EUROPEAN COMMISSION

DIRECTORATE-GENERAL FOR ENERGY

SAVE II Programme

Energy Savings by CHCP plants in the Hotel Sector

Energy Audits - Cyprus

May 2001

CONTENTS

1. Selection of hotels in Cyprus

An important part of the project was to conduct energy audits on a typical sample of hotels that cover the minimum criteria of CHCP installations in Cyprus. This is a description of the selection process, and the result of the energy audits.

Hotel characteristics in Cyprus

In Cyprus, the distribution on size categories of hotels is fairly even. The average sized hotel in Cyprus has 85 rooms (165 rooms), which implies that there are a number of very large hotels that increases the average size of Cypriot hotels.

Of total visitors to Cyprus, 95% are tourists visiting Cyprus for holidays, while only 5% come for business. This has resulted in the development of seaside tourist resort such as Larnaca, Paralimni, and Ayia Napa in the south-east, Limassol in the south-west and Pafos in the north-west part of the island.

The occupancy of the hotel units has a pronounced seasonal pattern. Arrivals of tourists during the winter months (January-March and November-December) correspond to 18% of total arrivals. Arrivals in the two peak months (July and August) are estimated to 28% of total arrivals. The highest *occupation rates* occur in Ayia Napa, Paralimni and Pafos reaching approximately 64% throughout the year. During the summer months of July and August, the occupation rates in Ayia Napa, Paralimni and Pafos, ranges from 77-89%. It is also important to note that the highest occupation rates occur in the categories from 5 star hotels to 3 star hotels.

The Cypriot hotel sector is further presented in tables and figures on the next page.

Minimum criteria of CHCP installations in Cyprus

- operation throughout the year (with thermal, cooling and electric load demands)
- large scale hotels (>100 rooms or >200 beds) since large hotels have more energy use compared to hotels with fewer rooms. Since the investment cost is not linear to the magnitude of the CHCP plant, larger hotels are more likely to obtain shorter payback time on their investment
- holiday hotels, since the majority of the hotels are holiday hotels
- high quality hotels (within the 5 star to 3 star range), since they represent the 65% of the total hotel units. In addition the hotel management pays special attention to quality leading to more investments geared towards greater comfort, and in consequence, towards better equipment
- cover the most attractive tourist destinations (Ayia Napa-Larnaca, Limassol, Pafos) which climate characteristics are quite similar (due to the small size of the island, see Table 1.2 below).

Based on those criteria, the sample consists of 2 hotels situated in Limassol, 1 in Ayia Napa, 1 in Larnaca, and 1 hotel situated in Pafos.

Table 1.1 Climate characteristics

	Ayia Napa	**Larnaca**	**Limassol**	**Pafos**
Latitude	*N 34° 59'*	*N 34° 52'*	*N 34° 40'*	*N 36° 45'*
Longitude	*E34° 02'*	*E 33° 40'*	*E 33° 00'*	*E 32° 25'*
Degree days	*850*	*850*	*850*	*850*
Ambient reference temperature	*+5° C*	*+5° C*	*+5° C*	*+5° C*

Table 1.2 Selected hotels in Cyprus

Case	**Location**	**Type Category**	**Rooms (*beds*)**	**Activities**	**Other, total area m^2**
Hotel 1	Ayia Napa	Holiday 4*	342 (*692*)	Swimming pool (outdoor and indoor - heating) 2 Restaurants / 4 Bars Conference / Ball Rooms	17700
Hotel 2	Ayia Napa	Holiday 4*	150 (*320*)	Laundry Swimming pool (outdoor and indoor – heating) 2 Restaurant / 3 Bars Conference / Ball Rooms	10000
Hotel 3	Limassol	Holiday 5*	350 (*700*)	Laundry 4 Restaurants / 8 Bar Conference / Ball Rooms	29400
Hotel 4	Limassol	Holiday 3*	114 (*217*)	Swimming pool (outdoor – heating) 1 Restaurant / 2 Bars Conference / Ball Rooms	4560
Hotel 5	Pafos	Holiday 3*	199 (*510*)	Restaurant / Bar Conference/Ball Rooms	36600

Table 1.3 Selected hotels in Cyprus

Cases	Room occupation rate	Laundry per day	Other
Hotel 1	92 %	-	
Hotel 2	79 % (8 months)	90 kg/day	
Hotel 3	61 %	110 kg/day	
Hotel 4	85 %	-	
Hotel 5	91 %	-	

2 Energy usage in hotels

The primary energy used in all hotels studied are a combination of electricity, light fuel oil (diesel) and liquefied petroleum gas (LPG).

Table 2.1 Energy input by energy source (MWh per year)

	Electricity	Thermal Energy	
CASES	MWh/ year	Diesel MWh/year	LPG MWh/year
Hotel 1	2.790	3.108	660
Hotel 2	1.040	1.678	360
Hotel 3	5.150	2.818	740
Hotel 4	550	580	175
Hotel 5	1.060	1.406	280

Table 2.2 Specific energy consumption (kWh/m^2 and MWh/room and year)

HOTELS	Total area, m²	Rooms	Energy consumption (MWh/year)			Specific Consumption	
			Thermal	Electrical	Total	kWh/m²	MWh/room
HOTEL 1	17.700	342	3.768	2.790	6.558	370	19,2
HOTEL 2	10.000	150	2.038	1.040	3.078	308	20,5
HOTEL 3	29.400	350	3.558	5.150	8.708	296	24,9
HOTEL 4	4.560	114	755	550	1.305	286	11,5
HOTEL 5	26.600	199	1.686	1.060	2.746	103	13,8

Table 2.3 Characteristics of energy end-use

Case	Type of energy demand	Installed capacity kW	Peak load kW and peak month	Energy MWh
Hotel 1	Electricity	1.000	826 - July	1.818
	Heat	2.325		3.108
	Cooling*	1089		972
Hotel 2	Electricity	830	379 - August	703
	Heat	1395		1.678
	Cooling*	1072		337
Hotel 3	Electricity	2.000	1.577 - August	2.979
	Heat	1.165		2.818
	Cooling*	5550		2.171
Hotel 4	Electricity	523	170- July	366
	Heat	900		580
	Cooling*	244		184
Hotel 5	Electricity	800	404 - August	838
	Heat	569		1.406
	Cooling*	570		222

- For the cooling demand the installed capacity is referred to cooling capacity and the energy consumption is referred to electrical energy consumption of electric chillers.

3 Systems installed

3.1 Hotel 1

It is located in the eastern Cyprus, in Ayia Napa. It is a luxury 4* hotel, holiday type, with full range of holiday services, operating the whole year round. It has 342 rooms with 692 beds.

The hotel consists of 32 bungalows and a main building with reception, restaurants, bars, conference halls and recreational areas.

The 2 restaurants (on the ground–floor) are public and not only for hotel and conference guests.

The hotel has a swimming pool (without heating), open from June to September.

Water supply

The water comes from the public distribution network. The total consumption is 56.500 m^3/year.

Heating and hot water production

The building and the bungalows are fully air conditioned (heating/cooling), including all the common areas. The rooms have their own individual fan coils units, which are thermostatically controlled. The common areas are served through a number of air handling units. The hotel is equipped with two oil-fired boilers (diesel) of 1.000.000 kcal/h each, only one boiler works at a time. They are used for space heating and domestic hot water - 56% and 23% respectively of the total thermal energy consumption (Figure 2.1).

The volume of hot water demand is 21.500 m^3/year.

Ventilation and Climate cooling

The climate cooling is produced by three water cooled chillers and 22 split units. The electrical energy consumption for air conditioning is 35% of the total electrical energy consumption.

Electricity used

Percentage of total electrical energy consumption

- 35 % air conditioning
- 15 % lighting
- 12 % catering
- 13 % laundry
- 9 % sewerage plant
- 3 % room fan coils
- 6 % refrigeration
- 7 % fans, pumps, lifts, etc.

Cooking and other cooling installations such as refrigerators

The energy source for cooking is LPG (propane) and represents 15% of the total thermal energy consumption.

Refrigeration electrical energy consumption represents 6% of the total electrical energy consumption.

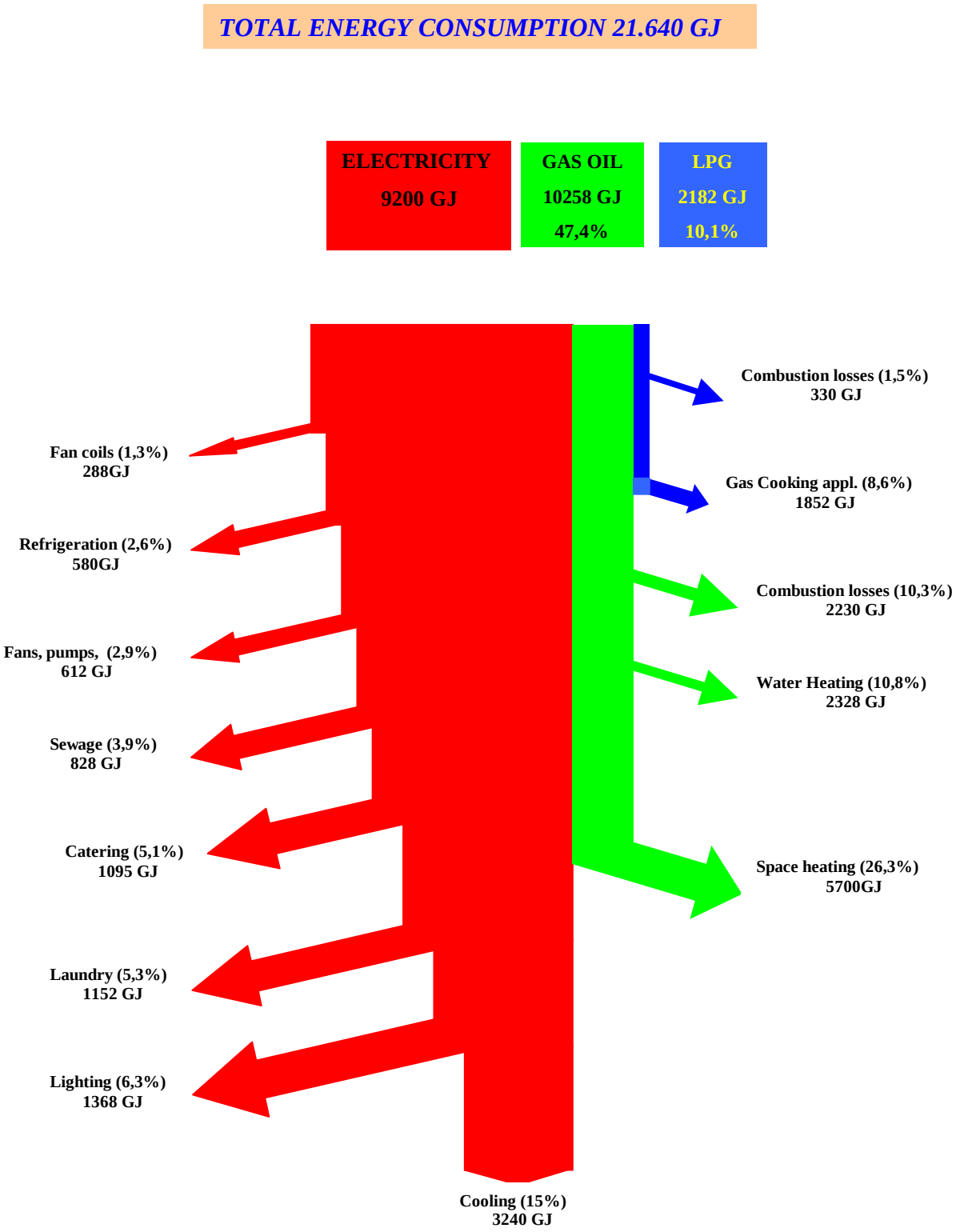
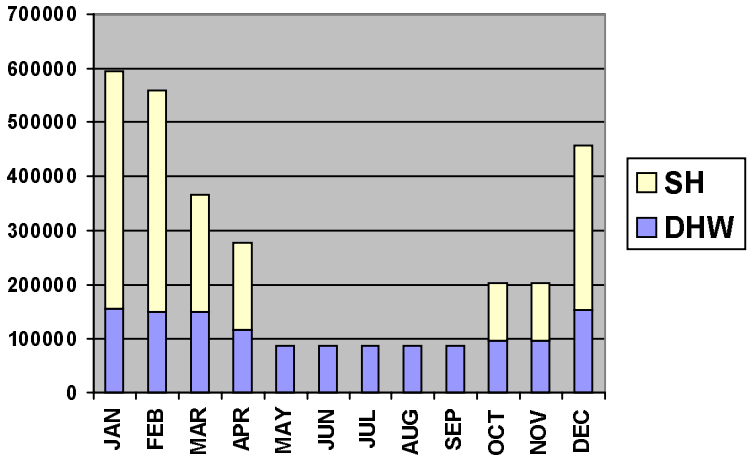
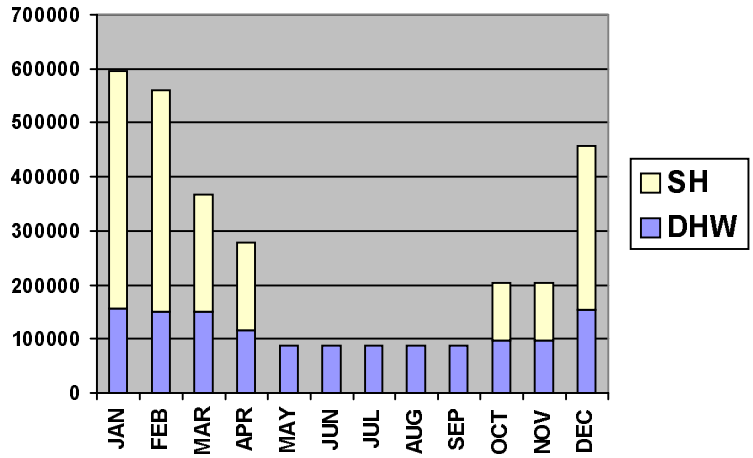


Figure 3.1. Annual total energy consumption. Hotel 1

Heating Demand Profile



Electricity - Cooling Demand Profile



3.2 Hotel 2

It is located in the eastern Cyprus, in Ayia Napa. It is a luxury 4* hotel, holiday type, with full range of holiday services, operating 8 months throughout the year (March – October). It has 150 rooms with 320 beds.

The hotel consists of a main building with the reception, restaurants, bars, conference halls and the recreational areas.

The 2 restaurants (on the ground–floor) are public and not only for hotel and conference guests.

It has one indoor and one outdoor swimming pool (with heating), open from March to October.

Water supply

The water comes from the public distribution network. The total consumption is 22.600 m^3/year.

Heating and hot water production

The building is fully air conditioned (heating/cooling), including all the common areas. The rooms have their own individual fan coils units, which are thermostatically controlled. The common areas are served through a number of air handling units. The hotel is equipped with two oil-fired boilers (diesel) of 600.000 kcal/h each, only one works at a time. They are used for space heating (20% of the total thermal energy consumption), and for domestic hot water (49% of the total thermal energy consumption), and one steam generator for laundry purposes (10% of the total thermal energy consumption (Figure 2.2)

The volume of hot water demand is 6.500 m^3/year.

Ventilation and Climate cooling

The climate cooling is produced by two water cooled chillers. The electrical energy consumption for air conditioning is 33,1% of the total electrical energy consumption.

Electricity used

Percentage of total electrical energy consumption

- 33 % air conditioning
- 23% process
- 14% equipment
- 14% HVAC fans
- 13% lighting
- 4% auxilliary

Cooking and other cooling installations such as refrigerators

The energy source for cooking is LPG (propane) and represents 15% of the total thermal energy consumption.

Refrigeration electrical energy consumption represents 7% of the total electrical consumption.

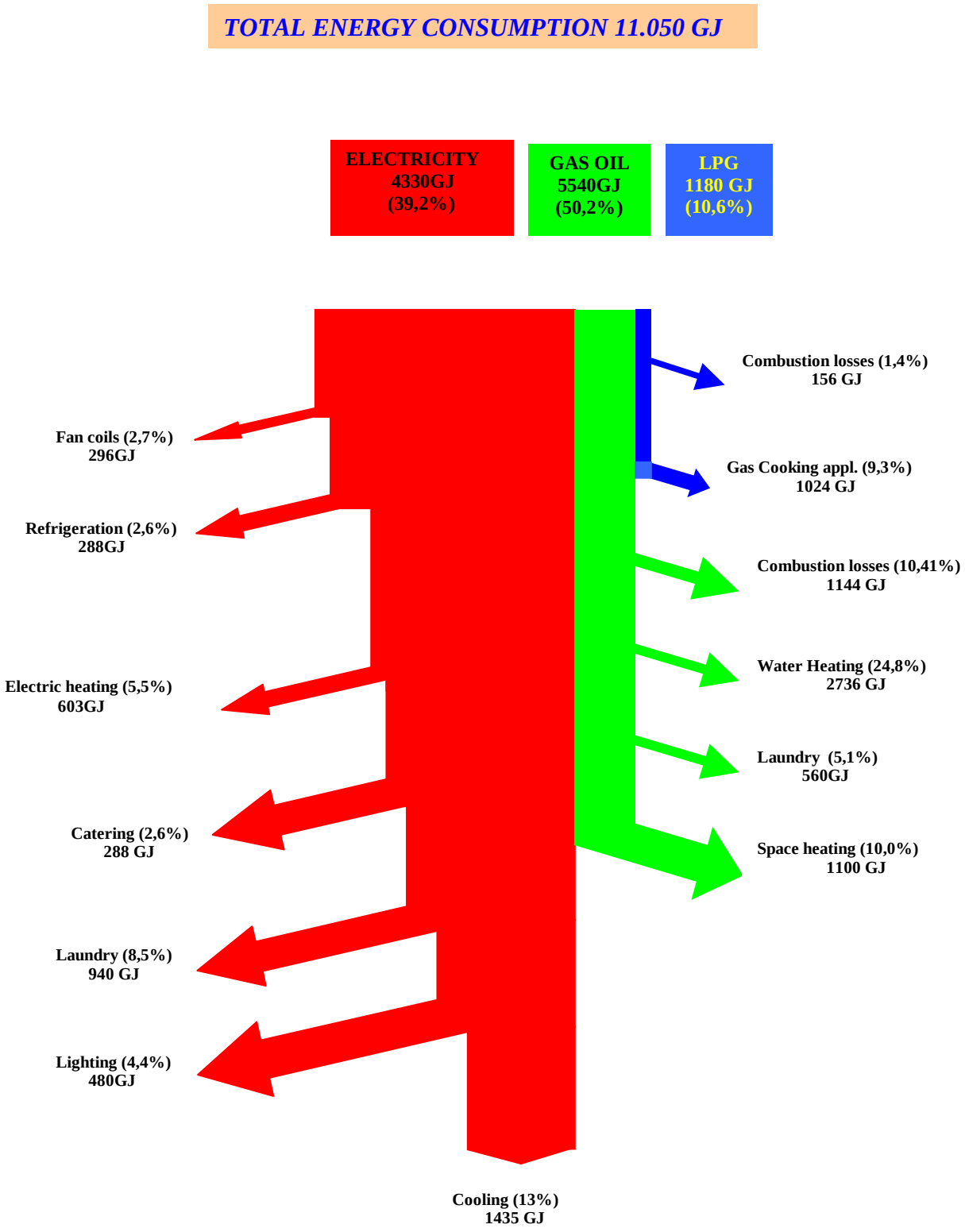
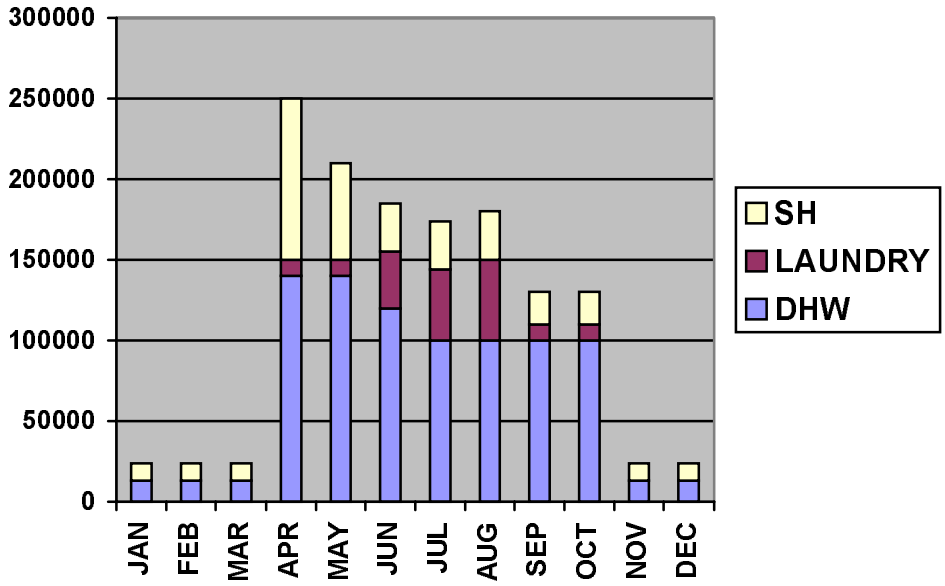
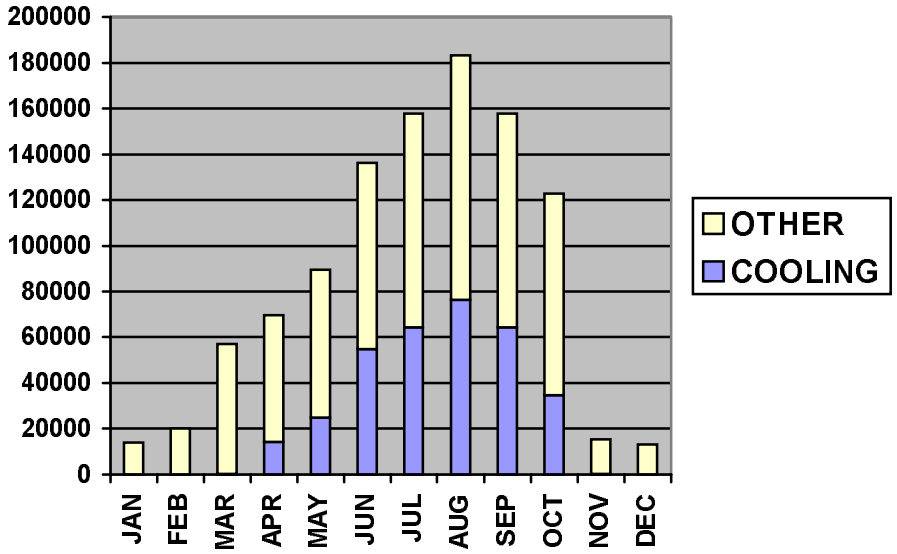


Figure 3.2. Annual total energy consumption. Hotel 2

Heating Demand Profile



Electricity - Cooling Demand Profile



3.3 Hotel 3

It is located in the southern Cyprus, in Limassol. It is a luxury 5* hotel, holiday type, with full range of holiday services, operating the whole year round. It has 350 rooms with 700 beds.

The hotel consists of 20 bungalows and a main building with the reception, the restaurants, the bars, the conference halls and the recreational areas.

The 3 restaurants (on the ground–floor) are public and not only for hotel and conference guests.

It has ten outdoor swimming pools (with heating), and four indoor swimming pools open throughout the year

Water supply

The water comes from the public distribution network. The total consumption is 80.420 m^3/year.

Heating and hot water production

The building and the bungalows are fully air conditioned (heating/cooling), including all the common areas. The rooms have their own individual fan coils units, which re thermostatically controlled. The common areas are served through a number of air handling units. The hotel is equipped with four oil-fired boilers (diesel) of 1.000.000 kcal/h each, used for space heating (55,6% of the total thermal energy consumption), for domestic hot water (11,4% of the total thermal energy consumption), and laundry (11,4% of the total thermal energy consumption). Heating is provided by two oil fired boilers (Figure 2.1)

The volume of hot water demand is 31.500 m^3/year.

Ventilation and Climate cooling

The climate cooling is produced by fifteen (15) water cooled chillers :

- three (3) chillers (Trane Centravac) of 265 kW each for the old section of the hotel
- two (2) chillers (Daikin) of 103 kW each for the new section of the hotel
- ten (10) chillers (Trane) of 30 kW each for the Conference Room)

and sixteen (16) split units with a total input capacity of 140 kW.

The electrical energy consumption for air conditioning is 42% of the total electrical energy consumption.

Electricity used: Percentage of total electrical energy consumption

- 42 % air conditioning
- 18 % lighting
- 10 % fans
- 20 % process
- 5 % equipment
- 5 % auxiliary

Cooking and other cooling installations such as refrigerators

The energy source for cooking is LPG (propane) and represents 17% of the total thermal energy consumption.

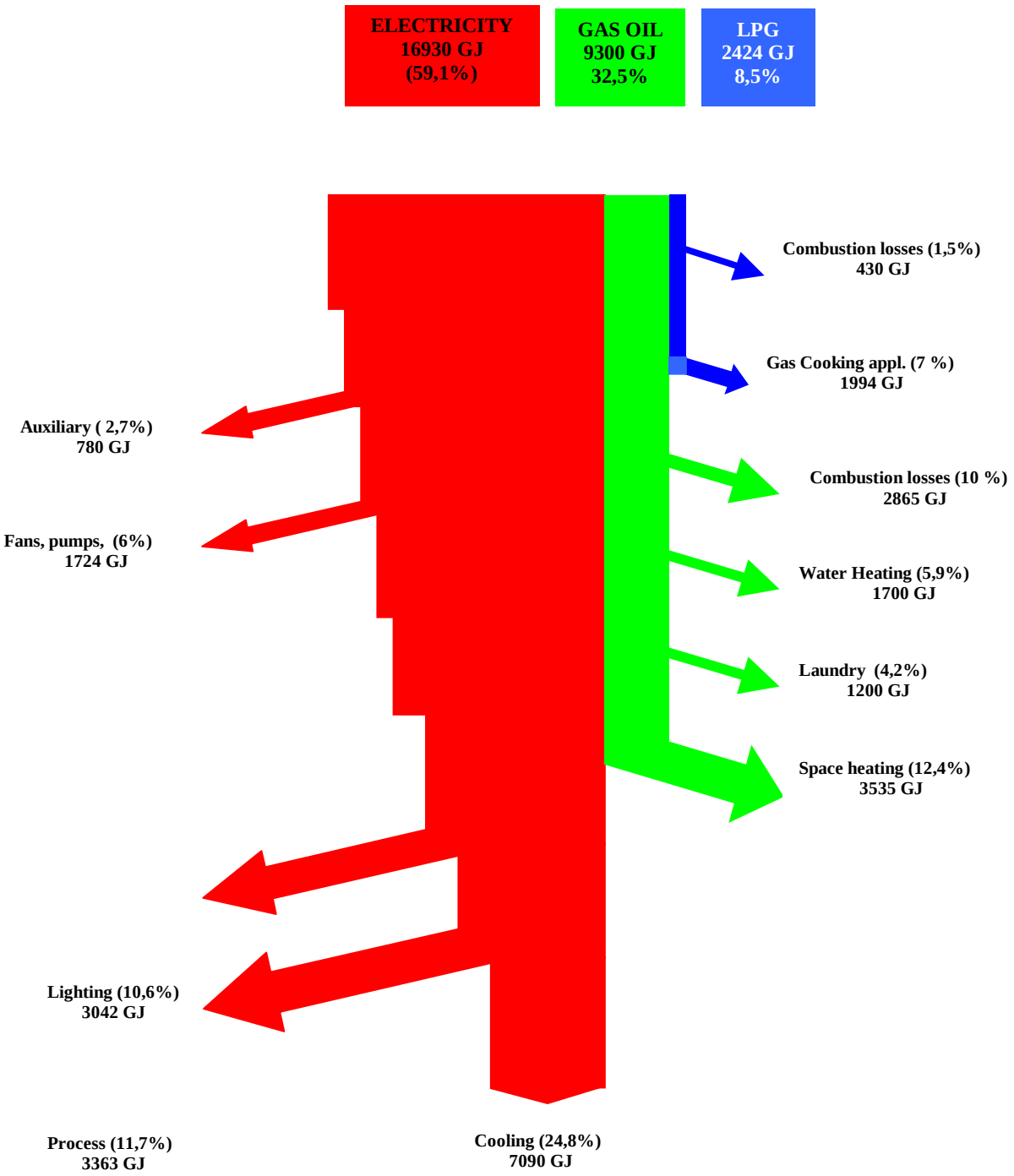
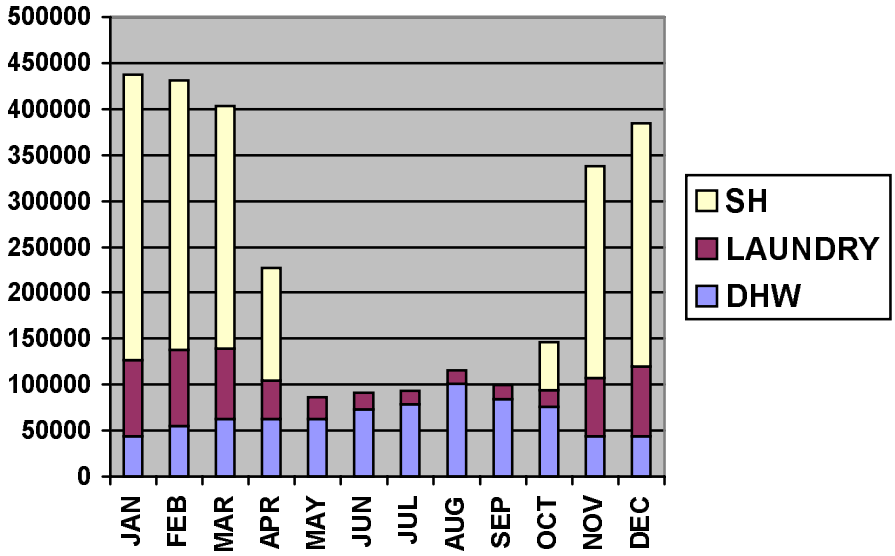
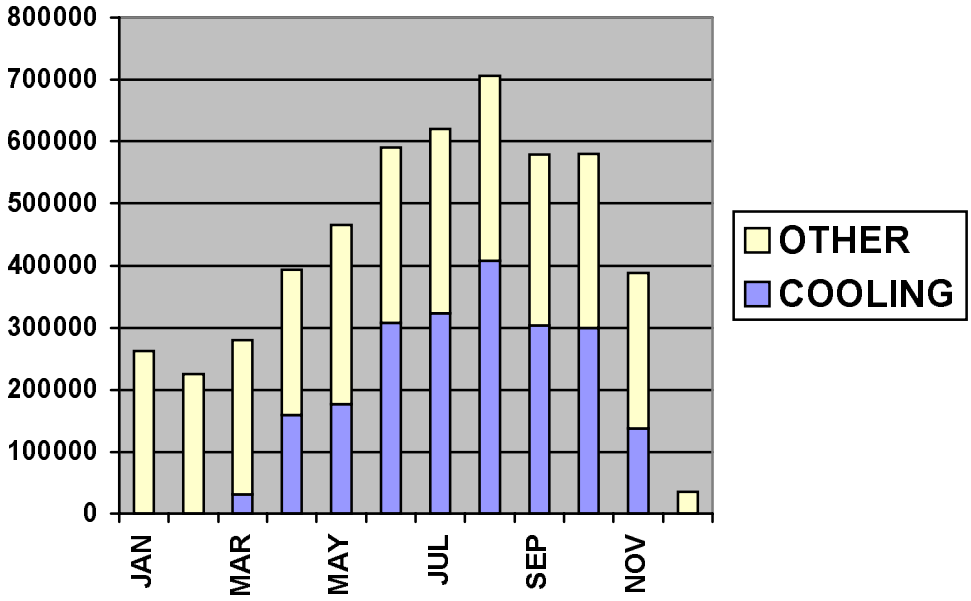


Figure 3.3 Annual total energy consumption. Hotel 3

Heating Demand Profile



Electricity – Cooling Demand Profile



3.4 Hotel 4

It is located in the southern Cyprus, in Limassol. It is a luxury 3* hotel, holiday type, with full range of holiday services, operating the whole year round. It has 114 rooms with 217 beds.

The hotel consists of the main building where the reception, the restaurants, the bars, the conference halls and the recreational areas are located.

The 2 restaurants (on the ground–floor) are public and not only for hotel and conference guests.

It has one swimming pool (without heating).

Water supply

The water comes from the public distribution network. The total consumption is 18.000 m^3/year.

Heating and hot water production

The building and the bungalows are fully air conditioned (heating/cooling), including all the common areas. The rooms, which occupy five floors, have their own individual fan coils units, which re thermostatically controlled. The common areas are served through a number of air handling units. The hotel is equipped with two oil-fired boilers (diesel) which have to work together to provide the heating needs of the building (49,2% of the total thermal energy consumption), and for domestic hot water (12,3% of the total thermal energy consumption. (Figure 2.4)

The volume of hot water demand is 7.000 m^3/year.

Ventilation and Climate cooling

The climate cooling is produced by two roof mounted Daikin water chillers, one of which is working at any one time during the summer. The electrical energy consumption for air conditioning is 33,6% of the total electrical energy consumption.

Electricity used - percentage of total electrical energy consumption

- 34 % air conditioning
- 16 % lighting
- 18 % catering
- 2 % refrigeration
- 6 % sewerage plant
- 3 % space heating
- 21 % fans, pumps, lifts, etc.

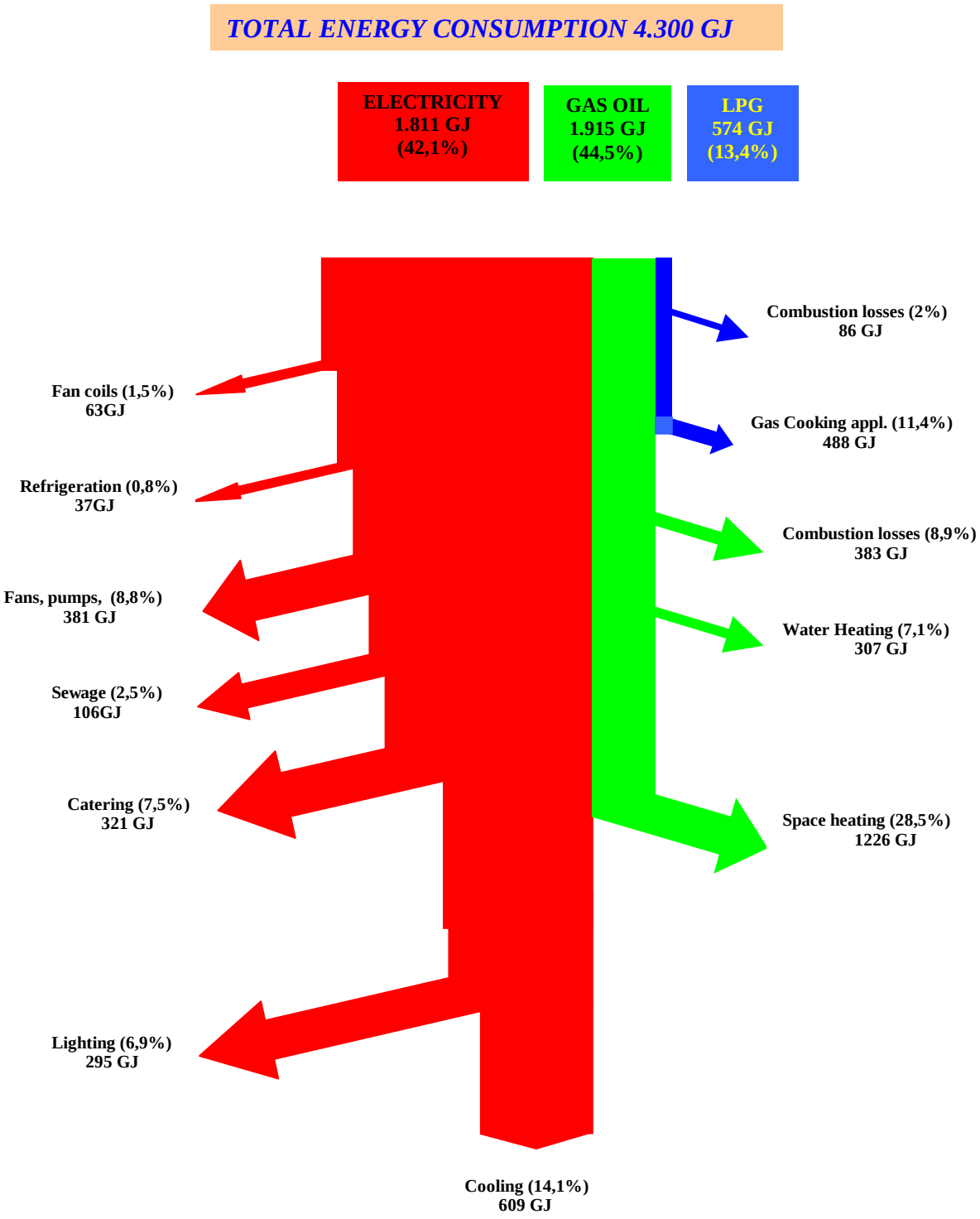
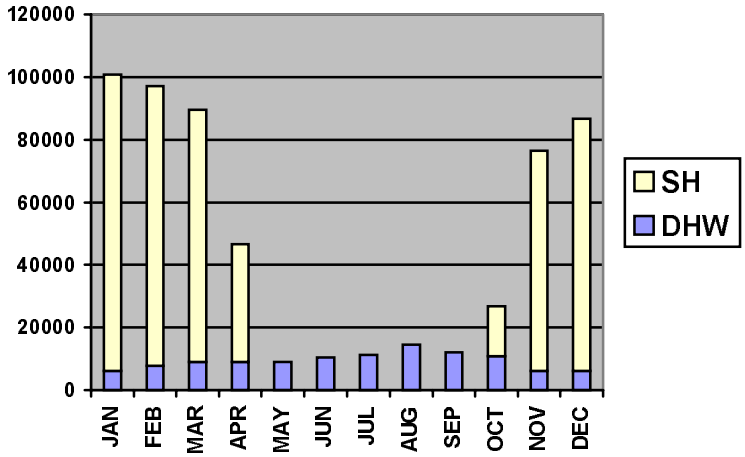
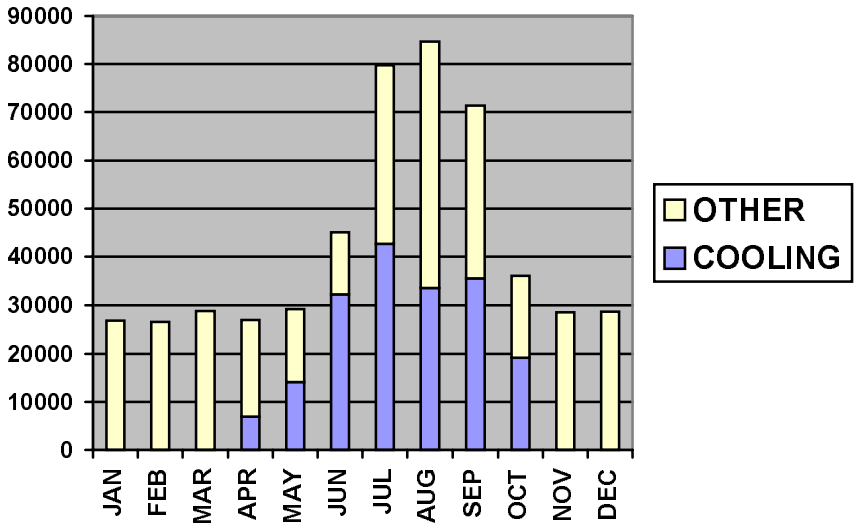


Figure 3.4. Annual total energy consumption. Hotel 4

Heating Demand Profile



Electricity Demand Profile



3.5 Hotel 5

It is located in the western Cyprus, in Pafos. It is a luxury 3* hotel, holiday type, with full range of holiday services, operating the whole year round. It has 199 rooms with 510 beds.

The hotel consists of 50 bungalows and a main building with the reception, the restaurants, the bars, the conference halls and the recreational areas.

The 2 restaurants (on the ground–floor) are public and not only for hotel and conference guests.

It has two outdoor swimming pool (with heating), open throughout the year.

Water supply

The water comes from the public distribution network. The total consumption is 40.400 m^3/year.

Heating and hot water production

The building and the bungalows are fully air conditioned (heating/cooling), including all the common areas. The rooms have their own individual fan coils units, which are thermostatically controlled. The common areas are served through a number of air handling units. The hotel is equipped with two oil-fired boilers (diesel) of 500.000 kcal/h total capacity, one used for space heating (59,6% of the total thermal energy consumption), and the other for domestic hot water (32% of the total thermal energy consumption).

The volume of hot water demand is 14.500 m^3/year.

Ventilation and Climate cooling

The climate cooling is produced by three water cooled chillers. The electrical energy consumption for air conditioning is 21% of the total electrical energy consumption.

Electricity used, percentage of total electrical energy consumption

- 37 % air conditioning
- 19 % lighting
- 18 % catering
- 4 % fan coils
- 10 % refrigeration
- 12 % fans, pumps, lifts, etc.

Cooking and other cooling installations such as refrigerators

The energy source for cooking is LPG (propane) and represents 19% of the total thermal energy consumption.

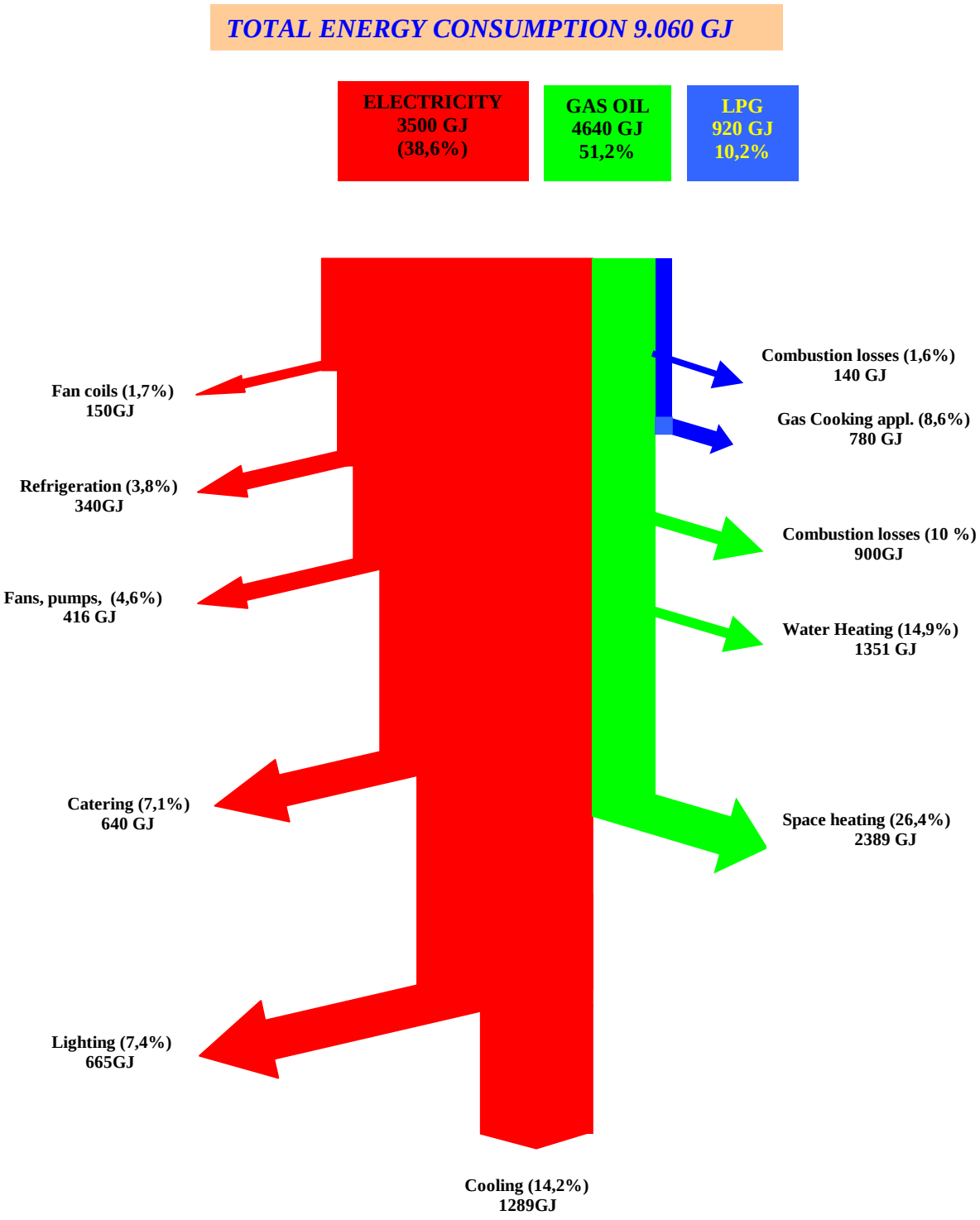
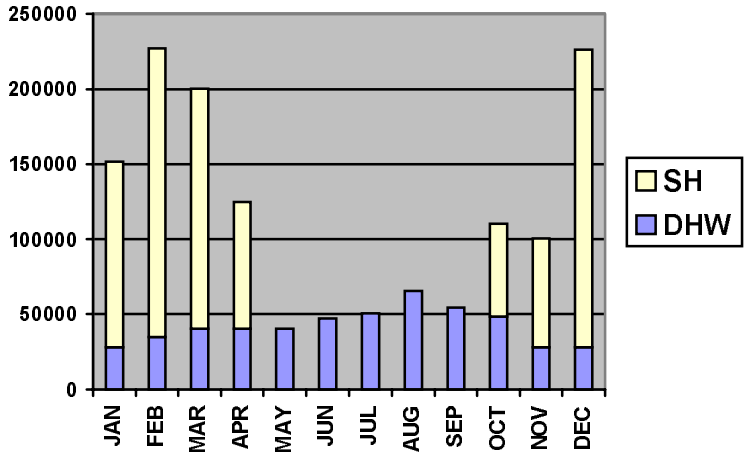


Figure 3.5. Annual total energy consumption. Hotel 5

Heating Demand Profile



Electricity Demand Profile