ENERGIZED CANOPY

Compactness ratio : 1.2

(thermic envelope / inhabitable area)
Smaller is better
1.9 = bad < 0.8 = good

A good compactness ratio lets to need less material and energy to build the buildings and also to use it. By diminishing the exchange area between the inside and the outside of the building, the building will need less energy to be cooled or heated.

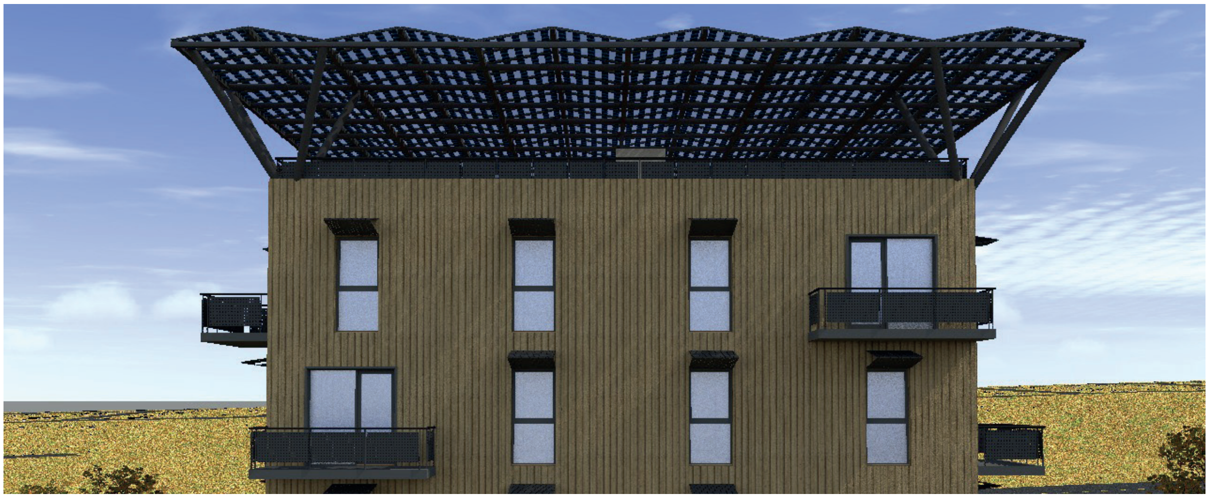
Openings ratio : 26%

(openings / inhabitable area)
20% = good < 25 % = very good

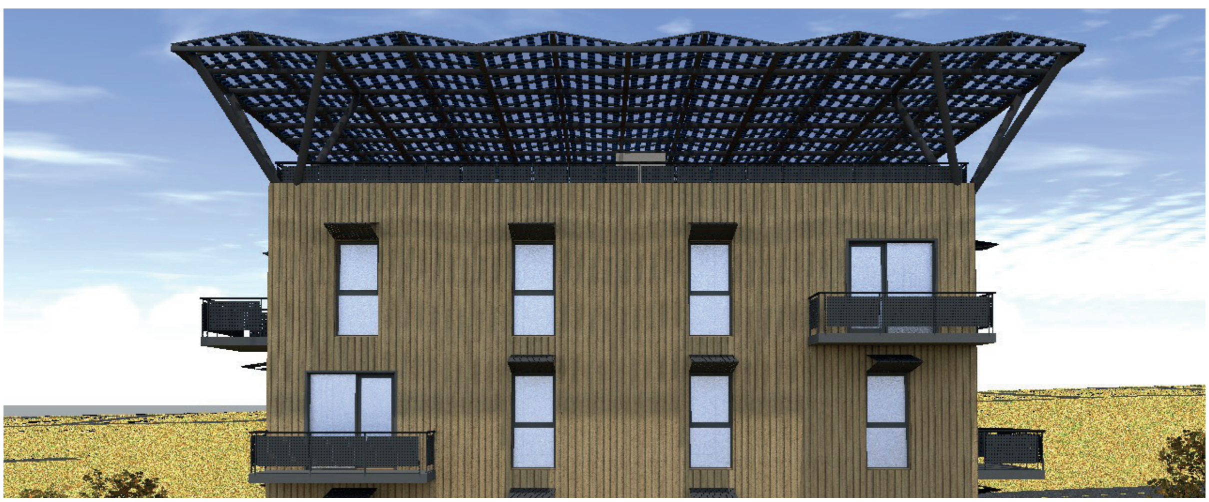
A very good opening ratio lets to need less electric light on during the day. So it leads to more energy savings and comfort for the inhabitants (views, natural light, sun).

Shading : South Elevation

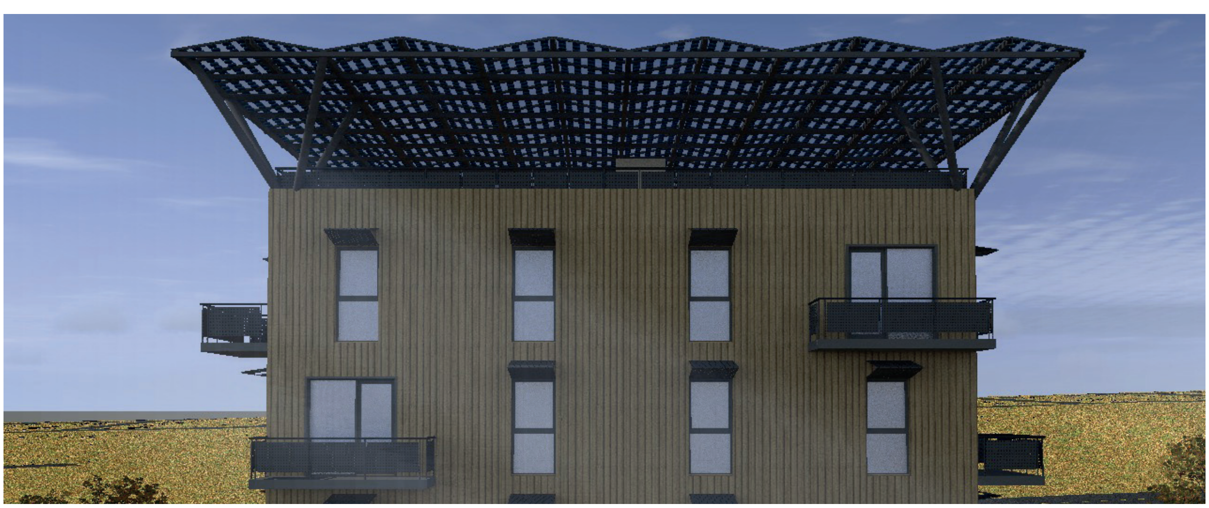
June 21st



9 am



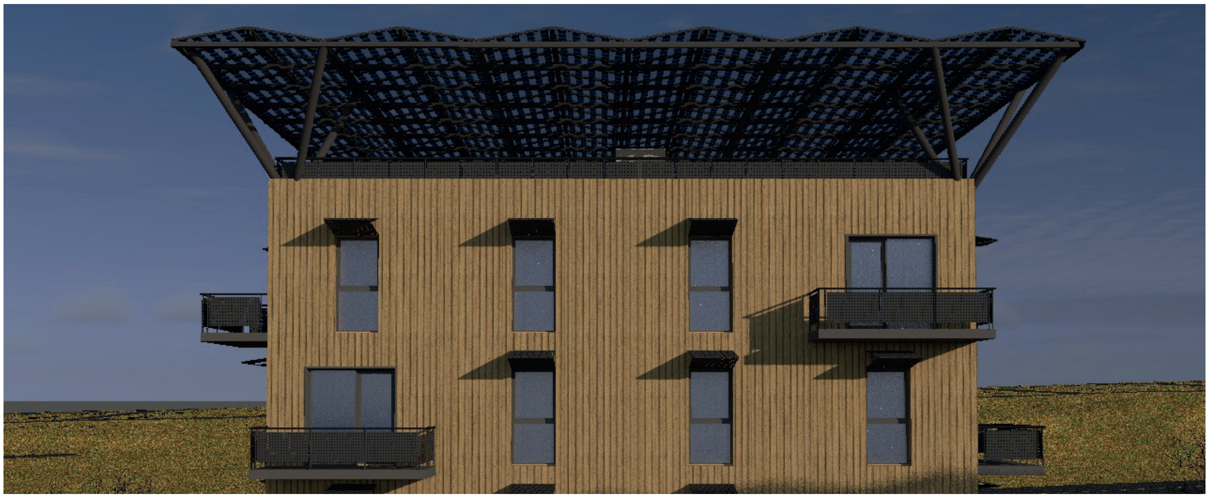
12.00



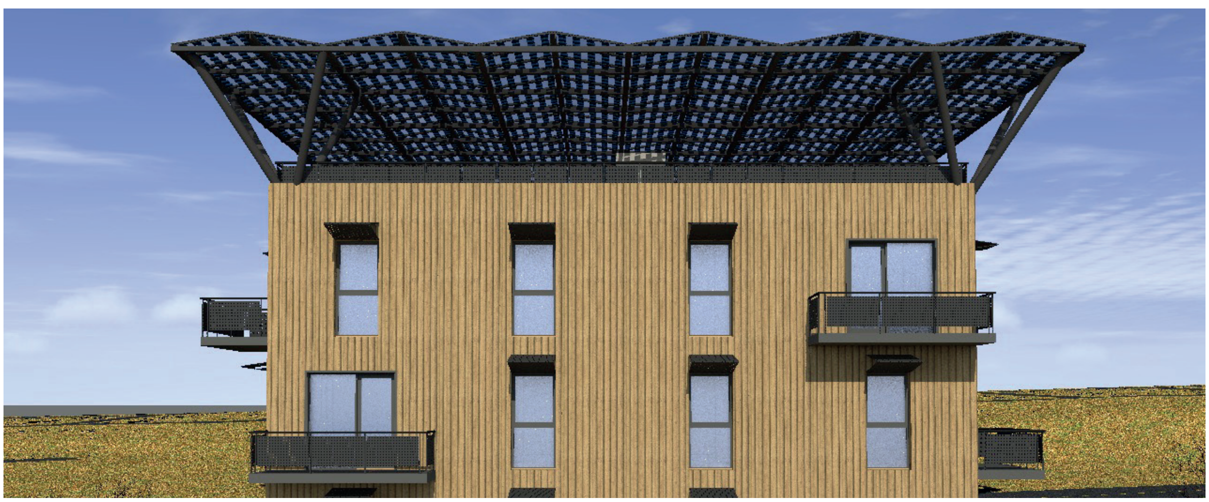
5 pm

Shading : South Elevation

December 21st



9 am

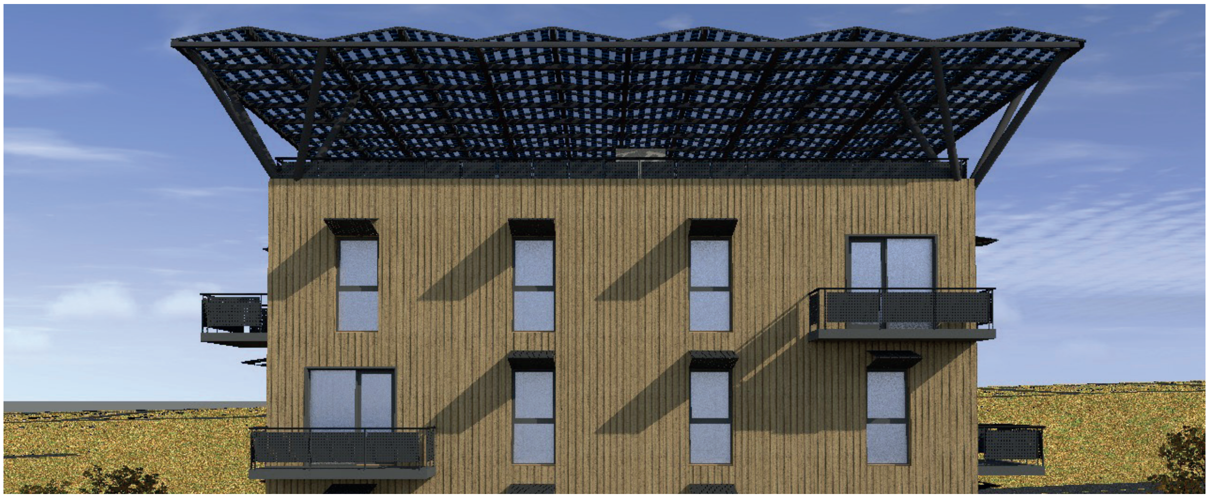


12.00

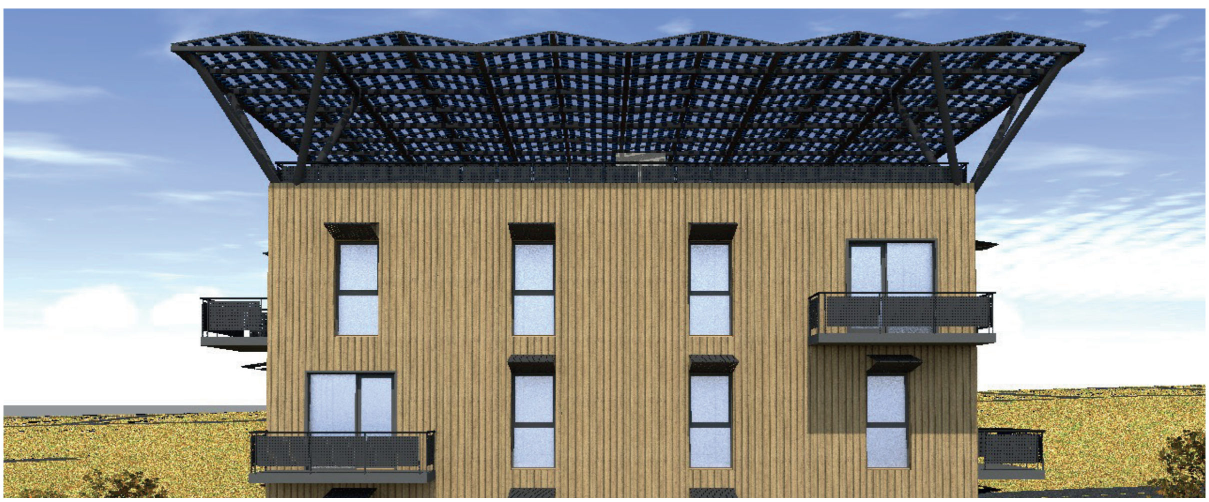
4 pm

Shading : South Elevation

March/September 21st



9 am

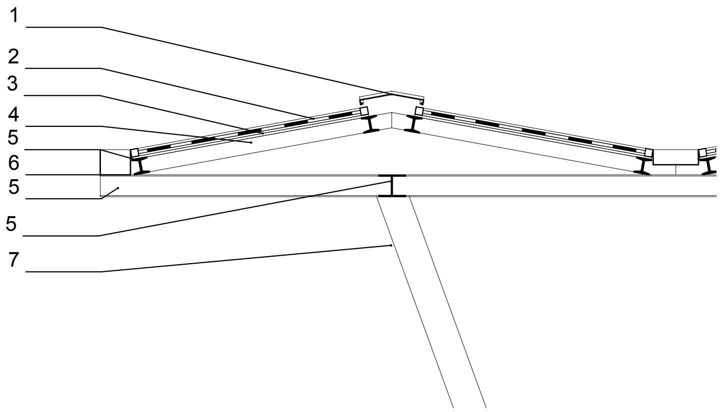


12.00

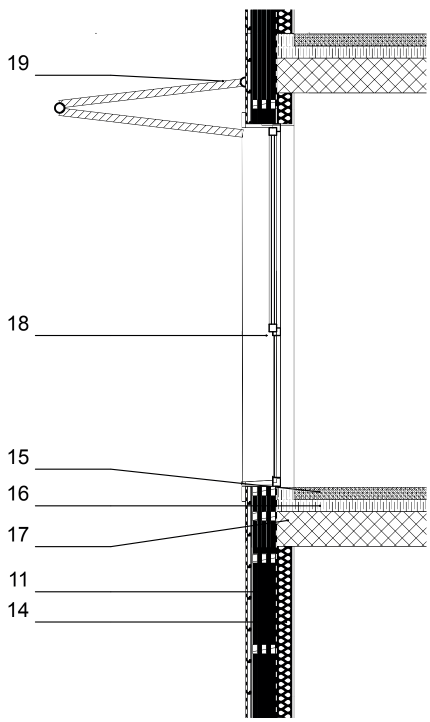
5 pm

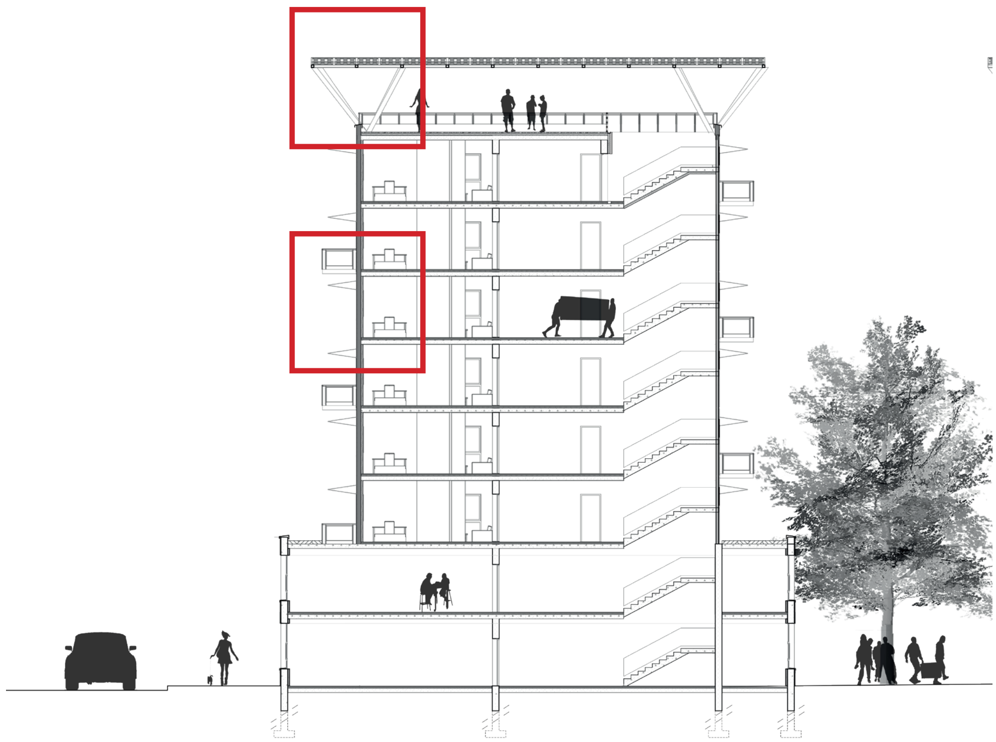
Construction details :

Photovoltaic canopy (1/50°) :



Facade (1/50°) :





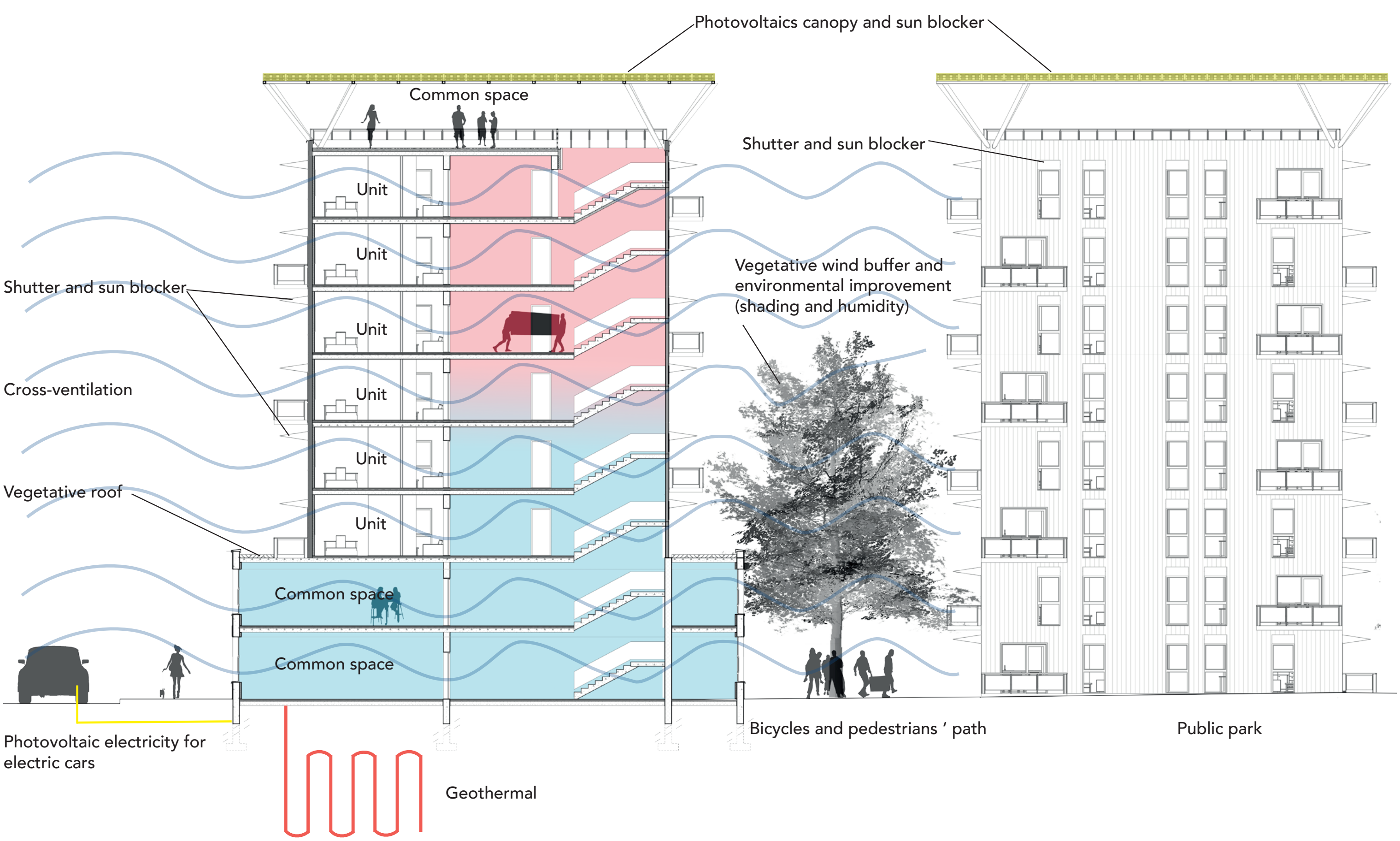
1 - ridge plate
2 - photovoltaic panel
3 - photovoltaic support
4 - metal farm
5 - iron beam
6 - steel gutter
7 - round steel post
11 - Panobloc ® PR5V (including vapor barrier, rain barrier, battens and wood siding)
12 - rain barrier
14 - inner wall with 100 mm insulation and BA13
15 - screed with underfloor heating
16 - underfloor heating’s insulation
17 - prefabricated concrete slab
18 - double glazed window
19 - shutter and sun blocker

Energy usage :

Each building will use its canopy roof as a way to provide shade on the roof and also enough energy to cover all the inhabitants usage thanks to photovoltaic panels.
The produced electricity will be used to cover all electricity needs thanks to the use of low-energy devices (washers, led lights...). Hot water will be provided by the photovoltaic panel in cogeneration. This will increase the panel efficiency and electricity production by lowering their temperature.
Heating will be provided by geothermal pump using the electricity produce by the photovoltaic canopy.
The extra electricity produce each day, mainly on peak hours (near noon) but with low electricity demands will be used to charge electric car batteries to provide green transportation to the university.
The electric car batteries will also work as energy buffers, to store each day energy that can also be used during the night in the buildings.
So theoretically, thanks to the sun and bio mass, the project could be self-energy sufficient and don't need any energy supplier.

The units have been designed with big openings to provide natural light, but also with the thermal comfort in mind, that's why the shutter also acts as sun blocker when opened.

The stairs and common circulation are made of concrete to have an important thermal mass, with the goal to help to cool the building during warm days.



A new way of life :

The project also aims to question our notion of comfort in a period where global warming is more and more destructive for natural ecosystems. Temperature isn't always the same during all seasons on the outside and it should also be the same on the outside. By doing so, people will be able to need less energy and therefore less money to heat or cool their housings. Instead of having an always constant temperature of 72 degree Fahrenheit all year long, inhabitants will be invited to have 67 degree Fahrenheit in winter and 78 degree Fahrenheit in summer.

Comfort isn't only about temperature but also about letting people take control of their living space. That is why the inside finishing will be very simple, clear concrete with a resine on the floor, white paint on the ceiling directly on the concrete. Bedrooms are insulated from each other and living paces thanks to their wardrobes. Each room offers enough space for a 2 people bed and a desk.

People will be invited to monitor their energy consumption and expenses for electricity, heating, cooling through an application on smartphones, tablets, and computer. They will be able to see the global energy production and consumption of the whole building in real time. The system will be smart enough to alert you on production peak hours that you can use as much electricity as you need for bigger usage (wash machines, cleaning, dryer...). The extra electricity produce each day will also be used to charge electric car batteries to provide green transportation to the university. The electric car batteries will also work as energy buffers, to store each day energy that can also be used during the night in the buildings. The system will also alert when there is not enough green electricity available on the site and will need to import from the grid.
This will help people to adapt their lifestyle to the building and nature capabilities.

The common stairs have natural light and views to encourage people to take them instead of the elevator.

The site has been thought of a park to encourage people to go outside to meet each other, to do sport, to study. This park will also help the project thermal comfort in summer thanks to the bio mass (trees, and grass) and also by providing shades on the floor and on the towers.

Energy production and consumption :

To benchmark the building, we will use the site energy ratio, since the project goal is to produce 100% of its energy consumption on site with renewable energy sources (solar, bio mass).
As we can see, the building isn't clearly achieving zero net energy
But if we take into account the photovoltaic production which will produce hot water by cogeneration(and that wasn't calculated) and the geothermal pump which will probably have a three-time energy coefficient (1 kWh of energy consumes for 3 kWh produced), then zero net energy goal will be met on site.
People will also be invited to question their energy's usages and needs to helps to achieve zero net energy.

	Calculated Energy Use (kWh/sf/year)	**Calculated Energy Use (kWh/year) for one tour**
HVAC	0.8	14 226
Lighting	1.4	24 443
Appliances and Plug Loads	43402	25 491
Domestic Hot Water	3.0	54 055
Total Consumption	6.6	118 215
Renewable Production	5.9	106 550
Net EUI	-0.7	-11 665

Yearly photovoltaic production of one tower.
4305,56 sf of photovoltaic panels by tour.

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at http://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

RESULTS

106,550 kWh per Year *

System output may range from 102,384 to 108,362kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	3.10	5,303	814
February	4.11	6,331	971
March	4.94	8,471	1,299
April	6.19	10,160	1,558
May	6.80	11,540	1,770
June	7.09	11,582	1,777
July	7.59	12,725	1,952
August	6.90	11,553	1,772
September	6.40	10,310	1,582
October	4.90	8,204	1,259
November	3.34	5,510	845
December	2.82	4,861	746
Annual	**5.35**	**106,550**	**$ 16,345**

Location and Station Identification

Requested Location	san francisco
Weather Data Source	(TMY2) SAN FRANCISCO, CA 11 mi
Latitude	37.62° N
Longitude	122.38° W

PV System Specifications *(Residential)*

DC System Size	68 kW
Module Type	Premium
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14%
Inverter Efficiency	96%
DC to AC Size Ratio	1.1

Economics

Average Cost of Electricity Purchased from Utility	0.15 $/kWh

Performance Metrics

Capacity Factor	17.9%

Total yearly consumption by usages :

Total yearly consumption by months and usages :