Annex 4

Findings from the Meetings with Related Technical Organizations

ANNEX 4 Findings from the Meetings with Related Technical Organizations

The major findings from the meetings in Heating, Ventilating, and Air Conditioning (HVAC) and lighting are as follows, and they are reflected and summarized in Table 2.3.3-1 of the main text.

(1) TTMD (Turkish Society of HVAC and Sanitary Engineers)

a) Regarding new constructions there are regulations to implement EE&C measures. Yet for existing buildings there is no regulation and no incentive scheme to apply EE&C measures. And the Study Team found that it is important to prepare regulation and incentive scheme for promoting EE&C in the existing buildings, however the most important issue is to illustrate the target EE&C model

b) First priority is adding insulation on walls/roofs and change into insulated sash. And next is change into high-efficient air conditioning for the reduced heating/cooling demand.

c) Inverter and heat pump technology can contribute EE&C in air conditioning. However inverter technology is more expensive compared to non-inverter ones and it is necessary to show the economic effect to introduce inverter air conditioners. In this context the inverter field test in ITU (Istanbul Technical University) will be a good example.

d) Regarding ventilation there is no regulation in Turkey. Present ventilation is mainly done by natural ventilation or opening the windows. By introducing insulated and air-tight sash, mechanical ventilation with heat exchanger should be equipped.

(2) Prof. Onaygil of ITU (Specialty in Lighting)

a) Important issue to the EE&C retrofitting for the governmental building lighting is “total design”. Not only the change of lighting fixture, but the target design should be clarified firstly.

b) In this context she doesn’t recommend to introduce CFL (Compact Fluorescent Lamp) / T5 lamp for future buildings. (These have been introduced in many governmental buildings)

c) Instead of these LED might be the future target model for future lighting in Turkey.

d) Within several years the technology of LED is sure to advance and the price is sure to reduce.

e) In parallel lighting control system, including the usage of sun light should be installed.

f) By introducing LED the cooling load can be reduced.

Annex 5

Result of Hearing from Major EVDs

Annex 5 Result of Hearing from Major EVDs

(1) EVDs in Turkey

There are 34 EVDs in Turley at the end of September 2012. But the number of actually active EVDs is limited. The list of EVDs and EVD association members in Turkey is shown in Table 5-1.

In 34 EVDs, 13 EVDs have licenses in both industry and building sectors, 6 in industry sector, and 15 in building sector. Regionally, 19 EVDs are in Istanbul, 4 in Ankara, 3 in Antalya, 2 in Izmir, 2 in Bursa, and the remainder 4 in other area.

Business of EVD stays in consulting, because the business is mainly to implement EE&C audit and propose retrofitting plan, and rarely to implement retrofitting work.

The current issue of EVDs is that there are enough book knowledge and information for EE&C, but lack of practical experiences through the actual audits.

In May 2010, Turkish EVD association was established. 29 Companies, including 22 EVDs, belong to the association as of September 2012. Although the association is the private one and its' activity is voluntary, the association provides information or submits proposal to relative ministries and organization, as an economic group, from the first stage of EE&C institutional design.

The association supplies to members several supports, including a) collecting and providing information relative to EE&C and b) implementing some programs to strengthen the capacity of EVDs. In the JICA study, the association said that they needed not only upgrading form and manual for audit and report but also program for strengthening the capacity, including OJT (on the job training) in actual site, as a capacity building for EVDs.

In the companies which belong to the EVD association, 7 companies do not have EVD licenses and 3 of them did not renew their licenses since qualified engineers in accordance with the En-Ver amended in October, 2011 could not be secured. Several EVDs, including these ones, dislike getting orders from governments, which qualification limit is strict. And they try to return their attention to getting orders from privates.

(2) Measuring Instruments for Audit

Measurement is indispensable for energy audit and EE&C proposal. However, there are quite few EVDs which own measuring instruments and can conduct measurement for audit under TS17025. Therefore, in some cases the measurement has been conducted by out-sourcing. It becomes a barrier for many EVDs to own and maintain all the measuring instruments, which are costly. The En-Ver amended in October, 2011 obligates EVDs to own instruments and conduct measurements by themselves. This discrepancy becomes a visible concern. In order to answer this issue, introducing a mechanism of instruments leasing and/or establishing governmental instrument bank system for instrument lending should be considered.

Table 5-1 List of EVDs in Turkey and EVD Association Members (As of September 2012)

No.	Name	Certificated EVD	Category		Member of Associaton	Location
			Industry	Building		
1	EVD Enerji Yönetimi ve Danışmanlık	1	1	1		Istanbul
2	EDSM Enerji Denetim Danışmanlık	X	(1)	(1)	1	Istanbul
3	VET Enerji Verimliliği	1		1	1	Ankara
4	MTB Enerji Danışmanlık	X	(1)		1	Ankara
5	EKOTEST Çevre Danışmanlık	X	(1)	(1)	1	Ankara
6	ALARKO CARRIER	1		1	1	Kocaeli
7	EKO-EVD Enerji Yönetimi	1	1	1	1	Antalya
8	İSTANBUL ENERJİ	1		1	1	Istanbul
9	ESCON Enerji Sistemleri	1	1			Istanbul
10	EPSİLON Enerji Danışmanlık	1	1			Istanbul
11	EFEKTİF Endüstriyel Enerji	1	1	1	1	Kayseri
12	SIEMENS Sanayi ve Ticaret Anonim Şirketi	1	1			Istanbul
13	BUREAU VERITAS Gözetim Hizmetleri	1	1	1	1	Istanbul
14	BES ENERJİ Danışmanlık	1		1	1	Istanbul
15	ENVE ENERJİ Eğitim Danışmanlık	1	1	1	1	Istanbul
16	UGETAM	1		1		Istanbul
17	ERENCO - Erdemir Mühendislik	1	1	1	1	Istanbul
18	SETAŞ ENERJİ	1	1	1		Izmir
19	ETİK ENERJİ Verimliliği Danışmanlık	1		1	1	Istanbul
20	AVD Enerji Verimliliği Danışmanlık	1		1	1	Bursa
21	GÜRIŞIK Enerji Verimliliği	1		1	1	Istanbul
22	TARU Mühendislik	1	1			Ankara
23	TEKNOYAD Teknoloji Yatırımları	X	(1)			Istanbul
24	ISORAST Yapı Elemanları	1		1	1	Istanbul
25	S.A.İ. ENERJİ	1	1			Bursa
26	3E Enerji Verimliliği Danışmanlık	1		1	1	Istanbul
27	PROMET İnşaat Proje	1	1	1	1	Istanbul
28	ATLAS Uluslararası Belgelendirme	1		1	1	Ankara
29	ENSA Enerji Verimliliği	1	1	1	1	Istanbul
30	ERKA-EVD	1	1		1	Adana
31	SCHNEIDER Elektrik	1	1	1	1	Istanbul
32	ARGE İNOVASYON	1		1		Antalya
33	EKONORM Enerji Danışmanlığı	1		1		Denizli
34	VEMEKS Mühendislik	1		1		Antalya
35	TFM Enerji ve Teknik Hizmetleri	1	1	1	1	Istanbul
36	MYB Isı Sistemleri	1		1		Ankara
37	ESKON Enerji Verimliliği	1	1	1	1	Izumir
38	S&Q Mart Eğitim Ve Yönetim Hizmetleri	1	1	1	1	Istanbul
39	ESER ESCO	XX		(1)	1	Ankara
40	Standart BM Trada	XX		(1)	1	Istanbul
41	Alberk QA Teknik, Belge. ve Kont. Hizmetleri	XX	(1)	(1)	1	Istanbul
42	EE Istanbul Proje ve Danışmanlık Ltd. Şti.	XX		(1)	1	Istanbul
TOTAL		34	19	28	29	—

Remark: X - Former EVD Company
XX - Potential EVD Company

Annex 6

Result of Energy Audit

6-1 Trial Calculation Using Japanese Evaluation Tool of Energy Conservation.

6-2-1 DSI Buildings

6-2-2 EM Hospital

Annex 6-1 Trial Calculation Using Japanese Evaluation Tool of Energy Conservation

Trial calculation using Japanese evaluation tool of energy conservation (Point Method) and Japanese simulation tool to set energy consumption target (ECTT) was conducted during the period of the energy audits from November to December 2012. The outline of it is summarized as follows.

(1) Outline of Target Buildings

1) DSI Buildings

Outline and facade of DSI Buildings are shown in Table 6-1-1 and Figure 6-1-1 respectively.

Table 6-1-1 Outline of DSI Buildings

Building name	Floor area (m^2)	Floor number	Construction year
A	29,449	13	1969
B	3,291	3	1969
C	7,444	7	1980
Conference hall	830	2	
Total	41,904	-	-

Figure 6-1-1 Facade of DSI Buildings

2) EM Hospital

Outline and facade of EM Hospital are shown in Table 6-1-2 and Figure 6-1-2 respectively.

Table 6-1-2 Outline of EM Hospital

Building name	Floor area (m^2)	Floor number	Construction year
Out-patient building	8,000	3	2003

Figure 6-1-2 Facade of EM Hospital

(2) Outline of Japanese Evaluation Tool of Energy Conservation

In Japan evaluation method of energy conservation, which utilizes Japanese evaluation tool, PAL (insulation) and CEC (equipment efficiency), equivalent of Turkish BEP-TR, has been applied. And before new construction, submission of the evaluation result is an obligation for a building owner. Besides for the purpose of evaluation of middle size and small sized buildings, simplified evaluation method, Point Method (without PAL/CEC calculation), was introduced. In order to promote energy conservation of large number of middle size and small sized buildings, this simplified evaluation method is worth being referred (See Figure 6-1-3 and Table 6-1-3 and -4).

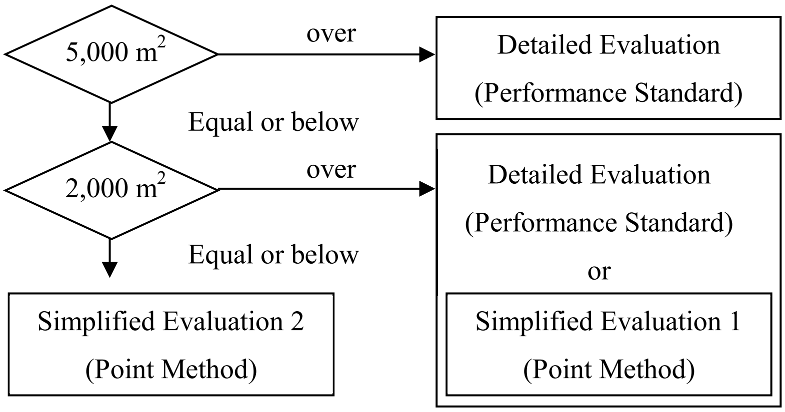


Figure 6-1-3 Japanese Evaluation Method by Building Size

Table 6-1-3　Evaluation Items of Japanese Point Method (1)

	1. Building heat loss	2. Air conditioning	3. Ventilation
	1) Basic building design	1) Reducing of fresh air heating /cooling	1) Control system
	Direction, plan, core position and floor height	Working time and pre-heating time	CO2, human sensor, temperature control, linkage to lighting, time schedule etc.
	2) Wall/roof insulation	2) Location of outdoor unit and length of pipe	2) Efficiency of motors
	3) Window insulation	3) Efficiency of air conditioner	3) Introduction of natural ventilation
	4) Solar heat control	4) Adjustment point	4) Adjustment point
Total point	100 ≦ Clear		
	100 > Not good		

Table 6-1-4　Evaluation Items of Japanese Point Method (2)

	4. Lighting	5. Hot water supply	6. Elevator
	1) Efficiency of lighting fixture	1) Piping root and insulation	1) Control system
	Type of lamps, efficiency of fixture	Insulation for pipes, bulbs and flange, root of pipe line and pipe diameter	Inverter control and regenerative control
	2) Control system	2) Control system	
	Human sensor, day light/dimmer control, brightness control, time schedule, zone or spot control etc.	Circulation pumps, water tap of lavatory and shower	
	3) Placement of fixtures luminous level and interior finish	3) Efficiency of heat source	
	Task and ambient lighting, room shape and interior color	Efficiency of heat source, solar heating and heat recovery	
	4) Adjustment point	4) Adjustment point	4) Adjustment point
Total point	100 ≦ Clear		
	100 > Not good		

(3) The Result of Trial Calculation Using Japanese Evaluation Tool of Energy Conservation (Point Method) and Simulation Tool to Set Energy Consumption Target (ECTT)

1) Evaluation result using Japanese evaluation tool of energy conservation (Point Method)

a) DSI Buildings

Summary of evaluation result for DSI Buildings A-C, using Japanese Point Method is shown in Table 6-1-5 to -7. Lack of insulation is clearly indicated. Besides the evaluation result using Turkish BEP-TR by Turkish EVD Association, which was conducted in accordance with the energy audits, was as follows.

Building A : G,　Building B : F　Building C : F

This evaluation result is almost same as that using Japanese Point Method.

Table 6-1-5 Evaluation Result for DSI Building A, Using Japanese Point Method

	1.Building heat loss	Point	2. Air conditioning	Point	3. Ventilation	Point
	1) Basic building design	12	1) Reduction of fresh air heating/cooling load	0	1) Control system	0
	2) Wall/roof insulation	0	2) Location of outdoor unit and lenth of pipe	0	2) Efficiency of motors	0
	3) Window insulaton	0	3) Efficiency of air conditioner	0	3) Introduction of natural ventilation	10
	4) Solar heat control	25				
	5) Adjustment point	10	4) Adjustment point	95	4) Adjustment point	80
Total point	100 ≦ Clear	47	100 ≦ Clear	95	100 ≦ Clear	80
	Evaluation	X	Evaluation	X	Evaluation	X

	4.Lighting	Point	5. Hot water supply	Point	6. Elavator	Point
	1) Efficiency of lighting fixture	0	1) Piping root and insulation	1	1) Control system	20
	2) Control system	11	2) Control system	0		
	3) Placement of fixtures, luminous level and interior finish	12	3) Efficiency of heat source	0		
	4) Adjustment point	80	4) Adjustment point	70	2) Adjustment point	80
Total point	100 ≦ Clear	103	100 ≦ Clear	71	100 ≦ Clear	100
	Evaluation	OK	Evaluation	X	Evaluation	OK

Table 6-1-6 Evaluation Result for DSI Building B, Using Japanese Point Method

	1.Building heat loss	Point	2. Air conditioning	Point	3. Ventilation	Point
	1) Basic building design	12	1) Reduction of fresh air heating/cooling load	0	1) Control system	0
	2) Wall/roof insulation	0	2) Location of outdoor unit and lenth of pipe	0	2) Efficiency of motors	0
	3) Window insulaton	0	3) Efficiency of air conditioner	0	3) Introduction of natural ventilation	10
	4) Solar heat control	0				
	5) Adjustment point	10	4) Adjustment point	95	4) Adjustment point	80
Total point	100 ≦ Clear	22	100 ≦ Clear	95	100 ≦ Clear	80
	Evaluation	X	Evaluation	X	Evaluation	X

	4.Lighting	Point	5. Hot water supply	Point	6. Elavator	Point
	1) Efficiency of lighting fixture	12	1) Piping root and insulation	1	1) Control system	
	2) Control system	0	2) Control system	0		
	3) Placement of fixtures, lminous level and interior finish	12	3) Efficiency of heat source	0		
	4) Adjustment point	80	4) Adjustment point	70	2) Adjustment point	80
Total point	100 ≦ Clear	104	100 ≦ Clear	71	100 ≦ Clear	
	Evaluation	OK	Evaluation	X	Evaluation	

Table 6-1-7 Evaluation Result for DSI Building C, Using Japanese Point Method

	1.Building heat loss	Point	2. Air conditioning	Point	3. Ventilation	Point
	1) Basic building design	12	1) Reduction of fresh air heating/cooling load	0	1) Control system	0
	2) Wall/roof insulation	20	2) Location of outdoor unit and lenth of pipe	0	2) Efficiency of motors	0
	3) Window insulaton	0	3) Efficiency of air conditioner	0	3) Introduction of natural ventilation	10
	4) Solar heat control	25				
	5) Adjustment point	10	4) Adjustment point	95	4) Adjustment point	80
Total point	100 ≦ Clear	67	100 ≦ Clear	95	100 ≦ Clear	80
	Evaluation	X	Evaluation	X	Evaluation	X

	4.Lighting	Point	5. Hot water supply	Point	6. Elavator	Point
	1) Efficiency of lighting fixture	18	1) Piping root and insulation	1	1) Control system	20
	2) Control system	0	2) Control system	0		
	3) Placement of fixtures, luminous level and interior finish	12	3) Efficiency of heat source	0		
	4) Adjustment point	80	4) Adjustment point	70	2) Adjustment point	80
Total point	100 ≦ Clear	110	100 ≦ Clear	71	100 ≦ Clear	100
	Evaluation	OK	Evaluation	X	Evaluation	OK

b) EM Hospital

Summary of evaluation result for EM Hospital, using Japanese Point Method is shown in Table 6-1-8. Inefficiency of air conditioning and ventilation is indicated.

Besides the evaluation result using Turkish BEP-TR by Turkish EVD Association, which was conducted in accordance with the energy audits, was ranked as C class. (For new construction, C or higher class can get permission in Turkish governmental buildings.)

Besides in case of the evaluation result using Japanese Point Method, it is not sufficient to get permission from Japanese government for new construction. (The scores for air conditioning, ventilation and hot water supply are lower than 100 point.)

Table 6-1-8 Evaluation Result for EM Hospital, Using Japanese Point Method

	1.Building heat loss	Point	2. Air conditioning	Point	3. Ventilation	Point
	1) Basic building design point	9	1) Reduction of fresh air heating/cooling load point	0	1) Control system point	0
	2) Wall/roof insulation point	25	2) Location of outdoor unit and lenth of pipe point	0	2) Efficiency of motors point	0
	3) Window insulaton point	75	3) Efficiency of air conditioner point	0	3) Introduction of natural ventilation point	0
	4) Solar heat control point	25				
	5) Adjustment point	▲25	4) Adjustment point	95	4) Adjustment point	80
Total point	100 ≦ Clear	134	100 ≦ Clear	95	100 ≦ Clear	80
	Evaluation	OK	Evaluation	X	Evaluation	X

	4.Lighting	Point	5. Hot water supply	Point	6. Elavator	Point
	1) Efficiency of lighting fixture point	6	1) Piping root and insulation point	15	1) Control system point	20
	2) Control system point	11	2) Control system point	0		
	3) Placement of fixtures, luminous level and interior finish point	12	3) Efficiency of heat source point	0		
	4) Adjustment point	80	4) Adjustment point	70	2) Adjustment point	80
Total point	100 ≦ Clear	109	100 ≦ Clear	85	100 ≦ Clear	100
	Evaluation	OK	Evaluation	X	Evaluation	OK

2) Evaluation result using Japanese simulation tool to set energy conservation target (ECTT)

Simulation result of energy conservation potential by using ECTT, Japanese simulation tool to set energy consumption target, is described below.

ECTT (Energy Conservation Target Tool) is a simulation tool of calculation of energy consumption target for commercial buildings which is developed by Energy Conservation of Japan, and calculates effects of 3 steps energy conservation measures, that is measures (1) zero investment, measures (2) small investment and measures (3) large investment.

a) DSI Buildings

Figure 6-1-4 shows proportion (%) of energy consumption of implemented measures to present condition of DSI buildings, which are present condition, measures (1), measures (1) + (2), measures (1) + (2) + (3) and measures by energy audit. The energy consumption of DSI buildings will be reduced to 42.6% when measures (1) + (2) + (3) are implemented.

As shown in energy audit results, energy conservation effects of reduction of room temperature in winter and insulation retrofit of building wall are large. In addition to measures by energy audit, introduction of high efficient boilers and high efficient air-conditioner performs more energy saving.

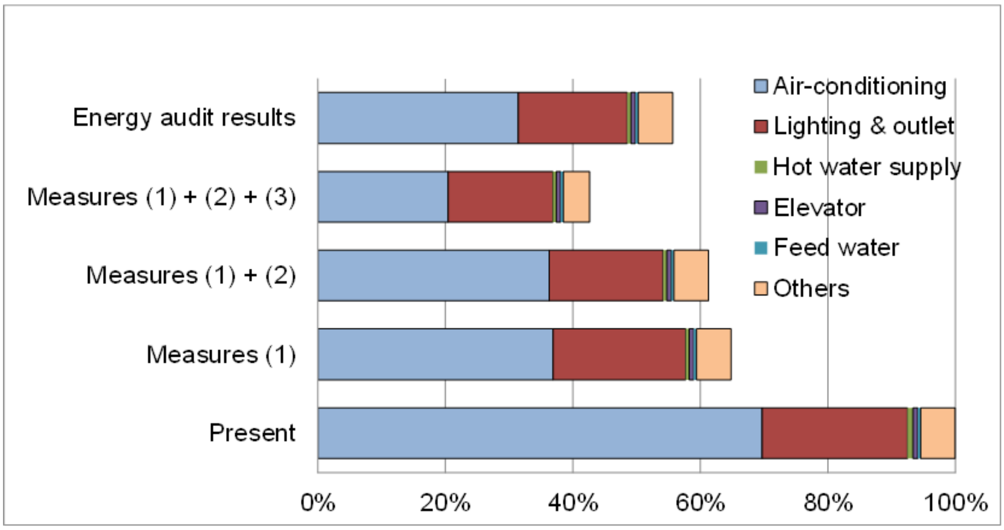


Figure 6-1-4 Simulation Result of Energy Conservation Potential of DSI Buildings by Using ECTT

b) EM Hospital

Figure 6-1-5 shows proportion (%) of energy consumption of implemented measures to present condition of EM Hospital, which are present condition, measures (1), measures (1) + (2), measures (1) + (2) + (3) and measures by energy audit. The energy consumption of EMH buildings will be reduced to 46% when measures (1) + (2) + (3) are implemented.

As shown in energy audit results, energy conservation effects of reduction of fresh air volume and enforcement of boiler operation management are large. In addition to measures by energy audit, introduction of high efficient boilers, high efficient chillers and LED lamps performs more energy saving.

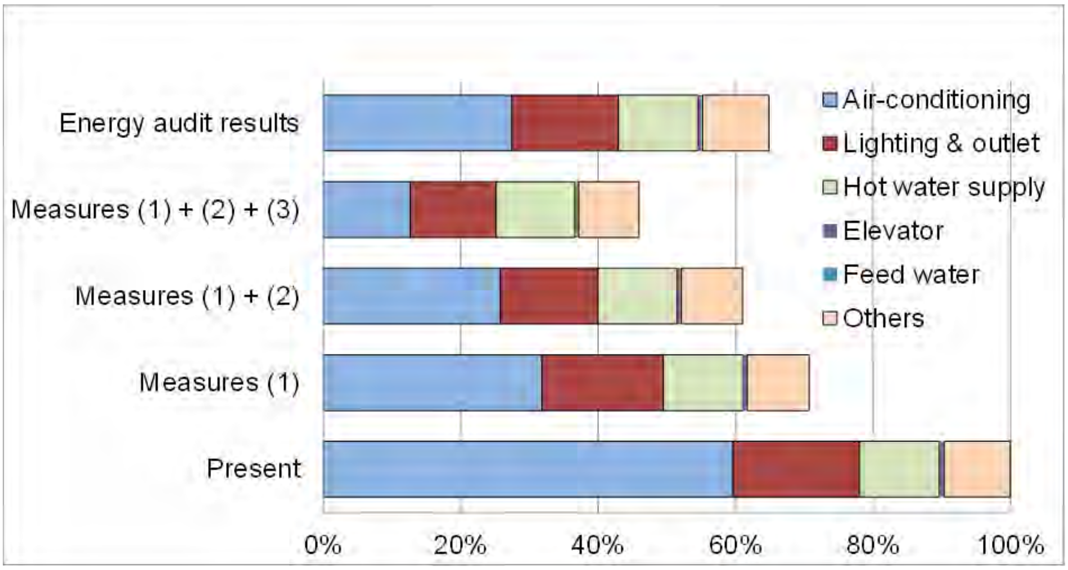


Figure 6-1-5 Energy conservation potential of EM Hospital by Using ECTT

Energy Audit Report
of
DSI Buildings

January 2013

Japan International Cooperation Agency (JICA)
J-POWER

Annex 6-2-1

1. Outline of the building

1.1 Building name	DSI Building			
1.2 District	Ankara			
1.3 Address of building	Devlet Mah. Inonu Bukvan No. 16			
1.4 Use of building	Block-A	Block-B	Block-C	Conference hall
1.5 Completion year	1969	1969	1980	
1.6 Renovation year				
1.7 Total floor area (m^2)	29,449	3,291	7,444	830
1.8 Stories above ground	13	2	7	1
1.9 Stories below ground	2	1		
1.10 Average persons in building Person/day	1500			

2. Outline of energy audit

a. Person engaged in energy audit

JICA Study Team: Dr. Kimio Yoshida (Architect)
Mr. Niro Okamoto (Civil)
Mr. Yukio Nakagawa (Architect)
Mr. Norio Fukushima (Heat)
Mr. Hisatoshi Akiyama (Electrical)

Representative of EVD Association: Gurisik, ENVE, EMAR,TFM and Sqmart:

b. Persons in charge of energy audit: Mr. Serhat Sayiner

b. Energy auditing date: Preliminary energy audit: 28 November 2012 (1 day)
Detailed energy audit: 3 to 5 December 2012 (3 days)

c. Request items on energy audit (main items)

Scope of energy audit is 3 buildings of Block-A, B and C

3. Energy audit results

(1) Improvement proposal items and the expected effect after improvement measure implementation

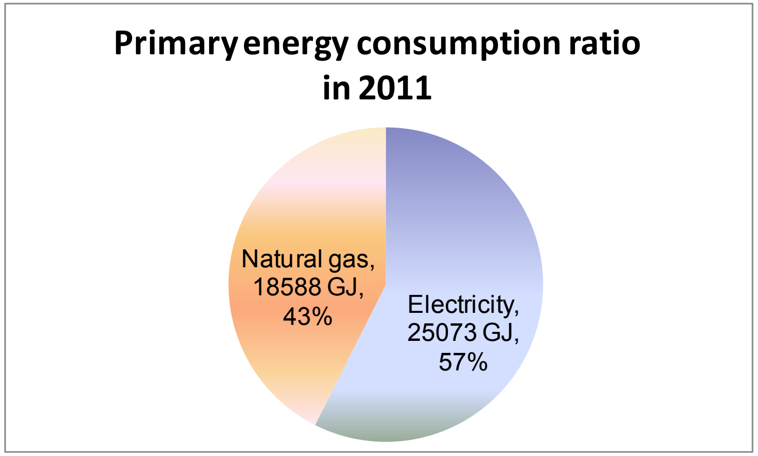
No.	Observation list Classification No.	Improvement items (Itemized corresponding to an appending observation list)	Expected effects					
			Kind of Energy	The amount of energy conservation (1,000m3/y, MWh/y etc.)		Amount of energy saving (TL/y)	Investment needed (TL)	Expected simple payback years
1	Enforcement of operation management							
1.1	1-1	Formulating PDCA cycle	Natural gas	27	km3	64,000	0	0
			Electricity	113	MWh			
1.2	1-6	Blind for heating period	Natural gas	23.1	km3	21,000	0	0
1.3	2-2-1)	Reduction of boiler: operation hour	Natural gas	107	km3	97,000	0	0
1.4	2-2-2)	Improvement of water boiler operation	Natural gas	25	km3	23000	0	0
2	Improvement of equipment with small investment							
2.1	3-1	Thermo control of inverter	Electricity	10	MWh	96000	43,000	0.4
			Natural gas	102	km3			
2.2	2-3-1)	Improvement of insulation of pipe in B block	Natural gas	4.5	km3	4,200	12,000	2.9
2.3	2-3-2)	Improvement of insulation of valves and pipe	Natural gas	18	km3	16,000	6,000	0.4
2.4	-2-1	Improvement of Boiler air ratio	Natural gas	17.5	km3	16,000	6,000	0.4
2.5	5-2-3)	Introduction of electronic ballast	Electricity	3	MWh	1100	5,000	4.4
2.6	5-2-4)	Introduction of motion sensor for WC	Electricity	4	MWh	1400	5,200	3.7
2.7	2-4	Introduction of high efficiency motor	Electricity	7.5	MWh	2600	18,000	6.8
2.8		Adjustment of energy saving in boiler	Natural gas	(16.0)	km3	(14,600)		
3	Improvement of system with large investment							
3.1	6-1	Improvement of insulation of wall and windows	Natural gas	261	km3	248,000	3,000,000	13.5
			Electricity	27	MWh			
3.2	6-1	Introduction of mechanical ventilation					360,000	
Total of expected results of Case 1: Room temperature control (1 + 2)			Fuel (total)	301,000 m3/y		327,500	95,200	0.3
			Electricity (total)	137.5 MWh/y				
A			Crude-oil equivalent of fuel and electric power (total)				286.4 TOE/y	
(A/B)×100			Energy conservation rate of the whole factory				26.7 %	
Total of expected results of Case 2: Room temperature control and Insulation (1 + 2 + 3)			Fuel (total)	562,000 m3/y		566,000	3,455,200	6.1
			Electricity (total)	154.5 MWh/y (Adjustment (10MWh))				
A			Crude-oil equivalent of fuel and electric power (total)				506.4 TOE/y	
(A/B)×100			Energy conservation rate of the whole factory				47.3 %	

(Note) Oil equivalent of electricity is 0.277 TOE/MWh, and that of natural gas is 0.825 TOE/km3, (B)=2,258,904*0.277/1,000+538,161*0.825/1,000=1,067.7 TOE/y

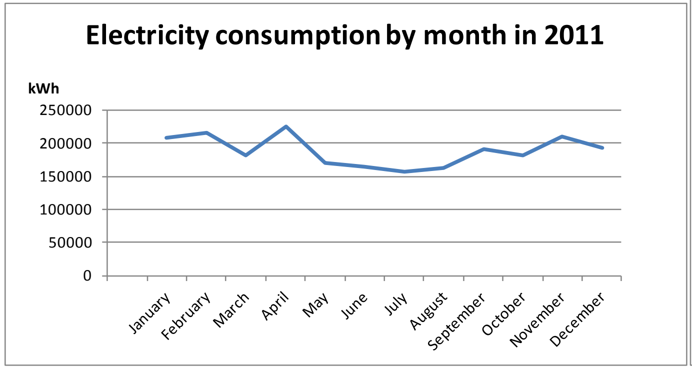
(2) The amount of the annual energy consumption, the energy cost ratio, and energy intensity of the building

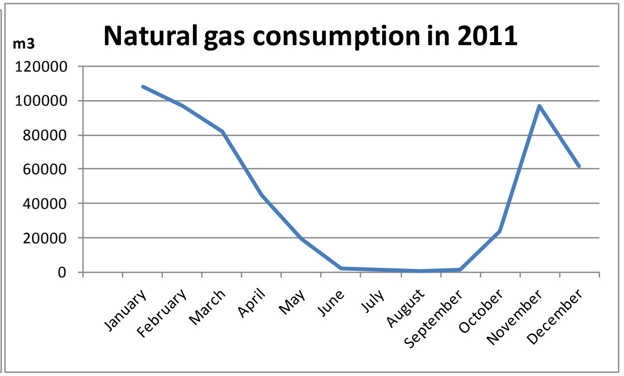
	Energy	Annual consumption		Conversion factor to MJ		Primary energy consumption		Energy intensity		Annual cost (*1)	
1	Electricity	2,258,904	kWh	11.1	MJ/kWh	25,073,834	MJ	611	MJ/m^2	797,393	TL/y
								55	kWh/m^2		
2	Natural gas	538,161	m^3	34.5	MJ/m3N	18,588,081	MJ	444		409,727	TL/y
3	Total					43,661,915	MJ	1,055	MJ/m^2	1,287,120	TL/y

(Note) (*1) For unit price, 2012 price is applied, electricity: 0.353TL/kWh, natural gas: 0.91TL/m3



Energy type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electricity (kWh)	208,800	215,820	180,720	224,880	169,440	164,160	156,480	162,960	190,080	182,400	210,000	193,164	2,258,904
Natural gas (m^3)	107,919	97,153	81,628	44,363	19,348	1,962	1,171	903	1,340	23,906	96546	61,924	538,163





Use of energy sources assumed by equipment capacity and load factor

Natural gas -------------------- Water boiler for space heating (93%) 500,000 m3N/y -------------- A Block Building (73%) 365,000 m3N/y

(538,000 m3N) ----------- Steam boiler for hot water supply (5%) 27,000 m3N/y -----------B Building (6%) 30,000 m3N/y

------------Gas range for cooking in restaurant (2%) 11,000 m3N/y ---------- C Building (16%) 80,000 n3N/y

---------- Conference hall (5%) 25,000 m3N/y

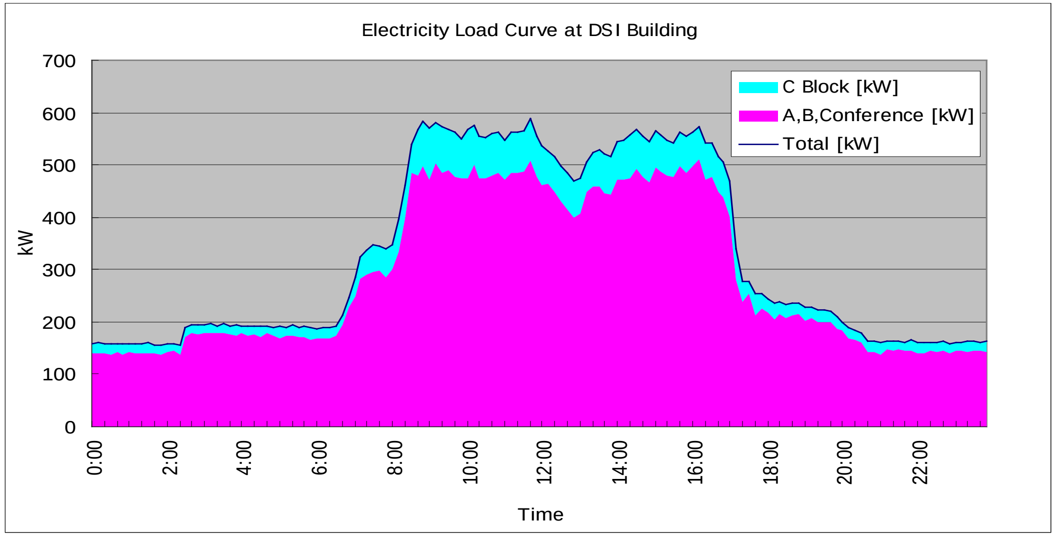
Electricity----------- Air conditioner of split type
------- Electrical space heater
------- Pump and fan for heat transfer
------ Lighting
------- Elevators
------- Office appliances: Computer, printer, etc.
------- Servers for LAN

(3) Daily electricity consumption by hour

(3)-1 Winter season (Date: 4 December 2012)

Hour	1	2	3	4	5	6	7	8	9	10	11	12	
Electricity(kWh)	158.2	157.4	181.0	193.6	191.4	190.1	219.3	339.8	519.7	567.1	558.5	561.8	
A+B Block(kWh)	139.9	139.6	164.3	177.8	173.9	170.5	197.1	292.2	444.0	484.7	481.0	484.1	
C Block(kWh)	18.3	17.8	16.7	15.8	17.5	19.6	22.2	47.6	75.7	82.4	77.5	77.7	
Hour	13	14	15	16	17	18	19	20	21	22	23	24	Total
Electricity(kWh)	495.2	523.3	555.9	554.6	524.9	274.6	234.6	217.3	173.4	163.0	161.0	161.5	7877.2
A+B Block(kWh)	427.0	454.6	479.6	487.5	458.2	238.0	209.8	196.1	153.3	144.9	143.4	143.6	6885.1
C Block(kWh)	68.2	68.7	76.3	67.1	66.7	36.6	24.8	21.2	20.1	18.1	17.6	17.9	992.1

Hour	12	13	14	15	16	17	18	19	20	21	22	23	
Electricity(kWh)	545.4	482.8	511.5	542.6	528.5	490.2	264.7	193.9	172.8	161.5	160.1	158.3	
A+B Block(kWh)	470.4	415.8	443.1	465.8	459.5	421.4	227.5	169.0	151.7	142.0	141.2	140.0	
C Block(kWh)	75.0	67.0	68.3	76.8	69.1	68.8	37.2	24.9	21.1	19.5	18.8	18.4	
Hour	24	1	2	3	4	5	6	7	8	9	10	11	Total
Electricity(kWh)	159.7	158.2	157.5	181.0	193.6	191.4	190.1	219.3	339.8	519.7	567.0	558.5	7648.1
A+B Block(kWh)	142.5	139.9	139.5	164.5	177.2	173.4	170.9	198.2	291.3	444.5	485.2	479.5	6654.0
C Block(kWh)	17.2	18.3	18.0	16.5	16.4	18.1	19.2	21.1	48.6	75.2	81.8	78.9	994.1



Remarks

Energy price

	2011	2012	Calorific value
Natural gas: (TL/m3)	0.761	0.91	8,250 kcal/m3N
Electric power: (TL/kWh)	0.294	0.353	

Building energy conservation audit
Observation list (Detailed explanation of improvement and expected effects are indicated in attached sheet)

1. General management items

Check items and contents	The present condition and problems	Measures for improvement
1.Energy management system - Development of organizational structure and human resource education - Goals for energy conservation and investment budget - Establishment of management standards - Implementation status of energy conservation - Annual plans, and medium- and long-term plans - PDCA management cycle	1) Top Management Concern for Energy Conservation. Responsible person is clear. 2) Control system, 3) Turn off of lighting is implemented. 4) Room interior color is good	PDCA cycle is to be established. Target of energy conservation is to be established. Effects of energy management activity: Reduction of energy is 5% Fuel saving volume: = 538,000 * 0.05 = 27,000 m3/y Fuel saving amount: = 27,000 * 0.91= 25,000 TL/y Electricity saving volume: = 2,259 * 0.05 = 113 MWh/y Electricity saving amount: = 113 * 353 = 39,900 TL/y
2. Implementation status of measurement and recording - Status of installation of measuring equipment and its operation - Status of implementation of measurement and recording - Status of introduction of measurement and control systems		
3. Management of energy consumption - Status of recording of daily reports - Daily consumption and daily load curve - Visualization - Monthly consumption - Comparison with previous fiscal year		
4. Maintenance management of equipment - Periodical inspection and daily check - Cleaning of filters and strainers		
5. Management of specific energy consumption - Management of specific consumption (MJ/(m2-year)) - Management of specific consumption (thousand TL/(m^2-year))		

Check items and contents	The present condition and problems	Measures for improvement
6.Building operation	Many blinds of windows are opened in winter time	At winter peak time, by closing blind, 0.5W/m2 energy can be saved = 3.3 m3/ym2, 3.0 TL/ym2

2. Heat source and heat-conveying equipment

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
1. Performance management of combustion equipment - Management of air ratio and exhaust gas - Burners, fuels, and ventilation systems - Combustion control devices - Fuel conversion (boilers, generators ,etc.)	3 sets of water boiler of capacity of 3,500,000 kcal/h for space heating are operated from November to April. 1) Air ratio of water boiler is 2.2. Measurement device of oxygen conents of exhaust gas is not installed. 2) Combustion control of burner is made by air damper with link lever mechanism according to fuel oil volume change.	1) Air ratio of water boiler is to be 1.3 from 2.2. Heat loss of exhaust gas is reduced by 3.5%. Fuel saving volume : 500,000 * 0.035 = 17,500 m3/y 2) Air damper of burner is adjusted by monitoring of oxygen contents (%) of exhaust gas with an oxygen analyser. An oxygen analizer is purchased. 3) Air damper control unit with oxygen analyser of Zirconia sensor is installed. 4) High efficient water boilers with smaller capacity are to be installed after renovation of building insulation.	1) Fuel saving amount : 17,500 * 0.91 = 16,000 TL/y Investment cost: 6,000 TL (Purchase of 1 set of oxygen analyzer) Payback year: = 6,000 / 16,000 = 0.4 years
2. Operational management and efficiency management - Status of load factor and start-up/shutdown - Control of number of units - Heat efficiency, heat balance, and heat distribution - Steam pressure - Water quality management, and blow management	1) Reduction of operation hours of boilers Operation of boilers start at 2:30 AM, although business starts at 8:30 AM. Temperature of office rooms rises from 20^0C to 24C for 4 hours after boilers combustion start.	1) Reduction of warming-up hour by 3 hour in the morning, because temperature of room rises to 24C in Room 522 for 3 hours. Room temperature rises to 24C by 8:30. Start time is changed at 2:30 to at 5:30 Natural gas saving volume: = 500,000 * 3/14 = 107,000 m3/y	1) Fuel saving amount: = 107,000 * 0.91 = 97,000 TL/y Investment cost: Free Payback year = 0 year

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
	2) Boiler operation pattern improvement Operation numbers of water boiler are 1 set usually and 2 sets in January of coldest season. Load factor of boilers are 70% at fuel gas combustion base, which shows lower efficiency Operation condition is not continuous but on-off operation. On-off operation is 5% lower than continuous operation in thermal efficiency	2) Continuous operation of 1 set of boiler, except for the coldest season such as January. Control of difference of water temperature between output and inlet of boiler is made. High load factor of boiler is to be kept within boiler capacity of 3,500,000 kcal/h Fuel saving volume: = 500,000 * 0.05 = 25,000 m3/y	2) Fuel saving amount: = 25,000 * 0.91 = 23,000 TL/y Investment cost: Free Payback year = 0 year
3. Operational management of auxiliary equipment - Operational control of cooling towers - Water quality management (electrical conductivity) - Operational control of pumps (water volume and pump head) - Improvement of routes	1) Insulation work of piping is not good especially in pipe duct. Piping in the office rooms in B1 floor of B building is not insulated of 80 mm diameter of 200m in total, which surface temperature is 60^0C.	1) Enforcement of insulation of pipes in the office room in B building Insulation work of pipes of 80 mm diameter of 200m length Glass wool insulation work Heat saving: 13,400 kcal/h Annual operation hour: 2,250h/y Boiler efficiency: 80% Natural gas saving volume: = 13,400 * 2,250 / 0.8 = 4,568 m3N/y Office work conditions will be improved.	1) Natural gas saving amount = 4,568 * 0.91 = 4,157 TL/y Investment cost: 12,000 TL for pipe of 80mm D X 200m L Payback year: = 12,000 / 4157 = 2.9 years

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
		2) Enforcement of insulation of pipes and valves for feed and return of hot water in buildings Insulation work of pipes of 100 mm to 150 mm diameter of 117m length in total. Rock wool insulation work Heat saving: 52,500 kcal/h Annual operation hour: 2,250h/y Boiler efficiency: 80% Natural gas saving volume: = 52,500 * 2250 / 0.8 = 17,898 m3N/y	2) Natural gas saving amount: = 17,898 * 0.91 = 16,287 TL/y Investment cost: 6,070 TL for piping Payback year: = 6,070 / 16,287 =.0.4 years
4. Operational management of heat-conveying equipment - Multiple unit control of pumps and fans - Control of rotation speed of pumps and fans - Status of opening and closing of valves (automatic valves, header bypass valves. etc.) - Flow rate and pressure - Improvement of routes (open and closed)	1) Heating system (Heat transmission system) Flow rate control of hot water Valves of circulation pumps are 100% open. Long operation time (2:30~17:30), and motor efficiency is normal.	1) Circulation pump for heating Introduction of high efficiency motor Motor efficiency is improved by introduction of high efficiency motor. 2 sets * 7.5kW of motor efficiency: 80% → 88.5% 15kW of motor efficiency: 83% → 90.6% Electricity saving volume: 2,255h/y*2*7.5kW*(100/80-100/88.5)=4,061kWh/y 2,255h/y*15kW*(100/83-100/90.6)=3,419kWh/y Total: 7,480kWh/y	1) Electricity saving amount: = 7,480 * 0.353 = 2,640 TL/y Investment cost: 18,000 TL_ Payback year: = 18,000 / 2,640 = 6.8 years

3. Air-conditioning and ventilating facilities

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
1. Operational management of air conditioners - Optimization of preset temperature and humidity - Appropriateness of humidified zones and methods - Appropriateness of reheating - Uneven distribution of temperature - Warm-up operation - Control of outdoor air intake volume- Review of operation hours - Switching-off of air conditioners in unused rooms - Outdoor air blocking - Indoor condition management (CO_2 etc.)	1) No thermal control of room temperature (Hot as 26^0C) 26 ^{0}C measured, some window are opened Present annual gas consumption 538,161m3/year (Around 95% is for heating) Flow rate control of hot water Valves of circulation pumps are 100% open.	1) Target room temp change from 26^0C to 22^0C = 20% reduction Temperature control system should be introduced such as thermostatic valve of convector. Visualize room temperature (setting thermometer) a) Adding temperature control system Fuel saving volume: = 538,161*0.95*0.2 =102,000m3/y 19% reduction b) Adding inverter controller into circulation pumps can reduce flow rate of 19%, which 15% Electricity can be saved for pumps: Electricity saving volume: 2,255h/y*30kW*0.15 =10,148kWh/y	1) a) Fuel saving amount by temperature control system = 102,000 * 0.91 = 92,820TL/y b) Electricity saving amount by inverter control: =10,148 * 0.353 = 3,582TL/y c) Total saving amount: = 96,000 TL/y Investment cost of temperature control system and inverter: 43,000 TL, Payback year: = 43,000 / 96,000 =0.4 years_
2. Management of air conditioning efficiency - Restriction of air conditioning areas - Use of outdoor air (outdoor air cooling) - Setting of dew-point control - Prevention of mixing loss - Night purge - Water sprinkling on rooftop and outdoor units - Accuracy of automatic control			

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
3. Management of ventilating equipment - Optimization of ventilation frequency - Review of operating hours - Control of ventilation in the parking space (CO concentration) - Management of operating temperature (electrical room. machine room, CVCF room) - Local ventilation - Switching-off of ventilators in unused rooms - Control of air blower speed (VAV. VWV)			

4. Hot water supply, feed water and drainage, freezing, refrigerating, and kitchen equipment

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, TL)	
1. Management of hot water Supply equipment - Hot water supply temperature - Improvement of hot water supply efficiency (descaling, etc.) - Stopping of operation except during winter - Scheduled control during holidays and at night-time - Utilization of waste heat - Use of solar heat	2 sets of steam boiler of capacity of 426,000 kcal/h for hot water supply are operated in all days. Load factor of steam boiler is 50% to 70%	In winter season, hot water of water boilers can be used instead of steam boilers, and so stop of steam boilers is recommended.	

5. Power receiving/transforming facilities, lighting and electrical system

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
1. Management of power receiving/transforming facilities - Adjustment of electrical voltage - Management of power factor - Control of improvement of power factor	1) Receiving transformers are supplied by electric distribution company. 2) Power factor control is implemented.		

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
2. Management of lighting systems - Management of optimum illumination - Turning off the lights during unnecessary time (use of daylight, etc.) - Cleaning and change of lighting apparatus - Mounting position of lamp fitting, and circuit partitioning - Darkening and extinction by automatic dimming control system - Local lighting - Use of energy-saving fluorescent tubes - Improvement of utilization factor (reflectance ratio) - Management of outdoor light - Turning off night-time guide light - Use of high efficiency lamps	1) Lightings are turned off at unnecessary area Some lighting circuit are separated → Easy to select the lighting area 2) Luminance measurement Entrance of C building is high (standard: 150, measurement result: 216 Lx) 3) 70% of Fluorescent lamp are used magnetic ballast	3) Reduction loss for ballast of fluorescent lamp Replacement of magnetic ballast into electronic ballast 10% Energy can be saved by replacement of ballast. Electricity of installed fluorescent lamps: 2*36W type (80W)*200units=16kW Electricity saving volume: 16kW*1,980h/y*10% = 3,168kWh/y	3) Electricity saving amount: = 3,168 * 0.353 = 1,100TL/y Investment cost: 5,000TL for 200sets of ballast Payback year: = 5,000/1,100 = 4.5 years
	4) Sensor control No motion sensor is installed at WC Lightings at WC are keeping turned on	4) Electricity reduction of unnecessary area Introduction of motion sensor for WC 30% Energy can be saved by introduction of motion sensor. Total lighting capacity: 6.72kW for 26 WC Electricity saving volume: = 6.72kW * 1,980h/y * 30% = 3,993kWh/y	4) Electricity saving amount: = 3,993 * 0.353 =1,400TL/y Investment cost: 5,200TL for 26sets of motion sensors Payback year: = 5200 / 1,400 = 3.7years
3. Management of office automation equipment - Reduction of standby electricity - Power-oft unless then are needed - Introduction of energy-saving types		.	

6. Buildings

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	A check item and contents
1. Energy conservation in buildings - Heat insulation properties of the structure - Heat insulation properties and air tightness of windows - Blocking of outdoor air - Sunlight protection of windows - Sunlight protection on the roof - Air-flow windows - Rooftop greening - Green government building project	1) Glass ratio is high and single glass with non-insulated sash for Building A and B, and connecting corridors. Double glass with non-insulated sash for Building C 2) No insulation for walls for Building A and B 3) Additionally building surface is old and not functional 4) So total retrofitting is needed a) For Building A and B, Heat loss through window and sash is high, Not closing blinds b) For Building C, Wall and heat insulation is good, but heat is being lost through sash. Insulation for sash is needed c) For connecting corridor, Wall insulation (XPS) is good, but heat is being lost through window. Insulation for window and sash is needed 5) Comparison of room temperature trend for 24 hours with a hospital building which is well insulated building. Temperature drop of DSI is 26^0C to 19^0C, while that of EMH is 23^0C to 22^0C in the night time due to insulation level.	1) Heating load (gas) reduction by building insulation a) Fuel saving volume by insulation enforcement: =182,000m3N/y b) Adding room temp control system from 26^0C to 22^0C Fuel saving volume by temperature control: = 62,600m3N/y a)+b) = 245,000m3N Heat supply is reduced by 48%. c) By 48% flow rate reduction, 40% of electricity can be saved for pumps Electricity saving volume: = 2,255h/y*30kW*0.40 =27,000kWh/y	1)-a) Natural gas saving amount: = 245,000 * 0.91 =238,000TL/y 1)-c) electricity saving amount: = 27,000 * 0.353 =10,000TL/y Total energy saving amount: 248,000TL/y Investment cost: Window and wall insulation :3,000,000TL, Mechanical ventilation: 360,000TL Payback year=3,360,000/248,000=13.5years (Refer to P21)

7. Elevators

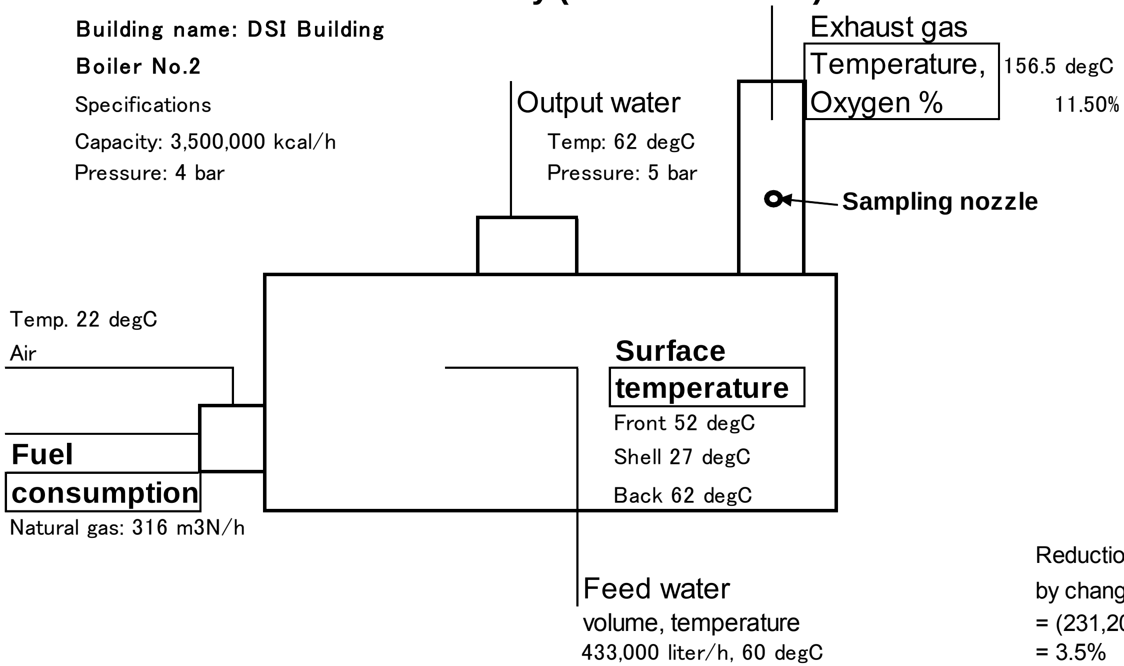
Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (m^3, kWh, 1000 TL)	
1. Operational management of elevators - Control of number of elevators in operation - Time-zone operation schedule management - Reduction of power transmission mechanical loss - Decrease in number of floors at which an elevator stops - Use of inverter control	Inverter control for elevators is installed. Every time all elevators works	Operating number control should be considered for night time and holidays	

Referential Information

1. Boiler

1.1 Improvement of air ratio of water boiler

Water boiler thermal efficiency (Indirect method)

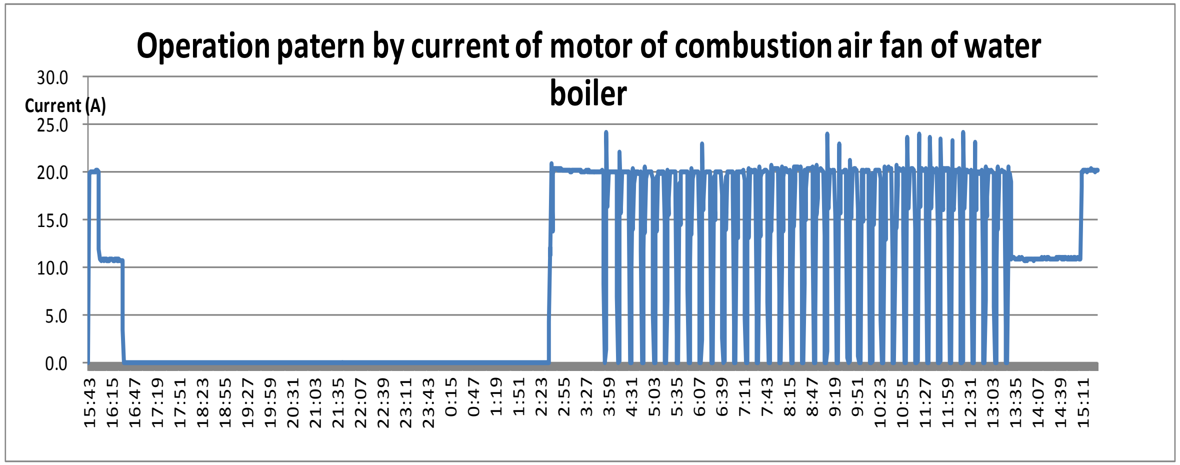


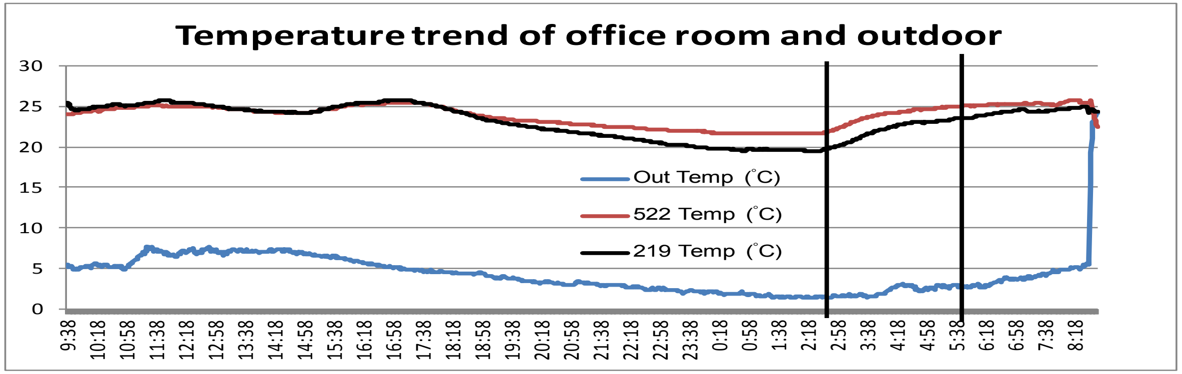
Reduction of exhaust gas heat loss
by change of air ratio 2.2 to 1.3
= (231,200 - 140,484) / 2,607,000 * 100
= 3.5%

1	Input heat				Equation
a	**Fuel combustion heat**	**2,607,000**	**kcal/h**		= b * c
b	Fuel heat value	8,250	kcal/m3N		
c	Fuel consumption	316.0	m3N/h		
d					

2	Heat loss	m=2.2		m=1.3	
e	**Exhaust gas heat loss**	**231,200**	**kcal/h**	**140484**	**kcal/h**
f	Theoretical gas volume	10.1	m3N/m3N	10.1	m3N/m3N
g	Theoretical air volume	9.2	m3N/m3N	9.2	m3N/m3N
h	Excess air ratio	2.20		1.3	
i	Specific heat of ex. gas	0.311	kcal/m3NC	0.311	kcal/m3NC
j	Actual exhaust gas vol.	21.19	m3N/m3N	12.87	m3N/m3N
k	Exhaust gas heat loss	732	kcal/m3N	444	kcal/m3N
l	**Radiation heat loss**	**6,468**	kcal/h	**6,468**	kcal/h
m	Convection heat loss	2,373	kcal/h	2,373	kcal/h
n	Emission heat loss	4,095	kcal/h	4,095	kcal/h

1.2 Improvement of operation pattern of water boiler
Reduction of operation hours of water boiler

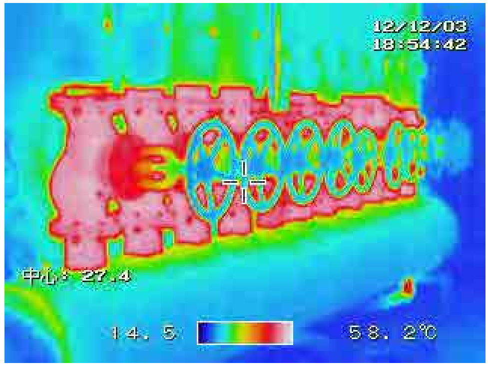




1.3 Enforcement of insulation of pipes and valves


Deteriorated insulation


No insulation



No insulation for valves

Insulation for valves

Date of measurement 5 Dec. 2012

No.	Equipment name	Pipe size	Quantity	Surface temp	Pipe length	Un-insulated length	Heat loss by insulation		heat loss at present		Saving
				deg C	m	m	kcal/h/m	kcal/h	kcal/h/m	kcal/h	kcal/h
1	**B-block B-1 piping @ W, S and E wall in the office room**	80A	2	60	100	100	16	3,200	83	16,600	13,400
2	**Piping**										
2.1	A-block high vertical pipe	100A	4	60	40	40	29	4,640	208	33,280	28,640
2.2	A-block low vertical pipe	100A	4	60	12	12	29	1,392	208	9,990	8,598
2.3	C-block horizontal pipe	100A	2	60	90	45	29	2,610	82	7,353	4,743
2.4	Boiler to B-block connecting	125A	2	60	30	30	34.4	2,064	95	5,728	3,664
2.5	Boiler to C-block connecting	150A	2	60	50	50	39.8	3,980	108	10,836	6,856
	Total of piping					177		14,686		67,186	52,500

2. Renovation of insulation of buildings

(1) Present condition of building

a) Glass ratio is high and single glass with non-insulated sash for Building A and B, and connecting corridors.
Double glass with non-insulated sash for Building C: U value = 4-5W/m2^{0}C
(U value is an indicator for evaluating insulation level)

b) No insulation for walls for Building A and B: U value = 4W /m2^{0}C
>> Average U value or windows and walls is 4.5W/m2^{0}C

c) Additionally building surface is old and not functional, and so total retrofitting is needed

For Building A and B,
Heat loss through window and sash is high, No closing blinds
For Building C,
Wall and heat insulation is good, but heat is being lost through sash. Insulation for sash is needed
For connecting corridor,
Wall insulation (XPS) is good, but heat is being lost through window. Insulation for window and sash is needed
Comparison of room temperature trend for 24 hours with a hospital building which is well insulated building.
Temperature drop of SDI is 26^{0}C to 19^{0}C, while that of TMH is 23^{0}C to 22^{0}C in the night time due to insulation level.

(2) Heating load (gas) reduction by building insulation

a) 2.5W/m2^{0}C*(22-(-12)) ^{0}C*13,000m2*(8760h*0.15) *1.2(loss)/8,250kcal/m3*0.86lcal/W=182,000m3

b) Adding room temp control system from 26^{0}C to 22^{0}C
(538,161*0.95-182,000-16,500)*0.2 = 62,600m3
a)+b) = 261,000m3=238,000TL/y   48 % reduction
48% flow rate reduction → 40% Electricity can be saved for pumps
2,255h/y*30kW*0.40 =27,000kWh/y=10,000TL/y
Totally 248,000TL/y reduction

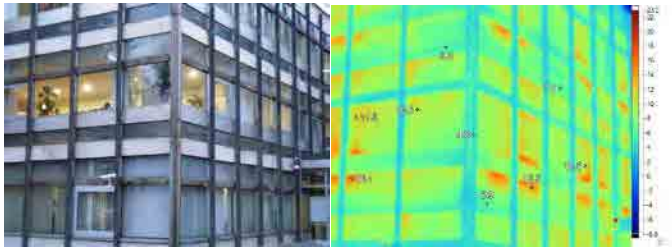
Reduction of cost

(1) Expected energy and cost reduction
Gas 261,00m3* 0.91TL/m3=238,000TL/y
Electricity 27,000kWh*0.353=10,000TL/y
Total 248,000TL/y saving
19.1TL/m2 (wall & window) / year can be saved

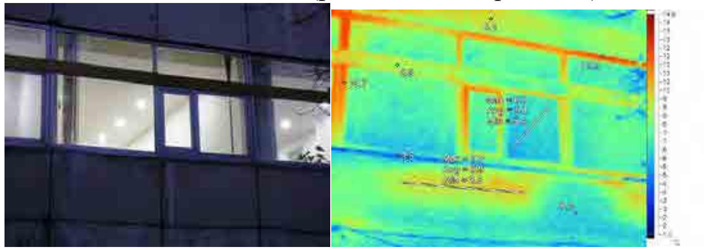
(2) Expected investment

1) Wall and glass insulation: 2,860,000TL (13,000m2*220TL/m2)
2) Additional design retrofitting + some equipment replacement
Total = 3,000,000TL?

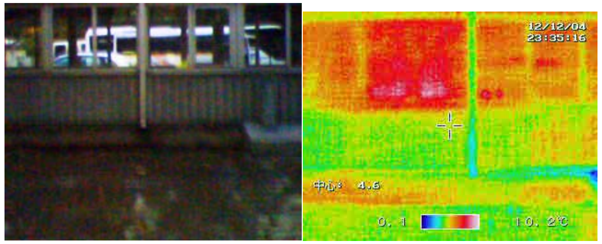
For Building A and B,
Heat loss through window and sash is high,
Not closing blinds



For Building B,
Waste of heat means waste of money:
456,000TL/y through wall and window (heat loss)
Since 1969, 18,000,000TL (present value equivalent)



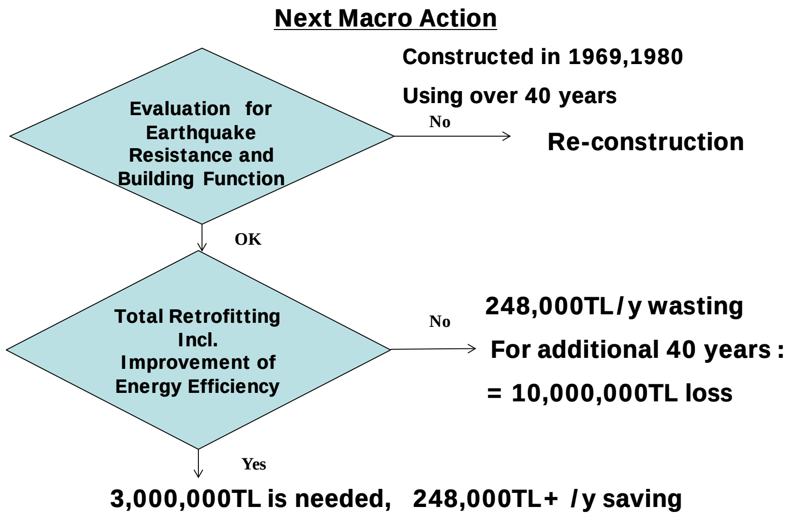
For Building C,
Wall and heat insulation is good, but heat is being lost through sash. Insulation for sash is needed.



For connecting corridor,
Wall insulation (XPS) is good, but heat is being lost through window. Insulation for window and sash is needed

Recommended procedure

DSI building was constructed in 1969,1980 and have been used over 40 years



3. Ventilation of building

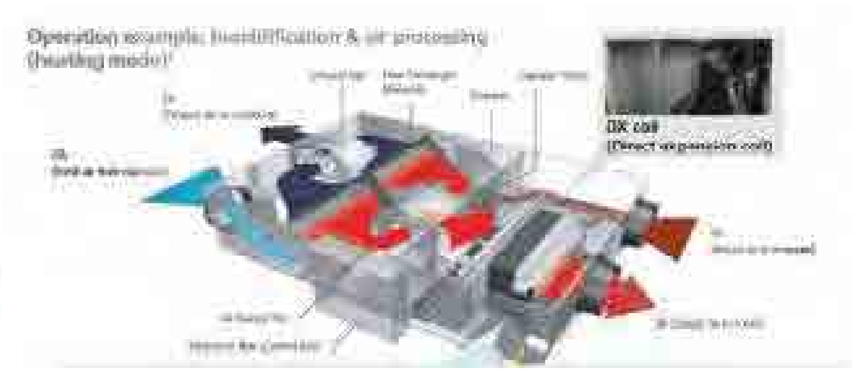
CO_2 density in meeting room is indicated as 1,800PPM > 1,000PPM (Criteria of Japanese office standard)

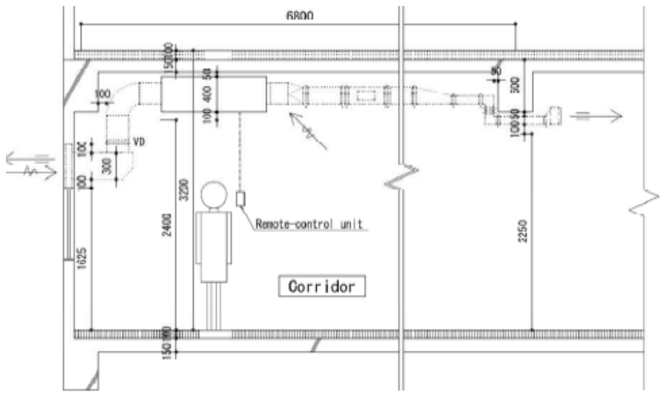
Now natural ventilation, but by introducing air tight sash (higher insulation), mechanical ventilation system should be also introduced

Ex) Introducing heat exchanger (HEX) (recover the wasted heat) is recommended

In DSI room size is small, so install HEX for corridor and meeting rooms only

Heat Exchanger (HEX) for Ventilation
Ex) 500m3/h HEX (Efficiency 70%) heat recovery
Price: 6,000TL/unit * 60 units = 360,000TL
1,500person * 20m3/h / (500m3/h) = 60 units





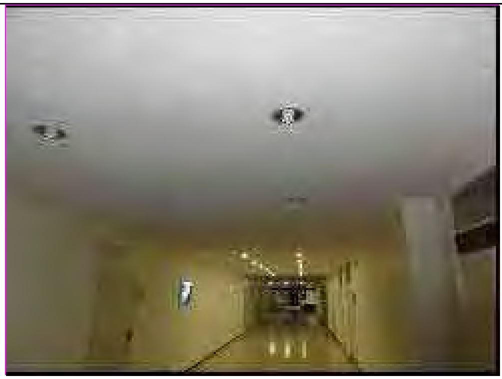
Heat Exchanger (HEX) for Ventilation

4. Lighting facilities

Survey for illuminance in the EM Hospital

Building (A, B, C)	Floor	Place (Office room, Corridor, etc.)	Illuminance [lx]	Measured height from floor [cm]	Notes (Main lamp equipment etc.)
A	Z	Corridor (in front of elevator)	35	15cm	CFL 18W
A	3	Meeting room	97	50cm	CFL 18W
A	3	Executive office room	141	50cm	FL 36W *2
A	3	WC	142	40cm	CFL 18W
A	3	Corridor (in front of elevator)	37	50cm	CFL 18W * 2
A	4	Corridor (in front of elevator)	52	60cm	CFL 18W * 2
A	12	Cafeteria	152	75cm	FL 36W *2
A	B1	Corridor (turned off lightings)	66	15cm	CFL 18W
A	B1	Corridor (turned on lightings)	133	15cm	CFL 18W
C	Z	Corridor	216	25cm	CFL 18W
C	6	Office room	168	55cm	CFL 18W

Typing room: 500lx
Documents room: 100lx
Administration room: 250lx
Waiting room: 150lx
Conference room: 200lx
Cafeteria: 150lx

		
Lightings are turned off at unnecessary areas	Only entrance of Building C is high (standard: 150lx, measurement result: 216lx)	70% of Fluorescent lamp are used magnetic ballast → Electronic ballast is more energy saving.
		
No thermal control of room temperature (Hot as 260C)	Lightings at WC are kept turned on →Energy can be saved easily by installing motion sensors	✓ Valves of circulation pumps are 100% open ✓ Long operation time (2:30~17:30), and motor efficiency is normal

5. Other energy conservation measures

Ref.1 Replacement of Fluorescent lamp into LED (In priority to long operation area)

Effects:

Existing Fluorescent lamp: 4 * 18W type (80W) * 100units, 2 * 36W type (80W) * 32units=10.56kW

→ 49% energy can be saved by installing LED

Electricity saving volume = 10.56kW * 1,980h/y * 49% = 10,581kWh/y

Electricity saving amount = 10,581 * 0.318 = 3,365TL/y

Investment cost: 41,867TL for 464units of LED lamps

Simple payback = 41,867 / 3,365 = 12.4 years

Ref.2 Replacement of split AC into inverter AC

Effects: Approx. 20% energy can be saved from the view point of SEER, not COP

Average 12,000BTU*200units*600h/y*20% saving

Electricity saving volume = 31,000kWh/y=11,000TL/y

Inverter AC: 3,800TL

Non-inverter AC: 2,000TL

Energy Audit Report
of
Etimesgut Military Hospital

January 2013

Japan International Cooperation Agency (JICA)
J-POWER

Annex 6-2-2

1. Outline of the building

1.1 Building name	Etimesgut Military Hospital		
1.2 District	Ankara		
1.3 Address of building	Erler Etimesgut, Etimesgut		
1.4 Use of building	Hospital		
	Outpatient (target of energy audit)	Main	Engineering & maintenance
1.5 Completion year	2003	1964	1978
1.6 Renovation year		Scheduled in 2013	
1.7 Total floor area (m^2)	8,000	14,475	3,725
1.8 Stories above ground story	3	4	2
1.9 Stories below ground story	0	0	0
1.10 Average persons in building Person/day	1,200	300	100

2. Outline of energy audit

a. Person engaged in energy audit
JICA Study Team: Dr. Kimio Yoshida (Architect)
Mr. Niro Okamoto (Civil)
Mr. Norio Fukushima (Heat)
Mr. Akiyama (Electrical)
Representatives of EVD Association: Gurisik, ENVE and EMAR

b. Persons in charge of energy audit: Mr. Alb.A.Hamdi

c. Energy auditing date: Preliminary energy audit: 29 November 2012 (1 day)
Detailed energy audit: 5 to 7 December 2012 (2.5 days)

d. Request items on energy audit (main items)
Scope of energy audit is outpatient building.
Main building is demolished in 2012 to rebuilt new building.

3. Energy audit results

(1) Improvement proposal items and the expected effect after improvement measure implementation

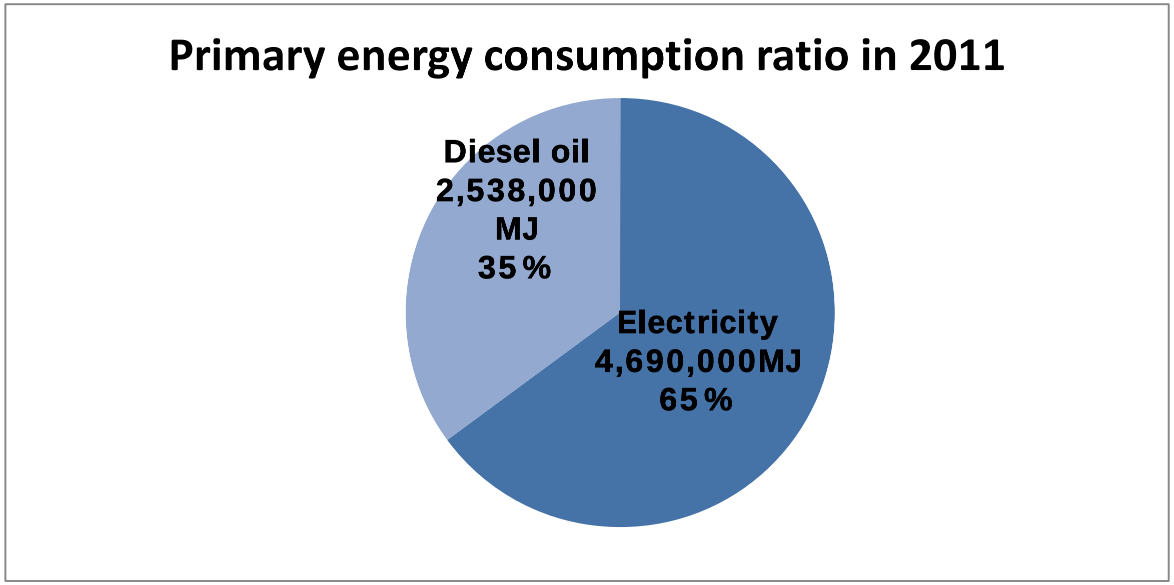
No.	Observation list Classification No.	Improvement items (Itemized corresponding to an appending observation list)	Expected effects: Kind of Energy	The amount of energy conservation (kL/y, MWh/y etc.)		Amount of energy saving (1000 TL/y)	Investment needed (1000TL)	Expected simple payback years
1	Enforcement of operation management							
1.1	1-1	Formulating PCDA cycle	Diesel oil	3.5	kL	6.8	0	0
			Electricity	21.1	MWh	6.7	0	0
1.2	1-6	Blind for heating period	Diesel oil	0.9	kL	1.7	0	0
1.3	2-3-1)	Reduction of boiler operation time	Diesel oil	7.7	kL	15.0	0	0
1.4	2-3-2)	Improvement of boiler operation	Diesel oil	3.5	kL	6.8	0	0
1.5	5-2-2)	Change setting of motion sensor for WC	Electricity	1.9	MWh	0.6	0	0
1.6	3-1-1)	Case1. Reduction of fresh air intake from 47,000m³/h to 30,000m³/h	Diesel oil	19.3	kL	37.4	0	0
			Electricity	36.6	MWh	11.6	0	0
2	Improvement of equipment with small investment							
2.1	3-1-2)	Case2. Reduction of fresh air intake to 20,000m³, Introducing small HEX and control	Diesel oil	27.4	kL	52.0	150.0	2.0
			Electricity	73.1	MWh	23.2		
2.2	2-1	Boiler: Air ratio improvement	Diesel oil	2.9	kL	5.7	6.0	1.1
2.3	2-4-2)	Insulation for valves	Diesel oil	1.3	kL	2.4	2.4	1.0
2.4	5-2-1)	Introduction of electronic ballast	Electricity	2.1	MWh	0.67	3.3	4.9
3	Improvement of system with big investment							
3.1	3-1-3)	Case 3. Replacement of Air Handling Unit				66.0	422.0	6.4
4		Adjustment of energy saving in boiler	Diesel oil	(0.9)	KL/y	(1.7)	0	
Total of expected results: Case 1			Fuel (total)	38.2	KL/y	74.1	11.7	0.1
			Electricity (total)	61.7	MWh/y	19.6		
		A	Crude-oil equivalent of fuel and electric power (total)				33.1+16.8= 49.9 TOE/y	
		(A/B)×100	Energy conservation rate of the building					28.1%
Total of expected results: Case 2			Fuel (total)	46.3	KL/y	88.7	161.7	1.3
			Electricity (total)	98.2	MWh/y	31.2		
		A	Crude-oil equivalent of fuel and electric power (total)				40.1+27.0 = 67.1 TOE /y	
		(A/B)×100	Energy conservation rate of the building					37.8%
Total of expected results: Case 3			Fuel (total)	48.3	KL/y	110.7	433.7	3.9
			Electricity (total)	61.6	MWh/y			
		A	Crude-oil equivalent of fuel and electric power (total)				41.9 +16.8=58.7 TOE/y	
		(A/B)×100	Energy conservation rate of the building					33.1%

(Note) Oil equivalent of electricity is 0.277 TOE/MWh, and that of diesel oil is 1.02 TOE/ton, , and 0.867 TOE/kilter, (B)=422.5*0.277/1,000+69,920*0.867/1,000=177.6 TOE/y

(2) The amount of the annual energy consumption, energy cost ratio and energy intensity of the building of outpatient in 2011

	Energy	Annual consumption		Conversion factor to primary energy		Energy consumption		Energy intensity per floor area		Annual cost (*1)	
1	Electricity	422,500	kWh	11.1	MJ/kWh	4,690,000	MJ	586.3	MJ/m^2	134,360	TL/y
2	Diesel oil	69,920	Liter	36.3	MJ/Liter	2,538,000	MJ	317.2	MJ/m^2	135,600	TL/y
3	Total					7,228,000	MJ	903.5	MJ/m^2	269,960	TL/y

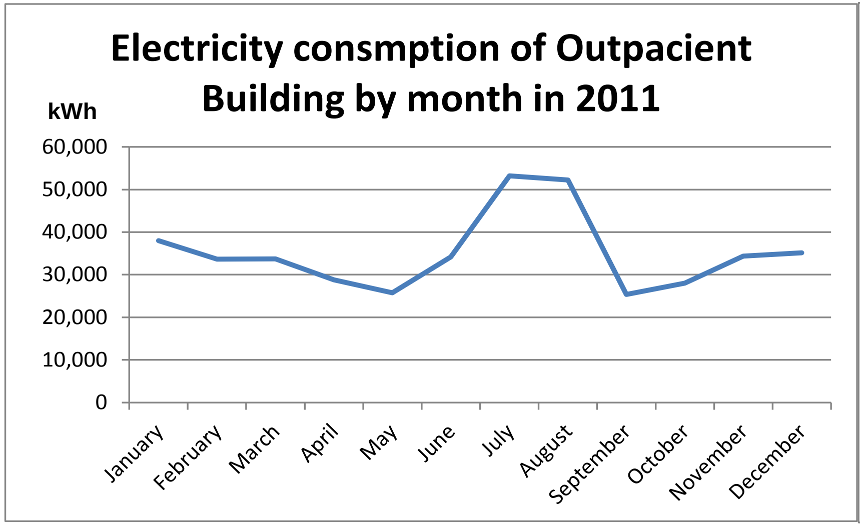
(Note) (*1) For unit price, 2012 price is applied, electricity:0.318TL/kWh, diesel oil: 1.94TL/liter

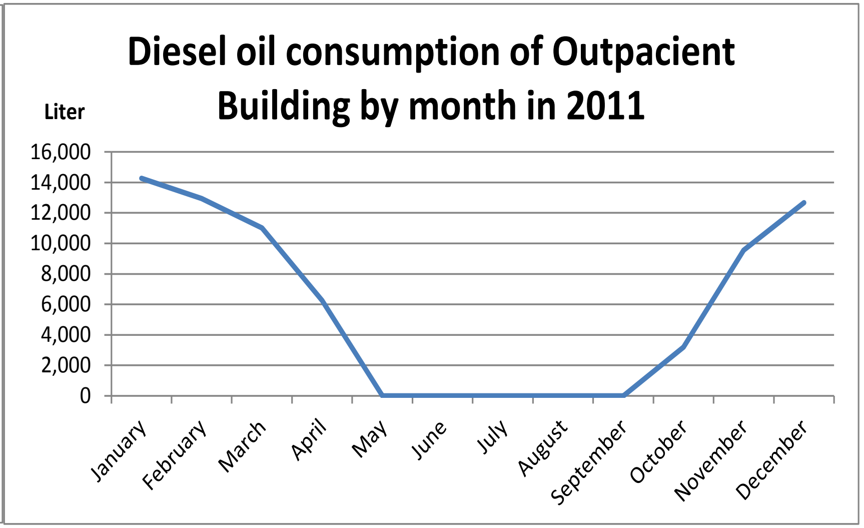


Energy consumption by month in 2011: Whole hospital

Energy type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electricity (kWh) Total	151,875	134,646	134,946	115,044	99,561	110,192	148,574	144,638	101,358	112,144	137,566	140,491	1,531,035
Electricity (kWh) Outpatient (*1)	37,975	33,667	33,742	28,766	25,774	34,163	53,243	52,246	25,344	28,041	34,397	35,129	422,488
LPG(kg) Main	333	333	333	333	333	333	333	333	333	333	333	333	4,000
LPG(kg) Engineering	4,765	4,331	4,303	1,976	0	0	0	0	0	120	3,073	4,404	22,972
LPG(kg) Total	5,098	4,664	4,636	2,309	333	333	333	333	333	453	3,406	4,737	26,972
Diesel oil (Liter) Main	34,290	35,860	34,180	24,220	11,200	7,470	6,140	5,640	6,560	18,650	35,230	36,780	256,220
Diesel oil (Liter) Outpatient	14,280	12,940	11,010	6,260	0	0	0	0	0	3,200	9,550	12,680	69,920
Diesel oil in total(Liter)	48,570	48,800	45,190	30,480	11,200	7,470	6,140	5,640	6,560	21,850	44,780	49,460	326,140

Note: (*1) Electricity consumption in outpatient building is estimated as 25% of the total electricity consumption of EM Hospital. In addition, electricity consumption of chiller is added to electricity consumption of outpatient building in summer season.

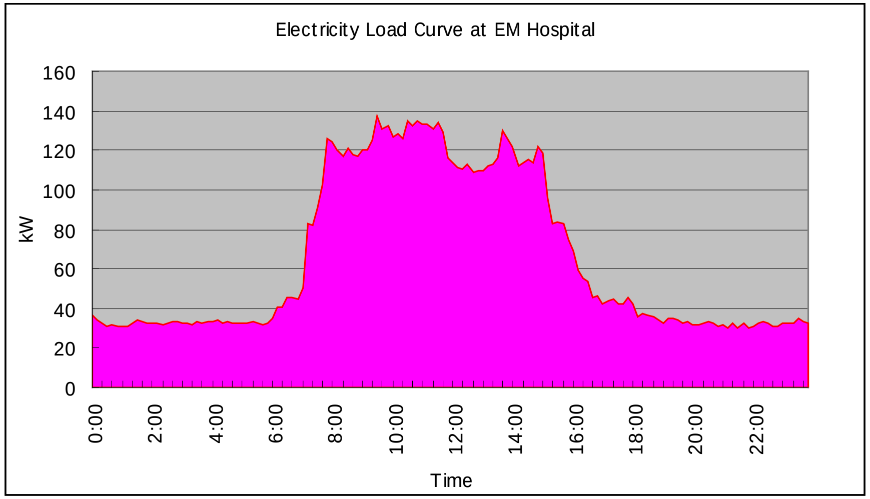




(3) Daily electricity consumption by hour

(3)-1 Winter season (Date: 6 December 2012)

Hour	1	2	3	4	5	6	7	8	9	10	11	12	
Electricity(kWh)	31.8	32.6	32.6	32.8	32.8	32.9	44.5	101.3	118.9	128.8	131.4	126.2	
Hour	13	14	15	16	17	18	19	20	21	22	23	24	Total
Electricity(kWh)	110.7	119.6	115.9	81.5	50.4	43.5	35.3	33.6	32.0	31.0	32.0	33.1	



Remarks

1. Energy price

1.1 Diesel oil: 2.22784TL/kg = 1.94 TL/liter (Specific weight = 0.85) in November 2012

1.2 Electric power: 0.318TL/kWh in 2012

Building energy conservation audit
Observation list (Detailed explanation of improvement and expected effects are indicated in attached sheet)

1. General management items

Check items and contents	The present condition and problems	Measures for improvement
1. Energy management system - Development of organizational structure and human resource education - Goals for energy conservation and investment budget - Establishment of management standards - Implementation status of energy conservation - Annual plans, and medium- and long-term plans - PDCA management cycle	Organization of energy management is established and General Manager, Mechanical Manager and Electrical manager are nominated for energy and environment management. Target of energy consumption is not decided. Environmental management meeting is held once 3 months. Sign boards of energy saving are installed on all the outlets and switches. Unnecessary lighting is switched off. All the lamps in the office room are switched off. All the personal computers are switched off at the completion of work. Elevators are stopped during night and off-day.	PDCA cycle is to be established. Target of energy conservation is to be established. Effects of energy management activity: Reduction of energy is 5% Fuel saving volume: = 69,920 * 0.05 = 3,500 L/y Fuel saving amount: = 3500 * 1.94= 6,800 TL/y Electricity saving volume: = 422.5 * 0.05 = 21.1 MWh/y Electricity saving amount: = 21.1 * 0.318 = 6,700 TL/y
2. Implementation status of measurement and recording - Status of installation of measuring equipment - Status of implementation of measurement and recording - Status of introduction of measurement and control systems	Fuel consumption is recorded every day. Flow meters of water of air-conditioning are not installed. Although electricity consumption is recorded everyday, not each building but the total of EM Hospital. Air ratio control unit is not installed. Lighting illumination and humidity are not regulated for buildings.	Measurement equipment are to be installed, and so energy management based on data analysis is to be implemented.
3. Management of energy consumption - Status of recording of daily reports - Daily consumption and daily load curve - Monthly consumption - Comparison with previous fiscal year	Energy consumption of heat and electricity is checked in the monthly meeting. Systematic energy data analysis is not implemented.	
4. Maintenance management of equipment - Periodical inspection and daily check - Cleaning of filters and strainers	Cleaning of strainer of water is implemented 2 times a year.	

Check items and contents	The present condition and problems	Measures for improvement
5. Management of specific energy consumption - Management of specific consumption (MJ/(m2-year)) - Management of specific consumption (1000 TL/(m^2-year))	Specific consumption is not checked	Specific consumption is to be compared with the other hospitals.
6. Building design and operation - Heat insulation properties of the structure - Heat insulation properties and air tightness of windows - Blocking of outdoor air	1) Insulation structure of building is good, which windows are double grazing type and wall is insulated with insulated material at exterior.	
	2) Many blinds of window are opened.	Energy saving of 0.5W/m2 by closing blind of windows Fuel saving volume = 1.8litter/ym2 * 500 = 900 liter/y Fuel saving amount: = 900 * 1.94 = 1,700 TL/y

2. Heat source and heat-conveying equipment

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Performance management of combustion equipment - Management of air ratio and exhaust gas - Burners, fuels, and ventilation systems - Combustion control devices - Fuel conversion (boilers, generators ,etc.)	2 sets of water boiler of capacity of 500,000 kcal/h for space heating are in operation from November to April. 1) Air ratio of water boiler is 2.2. Measurement device of oxygen conents of exhaust gas is not installed. 3) Combustion control of burner is made by air damper with servo motor according to fuel oil volume change.	1) Air ratio of water boiler is to be 1.3 from 2.2. Heat loss of exhaust gas is reduced by 4.2%. Fuel saving volume : 69,920 * 0.042 = 2,937 liter/y 2) Air damper of burner is adjusted by monitoring of oxygen contents (%) of exhaust gas with an oxygen analyser. An oxygen analizer is purchased. 3) Air damper control unit with oxygen analyser of Zirconia sensor is installed.	1) Fuel saving amount : 2,937 * 1.94 = 5,698 TL/y Investment cost: 6,000 TL (Purchase of 1 set of oxygen analyzer) Payback year: = 6000 / 5698 = 1.05 y
2. Performance management of refrigerating equipment - Coefficient of performance (COP) - Setting of chilled water outlet temperature - Setting of cooling water temperature - Descaling of heat exchange	1) Air-cooled chiller is installed and operated in summer season. COP of chiller is 2.07.	High efficient inverter air cooled chilling unit with COP 4.0 is to be installed at the timing of replacement.	

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
3. Operational management and efficiency management - Status of load factor and start-up/shutdown - Control of number of units - Heat efficiency, heat balance, and heat distribution	1) Reduction of operation hours of boilers Operation of boilers start at 6:20 AM, but temperature in office rooms doesn't rise until 8:30 AM.	1) Reduction of warming-up hour by 1 hour in the morning, because temperature of office room is not changed by 8:30. Start time is to be changed from 6:20 to at 7:20 Fuel saving volume: = 69,920*1/9 = 7,691 liter/y	1) Fuel saving amount: = 7,691 * 1.94 = 14,921 TL/y Investment cost: Free Payback year = 0 year
	2) Boiler operation pattern improvement Load factor of boilers are 52% and 55%, which shows lower efficiency Operation condition is not continuous but on-off operation. On-off operation is 5% lower than continuous operation in thermal efficiency	2) Continuous operation of 1 set of boiler, except for the coldest season such as January. Control of difference of water temperature between output and inlet of boiler is made. High load factor of boiler is to be kept within boiler capacity of 500,000 kcal/h Fuel saving volume: = 69,920*0.05 = 3,496 liter/y	2) Fuel saving amount: = 3,496 * 1.94 = 6,782 TL/y Investment cost: Free Payback year = 0 year
4. Operational management of auxiliary equipment - Operational control of cooling towers - Water quality management (electrical conductivity) - Operational control of pumps (water volume and pump head) - Improvement of routes	1) Cooling and heating system (Heat transmission system) a) Flow rate control - Damper of AHU (AC) is 100% open - Valve of piping for AHU is 100% open	1) Energy saving by reducing flow rate Refer to P18.	
	2) Insulation work of piping is almost good, but valves in the machine room are not insulated.	2) Enforcement of insulation of valves and pipes in the machine room Insulation work of valves of more than 65mm diameter Pack valves by insulation jackets Fuel saving volume: = 3994 * 2200h/y / 0.8 / 10200 = 1,077 kg/y = 1,267 L/y	2) Fuel saving amount: = 1,267 * 1.94 = 2,398 TL/y Investment cost: 2,400 TL for insulation work of 24 sets of valves Payback year: = 2400 / 2398 = 1 year

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
5. Operational management of heat-conveying equipment - Multiple unit control of pumps and fans - Control of rotation speed of pumps and fans - Status of opening and closing of valves (automatic valves, header bypass valves. etc.) - Flow rate and pressure - Improvement of routes (open and closed)	1) Variable speed control units are not installed in pumps and fans. 2) Flow-rate control of water and air is not implemented with valves. a) Thermal control of room temperature - All FCU have a thermal control unit	1) Energy saving by reducing flow rate Refer to P18	

3. Air-conditioning and ventilating facilities

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Operational management of air conditioners - Optimization of preset temperature and humidity - Appropriateness of humidified zones and methods - Appropriateness of reheating - Uneven distribution of temperature - Warm-up operation - Control of outdoor air intake volume - Review of operation hours - Switching-off of air conditioners in unused rooms - Outdoor air blocking	100% all fresh air intake and exhaust, no heat recovery. Effective heat for building heating and cooling is 23% of intake fresh air.	(Case1) Reduction of fresh air intake From 47,000m3/h to 30,000m3/h (36% Ventilation down) Fuel saving = 54,000 * 0.36 = 19,300 liter / year, Electricity saving of 35% for AHU by reduction of ventilation air volume by 36%= 47.5kW*0.35*2,200h/y = 36,600kWh/y	1) Fuel saving amount = 19,300 * 1.94 = 37,442 TL/y Electricity saving amount = 36,600 * 0.318 = 11,600TL/y Investment cost: Free (Refer to 2.2 a))

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
2. Reduction of fresh air intake and introduction of heat exchanger (HEX)	100% all fresh air intake and exhaust, no heat recovery. Effective heat for building heating and cooling is 23% of intake fresh air.	(Case2) Reduction of fresh air intake, introduction of HEX from 47,000m3/h to 20,000m3/h (57% Ventilation by AHU is down) Addition of Heat Exchanger (HEX) for ventilation: 500m3/h HEX (Efficiency 70%)* 20units, Fuel saving volume 27,400 liter / y Electricity saving volume of 70% for AHU by reduction of ventilation air of 57%:47.5kW*0.70*2,200h/y = 73,100kWh/y	2) Fuel saving amount = 27,400 * 1.94 = 52,000 TL/y Electricity saving amount = 73,100 * 0.318 = 23,200TL/y Investment cost: 49,900TL for 8 units of inverter, 5,000 TL/unit * 20 units = Total 100,000TL for HEX (Refer to 3.3.2 b)) Payback year: (49,900+100,000)/ (52,000+23,200)= 149,900/75,200 = 2.0 years
3. Replacement of AHU to heat recovery type	100% all fresh air intake and exhaust, no heat recovery. Effective heat for building heating and cooling is 23% of intake fresh air.	(Case3) Replacement of AHU 5 sets of AHU are replaced with new AHU of heat recovery type. Specifications and energy saving of new AHUs are shown in 2.2 c)	3) Energy saving amount: 66,000 TL / y Investment cost: 421,530 TL Payback year: 421,530/66,000 = 6.4 years
4. Introduction of energy-saving equipment - Control of heat-conveying speed (VAV.VWV) - Outdoor air intake control systems - Installation of total heat exchangers	100% all fresh air intake and exhaust, no heat recovery. Effective heat for building heating and cooling is 23% of intake fresh air.	1) Energy saving by installing VAV and VWV Refer to P18.	

4. Hot water supply, feed water and drainage, freezing, refrigerating, and kitchen equipment

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Management of hot water Supply equipment - Hot water supply temperature - Improvement of hot water supply efficiency (descaling, etc.) - Use of solar heat	Hot water is supplied from 1-set of heat exchanger with hot water of water boilers in winter season.		

5. Power receiving/transforming facilities, lighting and electrical system

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Management of power receiving/transforming facilities - Adjustment of electrical voltage - Management of power factor - Transformer capacity - Control of improvement of power factor - Low-loss transformers - Multiple unit control of transformers	1) Receiving transformers are supplied by electric distribution company. 2) Power factor control is implemented.		
2. Management of lighting systems - Management of optimum illumination - Turning off the lights during unnecessary time (use of daylight, etc.) - Cleaning and change of lighting apparatus - Mounting position of lamp fitting, and circuit partitioning - Darkening and extinction by automatic dimming control system - Local lighting - Use of energy-saving fluorescent tubes - Improvement of utilization factor (reflectance ratio) - Management of outdoor light - Turning off night-time guide light	Luminance survey was conducted (Refer to 3.4.1) - Lightings are turned off at unnecessary area - Some lighting circuits are separated Lighting equipment - CFLs (energy saving lamps) are used 1) Lightings with magnetic ballast are used	1) Reduction of ballast loss of fluorescent lamp Replacement of magnetic ballast with electronic ballast Electricity consumption of lamps = 4*18W type (80W)*100units + 2*36W type (80W)*32units =10.56kW Electricity saving rate by change of ballast = 10% Electricity saving volume: = 10.56kW*1,980h/y*0.1 = 2,091kWh/y	1) Electricity saving amount = 2,091 * 0.318 = 665 TL/y Investment cost: 3,267 TL for 132 sets of ballast Payback year: = 3,267 / 665 = 4.9 years

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
- Use of high efficiency lamps	2) Motion sensor at WC - Motion sensor is installed at WC, but lightings are kept turned on	2) Effective use of motion sensor for WC Changing set value of motion sensor for WC Electricity consumption of lamps: = 18W CFL*5 + 36W fluorescent lamp*24WC=3.12kW Electricity saving rate by change of set = 30% Electricity saving volume: 3.12kW*1,980h/y*0.3 = 1,853kWh/y	2) Electricity saving amount = 1,853 * 0.318 = 589TL/y Investment cost: Free Payback year: 0 year

6. Elevators

Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Operational management of elevators - Use of inverter control	1) Inverter control is used. 2) Operation control is not implemented.		

7. Others

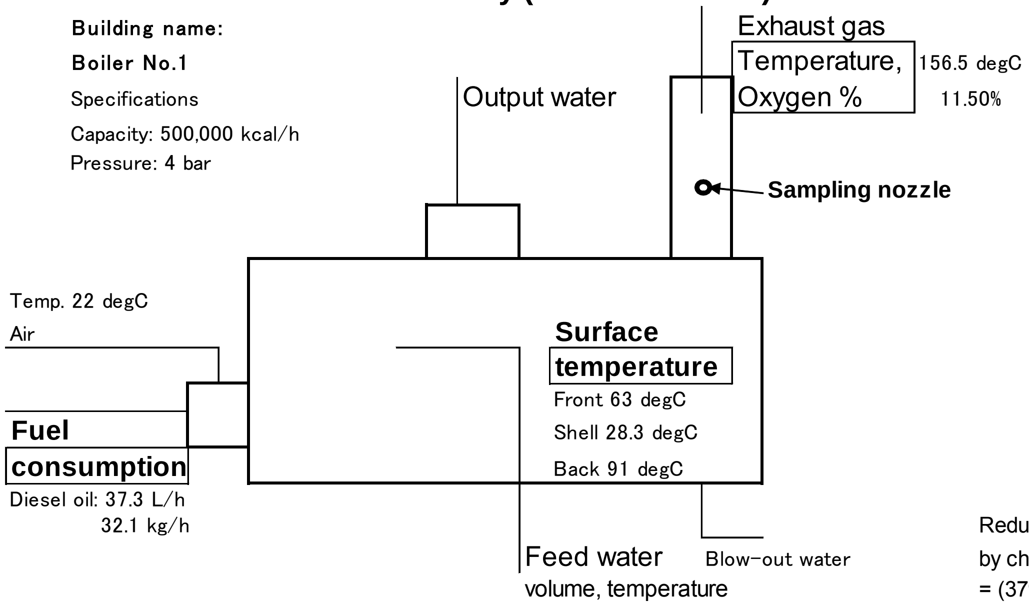
Check items and contents	The present condition and problems	The measure against improvement, and the expected effect per year (kliter, kWh, TL)	
1. Load leveling measures - Review of operation forms (operation hours, operating rate, load factor, etc.)	Demand contract is not necessary for public buildings.		
2. Co-generation/tri-generation - Operational management (dependence rate, power generation efficiency, utilization rate of waste heat, total efficiency, etc.)	Co-generation/tri-generation equipment is not installed.	Not effective Refer to P24	
3. Renewable energies - Fuel cells- Photovoltaic power generation - Solar heat- Wind power generation - Installation of heat pump system	Renewable energy is not used.	1) Installation of 100kW PV system on the roof top Annual power generation = 143,000kWh/y (Refer to P25)	1) Reduction of electricity purchasing = 143,000 * 0.318 =45,500TL/y Investment cost: 1,100,000 TL for 100kW PV system Payback year: = 1,100,000 / 45,500 = 24 years
		2) Installation of Heat pump hot water and cold water supply system Heat pump hot water and cold water supply system is installed instead of the existing air-cooled chiller and water boiler. Assumption: 55^0C of hot water is applicable for heating system Effects: COP (Heating): from 0.79 of water boiler to 3.03 of Heat pump system COP (Cooling): from 2.07 of air-cooled chiller to 5.82 of Heat pump system 65,131liter/y of diesel oil is saved, 143,669kWh/y electricity is increased	2) Benefit: 80,667TL/y Investment cost: 1,322,222TL for 595kW capacity of heat pump system Payback year: = 1,322,222 / 80,667 = 16.4 years

Referential Information

1. Boiler

1.1 Air ratio improvement

Water boiler thermal efficiency (Indirect method)



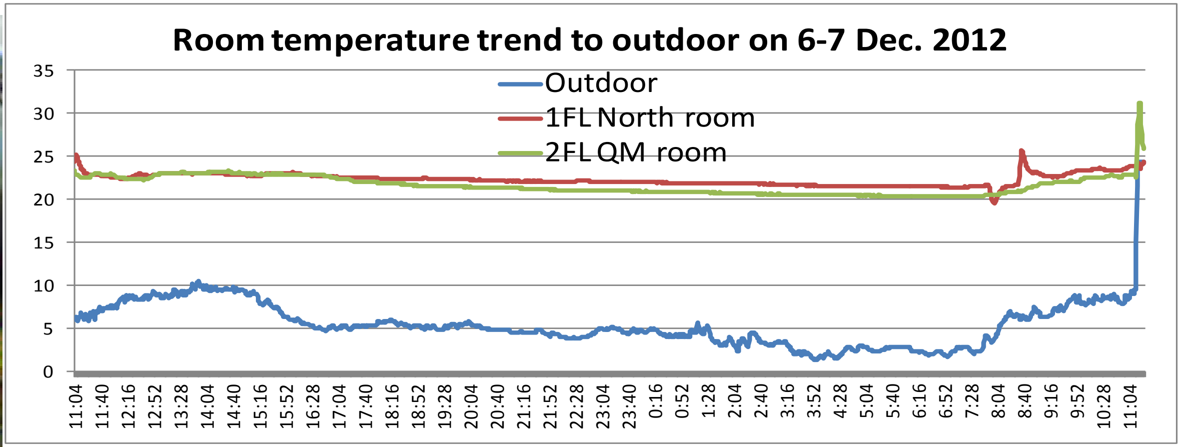
Reduction of exhaust gas heat loss
by change of air ratio 2.2 to 1.3
= (37900 - 23189) / 350404 * 100
= 4.2%

1	Input heat			Equation
a	**Fuel combustion heat**	**350,404**	**kcal/h**	= b * c
b	Fuel heat value	10,916	kcal/kg	
c	Fuel consumption	32.1	kg/h	
d				

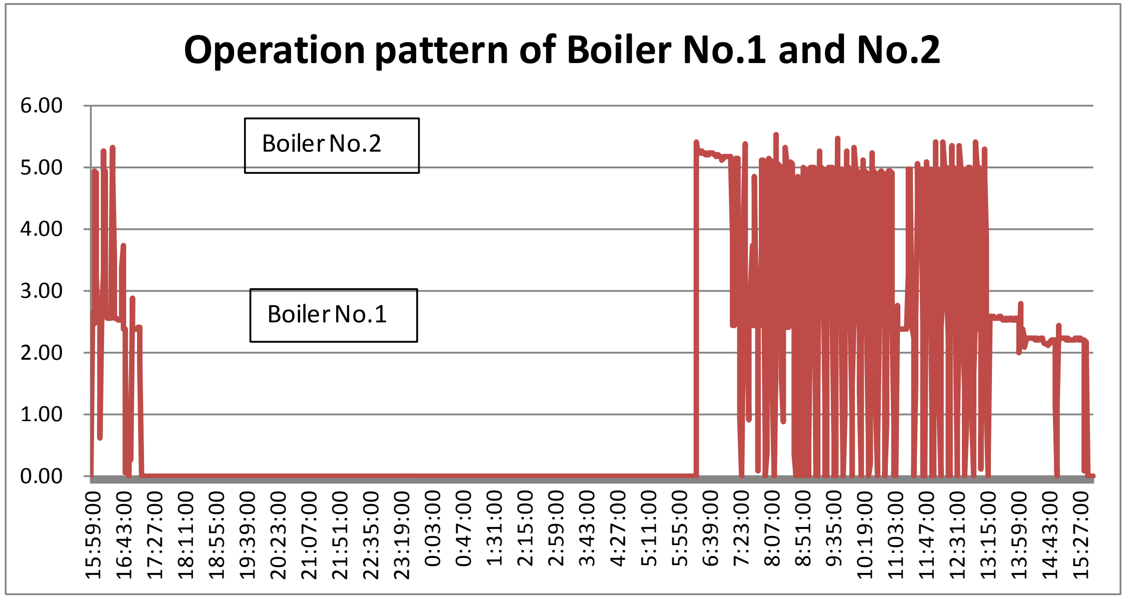
2	Heat loss	m=2.2		m=1.3	
e	**Exhaust gas heat loss**	**37,900**	**kcal/h**	**23,189**	**kcal/h**
f	Theoretical gas volume	13.3	m3N/kg	13.3	m3N/kg
g	Theoretical air volume	12.2	m3N/kg	12.2	m3N/kg
h	Excess air ratio	2.20		1.31	
i	Specific heat of ex. gas	0.315	kcal/m3NC	0.315	kcal/m3NC
j	Actual exhaust gas vol.	27.87	m3N/kg	17.05	m3N/kg
k	Exhaust gas heat loss	1,181	kcal/kg	722	kcal/kg
l	**Radiation heat loss**	**2,472**	kcal/h	**2,472**	kcal/h
m	Convection heat loss	1,212	kcal/h	1,212	kcal/h
n	Emission heat loss	1,260	kcal/h	1,260	kcal/h

1.2 Improvement of operation pattern of water boiler

Reduction of operation hours of water boiler



2 sets of boiler start operation at 6:20 AM, but room temperature doesn't rise.



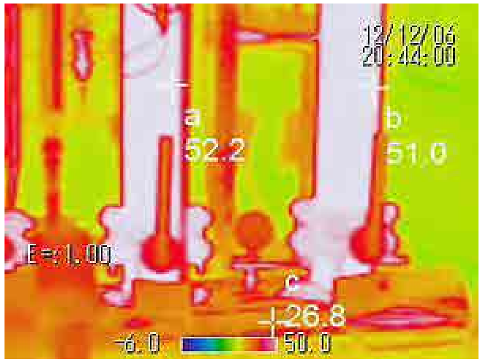
2 sets of boiler are in on-off operation.

1.3 Enforcement of Insulation of valves

Insulation of valves

Date of measurement: 2012/12/7

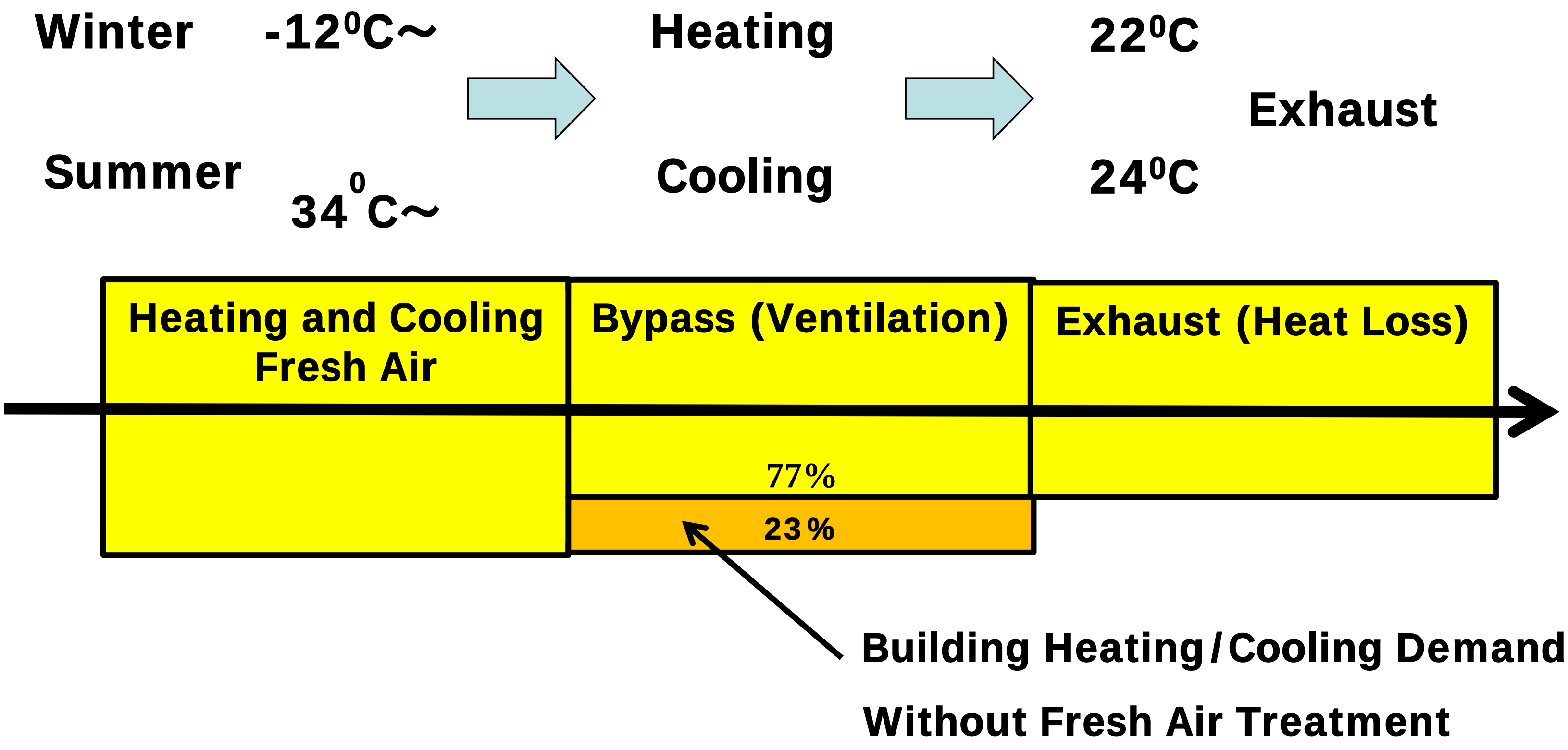
No.	Equipment name	Pipe size	Quantity	Surface temperature	Un-insulated length	Heat loss after insulation		Heat loss at un-insulation		Saving
				deg C	m	kcal/h/m	kcal/h	kcal/h/m	kcal/h	kcal/h
1	Boiler output valve	125A	2	55	1.4	25.9	73	182	510	437
2	Boiler input pipe	125A	2	52	1	25.9	52	182	364	312
3	Return water header valve	150A	2	52	1.5	30	90	214	642	552
4	Return water header valve	125A	1	52	1.4	25.9	36	182	255	219
5	Return water header valve	80A	1	52	1.25	17.8	22	122	153	130
6	Valve to AHU 1 to 5	125A	2	55	1.4	25.9	73	182	510	437
7	Fan coil (North, Center, South)	80A	6	55	1.25	17.8	134	122	915	782
8	Valve to Toilet	80A	2	55	1.25	17.8	45	122	305	261
9	Hot water valve	125A	2	55	1.4	25.9	73	182	510	437
10	Cooler header valve	125A	15	10	1.4	7.2			0	0
11	Cooler header valve	150A	6	10	1.5	8.4			0	0
12	AHU 1 to 4 valve	65A	4	55	1.23	15.1	74	102	502	428
13	Total		45				670		4664	3994



2. Air-conditioning and ventilating facilities: Fresh air intake reduction

2.1 Present condition

(1) 100% all fresh air intake and exhaust, no heat recovery >> Waste of energy and money



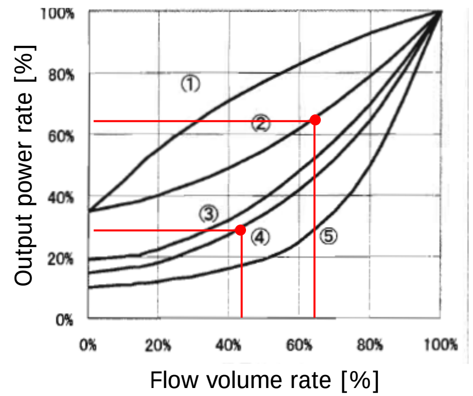
Heating: （Supply） 47,000m3/h *0.28kcal/m3 ^{0}C*(22-(-12)) ^{0}C * 1.2(loss)*8,760h/y*0.1/10,200kcal/kg*(1l/0.85kg)=54,000L/y
= 77% of total heating load,
Fuel cost = 54,000 * 1.94 = 105,000TL/y
(Exhaust) 40,000m3/h * 24 ^{0}C
Cooling: (Supply) 47,000m3/h*0.28kcal/m3 ^{0}C *(34-24) ^{0}C * 1.1*8,760*0.075/2.0(COP)/(860kcal/kWh) = 55,000kWh/y
(Exhaust) 40,000m3/h * 26 ^{0}C
Operating electricity: 40kW*10h*220day = 88,000kWh/y
Electricity consumption in total = 55,000 + 88,000 = 143,000kWh/y,

Electricity cost = 143,000 * 0.318 = 45,000TL/y

		
Damper of AHU (AC) is 100% open → Energy saving by reducing flow rate	Valve of piping for AHU is 100% open → Energy saving by reducing flow rate	Existing COP: 2.07 → High efficient HP chiller can save energy

2.2 Energy conservation measures

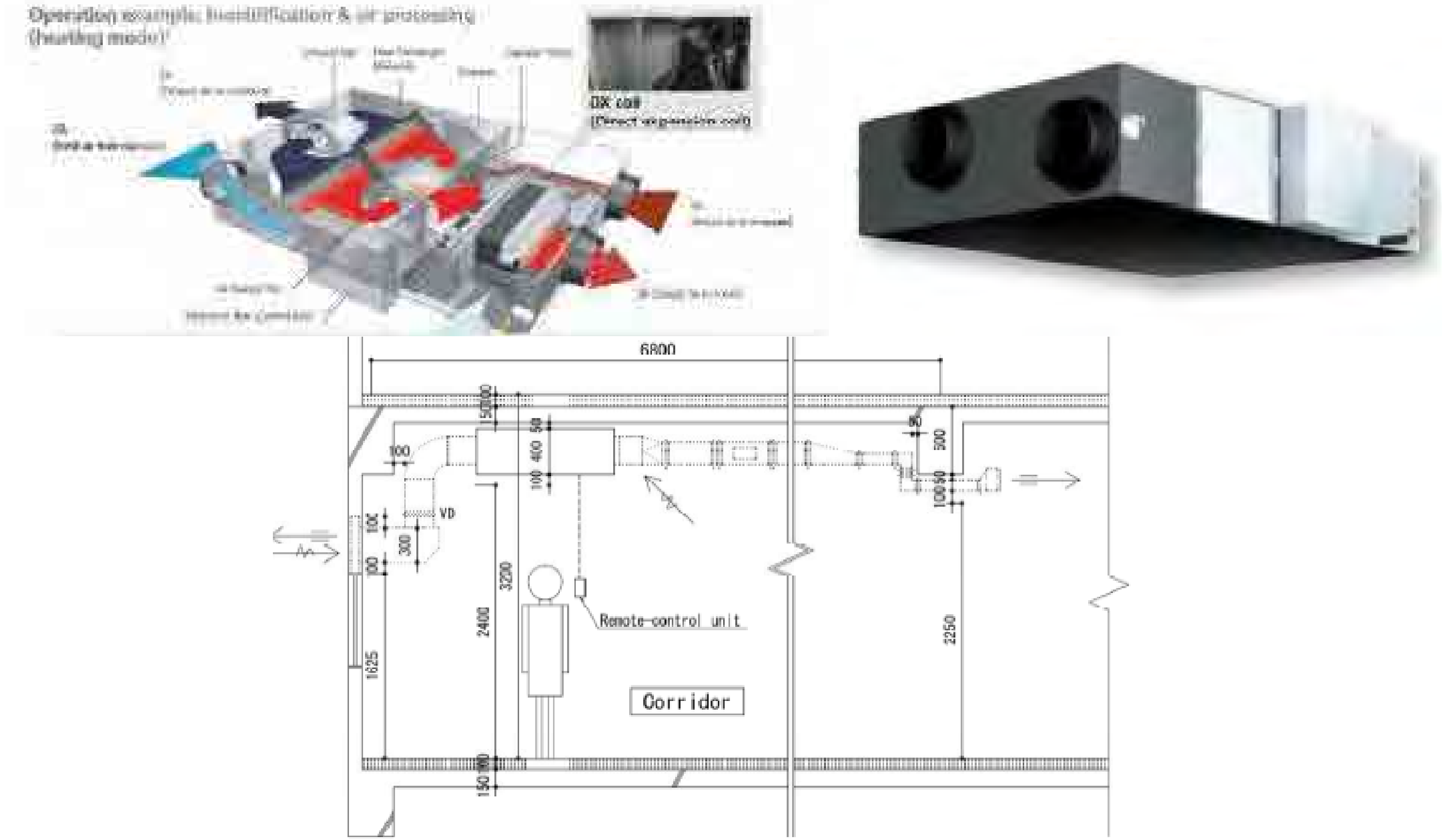
a) Reduce OA (fresh air) volume for air conditioning (Case 1)
Fresh air needed: 200-500 persons*30m3/h = 6,000-15,000m3/h << 47,000m3/h at present
Reduction of fresh air intake through AHU
From 47,000m3/h to 30,000m3/h (36% Ventilation down)
Fuel saving by reduction of heating and cooling demand or introducing more detailed control system for hot water, chilled water and air
= 54,000 * 0.36 = 19,300 liter / year
Fuel saving amount = 19,300 * 1.94 = 37,442 TL/y
Electricity saving of 35% for AHU by reduction of ventilation air volume by 36%:
= 47.5kW*0.35*2,200h/y = 36,600kWh/y
Electricity saving amount = 36,600 * 0.318 = 11,600TL/y
Investment cost: Free
(Damper operation system of AHU might be need to change)



b) Reduction of fresh air intake through AHU and introducing small heat exchanger (heat recovery system) (Case 2)
Reduction of fresh air intake through AHU from 47,000m^3/h to 20,000m^3/h
(57% Ventilation by AHU is down)
Addition of Heat Exchanger (HEX) for ventilation: 500m3/h HEX (Efficiency 70%)* 20units,
Fuel saving volume 27,400 liter / y

Fuel saving amount = 27,400 * 1.94 = 52,000 TL/y

Electricity saving volume of 70% for AHU by reduction of ventilation air of 57%:
47.5kW*0.70*2,200h/y = 73,100kWh/y
Electricity saving amount = 73,100 * 0.318 = 23,200TL/y
Investment cost: 49,900TL for 8 units of Inverter, 5,000 TL/unit * 20 units = Total 100,000TL for HEX
Payback year = (49,900+100,000) / (52,000 + 23,200) = 149,900 / 75,200 = 2.0 years



Heat Exchanger (HEX) for Ventilation

c) Replacement of Air handling unit (AHU) (Case 3)
5 sets of AHU are replaced with new AHU of heat recovery type.
Specifications and energy saving of new AHUs are shown in the following table
Energy saving amount: 66,000 TL / y, 69,920liter* 0.42=29.4kliter/y, 47,500kW*0.35*2,200h/y=36,600kWh/y

Investment cost: 421,530 TL
Simple payback = 421,530 / 66,000 = 6.4 years

				Actual AHU		New AHU			
Actual AHU	New AHU	Ventilation flow (m3/h)	Exhaust air flow (m3/h)	Cooling capacity (kcal/h)	Heating capacity (kcal/h)	Cooling capacity (kcal/h)	Heating capacity (kcal/h)	Cooling conservation (kcal/h)	Heating conservation capacity (kcal/h)
AHU-1 EF-1	GOLD RX-30	10,000	9,000	55,000	105,000	35,000	55,000	20,000	50,000
AHU-2 EF-2	GOLD RX-30	10,000	9,000	55,000	105,000	35,000	55,000	20,000	50,000
AHU-3 EF-3	GOLD RX-30	10,000	9,000	55,000	105,000	35,000	55,000	20,000	50,000
AHU-4 EF-4	GOLD RX-05	2,000	1,800	25,000	30,000	18,000	20,000	7,000	10,000
AHU-5 EF-5	GOLD RX-40	15,500	14,000	55,000	105,000	37,000	75,000	18,000	30,000
Total				245,000	450,000	160,000	260,000	85,000	190,000

Invesment of new situation

ACTUAL AHU	Heat Recovery Heating&Cooling Next AHU	Price Of Product(Euro)	Price Of Workers and other equip. (Euro)			
AHU1- EF1-	GOLD RX-30	27.000,00	2.000,00			
AHU2- EF2-	GOLD RX-30	27.000,00	2.000,00			
AHU3- EF3-	GOLD RX-30	27.000,00	2.000,00			
AHU4- EF4-	GOLD RX-05	21.800,00	2.000,00			
AHU5- EF5-	GOLD RX-40	42.520,00	2.000,00			
	TOTAL	145.320,00	10.000,00			
	%18 KDV	26.157,60	1.800,00			
	G.TOTAL	171.477,60	11.800,00	183.277,60	421.538	TL

3. Lighting facilities
3.1 Present condition

Survey for illuminance in the EM Hospital

Building	Floor	Place (Office room, Corridor, etc.)	Illuminance [lx]	Measured height from floor [cm]	Notes (Main lamp equipment etc.)
Outpatient	Z	Corridor	80	15cm	FL 18W*4
Outpatient	Z	WC	105	15cm	CFL 18W
Outpatient	Z	Blood inspection room	350	75cm	FL 18W*4
Outpatient	Z	Storage room of medicine	200	75cm	FL 18W*4
Outpatient	1	Entrance (Lighting is turned off)	130	15cm	CFL 18W
Outpatient	1	Entrance (Lighting is turned on)	440	15cm	CFL 18W
Outpatient	2	Office room (Lighting is turned off)	240	75cm	FL 18W*4
Outpatient	2	Corridor	250	15cm	CFL 18W

Turkish illuminous standard for Hospital
Work table: 400lx
General lighting: 150lx
WC: 50lx
Waiting room: 100lx
Conference room: 200lx
Cafeteria: 150lx

		
Lightings are turned off at unnecessary areas	Some lighting circuits are separated → Easy to select the lighting area	CFLs (energy saving lamps) are used
		
Lightings with magnetic ballast are used → Electronic ballast is more energy saving.	All FCU have a thermal control unit	Motion sensor is installed at WC, but lightings are kept turned on

4. Other energy conservation/ renewable measures

<u>Ref. 1 Replacement of Fluorescent lamp into LED (In priority to long operation area)</u>

Effects:

Existing Fluorescent lamp: 4 * 18W type (80W) * 100units, 2 * 36W type (80W) * 32units=10.56kW
→ 49% energy can be saved by installing LED
Electricity saving volume = 10.56kW * 1,980h/y * 49% = 10,581kWh/y
Electricity saving amount = 10,581 * 0.318 = 3,365TL/y
Investment cost: 41,867TL for 464units of LED lamps
Simple payback = 41,867 / 3,365 = 12.4 years

Ref. 2 Trial calculation to introduce tri-generation system

Checked by thermal demand/ electricity demand ratio:
Heating: 1,000,000kcal/h / (550 kW * 860kcal/kWh) = 2.0
Cooling: 436kW*2/ 550kW =1.8
Middle season: 0.0

Monthly Efficiency of tri-generation (Power, heat and chilled water supply)

Month	1	2	3	4	5	6	7	8	9	10	11	12
H/P ratio	2.0	2.0	1.5	0.0	0.0	0.5	1.8	1.8	0.5	0.0	0.5	1.5
Efficiency (%)	60	60	50	20	20	30	50	50	30	20	30	50

- Expected annual average total efficiency of tri-generation is 40% -45%
- Besides existing system efficiency is:

Power: 32.5% for 130kW*8760*0.4h*860kcal/kWh
Heating: 70% for 350,000,000kcal
Cooling: 32.5%*2.0 (COP)=65% for 60,000kWh*860kcal/kWh
Total efficiency is around 45%

>> Introducing tri (co)- generation is expected to be not effective

Ref. 3 Introducing 100kW PV system on the roof top

		Jun	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Global solar radiation	[kWh/m2/day]	1.75	2.16	4.27	5.62	6.05	7.83	7.54	6.82	5.89	3.81	2.31	1.96
Solar radiation (tilted 12deg.)	[kWh/m2/day]	2.11	2.45	4.74	5.87	6.06	7.70	7.49	7.04	6.52	4.51	2.86	2.53
Average temp.	[Deg.]	-2.46	-0.86	2.91	13.04	16.07	22.52	26.75	23.41	22.15	16.54	8.10	1.80
Power generation	[kWh/month]	5,086	5,798	12,228	14,059	14,795	17,675	17,413	16,619	14,994	10,979	6,984	6,568

$E_{pm} = C * P_{AS} * H_{AM} / G_s$

E_{pm}: Monthly energy production (kWh)
C: Monthly Basic design Coefficient
P_{AS}: Regulated output of modules under normal testing condition (kW)=100kW
H_{AM}: Monthly summation of solar radiation (kWh/m2/month)
G_s: Regulated solar radiation for normal testing condition (kW/m2)=1kW/m2

$C = C' * C_{pt}$

C': Basic design Coefficient=0.756
C_{pt}: Temperature Correction Co-efficient for each month

Annual power generation = 143,000kWh/y
Electricity saving amount = 143,000 * 0.318 = 45,500TL/y
Investment cost: 780,000TL for 100kW PV system on the roof top
Payback year = 780,000 / 45,500 =17 years

Ref. 4　Installation of heat pump hot water and cold water supply system

Existing system

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Outside air	Min temp.	℃	-4.0	-3.0	-1.0	4.0	8.0	12.0	15.0	15.0	10.0	6.0	1.0	-1.0	
	Max temp.	℃	4.0	6.0	11.0	17.0	22.0	26.0	30.0	30.0	26.0	20.0	11.0	6.0	
	Average temp.	℃	0.0	1.5	5.0	10.5	15.0	19.0	22.5	22.5	18.0	13.0	6.0	2.5	
Hot water	Supply hot water temp.	℃	55.0	55.0	55.0	55.0						55.0	55.0	55.0	
	Return hot water temp.	℃	50.0	50.0	50.0	50.0						50.0	50.0	50.0	
Cold water	Supply cold water temp.	℃					8.0	8.0	8.0	8.0	8.0				
	Return cold water temp.	℃					12.0	12.0	12.0	12.0	12.0				
Water boiler	Diesel consumption	L/month	13,566	12,293	10,460	5,947						3,040	9,073	12,046	66,424
	Heat value	kcal/L	8,670	8,670	8,670	8,670						8,670	8,670	8,670	
	Boiler efficiency		0.79	0.79	0.79	0.79						0.79	0.79	0.79	
	Heating load	kW.h/month	108,044	97,905	83,303	47,364						24,211	72,256	95,938	
	Fuel cost	TL/month	26,318	23,848	20,291	11,537						5,898	17,601	23,369	128,863
Chiller	Electricity consumption	kWh/month					1,173	8,815	21,459	21,442	0				52,889
	COP						2.07	2.07	2.07	2.07					
	Cooling load	kW.h/month					2,432	18,276	44,490	44,455	0				
	Electricity cost	TL/month					373	2,803	6,824	6,819	0				16,819

Proposed system

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Outside air	Min temp.	℃	-4.0	-3.0	-1.0	4.0	8.0	12.0	15.0	15.0	10.0	6.0	1.0	-1.0	
	Max temp.	℃	4.0	6.0	11.0	17.0	22.0	26.0	30.0	30.0	26.0	20.0	11.0	6.0	
	Average temp.	℃	0.0	1.5	5.0	10.5	15.0	19.0	22.5	22.5	18.0	13.0	6.0	2.5	
Hot water	Supply hot water temp.	℃	55.0	55.0	55.0	55.0						55.0	55.0	55.0	
	Return hot water temp.	℃	50.0	50.0	50.0	50.0						50.0	50.0	50.0	
Cold water	Supply cold water temp.	℃					8.0	8.0	8.0	8.0	8.0				
	Return cold water temp.	℃					12.0	12.0	12.0	12.0	12.0				
Heat pump system	Heating capacity	kW	467.6	489.7	543.4	625.8						625.8	560.5	504.4	
	Cooling capacity	kW					686.7	686.7	686.7	686.7	686.7				
	Power consumption	kW	174.3	176.1	180.4	185.5	118.0	118.0	118.0	118.0	118.0	185.5	181.5	177.4	
	Full load operation hours	h	219.5	190.0	153.3	75.7	3.5	26.6	64.8	64.7	0.0	38.7	128.9	190.2	
	Electricity consumption	kWh/month	38,260	33,458	27,648	14,040	418	3,139	7,642	7,636	0	7,177	23,404	33,738	196,558
	Electricity cost	TL/month	12,167	10,640	8,792	4,465	133	998	2,430	2,428	0	2,282	7,442	10,729	62,506
Water boiler	Load apportionment rate	%	5	5	0	0						0	0	0	
	Diesel consumption	L/month	678	615	0	0						0	0	0	1,293
	Heat value	kcal/kg	8,670	8,670	8,670	8,670						8,670	8,670	8,670	
	Boiler efficiency		0.79	0.79	0.79	0.79						0.79	0.79	0.79	
	Heating load	kW.h/month	5,402	4,895	0	0						0	0	0	
	Fuel cost	TL/month	1,316	1,192	0	0						0	0	0	2,508

○Effects

													Total
Cost reduction	TL/month	12,835	12,016	11,499	7,073	240	1,805	4,394	4,390	0	3,615	10,158	12,641	80,667

○Investment cost

Investment cost per cooling capacity	1,700	TL/kW	Diesel unit price	1.94	TL/L
Investment cost	1,011,500	TL/kW	Electricity unit price	0.318	TL/kWh

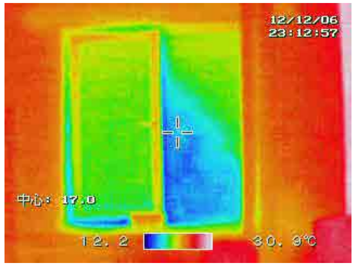
○Payback period

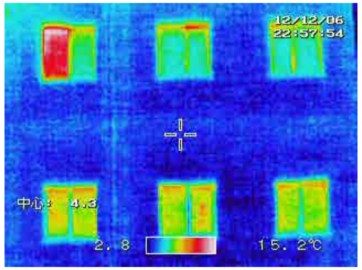
12.5 years

Cooling/Heating capacity 595 kW

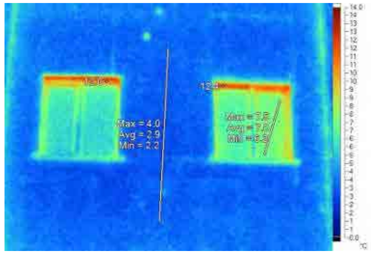
Ref. 5 Points for building wall and windows

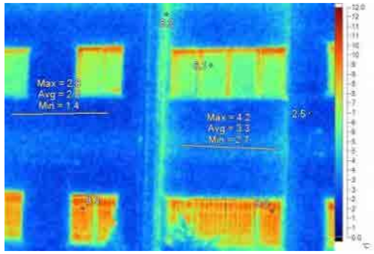
a) Some windows are opened to cool down the room temperature or for smoking





b) Upper part of windows, some leek of indoor air





c) A lot of windows' blinds are kept open in winter time

Annex 7

EE&C Technologies in Turkey

Annex 7 EE&C Technologies in Turkey

The following photos show the present conditions of Turkish typical buildings by technology.

(1) Building design (Insulation & sunshade, utilization of natural light with pair-and reflective glass and insulated sash, utilization of natural wind, etc.)

Figure 7-1 Sunshade, High Insulated Wall and Reflective Glass

Figure 7-2 Wide Windows with High Insulated Glasses & Utilizing Natural Wind

Figure 7-3 Solar Duct (Utilizing Sun Light)

Figure 7-4 Low-e Pair Glasses

Figure 7-5 High Insulated Wall Panel

Figure 7-6　Low-e Pair Glasses with Insulated Sash

Figure 7-7　Insulation for Valves and Pipes

Figure 7-8　Insulation for Hot Water Tank

(2) AC (high efficiency, inverter, VRF)

Figure 7-9　MENR Building

Figure 7-10　MOF Buildings

Figure 7-11　Environment Prevention Office

Figure 7-12　High School

Split type non-inverter ACs are partially installed. COP of these ACs ranges as low as 2.5 - 3.0 range.

(3) Lighting (high efficiency; LED, CFL, T8/T5, reflector, electronic ballast, etc.)

Figure 7-13 LED Lighting

Figure 7-14 T5 FL with Reflector

Figure 7-15 Reflector Lighting with Utilization of Sun Light

(4) Co (Tri)-generation with absorption chiller

Figure 7-16 Gas Co-Generation

Figure 7-17 Absorption Chiller (YAZAKI)

(5) Building energy management system (BEMS) & sensors

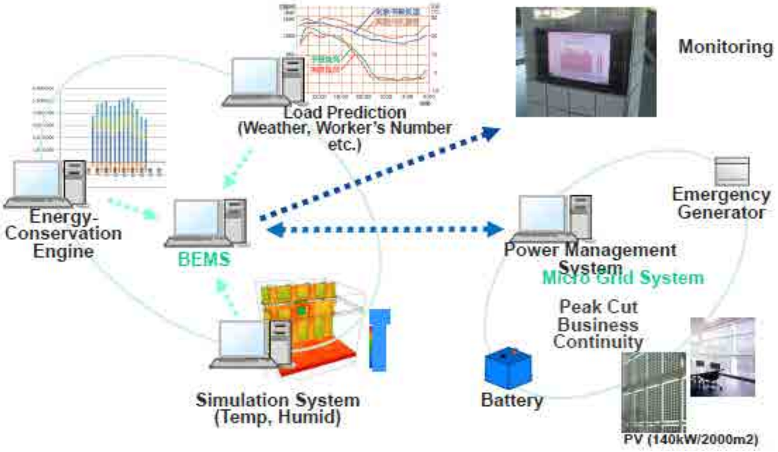


Figure 7-18 Image of BEMS

Figure 7-19 Automatic Control Sensors

Motion sensors are very popular in Turkey, in some sense more popular than in Japan.

(6) High efficient office equipment (PC, printer, etc.)

Figure 7-20 Inefficient Office Equipment

Conversion from inefficient office equipment, such as CRT PCs, old printers to new and high efficient ones reduces the cooling load.

Annex 8

AC (Air Conditioner) Field Test

ANNEX 8 AC (Air Conditioner) Field Test

1. Purpose of AC Field Test

For air conditioners (ACs), which are the most electricity consuming equipment in buildings, the field test of measuring electricity consumption in the actual offices in Istanbul was carried out. The purposes of this field test are as follows;

a) Electricity consumption of inverter ACs and non-inverter ACs is measured in the actual offices. Compared with both consumption data, energy saving by introduction of inverter ACs is clarified (Visualization of the energy saving effect).

b) The necessity of introducing SPF and APF, which will be applied worldwide as ISO 16358 in 2013, is recognized (For the details of SPF and APF, refer to Background Information at the end of this Annex 8).

2. Outline of AC Field Test

(1) Selected ACs

Considering the size and heat load of rooms targeted for AC field test, inverter and non-inverter ACs, which have approximately-same EER (for cooling) and COP (for heating), are selected. (See to Table 8-1)

Table 8-1 Specification of Selected ACs

Type	Cooling Capacity		Heating Capacity	
	kW	EER	kW	COP
Inverter AC	3.5kW	3.21	4.0kW	3.62
Non-inverter AC	3.52kW	3.21	3.7kW	3.63

(2) Measurement Period

Measurement period for cooling; From 31st of July 2012 to 2nd of October 2012

General cooling period in Istanbul is from June to September. This time, measurement has been conducted in half period for general cooling period.

Measurement period for heating; From 3rd of December 2012 to 4th of January 2013

Data was collected for the limited period, about 1 month, in order to complete the report at the end of January.

(3) Measured Items

Measured items are electricity consumption of AC and temperature and humidity in the rooms and outdoor.

(4) Measured Rooms

Two office-rooms for research assistants in the Istanbul Technical University (ITU), which are same size and located next to each other, were selected as the measured rooms. (See Figure 8-1 and -2)

Figure 8-1 Room No.1

Figure 8-2 Room No.2

(5) Measurement System

Network Analyzer, which is made in Turley, is used for measurement of electricity consumption of AC. Outline of Network Analyzer is shown in Figure 8-3. Schematic of AC field test is shown in Figure 8-4.

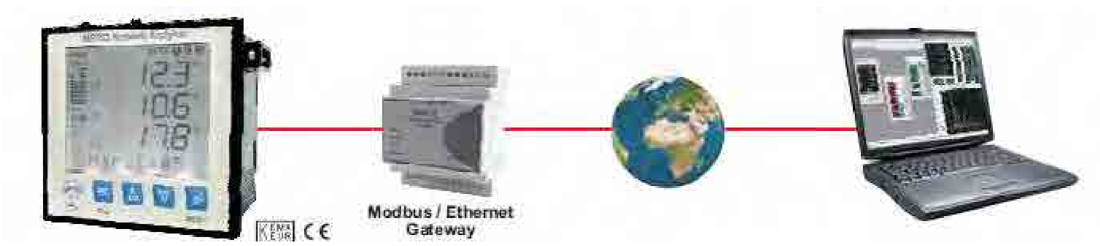


Figure 8-3 Outline of Network Analyzer

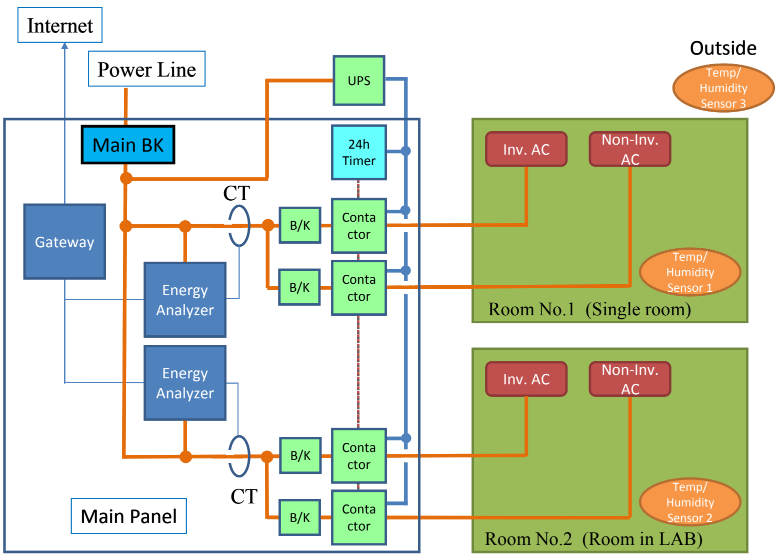


Figure 8-4 Schematic of AC Field Test

(6) Measurement Method

Method of field test is described in below.

- Inverter AC and non-inverter AC should be changed by using timer every day
- Inverter AC should be operated in the room No.1, when non-inverter AC is operated in the room No.2. Inverter AC should be operated in the room No.2, when non-inverter AC is operated in the room No.1.
- Data should be collected in one minute.
- Default value of set temperature is 27 degree. When changing the value, the temperature should be recorded.

3. Turkish Climate

In accordance with TS 825 Standard, Istanbul belongs to the 2nd region, which is "moderate". (See Figure 8-5)

Figure 8-5 Four Regions in Turkey according to TS 825

Table 8-2 shows the monthly average temperature values for 4 regions of TS 825.

Table 8-2 Monthly Average Temperature Values for 4 Regions (°C)

	1st Region	2nd Region	3rd Region	4th Region
January	8.4	2.9	-0.3	-5.4
February	9.0	4.4	0.1	-4.7
March	11.6	7.3	4.1	0.3
April	15.8	12.8	10.1	7.9
May	21.2	18.0	14.4	12.8
June	26.3	22.5	18.5	17.3
July	28.7	24.9	21.7	21.4
August	27.6	24.3	21.2	21.1
September	23.5	19.9	17.2	16.5
October	18.5	14.1	11.6	10.3
November	13.0	8.5	5.6	3.1
December	9.3	3.8	1.3	-2.8
Note: Please note that these temperatures are calculated by taking average of 24 hour values in a day.				

(1) Cooling Demand

Cooling season period in Istanbul is from June to September in accordance with the hearings from ITU. Monthly average temperatures in the period are in between 19.9 to 24.9 °C. From monthly average temperature data, the big cooling demand is not expected.

On the other hand, in view of the temperature change on a summer day (See to Figure 8-6), there is a wide daily range (23.5 – 34 °C). This shows that day time needs cooling but evening and morning times do not need cooling.

Istanbul has cooling needs but the cooling demand (cooling load × hours) is not big.

Note ; Tout : Outside air temperature, Rhout : Outside air humidity

Figure 8-6 Daily Curves of Outside Air Temperature and Humidity at the Field Test Site in Summer

(2) Heating Demand

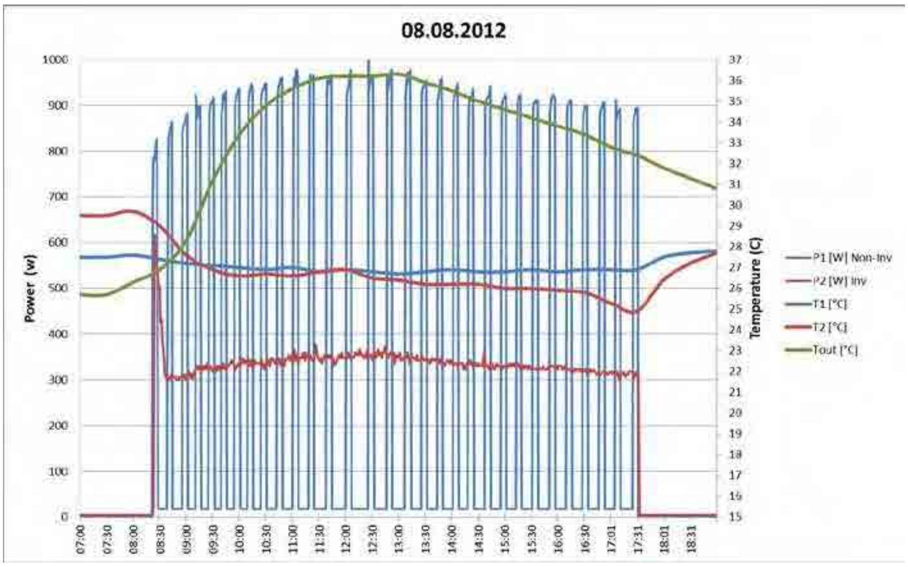
Heating season in Istanbul is mainly from mid-December to mid March in accordance with the hearings from ITU. Monthly average temperatures in the heating period are in between 2.9 to 8.5 °C. Since monthly average temperatures are low, certain heating demand is expected.

4. Analysis for Cooling

Three analyses of electricity consumption, average cumulative power, and electricity consumption on the selected typical days and the estimation of seasonal electricity consumption for cooling were conducted on the base of collected cooling data.

(1) Analysis of Electricity Consumption

Measured data of non-inverter AC (Room 1) and inverter AC (Room 2) on the typical day (8th August) is shown in Figure 8-7. Inverter AC continuously operates at the low power and non-inverter AC repeatedly operates at the high power and stops in operation hours. Figure 8-7 specifically shows the feature of inverter AC.



Note ; P1 : Power in room 1, P2 : Power in room 2, T1 : Air temperature in room 1, T2 : Air temperature in room 2, Tout : Outside air temperature

Figure 8-7 Changes of Electricity and Air Temperature on a Typical Day

Total electricity consumption for all hours and total electricity consumption for operation hours, which stand-by power is not included, for Room 1 and 2 in measurement period are shown in Table 8-3. And the costs are calculated by using 0.35 TRY/kW (ITU electricity price).

As the result, in the measurement period, inverter ACs show 21% saving of total electricity consumption and 25% saving of total electricity consumption for operation hours, as compared with non-inverter ACs.

Table 8-3 Analyses of Total Energy Consumption (E_{total}), Total Electricity Consumption for Operation Hours(E_{opr}), Costs (C_{total} / C_{opr}), and Saving Ratios on AC Field Test (31 July – 2 October)

	E_{total} (64 days) [kWh]	E_{opr} (43 days) [kWh]	C_{total} [TRY]	C_{opr} [TRY]
Inverter AC	66.4	63.5	23.2	22.2
Non-Inverter AC	87.0	84.4	30.5	29.5
Saving Ratio	21%	25%	21%	25%

(2) Analysis of Average Cumulative Power

Saving ratios calculated by average cumulative power (Pcave) in AC operation hours are shown in Table 8-4. Pcave is calculated, for each room, by dividing total electricity consumption in operation hours by operation hours.

Pcave saving ratio in Room 1 is 22% and that in Room 2 is 24%.

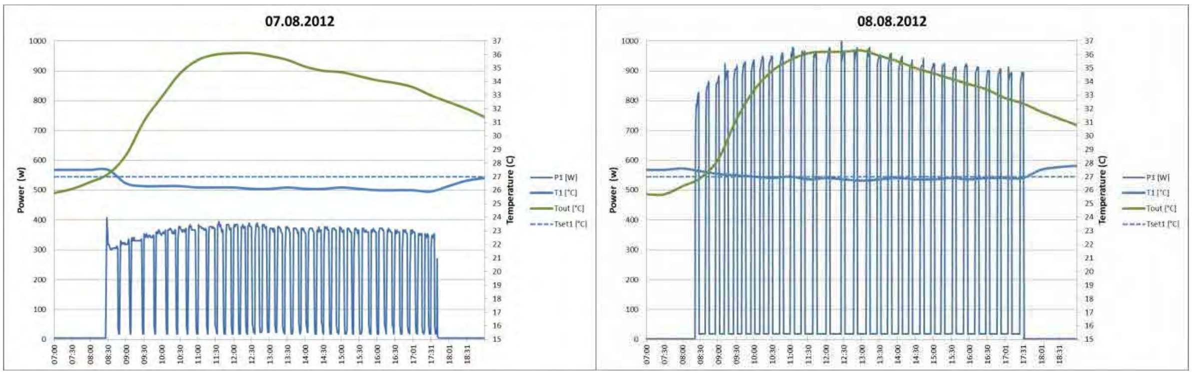
Table 8-4 Pcave Saving Ratio

	Pcave Inverter [W]	Pcave Non Inverter[W]	Pcave Saving Ratio [%]
Room 1	126.2	161.6	22%
Room 2	225.4	294.5	24%

(3) Analyses of Electricity Consumption on the Selected Typical Days

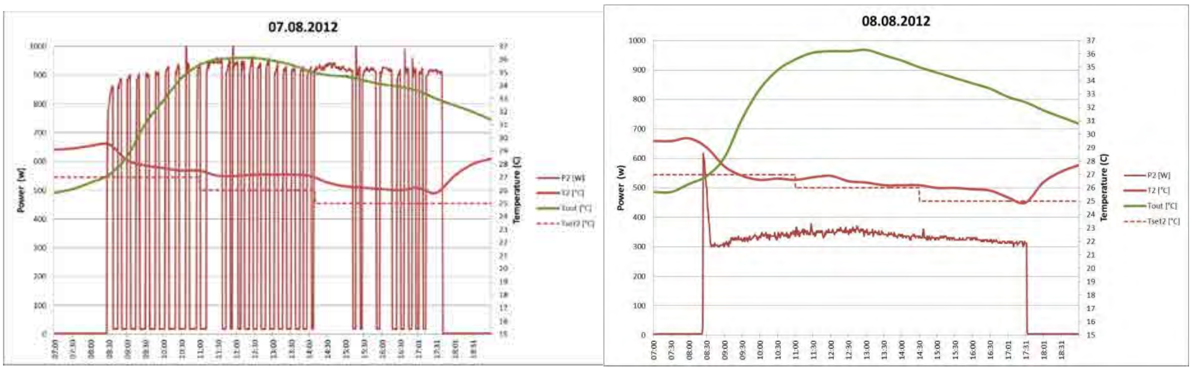
On two days of August 7th and 8th, which have similar outside and indoor air temperatures, the operation situations of inverter and non-inverter ACs for each room are shown in Figure 8-8 and 8-9.

Figure 8-8 and 8-9 clearly show the feature of inverter and non-inverter ACs. Besides, in Room 1, which had the high set temperature (27 ^{0}C), inverter AC also repeatedly operated and stopped since the cooling load was lower than the control range of inverter AC. This situation was noticeable in Room 2 when the set temperature was set at a high temperature and in both rooms when the outside air temperature decreased after mid-August. In order to take the maximum energy saving effect of inverter ACs, it is effective to select ACs with the suitable capacity, which is not an oversized capacity, and/or to introduce of ACs with the wide control range technically.



Note ; P1 : Power in room 1, T1 : Air temperature in room 1, Tout : Outside air temperature, Tset1 : Set temperature in room 1

Figure 8-8 Operation Situations in Room 1 for 7-8 August 2012



Note ; P2 : Power in room 2, T2 : Air temperature in room 2, Tout : Outside air temperature, Tset2 : Set temperature in room 2

Figure 8-9 Operation Situations in Room 2 for 7-8 August 2012

Electricity saving ratio of inverter AC for non-inverter AC (Esaving), which is calculated by using electricity consumption for common operation hours for August 7th and 8th, is shown in Table 8-5 and 8-6. Esaving in Room 1 shows 15% and that in Room 2 shows 38%.

The same analyses were conducted for additional other two cases (August 9th and 10th and August 16th and 17th). Esavings calculated in these cases are also shown in Table 8-5 and 8-6.

Since the set temperatures and outside air temperatures in two days are not same exactly, the figures have varied a little bit. But the electricity saving of inverter ACs for non-inverter ACs is confirmed.

Table 8-5 Average Power (Pave), Electricity Consumption (Eopr), and Electricity Saving Ratio (Esaving) for Common Operation Hours of Continuing 2 Days in Room 1

Date	07.08.2012	08.08.2012	09.08.2012	10.08.2012	17.08.2012	16.08.2012
AC Type	Inverter	Non-Inverter	Inverter	Non-Inverter	Inverter	Non-Inverter
Operation Hours	08:30-17:30	08:30-17:30	08:30-16:57	08:30-16:57	08:30-16:27	08:30-16:27
Pave [W]	267	316	255	293	191	215
Eopr [kWh]	2.41	2.84	2.16	2.48	1.52	1.71
Esaving [%]	15%		13%		11%	

Note; Set temperatures are usually 27°C in room 1

Table 8-6 Average Power (Pave), Electricity Consumption (Eopr), and Electricity Saving Ratio (Esaving) for Common Operation Hours of Continuing 2 Days in Room 2

Date	07.08.2012	08.08.2012	09.08.2012	10.08.2012	17.08.2012	16.07.2012
AC Type	Non-Inverter	Inverter	Non-Inverter	Inverter	Non-Inverter	Inverter
Operation Hours	08:30-17:30	08:30-17:30	08:30-16:57	08:30-16:57	08:30-16:27	08:30-16:27
Pave [W]	543	335	379	313	405	261
Eopr [kWh]	4.89	3.01	3.20	2.64	3.23	2.08
Esaving [%]	38%		17%		36%	

Note; Set temperatures are between 25-27 °C (mainly 25°C) in room 2

(4) Estimation of Seasonal Electricity Consumption for Cooling

Seasonal Electricity Consumption for Cooling is estimated by using correlation of the outside air temperature in the weather station, which is closest to ITU, the measured outside air temperature, and the measured electricity consumption.

Averages of 4-year outside air temperatures (2008 - 2011) are used as the model of the seasonal outside air temperatures. Period from June to September is set as the cooling period.

Electricity saving and the saving cost of inverter AC for non-inverter AC, which are calculated from estimation of seasonal electricity consumption are shown in Table 8-7. The electricity saving ratio of inverter AC for non-inverter AC in cooling period is estimated as about 20%.

Table 8-7 Estimation of Electricity Saving and the Cost Saving of Inverter AC for Non-inverter AC in Cooling Period (1 June – 30 September)

	E_{total} [kWh]	C_{total} [TRY]
Inverter AC	194	68.0
Non-Inverter AC	244	85.3
Saving	50	17.3
Saving Ratio	20%	

5. Analysis for Heating

Three analyses of electricity consumption, average cumulative power, and electricity consumption on the selected typical days and the estimation of seasonal electricity consumption for heating were conducted on the base of collected heating data.

Unfortunately, this field test for heating was conducted in the limited period, in which the peak season was not included.

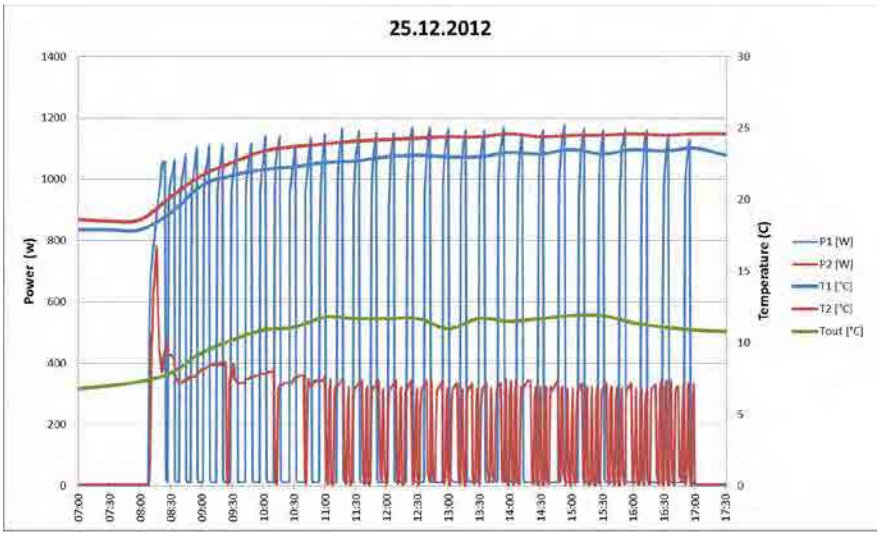
And, it is found that the difference between the setting temperature and the actual operational (room) temperature is not same for the tested ACs and too big to neglect them. Therefore, for the proper evaluation of energy saving effect, the setting temperatures were adjusted from December 24th in order to realize the same room air temperatures (heating load) in operations of inverter and non-inverter ACs,. As a result, data after December 24th is only used for the analyses for heating.

In addition, heat load in Room 2 was very low since there was heat gain from the neighbor room, which was heated by central system. And the effect of this heat gain is considered to spoil the data accuracy. For the reason, Data in Room 1 is only used for the analyses of electricity consumption on the selected typical days and estimation of seasonal electricity consumption for heating.

As a result, analyses for heating data became quite rough, as compared with analyses for cooling. Therefore, further continuous field test for collecting and analyzing heating data would be needed.

(1) Analysis of Electricity Consumption

Measured data of non-inverter AC (Room 1) and inverter AC (Room 2) on the typical day (25th of December) is shown in Figure 8-10. Non-inverter AC repeatedly operates at the high power and stops in operation hours. On the other hand, since, this field test for heating was conducted in the limited period, which has low heat load without peak period, therefore inverter AC was also operated in ON/OFF operation repeatedly.



Note ; P1 : Power in room 1, P2 : Power in room 2, T1 : Air temperature in room 1, T2 : Air temperature in room 2, Tout : Outside air temperature

Figure 8-10 Changes of Electricity and Air Temperature on a Typical Day

Total electricity consumption for all hours and total electricity consumption for operation hours, which stand-by power is not included, for Room 1 and 2 in the limited measurement period are shown in Table 8-8. And the costs are calculated by using 0.35 TRY/kW (ITU electricity price).

As the result, in the limited measurement period, inverter ACs show 32% saving of total electricity consumption and 35% saving of total electricity consumption for operation hours, as compared with non-inverter ACs.

Table 8-8 Analyses of Total Energy Consumption (E_{total}), Total Electricity Consumption for Operation Hours(E_{opr}), Costs (C_{total} / C_{opr}), and Saving Ratios on AC Field Test (24 December – 4 January)

	E_{total} (12 days) [kWh]	E_{opr} (9days) [kWh]	C_{total} [TRY]	C_{opr} [TRY]
Inverter AC	16.5	15.5	5.8	5.4
Non-Inverter AC	24.3	23.8	8.5	8.3
Saving Ratio	32%	35%	32%	35%

(2) Analysis of Average Cumulative Power

Saving ratios calculated by average cumulative power (Pcave) in AC operation hours are shown in Table 8-9. Pcave is calculated, for each room, by dividing total electricity consumption in operation hours by operation hours.

Pcave saving ratio in Room 1 is 39% and that in Room 2 is 16%.

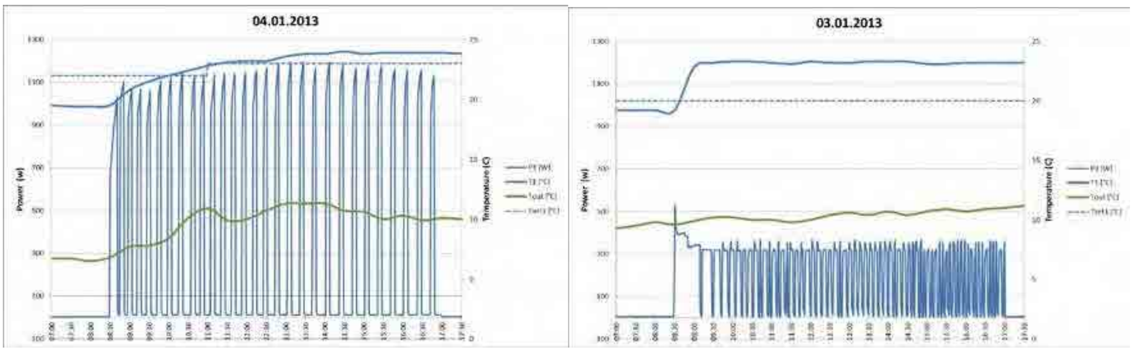
Table 8-9 Pcave Saving Ratio

	Pcave Inverter [W]	Pcave Non Inverter[W]	Pcave Saving Ratio [%]
Room 1	237.4	389.2	39%
Room 2	172.0	203.4	16%

(3) Analyses of Electricity Consumption on the Selected Typical Days

On the two days of January 3rd and 4th, which have similar indoor and outside air temperatures, the operation situations of inverter and non-inverter ACs in Room 1 are shown in Figure 8-11.

As mentioned in previous Section (1), this field test for heating was conducted in the limited period, which has low heat load without peak period. Therefore, not only non-inverter AC but also inverter AC operated in ON/OFF operation repeatedly



Note ; P1 : Power in room 1, T1 : Air temperature in room 1, Tout : Outside air temperature, Tset1 : Set temperature in room 1

Figure 8-11 Operation Situations in Room 1 for 3-4 January 2013

Electricity saving ratio of inverter AC for non-inverter AC (Esaving), which is calculated by using electricity consumption for common operation hours for January 3rd and 4th, is shown in Table 8-10. Esaving in Room 1 shows 45%.

The same analyses were conducted for additional other two cases (December 11th and January 3rd and December 19th and January 3rd). Esavings calculated in these cases are also shown in Table 8-10.

Since the set temperatures and outside air temperatures in two days are not same exactly, the figures have varied a little bit. But the electricity saving of inverter ACs for non-inverter ACs is confirmed.

Table 8-10 Average Power (Pave), Electricity Consumption (Eopr), and Electricity Saving Ratio (Esaving) for Common Operation Hours of Typical 2 Days in Room 1

Date	03.01.2013	11.12.2012	03.01.2013	19.12.2012	03.01.2013	04.01.2013
AC Type	Inverter	Non-Inverter	Inverter	Non-Inverter	Inverter	Non-Inverter
Operation Hours	08:30-17:00	08:32-17:00	08:30-17:00	08:34-17:00	08:30-17:00	08:30-17:00
Pave [W]	210	277	210	304	210	378
Eopr [kWh]	1,78	2.35	1,78	2.47	1,78	3.22
Esaving [%]	24%		31%		45%	

(4) Estimation of Seasonal Electricity Consumption for Heating

Seasonal electricity consumption for heating is estimated by using correlation of the outside air temperature in the weather station, which is closest to ITU, the measured outside air temperature, and the measured electricity consumption, as it is for cooling.

Averages of 4-year outside air temperatures (2008 - 2011) are used as the model of the seasonal outside air temperatures. Period from mid-November to mid-March is set as the heating period.

Electricity saving and cost saving of inverter AC for non-inverter AC, which are calculated from estimation of seasonal electricity consumption are shown in Table 8-11. The electricity saving ratio of inverter AC for non-inverter AC in heating period is estimated as about 30%.

Table 8-11 Estimation of Electricity Saving and the Cost Saving of Inverter AC for Non-inverter AC in Cooling Period (15 November – 15 March)

	E_{total} [kWh]	C_{total} [TRY]
Inverter AC	212	74.2
Non-Inverter AC	303	106.2
Saving	91	32.0
Saving Ratio	30%	

6. Energy Saving of Heating and Cooling

From the results of cooling and heating seasonal electricity consumption estimations, annual electricity saving and cost saving of inverter AC for non-inverter are calculated and shown in Table 8-12.AC. The electricity saving ratio of inverter AC for non-inverter AC in annual, cooling and heating, is estimated as 26%

Table 8-12Estimation of Annual Electricity Saving and the Cost Saving of Inverter AC for Non-inverter AC

	Cooling		Heating		Cooling and Heating	
	E_{total} [kWh]	C_{total} [TRY]	E_{total} kWh]	C_{total} [TRY]	E_{total} [kWh]	C_{total} [TRY]
Inverter AC	194	68.0	212	74.2	406	142.2
Non-Inverter AC	244	85.3	303	106.2	547	191.5
Saving	50	17.3	91	32.0	141	49.3
Saving Ratio	20%		30%		26%	

7. Conclusion

AC field text was conducted by using inverter AC and non-inverter AC with same EER and COP. And electricity consumption of both ACs was measured in actual offices. As the result, the followings are funded and confirmed;

a) As compared with non-inverter ACs, inverter ACs have 20% energy saving potential for cooling, 30% for heating, and 26% for total of cooling and heating.

b) The existing EER and/or COP, which are evaluation by the rated input and output, are difficult to evaluate the energy efficiency of inverter ACs. Therefore, the introduction of SPF and APF, which are new evaluation factors, is needed.

On the other hand, there are needs for cooling in peak summer season, however the demand (kWh) in cooling period is not large in Istanbul. Under such conditions, in order to promote EE&C through the introduction of inverter ACs, it seems to be effective to reduce the equipment cost and introduce the ACs with a wide control range as well as to select ACs with suitable capacity.

In addition, it is expected to increase the use of inverter ACs, as the equipment for both heating and cooling, in the south areas of Turkey, where cooling demand is large and gas has not been delivered for heating.

Background Information; SPF and APF

(1) Movement of SPF and APF

EER (Energy Efficiency Ratio) and COP (Coefficient of Performance), which evaluate the energy efficiency at the rated time, have been used in the past. However, with the spread of inverter ACs, which, following the fluctuation of the actual load, can operate, it is found that the existing EER and COP can’t evaluate the performance of variable operation.

Recently, preparation and introduction of SPF (Seasonal Performance Factor) and APF (Annual Performance Factor), which can evaluate seasonal and/or annual energy performance, as the evaluation standard, are starting in Japan and other countries. SPF and APF will be standard as ISO16358 in 2013 and will start operation of this standard.

SPF and APF will be also introduced in Europa. Therefore, it is expected that spread of inverter ACs in Turley will is promoted by the introduction of this standard.

(2) Outline of SPF and APF

1) EER and COP

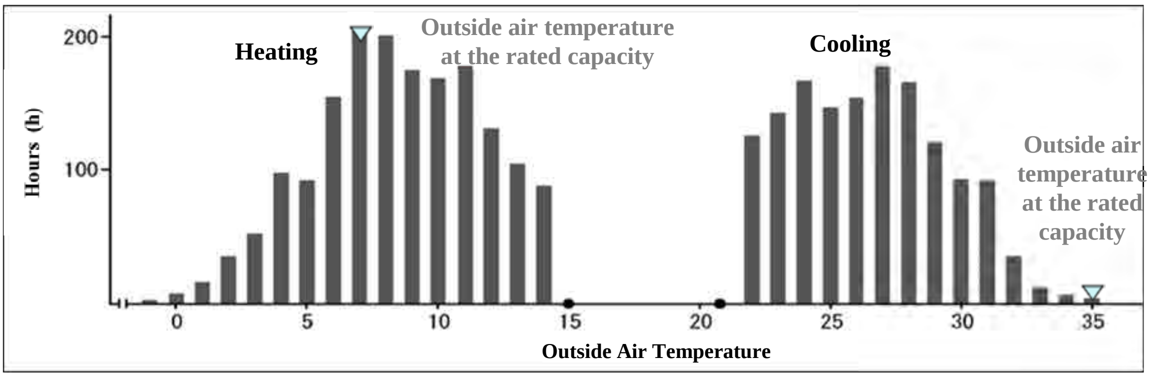
EER and COP, which are the existing energy efficiency evaluation standard, evaluate ACs only by using the capacities at the rated points.

$$EER = \frac{\text{Cooling Rated Capacity (W)}}{\text{Cooling Rated Energy Consumption (W)}}$$

$$COP = \frac{\text{Heating Rated Capacity (W)}}{\text{Heating Rated Energy Consumption (W)}}$$

2) Outside Air Temperature in Cooling and Heating Period

Distribution of outside air temperatures for calculating APF of the commercial and office buildings in Japan is shown in Figure 8-12. EER and COP can't evaluate the actual situation, since electricity consumption for cooling or heating in the actual operation varies in accordance with the change of outside air temperature. It is also funded the rated points of EER and COP are not always the representative points.



Source; Report of Air Conditioner Standard Subcommittee, Energy Efficiency Standard Subcommittee, Advisory Committee for Natural Resource and Energy

Figure 8-12 Distribution of Outside Air Temperatures for Calculating APF of the Commercial and Office Buildings in Tokyo

3) Energy Efficiency for Partial Load

Energy efficiency of ACs for partial load is shown in Figure 8-13. Inverter ACs have high energy efficiency for partial load. As shown in Figure 8-12, Distribution of outside air temperature, there are many operations under the partial load in actual operation. So, Inverter ACs, as compared with non-inverter ACs, can bring out high energy efficiency for actual operation.

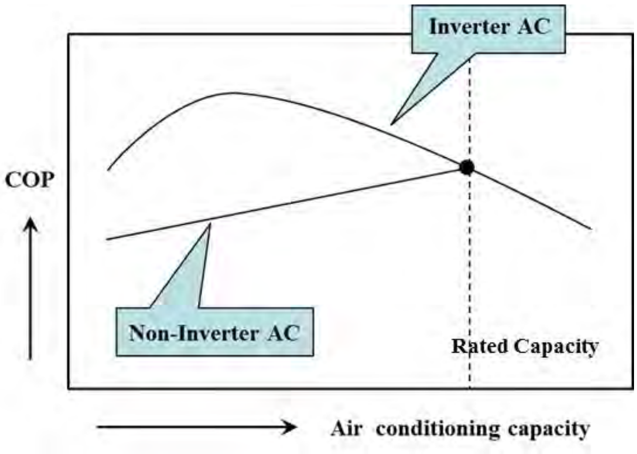


Figure 8-13 Energy Efficiency of ACs for Partial Load

4) SPF and APF to be defined in ISO 16358

In order to evaluate ACs on the near-actual operation conditions, SPF and APF, as new energy efficiency evaluation standards, which are calculated by using total loads for AC and the characteristics of electricity consumption of AC in cooling, heating, and annual periods, are defined.

i) Cooling Seasonal Performance Factor (CSPF)

$$CSPF = \frac{\text{Cooling Seasonal Total Load (CSTL) (W)}}{\text{Cooling Seasonal Energy Consumption (CSEC) (W)}}$$

ii) Heating Seasonal Performance Factor (HSPF)

$$HSPF = \frac{\text{Heating Seasonal Total Load (HSTL) (W)}}{\text{Heating Seasonal Energy Consumption (HSEC) (W)}}$$

iii) Annual Performance Factor (APF)

$$APF = \frac{\text{CSTL (W)} + \text{HSTL (W)}}{\text{CSEC (W)} + \text{HSEC (W)}}$$

In order to calculate SPF and APF, the energy consumption is not measured in actual field. In accordance with ISO 16358, the total heat load is prepared in consideration of each local climate in Turkey and the energy consumption is prepared by using a) the rated capacity and the half capacity for cooling, b) the rated capacity, the half capacity, and the low temperature capacity for heating. And the SPF and/or APF are calculated by the total heat load and the energy consumption.

Annex 9

Proposal of a Project Scheme for Energy Efficiency Retrofitting in Government Buildings

9-1 Abstract of Proposal

9-2 Project Proposal

Annex 9-1 Abstract of Proposal

Preliminary Draft Proposal for Effective Implementation of EE Retrofit Investments for Central Government Owned Buildings

October, 2012

JICA Study Team

Turkish rapid economic growth creates huge energy demands, and energy conservation is one of the most prioritized issues for its sustainable development. There are various possibilities to promote public buildings energy efficiency and conservation (EE&C) in Turkey. The JICA Study Team assumes that the target segment at the initial stage would be EE retrofitting of central government buildings, carrying forward the momentum of MOEU's 100 Buildings Project and the Government's Energy Efficiency Strategy Paper issued in February 2012.

JICA Study Team analyzed that there are three barriers for efficient implementation of EE retrofit investments for central government owned buildings, namely, 1) existence of a large number of small-sized projects scattered among ministries and their affiliated institutions; 2) the fact that each decision on EE retrofit investment has to be made by individual ministry/ institution; and 3) the fact that public procurement is based primarily on the lowest price.

In this preliminary draft proposal, JICA Study Team presents one implementation scheme, which seems feasible based on the acquired information as of end-September 2012, and explains critical factors for the implementation including the below;

1) Establishment of a powerful PMU with enforcement tools
2) Framework agreement* for the implementation of a large-number of small-scale sub-projects
3) Implementation of sub-projects by PMU for other ministries by delegation of authority to PMU
4) Evaluation of tender not by price of bids, but selecting the economically most advantageous tender by taking into account the factor other than price
5) Purchasing of only high energy efficiency equipments according to energy labeling regulations
6) Utilization of two implementation methods (energy audit method and bundling method)

* Framework Agreement means an agreement between one or more contracting authorities and one or more tenderers, which establishes the terms governing contracts to be awarded during a given period, in particular with regard to price and, where appropriate, the quantity envisaged.

Attached is the preliminary draft proposal for the new JICA financial and technical assistance project entitled, "Effective Implementation of **EE** Retrofit Investments for Central **G**overnment **O**wned **B**uilding**s** (EEGOBs) Project" prepared by JICA Study Team.

END

Annex 9-2 Project Proposal

Preliminary Draft Project Proposal

November 2012

JICA Study Team

Project name	Effective Implementation of EE Retrofit Investments for Central Government Owned Buildings (EEGOBs) Project
Objective	1) Goal: Achievement of EE improvement in public sector buildings in Turkey 2) Outcome: a) Reduction of energy budget of the Central Government b) Demonstration effect for private sector buildings 3) Output: Increase in the number of public sector buildings with EE&C improvements
Project period	2013-2018（5 years） Submit proposal following Turkish budgeting procedures 2013 Sub-project formation starting in 2013 Loan disbursement starting in 2014
Executing agency	MOEU (Project Management Unit / PMU will be established in MOEU upon the approval of the Prime Ministry/ High Planning Council)
Beneficiary	Government of Turkey
Funding sources	JICA and/or Other donor agencies
TA	Technical assistance to PMU to support the Project implementation and to EVD Association for the capacity development of EVDs through GDRE/ MENR
Main features	1) Utilization of two EE&C retrofit implementation methods: a) Energy Audit Method and b) Bundling Method 2) Establishment of a powerful PMU with enforcement tools 3) Utilization of framework agreement (Additional Article 2 of the Public Procurement Law (PPL) No. 4734 of 2002) for the implementation of a large-number of small-scale sub-projects 4) Implementation of sub-projects by PMU for other ministries by delegation of authority to PMU based on an entrustment agreement 5) Procurement via tender of economically most advantageous equipment and services by taking into account factors other than price (e.g. life-cycle costs) based on Public Procurement Law dated January 4, 2002 No.4734 (Revised version 2012 (Article 40) and Regulation Regarding the Increase of Energy Efficiency dated October 27, 2011 No. 28097 (Article 31) 6) Purchasing of high energy-efficiency equipment based on Regulation on Labeling of Products by Consumption of Energy and Other Resources dated 09/12/2011 No: 2011/2257 (Article 10)

1. Project Background & Objectives

In Turkey, the building sector is currently the largest energy consuming sectors surpassing industry, with a share of 35% in total energy consumption in 2010. At the same time, since more than 90% of existing 8.6 million buildings in Turkey was built before 2000, the year when the new thermal insulation regulations came into operation, it is assumed that 30% energy saving could be achieved in building sector without much difficulties.

The Government of Turkey (GOT), with the conviction that energy efficiency and conservation (EE&C) should first be promoted among public sector buildings to set a good example for the society, has been proactively promoting EE&C in public sector buildings since 2008 with the issuance of PM Circular 2008/ 2. There are currently two kinds of important legal and policy requirements in EE&C in public sector buildings. One is a legal requirement by the Regulation on Energy Efficiency of MENR of 2011 (En-Ver) under Energy Efficiency Law of 2007, which states that "The energy use of the buildings and enterprises belong to public sector shall be reduced by at least 20% in the year 2023 compared to the year 2010" in Article 31. The other is a policy requirement stipulated in the Energy Efficiency Strategy Paper 2012-2023 (EESP). According to Purpose 6/ Target 1/ Action1 (SP-06/ST-01/A-01) of EESP, "The efficiency improvement projects shall be prepared by making energy audits in the buildings and facilities of the public enterprises and the budget allowances of the maintenance shall be used for these projects with priority" so as to decrease annual energy consumption in the public enterprises buildings and facilities by 10% before 2015 and 20% before 2023.

MOEU, which is the ministry solely in charge of promoting EE&C in buildings, is currently conducting a pilot project involving energy audit and energy-improvement of 100 public-sector buildings in Ankara ("100 Buildings Project"). MOEU plans to 1) establish standard specifications through 100 Buildings Project, 2) guide (recommend) procurement for other ministries using thus established standard specification, and 3) make other ministries adopt the standard through the issuance of a PM Circular. After getting the lessons and feedback from this project, MOEU has another idea to extend similar studies to promote EE&C to 1,000 public sector buildings nationwide.

Thus, EE Retrofit Investments for Central Government Owned Buildings (EEGOBs) Project intends to support the achievement of GOT's purposes/ targets/activities set forth in EESP by providing a comprehensive financial and technical assistance to increase the number of public sector buildings with EE&C improvements, which will eventually reduce energy budget of the Central Government and foster demonstration effect for private sector buildings.

2. Barriers & Countermeasures

To overcome existing barriers (see the table below), a powerful Project Management Unit (PMU) will be created in the higher level of government structure or in MOEU with the support from and coordination with higher government authorities such as Prime Ministry. As well, "bundling method" will be introduced to implement EE&C retrofit investments of many small-sized sub-projects scattered across various ministries.

Principal Barrier	Counter Measure
Majority of sub-projects are "small," thus involves relatively high transaction costs	- To standardize investment decision and procedures of sub-projects so as to process easily - To use eligible equipment list for automatic sub-project approval - To bundle a large number of the same kind, small sized sub-projects into one large batch. At the same time, establish PMU for the entire project implementation, from budget handling, procurement, and contract, so as to avoid the implementation by each ministry.
Little interest for energy saving by building owner agencies (i.e. ministries), due to lack of financial benefits	- Not only raising awareness, educational, but also guidance, enforcement by authoritative power; - To set up a PMU in the highly recognized agency such as the Prime Ministry or in MOEU with support from and coordination with higher government authorities. - Another approach is to make compulsory by law, by regulation, or by the issuance of a Prime Ministry Circular so as to ensure that no agency could dismiss the implementation of EE&C improvements in buildings.

3. Project Components

1) Financial (ODA loan) assistance for implementation of EE&C of public sector buildings in Turkey
2) Technical assistance to PMU for a smooth, efficient and effective implementation of EE&C investments in sub-projects
3) Technical assistance aimed toward the broader capacity development for EE&C in Turkey, which would strengthen the prerequisites for the success of EE&C of public sector buildings (including Technical Assistance for EVD Associations via GDRE/ MENR for the capacity development of participating EVDs)

4. Roles and Responsibilities of Interested Parties

Organization	Roles and responsibilities/ Inputs
High Planning Council / Prime Ministry, etc.	【Roles and Responsibilities】 - To mandate PMU to carry out the EE retrofit investments for all ministries by the High Planning Council Decision, Prime Ministry Circular, (or by the approval of higher government bodies such as EECB.) 【Inputs】 - To grant enforcement power to PMU - To give PMU the mandate to implement EE retrofit investments for ministries
PMU	【Roles and Responsibilities】 - To take charge of the entire project implementation - PMU will provide participating ministries with a comprehensive support for energy audit, budget provision (finance), preparation of detailed design and tender documents, tender and sub-project implementation. - Implement a part of or the entire EE&C retrofit investments on behalf of participating ministry/ ministries based on an entrustment agreement signed with each of the participating ministries - Procure EE&C equipment and services from selected contractors and suppliers for an extended period of time on behalf of participating ministries based on a framework agreement signed between PMU and suppliers, contractors, etc. 【Inputs】 - Donor agencies and MOEU shall dispatch experts who specialize in a) project management, b) finance, c) sub-project identification, d) government negotiation, e) procurement of EE&C equipment and services, f) technical assistance, etc.
MOEU	【Roles and Responsibilities】 - To promote EE&C in the buildings sector of Turkey - To achieve purposes/ targets/ activities outlined in the Energy Efficiency Strategy Paper - To take leadership in the implementation of the Project as the executing agency: prepare and submit the Project proposal to MOD, support the smooth implementation of PMU by assisting negotiation with ministries and providing necessary logistics to PMU. - To contribute in sub-project identification by formulating new projects such as 1000 Buildings Project, and coordinate its implementation with PMU 【Inputs】 - To dispatch experts to PMU from the Energy Efficiency Department - To provide logistical support to the PMU, including fully equipped office facilities, administrative support

Organization	Roles and responsibilities/ Inputs
	- To offer the list of potential sub-projects to PMU
MENR	【Roles and Responsibilities】 - To support capacity development of EVDs - To provide technical support to PMU 【Inputs】 - To provide technical expertise and resources to promote the participation of EVDs in the Project
MOD	【Roles and Responsibilities】 - To approve the Project Proposal and list it up on the Investment Program - To put finance for the Project and report to MOF for final approval 【Inputs】 - To authorize the implementation of the Project as a multi-year donor-funded investment project, enabling annual budget disbursement under the Project for the entire duration of the Project.
Individual ministries	【Roles and Responsibilities】 - To implement EE&C retrofit investments of the existing buildings under the jurisdiction of each ministry - To cut the total amount of energy consumption by each ministry 【Inputs】 - To sign an entrustment agreement with PMU regarding the delegation of authority to PMU for the implementation of a part of or the entire EE&C retrofit investments
EVD Association	【Roles and Responsibilities】 - To provide technical support to EVDs which are selected by PMU for the procurement of works, equipment and services for EE&C retrofit investments - To coordinate capacity development of EVDs with MENR and PMU 【Inputs】 - To provide technical expertise and resources to promote the participation of EVDs in the Project
EVD	【Roles and Responsibilities】 - To implement EE&C retrofit investments 【Inputs】 - To conduct procurement of works, equipment and services to ministries and PMU necessary for EE&C retrofitting
MOSIT	【Roles and Responsibilities】 - To align Turkish regulations with European Energy Labeling and Eco Design. 【Inputs】 To expand the energy labeling coverage to promote high energy-efficiency equipment

Organization	Roles and responsibilities/ Inputs
Donors	【Roles and Responsibilities】 - To support the Government of Turkey for capacity development of related authorities through technical cooperation schemes. - To promote EE&C retrofit of central government buildings through the provision of capital funds and technical expertise. - To support the Government of Turkey in achieving purposes/ targets/activities outlined in the Energy Efficiency Strategy Paper 【Inputs】 - To dispatch experts, provide funding and technical assistance to PMU, MOEU and participating and supporting ministries

5. PMU

PMU shall be established and given the mandate to implement EE retrofit investments for ministries by the approval of a) High Planning Council or b) Prime Ministry. The location of the PMU office would be in the head office of MOEU in order to assure a responsive coordination between the two organizations. The PMU management team will consist of government officials seconded from relevant ministries and experts recruited from outside the government.

Division of labor between PMU and participating ministry (ministries) is shown in the following table. After conducting preliminary and, if necessary, full energy audit for the identified sub-project, participating ministry/ ministries will sign Agreement for Implementation with PMU: 1) Under Energy Audit Method, PMU shall provide full technical support as well as finance to the ministry concerned based on an entrustment agreement, and 2) under Bundling Method, PMU shall implement sub-projects on behalf of all participating ministries based on the entrustment agreement signed with each one of them and conduct a lump-sum procurement of equipment and services based on a framework agreement signed with suppliers, contractors, etc.

Advantages of establishing a PMU include the below:

1. Central implementation ensuring more professional and less cost for government
2. Monitoring of all applications and EE strategy targets
3. Effective utilization of donor credits
4. Mass purchasing of EE equipment and construction materials facilitate quick EE market transformation, additional employment effect, etc.

Activity	Energy Audit Method		Bundling Method	
	PMU	Ministry	PMU	Ministries
Sub-project identification	Identification by PMU, through requests from any participating ministries, or from any other sources.			
Agreement for Audit	◆━━━◆		◆━━━◆	
Preliminary energy audit	PR		PR	
Full scale energy audit	PR		Not applicable	
Agreement for Implementation	◆━━━◆ *Entrustment Agreement*		◆━━━◆ *Entrustment Agreement +Framework Agreement*	
Design, tender docs	TS	PR	PR	
Tender evaluation	TS	PR	PR	
Contract	TS	PR	PR	
Supervision of works	TS	PR	PR	
Final acceptance	TS	PR	PR	
Payment	PR	(Request to PMU)	PR	
Operation/maintenance		PR		PR

PR: Primary Responsible
TS: Technical Support

6. EE&C Retrofit Implementation Methods

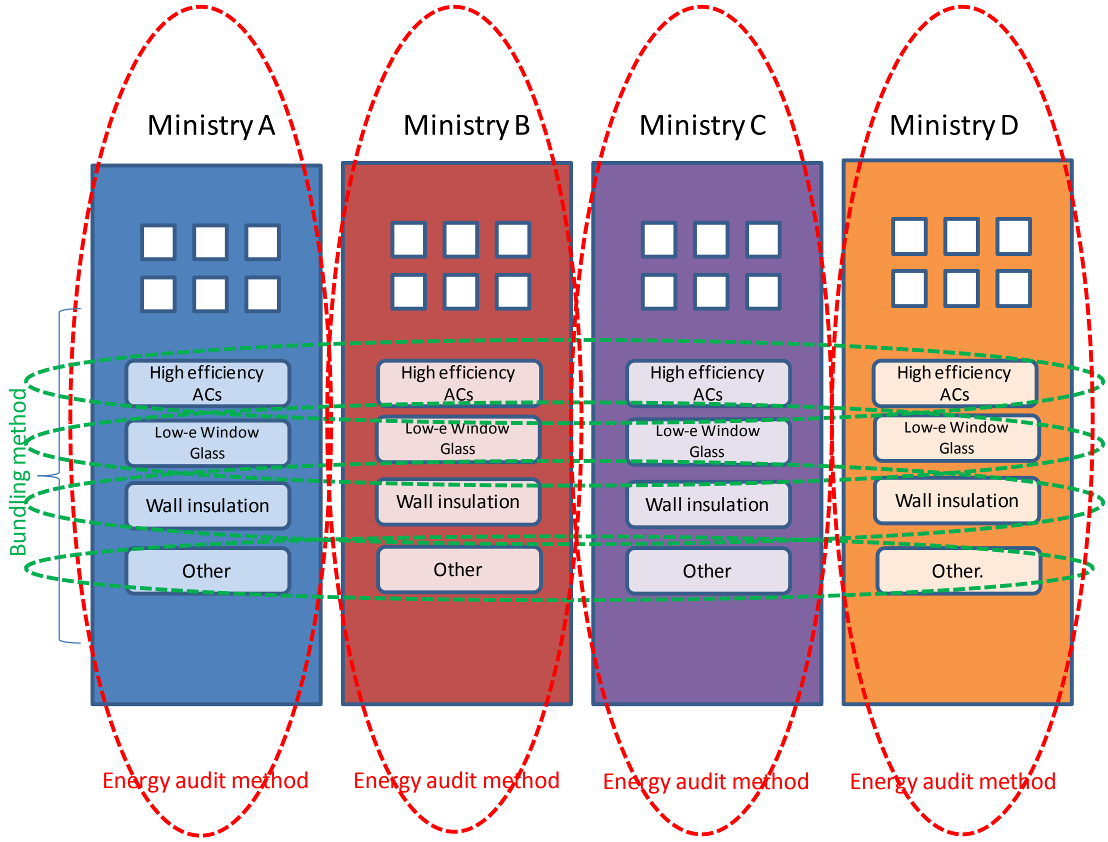
There are **two methods** for sub-project implementation:

1) Energy Audit Method:

Energy audits will be done for buildings having high energy saving potentials, based on which sub-projects consisting of several EE&C measures will be formulated. Sub-projects will then be appraised and approved by the PMU, if eligibility criteria are met. Approved sub-projects will be implemented by building owners (i.e. ministries, etc.), with comprehensive support from PMU for energy audit, budget provision (finance), preparation of detailed design and tender documents, tender and sub-project implementation. Since the primary responsibility to implement EE retrofit investments under this method lies with each building owner, it is important that the concerned ministry would take initiative by submitting a request to PMU for the participation in EEGOBs Project.

2) Bundling Method:

This is a single most promising EE&C measure, in which small scale but large number of thematic sub-projects, such as replacement of ACs, will be bundled across ministries and administrations, and implemented and financed by PMU. Information about the candidate sub-projects will be collected by PMU and MOEU, and each of the participating building owners shall sign an entrustment agreement with PMU regarding sub-projects implementation.



7. Implementation Steps and Agencies Involved in EEGOBs Project

EEGOBs Project implementation steps, from identification of sub-projects to outcome monitoring, are outlined in the following table. It is important that at the stages of identification of sub-projects (1) and request for participation (2), PMU/MOEU shall take leadership in collecting information from relevant stakeholders by interacting proactively with them. Nevertheless, for those building owners intending to implement EE retrofit investments under Energy Audit Method, identification of sub-projects and request for participation are expected to be made by them. At the tender stage (8), PMU shall conduct the screening of sub projects via energy audits for large-scale EE&C retrofit sub-projects utilizing Energy Audit Method, and via tender documents (which define standard specifications and the minimum procurement amount) for a batch of many small-sized sub-projects utilizing Bundling Method. Lastly, at the outcome monitoring stage (14), PMU/MOEU and JICA shall conduct strict monitoring so as to calculate the cost effectiveness and EE&C effects of the Project based on data provided in the reports submitted by participating ministries.

Procedure of Energy Audit Method

Project Implementation Steps	JICA	Ministries	PMU	MOEU	EVDs	Suppliers/ Contractors
(1) Identification of sub-projects	S	P	P	S	S	S
(2) Request for participation		P				
(3) Acceptance for participation			P			
(4) Initial energy audit by computer software			P		S	
(5) Agreement for investment		P	P			
(6) Appraisals for eligibility/approval	S		P			
(7) Agreement for sub-project implementation		P	P			
(8) Tender/ Tender documents		P	S		S	P
(9) Tender evaluation		P	S			
(10) Negotiation and signing of contract for supply/works		P			S	P
(11) Supervision of works			P		S	
(12) Final acceptance		P				
(13) Operation maintenance		P				
(14) Outcome monitoring	S	P	S	S		

P: Primaliry Responsible Agency
S: Supporting Agency

Procedure of Bundling Method

Project Implementation Steps	JICA	Ministries	PMU	MOEU	EVDs	Suppliers/ Contractors
(1) Identification of sub-projects	S	P	P	S	S	S
(2) Request for participation			P			
(3) Acceptance for participation		P				
(4) Initial energy audit by computer software					S	
(5) Agreement for investment		P	P			
(6) Appraisals for eligibility/approval	S		P			
(7) Agreement for sub-project implementation		P	P			
(8) Tender/ Tender documents			P		S	P
(9) Tender evaluation			P			
(10) Negotiation and signing of contract for supply/works			P		S	P
(11) Supervision of works			P		S	
(12) Final acceptance		P	S			
(13) Operation maintenance		P				
(14) Outcome monitoring	S	P	S	S		

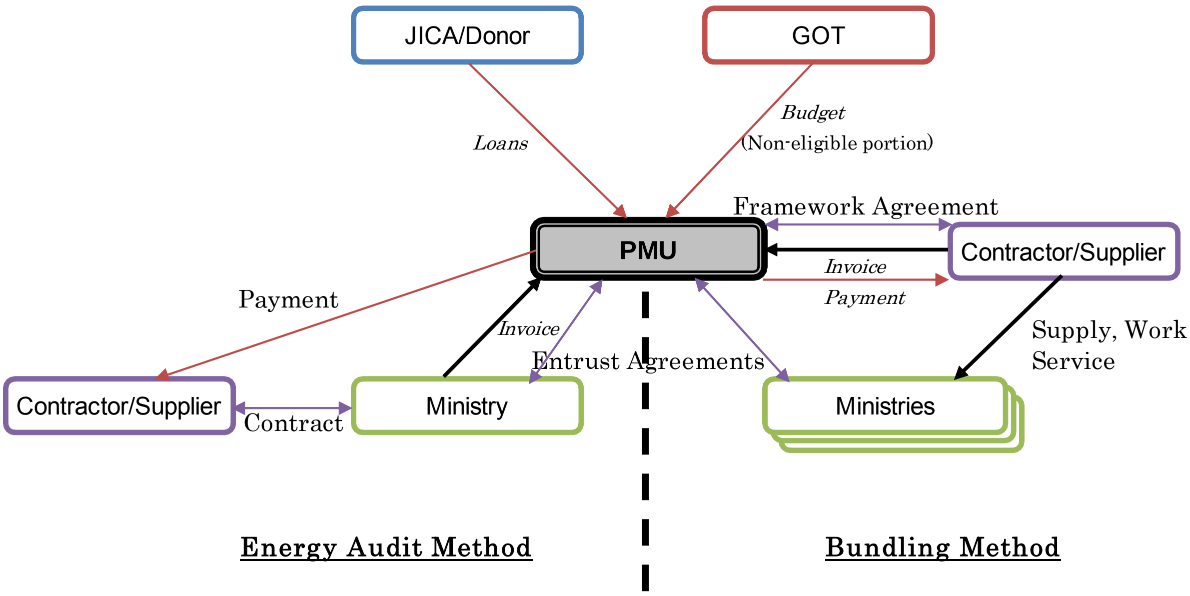
P: Primaliry Responsible Agency
S: Supporting Agency

8. Financial Mechanism under EEGOBs Project (Image)

The primary funding for the implementation of EE&C retrofit investments will come from JICA/ Donor agencies. Since the donor funds will cover only up to 75-85% of the cost of each sub-project, GOT will also provide funds to PMU from its annual capital investment budget. As a multi-year capital investment project, the total amount of funds approved and signed between GOT/UT and JICA/ Donor agencies under EEGOBs Project will be divided among the term (i.e. five years) to be disbursed each year to PMU. In practice, JICA/Donor agencies will transfer the funds to the Special Account established by GOT/UT for the sake of EEGOBs Project, to which the Director of PMU has the right of access throughout the Project term.

PMU will be responsible for the settlement of invoices submitted by EVDs, contractors and suppliers, but only upon request for Energy Audit Method which will be implemented primarily by each participating ministry with technical support of PMU.

Financial Mechanism



9. Timeframe for Preparation and Implementation of EEGOBs

The target timeframe for the preparation and implementation of EEGOBs Project is summarized in the table below. EEGOBs Project is a multi-year capital investment project, which requires an approval of MOD. To begin with, MOEU as the executing agency of the Project is expected to prepare and submit the proposal of the EEGOBs Project to MOD, with the assistance of JICA/ donor agency. According to the Turkish budgeting procedures, this shall be done prior to end-September 2013 when MOF should finalize and compile draft budget for the fiscal year 2014.

2012	➢ Project formation, and preparation of project proposal by JICA/ MOEU
2013	➢ Obtain approval at Energy Efficiency Coordination Board as the Project to implement an action of No. SP-06/ST-01/A-01 of Energy Efficiency Strategy Paper ➢ Obtain approval for the Project from the High Planning Council as inter-ministerial government priority project ➢ Obtain approval as Public Investment Program ➢ Negotiation between JICA/donor agencies and UT for project loan ➢ Budgeting (in bulk) as capital investment project in multi-year ➢ Identification and formulation of sub-projects
2014	➢ Implementation of the first series of sub-projects ➢ Continuation of formulation and implementation of sub-projects
2015 -	➢ Continuation of formulation and implementation of sub-projects

(Reference) With-Without-Comparison

1) With EEGOBs Project

PMU will be established to implement EEGOBs based on High Planning Council Decision/ PM Circular

Advantages

- Able to receive an abundant funding from donor agencies,
- Able to speed up implementation of EE retrofit investments by ministries

Disadvantages

- Need to establish and mandate PMU by the issuance of new government decisions

2) Without EEGOBs Project

MOEU would implement EE retrofit investments within the capacity of its Establishment Law + PM Circular

Advantage

- Able to conduct under the current law and regulation

Disadvantage

- Ministries have to use their own buildings maintenance budgets for EE retrofit investments
- Weak enforcement power over ministries
- Take longer time to implement EE retrofit investments by ministries (see the chart below)