Introduction of Green Energy Industry

(綠色能源產業概論)

-新興能源服務業之發展及功能

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賴文亮 教授

任課時間：From Feb, 2009 to July, 2009

上課大綱

- 上課大綱介紹、評分方式及著作權法 (1 week)
- 全球環境發展之趨勢 (2 weeks)
- 綠色能源產業介紹 (9 weeks)+影片欣賞 (6 week)
  - 太陽能、水力、風力、生質能(氫能、酒精、甲烷及柴油)、燃料電池
- 新興能源服務業之發展及功能(2 weeks)
  - 美國、日本、香港及台灣
- 電子產業之生命週期設計(1weeks)
- 政府之永續能源政策(1weeks)
- 期中書面及期末口頭報告(2 weeks)

美國能源服務業發展、經驗及趨勢

The development, experience and trends of the U.S. Energy services business

Erbin B. Keith, JD, PE
Senior Vice President
Sempra Energy Solutions

- 能源問題之解決(Energy Solutions)
- 美國的能源服務供給商(U.S. Energy Services Providers)
- 美國能源服務業之服務(Services provided by U.S. ESCOs)
- 美國能源服務業完成之一般計畫(Common Projects Implemented by U.S. ESCOs)
- 能源服務業發展及市場問題(ESCO Development & Market Issues)

能源服務業可提供之服務

- Infrastructure Services
- Physical Supply
- Information Services
- Risk Management
- Operations & Maintenance
- Flexible Pricing
- Engineering & Construction
- Load Management
- Capital Upgrades
- Energy Efficiency

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美國的能源服務供給商
U.S. Energy services providers

- **個體能源服務業(Independent ESCOs)**
  - Traditional ESCOs
  - Contractors
  - Consultants
  - Facilities Managers
- **相關設備之能源服務業(Utility-Affiliated ESCOs)**
- **生產設備相關之能源服務業(Equipment Manufacturer-affiliated ESCOs)**
- **趨勢(Trends)**
  - Consolidation/acquisition of the independent ESCOs
  - The emergence of utility affiliated ESCOs
  - Failure of early participants as an integrated retail energy provider
  - Expansion of ESCO services and measures implemented

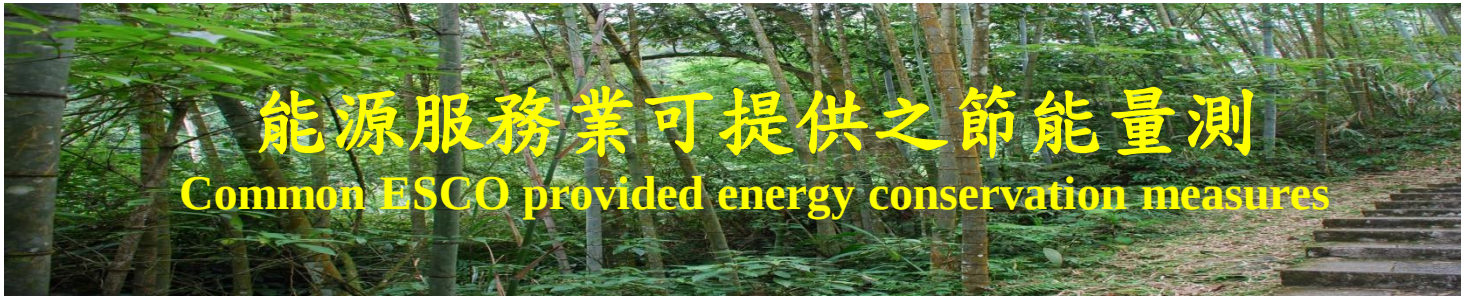
重要的能源客戶
Key U.S. End-users (ESCO market sectors)

- 過去的歷史(Historical)
  - Federal Government
  - Institutional
    - Colleges and Universities
    - K-12
    - State and Local Government
    - Hospital

- 未來趨勢(Trends)
  - Industrial
  - Commercial

能源服務業可提供的服務
Services provided by ESCOs

- 傳統的服務(Traditional Services)
  - Energy Audits
  - Project Engineering
  - Project/Construction Management
  - Project Financing
  - Operations and Maintenance
  - Measurement and Verification
- 衍生性服務(Expanded Services)
  - Water Conservation
  - Asset Minimization
  - Energy Information
  - Environmental
  - Energy Commodity/Commodity Risk Management
  - Substation Work (e.g., voltage upgrades)



能源服務業可提供之節能量測
Common ESCO provided energy conservation measures

- **Historical**
  - Lighting Retrofits/Ballast Disposal
  - HVAC Retrofits
  - Building Control Systems
  - Motors and Drives
  - Chiller and Boiler Upgrades
- **Trends**
  - Thermal Storage/Load Shaping
  - Generation Efficiency Improvement
  - On-site Power Generation (Distributed Generation, CHP, Cogeneration)
  - Power Quality
  - Industrial Processes (e.g., compressed air systems)

ESCO PROJECT EXAMPLES

Albany Medical Center (Albany, NY)

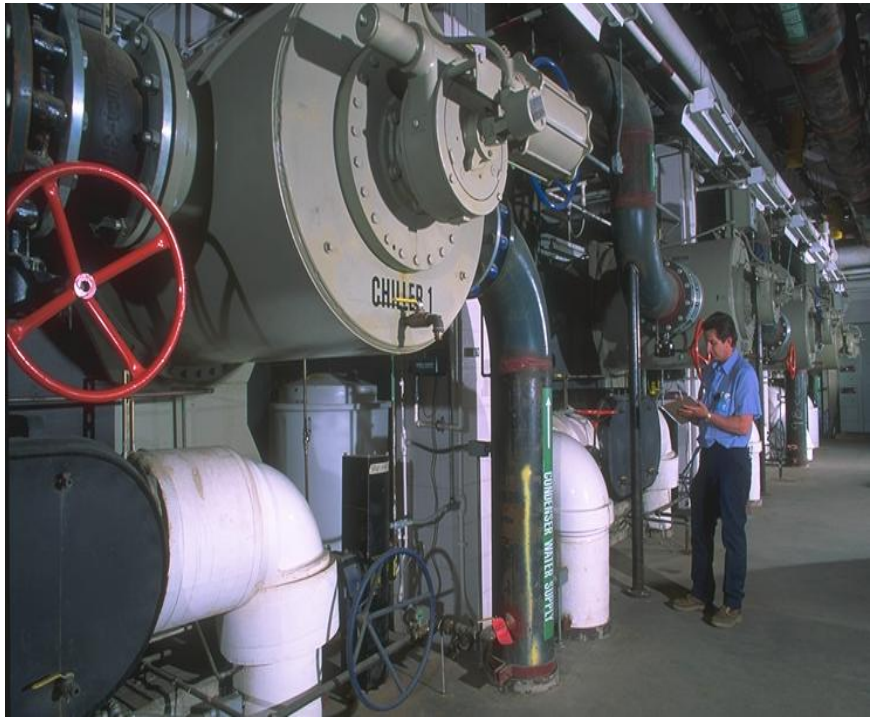
1994 U.S. Department of Energy Award

1993 New York Governor's Energy Awards

- 2.2 Million Square Feet
- 20 Buildings
- $7.7 Million Installed Cost
- $1.3 Million Annual Energy Savings

Comprehensive Approach
at Albany Medical

- **ECM Technologies**
  - Lighting retrofit-22,000 fixtures
  - 1000-point energy mgmt control system installation
  - 1200-ton central plant expansion
  - Replace air-cooled & DX air conditioning with distributed chilled water
  - High-efficiency motors
  - Boiler plant upgrade
  - Heat recovery
  - Expand chilled water loop to additional buildings
  - VSD's on AHU's and pumps
  - Domestic hot water conversions
  - 1000 energy-efficient windows
  - Chiller installations
  - Freon(二氯二氟代甲烷)transfer, storage & recovery installation



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Louisiana State University (LSU)

Baton Rouge, Louisiana

1995 Association of Energy Engineers Project of the Year

- 100 Buildings
- Linked to New Central Plant
- $18,650,000 Installed Cost
- $4,300,000 Annual Energy Savings
- $1,000,000 Annual Maintenance Savings

New Central Plant at LSU

- **ECM Technologies**
  - ✓ 5000 HP Gas-fired turbine powered by jet engine to drive a 6300 ton chiller and produce steam with a heat recovery boiler
  - ✓ 4.5 miles underground chilled water piping
  - ✓ 8000-ton cooling tower
  - ✓ 2000-point energy management control system + LSU-added 18,000 points
  - ✓ 2.25 miles underground fiber optic cable
  - ✓ Variable speed pumping
  - ✓ Relocate boiler controls to new central plant

Houston Independent School District

ESCO 1.0 Project

2.9 Million Sq. Ft.

- **Thermal Storage System Installations**
- **Energy Management Control Systems**
- **Lighting Upgrade - 24,000 Fixtures**
- **New Central Plant @ Administration Complex**

Facility Size: 21 schools + Admin. Complex
Project Cost: $12.75 Million
Projected Savings: $1.4 Million Annually

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Comprehensive Approach at Houston Independent School District

ECM Technologies

- 24,000 Fixture Lighting Retrofit
  - Ballasts, Bulbs, Reflectors, Lighting Controls
- 17 Thermal Energy Storage Systems
  - Ice and Chilled Water
- New Central Plant for Administration Complex
- Energy Management Control Systems
- Chiller Replacement
- Solar Screens
- Variable Speed Drives on Air Handlers & Chilled Water Pumps
- Power Factor Correction
- Window Tinting
- Conversion DX to Chilled Water
- Piping Associated With Connection to Central Plant
- Glycol(乙二醇;)to Water Heat Exchanger for Glycol Isolation
- Duct Dampers

HISD central plant

Three 500-Ton Chillers

800,355 Gallon Chilled Water Storage Tank

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ICE STORAGE TANKS

District-wide: 17 Thermal Storage Systems

totaling over 111,000 ton-hours

STATE UNIVERSITY OF NEW YORK (SUNY)

Buffalo Campus

Amherst, New York

1997 AEE Energy Project of the Year
1996 EUN Certificate of Merit
College/University Sector

ECMs Installed:

- **Campus-wide lighting retrofit**
- **4000 point energy management system**
- **High efficiency motor replacement**
- **Variable speed drives**
- **Steam, hydronic hot water & domestic hot water boilers**

Facility Size: 5.5 Million sq.ft.//60+ buildings
Project Value: *$17,213,000*
Annual Savings: *$1,600,000*

STATE UNIVERSITY OF NEW YORK (SUNY) Cortland Campus Cortland, New York

1996 EUN Energy Project of the Year
College/University Sector

ECMs Installed:

- Campus-wide lighting retrofit
  - 25,000 fixtures
- 3000-Point energy management
  - control system
- Chiller & cooling tower replacement
- Building envelope sealing &
  - insulation
- Gas-fired steam & hot water boilers
- Variable speed drives on AHUs, exhaust fans, pumps
- High efficiency motors

Project Value: ***$9,600,000***

Facility Size: ***2,500,000 sq. ft. in 50 buildings***

Annual Savings: ***$1,190,000***

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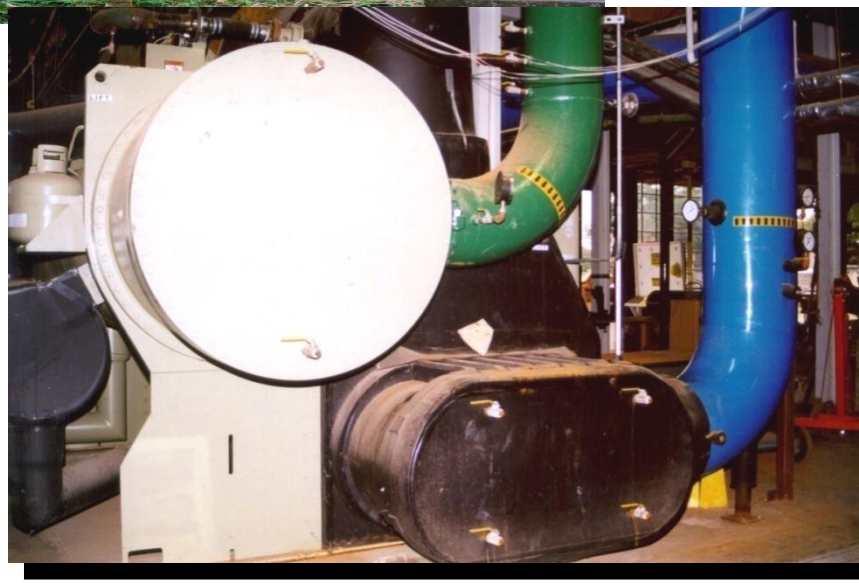
BAYLOR UNIVERSITY Waco, TX

In Commissioning



Technologies Installed

- Modify Central Plant Piping
- For Greater Operational
- Flexibility
- 4500 Tons Total
- Replace Two 25-Year-Old
- Chillers, Add One New
- Retrofit 50,000 Light Fixtures
- Expand Energy Management Control System

Facility Size:	**3,736,719 Sq. Ft.**
	90 Bldgs
Project Value:	**$15,000,000**
Projected Annual Savings:	**$1,630,000**

HILL AFB
Utah

- 1400 Buildings
- 14 Million Square Feet
- Fast Track Implementation
- Structured Around Multiple Task Orders
- Comprehensive Energy Conservation Technologies
- $20 Million Total Construction Value
- *EUN*'s 1996 Federal Project of the Year

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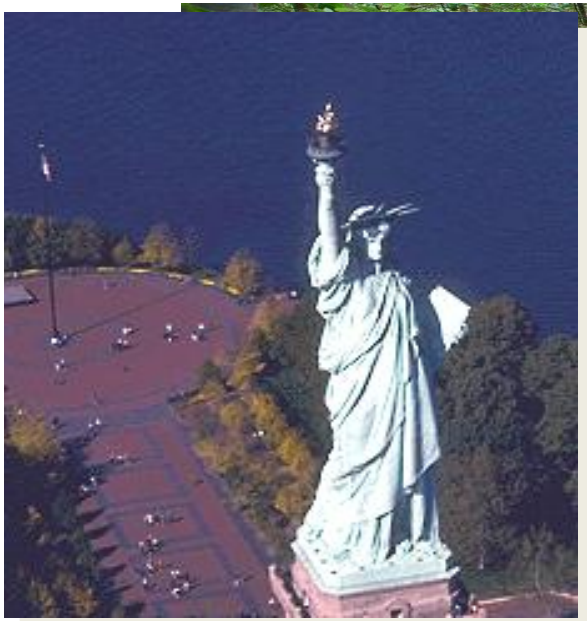
Hill AFB
ECM Technologies

- High Efficiency Chillers
- Cooling Towers
- Variable Speed Pumps and Fans
- High Efficiency Electronic Ballasts, T8 Lamps, Metal Halides, Sulfur Lighting
- Energy Management
- Control Systems
- Economizer Controls



Statue of Liberty/Ellis Island National Monuments New York, NY

Project includes: installation of Energy Management Control System, variable speed drives and lighting improvements to over 4000 fixtures.

Project Value: **$1,060,000**
Facility Size: **350,000 sq. ft.**
Projected Annual Savings: **$172,000**

Hampden County Courthouse
Hall of Justice *Springfield, MA*

ECMs Installed:

- **Electric to gas conversion, increase boiler plant size**
- **Electric to hot water reheat in duct work**
- **New chiller plant**
- **Upgrade and expand energy management control system**
- **6000-fixture lighting retrofit**
- **New transport gas contract**

Facility Size: **2 buildings.; 300,000 sq. ft.**
Project Value: **$2,798,000**
Projected Annual Savings: **$340,000**

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Sempra Energy Services

State of New York Ten Eyck Building Albany, NY

Technologies Installed

- **Lighting Retrofit**
- **Centrifugal Chillers**
- **“Free Cooling” System**
- **Closed Circuit Evaporative Towers**
- **Premium Efficiency Electric Motors**
- **Expansion of Existing**
- **Computerized Energy Management**
- **Control System**

Project Value: **$2,200,000**
Facility Size: **300,000 sq. ft. 16-story building**
Annual Savings: **$291,453**

City of BuffaloBuffalo, NY

Technologies Installed

- **Upgrade Over 18,000 Lighting Fixtures**
- **Installation of High Efficiency Motors**
- **800-h.P. Variable Speed Drive**
- **Improved Temperature Control**

Project Value: **$2,637,000**
Facility Size: **70 buildings located throughout the city**
Annual Savings: **$512,000**

Harris County Central Plant

Houston, TX

Facility Size:

Serves 7 Current Plus 3 Future Buildings

Project Cost:

$17.5 Million

Projected Savings:

$1.0 Million Annually

Technologies Installed

- **Six 1200-Ton Chillers**
- **Three 50,000 PPH Boilers**
- **Six 3600 GPM Cooling Towers**
- **Energy Management System**
- **Variable Speed Drives on Pumps**
- **Separate Electrical Switchgear Room**
- **Control Room**
- **Water Treatment Equipment**

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Austin Airport Central Plant

Austin, TX

Technologies Installed

- Four Chillers Totaling
- 3000 Tons Cooling
- Three Hot Water Boilers
- Totaling 900 HP
- 1.5 Million Gallon
- Thermal Storage Tank
- Three-Cell 9339 GPM Cooling tower
- Primary/Secondary
- Variable Pumping Systems

Sempra Energy Services Role:
Design & Construct
Facility Size:
500,000 Sq. Ft. on 4 Levels
Project Value:
$5,087,586

Jefferson County Government Complex
Louisville, KY

TECHNOLOGIES INSTALLED

- Replace 55-year old central system with 25 modular boilers
- 1000-point computerized energy control system.
- Upgrade over 2000
- lighting fixtures

Project value:	**$2,500,000**
Facility Size:	**901,295 sq. ft.**
Annual Savings:	**$512,972**

Century City Central Plant
Los Angeles, California

- ***Service*** - Provides chilled water and steam services to 10 million square ft.
- ***Diversity of Load*** - Includes the Theme Towers, Century Plaza Hotel, Shubert Theatre, ABC Entertainment Center, Century City Hospital, Century Park Condominiums
- ***Capital Investment*** - Expanded 22,000-ton chilled water plant to 27,000-tons in 1998
- ***Reliability*** - 24 hours per day / 7 days per week, year-round uninterrupted coverage since 1984

IEMS - Venetian Resort, Las Vegas

- Financed $70MM of energy facility infrastructure including the central plant, HVAC air-side, energy monitoring and control system, back-up power generation, and UPS
- 15,500-ton chilled water plant
- 9,200,000 square feet, 6000 rooms
- Turn-key operating and maintenance for entire resort
- Will have 60 employees dedicated on-site to provide 24X7 service when fully staffed, 80 employees when construction is complete
- Energy procurement services

Building Technical Services
STAPLES Center, Los Angeles

- 2,500-ton chilled water plant
- 260-ton ice making equipment
- 901,000 sqft
- Turn-key operation and maintenance of the entire energy infrastructure

Image of the Staples Center by the Los Angeles Kings

The U.S. ESCO development and market issues

- ***Market Drivers***
- Federal Legislation and Executive Orders
  - U.S. Government owns or operates over 400,000 buildings and has an energy bill of $4.2 billion/year. The Energy Policy Act of 1992 (EPACT) and subsequent executive orders have mandated significant reductions in energy consumption at Federal buildings and provided the legislative framework for Energy Savings Performance Contracting (ESPC).
- Trend toward outsourcing
  - Building owners are seeking a competitive advantage by outsourcing non-core functions to third-party "experts."
- DMS Programs
  - Demand-side management programs created as part of deregulation process spurs the implementation of energy services projects.
- Deregulation
  - Most of U.S. population is now facing a deregulated power market in the next five years. This is forcing the market to deal with retail commodity providers and developing a purchasing strategy that includes energy services projects. However, these programs usually provide less incentive than the Integrated Resource Planning DSM programs

The U.S. ESCO development and market issues(*conti.*)

- Performance Contracting
  - Performance contracting has expanded the development of the ESCO industry by attracting customers that otherwise would not invest in energy efficiency projects because of the cost and risk associated with the projects.
- Readily available financing sources
  - Low cost capital is readily available, particularly to the tax-exempt customer.
- The acute need for infrastructure renewal in the HUGS (Hospital, University, Government, and School markets.
  - This need along with favorable statutory authority and low cost (tax-exempt) financing has driven the U.S. performance contracting market.
- Transparent pricing
  - Transparent or “open book” pricing has opened the market but narrowed margins.
- Environmentally Driven Energy Projects
  - Important environmental issues and liabilities are driving some energy projects (e.g., CFC issues in chillers, emissions in boiler/power plants, PCBs in lighting ballast's).

美國能源服務業之發展及市場問題
The U.S. ESCO development and market issues (*conti.*)

Restraints/Challenges

- Lack of customer education
  - Customers are confused about a deregulated power market and the many options they face
- DSM Programs
  - Deregulation has all but ended old style Integrated Resource Management DSM programs. Newer programs generally provide lower incentives.
- Deregulation/apathy
  - Deregulation has created unreasonable expectations and a wait-and-see attitude in many customers.
- Difficult business development process
  - The sales cycle for energy services has traditionally been 12-24 months
- State and local government legislation
  - Many states have favorable legislation for performance contracting and state and local buildings.

美國能源服務業之發展及市場問題
The U.S. ESCO development and market issues(*conti.*)

- New ESCO market participants
  - Inexperienced new participants have created confusion the market
- Utility affiliates
  - Utility affiliate ESCOs bringing local brand/influence/experience to gain competitive advantage over non-utility ESCOs
- Lack of qualified energy professionals
  - Employment market lacks experienced energy professionals
- Negative experience by customers
  - Early market drivers (e.g., tax incentive driven projects in the 1980s) and project or ESCO failures negatively impact market.
- Strong U.S. economy
  - In a strong economy, energy cost savings are less of a factor to end users.

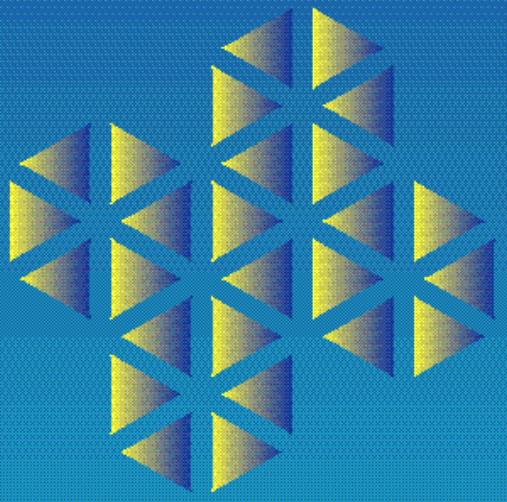
美國能源服務業之發展及市場問題
The U.S. ESCO development and market issues(*conti.*)

- Historical lack of participation of the commercial and industrial end-use sectors. Some of the "excuses" for lack of participation:
  - Sector already pays low unit price for energy
  - Energy costs is a small part of the product cost
  - Product considerations override energy considerations
  - Sector applies product style rate-of-return analysis to energy projects.
  - Sector feels it has internal resources to implement projects
  - Sector has internal capital to implement energy projects
  - Commercial end-use sector makes use of triple-net leases that don't provide an incentive to implement energy projects.

Trends of ESCO business in Japan

Hidetoshi Nakagami

Jyukankyo Research Institute



能源服務業之轉變史

History of creating ESCO business (1)

1996 MITI set up the Advisory Committee on ESCO Investigation

1997 Kyoto Protocol from COP3

1997 Association for ESCO Business Introduction in Japan(ECCJ)

1998 the Committee on ESCO Business Demonstration(ECCJ) the Committee to Investigate Measurement and Verification Methods(ECCJ)

1998 MITI set up a system of subsidies for energy efficiency retrofits

能源服務業之轉變史

History of creating ESCO business (2)

1998 Model energy efficiency retrofit demonstration project (the Committee on ESCO Business Demonstration)

May 1998 Law Concerning the Rational Use of Energy revised (Energy Conservation Law: MITI)

October 1998 Law Concerning the Promotion of Measures to Cope with Global Warming enacted (EA)

June 1999 New Japanese Appliance Energy Efficiency Standards enacted (A Top-Runner Approach: MITI)

July 1999 Law for Private Finance Initiative enacted(LPFI:EPA)

October 1999 JAESCO formed

Law concerning the Promotion of the Measures to Cope with Global Warming (October 1998:EA)

- In order to implement the Kyoto Protocol (COP3)
- To have the government and local authorities take the initiative in carrying out climate change countermeasures
- The government and all local authorities must propose, implement, and report on such countermeasures for all buildings that they manage themselves
- There are 47 prefectures and 3232 cities, towns, or villages
- Largest ESCO market in future

Law of Private Finance Initiative(LPFI) (July 1999:EPA)

-Promoting energy efficiency retrofits is not a goal of the LPFI of Japan

-Many points in common with ESCO business

-Apply private sector funding (Project finance)

-Cost savings

-Provide efficient services

-Alleviating financial difficulties of local authorities

Private sector actions(ESCOs)

-19 ESCOs in JAESCO

-Independent ESCO: The First Energy Service Company, Ltd.

-Utility ESCO: Gas and Power, Inc. (affiliate of Osaka Gas Co., Ltd.)

-Vendor ESCO: Mitsubishi Electric Corporation, Hitachi, Ltd., Sumitomo Metal Industries. Ltd., Omron Creative Facility Co., Ltd., Yamatake Building Systems Co., Ltd. Toshiba Corporation and American standard trane Japan Ltd.

-Construction ESCO: Chiyoda Corporation and Kajima Corporation

-Engineering ESCO: Nisinippon Environmental Energy Co., Inc., Kinden Corporation, Sankosha Corporation, Nippon Steel Engineering Osaka Co., Ltd., Toenec Corporation, ESCO Technologies Inc., West Japan Railway Technos Corporation and Kansai Tech Corporation

Utilities actions

-9 utilities in JAESCO

Electric Power Companies : Hokkaido, Tohoku, Tokyo, Chubu,
Kansai, Chugoku, Shikoku, Kyusyu

Gas Company : Tokyo Gas

-Utilities have not started ESCO businesses(except Osaka Gas)

-One electric power company planning to start ESCO business

-Utility company interest in ESCO business will increase

After they ascertain the current restructuring trends they will decide whether they should commercialize or not

Establishment of JAESCO

(October 1999)

- General knowledge of ESCO business is low
- The barriers for ESCO business are many
- Need to carry out market development
- Current members are 49

19 ESCOs

9 utilities

Jyukankyo Research Institute, ECCJ, Nippon Steel Corporation, Mitsubishi Corporation, and others

The aims of JAESCO

- Diffusion of and education about the ESCO industry
- Provision of information related to domestic and overseas ESCOs and information exchange between institutions related to ESCOs
- Support for research and development of energy efficient technologies related to ESCO business
- Recommendation of superior ESCOs
- Implementation of mediation and amicable settlement of disputes related to ESCO business

Market Barriers/Project financing

- Asset coverage and corporate financing
- the maximum financing limit is set (2 or 3 years)
- Many energy efficiency retrofits have long payback periods
- Project financing has not been done in Japan for small scale projects such as ESCO business
- Performance contracting could become the risk hedge for financiers, but lenders do not understand this point
- LPFI there is starting to use project financing
- Lenders are interested in ESCO business, provided that the risk hedge function of performance contracting
- It may become possible to apply project financing in Japan

Market barriers/application to local authorities

- Local authorities are expected to be the largest future market
- Local authority budgets are only for a single fiscal year
- local authority award the planning and implementation to separate vendors
- the criterion for choice of vendors is only price
- vendor is determined based on being within the estimated price range by even proposal-type bidding
- long-term financing cannot be borrowed from the private sector
- several local authorities are already studying the possibility of performance contracting under the present system

結論 Conclusions(1)

-Energy consumption by office buildings in Japan is 1,500 to 2,000 MJ/m^2-year, costing about \$30/m^2-year

-Investment in energy efficiency retrofit profitable at about \$50/m^2

-Contract lengths of 7 to 10 years

-EEMs :lighting, space conditioning equipment and cogeneration

-Market :hotels, hospitals, and office buildings

-The biggest future market will be local authorities

結論 Conclusions(1)

-MITI is expanding its program of subsidies for energy efficiency retrofits

-Environment Agency: the Law concerning the Promotion of the Measures to Cope with Global Warming

-JAESCO has been set up

-Private sector has taken notice of the future of ESCO business

-The role ESCO business will play in global climate change countermeasures is expected to expand

Association for ESCO Business Introduction(1997)

- ECCJ formed the association in 1997

- 233 specialists

- Working Groups

    - Institutional aspects

    - Performance contracting

    - M&VP

    - Case studies

        (industrial and commercial buildings)

Institutional aspects WG

- Introduction of project financing
- Application of flexible rules governing leasing
- Impediments accompanying the introduction of performance contracting at the national government and local administrative levels
- The need for government incentives such as broader subsidies and low-interest loans
- The need to implement demonstration projects
- The need for an association of ESCOs

Performance contracting WG

Performance contracting cannot apply to the government and

local authority

(A) Long term contracts are not possible

(B) Order the planning and implementation of a project from separate vendors

(C) Even with proposal-type bidding, the local authority estimates a standard bid price and uses this criterion to decide on the successful bidder

Case studies WG

<Industrial sector WG>

- Surveyed for examples of 108 cases energy efficiency retrofits
- The average investment : 1.36 million dollars
- Simple payback period : 4.4 years

<Commercial buildings sector WG>

- 16 buildings walk-through audits
- The average annual energy use : 1,200 to 2,000 MJ/m^2
- Annual outlays for lighting and fuel : \$32 to \$36/m^2
- Energy savings : less than 10 %
- Simple payback period : about 6 years

ESCO demonstration projects

- MITI subsidized one-third of the cost of a building energy efficiency retrofit
- Four were chosen by the Committee on ESCO Business Demonstration and model retrofits were done using ESCO methods
- The goal was demonstrate effectiveness of ESCO business for promotion of energy conservation

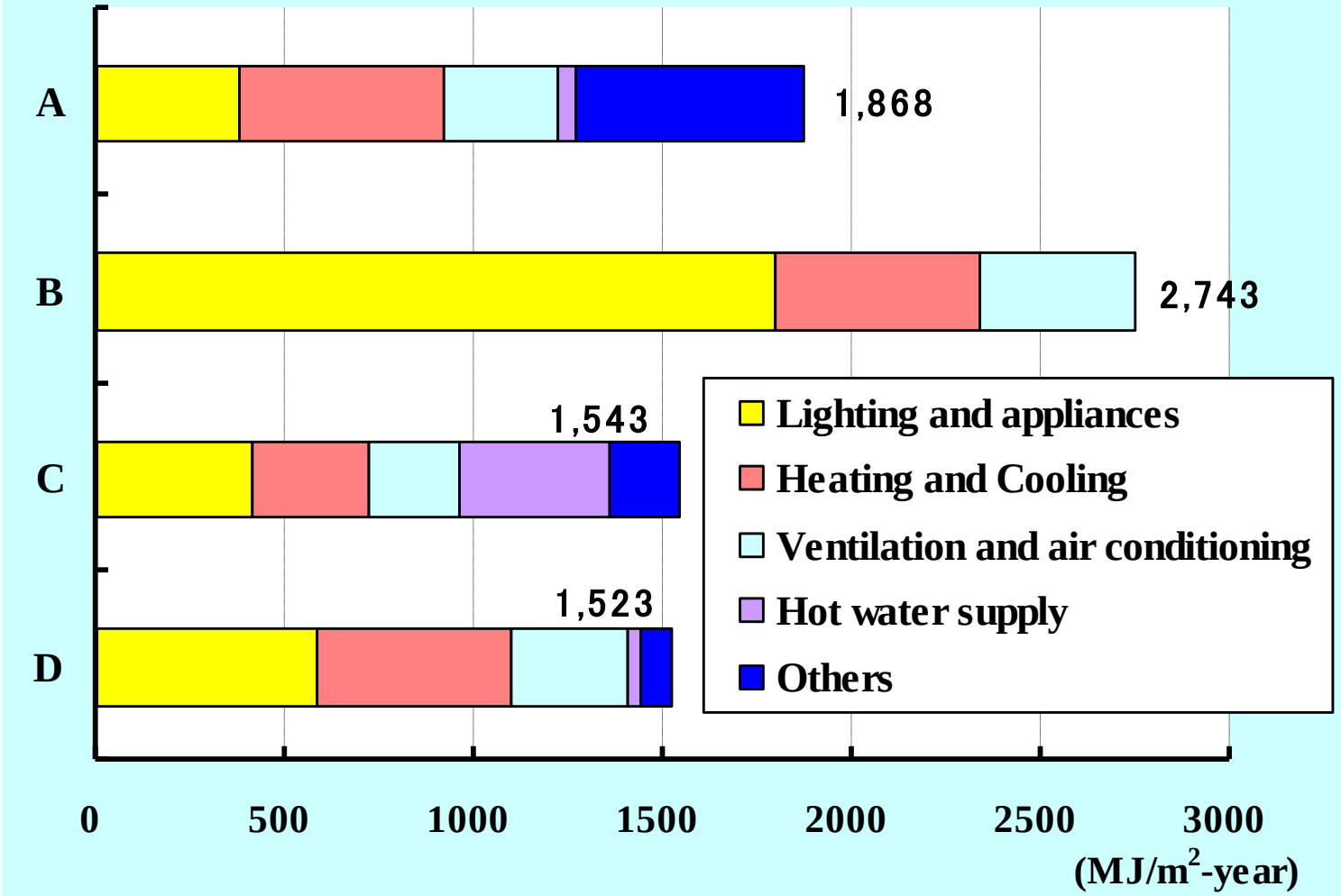
建築物節能之實例

Overview of demonstration project buildings

Building		unit	A	B	C	D
		-	office	office & research laboratoly	research & traning facility	office
completion		year	1993	1974	1993	1962
Total floor aria		m^2	33,118	12,750	10,659	9,237
Energy consumption	Lighting and appliances	MJ/m^2	374.7	1,797.7	411.0	582.9
	Heating and Cooling		543.6	538.9	311.2	511.0
	Ventilation and air conditioning		301.7	406.7	234.9	310.9
	Hot water supply		46.8	0.0	396.3	32.1
	Others		600.8	0.0	189.9	86.2
	Total		1,867.6	2,743.4	1,543.3	1,523.2
Utility Cost		$/$m^2$	30.1	51.4	26.4	27.4
Energy Price	Electricity	¢/kWh	14.8	19.1	20.4	20.4
	Average	¢/MJ	1.6	1.9	1.7	1.8

基礎單元之能源消耗

Baseline unit energy consumption



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能源效率測量

Energy efficiency measures(EEMs)

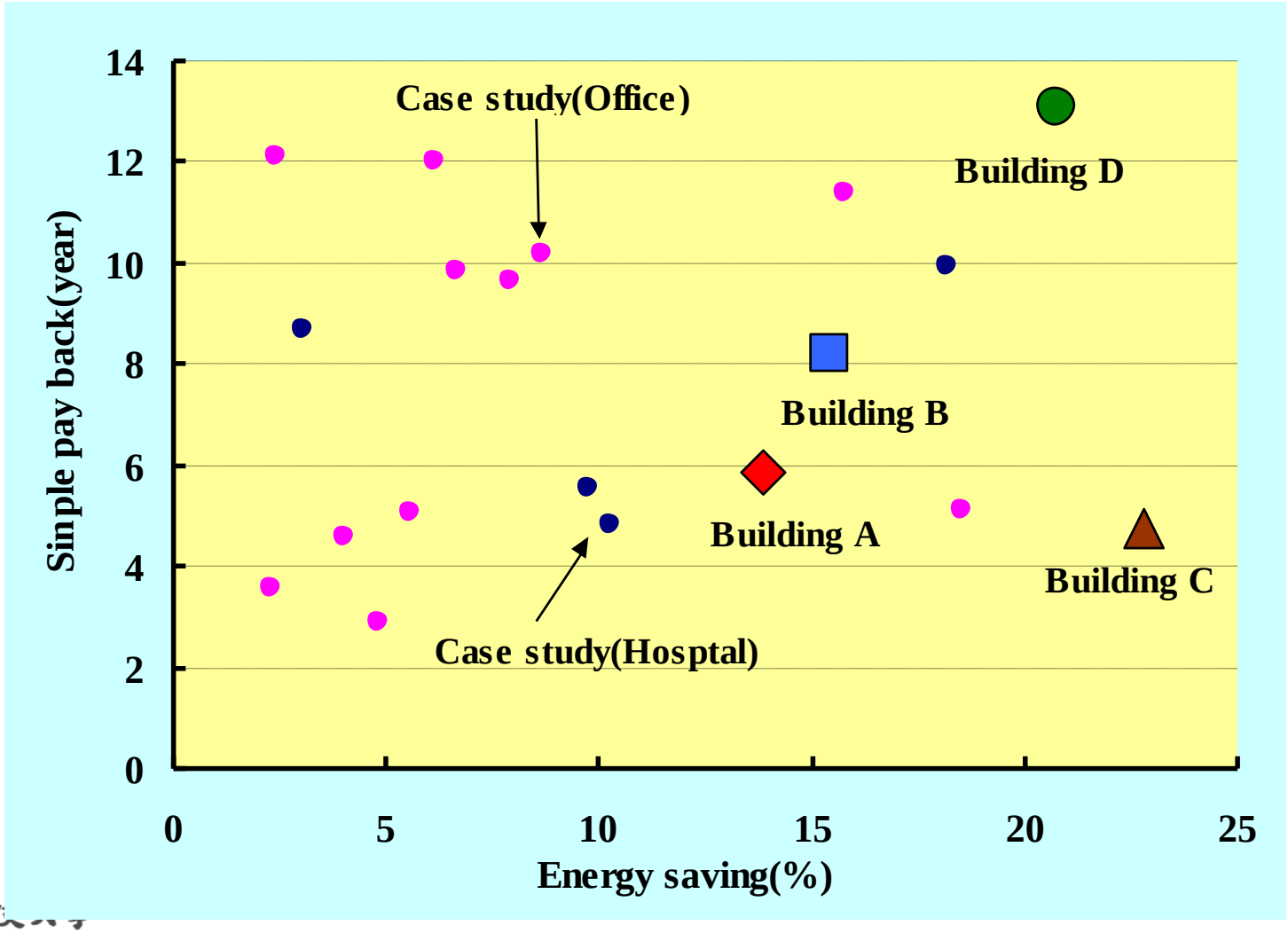
燈源 (Lighting)	high-efficiency fluorescent lighting, compact fluorescent lighting, occupancy sensors for lighting controls
電子裝置 (Electrical equipment)	distribution transformer, demand controller
空調 (Space conditioning)	Variable speed pumps and fans, insulating films, cold water radiant cooling, reconstruction of hot and cold water supply system
空調控制裝置 (Equipment to control space conditioning)	optimal control of heat source equipment, direct digital control of heating and cooling equipment, optimal control of temperature set levels, control of outside air quantity based CO_2 level, energy management system
共生裝置 (Cogeneration)	

Cost of Demonstration retrofits

Building	A	B	C	D
Construction Cost (1,000$)	**683**	**932**	**509**	**1,170**
Construction Cost ($/m^2)	**20.6**	**73.1**	**47.7**	**126.7**
ESCO Service Charge ($/m^2-year)	**1.99**	**3.57**	**2.05**	**4.77**
M&V Cost ($/m^2-year)	**0.33**	**1.28**	**1.02**	**1.18**
Decrease in Utility Costs ($/m^2-year)	**3.49**	**8.08**	**9.94**	**9.69**
Decrease Cost by EMS($/m^2-year)	**0.27**	**0.71**	**0.85**	**--**
Simple Pay Back Periods (year)	**5.9**	**9.0**	**4.8**	**13.1**
Decrease in Whole Building Energy Use (%)	**13.8**	**15.4**	**22.8**	**20.8**

節能源百分比

(Percentage of energy saved)

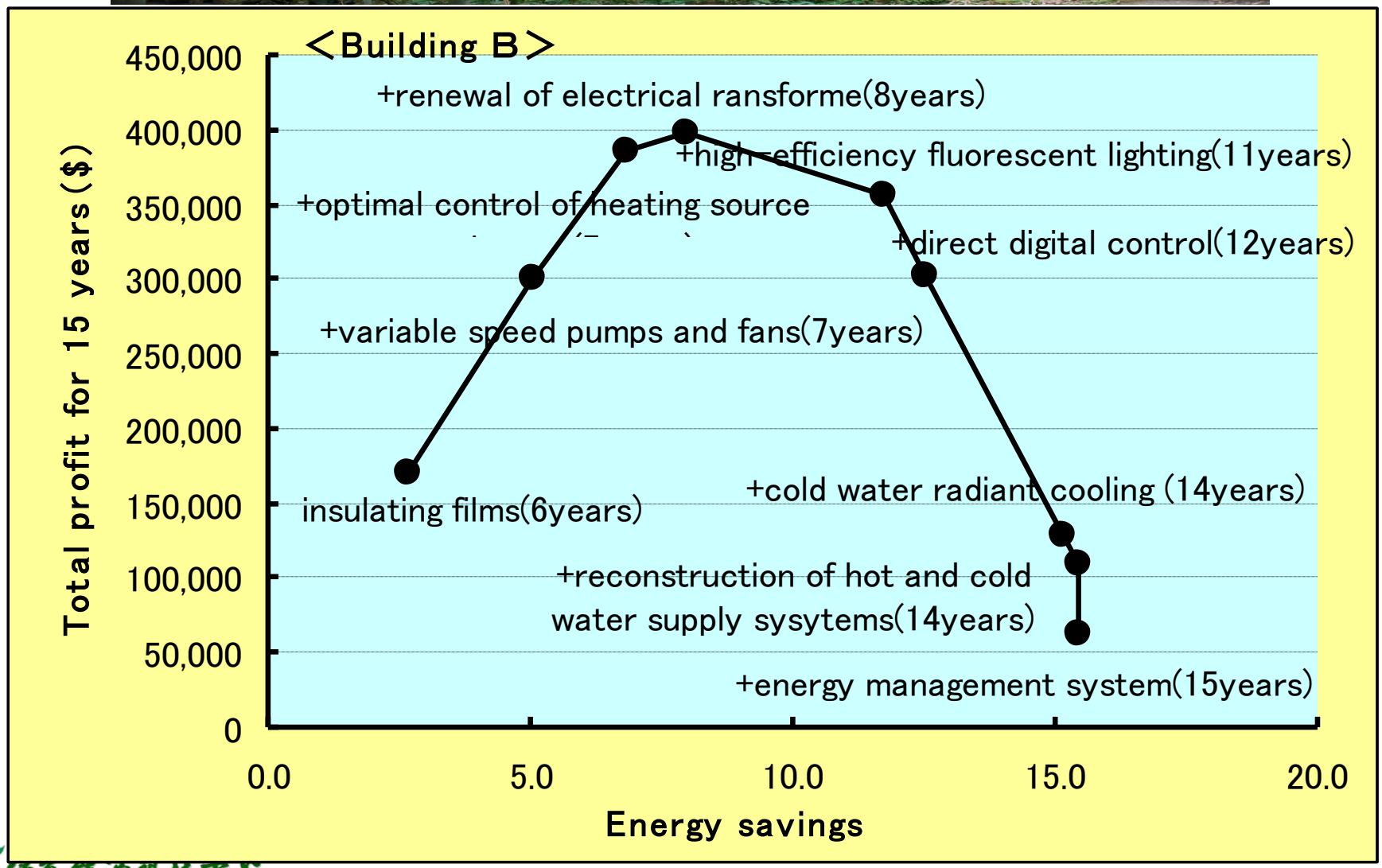


Minimum necessary contract length

years

Building	A	B	C	D
Base Case	10	17	7	>30
Subsidy Case	6	11	5	17
SPP	5.9	9.0	4.8	13.1

Total profit for 15 years



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Results of energy efficiency retrofits(A)

Building A	energy saving(%)	SPP(year)
Compact fluorescent lighting	**77**	**0.9**
Variable speed pumps	**76**	**1.6**
Variable speed funs	**58**	**4.0**
Energy management system	**-**	**8.7**
High-efficiency fluorescent lightings	**18**	**31.5**
Occupancy sensors for lighting controls	**26**	**53.4**
Whole building	**14**	**5.9**

Results of energy efficiency retrofits(B)

Building B	Energy saving(%)	SPP(year)
Insulating films	40	4.4
Variable speed pumps & funs	39	4.5
Optimal control of heat source equipment	20	5.5
Renewal of electrical transformer	51	8.4
High-efficiency fluorescent lighting	28	9.7
Direct digital control	40	13.2
Cold water radiant control	26	13.3
Reconstruction of hot and cold water supply system	4	14.3
Energy management system	--	--
Whole building	15	9.0

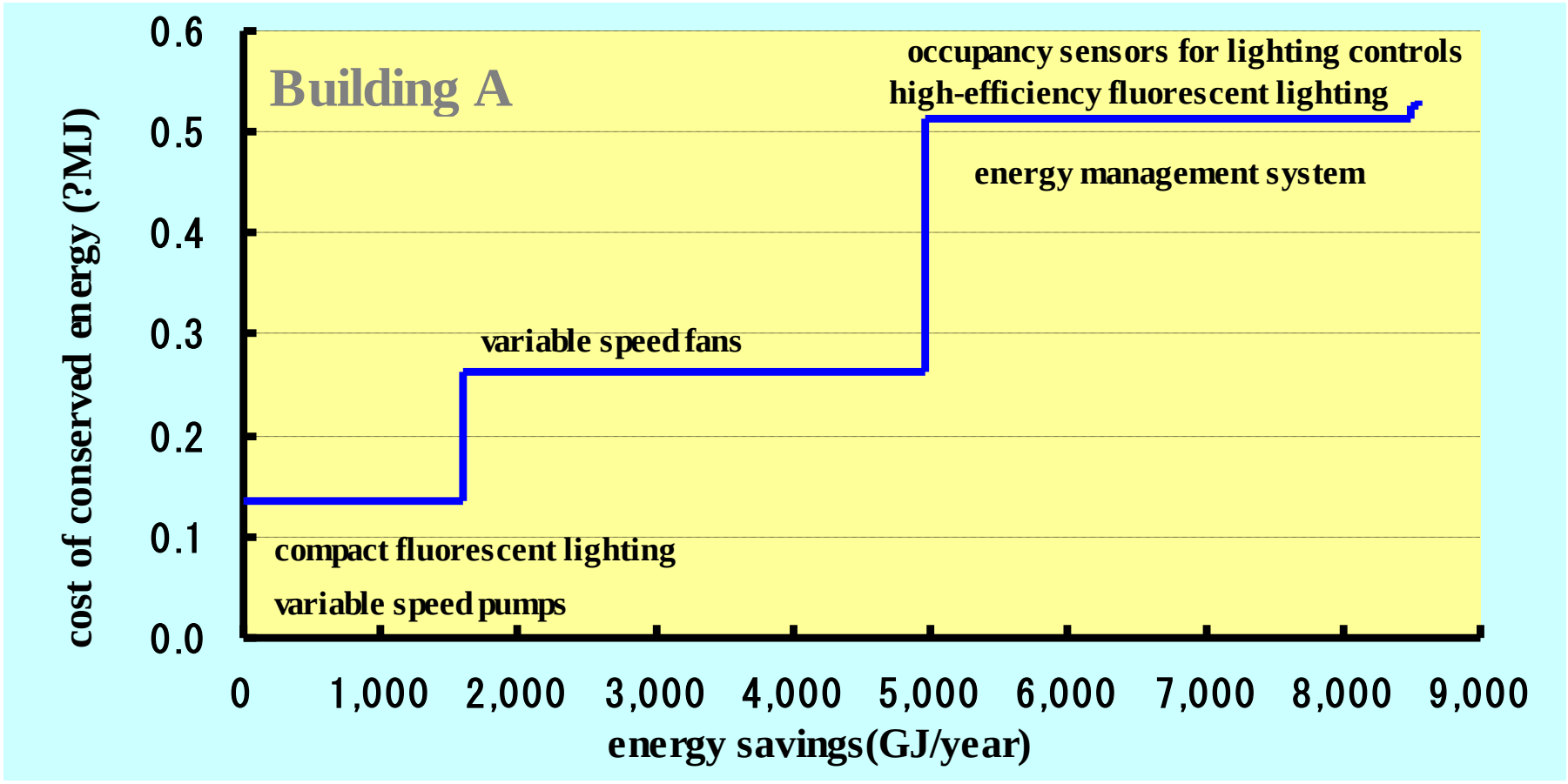
Results of energy efficiency retrofits(C)

Building C	Energy saving(%)	SPP(year)
Control of outside air CO_2 level	23	1.4
Demand controller	5	1.6
Reduction of power used to supply water	100	3.1
High-efficiency fluorescent lighting	10	3.6
Variable speed pumps	48	3.8
Insulating films	71	5.0
Energy management system	1	6.1
cogeneration	4	7.6
Control of electrical transformer	48	7.7
Whole building	23	4.8

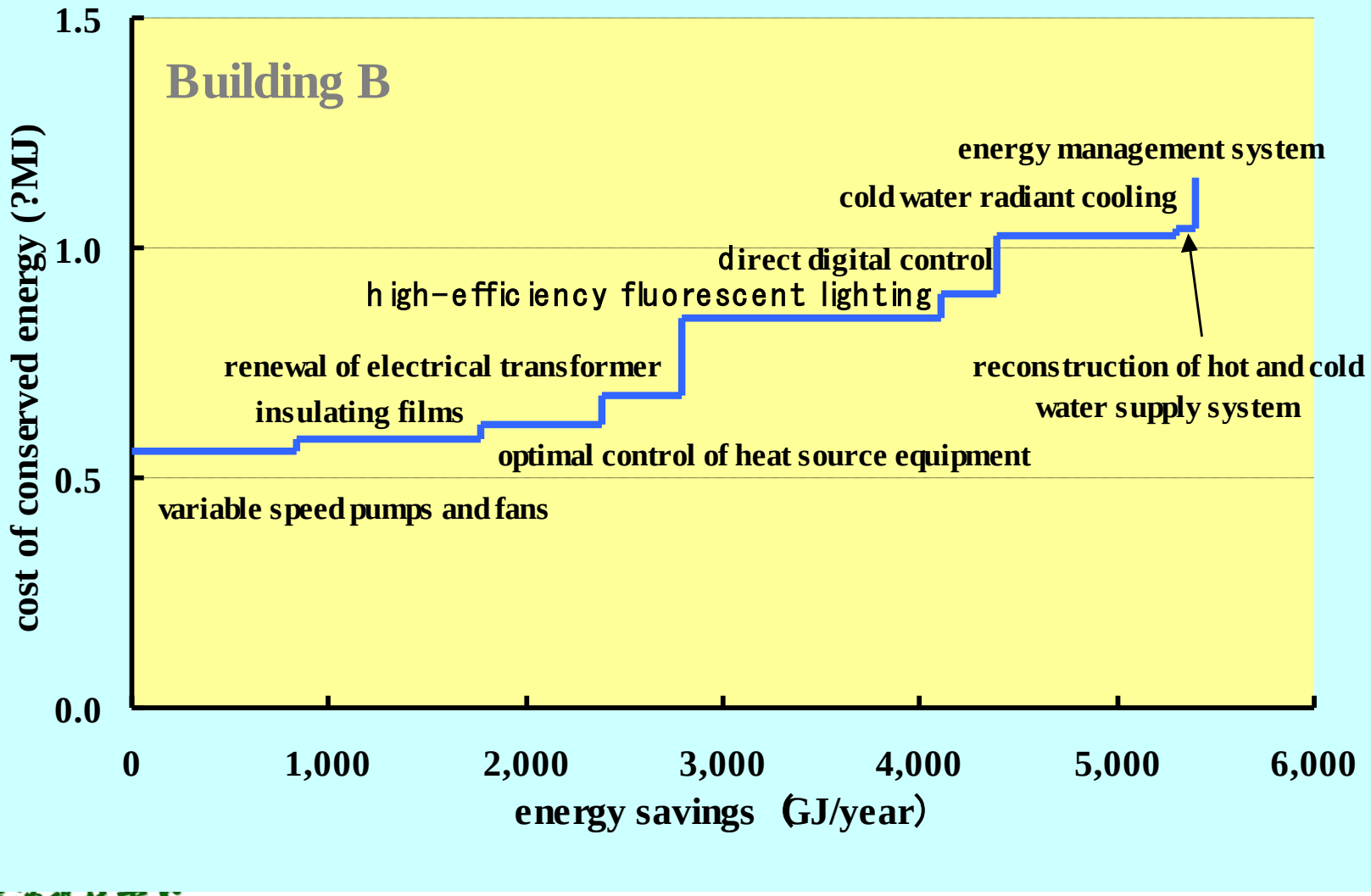
Results of energy efficiency retrofits(D)

Building D	Energy saving(%)	SPP(year)
High-efficiency fluorescent lighting	23	8.9
Variable speed pumps & funs	20	12.5
Optimal control of temperature set levels	10	24.4
Whole building	21	13.1

Curves of conserved energy(A)



Curves of conserved energy(B)



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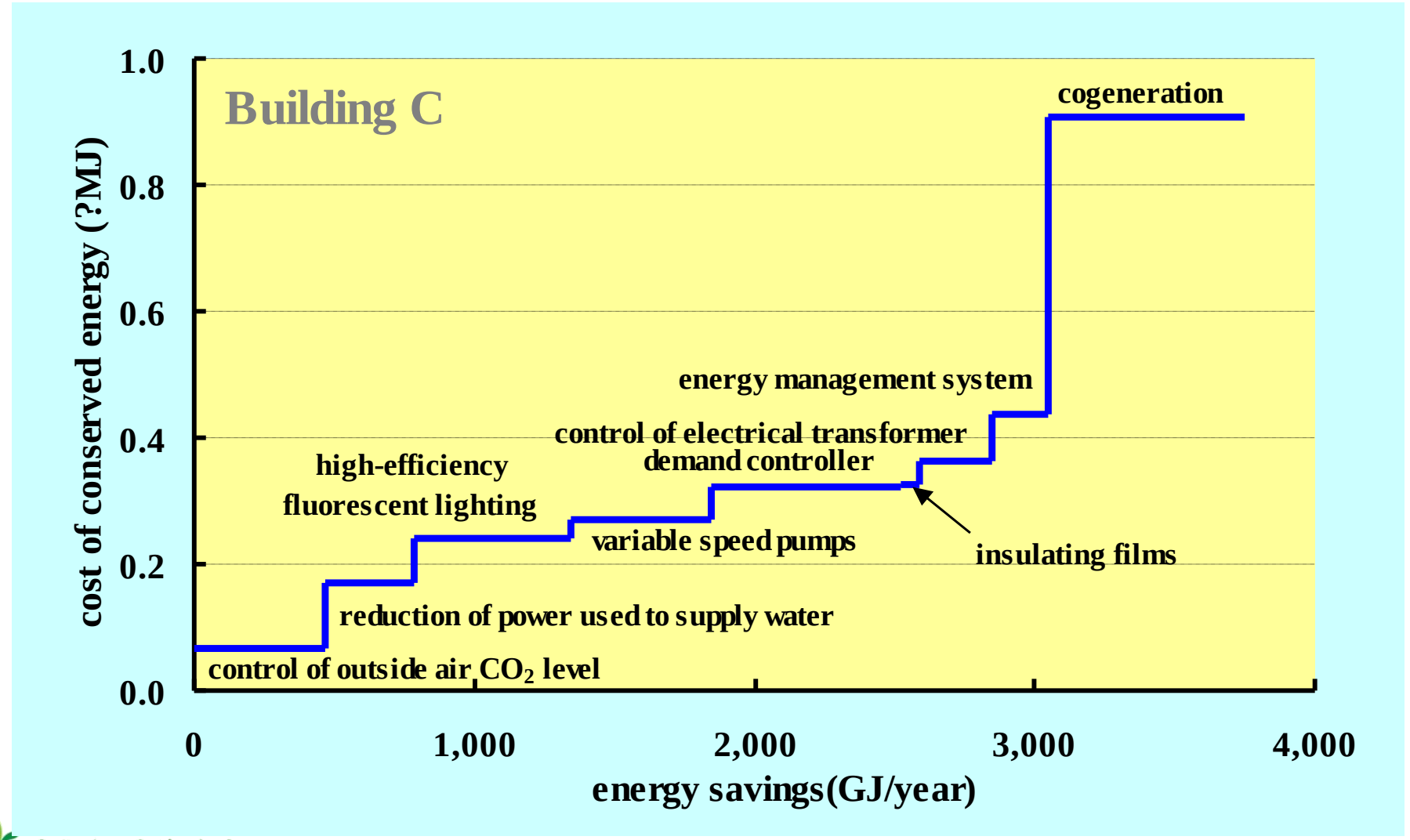
Curves of conserved energy(C)



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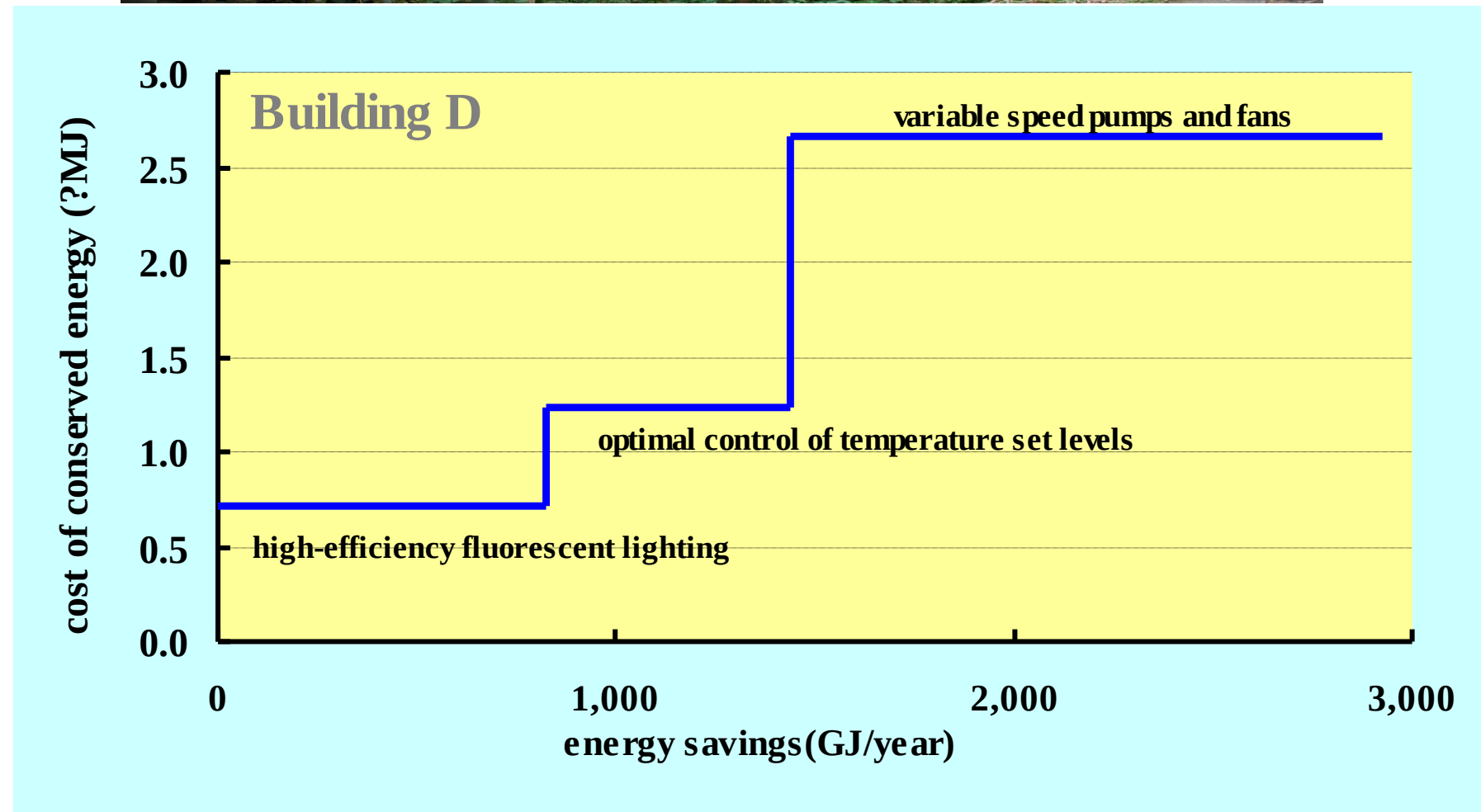
Curves of conserved energy(D)



Energy efficiency measures(EEMs)

Option A	**High-efficiency fluorescent lighting** **Compact fluorescent lighting** **Occupancy sensors for lighting controls**
Option B	**Variable speed pumps and funs** **Renewal of electrical transformer** **Optimal control of temperature set levels** **Direct digital control** **Optimal control of heat source equipment** **Demand controller** **Cogeneration** **Energy management system**
Option C	**Insulating films** **Energy management system** **Control of outside air CO2 level**
Option D	**Insulating films** **Renewal of air conditioning system** **Renewal of heat source equipment**

能源服務業在香港的發展
Development of ESCOs In Hong Kong

Peter Li 李 蘭 耀
Honeywell Limited
Hong Kong

Introduction 序言

- Honeywell first introduced PC in 1996
  霍尼韋爾於一九九六年首先引入保証節能合約
- Currently 3 sizable PC jobs, one university and two hospitals
  現有三項相當大的項目，一所大學及兩間醫院
- Market becoming active
  市場開始活躍
- Role of EMSD, the Electric Power Companies and the building service consultants
  機電工程署，電力供應公司及樓宇服務顧問所扮演的角色
- Current situation, ESCO's positioning and future development
  現狀，能源服務業的市場情況以及將來的發展
- Any barriers
  其它障礙

Current Situation in Hong Kong 香港的現今情況

- ESCO
  能源服務業
- Government Policy
  政府政策
- Electric Power Companies
  電力供應公司
- Customers
  客戶

香 港 的 現 今 情 況
Current Situation in Hong Kong

- ESCO 能 源 服 務 業
  - Mainly Automatic Control Companies
    主 要 在 自 動 控 制 公 司
  - Energy cost becoming concerns since the downturn of economy in 1998
    自 從 一 九 九 八 年 的 經 濟 衰 退 , 能 源 成 本 成 為 關 注 的 目 標
  - Divided into Energy Retrofit and Performance Contracting with saving guaranteed
    區 分 為 能 源 改 進 及 保 証 節 能 合 約
  - For PC, ESCO designs, installs, finances, measures, verifies, and guarantees the savings for a period of 5 to 7 years
    在 保 証 節 能 合 約 方 面 , 能 源 服 務 業 在 五 至 七 年 內 設 計 , 安 裝 , 財 務 , 措 施 , 查 証 以 及 節 能 保 証

香港的現今情況
Current Situation in Hong Kong

- ESCO 能源服務業
  - Cost of the project rebate via the dollar savings generated

    工程項目成本會由保証節能所產生的金錢回饋
  - Any shortfall to be repaid by ESCO

    能源服務業會償還所承諾而未達到的節能
  - Effect of environmental protection also important

    環境保護的影響亦為重要

香港的現今情況
Current Situation in Hong Kong

- Government Policy 政府政策
  - Two streams in EMSD, one heading for Energy PC and the other for Energy Retrofit

    機電工程署分為兩組,一為保証節能合約,另為能源改進
  - Opportunity for Government buildings is huge

    在政府樓宇中有龐大的機會
  - EMSD may become an ESCO due to their Trading Fund policy

    由於機電工程署的營運資金政策,它可能成為能源服務業之一

香港的現今情況
Current Situation in Hong Kong

- Electric Power Companies 電力供應公司
  - Two Electricity Supply Companies in HK

    在香港有兩所電力供應公司
  - Will be de-regulated and are competing with Gas Companies by subsidizing the replacement of Gas Boiler by Electricity Boiler

    將解除管制.與煤氣公司競爭而資助將煤氣氣鍋更換為電力氣鍋
  - Environment protection

    環境保護
  - Demand Side Management

    需求管理

香港的現今情況
Current Situation in Hong Kong

- Customers 客戶
  - Referring to those large energy consumers

    主要是那些大型能源消費者

    - Preferably single tenants rather than multi-tenants, like Hospitals, Universities, Government Buildings and Hotels

      傾向選擇單一租客而不選多個的租客,如醫院,大學,政府樓宇及酒店

    - Potential market of USD100M

      市場潛力為美金一億圓

香港的現今情況

Current Situation in Hong Kong

- Customers 客戶
  - Very interested in PC due to cost effective, environment protection and energy saving

    客戶因對成本效益，環境保護以及節能而對保証節能合約相當有興趣
  - Prefer to work with an experienced and reputable ESCOs for a guaranteed energy saving program

    會較樂意選擇與有經驗及有聲望的能源服務業合作

Barriers of ESCOS
能源服務業的障礙

- Partnering with Customer

  與客戶的合作

❿Building Characteristics

  樓宇的特性

❿Measurement and Verification (M&V) Methods

  量度及確認(M&V)方法

❿Tendering Procedures

  投標程序

Barriers of ESCOS
能源服務業的障礙

- Partnering with Customer 與客戶的合作
  - Both customer and the ESCO must have a partnership
    客戶與能源服務業雙方應視對方為合作伙伴
    - Customer must not view the ESCO as someone to grab some quick money and go away
      客戶不應視能源服務業為賺快錢而來的一般承包商
    - ESCO must pursuit further savings for the customer after site taken
      能源服務業在接受工程後應再為客戶爭取進一步的節約

能源服務業的障礙
Barriers of ESCOS

- Building Characteristics (建築物的特性)
  - Dynamic nature of the buildings making M&V difficult

    建築物動力的本性造成在量度及確認的困難

  - Metering approach

    量度的途徑

能源服務業的障礙
Barriers of ESCOS

- Measurement and Verification (M&V) Methods

  量度及確認(M&V)方法

  – M&V method must be agreed before entering into a Performance Contracting

    在簽署保証節能合約之前,應同意量度及確認方法

  – Reasonable changes or adjustments must be allowed since things may change over years

    由於事情會隨年而改變,合理的更改或修訂是可以允許

能源服務業的障礙
Barriers of ESCOS

- Tendering Procedures 投標程序
  - Different approach versus conventional contracts

    不同於傳統合約的途徑
  - Particular specifications cannot be specified but opened to different ESCOs for different saving strategies

    特別的規格不能具體,但可由不同的能源服務業作不同的節約策略
  - Contract period depending on financial investment

    合約期限視乎財務投資而定
  - Payment and Accounting problem in Government jobs

    在政府項目中有付款及會計的問題

能源服務業的前景
Future Prospects of ESCOs

- Customers like to deal with those ESCOs with oversea experience

  客戶喜歡與有海外經驗的能源服務業合作

- ESCOs like to work with single-tenant customers

  能源服務業喜歡與單一租客的客戶合作

➓ Huge opportunities, only 2 are with PC out of 47 hospitals and only 1 with PC out of 7 universities

  龐大的機會，在四十七間醫院中只有兩間，及七所大學中只有一所有保証節能合約

➓ Government's concern on energy savings and environmental protection

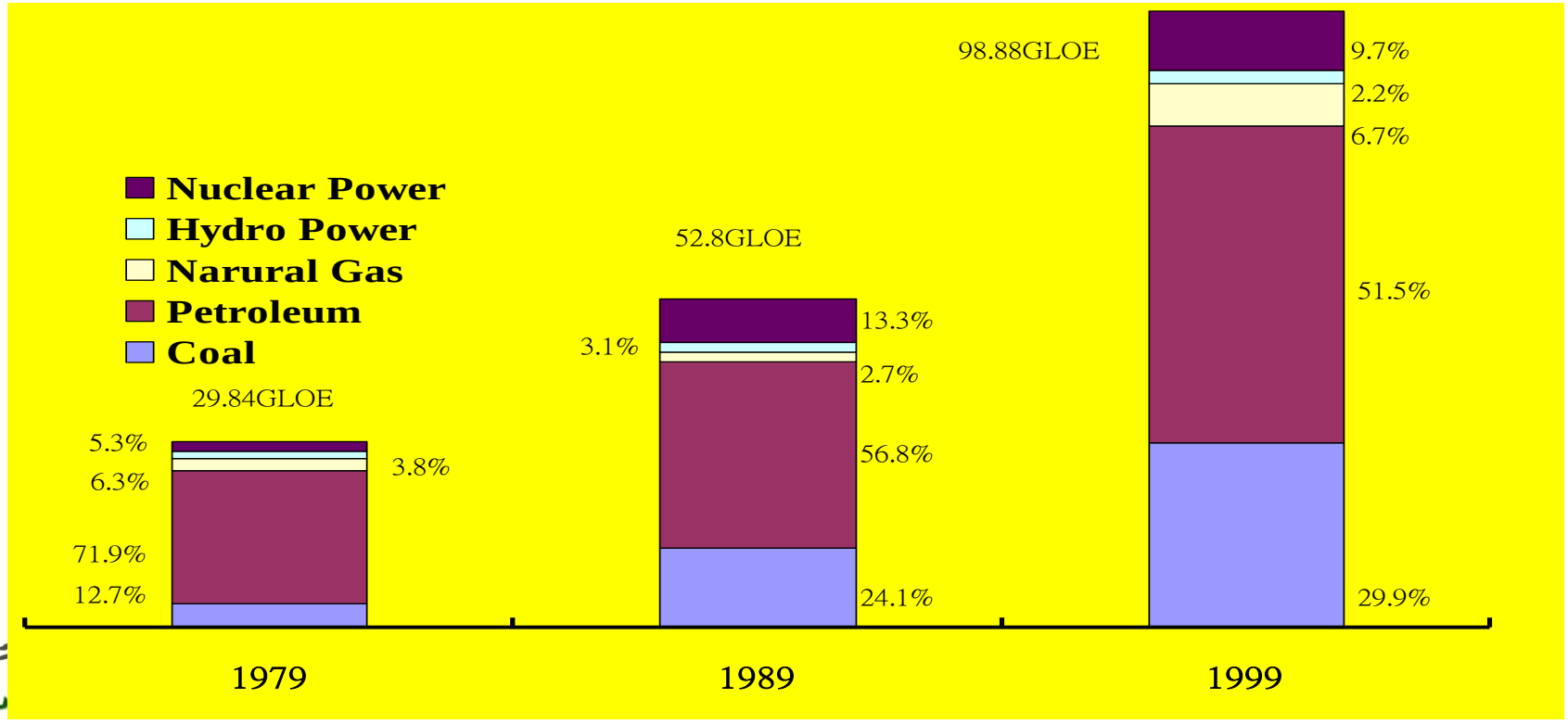
  政府對能源節約及環境保護的關注

台灣的能源事業
ESCO Business in Taiwan

Hung Yao CHAO
Energy Conservation Technology Development Center
CTCI Foundation
October 31, 2001

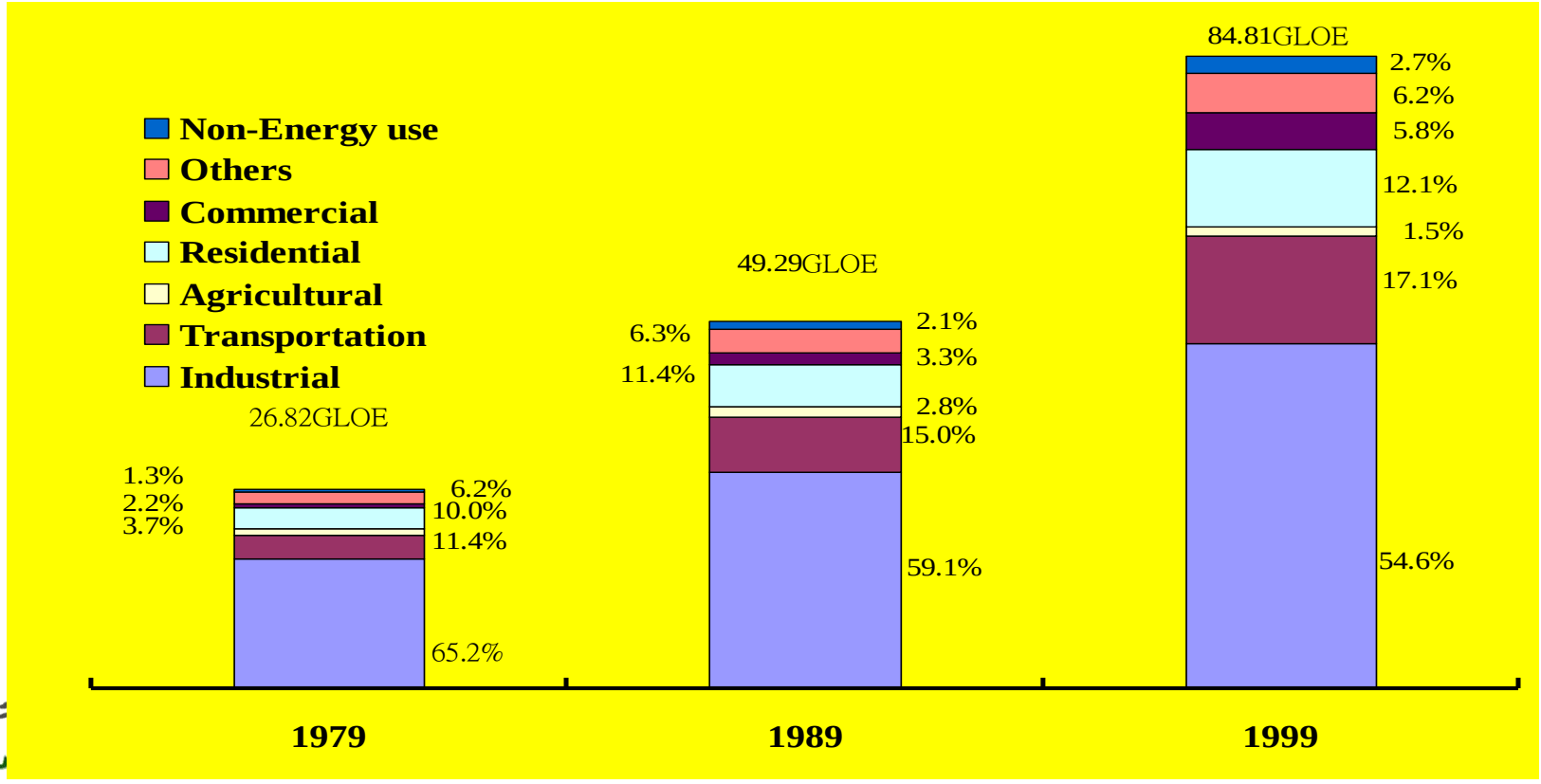
能源供給趨勢
Trend of Energy Supply

- 97% Energy Imported
- Average annual growth rate 6%



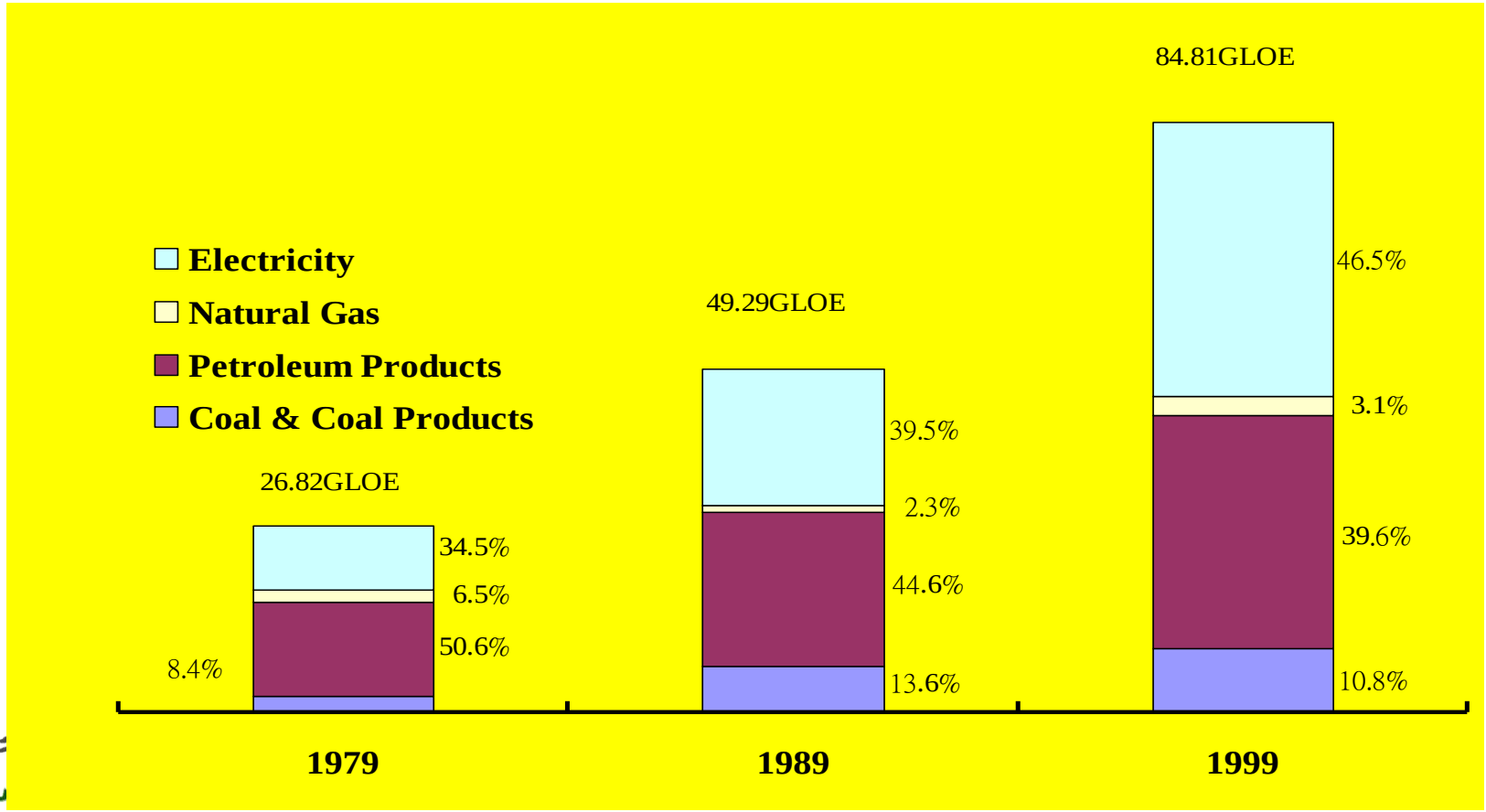
能源需求之趨勢-以業別
Trend of Energy Demand (by Sector)

Energy consumption in industrial, commercial and residential grows rapidly



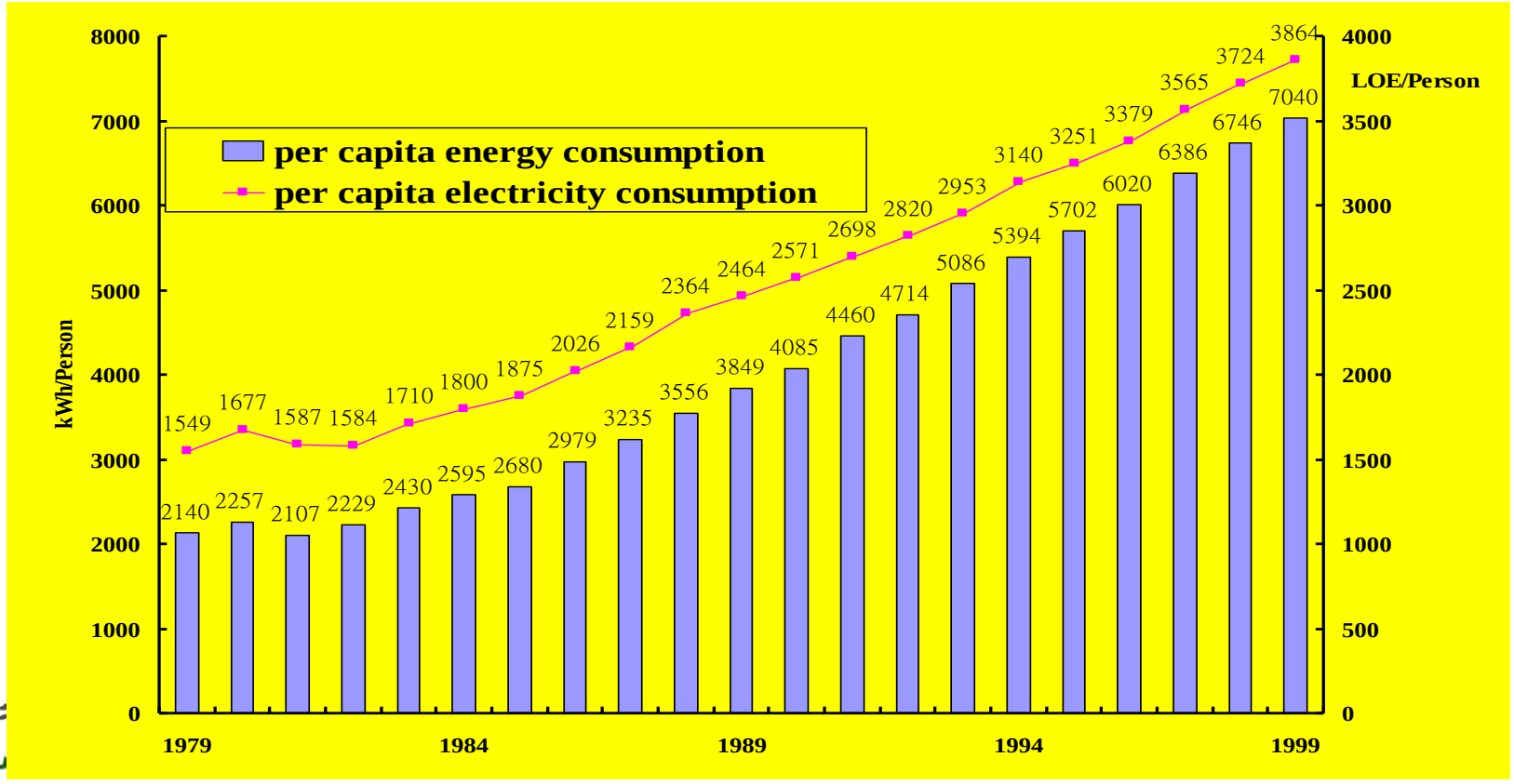
能源需求之趨勢-以能源
Trend of Energy Demand (by Energy)

- The ratio of electricity consumption grows yearly



每人能源消耗之趨勢
Trend of Per Capita Consumption

- **Average growth rate in per capita energy consumption 4.67%**
- **Average growth rate in per capita electricity consumption 6.13%**



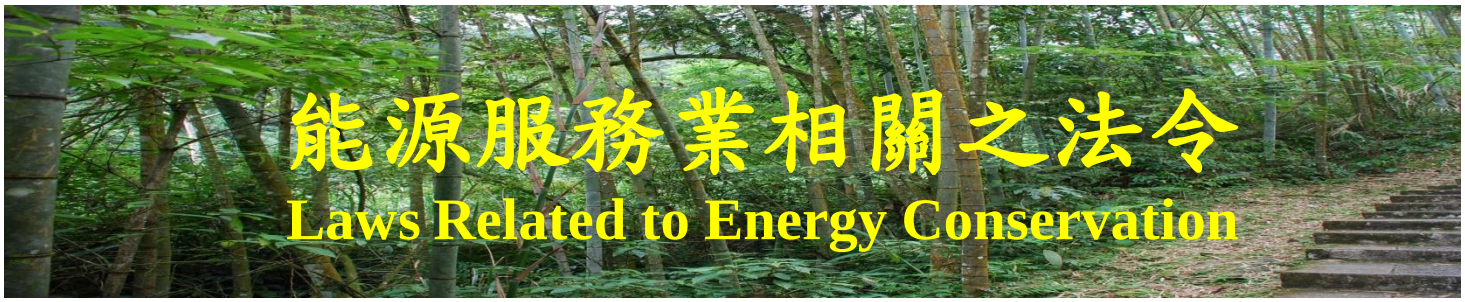
- Started survey on ESCOs business in USA & Japan from July, 1999
- Host an International Seminar of Development in ESCO business on Sep. 22, 2000
- Introduce and promote ESCO business in Taiwan areas

能源服務之供給商
Energy Service Providers

- 節能技術發展中心(Energy Conservation Technology Development Center, CTCI Foundation)
- 能源資源研究室(Energy and Resource Laboratory, ITRI)
- Taipower Company
- Taiwan Electric Research & Testing Center
- Chinese Petroluem Corporation
- 中國鋼鐵公司(China Steel Corporation)

能源服務業之參與者
The Players of ESCOs Business

- 3 equipment venders
- 2 control companies
- 2 trading companies
- 1 consultant company
- Just start getting into ESCOs business



能源服務業相關之法令
Laws Related to Energy Conservation

- Energy management law
- The statute for up-grading industries
- Incentives for Emerging Industries
- The measures for promoting company to install energy saving equipment/techonology or to use new and clean equipment/techonology

Incentives for ESCOs

- 5-year tax exemption

  or

- 20% tax credit for corporate investors
- 10% tax credit for individual investors

Incentives for Energy User

- Tax deductibles for high efficient equipment
- Accelerated depreciation
- Special low interest rate loans

大仁科技大學
綠色能源科技中心

能源服務業之阻礙
Obstacles of ESCOs Business

- Insufficient understanding
- Bank is NOT ready
- Low energy cost, long pay-back
- Lack of motivation to save energy
- The budget, bidding, contracing system of government MUST modify
- Lack of local M&V methodology