State of the art

Bars & Restaurants

Project: SME Energy CheckUP

Contract Number: IEE/13/384/S12.675577

Status: [Confidential]

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Co-funded by the Intelligent Energy Europe
Programme of the European Union

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1 INTRODUCCION

The goal of this document is to give an overview of energy use in restaurants and bars. The main consuming processes will be identified and discussed. Bars and restaurants are very different in size and business, so it is hard to give average numbers for all processes in the sector. For lighting and heating, ventilation and air conditioning (HVAC) general numbers can be used for the sector.

2 STATE OF THE ART IN BARS AND RESTAURANTS

2.1 Energy consumption identification

Bars and restaurants are part of the catering sector. There are several subcategories in the sector, vary from cafeterias to traditional restaurants and bistros. The size of the total sector in Poland is about 67 000 companies. See Table 1 for more details.

Table 1. Number of companies in catering sector. Data: Main Statistic Office 2014 [1]

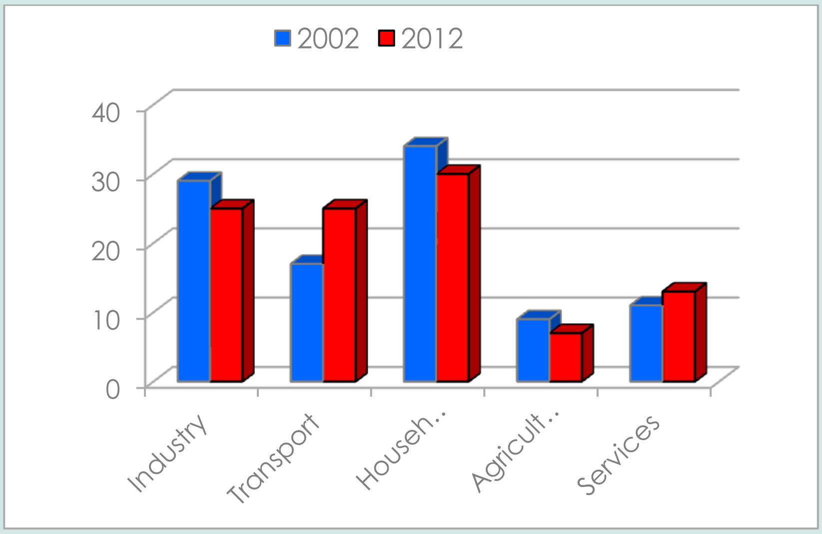
Sector	Companies
Restaurants and other eating houses	16 202
Cafés and beverages	24 931
Canteens	4 072
Food stands	21 761
Total	**66 966**

Although the number of companies of the sector show a decrease since the last few years (6% since 2010), the net revenue increase in the same time (see **Błąd! Nie można odnaleźć źródła odwołania.**). The energy costs are quite stable. In the subsector restaurants and other eating houses are energy costs relatively the highest.

Table 2 Net revenue in catering sector

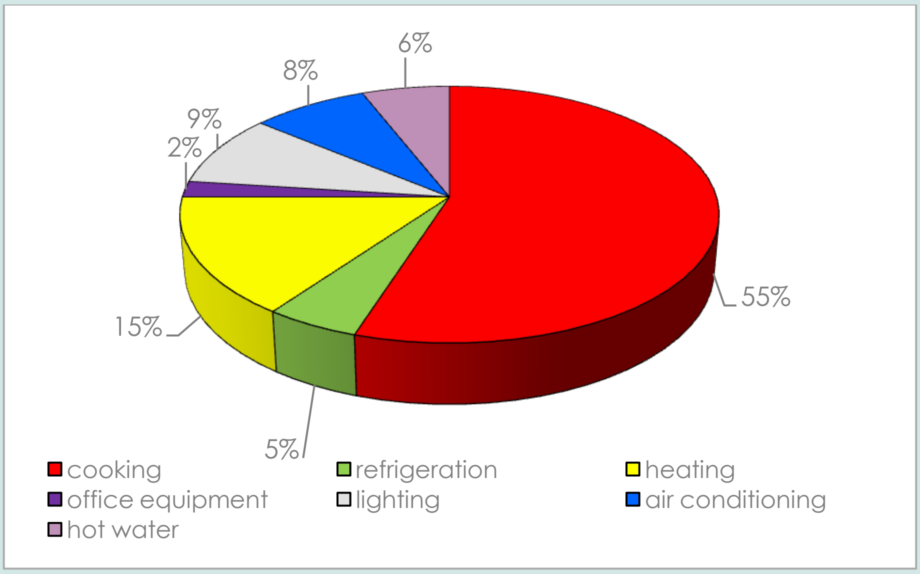
Sector	Year	Net revenue *mln PLN*
Catering total	**2010**	**21 682,8**
public		477,6
private		21 205,2
Catering total	**2013**	**26174,2**
public		401,5
private		25 772,7

In energy balances, the catering sector is part of the service sector, services and government. This sector is responsible for 12% of national energy consumption in Poland.



Picture 1 Structure of energy *consumption* by sector in Poland.

GUS: „Energy efficiency in Poland 2002-2012", Warszawa 2014



Picture 2 Structure of energy consumption in restaurants in Poland

Polish-Japanese Centrum of Energy Efficiency - Energy efficiency in services sector

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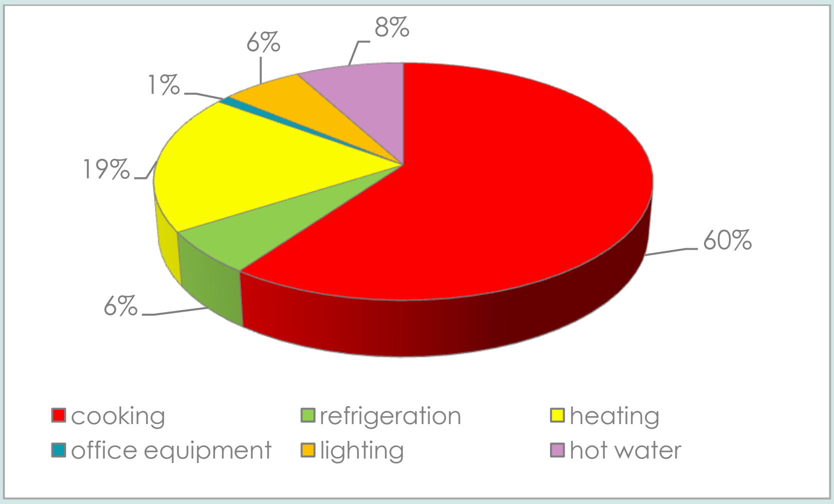


Picture 3 Structure of energy consumption in bars and food stands in Poland

Polish-Japanese Centrum of Energy Efficiency - Energy efficiency in services sector

The energy use share varies between the companies, because they can be very different from each other in scale, processes and energy consumption.

Specific catering processes like cooking (55-60%) and space heating (15-19%) are taking a large share of the total energy use of the company. Hot water and lightning is the other main user of energy.

Table 2 Energy use indicators in one of small size (100 m2) restaurant in kWh/m².

	kWh/m²
Lighting	38.6

Cooling and freezing	34.7
heating	110.4
kitchen appliances	80.1
other appliances	14.4
TOTAL	**278,2**

These results also show an important share of energy use for heating and kitchen appliances.

In the following paragraphs the categories of energy use will be discussed.

2.1.1 Cooking

According to the data from cooking takes at least 50% of total energy use in restaurants and bars. The main cooking appliances will be discussed.

Range Cookers

More and more induction units are used for cooking, especially in restaurants. The benefits of induction over gas are that induction is faster, safer (no heat production when there is no contact with a pan) and more hygienic. Cooking on gas is more efficient. Most cooks don't turn off the gas when it's not in use, so the benefit is a bit lost. After all, gas is the most energy efficient way of cooking. Induction comes as a second best. See Figure 6 for images of the technologies.

Picture 4 ***Gas unit (left) and induction unit (right)***

Salamander grills

This equipment is used to grill food and get a crispy layer on the food. Most salamanders are using electricity for energy supply. One of the reasons is that the supply has to be mobile, because salamanders are frequently displaced to another places in the kitchen because of its small size. Salamander have a warming-up time to get on the right temperature, that's why not all restaurants will turn off the salamander when it is not in use. Therefore, an alternative for salamander grills is IR-technology. The main difference is that an IR salamander heats the product directly, instead of heating the air around it. The most important benefit of this technology is that the warming-up time is much shorter, so it is easier to apply automatic turn-on and turn-off based on recognision of pans. This makes the operation time much shorter. See Table 4 for a comparison of the two techniques. The table shows that an IR Salamander can save a lot of energy, with a maximum of over 80% percent. Other catering equipment producers mention a saving of about 65%.

Table 3. Comparison electric and IR salamander (data: Meiko, 2012)

	Electric Salamander	*IR Salamander*
Power	3,8 kW	3,8 kW
Operating hours per day	6	0,72
Consumption per day	22,8 kWh	2,74 kWh
Consumpertion per year	8322 kWh	998,6 kWh

Picture 5 *IR Salamander*

Picture 6 ***Electric convention oven***

Hot air / steam convection ovens

The use of these ovens is rising. One of the causes is the change to decoupled cooking in big catering systems. Decoupled cooking is dissociating the cooking from the portioning. After cooking, the food is cooled and can be stored 72 hours. After portioning, the food can be regenerated (heated) at any moment necessary. Decoupled cooking releases the peak pressure from the chefs and the kitchen work can be divided more equally over time, which makes the process more efficient. For the heating of the food, steam convection ovens are used. See figure 1.5. These ovens are electric powered (sometimes up to 8 kW power) and take an important share of the electricity use of the kitchen.

Deep fryer

These units are using a lot of energy. Traditional deep fryer units are electricity powered and have a power consumptions about 7 to 10 kW for a single unit. Operating hours are about 2 hours a day, so the electricity consumption of a single electricity powered deep fryer is 14 to 20 kWh a day. Newer versions are mainly gas fired and much better insulated. See figure 1.6 for an example. High efficient gas fired deep fryers can save 33-57% compared to electricity powered deep fryers and up to 80% compared to old gas fired deep fryers. The gas use of a similar gas fired deep fryer is 5 – 9 m3 a day.

Picture 7 ***High efficiency gas fired deep fryer***

2.1.2 Cooling and refrigerators

Restaurants and bars are using multiple cooling appliances, varying from soft drink vending machines to big refrigerators. In this paragraph different cooling equipment will be discussed.

Ice cube machine

Most restaurants and bar has an ice cube machine, where ice cubes are produced from tap water. See Figure 10. The machine keeps the level of the ice cubes in the reservoir stable, and switches automatically on and off. For this document, a Foster F40 machine is taken as example. The F40 produces 24 ice cube in a cycle of 20 minutes. We assumed that a restaurant or bar uses about 500 ice cubes a day for soft drinks and wine cooling. This means that the ice cube machine needs 21 cycles of 20 minutes, resulting in a total operating time of 7 hours a day. The power consumption of the machine is 0,5 kW, so the energy consumption of an ice cube machine in a bar or restaurant will be 3,5 kWh a day. This is not much compared to other kitchen appliances.

Picture 8 Ice cube machine

Picture 9 Water cooling (up) and barrel cooling down

Beer coolers

Many restaurants and bars have a beer tap. When serving the beer, it has to be cold. The most common way to cool the beer is with a cold water circuit between the barrel and the tap. The water is being cooled by a cooling system. See Figure 11 The energy consumption is about 3 to 6 kWh per day. Energy can be saved by keeping the barrels cold, so there is less cooling capacity needed from the water cooling system. This can be achieved by storing the barrels in a cold room like a basement and by cooling the barrels in a refrigerator when they are in use. Gamko, a producer of these types of cooling, claims savings of 43% to 57% compared to water cooling systems. This means an annual saving of 700 – 900 kWh.

Beverage coolers

Picture 10 **Beverage cooler**

Picture 11 **Wine refrigerator**

These coolers are mainly used in bars and have the benefit that barkeepers can easily grab the bottles, without opening a door. The beverage cooler is often a combination between a closed and open part (see figure 1.9). For numbers about the energy consumption of beverage coolers data is used from Gamco. The traditional machine uses 3 to 6 kWh a day. Recently, there are new type of coolers on the market which are more energy efficient. The energy saving is achieved by using a better refrigerant and better use of condensed water. Savings are possible between 35% and 55%, an annual saving of 600 – 900 kWh.

Wine refrigerators

Bigger restaurants and specialized restaurants are also using refrigerators for their wine. These cabins are creating the optimal conditions for storing bottles of wine. See Figure 13. The energy consumption of these wine refrigerators varies. The energy use of these units are quite low, compared to other appliances in bars and restaurants. When choosing a new unit, about 50% of energy use can be saved per year.

Cooling/freezing displays and showcases

These units varies in design and are used for multiple purposes. It can be used for salads, fish, cakes and other cold food in restaurants. See figure 1.11 for examples. Ice cream bars and fast food sector use also this cooling and freezing showcases. The energy consumption is relatively high: an open freezing display uses 0,6 to 1,4 kW per meter (-16°C), depending on the content. Cooling displays use less electricity, because the lower difference in temperature with the atmosphere. The consumption of cooling displays is 0,2 to 0,5 kW per meter (5°C). The energy consumption of cooling and freezing displays are therefore quite high. One unit of 0,6 kW uses about 5200 kWh annual, based on permanent use. Half of the energy can be saved by applying a cover, like a door of glass or plexi-glass. It is important to use material with high insulation capacity. When using bright material, less extra lighting within the display is needed. Energy can also be saved by moving the products into freezers and refrigerators by night.

Picture 12 Cooling (left) and Freezing (right) display

Refrigerators and freezer

Most restaurants are using professional refrigerators and freezers for their ingredients and products (see Figure 15). It is not known what the average number of units per restaurants is, but it is expected that every restaurant needs a cooling and freezing device for their food preservation. The energy consumption is similar to the cooling and freezing displays. Although refrigerators and freezer are much bigger, they are much better insulated. The power consumption of a freezer is about 0,7 kW (-18°C/-20°C) and 0,6 kW for a refrigerator (+2°C/+8°C). When assuming permanent use during the year, the annual consumption is 5200 kWh for a refrigerator and 6100 kWh for a freezer.

Picture 13 Refrigerator/freezer

2.1.3 Other electric consumption

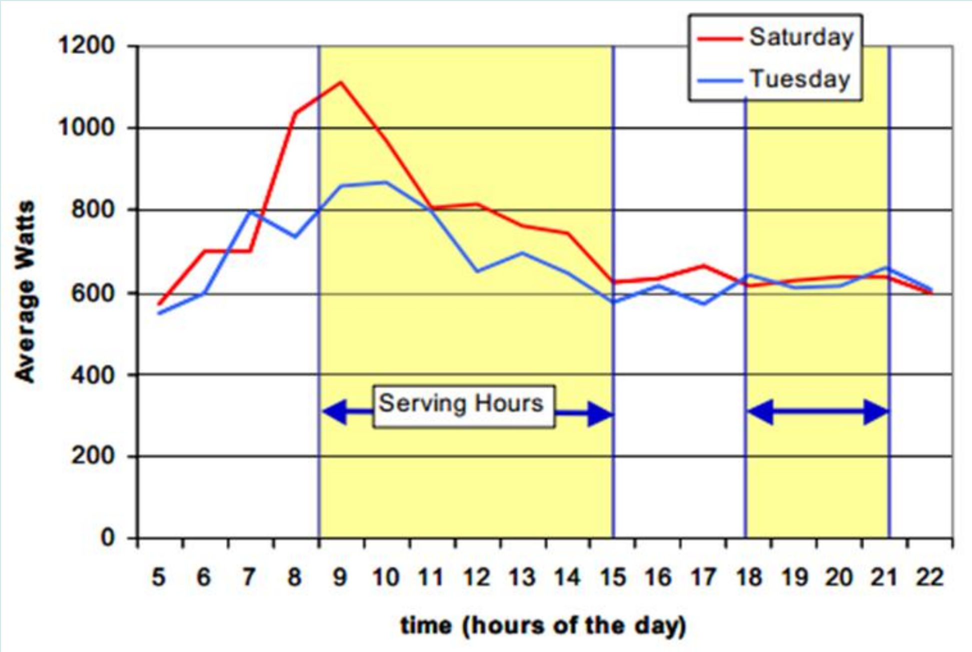
Beside the cooking and cooling processes in bars and restaurants, there are some other consumers of electricity. Coffee is a must have for every bar or restaurant, so every bar or restaurant have some kind of a coffee machine. There are several kinds of coffee machines. See figure 1.13. Due to the increasing demand for good and quality coffee, the number of espresso machines is increasing.

Picture 14 Basic coffee machine (left) and espresso machine (right)

In an espresso machine the quality of the coffee is the main goal, and the energy use is therefore quite inefficient. Most of the energy is used to produce heat water and steam. It is very common that most espresso machines are not being turned off after operating hours, because temperature changes within the system reservoirs are not good for the machine. A study to a two group espresso machines shows the importance of the non-productive energy consumption:

Table 4. Energy consumption espresso machine (50-80 drinks a day)

Testmodel	**LaSpaziale Model 3000NewEk**
Power consumption	
Stand-by	550 W
Light production	625 W
Heavy production	800 W
Energy consumption	
Production hours (17hrs)	11,9 kWh/d
Nighttime (7hrs)	3,9 kWh/d
Total	15,8 kWh/d



Picture 15 Graphic presentation of power consumption

As shown by the data, the energy consumption of espresso machines is very high. Energy can easily be saved by turning off the espresso machine during night time. This will save 25% of total energy use. Another 42% can be saved by insulation the boiler with hot water.

Hand dryers

In bars and restaurants are often hand dryers places in toilets. Hand dryers are blowing hot air, so guests can dry their wet hands. See figure 1.15. The air is electric heated, which uses a lot of energy. The power consumption of an electric hot air heater is about 1,5 to 1,8 kW. When assuming 2 units with 2 hours of operating time a day, the daily energy use is 6 to 7,2 kWh. Energy can be saved by using so called jet-dryers. See figure 1.15. These units are blowing air with high speed (up to 640 km/h) to blow the water drops off your hands. No air is heated, so energy consumption is much lower. Another difference is the operating time, because jet-dryers turn automatically off sooner. A comparison is showed in table 1.6. When using a jet-dryer, savings of 90% can be achieved.

Picture 16 Air dryer (left) and jet-dryer (right)

Table 5 Comparison air dryer and jet-dryer

	Air dryer	*Jet-dryer*
Power	1,7 kW	0,65 kW
Operating hours per day	2	0,33
Consumption per day	3,4 kWh	0,21 kWh
Consumpertion per year	1241 kWh	78 kWh

Washing machines

Most restaurants are using pass through dish washers. See Figure 19. There are several techniques developed to make the machines more efficient. Heat can be exchanged in the drain and in the cover, and the insulation of the cover has been improved. Water can be heated in multiple ways. Large systems can use a hot fill system, sometimes including a separate gas boiler only for the hot fill system. Water can also be electric heated, or heated by a heat pump. Heat exchangers can pre-heat the water. For this document, we assumend a basic pass through dish washer, with no heat pump, hot fill or heat exchangers. This type of machine is most common in the sector. In Table 7 a comparison is being made with a basic machine, but with heat exchanging included.

Picture 17 Pass through dish washer (right)

Table 6 comparison of dish washers

	Basic	***With heat-exchange***
Power	16,5 kW	9 kW
Full load hours per day	3	3
Standby power	0,8 kW	0,8 kW
Standby hours per day	3	3
Consumption per day	51,9 kWh	29,4 kWh
Consumpertion per year	18,9 MWh	10,7 MWh

2.1.4 Lighting

According to the data in table 1.3, lighting is responsible for 14 to 30 percent of total electricity consumption in bars and restaurants. Atmospheric lighting is very important for restaurants and bars. The average energy consumption is 12 W / m2.

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