

[smart tasccas]

saving electricity without spending money

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1. Introduction

This work is the beginning of a project called “smart tasca” and it aims to decrease the electricity consumption in typical Portuguese restaurants (*tascas*^{*}) in Mouraria. Additionally an idea for visualizing the electricity consumption and savings is given, which should be displayed in the *tascas*, making people more aware of their consumer behaviour and giving customers the opportunity of copying the electricity saving measures at home. This should be picked up in the ongoing work of this project and a system could be developed to make a competition between different *tascas* and increase their ambition of saving electricity.

Mouraria is one of the oldest neighborhoods of Lisbon. In the past it was a very critical zone with a lot of prostitution and crimes. The people living in that zone are from all over the world. They have different ethnic, religious and cultural backgrounds and speak various languages. It is a low income zone, but many projects are in progress to improve this zone and help the people which are living there to improve their daily live and “renovate” Mouraria.

2. Methodical procedure

During our work we used two different measurement devices – the *OWL[®]+USB Wireless Electricity Monitor* and the *VOLTCRAFT[®] Energy Logger 4000*.

The OWL device was used to measure the overall consumption. It consists of three clamps which are connected to a radio transmitter, and a display. After connecting the clamps to the electric board (one around each phase) they start measuring the current. Assuming a voltage of 230 V, the device is calculating the power. All these information, including time and date, can be read on a display that is wirelessly connected to that box. It allows displaying the consumption at a distance of up to 30 m from the electric board. The device doesn’t need internet and the data can be exported from the display via USB to a PC.



The VOLTCRAFT Energy Logger is used to measure certain devices directly. It is plugged between the device and the electrical socket and has a small display as well. The measured data is extracted via SD-card.

The measured data has to be interpreted with care, because both devices measure the apparent power, which is more than the *tasca* really uses and pays. Our estimated saving potentials might therefore be slightly overestimated.

OWL[®]+USB Wireless Electricity Monitor

VOLTCRAFT[®] Energy Logger 4000

In the beginning of the project, suitable *tascas* were selected. This was done by suggestions of the municipality and visits of those places. As we are both not fluent in Portuguese, we were always accompanied by Master Students of IST or members of the IN+ Innovation Center (namely: Miguel Meirinhos, Zé Pinto Ferreira, Natália Dias and Carlos

* A “*tasca*” is a small Portuguese tavern or café where people come together to drink something, have a snack, play cards or just communicate. They are known as the centres of socialising in small rural areas as well as in big cities.

Santos Silva). After two afternoons in Mouraria, three suitable tascas were found, which agreed to take part in the project.

In the following procedure the work was divided into three phases. The first and most time consuming phase was the data acquisition and analysis. In this phase we visited the three tascas and took notes of all the electrical equipment, their power and the daily usage profile of the owners. Additionally, general questions were answered,



for example about the business hours of the tascas, their monthly electricity consumption and their different tariffs. After this acquisition we tried to install the OWL measurement device in these places to measure their overall electricity consumption. However, there is not always a good access to the electricity board as there are a lot of old houses in Mouraria in which the electric wires were connected a bit chaotically. In the end, it was only possible to

connect the device in two of the tascas: “Taverna do Poço” with Sr. Paulo and “A Parreirinha” with Sr. Fernando (short profiles are attached in the annex). Accompanying these measurements, the VOLTcraft device was used to allocate some peaks and cycles in the overall consumption to certain devices in the tasca and as well to detect broken devices and high consumers. Parallel to this, measuring was done of some devices in our homes to have a comparison.

The second phase was started with interviews of the tasca owners, asking them if they think they can change something in their tasca to save electricity and trying to get to know their feeling about energy. Then, based on the data analysis, some suggestions were made to them how to save electricity by changing small things. Special attention was given to changes in their behaviour, as it would be unaffordable for them to do expensive technical measures (such as changing to more efficient equipment). At this point the social differences became more obvious as it was not so easy to explain them in a “non-engineering” way what and why they should change in their daily live.



In the final phase we measured the electricity consumption again to see if the owners put our suggestions into action and to verify how much they could save by these measures. This was only done in the Taverna do poço.

3. Saving potential

To find electricity saving potential the focus was put on the night time and the devices which are switched on 24 hours. Those are mostly the fridges, the freezer and the boiler. During the day time it is difficult to save energy without interfering with the business which was a big concern of Sr. Paulo and especially of Sr. Fernando. So the goal was to decrease the constant electricity demand every day by analysing the consumption at night.

The following suggestions to save electricity were explained to Sr. Paulo (Taverna do Poço):

Swapping the freezer – in the “Taverna do Poço” a broken freezer was detected. It didn’t work in cycles anymore but instead was always switched on (see profile in the annex). Additionally, it had a thick layer of ice (approx. 3cm) on the inside of its walls. Fortunately, Sr. Paulo had another freezer that was not in use. With some raw calculations and the assumption that the “new” freezer had the same power as the broken one, but only works half of the time (because of its cycle), the average actual electricity consumption would be 2,56 kWh/d instead of 5,1 kWh/d. If adding this up to a month, Sr. Paulo could save around 10 € by changing the freezer with another one that he is not using, but hopefully works better.

Changing the usage time of the boiler – the boiler in this tasca is controlled by a timer and switches on at 9pm and off again at 4am, every second night. However, the low cost period of the dual tariff that Sr. Paulo has, starts at midnight and ends at 7am [edp1, 2013]. In other words, the boiler is working 3 hours in the expensive tariff. Changing the timer to midnight, and with the assumption that the boiler needs 1 kWh for one hour of heating and that it is used only 15 days a month, the savings will be around 3€/month.

Decrease the contracted power – Sr. Paulo has a very high contracted power (20,7 kV.A). If looking at the data of a normal business day, the highest demand of the tasca is just above 10 kV.A. By changing this contracted power to 13,8 kV.A (to be on the save side), he can easily save around 9€/month [edp2, 2013].

Switch off the fridges at night (in winter) – this measure was done by Sr. Paulo before the project started. With the measured data it was confirmed that savings of 30-40% were achieved in a winter night (see further information and the profile in the annex). This adds up to 11 € per (winter) month.

Additionally to the mentioned suggestions, the tasca owner received the electricity consumption profiles and we explained them to him. He also agreed to make some experiments, like leaving the fridges in the bar switched on one night and switching them off another night, so that it was easier to calculate the real savings.

Moreover, the tasca owner got a simple table sheet and he was asked to write down any changes he was doing with the time and the date. With this information it would be possible to directly match devices and changes of behaviour to the total electricity consumption.

In the “A Parreirinha” it was more difficult to find any saving opportunities. One reason for that was that the tasca was newer and better equipped and that Sr. Fernando had already a good understanding of electricity. The other reason was that Sr. Fernando was not as open and cooperative as Sr. Paulo. He was often suspicious and not very communicative. Additionally he was convinced that there was nothing to save in his tasca. Our suggestions to him were the following:

Defrost the freezer more frequently – Sr. Fernando said that he defrosts the freezer once in a while. A visit of the same showed that there was still a quite thick layer of ice. It was suggested to do this more frequently.

Completely turn off not needed devices at night – a continuous base demand was discovered in this tasca as well. This derived from some stand by devices but mainly from a machine that was turned on the whole night. As this machine is not needed at night, around 5-10 € could be saved per month.

Unfortunately there was not enough data measured in this tasca to estimate more savings.

4. Implementation of suggestions

“Where habits are strong, behavioural changes [...] may be unlikely.” [Azevedo et.al., 2012]

In “A Parreirinha” it was not possible to check whether the owner put the suggested measures into action or not, because the cooperation was ended before. Sr. Fernando was never really interested in the work and it was never possible to get a real connection to him.

In the “Taverna do Poço” it was different. A nice connection was developed with Sr. Paulo which made the work much easier. He was very glad about the measures that were suggested to him and he was interested in how he could apply them. The only thing he was suspicious about was changing the contracted power, because he was afraid that he would not be allowed to increase it again once his business will get better.

However, after measuring again, the data didn’t show any big difference and Sr. Paulo did not fill in the paper sheet that was given to him. After asking him again, he said that he did change the freezer immediately after it was suggested and that he changed the timing of the boiler as well. This could have different reasons. One of them is that Sr. Paulo was always so happy about the project that he didn’t want to tell us now that he wasn’t able to change the freezer yet. This is assumed, because he didn’t want us to go to the back again and measure the “new” freezer. On the other hand it is quite possible that the other freezer as well wasn’t working in cycles anymore as it was already old and we couldn’t test this before.

For changing the contracted power he didn’t have time yet. Additionally he said he switches off the fridges every night. Our data showed something different here as well. There are some nights when he switches all of them off, some nights when he only switches some equipment off and some nights when he leaves all of them turned on. At this point it might be useful to have some kind of reminder that gives him an alert when he forgets to switch something off before he leaves the tasca at night.



5. Improvement through visualization

The visualization is an important tool in improving energy saving ambitions. With a nice design and interactive display it can attract people and make them interested in electricity

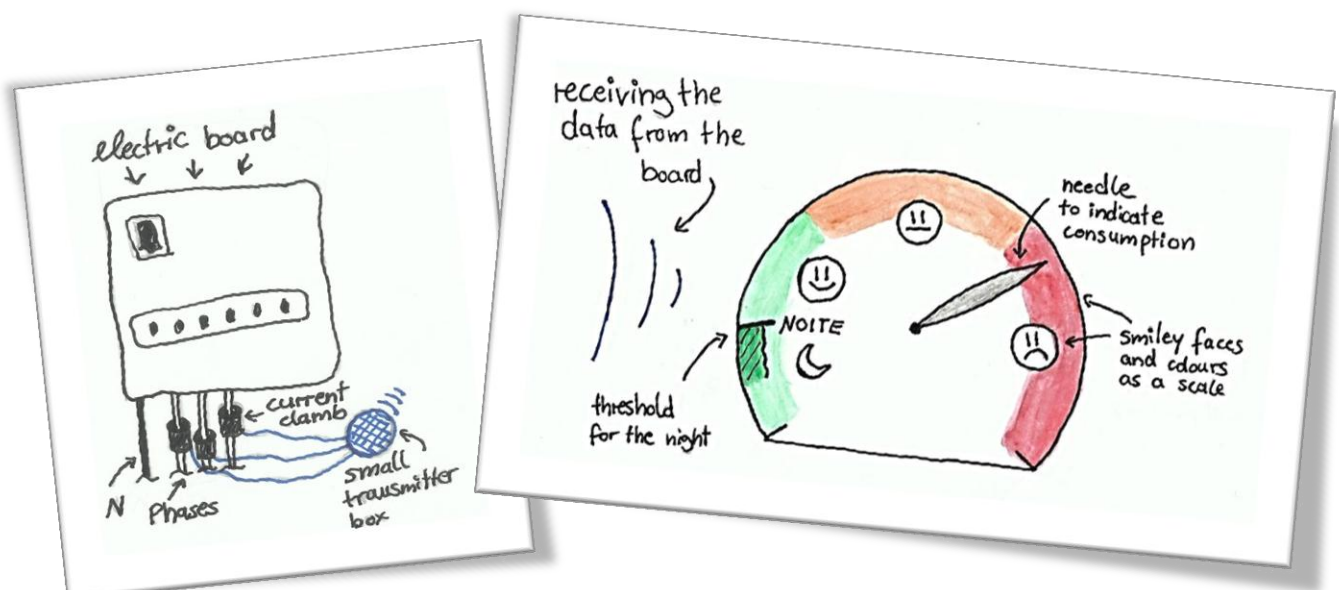
consumption and savings. The following requirements of the display were found out to be useful:

- The actual consumption compared with a reference, like the last day/week/month
- In case of saving electricity it should give a clear sign that at this very moment electricity is saved. The same in the opposite way.
- The accumulated electricity which is saved from the beginning of the record.

A possible display can be a combination of a traffic light and tachometer with three traffic light phases in the tachometer. Green shows that electricity is saved. The aim of the owner should be to keep the needle in this part. Yellow means that the electricity consumption is similar to the reference. Red means that the consumption is too high and he should try to reduce it. No direct unit will be shown at the tachometer. The already saved electricity can be shown in Euro below or inside the tachometer.

The display has also a marked night phase, where the needle should be at night times. If the needle is not in the range of the night phase the owner can check if he forgot to switch off something. Additionally, one of the traffic lights is shining in the morning of the next day, depending on the total electricity consumed during the last night. This is needed, because the devices which might be consuming electricity in the night work in cycles. When closing the tasca it could happen that all of them are not consuming at this specific moment, but a different device is switched on. On the next morning the owner sees a red light on the display and knows that he forgot to switch off something. It is more a reminder for the next nights.

The device would be installed at the electricity board and transmit the data wirelessly to the display, same like the OWL measurement device. It is very important that the display has a big size, so that everybody can easily see and read it. It should also be placed at a location where the owner and the customers have a good sight on it.



The display itself is converting the apparent power to the actual power and visualizing the kilowatt every minute with a needle. The scale for the three colours needs to be defined in the beginning. In case of the “Taverna do Poço” a possible display is shown above. The middle of the orange phase is defined as the average electricity consumption of a day, which is around 3 kW. The green phase goes until 2 kW and the red phase from 4-6 kW. The maximum night consumption is defined as the peak night consumption in the tasca, when all the not needed devices are switched off (here: 0,8 kW).

6. Advices for ongoing projects

The key issue is to get a good connection to the tasca owners and their family. It helps a lot to bring a good communicator that “wins” the attention of the whole tasca. In our case, this was achieved when we brought Natalia Dias with us. Make sure the owner is always encouraged, let him know about the stage of the project and how much he can save by easy measures, explaining these measures to him in a detailed but easy way, so that he understands what he is doing.

Involving the customers in a positive way and in a certain frame makes them interested and increases the social pressure on the owner.

Finding more than one or two tascas to make a competition to encourage them to save more electricity seems a good way to proceed with the project.



7. References

- [edp1, 2013] edp, 2013, Horários Baixa Tensao Normal, Ciclo Semanal inverno.
<http://www.edpsu.pt/pt/particulares/tarifasehorarios/horarios/Pages/HorariosBTN.aspx> (31.01.2013)
- [edp2, 2013] edp, 2013, Tarifa transitória de venda a clientes finais em BTN ($\leq 20,7\text{kVA}$).
<http://www.edpsu.pt/pt/particulares/tarifasehorarios/BTN/Pages/TarifasBTNate20.7kVA.aspx> (29.01.2013)
- [Azevedo et.al., 2012] Azevedo, I. L., Sonnberger, M., Thomas, B. A., Morgan, G., Renn, O., 2012, The Need to Account for Consumer Behaviour in order to Develop Robust Energy Efficiency Policies. International Risk Governance Council, Geneva.

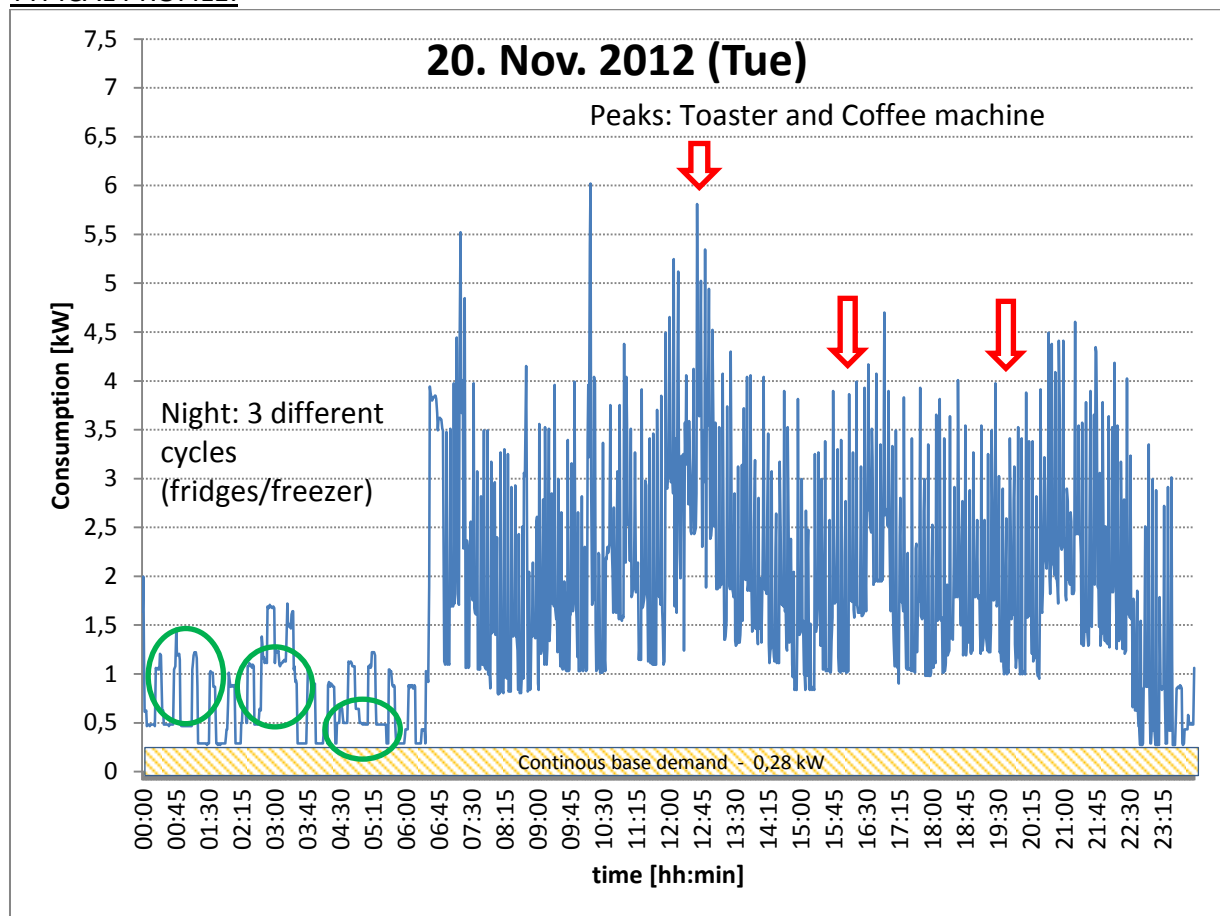
8. Annex

8.1 Profiles of the Tascas

A PARREIRINHA	
<i>Owner:</i>	Sr. Fernando
<i>Business:</i>	Café/Bar with lunch, outside area
<i>Opening hours:</i>	8-23:30h
<i>Contracted power:</i>	3,45 kV.A
<i>Monthly consumption:</i>	1125 kWh
<i>Monthly electricity bill:</i>	≈ 205 €
<i>Electricity saving measure before project:</i> <ul style="list-style-type: none"> • Motion detector in the bathroom • Defrosting the freezer 	

TYPICAL PROFILE:



TAVERNA DO POÇO

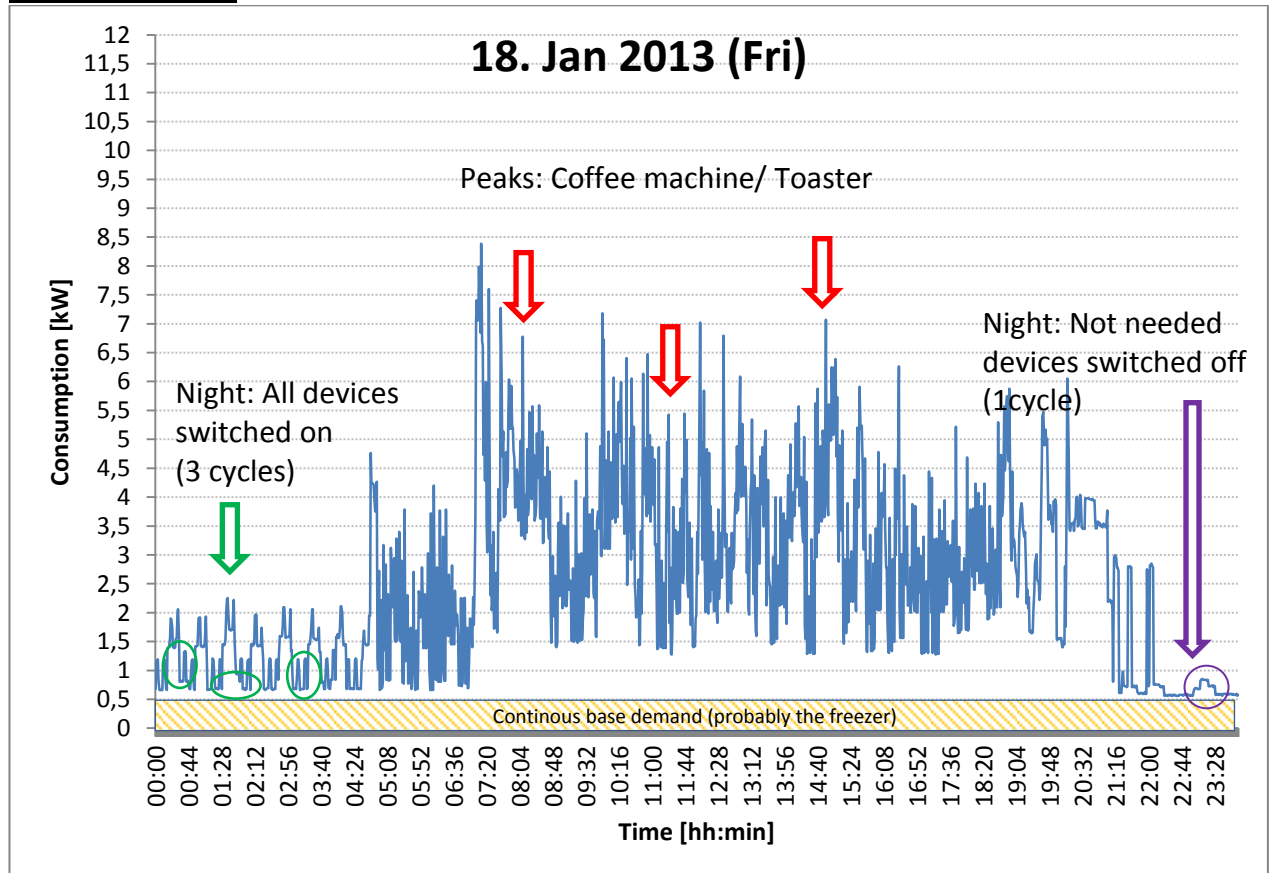
Owner: Sr. Paulo
Business: Tavern/Bar with some lunch
Opening hours: 7-19h
Contracted power: 20,7 kV.A
Monthly consumption: 415 kWh (in off-peak hours)
Monthly electricity bill: ≈ 285€



Electricity saving measure before project:

- Switching off beverage fridges at night
- Motion detector in one bathroom
- Half of the lights are switched off
- Disconnected the light from the cigarette vending machine

TYPICAL PROFILE:



8.2 Measured freezer in the Taverna do Poço

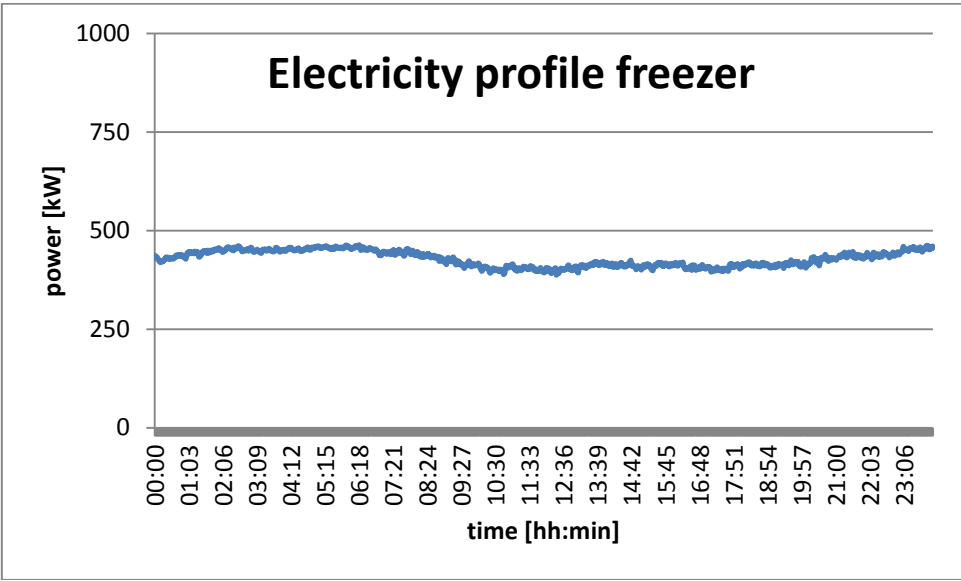


Figure 1: Broken freezer in the Taverna do Poço

8.3 Three different night behaviors (Taverna do Poço)

On the 15.01.13 between midnight and 4am, two electric devices with cycles were working and a constant base demand of around 500 W was there. The first cycle (surrounded with yellow) has a frequency of 10 min and the working duration is around 7 min. This cycle is probably a fridge that cools the beverages in the bar.

The electricity consumption is approx. 0,5-0,6 kW. The second cycle (surrounded with green) has a longer frequency of about 1 hour, the working duration is 25 min and the electricity consumption is around 0,2-0,3 kW. It is probably the fridge in the kitchen. It is always switched on, because of food.

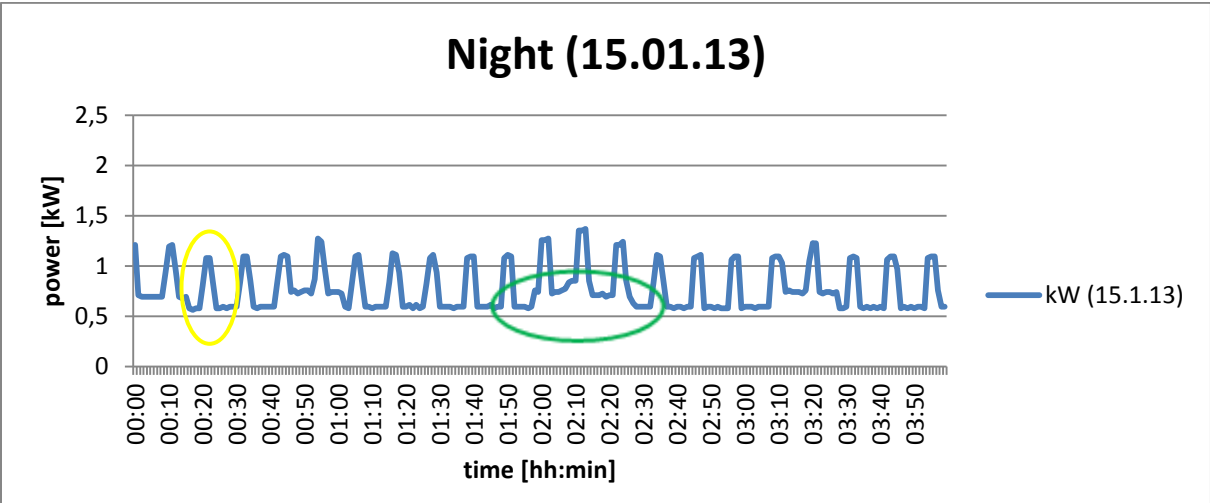


Figure 2: Night consumption 15.01.13 (Taverna do Poço)

In this night (18.01.13) the above mentioned yellow cycle, the green cycle and the base demand are present and a third cycle (surrounded with purple) with a frequency of 40 min and a working duration of 20 min. This cycle consumes around 0,7 kW. This cycle has a peak power of approx. 0,7 kW.

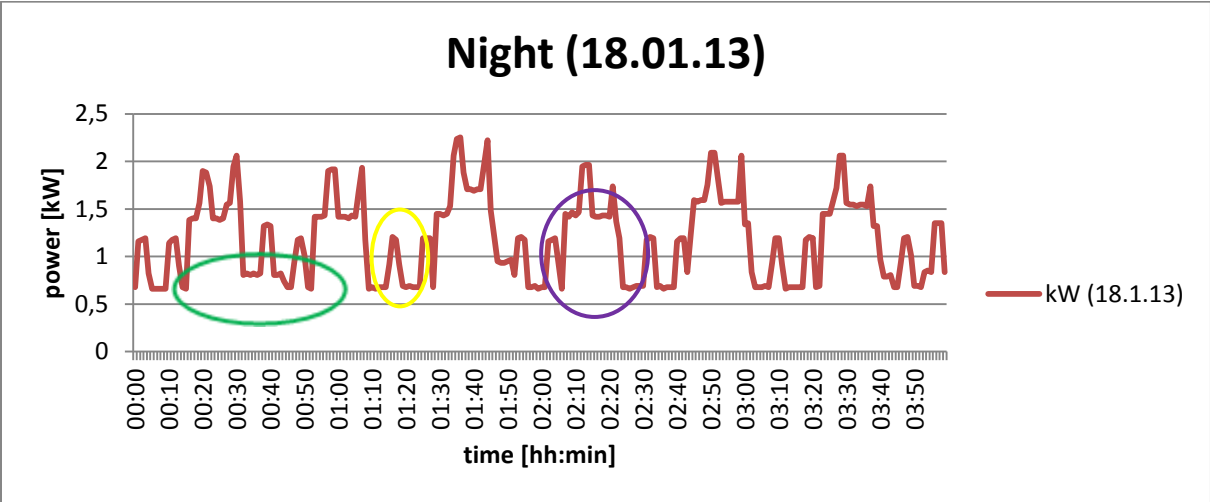


Figure 3: Night consumption 18.01.13 (Taverna do Poço)

The night of the 19.01.13 shows a profile only with one cycle, the green cycle. In this night the owner switched off all not needed devices.

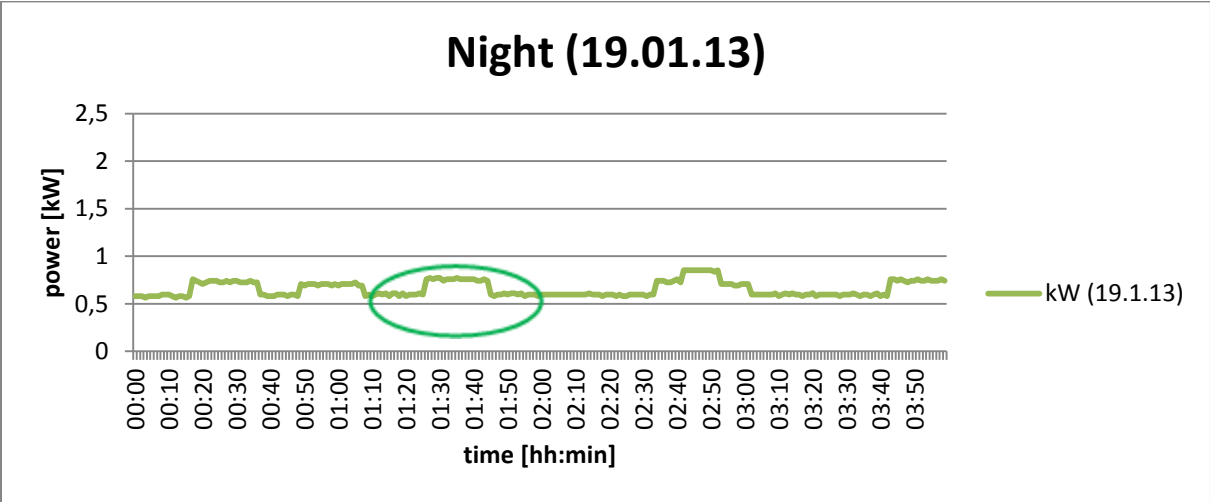


Figure 4: Night consumption 19.01.13 (Taverna do Poço)

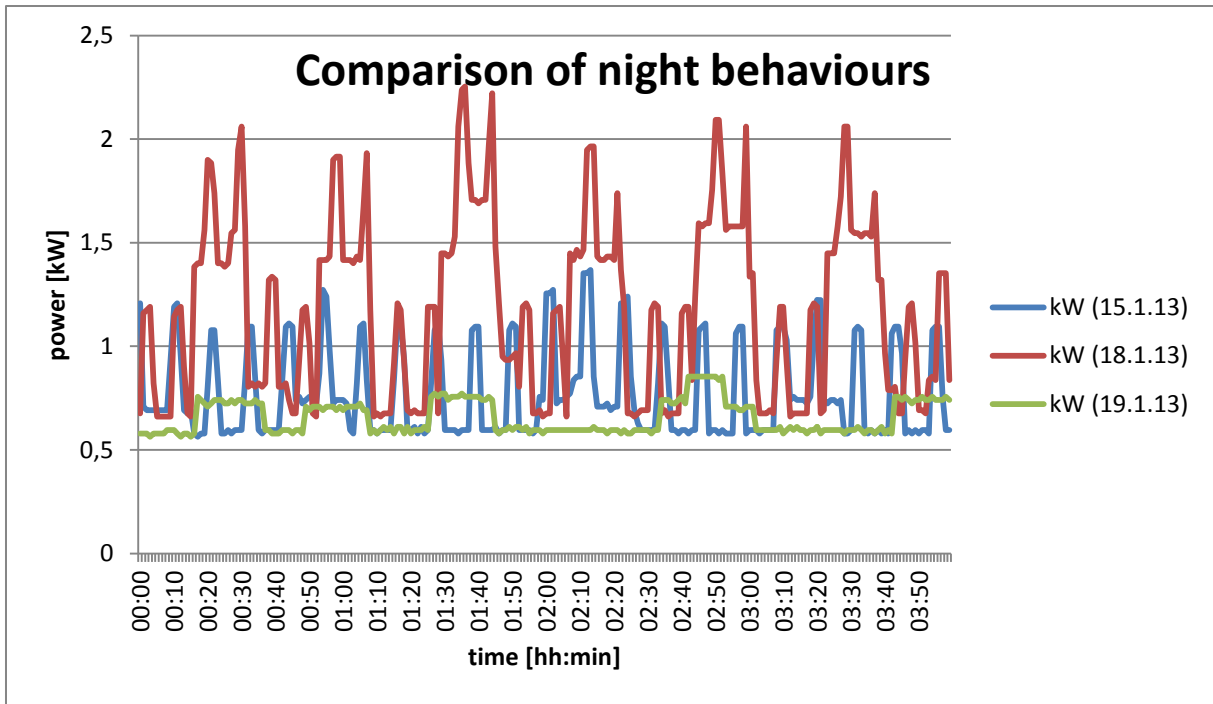


Figure 5: All three night behaviours in one chart