



**EUROVENT**  
SUMMIT  
ANTALYA  
25-28 OCT 2022

#BuildingBridges



# TTMD

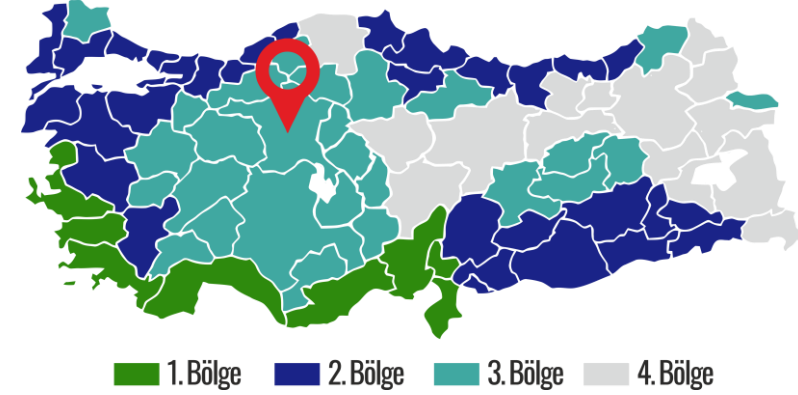
**NERMİN KÖROĞLU ISIN**

MECHANICAL SYSTEMS DESIGNER  
VICE PRESIDENT OF TTMD

# ENERGY RENOVATION PROJECTS

A- STATE HOSPITAL PROJECT  
ISTANBUL

B- HIGH SCHOOL PROJECT  
ANKARA



# STATE HOSPITAL PROJECT



Number of Intensive Care Units : 1  
Inpatient Bed Availability : 80  
Number of Employees : 281

Height of the building : ~24,5m (Vertical distance between 0 level and the highest point of the building)  
Construction Area : 13549 m<sup>2</sup>  
Number of Basement Floors : 1  
Number of Floors : 4+1 (Mechanical Floor)  
Coordinates : 41° 5'23.83"K x 30°44'16.95"D

- Existing Building
- Project Goal: Find out solutions to decrease the Energy Use, verify by simulation
- Climate: Istanbul, mild climate.
- The Consumption Rates:

Electricity Consumption : 1,606,000 Kwh

Natural Gas Consumption: 156,100 m<sup>3</sup>

## A- Renewable Energy Design- Preliminary Phase- WHAT CAN WE DO HERE TO IMPROVE EFFICIENCY

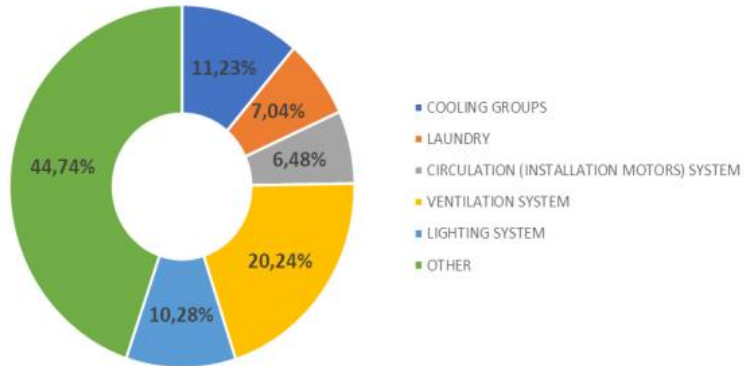
1. Can we use Solar energy?
2. Can we integrate Heat Pump Technologies ,Radiative Cooling,District Cooling
3. Geothermal energy?
4. What kind of controls can we add?
5. Isolation control
6. Can we improve Ventilation systems (heat recovery units)
7. Are the plants and the secondary equipments efficient?
8. Other low cost-no cost solutions

# MECHANICAL SYSTEM AND ENERGY CONSUMPTION RATES

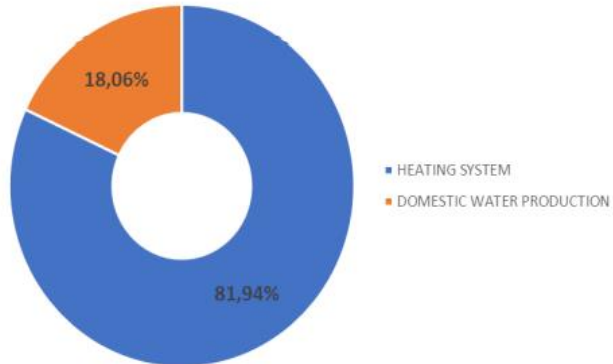
## Energy Consumption

The shares of energy-consuming components in total energy consumption were determined. Projected consumption rates are given below.

Graphic 2 ELECTRICITY CONSUMPTION RATES



Graphic 3 NATURAL GAS CONSUMPTION RATES



SYSTEM:

4-P FCU  
AIR HANDLING UNITS  
2 CHILLERS  
2 BOILERS  
SOLAR PANELS



# Energy Saving Scenarios

BASE, DEEP and MIXED scenarios

## 1- Replacing AC Chillers with a 1 Multi Compressor High Efficient AC Chiller

Chillers poor performance- 2nd chiller has compressor failure.

SEER: Increases from 2.5 to minimum 4.8



# Energy Saving Scenarios

## 2- Placing A Heat Pump Supporting Chiller and Boiler

# Building Bridges



Decided to exploit ground source energy by making drills to the well and exploit the energy of the ground water through a heat exchanger.

Ground source energy is used, ground water not used directly, given back to the ground.

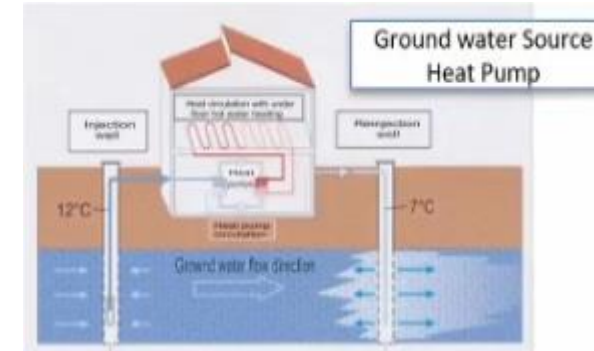
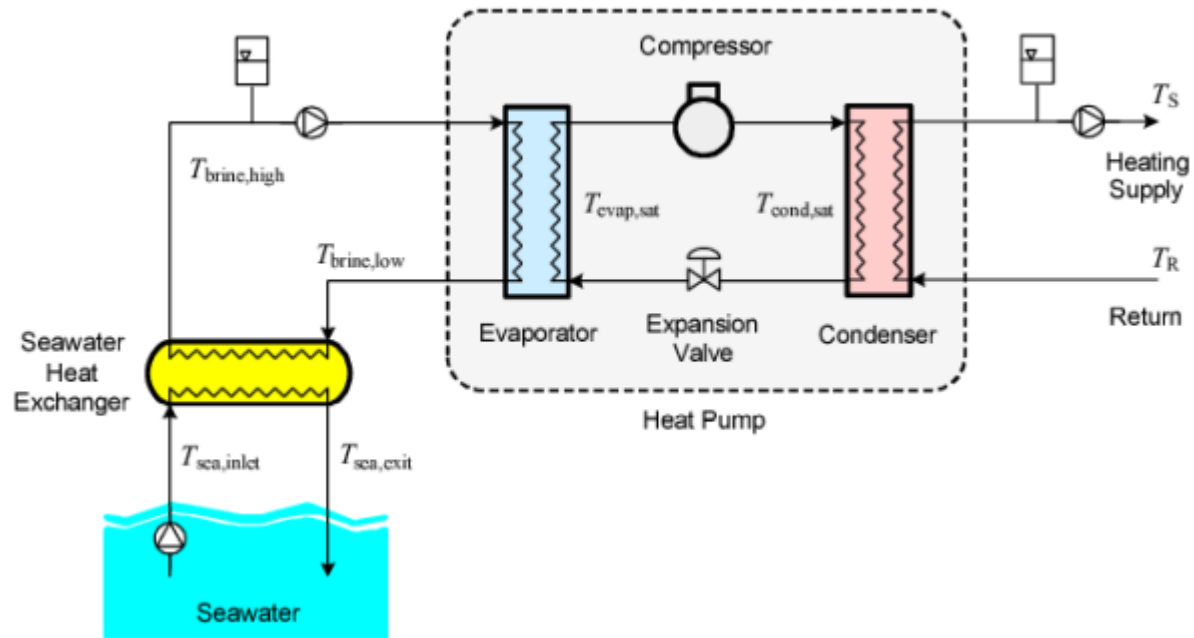
Closed-loop drilling system

Advantage: Water source  
Problem: Distribution System!!  
Solution: Ground Water!! Found 10-12m below surface  
Support the existing air conditioning system (boiler, chiller) with a ground water source heat pump (Hybrid System)



# Energy Saving Scenarios

## 2- System Schematics





# Energy Saving Scenarios



3- There are heat recovery units.  
Frequency Control is Added to Air  
Handling Units



4- LED Conversion

i 150 lighting fixtures are replaced by LED Fixtures

# Energy Saving Scenarios

## 5- Establishment of PV Panels

- Most of the Solar Panels are damaged.
- The Solar panels are not useful anymore



- 298 pieces were installed
- 150.300kwh electricity will be produced

# Energy Saving Scenarios

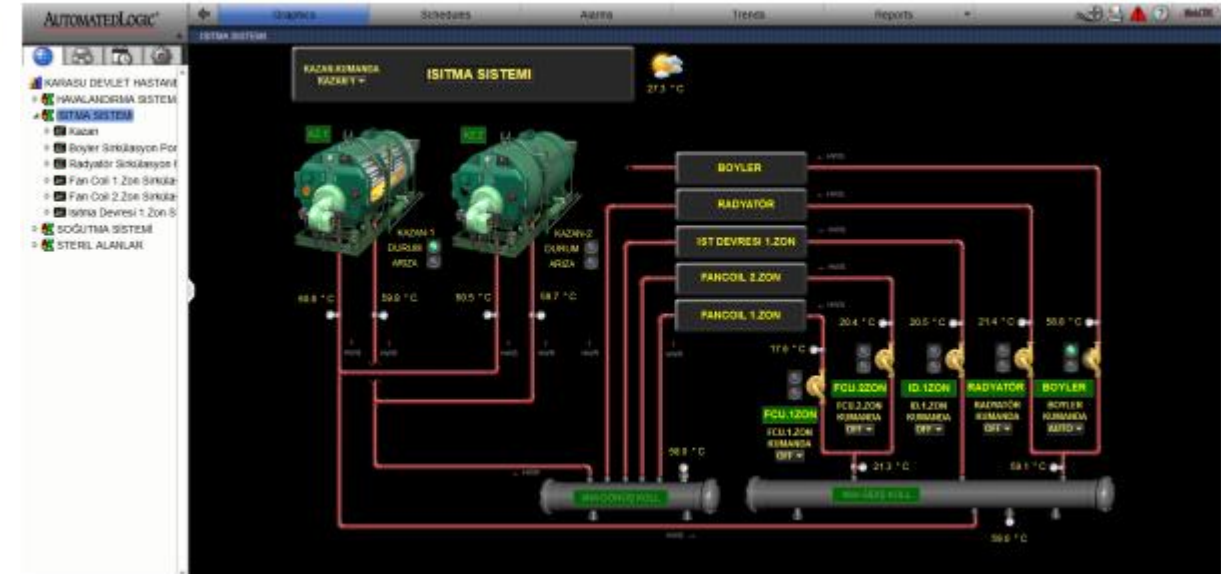
# Building Bridges

## 6- BUILDING MANAGEMENT SYSTEM IS ADDED

Resim 32 AUTOMATEDLOGIC® MERKEZİ HAVALANDIRMA ÜNİTESİ KONTROL PANELİ ÖRNEK GÖRSELİ (HKS-12)



Resim 34 AUTOMATEDLOGIC® MERKEZİ KAZAN KONTROL PANELİ ÖRNEK GÖRSELİ



## 7- PERSONNEL AND OPERATORS ARE TRAINED



MEASURE SEQUENCE NO	EEM	ENERGY TYPE	ESTIMATED ANNUAL ENERGY SAVINGS			EMISSION REDUCTION TON.CO <sub>2</sub>	ESTIMATED COST OF IMPLEMENTATION ₺	SIMPLE PAYBACK PERIOD YEAR	NET PRESENT VALUE (NBD) ₺	INTERNAL RATE OF RETURN (IRR) %
			Final Energy		Primary Energy					
			TOE/YEAR	₺/YEAR	TOE/YEAR					
K01	Replacing the defective Chiller with a high efficiency air-cooled replacement (1 air-cooled, screw compressor, frequency controlled with 600kW cooling capacity)	ELECTRICITY	5,81	₺162.395,80	8,04	41,51	₺2.601.599,85	16,02	₺157.514,46	15,57%
K02	Supporting existing air conditioning systems (Central boiler, chiller groups) with water source heat pump (400kW capacity well water source heat pump will be installed)	ELECTRICITY	-1,24	-₺32.592,59	-1,72	-0,0008	₺1.741.075,84	14,84	₺73.472,43	15,40%
		NATURAL GAS	47,65	₺149.878,14	47,65	111,93				
K03	Frequency control unit installation for all air handling units motors (28 frequency converters will be installed in existing power panels. Frequency converter power and numbers are given in Table 78 in this report.)	ELECTRICITY	6,89	₺180.604,41	9,53	49,20	₺381.889,54	2,11	₺1.851.130,20	57,42%
K04	Completion of LED conversions of existing lighting elements. A total of 808 luminaires will be replaced (60x60 Flush Mount LED Luminaire 617 Units; 30x120 Surface Mounted LED Luminaire 141 Units; 30x60 Recessed LED Luminaire 50 Units).	ELECTRICITY	5,19	₺136.056,80	7,18	37,06	₺688.653,90	5,06	₺777.319,66	26,91%

5%

35%

6%

5%



MEASURE SEQUENCE NO	EEM	ENERGY TYPE	ESTIMATED ANNUAL ENERGY SAVINGS			EMISSION REDUCTION TON.CO <sub>2</sub>	ESTIMATED COST OF IMPLEMENTATION ₺	SIMPLE PAYBACK PERIOD YEAR	NET PRESENT VALUE (NBD) ₺	INTERNAL RATE OF RETURN (IRR) %
			Final Energy		Primary Energy					
			TOE/YEAR	₺/YEAR	TOE/YEAR					
K05	Establishment of photovoltaic energy plant in the <b>park area</b> (300 pcs. Half-Cut Monocrystalline Panels will be installed on steel construction.Capacity 135kWp)	ELECTRICITY	14,93	₺391.385,01	20,65	106,62	₺5.817.567,56	14,86	₺745.677,87	16,19%
K06	Establishment and efficiency of the energy management system within the framework of EN ISO 50001 standard (Consultancy System)	NATURAL GAS	11,90	₺37.438,90	11,90	27,96	₺2.941.259,12	8,63	₺1.566.756,98	20,58%
	Building Management System (BMS), Digital Building Energy Management System, Automation System (Central boiler, chiller groups, heating, cooling circulation system, Re-circulation pumps, air conditioning units, operating room, intensive care units, monitoring, control and intervention)	ELECTRICITY	11,57	₺303.241,99	16,00	82,60				
<b>TOTAL:</b>			102,71	<b>1.328.408,46</b>	119,24	456,88	<b>14.172.045,81</b>	10,67	-	-
<b>Total Energy Saving [%]</b>			<b>38,47%</b>							

15%

12%

11%

# HIGH SCHOOL PROJECT



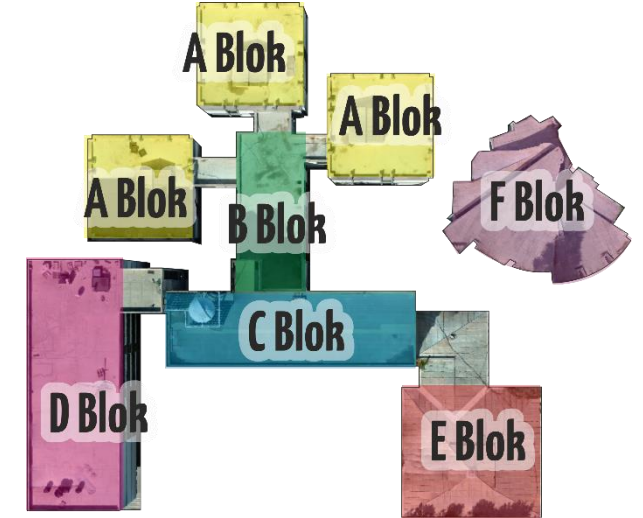
Öğretmen Sayısı : 43  
Derslik Sayısı : 17  
Atölye + Lab. Say. : 7

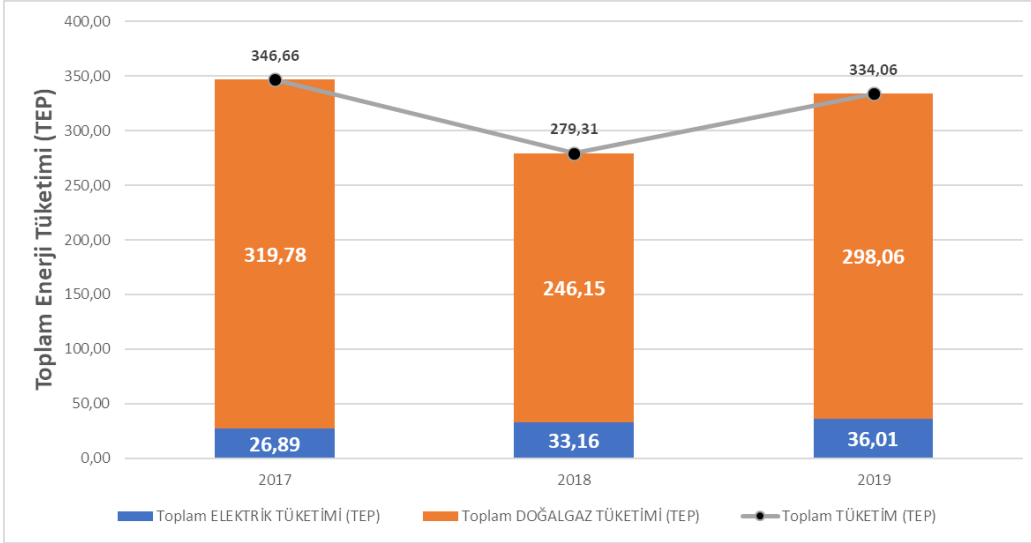
Toplantı Salonu : 1  
Konferans Sal. : 1  
Öğrenci Sayısı : 482

- Existing Building
- Project Goal: Find out solutions approach NZeb, verify by simulation
- Climate: Ankara.
- The Consumption Rates:

Electricity Consumption : 372,000 Kwh

Natural Gas Consumption: 349,000 m<sup>3</sup>





	U <sub>WALL</sub> W/m²k	U <sub>ROOF</sub> W/m²k	U <sub>WINDOW</sub> W/m²k
RECOMMENDED U VALUE	0,500	0,300	2,400
FEN LİSESİ MERKEZ BİNA DONATISIZ DUVAR (DIŞ HAVAYA AÇIK) 30 cm	2,842	-	-
FEN LİSESİ MERKEZ BİNA DONATISIZ DUVAR (DIŞ HAVAYA AÇIK) 25 cm	3,110	-	-
FEN LİSESİ MERKEZ BİNA DONATILI DUVAR (DIŞ HAVA AÇIK) 30 cm	3,448	-	-
FEN LİSESİ MERKEZ BİNA DONATILI DUVAR (TOPRAĞA TEMAS) 30 cm	4,000	-	-
KÜLTÜR MERKEZİ DONATISIZ DUVAR (DIŞ HAVA AÇIK) 30 cm	1,149	-	-
KÜLTÜR MERKEZİ DONATILI DUVAR (DIŞ HAVAYA AÇIK) 30 cm	1,149	-	-
KÜLTÜR MERKEZİ DONATILI DUVAR (TOPRAĞA TEMAS) 30 cm	4,000	-	-
YEMEKHANE BİNASI TUĞLA DUVAR (DIŞ HAVAYA AÇIK) 25 cm	0,641	-	-
YEMEKHANE BİNASI DONATILI DUVAR (DIŞ HAVAYA AÇIK) 35 cm	3,704	-	-
YEMEKHANE BİNASI DONATILI DUVAR (TOPRAĞA TEMAS) 35 cm	3,502	-	-
FEN LİSESİ MERKEZ BİNA TERAS ÇATI BÖLÜMLERİ	-	3,876	-
FEN LİSESİ MERKEZ BİNA KIRMA ÇATI BÖLÜMLERİ	-	4,274	-
KÜLTÜR MERKEZİ KIRMA ÇATI	-	3,448	-
YEMEKHANE TERAS ÇATI	-	3,545	-
4x12x4 PENCERE (ALÜMİNYUM DOĞ.)	-	-	3,700
4x16x4 PENCERE (ALÜMİNYUM DOĞ.)	-	-	3,600
TEK CAM (ALÜMİNYUM DOĞ.) <sup>58</sup>	-	-	5,900

1- Envelope: Wall- isolation varies between 2 to 3 cm.

no isolation on reinforced concrete

Roof- 2cm isolation

Window- 1 Layer- no film, frames aluminum, high infiltration

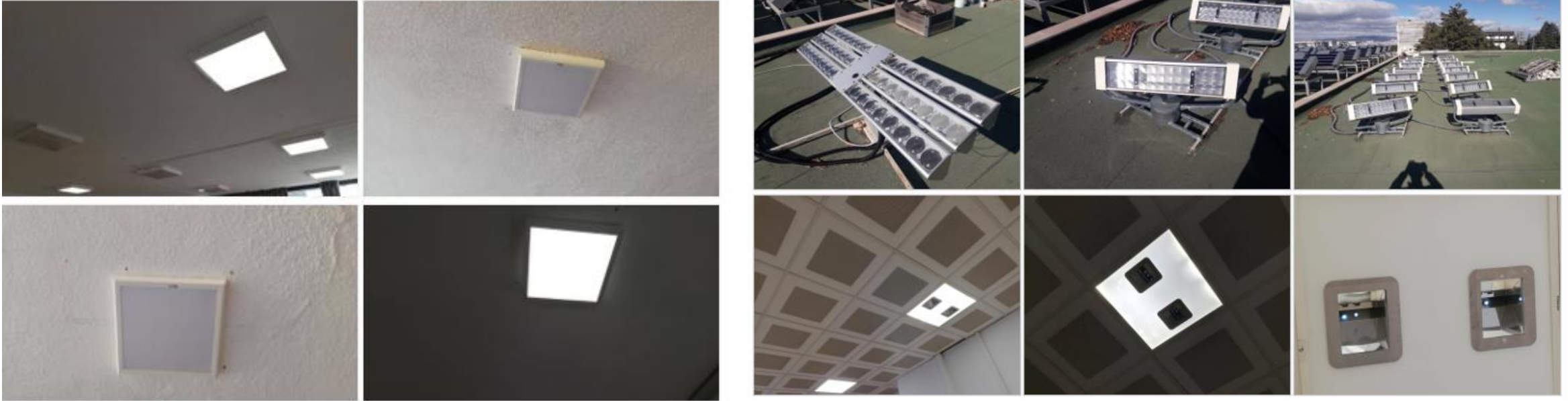


Solution : Wall- 16 cm isolation  
Roof- 20cm isolation  
Window- 3 Layers- 0,99W/m2K U value



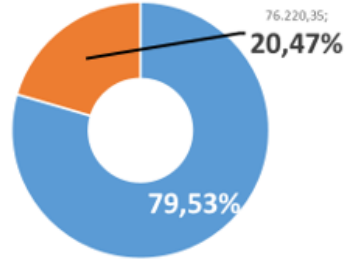


## 2- LED and Solar Fixtures Transformation

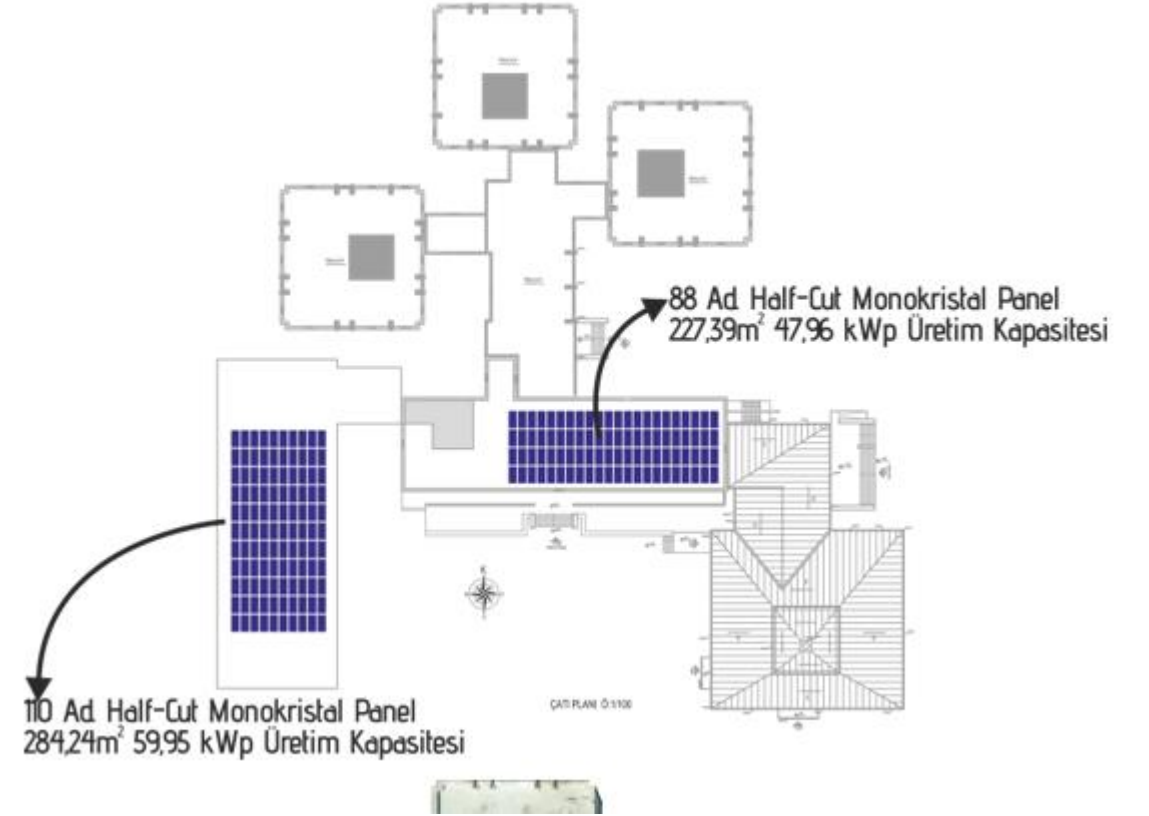


### 3- Replacing Electrical motors with high tech efficient motors

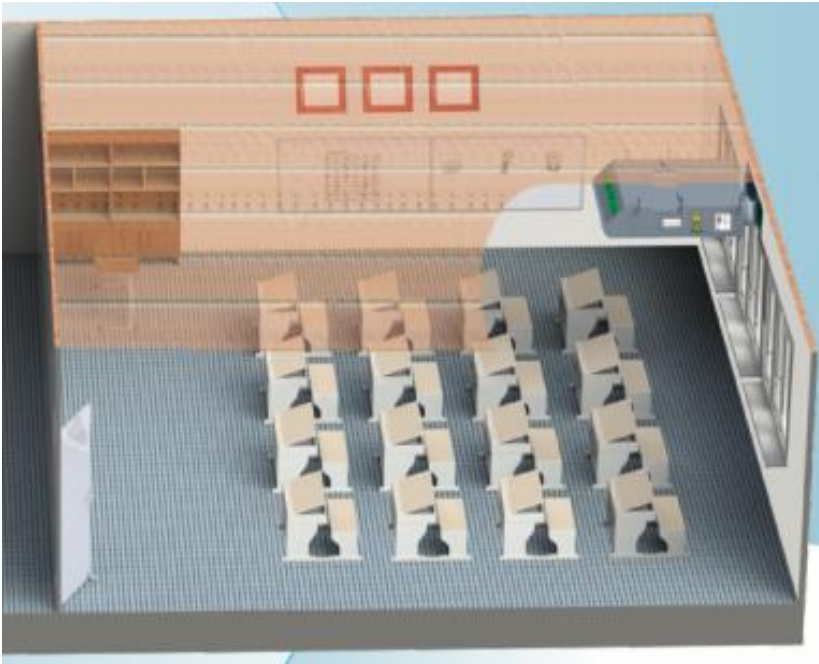
TOPLAM ELEKTRİK TÜKETİMİ (A) (kWh)	ÖLÇÜM YAPILAN MOTORLARIN YILLIK ELEKTRİK TÜKETİMİ (B) (kWh)	ORAN (%)
372.291,58	76.220,35	20,47%



## 4- PV SYSTEMS on The Roof



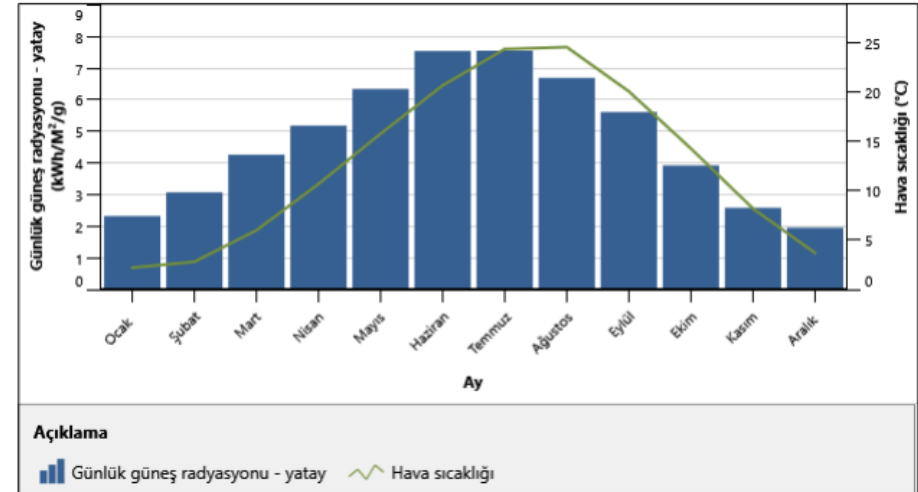
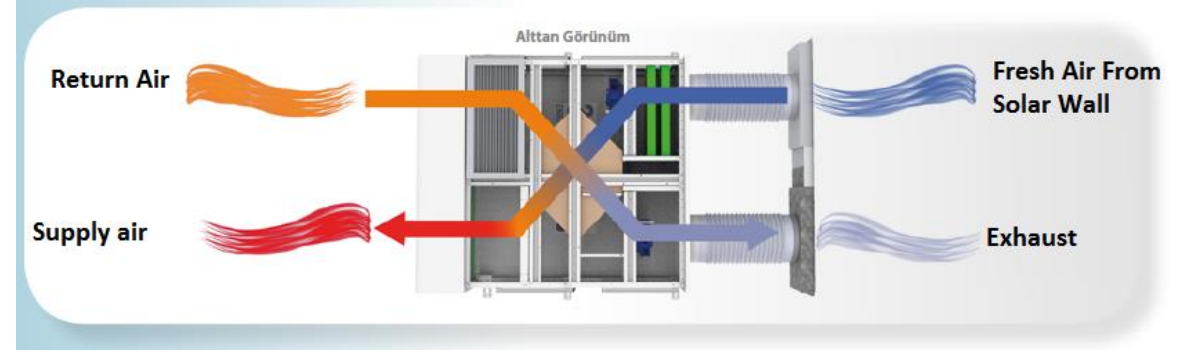
## 5- Heat Recovery Units to the Classrooms



- With 2 Phase electric heater 2kW + 2kW that operates due to demand



## 6- Solar Wall



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				NO SW						
Month	Ambient Temp	SolarWall Exit Temp	Efficiency	Indoor Air	Heat Recovery Exhaust Temp	Supply Temp	Air Flow	Ort. Isıl Güç	Monthly use	Monthly Electricity Consumption
	°C	°C	%	°C	°C	°C	m3/h	kW	hours	kWh
JANUARY	-10		0,75	20	12,5	21	1000	3	300	863
FEBRUARY	-3		0,75	20	14,3	21	1000	2	300	682
MARCH	0		0,75	20	15,0	21	1000	2	300	605
APRİL	5		0,75	20	16,3	21	1000	2	300	477
MAY										
JUNE										
JULY										
AUGUST										
SEPTEMBER										
OCTOBER	5		0,75	20	16,3	21	1000	2	300	477
NOVEMBER	0		0,75	20	15,0	21	1000	2	300	605
DECEMBER	-10		0,75	20	12,5	21	1000	3	300	863
									Toplam	4570
				SW SYSTEM						
Month	Ambient Temp	SolarWall Exit Temp	Efficiency	Indoor Air	Heat Recovery Exhaust Temp	Supply Temp	Air Flow	Ort. Isıl Güç	Monthly use	Monthly Electricity Consumption
	°C	°C	%	°C	°C	°C	m3/h	kW	hours	kWh
JANUARY	-10	-2,00	0,75	20	14,5	21	1000	2	300	656
FEBRUARY	-3	5,00	0,75	20	16,3	21	1000	2	300	477
MARCH	0	8,00	0,75	20	17,0	21	1000	1	300	401
APRİL	5	13,00	0,75	20	18,3	21	1000	1	300	274
MAY										
JUNE										
JULY										
AUGUST										
SEPTEMBER										
OCTOBER	5	13,00	0,75	20	18,3	21	1000	1	300	274
NOVEMBER	0	8,00	0,75	20	17,0	21	1000	1	300	401
DECEMBER	-10	-2,00	0,75	20	14,5	21	1000	2	300	656
									Toplam	3139
									SAVING	31,31%

	ENERGY EFFICIENCY MEASURE (EEM)	ENERGY SOURCE	ESTIMATED ANNUAL ENERGY SAVING (kWh)	ESTIMATED ANNUAL ENERGY SAVING (TOE)	RATIO OF SAVING TO BASE ENERGY CONSUMPTION %	ESTIMATED ANNUAL COST SAVING (₺)	EMISSION REDUCTION (ton CO <sub>2</sub> )
B01	Pencerelerin tamamının 0,99W/m <sup>2</sup> K ısı geçirgenlik katsayısına sahip ikameleri ile birebir değişiminin sağlanması, Çatıların tamamına 20 cm mineral yünü (Isıl İletkenlik değeri 0,035W/mK) ısı yalıtımı tesisi (Dışardan)	NATURAL GAS	341.709,70	26,5	8,28%	₺83.377,17	62,24
B02	Tesisat yalıtımının yenilenmesi, yalıtımsız bağlantı elemanlarının tamamına termal yalıtım tesisi edilmesi.	NATURAL GAS	19.314,03	1,5	0,47%	₺4.712,62	3,52
B03	LED dönüşümü gerçekleştirilmeyen armatürlerin tamamının LED dönüşümlerinin gerçekleştirilmesi. (Bu kapsamda farklı tiplerde 234 Ad. armatür değişimi gerçekleştirilecektir.)	ELEKTRİK	2.724,77	0,23	0,07%	₺6.141,63	1,67
B04	Verim sınıfı belirlenemeyen ve Verim sınıfı IE2 olan motorların (Asıl) IE3 sınıfı motorlar ile değiştirilmesi. (Bu kapsamda toplam 7 Ad. motor değişimi gerçekleştirilecektir.)	ELEKTRİK	3.107,63	0,27	0,08%	₺7.004,60	1,91
	Merkez Bina D Blok ve Ek Derslik Binası E						

26%

1,5%

0,25%

0,3%

B05	Merkez Bina D Blok ve Ek Derslik Binası E Blok teras çatı üzerine PV ünitelerinin (198 Ad. Half-Cut Monokristal Panel) tesisi ile güneşten elektrik üretiminin sağlanması (Toplam Üretim Kapasitesi 107,91kW <sub>p</sub> , Toplam yüzey alanı:511,63m <sup>2</sup> )	ELEKTRİK	150.234,40	12,92	4,04%	₺307.406,94	92,24	13%
B06	Profesyonel seviyede enerji yönetim sisteminin kurulması ve etkinliğinin sağlanması.	ELEKTRİK	3.722,92	0,32	0,10%	₺8.391,45	2,29	0,3%
B07	SIMPLEMENTING SOLAR WALL	NATURAL GAS	450.400,00	4,5	1,41%	₺14.157,45	10,57	4,5%
TOTAL		ELEKTRİK	151.822,68	13,06	4,08%	₺310.986,91	93,22	
		NATURAL GAS	419.046,07	32,49	10,15%	₺102.247,24	76,33	
RATIO OF TOTAL SAVINGS TO TOTAL BASED CONSUMPTION				14,23%				



## What do we get ?

1. Buildings with (very) low energy use
2. Buildings, which consumes energy and generates energy from renewable sources ("prosuming" buildings)
3. Buildings, in which the annual balance between consumption and generation is close to zero (near zero, net zero or plus)
4. Buildings, which is connected to energy infrastructure and interact with it

Thank you for your attention



# Building Bridges

