



SHARING OUR EXPERIENCE with Building Integrated Modeling (BIM) and software developments for BIPV applications



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> PVSITES Software



by Philippe ALAMY

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> Why did we join this project?

What is the objective of our meeting today?



> Why CADCAMation joined the PVsites project



PVsites

CADCAM**ation**



> Background - Ambition



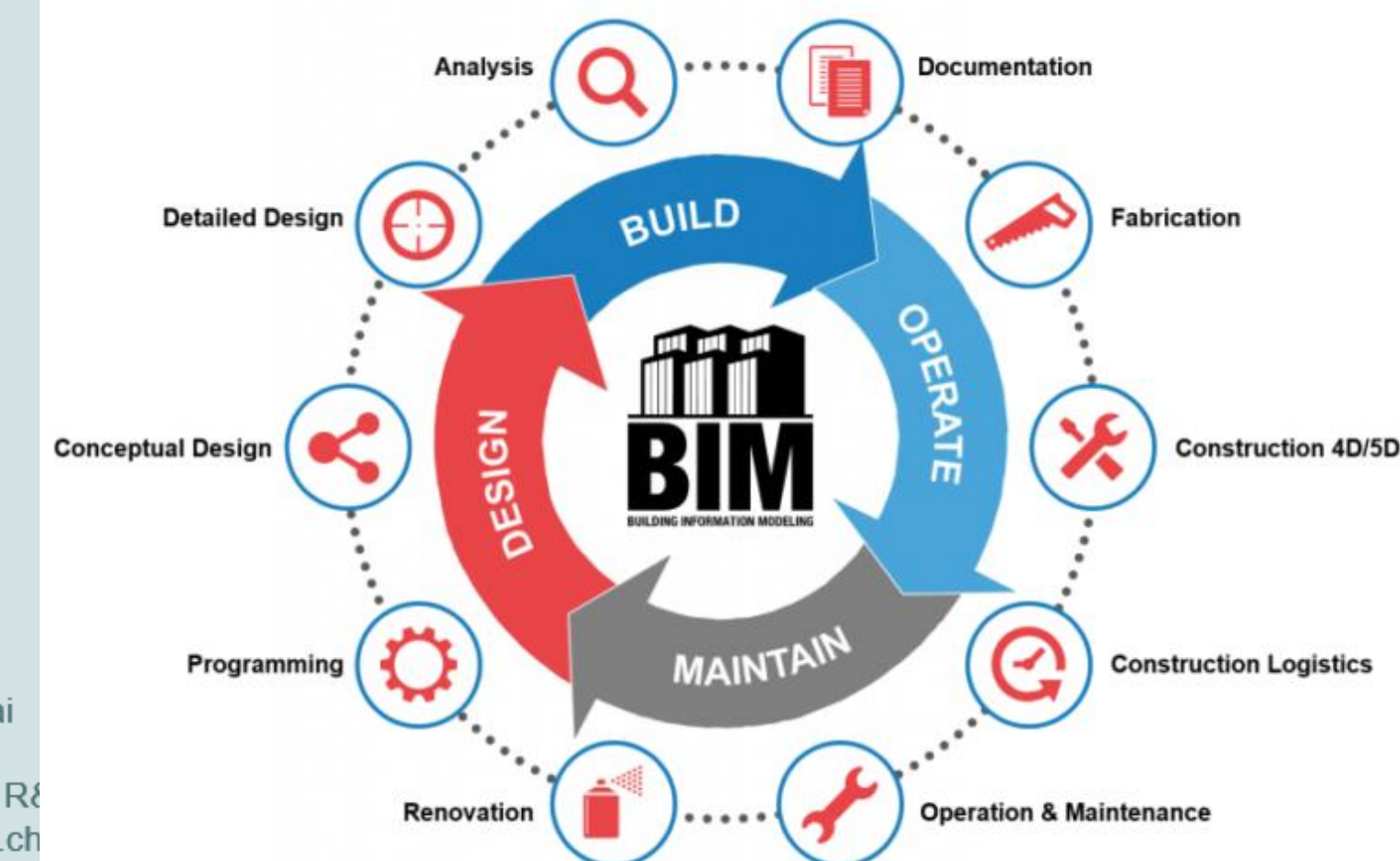
PVsites




CADCAMation SA

- Located in Onex/Genève-Switzerland
- 1993 : **Fidia KMR SA** CAD/CAM competence centre of FIDIA group (Torino)
Development of Hi-MILL software for on-line milling
- 1997 : **CADCAMation SA - Autodesk VAR**
Shaping your ideas (Digital and 3D technologies). BIM introduction in 2005
- 2010 : **CADCAMation SA – EU R&D Partner (FP7, H2020)**
 - **FOF-Industry 4.0** : FoFdration with Airbus & Delcam-Autodesk, KAP with SAP...
 - **EeB-BIM**: PVsites, SUPERPV...
- 2018 : **Alliance CADCAMation SA – AriCAD Platinum partner**
BIM & PLM integration, Solar bioclimatic simulation, PV Digital twin.
- 2019 : *Accompagner les acteurs de la Construction dans leur transformation digitale*

NGUYEN Van Khai
dipl. EPFL
Consultant PLM & R&D
www.cadcamation.ch





BIM

BUILDING INFORMATION MODELLING

> Today's meeting purpose



1. Present our work
2. Open perspectives: next webinars
3. Foster BIM innovation for BIPV

OUR WORK



> Challenge

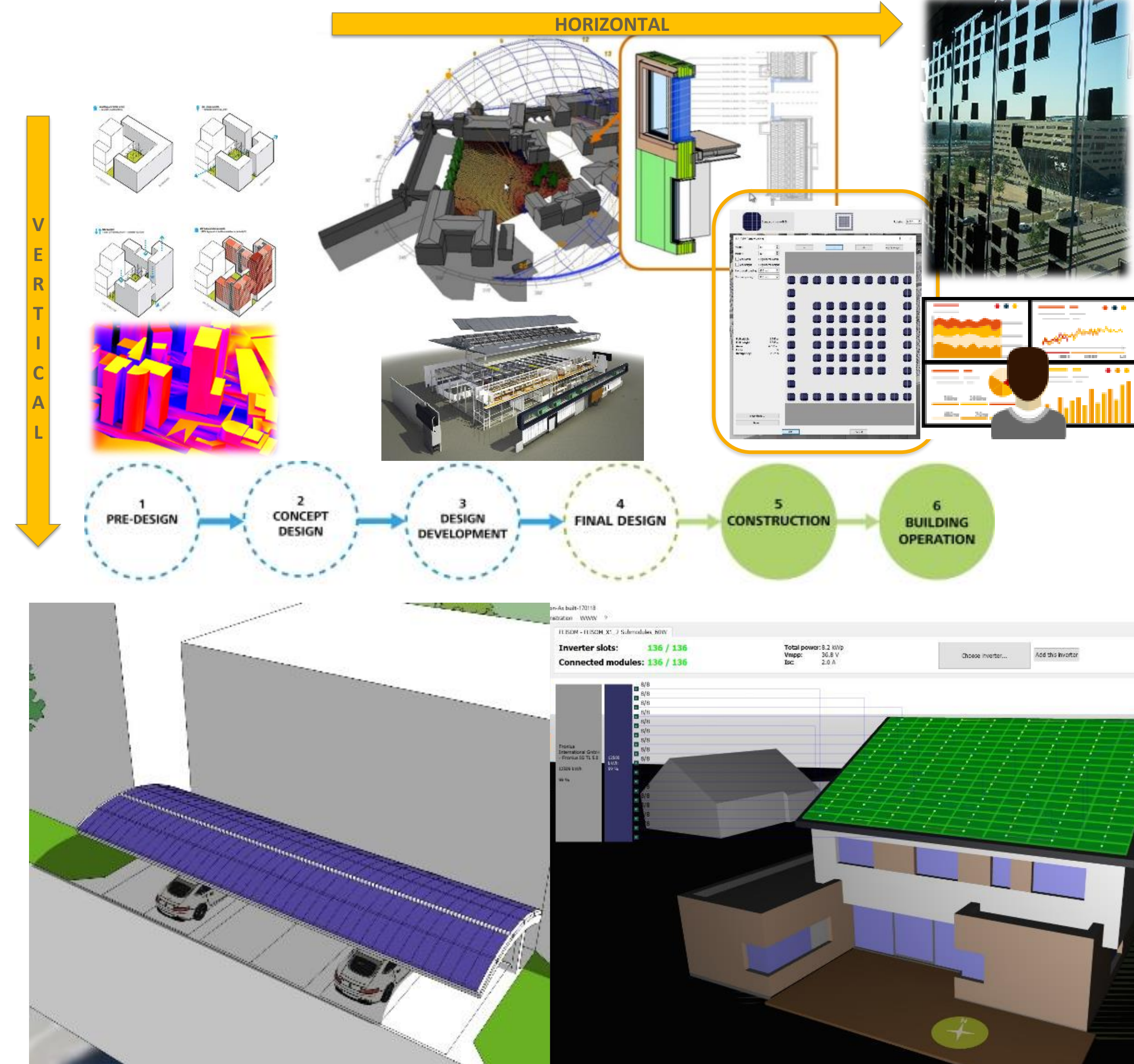
Software tool for the joint simulation of BIPV products and building energy performance

> Solution

An accurate, user-friendly, integrated SW tool for the simulation of BIPV products performance and their impact on building energy demands

BIM-based SW tool

(available on <https://cadcamation.ch/solutions/bim-solar/>)





> What is PVSITES software,
based on BIMsolar[®]?



> What is the role of BIM for BIPV?



PVSITES: BIM software

> Software presentation

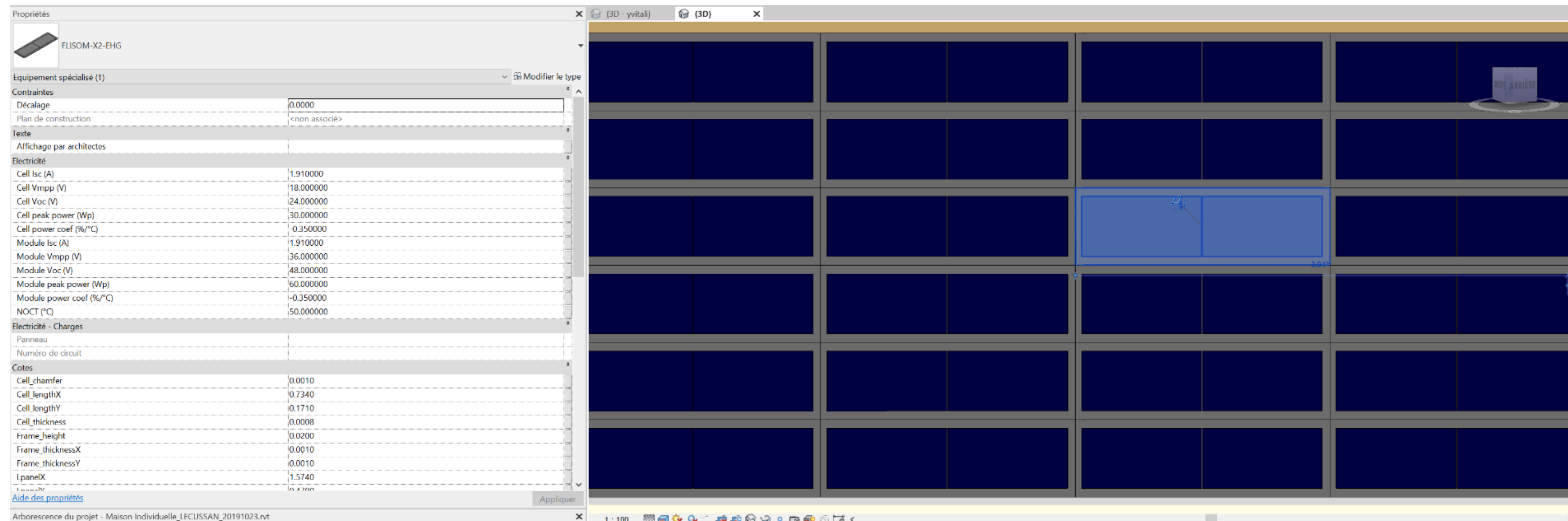


PVSITES Products

→ Virtualization

→ Parametrics

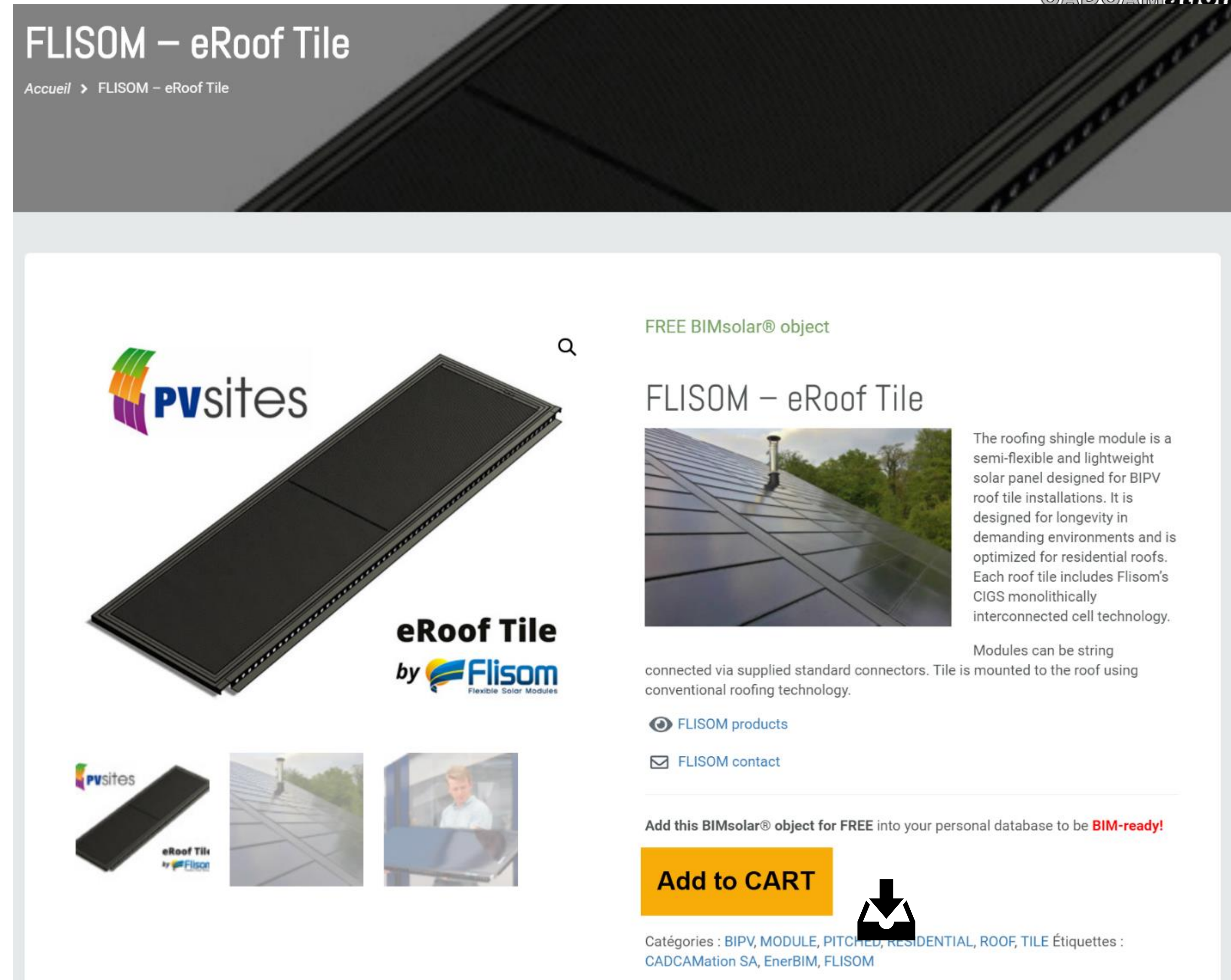
FLISOM - Thin Film CIGS products





Version	Date	Comments	Author
01.00	2017-02-28	Initial	Schmitt, N.
01.00	2017-02-15	Browsers Drawing	Rivarino, N.





> PVSITES in the market Thin film CIGS products

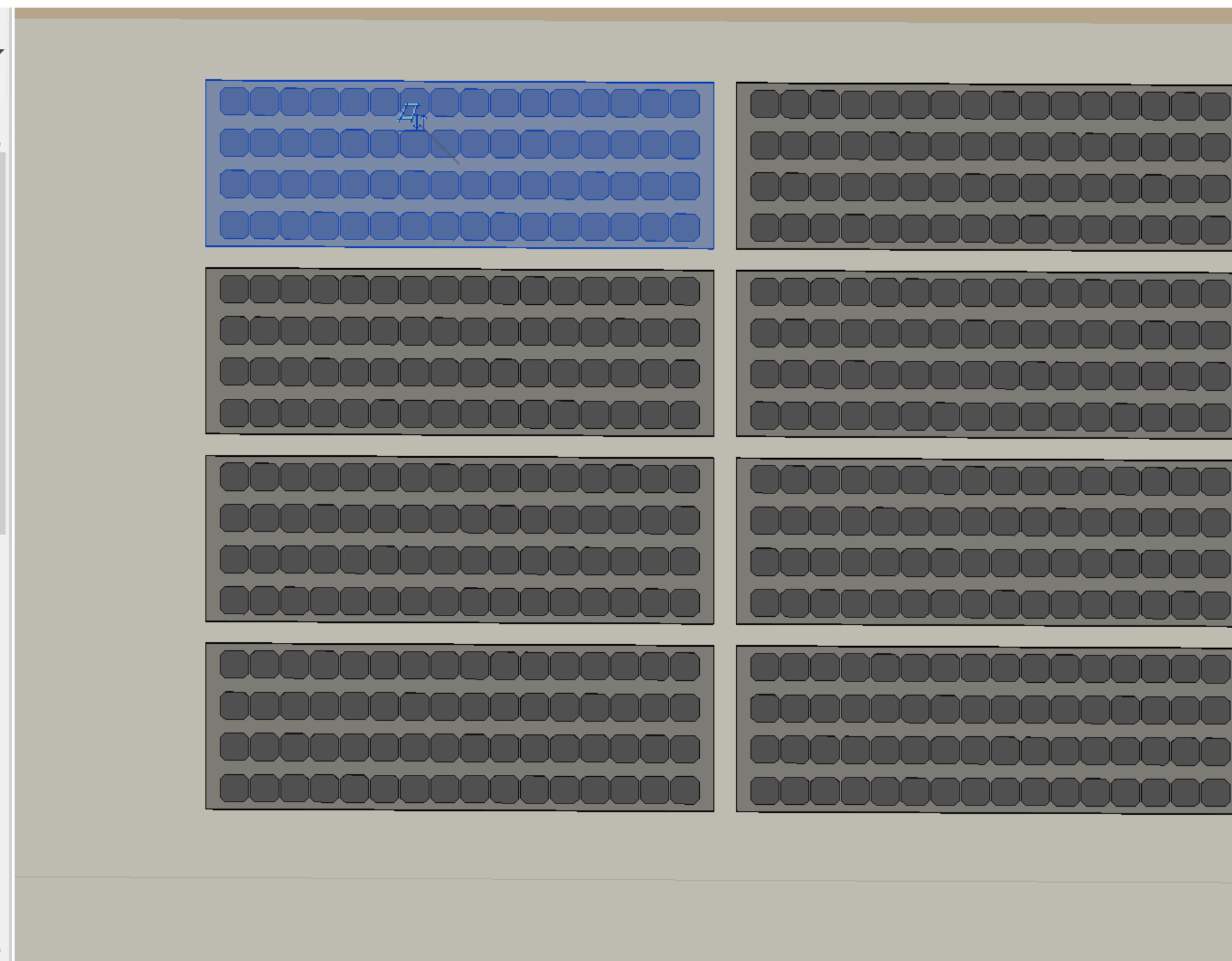
FD2 HOUSE
PVSITES Project



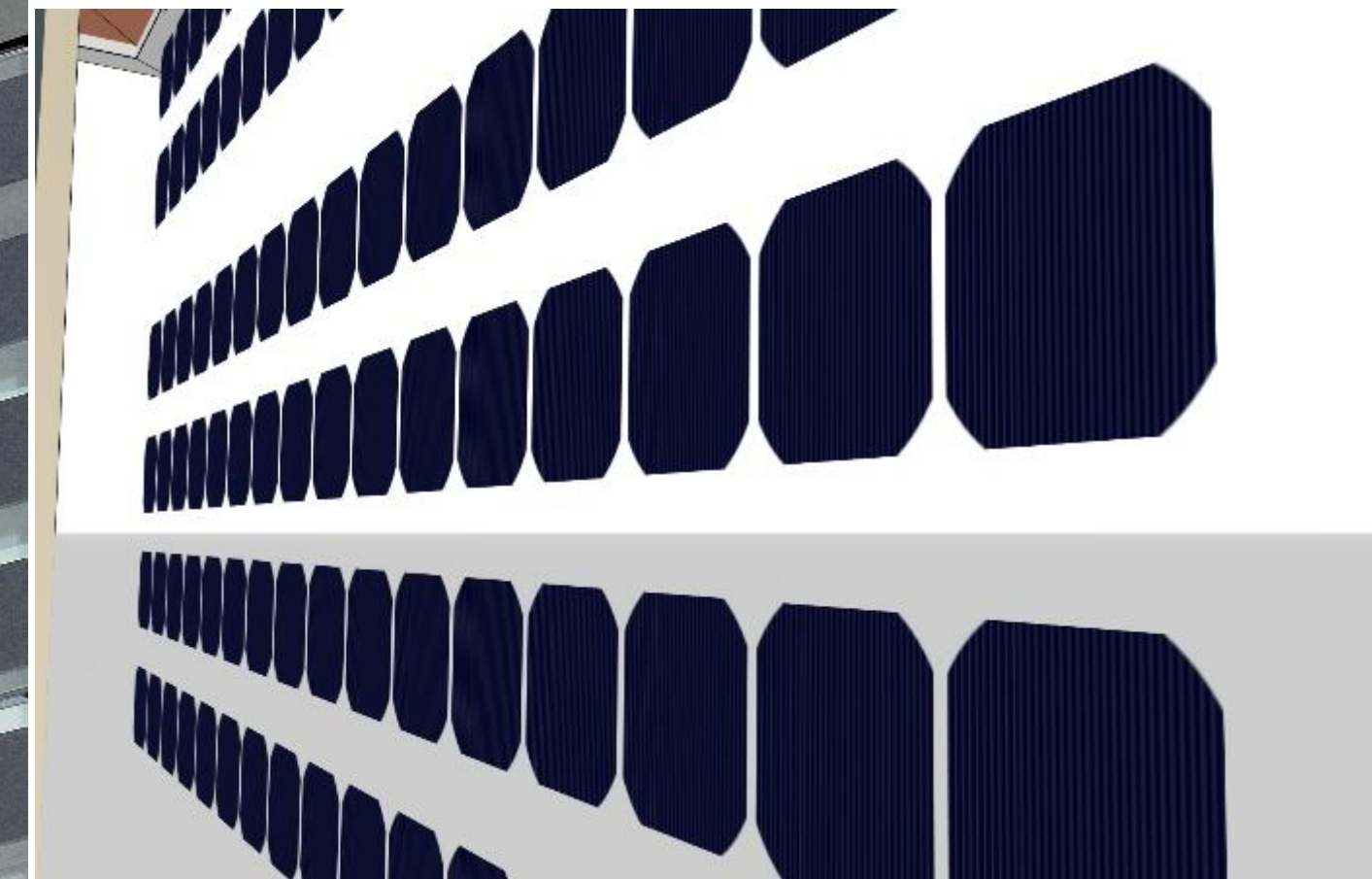
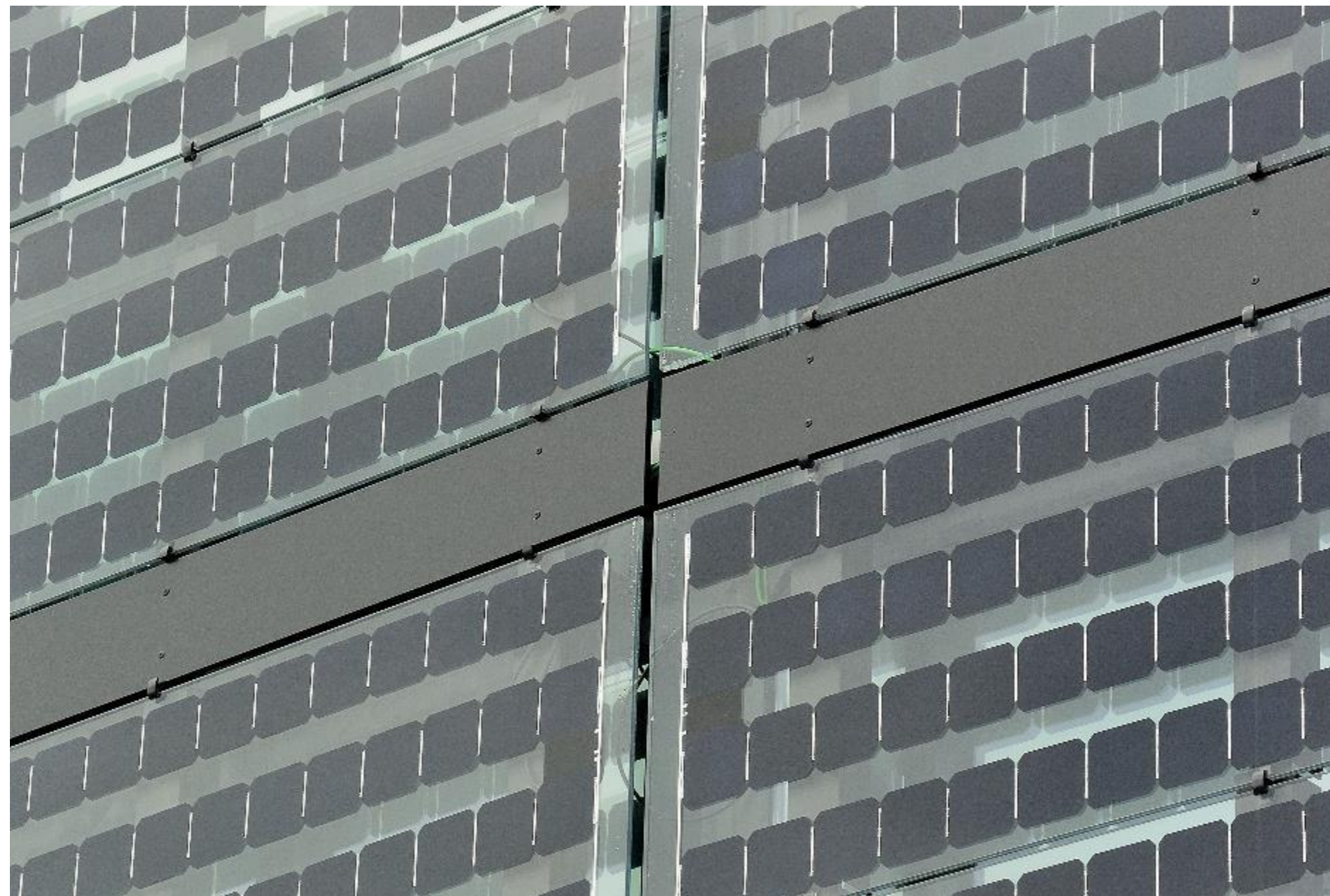
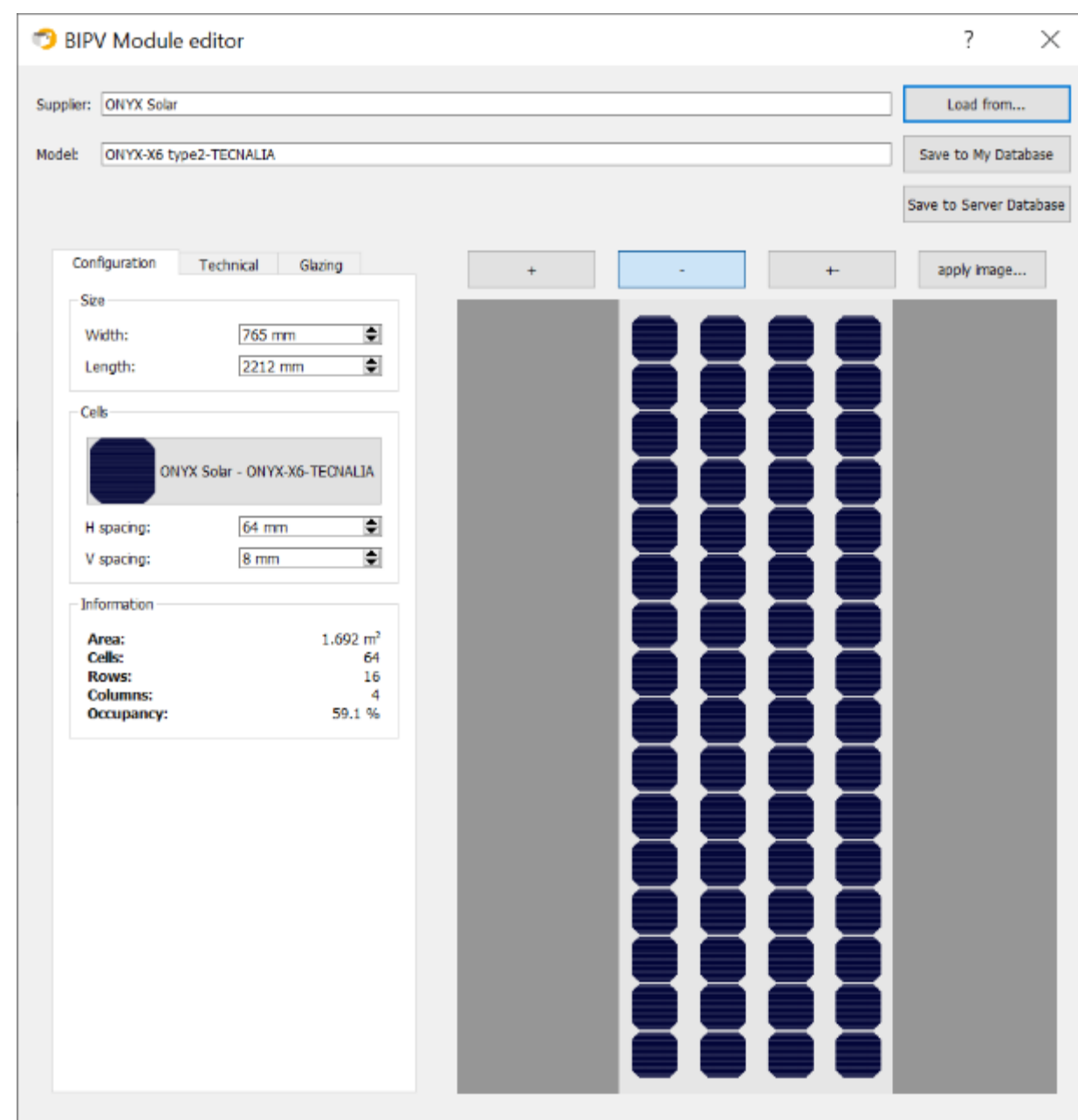


ONYX Solar – cSi products

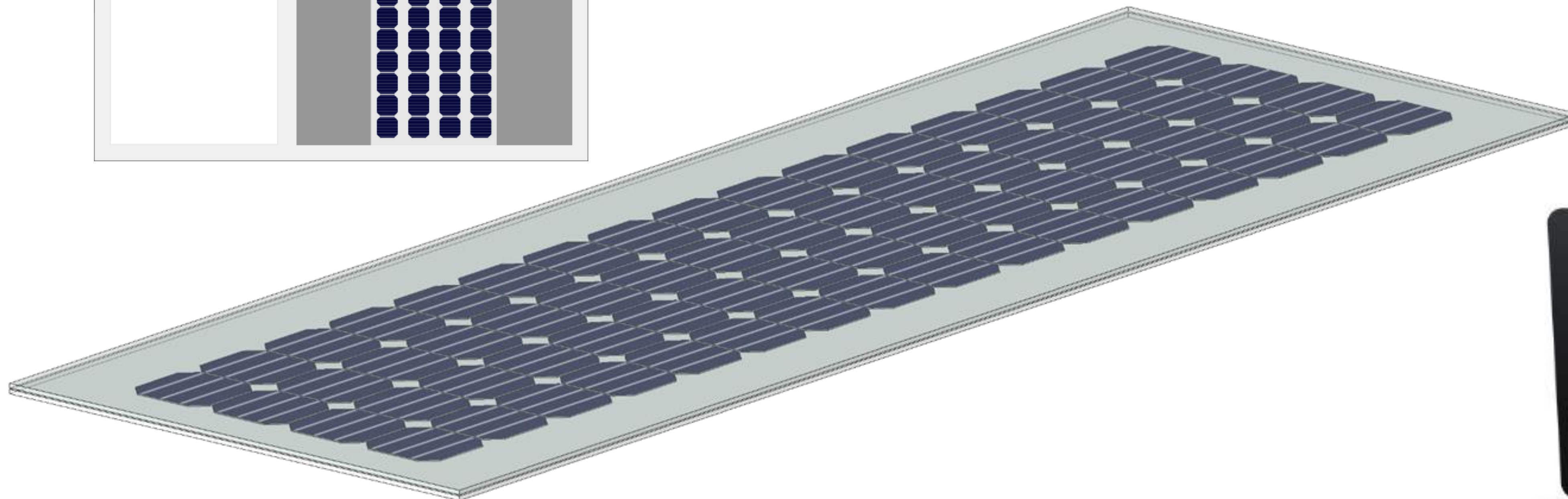
ONYX-X6-TECNALIA	
Equipement spécialisé (1) Modifier le type	
Contraintes	
Décalage	32.44
Plan de construction	<non associé>
Matériaux et finitions	
Glass_mat1	Verre, vitrage transparent
Glass_mat2	Verre, vitrage transparent
Electricité	
Module peak power (Wp)	192.000000
Module power coef (%/°C)	-0.300000
Module Voc (V)	41.599998
Module Vmpp (V)	34.880001
Module Isc (A)	5.700000
Cell peak power (Wp)	3.000000
Cell power coef (%/°C)	-0.300000
Cell Voc (V)	2.600000
Cell Vmpp (V)	2.180000
Cell Isc (A)	1.425000
NOCT (°C)	45.000000
Electricité - Charges	
Panneau	
Numéro de circuit	
Cotes	
Cell_chamfer	2.08
Cell_lengthX	12.50
Cell_lengthY	12.50
Cell_thickness	0.18
Frame_height	1.00
Frame_thicknessX	0.00
Frame_thicknessY	0.00
LpanelX	76.00
LpanelY	225.00



> From datasheet to
web storefront for
BIM-ready products

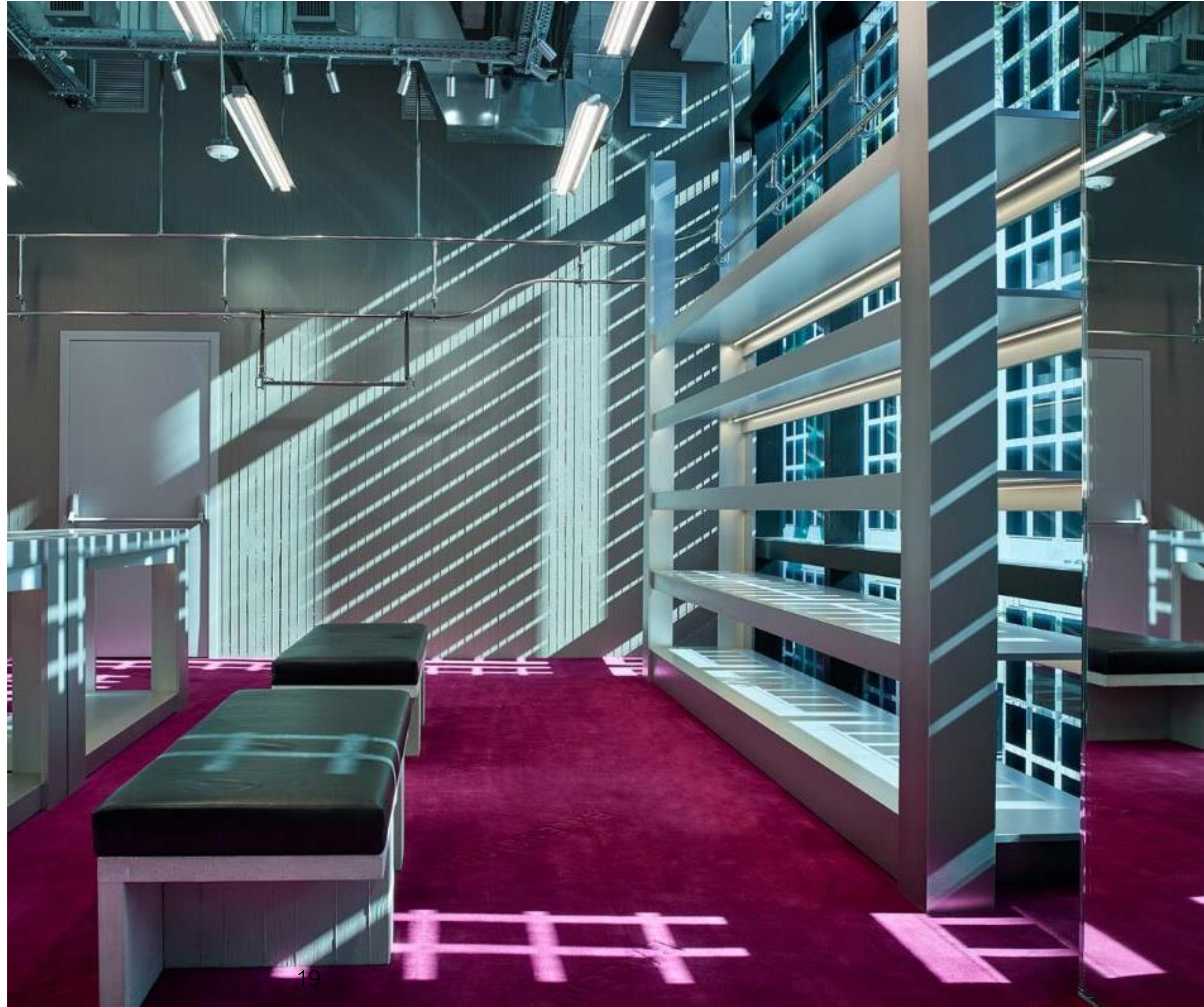


PVsites



> PVSITES in the market c-Si products

16 kW BIPV glass-glass blue tinted curtain wall (ONYX Solar) at Balenciaga storefront (Miami, USA)



> PVSITES in the market c-Si products

Awarded Most Innovative
Curtain Wall project ” in the US

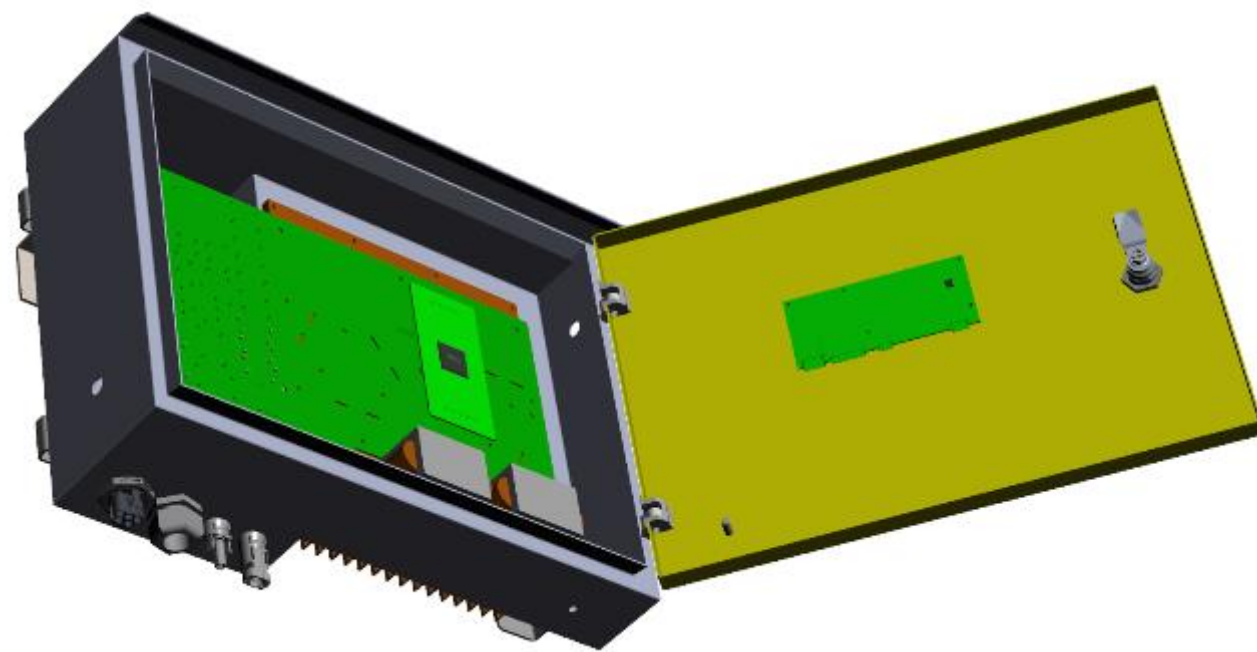
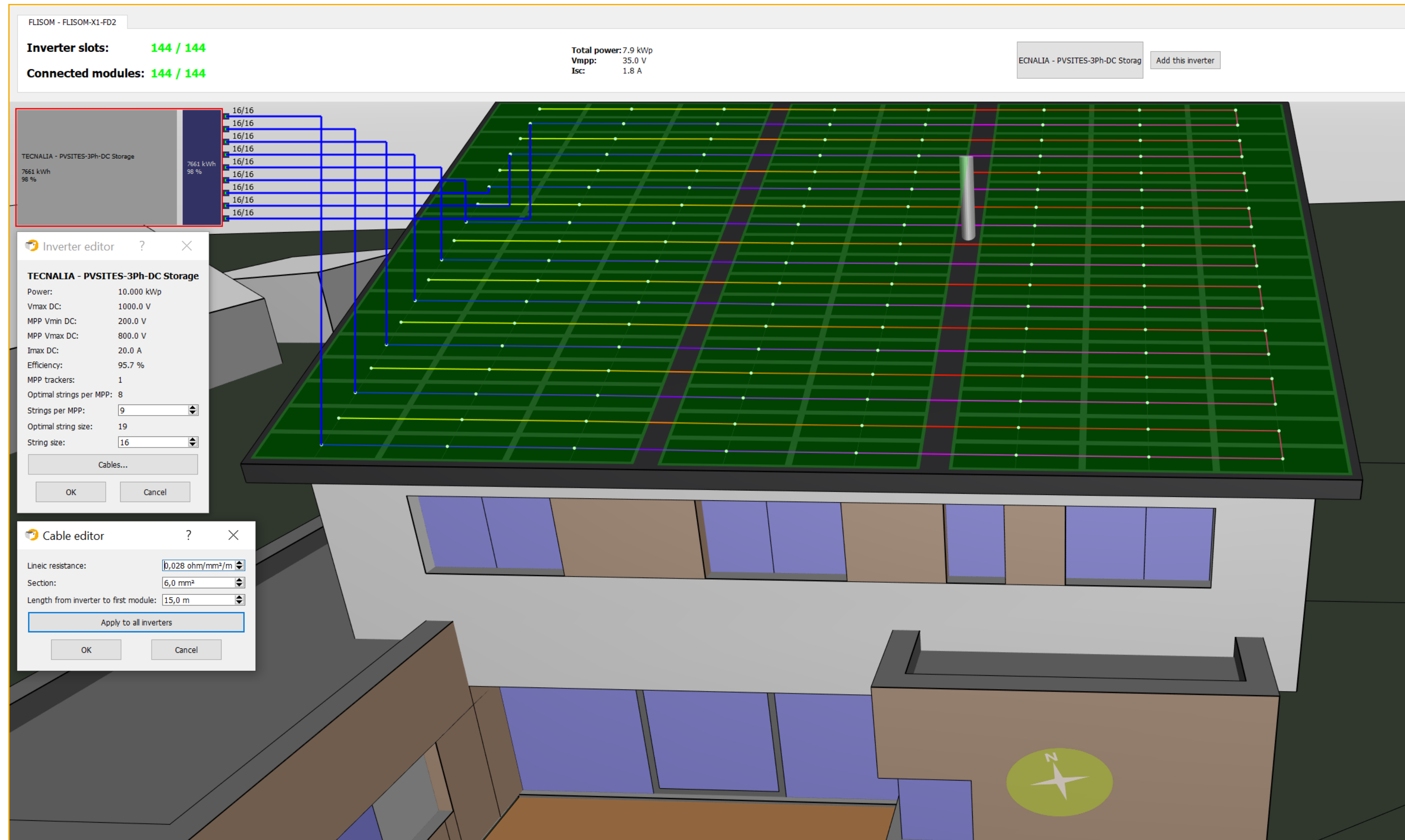


>

CEA | Si-C inverter

TECNALIA | DC coupled charge inverter

> Virtual inverters-MPPTs



PVSITES demos

> PVSITES demonstrators



> 1. Single family house-Belgium

Location	Stambruges (Belgium)
Typology	Residential & office
Area	280 m ² (219 m ² heated floor)
Floors	3

Characteristics

New construction. Detached passive wooden house, located in a rural area, with residential and professional uses (architectural office).



Area available for BIPV

Single 30° sloped roof.

Area of 107 m² available for BIPV systems. Small shadows caused by a chimney. Optimum orientation and inclination with maximum production guaranteed.

Orientation: +14° (NNW).

Inclination: 30°.

> Single family house



BIPV tile by FLISOM

Semi-flexible and lightweight CIGS PV element to be directly assembled to each other. Series connectivity enable to be carried out during the installation works, with hidden connection boxes and cables not disturbing fastening.



Solar inverter by TECNALIA

3-phase DC-coupled PV storage inverter 10 kW power, with advanced MPPT system, battery DC current/voltage regulation, and active and reactive current AC power regulation for grid-connected operation.

BIPV roof tile by FLISOM & Solar inverter by TECNALIA

> Single family house

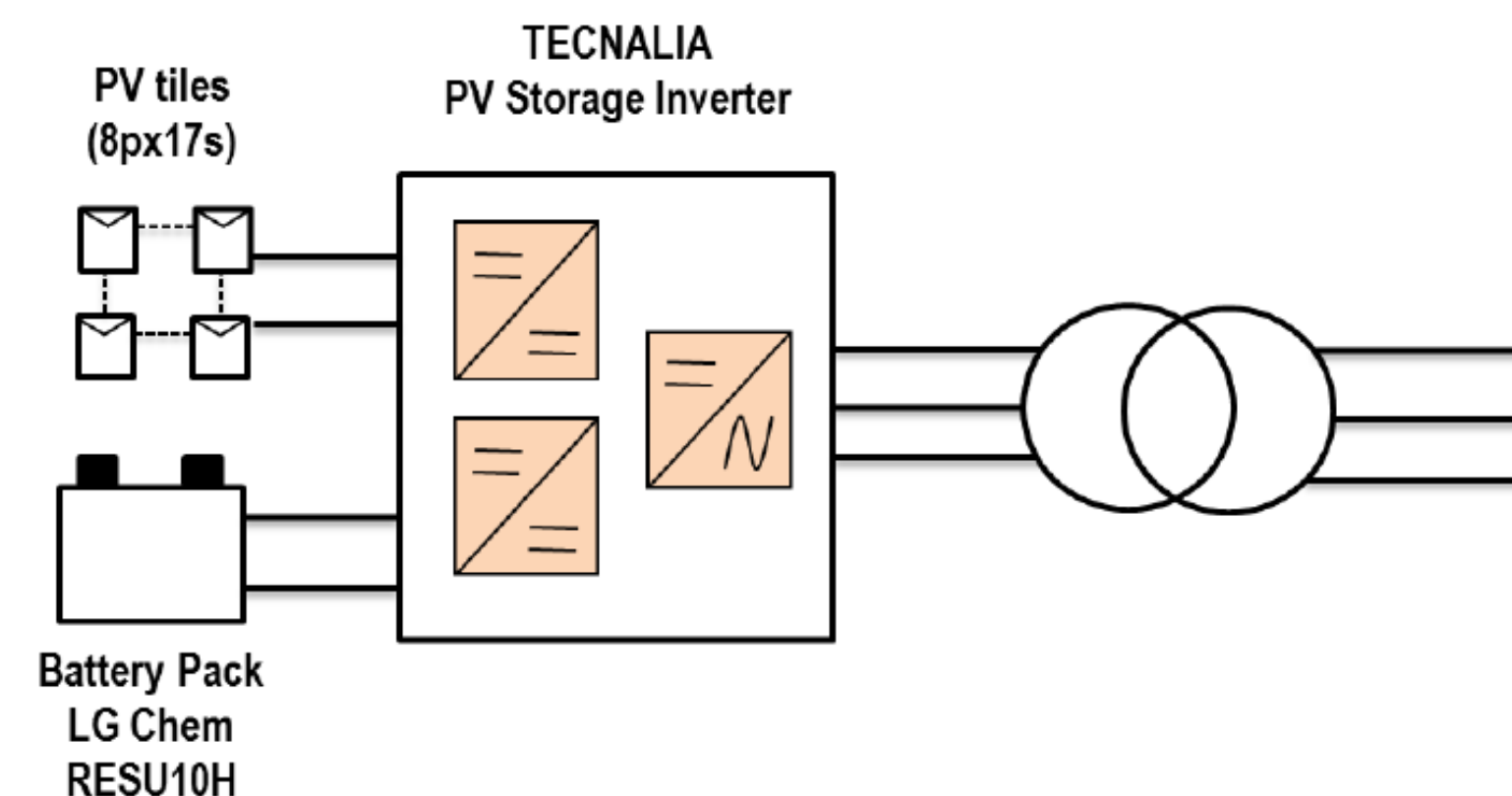
PV system 7.9 kWp

Solar field		
System power	7,9	kWp
Orient // Inclín	+14° // 30°	(°)
Occupied area	100	m ²
No. modules	144	units
PV module		
Module power	55	Wp
Dimensions	465 x 1575	mm
Production		
Specific production	864	kWh/kWp/ year
Estimated production	8200	kWh/year

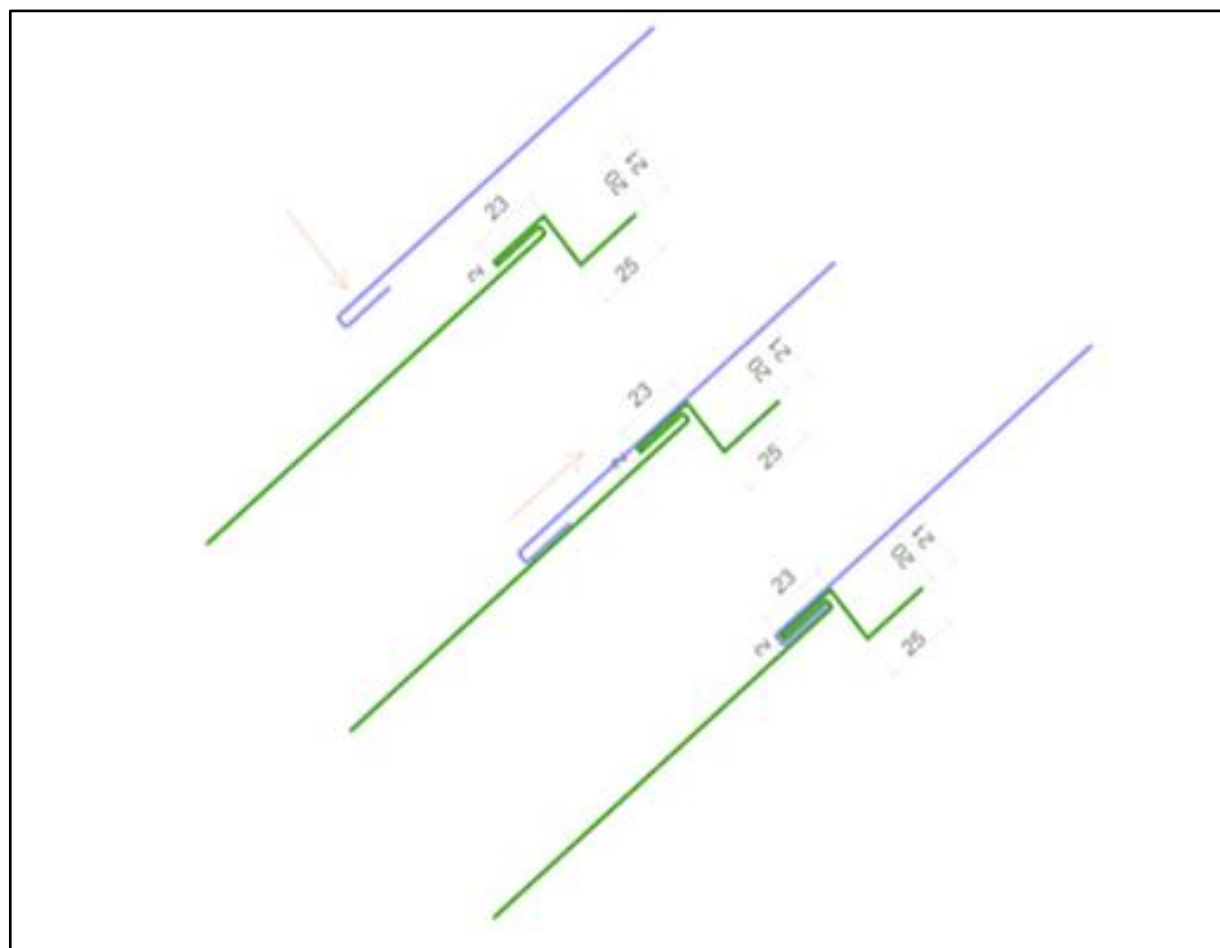
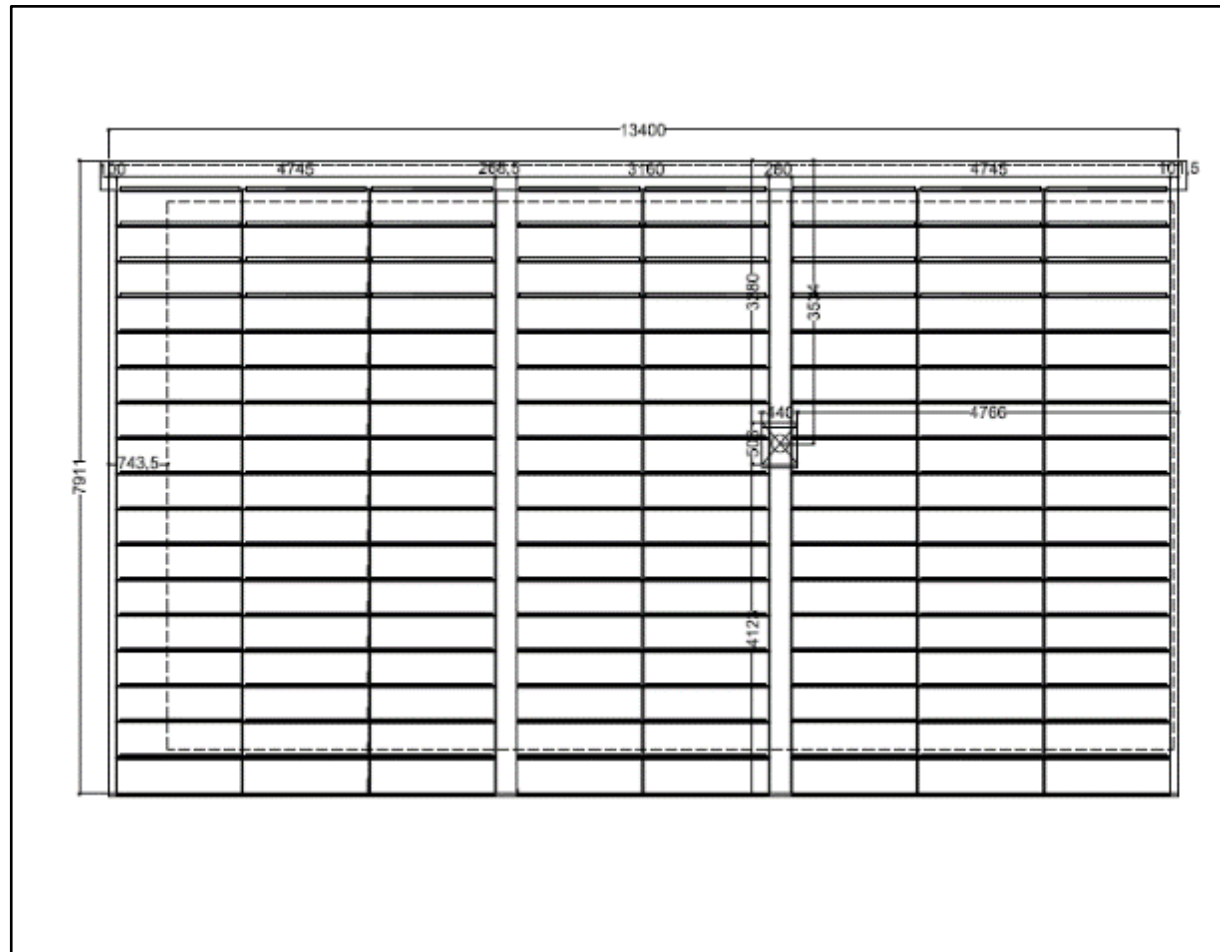
Operation mode

Different operational possibilities, by means of both storing the energy produced and injecting it in the grid.

Electrical configuration for FD2 demo site:



BIPV solar roof



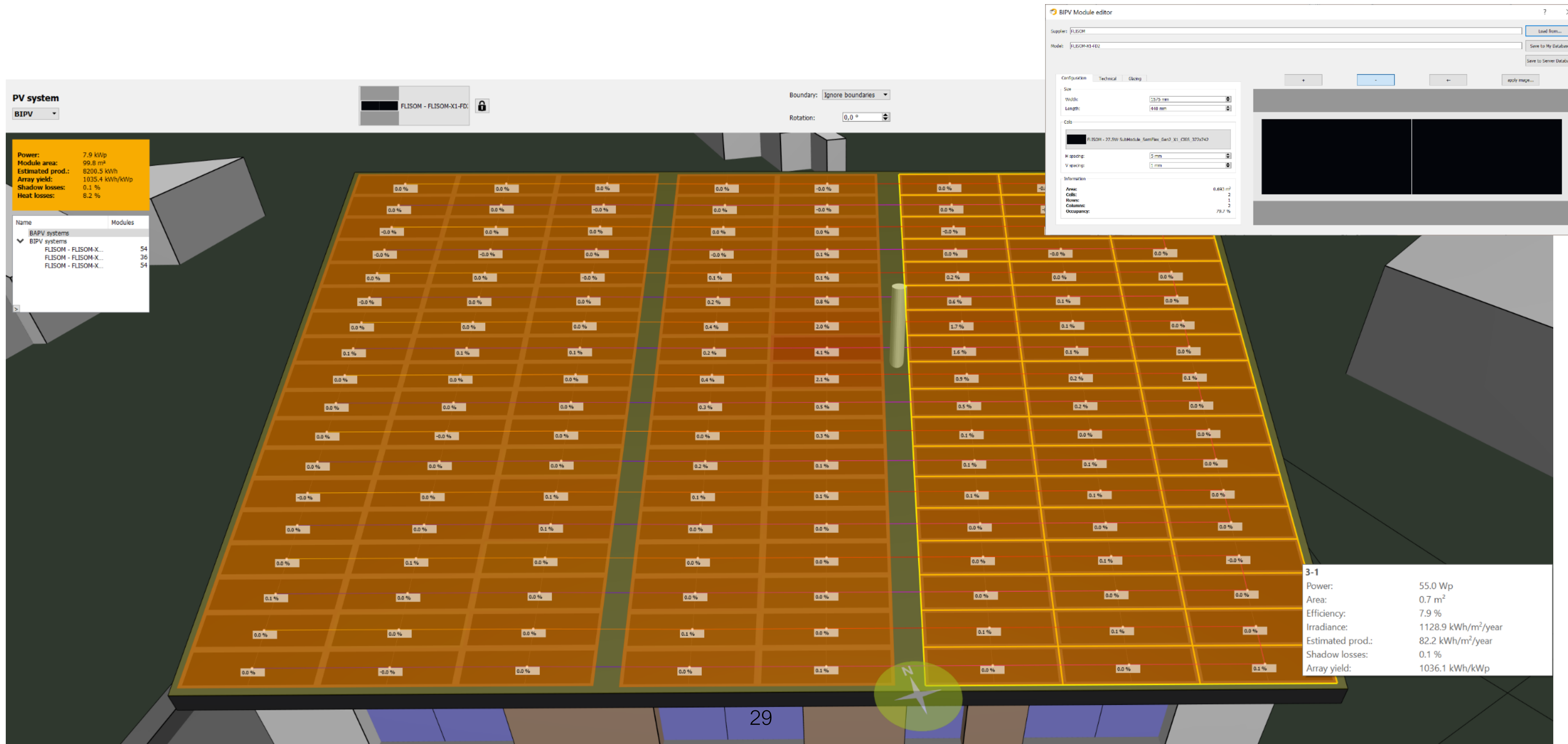
Building integration design

- Size and shape: module dimensions chosen to guaranty a high aesthetical quality and make easy installation. and connection works.
- Joints and fixings: minimizing of joints and non-visible fixings for a better aesthetical quality, by means of the interlocking system for the assembly of the tiles each other: the bottom of the upper module connects with the top of the lower module by sliding the module up.
- Visual appearance: colour and material are close or compatible to those used in the building.
- Roof edges and rims: specially cared finishing for functional and aesthetical reasons.

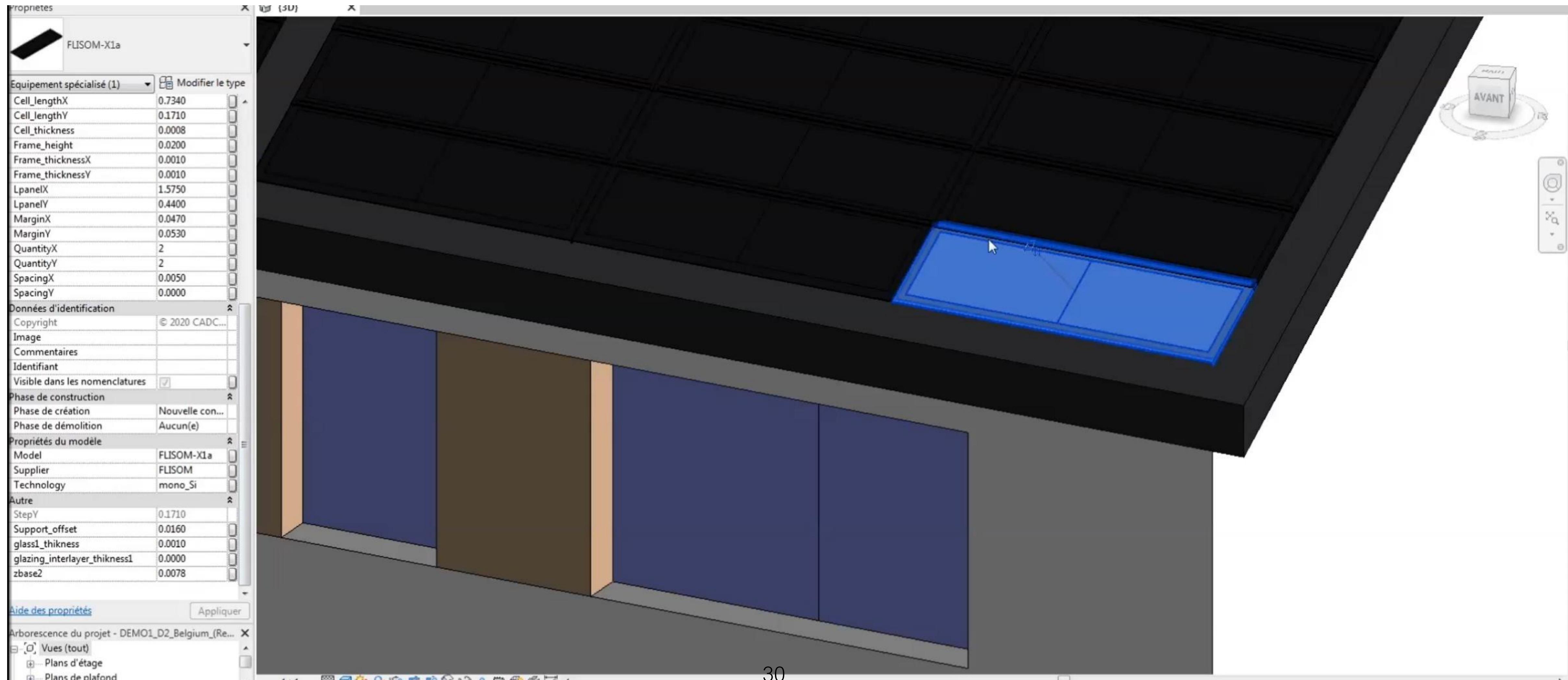
> Single family house: simulation



PV sites



> Single family house: BIM



> Single family house: real



> BIPV solar roof



> Single family house: real



> BIPV solar roof



> 2.Educational Building - Geneva

Location	Geneva (Switzerland)
Typology	Educational building
Buildings	Pavilion 1 & Pavilion 2
Floors	2

Characteristics

The École Hôtelière de Genève (EHG) is a complex of buildings including not only the school facilities but also a hotel for the students hosting.



Area available for BIPV

Two brick masonry facades of two different modern pavilions, available to integrate BIPV: east facade of the Pavilion 1 (31.6 m²), which has two windows rows at the edges and a central curtain wall; and west facade of the Pavilion 2 (78.4 m²), which has two centered vertical windows rows.

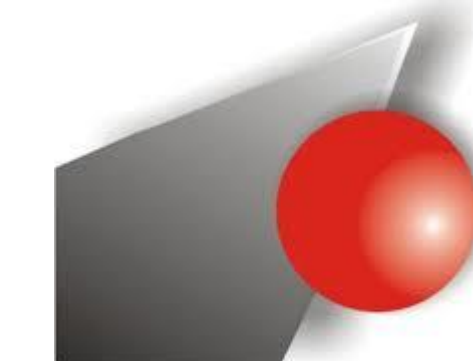
Orientation: -80° (E) / +100° (W).

Inclination: 90° / 90°.

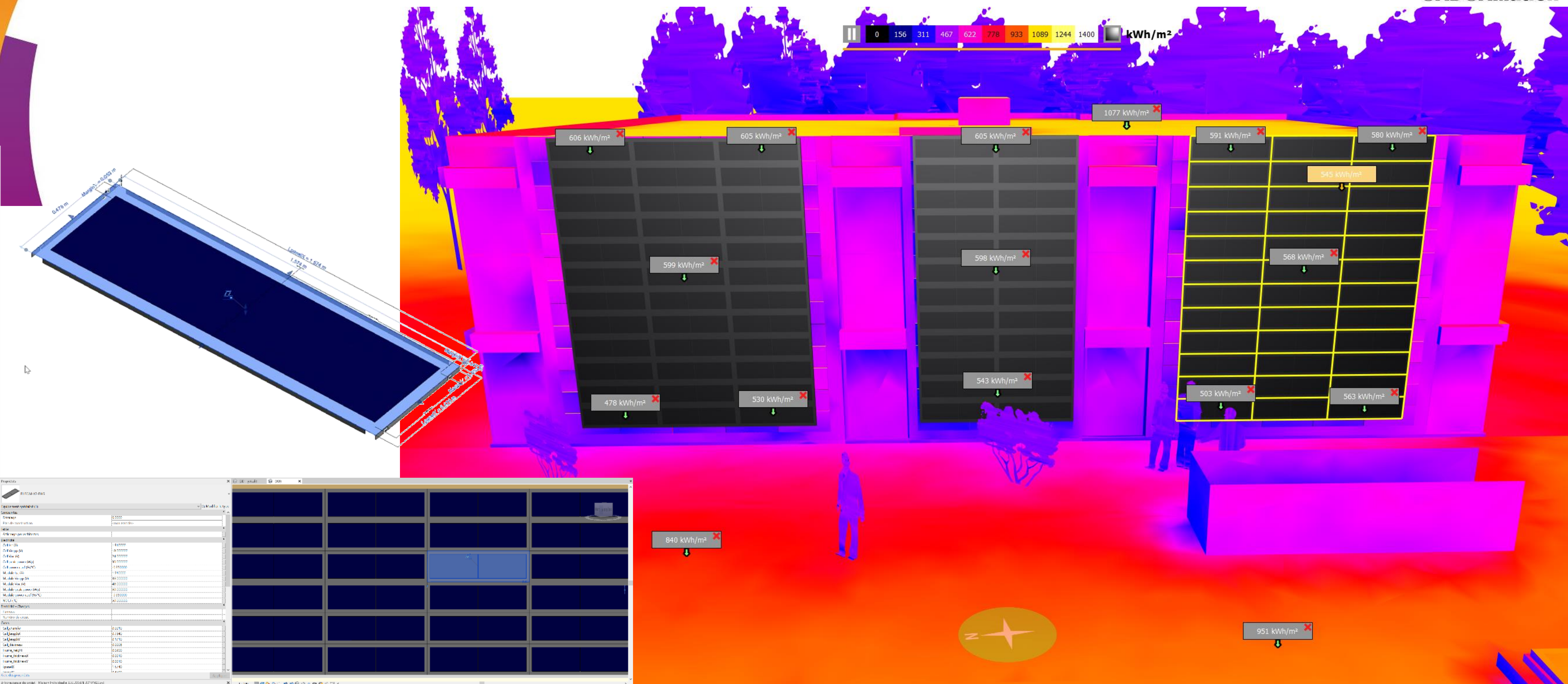
> 2.Educational Building: virtual



PVsites

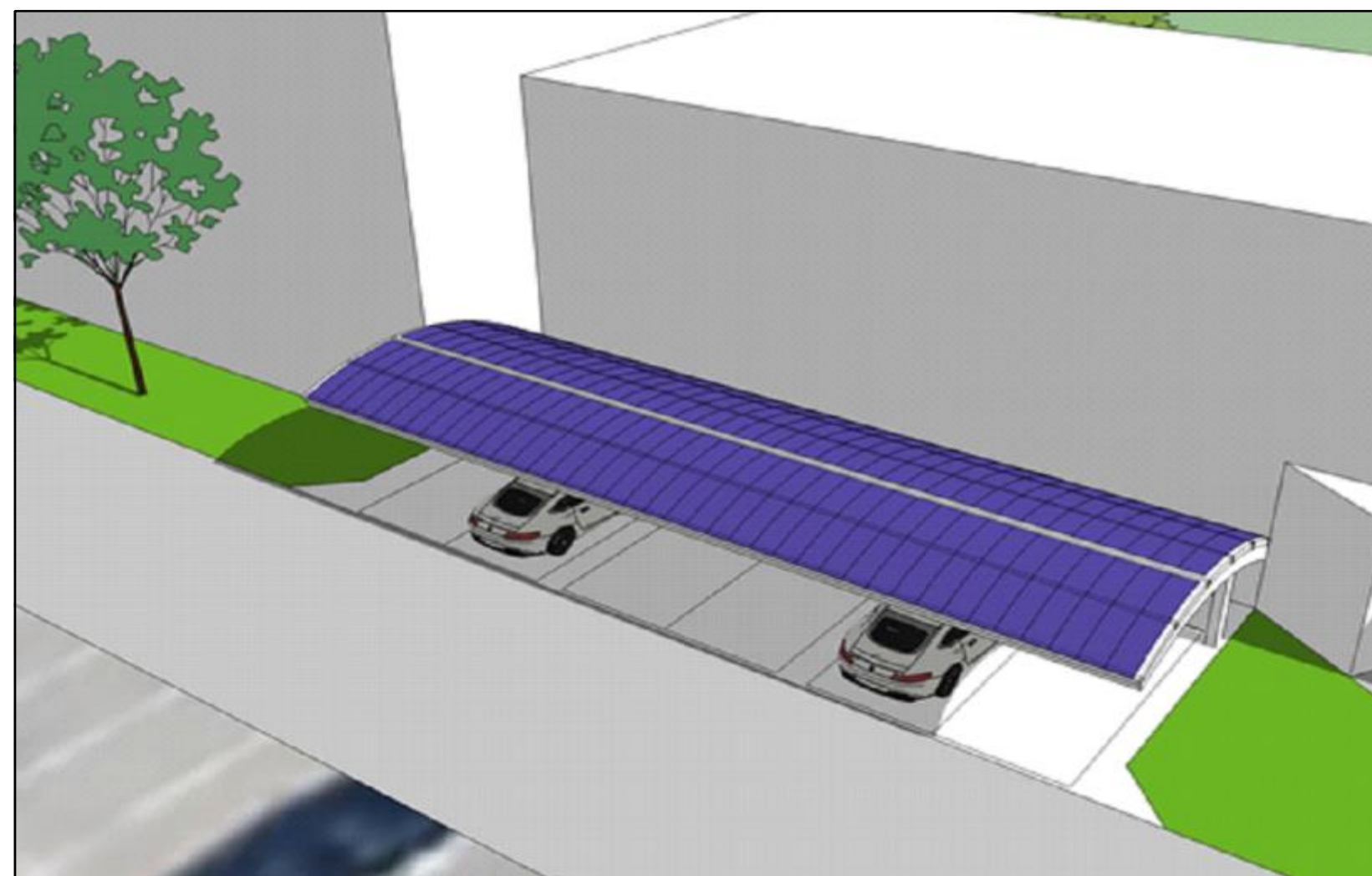


CADCAMation

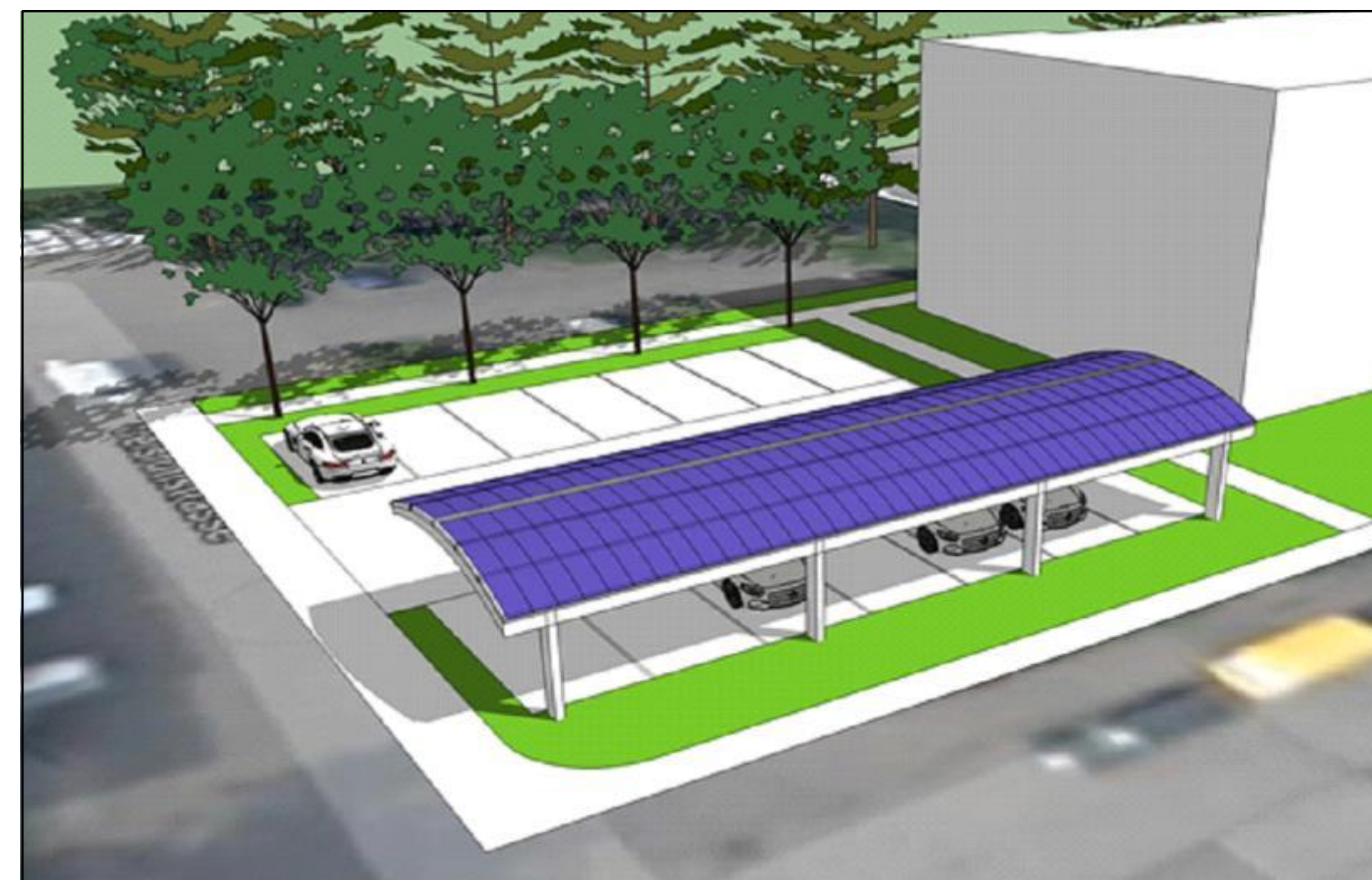


> 3. Carports - Zurich

Location	Dübendorf (Switzerland)	Characteristics Carports located at EMPA and EKZ facilities, with 6 parking spots each, providing energy to charge cars or to contribute to the building power supply.
Typology	Parking carports	
Area	93 m ² / 103 m ²	
Capacity	6 parking spots	

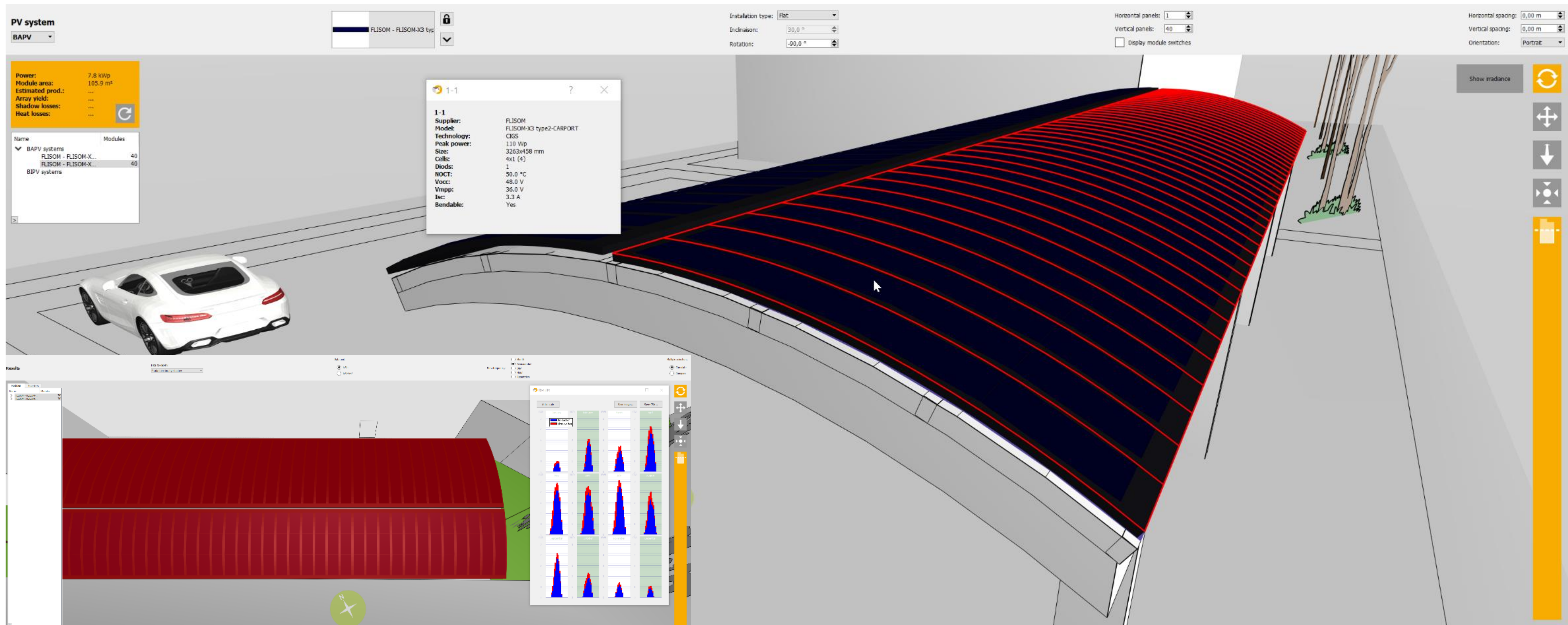


EMPA: Swiss Federal Laboratories for Materials Science.



EKZ: regional electrical provider.

> 3.Carports – Zurich: virtual



> 3. Carports – Zurich: real

> Carport Module “Model 3x1” & “Model 4x1” by FLISOM



> 4. Industrial Building - Granollers



Location	Granollers (Spain)
Typology	Industrial building
Area	13635 m ² (built area)
Floors	2

Characteristics

Industrial and office buildings dedicated to the manufacturing of glass. One of the industrial buildings has recently been constructed.

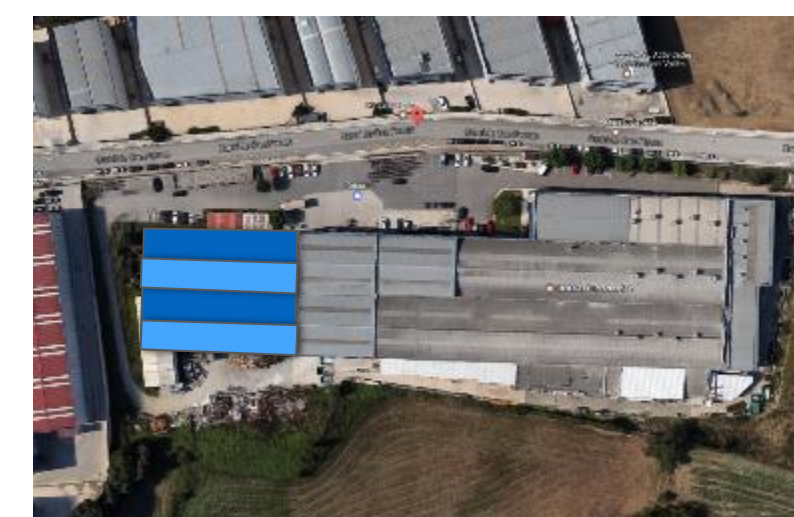


Area available for BIPV

The new industrial building (blue in the picture) is roofed by metal sheet. An effective BIPV implementation, in the south slope, would be possible. The available area is 530 m².

Orientation: +2° (S).

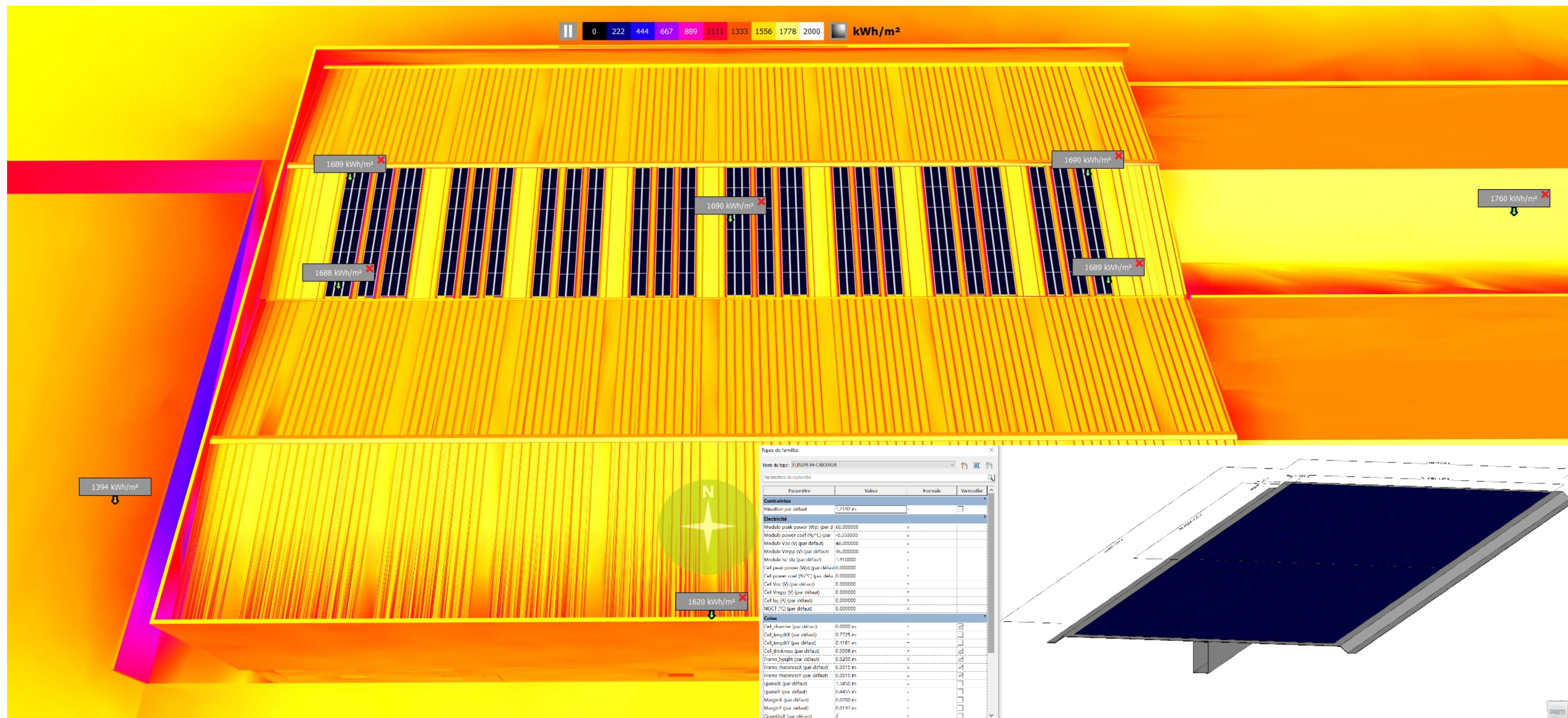
Inclination: 6°.



> 4. Industrial Building: virtual



PVsites



> 4. Industrial Building: real



> 5. Apartments building - France

Location Wattignies (France)		Characteristics
Typology	Apartments building	
Area	3639 m ² (built area)	
Floors	8	
		Residential multi-storey block built in 1975, with 48 social dwellings of different typologies, currently in a retrofitting process.



Area available for BIPV

The building is in a retrofitting process aimed to improve the building energy performance.

The double wall south façade is entirely covered with brick cladding and a vertical string of windows.

An area of 140 m² is available for BIPV, from the first-floor slab to the roof.

Orientation: -16° (SSE).

Inclination: 90°.

> 5. Apartments building - France

Facade PV module by ONYX & Solar inverter by TECNALIA



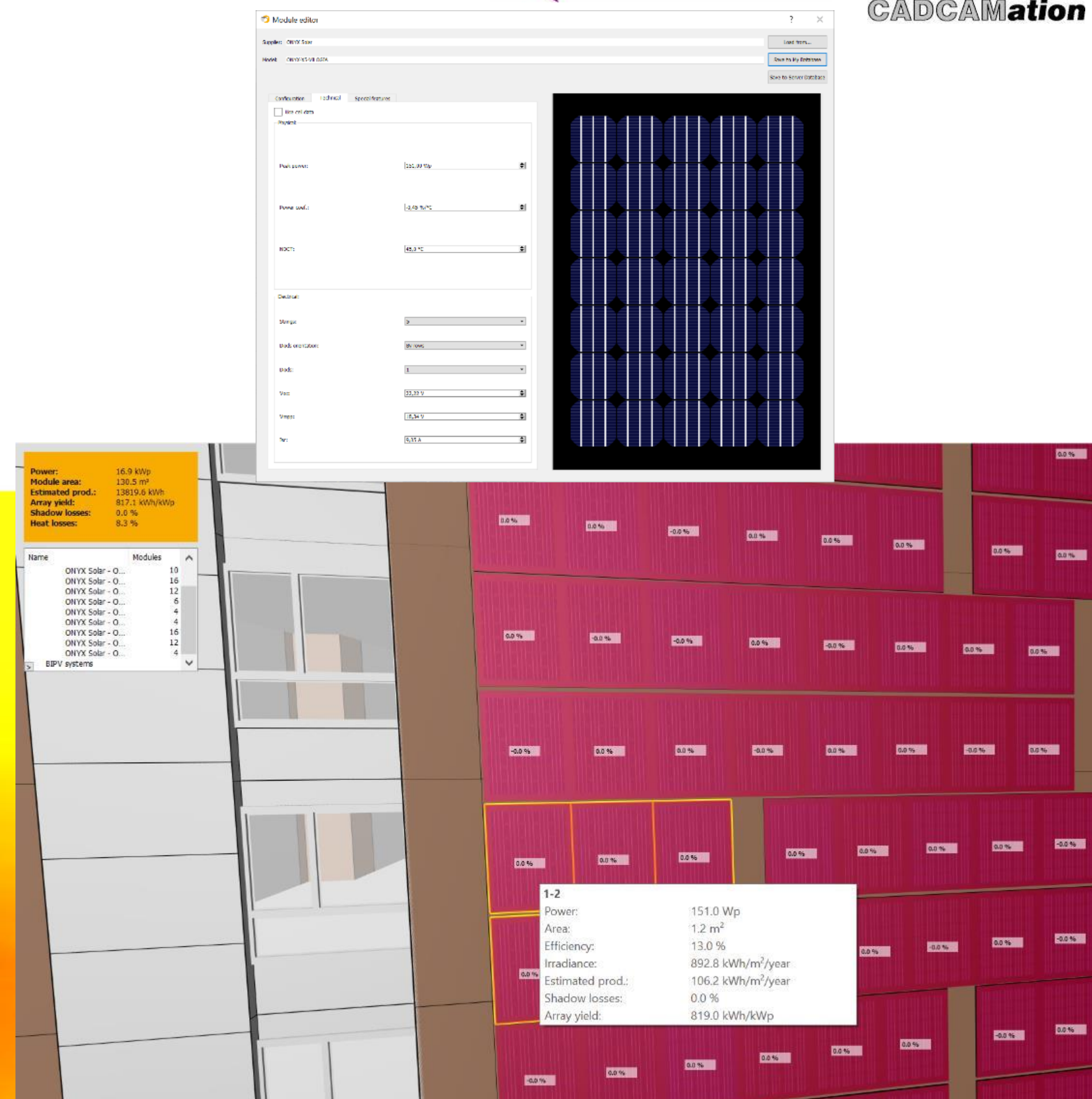
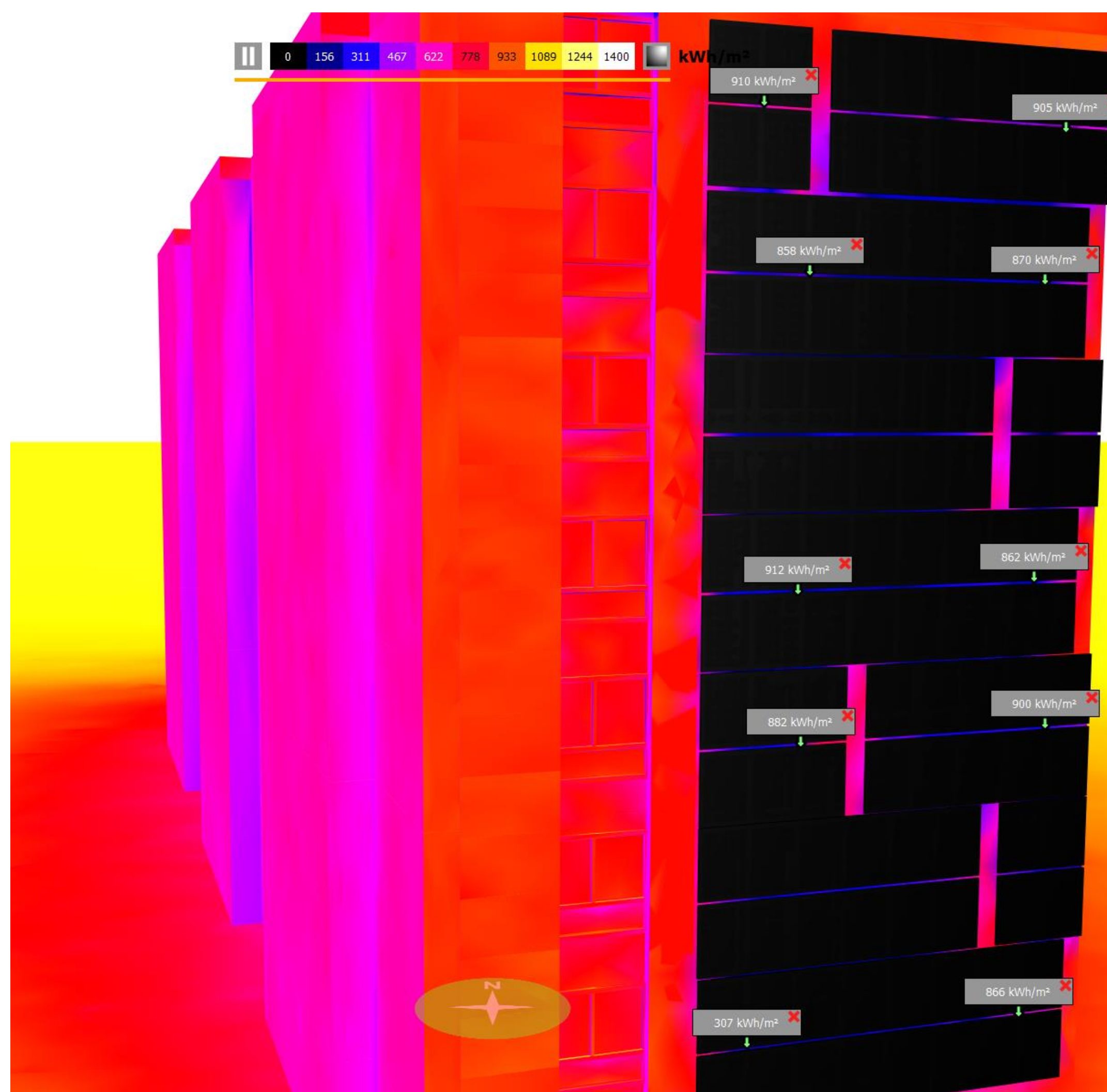
Opaque ventilated façade PV module by ONYX

Fully opaque C-Si glass-glass module, 151 Wp power, with hidden bus bars and L interconnection.



Solar inverter by TECNALIA

3-phase DC-coupled PV storage inverters 10 kW power, with advanced MPPT system, battery DC current/voltage regulation, and active and reactive current AC power regulation for grid-connected operation.



> 5. Apartments building: real



> 6. Office building-San Sebastian

Location	San Sebastian (Spain)
Typology	Office building
Area	162 m2
Floors	4

Characteristics

TECNALIA office building with laboratories. The most suitable zone for BIPV are the offices zone located in the 2nd and 3rd floors.



Area available for BIPV

Polygonal section façade with a glass cladding. The irregular geometry of the facades requires a special design effort to carry out the architectural integration, as well as a well conceived electrical connecting strategy.

Orientation:

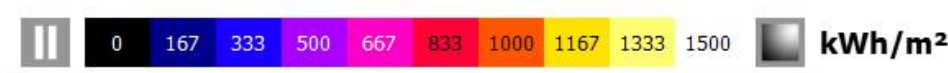
$(-1^{\circ}$ to $+4^{\circ}$) (S) & $(-31^{\circ}$ to -36° (SE)

Inclination: 90° .

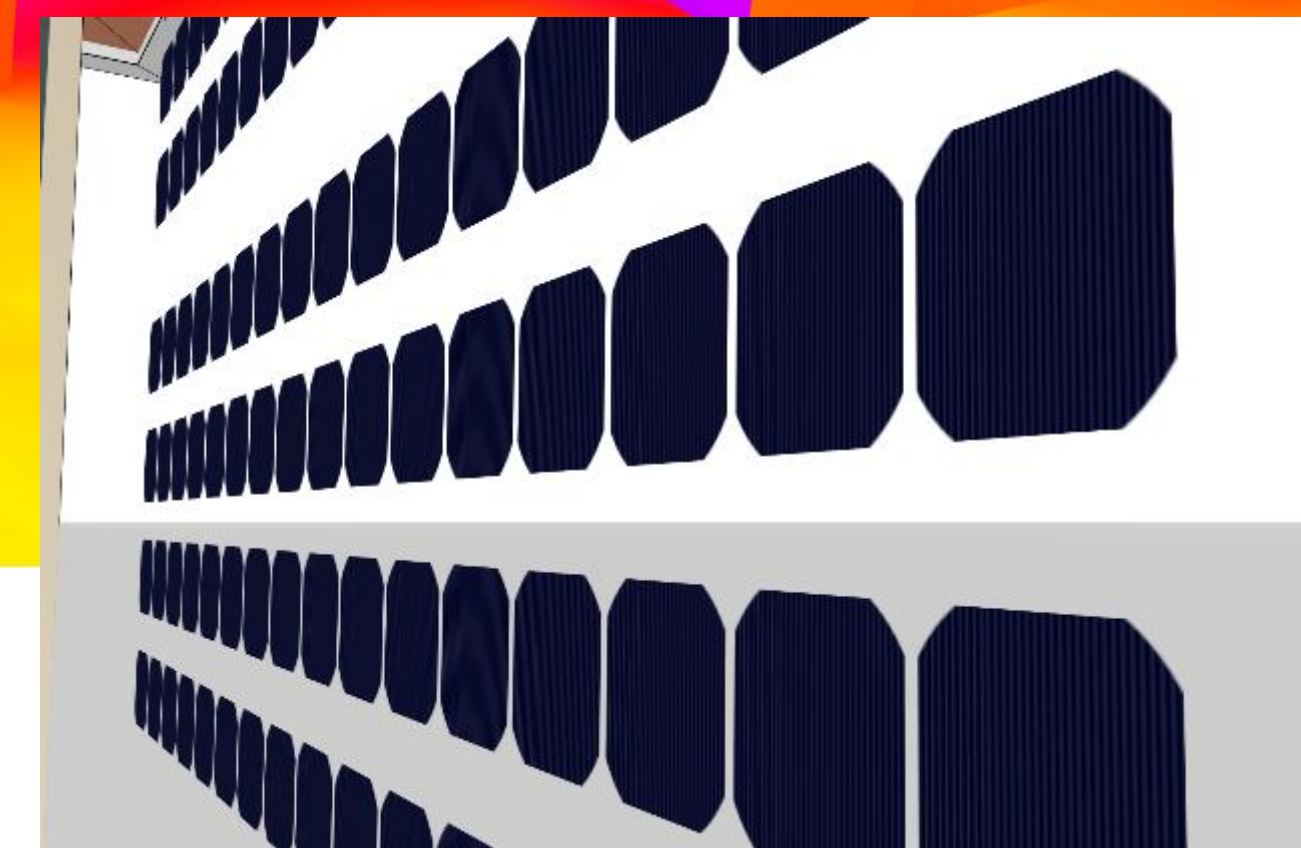
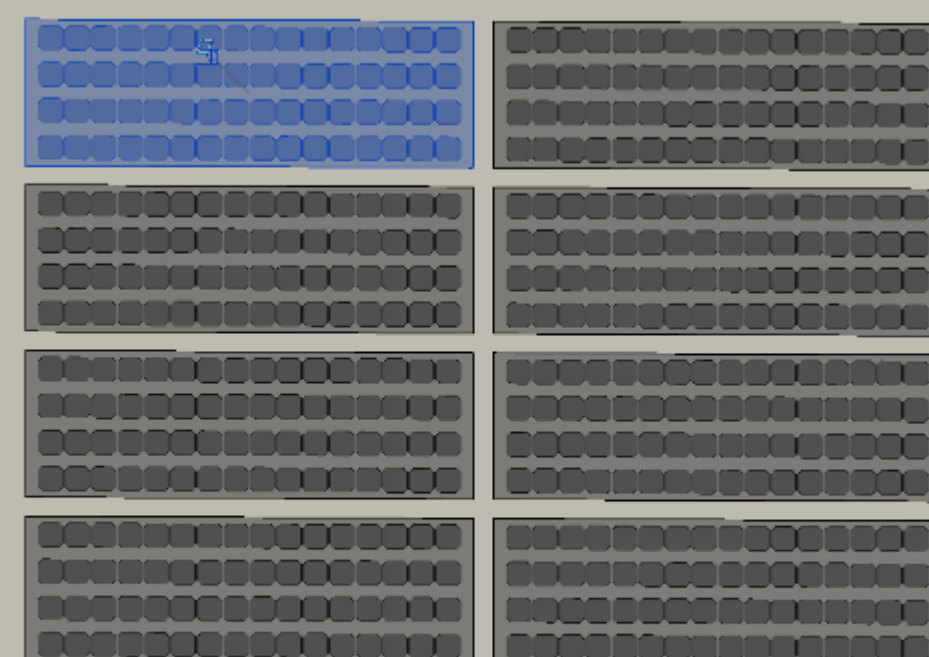
> 6. Office building: virtual



PVsites



Équipement spécialisé (1)	
Contraintes	
Décalage	52.44
Plan de construction	Screen assistant
Matériau et finition	
Glass_mat1	View, vitrage transparent
Glass_mat2	View, vitrage transparent
Électrique	
Module peak power (Wp)	192.000000
Module power coef (Wp/°C)	0.400000
Module Voc (V)	41.599998
Module Vmp (V)	34.880001
Module Isc (A)	5.700000
Cell peak power (Wp)	3.000000
Cell power coef (Wp/°C)	-0.400000
Cell Voc (V)	2.600000
Cell Vmp (V)	2.180000
Cell Isc (A)	1.425000
NOCT (°C)	45.000000
Décritique - Charges	
Panneau	
Nombre de circuit	
Cotes	
Cell_height	2.00
Cell_lengthX	12.50
Cell_lengthY	12.50
Cell_thickness	0.18
Frame_height	1.00
Frame_thicknessX	0.00
Frame_thicknessY	0.00
IparrX	75.00
IparrY	275.00



> 6. Office building: real



PVsites



> CONCLUSIONS

- ✓ Main efforts put on products virtualization
- ✓ Collaborative digital workspace: design, simulation, calculation
- ✓ BIM-readiness from element to building level
- ✓ Web platform to retrieve every digital asset

www.bim-solar.com

**PUBLIC RELEASE
1/7/2020**

> **THANK YOU for your
ATTENTION!**



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