Moreelse Solar Monuments

Studio Ossidiana
Alessandra Covini
Giovanni Bellotti

Moreelse
Solar
Monuments

Contents

Moreelse Solar Monuments

This book is the result of a three month research, initiated by Studio Ossidiana following an invitation from the Young Innovator Program. We were asked to research ways to integrate solar panels and solar collectors to monuments, working on Moreelse, a case study area in Utrecht.

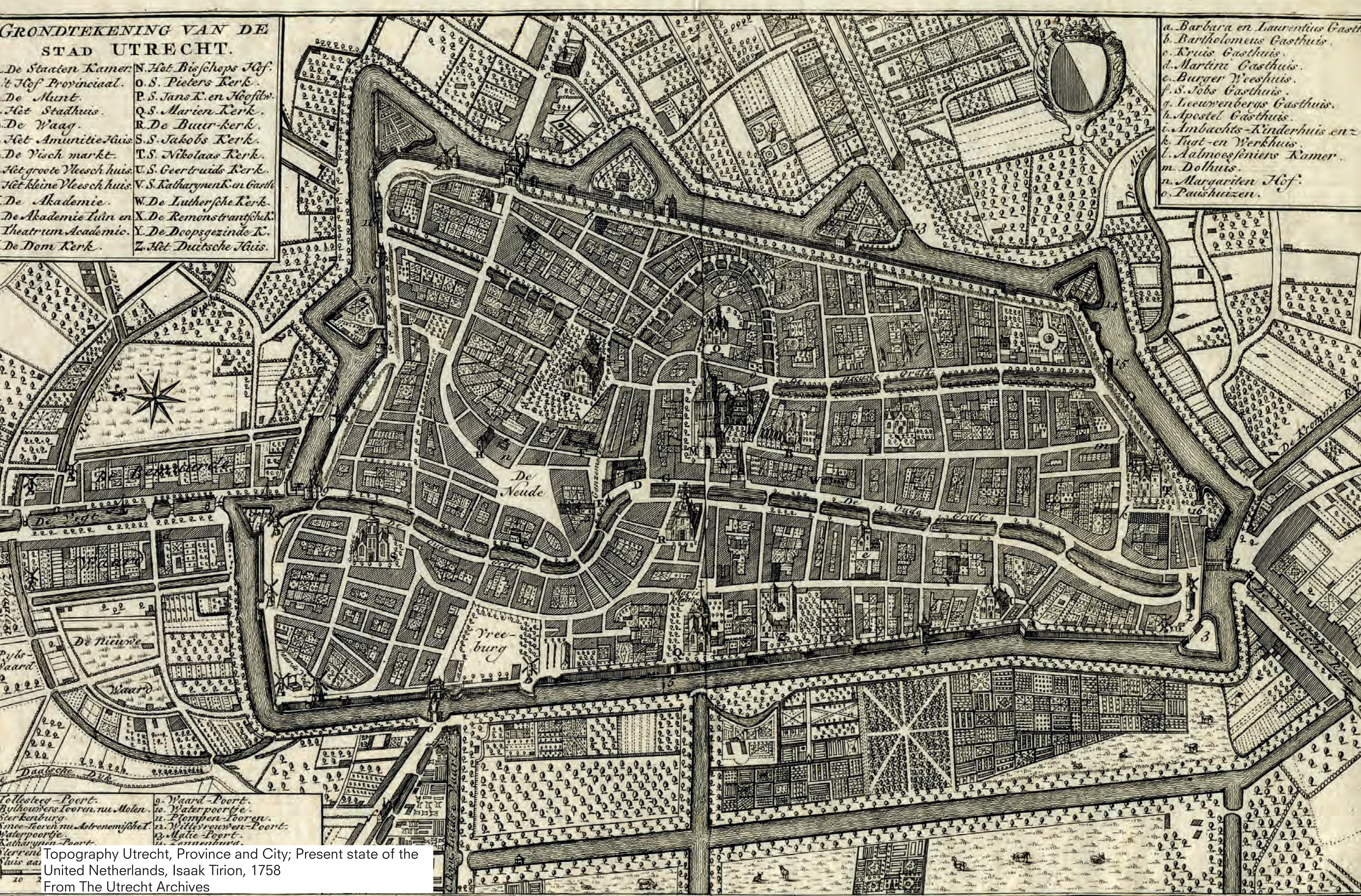
Moreelse is a neighborhood close to the central station, mainly occupied by governmental buildings, within which there are a series of listed buildings, for which conventional strategies of integration with renewable energy system are difficult, if not impossible to apply. The area is currently the subject of an experimental energy masterplan, which aims to transform the historical neighbourhood, once the site of gardens and *lusthoven*, into a carbon neutral, water retaining, public space oriented site.

As conventional techniques (solar panels on roofs, better insulation, new glazing and windows) are not compatible with listed buildings, where little to no modifications are allowed on both the exterior and the interior the project had to question the meaning of sustainability and preservation, and seemed to find an alternative to the typical concealment of technology in preservation projects. We addressed this issue by proposing sustainability itself as a possible form of monumentality, questioning and developing the aesthetics of the technology, and thinking of the design as the space where to rethink the material culture of PV, as well as the place where proposals about its future can be formulated.

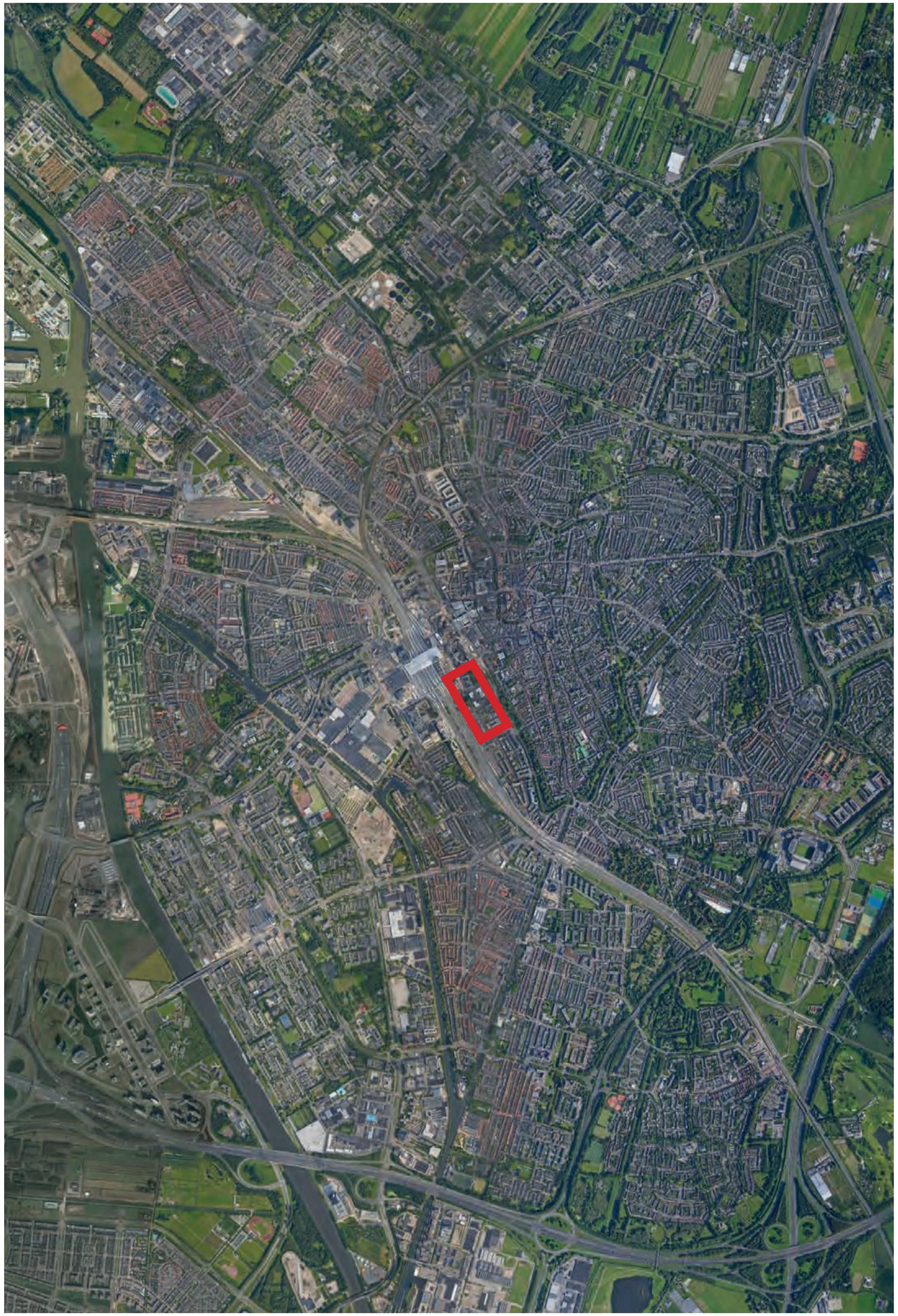
As we researched solar panel technology, the ambition and culture behind them, we began to understand these projects, especially when carried out a at a grand, public scale, to constitute true monuments of our time, reflecting our ambitions, fears, and representative of an emerging aesthetic, that would, in time, inform taste and fashion, and produce new ideas of beauty. We believe that this form of emerging monumentality should be in dialogue with the historical monumentality of places like Moreelse, and that design could be the common language for this exchange, where the result of the dialogue should not be a compromise, but a new form of sustainability, where the utilitarian could become decorative, and the formal could become functional.

We present here a series of strategies illustrating the concept, precedents, strategies, and an overview of the current and upcoming PV systems, as well as a series of working prototypes developed by Studio Ossidiana in collaboration with TU Delft, which reimagine PV cells as a material that can be woven and cast, into solar curtains and solar terrazzo.

Moreelse as a Garden



Topography Utrecht, Province and City; Present state of the United Netherlands, Isaak Tirion, 1758
From The Utrecht Archives

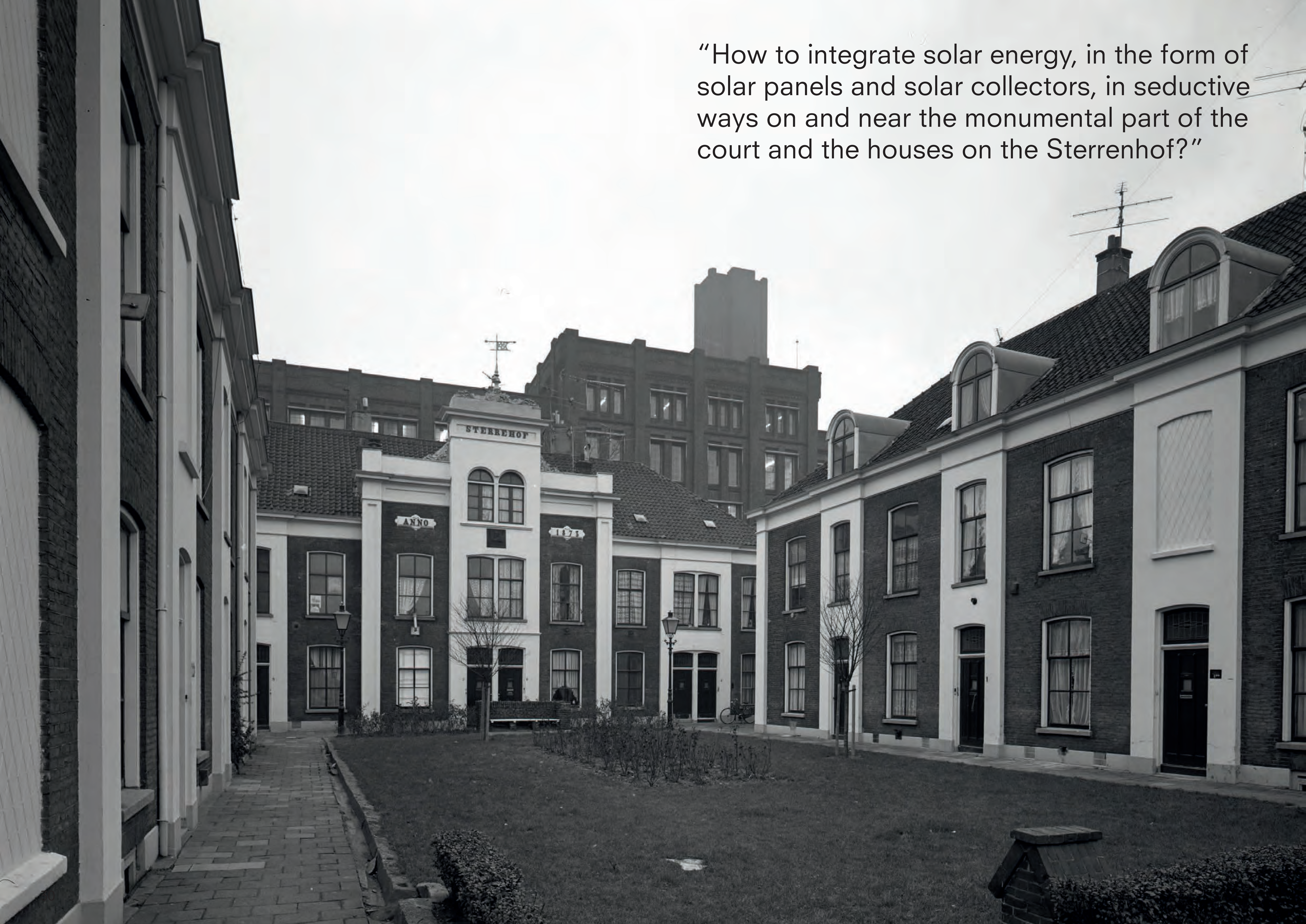


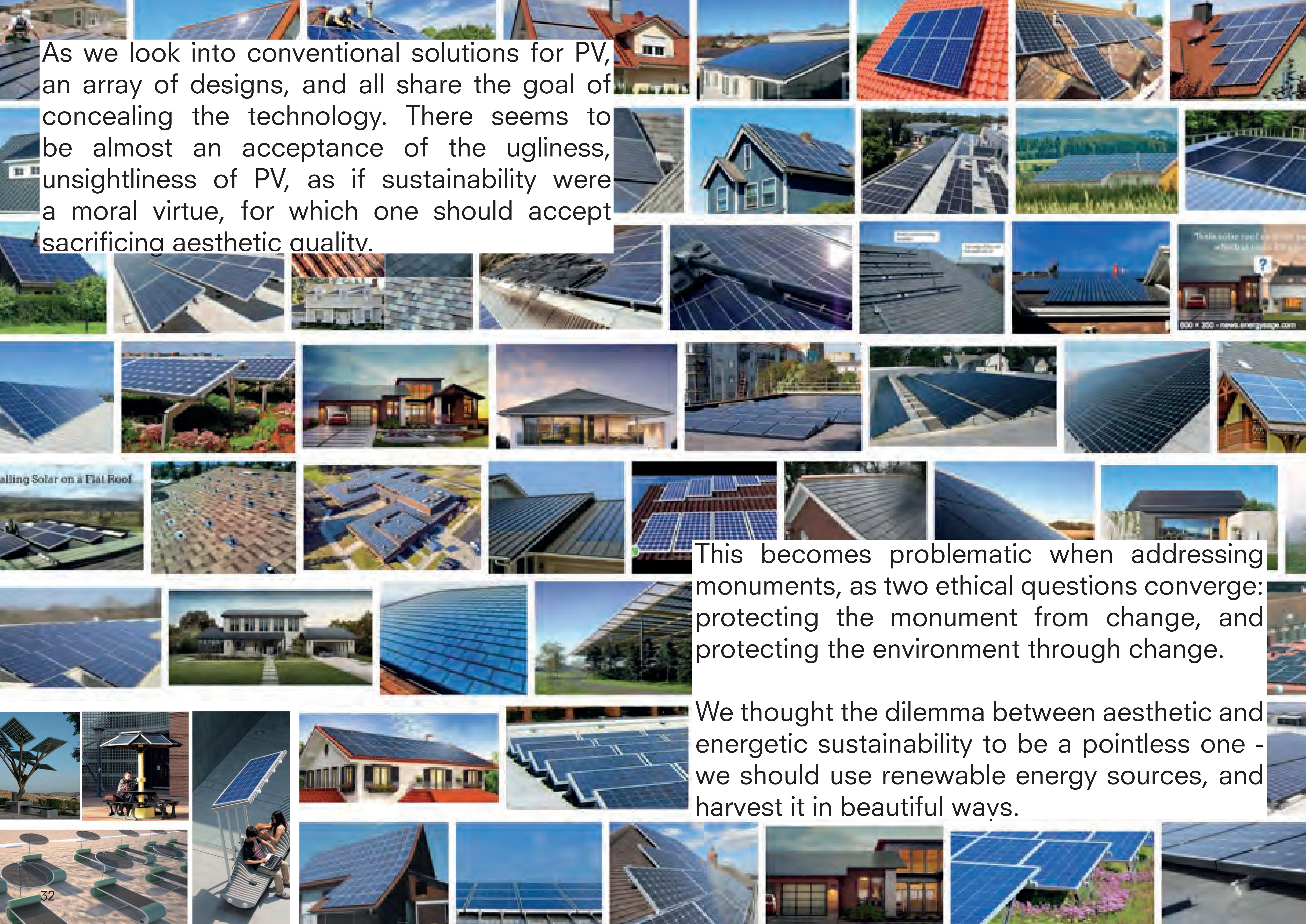
The Monuments (in red) in Moreelse and the institutional buildings. The Sterrenhof is, today, one of the few residential buildings in the area.

Around the Sterrenhof and Justitiaplein, monuments, public and semi public spaces. Photos by the authors.

New Monuments

“How to integrate solar energy, in the form of solar panels and solar collectors, in seductive ways on and near the monumental part of the court and the houses on the Sterrenhof?”

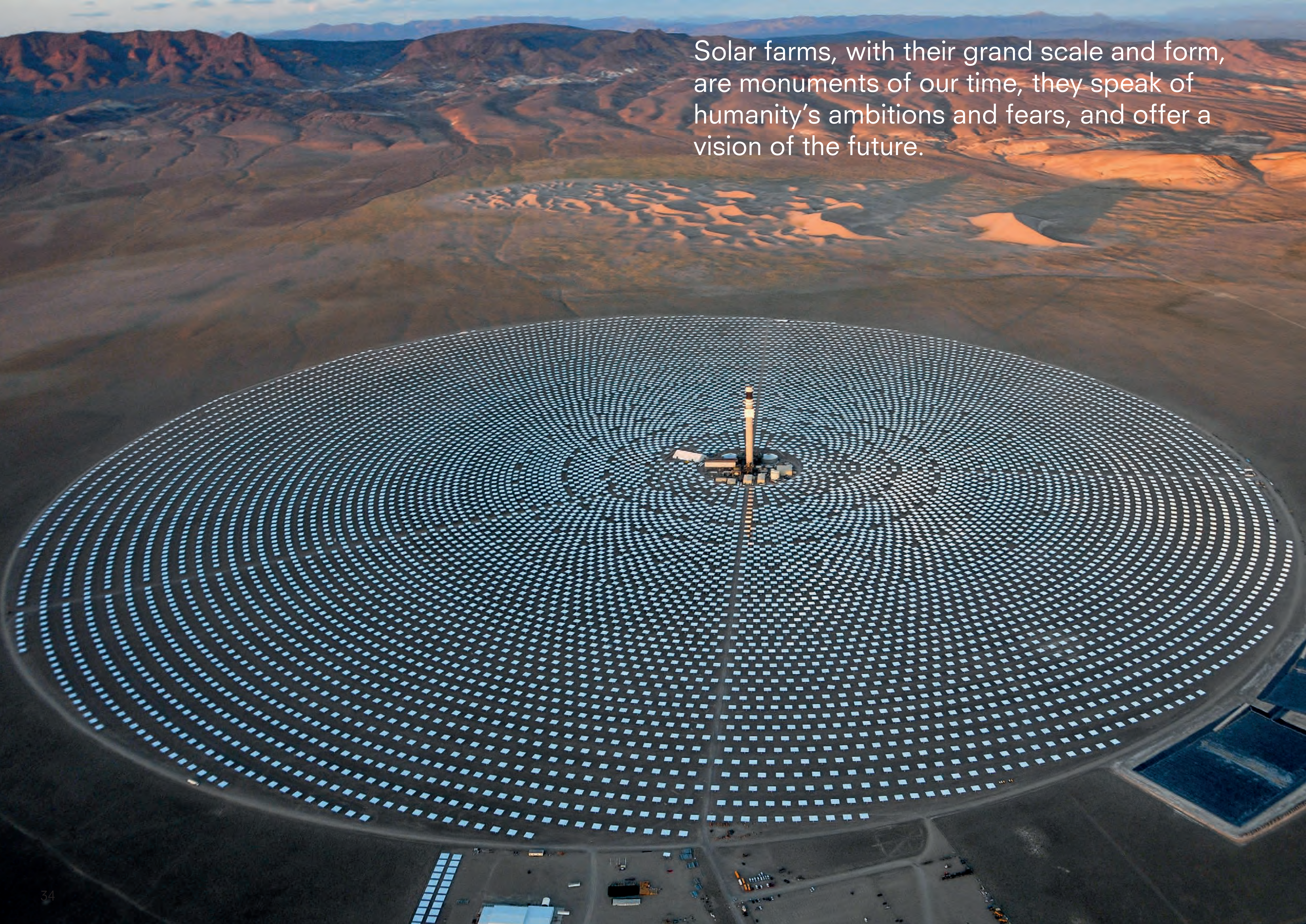




As we look into conventional solutions for PV, an array of designs, and all share the goal of concealing the technology. There seems to be almost an acceptance of the ugliness, unsightliness of PV, as if sustainability were a moral virtue, for which one should accept sacrificing aesthetic quality.

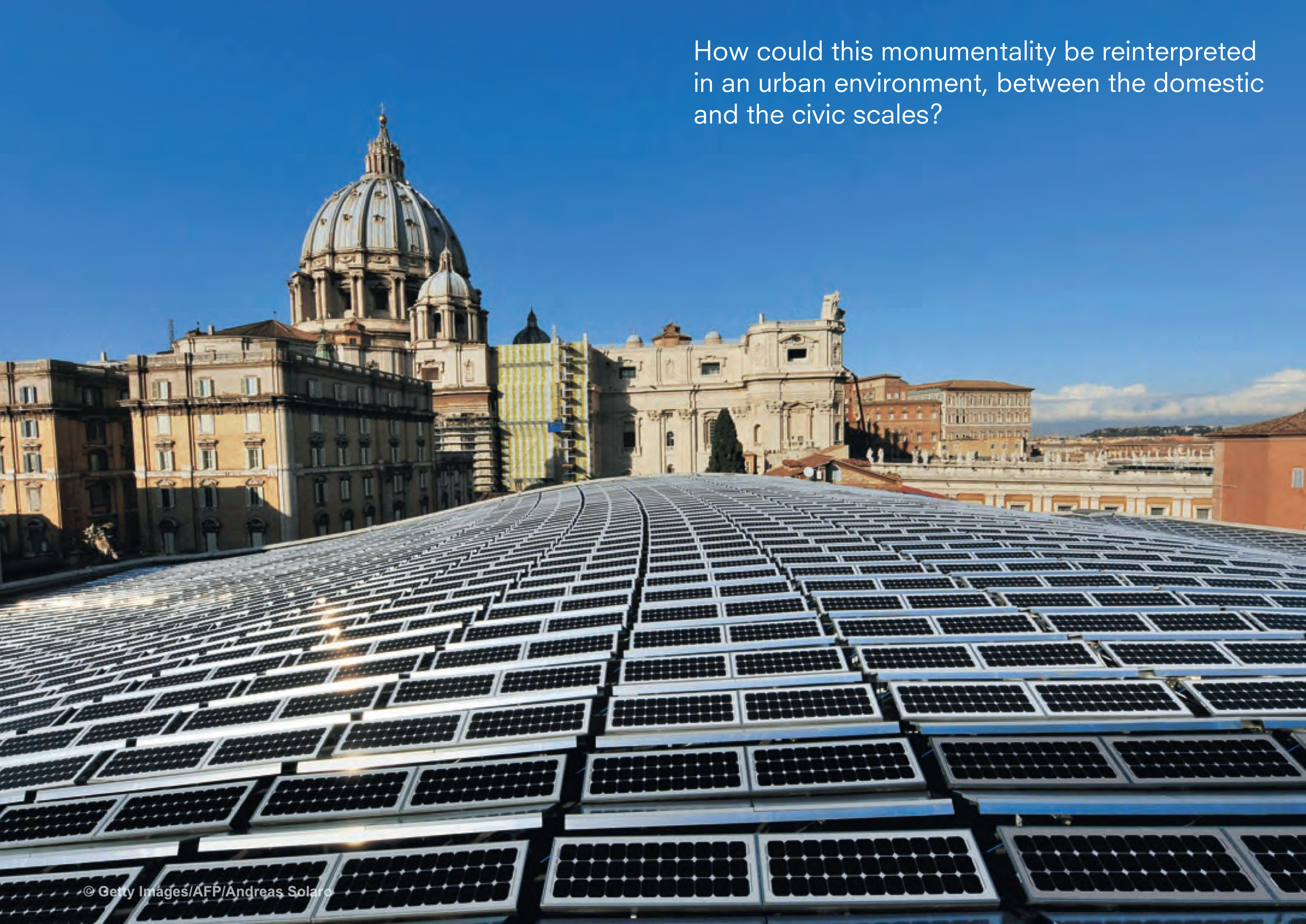
This becomes problematic when addressing monuments, as two ethical questions converge: protecting the monument from change, and protecting the environment through change.

We thought the dilemma between aesthetic and energetic sustainability to be a pointless one - we should use renewable energy sources, and harvest it in beautiful ways.

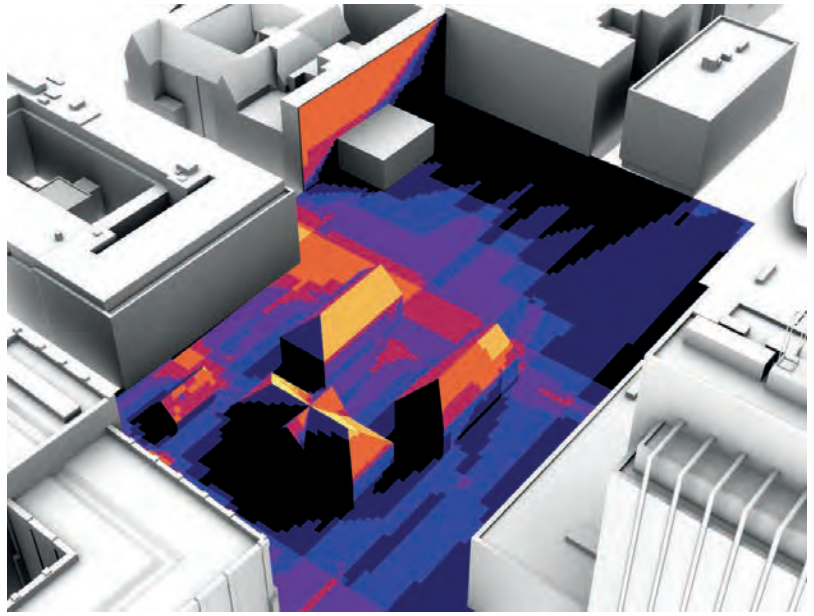


Solar farms, with their grand scale and form, are monuments of our time, they speak of humanity's ambitions and fears, and offer a vision of the future.

How could this monumentality be reinterpreted in an urban environment, between the domestic and the civic scales?



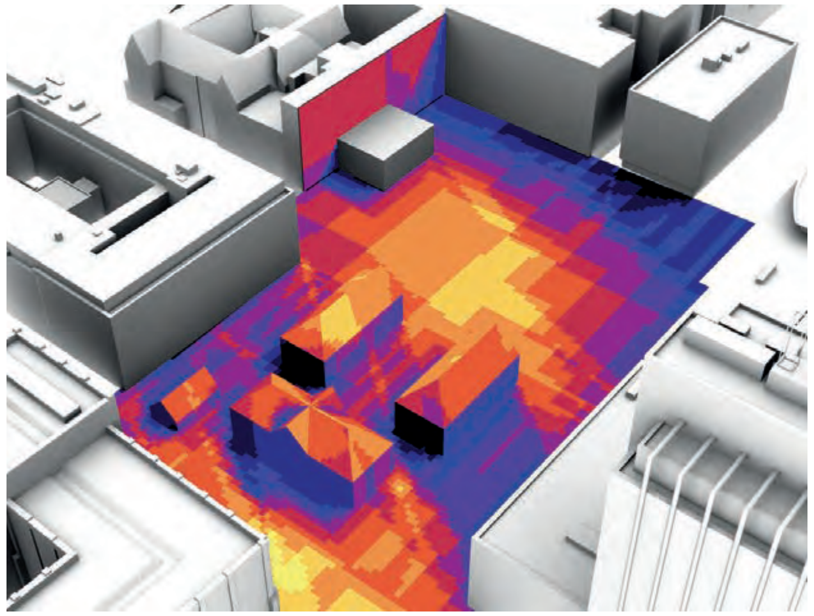
Analysis



21 Feb
Sunrise 07:44
Sunset 18:04
Total 10:19

To understand the spatial implications of solar energy, we visualized the radiation on the site, and approximated potential energy production following a sequence of scenarios.

We considered solar cells with an efficiency between 22% and 11%, depending on the light conditions.



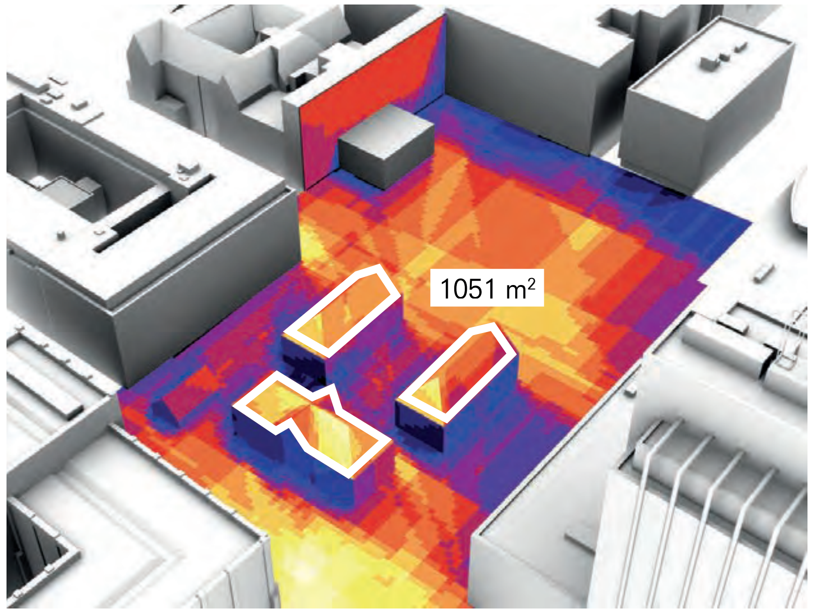
21 Apr
Sunrise 06:30
Sunset 20:48
Total 14:18

The average Dutch household consumes approximately 4000 kWh per year*.

<u>*E = A * r * H * PR*</u>

E = Energy (kWh)
A = Total solar panel Area (m2)
r = solar panel yield or efficiency(%)
H = Annual average solar radiation on tilted panels (shadings not included)
PR = Performance ratio, coefficient for losses (range between 0.5 and 0.9, default value = 0.75)

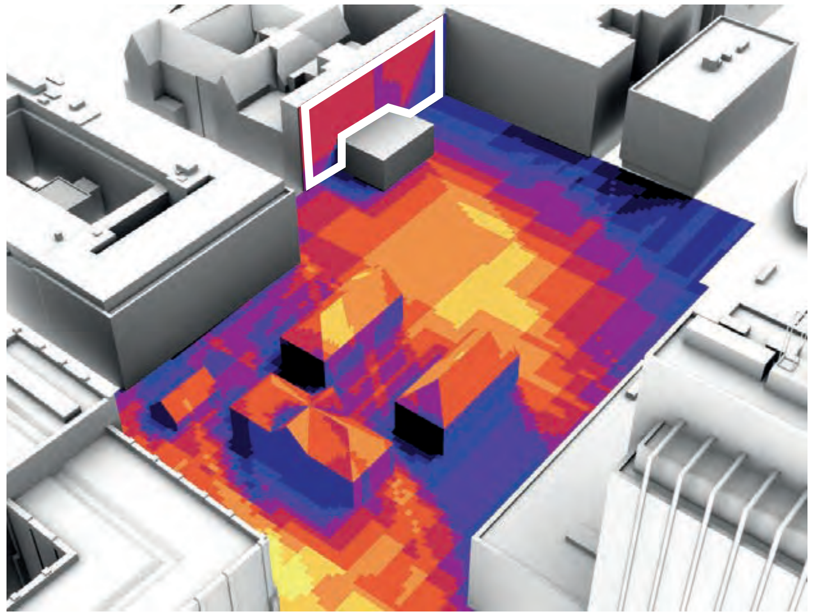
* https://www.worlddata.info/europe/netherlands/energy-consumption.php



21 Jun
Sunrise 05:18
Sunset 22:06
Total 16:48

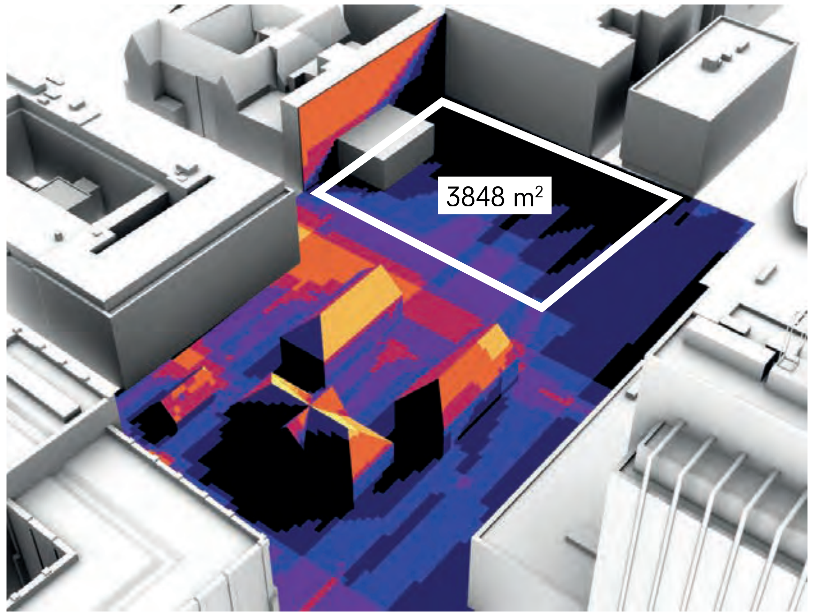
If all roofs of the Sterrenhof were covered with PV, the area would produce 106.455 kWh per year, enough for 27 average households*.
We considered solar cells with an efficiency between 22% and 11%, depending on the light conditions.

* average household in the Netherlands is 2,15 people



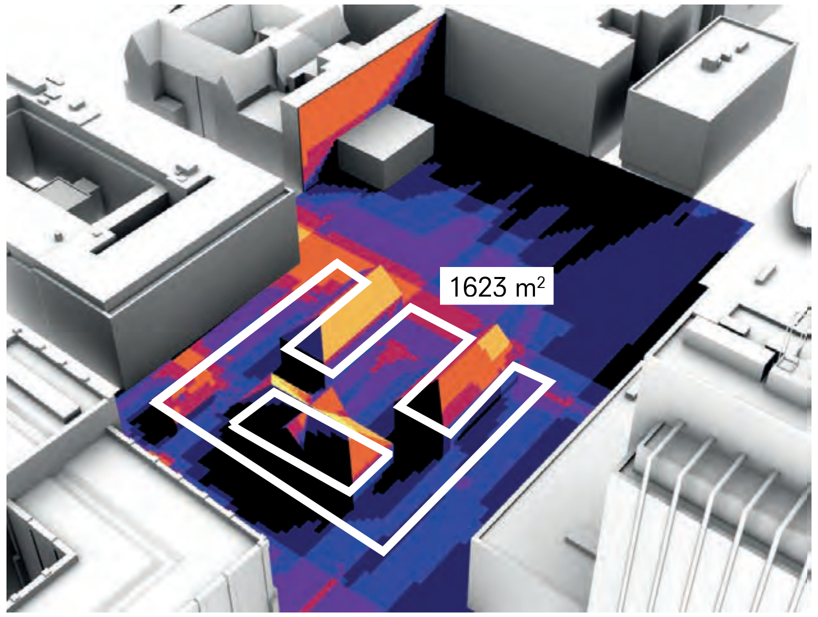
21 Aug
Sunrise 06:32
Sunset 20:53
Total 14:21

If the facade of the palace of Justice was entirely covered in PV, it would yield 42.550 kWh per year, enough for 10 households.



21 Oct
Sunrise 08:15
Sunset 18:33
Total 10:18

If Justitiaplein was covered in PV, the yield of 186.448 kWh per year would be enough for 46 households.



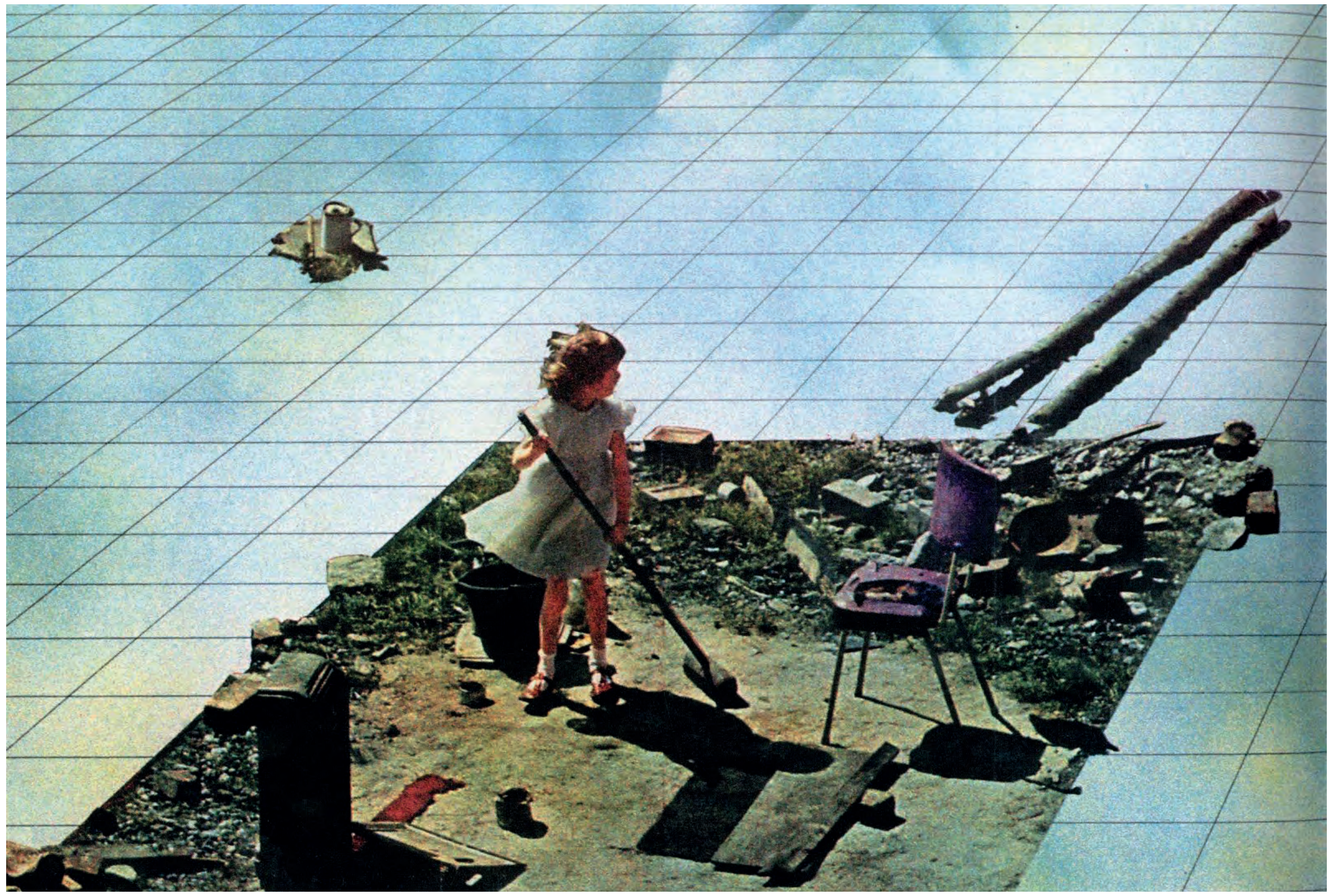
21 Dec
Sunrise 08:47
Sunset 16:28
Total 07:41

If all the Sterrenhof Gardens were covered in PV, the yield of 93.451 kWh per year would match the energy demand of 62 people.

Solar Terrazzo

Case Studies

Dimitris Pikionis, Paving to the Acropolis, Athens



Superstudio, Monumento Continuo

Superstudio, Monumento Continuo

Aldo van Eyck, Playground, Amsterdam

Platio, Solar panel paving, Budapest

Solar Panel Road, France

Solar Bike Lane, Amsterdam

Platio, Solar panel paving, Budapest

New technologies offer a range of pixellated colour prints that allow to achieve different colours range, leading to re-produce any sort of colour of images

Solar Terrazzo

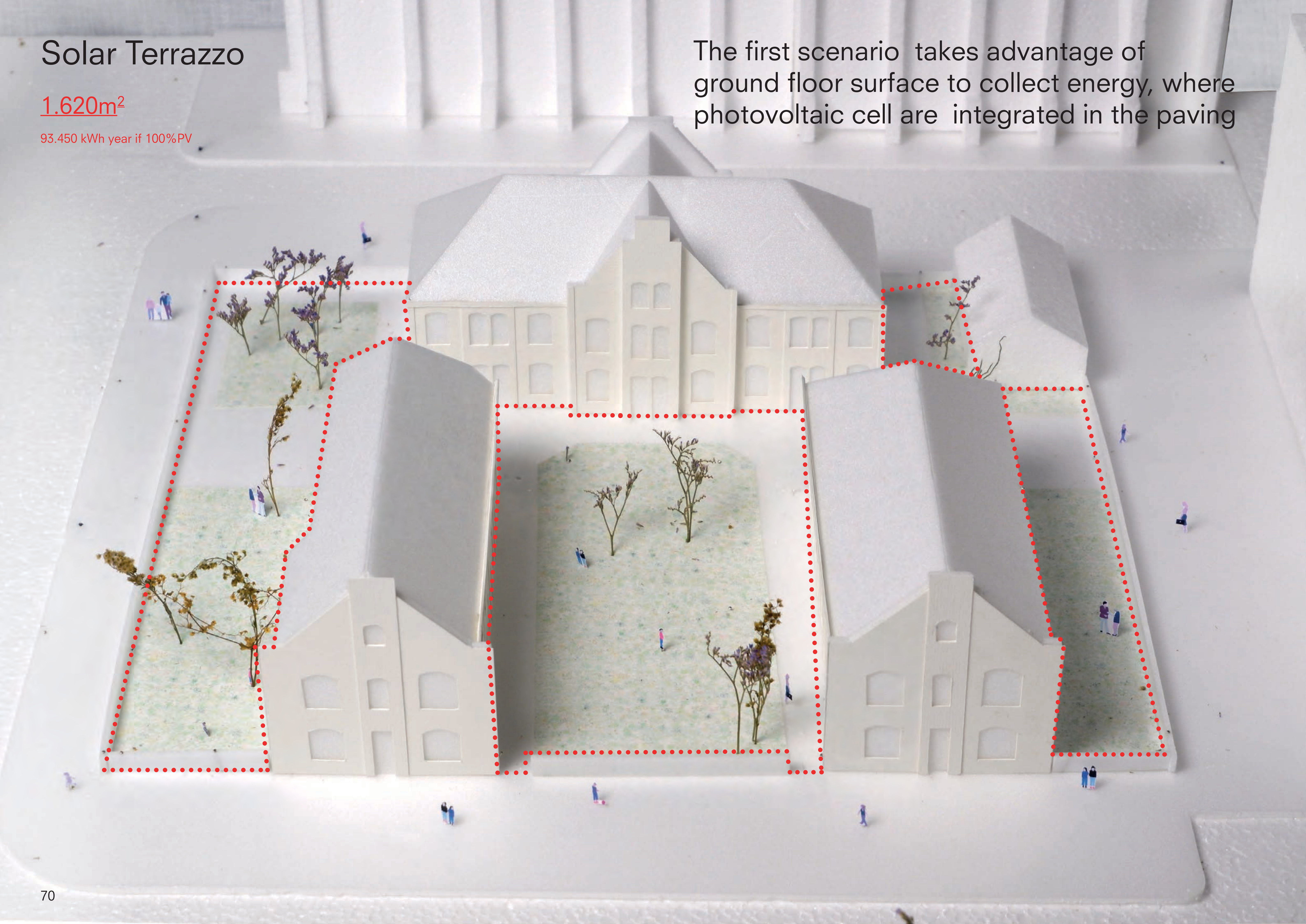
Paving

Solar Terrazzo

1.620m^2

93.450 kWh year if 100%PV

The first scenario takes advantage of ground floor surface to collect energy, where photovoltaic cell are integrated in the paving



Solar Terrazzo

390m²

15,000 kWh year if 100%PV
(average household need of 5
families)

this could be thought of as a carpet of solar cells, which could suggest uses and activities

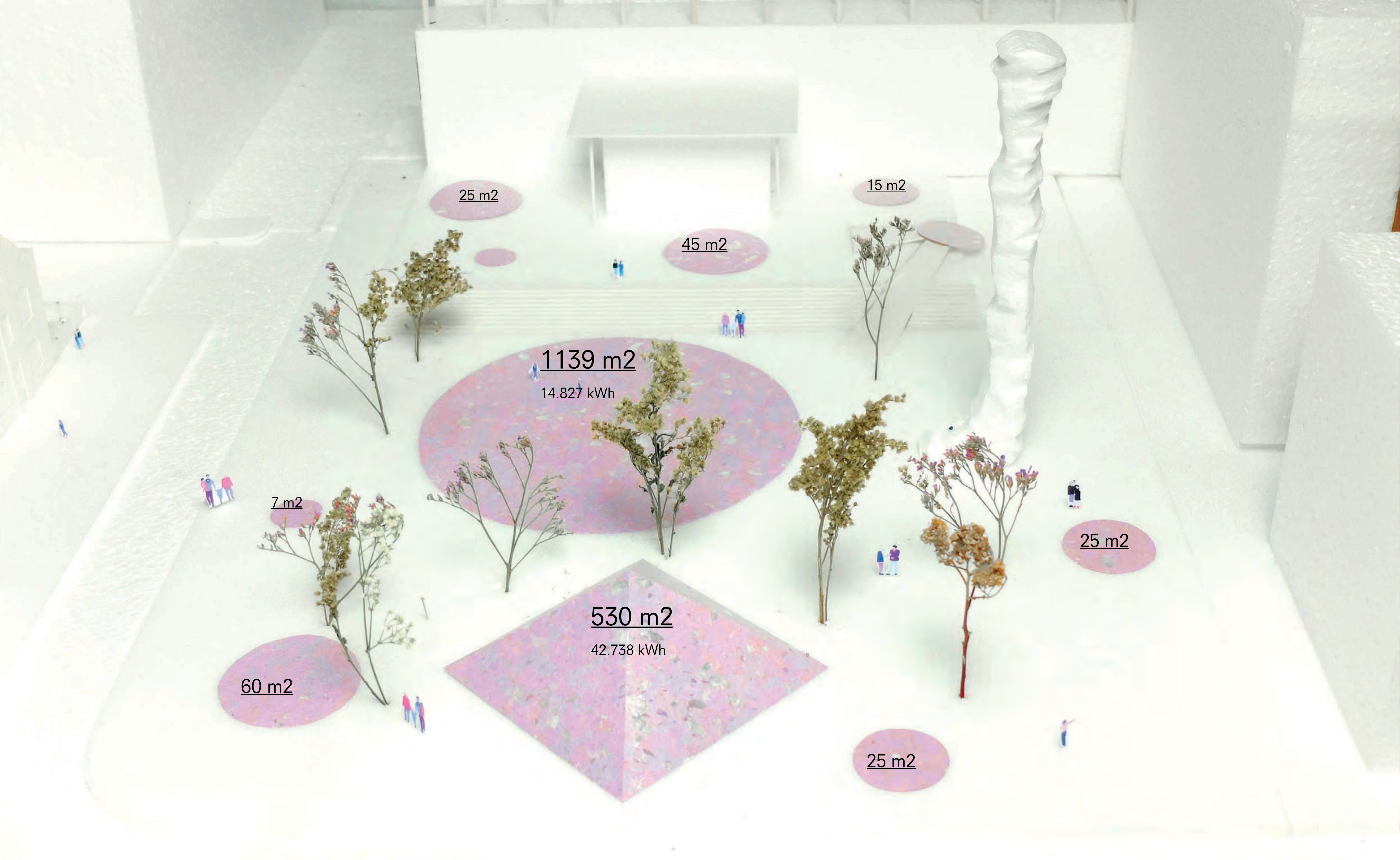
Solar Terrazzo

This strategy could aquire a civic scale

3848m^2

186.448 kWh year if 100%PV
(average household need of 48
families)

Solar Terrazzo

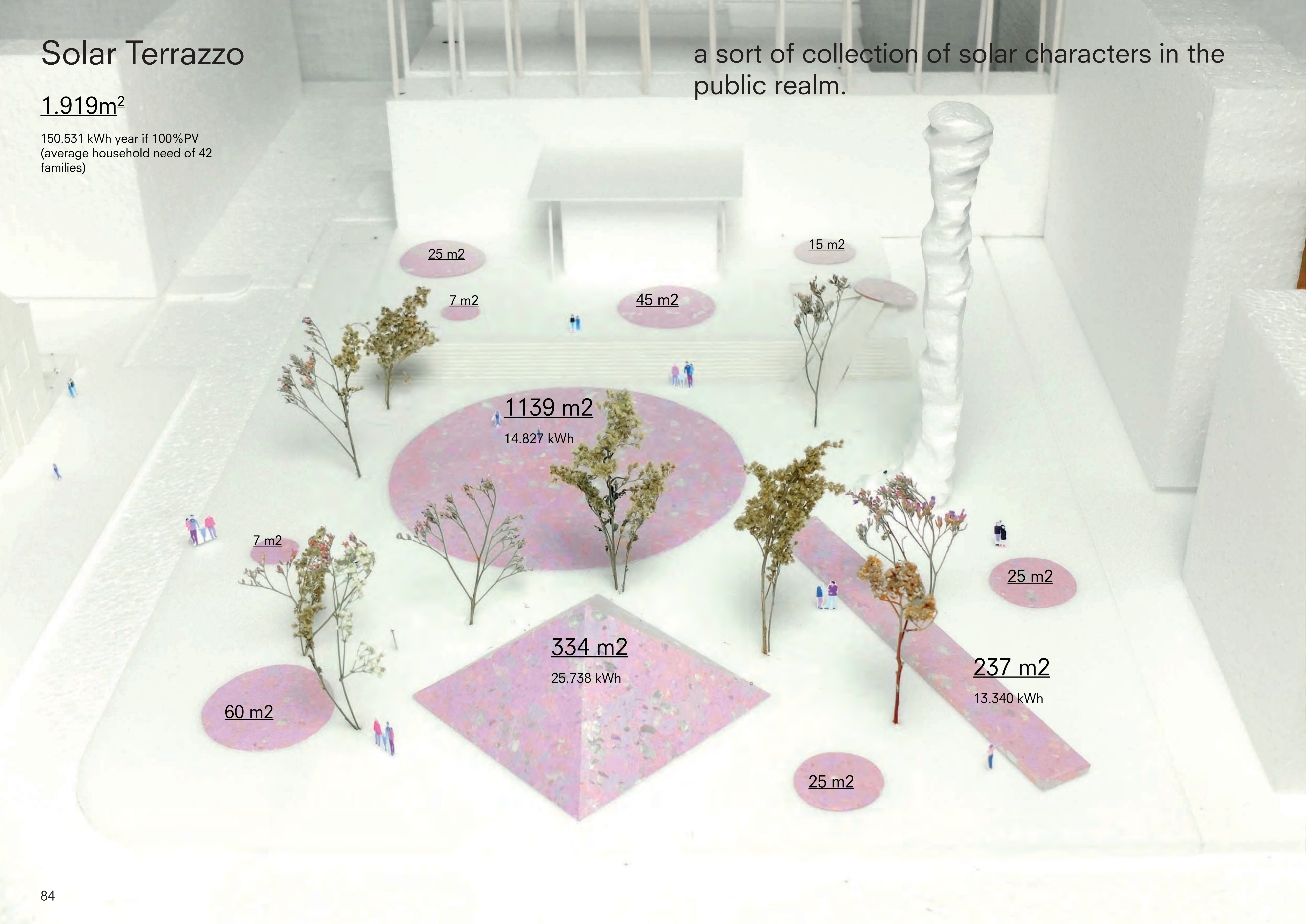


Solar Terrazzo

a sort of collection of solar characters in the public realm.

1.919m^2

150.531 kWh year if 100%PV
(average household need of 42 families)

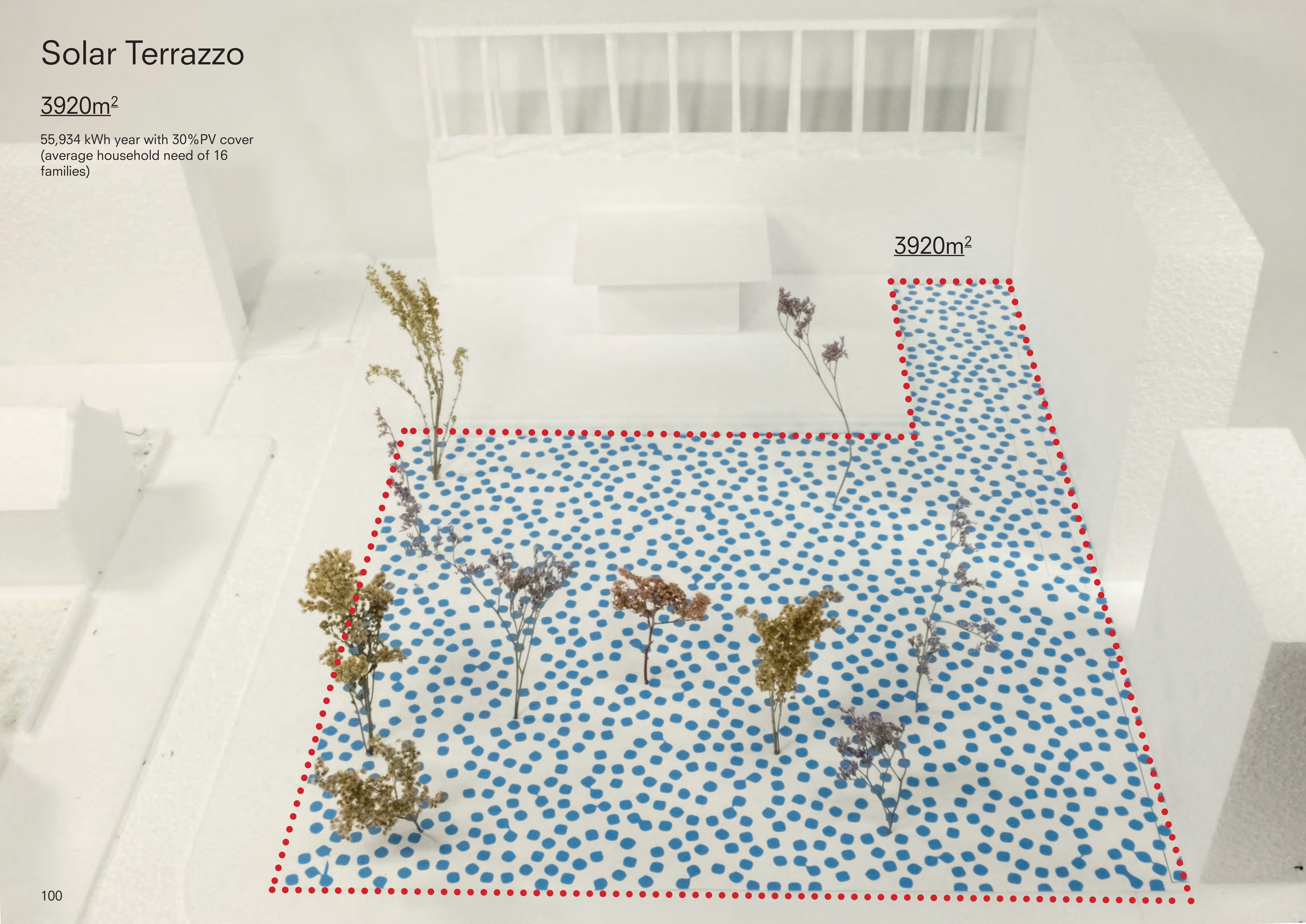


integrating with the city's strategy for the greening of Moreelse could be interesting

Solar Terrazzo

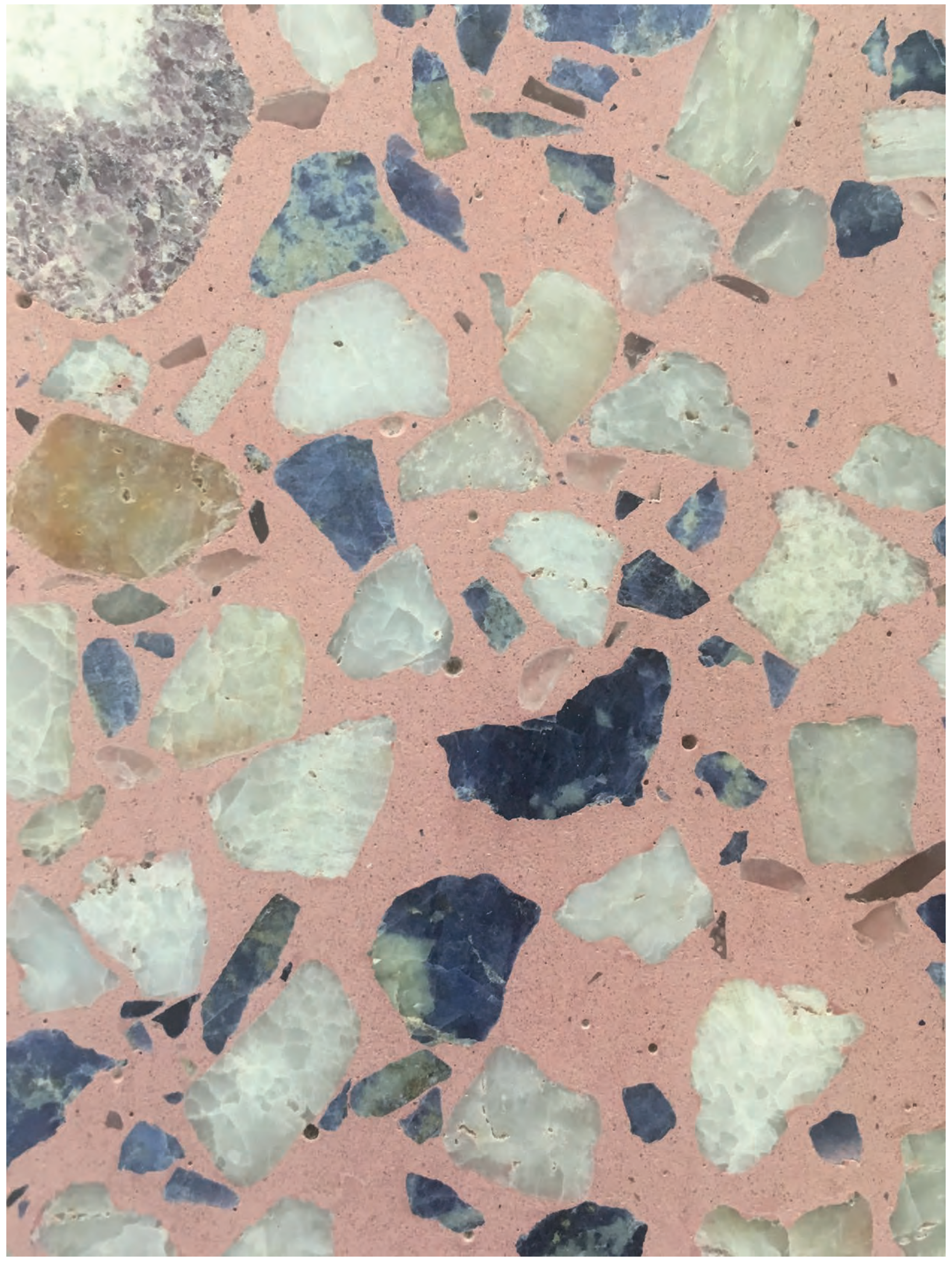
<u>3920m^2</u>

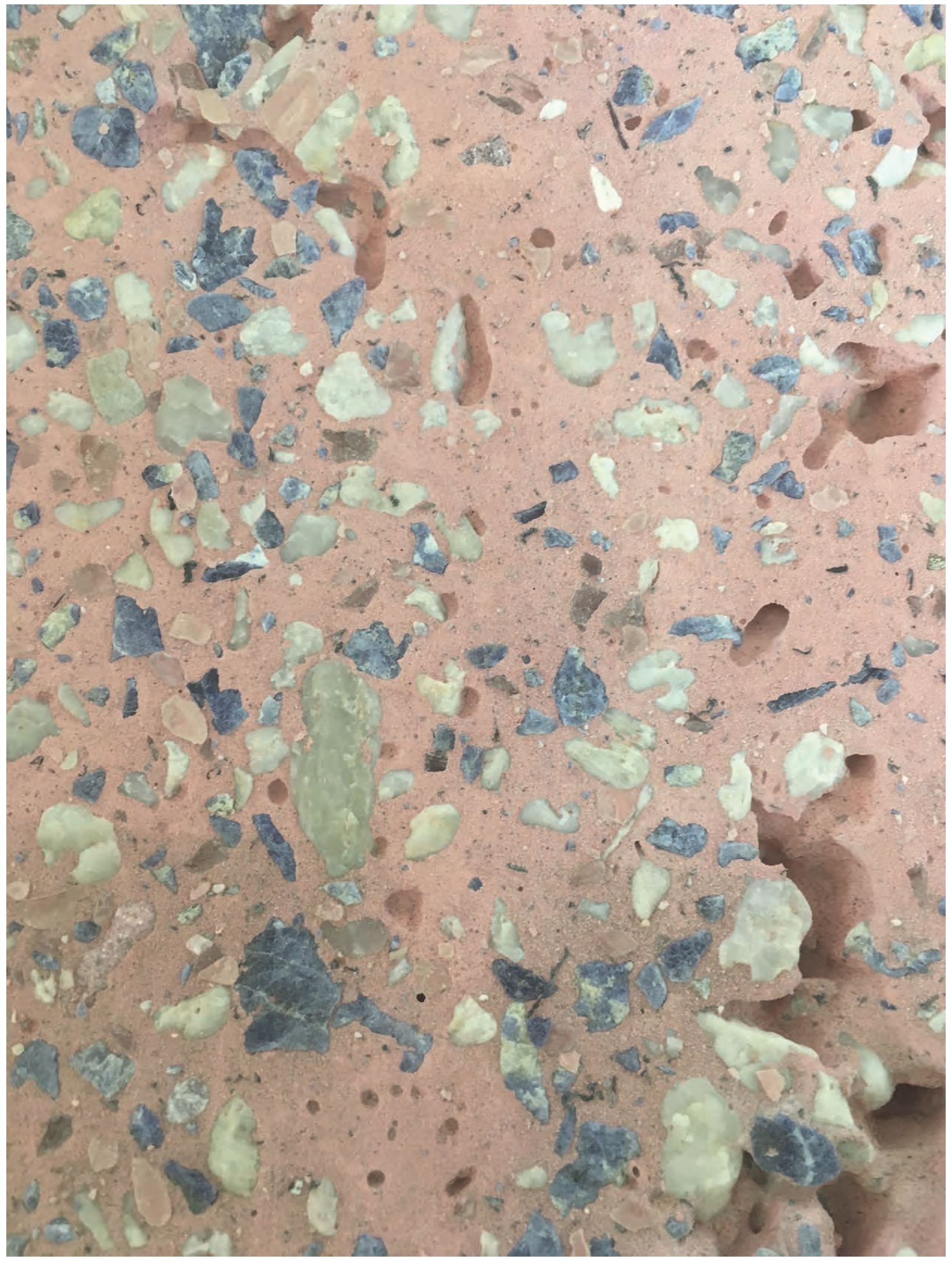
55,934 kWh year with 30%PV cover (average household need of 16 families)

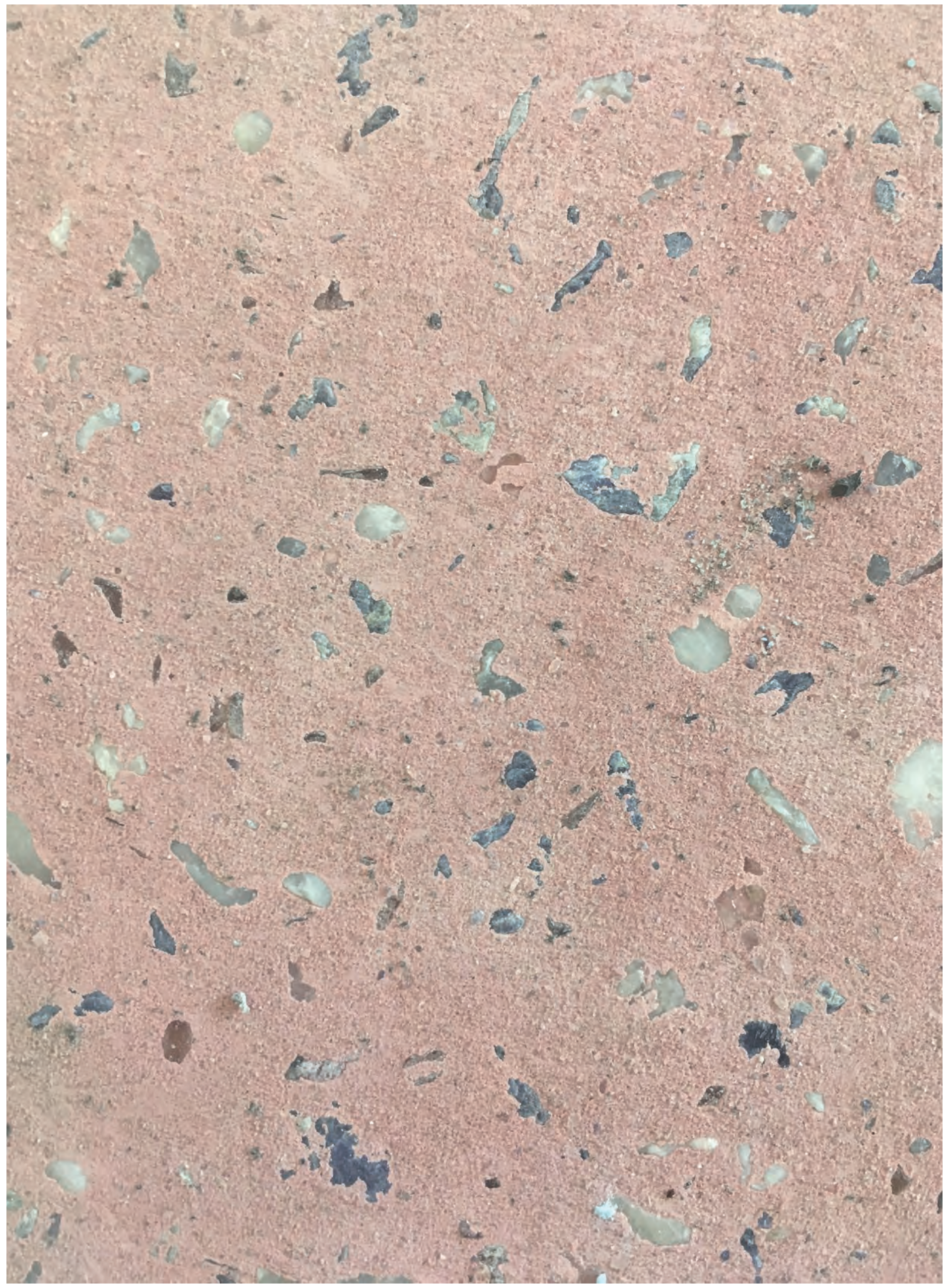


Solar Terrazzo

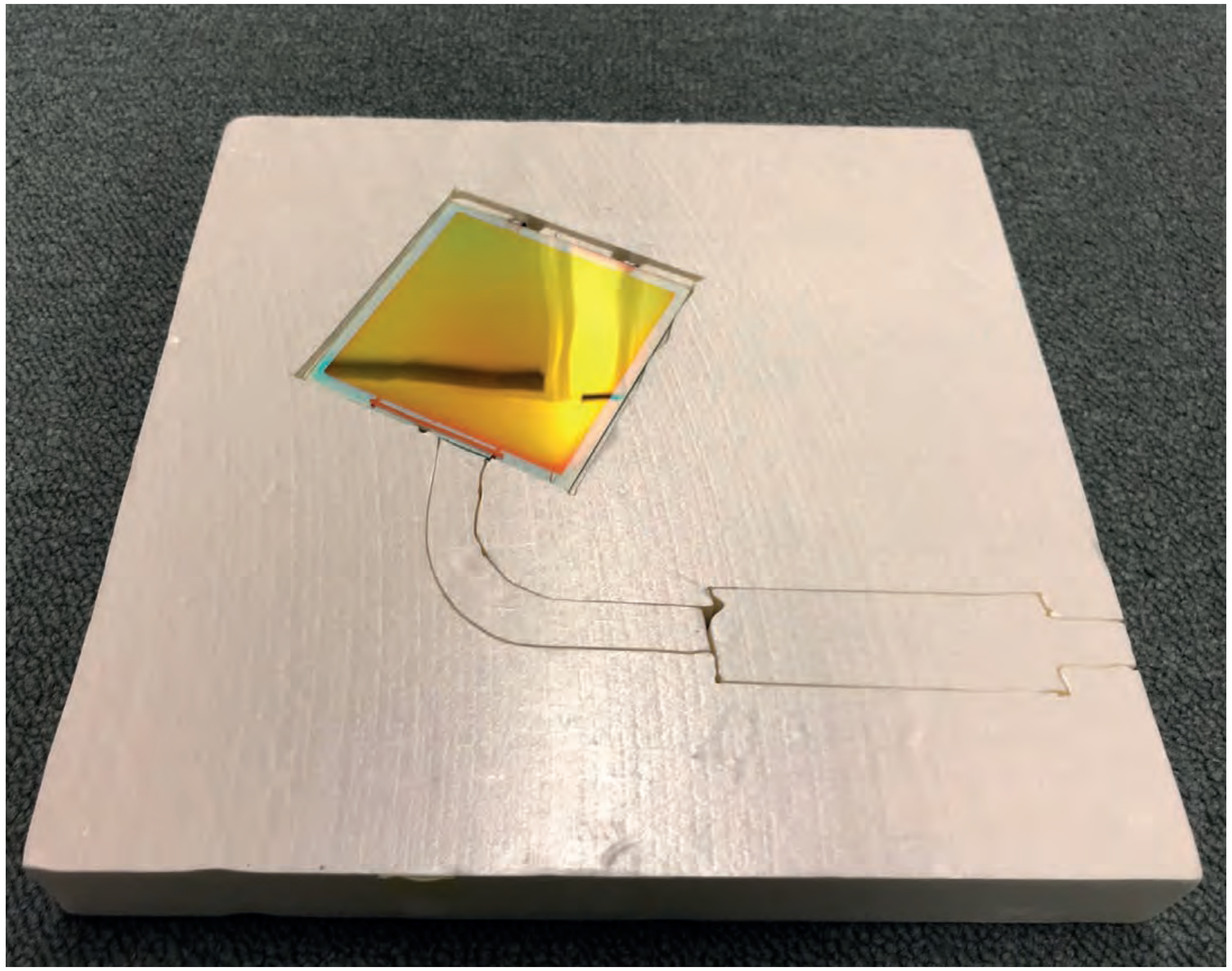
Prototypes



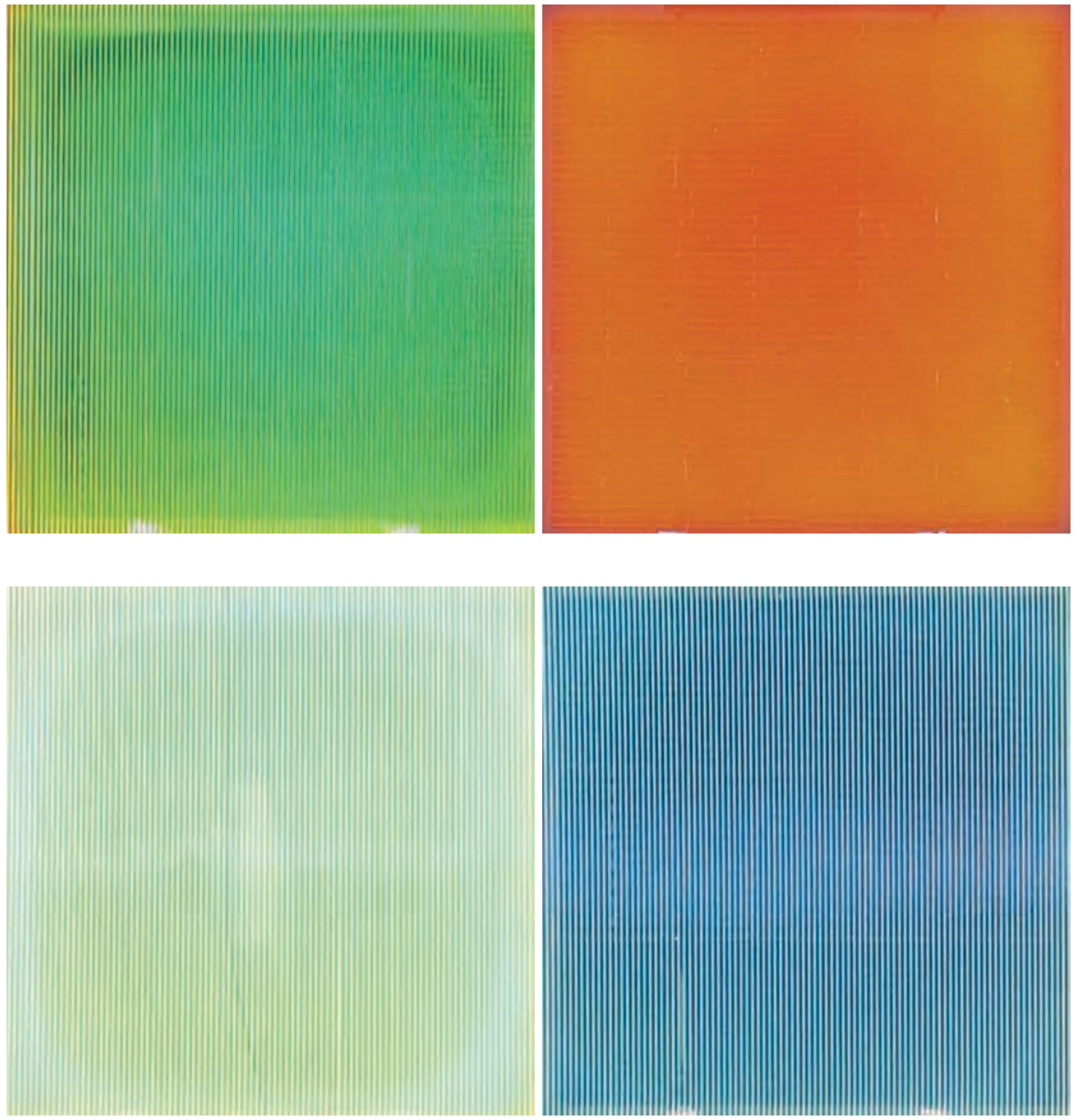




Terrazzo studies, Studio Ossidiana Workshop / TUDelft

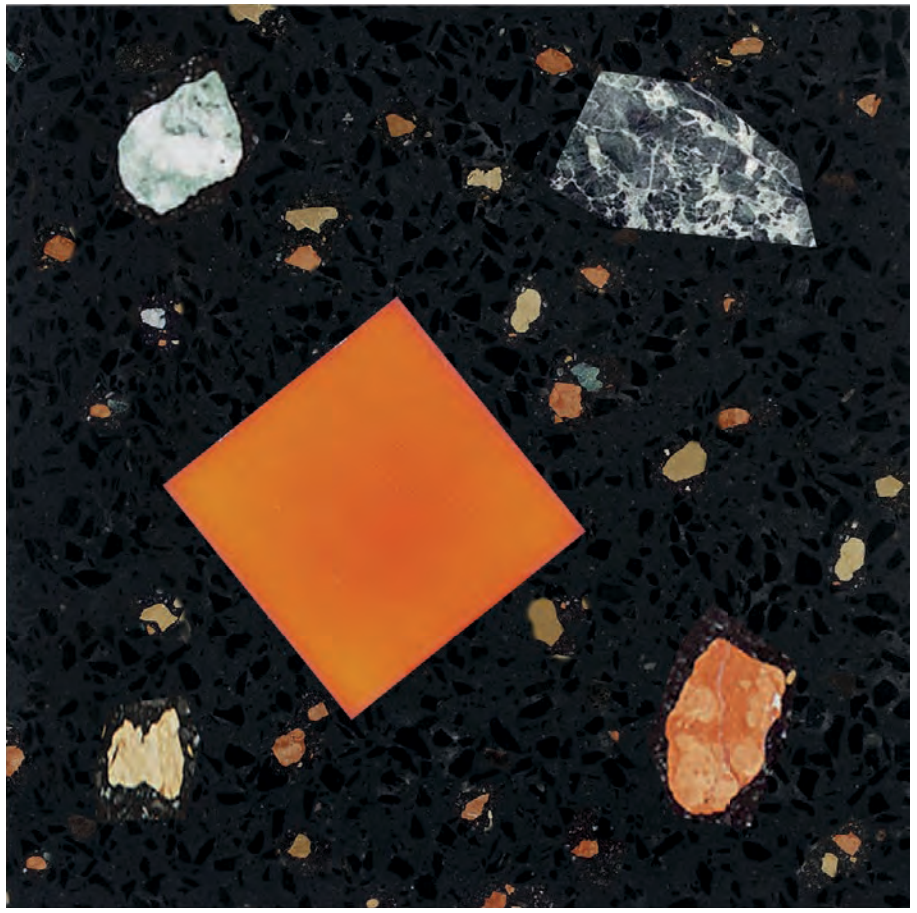
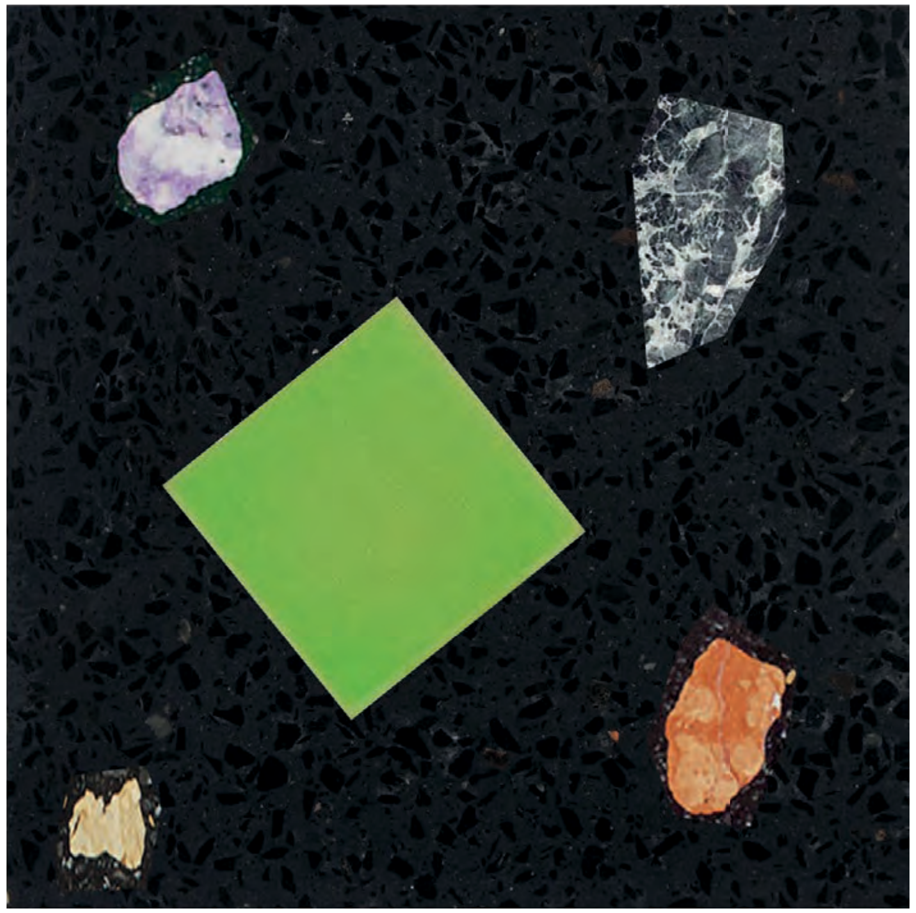
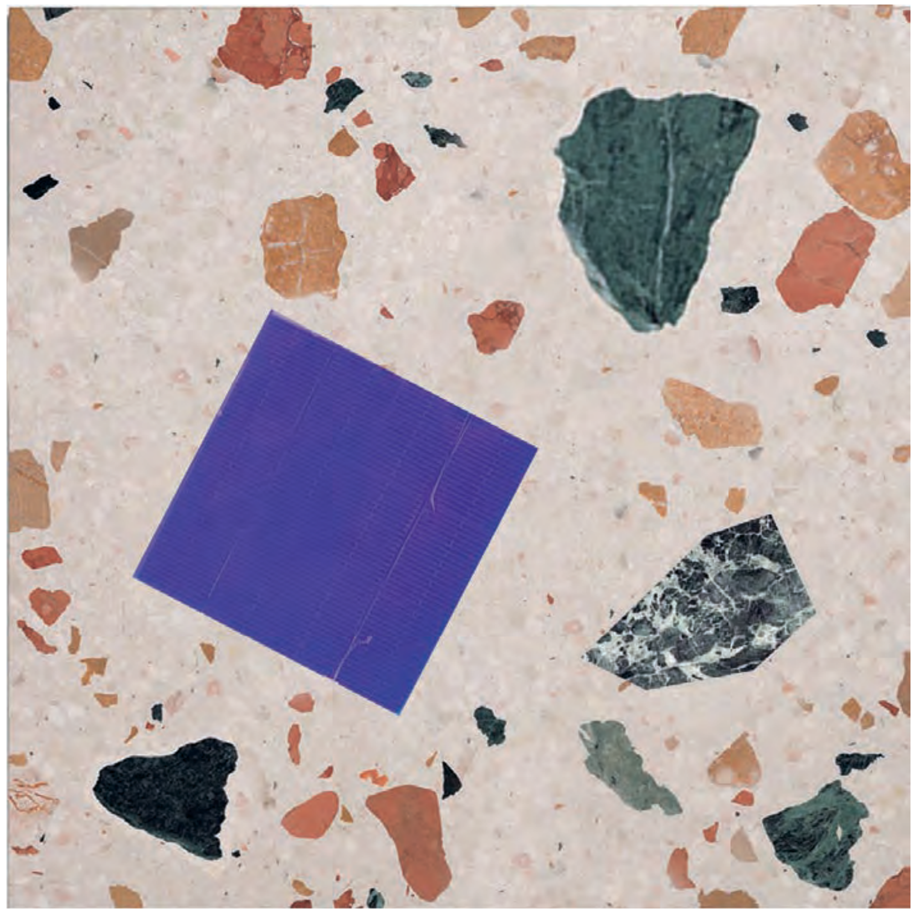


Early prototype for the solar Tile

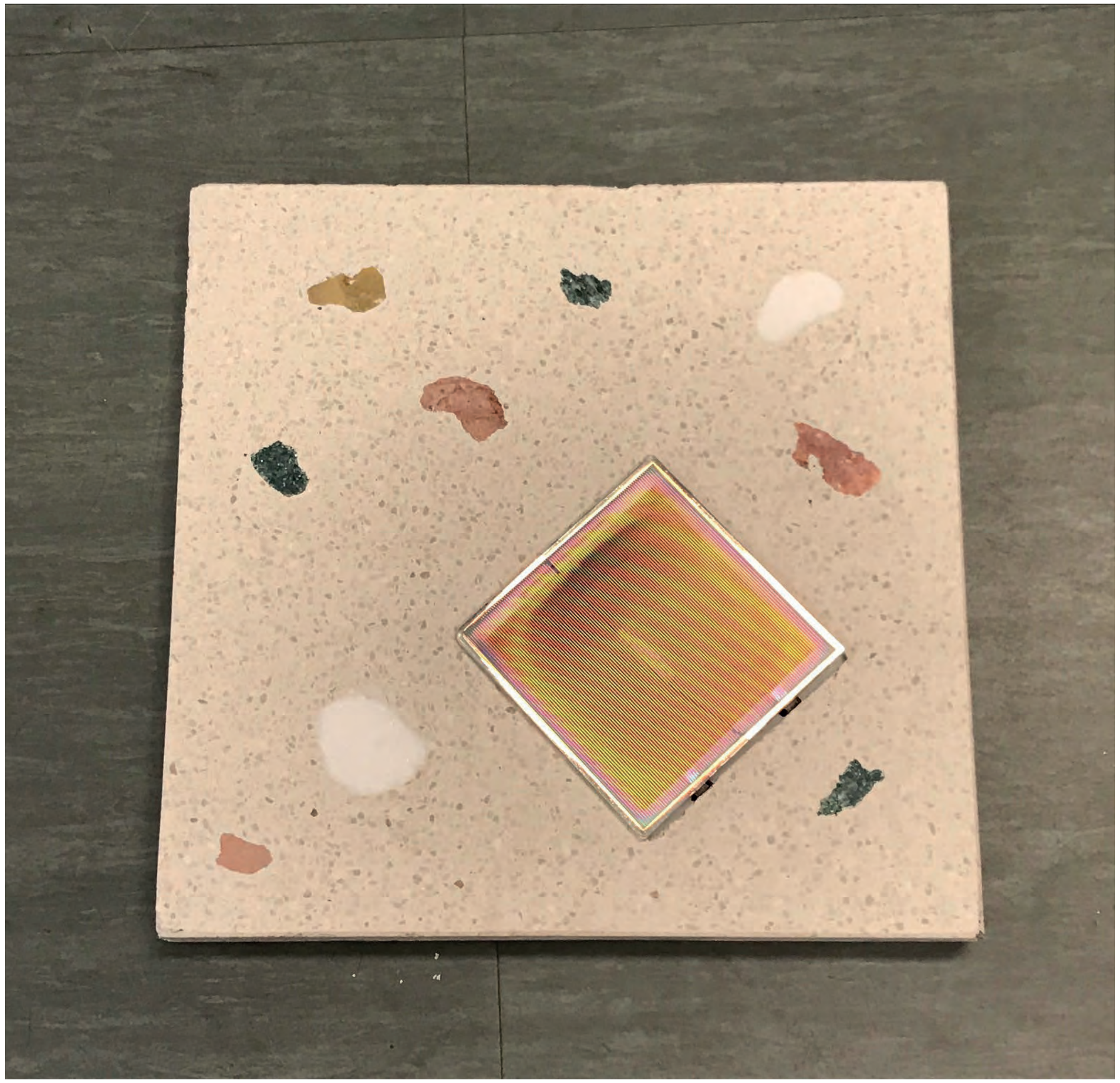


Solar Cells (100 mm x 100 mm x 3 mm)
courtesy of Juan Camilo Ortiz Lizcano / Solar Urban TuDelft

Solar Tile protype. Prototype by Studio Ossidiana with the support of
Tomaello concrete manufactory and TU Delft/PV Lab

Concrete mixture and PV chromatic tests.



Working protypes of 30x30 concrete terrazzo
tiles, integrated wioth 2V solar cells

Solar Textile

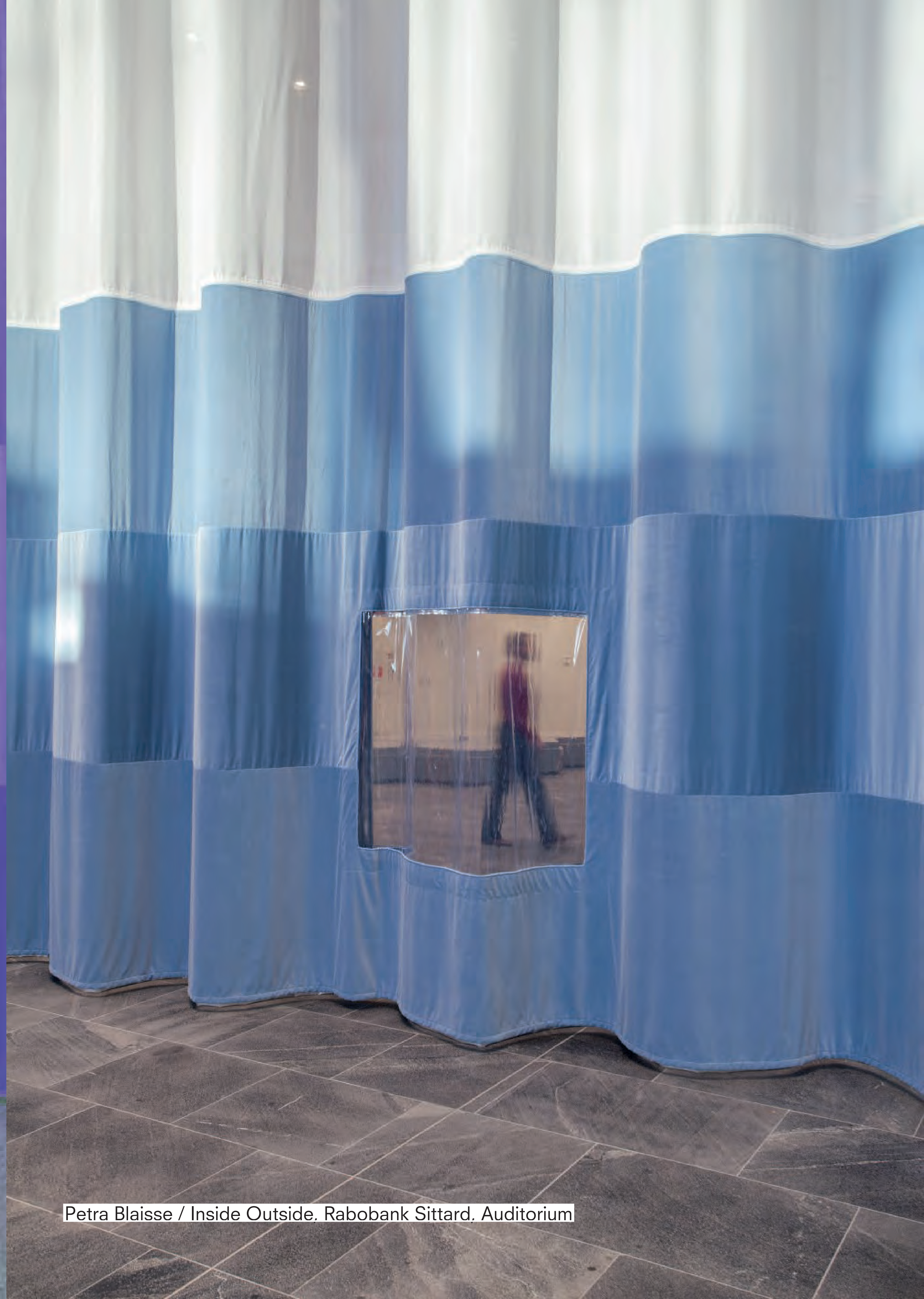
Case Studies

Hertl Architekten, Aichinger House, Austria

Chisto and Jeanne-Claude, The Reichstag 1995, Berlin

Superstudio, Monumento Continuo

Petra Blaisse / Inside Outside, Re-set, Dutch Pavilion, Venice Biennale 2012



Petra Blaisse / Inside Outside, Rabobank Sittard, Auditorium

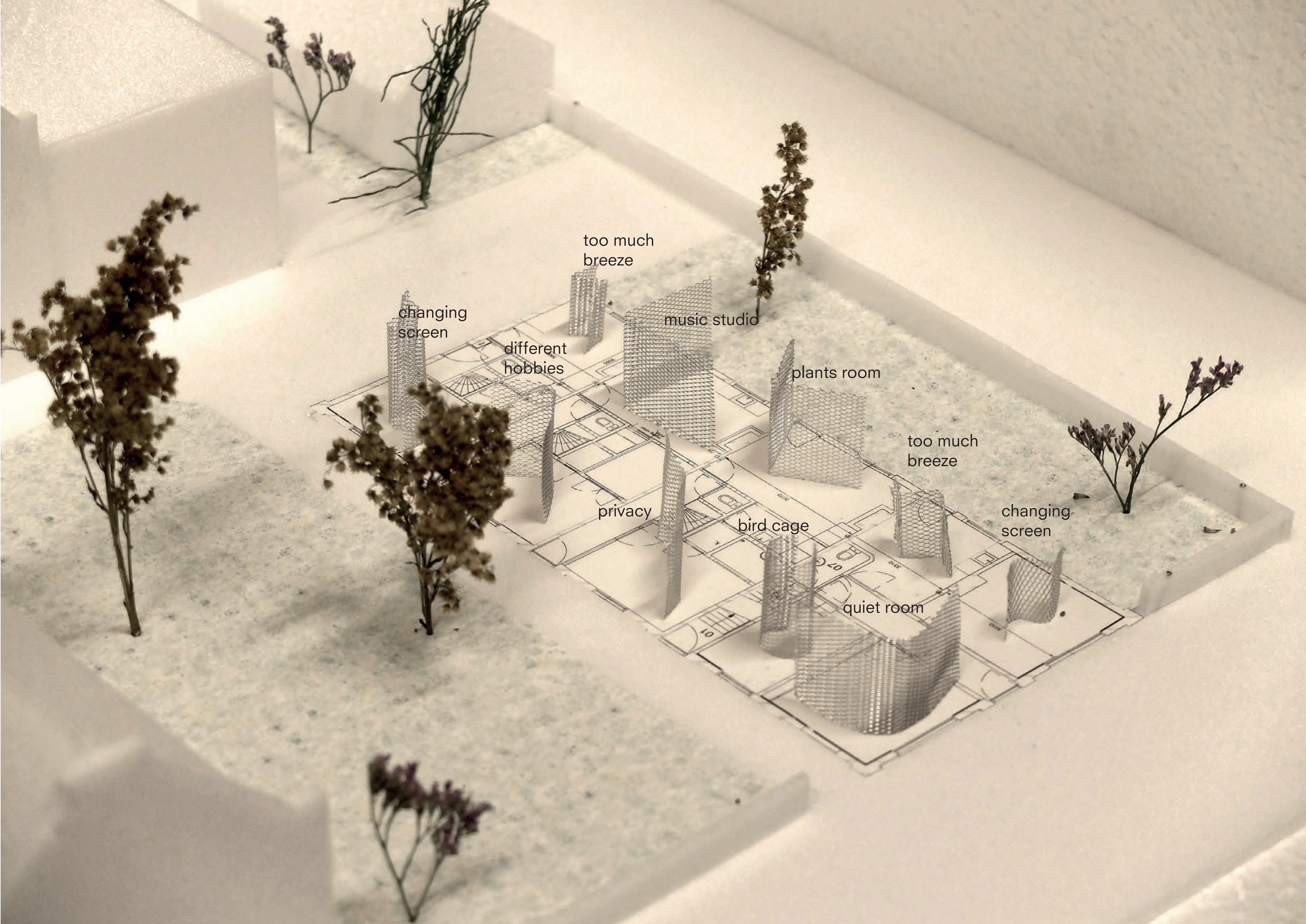
Prototype Solar curtains, meeting with Sheila Kennedy

Petra Blaisse / Inside Outside. Solar Curtain. Textile Museum Tilburg

Solar Textiles

the Interior

we began by thinking of the most subtle move,
from the inside of the homes.


too much breeze
changing screen
different hobbies
music studio
plants room
too much breeze
privacy
bird cage
changing screen
quiet room

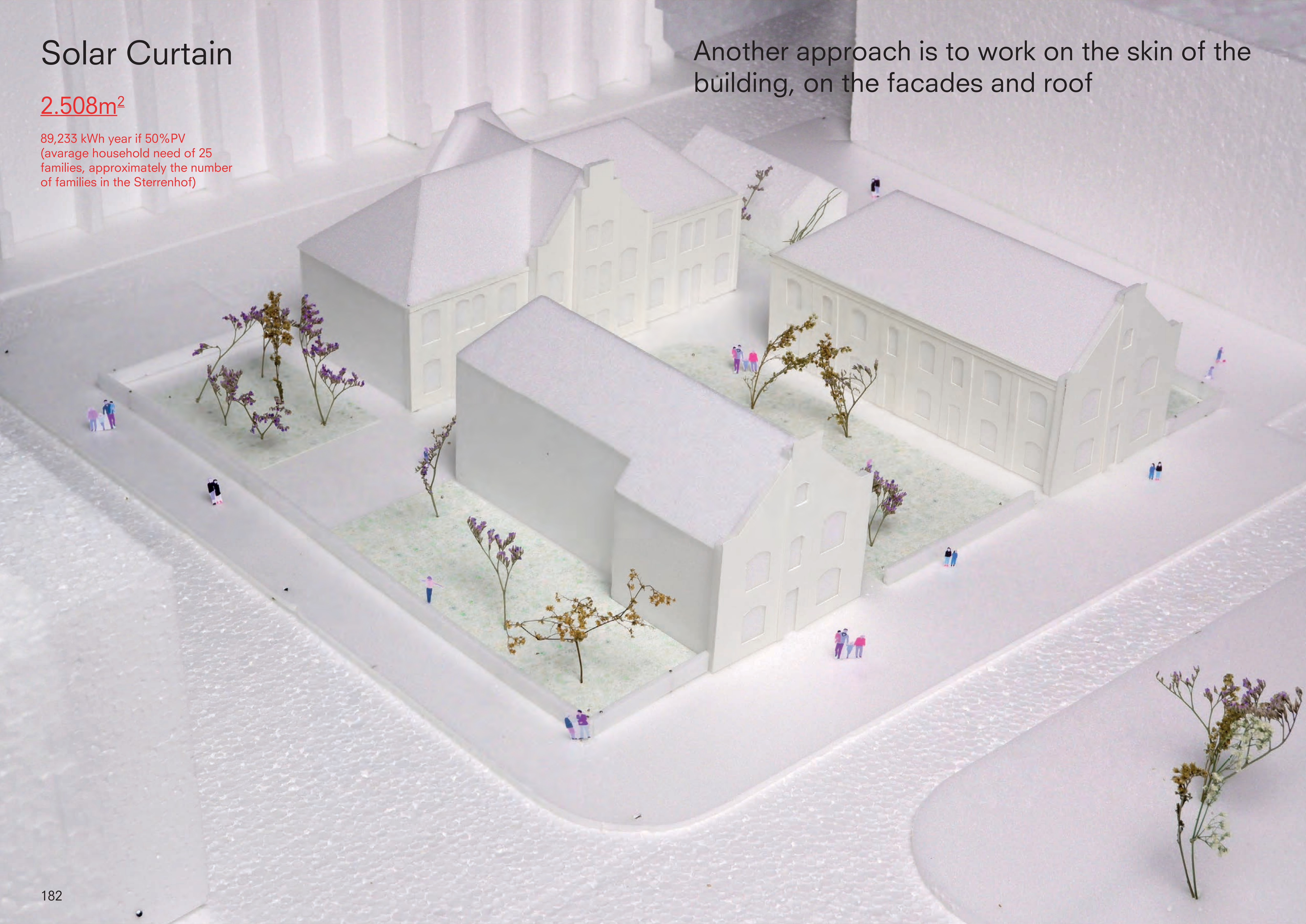
from the outside it could appear like an art piece at the scale of the building

and introduce new textures within the homes

or Instiutional buildings

Solar Curtain

The Shell



Solar Curtain

2.508m²

89,233 kWh year if 50%PV (avarage household need of 25 families, approximately the number of families in the Sterrenhof)

Another approach is to work on the skin of the building, on the facades and roof

Solar Curtain

2.508m²

89,233 kWh year if 50%PV
(avarage household need of 25
families, approximately the number
of families in the Sterrenhof)

or sealing the house when away for a while in the summer


Sterrenbos


Sterrenbos

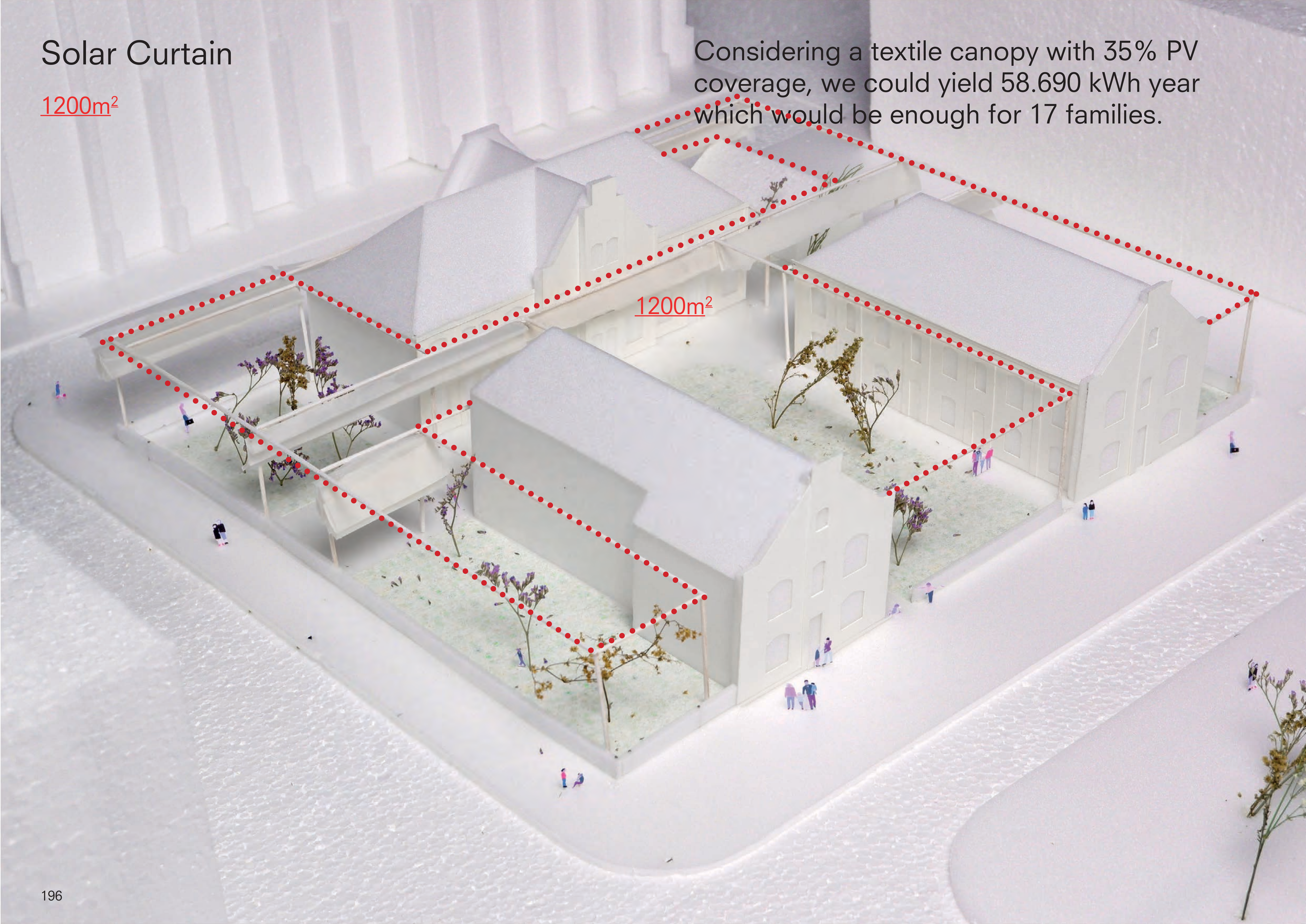
Solar Curtain

The Canopy

Solar Curtain

1200m^2

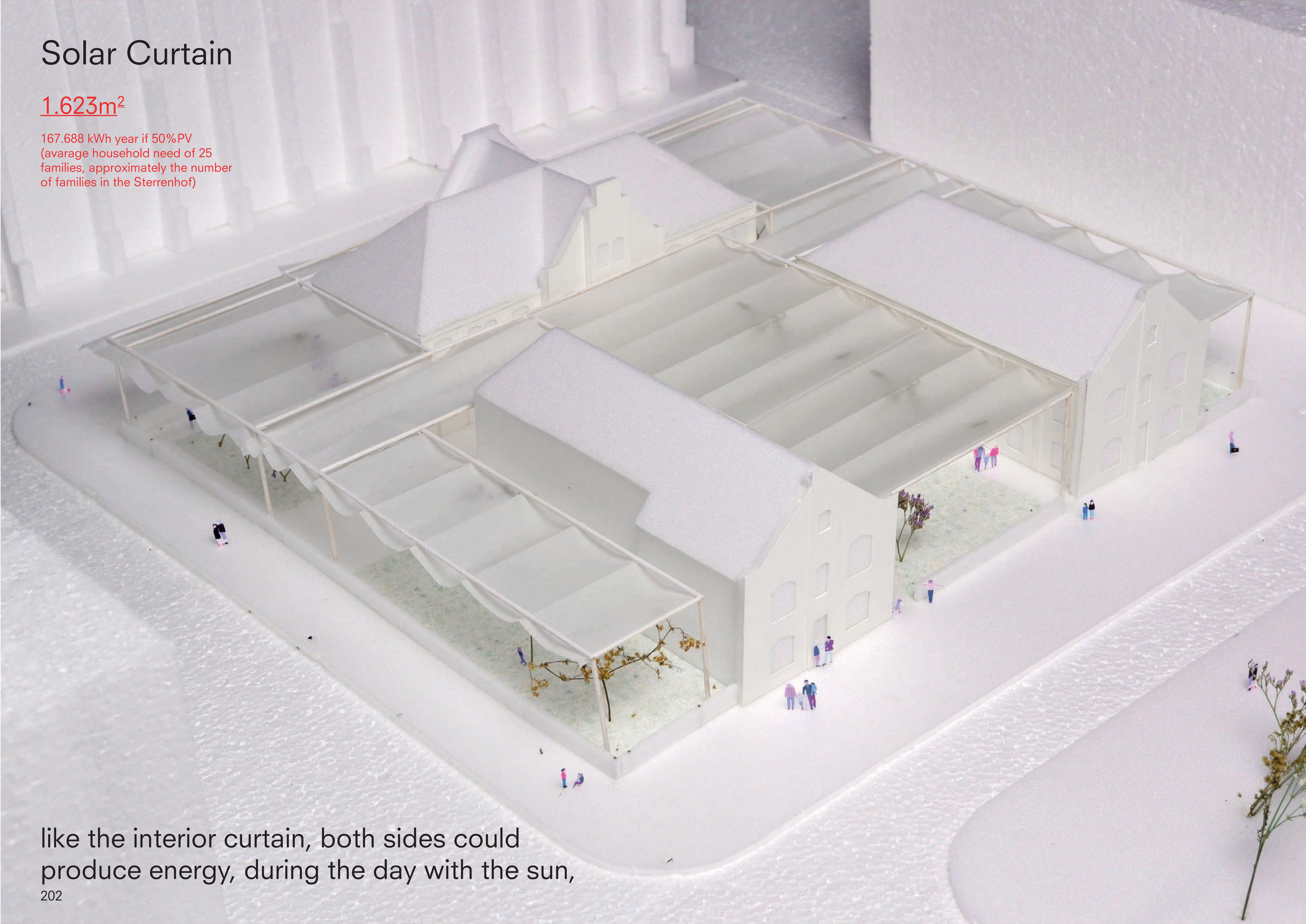
Considering a textile canopy with 35% PV coverage, we could yield 58.690 kWh year which would be enough for 17 families.



Solar Curtain

1.623m²

167.688 kWh year if 50%PV
(avarage household need of 25
families, approximately the number
of families in the Sterrenhof)

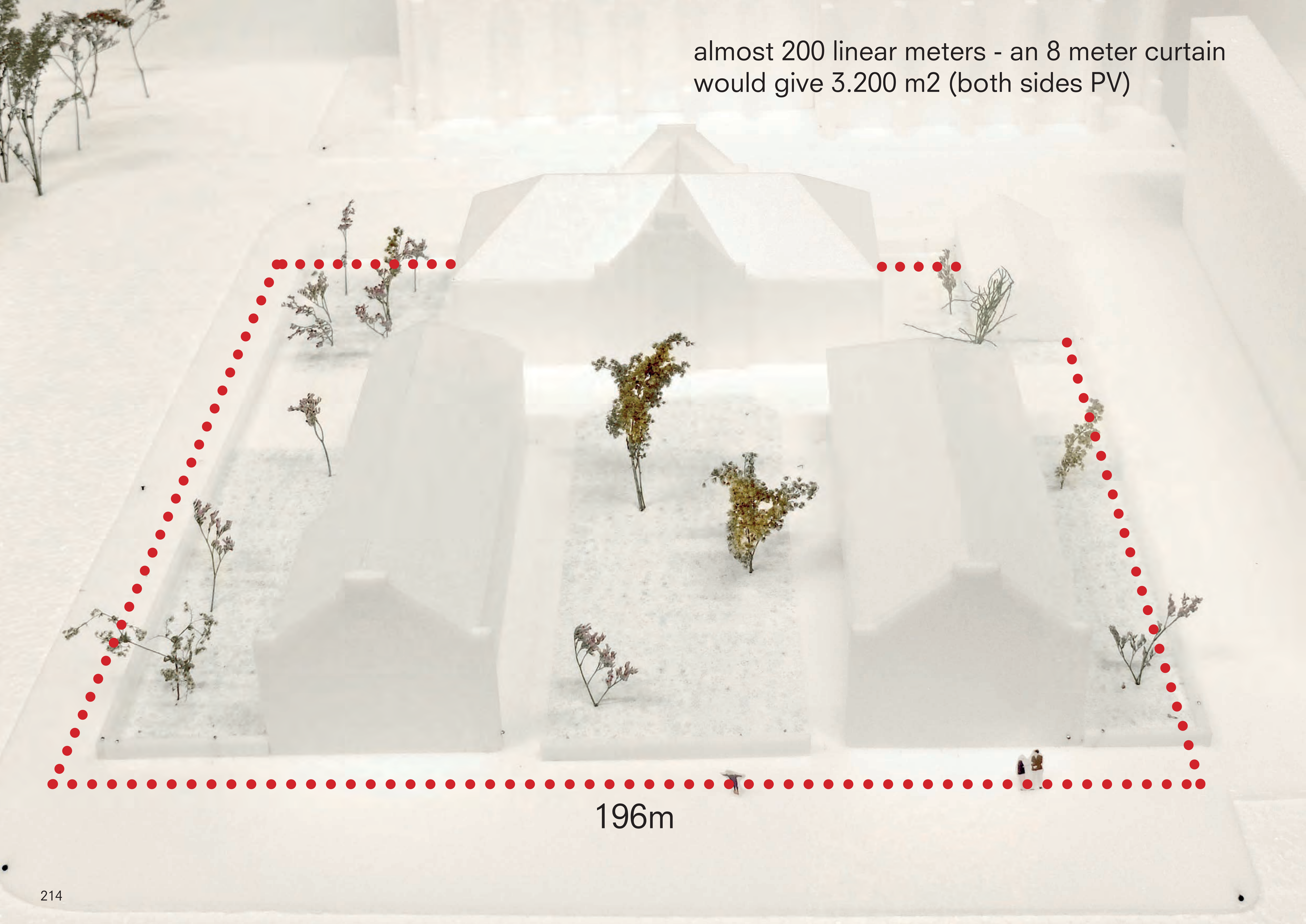


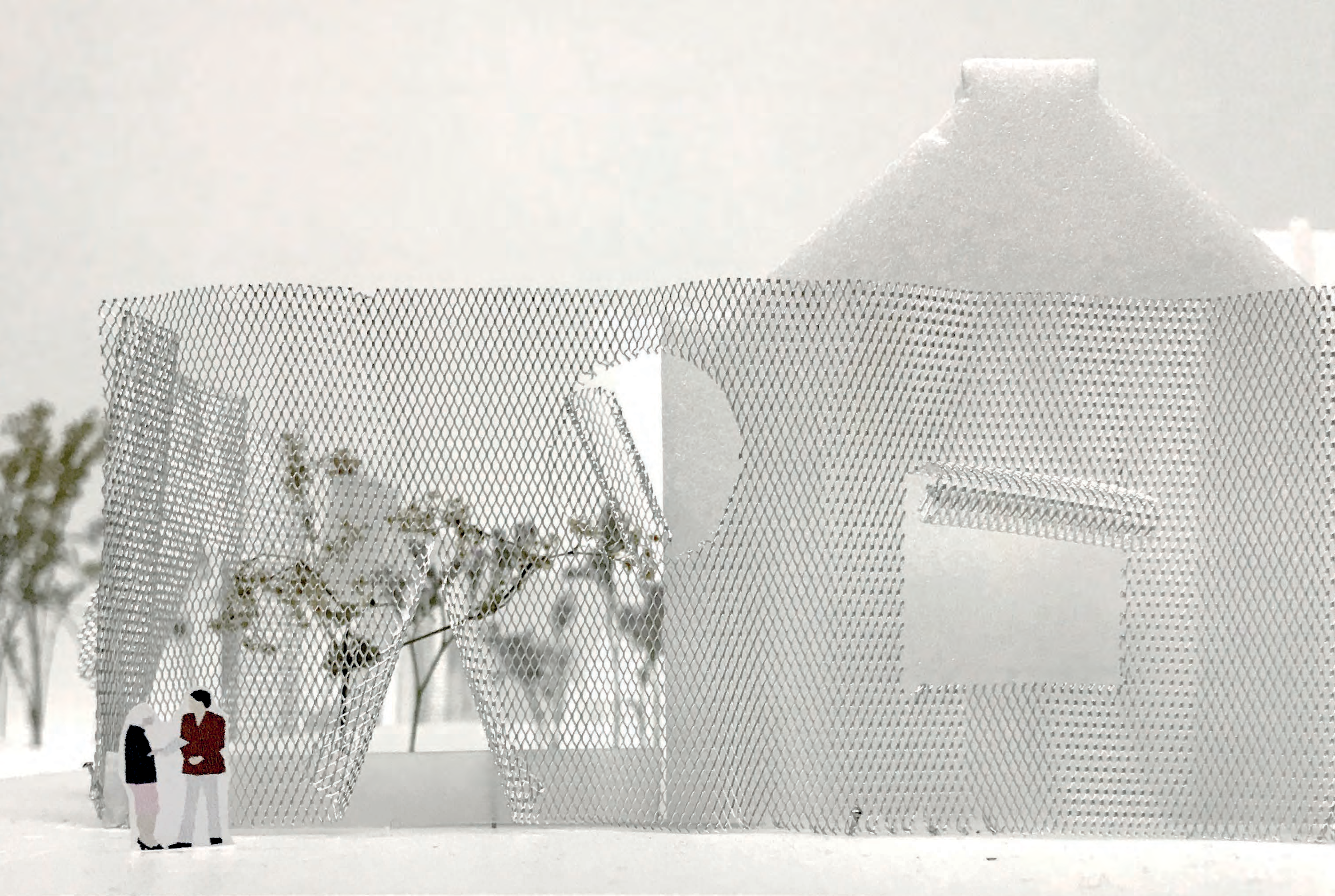
like the interior curtain, both sides could
produce energy, during the day with the sun,

Solar Curtain

at night by trapping public illumination beneath the canopy while creating enclosed gardens and microclimates beneath.

Solar Curtain
The Fence


almost 200 linear meters - an 8 meter curtain
would give 3.200 m2 (both sides PV)
196m



closing itself

or opening up

to different degrees , offering a site to the
monument with is never the same

Solar Curtain

The Dance of the Leg, the Terrace, and the Theatre

We propose three elements for the square

Following the sun as it moves

741m²

21.116 kWh per year

A huge skirt, covering the often loathed leg

Gathering solar energy as it covers it.

1127m²

26.827 kWh per year

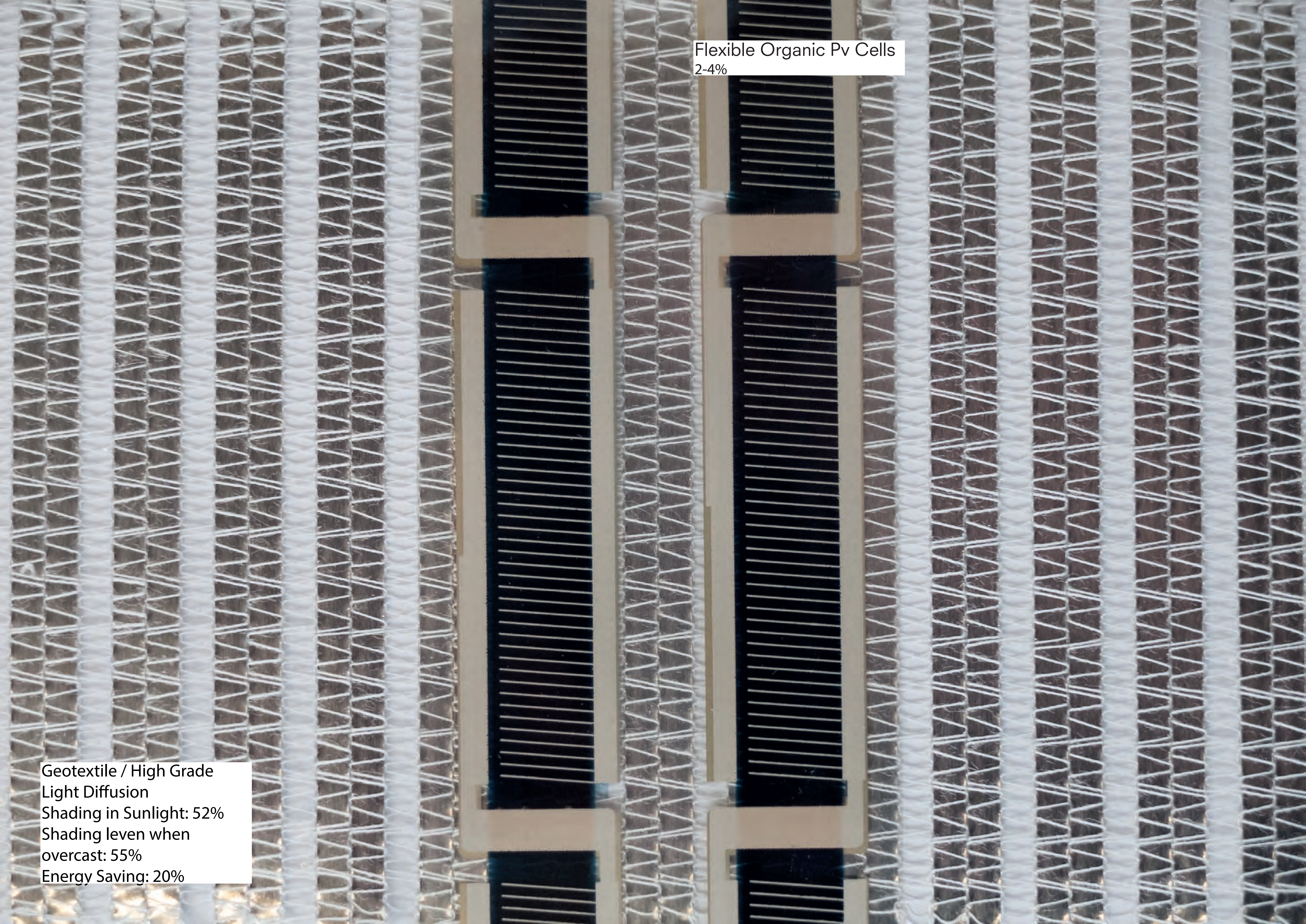
And a vast circular curtain

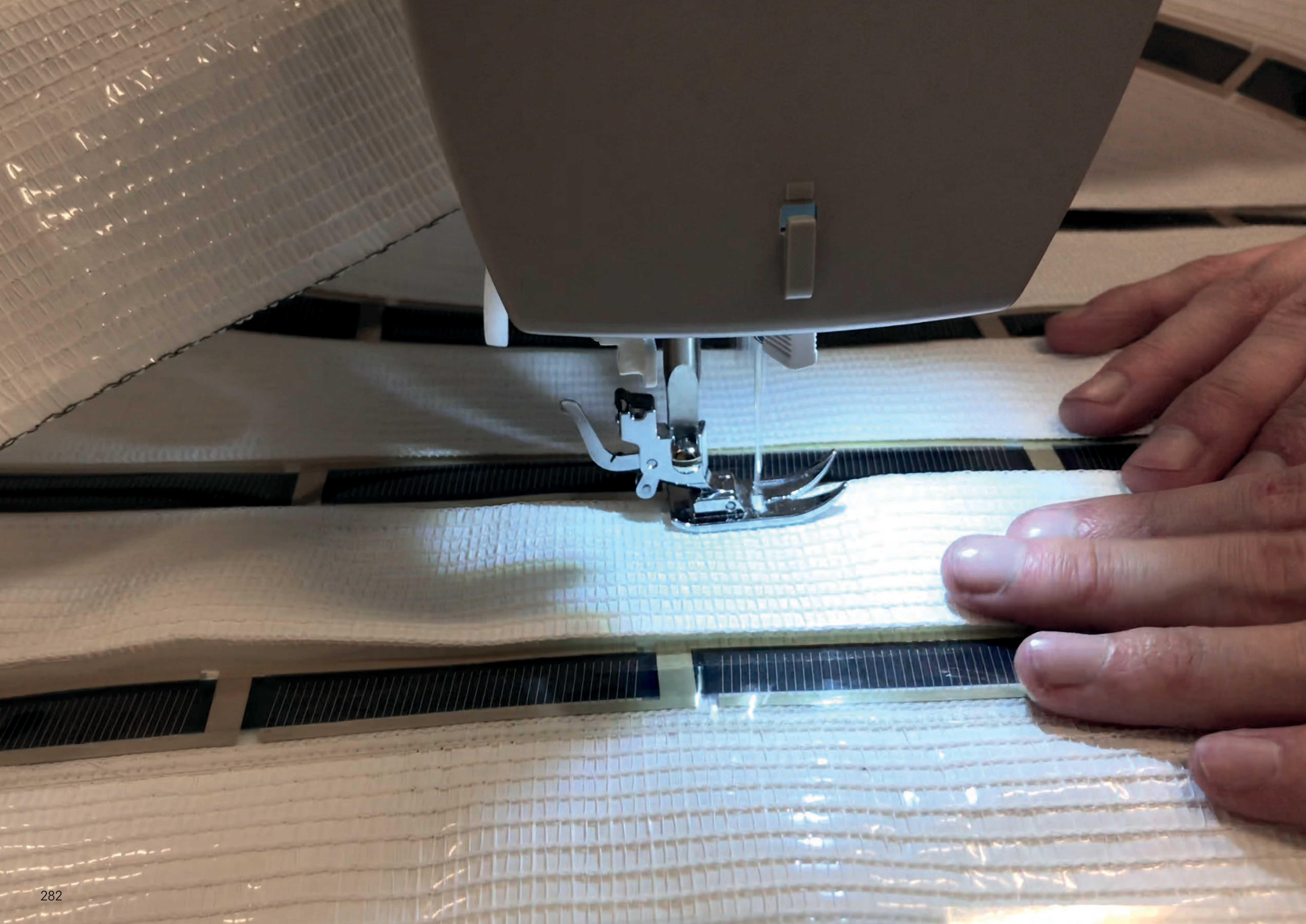
A stage for improvised performances, or rallies

Together they compose a choreographic dance, following the sun, or the needs of a group.

Weaving PV

Prototype


Flexible Organic Pv Cells
2-4%
Geotextile / High Grade
Light Diffusion
Shading in Sunlight: 52%
Shading leven when
overcast: 55%
Energy Saving: 20%



Weaving PV

Technologies

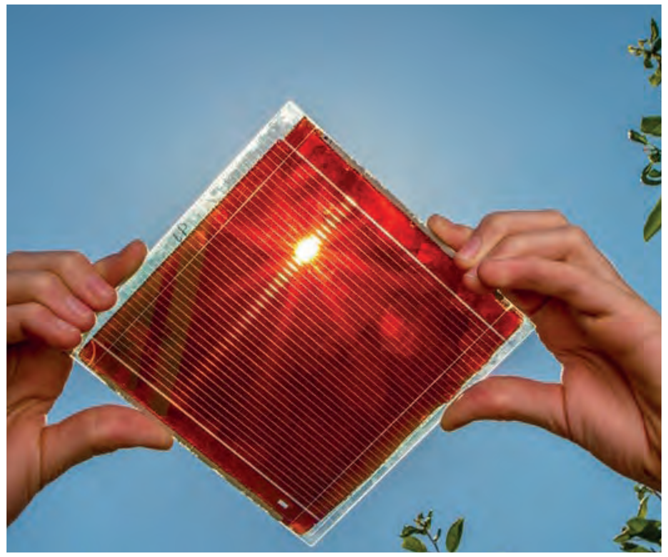
non-flexible

1. c-Si (Silicon based PV)

- Crystalline cells
\'First Generation'

1. c-Si (Silicon based PV)

Crystalline cells
- traditional solar cells
- high efficiency
- not flexible



flexible

2. Thin-film PV

- CIGS (copper indium gallium selenide)
- CdTe (Cadmium telluride)
- a-Si (amorphous silicon)

'Second Generation'

2. Thin-film PV

CIGS (copper indium gallium selenide):
- cheap to produce
- 22% efficient
- available on the market today
- gallium and indium are rare materials, so a large market share isn't likely
- for now the most efficient flexible solar cells available

CdTe (Cadmium telluride):
- simple to produce
- 22% efficient
- cadmium is toxic and scarce
- not available on the market
- a large market share isn't likely

a-Si (amorphous silicon)
- no toxic materials
- low efficiency
- not an attractive technology at the moment

3. Emerging PV

- Organic
- DSC (dye sensitised cells)
- CZTSSe (copper zinc tin sulfide)
- Perovskite

'Third Generation'

3. Emerging PV

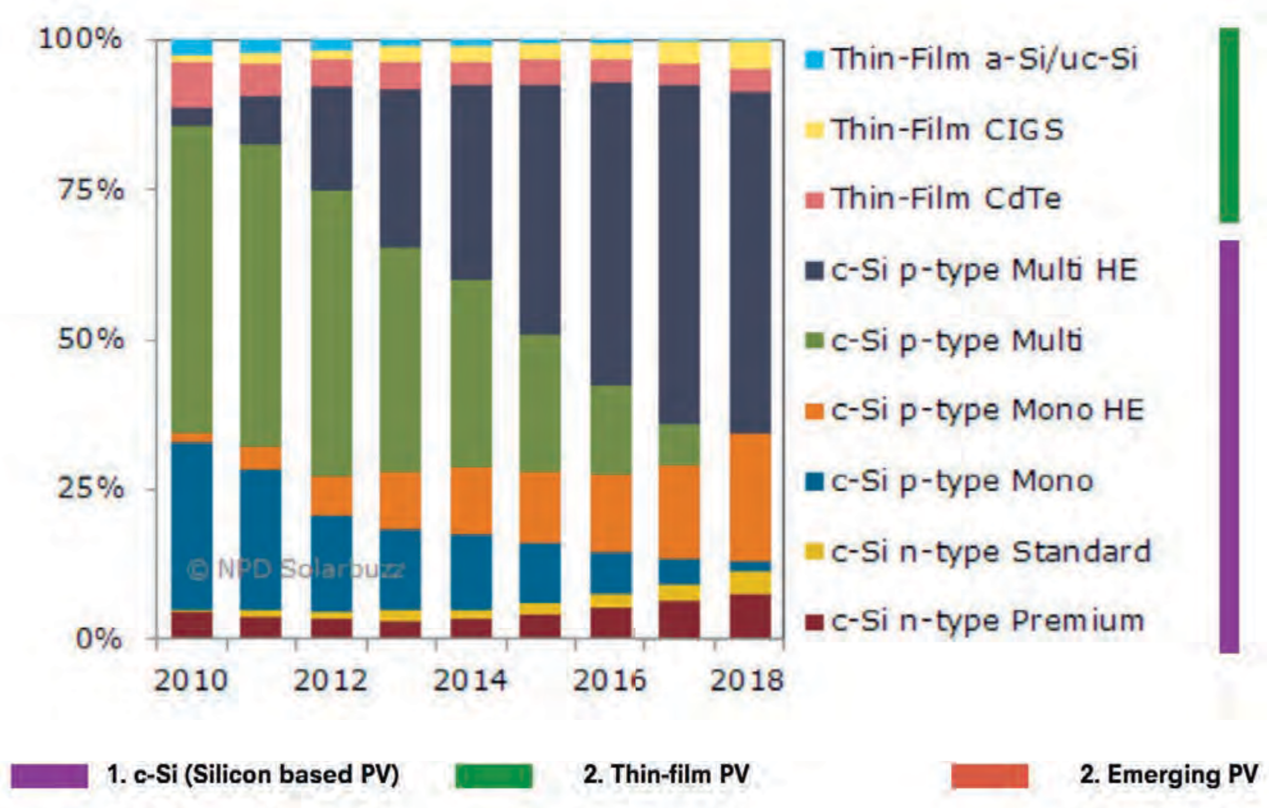
Organic
- low cost
- printing roll to roll (R2R)
- low efficiency (8%)
- unstable performance

DSC (dye sensitised cells)
- printing roll to roll (R2R)
- semi-transparent and semi-flexible
- 17% efficient
- works in low-light conditions

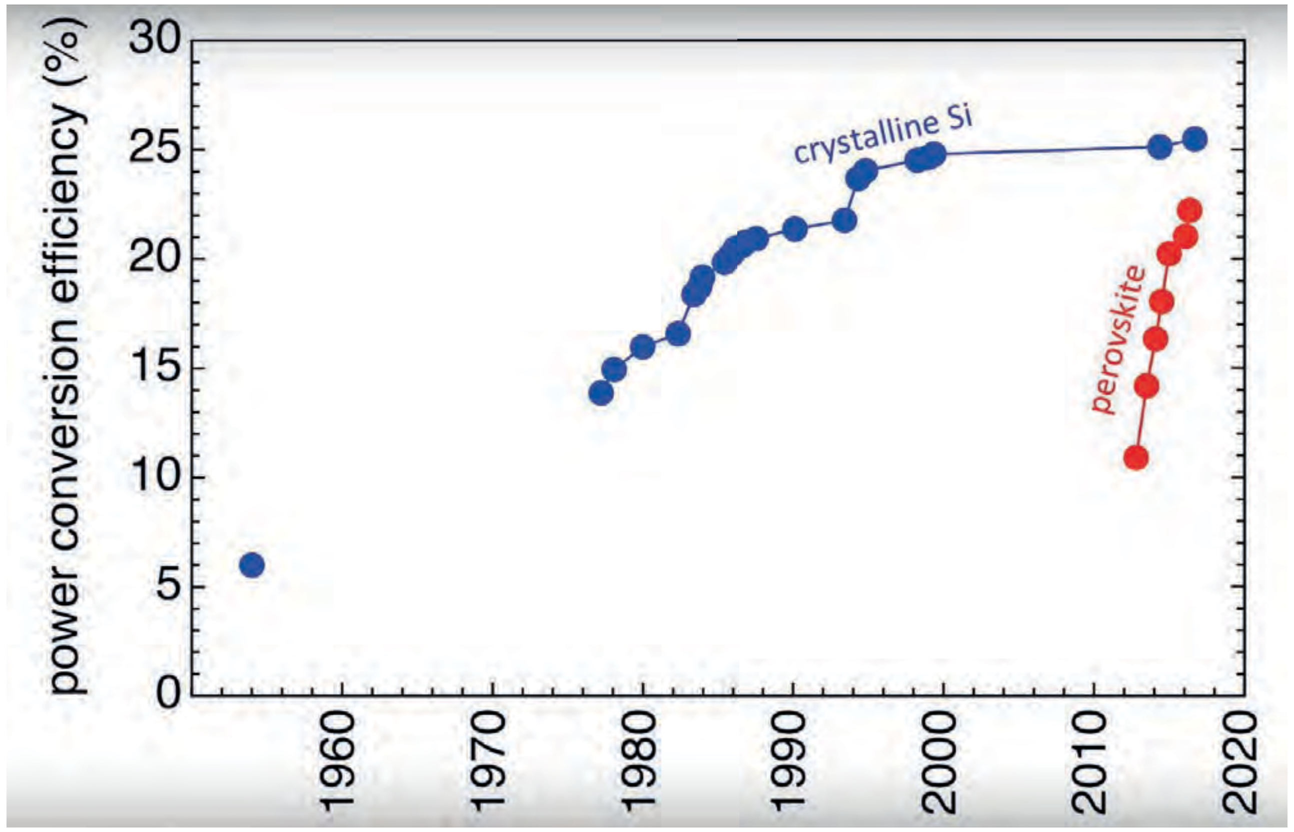
CZTSSe (copper zinc tin sulfide)
- a possible alternative to CdTe, but is currently still in a very experimental phase.

Perovskite
- made from the most abundant material available on the earth
- "fastest developing pv technology ever"
- 22 % efficient
- not stable yet: degrades in days or hours, but a lot of research is being done find solutions

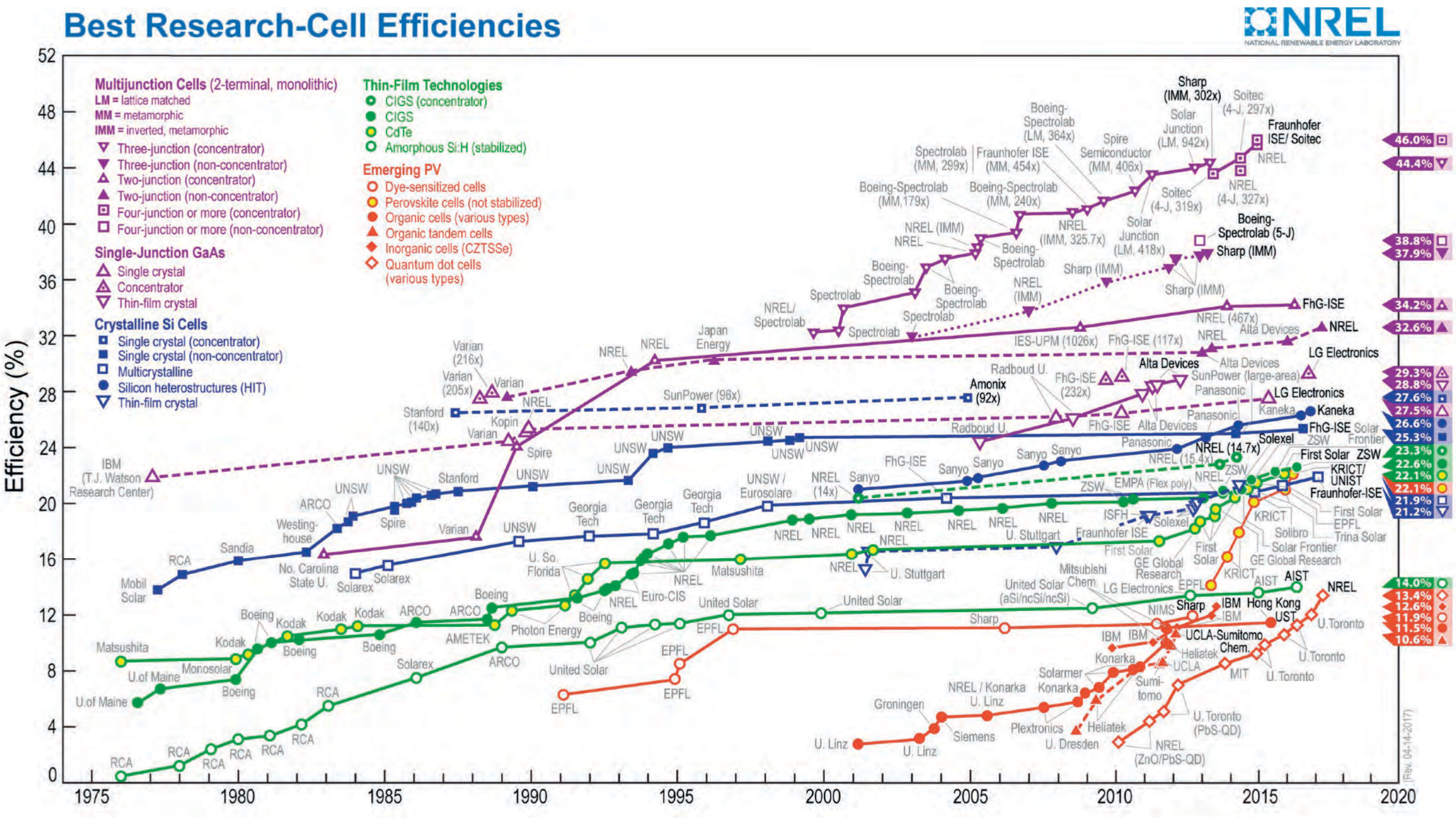
Comparing the market share of different technologies, the Silicon based PV still has by fare the largest share in all existing solar products



Comparing crystalline Si and Perovskite, it emerges that Perovskite technology is in rapid development in terms of efficiency.



The Silicon based PV remain the most efficient regharding power conversion, although Thin-Film PV are rapidly increasing their efficiency.



1. c-Si (Silicon based PV)

2. Thin-film PV

2. Emerging PV

https://www.nrel.gov

Colophon

Moreelse Solar Monuments is a project by Alessandra Covini and Giovanni Bellotti with Arthur Schoonenberg, Matt Grimshaw, Hugo Lopez, Akina Yoshitake Lopez, Lauren Boots, Sze Wing Chan.

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