

Project of Work-Linked Training

Our theoretical school's electrical consumption and potential savings

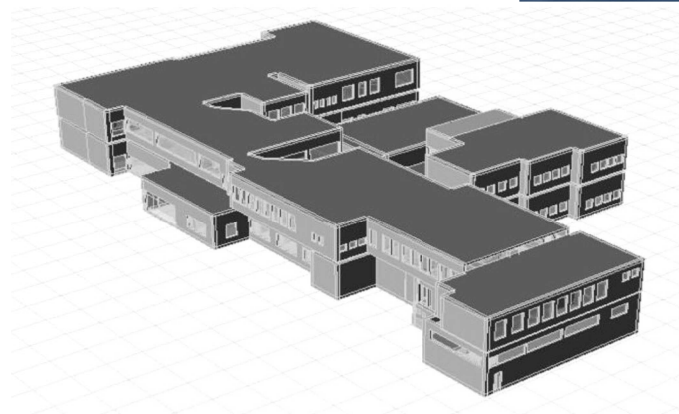
We were assured that our school building used to waste high amounts of energy - but was it only a fault of the structure itself?



We were basically convinced that the consumption observed in the last years could be mostly caused by an eco-destructive behaviour of our fellow students and teachers.



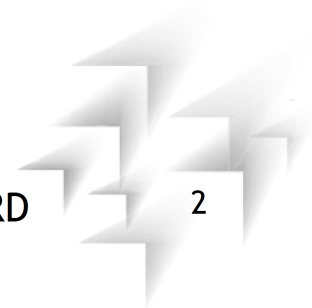
Therefore we decided to develop that project in order to show how much could the final users of a public building effect its consumption. Furthermore we also struggled in order to reach a convincing “saving plan” - that became our last goal.



The Method We Used



1. Carry out a survey with all school building's electrical devices
2. Find the necessary data/information
 - School hours table
 - Weather data
 - Classrooms' devices usage
3. Create Excel sheets
 - Lighting and Devices' sheet
 - Theoretical illumination's sheet
4. Graphs creation
5. Analyse the results





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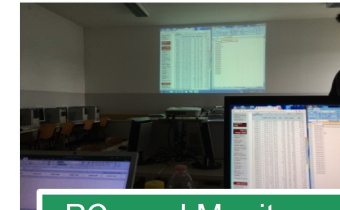
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Examples



Servers



PCs and Monitors



Vending Machines



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| Giorno | T Media | T min | T max | Precip. | Umidità | Vento Max | Raffica | Fenomeni | Info |
|--------|---------|-------|-------|---------|---------|-----------|---------|----------|------|
| 1 | - | - | - | - | - | - | - | - | n/d |
| 2 | - | - | - | - | - | - | - | - | n/d |
| 3 | 16°C | 13°C | 19°C | - | 64% | 11 km/h | - | Nessuno | |
| 4 | 14°C | 11°C | 18°C | n/d | 85% | 18 km/h | - | | |
| 5 | 15°C | 10°C | 21°C | n/d | 76% | 13 km/h | - | | |
| 6 | 14°C | 10°C | 19°C | n/d | 81% | 13 km/h | - | | |
| 7 | 15°C | 12°C | 18°C | n/d | 84% | 15 km/h | - | | |
| 8 | 16°C | 11°C | 21°C | n/d | 85% | 11 km/h | - | | |
| 9 | 16°C | 13°C | 19°C | n/d | 75% | 18 km/h | - | | |
| 10 | 13°C | 10°C | 18°C | n/d | 73% | 17 km/h | - | | |
| 11 | 15°C | 12°C | 17°C | n/d | 84% | 17 km/h | - | | |
| 12 | 19°C | 16°C | 24°C | n/d | 77% | 18 km/h | - | | |
| 13 | 19°C | 14°C | 25°C | n/d | 75% | 13 km/h | - | | |
| 14 | 20°C | 15°C | 26°C | n/d | 74% | 13 km/h | - | | |
| 15 | 19°C | 15°C | 26°C | n/d | 74% | 30 km/h | - | | |
| 16 | 20°C | 12°C | 27°C | - | 63% | 11 km/h | - | Nessuno | |
| 17 | 22°C | 17°C | 27°C | - | 53% | 13 km/h | - | Nessuno | |
| 18 | 22°C | 19°C | 26°C | - | 55% | 11 km/h | - | Nessuno | |
| 19 | 19°C | 16°C | 25°C | n/d | 72% | 21 km/h | - | | |



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2. Find the necessary data/information

- School hours table
- Weather data
- Classrooms' devices usage

| A | B | C | D | E | F | G | H |
|---------|-------------------------------------|---------------------------|---------------------------|----------------------------|---------------------------|---------------------|---|
| N° Varo | Destinazione d'uso | Illuminazione 30W (2*18W) | Illuminazione 72W (2*36W) | Illuminazione 110W (2*55W) | Watt Illuminazione Totale | Watt Strumentazione | NOTE |
| 2 | 0001 Altro (Atrio e Corridoi) | 13 | 14 | 4 | 1540 | 0 | 1 PC (100W) + 1 Monitor (20W) |
| 3 | 0009 Aula Digitale | | | 4 | 464 | 252 | Altri dispositivi (Apple TV...) connessi nelle 24/7 |
| 4 | 0018 Aula Normale | | | 4 | 464 | 252 | |
| 5 | 0019 Altro (Aula Magna) | | 5 | | 360 | 640 | 1 Proiettore (270W) + 1 PC (100W) + 1 Monitor (20W) + Applicazione (250W) |
| 6 | 0021 Aula Normale | | 6 | | 432 | 252 | |
| 7 | 0022 Aula Normale | | 6 | | 432 | 252 | |
| 8 | 0023 Aula Normale | | 6 | | 432 | 252 | |
| 9 | 0024 Aula Normale | | 6 | | 432 | 252 | |
| 10 | 0025 Aula Normale | | 6 | | 432 | 252 | |
| 11 | 0026 Altro (Stanza Fotocopie) | | 1 | | 72 | 180 | 1 PC (100W) + 1 Monitor (20W) + 1 Stampante (60W di media) |
| 12 | 0027 Altro (Centralino) | | | | 0 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 13 | 0028 Altro (Segreteria) | | 4 | | 464 | 360 | 1 PC (100W) + 3 Monitor (20W) |
| 14 | 0029 Altro (Ufficio) | | 2 | | 252 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 15 | 0030 Altro (Ufficio) | | 2 | | 252 | 360 | 1 PC (100W) + 3 Monitor (20W) |
| 16 | 0031 Altro (Presidenza) | | 2 | | 252 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 17 | 0032 Altro (Vicespresidenza) | | 2 | | 252 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 18 | 0033 Polo Storia | | | | 0 | 0 | |
| 19 | 0034 Palestra Piccola | | | 8 | 928 | 0 | |
| 20 | 0035 Laboratorio Linguistico | | 6 | | 432 | 2040 | 22 PC (100W) + 22 Monitor (20W) |
| 21 | 0036 Altro (Computer insegnanti...) | | 2 | | 144 | 480 | 4 PC (100W) + 4 Monitor (20W) |
| 22 | 0042 Altro (Ufficio) | | 2 | 1 | 116 | 340 | 2 PC (100W) + 2 Monitor (20W) |
| 23 | 43 Aula insegnanti | | | 3 | 348 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 24 | 0044 Aula Normale | | | 4 | 464 | 252 | |
| 25 | 0045 Aula Normale | | | 4 | 464 | 252 | |
| 26 | 0046 Aula Normale | | | 4 | 464 | 252 | |
| 27 | 0056 Altro (Popolazioni) | | 2 | | 144 | 0 | |
| 28 | 0053 Palestra Grande | | 72 | | 2592 | 0 | |
| 29 | 0058 Altro (Biblioteca) | | 6 | | 432 | 120 | 1 PC (100W) + 1 Monitor (20W) |
| 30 | 0061 Aula Normale | | 4 | | 252 | 252 | |
| 31 | 1002 Laboratorio Multimediale | | 6 | | 432 | 2387 | 22 PC (80W) + 22 Monitor (28,5W) |
| 32 | 1003 Aula Normale | | 6 | | 432 | 252 | |
| 33 | 1004 Aula Normale | | 6 | | 432 | 252 | |
| 34 | 1005 Aula Normale | | 6 | | 432 | 252 | |
| 35 | 1006 Aula Normale | | 6 | | 432 | 252 | |
| 36 | 1007 Altro (Stanza Fotocopie) | | 1 | | 72 | 180 | 1 PC (100W) + 1 Monitor (20W) + 1 Stampante (60W di media) |
| 37 | 1008 Corsi di | | | 20 | 2120 | 0 | |
| 38 | 1009 Laboratorio di Scienze | | | 7 | 812 | 120 | 1 PC (100W) + 1 Monitor (20W) |

3. Create Excel sheets

- Lighting and Devices' sheet
- Theoretical illumination's sheet

4. Graphs creation

5. Analyse the results

| A | B | C | D |
|----|------------|------|-----|
| 1 | 01/05/2017 | 7,4 | 0 2 |
| 2 | 02/05/2017 | 0,2 | 0 2 |
| 3 | 03/05/2017 | 3 | 0 2 |
| 4 | 04/05/2017 | 20,8 | 2 3 |
| 5 | 05/05/2017 | 0 | 0 2 |
| 6 | 06/05/2017 | 15,8 | 2 3 |
| 7 | 07/05/2017 | 0,6 | 0 2 |
| 8 | 08/05/2017 | 0,4 | 0 2 |
| 9 | 09/05/2017 | 18,6 | 2 3 |
| 10 | 10/05/2017 | 1,4 | 0 2 |
| 11 | 11/05/2017 | 0 | 0 2 |
| 12 | 12/05/2017 | 0 | 0 2 |
| 13 | 13/05/2017 | 0,4 | 0 2 |
| 14 | 14/05/2017 | 23,2 | 2 3 |
| 15 | 15/05/2017 | 13,8 | 2 3 |
| 16 | 16/05/2017 | 0,2 | 0 2 |
| 17 | 17/05/2017 | 0 | 0 2 |
| 18 | 18/05/2017 | 0 | 0 2 |
| 19 | 19/05/2017 | 11 | 2 3 |
| 20 | 20/05/2017 | 5,8 | 0 2 |
| 21 | 21/05/2017 | 0,2 | 0 2 |
| 22 | 22/05/2017 | 0 | 0 2 |
| 23 | 23/05/2017 | 0 | 0 2 |
| 24 | 24/05/2017 | 0 | 0 2 |
| 25 | 25/05/2017 | 0,4 | 0 2 |
| 26 | 26/05/2017 | 0 | 0 2 |
| 27 | 27/05/2017 | 0 | 0 2 |
| 28 | 28/05/2017 | 0 | 0 2 |
| 29 | 29/05/2017 | 0 | 0 2 |
| 30 | | | |

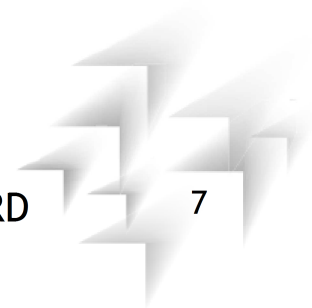
| | | Tipo Strumento | Media (W) | Usato (S) | Speso (S) | Tempo di utilizzo (minuterie) | Media totale (kWh/giorno) | note |
|-------------------------------|---------------------------|----------------|-----------|-----------|-----------|-------------------------------|---|--|
| Aula PC | Aula PC vecchia | Computer | 80 | 3 | ✓ | variabile | 30 | I dati riguardanti i PC del Laboratorio Linguistico sono stimati |
| | Monitor | 24,5 | 0,5 | ✓ | variabile | 30 | | |
| | Monitor | 100 | 0,5 | ✓ | variabile | 30 | | |
| Illuminazione | Plaf. 1 | 36 | 0,5 | ✓ | variabile | | Per ogni piattaforma (Cinema riferita a piattaforma, classe 2 teatri) | |
| | Plaf. 2 | 72 | 0,5 | ✓ | variabile | | | |
| | Plaf. 3 | 110 | 0,5 | ✓ | variabile | | | |
| Aula Normale | LAN | 100 | 0,5 | ✓ | variabile | | | |
| | Cable (network) | 8 | 0,5 | ✓ | variabile | | | |
| Supplemento per aula digitali | | Apple TV | 3,3 | 1,2 | ✓ | 200' | 2 0,3 | |
| Nucleo Informatico | Apple iPad | 8 | 0,5 | ✓ | variabile | 200' | 1 0,6 | Il consumo dei server è stimato |
| | Server 1 PC | 100 | 0,5 | ✓ | 200' | 9 21,8 | | |
| | Server 2 | 100 | 0,5 | ✓ | 200' | 1 0,6 | | |
| | Server 3 | 100 | 0,5 | ✓ | 200' | 3 0,8 | | |
| | Monitor | 24,5 | 0,5 | ✓ | variabile | 200' | 2 0,9 | |
| Distributori Automatici | Mac (Server) | 100 | 0,5 | ✓ | 200' | 2 0,9 | I dati sono stati reperiti in internet | |
| | Compartimenti | 100 | 0,5 | ✓ | 200' | 1 0,6 | | |
| | Nota Atria (APF) | 142 | 0,5 | ✓ | 200' | 1 0,6 | | |
| Laboratorio Chimica | Nota Santa Maria (Server) | 100 | 0,5 | ✓ | 200' | 4 10,2 | Solo i dati relativi all'attivazione della durata di 30 min ogni 2 ore. L'orario di lavoro è stimato. | |
| | Aspiratore | 150 | 0,5 | ✓ | variabile | 1 | | |
| | Impugnatura magnetica | 24 | 0,5 | ✓ | 200' | 1 0,6 | | |
| | Poligrafico SENS | 24 | 0,5 | ✓ | 200' | 1 0,6 | | |



The Method We Used



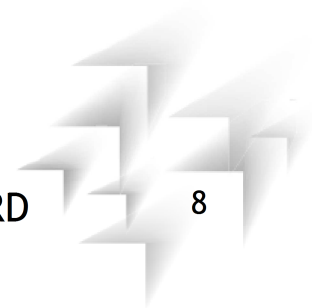
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To understand the graphs

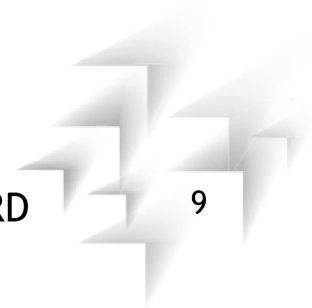


Total Amount of power consumption

Note: We used random amounts



TAKING COOPERATION FORWARD



To understand the graphs

Lightning

Devices

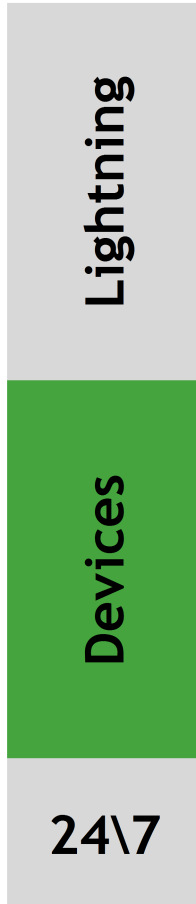
| Location | Device | Power Consumption (W) | Usage | Number of units | Daily Consumption (KWh/Day) |
|----------------------|------------------------------|-----------------------|-------|-----------------|-----------------------------|
| Special classrooms | Apple TV | 1,5 | 24\7 | 2 | 0,1 |
| | Router Apple | 8 | 24\7 | 2 | 0,4 |
| Servers room | Server + PC | 100 | 24\7 | 9 | 21,6 |
| | Switch HP | 795 | 24\7 | 1 | 19,1 |
| | Switch Tp-Link | 11,2 | 24\7 | 3 | 0,8 |
| | Mac (Server) | 100 | 24\7 | 2 | 4,8 |
| | Condizionatore | 860 | 24\7 | 1 | 20,6 |
| Vending Machines | Necta Astra (caffè) | 142 | 24\7 | 1 | 3,4 |
| | Necta Samba (bibite e snaks) | 630 | 24\7 | 4 | 60,5 |
| | Necta Canto (caffè) | 175 | 24\7 | 2 | 8,4 |
| Chemistry Laboratory | Frigorifero INDESIT | 14 | 24\7 | 1 | 0,3 |
| Infirmary | Frigorifero IGNIS | 25 | 24\7 | 1 | 0,6 |

24\7

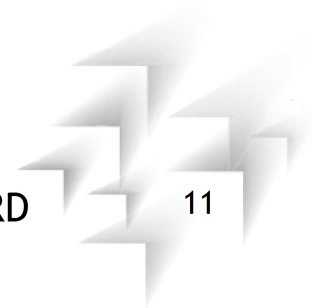
Permanent consumption (servers, vending machines, etc.)



To understand the graphs



How we managed to get the whole amount of devices' power consumption in each classroom



To understand the graphs

Lightning

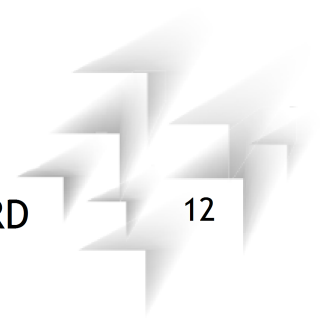
Lighting Power consumption

Devices

We worked out a theoretical illumination “algorithm” in order to achieve a convincing lighting time - so without any waste or bother registered by the users.

Our choices depends on the stint in which we carried out the survey – that is May.

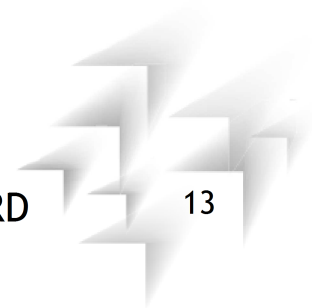
24\7



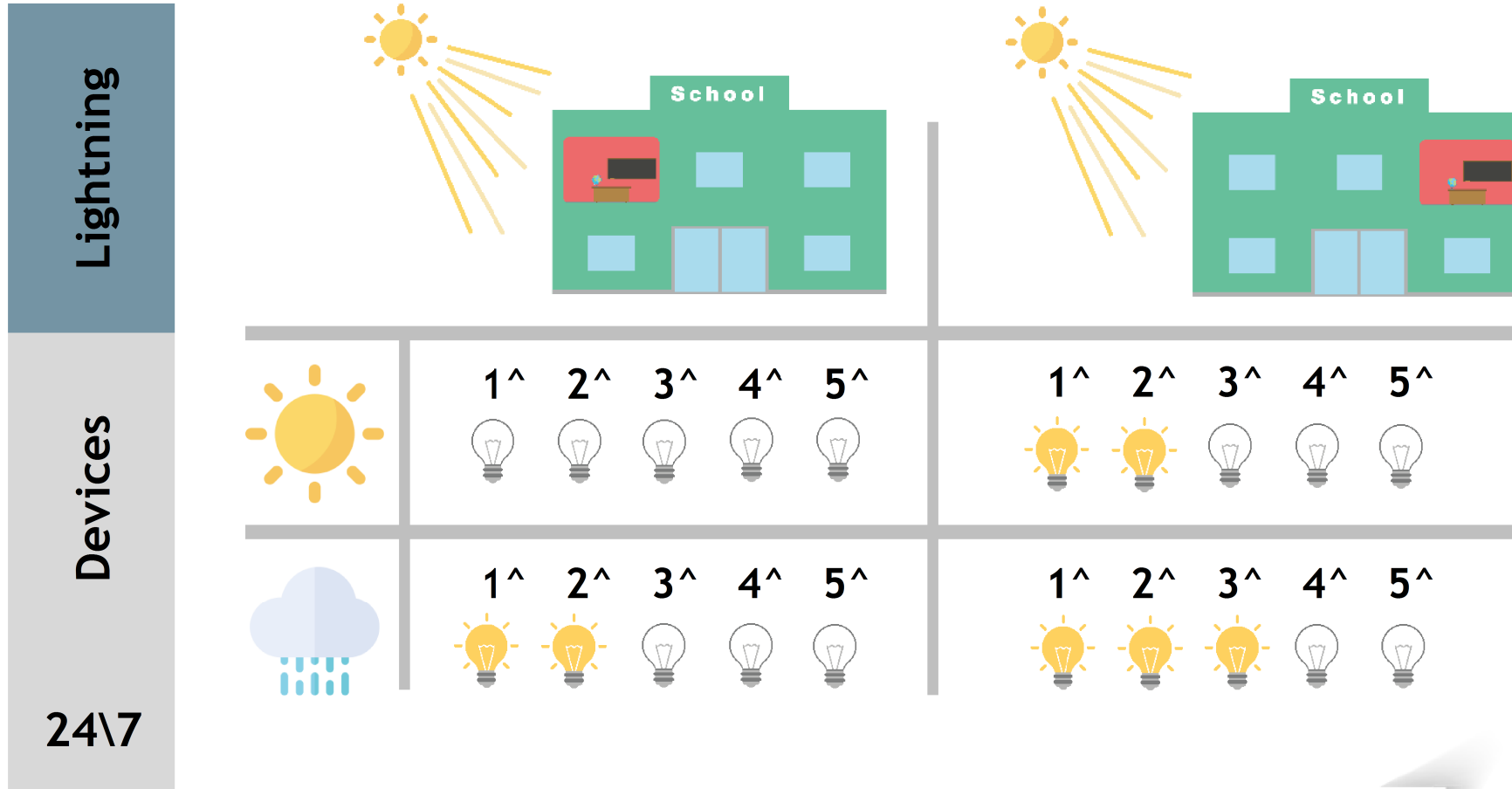
To understand the graphs



How we managed to get the whole amount of lightning's power consumption in each classroom



Weather Algorithm



The Graph

Linking all the data and information we searched for, our group was able to create a daily consumption's graph - the yellow one - comparing it with the real one - the red graph - whose data are recorded by a Smart Meter that send them on an online platform called Energy Sentinel.

We arranged this comparison for each school day of the two weeks we considered - the first one and the last one of May.

Monday 01-05-'17



The Graph

Linking all the data and information we searched for, our group was able to create a daily consumption's graph - the yellow one - comparing it with the real one - the red graph - whose data are recorded by a Smart Meter that send them on an online platform called Energy Sentinel.

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Monday 22-05-'17

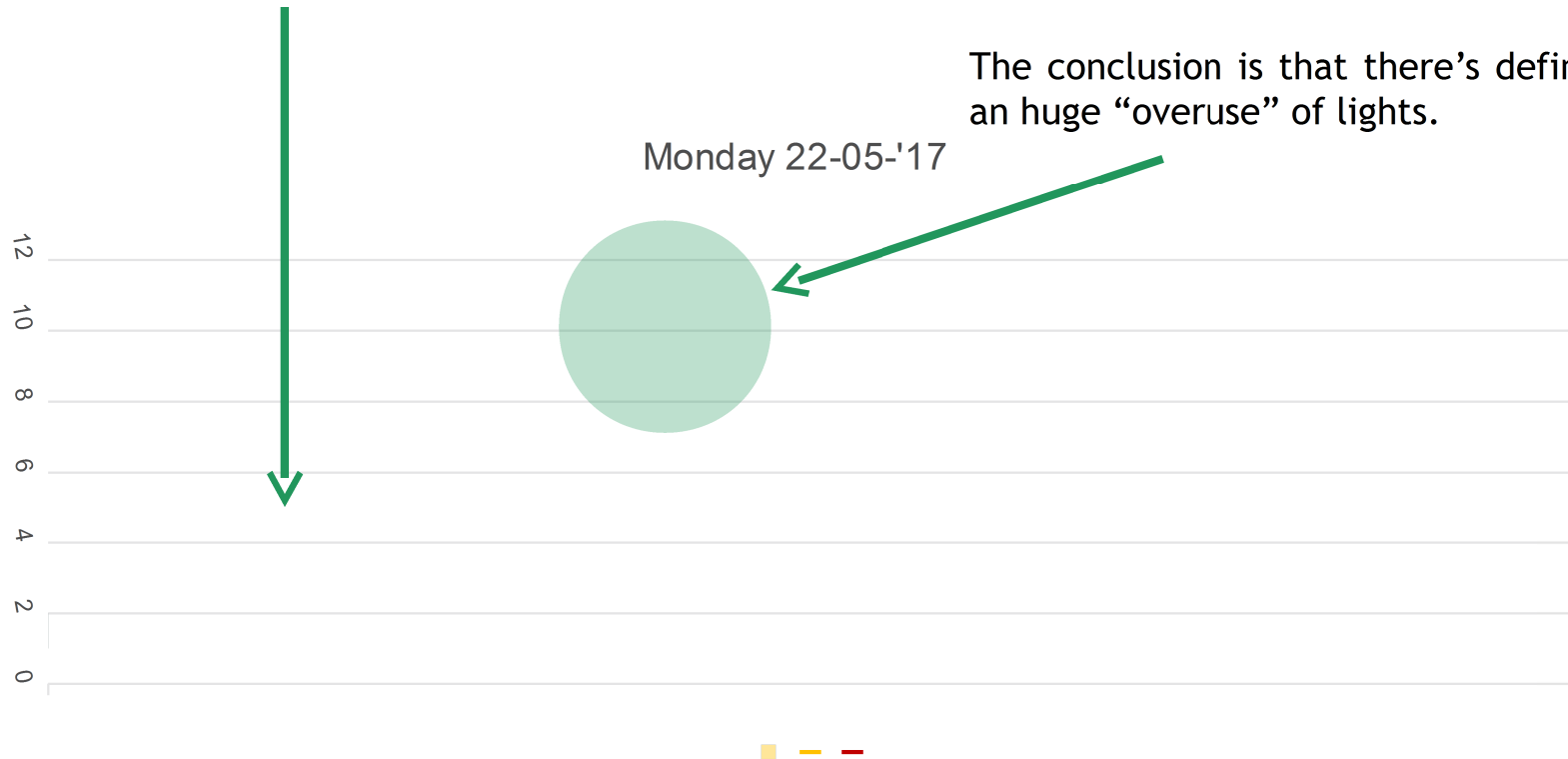


Analysing The Graph

It can be seen how the two graphs are almost overlapped in the permanent consumption zone.

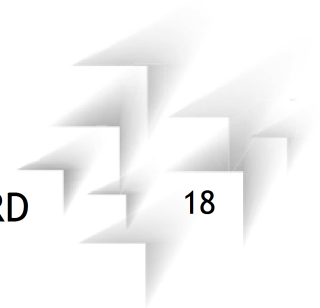
We realized that until 9:00 the two graphs basically follow the same trend - in the stint during which we theoretically “switched off” the lights.

The conclusion is that there’s definitely an huge “overuse” of lights.

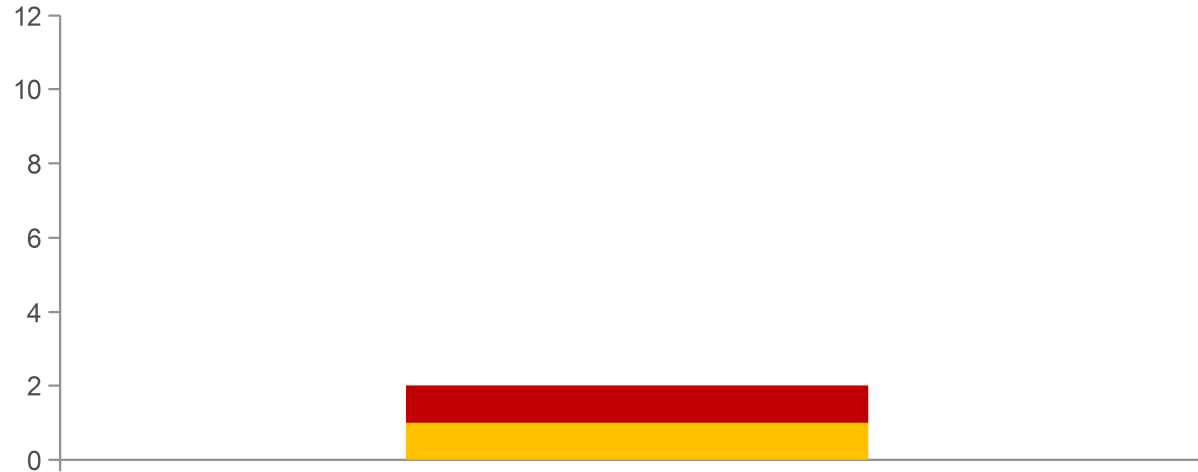


Week Analysis

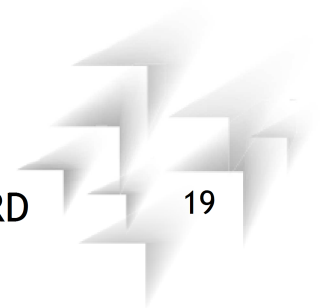
| Day | Real Consumption (Wh) | Theoretical Consumption (Wh) | Waste | Waste Rate | Potential Saving |
|----------------------|-----------------------------|---------------------------------|--------|------------|------------------|
| Monday | 319671 | 216188 | 103483 | 32% | 20,70 € |
| Tuesday | 305883 | 216526 | 89357 | 29% | 17,87 € |
| Wednesday | 327660 | 210707 | 116953 | 36% | 23,39 € |
| Thursday | 331355 | 242200 | 89155 | 27% | 17,83 € |
| Friday | 298963 | 220389 | 78574 | 26% | 15,71 € |
| Saturday | 262364 | 241849 | 20515 | 8% | 4,10 € |
| Weekly Waste Average | | | | 26% | 99,61 € |



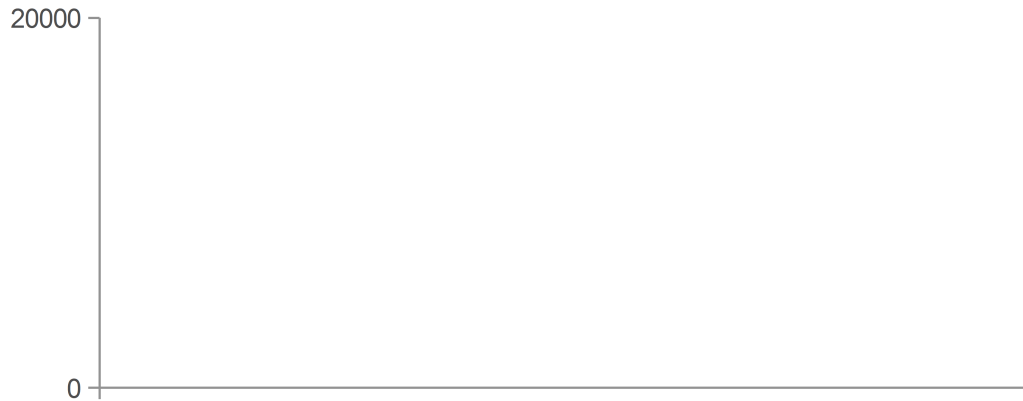
Week Analysis



Even if the theoretical amount of electricity consumed on Saturday is one of the highest, the total consumption is the lowest of the week.



Week Analysis

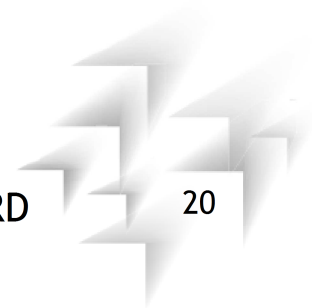


This phenomenon is determined by the lower waste of energy registered.



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Week Analysis

Saturday 6-05-'17



The lower waste is caused by the lack of activities during Sunday's afternoons - as the school is usually closed earlier.



TAKING COOPERATION FORWARD

Achieving Our Goal

How can we reduce energy waste in our school?

Is there a plan to follow in order to save money?

The last step is now setting a realistic saving plan – improved in order to cut off the waste registered.

We are looking forward to promote a kind of “Guerriglia Marketing Plan” in our school. That strategy is basically based on several low-cost actions - which swiftly attract interests of different users.

Anyway, we are assured that any project to carry out in our school must follow three essential points:

- • Reduce consumption significantly
- • Make users enjoy and believe the project itself
- • Durable effects



Applied Examples

We hang some posters on the hall walls that reminds to save energy

- ✓ Reduce consumption significantly
- ✓ Make users believe and enjoy the project itself
- ✗ Durable effects

Tell students the importance of saving energy during a “students assembly”

- ✗ Reduce consumption significantly
- ✓ Make users believe and enjoy the project itself
- ✗ Durable effects

The head teachers removes the vending machines forever

- ✓ Reduce consumption significantly
- ✗ Make users believe and enjoy the project itself
- ✓ Durable effects

Organize an “energy team” which cares about school consumption and the ways to reduce it

- ✓ Reduce consumption significantly
- ✓ Make users believe and enjoy the project itself
- ✓ Durable effects

