Acceptance of building integrated PV (BIPV) solutions in urban renewal: obstacles and opportunities in Switzerland

Martin Boesiger[1*], Jean-Philippe Bacher[1]

[1]Institute for Applied Research in Energy Systems, University of Applied Sciences and Arts Western Switzerland / HES-SO Fribourg, Bd de Pérolles 80, 1700 Fribourg, Switzerland

* Martin Boesiger, martin.boesiger@hefr.ch

Abstract

The energy transition raises the questions of the performance, the facade potential and the architectural integration of photovoltaic solutions. In this context, understanding the obstacles and opportunities of the market development in a holistic way is a major issue. This contribution relies on the results of the SNSF PNR70 ACTIVE INTERFACES project (sub-project 05) and emphasizes on the aspects of architectural integration (design and technique) as well as on socio-economic aspects, normative and legal aspects and knowledge transfer between the different actors along the value chain of BIPV products. This research considers the urban residential renewal of the city of Neuchatel as a case study in order to evaluate the market potential of BIPV. The used methodology consists in a pragmatic approach, interviewing architects and owners on choices they made for their specific renovation project as well as their viewpoint and beliefs towards PV and BIPV. A planned behavior acceptance model was used to evaluate the influence of different factors such as outcome appraisal, performance beliefs, effort expectancy, normative beliefs and motivation to comply - which generate the behavioral intention - as well as personal skills, environmental constraints and facilitating conditions, which enable action. The findings of this study give a better understanding of the market potential of BIPV in urban renewal process and provide new perspectives on public policies and existing incentive mechanisms. Based on the analysis of stakeholders interviews, practical recommendations that could significantly change current practices in this area are proposed.

La transition énergétique soulève les questions de la performance, du potentiel de façade et de l'intégration architecturale des solutions photovoltaïques. Dans ce contexte, la compréhension holistique des obstacles et des opportunités du marché est un enjeu majeur. Cette contribution s'appuie sur les résultats du projet SNSF PNR70 ACTIVE INTERFACES (sous-projet 05) et met l'accent sur les aspects d'intégration architecturale (design et technique) ainsi que sur les aspects socio-économiques, les aspects normatifs et juridiques et le transfert de connaissances entre les différents acteurs le long de la chaîne de valeur des produits BIPV. Cette recherche considère le renouvellement urbain résidentiel de la ville de Neuchâtel comme une étude de cas afin d'évaluer le potentiel commercial du BIPV. La méthodologie utilisée consiste en une approche pragmatique, en interrogeant les architectes et les propriétaires sur les choix qu'ils ont faits pour leur projet de rénovation spécifique ainsi que leur point de vue et leurs croyances à l'égard du PV et du BIPV. Un modèle d'acceptation du comportement planifié a été utilisé pour évaluer l'influence de différents facteurs tels que l'appréciation de la valeur ajoutée, les attentes en termes de performance, la perception des efforts induits, les croyances normatives et la motivation à se conformer - ce qui génère l'intention comportementale - ainsi que les compétences personnelles, les contraintes spécifiques et les conditions facilitant l'adoption du BIPV qui, elles, génèrent l'action. Les résultats de cette étude permettent de mieux comprendre le potentiel de marché du BIPV dans le processus de rénovation urbaine et offrent de nouvelles perspectives sur les politiques publiques et les mécanismes d'incitation existants. Sur la base de l'analyse des entretiens avec les parties prenantes, des recommandations concrètes susceptibles de modifier de manière significative les pratiques actuelles dans ce domaine sont proposées.

1. Introduction

Reduction of energy consumption and greenhouse gas emissions are an important preoccupation for most European countries. To accomplish this goal, they are turning their attention towards renewable energies, especially solar energy. In Switzerland, each of the 3.4 million households consumes an average of 5’400 kWh of electricity per year. This corresponds to about one-third of the country's electricity consumption [1]. In 2017, electricity production from photovoltaic installations amounted to 1.67 GWh, representing an increase of 349 MWh (+21%) compared to the previous year [2]. These values make photovoltaics the second largest source of renewable electricity production in Switzerland after hydroelectric power stations. However, this proportion of production has grown the most in recent years with an increasing number of photovoltaic solar installations (see Figure 1).

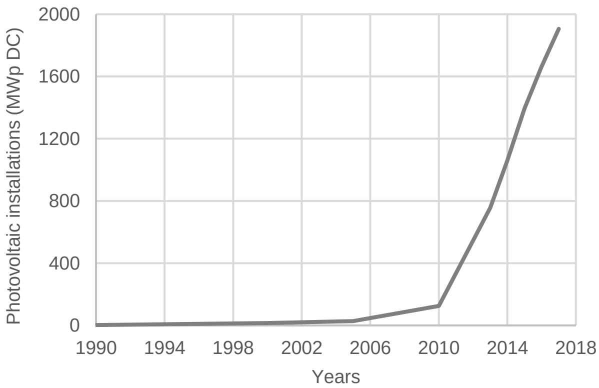

Figure 1 *Nominal power (MWp DC) of photovoltaic installations connected to grid and off-grid at the end of the year since 1990 in Switzerland [2].*

The increased energy transition raises the questions of the performance [3] [4], the facade potential [5] [6] and the architectural integration [7] [8] of photovoltaic solutions. In this context, understanding the obstacles and opportunities of the market development is a topical issue [9]. This research falls within the ACTIVE INTERFACES project [10], which addresses the issue of the diffusion of BIPV in a holistic way, focusing also on the aspects of architectural integration (design and technique), socio-economic aspects, normative and legal aspects and knowledge transfer between the different actors along the value chain of BIPV products. One goal of this work is to give a better understanding of the market potential of BIPV in urban renewal processes. Results will be used to establish and implement practical recommendations that could significantly change current practices in this area. In order to bring a relevant contribution to the Energy Strategy 2050, which requires 10 GW of solar electricity [11], this project focuses on technology acceptance of building integrated photovoltaics (BIPV) into urban renewal processes. Despite technological progress and costs reductions, only a marginal part of the solar electricity potential of BIPV is currently valorised in urban areas (integration into facades or roofs elements).

2. Methodology

2.1 Structure of the research

The current research consisted of the following phases:

1. Inventory of building permits issued in Neuchatel between 2011 and 2015 in order to segment the construction market;
2. Analyze building permits for residential renovation and building topology;
3. Select representative projects for in-depth analysis;
4. Structured face-to-face interviews of the main stakeholders of each selected project;
5. Analysis and synthesis of interviews.

2.2 Representative retrofit projects in the city of Neuchatel

The city of Neuchatel can be considered in terms of architecture as representative of the typical middle-size city of the Swiss Plateau [12]. As the construction market in Switzerland is rather homogeneous, the results obtained can be generalized to the same type of agglomerations in Switzerland. A previous study [13] was based on an analysis of the building permits issued in

Neuchatel and highlighted the good potential for introducing BIPV in existing constructions. Indeed, 'transformations' and 'outside modifications' represent about 45% of the sample of 212 building permits issued between 2011 and 2015 and half of the renovations were to residential multi-storey buildings. At the same time, statistics from the city of Neuchatel show a clear reduction in the investment costs required for photovoltaic energy (5'029 CHF/kWp in 2012 versus 3'200 CHF/kWp at the end of 2015) and an interesting increase in the active surface installed on residential multi-storey buildings. From this analysis, 34 retrofit projects revealed a good BIPV potential with the following transformations: renovation with new PV/BIPV installation (type I), façade transformation without new PV/BIPV installation (type II) and roof transformation without new PV/BIPV installation (type III).

A multi-criteria selection allowed to identify 12 representative case studies from these 34 retrofit projects by taking into account the type of retrofit and the building archetype. Building archetypes are based on *S. Aguacil*'s study [14] and defined by: i) the construction period, ii) the urban context (adjacent or isolated building), iii) the shape of the roof (sloped or flat), iv) the number of floors and v) the building protection level.

2.3 Interviews of architects and owners

The realization of a BIPV project requires the participation and collaboration of several stakeholders throughout the process. A previous study of the ACTIVE INTERFACES project [15] divided this process into six phases and developed a value chain for the BIPV (see Figure 2). A study carried out in the Netherlands [16] proposed a determination of the relations between the various actors and their position within the process. It differentiated between primary actors - initiators and responsible for the execution of the work - secondary actors - key partners without whom operations would not be possible - and tertiary actors - who have a supporting role -. It defined as primary actors the BIPV manufacturers and suppliers, the project owners, and the architects. As the research described in this paper is focused on urban renewal projects already carried out with or without PV/BIPV, the two actors necessary and common to the 12 case studies are the owner (private, institutional, property developer, etc.) and the architect. The questionnaires have therefore been written for these two target groups and will bring out their relationships with other stakeholders presented in this value chain. They are adapted differently for these two types of stakeholders but have a similar structure: i) personal information, ii) experience with BIPV, iii) the case study, iv) specific questions on technological, economic aspects and the legal and political framework conditions related to BIPV and v) future prospects for BIPV. These questionnaires were filled in during face-to-face interviews with each of the stakeholders in order to ensure the understanding of the questions and the quality of the answers. This methodology has already proved its worth in several investigations related to BIPV acceptance [17] [18]. These qualitative interviews allowed to spontaneously develop specific points during open discussion with the respondents and to gather crucial details for the understanding of each case study.

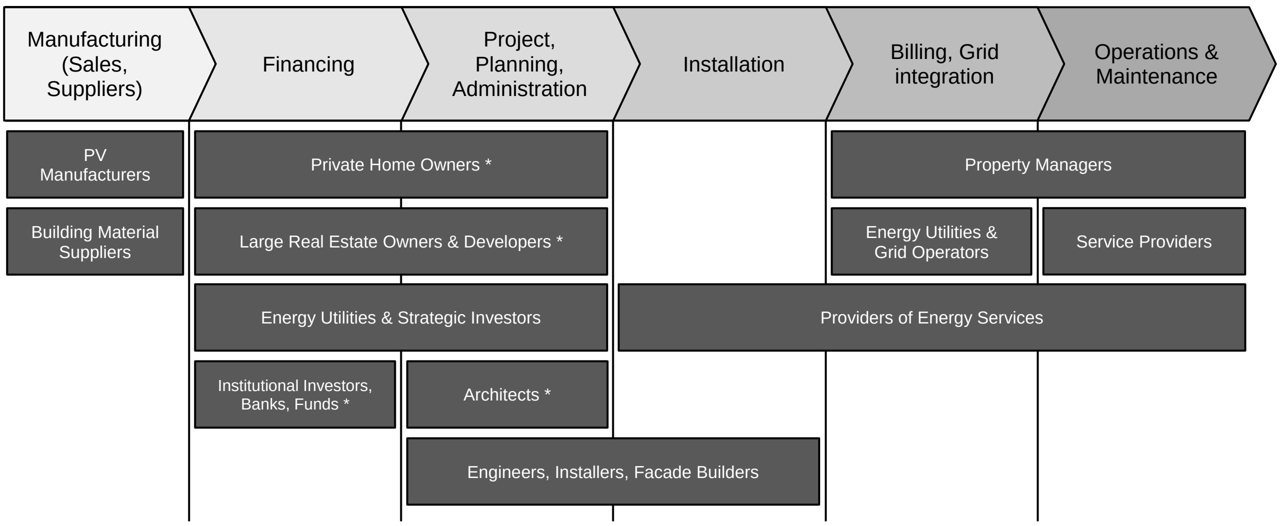

Figure 2 BIPV value chain from H. Curtius study [15] modified by the authors with interviewed stakeholders for this research (*).

2.4 Acceptance model

Several known models exist to assess the acceptance of a new technology [19] [20]. These models identify improvement areas to make technology acceptable to users and their theories are still valid [21]. The Figure 3 shows a theoretical model of planned behavior that takes into account factors that influence the intention and also facilitating conditions that allow to move from intention to action. This model claims that the intention to adopt a new technology depends on the following three factors: performance expectations, efforts required to carry out the project and the social influence.

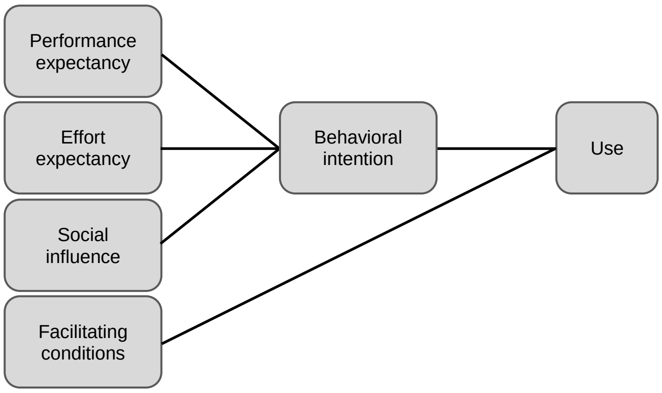

Figure 3 Theoretical model of planned behavior with factors that influence the intention to adopt a new technology and also facilitating conditions that allow to move from intention to action.

This model is used in order to assess the BIPV acceptance among main stakeholders. Each of these factors depend on several aspects that have an influence on the decision-maker. The main influential aspects could be identified through the face-to-face interviews with architects and owners of the 12 case studies. The performance of a BIPV installation is a combination of its cost, energy efficiency and architectural integration. Then, there are three noticed sources of efforts: imposed regulations and norms to respect, planning process and coordination between each stakeholders and lack of knowledge about BIPV to be filled. Finally, social influence is defined as the combination of the influence of society, e.g. personal beliefs on ecology and renewable energies, the influence of the neighbourhood or family, and the influence that can be exerted by the different stakeholders in construction among themselves. The following tables detail the elements of surveys, discussed during interviews with architects and owners, which allow the assessment of the influence of each of these aspects on their intention to install BIPV.

	Architects	**Owners**
Costs	- Financial interest to propose BIPV for the architect - BIPV's influence on the value of a building - The necessity of subsidies for the BIPV installation to be cost-effective	- BIPV's economic performance - BIPV's influence on the value of a building - The necessity of subsidies for the BIPV installation to be cost-effective
Efficiency	- Energy autonomy of the building (self-consumption) - Efficiency loss due to module integration (orientation, color, texture, etc.) - The maturity of technology	- Energy autonomy of the building (self-consumption) - Efficiency loss due to module integration (orientation, color, texture, etc.) - The maturity of technology
Architectural integration	- The choice of suitable BIPV products (size, shape, color, texture, etc.) - Technical integration of BIPV modules on roofs or facades - Aesthetic motivation to install BIPV	- The choice of suitable BIPV products (size, shape, color, texture, etc.) - Aesthetic motivation to install BIPV

Table 1 Surveyed elements describing performance expectancy indicators for architects and owners.

	Architects	Owners
Regulation & norms	- The need for a building permit for BIPV on the facade - The approval of the urban planning commission - Administrative procedures - Fire standards - Electrical standards compliance	- The need for a building permit for BIPV on the facade - The approval of the urban planning commission - Administrative procedures - Oppositions from the neighbourhood
Planning & coordination	- Additional efforts required for the study of the BIPV project - Additional efforts required for coordination between actors - Management of partnerships between the different actors - Complexity of the planning process of a BIPV installation	-
Knowledge	- Knowledge of PV/BIPV among architects - Knowledge of PV/BIPV among owners - Lack of information and technical advice - General lack of knowledge and awareness of BIPV - Overlapping skills between trades	- Knowledge of PV/BIPV among architects - Knowledge of PV/BIPV among owners - General lack of knowledge and awareness of BIPV - The formation of architects

Table 2 *Surveyed elements describing effort expectancy indicators for architects and owners.*

	Architects	Owners
Society	- Personal conviction - BIPV examples - Ecological sensitivity in everyday life	- Personal conviction - BIPV examples - Ecological sensitivity in everyday life - The perception of the future of BIPV in Switzerland
Actors	- The owner's interest in BIPV - Distinction from competitors - The architect's proposal to consider BIPV for the case study	- The architect's advice - Another stakeholder's proposal to consider BIPV for the case study - The owner's request to consider the BIPV for the case study - Lack of political pressure

Table 3 *Surveyed elements describing social influence indicators for architects and owners.*

From the interviews, it is possible to qualitatively determine whether these indicators have a positive or negative influence on the intention to install BIPV among architects and owners. A rating of *1* for positive influence, *0* for no influence and *-1* for negative influence is assigned to each indicator for each stakeholder interviewed. For each indicator, the ratings are summed and the result is then reduced in percentage (from *100%* to *-100%*), for architects and owners separately, in order to extract those that predominate in the BIPV acceptance processes of both stakeholders.

3. Results

3.1 Description of case studies

The following figures show some examples of these case studies in the city of Neuchatel before and after renovation. The case studies are located on the map in the Figure 8 and listed in Table 4 according to their building archetype, the type of renovation carried out and the interviewed stakeholders: architect (A) and/or owner (O).

Figure 4 *Louis-Favre 1: Roof replacement, installation of 171 m2 of integrated photovoltaic cells for a production of about 27.7 kWp (Archetype 1, Renovation type I). Pictures from Pro Natura Neuchatel (left) and from the architect (right).*

Figure 5 *Draizes 4: Energy-conserving renovation and elevation of the building. Installation of 10 thermal solar panels on the roof (Archetype 1, Renovation types II and III). Pictures from architect.*

Figure 6 *Orée 50: Renovation and insulation of facades, replacement and enlargement of balconies (Archetype 3, Renovation type II). Pictures from architect.*

Figure 7 Trois-Portes 61-63: Insulation of the envelope, enlargement of the balconies and installation of 60 m^2 of thermal solar panels (Archetype 4, Renovation type II). Pictures from architect.

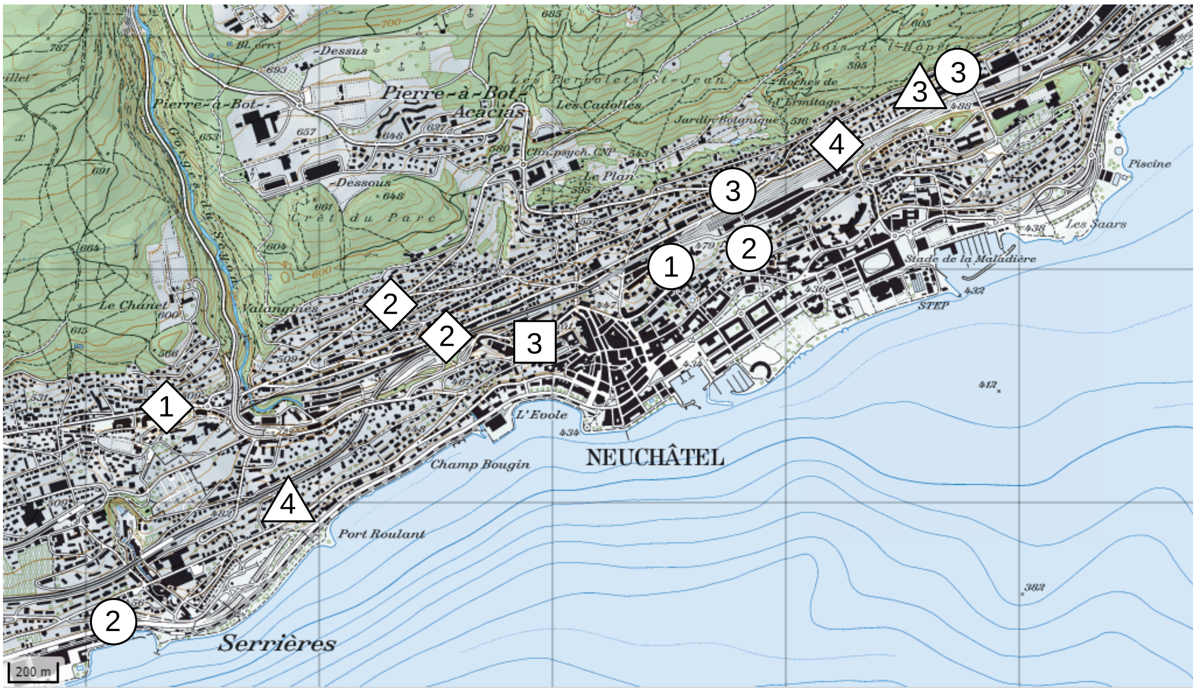

Figure 8 Map of the city of Neuchatel (from the Geoportal of Territorial Information System of Neuchatel[1]) with the selected retrofit projects locations in the renovation type corresponding pattern (circle for Type I, triangle for Type II, square for Type III, diamond for Type II+III) and the archetype corresponding number (1 to 4 for archetypes 1 to 4).

[1] Geoportal of the Territorial Information System of Neuchatel: *https://sitn.ne.ch/theme/main* (13.08.18).

	Federal building Id. (EGID)	Short designation of the street and entry number	Building archetype	Renovation type	Surveyed stakeholder
1	1480656	*Rue Louis-Favre 1*	1	**I**	A and O
2	1478638	*Rue des Draizes 4*	1	**II + III**	A
3	1480742	*Ruelle Vaucher 22*	2	**I**	O
4	1478824 1478825	*Chaussée I.-de-Charrière 5, 7*	2	**I**	A and O
5	1479241	*Av. des Alpes 78*	2	**II + III**	A and O
6	1479342 1479343	*Rue des Parcs 77, 79*	2	**II + III**	A and O
7	1480232 1480234 1480237	*Rue de l'Orée 58-62, 68*	3	**I**	A and O
8	1480017	*Rue de la Côte 3*	3	**I**	A
9	1480192 1480195 1480212	*Rue de l'Orée 38, 44-46, 50*	3	**II**	A and O
10	1480299	*Rue de l'Ecluse 37*	3	**III**	A and O
11	1479577 1479578	*Ch. de Trois-Portes 61, 63*	4	**II**	A and O
12	1480129	*Rue des Fahys 73*	4	**II + III**	A

Table 4 Classification of the 12 selected retrofit projects for the in-depth analysis with 11 architects (A) and 9 owners (O) as surveyed stakeholders.

3.2 Interviewees profiles

As mentioned in the Table 4, 11 architects and 9 owners were interviewed. The respondents were all male, experienced (54.5 years for architects and 60.6 years for owners). The architects come mostly from independent architectural offices (91%). They all have some experience (between 14 and 50 years of practice) and all have some urban renovation/transformation projects including a solar installation (PV, BIPV or solar thermal) per year but only six of them have already dealt with BIPV (only on roof) (55%). The owners include five pension funds, a foundation, a housing cooperative, a public entity (the city of Neuchatel) and a private owner. Most of them have more than ten residential buildings in urban areas (78%), the majority have some buildings equipped with conventional PV (78%) but only one has already installed BIPV (on roof).

3.3 Acceptance model

The main trends observed through the interviews with stakeholders are detailed in the following tables that list the most frequent elements of answers. The results of this study prove that there is not only one aspect of the acceptance model that plays a negative role on the diffusion of the BIPV. Above plots show the qualitative evaluation of acceptance models' indicators calculated using the method proposed in Section 2.4 and listed in the Table 8. From the architects' point of view, the detrimental aspects to the BIPV's dissemination are clearly identified:

- A general lack of knowledge about BIPV among both architects and customers;
- The lack of social pressure from the owners and from policy makers;
- The price of BIPV installations, which they say discourages investors.

Another difficulty noted by the architects concerns planning and coordination between the actors. They consider that this additional complexity is mainly due to the lack of practice and habit in the BIPV field and that the effort/fee ratio improves with the experience acquired as installations are carried out. The owners agree with the architects on these three points mentioned above but also criticize the administrative procedures too tedious and frequently revised.

Costs	- Because BIPV is often not the priority of a retrofit project, it is usually left out if the budget is critical. - Most owners consider a PV/BIPV installation as an economic performance object. - No surveyed owner finds that a BIPV installation represents a profitable investment. - The pension funds aim for a payback time of 10 years for a BIPV installation while the housing cooperative and the public entity aim for a payback time of 25-30 years. - Most owners have no particular difficulty in raising additional capital to invest in a BIPV installation if they demonstrate that it is economically profitable. - Owners consider that a BIPV installation has no (or very little) influence on the value of the building. - 81% of architects think that releasing funds to increase or at least guarantee the unique retribution (RU) would be an effective measure to promote photovoltaics. - BIPV increases renovation costs and therefore architects' fees. However, the effort/fee ratio is not interesting especially during the first installations when the architect does not yet have experience in this field.
Efficiency	- No negative a priori from the point of view of architects on the efficiency of integrated modules which may be lower than the standard modules due to their orientation or the various films or surface treatment applied to them to improve the aesthetic. However, half of the owners are reluctant to sacrifice part of the efficiency of the modules for aesthetic reasons. - The optimal integration of this roof and facade technology takes precedence over the amount of energy produced from the point of view of architects.
Architectural integration	- Architects want to have a larger choice of products in terms of size, form, color, texture, etc. to increase the possibilities of integration. However, 70% of the surveyed architects say that available products already allow a good architectural integration. - 66% of owners are satisfied with the existing BIPV product range available on the market. - The aesthetics of a BIPV installation is not the priority of owners.

Table 5 Most frequent elements from interviews with architects and owner concerning the performance expectancy.

Regulations & norms	- From the point of view of architects, regulations and norms have a positive effect: they frame their work and avoid unsightly installations. - 83% of architects and 55% of owners consider it necessary to apply for a building permit for a BIPV façade installation - The limitation up to 30 kWp for the federal incentive programs (one-time fee) prevented a complete integration of one of the case studies in order to obtain the subsidy. Current policies do not seek to promote a more demanding integration at the PV level. - Owners criticize fastidious administrative procedures related to a PV/BIPV installation.
Planning & coordination	- New stakeholders necessary in the process make the coordination more complex, especially for the distribution of fees, and require more effort for architects. - Architects witness communication issues due to the lack of skill overlaps between stakeholders. - Architects mentioned that the search of suppliers and technical details on products is not an easy task because of the lack of visibility of suppliers.
Knowledge	- Owners consider architects' knowledge of BIPV better than their own but think they know PV better than architects do. - Architects consider their knowledge of both PV and BIPV (without distinction) to be low but better than that of owners. - Architects seek information about BIPV primarily from suppliers who only offer a limited range of products. They would like more independent advices on the BIPV. - Specialized magazines are more popular with architects and owners than exhibitions. It is difficult to attract them to PV/BIPV exhibitions.

Table 6 Most frequent elements from interviews with architects and owner concerning the effort expectancy.

Society	- Successful BIPV examples motivate both architects and owners to consider this technology in the future. - Owners are motivated to install PV/BIPV more by personal conviction or interest in the technology than by aesthetics or economic interest. - All surveyed architects and most of the surveyed owners are prone to ecology.
Actors	- Although 90% of the surveyed architects assert themselves ready to consider the BIPV if the request comes from the customer, half regrets that the BIPV is not the priority of the owner. - Only 33% of owners say that the architect's advice could motivate them to install BIPV. - Architects do not perceive any value of the BIPV in terms of differentiation with respect to their peers. - Architects and owners feel that political pressure is not sufficient to motivate the BIPV's diffusion. - For architects, the most important stakeholders for the dissemination of BIPV in Switzerland are policy makers (State, cantons, communes), architects and owners. - For owners, the most important stakeholders for the dissemination of BIPV in Switzerland are policy makers (State, cantons, communes), energy distributors and architects.

Table 7 Most frequent elements from interviews with architects and owner concerning the social influence.

Some positive aspects emerged from this study:

- Both architects and owners are convinced by the effectiveness of BIPV technology;
- The solutions on the market today seem to be satisfactory in terms of choice of size, shape, color, texture, etc. although architects are still hoping for more choice in order to have more freedom of integration;
- All people surveyed said they were prone to ecology and renewable energy in general;
- Successful BIPV installations demonstrate the feasibility of such projects, they also make this technology more tangible and visible and motivate people to consider it in the future.

The discussions with architects and owners allowed to identify some facilitating conditions to install BIPV. Building transformation or retrofit is the main opportunity for BIPV. Because BIPV is a building component, its installation saves construction material contrary to building-added photovoltaic (BAPV). However, without obsolescence of the existing roof or facade, there is no point in replacing them with BIPV. The collaboration with a BIPV specialist can help convince architects to install this technology. Indeed, a specialist has a better overview of available products on the market and can fill the technical gaps of architects in the field of PV. Finally, the city of Neuchatel gives a second RU (500 CHF/kWp in 2016) in addition to the federal incentive programs (one-time fee) for PV installation up to 20 kWp. Because it can sometimes be complex to find additional capital for BIPV in a retrofit project, this extra help allows to reduce investment costs and improve the economical profitability. This initiative meets the expectation of 81% of interviewees who want the state to release funds to increase the federal incentive programs.

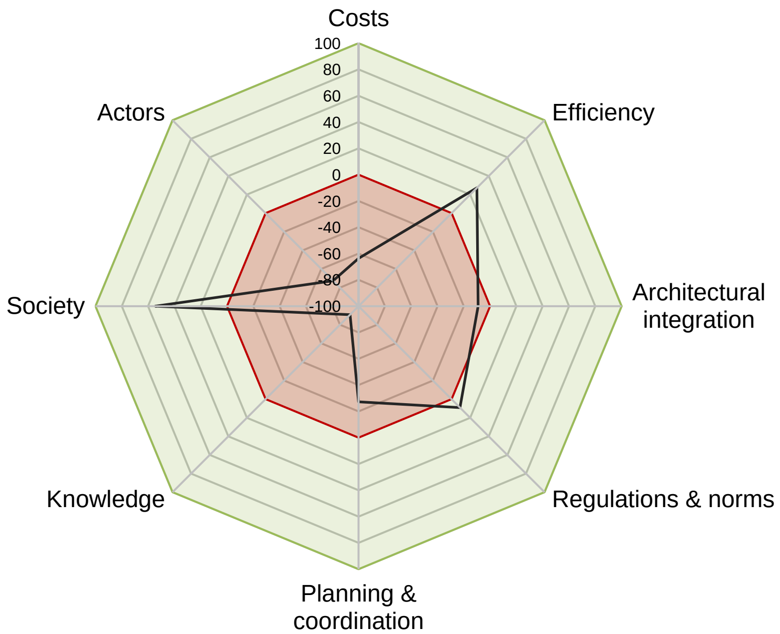

Figure 9 *Indicators appreciations for architects with positive value (from 0 to 100% in green field) for favorable influence on the behavioral intention to install BIPV and negative value (from 0 to -100% in red field) for unfavorable influence.*

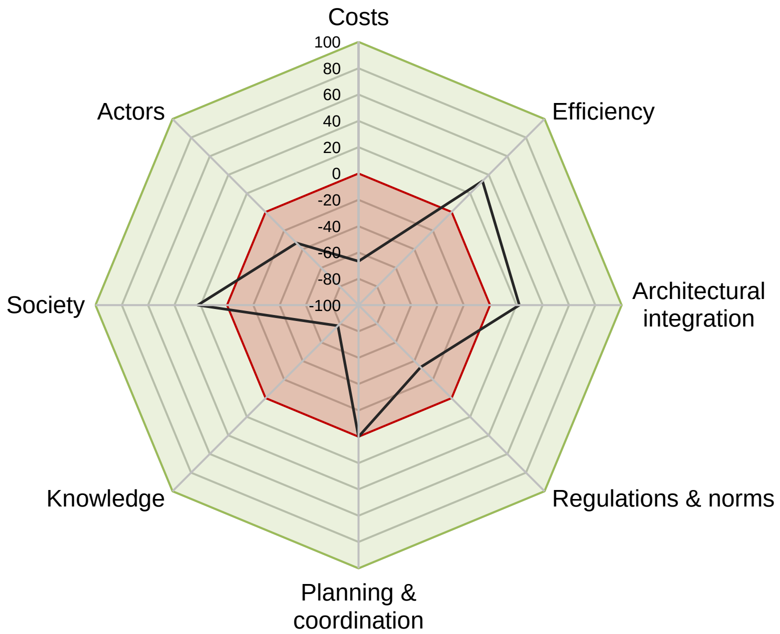

Figure 10 *Indicators appreciations for owners with positive value (from 0 to 100% in green field) for favorable influence on the behavioral intention to install BIPV and negative value (from 0 to -100% in red field) for unfavorable influence.*

	Indicators	**Architects**	**Owners**
Performance expectancy	Costs	-64%	-67%
	Efficiency	27%	33%
	Architectural integration	-9%	22%
Efforts expectancy	Regulations & norms	9%	-33%
	Planning & coordination	-27%	-
	Knowledge	-91%	-78%
Social influence	Society	55%	22%
	Actors	-73%	-33%

Table 8 *Qualitative evaluation of aggregated acceptance model indicators based on interview analysis with positive value (from 0 to 100%) for a favorable aspect for BIPV and negative value (from 0 to -100%) for an unfavorable aspect for BIPV.*

4. Conclusions

The hypothesis which states that the problems related to the diffusion of BIPV in Switzerland is not due to a single obstacle and must be treated holistically is confirmed by this study. The acceptance model shows that despite the fact that stakeholders are prone to ecology and seem convinced by renewable energies, there are obstacles that prevent them from installing BIPV. The first one is their lack of knowledge in the field. They must devote time to familiarize themselves with these new technologies. Most of them do not know where to look for information or whom to ask. BIPV specialists or solar integrators can help architects by offering technical advice on products and their integration. The promotion of pilot projects can show the integration potential of BIPV and the energy efficiency of these solutions. These pilot projects work as a showcase for these new products, inspire architects and convince owners to use the solutions in their future projects. BIPV suppliers, but also schools and research institutes, must play their role and disseminate information to make this technology more widely known and affordable to architects and owners alike. The knowledge transfer can be improved by the implementation of education programs or the publication of detailed case studies. This model also showed that the investment costs for a BIPV facility was a considerable obstacle. The development of integrated constructive solutions from BAPV can help to reduce the costs of integrated installations. Because prices of BAPV technologies are constantly decreasing, modifying their coating, their fastening system or other parameters which could improve their integrability seems to be a good alternative to provide BIPV solutions at a reasonable price. Finally, this study has highlighted that changes are needed to generate a bigger market pull. Installing BIPV is not financially interesting from the point of view of architects and is not the priority of owners for a retrofit. As long as the political pressure is done, the BIPV will remain a niche market and the main reason for installing it will remain the owner's personal conviction.

It would be interesting to compare these results with those of a quantitative study conducted on a much larger sample. The small number of architects and owners interviewed during this study was constrained by the desire to personally meet each of them in order to analyze in detail the case of study in the most extensive way possible. Consideration of other stakeholders along the value chain, such as private installers, electrical distributors, PV installators, engineering offices, BIPV panels manufacturers, roof makers, facade makers or energy contracting companies, would add an additional dimension to the study and would help to highlight other obstacles to the acceptance of BIPV. The representativeness of the city of Neuchatel, which encourages the PV by proposing a second RU, in relation to the Swiss market could be determined by a similar study carried out in other cities. In this case, the methodology proposed in this document, i.e. the analysis of 115 building permits issued in five years and concerning urban renewal, which is relatively heavy, could be simplified without introducing significant bias. For example by selecting architects and owners upon other criteria than according to renovation projects.

The next step in the ACTIVE INTERFACES project is to gather feedback from the various stakeholders in BIPV projects carried out in Switzerland in order to identify the motivations, possible constraints and above all the opportunities and means used to integrate photovoltaics. Questionnaires will be submitted to all stakeholders involved in the selected projects in order to highlight recurrent process mechanisms that have led to the realization of a BIPV installation.

5. Acknowledgements

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