



## //// active interfaces

Sustainable buildings with photovoltaic systems  
Perspectives and obstacles for architects

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Energy Turnaround  
National Research Programme

ACTIVE INTERFACES

### CONTEXT | Issues and challenges

- Importance of **photovoltaics (PV)** to energy turnaround (quantitative issues) might require > 30% coverage of Swiss roofs/façade
- Importance of **urban renewal** for the evolution of built environment towards sustainability (National Research Programme 54)
- **PV integrated into the building (BIPV)** : higher acceptance, required for massive penetration of PV in CH with potential lower costs (substitution effects)

But **not many good examples** of BIPV in the current practice and many obstacles prevent a **qualitative and quantitative development** of PV

**ACTIVE INTERFACES** = NRP 70 interdisciplinary research project aiming at crossing over these obstacles

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**CURRENT PRACTICE | Technological barriers**



*Strong cost difference between standard and custom-made products (SEAT Manufacture in Martorell | Solar Decathlon House of Cardenal Herrera University)*

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**CURRENT PRACTICE | Design barriers**



*Esthetic and economical efficiency problems of building renovations without real integration of PV elements*

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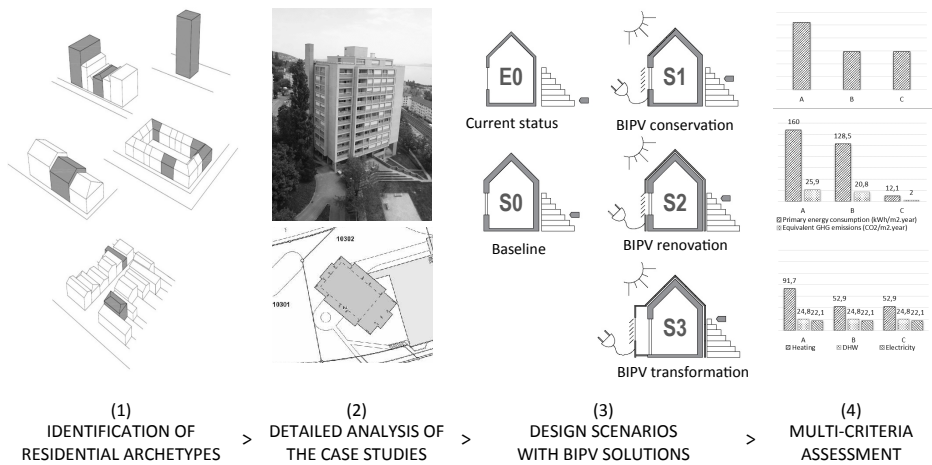
**RESEARCH | Real case study | City of Neuchâtel**



Representative of the urban areas in the Swiss plateau, strong interest for energy issues, development of a new masterplan

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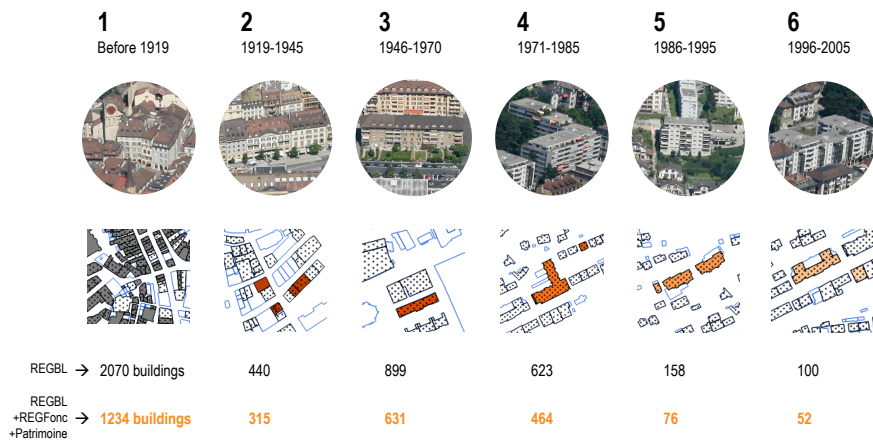
**RESEARCH | Main phases of the methodology**



Methodology for the development of renewal scenarios

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## RESEARCH | Phase 1 : Identification of residential archetypes

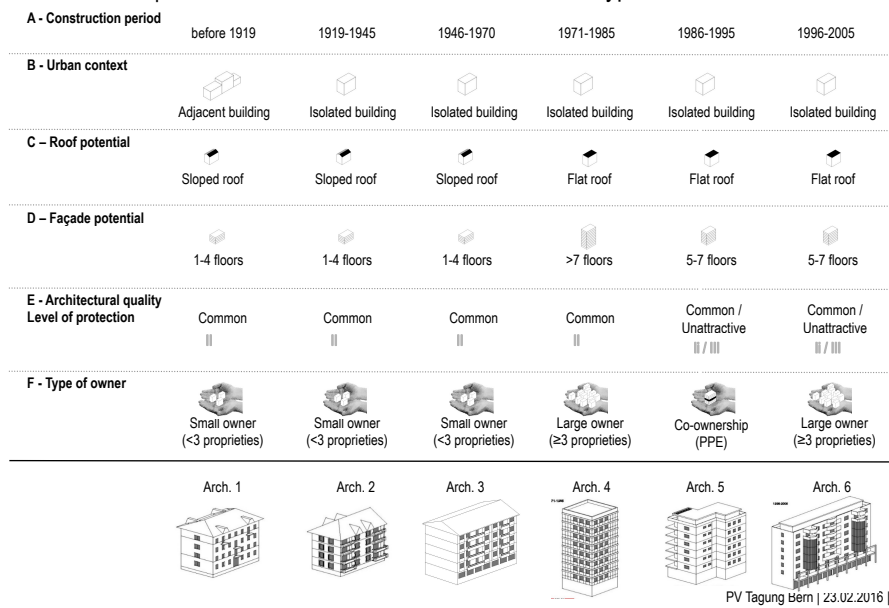


Typology based on construction period and constructive features (complete data for 2772 buildings)

Ref.: Office fédéral de la statistique (OFS), 2014

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## RESEARCH | Phase 1 : Identification of residential archetypes



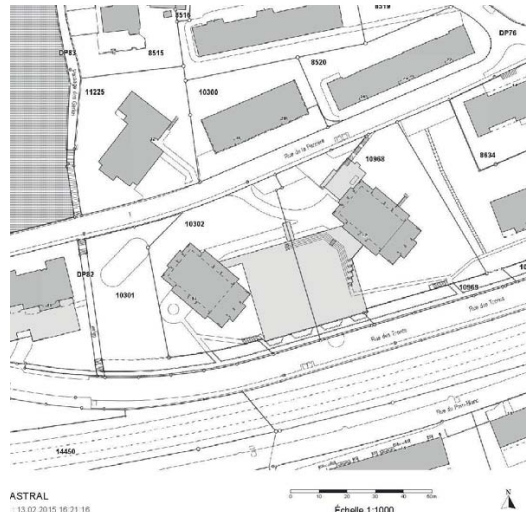
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### RESEARCH | Phase 1 : Identification of residential archetypes

A - Construction period	before 1919	1919-1945	1946-1970	1971-1985	1986-1995	1996-2005
B - Urban context	Adjacent building 	Isolated building 	Isolated building 	Isolated building 	Isolated building 	Isolated building 
C - Roof potential	Sloped roof 	Sloped roof 	Sloped roof 	Flat roof 	Flat roof 	Flat roof 
D - Façade potential	1-4 floors 	1-4 floors 	1-4 floors 	>7 floors 	5-7 floors 	5-7 floors 
E - Architectural quality Level of protection	Common 	Common 	Common 	Common 	Common / Unattractive 	Common / Unattractive 
F - Type of owner	Small owner (<3 proprieties) 	Small owner (<3 proprieties) 	Small owner (<3 proprieties) 	Large owner (≥3 proprieties) 	Co-ownership (PPE) 	Large owner (≥3 proprieties) 
	Arch. 1 	Arch. 2 	Arch. 3 	Arch. 4 	Arch. 5 	Arch. 6 

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### RESEARCH | Phase 2 : Analysis of the case study



First case study : Rue Troncs 12 (Residential archetype 4, Period of construction: 1972-1973)

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## RESEARCH | Phase 3 : Design scenarios with BIPV solutions



Current status



Baseline: Compliance with current legal requirements



BIPV conservation: Maintaining the expression of the building while improving the energy performances of the building (at least current legal requirements)



BIPV renovation: Maintaining the general expressive lines of the building while reaching high energy performances (at least Minergie standard)



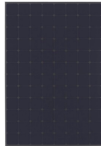
BIPV transformation: Best energy performances and maximum electricity production possible with aesthetic and formal coherence of the whole building (at least 2000 Watt Society | Energy strategy 2050)

Definition of the design scenarios

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## RESEARCH | Phase 3 : Design scenarios with BIPV solutions

(a)



Evolutive : Products directly issued from mainstream PV, but which naturally fits better for BIPV (e.g. "smart wire" modules, Metallization-Wrap-Through – MWT – modules).

(b)



Transformative : Products based on low-cost "standard" technology products, but which integrate low-cost modifications, such as texture or colour variation with "adaptation" foils.

(c)

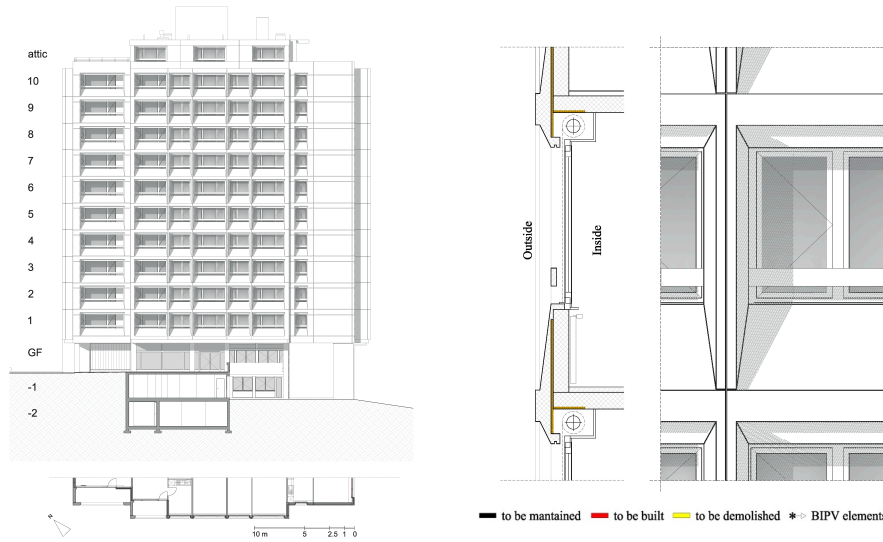


Disruptive : Products including customized-size products or on-site shaping of PV elements.

(a) Polycrystalline silicon PV module (55% of the market) with a black backsheet (SIGNATURE™ BLACK) - <http://us.sunpower.com/>  
 (b) White c-Si based PV modules (shiny & matt) as developed by CSEM and now commercialized by Solaxess.  
 (c) Customized-size PV modules by Meyer Burger AG - [www.meyerburger.ch](http://www.meyerburger.ch)

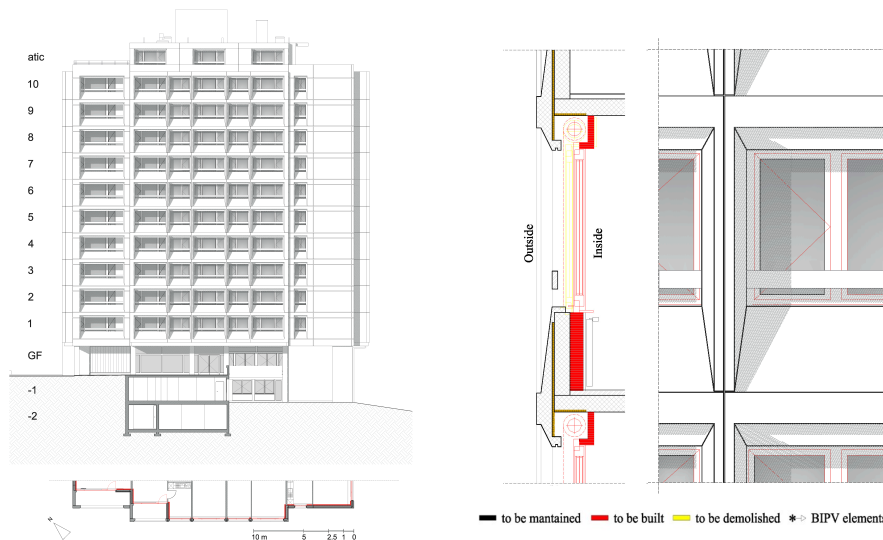
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RESEARCH | Phase 3 : Design scenarios | E0 – Current status



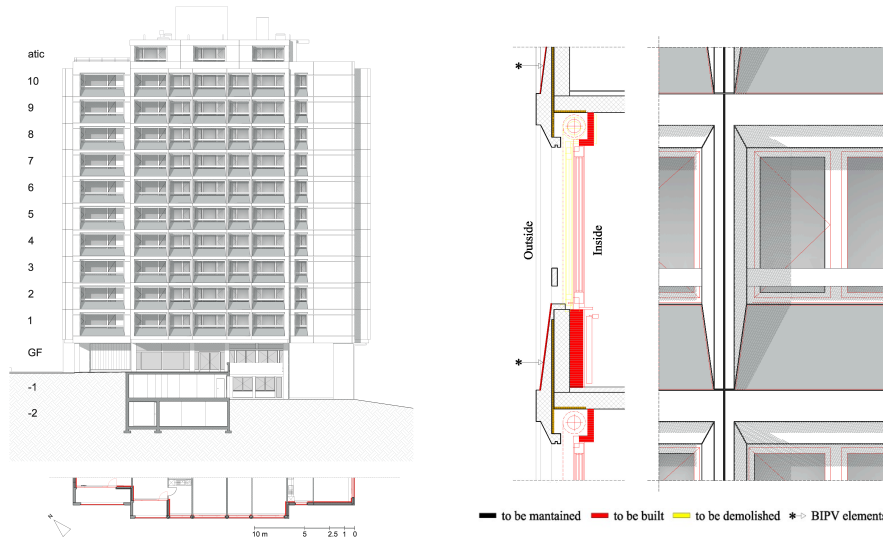
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RESEARCH | Phase 3 : Design scenarios | S0 – Baseline



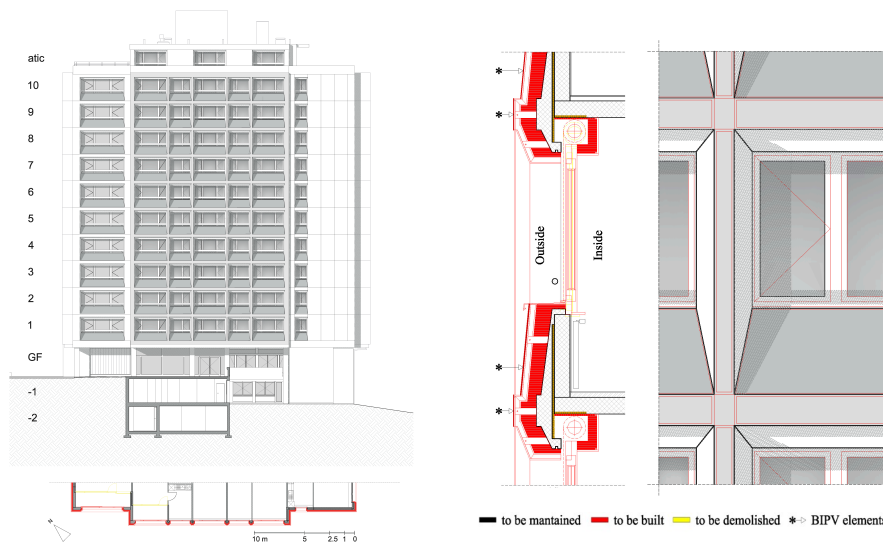
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RESEARCH | Phase 3 : Design scenarios | S1 – Conservation



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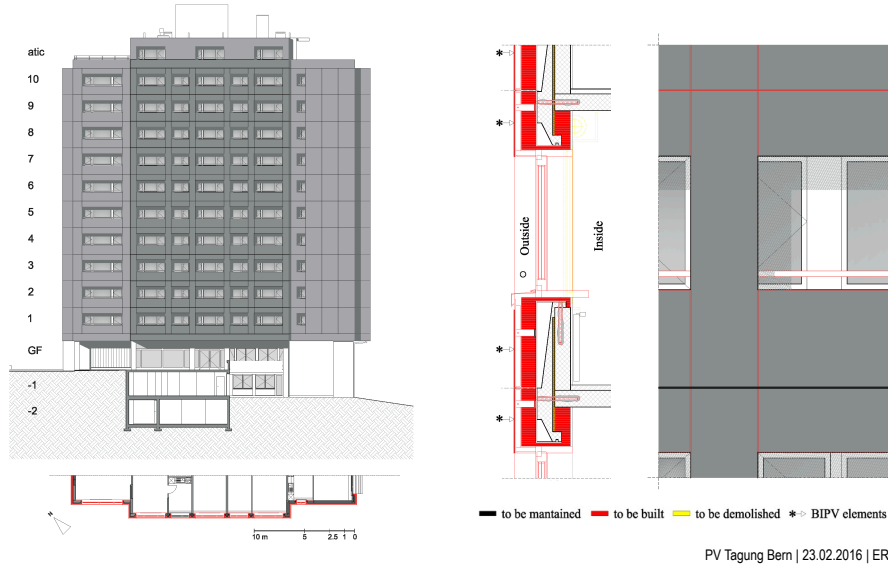
RESEARCH | Phase 3 : Design scenarios | S2 – Renovation



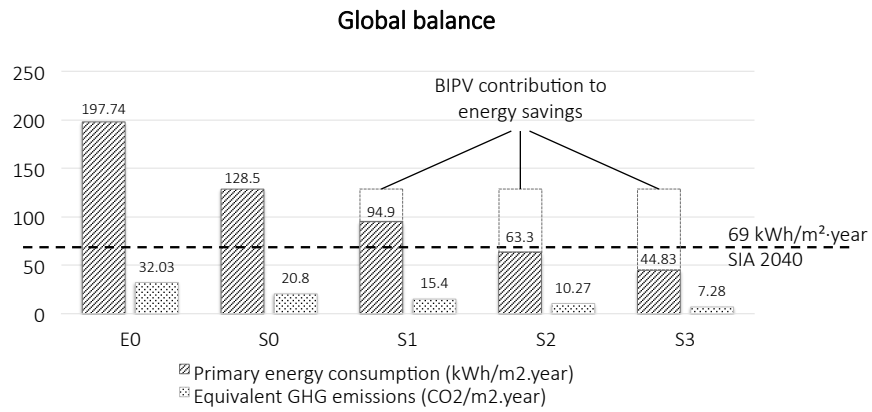
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RESEARCH | Phase 3 : Design scenarios | S3 – Transformation



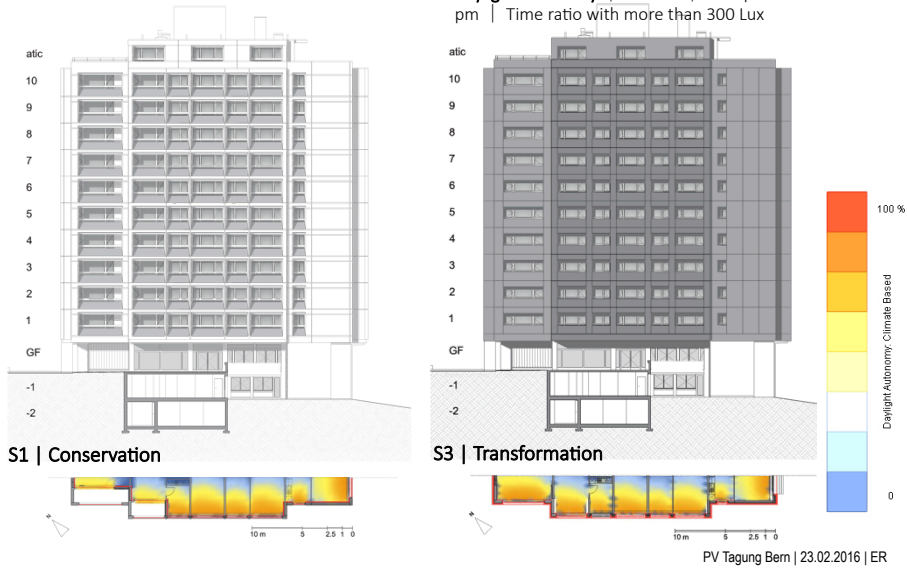
RESEARCH | Phase 4 : Assessment | Energy and emissions



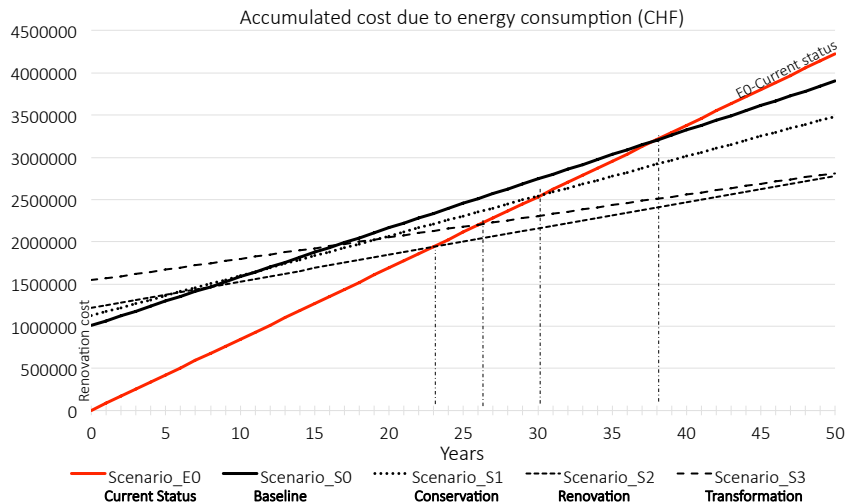
SIA 2040: La voie SIA vers l'efficacité énergétique (objectif «2000W society»)

RESEARCH | Phase 4 : Assessment | Indoor comfort

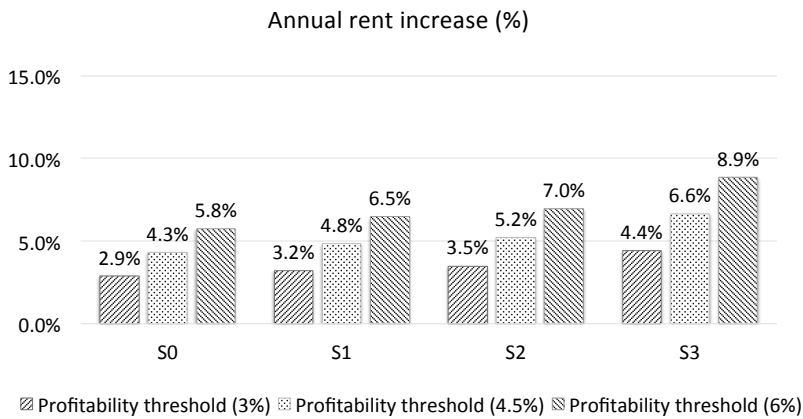
Daylight Autonomy | 300 lux | Occupation 8 am – 10 pm | Time ratio with more than 300 Lux



RESEARCH | Phase 4 : Assessment | Global cost-effectiveness



### RESEARCH | Phase 4 : Assessment | Global cost-effectiveness

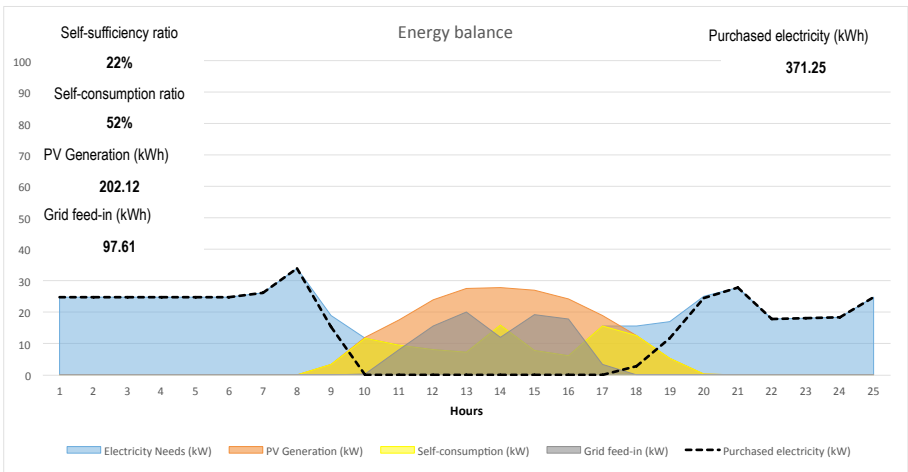


Mean rent level in Neuchatel: 220 CHF/m2 per year

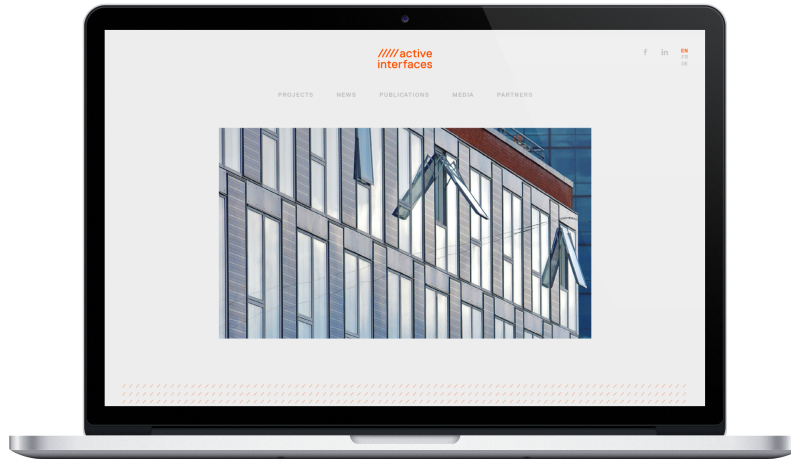
### RESEARCH | Phase 4 : Assessment | Photovoltaic installation

#### Daily analysis

S1 - Conservation



**COMMUNICATION** | Website [www.activeinterfaces.ch](http://www.activeinterfaces.ch)



Homepage of the Active Interfaces website

**TEAM** | 10 Research groups | 9 Post-doc | 5 Phd students

