Guest Room Management

Scope

The scope of this exercise was to produce the calculations required to be able to quantify the Return of Investment resulting from installing Guest Room Management (GRM) Systems which switch off the lights and the air-conditioning systems during unoccupied periods.

Overview

The calculation is modular, based on a number of Guest Rooms. The user inputs the variables listed in Table 1. The number of similar guest rooms and the overall annual occupancy rate are inputted in variables i1 and i2 respectively. The anticipated time a guest occupies the room is defined in i3. The anticipated durations of switched on lights and air-conditioning are defined in variables i4 and i5 respectively. The total power of the installed luminaires is inputted in i6. The cooling capacity of the AC system is defined in i7. The AC's Seasonal Energy Efficiency Ratio (SEER) or even better the European SEER (ESEER) for cooling and the Seasonal Coefficient of Performance (SCOP) for heating are inputted in i8 and i9 respectively.

Input variables i1 to i7 are inputted for the different room types (numbered 1 to n).

Variable No	Input Variable	Symbol	Unit
i1	No of similar rooms	Z	No
i2	Occupancy Rate of Hotel Room N	Occ_N	%
i3	Time - Guest use of room N	$t_{G.N}$	hrs/day
i4	Time - Lights Switched ON – Room N	$t_{L.N}$	hrs/day
i5	Time - AC Switched ON – Room N	$t_{AC.N}$	hrs/day
i6	Installed Lighting Power – Room N	L_N	kW/room
i7	Installed Air-conditioning Power (Cooling Capacity) – Room N	Q_N	kW/room
i8	AC – Cooling E/SEER	SEER	W/W
i9	AC – Heating SCOP	SCOP	W/W

Table 1: Required Inputs

The user inputs the costs in financial variables fi1 to fi4 (listed in Table 2) and defines the discount rate and the required Return of Investment (ROI) period in variables fi5 and fi6 respectively. The appropriate electricity tariff is defined in variable fi7. The tariffs are shown in Appendix 1.

Variable No	Input Variable	Symbol	Unit
fi1	Dismantling Cost	C_1	€
fi2	Disposal Cost	C_2	€
fi3	Capital Cost	C_3	€
fi4	Installation Cost	C_4	€
fi5	Discount Rate	i	%
fi6	ROI period	R	Years
fi7	Electricity Tariff	r	€/kWh

Table 2: Required Inputs – Financial

The algorithm calculates and presents the outputs listed in Table 3 and Table 4.

The Return of Investment and the Payback period (variables fo3 to fo6) are calculated based on the savings (variable fo1) and the total investment cost (variable fo2).

Variable No	Output Variables	Symbol	Unit
o1	Total Installed Lighting Power – Room N	L_{tN}	kW
o2	Total Installed Air-Conditioning Power – Room N	Q_{tN}	kW
o3	Current Electricity Consumption – Lighting - Room N	$E_{L.CN}$	kWh/day
o4	Current Electricity Consumption – AC Cooling - Room N	$E_{AC.C.CN}$	kWh/day
o5	Current Electricity Consumption – AC Heating - Room N	$E_{AC.C.CN}$	kWh/day
o6	Current Electricity Consumption – Room N	E_{CN}	kWh/year
o7	Proposed Electricity Consumption – Lighting - Room N	$E_{L.PN}$	kWh/day
o8	Proposed Electricity Consumption – AC Cooling - Room N	$E_{AC.C.PN}$	kWh/day
o9	Proposed Electricity Consumption – AC Heating - Room N	$E_{AC.C.PN}$	kWh/day
o10	Proposed Electricity Consumption – Room N	E_{PN}	kWh/year
o11	Electricity Consumption Savings – Zone N	E_{SN}	kWh/day
o12	Percentage Electricity Savings – Zone N	S_N	%
o13	Total Annual Current Electricity Consumption	E_C	kWh/year

o14	Total Annual Current Electricity Cost	C_C	€/year
o15	Total Annual Proposed Electricity Consumption	E_P	kWh/year
o16	Total Annual Proposed Electricity Cost	C_P	€/year
o17	Total Annual Electricity Consumption Savings	E_S	kWh/year
o18	Percentage Electricity Savings	S	%

Table 3: Calculated Outputs

Variable No	**Output Variables**	**Symbol**	**Unit**
fo1	Total Annual Electricity Cost Savings	C_S	€/year
fo2	Total Investment Cost	C_t	€
fo3	Pay Back Period - Simple	t_{SPB}	years
fo4	Pay Back Period - NPV	T_{NPV}	years
fo5	ROI after R years	ROI_R	€
fo6	Percentage ROI after R years	$ROI_{R\%}$	%

Table 4: Calculated Outputs - Financial

Conclusion

A preview with three room types and dummy values is shown in Appendix 2. The number of room types can be increased accordingly.

Appendix 1: Enemalta Tariffs

Band	Cumulative Consumption (kWh)	Tariff (€/kWh)
1	0 - 2,000	0.1215
2	2,001 - 6,000	0.1275
3	6,001 - 10,000	0.1373
4	10,001 - 20,000	0.1485
5	20,001 - 60,000	0.1613
6	60,001 - 100,000	0.1500
7	100,001 - 1,000,000	0.1403
8	1,000,001 - 5,000,000	0.1275
9	5,000,000 & over	0.1080

Appendix 2: Excel version of Calculations

Guest Room Number	Similar Rooms	Occupancy of Hotel Room	Guest Use of Room	Lights Switched ON	AC Switched ON	Installed Lighting Power		Installed Air Conditioning Power (Cooling Capacity)		Current Energy Consumption (without GRM)				Proposed Energy Consumption (with GRM)				Energy Savings	
										Lighting	AC-Cooling	AC-Heating	Total	Lighting	AC-Cooling	AC-Heating	Total		
	Z	Occ_N	$t_{G.N}$	$t_{L.N}$	$t_{AC.N}$	L_N	L_{tN}	Q_N	Q_{tN}	$E_{L.CN}$	$E_{AC.C.CN}$	$E_{AC.H.CN}$	E_{CN}	$E_{L.PN}$	$E_{AC.C.PN}$	$E_{AC.H.PN}$	E_{PN}	E_{SN}	S_N
	No	%	Hrs/day	Hrs/day	Hrs/day	kW/Room	kW	kW/Room	kW	kWh/day	kWh/day	kWh/day	kWh/year	kWh/day	kWh/day	kWh/day	kWh/year	kWh/year	%
1	200	75	14	7	14	0.2	40.0	3.5	700.0	510	1,593.9	292.3	571,385	210	930	171	301,370	270,015	47.3
2	1	100	14	7	14	0.2	0.2	3.5	3.5	3.4	10.6	1.9	3,809	1	6	1	2,009	1,800	47.3
3	5	75	14	7	14	1	5.0	7.5	37.5	63.75	85.4	15.7	43,906	26	50	9	21,620	22,286	50.8
						TOTAL	45		741				619,100				324,999	294,101	47.5

INPUTS

Item	Symbol	Value	Unit
AC - Cooling SEER	SEER	4	W/W
AC - Heating SCOP	SCOP	5	W/W
Dismantling Cost	C_1	0	EUR
Disposal Cost	C_2	0	EUR
Capital Cost	C_3	40,000	EUR
Installation Cost	C_4	10,000	EUR
Discount Rate	i	2.00	%
ROI period	R	4	years
Electricity Tariff	r	0.1403	EUR/kWh

OUTPUTS

Cost Item		Symbol	Value	Unit
Total Investment Cost		C_t	50,000	EUR
Current Electricity Consumption		E_C	619,100	kWh/year
		C_C	86,860	EUR/year
Proposed Electricity Consumption		E_P	324,999	kWh/year
		C_P	45,597	EUR/year
Electricity Consumption (savings)		E_S	294,101	kWh/year
		C_S	41,262	EUR/year
		S	47.5	%
Pay Back Period	Simple	t_{SPB}	1.21	years
			14.5	months
	NPV	t_{NPV}	1.24	years
			14.9	months
Return of Investment after year no. R (using NPV)		ROI_R	107,116	EUR
		$ROI_{R\%}$	214.2	%