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Solar Panels

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The research topic

Your school wants to equip most of its roof with solar panels.

Can you estimate the possible number of panels and the expected yield in a year?

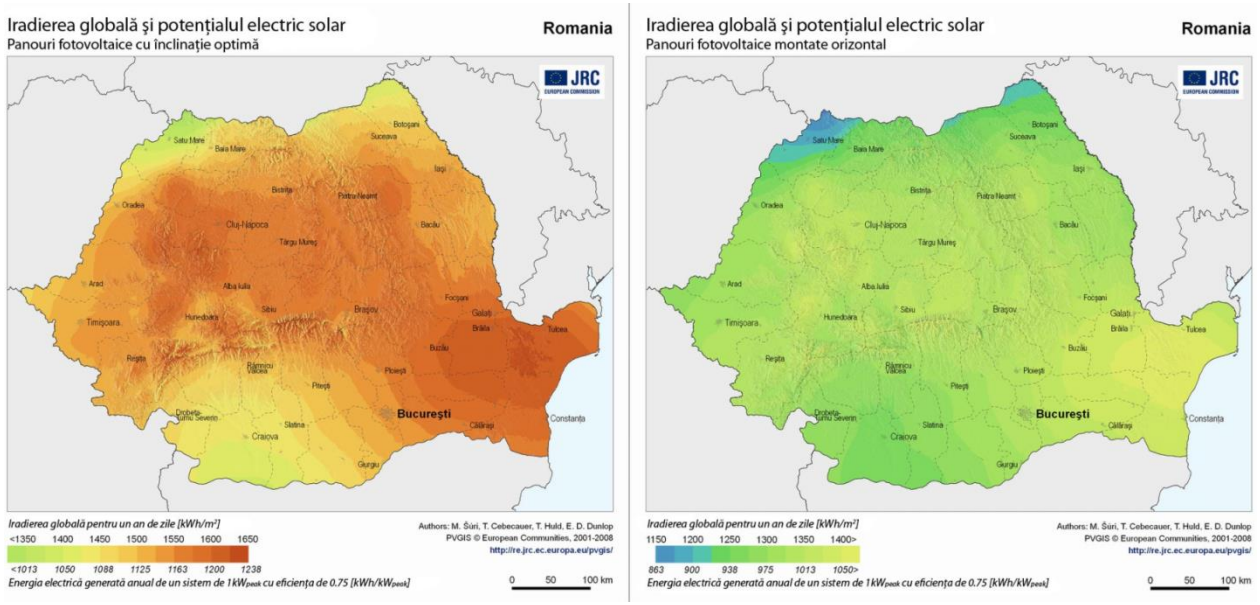
The Approach:

- Sun
- Roof
- The school's energy consumption
- Electrical energy formula

The method of the students from Cluj

General information

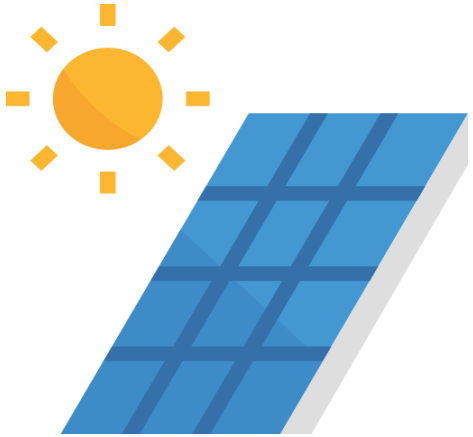
- The solar radiation on a sunny day = 1000 W.
- In a year, in Europe, the annual energy flux = 1000 kWh/m^2.
- In Cluj, the annual energy flux = **1500 kWh/m^2.**



The method of the students from Cluj

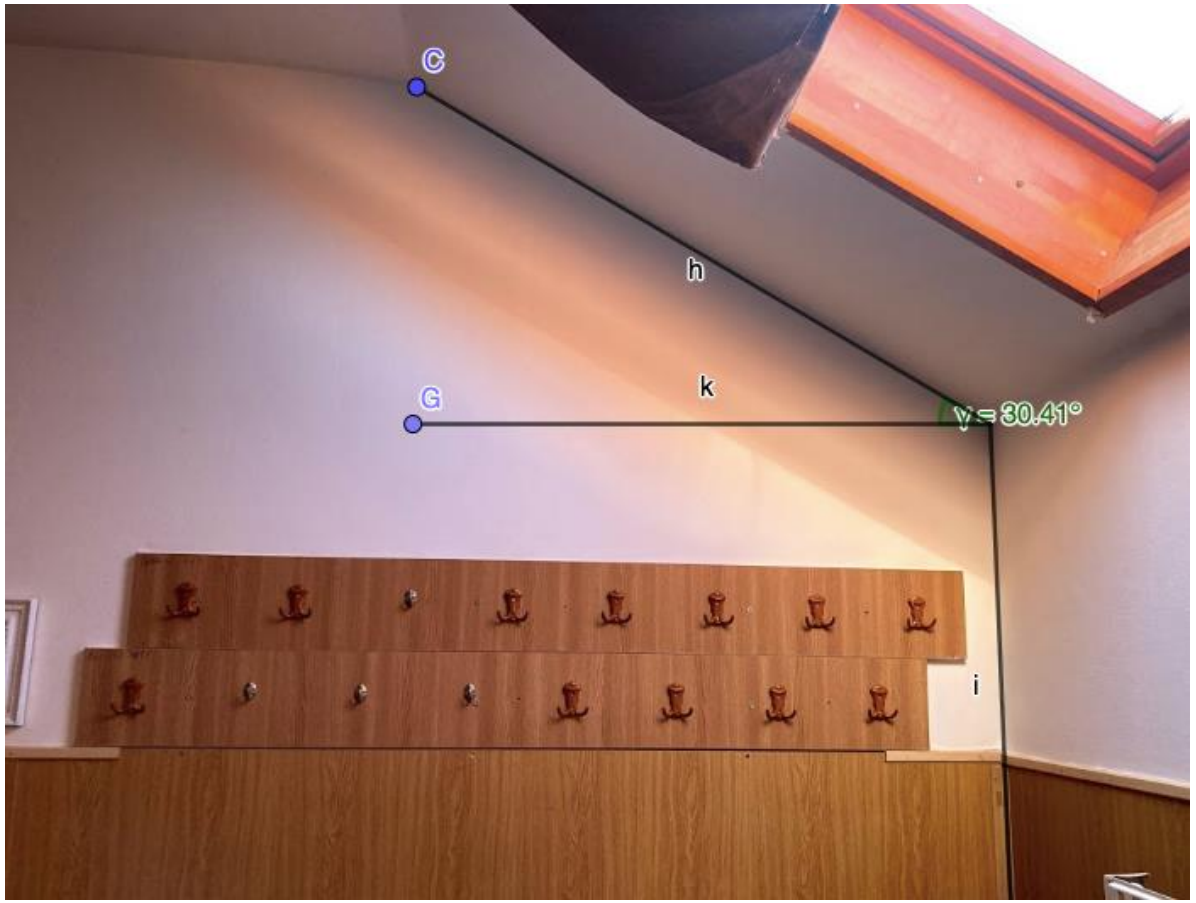
Information about solar panels

- The most advantageous type of solar panels is the *thin film*.
- The most advantageous inclination is between 30° - 45°
- Its efficiency = **20%**.
- The surface = 1 x 1.7 (so, 1.7 m^2).
- The solar panels should be placed on the South side of the roof.



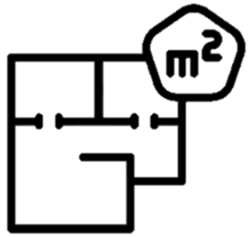
The method of the students from Cluj

Information about our school



The method of the students from Cluj

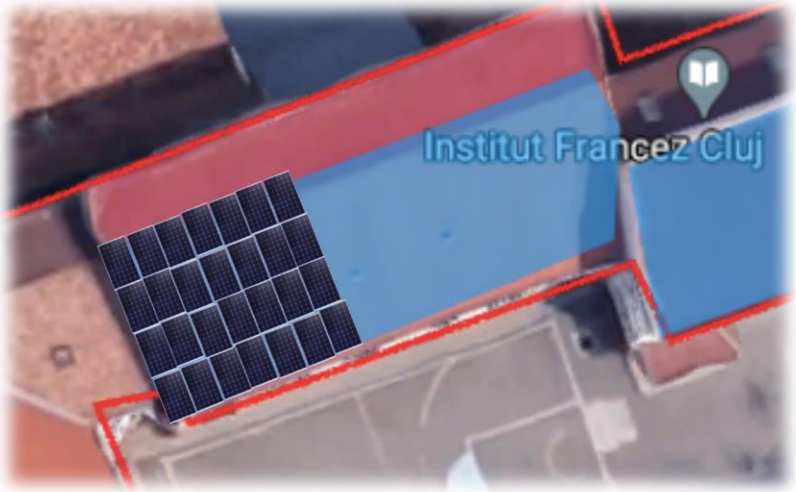
Information about our school



- The surface of the roof (on which we can place the panels) = 782.8 m^2.

(without the windows, 735.2 m^2)

- Since the surface of a solar panel = 1.7 m^2, the total surface covered by panels = **734.4 m^2**, which means 432 panels.



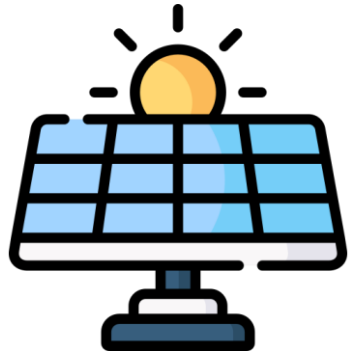
The method of the students from Cluj

The formula

The electrical energy generated by a photovoltaic system:

$$E = A * R * H * PR$$

Amar Solar Energy Blog



- *A = the total surface of the panels*
- *R = the solar panel efficiency*
- *H = the average solar radiation/year*
- *PR = the loss coefficient (it usually equals 0,75)*

https://amarsolarenergy.ro/blog/instrumente-gratuite/estimarea-productiei-de-energie/

The method of the students from Cluj

The solution

- The total surface covered by solar panels = 734.4 m^2
- The panel efficiency = 20%
- The annual energy flux = 1500 kWh/m^2
- The loss coefficient= 0.75

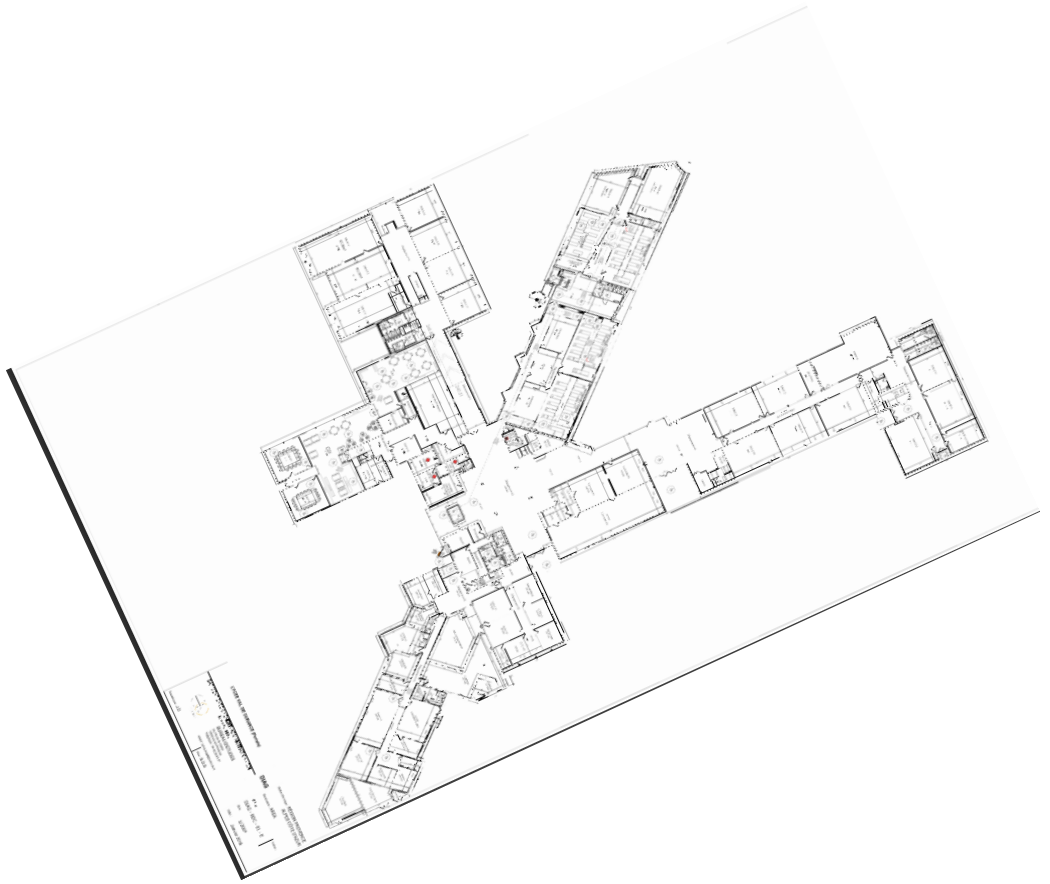
Year	Month	Energy consumption(kWh)	Total energy (Kwh)
2017	1	9954	74810
	2	8748	
	3	9725	
	4	6040	
	5	0	
	6	7273	
	7	4346	
	8	2592	
	9	2860	
	10	5787	
	11	8600	
	12	8921	

By multiplying these variables (using the formula), our final result will be:

734.4 x 20/100 x 1500 x 0.75 = ***165.240*** **kWh** (more than the annual energy flux from 2017)

The method of the students from Pertuis

- How many solar panels can we put?



The method of the students from Pertuis

- Method to find the surface of our roofs and the slope

Slope at 20°

The method of the students from Pertuis

- Usable surface and orientation

Best orientation: *South*

Our best orientation: *South East*

Efficiency of a South-East slope :

Inclination	Efficiency
0°	86%
30°	93%
60°	87%
90°	65%

20°= 2/3 * (30° + 0°) + 0°
Efficiency for 20°: 2/3 * (93% - 86%) + 86%= *90,6 %*

The method of the students from Pertuis

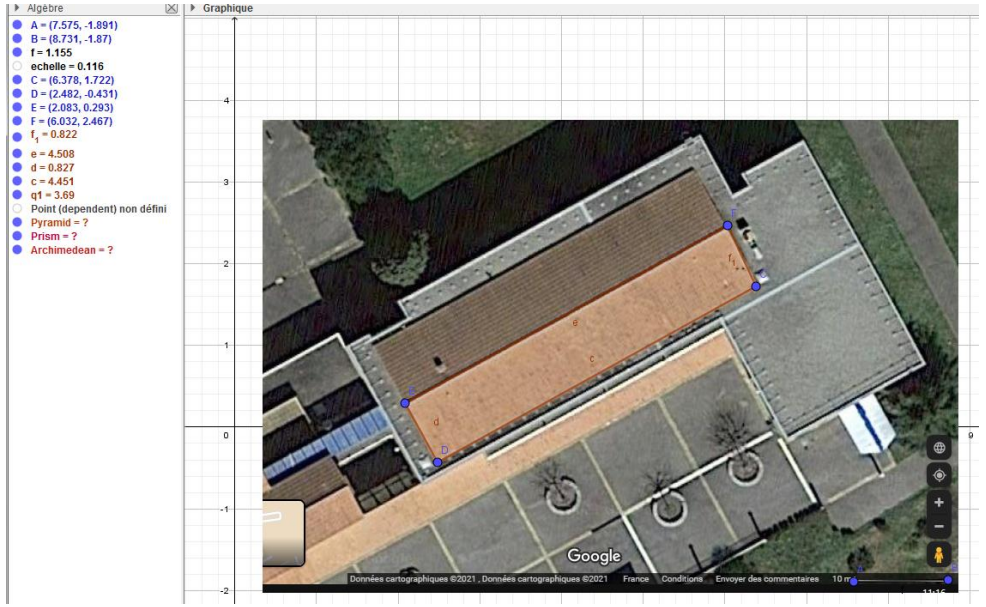
- Dimension of Building D

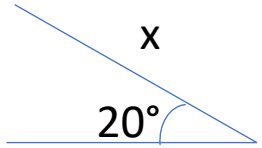
Scaling: 1.16 u ⇔ 10 m in real

Length: (4.5 * 10)/1.16= 38.79 m

Width of the base :

(0.8 * 10)/1.16= 7.1 m





Width of the base

x= 7.1/cos(20°) = 7.6 m

The method of the students from Pertuis

- Total number of panels on the building D

Size of a typical monocrystalline panel : 1.7m by 1m

If placed horizontally : 38 in length and 4 in width therefore: 38 x 4= 152 possible panels

If placed vertically : 22 in length and 7 in width therefore: 22 x 7= 154 possible panels

Maximum of solar panels : 154 panels

The method of the students from Pertuis

- Formula to calculate the energy provided by our panels in one year

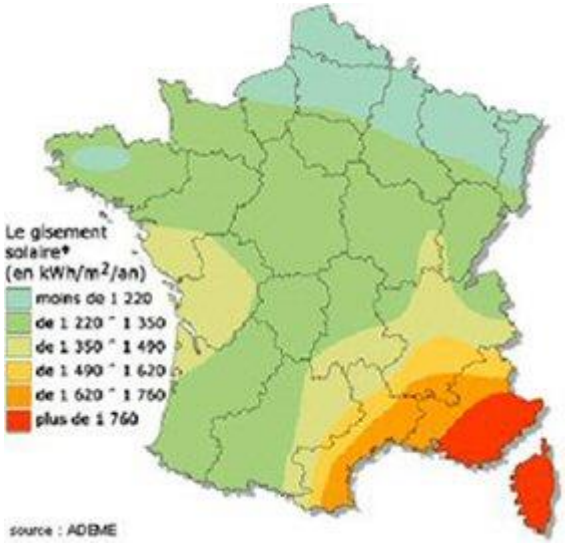
  E= S*R*Eslope*Potential energy

  S is the surface of solar panel (1.7 m^2 for us)

  R is the efficiency of the solar panel (0.20 for us)

  Eslope is the efficiency of the slope (0.906 for us)

  The potential energy gives the number of Kwh per m^2 and per year received (1700 for us)



The method of the students from Pertuis

- Results

  By our values we get :

  E=1.7 x 0.2 x 0.906 x 1700=523 kWh

  The price per kWh is 0.1765

  523 x 0.1765 x 154=14 215.663

  Our panels would save almost €14 215/year

  However, as they cost 330€ piece their purchase cost will be:

  330 x 154=€50160, so it will take about 3 years and 6 month to make them profitable

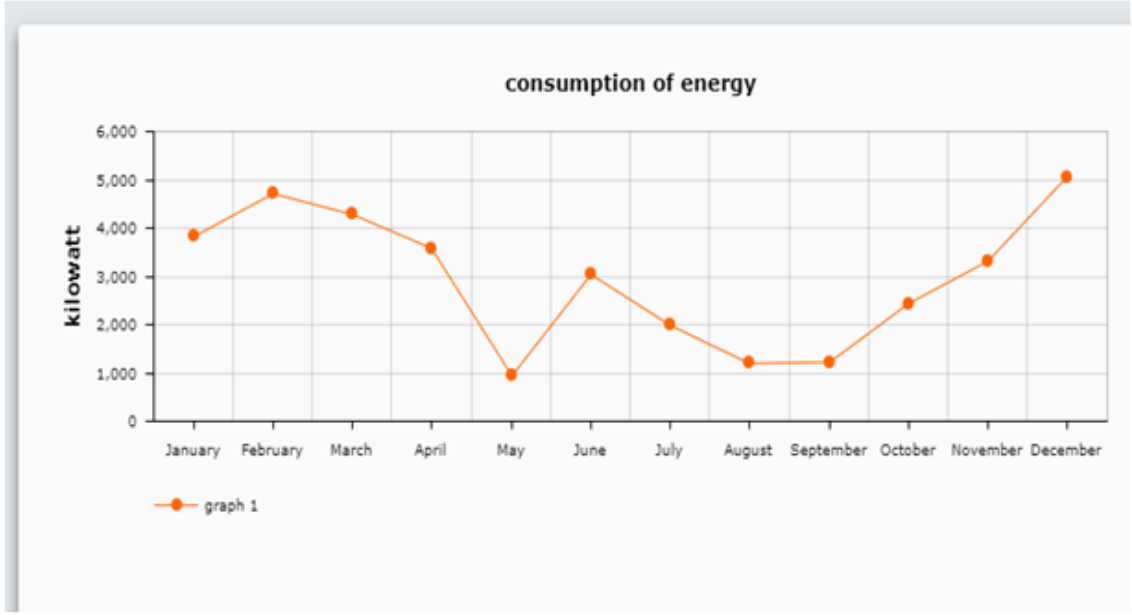
The method of the students from Satu Mare

Information about
our school:

The method of the students from Satu Mare

- The consumption of energy from our school:

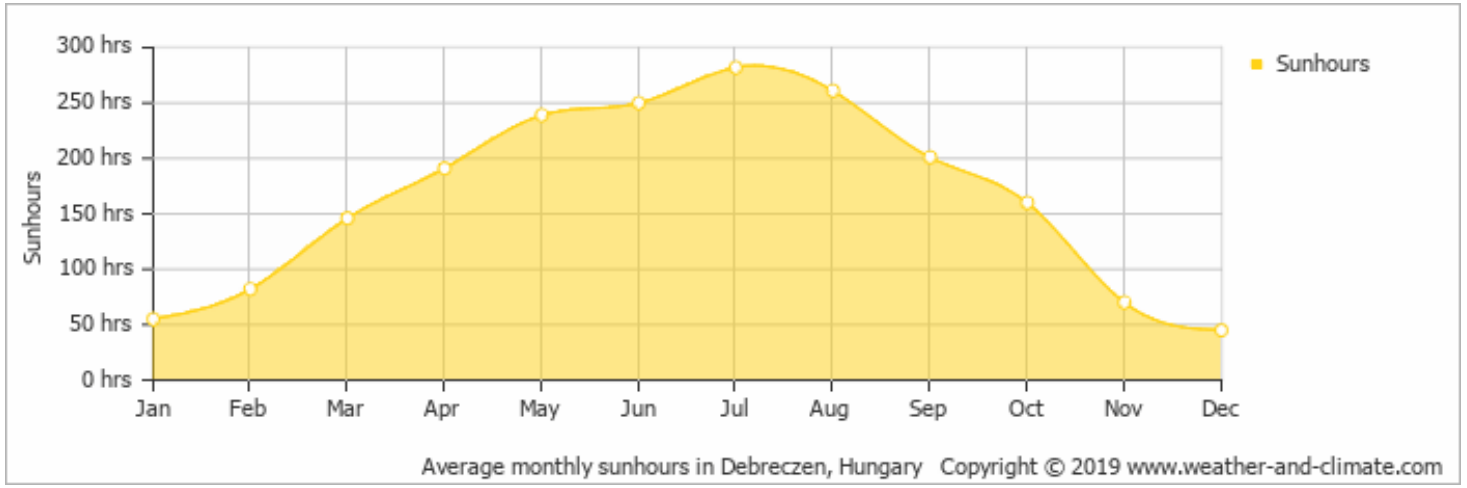
This graph shows the amount of energy consumed each month by our school in 2019 (we have decided not to use the year 2020 in our studies because it does not show the usual energy consumption of a school year due to pandemic).



The method of the students from Satu Mare

Average monthly sunshine hours:

In order to find the number of solar panels needed, we calculated the average number of hours of sunshine we had each day, each month.



The method of the students from Satu Mare

- What kind of solar panels should we use?

  After researching the internet for different types of solar panels, we decided that monocrystalline panels would be the most suitable for our school because they produce energy more efficiently and they have 10-15% more power than polycrystalline panels. . The image on the right shows which solar panel we have chosen for our research.

  the roof area is 300 m ^ 2 and the total area of our panels is 23 * 2 = 46 m ^ 2.

The method of the students from Satu Mare

- How to know how many solar panels we need:

H = hourly energy consumption
D = peak daily sunshine hours
P = number of panels
C = “cushion“ (25%)

P=H*1000/D/350 P=18 P+C=23(P final)

350=maximum energy (in watts) that we think a solar panel would produce.

The method of the students from Satu Mare

- The cost and efficiency of solar panels

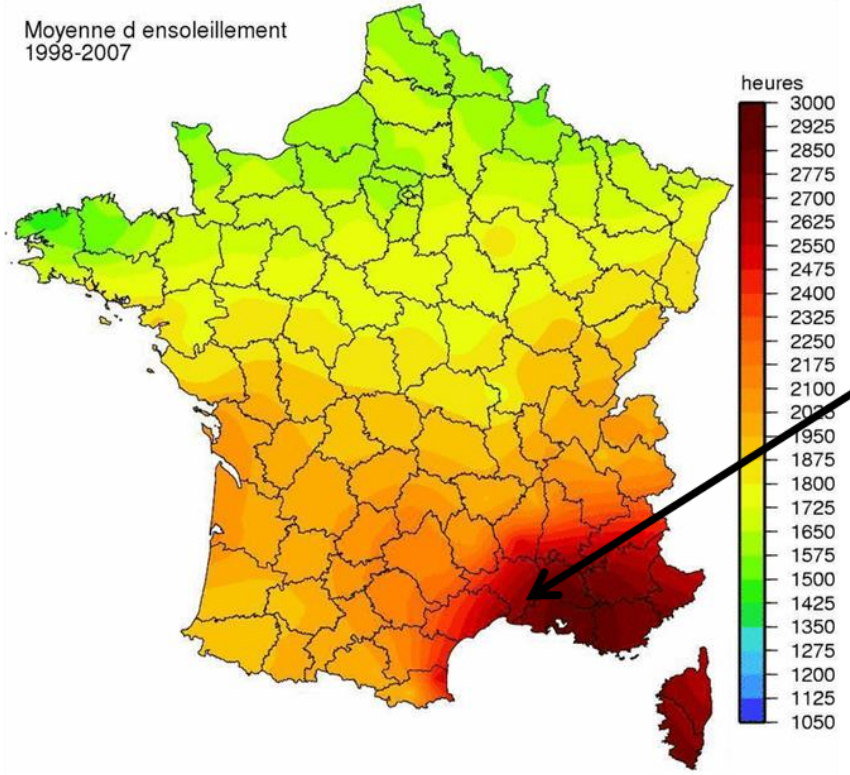
C (cost of solar panels) = 200 € * 23 = 4600 € (not including installation and wiring)

In about four years, our school would cover the cost of the solar panels using only the clean energy created by them.

The method of the students from Alès

- Some general information

- Our school consummation : 163 510 kW/ year (17 000 €)
- Production of one m² of solar panel : 5047 kW/year
- In our region: 2600 h of sunshine /year

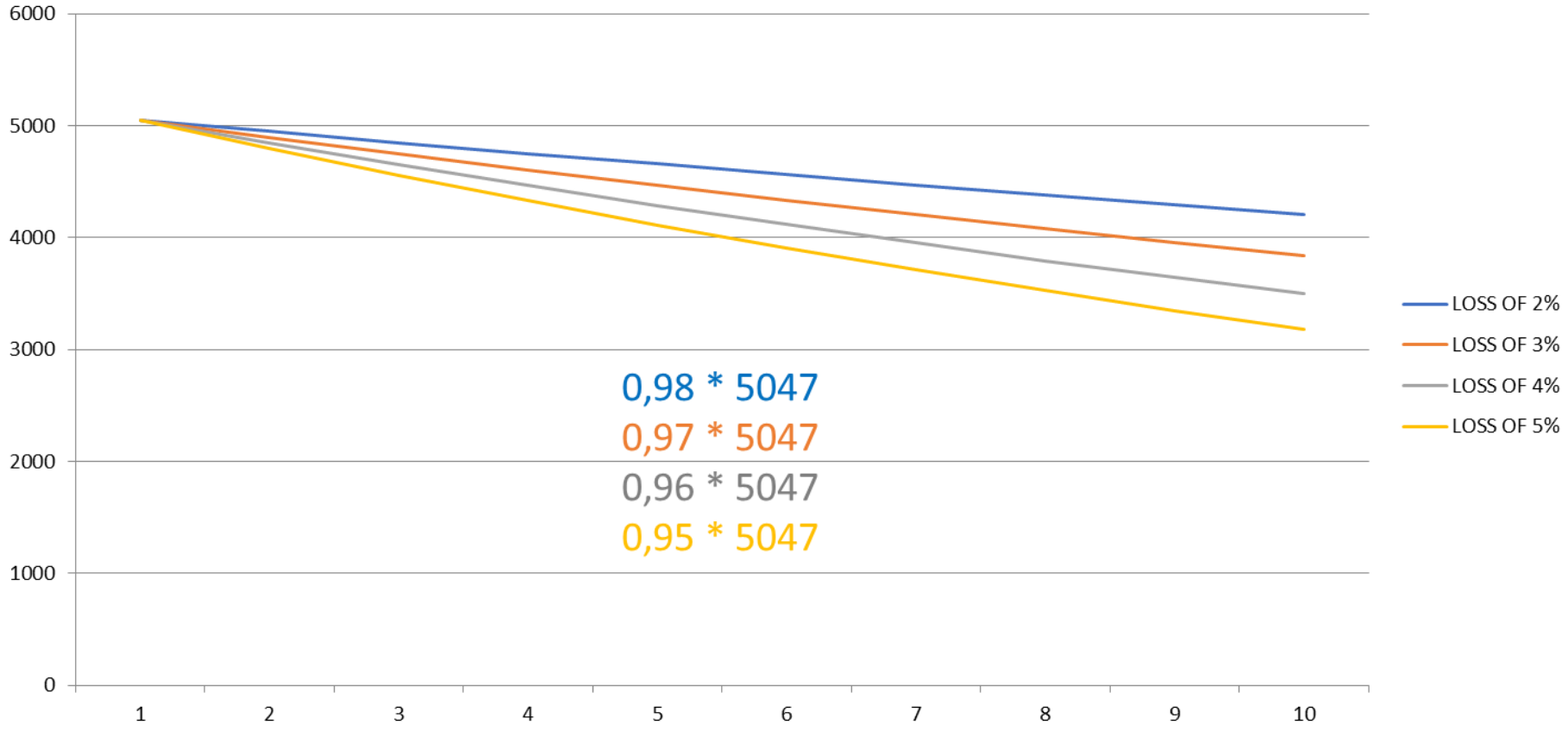


So 1 m² of solar panel produces <u>5047 kW/year</u>

The method of the students from Alès

- Some information about production :

Every year: production of solar panel drops between -2% and 5%



The method of the students from Alès

- Solar panels emplacement

The method of the students from Alès

- Concerning money and conclusion

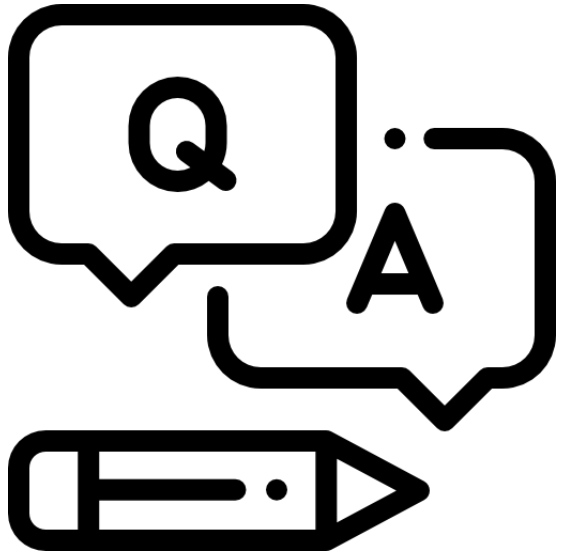
  - Our school consumption: 17 700 €/year
  - Cost of 1 m^2 of solar panels: 2 400 €
  - Cost of 52 m^2 of solar panels: 124 800 €

  - $\frac{124\ 800}{17\ 700} \approx 7{,}1$ years

  - We get the money back after 8 year.

It's <u>impossible</u> to make money over 1 year only

Thank you for listening!
We are available to answer your questions.



If you want to follow our work: https://twinspace.etwinning.net/122026/home