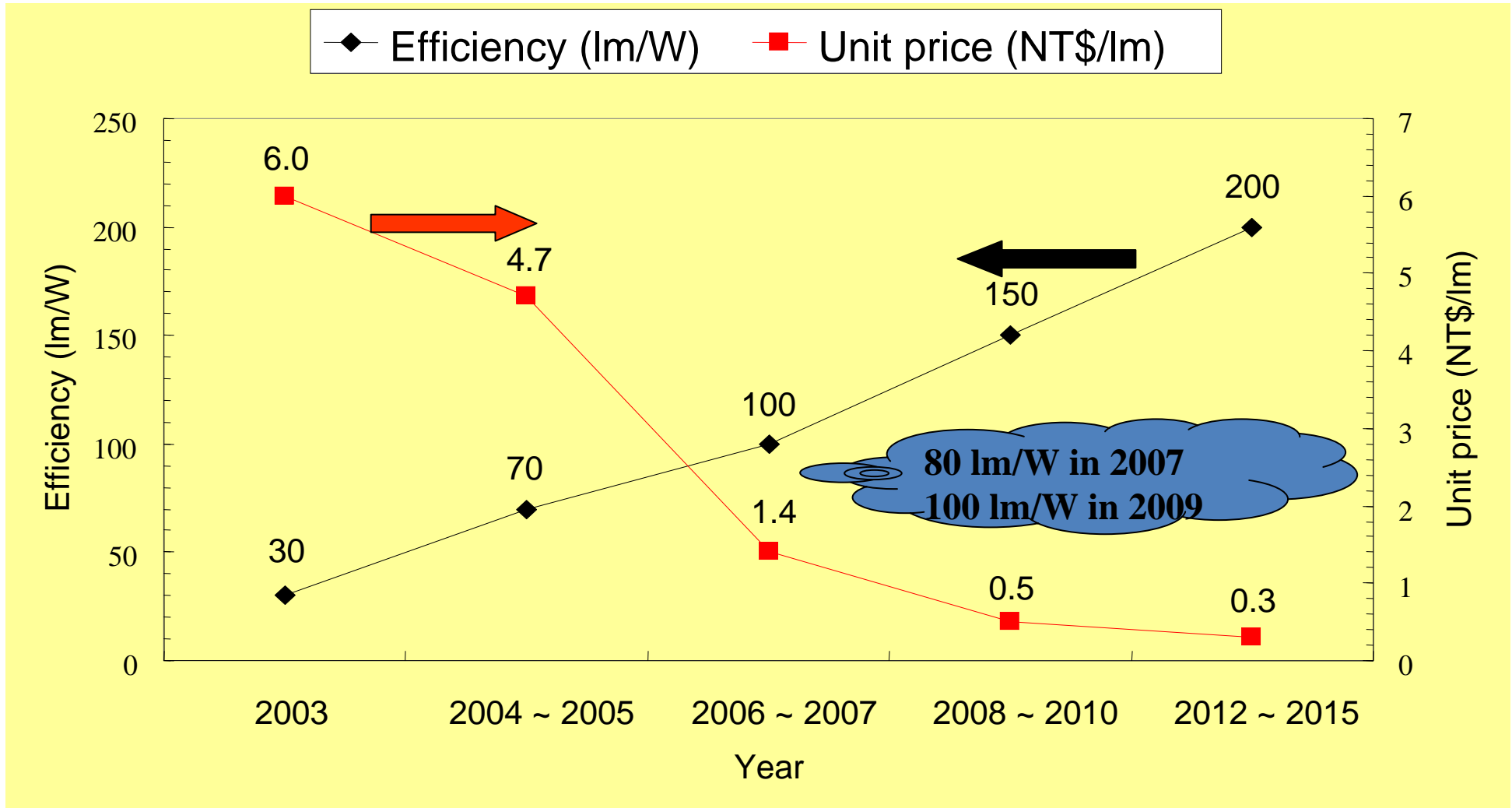


- Surpassing 1000 MW installed capacity 2010-2011, with 2025 total development target of 3000 MW
- Off-shore wind turbines, with minimum maintenance requirements and maximum marine durability, and small wind power generators (~10 kW) are future focuses

2B. Energy Conservation

- LED Lighting & EV-

Technology Trend of White LED Lighting



World Class Lighting Laboratory

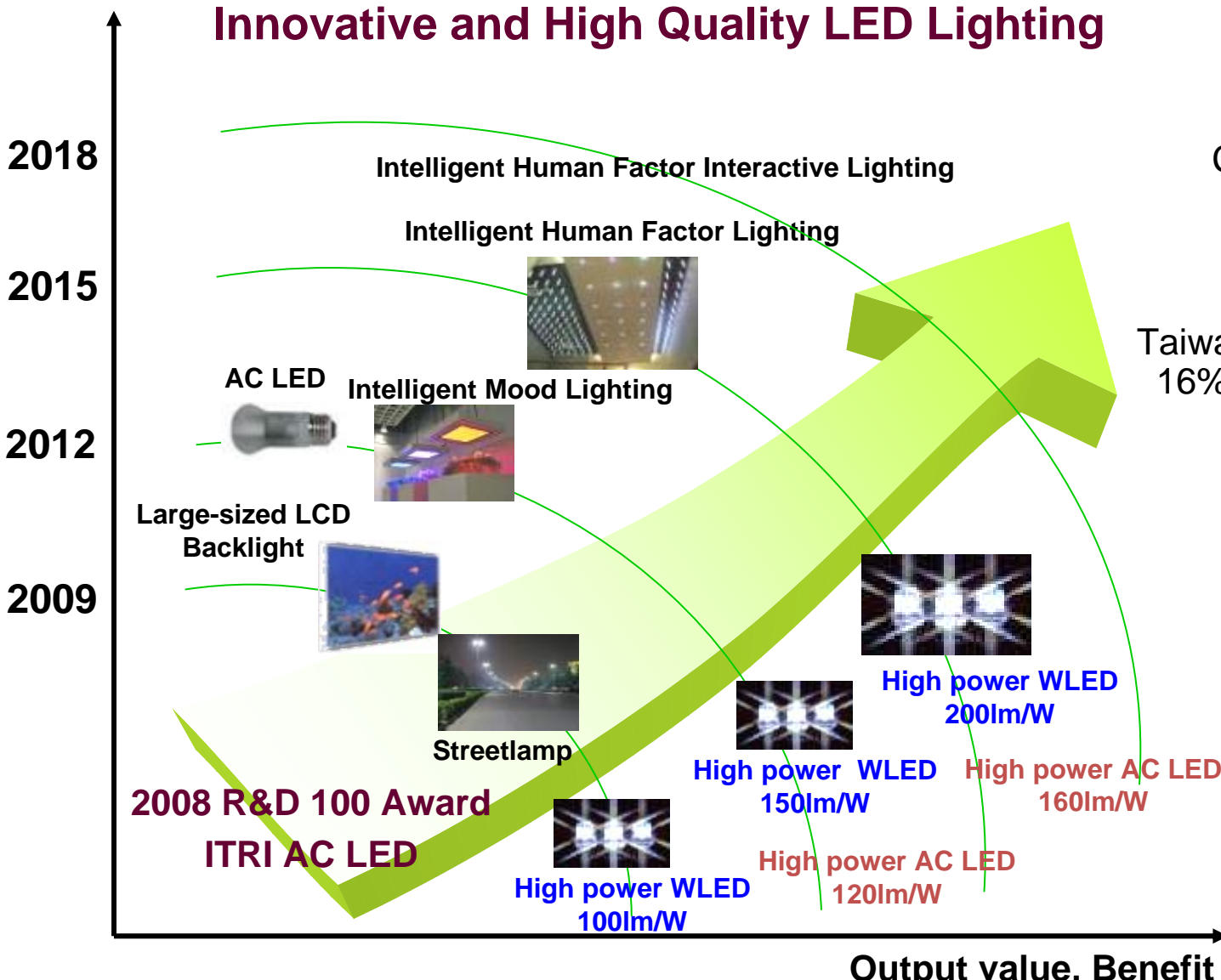
- **The first non US-based NIST certified testing laboratory at ITRI**
- **Provide a platform for standardization and an information hub**
- **Leverage international collaboration for quality products**



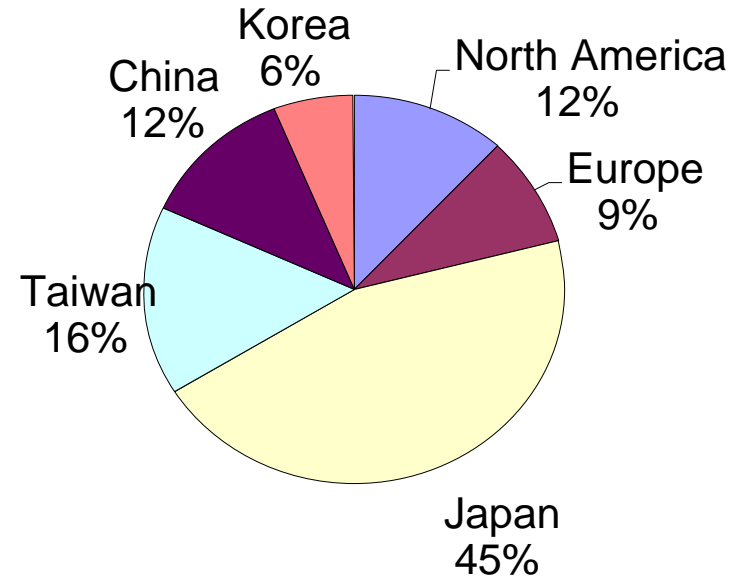
NIST: National Institute of Standards and Technology

2015-2018 Scenario

Innovative and High Quality LED Lighting



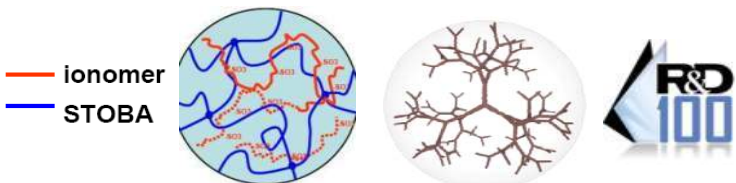
2007



- No.1 in production & sales volume, and No.2 in revenue
- Competitive position due to Taiwan's ICT & LCD industrial base and business model

Electrified Road Transport – EV

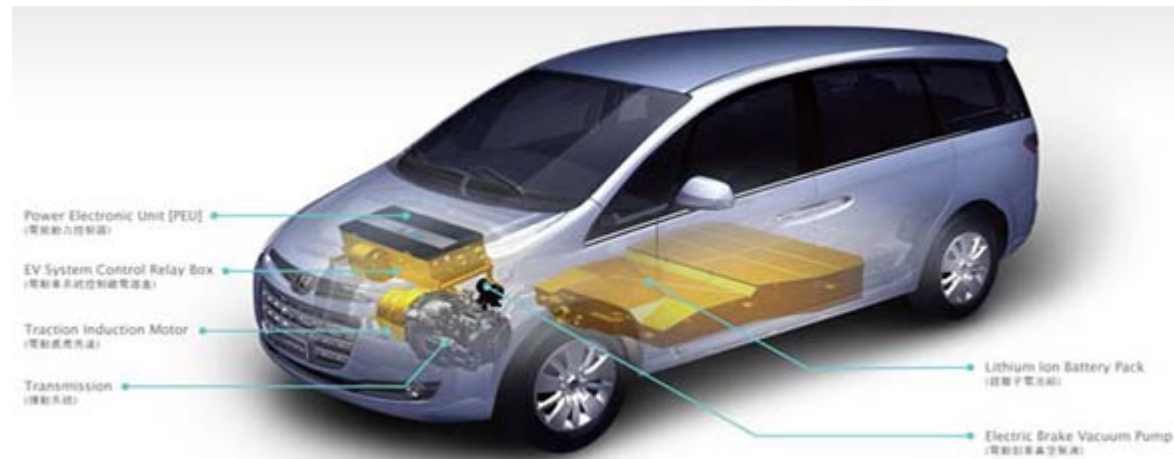
■ Transportation further electrified, in addition to the mass transit system, for personal road transport, representing a significant future modal shift for sustainability



ITRI STOBA: self-terminated oligomers with hyper-branched architecture



- Strong industrial base for bicycle, motorcycle, motor, power supply and Li-ion battery module in Taiwan
- Demonstration program for 160 thousand LEVs underway



Source: <http://www.luxgen-motor.com.tw/cars/EV>



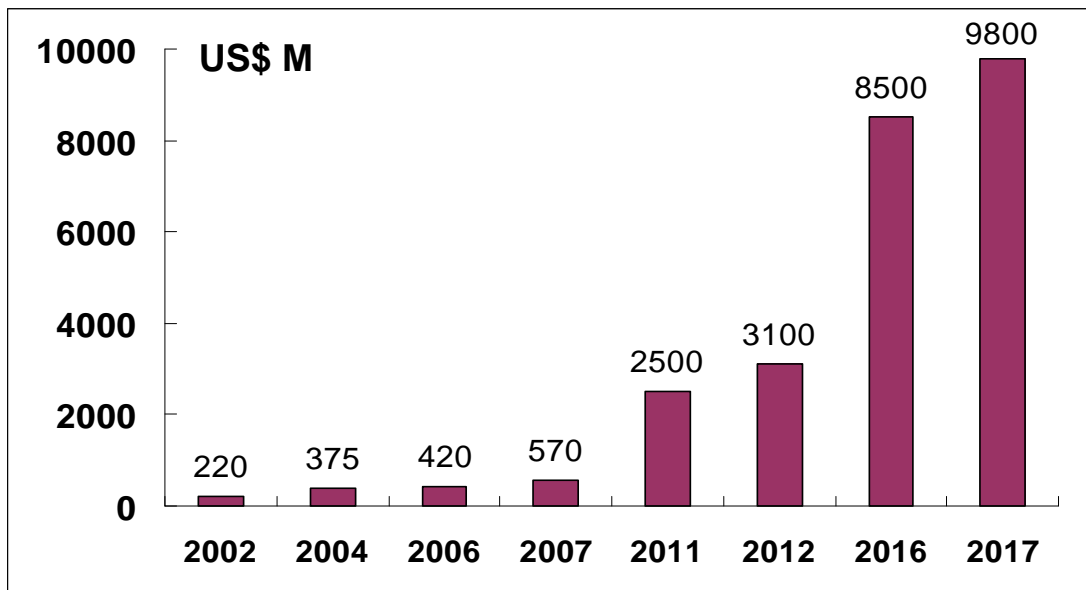
2C. New Energy Technology

- PEMFC & H₂ -

Global Trend & Status (1/3)

- Fuel cell market was projected (2007) to grow significantly after 2010
 - The purchase of 10,000 fuel cell backup power systems by ACME, India represents the biggest order in years, starting delivery 2009, firmly catapulting FC backup powers into the demand-driven market
- Stationary applications represent the largest potential market for the projected period

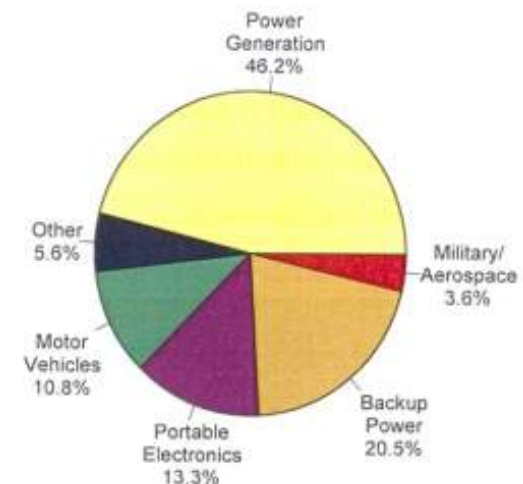
World Fuel Cells Market Projection



Sources : Freedonia Group (2007/05,2008/04), ITRI IEK (2007/08)

US Fuel Cells Market Projection

FUEL CELL DEMAND BY MARKET, 2012
(\$975 million)

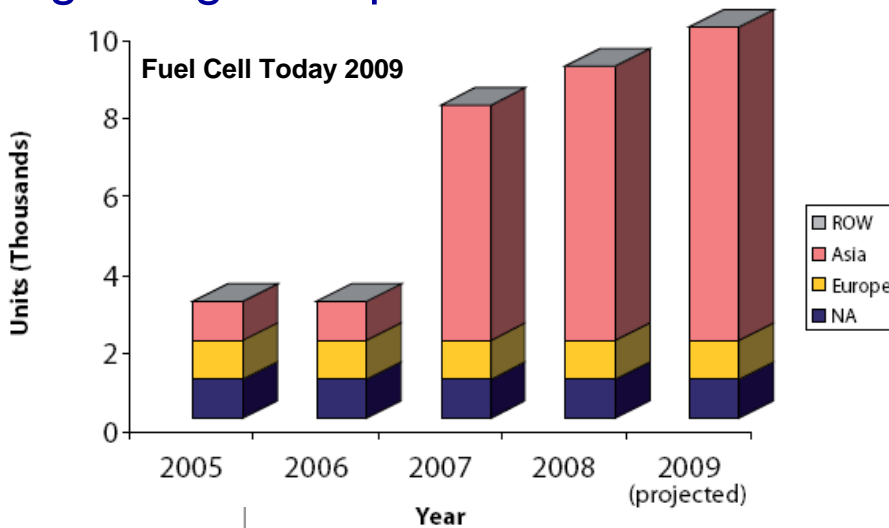


Source: The Freedonia Group, Inc.

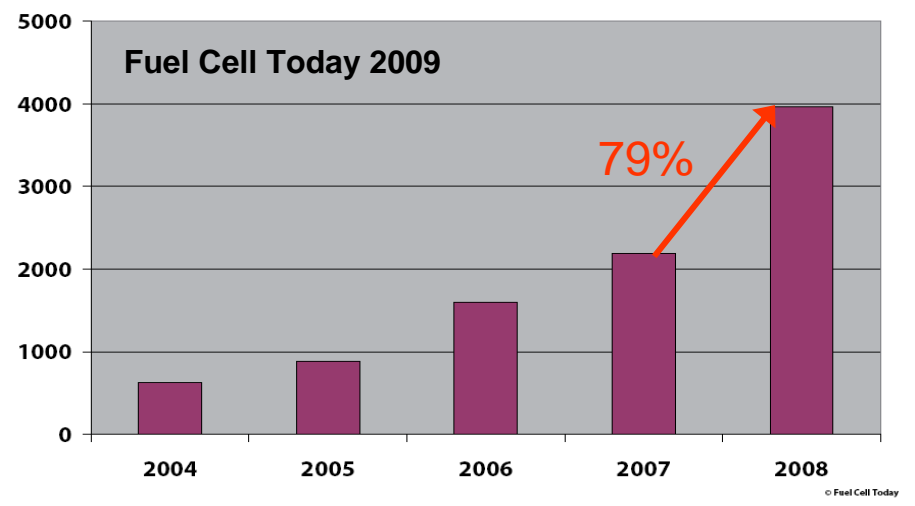
1. 55% market share for non-industrial stationary applications in 2006
2. 40% market share projected in 2016

Global Trend & Status (2/3)

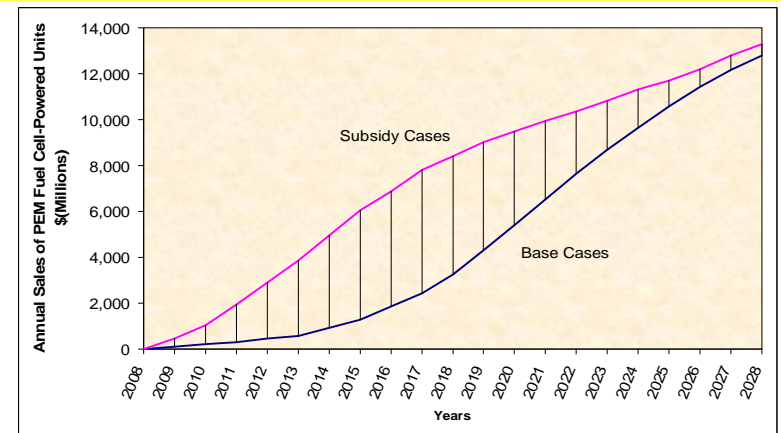
- US triples its subsidy, tax credit @ 30% installation cost up to US\$ 3,000/kW
- Japan begins subsidizing residential PEMFC CHP system purchase (up to 40%), projected market size exceeding US\$ 130 million in 2009 and US\$300 million in 2010, and Germany and Demark follow suit
- Niche markets of backup power units, forklifts and portable applications have the highest growth potential



New Small (<10 kW) Stationary FC Shipments



Global Backup Power/Forklift Market Projection (Battelle Memorial Institute, 2007)



Global Trend & Status (3/3)

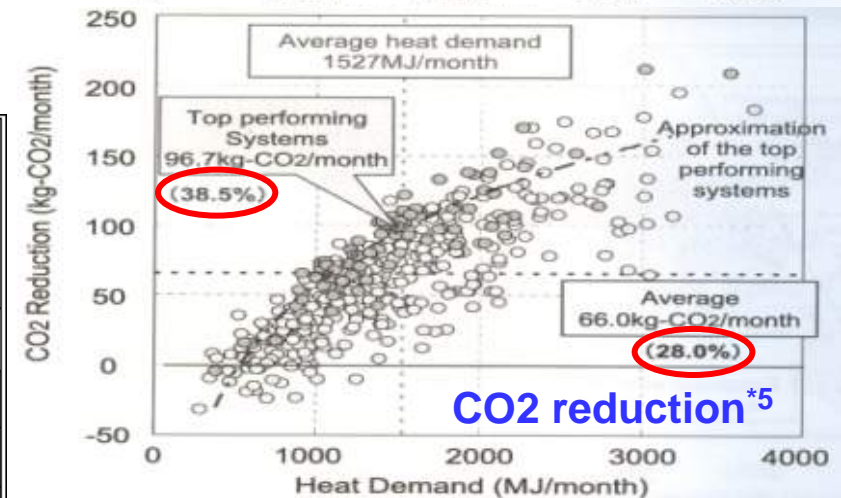
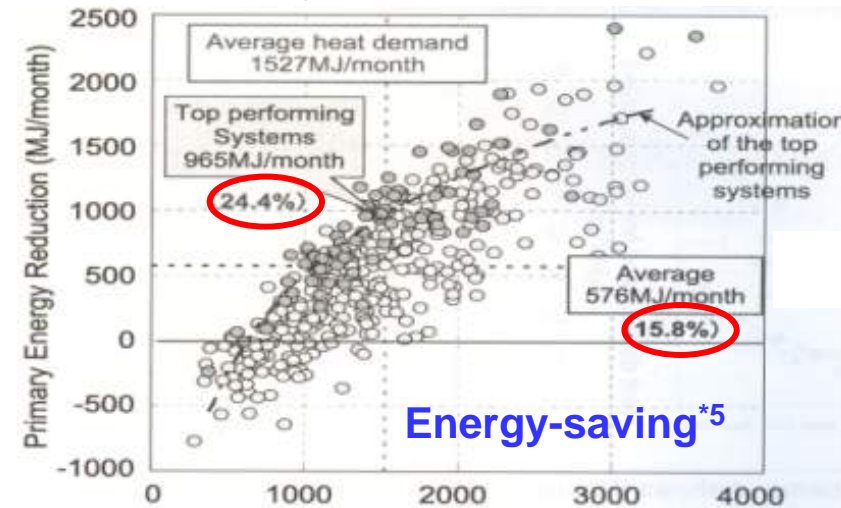
- Markets of stationary FC products growing, due to economic, energy-saving and emission mitigation benefits
 - Residential CHP market expected to grow in temperate and cold climate regions via PV market growth model
 - Backup power and forklift markets worldwide

NPV Analysis of FC Backup Powers vs Battery
(Battelle Memorial Institute, 2007)

	3-Year Battery Replacement			5-Year Battery Replacement							
	Battery-Gen.*	PEMFC [†] without Tax Incentive	PEMFC with Incentive	Battery-Gen.	PEMFC without Tax Incentive	PEMFC with Tax Incentive	Gen. New Installation	Gen. Repl. Existing Installation	Battery-only	PEMFC without Tax Incentive	PEMFC with Tax Incentive
8-hour Runtime									19,037	14,023	12,136
52-hour Runtime	69,860	63,521	58,804	61,082	61,326	56,609					
72-hour Runtime				47,318	33,901	32,014	28,283	24,886			
176-hour Runtime	93,129	102,403	97,686	75,575	100,209	95,491					

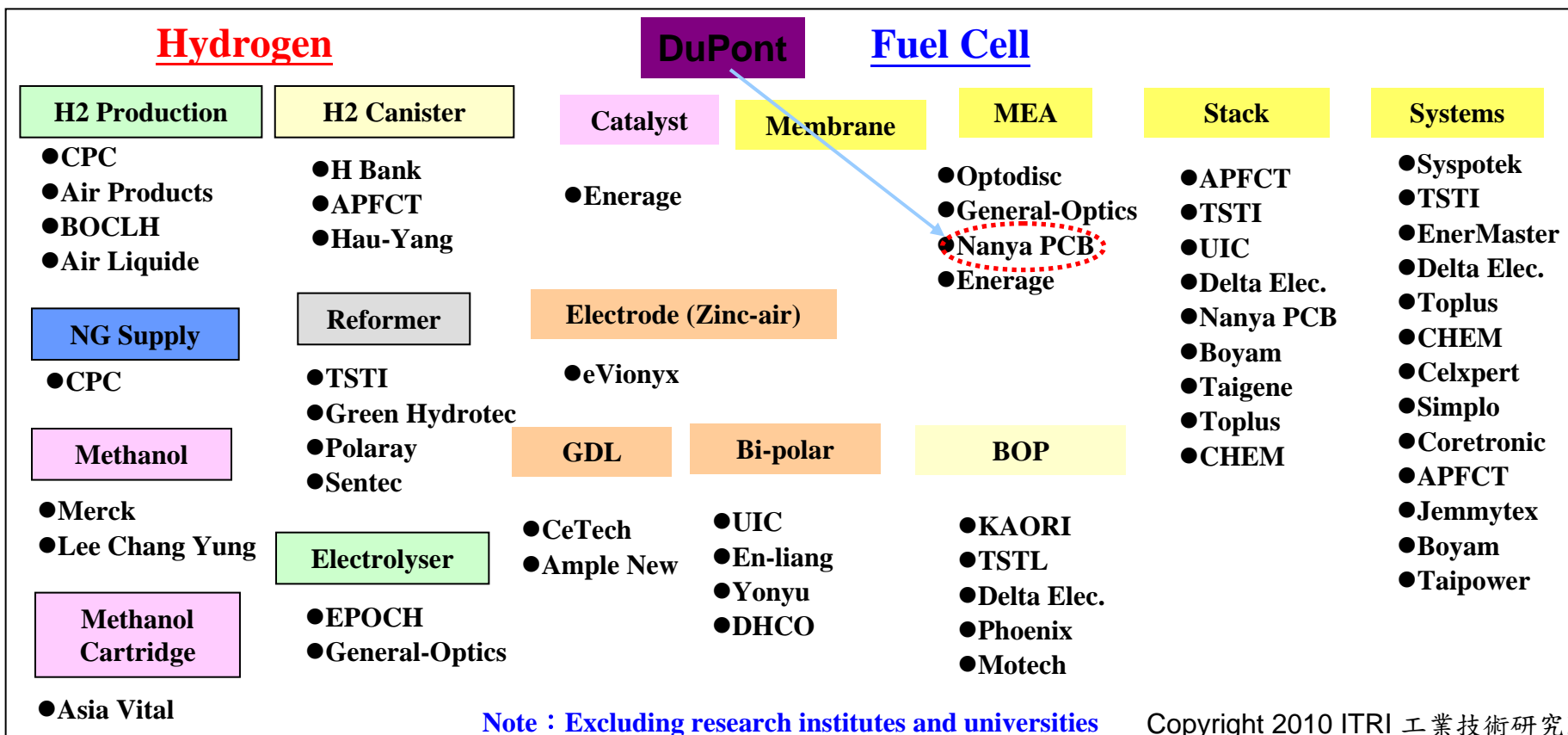
*Gen. is generator, [†]PEMFC is PEM fuel cell

Real-life FC CHP Benefits
(New Energy Foundation, Japan, 2009)



Status & Trend in Taiwan

- A fast-growing local supply chain centered around stationary and portable applications is gradually in shape
 - Maturing supply chain of SMEs reputable in mass production and business network for small industrial and consumer goods
- Public-supported demonstration & validation program started 2009, 16 projects approved, with REDA giving additional future support



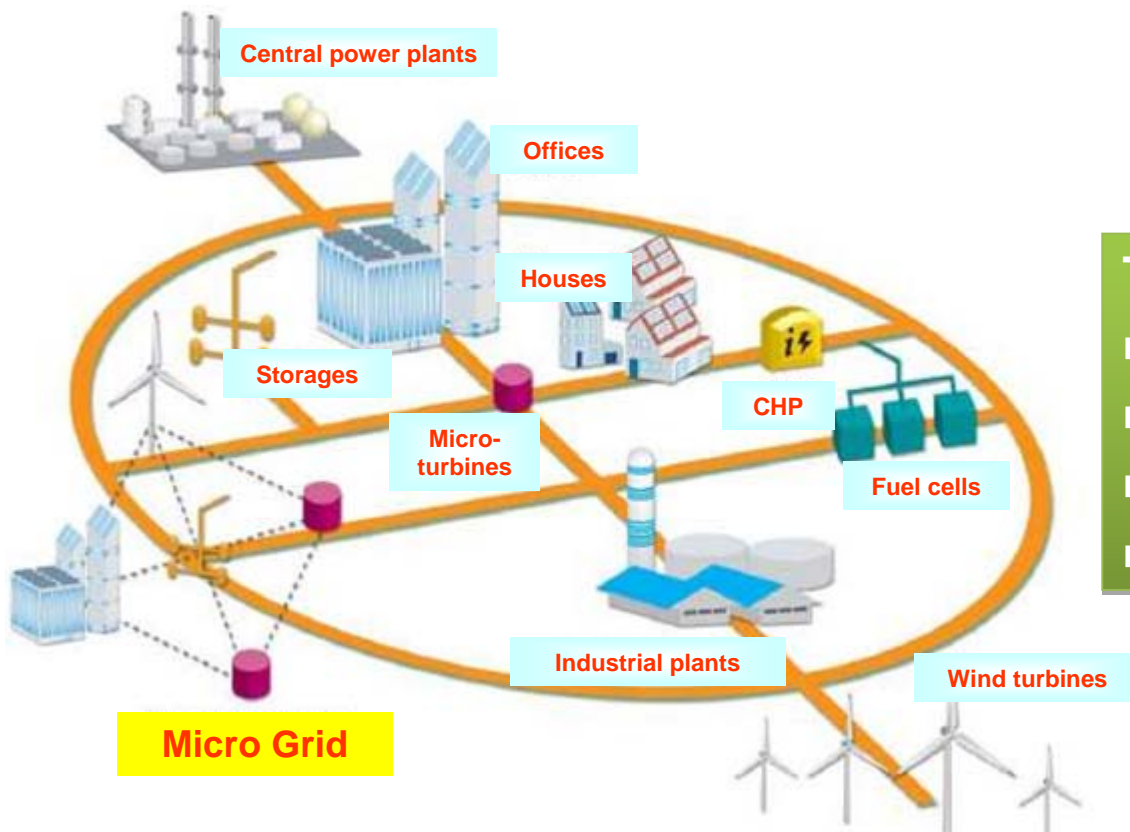


2D. Technology Convergence I

- System Smart Networking -

Distributed Energy System

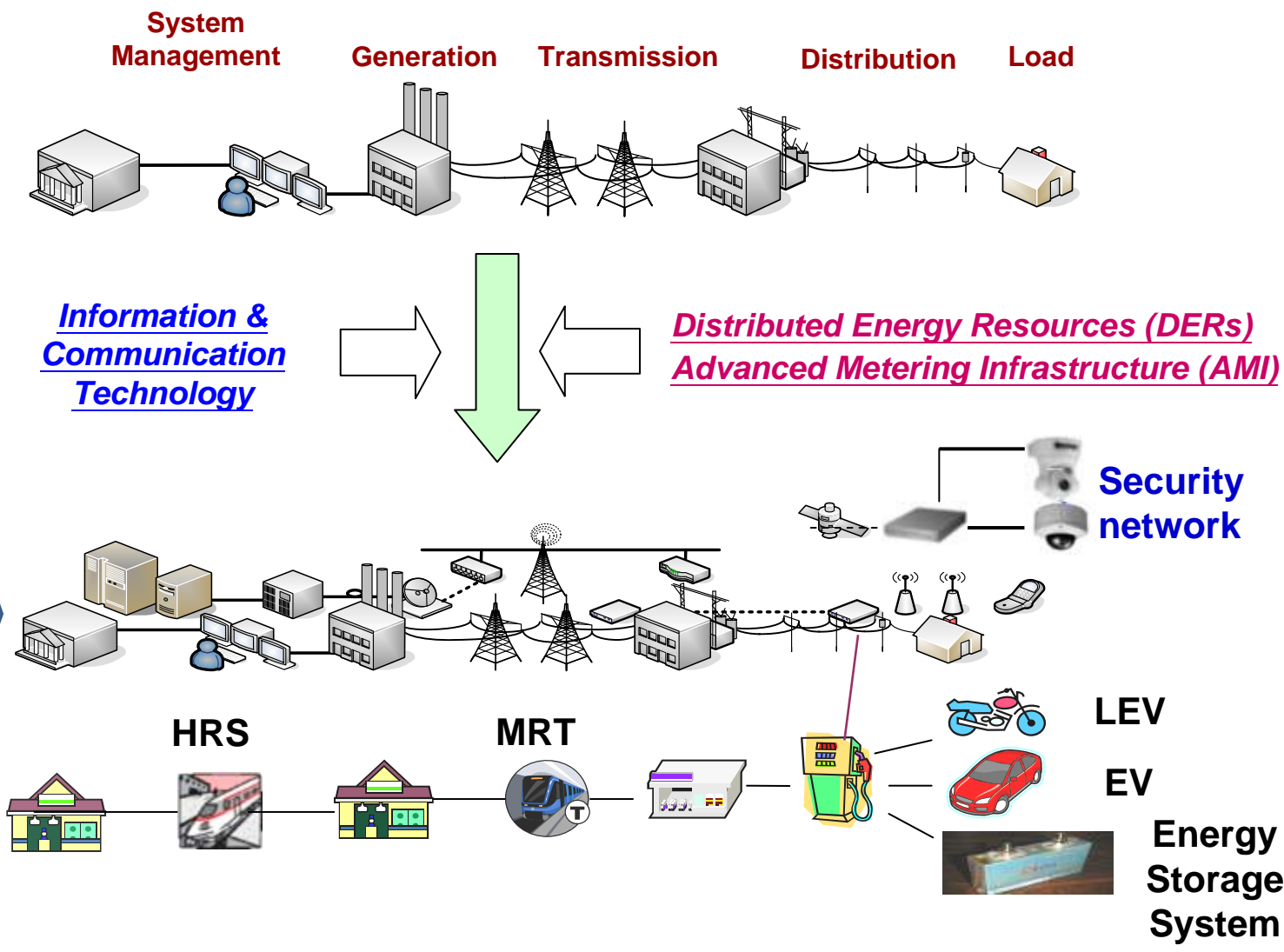
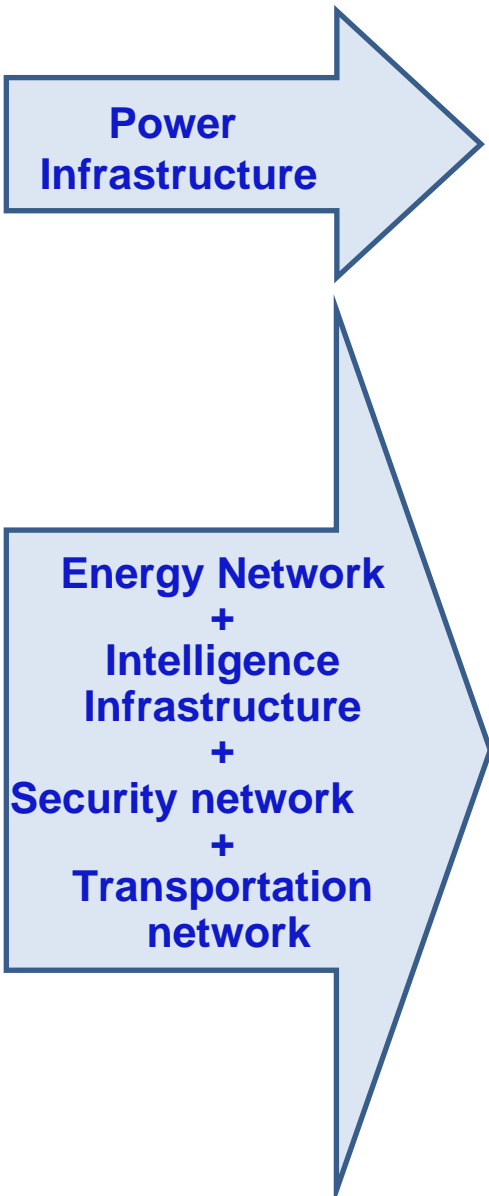
The full potential of DE can be realized by integrating generation, transmission & distribution and energy storage in a seamless, intelligent network



Technology Scope:

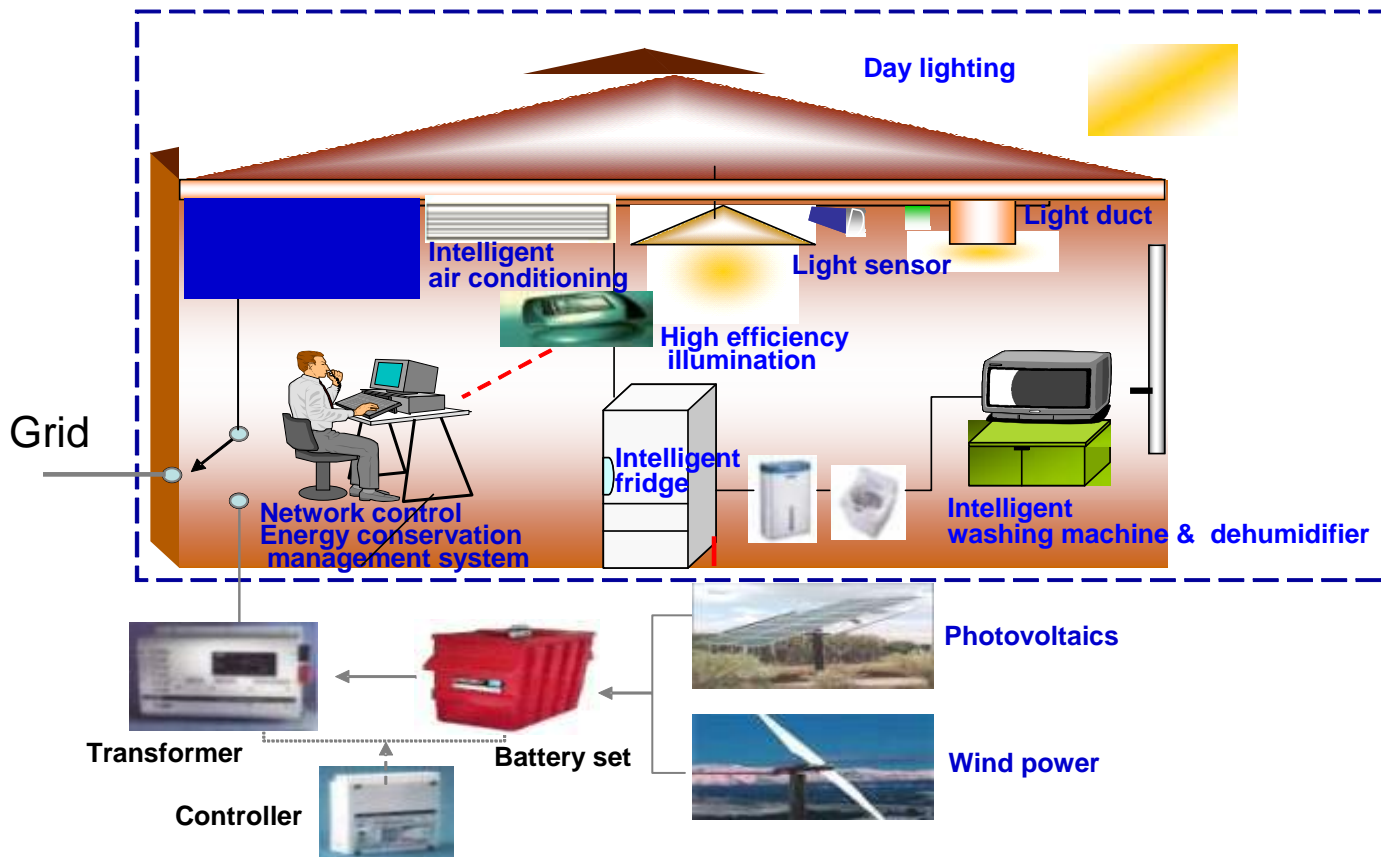
- Renewable Energy
- Advanced Power Electronics
- Efficient Energy Storage
- Smart Grid

Future Intelligent Network (FIN)



Building Blocks for a Low Carbon Community

- Energy-efficient and smart appliances technology combined with ICT infrastructure and technologies (e.g. smart grid)
- On-site energy and resources first, and waste (heat) recycling
- Time-pricing of electricity and real-time DMS technologies



Convenient stores



The monitor system

2E. Technology Convergence II

- Low Carbon Island Penghu -

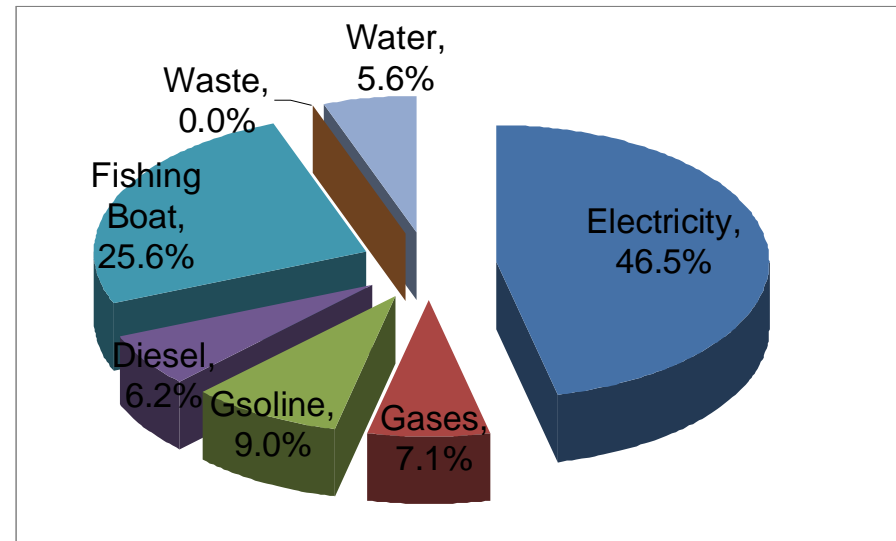
Taiwan's Offshore Pearl - Penghu Archipelago



Background Information

- ❑ **Land Area:** 96 km²
- ❑ **Resident:** 86,000
- ❑ **Tourist:** 500,000/year
- ❑ **Transportation:** 60,000 scooters, 18,000 passenger cars, a few hundred buses and fishing boats
- ❑ **Electricity:** peak load 65.5 MW, lowest demand 26.3 MW; 4.8 MWp wind farm
- ❑ **Water:** require 30,000 m³/day, rainfall 1130 mm < evaporation 1593 mm/yr
- ❑ **Waste:** 50 tons/day

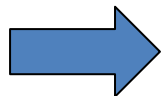
CO₂ Emission Distribution



**GHG Emission: 465,000 tons e-CO₂/year
(5.44 tons e-CO₂/year per capita)**

Energy Consumption: 145,000 KLOE/year

Planning Targets:



- Reduce GHG emission by 50% within 4 years
- Become a test bed of low carbon technologies

Closing Remarks

- Taiwan, taking advantages of its strong ICT industrial base, enacts legislations and provides new investments to support R&D and the development of green energy industries in pursuit for a strong post fossil economy and sustainability.
- In June 2009, Taiwan passed the Renewable Energy Development Act, more effectively accelerating the green energy industries development and the transition to a low carbon society.
- Taiwan strategically focuses on two major and five emerging industries for growth, and open innovations and industrial cooperation are needed to accelerate technical breakthroughs and, hence, the low-carbon economy development.



***Thank You
For Your Attention !***