

PaIGBC NEW OFFICE BUILDING – RETROFIT PROJECT

Energy Modeling Report

Submitted To: Palestine Green Building Council (PaIGBC)

Date: November, 2022

HB

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EXECUTIVE SUMMARY

This report presents energy modeling results for PalGBC new rented office. The office is located in an old building in Al-Bireh city. It consists of two floors only, the basement (GF) and the first floor. The PalGBC office occupies the first floor.

In the first stage, the architect developed the as-built documents that include all existing building components, with detailed specifications. Then, retrofitting ideas were developed, that are; insulating external walls and roof, replacing existing walls and windows, and retrofitting lighting system from fluorescent to LED. To do the comparison and estimate the retrofit savings, two building models were developed using HAP 4.9 software, which are, pre-retrofit (baseline) and post-retrofit.

Electrical energy is the main energy source of the building while the existing systems were classified into HVAC and Non-HVAC components.

By comparing the final results of pre and Post-retrofit conditions, it was observed that reasonable savings in term of annual costs and consumed energy quantities can be achieved.

The normalized annual costs of considering the investment in HVAC higher efficiency units reduced both cooling and heating annual costs from 5.6\$/m² and 6.1\$/m² to 4.5\$/m² and 5.3\$/m², respectively, and after considering all lighting and building envelope other retrofits, these figure decreased to 3.1\$/m² and 2.7\$/m², respectively. The non-HVAC annual consumption went down from 20.9\$/m² to 17.5 \$/m². Finally, the total annual consumption decreased from 32.6\$/m² to 23.3 \$/m². Overall, the estimated energy baseline cost is 5,441 \$/year, that represents the building consumption before implementing any of the proposed energy efficiency improvement alternatives, while this value will decrease to 3,884 \$/year in case of applying all alternatives, which is about 28.6% saving of the annual expenses.

INTRODUCTION

Energy modelling is known as a virtual, computerized simulation of a building or complex envelopes. It focuses on energy consumption of all demanded systems, including HVAC, lighting, hot water, office equipment, and occupant behavior and activities. Energy models simulate the occupant's behavior and resulted consumption process. It is used for residential houses, commercial building and industrial complex. It can be used for individual building and also scaled up to urban area.

Due to overall global imbalances between the demand and supply of fossil fuels and natural resources, as well as the necessity to mitigate global climate change and other energy related environmental impacts. Understanding the role energy plays in these global concerns requires an awareness of how energy is produced and consumed. Buildings consumes significant amount of energy on the global scale. In Palestine, buildings sector consumes about 50% of the total energy balance.

Building energy modelling is a powerful mathematical tool for engineers, which predict building energy use and systems performance. Different types of energy models can be developed at various stages of the building lifecycle. Achieved simulation results provide detailed insight for engineers about the building envelope performance, and enables them to propose, compare, and choose better alternatives to ensure economic viability and environment protection.

This report presents the results of modeling an old local building to be used as offices for Palestine Green Building Council in Ramallah. To do so, Hourly Analysis Program (HAP 4.9) is used. It includes detailed description of the building components, its intended usage, and estimated performance from energy consumption point of view.

LOCAL WEATHER DATA

The building is located in Ramallah and Al-Bireh governorate, specifically in Al-Bireh city. Table (1) presents the design parameters, the most recent weather data available in (<http://ashrae-meteo.info/v2.0/>) were considered. That is credible in the field of buildings simulation and HVAC design worldwide. The building weather design's main parameters are summarized in Table (1) below.

Table 1: Building weather design main parameters.

City Name	Ramallah & Al-Bireh
Location	Palestine
Latitude	31.9 Deg
Longitude	-35.2 Deg.
Elevation	759.0 m
Summer Design Dry-Bulb	31.8 °C
Summer Coincident Wet-Bulb	18.3 °C
Summer Daily Range	10.4 °K
Winter Design Dry-Bulb	2.2 °C
Winter Design Wet-Bulb	-2.5 °C
Atmospheric Clearness Number	1.00
Average Ground Reflectance	0.20
Soil Conductivity	1.385 W/(m.°K)
Local Time Zone (GMT +/- N hours)	-2.0 hours
Consider Daylight Savings Time	Yes
Daylight Savings Begins	April, 1
Daylight Savings Ends	October, 31
Simulation Weather Data	Ramallah & Al-Bireh (Avg)
Current Data is	User Modified
Design Cooling Months	June to September

Other necessary design parameters are the dry-bulb and solar radiation variability around the year, these data are presented in Tables (2 & 3).

*Table 2: Dry-Bulb Temperature Statistics (*C)*

Month	Absolute Max.	Average Max.	Average	Average Min.	Absolute Min.
January	12.2	12.2	7.7	3.9	3.9
February	13.2	13.2	8.6	4.4	4.4
March	15.5	15.5	10.5	6.1	6.1
April	22.8	22.7	15.6	9.4	9.4
May	28.3	28.3	20.6	13.9	13.9
June	30.6	30.5	22.8	16.1	16.1
July	31.6	31.6	24.5	18.3	18.3
August	32.2	32.2	24.8	18.3	18.3
September	31.1	31.1	23.3	16.7	16.7
October	27.2	27.2	20.1	13.9	13.9
November	21.1	21.1	15.1	10.1	10.1
December	15.0	15.0	9.9	5.6	5.6

Table 3: Daily Solar Radiation Statistics

Month	Daily Total Solar on Horizontal (kJ/m ²)			Daily Clearness Number (dimensionless)		
	Maximum	Average	Minimum	Maximum	Average	Minimum
January	12011.3	10903.9	10087.2	0.538	0.538	0.537
February	14513.5	13036.9	11712.1	0.520	0.519	0.520
March	20077.9	18308.6	16429.2	0.587	0.586	0.584
April	23902.0	22579.3	21073.8	0.618	0.615	0.613
May	27715.1	27104.7	26157.8	0.674	0.675	0.674
June	30573.9	30492.2	30266.8	0.737	0.737	0.736
July	30924.4	30368.6	29618.0	0.748	0.747	0.745
August	28325.2	27007.8	25474.4	0.716	0.714	0.711
September	25453.2	23599.9	21752.3	0.713	0.712	0.716
October	20116.9	18012.7	15956.2	0.667	0.664	0.662
November	14988.6	13485.8	12300.2	0.627	0.626	0.628
December	10773.9	10391.1	10224.1	0.553	0.554	0.553

The simulation model took into consideration the year 2022. So, the 1st of January was considered as Saturday, and the year estimated holidays are as described in Table (4).

Table 4: Simulation considered holiday, 2022

Jan	1			
Feb	28			
May	1	2	3	
Aug	9	10	11	30
Oct	8			
Nov	15			
Dec	25			

In addition, it is important for HVAC design and load estimation to understand the maximum weather conditions. the 15th of July is considered so in the presented simulation. Figures (1 & 2) present dry and wet bulb temperatures and solar radiation profiles for this day specifically.

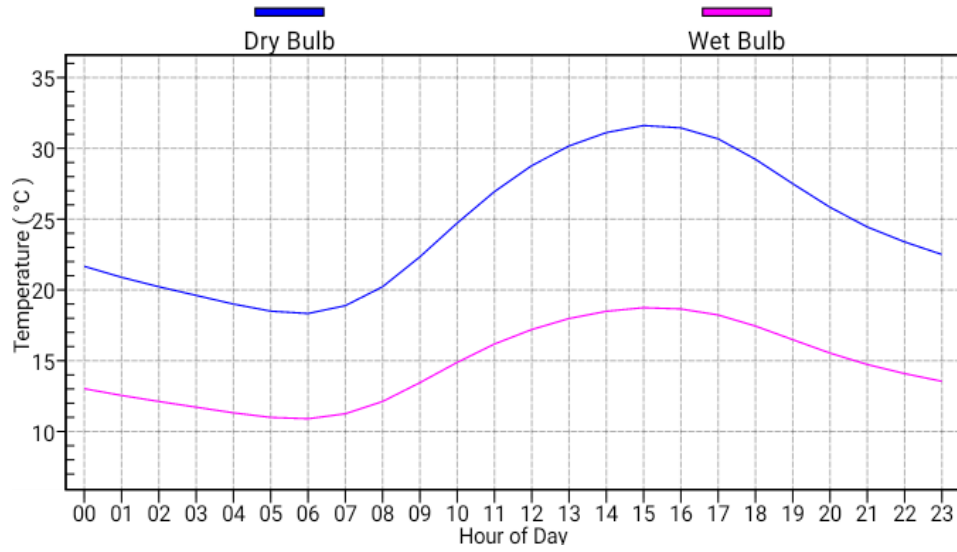


Figure 1: Temperature Profiles for Friday, July 15 (day 196) thru Friday.

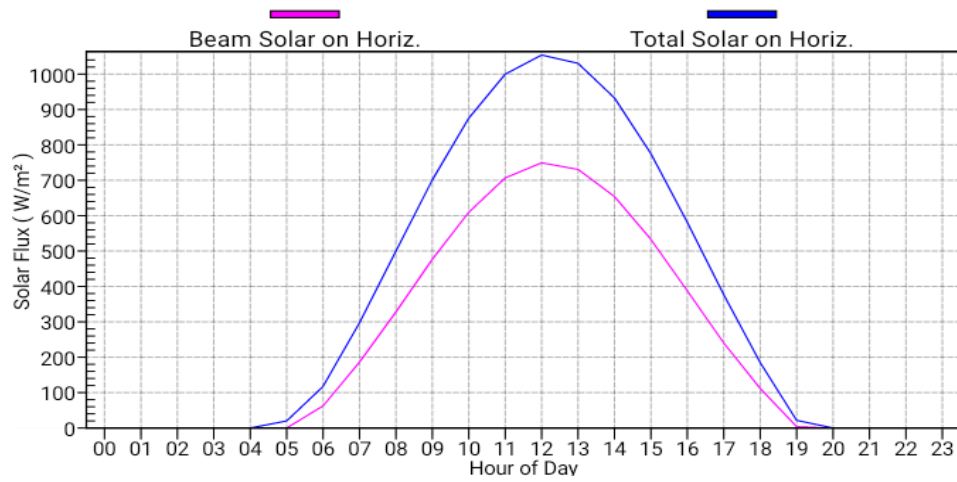


Figure 2: Solar Profiles for Friday, July 15 (day 196) thru Friday.

BUILDING DESCRIPTION

As mentioned before, the building is an old one; it is composed of basement (GF) and first floor only. The basement is used for commercial units, while the first floor the is the targeted space in this report modeling and simulation. Figure (3) shows the building location and neighborhood, it can be noticed that the building nearby urban does not form shading on it. Therefore, solar water heater and PV panels can be installed on the rooftop.



Figure 3: Building location map.

The targeted first floor internal design details are very important for insuring accurate modeling and simulation results. Figures (4&5) show the internal spaces usage, its dimensions, and building envelope necessary dimensions, which are windows, doors and external walls.

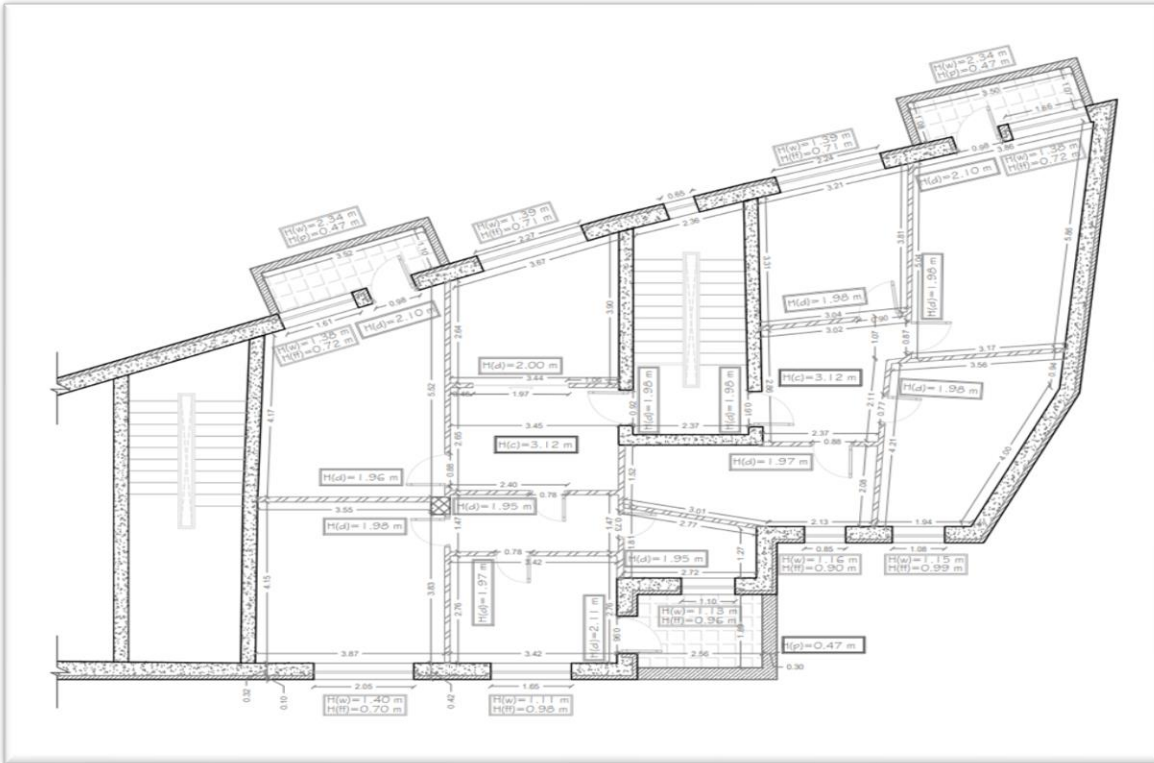


Figure 4: Building shell components and internal spaces dimensions.

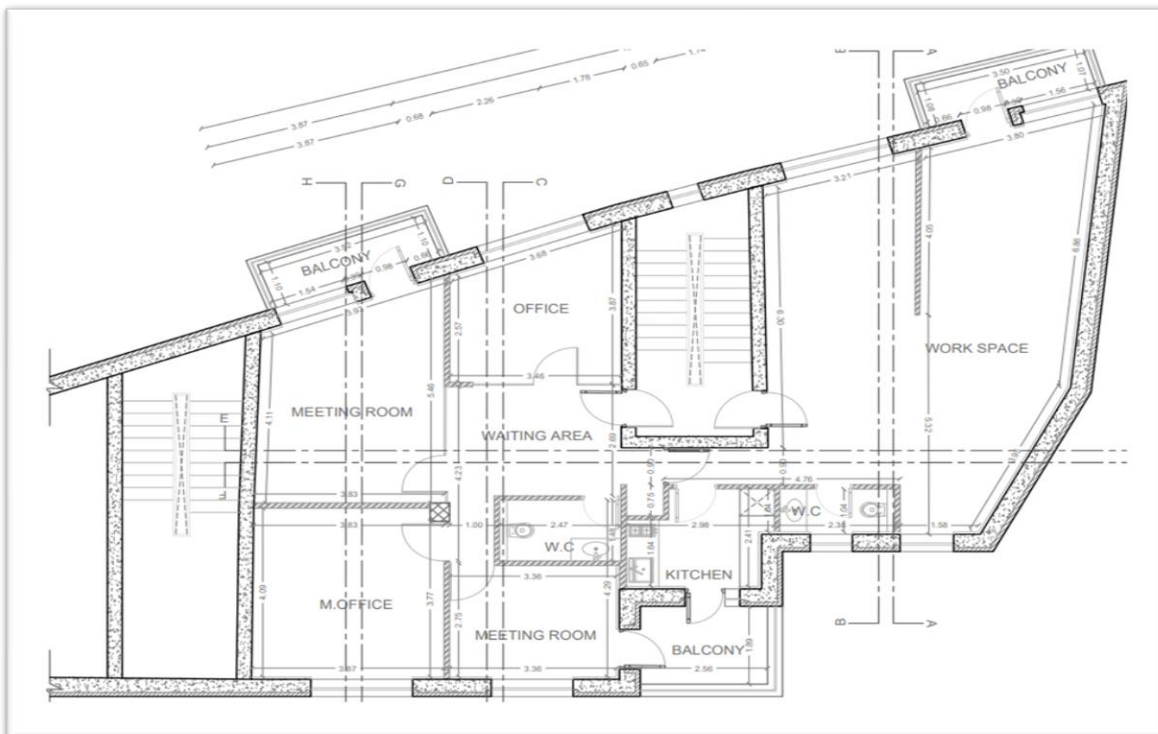


Figure 5: Building internal spaces division and intended usage.

For building the model, it is necessary to identify the dimensions and thermal properties of the building components, tables (5–7) show building envelope walls, doors, and windows properties, respectively. Table (5) presents the building shell external walls composite layers and its dimensions and the position and dimensions of included windows and doors. Moreover, it presents the overall heat transfer coefficient (U_{ov}) in $W/m^2 \cdot ^\circ C$, external and internal thin air film thermal resistance is considered $0.06 m^2 \cdot ^\circ C / W$ and $0.12 m^2 \cdot ^\circ C / W$, respectively. For the post-retrofit specifications, adding 2 cm of polyurethane insulation (thermal conductivity = $0.02 W / m K$) will add 1.0 thermal resistance to external walls. Leads that the U_{ov} values for external walls, with and without stones changed from 2.444 and 2.597, to 1.336 and 1.381, respectively. Similarly, adding 3 cm of polyurethane insulation to the roof changed the U_{ov} value from 3.603 to 2.137. For windows, before the overall heat transfer coefficients are 5.6 and $3.2 W/m^2 \cdot ^\circ C$ for pre-retrofitting (metal and single glass) and post-retrofitting (Aluminum and double glass), respectively. In the same context, wood, steel, multi-lock, and glass doors overall heat transfer coefficients are $2.7 W/m^2 \cdot ^\circ C$, $5.8 W/m^2 \cdot ^\circ C$, $2.3 W/m^2 \cdot ^\circ C$, and $5 W/m^2 \cdot ^\circ C$, respectively.

Table 5: Building envelope dimensions and properties

Wall #	Orientation	Length × height	Layers	Thermal conductivity (W / m. K)	U_{ov} including air thin film resistance $W/m^2 \cdot ^\circ C$	Included windows	Included doors
1	South – West	18.3×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438	W01, W02, W03, W04, & W09	D02 (2 items)
2	North	6.86×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438		
3	North – East	3.95×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438		
4	East	4.25×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438	W07 & W08	
5	North	1.33×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438		
6	East	2.86×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438		D08
7	North	2.19×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438		D07
8	East	7.93×3.12	0.3 concrete 0.07 stone	1.75 1.70	2.438	W05 & W06	
9	South (exposed to the next building stairs)	9.06×3.12	0.3 concrete	1.75	2.846		
Stairs1		5.22×3.12	0.3 concrete	1.75	2.846		D09 (same D01)
Stairs2		6.17×3.12	0.3 concrete	1.75	2.846		D09 (same D01)
Stairs3		2.77×3.12	0.3 concrete	1.75	2.846		
Roof		$170 m^2$	0.17		3.603		

Table 6: Building doors dimensions and properties

Label	H (m)	W (m)	Area (m^2)	# of units	Type
D01	2.00	0.9	1.8	2	Multi-lock
D02	2.00	1.0	2	2	Multi-lock
D03	2.00	0.9	1.8	1	Multi-lock

D04	2.00	0.8	1.6	2	Wooden
D05	2.00	0.9	1.8	1	Wooden
D06	2.00	0.9	1.8	4	Glass (internal)
D07	2.00	0.95	1.9	1	Multi-lock
D08	2.00	0.8	1.6	1	Multi-lock
D09	2.00	0.9	1.8	2	Glass
D10	2.34	1.3	3.042	1	Multi-lock

Table 7: Building windows dimensions and properties.

Label	H(m)	W(m)	Area (m ²)	# of units
W01	1.38	1.66	2.29	1
W02	1.39	2.24	3.11	1
W03	1.39	2.27	3.16	1
W04	1.38	1.61	2.22	1
W05	1.40	2.05	2.87	1
W06	1.11	1.56	1.73	1
W07	1.16	0.85	0.99	1
W08	1.15	1.08	1.24	1
W09	5.72	0.65	3.72	1

BUILDING OCCUPANCY AND SYSTEMS ON/OFF SCHEDULE

Energy consumption happens when there are some activities inside the building; therefore, understanding the occupancy, lighting, and HVAC schedule is essential to estimate every system consumption. Table (8) presents the occupancy schedule over 24 hours per typical day, it was divided essentially into working and holiday schedules (On/Off days). The value zero represent that the building is empty while 100% represent that the building is under full occupancy. Table (9) presents the year-round occupancy schedule, where the letters “O” stands for occupied and ‘U’ unoccupied state. The lighting and HVAC schedules were defined similarly. Finally, instantaneous electric boiler with 1kW capacity is considered for winter season water heating demand, its schedule is assumed as 1.5 hours per day in winter season.

Table 8: Occupancy working days schedule.

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
On	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0

Table 9: Occupancy working days schedule around the year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	O	O	O	O	O	O	O	O	O	O	O	O
Monday	O	O	O	O	O	O	O	O	O	O	O	O
Tuesday	O	O	O	O	O	O	O	O	O	O	O	O
Wednesday	O	O	O	O	O	O	O	O	O	O	O	O
Thursday	O	O	O	O	O	O	O	O	O	O	O	O
Friday	U	U	U	U	U	U	U	U	U	U	U	U
Saturday	U	U	U	U	U	U	U	U	U	U	U	U
Sunday	O	O	O	O	O	O	O	O	O	O	O	O
Holiday	U	U	U	U	U	U	U	U	U	U	U	U

EXTERNAL WALLS AND ROOF CONSTRUCTION DESCRIPTION

Building external walls can be divided into two main categories, which are with and without stone on the external layer. Table (10) shows the data of the common type, which is with stone, its color is medium. This wall has an absorptivity value of 0.675, and calculated overall heat transfer coefficient of 2.444 W/(m².°K). The other type which is without stone and separate the building from its neighborhood buildings data is presented in Table (11), where the color and absorptivity are considered the same, while the overall heat transfer coefficient became 2.597 W/(m².°K).

Table 10: External walls (with stone) model input data.

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² -°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
stone	70.000	1750.0	0.75	0.04130	122.5
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	400.000	-		0.40915	914.5

Table 11: External walls (without stone) model input data.

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² -°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
plaster	30.000	2400.0	0.75	0.01714	72.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	330.000	-		0.39000	792.0

For the roof construction data, the absorptivity and external color are considered the same, 0.675 and medium, respectively. The detailed construction data is presented in table (12), where the overall heat transfer coefficient equals to 3.603 W/ (m². °K).

Table 12: Roof model input data.

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² -°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Solid slab	170.000	2242.6	0.84	0.09822	381.2
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	170.000	-		0.27750	381.2

Finally, for the building internal walls, color is considered as light, absorptivity equals to 0.450, and overall heat transfer coefficient is 2.731 W/ (m². °K). Its detailed construction model input data is presented in Table (13).

Table 13: Internal wall model input data.

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² -°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
102mm HW concrete block	101.600	977.1	0.84	0.12490	99.3
Outside surface resistance	0.000	0.0	0.00	0.12064	0.0
Totals	101.600	-		0.36618	99.3

RETROFITTING ALTERNATIVES INITIAL SCREENING

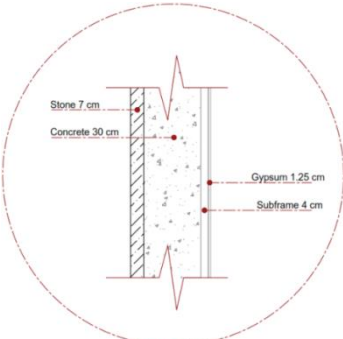
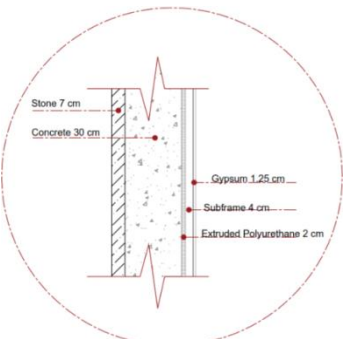
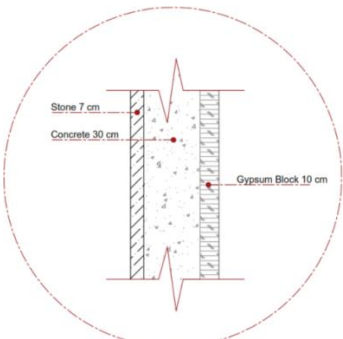
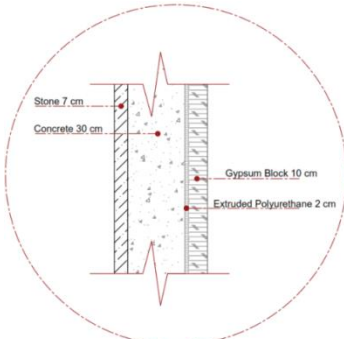
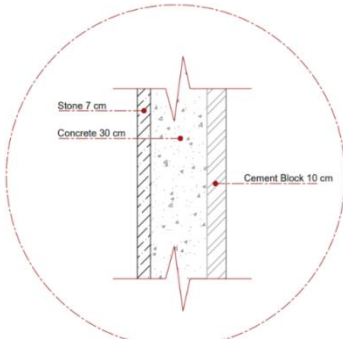
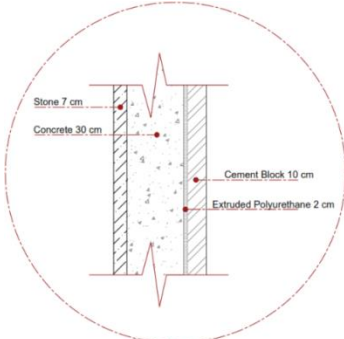
In the design stage, many retrofitting alternatives were considered, that were classified into direct energy consumers, and significant influencers. The direct energy consumers were the HVAC and lighting systems, while the influencers were the building envelope components. That includes external walls, roof, windows, and external doors. For doors, two alternatives were considered; metal doors and multi-lock doors. The second option was selected for security and energy efficiency purposes. Similarly, two alternatives were considered for windows, that were, retrofitting the current metallic frame with aluminum frame, either with single or double glaze, the aluminum frame alternative was considered for better building envelope tightness, and less thermal conductivity though, more efficient energy utilization. When choosing between single and double-glazing options, the second option was selected for both energy and noise reduction purposes. Especially that the building is located in a crowded street, with heavy traffic during the day.

The other building envelope important components were external walls and roof, here, different practical alternatives were considered with and without insulation layer. Then, the overall heat transfer coefficient was calculated for each alternative. Table 14 shows all considered alternatives with detailed description of the composite layers.

After determining all practical potential alternatives, estimated percent savings in energy consumption were calculated using equation 1. All estimated savings are provided in table 15. It can be noticed from these calculations that savings will vary between 40% and 89% for the external walls, and between 16% and 84% for the roof, were two alternatives were considered, with one difference only, 2cm thickness of insulation. However, these values should not mistakenly lead to a conclusion that energy bills will be lower in the same percentage, since other HVAC consumption variables play vital role in determining the actual consumption, including air infiltration, ventilation, and inside heat generating activities.

$$\% \text{ saving} = \left(\frac{U_{ov\text{baseline}} - U_{ov\text{retrofit}}}{U_{ov\text{baseline}}} \right) \times 100\%$$

Table 14: building envelope external walls and roof considered insulation alternatives

External walls alternatives	
Without insulation	With insulation
 <p>Stone 7 cm Concrete 30 cm Gypsum 1.25 cm Subframe 4 cm</p> <p>$U = 0.43 \text{ W/m}^2.\text{C}^\circ$</p>	 <p>Stone 7 cm Concrete 30 cm Gypsum 1.25 cm Subframe 4 cm Extruded Polyurethane 2 cm</p> <p>$U = 0.30 \text{ W/m}^2.\text{C}^\circ$</p>
ExWa 1	ExWa 4
 <p>Stone 7 cm Concrete 30 cm Gypsum Block 10 cm</p> <p>$U = 1.39 \text{ W/m}^2.\text{C}^\circ$</p>	 <p>Stone 7 cm Concrete 30 cm Gypsum Block 10 cm Extruded Polyurethane 2 cm</p> <p>$U = 0.58 \text{ W/m}^2.\text{C}^\circ$</p>
ExWa 2	ExWa 5
 <p>Stone 7 cm Concrete 30 cm Cement Block 10 cm</p> <p>$U = 1.62 \text{ W/m}^2.\text{C}^\circ$</p>	 <p>Stone 7 cm Concrete 30 cm Cement Block 10 cm Extruded Polyurethane 2 cm</p> <p>$U = 0.62 \text{ W/m}^2.\text{C}^\circ$</p>
ExWa 3	ExWa 6

<p>Sloping Screed avg. 8cm Existing Solid Slab 17cm</p> <p>$U = 4.29 \text{ W/m}^2.\text{C}^\circ$</p>	<p>Sloping Screed avg. 8cm Extruded Polyurethane 3 cm Existing Solid Slab 17cm</p> <p>$U = 0.81 \text{ W/m}^2.\text{C}^\circ$</p>
Roof 1	Roof 2

Table 15: Estimated percent savings for each retrofit alternatives.

Alternative	U_{ov} Baseline	U_{ov} retrofit	% saving
Windows	5.60	3.20	43%
Doors	5.80	2.30	60%
ExWa1	2.72	0.43	84%
ExWa2	2.72	1.39	49%
ExWa3	2.72	1.62	40%
ExWa4	2.72	0.30	89%
ExWa5	2.72	0.58	79%
ExWa6	2.72	0.62	77%
Roof 1	5.08	4.29	16%
Roof 2	5.08	0.81	84%

From Table 15, it can be noticed that adding the insulation layer to either the roof of external walls has a significant effect on wasted energy due to thermal conduction. The thicker the layer, leads to higher estimated savings, but also higher initial investment and will result in losing some internal space. Therefore, a good compromise between initial investment and estimated savings should be taken into consideration; many local Palestinian studies claimed that the most optimal required thicknesses vary between 1 to 4cm. In all performed calculations and model simulations, defining alternatives' baselines are essential when calculating potential saved energy. For doors, the metallic door was considered as baseline, for windows, the single glaze metal frame window was considered as a baseline when calculating the energy savings. For roof, the old 17cm thickness solid slab was considered as the baseline, and finally, for external walls, the 7cm stone, and 30cm concrete composite wall layers were considered as the baseline.

When selecting the suitable retrofit alternative for the roof, Roof-2 alternative that contains 3cm extruded polyurethane layer was selected, it can provide as high as 84% energy saving compared to 16% that can be achieved by selecting Roof-1as alternative, the energy saved comes from reducing the heat transfer through the roof by conduction. Similarly, when selecting the most

suitable external wall alternative, ExWa1 was selected; it could achieve around 84% energy saving by reducing conduction heat transfer between wall inside and outside surfaces. In addition, ExWa1 alternative is within available budget compared to other competing alternatives.

PRE-RETROFIT (BASELINE) VS. POST-RETROFIT BUILDING PERFORMANCE SIMULATION

Pre-retrofit (baseline) and post-retrofit scenarios modeling have been conducted based on insulating external walls and roof, replacing existing doors and windows, investing in energy efficient HVAC units, and retrofitting lighting system from fluorescent to LED, which lead to reduce the annual cost side by side with the annual HVAC coil loads. This section presents the results of simulating pre-retrofit (baseline) versus post-retrofit scenarios and its economic effect. The annual cost before and after retrofit data is presented in Table 16 while the data of annual cost per unit floor area is presented in Table 17. It can be noticed that replacing standard HVAC equipment and installing higher efficiency units, resulted in 5.9% overall energy saving of the whole building annual consumption, and 16.4% saving of the annual HVAC system's consumption. Similarly, replacing standard fluorescent lighting system with LED energy efficient one resulted in 68.3% savings in lighting consumption, and 10.7% of overall energy consumption. And for building envelope components improvement, that are insulating walls and roof, and replacing windows and doors with higher efficiency types, resulted in 50.3% savings from the overall HVAC system's consumption, and 18% of electric bill's overall annual value.

Table 16: Annual costs of pre-retrofit vs post-retrofit models.

Component	baseline (\$)	Replacing HVAC system to energy efficient (\$)	Replacing lighting, HVAC, and retrofitting building envelope (\$)
Cooling	934	747	519
Heating	1,010	877	449
HVAC Sub-Total	1,945	1,625	967
Lights	851	851	270
Electric Equipment	2,646	2,646	2,646
Non-HVAC Sub-Total	3,497	3,497	2,916
Grand Total	5,441	5,122	3,884

Table 17: Annual cost per unit floor area of pre-retrofit vs post-retrofit models.

Component	baseline (\$/m ²)	Replacing HVAC system to energy efficient (\$/m ²)	Replacing lighting, HVAC, and retrofitting building envelope. (\$/m ²)
Cooling	5.594	4.475	3.107
Heating	6.050	5.254	2.687
HVAC Sub-Total	11.644	9.729	5.793
Lights	5.093	5.093	1.617
Electric Equipment	15.846	15.846	15.846
Non-HVAC Sub-Total	20.939	20.939	17.463
Grand Total	32.583	30.668	23.256
Gross Floor Area (m ²)	167.0	167.0	167.0
Conditioned Floor Area (m ²)	117.0	117.0	117.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 18 below summarizes the annual cost, annual cost per unit floor area based on the gross building floor area (167.0m²), and the cost percentage of each component.

Table 18: Component Cost as a Percentage of Total Cost

	Baseline	Replacing HVAC system to energy efficient	Replacing lighting, HVAC, and retrofitting building envelope.
Component	Percent of Total (%)	Percent of Total (%)	Percent of Total (%)
Air System Fans	0.0	0.0	0.0
Cooling	17.2	14.6	13.4
Heating	18.6	17.1	11.6
Pumps	0.0	0.0	0.0
Heat Rejection Fans	0.0	0.0	0.0
HVAC Sub-Total	35.7	31.7	24.9
Lights	15.6	16.6	7.0
Electric Equipment	48.6	51.7	68.1
Misc. Electric	0.0	0.0	0.0
Misc. Fuel Use	0.0	0.0	0.0
Non-HVAC Sub-Total	64.3	68.3	75.1
Grand Total	100.0	100.0	100.0

Table 19 represents overall summary of HVAC vs Non-HVAC loads. The retrofit activities resulted decrease of HVAC load percentage from 35.7% to 31.7 in case of investing in more energy efficient units, and to 24.9% in case of adopting all proposed retrofits. It means that the proposed building envelope improvement retrofits are effective.

Table 19: Annual costs of HVAC vs Non-HVAC of pre-retrofit vs post-retrofit models

	Baseline			Replacing HVAC system to energy efficient.			Replacing lighting, HVAC, and retrofitting building envelope.		
Component	Annual Cost (\$/yr)	(\$/m ²)	Total (%)	Annual Cost (\$/yr)	(\$/m ²)	Total (%)	Annual Cost (\$/yr)	(\$/m ²)	Total (%)
HVAC	1,945	11.644	35.7	1,625	9.73	31.7	967	5.79	24.9
Non-HVAC	3,497	20.939	64.3	3,497	20.94	68.3	2,916	17.46	75.1
Grand Total	5,441	32.583	100.0	5,122	30.67	100.0	3,884	23.26	100.0

Looking more deeply at HVAC load analysis, Table 20 presents kWh, and kWh/m² for both heating and cooling coils consumption.

Table 20: Annual HVAC coils load of pre-retrofit vs post-retrofit models

	Baseline		All interventions effects	
Component	Load (kWh)	(kWh/m ²)	Load(kWh)	(kWh/m ²)
Cooling Coil Loads	15,080	90.301	10,548	63.160
Heating Coil Loads	15,430	92.393	7,773	46.544
Grand Total	30,510	182.695	18,321	109.704

Monthly energy consumption variation of cooling, heating, lights and equipment in pre and post retrofit cases are shown in Figure 6 below while the monthly energy consumption variation of HVAC and non-HVAC are shown in Figure 7 below for the pre and post retrofit cases.

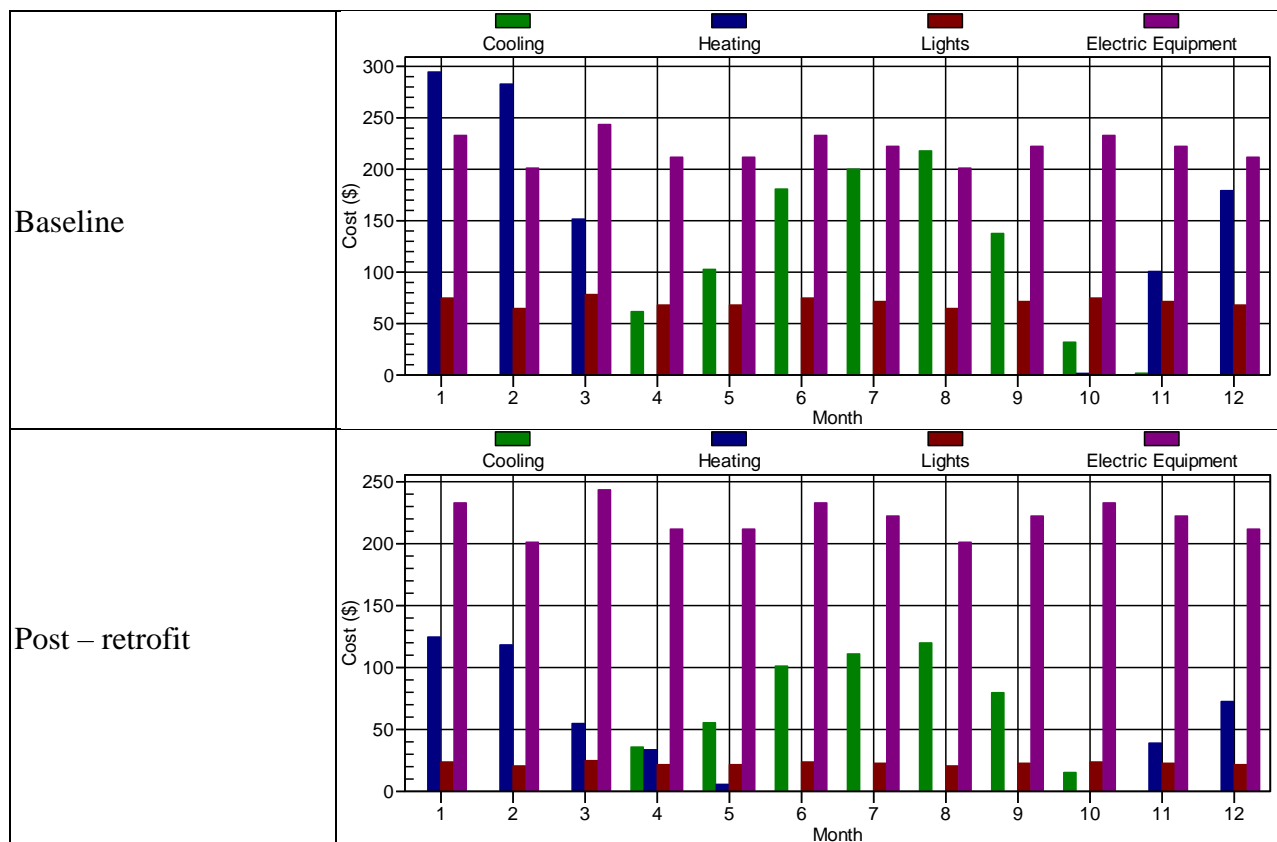
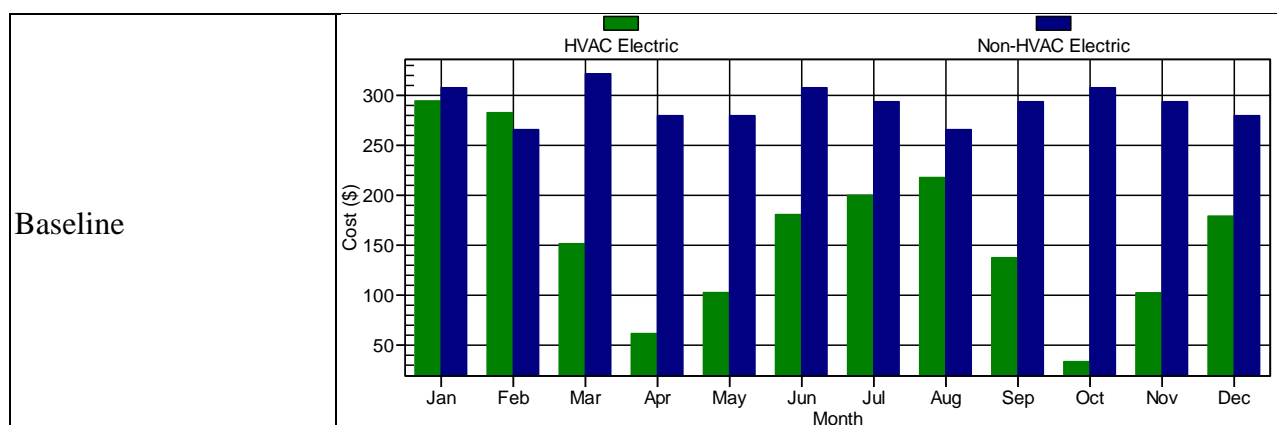


Figure 6: Monthly energy consumption variation cooling/heating/lights/equipment



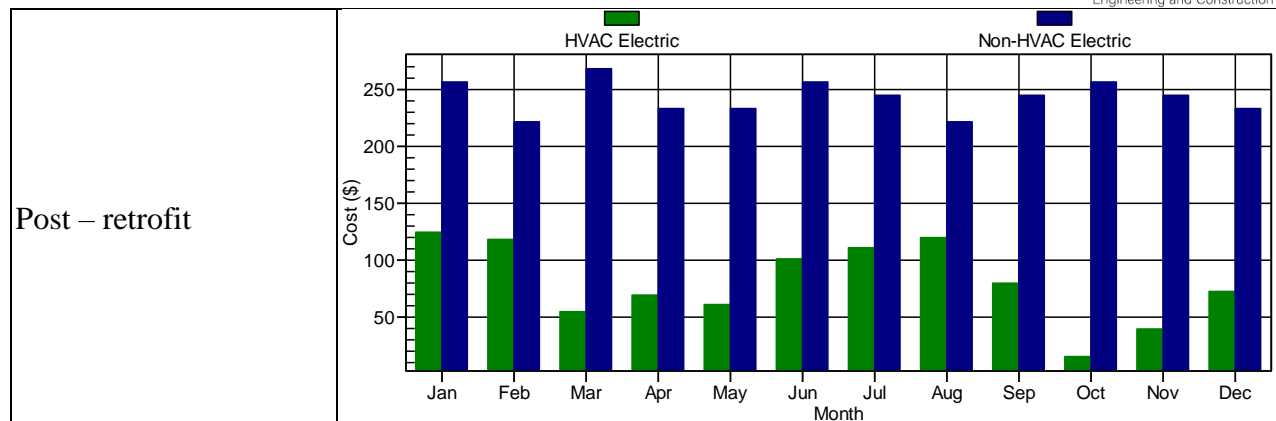


Figure 7: Monthly energy consumption variation HVAC/non-HVAC

It was noticed that the retrofit activities resulted significant differences in the requested HVAC equipment required capacities. Table (21) presents the results of auto-sizing the requested HVAC capacities using the software design algorithm. Results show that retrofitting components led to 2.3 refrigeration ton capacity reduction, thus, lowering the required initial investment.

Table 21: HVAC cooling and heating necessary rated power in kW and refrigeration ton

Room	Work Space	M. Office	Meeting room	Meeting room	Office
Area	62	16	9.4	18.3	11.3
Cooling Load kW (baseline)	15.4	4.1	2.8	4.3	3.8
Heating Load kW (baseline)	11.5	2.7	2.2	3	2
Cooling Load kW (Post)	11.2	2.6	2.3	3.2	3
Heating Load kW Post	7.5	1.6	1.4	1.9	1.3
R.T cooling (baseline)	4.4	1.17	0.80	1.22	1.08
R.T heating (baseline)	3.3	0.77	0.63	0.85	0.57
R.T cooling (Post)	3.2	0.74	0.65	0.91	0.85
R.T heating (Post)	2.1	0.45	0.40	0.54	0.37
% Reduction in cooling load	27%	37%	18%	26%	21%
% Reduction in heating load	35%	41%	36%	37%	35%

After simulating all retrofit options, saving contribution from each option can be determined. In this context, Table 22 presents estimated savings of each considered option. It can be noticed that insulating external walls and roof, and lighting system efficiency has the highest impact on the electric bill. However, building envelope components retrofit estimated savings are due to conduction losses reduction only.

Table 22: Estimated percent saving from each retrofit option.

	Uov	Saved \$ per year	%saving of total annual baseline bill
Overall heat transfer coefficient Uov_building baseline	3.161787	---	---
External wall insulation	2.562299	284	5.2%

Window retrofitting	3.066165	45	0.8%
Doors retrofitting	3.061765	47	0.9%
Roof insulation	2.568274	281	5.2%
HVAC higher efficiency units	---	320	6%
Lighting higher efficiency units	---	581	11%

ENVIRONMENTAL EFFECT

The most common way to estimate environmental benefits is to calculate saved CO2 equivalent emissions. In this context, Palestine imports most of its energy (more than 90%) from outside, where the source energy mix generates 0.000823-ton CO2 equivalent per kWh generated. Therefore, this value can be used to estimate the potential saved energy resulted in ton of CO2 equivalent, and in the number of trees saved. Figure (8) presents these figures, it can be noticed that all retrofits can result in 6.4 tCO2 savings, that offset is equivalent to 256.3 trees per year.

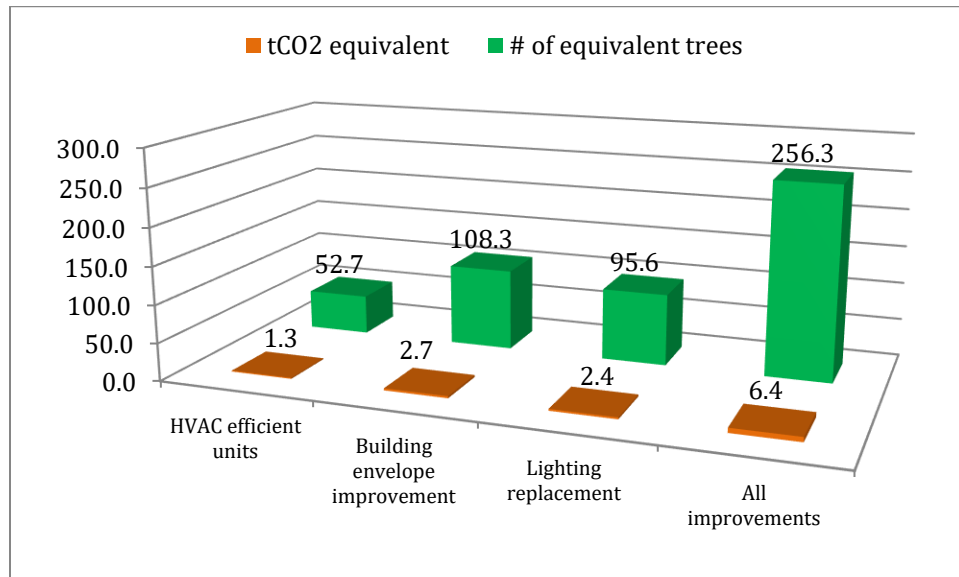


Figure 8: Retrofits estimated tCO2 equivalent reduction and annual trees offset.

ECONOMIC PERFORMANCE

Each retrofit activity caused energy reduction, which lead to lower annual energy bills. Retrofit activities are roof and external walls insulation, windows and doors, and lighting. Table (23) presents the economic analysis results. It can be noticed that assuming the whole lighting and building envelope investment as a must for achieving the estimated savings, is not feasible. The Simple Payback Period (SPP), Present Value (PV), and Internal Rate of Return (IRR) are all not attractive. The considered Minimum Attractive Rate of Return (MARR), lighting system life time, and building envelope components life time were considered as 10%, 8 years, and 30 years, respectively, except lighting system, where the lamps lifetime was considered as 8 years. The initial investment for doors was calculated based on the average cost difference between a multi-lock and metal doors. Similarly, for windows, the initial investment was considered as the difference between single and double glazing options.

Table 23: Economic evaluation of retrofitting activities based on annual estimated energy savings.

Retrofit	Investment (\$)	Saving (\$/year) *	SPP (years)	PV (\$)	IRR
Lighting	950	581	1.5	2,293	61%
Walls insulation	3,000	834	3.8	5,914	27%
Roof insulation	1,400				
Windows	400				
Doors	350				

* The provided savings are for year number one; these savings will increase annually due to fuel escalation rate.

Based on the market available AC units, and taking into consideration that about 2.3 refrigeration ton capacity can be reduced from initial investment, leading to a reduction of about \$1,800 as initial investment, thus, improving the overall economic performance of the alternative. For the lighting system, it is more convenient to consider lamps replacement instead of whole system, since most of the lighting fixtures will not be changed. Moreover, it is worth to mention that fuel escalation rate was considered in the analysis, it is for taking into account electricity price increase over time, in this research, 2% per year is considered. Table (24) presents load estimation for windows, walls, and doors for each air-conditioned space in Watts (W), it also shows the load reduction percentage by implementing each retrofit activity. It can be noticed that the largest percentage of load reduction can be achieved from walls and roof components, both for cooling and heating demands. Based on that, it is advisable to give priority for retrofitting roof, followed by external walls. It is worth to also mention that the roof and walls retrofitting costs presented in Table (24) are for the whole building, not the conditioned space only, eliminating unconditioned spaces costs, will lead to more economic attractive results.

Similar to HVAC systems, the office includes a refrigerator (serial number: SJ-SE70D-SL5), A+ energy label, with a net volume of 553L, it consumes around 460kWh/year in case of rationale usage behavior. Taking into consideration that this type of energy efficient refrigerators reduce electric consumption be around 25% compared to standard models, this refrigerator will save around 115kWh per year, that is equivalent to \$23, 0.019 tCO₂ emissions reduction, and 0.76 tree effect per year.

Table 24: Estimated cooling and heating loads for windows, walls, and roof.

Space	Component	Baseline (W)		Retrofit (W)		% Load reduction	
		Cooling	Heating	Cooling	Heating	Cooling	Heating
M. Office (16m ²)	Window	404	N.A *	356	N.A *	12%	N.A *
	Wall	182	418	91	219	50%	48%
	Roof	1349	1090	446	647	67%	41%
Meeting room (9.4m ²)	Window	275	N.A *	231	N.A *	16%	N.A *
	Wall	199	583	109	305	45%	48%
	Roof	537	641	194	380	64%	41%
Meeting room (19.3m ²)	Window	381	N.A *	197	N.A *	48%	N.A *
	Wall	116	376	69	196	41%	48%
	Roof	1543	1247	378	740	76%	41%
Office (11.3m ²)	Window	640	N.A *	538	N.A *	16%	N.A *
	Wall	123	379	71	198	42%	48%
	Roof	903	770	333	457	63%	41%
Work space (62m ²)	Window	1101	N.A *	1059	N.A *	4%	N.A *
	Wall	713	2288	358	1197	50%	48%
	Roof	5228	4225	1828	2506	65%	41%

* N.A: Not applicable, since in heating load calculation standard procedure, we do not consider the solar radiation gained heat through windows.

RENEWABLE ENERGY UTILIZATION

In the last decades, it is obvious that investing in renewable energy sources became feasible, both from economic and environment point of view, which happened due to modern systems, higher efficiency, and production's lower costs. However, installing such systems should be the last choice, where it is always more beneficial to reduce energy consumption that generating renewable energy to compensate losses, which are avoidable. Figure (9) shows this concept where smart procedure can be describes as; using existing systems in more rational and resource efficient manner, followed by retrofitting these systems to higher efficient ones, and lastly investing in renewable energy sources.

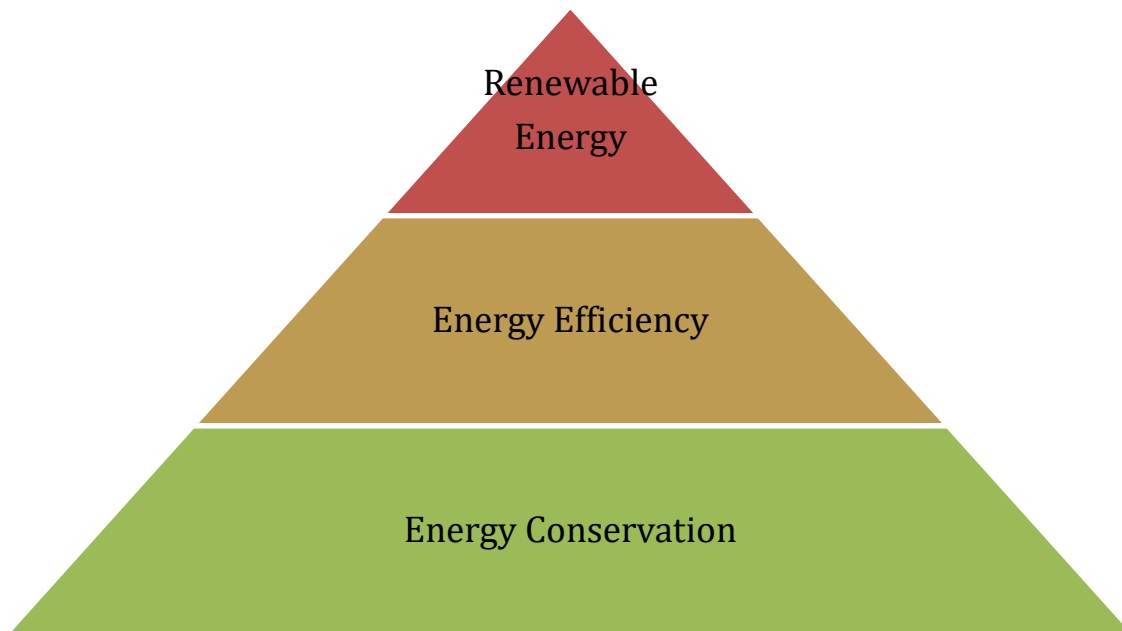


Figure 9: Energy management pyramid.

Following this smart procedure, and after implementing energy conservation and efficiency feasible options, two renewable energy systems were proposed, solar PV and solar water heater.

For solar PV system, a detailed design of 15.84 kW system was proposed, if installed, it is expected to generate 24,031 kWh per year. For solar water heater, it was assumed that 150 liter of hot water at 45°C is demanded per day, for 80 sunny and relatively cold days per year. Taking the tap water average winter temperature is about 12°C, and assuming the alternative as electric boiler, with average efficiency equals to 97%, the saved electricity due to solar water heater utilization is around 5.93 kWh per day, that is 474 kWh per year. Figure (10) presents the potential saved tCO₂ equivalent and offset trees per year for these two renewable energy systems. Knowing that the whole building consumption estimated consumption after implementing all interventions is about 19,456 kWh per year, this means that the PV generated electricity will be higher, and such building can be considered as a net positive emissions building.

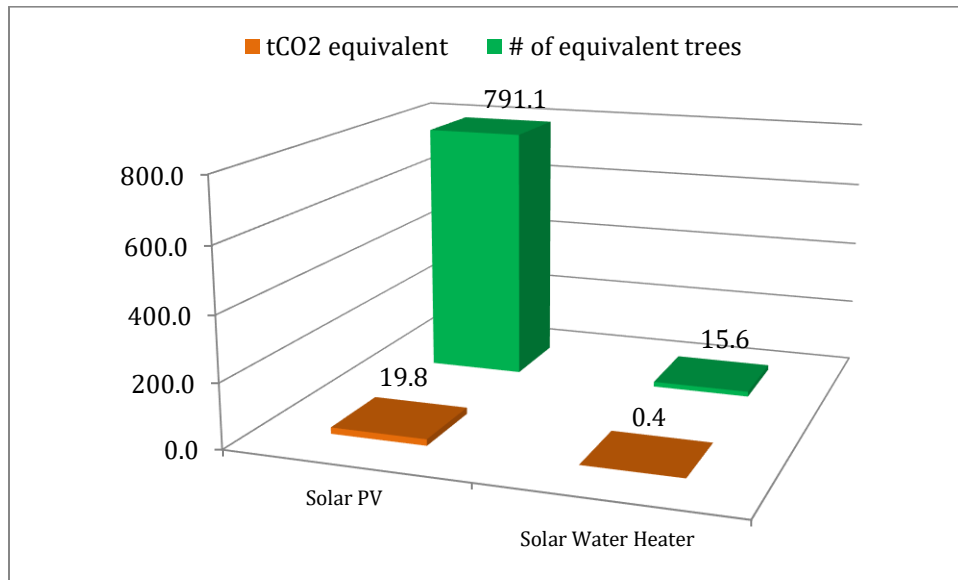


Figure 10: Renewable energy systems saved tCO2 equivalent and trees offset.

ANNEX 1

(PV SIMULATION REPORT)

PVsyst - Simulation report

Grid-Connected System

Project: 15kWp PV Project

Variant: Simulation Varian #1

No 3D scene defined, no shadings

System power: 15.84 kWp

Al Bīrah - Palestine, State Of

Author

Birzeit

Ramallah / 00970

Palestine



Project: 15kWp PV Project

Variant: Simulation Varian #1

PVsyst V7.2.4

VC0, Simulation date:
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with v7.2.4

Project summary

Geographical Site	Situation	Project settings
Al Birah	Latitude 31.91 °N	Albedo 0.20
Palestine, State Of	Longitude 35.22 °E	
	Altitude 846 m	
	Time zone UTC+2	
Meteo data		
Al Birah		
Meteonorm 8.0 (2006-2011), Sat=100% - Synthetic		

System summary

Grid-Connected System	No 3D scene defined, no shadings	
PV Field Orientation	Near Shadings	User's needs
Fixed plane	No Shadings	Unlimited load (grid)
Tilt/Azimuth 15 / 0 °		
System information		
PV Array	Inverters	
Nb. of modules 24 units	Nb. of units 1 Unit	
Pnom total 15.84 kWp	Pnom total 15.00 kWac	
	Pnom ratio 1.056	

Results summary

Produced Energy 24.03 MWh/year	Specific production 1517 kWh/kWp/year	Perf. Ratio PR 76.44 %
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Project and results summary	2
General parameters, PV Array Characteristics, System losses	3
Main results	6
Loss diagram	7
Special graphs	8
P50 - P90 evaluation	9



Project: 15kWp PV Project

Variant: Simulation Varian #1

PVsyst V7.2.4

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General parameters

Grid-Connected System	No 3D scene defined, no shadings	
PV Field Orientation	Sheds configuration	Models used
Orientation	No 3D scene defined	Transposition Perez
Fixed plane		Diffuse Perez, Meteonorm
Tilt/Azimuth 15 / 0 °		Circumsolar separate
Horizon	Near Shadings	User's needs
Free Horizon	No Shadings	Unlimited load (grid)

PV Array Characteristics

PV module		Inverter	
Manufacturer	Trina Solar	Manufacturer	Sungrow
Model	TSM-DE21-(II)-660	Model	SG15KTL
(Custom parameters definition)		(Original PVsyst database)	
Unit Nom. Power	660 Wp	Unit Nom. Power	15.0 kWac
Number of PV modules	24 units	Number of inverters	1 Unit
Nominal (STC)	15.84 kWp	Total power	15.0 kWac
Array #1 - String 1			
Number of PV modules	12 units	Number of inverters	1 * MPPT 50% 0.5 units
Nominal (STC)	7.92 kWp	Total power	7.5 kWac
Modules	1 String x 12 In series		
At operating cond. (50°C)		Operating voltage	380-800 V
Pmpp	6.61 kWp	Pnom ratio (DC:AC)	1.06
U mpp	391 V		
I mpp	17 A		
Array #2 - String 2			
Number of PV modules	12 units	Number of inverters	1 * MPPT 50% 0.5 units
Nominal (STC)	7.92 kWp	Total power	7.5 kWac
Modules	1 String x 12 In series		
At operating cond. (50°C)		Operating voltage	380-800 V
Pmpp	6.61 kWp	Pnom ratio (DC:AC)	1.06
U mpp	391 V		
I mpp	17 A		
Total PV power		Total inverter power	
Nominal (STC)	16 kWp	Total power	15 kWac
Total	24 modules	Nb. of inverters	1 Unit
Module area	74.6 m ²	Pnom ratio	1.06

Array losses

Array Soiling Losses		Thermal Loss factor		DC wiring losses	
Loss Fraction	2.0 %	Module temperature according to irradiance		Global array res.	376 mΩ
		Uc (const)	29.0 W/m ² K	Global wiring resistance	188 mΩ
		Uv (wind)	0.0 W/m ² K/m/s	Loss Fraction	1.5 % at STC
LID - Light Induced Degradation		Module Quality Loss		Module mismatch losses	
Loss Fraction	2.0 %	Loss Fraction	0.4 %	Loss Fraction	2.0 % at MPP
Strings Mismatch loss					
Loss Fraction	0.1 %				



Project: 15kWp PV Project

Variant: Simulation Varian #1

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Array losses

IAM loss factor

Incidence effect (IAM): Fresnel AR coating, $n(\text{glass})=1.526$, $n(\text{AR})=1.290$

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000



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AC wiring losses

Inv. output line up to injection point

Inverter voltage	400 Vac tri
Loss Fraction	0.00 % at STC
Inverter: SG15KTL	
Wire section (1 Inv.)	Copper 1 x 3 x 3 mm ²
Wires length	0 m



Project: 15kWp PV Project

Variant: Simulation Varian #1

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Main results

System Production

Produced Energy 24.03 MWh/year

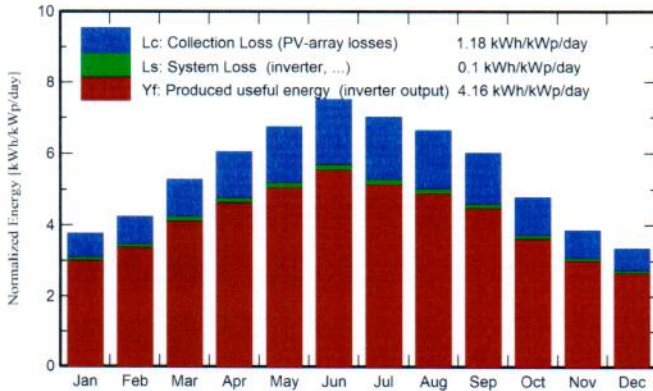
Specific production

1517 kWh/kWp/year

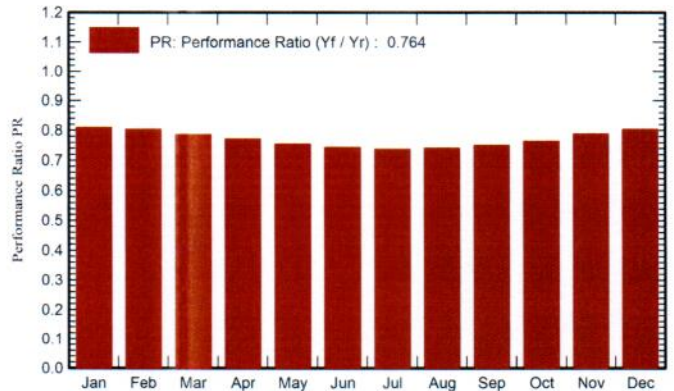
Performance Ratio PR

76.44 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T_Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR ratio
January	91.5	37.94	7.69	116.4	111.0	1.527	1.491	0.808
February	100.1	43.68	9.17	118.5	113.3	1.544	1.507	0.802
March	147.5	60.13	12.84	163.5	156.7	2.085	2.034	0.785
April	173.9	73.50	16.78	181.4	173.8	2.273	2.217	0.772
May	209.0	78.59	21.61	208.6	199.6	2.554	2.491	0.754
June	231.2	62.78	24.35	225.0	215.3	2.710	2.644	0.742
July	221.1	72.30	26.67	217.4	207.9	2.601	2.537	0.737
August	200.6	73.31	26.43	206.0	197.4	2.473	2.414	0.740
September	166.1	60.77	23.78	180.4	172.9	2.194	2.142	0.749
October	127.2	51.57	20.47	148.0	141.6	1.835	1.791	0.764
November	93.6	37.84	14.22	115.6	110.5	1.477	1.441	0.787
December	81.8	37.89	9.59	103.9	99.0	1.354	1.322	0.803
Year	1843.5	690.30	17.85	1984.7	1899.0	24.627	24.031	0.764

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		



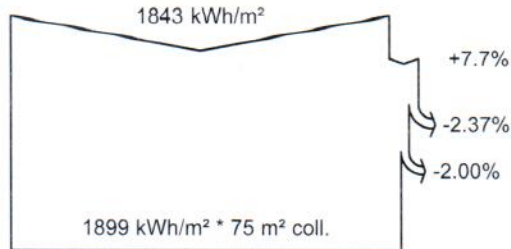
Project: 15kWp PV Project

Variant: Simulation Varian #1

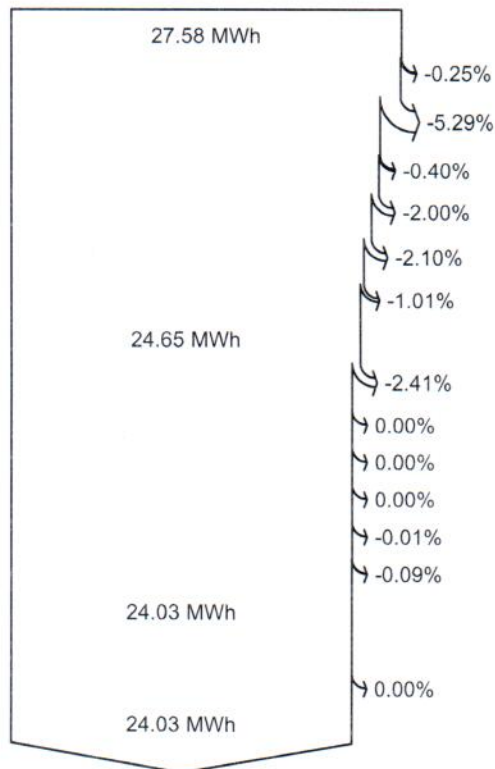
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Loss diagram



efficiency at STC = 19.48%



Global horizontal irradiation

Global incident in coll. plane

IAM factor on global

Soiling loss factor

Effective irradiation on collectors

PV conversion

Array nominal energy (at STC effic.)

PV loss due to irradiance level

PV loss due to temperature

Module quality loss

LID - Light induced degradation

Mismatch loss, modules and strings

Ohmic wiring loss

Array virtual energy at MPP

Inverter Loss during operation (efficiency)

Inverter Loss over nominal inv. power

Inverter Loss due to max. input current

Inverter Loss over nominal inv. voltage

Inverter Loss due to power threshold

Inverter Loss due to voltage threshold

Available Energy at Inverter Output

AC ohmic loss

Energy injected into grid

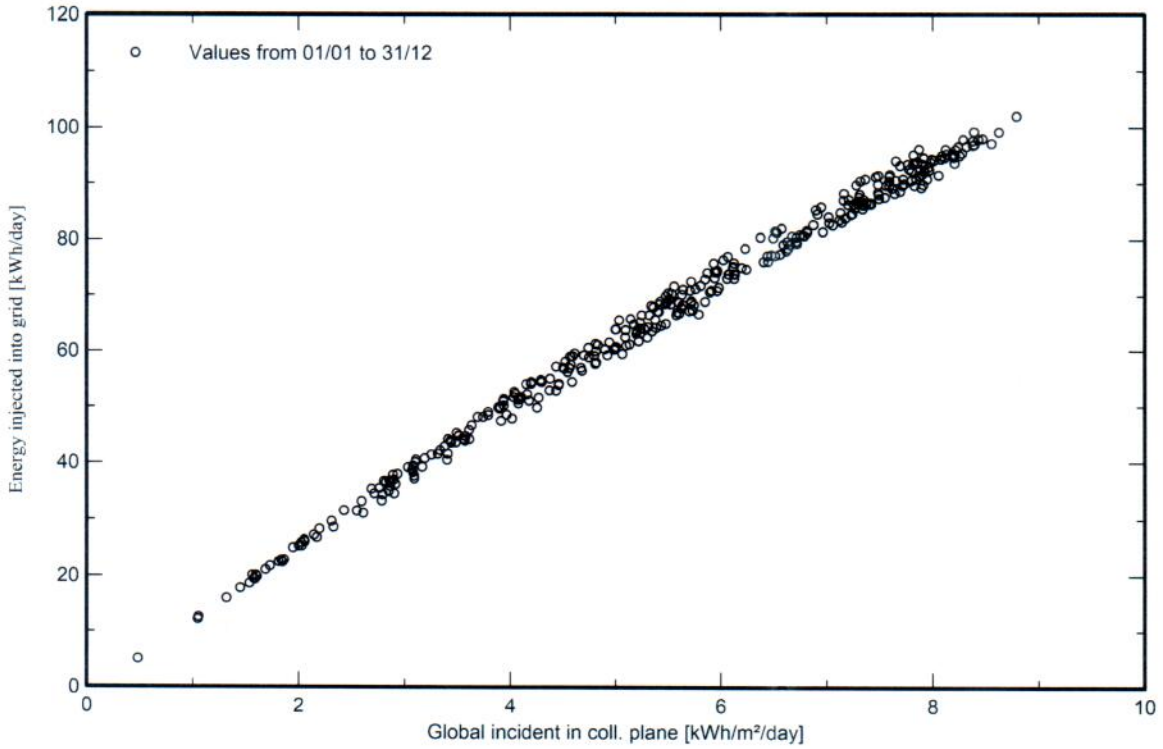


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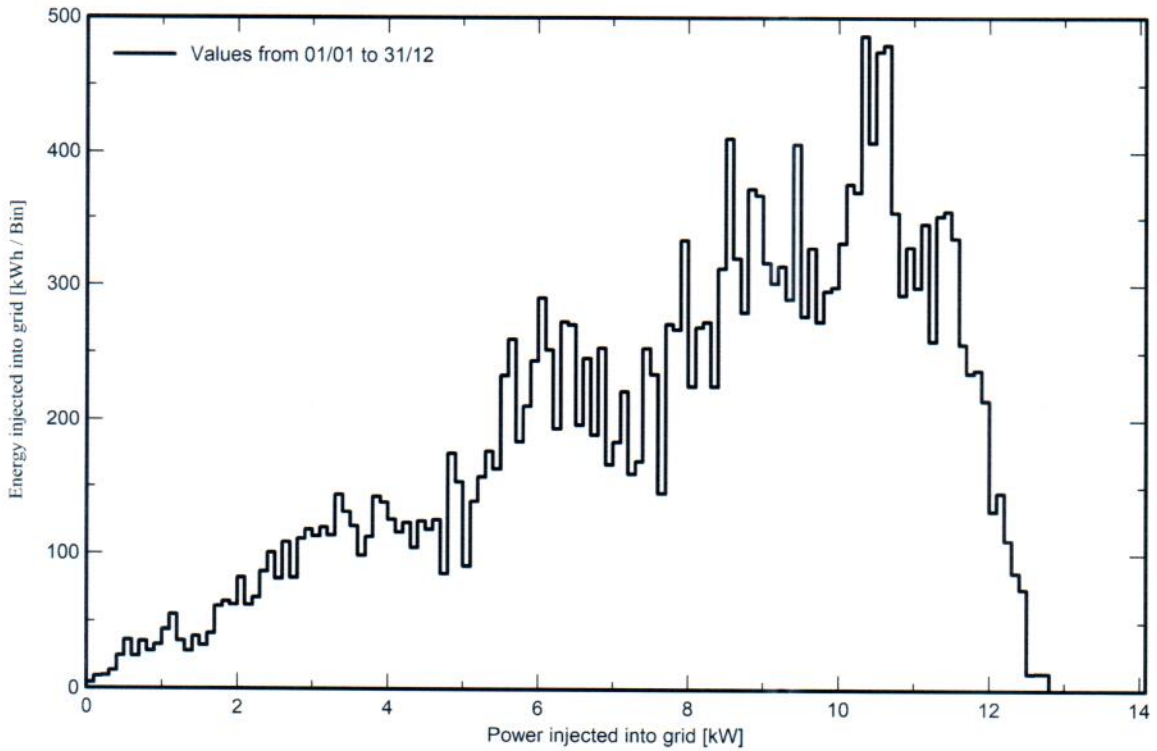
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Special graphs

Daily Input/Output diagram



System Output Power Distribution





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P50 - P90 evaluation

Meteo data

Meteo data source: Meteonorm 8.0 (2006-2011), Sat=100%
Kind: Monthly averages
Synthetic - Multi-year average
Year-to-year variability(Variance): 0.5 %

Specified Deviation

Climate change: 0.0 %

Global variability (meteo + system)

Variability (Quadratic sum): 1.9 %

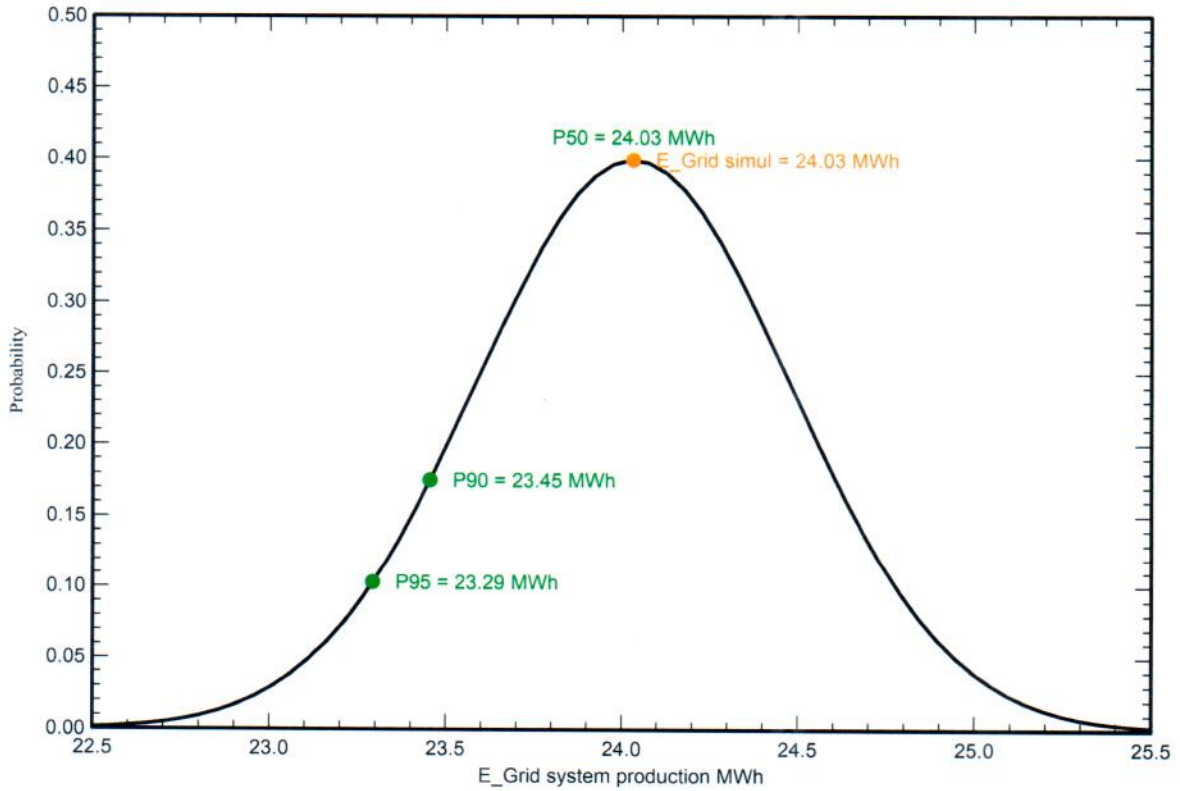
Simulation and parameters uncertainties

PV module modelling/parameters: 1.0 %
Inverter efficiency uncertainty: 0.5 %
Soiling and mismatch uncertainties: 1.0 %
Degradation uncertainty: 1.0 %

Annual production probability

Variability: 0.45 MWh
P50: 24.03 MWh
P90: 23.45 MWh
P95: 23.29 MWh

Probability distribution



ANNEX 2

(HAP SIMULATION DETAILED REPORTS)

Design Weather Parameters & MSHGs

PalGBC building retrofit project - baseline

10/18/2022

HB

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Design Parameters:

City Name **Ramallah & Al beireh**
 Location **Palestine**
 Latitude **31.9** Deg.
 Longitude **-35.2** Deg.
 Elevation **759.0** m
 Summer Design Dry-Bulb **33.1** °C
 Summer Coincident Wet-Bulb **18.3** °C
 Summer Daily Range **10.4** °K
 Winter Design Dry-Bulb **2.2** °C
 Winter Design Wet-Bulb **-2.5** °C
 Atmospheric Clearness Number **1.00**
 Average Ground Reflectance **0.20**
 Soil Conductivity **1.385** W/(m-°K)
 Local Time Zone (GMT +/- N hours) **-2.0** hours
 Consider Daylight Savings Time **Yes**
 Daylight Savings Begins **April, 1**
 Daylight Savings Ends **October, 31**
 Simulation Weather Data **Jerusalem-Atarot AP (EXT)**
 Current Data is **User Modified**
 Design Cooling Months **January to December**

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in W/m²)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	74.1	74.1	94.4	323.9	564.4	709.2	794.4	792.8	773.6
February	86.0	86.0	221.2	444.8	655.2	768.6	779.6	730.1	691.0
March	99.3	104.8	359.5	577.6	702.2	759.6	711.3	610.1	550.5
April	112.1	252.0	463.2	637.4	714.9	683.3	590.7	443.0	360.6
May	121.1	350.0	529.0	659.6	695.1	626.2	488.2	311.9	231.2
June	153.0	382.1	551.0	663.8	678.5	592.1	441.7	260.0	189.0
July	126.0	343.0	529.9	653.0	679.5	604.1	475.9	301.6	223.7
August	117.3	245.1	458.2	618.7	686.9	658.9	569.0	426.5	347.6
September	103.0	108.7	326.7	547.1	678.1	717.9	687.9	595.3	538.8
October	89.0	89.0	192.4	452.0	626.2	734.2	758.1	711.8	675.5
November	75.4	75.4	91.2	329.6	541.2	709.5	769.1	777.3	765.5
December	68.9	68.9	68.9	259.0	517.0	681.3	781.3	798.5	793.4
Month	SSW	SW	WSW	W	WNW	NW	NNW	HOR	Mult
January	794.2	792.5	714.3	552.7	341.0	77.0	74.1	554.0	1.00
February	733.7	785.1	760.0	660.8	457.5	214.1	86.0	680.6	1.00
March	613.5	712.9	760.9	716.1	561.3	360.4	110.8	793.7	1.00
April	442.5	587.9	692.9	713.2	625.2	471.7	251.3	854.3	1.00
May	311.0	484.6	629.8	691.5	650.1	539.9	349.9	872.8	1.00
June	258.3	434.1	597.4	671.1	657.0	562.5	383.1	870.5	1.00
July	299.3	467.2	615.1	672.1	643.9	536.4	346.4	859.5	1.00
August	426.2	566.3	667.9	687.9	604.8	458.9	249.3	836.2	1.00
September	595.7	688.3	715.6	679.7	546.5	323.3	109.5	770.1	1.00
October	707.6	750.6	741.1	617.4	447.1	207.2	89.0	672.4	1.00
November	774.7	775.1	708.3	548.7	317.8	95.2	75.4	554.1	1.00
December	796.6	771.9	689.6	506.3	279.4	68.9	68.9	500.8	1.00

Mult. = User-defined solar multiplier factor.

Cooling Design Temperature Profiles

PalGBC building retrofit project - baseline

10/18/2022

HB

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Location: Ramallah & Al beireh, Palestine

(Dry and Wet Bulb temperatures are expressed in °C)

Hr	January		February		March		April		May		June	
	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB
0000	18.2	11.0	19.3	11.6	21.0	13.6	22.3	13.9	23.5	14.5	24.6	15.7
0100	17.7	10.8	18.8	11.4	20.5	13.4	21.7	13.7	22.9	14.3	24.0	15.5
0200	17.1	10.6	18.3	11.2	20.0	13.2	21.1	13.5	22.4	14.1	23.5	15.3
0300	16.7	10.4	17.8	11.1	19.6	13.0	20.6	13.3	21.9	13.9	23.0	15.2
0400	16.4	10.3	17.5	10.9	19.3	12.9	20.2	13.1	21.4	13.7	22.6	15.0
0500	16.3	10.2	17.4	10.9	19.2	12.9	19.9	13.0	21.1	13.6	22.2	14.9
0600	16.5	10.3	17.6	11.0	19.4	13.0	19.8	13.0	21.0	13.6	22.1	14.9
0700	17.0	10.5	18.2	11.2	19.9	13.2	20.0	13.0	21.2	13.7	22.4	14.9
0800	18.0	10.9	19.1	11.6	20.8	13.5	20.5	13.2	21.8	13.9	22.9	15.1
0900	19.3	11.5	20.4	12.1	22.2	14.0	21.4	13.6	22.7	14.2	23.8	15.4
1000	20.9	12.1	22.0	12.7	23.7	14.6	22.8	14.1	24.0	14.7	25.2	15.9
1100	22.7	12.8	23.8	13.4	25.5	15.2	24.4	14.6	25.6	15.2	26.7	16.4
1200	24.3	13.4	25.4	14.0	27.2	15.8	26.1	15.3	27.4	15.8	28.5	17.0
1300	25.6	13.9	26.7	14.4	28.4	16.2	27.8	15.8	29.0	16.4	30.2	17.5
1400	26.4	14.2	27.5	14.7	29.2	16.5	29.0	16.3	30.3	16.8	31.4	17.9
1500	26.7	14.3	27.8	14.8	29.6	16.6	29.9	16.5	31.1	17.1	32.2	18.2
1600	26.4	14.2	27.5	14.7	29.2	16.5	30.2	16.6	31.4	17.2	32.5	18.3
1700	25.7	13.9	26.8	14.5	28.5	16.2	29.9	16.5	31.1	17.1	32.2	18.2
1800	24.5	13.5	25.6	14.0	27.4	15.8	29.1	16.3	30.4	16.9	31.5	18.0
1900	23.2	13.0	24.3	13.5	26.0	15.4	28.0	15.9	29.2	16.5	30.4	17.6
2000	21.8	12.5	22.9	13.1	24.7	14.9	26.6	15.4	27.9	16.0	29.0	17.2
2100	20.7	12.0	21.8	12.6	23.5	14.5	25.3	15.0	26.5	15.6	27.7	16.7
2200	19.6	11.6	20.8	12.2	22.5	14.1	24.2	14.6	25.4	15.2	26.5	16.4
2300	18.8	11.3	19.9	11.9	21.7	13.8	23.1	14.2	24.4	14.8	25.5	16.0

Cooling Design Temperature Profiles

PalGBC building retrofit project - baseline

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Hr	July		August		September		October		November		December	
	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB	DB	WB
0000	25.2	15.7	25.2	15.7	24.1	15.1	22.9	14.4	20.0	13.0	18.7	11.7
0100	24.6	15.5	24.6	15.5	23.5	14.9	22.3	14.2	19.5	12.8	18.2	11.5
0200	24.1	15.3	24.1	15.3	22.9	14.7	21.8	14.0	18.9	12.6	17.7	11.3
0300	23.5	15.2	23.5	15.2	22.4	14.5	21.2	13.8	18.5	12.4	17.3	11.1
0400	23.1	15.0	23.1	15.0	22.0	14.4	20.8	13.7	18.2	12.3	17.0	11.0
0500	22.8	14.9	22.8	14.9	21.7	14.3	20.5	13.5	18.1	12.2	16.9	11.0
0600	22.7	14.9	22.7	14.9	21.6	14.2	20.4	13.5	18.3	12.3	17.1	11.0
0700	22.9	14.9	22.9	14.9	21.8	14.3	20.6	13.6	18.8	12.5	17.6	11.3
0800	23.4	15.1	23.4	15.1	22.3	14.5	21.1	13.8	19.8	12.9	18.5	11.6
0900	24.4	15.4	24.4	15.4	23.3	14.8	22.1	14.1	21.1	13.4	19.9	12.2
1000	25.7	15.9	25.7	15.9	24.6	15.3	23.4	14.6	22.7	14.0	21.4	12.8
1100	27.3	16.4	27.3	16.4	26.2	15.8	25.0	15.2	24.5	14.6	23.2	13.4
1200	29.0	17.0	29.0	17.0	27.9	16.4	26.8	15.8	26.1	15.2	24.9	14.0
1300	30.7	17.5	30.7	17.5	29.6	17.0	28.4	16.3	27.4	15.6	26.1	14.5
1400	32.0	17.9	32.0	17.9	30.8	17.4	29.7	16.7	28.2	15.9	27.0	14.8
1500	32.8	18.2	32.8	18.2	31.7	17.6	30.5	17.0	28.5	16.0	27.3	14.9
1600	33.1	18.3	33.1	18.3	32.0	17.7	30.8	17.1	28.2	15.9	27.0	14.8
1700	32.8	18.2	32.8	18.2	31.7	17.6	30.5	17.0	27.5	15.7	26.2	14.5
1800	32.1	18.0	32.1	18.0	30.9	17.4	29.8	16.8	26.3	15.3	25.1	14.1
1900	30.9	17.6	30.9	17.6	29.8	17.0	28.6	16.4	25.0	14.8	23.7	13.6
2000	29.6	17.2	29.6	17.2	28.5	16.6	27.3	15.9	23.6	14.3	22.4	13.1
2100	28.2	16.7	28.2	16.7	27.1	16.1	25.9	15.5	22.5	13.9	21.2	12.7
2200	27.1	16.4	27.1	16.4	26.0	15.8	24.8	15.1	21.4	13.5	20.2	12.3
2300	26.0	16.0	26.0	16.0	24.9	15.4	23.7	14.7	20.6	13.2	19.4	12.0

Design Temperature Profile

PalGBC building retrofit project - baseline

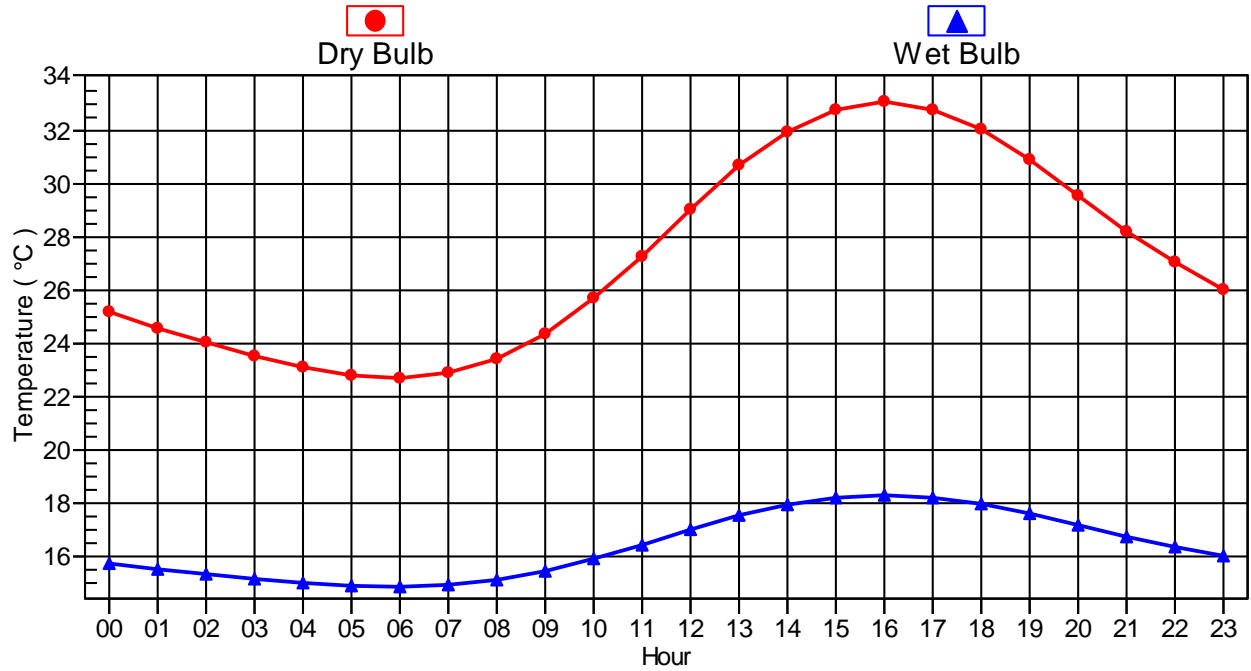
10/18/2022

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Location: Ramallah & Al beireh, Palestine

Design Temperature Profiles for July



Design Solar Flux and Heat Gain Profiles

PalGBC building retrofit project - baseline

10/18/2022

HB

09:10AM

Location: Ramallah & Al beireh, Palestine

Design Solar Fluxes for July

(Values for each exposure are expressed in W/m²)

Hour	N	NNE	NE	ENE	E	ESE	SE	SSE	
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0600	104.8	188.6	248.2	272.9	258.3	207.1	128.4	35.7	
0700	200.1	416.5	583.9	673.0	667.8	569.3	395.2	175.6	
0800	167.9	419.1	626.9	756.0	783.6	704.8	533.7	299.9	
0900	127.9	341.3	548.4	693.3	751.2	711.9	582.5	385.0	
1000	141.8	233.4	410.2	548.5	625.8	628.9	557.3	423.2	
1100	150.9	156.5	245.2	357.7	440.3	480.0	470.1	412.3	
1200	154.9	156.4	159.1	162.7	221.7	287.2	334.1	354.9	
1300	153.6	150.1	150.1	150.1	153.8	157.3	165.3	257.8	
1400	147.0	142.0	142.0	142.0	142.0	142.0	145.3	152.5	
1500	135.6	127.7	127.7	127.7	127.7	127.7	127.7	131.7	
1600	137.4	107.4	107.4	107.4	107.4	107.4	107.4	107.4	
1700	190.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	
1800	181.0	48.4	45.0	45.0	45.0	45.0	45.0	45.0	
1900	0.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Hour	S	SSW	SW	WSW	W	WNW	NW	NNW	HOR
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	20.2	20.2	20.2	20.2	20.2	20.2	20.2	22.6	61.6
0700	64.2	64.2	64.2	64.2	64.2	64.2	64.2	67.2	281.1
0800	101.5	94.8	94.8	94.8	94.8	94.8	94.8	94.8	496.3
0900	152.3	118.1	118.1	118.1	118.1	118.1	118.1	118.1	685.0
1000	248.5	142.5	135.5	135.5	135.5	135.5	135.5	135.5	834.5
1100	315.9	196.5	154.1	146.7	146.7	146.7	146.7	146.7	934.8
1200	346.4	309.9	251.2	179.5	160.5	157.4	155.4	151.7	979.2
1300	336.4	388.5	406.0	386.0	331.7	251.7	161.8	157.0	964.7
1400	287.1	423.7	519.9	559.9	537.2	455.3	328.0	175.6	892.2
1500	204.2	410.5	578.2	679.3	696.7	627.3	483.1	288.2	766.7
1600	117.0	348.8	568.5	721.5	781.2	737.2	597.1	385.4	596.5
1700	85.1	243.0	478.4	658.1	750.7	739.8	627.2	433.1	392.9
1800	45.0	105.5	283.9	430.3	519.5	535.4	475.1	349.6	171.0
1900	0.1	0.1	0.8	1.4	1.8	1.9	1.8	1.4	0.3
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Design Solar Flux and Heat Gain Profiles

PalGBC building retrofit project - baseline

10/18/2022

HB

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Location: Ramallah & Al beireh, Palestine

Design Beam Solar Heat Gains for July

(Values for each exposure are expressed in W/m²)

Hour	N	NNE	NE	ENE	E	ESE	SE	SSE	
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0600	51.8	130.3	181.6	200.6	189.9	146.3	75.0	1.6	
0700	58.6	262.9	409.8	485.5	481.3	397.2	243.1	39.9	
0800	12.8	217.7	410.6	522.3	546.2	478.1	327.3	103.3	
0900	0.0	111.5	311.0	442.8	493.1	459.1	343.1	151.9	
1000	0.0	20.7	154.4	289.4	362.9	365.8	298.0	166.8	
1100	0.0	0.0	20.3	95.0	169.8	208.3	198.6	143.3	
1200	0.0	0.0	0.0	0.0	9.2	39.7	71.7	88.0	
1300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.5	
1400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1600	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1700	33.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1800	72.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1900	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Hour	S	SSW	SW	WSW	W	WNW	NW	NNW	HOR
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5
0700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.9
0800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	327.0
0900	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	496.8
1000	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	634.1
1100	62.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	725.3
1200	81.1	54.2	20.6	0.6	0.0	0.0	0.0	0.0	762.3
1300	74.8	118.2	133.9	115.9	71.2	21.6	0.0	0.0	750.6
1400	46.5	159.5	253.4	292.6	270.3	190.0	75.7	1.3	687.2
1500	12.2	164.3	327.4	420.3	435.7	373.3	235.2	58.8	571.4
1600	0.0	131.5	343.3	478.7	530.4	492.3	369.4	166.4	417.1
1700	0.0	72.0	295.3	453.6	533.3	524.1	426.9	252.6	234.3
1800	0.0	15.0	171.9	302.6	378.4	390.6	341.4	232.4	60.2
1900	0.0	0.0	0.4	1.0	1.3	1.4	1.3	1.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Design Solar Flux and Heat Gain Profiles

PalGBC building retrofit project - baseline

10/18/2022

HB

09:10AM

Location: Ramallah & Al beireh, Palestine

Design Diffuse Solar Heat Gains for July

(Values for each exposure are expressed in W/m²)

Hour	N	NNE	NE	ENE	E	ESE	SE	SSE	
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0600	23.5	29.8	35.2	37.7	36.2	31.4	25.1	19.5	
0700	65.4	80.1	94.3	102.8	102.2	92.9	78.5	64.0	
0800	88.3	103.4	119.3	130.7	133.3	126.0	111.8	95.6	
0900	104.0	116.3	130.3	141.7	146.6	143.2	132.8	119.0	
1000	115.4	123.8	133.9	143.3	149.0	149.2	143.9	134.7	
1100	122.7	127.3	133.2	139.4	144.5	147.0	146.4	142.7	
1200	126.0	127.2	129.4	132.4	135.9	139.3	141.8	143.0	
1300	124.9	122.1	122.1	122.1	125.1	128.0	131.9	136.4	
1400	119.6	115.5	115.5	115.5	115.5	115.5	118.2	124.1	
1500	110.3	103.9	103.9	103.9	103.9	103.9	103.9	107.1	
1600	96.9	87.4	87.4	87.4	87.4	87.4	87.4	87.4	
1700	78.3	65.8	65.8	65.8	65.8	65.8	65.8	65.8	
1800	48.6	39.4	36.6	36.6	36.6	36.6	36.6	36.6	
1900	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Hour	S	SSW	SW	WSW	W	WNW	NW	NNW	HOR
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	16.4	16.4	16.4	16.4	16.4	16.4	16.4	18.4	25.3
0700	52.3	52.3	52.3	52.3	52.3	52.3	52.3	54.7	65.3
0800	82.6	77.1	77.1	77.1	77.1	77.1	77.1	77.1	81.6
0900	106.1	96.1	96.1	96.1	96.1	96.1	96.1	96.1	89.7
1000	124.6	115.9	110.2	110.2	110.2	110.2	110.2	110.2	94.0
1100	137.0	130.8	125.3	119.4	119.4	119.4	119.4	119.4	96.3
1200	142.5	140.5	137.4	133.8	130.6	128.0	126.4	123.4	97.2
1300	140.7	143.8	144.8	143.6	140.5	136.1	131.6	127.7	96.9
1400	131.7	139.8	146.1	149.0	147.3	141.8	134.0	126.1	95.4
1500	116.2	128.0	139.6	147.5	148.9	143.3	132.8	120.7	92.2
1600	95.2	108.5	123.8	136.4	141.7	137.8	126.1	110.8	86.4
1700	69.2	81.3	97.2	112.2	120.9	119.9	109.5	93.8	75.2
1800	36.6	44.3	55.6	67.6	76.0	77.6	71.7	60.7	50.5
1900	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Design Solar Flux and Heat Gain Profiles

PalGBC building retrofit project - baseline

10/18/2022

HB

09:10AM

Location: Ramallah & Al beireh, Palestine

Design Total Solar Heat Gains for July

(Values for each exposure are expressed in W/m²)

Hour	N	NNE	NE	ENE	E	ESE	SE	SSE	
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0600	75.3	160.1	216.8	238.3	226.1	177.7	100.1	21.1	
0700	124.0	343.0	504.1	588.2	583.6	490.1	321.5	104.0	
0800	101.1	321.1	529.9	653.0	679.5	604.2	439.1	199.0	
0900	104.0	227.8	441.2	584.5	639.7	602.4	475.9	271.0	
1000	115.4	144.5	288.4	432.7	511.9	515.1	441.9	301.6	
1100	122.7	127.3	153.6	234.4	314.3	355.3	345.0	286.0	
1200	126.0	127.2	129.4	132.4	145.1	178.9	213.5	231.0	
1300	124.9	122.1	122.1	122.1	125.1	128.0	131.9	161.0	
1400	119.6	115.5	115.5	115.5	115.5	115.5	118.2	124.1	
1500	110.3	103.9	103.9	103.9	103.9	103.9	103.9	107.1	
1600	98.0	87.4	87.4	87.4	87.4	87.4	87.4	87.4	
1700	112.2	65.8	65.8	65.8	65.8	65.8	65.8	65.8	
1800	120.8	39.4	36.6	36.6	36.6	36.6	36.6	36.6	
1900	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Hour	S	SSW	SW	WSW	W	WNW	NW	NNW	HOR
0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	16.4	16.4	16.4	16.4	16.4	16.4	16.4	18.4	35.8
0700	52.3	52.3	52.3	52.3	52.3	52.3	52.3	54.7	204.2
0800	82.6	77.1	77.1	77.1	77.1	77.1	77.1	77.1	408.6
0900	107.7	96.1	96.1	96.1	96.1	96.1	96.1	96.1	586.5
1000	152.7	115.9	110.2	110.2	110.2	110.2	110.2	110.2	728.1
1100	199.5	134.8	125.3	119.4	119.4	119.4	119.4	119.4	821.5
1200	223.7	194.7	157.9	134.5	130.6	128.0	126.4	123.4	859.5
1300	215.6	261.9	278.7	259.5	211.7	157.8	131.6	127.7	847.5
1400	178.2	299.3	399.5	441.5	417.7	331.8	209.7	127.4	782.6
1500	128.4	292.3	467.1	567.7	584.6	516.6	368.0	179.5	663.6
1600	95.2	240.0	467.2	615.2	672.1	630.1	495.5	277.3	503.5
1700	69.2	153.3	392.5	565.8	654.3	643.9	536.4	346.4	309.5
1800	36.6	59.3	227.5	370.2	454.4	468.2	413.1	293.1	110.7
1900	0.1	0.1	0.6	1.2	1.6	1.7	1.6	1.2	0.2
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Simulation Weather Summary for Jerusalem-Atarot AP, ISR (EXT)

PalGBC building retrofit project - baseline

10/18/2022

HB

09:10AM

Descriptive Parameters:

City **Jerusalem-Atarot AP**
 Location **ISR**
 Type of Data **(EXT)**
 Latitude **31.9** Deg.
 Longitude **-35.2** Deg.
 Elevation **757.0** m
 Local Time Zone (GMT +/- N hours) **-2.0** hours
 Daylight Savings Begins **April, 1**
 Daylight Savings Ends **October, 31**
 Average Ground Reflectance **0.20**

Dry-Bulb Temperature Statistics (°C):

Month	Absolute Maximum	Average Maximum	Average	Average Minimum	Absolute Minimum
January	17.2	11.9	8.4	5.1	0.4
February	17.5	11.2	7.3	3.7	-1.0
March	22.5	14.7	10.5	6.5	1.0
April	30.4	20.2	14.8	9.4	0.3
May	34.4	24.3	18.7	13.7	8.0
June	33.4	26.6	20.9	15.6	12.7
July	32.1	27.5	22.3	17.7	15.9
August	36.6	29.0	23.1	17.8	15.6
September	34.8	26.6	20.7	16.0	10.3
October	31.6	25.2	19.9	15.3	9.0
November	26.0	17.6	13.7	10.0	2.0
December	21.2	15.6	11.1	7.3	4.3

Daily Solar Radiation Statistics:

Month	Daily Total Solar on Horizontal (kJ/m ²)			Daily Clearness Number (dimensionless)		
	Maximum	Average	Minimum	Maximum	Average	Minimum
January	15008.2	10009.3	4475.1	0.700	0.492	0.220
February	20419.3	12803.1	5735.4	0.736	0.508	0.222
March	22958.0	17234.4	8783.0	0.728	0.551	0.286
April	29915.4	22355.5	5633.4	0.793	0.609	0.164
May	30467.7	25444.3	7974.1	0.756	0.634	0.205
June	31645.8	29236.6	22404.7	0.764	0.706	0.544
July	30711.0	28399.0	21953.1	0.744	0.699	0.553
August	29110.3	26482.9	19315.6	0.745	0.699	0.488
September	24782.4	22580.8	18462.3	0.694	0.681	0.532
October	20615.1	17006.5	11408.0	0.682	0.626	0.411
November	15759.1	11641.5	6476.3	0.673	0.539	0.324
December	13077.5	9915.3	3082.3	0.672	0.526	0.165

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Time of Occurrence for Maximums and Minimums:

Month	Highest Dry-Bulb Temperature	Lowest Dry-Bulb Temperature	Maximum Total Solar	Minimum Total Solar
January	Jan 1, 1300	Jan 18, 1200	Jan 25	Jan 17
February	Feb 17, 1100	Feb 20, 0400	Feb 27	Feb 18
March	Mar 29, 1100	Mar 8, 0500	Mar 17	Mar 13
April	Apr 27, 1400	Apr 3, 0600	Apr 22	Apr 1
May	May 8, 1600	May 3, 0500	May 17	May 1
June	Jun 7, 1400	Jun 5, 0500	Jun 13	Jun 3
July	Jul 1, 1400	Jul 2, 0500	Jul 3	Jul 30
August	Aug 15, 1200	Aug 3, 0200	Aug 6	Aug 1
September	Sep 4, 1300	Sep 28, 0200	Sep 1	Sep 7
October	Oct 1, 1400	Oct 28, 0600	Oct 1	Oct 13
November	Nov 8, 1100	Nov 16, 0500	Nov 4	Nov 27
December	Dec 28, 1100	Dec 11, 0400	Dec 2	Dec 29

Calendar Data:

Day of Week for January 1st **Saturday**

Holidays:

Jan	1				
Feb	28				
May	1	2	3		
Aug	9	10	11	30	
Oct	8				
Nov	15				
Dec	25				

AC cooling system (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	2	2	2	1	1	1	1	1	1	2	2	2
Monday	2	2	2	1	1	1	1	1	1	2	2	2
Tuesday	2	2	2	1	1	1	1	1	1	2	2	2
Wednesday	2	2	2	1	1	1	1	1	1	2	2	2
Thursday	2	2	2	1	1	1	1	1	1	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	2	2	2	1	1	1	1	1	1	2	2	2
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

AC summer cooling (Fan / Thermostat)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	U	O	O	O	O	O	O	O	O	O	U	U	U	U	U	U	U

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

O = Occupied; U = Unoccupied

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	2	2	2	1	1	1	1	1	1	2	2	2
Monday	2	2	2	1	1	1	1	1	1	2	2	2
Tuesday	2	2	2	1	1	1	1	1	1	2	2	2
Wednesday	2	2	2	1	1	1	1	1	1	2	2	2
Thursday	2	2	2	1	1	1	1	1	1	2	2	2
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	2	2	2	1	1	1	1	1	1	2	2	2
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Kitchen equipment (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	80	20	0	0	20	0	0	0	0	0	0	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	1	1	1	1	1	1	1	1	1	1	1	1
Tuesday	1	1	1	1	1	1	1	1	1	1	1	1
Wednesday	1	1	1	1	1	1	1	1	1	1	1	1
Thursday	1	1	1	1	1	1	1	1	1	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	1	1	1	1	1	1	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Meeting room (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	80	80	80	80	80	50	50	50	0	0	0	0	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	1	1	1	1	1	1	1	1	1	1	1	1
Tuesday	1	1	1	1	1	1	1	1	1	1	1	1
Wednesday	1	1	1	1	1	1	1	1	1	1	1	1
Thursday	1	1	1	1	1	1	1	1	1	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	1	1	1	1	1	1	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Operating hours (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	1	1	1	1	1	1	1	1	1	1	1	1
Tuesday	1	1	1	1	1	1	1	1	1	1	1	1
Wednesday	1	1	1	1	1	1	1	1	1	1	1	1
Thursday	1	1	1	1	1	1	1	1	1	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	1	1	1	1	1	1	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Waiting area (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	50	50	50	50	50	50	50	50	50	0	0	0	0	0	0	0

2:Profile Two

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	1	1	1	1	1	1	1	1	1	1	1	1
Tuesday	1	1	1	1	1	1	1	1	1	1	1	1
Wednesday	1	1	1	1	1	1	1	1	1	1	1	1
Thursday	1	1	1	1	1	1	1	1	1	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	1	1	1	1	1	1	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Space Input Data

PalGBC building retrofit project - baseline

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HB

09:12AM

Water heating boiler (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	100	0	0	0	50	0	0	0	0	0	0	0	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	2	2	2	2	2	2	1	1	1
Monday	1	1	1	2	2	2	2	2	2	1	1	1
Tuesday	1	1	1	2	2	2	2	2	2	1	1	1
Wednesday	1	1	1	2	2	2	2	2	2	1	1	1
Thursday	1	1	1	2	2	2	2	2	2	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	2	2	2	2	2	2	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Working space (Fractional)

Hourly Profiles:

1:On day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	100	100	100	100	100	100	100	100	100	50	50	50	50	0	0	0

2:Off day

Hour	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Assignments:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design	1	1	1	1	1	1	1	1	1	1	1	1
Monday	1	1	1	1	1	1	1	1	1	1	1	1
Tuesday	1	1	1	1	1	1	1	1	1	1	1	1
Wednesday	1	1	1	1	1	1	1	1	1	1	1	1
Thursday	1	1	1	1	1	1	1	1	1	1	1	1
Friday	2	2	2	2	2	2	2	2	2	2	2	2
Saturday	2	2	2	2	2	2	2	2	2	2	2	2
Sunday	1	1	1	1	1	1	1	1	1	1	1	1
Holiday	2	2	2	2	2	2	2	2	2	2	2	2

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Kitchen (4)

1. General Details:

Floor Area **6.0** m²
 Avg. Ceiling Height **2.7** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **GENERAL: Coffee station**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **15.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Operating hours**

2.4. People:

Occupancy **3.0** People
 Activity Level **Sedentary Work**
 Sensible **82.1** W/person
 Latent **79.1** W/person
 Schedule **Kitchen equipment**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **200** W
 Schedule **Kitchen equipment**
 Latent **50** W
 Schedule **Kitchen equipment**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Kitchen equipment**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	4.4	0	0	0
E	9.5	0	0	1

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**

3.2. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**
 Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	6.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **6.0** m²
 Total Floor U-Value **0.568** W/(m²·°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**
 Area **8.8** m²

U-Value **7.000** W/(m²·°K)
 Uncondit. Space Max Temp **23.9** °C
 Ambient at Space Max Temp **35.0** °C

Space Input Data

PalGBC building retrofit project - baseline

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09:12AM

Uncondit. Space Min Temp **23.9** °C
Ambient at Space Min Temp **12.8** °C

7.2. 2nd Partition Details:
(No partition data).

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

M. office (7)

1. General Details:

Floor Area **16.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **12.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Operating hours**

2.4. People:

Occupancy **3.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Operating hours**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Operating hours**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **37.50** W/m²
 Schedule **Operating hours**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
E	12.3	1	0	0

3.1. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**
 1st Window Type **W05**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	16.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **16.0** m²
 Total Floor U-Value **0.568** W/(m²·°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**
 Area **13.0** m²
 U-Value **2.564** W/(m²·°K)
 Uncondit. Space Max Temp **27.0** °C
 Ambient at Space Max Temp **35.0** °C
 Uncondit. Space Min Temp **15.0** °C
 Ambient at Space Min Temp **12.8** °C

7.2. 2nd Partition Details:

(No partition data).

Space Input Data

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Space Input Data

PalGBC building retrofit project - baseline

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HB

09:12AM

Meeting room (6)

1. General Details:

Floor Area **9.4** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **15.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Meeting room**

2.4. People:

Occupancy **6.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Meeting room**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Meeting room**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **64.00** W/m²
 Schedule **Meeting room**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	6.0	0	0	1
E	10.7	1	0	0

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**
 Door Type **Occupied space ext. door**

3.2. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**
 1st Window Type **W06**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	9.4	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **9.4** m²
 Total Floor U-Value **0.568** W/(m²·°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Meeting room (8)

1. General Details:

Floor Area **18.3** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **15.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Meeting room**

2.4. People:

Occupancy **8.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Meeting room**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Meeting room**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Meeting room**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	12.5	1	0	1

3.1. Construction Types for Exposure SW

Wall Type **Ext. wall (stone)**
 1st Window Type **W04**
 Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	18.3	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **18.3** m²
 Total Floor U-Value **0.568** W/(m²-°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Office (9)

1. General Details:

Floor Area **11.3** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **12.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Operating hours**

2.4. People:

Occupancy **4.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Operating hours**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Operating hours**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Operating hours**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	11.7	1	0	0

3.1. Construction Types for Exposure SW

Wall Type **Ext. wall (stone)**
 1st Window Type **W03**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	11.3	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **11.3** m²
 Total Floor U-Value **0.568** W/(m²·°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Waiting area (10)

1. General Details:

Floor Area **10.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Main entry lobby**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **15.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Waiting area**

2.4. People:

Occupancy **2.0** People
 Activity Level **Seated at Rest**
 Sensible **67.4** W/person
 Latent **35.2** W/person
 Schedule **Waiting area**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **50** W
 Schedule **Waiting area**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **0.00** W/m²
 Schedule **Waiting area**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	9.4	0	0	1

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**
 Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	10.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**
 Floor Area **10.0** m²
 Total Floor U-Value **0.568** W/(m²·°K)
 Unconditioned Space Max Temp. **27.0** °C
 Ambient at Space Max Temp. **35.0** °C
 Unconditioned Space Min Temp. **15.0** °C
 Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - baseline

10/18/2022

HB

09:12AM

Work space (1, 2, 12)

1. General Details:

Floor Area **62.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **15.00** W/m²
 Ballast Multiplier **1.10**
 Schedule **Working space**

2.4. People:

Occupancy **12.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Working space**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **200** W
 Schedule **Working space**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Working space**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	21.7	0	0	0
NE	12.8	0	0	0
E	6.2	1	0	0
SW	19.4	1	1	1

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**

3.2. Construction Types for Exposure NE

Wall Type **Ext. wall (stone)**

3.3. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**
 1st Window Type **W08**

3.4. Construction Types for Exposure SW

Wall Type **Ext. wall (stone)**
 1st Window Type **W01**
 2nd Window Type **W02**
 Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	62.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.80** ACH
 Design Heating **1.20** ACH
 Energy Analysis **1.20** ACH
 Infiltration occurs at all hours.

Space Input Data

PalGBC building retrofit project - baseline

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HB

09:12AM

6. Floors:

Type **Floor Above Unconditioned Space**
Floor Area **62.0** m²
Total Floor U-Value **0.568** W/(m²-°K)
Unconditioned Space Max Temp. **27.0** °C
Ambient at Space Max Temp. **35.0** °C
Unconditioned Space Min Temp. **15.0** °C
Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**
Area **26.7** m²
U-Value **2.564** W/(m²-°K)
Uncondit. Space Max Temp **27.0** °C
Ambient at Space Max Temp **35.0** °C
Uncondit. Space Min Temp **15.0** °C
Ambient at Space Min Temp **12.8** °C

7.2. 2nd Partition Details:

Partition Type **Wall Partition**
Area **25.5** m²
U-Value **7.000** W/(m²-°K)
Uncondit. Space Max Temp **27.0** °C
Ambient at Space Max Temp **35.0** °C
Uncondit. Space Min Temp **15.0** °C
Ambient at Space Min Temp **12.8** °C

M.office (7) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

1. General Details:

Air System Name **M.office (7)**
 Equipment Type **Split AHU**
 Air System Type **Single Zone CAV**
 Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control **Constant Ventilation Airflow**
 Ventilation Sizing Method **Sum of Space OA Airflows**
 Unocc. Damper Position **Closed**
 Damper Leak Rate **0** %
 Outdoor Air CO2 Level **400** ppm

Central Cooling Data:

Supply Air Temperature **14.4** °C
 Coil Bypass Factor **0.100**
 Cooling Source **Air-Cooled DX**
 Schedule **JFMAMJJASOND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature **35.0** °C
 Heating Source **Air Source Heat Pump**
 Schedule **JFM* * * * * OND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type **Forward Curved**
 Configuration **Draw-thru**
 Fan Performance **0** Pa
 Overall Efficiency **54** %
 Fan Control **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain **0** %
 Duct Leakage **0** %

Return Duct or Plenum Data:

Return Air Via **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
M. office (7)	x1

Thermostats and Zone Data:

Zone **All**
 Cooling T-stat: Occ. **23.9** °C
 Cooling T-stat: Unocc. **26.7** °C
 Heating T-stat: Occ. **21.1** °C
 Heating T-stat: Unocc. **18.3** °C
 T-stat Throttling Range **0.83** °K
 Diversity Factor **100** %
 Direct Exhaust Airflow **0.0** L/s
 Direct Exhaust Fan kW **0.0** kW
 Thermostat Schedule **AC summer cooling**
 Unoccupied Cooling is **Not Available**

Supply Terminals Data:

Zone **All**
 Terminal Type **Diffuser**
 Minimum Airflow **0.00** L/s/person

Zone Heating Units:

Zone **All**
 Zone Heating Unit Type **None**

M.office (7) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

Zone Unit Heat Source **Electric Resistance**
 Zone Heating Unit Schedule **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Cooling Supply Temperature **14.4** °C
 Supply Fan Airflow **360.0** L/s
 Ventilation Airflow **12.3** L/s
 Heating Supply Temperature **35.0** °C

Hydronic Sizing Specifications:

Chilled Water Delta-T **5.6** °K
 Hot Water Delta-T **11.1** °K

Safety Factors:

Cooling Sensible **20** %
 Cooling Latent **20** %
 Heating **0** %

Zone Sizing Data:

Zone Airflow Sizing Method **Sum of space airflow rates**
 Space Airflow Sizing Method **Individual peak space loads**

Zone	Supply Airflow (L/s)	Zone Htg Unit (kW)	Reheat Coil (kW)	- (L/s)
1	360.0	-	-	

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load **4.1** kW
 Design OAT **35.0** °C
 Equipment Sizing **(Auto-Sized) 4.1** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **2.800** EER
 DX System Configuration **1-stage compression, 1 circuit**
 Conventional Cutoff OAT **12.8** °C
 Low Temperature Operation **Used**
 Low Temperature Cutoff OAT **-17.8** °C

Central Heating Unit - ASHP

Estimated Maximum Load **2.7** kW
 Design OAT **8.3** °C
 Equipment Sizing **(Auto-Sized) 2.7** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **3.300** COP
 Cutoff OAT **-26.1** °C

Auxiliary Heating:

Auxiliary Heating Type **Electric Resistance**
 Auxiliary Heating Upper Cutoff **4.4** °C

Meeting room (6) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

1. General Details:

Air System Name **Meeting room (6)**
 Equipment Type **Split AHU**
 Air System Type **Single Zone CAV**
 Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control **Constant Ventilation Airflow**
 Ventilation Sizing Method **Sum of Space OA Airflows**
 Unocc. Damper Position **Closed**
 Damper Leak Rate **0** %
 Outdoor Air CO2 Level **400** ppm

Central Cooling Data:

Supply Air Temperature **14.4** °C
 Coil Bypass Factor **0.100**
 Cooling Source **Air-Cooled DX**
 Schedule **JFMAMJJASOND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature **35.0** °C
 Heating Source **Air Source Heat Pump**
 Schedule **JFM* * * * * OND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type **Forward Curved**
 Configuration **Draw-thru**
 Fan Performance **0** Pa
 Overall Efficiency **54** %
 Fan Control **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain **0** %
 Duct Leakage **0** %

Return Duct or Plenum Data:

Return Air Via **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
Meeting room (6)	x1

Thermostats and Zone Data:

Zone **All**
 Cooling T-stat: Occ. **23.9** °C
 Cooling T-stat: Unocc. **26.7** °C
 Heating T-stat: Occ. **21.1** °C
 Heating T-stat: Unocc. **18.3** °C
 T-stat Throttling Range **0.83** °K
 Diversity Factor **100** %
 Direct Exhaust Airflow **0.0** L/s
 Direct Exhaust Fan kW **0.0** kW

Thermostat Schedule **AC summer cooling**
 Unoccupied Cooling is **Not Available**

Supply Terminals Data:

Zone **All**
 Terminal Type **Diffuser**
 Minimum Airflow **0.00** L/s/person

Zone Heating Units:

Zone **All**
 Zone Heating Unit Type **None**

Meeting room (6) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

Zone Unit Heat Source **Electric Resistance**
 Zone Heating Unit Schedule **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:
 Cooling Supply Temperature **14.4** °C
 Supply Fan Airflow **233.1** L/s
 Ventilation Airflow **17.8** L/s
 Heating Supply Temperature **35.0** °C

Hydronic Sizing Specifications:
 Chilled Water Delta-T **5.6** °K
 Hot Water Delta-T **11.1** °K

Safety Factors:
 Cooling Sensible **20** %
 Cooling Latent **20** %
 Heating **0** %

Zone Sizing Data:

Zone Airflow Sizing Method **Sum of space airflow rates**
 Space Airflow Sizing Method **Individual peak space loads**

Zone	Supply Airflow (L/s)	Zone Htg Unit (kW)	Reheat Coil (kW)	- (L/s)
1	233.1	-	-	

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load **2.8** kW
 Design OAT **35.0** °C
 Equipment Sizing **(Auto-Sized) 2.8** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **2.800** EER
 DX System Configuration **1-stage compression, 1 circuit**
 Conventional Cutoff OAT **12.8** °C
 Low Temperature Operation **Used**
 Low Temperature Cutoff OAT **-17.8** °C

Central Heating Unit - ASHP

Estimated Maximum Load **2.2** kW
 Design OAT **8.3** °C
 Equipment Sizing **(Auto-Sized) 2.2** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **3.300** COP
 Cutoff OAT **-26.1** °C

Auxiliary Heating:
 Auxiliary Heating Type **Electric Resistance**
 Auxiliary Heating Upper Cutoff **4.4** °C

Meeting room (8) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

1. General Details:

Air System Name **Meeting room (8)**
 Equipment Type **Split AHU**
 Air System Type **Single Zone CAV**
 Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control **Constant Ventilation Airflow**
 Ventilation Sizing Method **Sum of Space OA Airflows**
 Unocc. Damper Position **Closed**
 Damper Leak Rate **0** %
 Outdoor Air CO2 Level **400** ppm

Central Cooling Data:

Supply Air Temperature **14.4** °C
 Coil Bypass Factor **0.100**
 Cooling Source **Air-Cooled DX**
 Schedule **JFMAMJJASOND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature **35.0** °C
 Heating Source **Air Source Heat Pump**
 Schedule **JFM* * * * * OND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type **Forward Curved**
 Configuration **Draw-thru**
 Fan Performance **0** Pa
 Overall Efficiency **54** %
 Fan Control **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain **0** %
 Duct Leakage **0** %

Return Duct or Plenum Data:

Return Air Via **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
Meeting room (8)	x1

Thermostats and Zone Data:

Zone **All**
 Cooling T-stat: Occ. **23.9** °C
 Cooling T-stat: Unocc. **26.7** °C
 Heating T-stat: Occ. **21.1** °C
 Heating T-stat: Unocc. **18.3** °C
 T-stat Throttling Range **0.83** °K
 Diversity Factor **100** %
 Direct Exhaust Airflow **0.0** L/s
 Direct Exhaust Fan kW **0.0** kW

Thermostat Schedule **AC summer cooling**
 Unoccupied Cooling is **Not Available**

Supply Terminals Data:

Zone **All**
 Terminal Type **Diffuser**
 Minimum Airflow **0.00** L/s/person

Zone Heating Units:

Zone **All**
 Zone Heating Unit Type **None**

Meeting room (8) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

Zone Unit Heat Source **Electric Resistance**
 Zone Heating Unit Schedule **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Cooling Supply Temperature **14.4** °C
 Supply Fan Airflow **363.9** L/s
 Ventilation Airflow **25.5** L/s
 Heating Supply Temperature **35.0** °C

Hydronic Sizing Specifications:

Chilled Water Delta-T **5.6** °K
 Hot Water Delta-T **11.1** °K

Safety Factors:

Cooling Sensible **20** %
 Cooling Latent **20** %
 Heating **0** %

Zone Sizing Data:

Zone Airflow Sizing Method **Sum of space airflow rates**
 Space Airflow Sizing Method **Individual peak space loads**

Zone	Supply Airflow (L/s)	Zone Htg Unit (kW)	Reheat Coil (kW)	- (L/s)
1	363.9	-	-	

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load **4.3** kW
 Design OAT **35.0** °C
 Equipment Sizing **(Auto-Sized) 4.3** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **2.800** EER
 DX System Configuration **1-stage compression, 1 circuit**
 Conventional Cutoff OAT **12.8** °C
 Low Temperature Operation **Used**
 Low Temperature Cutoff OAT **-17.8** °C

Central Heating Unit - ASHP

Estimated Maximum Load **3.0** kW
 Design OAT **8.3** °C
 Equipment Sizing **(Auto-Sized) 3.0** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **3.300** COP
 Cutoff OAT **-26.1** °C

Auxiliary Heating:

Auxiliary Heating Type **Electric Resistance**
 Auxiliary Heating Upper Cutoff **4.4** °C

Office (9) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

1. General Details:

Air System Name **Office (9)**
 Equipment Type **Split AHU**
 Air System Type **Single Zone CAV**
 Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control **Constant Ventilation Airflow**
 Ventilation Sizing Method **Sum of Space OA Airflows**
 Unocc. Damper Position **Closed**
 Damper Leak Rate **0** %
 Outdoor Air CO2 Level **400** ppm

Central Cooling Data:

Supply Air Temperature **14.4** °C
 Coil Bypass Factor **0.100**
 Cooling Source **Air-Cooled DX**
 Schedule **JFMAMJJASOND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature **35.0** °C
 Heating Source **Air Source Heat Pump**
 Schedule **JFM* * * * * OND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type **Forward Curved**
 Configuration **Draw-thru**
 Fan Performance **0** Pa
 Overall Efficiency **54** %
 Fan Control **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain **0** %
 Duct Leakage **0** %

Return Duct or Plenum Data:

Return Air Via **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
Office (9)	x1

Thermostats and Zone Data:

Zone **All**
 Cooling T-stat: Occ. **23.9** °C
 Cooling T-stat: Unocc. **26.7** °C
 Heating T-stat: Occ. **21.1** °C
 Heating T-stat: Unocc. **18.3** °C
 T-stat Throttling Range **0.83** °K
 Diversity Factor **100** %
 Direct Exhaust Airflow **0.0** L/s
 Direct Exhaust Fan kW **0.0** kW

Thermostat Schedule **AC summer cooling**
 Unoccupied Cooling is **Not Available**

Supply Terminals Data:

Zone **All**
 Terminal Type **Diffuser**
 Minimum Airflow **0.00** L/s/person

Zone Heating Units:

Zone **All**
 Zone Heating Unit Type **None**

Office (9) Input Data

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:13AM

Zone Unit Heat Source **Electric Resistance**
 Zone Heating Unit Schedule **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:

Cooling Supply Temperature **14.4** °C
 Supply Fan Airflow **317.2** L/s
 Ventilation Airflow **13.4** L/s
 Heating Supply Temperature **35.0** °C

Hydronic Sizing Specifications:

Chilled Water Delta-T **5.6** °K
 Hot Water Delta-T **11.1** °K

Safety Factors:

Cooling Sensible **20** %
 Cooling Latent **20** %
 Heating **0** %

Zone Sizing Data:

Zone Airflow Sizing Method **Sum of space airflow rates**
 Space Airflow Sizing Method **Individual peak space loads**

Zone	Supply Airflow (L/s)	Zone Htg Unit (kW)	Reheat Coil (kW)	- (L/s)
1	317.2	-	-	

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load **3.8** kW
 Design OAT **35.0** °C
 Equipment Sizing **(Auto-Sized) 3.8** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **2.800** EER
 DX System Configuration **1-stage compression, 1 circuit**
 Conventional Cutoff OAT **12.8** °C
 Low Temperature Operation **Used**
 Low Temperature Cutoff OAT **-17.8** °C

Central Heating Unit - ASHP

Estimated Maximum Load **2.0** kW
 Design OAT **8.3** °C
 Equipment Sizing **(Auto-Sized) 2.0** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **3.300** COP
 Cutoff OAT **-26.1** °C

Auxiliary Heating:

Auxiliary Heating Type **Electric Resistance**
 Auxiliary Heating Upper Cutoff **4.4** °C

Monthly Simulation Results for M.office (7)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

1. General Details:

Air System Name **Work space (1, 2, 12)**
 Equipment Type **Split AHU**
 Air System Type **Single Zone CAV**
 Number of zones **1**

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control **Constant Ventilation Airflow**
 Ventilation Sizing Method **Sum of Space OA Airflows**
 Unocc. Damper Position **Closed**
 Damper Leak Rate **0** %
 Outdoor Air CO2 Level **400** ppm

Central Cooling Data:

Supply Air Temperature **14.4** °C
 Coil Bypass Factor **0.100**
 Cooling Source **Air-Cooled DX**
 Schedule **JFMAMJJASOND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Central Heating Data:

Supply Temperature **35.0** °C
 Heating Source **Air Source Heat Pump**
 Schedule **JFM* * * * * OND**
 Capacity Control **Cycled or Staged Capacity - Fan On**

Supply Fan Data:

Fan Type **Forward Curved**
 Configuration **Draw-thru**
 Fan Performance **0** Pa
 Overall Efficiency **54** %
 Fan Control **1-speed fan, cooling and heating**

Duct System Data:

Supply Duct Data:

Duct Heat Gain **0** %
 Duct Leakage **0** %

Return Duct or Plenum Data:

Return Air Via **Ducted Return**

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
Work space (1, 2, 12)	x1

Thermostats and Zone Data:

Zone **All**
 Cooling T-stat: Occ. **23.9** °C
 Cooling T-stat: Unocc. **26.7** °C
 Heating T-stat: Occ. **21.1** °C
 Heating T-stat: Unocc. **18.3** °C
 T-stat Throttling Range **0.83** °K
 Diversity Factor **100** %
 Direct Exhaust Airflow **0.0** L/s
 Direct Exhaust Fan kW **0.0** kW

Thermostat Schedule **AC summer cooling**
 Unoccupied Cooling is **Available**

Supply Terminals Data:

Zone **All**
 Terminal Type **Diffuser**
 Minimum Airflow **0.00** L/s/person

Zone Heating Units:

Zone **All**
 Zone Heating Unit Type **None**

Monthly Simulation Results for M.office (7)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

Zone Unit Heat Source **Electric Resistance**
 Zone Heating Unit Schedule **JFMAMJJASOND**

4. Sizing Data (Computer-Generated):

System Sizing Data:

Sizing Data:
 Cooling Supply Temperature **14.4** °C
 Supply Fan Airflow **1472.6** L/s
 Ventilation Airflow **48.6** L/s
 Heating Supply Temperature **35.0** °C

Hydronic Sizing Specifications:

Chilled Water Delta-T **5.6** °K
 Hot Water Delta-T **11.1** °K

Safety Factors:

Cooling Sensible **20** %
 Cooling Latent **20** %
 Heating **0** %

Zone Sizing Data:

Zone Airflow Sizing Method **Sum of space airflow rates**
 Space Airflow Sizing Method **Individual peak space loads**

Zone	Supply Airflow (L/s)	Zone Htg Unit (kW)	Reheat Coil (kW)	- (L/s)
1	1472.6	-	-	

5. Equipment Data

Central Cooling Unit - Air-Cooled DX

Estimated Maximum Load **15.4** kW
 Design OAT **35.0** °C
 Equipment Sizing **(Auto-Sized) 15.4** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **2.800** EER
 DX System Configuration **1-stage compression, 1 circuit**
 Conventional Cutoff OAT **12.8** °C
 Low Temperature Operation **Used**
 Low Temperature Cutoff OAT **-17.8** °C

Central Heating Unit - ASHP

Estimated Maximum Load **11.5** kW
 Design OAT **8.3** °C
 Equipment Sizing **(Auto-Sized) 11.5** kW
 Capacity Oversizing Factor **0** %
 ARI Performance Rating **3.300** COP
 Cutoff OAT **-26.1** °C

Auxiliary Heating:

Auxiliary Heating Type **Electric Resistance**
 Auxiliary Heating Upper Cutoff **4.4** °C

Air System Simulation Results:

Monthly Simulation Results for M.office (7)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	630	630	207	0
February	0	0	0	568	568	190	0
March	0	0	0	308	308	100	0
April	113	113	35	0	0	0	0
May	185	185	57	0	0	0	0
June	347	347	107	0	0	0	0
July	361	361	110	0	0	0	0
August	367	367	116	0	0	0	0
September	238	238	74	0	0	0	0
October	0	0	0	3	3	1	0
November	0	0	0	221	221	70	0
December	0	0	0	425	425	133	0
Total	1611	1611	499	2155	2155	702	0

Air System Simulation Results:

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	42	119
February	0	0	36	103
March	0	0	44	124
April	0	0	38	108
May	0	0	38	108
June	0	0	42	119
July	0	0	40	113
August	0	0	36	103
September	0	0	40	113
October	0	0	42	119
November	0	0	40	113
December	0	0	38	108
Total	0	0	475	1350

Monthly Simulation Results for Meeting room (6)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

Air System Simulation Results:

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Ctg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	495	495	164	0
February	0	0	0	458	458	154	0
March	0	0	0	253	253	83	0
April	78	78	24	0	0	0	0
May	131	131	40	0	0	0	0
June	254	254	78	0	0	0	0
July	270	270	82	0	0	0	0
August	282	281	88	0	0	0	0
September	178	178	55	0	0	0	0
October	0	0	0	2	2	1	0
November	0	0	0	166	166	53	0
December	0	0	0	323	323	102	0
Total	1194	1193	367	1698	1698	555	0

Air System Simulation Results:

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	19	73
February	0	0	16	63
March	0	0	20	76
April	0	0	17	66
May	0	0	17	66
June	0	0	19	73
July	0	0	18	69
August	0	0	16	63
September	0	0	18	69
October	0	0	19	73
November	0	0	18	69
December	0	0	17	66
Total	0	0	213	827

Monthly Simulation Results for Meeting room (8)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

Air System Simulation Results:

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Ctg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	596	596	198	0
February	0	0	0	576	576	194	0
March	0	0	0	311	311	101	0
April	136	136	42	0	0	0	0
May	215	215	66	0	0	0	0
June	394	394	121	0	0	0	0
July	415	415	126	0	0	0	0
August	445	442	138	0	0	0	0
September	310	308	94	0	0	0	0
October	0	0	0	0	0	0	0
November	0	0	0	202	202	64	0
December	0	0	0	360	360	114	0
Total	1916	1910	586	2045	2045	672	0

Air System Simulation Results:

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	37	111
February	0	0	32	96
March	0	0	38	116
April	0	0	33	101
May	0	0	33	101
June	0	0	37	111
July	0	0	35	106
August	0	0	32	96
September	0	0	35	106
October	0	0	37	111
November	0	0	35	106
December	0	0	33	101
Total	0	0	415	1258

Monthly Simulation Results for Office (9)

Project Name: PalGBC building retrofit project - baseline

10/18/2022

Prepared by: HB

09:29AM

Air System Simulation Results:

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Ctg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	301	301	102	0
February	0	0	0	304	304	104	0
March	0	0	0	141	141	46	0
April	151	151	45	0	0	0	0
May	217	217	65	0	0	0	0
June	353	353	108	0	0	0	0
July	369	369	111	0	0	0	0
August	379	379	119	0	0	0	0
September	305	305	92	0	0	0	0
October	0	0	0	0	0	0	0
November	0	0	0	91	91	29	0
December	0	0	0	155	155	49	0
Total	1774	1774	540	992	992	332	0

Air System Simulation Results:

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	30	112
February	0	0	26	97
March	0	0	31	117
April	0	0	27	102
May	0	0	27	102
June	0	0	30	112
July	0	0	28	107
August	0	0	26	97
September	0	0	28	107
October	0	0	30	112
November	0	0	28	107
December	0	0	27	102
Total	0	0	336	1271

Annual Cost Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM

Air System Simulation Results:

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Ctg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	2419	2419	801	0
February	0	0	0	2292	2292	770	1
March	0	0	0	1317	1317	427	0
April	516	516	162	0	0	0	0
May	906	906	285	0	0	0	0
June	1586	1586	490	0	0	0	0
July	1860	1860	571	0	0	0	0
August	1989	1987	628	0	0	0	0
September	1197	1197	373	0	0	0	0
October	500	500	160	20	20	6	0
November	29	29	9	903	903	286	0
December	0	0	0	1588	1588	498	0
Total	8585	8583	2678	8539	8539	2789	1

Air System Simulation Results:

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	248	750
February	1	0	214	648
March	0	0	259	784
April	0	0	225	682
May	0	0	225	682
June	0	0	248	750
July	0	0	236	716
August	0	0	214	648
September	0	0	236	716
October	0	0	248	750
November	0	0	236	716
December	0	0	225	682
Total	1	0	2813	8525

Annual Cost Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM

Ext. wall (No stone)

Wall Details

Outside Surface Color **Light**
 Absorptivity **0.450**
 Overall U-Value **2.597** W/(m²·°K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	360.000	-		0.38499	864.0

Ext. wall (stone)

Wall Details

Outside Surface Color **Light**
 Absorptivity **0.450**
 Overall U-Value **2.444** W/(m²·°K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
Stone	70.000	1750.0	0.75	0.04130	122.5
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	400.000	-		0.40915	914.5

Annual Cost Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

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Roof

Roof Details

Outside Surface Color **Medium**
Absorptivity **0.675**
Overall U-Value **3.603** W/(m²·°K)

Roof Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg · °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Solid slab	170.000	2242.6	0.84	0.09822	381.2
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	170.000	-		0.27750	381.2

Annual Cost Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

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W01

Window Details:

Detailed Input **No**
Height **1.38** m
Width **1.66** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W02

Window Details:

Detailed Input **No**
Height **1.39** m
Width **2.24** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W03

Window Details:

Detailed Input **No**
Height **1.39** m
Width **2.27** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W04

Window Details:

Detailed Input **No**
Height **1.38** m
Width **1.61** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W05

Window Details:

Detailed Input **No**
Height **1.40** m
Width **2.05** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W06

Window Details:

Detailed Input **No**
Height **1.11** m
Width **1.56** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

W07

Window Details:

Detailed Input **No**
Height **1.16** m
Width **0.85** m
Overall U-Value **5.600** W/(m²·°K)
Overall Shade Coefficient **0.811**

Annual Cost Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

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W08

Window Details:

Detailed Input **No**
Height **1.15** m
Width **1.08** m
Overall U-Value **5.600** W/(m²-°K)
Overall Shade Coefficient **0.811**

W09

Window Details:

Detailed Input **No**
Height **5.72** m
Width **0.65** m
Overall U-Value **5.600** W/(m²-°K)
Overall Shade Coefficient **0.811**

Occupied space ext. door

Door Details:

Gross Area **1.8** m²
Door U-Value **5.800** W/(m²-°K)

Glass Details:

Glass Area **0.0** m²
Glass U-Value **3.293** W/(m²-°K)
Glass Shade Coefficient **0.880**
Glass Shaded All Day? **No**

Annual Cost Summary

PaIGBC building retrofit project - baseline

10/18/2022

HB

09:21AM

Annual Costs

Component	PaIGBC baseline (\$)
Air System Fans	0
Cooling	934
Heating	1,010
Pumps	0
Heat Rejection Fans	0
HVAC Sub-Total	1,945
Lights	851
Electric Equipment	2,646
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	3,497
Grand Total	5,441

Annual Cost per Unit Floor Area

Component	PaIGBC baseline (\$/m ²)
Air System Fans	0.000
Cooling	5.594
Heating	6.050
Pumps	0.000
Heat Rejection Fans	0.000
HVAC Sub-Total	11.644
Lights	5.093
Electric Equipment	15.846
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	20.939
Grand Total	32.583
Gross Floor Area (m ²)	167.0
Conditioned Floor Area (m ²)	117.0

Note: Values in this table are calculated using the Gross Floor Area.

Component Cost as a Percentage of Total Cost

Component	PaIGBC baseline (%)
Air System Fans	0.0
Cooling	17.2
Heating	18.6
Pumps	0.0
Heat Rejection Fans	0.0
HVAC Sub-Total	35.7
Lights	15.6
Electric Equipment	48.6
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	64.3
Grand Total	100.0

Annual Energy and Emissions Summary

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM

Annual Costs

Component	PalGBC baseline (\$)
HVAC Components	
Electric	1,945
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Remote CW	0
HVAC Sub-Total	1,945
Non-HVAC Components	
Electric	3,497
Natural Gas	0
Fuel Oil	0
Propane	0
Remote HW	0
Remote Steam	0
Non-HVAC Sub-Total	3,497
Grand Total	5,441

Annual Energy Consumption

Component	PalGBC baseline
HVAC Components	
Electric (kWh)	9,723
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0
Non-HVAC Components	
Electric (kWh)	17,484
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Totals	
Electric (kWh)	27,207
Natural Gas (na)	0
Fuel Oil (na)	0
Propane (na)	0
Remote HW (na)	0
Remote Steam (na)	0
Remote CW (na)	0

Annual Energy and Emissions Summary

PaIGBC building retrofit project - baseline

10/18/2022

HB

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Annual Emissions

Component	PaIGBC baseline
CO2 Equivalent (kg)	0

Annual Cost per Unit Floor Area

Component	PaIGBC baseline (\$/m ²)
HVAC Components	
Electric	11.644
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Remote CW	0.000
HVAC Sub-Total	11.644
Non-HVAC Components	
Electric	20.939
Natural Gas	0.000
Fuel Oil	0.000
Propane	0.000
Remote HW	0.000
Remote Steam	0.000
Non-HVAC Sub-Total	20.939
Grand Total	32.583
Gross Floor Area (m ²)	167.0
Conditioned Floor Area (m ²)	117.0

Note: Values in this table are calculated using the Gross Floor Area.

Component Cost as a Percentage of Total Cost

Component	PaIGBC baseline (%)
HVAC Components	
Electric	35.7
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Remote CW	0.0
HVAC Sub-Total	35.7
Non-HVAC Components	
Electric	64.3
Natural Gas	0.0
Fuel Oil	0.0
Propane	0.0
Remote HW	0.0
Remote Steam	0.0
Non-HVAC Sub-Total	64.3
Grand Total	100.0

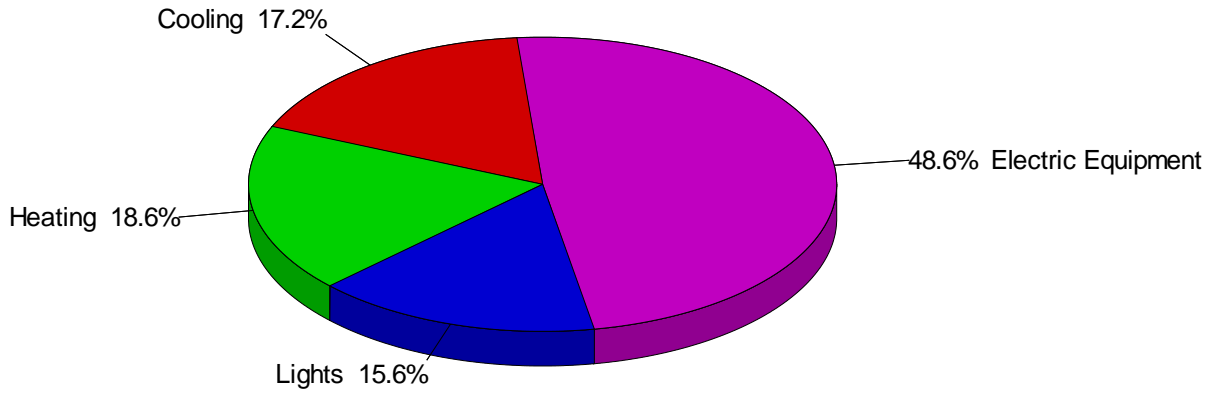
Annual Component Costs - PalGBC baseline

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM



1. Annual Costs

Component	Annual Cost (\$)	(\$/m ²)	Percent of Total (%)
Air System Fans	0	0.000	0.0
Cooling	934	5.594	17.2
Heating	1,010	6.050	18.6
Pumps	0	0.000	0.0
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	1,945	11.644	35.7
Lights	851	5.093	15.6
Electric Equipment	2,646	15.846	48.6
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	3,497	20.939	64.3
Grand Total	5,441	32.583	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²
 Conditioned Floor Area **117.0** m²

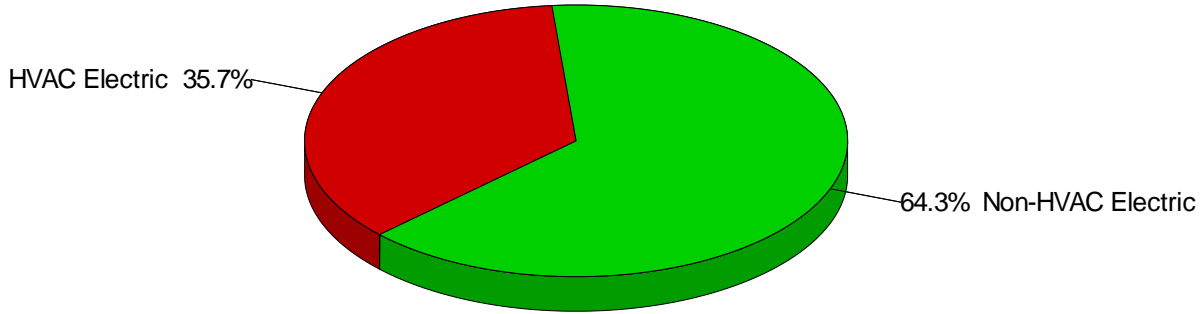
Annual Energy Costs - PalGBC baseline

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM



1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/m ²)	Percent of Total (%)
HVAC Components			
Electric	1,945	11.644	35.7
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	1,945	11.644	35.7
Non-HVAC Components			
Electric	3,497	20.939	64.3
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	3,497	20.939	64.3
Grand Total	5,441	32.583	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 167.0 m²
 Conditioned Floor Area 117.0 m²

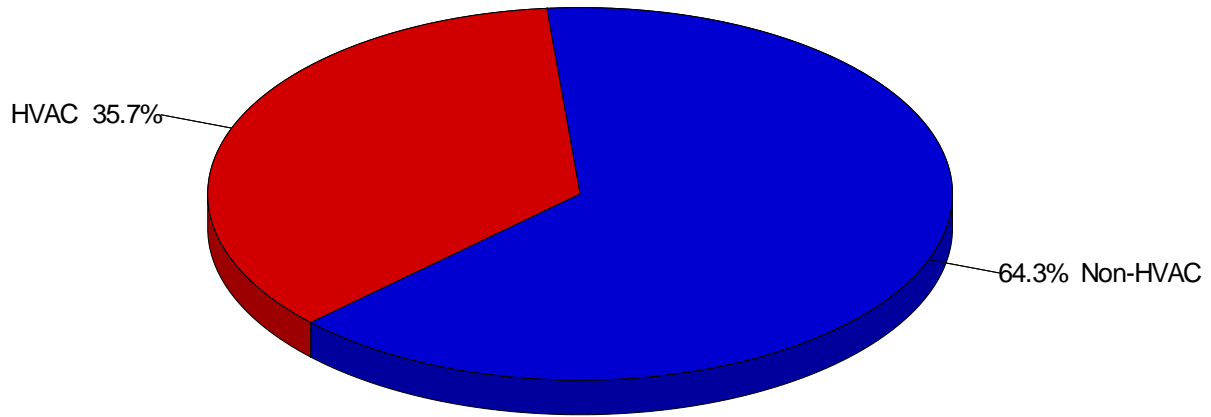
Annual HVAC & Non-HVAC Cost Totals - PaIGBC baseline

PaIGBC building retrofit project - baseline

10/18/2022

HB

09:21AM



1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/m ²)	Percent of Total (%)
HVAC	1,945	11.644	35.7
Non-HVAC	3,497	20.939	64.3
Grand Total	5,441	32.583	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²
 Conditioned Floor Area **117.0** m²

Energy Budget by System Component - PalGBC baseline

PalGBC building retrofit project - baseline

10/18/2022

HB

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1. Annual Coil Loads

Component	Load (kWh)	(kWh/m ²)
Cooling Coil Loads	15,080	90.301
Heating Coil Loads	15,430	92.393
Grand Total	30,510	182.695

2. Energy Consumption by System Component

Component	Site Energy (kWh)	Site Energy (kWh/m ²)	Source Energy (kWh)	Source Energy (kWh/m ²)
Air System Fans	0	0.000	0	0.000
Cooling	4,670	27.967	16,680	99.881
Heating	5,052	30.250	18,042	108.035
Pumps	0	0.000	0	0.000
Heat Rejection Fans	0	0.000	0	0.000
HVAC Sub-Total	9,722	58.217	34,722	207.916
Lights	4,252	25.463	15,187	90.940
Electric Equipment	13,231	79.227	47,253	282.955
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	17,483	104.691	62,440	373.895
Grand Total	27,205	162.907	97,162	581.811

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 - Gross Floor Area **167.0** m²
 - Conditioned Floor Area **117.0** m²

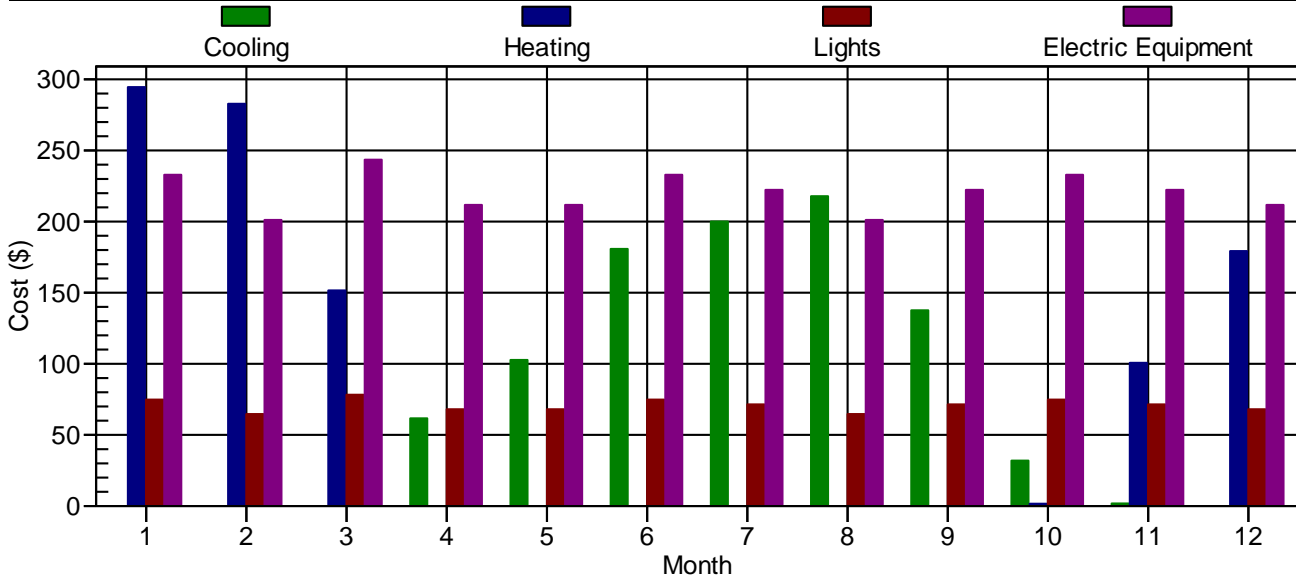
Monthly Component Costs - PalGBC baseline

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM



1. HVAC Component Costs

Month	Air System Fans (\$)	Cooling (\$)	Heating (\$)	Pumps (\$)	Heat Rejection Fans (\$)	HVAC Total (\$)
January	0	0	295	0	0	295
February	0	0	283	0	0	283
March	0	0	152	0	0	152
April	0	62	0	0	0	62
May	0	103	0	0	0	103
June	0	181	0	0	0	181
July	0	200	0	0	0	200
August	0	218	0	0	0	218
September	0	138	0	0	0	138
October	0	32	2	0	0	34
November	0	2	101	0	0	103
December	0	0	179	0	0	179
Total	0	934	1,010	0	0	1,945

2. Non-HVAC Component Costs

Month	Lights (\$)	Electric Equipment (\$)	Misc. Electric (\$)	Misc. Fuel Use (\$)	Non-HVAC Total (\$)	Grand Total (\$)
January	75	233	0	0	308	603
February	65	201	0	0	266	549
March	78	243	0	0	322	474
April	68	212	0	0	280	342
May	68	212	0	0	280	383
June	75	233	0	0	308	489
July	71	222	0	0	294	494
August	65	201	0	0	266	484
September	71	222	0	0	294	432
October	75	233	0	0	308	342
November	71	222	0	0	294	397
December	68	212	0	0	280	459
Total	851	2,646	0	0	3,497	5,441

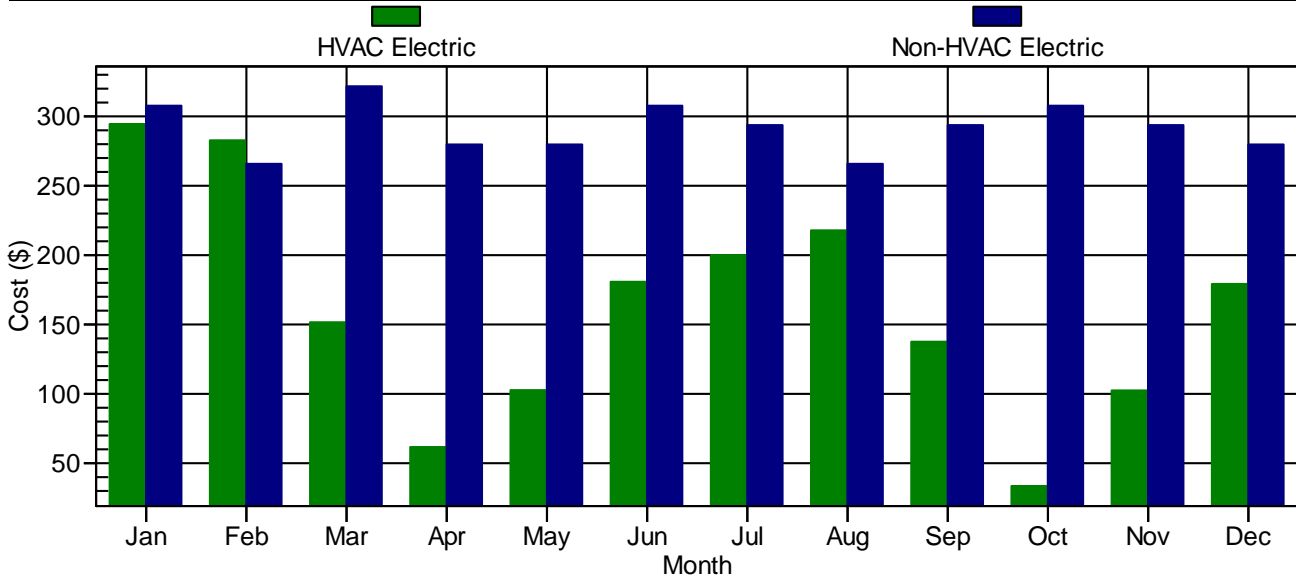
Monthly Energy Costs - PalGBC baseline

PalGBC building retrofit project - baseline

10/18/2022

HB

09:21AM



1. HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)	Remote Chilled Water (\$)
January	295	0	0	0	0	0	0
February	283	0	0	0	0	0	0
March	152	0	0	0	0	0	0
April	62	0	0	0	0	0	0
May	103	0	0	0	0	0	0
June	181	0	0	0	0	0	0
July	200	0	0	0	0	0	0
August	218	0	0	0	0	0	0
September	138	0	0	0	0	0	0
October	34	0	0	0	0	0	0
November	102	0	0	0	0	0	0
December	179	0	0	0	0	0	0
Total	1,945	0	0	0	0	0	0

2. Non-HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)
January	308	0	0	0	0	0
February	266	0	0	0	0	0
March	322	0	0	0	0	0
April	280	0	0	0	0	0
May	280	0	0	0	0	0
June	308	0	0	0	0	0
July	294	0	0	0	0	0
August	266	0	0	0	0	0
September	294	0	0	0	0	0
October	308	0	0	0	0	0
November	294	0	0	0	0	0
December	280	0	0	0	0	0
Total	3,497	0	0	0	0	0

Space Input Data

PalGBC building retrofit project - after

11/03/2022

An-najah

01:26AM

1. Component Charges

Billing Period	Energy Charges (\$)	Demand Charges (\$)	Customer Charges (\$)	Taxes (\$)	Total Charge (\$)
Jan	602	0	0	0	602
Feb	549	0	0	0	549
Mar	473	0	0	0	473
Apr	341	0	0	0	341
May	382	0	0	0	382
Jun	488	0	0	0	488
Jul	494	0	0	0	494
Aug	484	0	0	0	484
Sep	431	0	0	0	431
Oct	341	0	0	0	341
Nov	396	0	0	0	396
Dec	459	0	0	0	459
Totals	5,441	0	0	0	5,441

2. Totals

Billing Period	Total Charges (\$)	Total Consumption (kWh)	Avg Price (\$/kWh)
Jan	602	3,011	0.2000
Feb	549	2,743	0.2000
Mar	473	2,366	0.2000
Apr	341	1,707	0.2000
May	382	1,912	0.2000
Jun	488	2,442	0.2000
Jul	494	2,469	0.2000
Aug	484	2,418	0.2000
Sep	431	2,156	0.2000
Oct	341	1,706	0.2000
Nov	396	1,981	0.2000
Dec	459	2,295	0.2000
Totals	5,441	27,207	0.2000

Space Input Data

PalGBC building retrofit project - after

11/03/2022

An-najah

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3. Consumption Totals

Billing Period	Peak (kWh)	Mid-Peak (kWh)	Normal Peak (kWh)	Off-Peak (kWh)	Overall (kWh)
Jan	0	0	0	0	3,011
Feb	0	0	0	0	2,743
Mar	0	0	0	0	2,366
Apr	0	0	0	0	1,707
May	0	0	0	0	1,912
Jun	0	0	0	0	2,442
Jul	0	0	0	0	2,469
Aug	0	0	0	0	2,418
Sep	0	0	0	0	2,156
Oct	0	0	0	0	1,706
Nov	0	0	0	0	1,981
Dec	0	0	0	0	2,295
Totals	0	0	0	0	27,207

4. Billing Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	10.1
Feb	0.0	0.0	0.0	0.0	9.4
Mar	0.0	0.0	0.0	0.0	8.8
Apr	0.0	0.0	0.0	0.0	14.6
May	0.0	0.0	0.0	0.0	16.5
Jun	0.0	0.0	0.0	0.0	15.7
Jul	0.0	0.0	0.0	0.0	14.4
Aug	0.0	0.0	0.0	0.0	17.6
Sep	0.0	0.0	0.0	0.0	16.9
Oct	0.0	0.0	0.0	0.0	9.6
Nov	0.0	0.0	0.0	0.0	8.6
Dec	0.0	0.0	0.0	0.0	8.1

5. Maximum Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	10.1
Feb	0.0	0.0	0.0	0.0	9.4
Mar	0.0	0.0	0.0	0.0	8.8
Apr	0.0	0.0	0.0	0.0	14.6
May	0.0	0.0	0.0	0.0	16.5
Jun	0.0	0.0	0.0	0.0	15.7
Jul	0.0	0.0	0.0	0.0	14.4
Aug	0.0	0.0	0.0	0.0	17.6
Sep	0.0	0.0	0.0	0.0	16.9
Oct	0.0	0.0	0.0	0.0	9.6
Nov	0.0	0.0	0.0	0.0	8.6
Dec	0.0	0.0	0.0	0.0	8.1

Space Input Data

PalGBC building retrofit project - after

11/03/2022

An-najah

01:26AM

6. Time Of Maximum Demands

Billing Period	Peak (m/d/h)	Mid-Peak (m/d/h)	Normal Peak (m/d/h)	Off-Peak (m/d/h)	Overall (m/d/h)
Jan	n/a	n/a	n/a	n/a	1/18/0900
Feb	n/a	n/a	n/a	n/a	2/20/0900
Mar	n/a	n/a	n/a	n/a	3/14/0900
Apr	n/a	n/a	n/a	n/a	4/26/1600
May	n/a	n/a	n/a	n/a	5/8/1600
Jun	n/a	n/a	n/a	n/a	6/15/1600
Jul	n/a	n/a	n/a	n/a	7/25/1600
Aug	n/a	n/a	n/a	n/a	8/15/1400
Sep	n/a	n/a	n/a	n/a	9/5/1500
Oct	n/a	n/a	n/a	n/a	10/2/1600
Nov	n/a	n/a	n/a	n/a	11/16/0900
Dec	n/a	n/a	n/a	n/a	12/11/0900

Hour	Saturday Jan 1 (kW)
0000	2.5
0100	2.5
0200	2.7
0300	2.8
0400	2.9
0500	2.9
0600	3.2
0700	3.2
0800	2.6
0900	2.4
1000	2.0
1100	1.5
1200	1.0
1300	0.5
1400	0.4
1500	0.4
1600	0.5
1700	0.7
1800	0.8
1900	1.0
2000	1.1
2100	1.3
2200	1.4
2300	1.6

Space Input Data

PalGBC building retrofit project - after

11/03/2022

An-najah

01:26AM

Kitchen (4)

1. General Details:

Floor Area **6.0** m²
 Avg. Ceiling Height **2.7** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **GENERAL: Coffee station**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s·m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Operating hours**

2.4. People:

Occupancy **3.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Kitchen equipment**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **200** W
 Schedule **Kitchen equipment**
 Latent **50** W
 Schedule **Kitchen equipment**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Kitchen equipment**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	4.4	0	0	0

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Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
E	9.5	0	0	1

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**

3.2. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**

Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	6.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **6.0** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**

Space Input Data

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Area	8.8	m ²	7.2. 2nd Partition Details:
U-Value	7.000	W/(m ² -°K)	(No partition data).
Uncondit. Space Max Temp	23.9	°C	
Ambient at Space Max Temp	35.0	°C	
Uncondit. Space Min Temp	23.9	°C	
Ambient at Space Min Temp	12.8	°C	

Space Input Data

PalGBC building retrofit project - after

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An-najah

01:26AM

M. office (7)

1. General Details:

Floor Area **16.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Operating hours**

2.4. People:

Occupancy **1.0** Person
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Operating hours**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Operating hours**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **37.50** W/m²
 Schedule **Operating hours**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
E	12.3	1	0	0

3.1. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**

Space Input Data

PalGBC building retrofit project - after

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An-najah

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1st Window Type **W05**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	16.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **16.0** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**

Area **13.0** m²

U-Value **2.564** W/(m²-°K)

Uncondit. Space Max Temp **27.0** °C

Ambient at Space Max Temp **35.0** °C

Uncondit. Space Min Temp **15.0** °C

Ambient at Space Min Temp **12.8** °C

7.2. 2nd Partition Details:

(No partition data).

Space Input Data

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Space Input Data

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An-najah

01:26AM

Meeting room (6)

1. General Details:

Floor Area **9.4** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Meeting room**

2.4. People:

Occupancy **6.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Meeting room**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Meeting room**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **64.00** W/m²
 Schedule **Meeting room**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	6.0	0	0	1
E	10.7	1	0	0

Space Input Data

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3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**

Door Type **Occupied space ext. door**

3.2. Construction Types for Exposure E

Wall Type **Ext. wall (stone)**

1st Window Type **W06**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	9.4	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **9.4** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - after

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An-najah

01:26AM

Meeting room (8)

1. General Details:

Floor Area **18.3** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Meeting room**

2.4. People:

Occupancy **8.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Meeting room**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Meeting room**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Meeting room**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	12.5	1	0	1

3.1. Construction Types for Exposure SW

Wall Type **Ext. wall (stone)**

Space Input Data

PalGBC building retrofit project - after

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An-najah

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1st Window Type **W04**

Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	18.3	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **18.3** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - after

11/03/2022

An-najah

01:26AM

Office (9)

1. General Details:

Floor Area **11.3** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Operating hours**

2.4. People:

Occupancy **4.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Operating hours**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **10** W
 Schedule **Operating hours**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Operating hours**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	11.7	1	0	0

3.1. Construction Types for Exposure SW

Wall Type **Ext. wall (stone)**

Space Input Data

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An-najah

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1st Window Type **W03**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	11.3	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **11.3** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - after

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Waiting area (10)

1. General Details:

Floor Area **10.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Main entry lobby**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Waiting area**

2.4. People:

Occupancy **1.0** Person
 Activity Level **Seated at Rest**
 Sensible **67.4** W/person
 Latent **35.2** W/person
 Schedule **Waiting area**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **50** W
 Schedule **Waiting area**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **0.00** W/m²
 Schedule **Waiting area**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	9.4	0	0	1

3.1. Construction Types for Exposure N

Wall Type **Ext. wall (stone)**

Space Input Data

PalGBC building retrofit project - after

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Door Type **Occupied space ext. door**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	10.0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof**

5. Infiltration:

Design Cooling **0.40** ACH

Design Heating **0.60** ACH

Energy Analysis **0.60** ACH

Infiltration occurs at all hours.

6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **10.0** m²

Total Floor U-Value **0.568** W/(m²-°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

(No partition data).

Space Input Data

PalGBC building retrofit project - after

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An-najah

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Work space (1, 2, 12)

1. General Details:

Floor Area **62.0** m²
 Avg. Ceiling Height **3.1** m
 Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage **OFFICE: Office space**
 OA Requirement 1 **2.5** L/s/person
 OA Requirement 2 **0.30** L/(s-m²)
 Space Usage Defaults . **ASHRAE Standard 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Free Hanging**
 Wattage **5.00** W/m²
 Ballast Multiplier **1.00**
 Schedule **Working space**

2.4. People:

Occupancy **12.0** People
 Activity Level **Office Work**
 Sensible **71.8** W/person
 Latent **60.1** W/person
 Schedule **Working space**

2.2. Task Lighting:

Wattage **0.00** W/m²
 Schedule **None**

2.5. Miscellaneous Loads:

Sensible **200** W
 Schedule **Working space**
 Latent **0** W
 Schedule **None**

2.3. Electrical Equipment:

Wattage **50.00** W/m²
 Schedule **Working space**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	21.7	0	0	0
NE	12.8	0	0	0
E	6.2	1	0	0

Space Input Data

PalGBC building retrofit project - after

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Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
SW	19.4	1	1	1

3.1. Construction Types for Exposure N

Wall Type Ext. wall (stone)

3.2. Construction Types for Exposure NE

Wall Type Ext. wall (stone)

3.3. Construction Types for Exposure E

Wall Type Ext. wall (stone)

1st Window Type W08

3.4. Construction Types for Exposure SW

Wall Type Ext. wall (stone)

1st Window Type W01

2nd Window Type W02

Door Type Occupied space ext. door

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	62.0	0	0

4.1. Construction Types for Exposure H

Roof Type Roof

5. Infiltration:

Design Cooling 0.40 ACH

Design Heating 0.60 ACH

Energy Analysis 0.60 ACH

Infiltration occurs at all hours.

Space Input Data

PalGBC building retrofit project - after

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6. Floors:

Type **Floor Above Unconditioned Space**

Floor Area **62.0** m²

Total Floor U-Value **0.568** W/(m²·°K)

Unconditioned Space Max Temp. **27.0** °C

Ambient at Space Max Temp. **35.0** °C

Unconditioned Space Min Temp. **15.0** °C

Ambient at Space Min Temp. **12.8** °C

7. Partitions:

7.1. 1st Partition Details:

Partition Type **Wall Partition**

Area **26.7** m²

U-Value **2.564** W/(m²·°K)

Uncondit. Space Max Temp **27.0** °C

Ambient at Space Max Temp **35.0** °C

Uncondit. Space Min Temp **15.0** °C

Ambient at Space Min Temp **12.8** °C

7.2. 2nd Partition Details:

Partition Type **Wall Partition**

Area **25.5** m²

U-Value **7.000** W/(m²·°K)

Uncondit. Space Max Temp **27.0** °C

Ambient at Space Max Temp **35.0** °C

Uncondit. Space Min Temp **15.0** °C

Ambient at Space Min Temp **12.8** °C

Monthly Simulation Results for M.office (7)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	341	341	98	0
February	0	0	0	299	299	88	0
March	0	0	0	140	140	40	0
April	69	69	17	69	69	21	0
May	117	117	29	9	9	2	0
June	223	223	55	0	0	0	0
July	240	240	59	0	0	0	0
August	241	241	61	0	0	0	0
September	154	154	38	0	0	0	0
October	0	0	0	0	0	0	0
November	0	0	0	109	109	30	0
December	0	0	0	226	226	62	0
Total	1045	1045	259	1193	1193	341	0

Air System Simulation Results (Table 2) :

Monthly Simulation Results for M.office (7)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	16	119
February	0	0	14	103
March	0	0	17	124
April	0	0	14	108
May	0	0	14	108
June	0	0	16	119
July	0	0	15	113
August	0	0	14	103
September	0	0	15	113
October	0	0	16	119
November	0	0	15	113
December	0	0	14	108
Total	0	0	180	1350

Monthly Simulation Results for Meeting room (6)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	219	219	64	0
February	0	0	0	197	197	59	0
March	0	0	0	87	87	25	0
April	72	72	18	50	50	15	0
May	117	117	28	5	5	1	0
June	218	218	53	0	0	0	0
July	239	239	57	0	0	0	0
August	242	242	60	0	0	0	0
September	162	162	39	0	0	0	0
October	0	0	0	0	0	0	0
November	0	0	0	61	61	17	0
December	0	0	0	131	131	36	0
Total	1050	1050	256	751	751	218	0

Air System Simulation Results (Table 2) :

Monthly Simulation Results for Meeting room (6)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	6	73
February	0	0	5	63
March	0	0	6	76
April	0	0	5	66
May	0	0	5	66
June	0	0	6	73
July	0	0	5	69
August	0	0	5	63
September	0	0	5	69
October	0	0	6	73
November	0	0	5	69
December	0	0	5	66
Total	0	0	65	827

Monthly Simulation Results for Meeting room (8)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	246	246	73	0
February	0	0	0	239	239	72	0
March	0	0	0	101	101	29	0
April	117	117	28	63	62	19	0
May	181	181	44	8	8	2	0
June	323	323	79	0	0	0	0
July	357	357	86	0	0	0	0
August	373	372	92	0	0	0	0
September	271	271	65	1	1	0	0
October	0	0	0	0	0	0	0
November	0	0	0	70	70	20	0
December	0	0	0	124	124	35	0
Total	1623	1621	394	851	851	250	0

Air System Simulation Results (Table 2) :

Monthly Simulation Results for Meeting room (8)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	11	111
February	0	0	10	96
March	0	0	12	116
April	0	0	10	101
May	0	0	10	101
June	0	0	11	111
July	0	0	11	106
August	0	0	10	96
September	0	0	11	106
October	0	0	11	111
November	0	0	11	106
December	0	0	10	101
Total	0	0	126	1258

Monthly Simulation Results for Office (9)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	97	97	29	0
February	0	0	0	98	98	30	0
March	0	0	0	35	35	10	0
April	144	144	34	24	24	8	0
May	202	202	47	1	1	0	0
June	309	309	75	0	0	0	0
July	329	329	79	0	0	0	0
August	332	332	83	0	0	0	0
September	283	283	67	0	0	0	0
October	0	0	0	0	0	0	0
November	0	0	0	21	21	6	0
December	0	0	0	33	33	9	0
Total	1598	1598	384	309	309	93	0

Air System Simulation Results (Table 2) :

Monthly Simulation Results for Office (9)

Project Name: PalGBC building retrofit project - after

11/03/2022

Prepared by: An-najah

01:27AM

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	11	112
February	0	0	10	97
March	0	0	12	117
April	0	0	10	102
May	0	0	10	102
June	0	0	11	112
July	0	0	11	107
August	0	0	10	97
September	0	0	11	107
October	0	0	11	112
November	0	0	11	107
December	0	0	10	102
Total	0	0	127	1271

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

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Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Central Heating Coil Load (kWh)	Central Heating Eqpt Load (kWh)	Central Unit Htg Input (kWh)	Central Unit Aux. Htg. Load (kWh)
January	0	0	0	1235	1235	358	0
February	0	0	0	1161	1161	343	0
March	0	0	0	594	594	169	0
April	328	328	82	350	350	105	0
May	516	516	129	81	81	22	0
June	987	987	244	0	0	0	0
July	1126	1126	275	0	0	0	0
August	1203	1203	303	0	0	0	0
September	760	760	188	1	1	0	0
October	299	299	76	1	1	0	0
November	13	13	3	440	440	122	0
December	0	0	0	805	805	221	0
Total	5232	5232	1300	4669	4669	1341	0

Air System Simulation Results (Table 2) :

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

Month	Central Unit Aux. Htg. Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	0	75	750
February	0	0	65	648
March	0	0	78	784
April	0	0	68	682
May	0	0	68	682
June	0	0	75	750
July	0	0	72	716
August	0	0	65	648
September	0	0	72	716
October	0	0	75	750
November	0	0	72	716
December	0	0	68	682
Total	0	0	853	8525

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

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Ext. wall (No stone)

Wall Details

Outside Surface Color **Light**
 Absorptivity **0.450**
 Overall U-Value **1.381** W/(m²·°K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg · °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
13mm gypsum board	12.700	800.9	1.09	0.07890	10.2
Air space	20.000	0.0	0.00	0.16026	0.0
Foam insulation	20.000	0.0	0.00	0.10000	0.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	412.700	-		0.72415	874.2

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

Ext. wall (stone)

Wall Details

Outside Surface Color **Light**
 Absorptivity **0.450**
 Overall U-Value **1.336** W/(m²·°K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg · °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
13mm gypsum board	12.700	800.9	1.09	0.07890	10.2
Air space	20.000	0.0	0.00	0.16026	0.0
Insulation foam	20.000	0.0	0.00	0.10000	0.0
Plaster	30.000	2400.0	0.75	0.01714	72.0
Concrete	300.000	2400.0	0.75	0.17143	720.0
Stone	70.000	1750.0	0.75	0.04130	122.5
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	452.700	-		0.74831	924.7

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

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Roof

Roof Details

Outside Surface Color **Medium**
 Absorptivity **0.675**
 Overall U-Value **2.137** W/(m²·°K)

Roof Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m ³	Specific Ht. kJ / (kg - °K)	R-Value (m ² ·°K)/W	Weight kg/m ²
Inside surface resistance	0.000	0.0	0.00	0.12064	0.0
Solid slab	170.000	2242.6	0.84	0.09822	381.2
Insulation Foam	30.000	0.0	0.00	0.15000	0.0
Concrete	70.000	2400.0	0.75	0.04045	168.0
Outside surface resistance	0.000	0.0	0.00	0.05864	0.0
Totals	270.000	-		0.46795	549.2

W01

Window Details:

Detailed Input **No**
 Height **1.38** m
 Width **1.66** m
 Overall U-Value **3.200** W/(m²·°K)
 Overall Shade Coefficient **0.682**

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

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W02

Window Details:

Detailed Input **No**
Height **1.39** m
Width **2.24** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

W03

Window Details:

Detailed Input **No**
Height **1.39** m
Width **2.27** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

W04

Window Details:

Detailed Input **No**
Height **1.38** m
Width **1.61** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

An-najah

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W05

Window Details:

Detailed Input **No**
Height **1.40** m
Width **2.05** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

W06

Window Details:

Detailed Input **No**
Height **1.11** m
Width **1.56** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

W07

Window Details:

Detailed Input **No**
Height **1.16** m
Width **0.85** m
Overall U-Value **3.200** W/(m²-°K)
Overall Shade Coefficient **0.682**

Annual Cost Summary

PalGBC building retrofit project - after

11/03/2022

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W08

Window Details:

Detailed Input **No**
Height **1.15** m
Width **1.08** m
Overall U-Value **3.200** W/(m²·°K)
Overall Shade Coefficient **0.682**

W09

Window Details:

Detailed Input **No**
Height **5.72** m
Width **0.65** m
Overall U-Value **3.200** W/(m²·°K)
Overall Shade Coefficient **0.682**

Occupied space ext. door

Door Details:

Gross Area **1.8** m²
Door U-Value **2.300** W/(m²·°K)

Glass Details:

Glass Area **0.0** m²
Glass U-Value **3.293** W/(m²·°K)
Glass Shade Coefficient **0.880**
Glass Shaded All Day? **No**

Annual Cost Summary

PaIGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

Table 1. Annual Costs

Component	PaIGBC after (\$)
Air System Fans	0
Cooling	519
Heating	449
Pumps	0
Heat Rejection Fans	0
HVAC Sub-Total	967
Lights	270
Electric Equipment	2,646
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	2,916
Grand Total	3,884

Annual Cost Summary

PaIGBC building retrofit project - after

11/03/2022

An-najah

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Table 2. Annual Cost per Unit Floor Area

Component	PaIGBC after (\$/m²)
Air System Fans	0.000
Cooling	3.107
Heating	2.687
Pumps	0.000
Heat Rejection Fans	0.000
HVAC Sub-Total	5.793
Lights	1.617
Electric Equipment	15.846
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	17.463
Grand Total	23.256
Gross Floor Area (m ²)	167.0
Conditioned Floor Area (m ²)	117.0

Note: Values in this table are calculated using the Gross Floor Area.

Annual Cost Summary

PaIGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

Table 3. Component Cost as a Percentage of Total Cost

Component	PaIGBC after (%)
Air System Fans	0.0
Cooling	13.4
Heating	11.6
Pumps	0.0
Heat Rejection Fans	0.0
HVAC Sub-Total	24.9
Lights	7.0
Electric Equipment	68.1
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	75.1
Grand Total	100.0

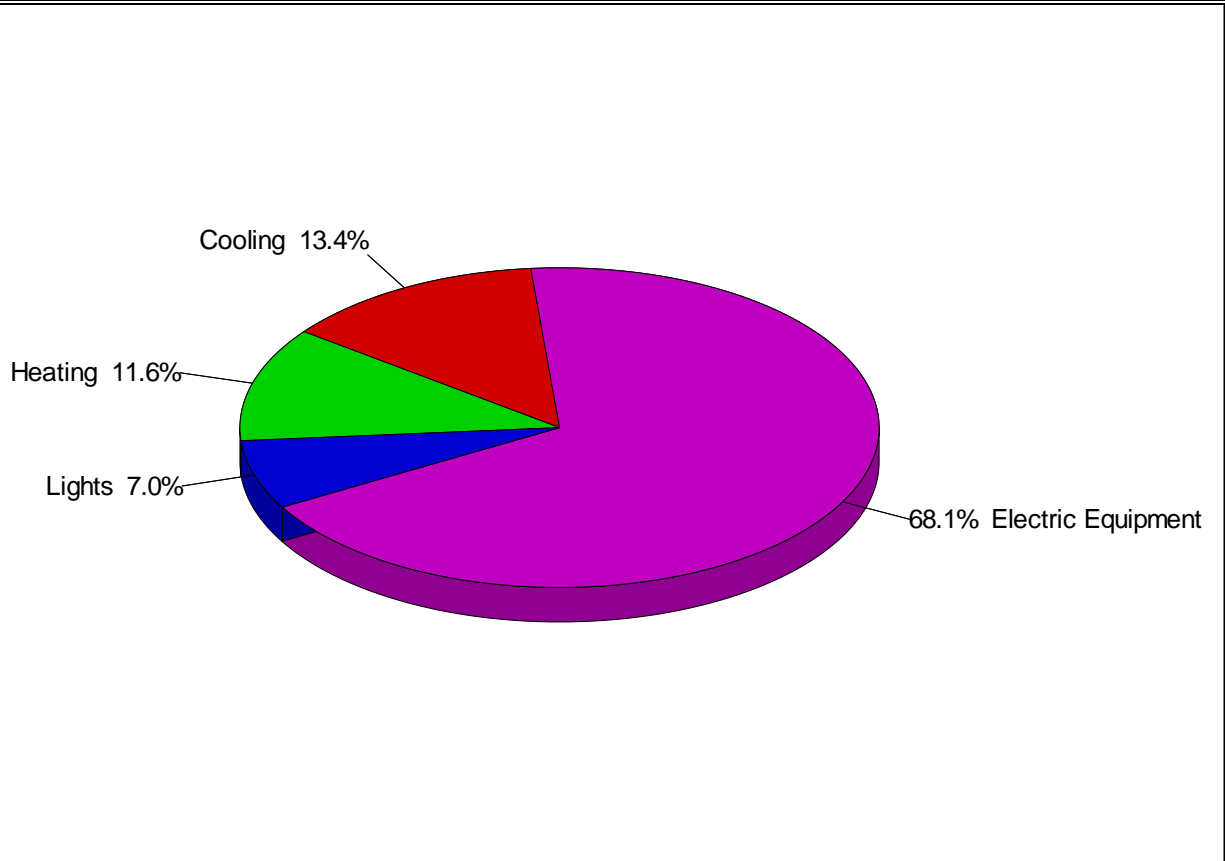
Annual Component Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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1. Annual Costs

Annual Component Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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Component	Annual Cost		Percent of Total (%)
	(\$)	(\$/m ²)	
Air System Fans	0	0.000	0.0
Cooling	519	3.107	13.4
Heating	449	2.687	11.6
Pumps	0	0.000	0.0
Heat Rejection Fans	0	0.000	0.0
HVAC Sub-Total	967	5.793	24.9
Lights	270	1.617	7.0
Electric Equipment	2,646	15.846	68.1
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	2,916	17.463	75.1
Grand Total	3,884	23.256	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²

Conditioned Floor Area **117.0** m²

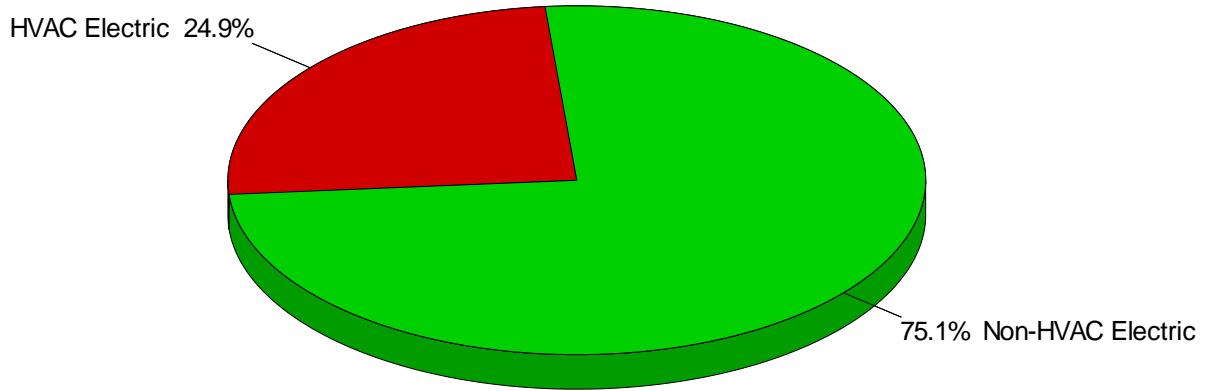
Annual Energy Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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1. Annual Costs

Annual Energy Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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Component	Annual Cost (\$/yr)	(\$/m ²)	Percent of Total (%)
HVAC Components			
Electric	967	5.793	24.9
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	967	5.793	24.9
Non-HVAC Components			
Electric	2,916	17.463	75.1
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	2,916	17.463	75.1
Grand Total	3,884	23.256	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²

Conditioned Floor Area **117.0** m²

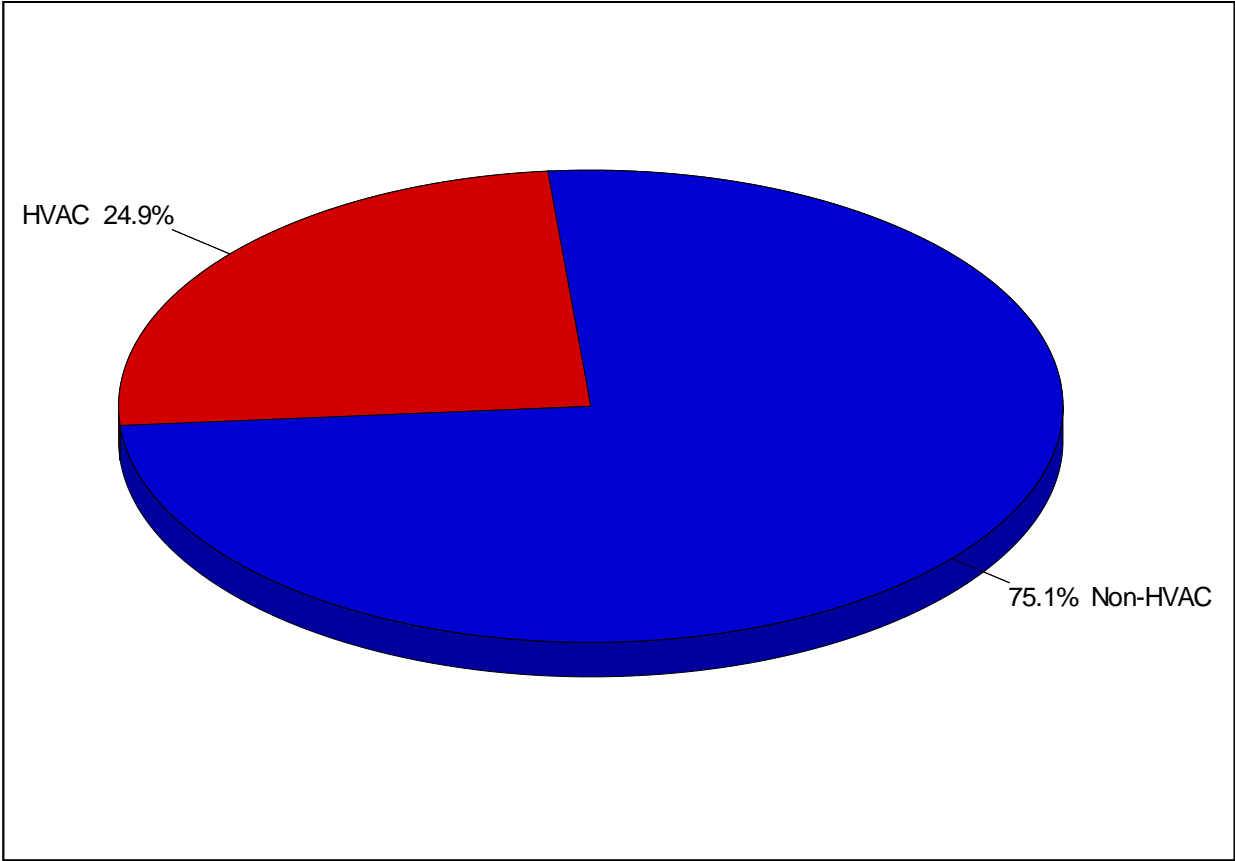
Annual HVAC & Non-HVAC Cost Totals - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

01:29AM



1. Annual Costs

Component	Annual Cost		Percent of Total (%)
	(\$/yr)	(\$/m ²)	
HVAC	967	5.793	24.9
Non-HVAC	2,916	17.463	75.1
Grand Total	3,884	23.256	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²

Conditioned Floor Area **117.0** m²

Energy Budget by System Component - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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1. Annual Coil Loads

Component	Load	
	(kWh)	(kWh/m ²)
Cooling Coil Loads	10,548	63.160
Heating Coil Loads	7,773	46.544
Grand Total	18,321	109.704

2. Energy Consumption by System Component

Component	Site Energy	Site Energy	Source Energy	Source Energy
	(kWh)	(kWh/m ²)	(kWh)	(kWh/m ²)
Air System Fans	0	0.000	0	0.000
Cooling	2,594	15.533	9,264	55.473
Heating	2,243	13.433	8,012	47.974
Pumps	0	0.000	0	0.000
Heat Rejection Fans	0	0.000	0	0.000
HVAC Sub-Total	4,837	28.965	17,276	103.447
Lights	1,350	8.084	4,821	28.871
Electric Equipment	13,231	79.227	47,253	282.955
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	14,581	87.311	52,075	311.826
Grand Total	19,418	116.276	69,351	415.273

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.

Gross Floor Area **167.0** m²

Conditioned Floor Area **117.0** m²

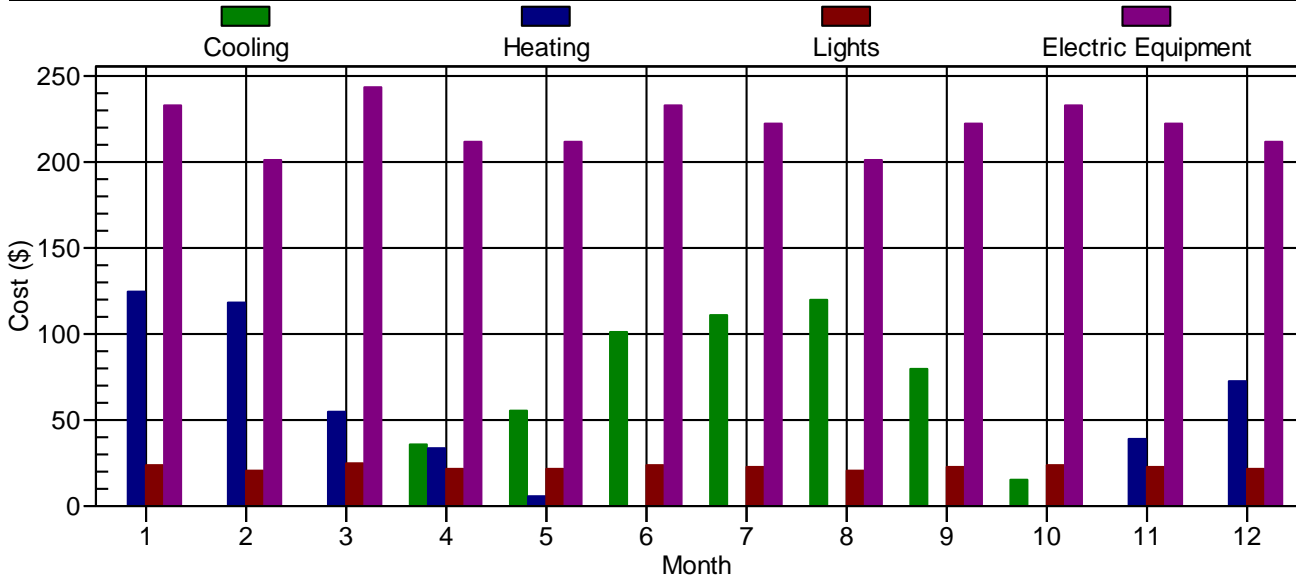
Monthly Component Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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1. HVAC Component Costs

Month	Air System Fans (\$)	Cooling (\$)	Heating (\$)	Pumps (\$)	Heat Rejection Fans (\$)	HVAC Total (\$)
January	0	0	125	0	0	125
February	0	0	118	0	0	118
March	0	0	55	0	0	55
April	0	36	34	0	0	70
May	0	55	6	0	0	61
June	0	101	0	0	0	101
July	0	111	0	0	0	111
August	0	120	0	0	0	120
September	0	80	0	0	0	80
October	0	15	0	0	0	15
November	0	1	39	0	0	40
December	0	0	73	0	0	73
Total	0	519	449	0	0	967

2. Non-HVAC Component Costs

Monthly Component Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

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Month	Lights (\$)	Electric Equipment (\$)	Misc. Electric (\$)	Misc. Fuel Use (\$)	Non-HVAC Total (\$)	Grand Total (\$)
January	24	233	0	0	257	382
February	21	201	0	0	222	340
March	25	243	0	0	268	323
April	22	212	0	0	233	303
May	22	212	0	0	233	294
June	24	233	0	0	257	358
July	23	222	0	0	245	356
August	21	201	0	0	222	342
September	23	222	0	0	245	325
October	24	233	0	0	257	272
November	23	222	0	0	245	285
December	22	212	0	0	233	306
Total	270	2,646	0	0	2,916	3,884

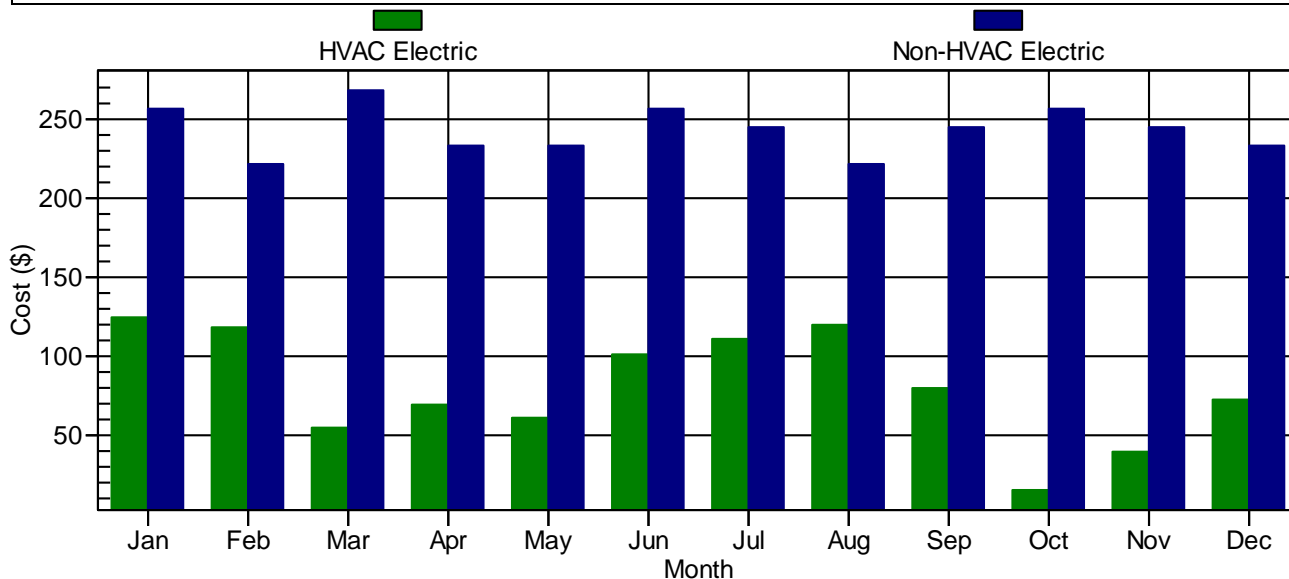
Monthly Energy Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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1. HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)	Remote Chilled Water (\$)
January	125	0	0	0	0	0	0
February	118	0	0	0	0	0	0
March	55	0	0	0	0	0	0
April	69	0	0	0	0	0	0
May	61	0	0	0	0	0	0
June	101	0	0	0	0	0	0
July	111	0	0	0	0	0	0
August	120	0	0	0	0	0	0
September	80	0	0	0	0	0	0
October	15	0	0	0	0	0	0
November	40	0	0	0	0	0	0
December	73	0	0	0	0	0	0
Total	967	0	0	0	0	0	0

2. Non-HVAC Costs

Monthly Energy Costs - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)
January	257	0	0	0	0	0
February	222	0	0	0	0	0
March	268	0	0	0	0	0
April	233	0	0	0	0	0
May	233	0	0	0	0	0
June	257	0	0	0	0	0
July	245	0	0	0	0	0
August	222	0	0	0	0	0
September	245	0	0	0	0	0
October	257	0	0	0	0	0
November	245	0	0	0	0	0
December	233	0	0	0	0	0
Total	2,916	0	0	0	0	0

Billing Details - Electric - PaIGBC after

PaIGBC building retrofit project - after

11/03/2022

An-najah

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1. Component Charges

Billing Period	Energy Charges (\$)	Demand Charges (\$)	Customer Charges (\$)	Taxes (\$)	Total Charge (\$)
Jan	381	0	0	0	381
Feb	340	0	0	0	340
Mar	323	0	0	0	323
Apr	303	0	0	0	303
May	294	0	0	0	294
Jun	358	0	0	0	358
Jul	356	0	0	0	356
Aug	341	0	0	0	341
Sep	325	0	0	0	325
Oct	272	0	0	0	272
Nov	285	0	0	0	285
Dec	306	0	0	0	306
Totals	3,884	0	0	0	3,884

2. Totals

Billing Details - Electric - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

Billing Period	Total Charges (\$)	Total Consumption (kWh)	Avg Price (\$/kWh)
Jan	381	1,906	0.2000
Feb	340	1,700	0.2000
Mar	323	1,615	0.2000
Apr	303	1,513	0.2000
May	294	1,472	0.2000
Jun	358	1,789	0.2000
Jul	356	1,780	0.2000
Aug	341	1,707	0.2000
Sep	325	1,624	0.2000
Oct	272	1,360	0.2000
Nov	285	1,423	0.2000
Dec	306	1,529	0.2000
Totals	3,884	19,419	0.2000

3. Consumption Totals

Billing Period	Peak (kWh)	Mid-Peak (kWh)	Normal Peak (kWh)	Off-Peak (kWh)	Overall (kWh)
Jan	0	0	0	0	1,906
Feb	0	0	0	0	1,700
Mar	0	0	0	0	1,615
Apr	0	0	0	0	1,513
May	0	0	0	0	1,472
Jun	0	0	0	0	1,789
Jul	0	0	0	0	1,780
Aug	0	0	0	0	1,707
Sep	0	0	0	0	1,624
Oct	0	0	0	0	1,360
Nov	0	0	0	0	1,423
Dec	0	0	0	0	1,529
Totals	0	0	0	0	19,419

Billing Details - Electric - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

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4. Billing Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	6.7
Feb	0.0	0.0	0.0	0.0	6.5
Mar	0.0	0.0	0.0	0.0	6.2
Apr	0.0	0.0	0.0	0.0	9.8
May	0.0	0.0	0.0	0.0	10.8
Jun	0.0	0.0	0.0	0.0	10.5
Jul	0.0	0.0	0.0	0.0	10.0
Aug	0.0	0.0	0.0	0.0	11.8
Sep	0.0	0.0	0.0	0.0	11.4
Oct	0.0	0.0	0.0	0.0	7.3
Nov	0.0	0.0	0.0	0.0	6.4
Dec	0.0	0.0	0.0	0.0	6.0

5. Maximum Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	6.7
Feb	0.0	0.0	0.0	0.0	6.5
Mar	0.0	0.0	0.0	0.0	6.2
Apr	0.0	0.0	0.0	0.0	9.8
May	0.0	0.0	0.0	0.0	10.8
Jun	0.0	0.0	0.0	0.0	10.5
Jul	0.0	0.0	0.0	0.0	10.0
Aug	0.0	0.0	0.0	0.0	11.8
Sep	0.0	0.0	0.0	0.0	11.4
Oct	0.0	0.0	0.0	0.0	7.3
Nov	0.0	0.0	0.0	0.0	6.4
Dec	0.0	0.0	0.0	0.0	6.0

Billing Details - Electric - PalGBC after

PalGBC building retrofit project - after

11/03/2022

An-najah

01:29AM

6. Time Of Maximum Demands

Billing Period	Peak (m/d/h)	Mid-Peak (m/d/h)	Normal Peak (m/d/h)	Off-Peak (m/d/h)	Overall (m/d/h)
Jan	n/a	n/a	n/a	n/a	1/18/0900
Feb	n/a	n/a	n/a	n/a	2/20/0900
Mar	n/a	n/a	n/a	n/a	3/14/0900
Apr	n/a	n/a	n/a	n/a	4/27/1300
May	n/a	n/a	n/a	n/a	5/8/1600
Jun	n/a	n/a	n/a	n/a	6/15/1300
Jul	n/a	n/a	n/a	n/a	7/26/1300
Aug	n/a	n/a	n/a	n/a	8/15/1300
Sep	n/a	n/a	n/a	n/a	9/4/1300
Oct	n/a	n/a	n/a	n/a	10/3/1300
Nov	n/a	n/a	n/a	n/a	11/8/1300
Dec	n/a	n/a	n/a	n/a	12/1/0900

Hourly Use Profiles - Electric - PalGBC after

PalGBC building retrofit project - after

10/18/2022

HB

09:28AM

Hour	Saturday
	Jan 1 (kW)
0000	1.1
0100	1.1
0200	1.2
0300	1.2
0400	1.3
0500	1.3
0600	1.5
0700	1.5
0800	1.2
0900	1.1
1000	1.0
1100	0.8
1200	0.7
1300	0.5
1400	0.5
1500	0.5
1600	0.5
1700	0.6
1800	0.6
1900	0.6
2000	0.6
2100	0.6
2200	0.7
2300	0.7