Energy
National Research Programmes 70 and 71

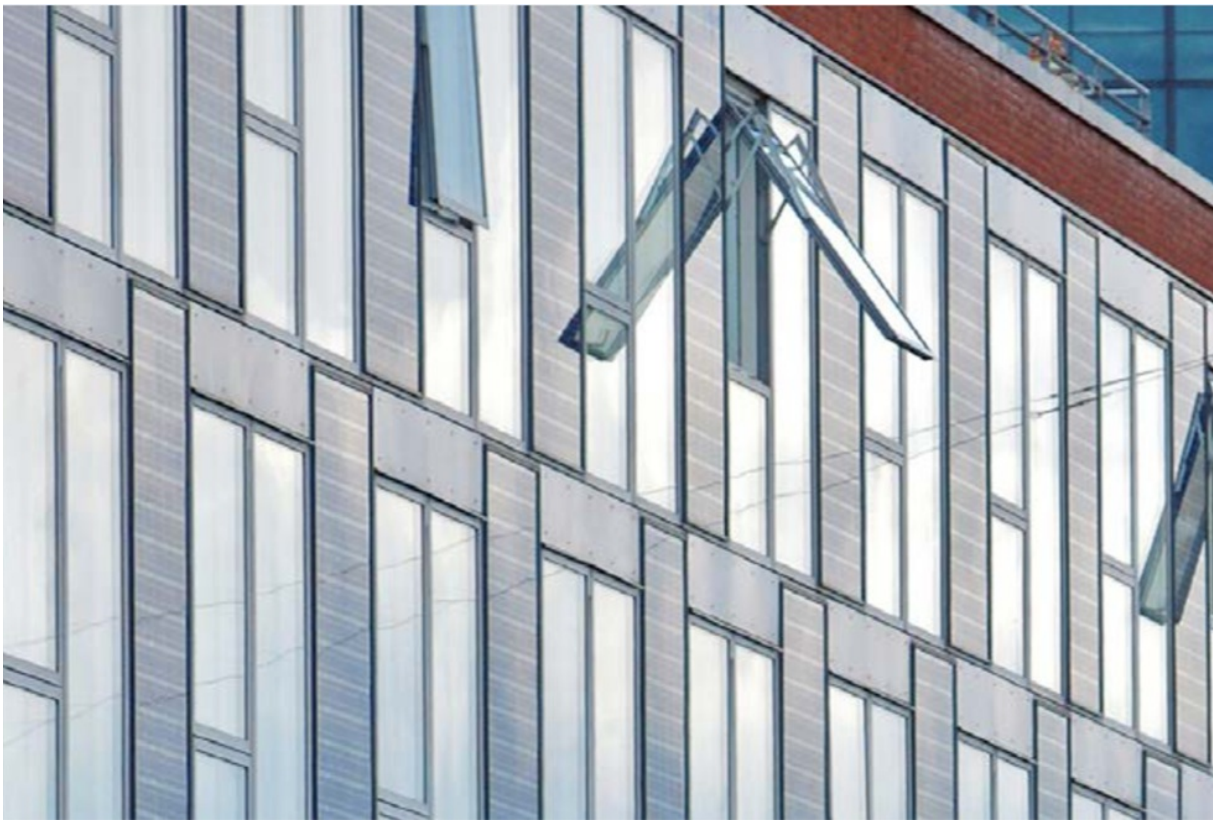
Project

Building-integrated photovoltaics

The best of both worlds: combining building shells and energy production

The best of both worlds: combining building shells and energy production

A market boom for building-integrated photovoltaics (BiPV) has been predicted for many years – but little has happened until now. The market continues to be dominated by separate solar module on roofs. The joint project “Active interfaces” investigated what can help BiPV make a definitive breakthrough.



Photovoltaic modules integrated directly in the building envelope open up an enormous area for the generation of electricity. *Source:* activeinterfaces.ch

At a glance

- Equipping roofs on new buildings with photovoltaic modules alone will not be enough to achieve the ambitious goal of the Energy Strategy 2050.
- The roofs and facades of existing buildings must also be used to generate energy from sunlight.
- The "Active Interfaces" joint project is investigating this approach.

The federal government’s energy strategy states that 20 % of Switzerland’s energy requirements should be covered by photovoltaics by 2050. This objective is ambitious given the currently small share accounted for by solar electricity: this figure grew from basically nothing to 2.2 % between 1990 and 2016. How can the goal of generating 20 % of energy from photovoltaics by 2050 be achieved?

This question is being address by the joint project “Active interfaces”. Its work is based on the knowledge that equipping roofs on new buildings with photovoltaic modules alone will not be enough to meet the ambitious target stipulated under Energy Strategy 2050. The roofs and facades of existing buildings must also be used to generate energy from sunlight.

Holistic approach

“Active interfaces” has therefore set itself the objective of investigating photovoltaic modules integrated in the building envelope, for example in the form of roof tiles or facade elements. Combining the outer envelope of buildings with electricity production simultaneously meets two requirements of the energy turnaround: the saving of energy through energetically insulating materials for the building envelope and the generation of energy through photovoltaics.

As obvious as this approach sounds, the innovative construction elements pose developers as well as architects, legislators and building owners with a range of challenges due to their double function. The project “Active interfaces” therefore adopts a holistic approach. This is because it is not sufficient to develop roof tiles that can produce solar electricity but which do not meet an architect’s aesthetic requirements. The sub-projects of the joint project are investigating a total of five questions: • Technology: which technological hurdles have to be overcome in order for building-integrated photovoltaics (BiPV) to succeed? • Design: which architectural design strategies will allow for the use of BiPV in urban renovation projects? • Socioeconomics: what are the requirements of consumers and investors with respect to BiPV? • Assessment: how can standards and certification processes for BiPV be simplified by the legislators? • Distribution: which platforms (websites, conferences, workshops) are needed to promote the acceptance and distribution of BiPV?

Specific renovation projects

In order to obtain practice-relevant knowledge, “Active interfaces” is testing its approaches with very specific renovation projects. Successes have been recorded in several sub-projects, for example in a study in Neuchâtel. Here, researchers from the Swiss Federal Institute of Technology Lausanne (EPFL) showed that BiPV can be used during the renovation of facades of buildings of different ages.

The joint project is providing importing findings for the future use of BiPV in various areas:

- Buildings: combining the building envelope and electricity generation reduces the consumption of fossil energies as well as greenhouse gas emissions. At the same time, building owners save on materials and electricity costs.
- Financial attractiveness: although the initial investments for renovation projects with BiPV are higher than the costs for a conventional renovation, the effort is worthwhile when viewed over the long term. The amortisation period is shorter than the expected service life of a BiPV system.
- Market conditions and regulation: in 2014, the cantons agreed on new standards in the area of energy legislation for buildings (as part of the fourth revision of the model provisions of the cantons in the energy sector (MuKEn)). It will only be possible to significantly improve the distribution of BiPV if the MuKEn are appropriately implemented by the cantons.
- Acceptance: a survey shows that building owners have a positive attitude when it comes to BiPV. Of the 500 surveyed building owners, 85 % were not put off by the greater initial costs in light of the long-term benefits.
- Reduction of complexity: simpler solutions are required in order to make BiPV more attractive for building owners and investors. For example, only when suppliers are able to offer “ready-to-use” solar roofs as part of renovation projects will the technology enjoy greater distribution.

Despite all of the positive findings: there is still a great deal of work for all stakeholders. Legislators, architects, building owners and technology providers must work together hand in hand in order to quickly conquer the new field of BiPV. All information on the joint project can be found at www.activeinterfaces.ch.

Produkte aus diesem Projekt

- Integrated thinking for photovoltaics in buildings
  Date of publication: 01.01.18
- Active surfaces selection method for building-integrated photovoltaics (BIPV) in renovation projects based on self-consumption and self-sufficiency
  Date of publication: 01.01.18
- Beauty and the budget: A segmentation of residential solar adopters
  Date of publication: 01.01.18
- 3D model discretization in assessing urban solar potential: the effect of grid spacing on predicted solar irradiation
  Date of publication: 01.01.18
- A toolkit for multi-scale mapping of the solar energy-generation potential of buildings in urban environments under uncertainty
  Date of publication: 01.01.18
- Thermo-mechanical stability of lightweight glass-free photovoltaic modules based on a composite substrate
  Date of publication: 01.01.18
- Light and durable: Composite structures for building-integrated photovoltaic modules
  Date of publication: 01.01.18
- Red is the new blue – The role of color, building integration and country-of-origin in homeowners' preferences for residential photovoltaics
  Date of publication: 01.01.18
- Acceptance of building integrated PV (BIPV) solutions in urban
- ACTIVE INTERFACES. Holistic design strategies for renovation projects with building- integrated photovoltaics (BIPV): case study from the 1900s in Neuchâtel (Switzerland)
  Date of publication: 01.01.18
- PHOTOVOLTAÏQUE ET GESTION DE L'ÉNERGIE: UN APERÇU DES ACTIVITÉS AU CSEM-PV-CENTER
  Date of publication: 01.01.18
- ARCHITECTURE SOLAIRE: DU DÉVELOPEMENT TECHNOLOGIQUE AUX MATÉRIAUX DE CONSTRUCTION
  Date of publication: 01.01.18
- VISUELLE BEWERTUNG DER GEBÄUDEINTEGRIERTEN FOTOVOLTAIKSYSTEME (GIPV)
  Date of publication: 01.01.18
- FARBIGE PV-MODULE - TECHNOLOGIEN, TYPEN UND ANWENDUNGEN
  Date of publication: 01.01.18
- Farbige PV-Module - Technologien, Typen und Anwendungen
  Date of publication: 01.01.18
- THE BEARABLE LIGHTNESS OF SOLAR MODULES - Part 1
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- THE BEARABLE LIGHTNESS OF SOLAR MODULES - Part 2
  Date of publication: 01.01.18
- NOVEL DESIGN AND MATERIALS FOR DURABLE PV MODULES: APPLICATIONS ON THE GROUND, IN CITIES AND IN THE AIR
  Date of publication: 01.01.18

renewal: obstacles and opportunities in Switzerland
Date of publication: 01.01.18

- ACTIVE INTERFACES website
  Date of publication: 01.01.18
- Proceedings of the Ecoparc Forum
  Date of publication: 01.01.18
- Potentiel solaire des territoires urbains - Vers de nouveaux paradigmes?
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- Stratégies de rénovation active pour le parc bâti suisse
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- Du photovoltaïque sur mesure
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- Energy performance analysis in interdisciplinary education – Lessons learned from a simulation-based teaching approach
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- Integrating urban energy simulation in a parametric environment: a Grasshopper interface for CitySim
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- Integrated design strategies for renovation projects with Building-Integrated Photovoltaics towards Low-Carbon Buildings: Two comparative case studies in Neuchâtel (Switzerland)
  Date of publication: 01.01.18
- Quantitative Evaluation of BIPV Visual Impact in Building Retrofits Using Saliency Models
  Date of publication: 01.01.18
- Market potential and acceptance of building integrated PV (BIPV) solutions, a practical approach
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- ACTIVE INTERFACES – Understanding consumer and investor preferences to overcome barriers for a large use of BIPV in the Swiss urban context
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- Towards integrated design strategies for implementing BIPV systems into urban renewal processes. First case study in Neuchâtel (Switzerland)
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- SUSTAINABLE BUILDINGS WITH PHOTOVOLTAIC SYSTEMS. PERSPECTIVES AND OBSTACLES FOR ARCHITECTS
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- PROJET DE RECHERCHE INTERDISCIPLINAIRE ACTIVE INTERFACES: VERS UNE INTÉGRATION ARCHITECTURALE DU PHOTOVOLTAÏQUE AUX PROCESSUS DE RENOUVELLEMENT URBAIN
  Date of publication: 01.01.18
- NOUVELLES SOLUTIONS PHOTOVOLTAÏQUES POUR L'ENVIRONNEMENT CONSTRUIT: TECHNOLOGIES, PRIX ET ACCEPTATION
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- Hail resistance of composite-based glass-free lightweight modules for building integrated photovoltaics applications
  Date of publication: 01.01.18
- Ultra-Lightweight PV module design for Building Integrated Photovoltaics
  Date of publication: 01.01.18
- Towards integrated design strategies for implementing BIPV systems into urban renewal processes: First case study in Neuchâtel (Switzerland)
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- Architectural design scenarios with building-integrated photovoltaic solutions in renovation processes: Case study in Neuchâtel (Switzerland)
  Date of publication: 01.01.18
- Sensitivity of calculated solar irradiation to the level of detail: insights from the simulation of four sample buildings in urban areas
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- 3D-Modeling of vegetation from Lidar point clouds and assessment of its impact on façade solar irradiation
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- Review and critical analysis of early-design phase evaluation metrics for the solar potential of neighborhood designs
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- Building Integrated Photovoltaic Elements: Challenges in Design and Reliability
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- Towards integrated design strategies for implementing BIPV systems into urban renewal
- SIMULATION OF ON-SITE CONSUMPTION FOR BUILDING INTEGRATED PHOTOVOLTAICS (BIPV)
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- RELIABILITY OF PV MODULES AND LONG-TERM PERFORMANCE PREDICTION
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- VISUAL IMPACT THRESHOLDS OF PHOTOVOLTAICS ON RETROFITTED BUILDING FACADES IN DIFFERENT BUILDING ZONES USING THE SALIENCY MAP METHOD
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- DES BÂTIMENTS DURABLES GRÂCE AU PHOTOVOLTAÏQUE. PERSPECTIVES ET OBSTACLES POUR LES ARCHITECTES
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- GEBÄUDEINTEGRIERTE PHOTOVOLTAIK ALS BAUPRODUKT: KÖNNEN NORMEN HELFEN ODER NUR BREMSEN?
  Date of publication: 01.01.18

processes: Preliminary case study in Neuchâtel (Switzerland)
Date of publication: 01.01.18

- Sampling of building surfaces towards an early assessment of BIPV potential in urban contexts
  Date of publication: 01.01.18
- Architectural Design Strategies for Building-Integrated Photovoltaics in residential building renovation processes
  Date of publication: 01.01.18
- Urban planning support based on the photovoltaic potential of buildings: a multi-scenario ranking system
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- Glass-free lightweight PV building elements: solutions to minimize weight and maximize durability
  Date of publication: 01.01.18
- Diffusion of Solar Photovoltaics: Consumer Preferences, Peer Effects and Implications for Clean Energy Marketing
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- Visual impact assessment of BIPV in building retrofits using saliency models
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- Vers une nouvelle ère pour des villes solaires
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- Forum Ecoparc "Potentiel solaire des territoires urbains: Vers de nouveaux paradigmes?"
  Date of publication: 01.01.18
- Man hat erkannt, dass man jetzt handeln muss.
  Date of publication: 01.01.18
- Interview with Prof. Emmanuel Rey and Rolf Wuestenhagen
  Date of publication: 01.01.18
- Solaranlagen. Elegante Zellen, kräftige Speicher
  Date of publication: 01.01.18
- Unsichtbare Solarmodulen
  Date of publication: 01.01.18
- Die Energiewende steckt noch in den Kinderschuhen
  Date of publication: 01.01.18
- Hohe Hürden auf dem Weg zur Energiewende
  Date of publication: 01.01.18

Geodata to BIPV yield estimation: Towards an urban-scale simulation workflow

Date of publication: 01.01.18

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Connected projects

ACTIVE INTERFACES - Holistic strategy for PV adapted solutions embracing the key technological issues.

Maximum electricity generation in a minimum of space

PV and urban renewal

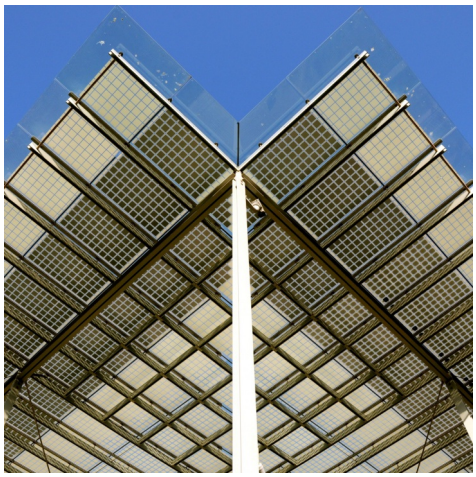
Intelligent building façade generates energy

Overcoming opposition to PV

Facing the sun with red modules

Standards for photovoltaics

Aesthetic Power Production: Colourful Photovoltaic Systems to Promote the Development of Solar Energy



Accelerating PV applications

Building-integrated solar cells

All information provided on these pages corresponds to the status of knowledge as of 10.05.2019.