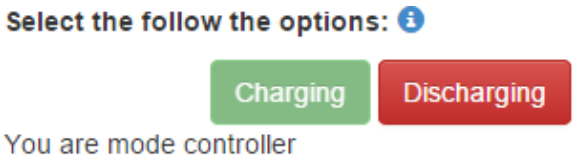
Windmill Lab description

The Windmill Lab has been designed in order to allow users to study:

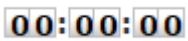
- from one side the difference between the amount of energy that the battery will store depending on the power of the fun and the position of the windmill blades;
- and from the other side the amount of energy used from the battery in order to make the big wheel to turn.

The user will be able to select either a charging or discharging mode:



and he is also informed of his role (controller or observer). The observers will not be able to change modes, just the controller.

In its charging mode, the Windmill Lab is composed of:

	A fun, which electrical power goes from 0W (stopped) to 168.
	A windmill, which blades can be turn left or right.
	A battery. A minimum amount of energy needs to be stored in order to be able to move the weight.
	A clock. It can be used to select for how long you want the battery to be charging.

Whenever you connect to the lab to start an experiment you will find:

- The fun switched off (0W).
- The windmill blades in its resting position, perpendicular to the fun.
- The battery will show its present charge. If the charge is below the minimum it will be shown in red and you will be asked to load it.

- The clock showing 00:00:00.

Two user roles have been defined:

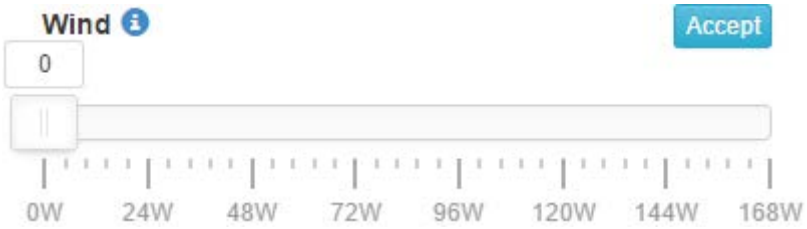
- Controller. He will be able to interact with the elements described above.
- Observer. He will be able to notice the values given by the controller to the different elements and the results of the experiment.

The controller will be able to:

- Select at which electrical power is the fun going to run. The bigger this number is, the faster the battery charges. In order to start charging the battery, the fun must be switched on.
- Select the position for the windmill blades. Depending on this position in relation to the fun, the wind will have a higher impact on the windmill.

  For both, for the fun and windmill, the user could:

  - Either select a value in each slider and then click on the corresponding Accept button.

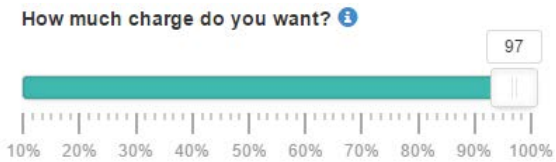


  - Or to select the desired values for all parameters and then click on the Start button.

  It is recommended to make use of the Accept button in order to be sure that the parameters are the desired ones before starting the experiment.

- Decide between:

  - How much does he want to charge the battery and click on the Start button.



    The battery will charge till it reaches the selected value or the user clicks on the Stop button.

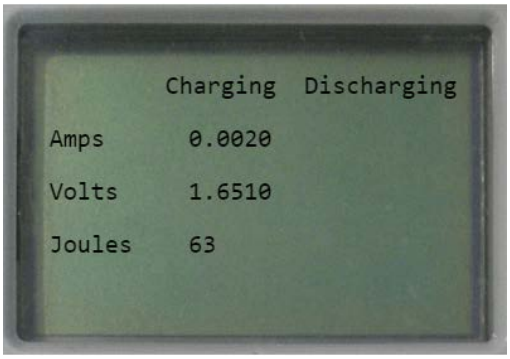
  - For how long does he want to charge the battery and click on the Start button.

The battery will charge for the selected lapse of time or till the user clicks on the Stop button.

- Give values to both: to the amount of energy desired and the maximum time the battery will be charging and click on the Start button.
  In this case the battery will charge till the first variable fits the selected value or till the user clicks on the Stop button.
- If you do not give values to any of the variables and click on the Start button, then the battery will charge till it reaches its maximum, till you experiment time expires, or till you click on the Stop button.

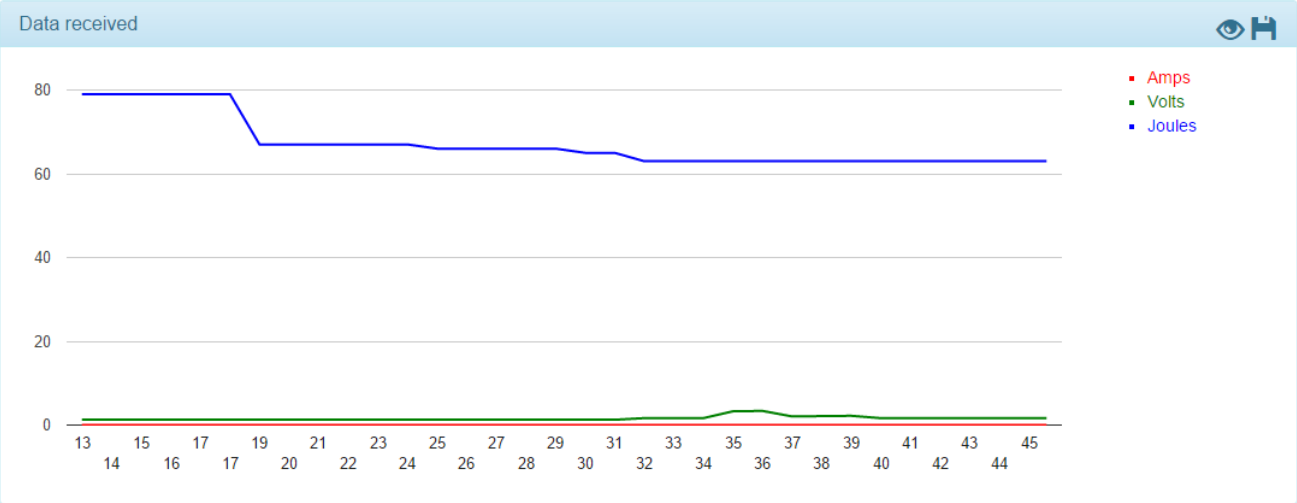
The observers will be able see in its navigator the modifications done by the controller and the data produced by the laboratory.

The data produced by the laboratory will be shown as follow:



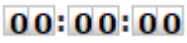
The amps and volts entering the windmill, and the joules stored in the battery will be updated for the observers.

These data are also represented in a graph and can be downloaded.



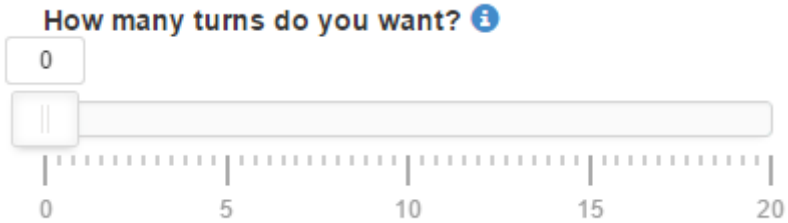
At any time, the controller will be able to change from the charging mode to the discharging mode. In this case, the charging mode will be stopped.

<u>In its discharging mode, the Windmill Lab is composed of:</u>

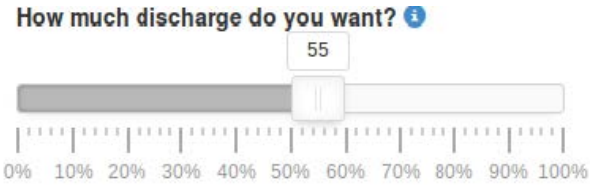
	A big wheel.
	A battery. A minimum amount of energy needs to be stored in order to be able to move the weight.
	A clock. It can be used to select for how long you want the battery to be charging.

The controller will be able to:

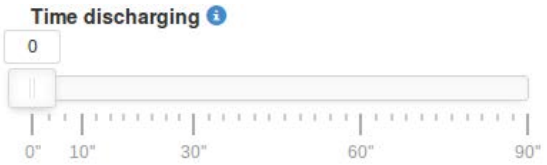
- Decide to move the big wheel a number of turns.
  The big wheel does not have an initial position; it will remain where the latest user has decided.



- Decide the final battery charge value.



- Decide for how long you want the big wheel to be spinning.



For these three variables you could:

- Select just the number of turns and click on the Start button.

  The big wheel will move till it reaches the selected value or the user clicks on the Stop button.

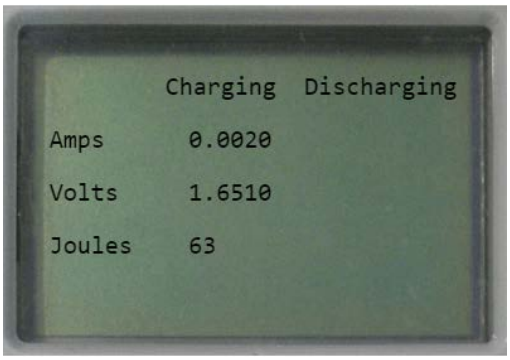
- Select just the final joules stored in the battery and click on the Start button.
  The big wheel will move till it reaches the selected value or the controller clicks on the Stop button.

- Select for how many seconds you want the big wheel to be spinning and click on the Start button.
  The big wheel will move till it reaches the selected value or the controller clicks on the Stop button.

- Select any combination for the three variables above: (turns, joules), (turns, seconds), (joules, seconds), (turns, joules, seconds) and click on the Start button.
  The big wheel will move till the first of the variables reaches the selected value, till the time assigned for the experiment expires, or the controller clicks on the Stop button.

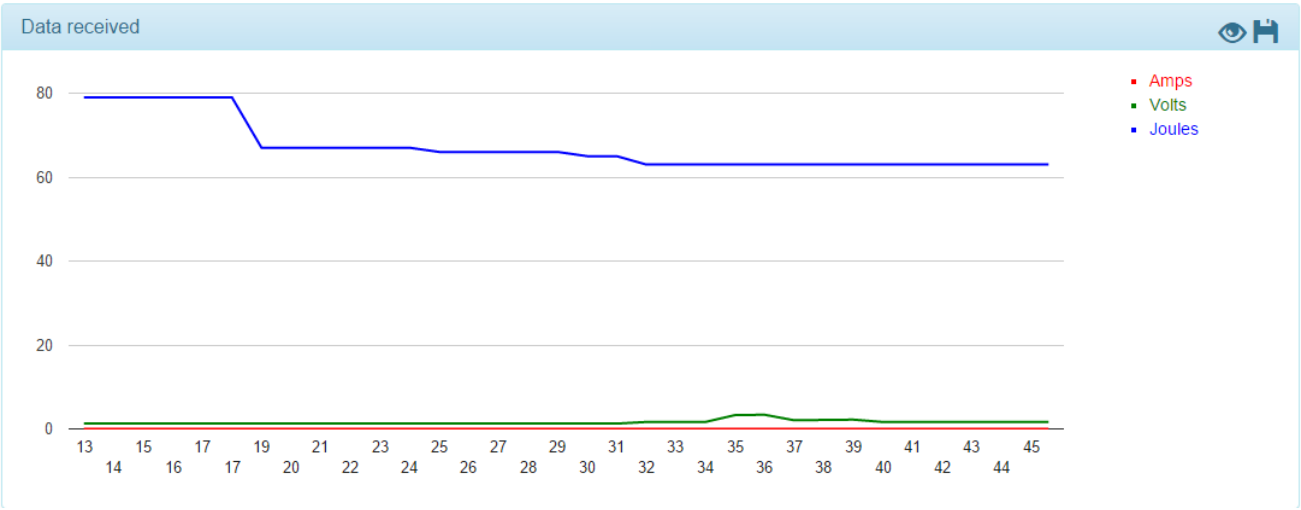
The observers will be able see in its navigator the modifications done by the controller and the data produced by the laboratory.

The data produced by the laboratory will be shown as follow:



The amps and volts exiting the windmill, and the joules stored in the battery will be updated for the observers.

These data are also represented in a graph and can be downloaded.



It is not allowed to change from discharging mode to charging mode.