

Development of Smart Grid in Taiwan

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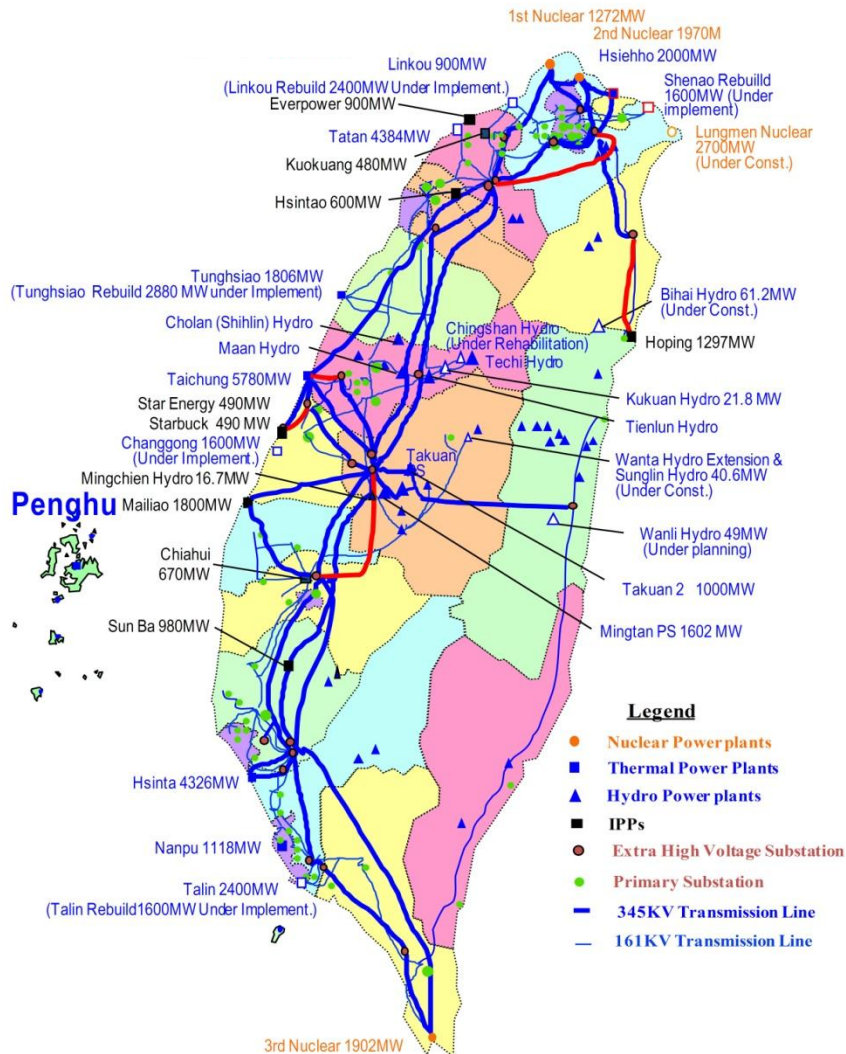
Overview of Taipower's System

Installed Capacity in Year 2011: **41,400 MW**

		Installed Capacity	MW	%	
Taipower	Nuclear		5,144.00	12.6	
	Thermal		22,717.60	54.90	
		Oil		3,324.6	8.00
		Coal		8,800.0	21.30
		LNG		10,593.0	25.60
	Hydro		4,353.60	10.5	
		Conventional Hydro		1,751.6	4.20
		Pumped storage Hydro		2,602.0	6.30
		Wind		286.76	0.70
		PV		6.10	0.01
	Subtotal of Taipower			32,508.06	78.50
IPP	Thermal		7,707.10	18.60	
		Coal		3,097.1	7.50
		LNG		4,610.0	11.10
	Hydro		289.10	0.70	
	Wind		236.10	0.50	
	PV		38.30	0.01	
		CoGeneration		622.00	1.50
Subtotal of IPP			8,892.60	21.5	
Total Installed Capacity			41,400.7	100	

Substation	No.	MVA
EHV	28	56000
Primary	261	68450
Secondary	295	20728

	ckt-km
Transmission Lines	16,898
Distribution Lines	339,057



Overview of Taipower's System

(1) Current Status of Energy Use

- a. Due to an extreme lack of indigenous energy resources, Taiwan relies on imported energy resources for 99% of its needs.
- b. Fossil fuels play a major role in the energy supply structure, having a tendency of excessive concentration.
- c. As an isolated power system, Taiwan Power network has not yet been connected to other power systems.
- d. Under the government's policy, energy prices have been failing to reasonably reflect the costs.

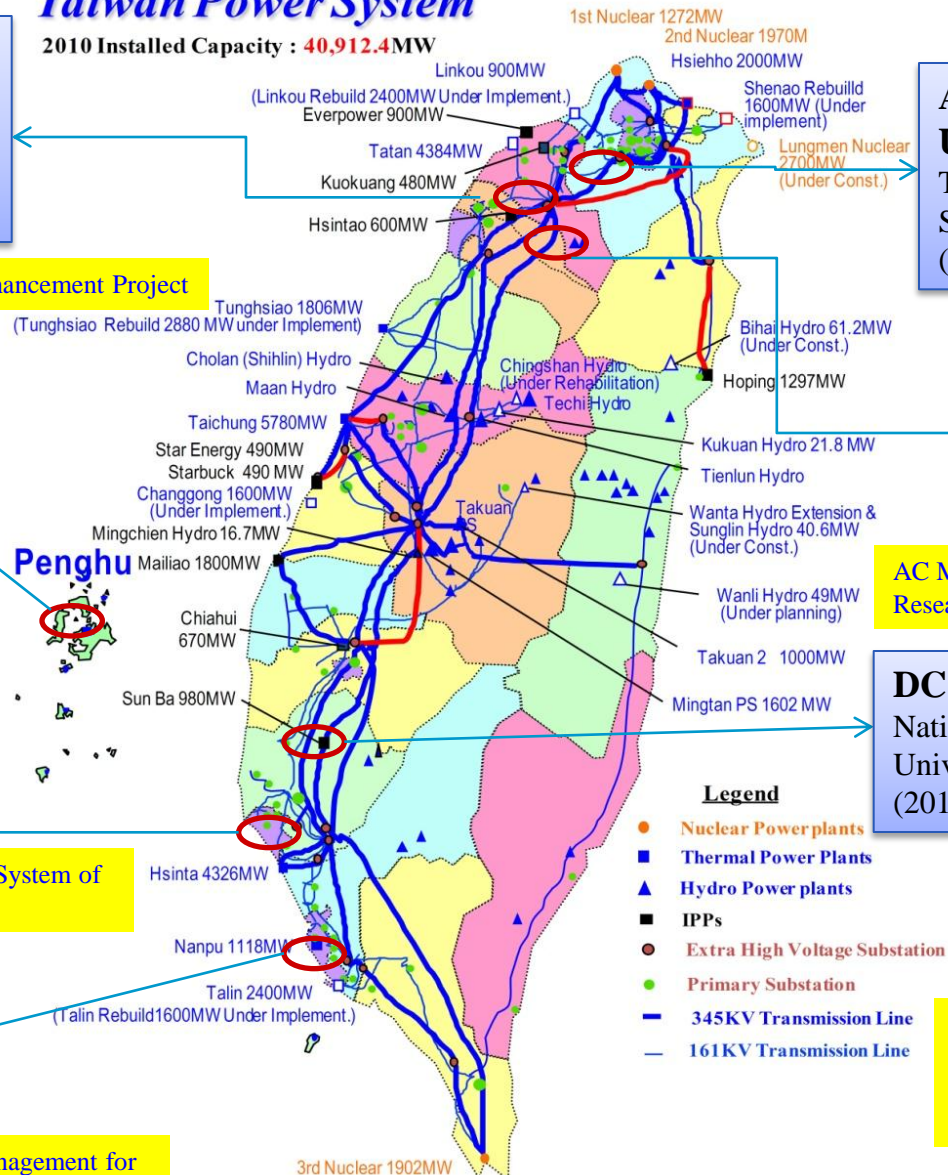
(2) Energy Policy

- a. Steadily Reducing Nuclear Dependency
 - a) No extension to life spans of existing plants, and the decommissioning plan should be launched as planned.
 - b) The security of the 4th Nuclear Power Plant must be ensured prior its commercial operation.
- b. Replacing Nuclear with LNG for Base Load
 - a) LNG total installation capacity is expected to reach 26,532 MW (accounting for 40% of total capacity of power installations) by 2030.
- c. Promoting Renewable Energy Extensively
 - a) Under the campaign of “one thousand wind mills” and “one million sunshine roofs”, the installed capacity of renewable energy is expected to reach 12,502 MW (accounting for 16% of total power installations) by 2030.

National Energy Project – Smart Grid and AMI

Taiwan Power System

2010 Installed Capacity : 40,912.4MW



AMI (Institute for Information Industry)
National Center University,
Taoyuan
(2011~2013)

Advanced DAS pilot project

Advanced DAS(I-Shou University)
Taipower Research Institute,
Shulin
(2011~2013)

Advanced Metering Infrastructure (AMI) Enhancement Project

Smart Grid Demo Site

National Energy Project – Smart Grid and AMI
(2013~2018)

AC Microgrid
INER, Long Tong
(2011~2013)

Smart Home(Building)EMS

National Cheng Kung University, Tainan
(2011~2013)

AC Microgrid Pilot Project,
Research on DC Smart Microgrid

DC Microgrid
National Chung Cheng University, Chiayi
(2011~2013)

Leading Project on Power Energy Management System of Smart Home (Building)

Development and Applications of Power Quality Monitoring Techniques for Electric Power Transmission System

EV Charging Stations

National Sun Yat-sen University, Kaohsiung
(2012~2014)

Initiatives of Advanced Applications of Wide-area Measurement System (WAMS)

Pilot Project Strategic Power Supply Management for Electric Vehicle Charging

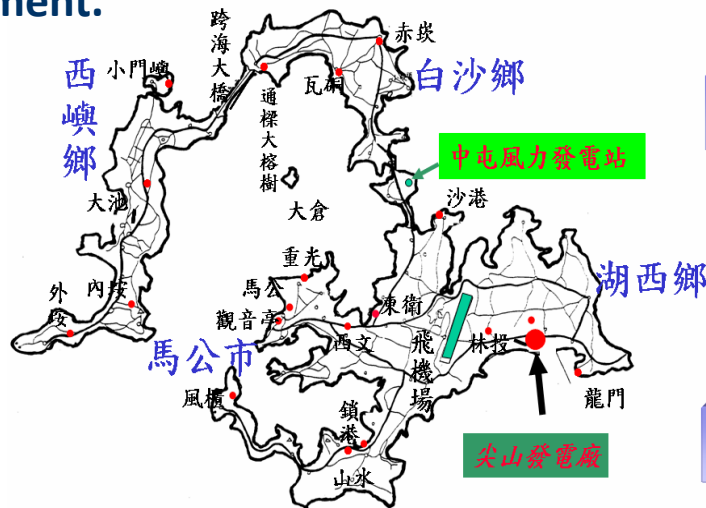
Overall Demonstration to Promote the Idea of Smart Grid and AMI

Using results from the 1st phase of this project, cooperating with the Executive Yuan to implement Low Carbon Island Project in Penghu archipelago (50Km from Taiwan, inhabitants 89,000, average load 45MW, peak load 83MW), as well as with the Bureau of Energy, Ministry of Economic Affairs and TPC to promote AMI, micro grid, advanced power distribution, smart home and building energy management, and electric vehicle energy supply management.

Smart Meters

Substation
Intelligentize

Power
Management System



Photovoltaic system

Large-scale Wind Turbine

Small-scale Wind Turbine

Electric Vehicle
Charging Stations

Items	2011	2012	2013	2014	2015
Wind Power	4.8MW	10.2MW		50MW	96MW
Solar Power	1.5MW				
AMI		500	1000	2000	6000
LED Road Light	2000	4000			
Electric Motorcycle	2000	4000	6000		

Taiwan Smart Grid Industry Association (TSGIA)

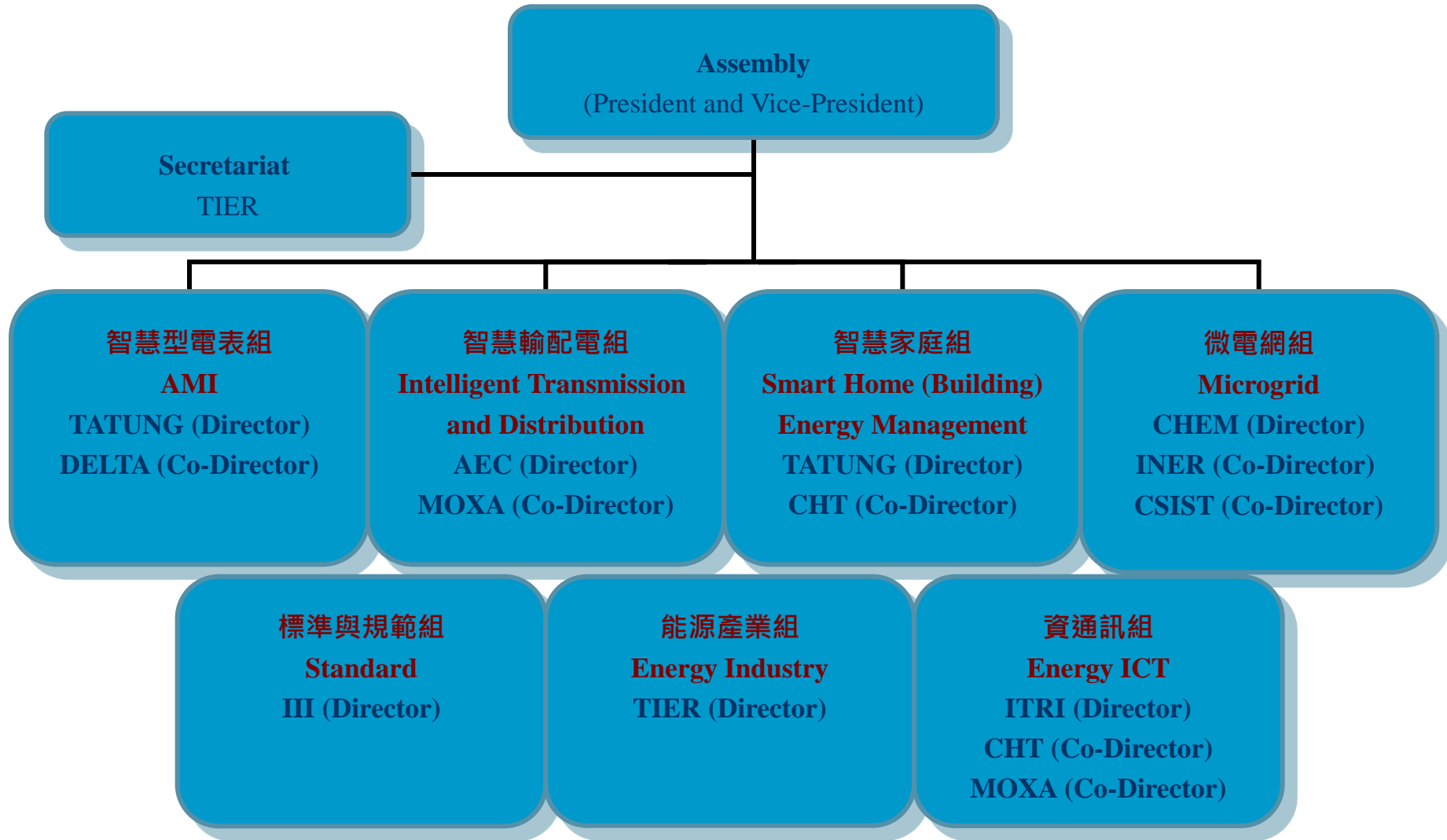
■ Object

- To coordinate the development of power system, power electronics and ICT to develop the smart grid industry in Taiwan.

■ Mission

- Build up design and integration capabilities of smart grid.
- Establish a platform for integration and exchanging smart grid technology.
- Bridge the industry to the government to create an industry-friendly society and policy structure encouraging the development of smart grid industry.
- Assist Taiwan smart grid industry to reinforce the opportunities of international market shares.

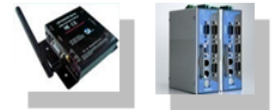
Structure of TSGIA



- Conventional power equipment industry:
Generators, motors, micromotors,
transformers, high- and low-voltage
switchgear, circuit breakers

Demand for smart grids by advanced and developing countries

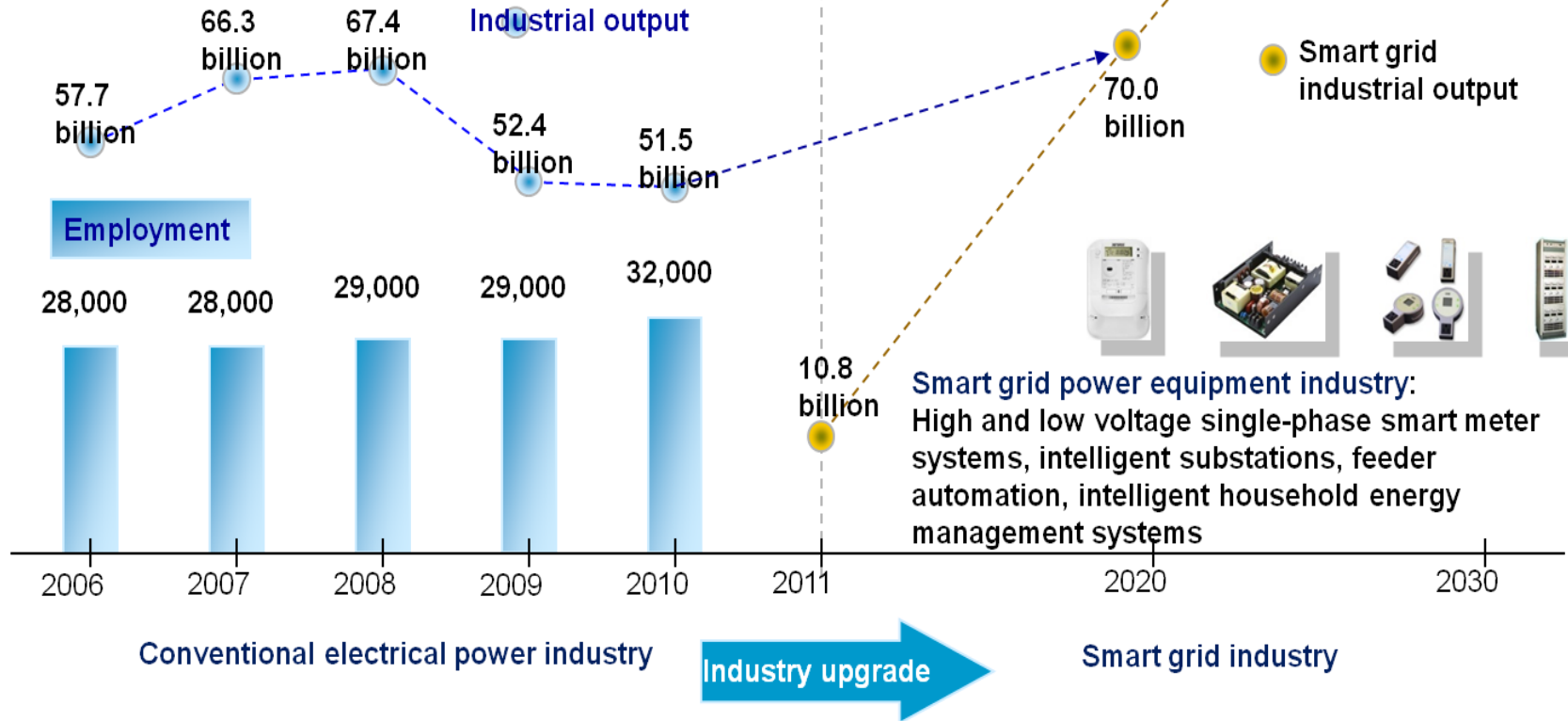
Smart grid IT equipment industry:
Meter data management systems,
communications modules, group
sensors



Smart grid
industrial output



Smart grid power equipment industry:
High and low voltage single-phase smart meter
systems, intelligent substations, feeder
automation, intelligent household energy
management systems



Taiwan AMI Components Provider

- The high voltage AMI System of Taiwan Power Company is constructed by Tatung (with Institute for Information Industry). MIU is provided by Tatung and CHEM
- The scale of low voltage AMI is about 6 million smart meters.

Component	Provider in Taiwan
Smart Meter	TATUNG, CHEM, SHIHLIN(Arch), DELTA, AcBel, Itron, Danielgroup, Schneider Taiwan
Communications Module	AcBel, DELTA Networks, Billion Electric, TATUNG , Arch, MOXA, SensingTEK, Itron, ITRI
Concentrator or MIU	MOXA, AcBel, DELTA Networks, ZyXEL, Itron, ITRI
AMI Sytem	III, TATUNG, DELTA, Chunghwa Telecom, Ladis+Gyr 、 Itron, Altos , ITRI
Meter Data Management System(MDMS)	TATUNG , III,Chunghwa Telecom, eMeter, Oracle, Ladis+Gyr, Itron, Altos

Taiwan DAS Equipment Provider

Sort	Equipment	Provider
Power Distribution Equipment)	Transformer Oil Gas Analyzer	CHEM, Fortune, SHIHLIN, TATUNG, PIC(G.E)
	Pad- & Pole-Mounted Transformers	TATUNG, SHIHLIN, Fortune, ALLIS
	Recloser	Fortune, SHIHLIN
	Automatic Line Switches	CHEM, Fortune, ALLIS, SHIHLIN, TECO, TATUNG, Schneider Taiwan
Distribution Feeder Automation System	RTU, FRTU, FTU	CHEM, Connet, HCE , TATUNG
	SCADA System	CHEM, Connet, HCE , TATUNG , Chunghwa Telecom, Siemens 、 ACS 、 SNC
	SCADA Server	ADVANTECH, HP
	GPRS/Fiber MODEM	Korenix, MOXA, EDIMAX
	Switch, Router	Connet, Wallnet, TATUNG, MOXA, Cisco, Altran

History and Trend of Smart Appliances

Traditional Appliances



First Generation Smart Appliances

Display current power costs and have automatic driving function, such as energy-saving frequency conversion appliances.



Automatically regulate the water volume
Zero-consumption Reduce 76% of power consumption from digital standby.



Sharp Multi-spots Induction Reduce 64% power consumption by adjusting the temperature of the refrigerator automatically.



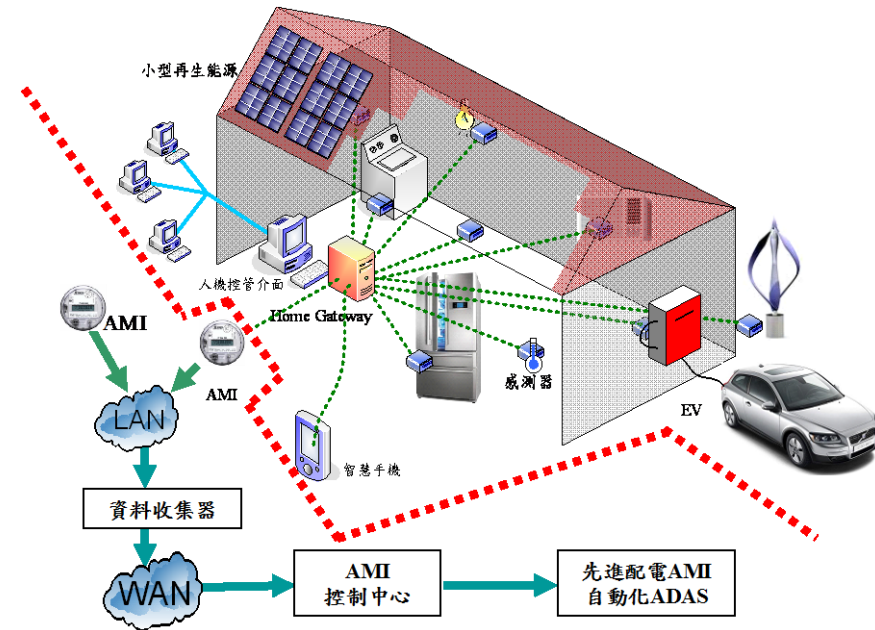
Display temperature and power consumption
 Decrease electric power to 45W(as same electric fan)
 Reduce 26% of power consumption

Automatically judge the amount of refuse
 Automatically regulate power supply and suction



Second Generation Smart Appliances (Future)

An household appliances integration system to truly reflect power cost by integrating ICT technologies with Smart appliances and expanding users' involvement.



The time for smart appliances to enter general household

- (1) Standardize the information connection system of smart appliances
- (2) Establish TOU pricing system.

1949

2000

2014 ~2016

Taiwan Smart Home and Building Equipment Provider

Equipment	Provider
Intelligent home appliances	EHome : Cheng Xiang Control4 EMS : Justyle, ITRI
Electric vehicles charger	DELTA, ALLIS, LITEON, Fortune, Schneider Taiwan, ITRI
Power management chips	VIA
Energy management system (Interface)	Panasonic Taiwan, Chunghwa Telecom, INTEC, Tung-Chou, ITRI, Schneider Taiwan
Home Gateway	Panasonic Taiwan, Micortime Chunghwa Telecom, ITRI, Schneider Taiwan
Human-machine interface control	Panasonic Taiwan, Chunghwa Telecom, ITRI, Schneider Taiwan
Load type of control interface	Netvox, JosephTech
Wireless sensors	ZigBee : ICP DAS, Netvox
Wired sensors	Hom-thai, Winling
Communications Module	PLC : AcBel, Billion, ITRI ZigBee : ICP DAS, Netvox , ITRI Wi-Fi , Ethernet :MOXA

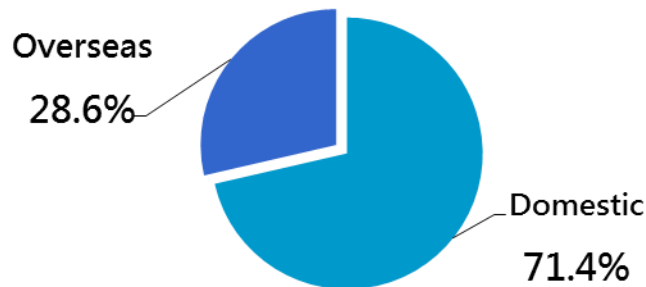
Taiwan Microgrid and DG Equipment Provider

Equipment	Provider
DG – Stationary fuel cell	CHEM, ITRI
DG - PV	Unienergy, HELIUS, ALLIS, Lucky Power, JosephTech, MOTECH, GPI, DELTA, ITRI, TATUNG
DG – Small wind turbine	Hi-VAWT, PGC, Boltun, iWIND, STU, ITRI, TATUNG
DG – Micro turbine	AIDC
DG – Energy saving system	FEMTC, AcBel, ALLIS, Lucky Power, ITRI, CSISTDUP
Electric vehicle quick charger	ALLIS, DELTA, LITEON, Fortune, Schneider Taiwan, ITRI
Bi-directional dc-dc converter	CHEM, DELTA, AblereX, MOTECH, INER, ITRI, TATUNG
Micro Inverter	ALLIS, DELTA, Fortune, CHEM, Jubilee, Top Tower, GEOPROTEK, Schneider Taiwan, ITRI, TATUNG
Maximum Power Point Tracker	DELTA, INER, ITRI
Local SCADA	ALLIS, ADX, 榮成興業, CHEM, Chunghwa Telecom, ITRI, TATUNG
LVRT (AVR)	MOTECH
Distribution SVC	DELTA, TAIK
Distribution STATCOM	DELTA
AVR	DELTA, CHEM
Power controller / conditioner	INER
Loop Balance Controller (LBC)	NA
Static switch	榮成興業
Protective Relay	ALLIS, TAIK, Schneider Taiwan
Communication Equipment	MOXA

Results of Smart Grid Industry Survey in Taiwan-1

- In 2009, the total sales of smart grid products are 2.13 billion dollars, among which, 1.52 billion dollars, 71.4% of the total sales, are from domestic sales and 0.61 billion dollars, 28.6% of the total sales, are from products sold abroad. In 2010, the total sales of smart grid products are 5.549 billion dollars, among which, 2.87 billion dollars, 51.6% of the total sales, are from domestic sales and 2.68 billion dollars, 48.4% of the total sales, are from products sold abroad. This shows that the demand of our domestic smart grid products is increasing significantly with the average growth rate of 20% from 2011 to 2015.
- The main export equipment include power transmission switching mechanism, concentrators, transformer remote monitoring module, raw material of smart grid products, exchange board, embedded computers, home display unit, converter, electric meter detection equipment and active power filter.

Proportion of sales of smart grid related products in 2009



Proportion of sales of smart grid related products in 2010



	Domestic	Overseas	Total
Total Sales of Smart Grid Products in 2009	1.50 billion dollars	0.61 billion dollars	2.13 billion dollars
Total Sales of Smart Grid Products in 2010	2.866 billion dollars	2.684 billion dollars	5.55 billion dollars
Growth Rate	88.55%	340%	160.56%

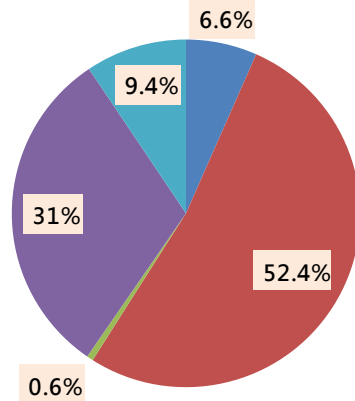
Notes : (1) Due to some companies readjusted their category of their smart grid products in 2011, the result of the second survey might different from the first one.

(2) This data is based on the questionnaire survey from 21 companies of the smart grid industry, but lacking of the questionnaire from Hsiang Cheng Electric, Teco, Shih Lin Electric and Controlnet .

Results of Smart Grid Industry Survey in Taiwan-2

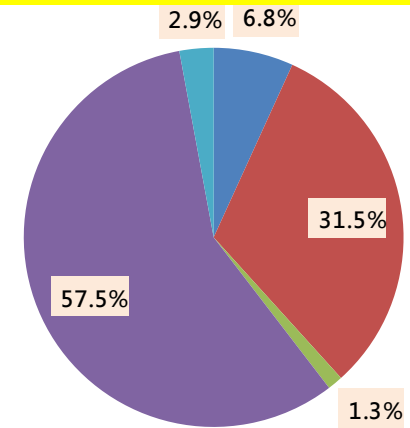
This survey is also aim at the value of sales of " Advanced Metering Infrastructure Related Equipment ", " Advanced Distribution Automation and Distribution Management Related Equipment" , "Smart Homes and Building Related Equipment" , " Distributed Power and Microgrid Related Equipment" , "Power Generation Equipment and Transmission Status Monitoring System" five categories. The result shows: the value of other categories increase significantly except "Power Generation Equipment and Transmission Status Monitoring System" . In 2010, the annual sales of "Smart Homes and Building Related Equipment" increase the most which is 5 times the original sales. Ranked in second place is " Distributed Power and Microgrid Related Equipment" , which the annual sales increase about four times the original sales.

Sales of Smart Grid Related Production in 2009



- Advanced Metering Infrastructure Related Equipment
- Advanced Distribution Automation and Distribution Management Related Equipment
- Smart Homes and Building Related Equipment
- Distributed Power and Microgrid Related Equipment
- Power Generation Equipment and Transmission Status Monitoring System

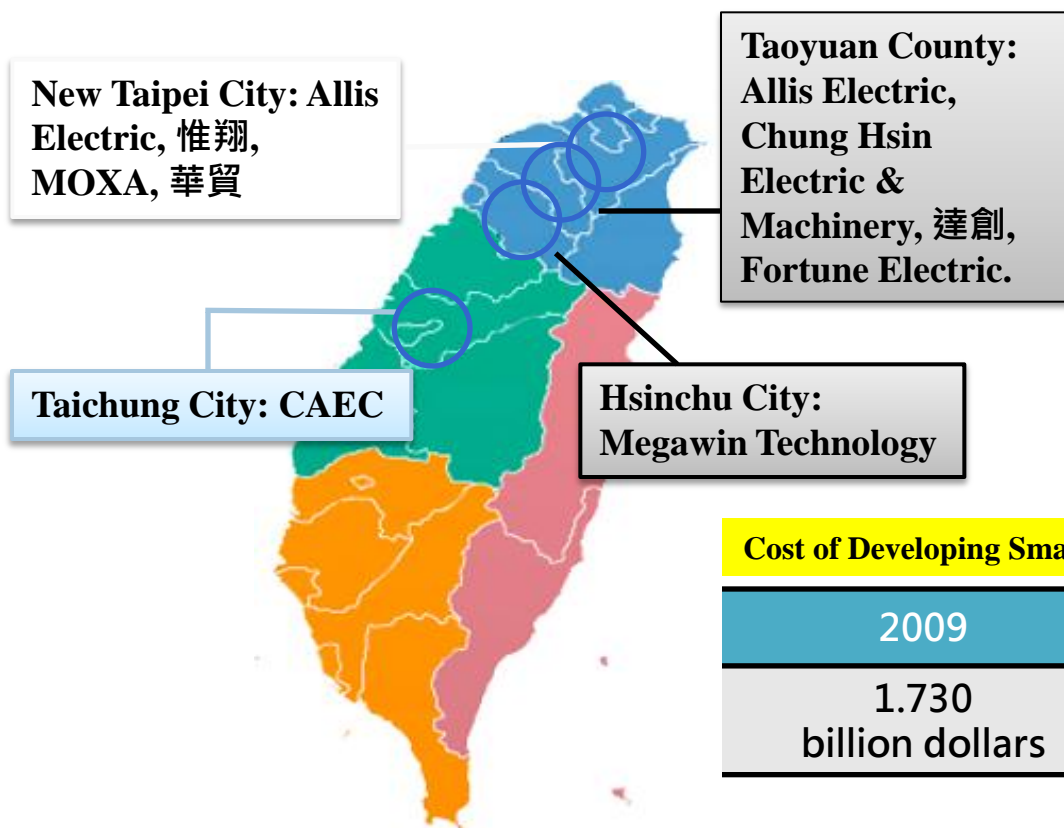
Sales of Smart Grid Related Production in 2010



Production Category	1. Advanced Metering Infrastructure Related Equipment	2. Advanced Distribution Automation and Distribution Management Related Equipment	3. Smart Homes and Building Related Equipment	4. Distributed Power and Microgrid Related Equipment	5. Power Generation Equipment and Transmission Status Monitoring System	Total
Sales of Smart Grid Related Production in 2009	17.72 million dollars	140 million dollars	1.50 million dollars	82.84 million dollars	25 million dollars	267 million dollars
Sales of Smart Grid Related Production in 2010	51.61 million dollars	240 million dollars	10 million dollars	438 million dollars	22 million dollars	761 million dollars
Growth Rate	191.25%	71.42%	566.6%	428.7%	-12%	185%

Results of Smart Grid Industry Survey in Taiwan-3

Classify by region, in 2009-2010, the major markets of Taiwanese smart grid related products are as follow : China, Japan, South Korea, India, Australia, Germany, United Kingdom, USA, Canada, Mexico, Brazil, South Africa. Factories are expecting to develop Japan, China, Southeast Asia, India, Europe, Middle Asia, USA, South America.



Most of domestic factories which produce smart grid related products are located in New Taipei City, Taoyuan County, Hsinchu City and Taichung City. Otherwise, most of foreign locations are in Qingdao, Shanghai, Jiangsu, Shenzhen, Guangzhou, Dongguan, Berlin (Germany).

Cost of Developing Smart Grid Related Products in Taiwan from 2009 to 2010

2009	2010	Growth Rate
1.730 billion dollars	2.057 billion dollars	18.9%

unit : NTD

Location of Producing Taiwanese Smart Grid Related Products

Smart Grid Industry Technology Roadmap

	Phase	Outcome	Steps	Comments	Keys for Vendors
1	Innovation and Validation	Establish proof of concept and reliability Measures	<ul style="list-style-type: none"> Innovation developed Engineering tests Pilots 	<ul style="list-style-type: none"> Dominated by large utilities, large grid vendors, labs Testing in cooperation with utilities or large energy users, often with funding from state (e.g. California's PIER program) or federal programs (e.g. DOE) 	<ul style="list-style-type: none"> Compelling technology Testing and demonstration Strong reputation with leading Utilities
2	Standards Development	Establish industry standard	<ul style="list-style-type: none"> Early deployments Joint standards Development 	<ul style="list-style-type: none"> Key grid standards bodies include IEEE and ASME Technical associations that include vendors, users, and researchers try to influence standards Regulators may also establish working groups to sort out the emerging standard Validity data 	<ul style="list-style-type: none"> Links to standards bodies and Regulators
3	Standards Deployment	Generate standard technical specification	<ul style="list-style-type: none"> Incorporation into functional requirements Standards education Regulations, mandates & Incentives 	<ul style="list-style-type: none"> Integrators and manufacturers begin incorporating the standard Regulators are lobbied to increase adoption by removing barriers, developing mandates or adding incentives Note: Many standards never make it to full deployment 	<ul style="list-style-type: none"> Marquee reference customers Central role in consortia or platform efforts
4	Product Acceptance	Integrate into established buying practices	<ul style="list-style-type: none"> Incorporation into new products Broad set of utilities begin considering Core requirements stabilized, yet differentiation remains 	<ul style="list-style-type: none"> Utilities begin broader integration of the standard into specifications for new purchases Opinion-leading utilities monitored carefully as models of why and how to implement these technologies 	<ul style="list-style-type: none"> Brand presence Financial strength Product and market alliances

Standard structure of smart grid technology in Taiwan

Industry Association of Taiwan's smart grid planning standard structure of smart grid technology, with the intention of facilitating the involvement of the industry.

Intelligent Generation

1. Coordination of conventional power network source
2. New energy generation and network
3. Large scale energy storage systems facilitate network

Intelligent Transmission

1. Flexibility DC transmission
2. Flexible AC Transmission
3. Line Status and Operational Environment Monitoring

Smart Electrical substation

1. Smart Electrical substation
(Taipower、Fortune Electric Co.、ALLIS ELECTRIC CO.)

Intelligent Distribution

1. Distribution Automation
2. Distributed power grid
3. Distributed energy storage systems and network (Tatung Company、Chung Hsin Electric & Machinery Mfg. Corp.、ALLIS ELECTRIC CO.)

Information and communications

1. Transmission network
2. Distribution and User-side communication network
3. Services Network
4. Communications support network
5. Smart grid information infrastructure platform
6. Smart grid information application platform
7. Information and Communication Security

(Chunghwa Telecom、Institute for Information Industry)

Smart Power Consumption

- Two-way interactive services
- Electricity information collection
- Smart electricity services
- Electric vehicles charge – discharge
- Intelligent measurement (Tatung Company、Chung Hsin Electric & Machinery Mfg. Corp.、VIA Technologies, Inc.、ALLIS ELECTRIC CO)

Intelligent transmission

1. Smart grid scheduling support system
2. Grid operation control

comprehensive planning

1. Terminology and methodology of the smart grid
2. Smart grid planning and design

Reference : 1. 台灣智慧型電網產業協會，「智慧電網標準合作討論會議」，2011.5.9
2. 許世哲，智慧電網相關規範之發展現況，2011.5.6

*Thank You for Your
Listening!*