## Energy Conservation Measures for Commercial Buildings and ESCO Business

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ESCO Promotion Office The Energy Conservation Center, Japan

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## **Outline of Energy Conservation Measures**

Sector	Measures	Energy Saving (crude oil equivalent)	
Industrial	Keidanren Environmental Voluntary Action Plan Energy conservation measures at midsize plants High-performance industrial furnace, etc	Million k1 20.50	
Residential & Commercial	Improvement of appliance efficiency by top-runner regulation Expansion of top-runner appliances Accelerated adoption of high efficiency appliances Reduction in standby power consumption Adoption of Home Energy Management System(HEMS) for hou Adoption of Building Energy Management System(BEMS) for of	Million k 18.60 seholds 1.6 n of wi	nillion kl; nich 1.0 million
Transportation	Improvement of appliance efficiency by top-runner regulation Promotion to adopt clean energy cars Accelerated introduction of cars that meet top-runner standar	Million k1 16.90 d, etc	
Across Sectors	Technology development High-performance boiler, High-efficiency light and so on	1.00 Million k1	
Total	<ul> <li>( current measures) 5 0 million kl</li> <li>( new measures) 7 million kl</li> </ul>	Million k1	

Source: Advisory Committee for Resources and Energy, Study Group for Supply and Demand (June 2001)



## Energy Conservation Measures for Commercial Buildings





#### Establishment of recognition of ESCO business



## **Outline of ESCO Business**

An ESCO is an Energy Service Company that is engaged in "energy conservation" as a "company business"

#### **Definition of ESCO business**

The business of providing blanket services relating to energy conservation, and receiving part of the money saved by customers through energy conservation as compensation.



## **Features of ESCO Business**

Provision of blanket services

- Guaranteeing energy conservation effects
- Verifying reductions in energy consumption
- Implementation of blanket engineering work
- Equipment refurbishment costs are recovered through the money saved by reducing energy consumption
- Project finance





## General Flow Chart of ESCO Business



# Expenditure and Profit Distributions for ESCO Business





# **Superior Qualities of ESCO Business**

- Even if customers have no energy conservation know-how, and cannot obtain personnel for the work, ESCO operators assume responsibility for all energy conservation work.
- In the case of shared savings format (ESCO operator's assets) it is possible to shift from balance sheet to offbalance-sheet methods.
- Through blanket consideration, it is possible to achieve the 1% annual reduction required by the Energy Conservation Law over several years.
- The "environmentally friendly" aspect of the work can be used for corporate PR.
- Provides excellent means for planning energy conservation refurbishment using subsidies.
- Measures to meet stricter regulations on buildings for office use



## Flow of Funds for Guaranteed Savings Contract

#### Performance risk





## Flow of Funds for Shared Savings Contract



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# **Facilities Targeted by ESCOs**

- Public and private schools
- Local authorities and government institutions
- Universities and research institutes
- Hospitals and clinics
- General commercial buildings
- Industrial facilities



#### Breakdown of Energy Consumption in Office Buildings



Government offices, meeting halls, laboratories, schools, and department stores also show similar tendencies.



# **Energy Conservation Methods**

#### Electrical equipment

- Upgrading to highly efficient fluorescent light fittings
- Controlling the number of distribution transformers, and upgrading them
- Converting to fluorescent bulb lamps
- Lighting control using infrared sensors
- Introduction of demand controllers
- Installation of highperformance reflectors for light fittings

#### Air-conditioning equipment

- Converting to high-performance motors
- Installation of inverter for pumps
- Installation of inverter for fans
- EMS introduction
- Affixing thermal insulation film
- Introduction of co-generation system
- Introduction of chilled sealing
- Improvement of supply systems for hot and cold water
- Optimal control of heat sources
- DDC control of air-conditioners
- Optimal control of temperatures set for air-con
- CO<sub>2</sub> control of ambient air flow
- Introduction of thermal-storage heat pumps
- Improvement of ventilation control methods
- Installation of overall heat exchangers



# **Case Studies of ESCO Introduction**

Name of introduction location		introduction location	Energy conservation methods used	Conservation rate
Private sector	Buildings	Technology Development Center, Sumikin Management Kashima	Reduction in power consumed by rotating machines (inverter control); reduction in power used for lighting (voltage adjusters) introduction of co-generation; demand monitoring and environment/energy management system; air-con energy conservation measures; control of number of operational transformers	22%
		Japan Anti-Tuberculosis Association; Fukujuji Hospital	Introduction of co-generation	
	Plants	Omron; Mishima Plant	Installation of inverters for secondary pump for cold water and A upgrading to high-efficiency lighting; conversion from incandescent to fluorescent lighting; lighting control using infra- sensors; EMS introduction	AHU ;14% red
		A certain Steel Piping	Improvement in blow dryer on acid rinse line for steel bands (relative to refurbished equipment)	42%
		Matsushita Battery Industrial	Changing to steam as heating method for air generator for drye control of number of air compressors; use of vacuum pump exhaust as drying air; replacement of intake ducts for dryers (relative to refurbished equipment)	rs; 61.6%
		Yokogawa Electric; Kofu Plant	Upgrading to high-efficiency lighting; inverter control of motors	10%
		Toyama City Hospital	Upgrading to high-efficiency lighting; inverter control of motors; introduction of energy monitoring system	10%
		Mie Prefectural Office	Upgrading to high-efficiency lighting	7%
Local authoriti	uthorities	Mitaka City Office	Upgrading to high-efficiency lighting; improvement in efficiency cooling towers; installation of inverters for fans and pumps; introduction of energy monitoring system	of 10%
		Osaka Medical Center and Research Institute for Materna and Child Health	Energy-efficient lighting; inverter control for air-con fans and lpumps; co-generation; others	25%

Web site of the Energy Conservation Center, Japan: http://www.eccj.or.jp/esco/

# **Market Potential of ESCO Business**

- Amount of energy saved as crude oil equivalent: 4,040,000 kl
- Scale of potential engineering investment: ¥2,471,500

¥2,471,500,000,000

Business field:

Energy conservation rate of 25%, 7 years required for net recovery

Amount of energy saved: 1,840,000 kl

Scale of investment: ¥2,047.5 billion

Industrial field:

Energy conservation rate of 10%, 4 years required for net recovery

Amount of energy saved: 2,200,000 kl

Scale of investment: ¥424 billion

Source: March 1998 Report of ESCO Business Introduction Study Group Energy Conservation Center, Japan



### **Number of Orders Received by ESCO**



**Reference: Findings on ESCO Promotion Council Research** 



#### **Amount of Orders Received by ESCO**



**Reference: Survey Results of ESCO Promotion Council Research** 

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### Measures to Support Energy Conservation (FY2002)

NEDO's public subscription (New Energy & Industrial Technology Development Organization)

- Projects to support business operators for rationalization of energy use; 9.1 billion yen
- Projects to promote introduction of high-efficiency energy system to residential and commercial buildings;
   12.31 billion yen

High-efficiency energy system for residential and commercial buildings 2.12 billion yen BEMS (Building Energy Management System) 3.62 billion yen High-efficiency bot water supply equipment (CO, refrigerant beat pump bot water supply/

High-efficiency hot water supply equipment (CO<sub>2</sub> refrigerant heat pump hot water supply/ latent heat recovery type hot water supply) 6.56 billion yen

- Projects to promote regional energy conservation vision;
   680 million yen
- Projects to promote enhancing awareness of energy conservation on regional basis; 3.76 billion yen
- Project to support global warming prevention activities on regional basis; 600 million yen

(The items in blue are new projects)



# Projects to support business operators for rationalization of energy use

This scheme is designed to provide subsidies to business operators for their cost for equipment introduction, equipment remodeling and system expenditure, who are willing to make efforts in developing comprehensive energy-saving projects which are planned on their initiative, and that prove to have a high energy conservation effect and appropriate cost performance.

The subsidies will be especially focused on projects that have high political significance, and are in line with the principles advocated by advisory committee for resources and energy, working group for energy conservation.

Target business operators: all types of businesses (note: ESCO applicants should make a joint application with a facility installation operator)

**Outline of subsidiary projects:** they should be planned to introduce energy conservation systems in the existing plants and workplaces which are expected to have a high energy saving effect and prove to have appropriate cost performance. The subsidies will be focused on projects of medium- and long-term plans set by the energy conservation law, positioned in Keidanren environmental voluntary action plan, projects to introduce high-performance industrial furnace that medium and small-sized companies applied for, and ESCO projects relating to commercial buildings.

Target for subsidies: equipment and construction works relating to energy conservation Portion of costs covered by subsidy: 1/3 of the project cost (max. ¥200 million/project)



#### Projects to promote introduction of high-efficiency energy system to residential and commercial buildings (high-efficiency energy system for residential and commercial buildings)

This scheme is designed to provide subsidies to business operators (building owners) for their cost for the introduction of high-efficiency energy system relating to residential and commercial buildings. The scheme is also planned to carry out researches and studies for accelerating energy conservation activities.

**Target business operators:** they should be building owners, etc., who plan to introduce designated systems to residential and commercial buildings to enable the monitoring of their functions.

**Outline of subsidy projects:** the scheme is designed to provide subsidies to business operators to support a part of their cost spending which will be required for introduction of high-efficiency energy system to residential and commercial buildings. The scheme also intends to disclose information concerning the system's function and cost performance, so as to enhance awareness of energy conservation relating to residential and commercial buildings.

**Target for subsidies:** high-efficiency energy system relating to residential and commercial buildings

Portion of costs covered by subsidy: 1/3 of the project cost



#### Projects to promote introduction of high-efficiency energy system to residential and commercial buildings BEMS (Building Energy Management System)

This scheme is designed to provide subsidies to business operators for a part of their cost for introduction of BEMS (Building Energy Management System) aiming to provide optimal control over energy demand. Under the scheme, BEMS is defined as system to reduce energy consumption through grasping indoor environment and energy consumption among commercial buildings, as well as controlling operation of equipment and systems to fit indoor environment. BEMS is comprised of systems for measuring/weighing, control, monitoring, data storage/analysis/diagnosis and so forth.

Target business operators: building owners who introduce BEMS to existing buildings, new buildings and those to be extended and remodeled.

- Target for subsidies:
- ∞ (2) Capability to reduce energy consumption by introduction of BEMS.
- In the case of the new buildings and extended/renovated buildings, based on law relevant to streamlining energy consumption, they should fulfill performance specified as "standard for builders regarding to streamlining of energy consumption relating to buildings" (Notification No.1 March 30, 1999, Ministry of International Trade and Industry/Ministry of Construction).
- (3) Energy consumption should be measured according to system categories for heat source (refrigerating machine, heat pump and cooling tower), pumps, lighting outlet and other equipment.
- ∞ (4) Measuring/weighing data should be properly collected and stored.
- ∞ (5) Energy control system should be properly established.
- (6) The operators should have a capability to keep the data for 3 years after the introduction of BEMS and to submit reports on energy conservation.
- Portion of costs covered by subsidy: 1/3 of the project cost (the subsidy is capped at 100 million yen per project)



# Projects to promote regional energy conservation visions

This scheme is designed to provide subsidies to local authorities, etc. for all costs for formulating 'Vision' to promote energy conservation in their regions as well as for feasibility study cost for launching projects, in view of enhancing activities to facilitate energy savings on regional basis.

Target business operators: local authorities, or investing corporations

 (in this case, business operators shall implement feasibility studies for projects by themselves)

28-	Target projects for subsidies:
20	(1) research at initial stage
20	(2) research for formulating regional energy conservation vision
20	(3) feasibility study for business projects
20-	Period covered by subsidy: 1 or 2 years for (1) and (2)
20	1 year for (3)
28-	Portion of costs covered by subsidy: fixed amount (100%)

#### Projects to promote enhancing awareness of energy conservation on regional basis

This scheme is designed to provide subsidies to local authorities for their cost for introduction of energy-saving systems that prove to have high demonstration effect, to hospitals, public halls, water supply and sewerage systems, etc.

- Target business operators: local authorities
- Target projects for subsidies:
  - (1) projects to promote awareness of energy conservation on regional basis
  - (2) projects to promote enhancing and enlightening awareness of energy conservation on regional basis
- Period covered by subsidy:
- (1) 4 years at the maximum
- (2) basically 1 year
- Portion of costs covered by subsidy:
  - (1) 1/2 or 1/3 of the project cost
  - (2) fixed amount (100%: the subsidy is capped at 20 million yen)



# Projects to support global warming prevention activities on regional basis

The primary objective is to establish the regionally-initiated model cases for global warming preventive measures, and to disseminate them in wider areas, with a scheme to provide subsidies to local authorities, local communities which have tie-ups with local authorities, environmental NPO or business operators for their costs for implementing businesses. These should be eligible for a model project having an advanced and high effect for introduction of new energy and energy saving systems.

- **Target projects for subsidies:** projects planning to introduce two or more new energy systems or energy-saving systems, based upon programs that local authorities formulated in accordance with the law relating to the promotion of global warming prevention measures.

- Portion of costs covered by subsidy: within 1/2 or 1/3 of the project cost



# Law on Promoting Green Purchasing

- Targets: National government and independent administrative institutions (also applied to local governments)
- Service items: energy conservation audit
- Criteria: a person who has technical qualification or ability, a firm that employs such a person
  - -Equipment covered: inspection and analysis of the operating state of and energy consumption by air conditioners, lighting, heaters, power substations, controllers, plumbing equipment, etc.
- Objectives to be set up: the number of contracts for energy conservation audit services to be made within the relevant year.



## **Efforts for Promotion of ESCO Business**

- ESCO Study Committee: April 1996
- Study Group for Introduction of ESCO Business: 1997
- ESCO Business Demonstration Committee: 1998
- Committee for Study on Techniques for Measuring and Verifying Energy Conservation Effects: 1999-
  - -Manuals for ESCO introduction, baseline estimation technique
  - -Studies on problems with guidelines for measurement and verification, and with ESCO introduction into local governments
- Promotion Council: October 1999



## Measurement and Verification of Energy Conservation Effects

- Accurate measurement and calculation of the baseline (energy consumption before modification) and energy consumption after modification is essential.
- Variable factors
  - -electric equipment: operation time and operation rate of equipment
  - -air-conditioning equipment:

operation time, external fluctuating load (outdoor temperature, insolation), internal fluctuating load (indoor temperature, internal heat generation, number of persons in each room)



### **Establishment of ESCO Promotion Council (1)**

#### Objectives of the Council

- -To provide support for development of markets for ESCO business and to ensure sound development of the market.
- -To increase chances to provide customers with cost-effective all-round energy conservation services
- To promote efficient energy use and to protect global environment
- Initial members: 16 organizations and firms (117 organizations, corporations : as of May 2003)
   Chairman: Yoichi Kaya (emeritus professor of University of Tokyo)





### **Establishment of ESCO Promotion Council (2)**

- Activity
  - -To spread ESCO businesses, enhance public awareness, and develop markets
  - -To provide information on domestic and overseas ESCO businesses, and exchange information with other ESCOrelated organizations
  - -To recommend excellent ESCOs that meet required conditions
- Contact: Secretariat of ESCO Promotion Council http://www.jaesco.gr.jp



## Target Energy-conservation Products of Energy Solution

Energy-conse	rvation and Eco-friendly	Facilities
	Co-generation system Cool and hot water supplier with waste heat	Supply of electricity and heat, Waste heat recovery Utilization of heat exhausted from engine for air conditioner
	Cool and hot water supplier utilizing the difference in temperature of water	Power reduction by using the difference in temperature of cooling water
Energy-conservation (Reduction of CO <sub>2</sub> emission)	Heat recovery pump	Energy conservation by waste heat recovery
	Amorphous transformer	Reduction of non-loss load
	Inverter control	Power consumption reduction of compressor, pump, and fan
	Energy-conservation type lighting	Utilization of daylight, Zone luminosity control high-frequency operation, Power saving by inverter control
	Absorption refrigerator	Environment consciousness
Reduction of burden on the environment	Turbo refrigerator	Ozone layer depletion factor
	Waste water recovery system	Effective use of finite water resources
Leveling of load	Ice heat storage system	
	Electricity storage	Peak load cut of electricity consumption
Utilization of new and renewable energy	Solar and wind power generation	Utilization of natural energy



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## Concept of Introducing Energy-conservation and Eco-friendly Facilities





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## Outline of a Mechanical Research Institute Introducing ESCO Business

Implementation	September, 1974
Number of stories, Total floor area	Four stories from the ground, About 12,750 m <sup>2</sup>
Contract electric power consumption	1,800 kW(6.6 kV receiving electric power)
Major heat source equipment	Absorption cool and heat water supplier (422 kW × 2 units)
	Ice heat storage unit Heat storage capacity:221 kW/d Chiller cooling capacity:95 kW



## Outline of Energy Conservation Refurbishment Work



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# **Necessity of ESCO Business**

- For companies, ESCO business is a new activity that encourages energy conservation investment in a rational way.
- For the nation, it promotes Japan's COP3 commitment at the private sector level.
- For consumers, it provides services that serve for both energy conservation and cost reduction.
- For financial institutions, it provides a partner to develop a new market.



## **Future prospects**

ESCO projects, with supportive measures shown below, are expected to achieve considerable yearly growth

- Expansion of national supports relating to ESCO, including subsidies,
- Expansion of ESCO projects at "1st class designated Energy Management Factory" and reinforcement of report obligation according to the revision of Energy Conservation Law.
- Expansion of ESCO projects at local authorities, through effective use of regional energy conservation visions and Green Purchasing Law.
- Expansion of shared-savings contracts through provision of financial basis

