Solar Sharing Economy or "My Home is My Power Plant"? Profiling Collective and Individual Solar Prosumers in Southern Switzerland

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Abstract

Increasingly energy policies aim to bring the consumers to the centre of the energy transition. One popular approach is for homeowners and renters in single- and multi-family houses to become solar prosumers. A consumer survey in Switzerland sheds light on the early movers leading the shift towards decentralised energy production.

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Citizen solar power for a just and speedy energy transition

As several other countries in Europe and in the world, Switzerland is facing the two-fold challenge of dramatically curbing greenhouse gas emissions while ensuring a secure and affordable energy supply to its consumers. In the case of Switzerland, the government has pledged to cut emissions by 50% by 2030 (NDC 2020) and reach net zero by 2050 (Swiss Federal Office of Energy 2018).

The restructuring of the energy and electricity systems implied by the Swiss Energy Strategy 2050 requires, among other things, a massive increase in renewable-based generation capacities (Swiss Federal Office of Energy 2018). The involvement of citizens is increasingly important to meet the medium- and long-term renewable generation targets for many reasons. Firstly, citizens' involvement enables key decentralized solutions for renewable generation and climate mitigation, such as solar energy on buildings. Building-scale solar PV systems can not only reduce the climate footprint of buildings, a sector which makes up for a third of Swiss carbon emissions (Federal Office for the Environment 2021), but can also power clean electric mobility (SolarPowerEurope 2019). Further, the participation of citizens in renewable energy investment decisions may help extending the benefits of the energy transition to all consumption segments, including individuals and families with a lower income. Procedural and distributional justice, i.e. a fair decision process and benefit sharing, foster social acceptance of new renewable energy infrastructure and climate policies (Gross 2007, Wolsink 2007). This is particularly important in the case of Switzerland, where the long-standing tradition of national, cantonal, and local referenda makes citizens' consensus of paramount importance to any long-term transition process.

This article provides an insight into the role of households in contributing to renewable energy targets, and what their contribution may be in the next few years. Using survey data, we analyse the adoption of building-scale solar photovoltaic (PV) panels among the residents in Canton Ticino, the southernmost and sunniest region of Switzerland. In particular, we focus on market segments whose potential contribution is still untapped: tenants and homeowners living in multi-family houses. We profile the early adopters of solar solutions for single family houses (SFH) and multi-family houses (MFH). Identifying the "early movers" is relevant for policymakers and solar marketers, as early adopters can speed up the adoption of the technology through spill over and peer effects. In fact, their observable behaviour can increase confidence in the innovative solutions via word of mouth and social learning (Baranzini et al. 2017), or can activate the need to comply with a social norm (Curtius et al. 2018). These mechanisms foster innovation adoption in the rest of the population (such as the so called "late majority").

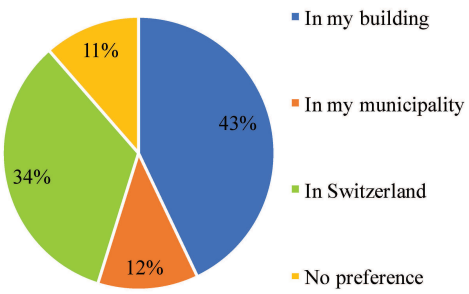
Please in my backyard (PIMBY)

Our analysis of solar adoption in SFHs and MFHs is based on an on-line survey distributed in Canton Ticino, Switzerland, between September and November 2021 in cooperation with four local electricity suppliers (O-FPE 2021)[1]. Around 30'000 households received the invitation to fill in the survey and 2'299 respondents validly completed it, yielding a response rate of 7.6%. While it is not fully representative, the final sample reasonably reflects the local population in terms of education and income.

The origin of the electricity they consume is important for a vast majority of the respondents (89% of the sample, Chart 1). Survey responses suggest indeed a strong preference for very local electricity: 43% of their respondents state they would like to consume electricity generated in the building where they live, and 12% would appreciate electricity generated within their municipality. In both cases, the respondents state they would be ready to accept a price increase of around 10% as compared to actual prices. The preference for electricity generated in the own building is only slightly

higher among homeowners (46%) than tenants (40%). This suggests that a good share of households might be willing to support the shift to the renewable energy supply of buildings.

Chart 1 – Preferred origin of the own electricity supply in Canton Ticino (% of respondents)



Diffusion of solar among tenants and homeowners

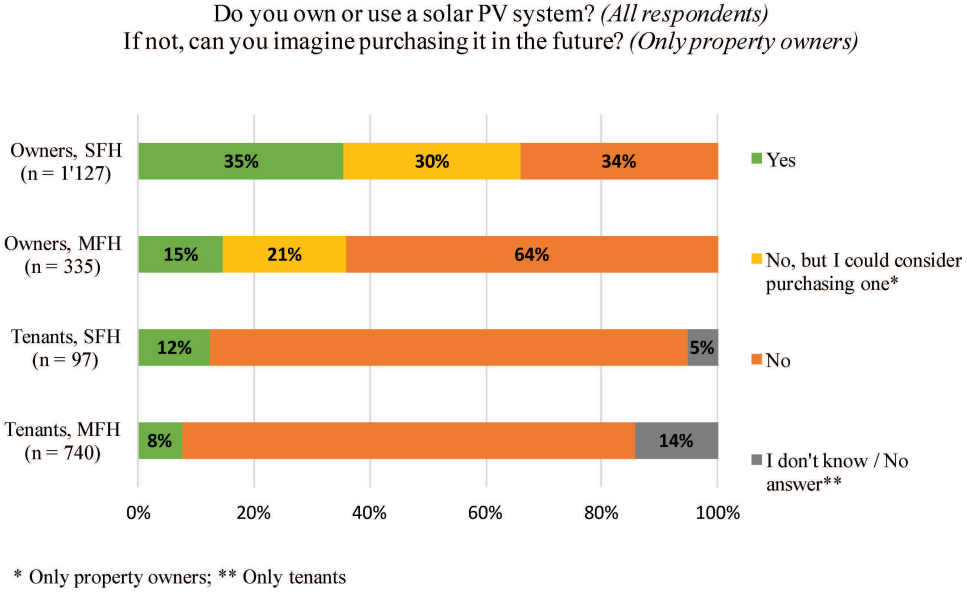
Despite the clear preference for local electricity generated in one's building, only 22.5% of the respondents state that they already own or use PV. The consumption of distributed solar electricity is more common among households in single-family houses (SFH, 34%) than in multi-family houses (MFH, 10%). Moreover, property owners are more likely than tenants to own and use solar, no matter whether they live in a SFH or MFH: homeowners living in SFH are almost three times as likely to have PV as tenants living in the same kind of dwelling (35% vs. 12%, Chart 2), and apartment owners living in MFH are twice as likely to have PV as tenants in the same housing solution (15% vs 8%). Homeowners also declare a relatively high interest in purchasing PV, with 30% of those living in SFH and 21% of those living in MFH considering the purchase in the next few years.

Although the diffusion of PV is higher among homeowners than among tenants, renters also hold a very positive attitude towards solar PV systems installed on their roofs. 83% declare indeed they would be ready to back the project of installing a solar PV system on the common roof, and 71% state they would even try to convince their neighbours to approve the plan (Chart 3). 76% of the tenants living in MFH think, moreover, that the households living in a MFH should not have the right to oppose the installation of PV panels on the common roof, as long as the electricity bill does not increase, whereas only 7% think that each household should have a veto right.

A portrait of solar prosumers in single and multi-family houses

Depending on the living situation, citizens can contribute differently to the uptake of solar in residential buildings. Those citizens owning and living in a SFH can turn their home into their own power plant by installing a solar PV system on their roof or façade. We name them the "individual solar prosumers", as they produce and consume their own electricity at the same location. As shown above, as of 2021, in the sunniest region of

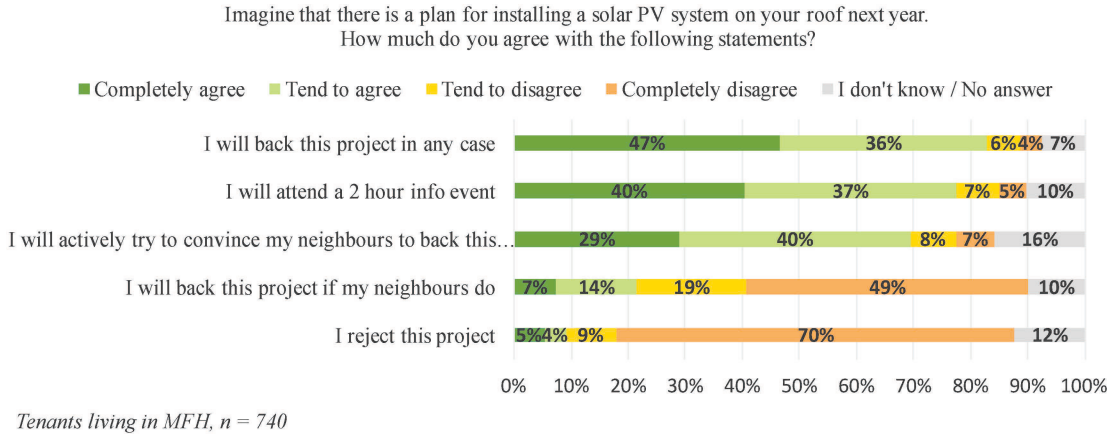
Chart 2 – Ownership and use of distributed solar PV system in Canton Ticino, by housing solution (% respondents)



* Only property owners; ** Only tenants

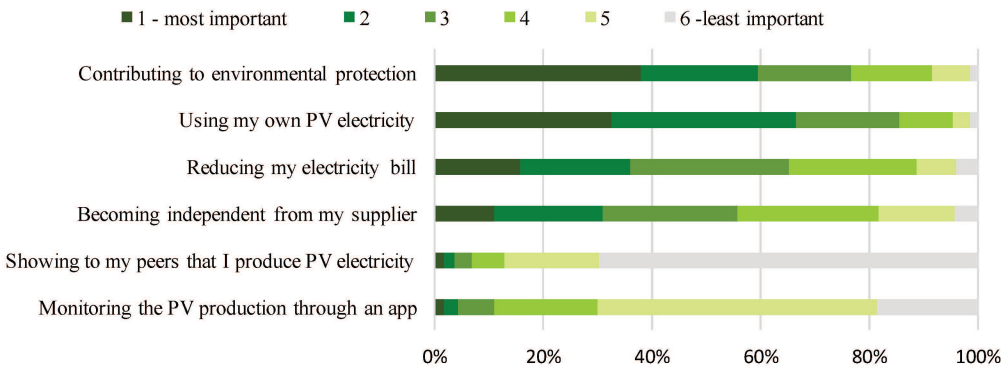
Note: In the questionnaire we asked two different questions to owners and tenants, namely "Do you own or can you imagine owning a solar PV system?" and "As a tenant, do you use a solar PV system?" (text translated from Italian).

Chart 3 – Tenants' interest in a solar PV system on the common roof (% respondents)



Tenants living in MFH, n = 740

Chart 4– Ranking of reasons to invest in a solar PV system for homeowners (% respondents)



(n = 863; homeowners living in MFH or SFH who have a solar PV system or are interested in purchasing one)

Switzerland, individual solar prosumers are already a reality: about a third of the SFH owners in our sample own or use a solar PV system (Chart 2). When asked about the main reasons to invest in PVs, the homeowners mention their desire to contribute to environmental protection, increase self-sufficiency (consuming their own electricity), and reduce their electricity bill (Chart 4).

Citizens inhabiting MFHs could contribute to the uptake of solar in residential buildings by participating in a building-scale "collective self-consumption scheme". In such a scheme the production of solar PV system located on the common roof is sold to all the MFH residents. We name citizens living in MFHs who actively support a common roof solar PV system as "collective solar prosumers". We take as a proxy of active support the stated willingness to convince their own neighbours to support the project of a solar system on the common roof of an MFH.

Individual and collective solar prosumers display stronger environmental concern and are less reluctant to try out new technologies than others (Table 1). However, while individual solar prosumers tend to be slightly richer (higher income and more assets) than other SFH owners, collective solar prosumers are not necessarily richer or poorer than other citizens living in MFHs.

Table 1 – Profiling individual and collective solar prosumers in Canton Ticino

Relevant demographic or behavioural profiles	Homeowners living inSFH			Apartment owners living in MFHs			Tenants living in MFHs			Variable range
	With PVs **Individual solar prosumers**	Without PVs	p-value*	Willing to convince neighbours **Collective solar prosumers**	NOT willing to convince neighbours	p-value*	Willing to convince neighbours **Collective solar prosumers**	NOT willing to convince neighbours	p-value*	
Wealth measure 1: Gross monthly household income	**4.41**	**4.10**	**p<.01**	4.29	4.29	p=0.96	3.39	3.61	p=0.06	1 to 6 (3: from 4.501 CHF to 6'000 CHF; 4 from 6'001 to 9'000 CHF)
Wealth measure 2: Net household assets	**3.48**	**3.14**	**p<.01**	3.41	3.36	p=0.81	2.39	2.28	p=0.29	1 to 6 (2: from 10'001 CHF to 100'000 CHF; 3: from 100'001 CHF to 500'000 CHF)
Environmental concern measure: % of respondents who think that the speed of the energy transition in Switzerland is too slow	**69.0%**	**51.9%**	**p<.01**	57.3%	46.3%	p=0.08	**62.3%**	**41.2%**	**p<0.01**	Dummy: 0 (no), 1 (yes)
Technical affinity measure: Reluctant to try new technologies	**3.6**	**3.5**	**p=0.02**	**3.6**	**3.4**	**p=0.03**	**3.5**	**3.2**	**p<0.01**	1 (completely agree) to 4 (completely disagree)
Collectivism measure 1: Happy to share things with neigbours	2.1	2.1	p=0.48	**2.2**	**2.5**	**p=0.01**	**2.1**	**2.4**	**p<0.01**	1 (completely agree) to 4 (completely disagree)
Collectivism measure 2: Happy to use shared mobility	2.7	2.8	p=0.45	**2.5**	**3.0**	**p<0.01,**	**2.3**	**2.7**	**p<0.01**	1 (completely agree) to 4 (completely disagree)
Trust measure: Tends to trust people	2.2	2.1	p=0.67	**2.2**	**2.5**	**p<0.01**	**2.2**	**2.5**	**p<0.01**	1 (completely agree) to 4 (completely disagree)
EV ownership or interest % of respondents who own an electric car or are interest in purchasing one	**64%**	**44%**	**p<.01**	54%	43%	p=0.12	**51%**	**36%**	**p=0.005**	Dummy: 0 (no), 1 (yes)
n	*400*	*727*		*253*	*82*		*514*	*226*		

* p-value refers to a mean or proportion difference test between the subgroups.

** p-value refers to a mean or proportion difference test between the subgroups.*

Three other characteristics distinguish collective solar prosumers. Firstly, they display a higher collectivist attitude than other citizens living in MFHs. The collectivist attitude or "societal interest value orientation" is defined as a preference for being a member of the group rather than apart from the group (Erdem et al. 2006). More collectivist individuals are more likely to be happy to share things with neighbours and use shared mobility services. Secondly, collective solar prosumers tend to display a stronger general sense of trust in other people. A sense of trust is needed to achieve a high acceptance and willingness to participate in projects that share energy among a group of people: in this setting one member's consumption of the common solar kWh makes those units unavailable to others. A sense of mutual trust can mitigate the perceived risk of conflicts over the use of the common electricity production. Thirdly, collective solar prosumers are more likely to own or being interested in an electric vehicle than other MFH inhabitants. Stronger support for solar could be triggered by interest in inhouse electric charging.

Policy implications and conclusions

The inclusion of citizens in the renewable energy investment decisions is regarded as a cornerstone of a just and speedy energy transition. Citizen involvement enables key solutions for decentralized renewable energy generation, in particular the shift to renewable electricity supply of existing buildings. Depending on whether citizens own or rent their dwelling and on whether they reside in single- or multi-family houses, they can contribute differently to the uptake of solar in residential buildings. Single-family house owners can install a solar PV system on their roof or façade; they turn their home into their own power plant and become "individual solar prosumers". As shown above, as of 2021, in the sunniest region of Switzerland, individual solar prosumers are not a niche anymore: based on survey data, about a third of our respondents owning an SFH already own or use a solar PV system. They tend to be wealthier, more environmentally concerned and less reluctant to try out new technologies than other SFH owners. In the same region, citizens who live in a MFH are significantly less likely to consume solar electricity produced in the building where they live. We identify an untapped potential for solar on MFHs since many MFH inhabitants display a strong preference for locally generated electricity. Solar promotion policies and marketing strategy could specifically target this promising segment, potentially exploiting local ambassadors. We identify a group of MFH residents who can become local ambassadors for solar PV investments on MFHs: the "collective solar prosumers". They care about the environment, are already familiar with sharing services (e.g. mobility) and products with their neighbours or other people, and are not necessarily richer than other citizens living in MFHs. This finding suggests that solar systems on MFHs' roofs may help include households with different income levels in the energy transition. The portrait of collective solar prosumers suggests high potential for solar on MFHs in contexts where trust and relationships between neighbours are already strong (e.g. cooperative housing). As the collective solar prosumers are more likely to own an electric vehicle than other MFH inhabitants, we suggest that the diffusion of electric vehicles is an opportunity to promote and find acceptance for solar PV on MFH.

Footnotes

[1] The survey replicates the annual Consumer Barometer of Renewable Energies conducted by the University of St.Gallen since 2011 (www.kuba.iwoe.unisg.ch).

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