

First-year 3FiRES Booklet

- Workshop and network updates about
- Research on BIPV Photovoltaic Facades for Fire Spread Mechanisms, Structural Failures and Resilience Improvement Methodologies
- edited by Chiara Bedon & Yu Wang •

[...] There are no doubts that the first-year of scientific activities for the running 3FiRES project represented a powerful opportunity of scientific network and growth for the members of research units on both the Italian and Chinese sides, as well as a unique international experience to share methodologies and discuss new strategies for the analysis of BIPV components and facades in fire [...]

Chiara Bedon, Yu Wang

[...] Talking about the optimization of novel prototypes, for example, robust standardized methodologies of experimental investigation are of utmost importance. However, the same consideration can be extended to in-service plants, where efficient diagnostic strategies have a primary role for the analysis of photovoltaic components and systems, both under ordinary and accidental operational conditions. [...]

Chiara Bedon, Yu Wang

[...] solar energy has become part of the building fabric as a sustainable alternative, and then it has become obligatory and, today, increasingly indispensable. This is a great opportunity for architectural, urban and landscape design, but let us not forget that when we use and transform this technological device in architecture, solar is synonymous with happiness and beauty [...]

Adriano Venudo

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Workshop and network updates about
"Research on BIPV Photovoltaic Facades for
Fire Spread Mechanisms, Structural Failures
and Resilience Improvement Methodologies"

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Observatory (SDO), 2010.*



This volume collects some scientific research results from the first year of activities and Workshop contributions (October 7th, 2024, Trieste & online) of the running "Particular Relevance" Italy-China bilateral project 3FiRES – "Research on BIPV Photovoltaic Facades for Fire Spread Mechanisms, Structural Failures and Resilience Improvement Methodologies" (2024-2025). 3FiRES research partners are the University of Trieste, Department of Engineering and Architecture (Principal Investigator Prof. Chiara Bedon) and University of Science and Technology of China, State Key Laboratory of Fire Science (Principal Investigator Prof. Yu Wang). The scientific activities of 3FiRES project are partly financially supported by the Italian Ministry of Foreign Affairs and International Cooperation (grant number CN24GR03) and National Key R&D Program of China (grant number 2023YFE0116700).

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Seeking for reinterpretations: re-grounding solar energy

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Abstract

By moving away from the conventional interpretation of solar technology as a purely mechanical issue, the contribution seeks to explore and detect recent experimental practices that formulated new manners of integrating solar energy into the design process. Highlighting the potential of shifting the interpretation of these elements from alien, must-hidden and afterthought additions to emotional and cultural components, the presented projects delimited a new ground of intervention and evolution for solar energy. In fact, if nowadays we are confronting daily with an urban environment increasingly characterized by the formation of techno-natures, the very architectural discipline needs to formulate a new balance, embodying solar energy within the architectural body, interpreting its *dispositifs* as companions within the contemporary project, dispelling the idea that technology is cold and complicated, and defining technical solutions capable of becoming an integrated and aesthetically pleasing part of our living environment.

Keywords

Solar perceptions; organic photovoltaic panels; solar as a cultural issue.

Seeking for reinterpretations: re-grounding solar energy

Nowadays, architecture faces multiple crises: climate change, resource depletion, and the increasingly frequent occurrence of extraordinary climatic phenomena have led to a collective run for rescue, concretized in the recourse to *green* [01] strategies and the increasing adoption of renewable energy.

The tension between the urgent call for renovation and the deployment of architectural reactions has decisively influenced the contemporary architectural debate, seeking to formulate a new ethical-aesthetic [02] language to endure substantial ecological paths.

Antoine Picón, in presenting his latest book, *Natures Urbaines*, discussed the evolving relationship between humans and *natures*, recognizing technology as its very means of negotiation throughout history. “Technological tools have always allowed *natures* [03] to assume a clear structure within urban contexts [...] Today, we encounter “techno-natures,” and, therefore, we must pursue new paths to reconcile natures and technology to reconstruct society meaningfully.” [04]

Following this reasoning, technological elements such as solar panels, photovoltaic systems, heat accumulators, and water collection tanks should be viewed no more as foreign components but as an integral part of the architectural body. The architect Marjan van Aubel reinforced this necessity, underlying the importance of embodying technology in a more perceptive and sensory manner: “I wondered how you could add emotional value to solar energy [...] exploring how technology and aesthetics can be harmonized.” [05]

This raises the question: Can the new technological dispositifs be translated into a new architectural taxonomy and integrated into the design process? And how can we trigger the establishment of a renewed, even emotional, relationship between humans and technology?

Solar energy: shifting from a cold alien to an emotional component

A fundamental shift in focus is necessary to effectively incorporate technology and architecture, especially concerning solar panels. The Sun is holistic and perceptible in our daily lives through our sight and the warmth it imparts to our skin. Many designers use these emotional and sensory experiences when grounding solar design within architecture.



This approach is evident in the work of Pauline van Dongen, a Dutch fashion designer specialized in smart textiles and clothing. She explains, “It is never technology for technology’s sake. Our designs begin and end with the moving body in space.” [06] Through investigating the human body in space and its relations with its surroundings — that is, with its climatic conditions — her studio creates cross-disciplinary works that seek new balances between body, fashion, and technology. The solar panels thus become a sort of double skin, serving as both energy collectors and body protectors. These elements are reduced to their minimum thickness, intricately intertwined with various materials through a constant experimental process, and are programmed pixel by pixel. This operation, visible in many works such as *Flip-Dot Dress. A kinetic sound-responsive garment* (2012), *Harnessing the Power of the Sun* (2013), and *Solar Parka* (2015), turns technology into an intuitive notion.

Figures 1-3. Pauline van Dongen, *Solar fabrics studies*, 2012-2020,

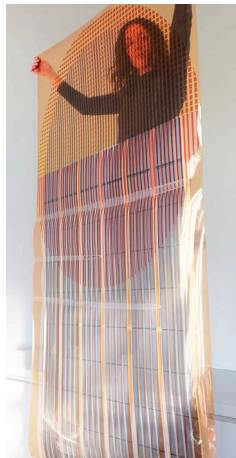
Figure 4. Pauline van Dongen, *Zonnestof. A woven solar fabric*, 2020.

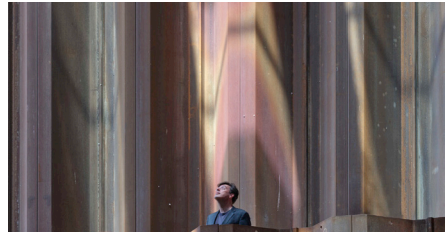
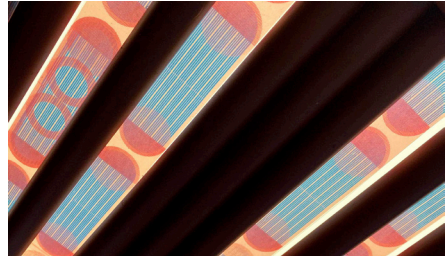
Furthermore, her explorations have led to projects strictly connected with architecture. For instance, in 2020, she presented *Zonnestof. A woven solar fabric* (2020), aiming to “weave solar into the everyday.” [07] This was followed by the *Lightweight woven solar textile* (2022), which expanded the concept from everyday use to the “world around us.” [08]

These textiles incorporate thin-film organic photovoltaic (OPV) panels, making them suitable for applications in tensile architecture. The employment of this organic material remarks a shared vision between Pauline van Dongen and V8 architects, both convinced that solar panels can enhance energy efficiency while simultaneously improving the aesthetic quality of architectural designs.

In fact, their perspectives can be harmoniously aligned: “Regular solar panels are based on a technology in which a mixture of black and dark blue dominates because those colors absorb the most significant amount of light. But there are many colors in the sunlight spectrum. Solar panels take part in that spectrum and convert sunlight into energy. Various techniques can be used to accurately adjust a solar panel to absorb a small, specific part of the spectrum or allow it to pass through. Colored solar panels will enable you to make that technology visible.” [09] This sentiment is echoed by Pauline

Figure 5. Marjan van Aubel, *Studies for the Dutch Biotope Pavilion OPV panels*, Dubai, United Arab Emirates, Expo 2022.





van Dongen, who states, “A solar textile could offer a much more physical and tactile way for people to interact with and relate to the Sun and its energy. [...] We believe that dealing with the Sun in a more tangible and cultural way is vital.” [10]

The *Dutch Biotope Pavilion*, [11] created for Dubai Expo 2020, integrates solar technology into its design. Its temporary circular climate system functions as a harvesting machine and addresses the theme of “uniting water, energy, and food.” The pavilion utilizes a unique technology to extract water from the outdoor air, providing “hope in the desert.” It features an 18-meter-high food cone that contains a cave-like space. The collected water falls like rain on visitors inside this structure, nourishing dozens of kilograms of oyster mushrooms planted on its surface. Externally, the same water irrigates over 9,000 edible plants growing on its walls. Additionally, the water is purified and offered to visitors.

The ceilings are characterized by translucent, colorful solar panels crafted from an organic thin-film technology. These elements not only generate energy for the entire system but allow sunlight inside, enabling an essential process for photosynthesis.

Figures 6-8.
V8 architects
and Marjan van
Aubel, *The Dutch
Biotope Pavilion*,
Dubai, United Arab
Emirates, Expo
2020.

The Solar Pavilion represents a further shift in perspective on solar energy. Built during the first *Solar Biennale*, [12] it aimed at “counterbalancing the prevailing technological and economic viewpoints on solar energy,” and was imagined as “a space to experience the poetic power of the sun, marking a transition from solar technology to solar architecture.” [13] The visitor’s experience was structured in three keys areas: the roof’s colorful solar field, the intimate alcove warmed by solar-powered infrared panels, and the central Circle for lectures and performances.

Solar energy: refusing alienation and experimenting with aesthetical potentials

In contemporary times, reflecting on new ways of inhabiting the world and rebuilding a balanced relationship between human beings and the environment is crucial. The shared etymology of the terms “habitus” and “habitat” (from “habitō”) emphasizes this connection, suggesting the idea of existing within a specific environment, as implied by the term “habitat.” Human beings and their habitats, biology and ecology, are interlinked through the practice of weaving a system of interactions and relationships that closely connect places, bodies, practices, and knowledge.

Today, it is essential to radically renegotiate and mediate this system of relationships to navigate the techno-natures that define our everyday lives by hybridizing technical aspects with sensory experiences, as well as efficient functionalities with emotional perceptions.

Figures 9-10.
V8 architects and
Marjan van Aubel,
The Solar Pavilion,
Eindhoven, the
Netherlands,
2022.



There is a growing sensitivity toward a renewed approach to embodying solar energy within architectural design. Many designers, eager to respond to climate change, are challenging conventional practices by rejecting a purely technical perspective. They begin to view advanced technological components not as alien entities but as integral companions in the contemporary design process. This shift dispels the notion that technology is cold and complicated, leading to the development of technical solutions that can be seamlessly integrated into, and aesthetically enhance, our living environments.

References

- [01] To deepen this topic see: M. D'Oria, *Another Break in the Wall*, in: "Rassegna dell'Architettura e dell'Urbanistica", n. 169, 2023, pp. 49-55.
- [02] B. Decroos, K. Dimitrova, S. Mandias, E. Ronner, [editors of the issue] *Ecology and Aesthetics, OASE*, n. 112, 2022.
- [03] The word *natures* is intentionally introduced with the plural form, pointing out that each community and civilization has its own conception of nature, understood as a cultural construction. To deepen these concepts: B. Latour, *Facing Gaia: Eight lectures on the New Climatic Regime*, Medford, MA, Polity Press, 2017; D. J. Haraway, *Staying with the Trouble. Making Kin in the Chthulucene*, Durham and London, Duke University Press, 2016; R. Braidotti, *The Posthuman*, Cambridge, Polity Press, 2013.
- [04] Quote taken from Antoine Picon presentation of his latest book on the occasion of the 4th International Conference of the Association of Architecture and Urban Planning Historians (AhAU - Spain), dedicated to the topic City and Nature, that took place in the Real Colegio María Cristina, San Lorenzo de El Escorial, Madrid, Oct 24–25, 2024.
- [05] Quote taken from the online interview *Marjan van Aubel: Solar Power to the People*, by A. van Gaalen, published in the online magazine *TIOC*, on 13.10.2023, <<https://tioc.nl/article/MARJAN-VAN-AUBEL:-SOLAR-POWER-TO-THE-PEOPLE>>; accessed on 29/10/2024.
- [06] Quote taken from Pauline van Dongen official website, to deepen check: <https://www.paulinevandongen.nl/>
- [07] [08] *Ibidem*.
- [09] Quote taken from the online interview *Marjan van Aubel: Solar Power to the People*, by A. van Gaalen, published in the online magazine *TIOC*, on 13.10.2023, <<https://tioc.nl/article/MARJAN-VAN-AUBEL:-SOLAR-POWER-TO-THE-PEOPLE>>; accessed on 29/10/2024.
- [10] Quote taken from Pauline van Dongen official website, to deepen

Figure 11.
Marjan van Aubel,
*Ra. Self-powering
solar tapestry*,
2020.

check: <https://www.paulinevandongen.nl/>

[11] Designed by V8 Architects in collaboration with Marjan van Aubel

[12] The Solar Biennale, organized in the context of the Dutch Design Week, was born as a collaborative project of solar designers Marjan van Aubel and Pauline van Dongen that took place from September 8 to October 2022 in both Rotterdam and Eindhoven. To deepen, check the official website: <https://thesolarbiennale.com/>

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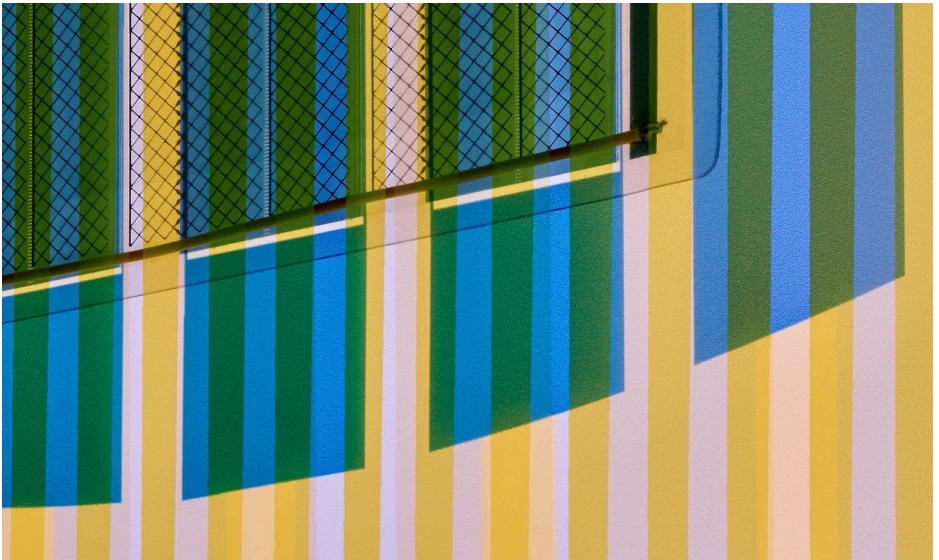
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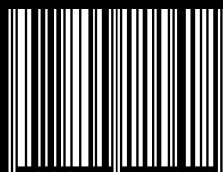
The First-year 3FiRES Booklet is a collection of research outcomes and advancements from the first year of scientific activities for the running “Particular Relevance” Italy-China bilateral project, which involves the University of Trieste (Principal Investigator Chiara Bedon) and the University of Science and Technology of China (Principal Investigator Prof. Yu Wang).

Most of research contributions that are collected in this book have been orally presented during the “First-year 3FiRES Workshop” international event, that took place at the University of Trieste, on October 7th, 2024. It represented a very efficient and constructive networking opportunity, for the involved research units on the Italian and Chinese side, as well as for several international experts and students, with both engineering and architectural background, and this confirms the high multidisciplinary and innovative nature of the project topic.

This first-year booklet also represents a strategic opportunity of networking and scientific growth, thanks to the research contributions and the research experiences that are shared by members of the extended and highly multidisciplinary 3FiRES network.

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