THE POWER USAGE FOR A HOUSEHOLD AND THE INSIGHTS OR PATTERNS WHICH ARE SHOWN

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Abstract

This report describes an investigation into the insights of Power Usage, and the patterns which can be observed alongside studying Solar Generation. Power Usage was collected for a household and analysed. For all results, an interesting pattern was found, showing that when more solar power is generated, there is more power usage. These results can be used to as a starting point to study power usage within a community and how to better adapt to the needs.

Background

The usage of power is very important in this day and age, this is because it'll only increase evermore, for this reason I was interested to investigate the power usage for my own household. I felt that studying the day by day usage would allow a depth of insights. Specifically the parameters of power usage and solar generation each day. I believed that studying this would allow myself to learn more about my own power usage and ways it could be decreased.

The key hypothesis for this investigation is:

> A household which contains solar generation will result in lower power usage than the average household.

Methodology

Participants

Participants in this study concluded just a single Household. Within this household there are a family of 4 people who were all between the ages of 19-48. With all participants within the household working, though with irregular schedules.

Materials

Power usage is calculated by a Western Power EM1000 machine, this machine calculates the amount of kWh it imports. Alongside the household includes solar panels which uses a SUNNY BOY 4500TL-JP inverter. These materials where required in-order to gather data. The study also used a program to create the output, this program is started by

```
python3 app.py
```

And requires you to select the option '1. Power Usage'. Additional Input files are also required the specific format is available in the user guide, otherwise the following files are already there to use,

```
usage.csv
```

```
solar.csv
```

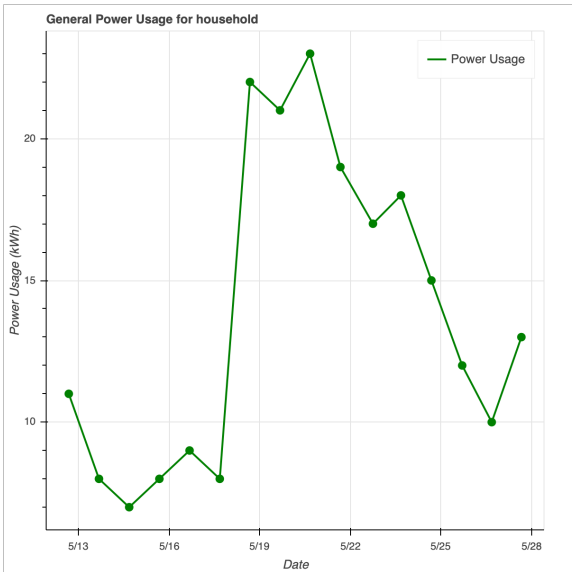
Procedure

Between 12/05/20 and 28/05/20 each day at 4pm the household had its power meter checked and logged to see the amount of kWh, afterwards the solar inverter was checked and logged to see the amount of power generated for that day. This was repeated each day around the same time +/- 1hr.

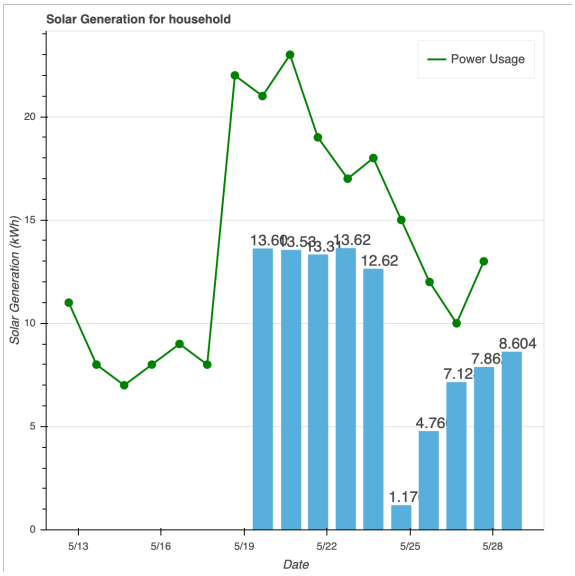
Results

The power usage for the average household in autumn is 20 kWh ("Typical House Energy Use - Australian Housing Data", 2013), the power usage for the household was studied for 16 days and within those days there was a pattern which was observed, this is strange pattern between power usage and solar generation.

The results for simulation 1, the General power usage alone are shown below in figure 1 also simulation 2, the Solar Generation in figure 2.



(Figure 1)



(Figure 2)

These results present a strange pattern, when more solar generation has occurred it leads to an increase in power usage for the household. The results show that the null hypothesis has to be accepted, contrary to the expectations.

Conclusions

The results of this study were clearly contrary to the expectations. The hypothesis suggested that a household with solar generation will have lower power usage, this was presented to be the opposite, showing an increase of power usage with solar generation.

The possible reason why this pattern occurred could be due to the weather, though this was not accounted for when the data was being collected therefore we are unable to correlate the weather and power usage, it is recommended to looking into other factors which could influence power usage alongside in future studies.

As mentioned above future research is required into this topic to further address the correlation of power usage and solar generation. It is important that future studies take more factors into account as weather, temperature and household occupancy availability.

References

Typical House Energy Use - Australian Housing Data. Australian Housing Data. (2013). Retrieved 31 May 2020, from https://ahd.csiro.au/other-data/typical-house-energy-use/.

THE POWER MODELLING FOR A HOUSEHOLD AND THE INSIGHTS OR PATTERNS WHICH ARE SHOWN

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31st May 2020

Abstract

This report describes an investigation into the insights of Power Modelling, and the patterns which can be observed between appliance usage and power usage. The appliance and power usage were both collected for a household and analysed. For all results, the investigation into appliance usage times found that there was a pattern with appliance usage, there is a window where appliances are used the most which correlated to power usage. These results can be used to as a starting point to study power modelling within a household and how to better adapt to the needs.

Background

The usage of power is very important in this day and age, this is because it'll only increase evermore, for this reason I was interested to investigate the power modelling for my own household. It's important to see how different appliances affect how much power is being used and if appliances cause power usage to increase. I believed that studying this would allow myself to learn more about my own power usage and ways it could be decreased.

The key hypothesis for this investigation is:

> A household which contains many electronic products will result in higher power usage during the peak appliance usage.

Methodology

Participants

Participants in this study concluded just a single Household. Within this household there are a family of 4 people who were all between the ages of 19-48. With all participants within the household working, though with irregular schedules.

Materials

Power usage is calculated by a Western Power EM1000 machine, this machine calculates the amount of kWh it imports. Alongside the household includes several appliances, the list can be found in the model input file. The usage was studied and average usage time were calculated. These materials where required in-order to gather data. The study also used a program to create the output, this program is started by

```
python3 app.py
```

And requires you to select the option '2. Power Modelling'. Additional Input files are also required the specific format is available in the user guide, otherwise the following files are already there to use,

```
daily.csv
```

```
model.csv
```

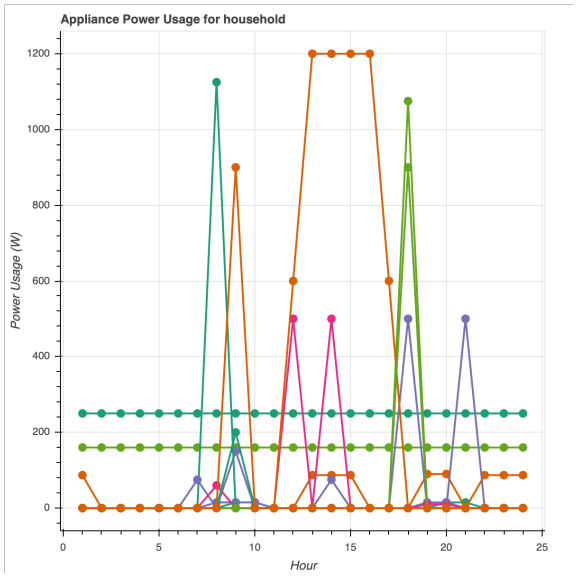
Procedure

On 27/05/20 the household had its power meter checked and logged to see the amount of kWh. This was repeated every 2 hours around the same time +/- 30min. Each individual appliance was studied throughout the course of one week to find the average usage then it was giving a number from zero to one to show activity for that hour of the day.

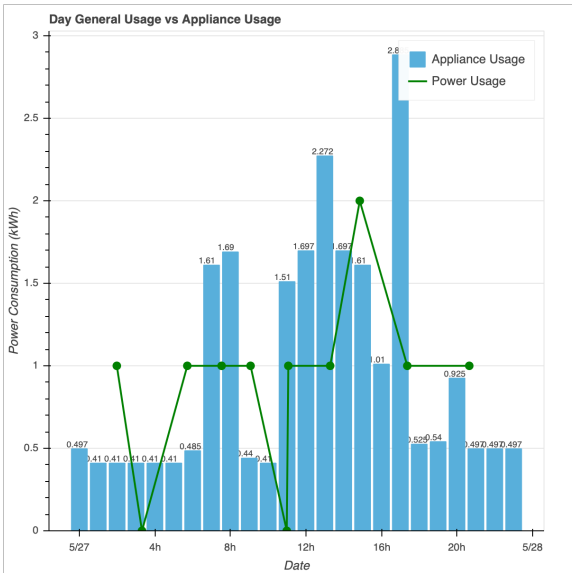
Results

The power usage for the household was studied for 24 hours and within those hours there was a pattern which was observed, this pattern shows that during the day, usage is much higher than night time, which coincides with appliance usage which is more popular during the day than night.

The results for simulation 1, the Appliance Usage are shown below in figure 1 alongside figure 2 shows simulation 2, the General power usage with average appliance power usage.



(Figure 1)



(Figure 2)

Figure 1 presents the power usage in watts (W) for each appliance, it clearly shows that appliances have a pattern of being most active during daytime.

These results present a strong pattern, this pattern shows that appliance usage correlates with power usage and when appliance usage is at its peak that is also when power usage is peaking. The results show that the hypothesis can be accepted, therefore proven.

Conclusions

The results of this study were clearly consistent with the expectations. The hypothesis suggested that a household which contains many electronic products will have higher power usage during the peak appliance usage, this presented to be true, showing an increase of power usage alongside an increase of appliance usage.

Some inconsistencies where seen within the study as a spike in appliance usage but no power usage spike, its impossible to have appliance usage mimic the average usage, there are always outliers which can effect the results. This should in further investigations into the topic be addressed.

Future research is required into this topic to further address the correlation of power usage and appliance usage. It is important that future studies take more factors into account as average usage, weather, temperature and household occupancy availability.

References

N/A

THE POWER SIMULATION FOR A HOUSEHOLD AND THE INSIGHTS OR PATTERNS WHICH ARE SHOWN

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29th May 2020

Abstract

This report describes an investigation into the insights of Power Simulation, and the patterns which can be observed in multi household power usage. The power usage were collected for a household and analysed. For all results, we saw that households presented with a strong usage pattern, and saw the greater the amount of households in a suburb the great the power usage during peak times. These results can be used to as a starting point to study power simulation within a community and how a suburb can better adapt to the needs.

Background

The usage of power is very important in this day and age, this is because it'll only increase evermore, for this reason I was interested to investigate the power simulation in the perspective of a power company. It's important to see usages of a community in-order to be ready for any power surges and how the amount of households effect the power demand. I believed that studying this would allow myself to learn more about my own power usage and ways it could be decreased.

The key hypothesis for this investigation is:

> If we increase the proportion of houses then the load of power usage will also increase in demand.

Methodology

Participants

In 2012/2013 CSIRO conducted a study ("Typical House Energy Use - Australian Housing Data", 2013) of the energy use of 209 Australian households. The power usage data was taken every 30 minutes at households in VIC, QLD and SA. Alongside another study ("Electricity consumption benchmarks", 2014) is one by the Australian government in 2014 which did a survey for 25 Victorian households power usage.

Materials

Due to the data coming from external sources the specific materials cannot be found. More information about specifics can be found at the data source. The study also used a program to create the output, this program is started by

```
python3 app.py
```

And requires you to select the option '3. Power Simulation'. Additional input files are also required the specific format is available in the user guide, otherwise the following files are already there to use,

```
simulation.csv
```

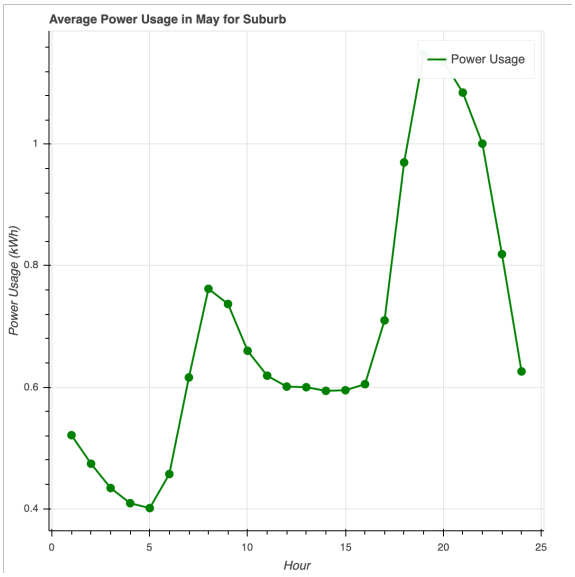
Procedure

The CSIRO study had households power usage checked and logged to see the amount of kWh. This was repeated every 30 minutes for 2 years. For the government study a questionnaire ("Electricity consumption questionnaire", 2014) was taken by respondents to gather usage information.

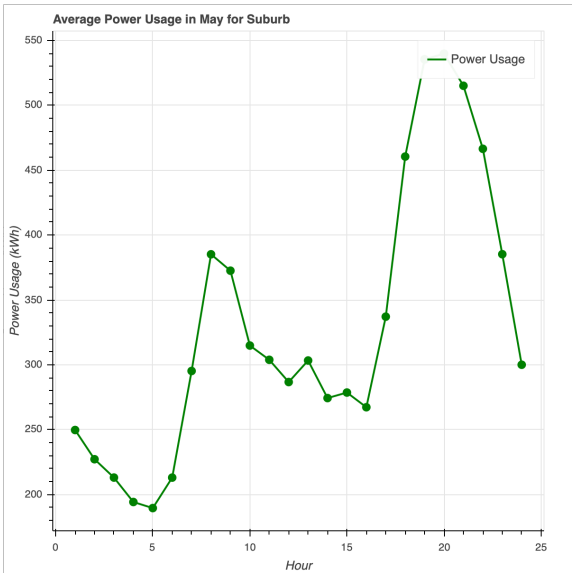
Results

The power usage for the first simulation present the average power usage for a household in may according the the CSIRO statistics, this shows that there are multiple peaks, a clear pattern. Usage is much higher during the morning and evening compared to the afternoon.

The results for simulation 1, the Appliance Usage are shown below in figure 1 alongside figure 2 shows simulation 2, the General power usage with average appliance power usage.

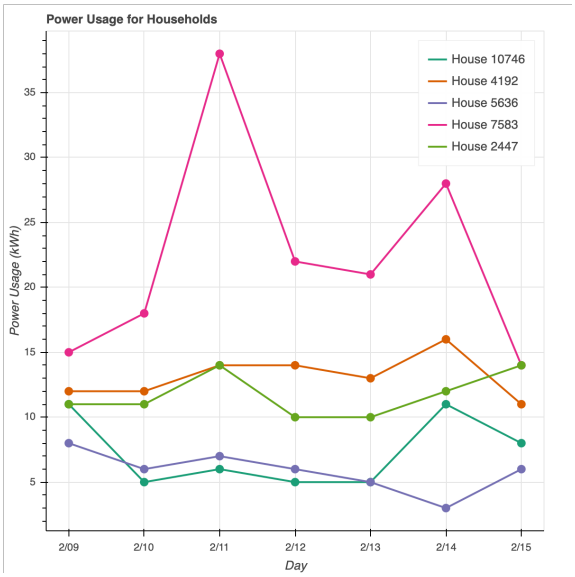


(Figure 1 - 1 household)



(Figure 2 - 500 households)

These results present a strong pattern, and when the number of households are increased it therefore increases the power usage demand, this is shown at figure 1, a single household at peak only requires 2 kWh of power while figure 2 with 500 households requires around 550 kWh. The results show that the hypothesis can be accepted, therefore proven.



(Figure 3)

The results in figure 3 present multiple households from the government study and show that peak usage for a household is around 13-15 kWh per day and peaks during the weekend, compared to the weekday. There is a clear pattern and the greater amount of houses means a greater demand for power during those peak times, also proving the hypothesis.

Conclusions

The results of this study were clearly consistent with the expectations. The hypothesis suggested that If we increase the proportion of houses then the load of power usage will also increase in demand, this presented to be true, showing an increase of power usage alongside an increase of households.

Due to this study being done by other organisations it is difficult to verify the accuracy and if any factors complicated the results, though the results are taken from two trustworthy entities so there is little doubt on the accuracy.

Future research is required into this topic to further address the correlation of power usage and households. It's important to get more up to date data in the future or conduct a study with data collected myself which can take more factors into account as average usage, weather, temperature and household occupancy availability.

References

Typical House Energy Use - Australian Housing Data. Australian Housing Data. (2013). Retrieved 31 May 2020, from https://ahd.csiro.au/other-data/typical-house-energy-use/.

Electricity consumption benchmarks. Data.gov.au. (2014). Retrieved 31 May 2020, from https://data.gov.au/dataset/ds-dga-0f3d60db-bd63-419e-9cd9-0a663f3abbc9/details.

Electricity consumption questionnaire. Data.gov.au. (2014). Retrieved 31 May 2020, from https://data.gov.au/dataset/ds-dga-0f3d60db-bd63-419e-9cd9-0a663f3abbc9/distribution/dist-dga-e388fd02-e6dd-4989-8c0a-00bf9152869f/details?q=.