

The birth of Hungarian energy citizenship - a systematic review based on the PRISMA method and a Hungarian case study

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Abstract— This study aims to reveal the role of solar PV systems in the participatory energy transition, examine these technologies' contribution to the establishment of energy citizenship, and provide a case study. A systematic literature review of 59 studies based on the PRISMA method is described. It can be stated that household-scale solar systems represent the practical implementation of these theories. In many cases, prosumers can effectively represent their interests and influence policy and decision-making through active citizen participation. In Hungary, a striking example is the successful defense by households with solar PV systems of pre-existing contracts involving a net metering system in August and September 2023. The timeline of this is revealed and presented using discourse analysis. The case study shows that when the number of prosumers reaches a critical mass, they can influence decision-making even under a competitive authoritarian system.

Index Terms-- solar PV, energy democracy, energy citizenship, participatory energy transition, Hungary

I. INTRODUCTION

Active citizen participation is increasingly at the heart of the debate about how to promote a sustainable, fair, and equitable energy transition and is already a strong feature of EU energy policy. There is a need for a decentralized and democratic energy system based on renewable energy sources in which prosumers and energy communities are present. Previous passive, one-way relationships are becoming dynamic, with energy citizens taking responsibility for energy production and consumption. Household-scale solar systems represent an interesting and important field of research that is intertwined with theories of energy justice, energy communities, energy citizenship, and energy democracy. These concepts are often overlapping, but they have in common that they are based on active citizen participation with an emphasis on inclusiveness, a high level of acceptance and adaptation of renewable energy technologies, openness to joining energy communities, support for local energy initiatives, and involvement in policy making. These can be seen as social processes in which solar photovoltaic (PV) systems have played a prominent role due to their moderate cost and relative ease of use.

This paper presents a systematic literature review of the social issues regarding the participatory energy transition. I use the PRISMA (~Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method to analyze the role of solar PV systems in the participatory energy transition, illustrating the emergence of prosumer-based energy citizenship, the related energy justice issues, and one possible outcome of this process: energy democracy. A case study shows how prosumers can influence policy decisions even in a hybrid regime.

II. METHODOLOGY

The aim of a systematic literature search and synthesis is to identify and collect literature according to objective criteria and provide an answer to a predefined, specific research question by summarising and synthesizing the results without bias and avoiding subjectivity [1]. An important condition is that the collection process can be repeated at any time. The method provides an opportunity to review and clarify relevant terms and terminology, to identify gaps in research, and thus to identify future research directions [2].

PRISMA is the most reliable and commonly used method for systematic reviews. It was developed in 2005 [3] and, after minor modifications, was published first in 2009 and then in 2020 in its current form [4]. Originally focused on health and medical (clinical) research, the methodology was quickly adopted by almost all disciplines. One of the main principles is transparency, i.e., that the summarisation of previously published studies is done transparently, minimizing the subjective opinions of researchers and the resulting biases. The checklist consists of 27 points describing the methodology's main steps. These can be grouped into three main categories: identification, review and screening (which includes the assessment of appropriateness), and selection.

Based on the PRISMA methodology, the following research question was formulated: 'How do solar PV systems contribute to the participatory energy transition?'. The goal was defined as systematically reviewing the available literature to define the conceptual framework needed to answer this question and set the direction for future empirical research.

Three databases were selected: Web of Science, ScienceDirect, and EBSCO. In all cases, keyword searches were carried out based on the titles and abstract texts of the articles between 18-24 June 2024. Inclusion and exclusion criteria were defined. The first query (identification) resulted in 237 articles. In 12 cases, the respective articles were unavailable despite being published as Open Access. These were removed from the final list. After applying the inclusion criteria and filtering out duplicates, 143 studies remained. A further 28 articles were added using the snowball method. After a further review, 112 cases were found to meet at least one exclusion criterion and were eliminated. Finally, a systematic review of a total of 59 publications was performed.

III. SOLAR PV SYSTEMS, PROSUMERS, AND ENERGY TRANSITION – SYSTEMATIC REVIEW

The socio-economic impact of solar PV systems should be considered from two perspectives. First, by size (household vs. industrial-scale) and second, by location (Global South vs. Global North). In this section, the advantages and disadvantages of solar PV systems are reviewed, the related energy justice issues are discussed, and their contribution to energy citizenship and energy democracy is discussed, in line with these two perspectives.

A common problem associated with evaluating the value of solar panels is that direct economic and financial benefits take precedence over environmental or local community impacts [5]. Both [6] and [7] confirm that solar PV systems with batteries reduce the carbon intensity of the electricity mix and energy dependence, create jobs, contribute to income generation, and improve energy security. Households can move up the energy ladder, replacing more polluting energy sources with clean energy [8]. [6] demonstrates this by looking at community energy projects of indigenous Indians in sparsely populated areas of Canada and [7] cites the example of hurricane-affected communities in Puerto Rico. Prosumers are becoming more informed about energy issues, changing and rationalizing their energy use patterns with the help of smart meters, and are increasingly supportive of environmental activities and movements [9]. In many cases, solar PV systems are also an answer to energy poverty, but this requires the involvement of local communities in decision-making and implementation. Otherwise, energy poverty will not be significantly reduced, as was the case with a scheme introduced in China in 2014 that involved installing solar panels in two million households in rural areas, with results far below expectations [10].

[11] identifies also the benefits of improved health care and rising education standards. However, the picture is nuanced by the fact that in Rwanda, for example, although solar power plants provide jobs, improve the income situation of local residents, and improve relations between local communities, social inequalities have not been reduced, social consultation and stakeholder involvement during installation and operation were limited and anonymous, and there was a certain degree of centralization of decisions at the national level [11].

[12] also points to the risk of increasing social, income, and gender inequalities – that the solar sector, simply put, becomes a playground for "middle-class white men" [12, p. 11]. An even

more radical position is taken by [13], who explicitly focuses on the racial and gendered energy justice (injustice) associated with solar PV systems in a discussion of fossil and renewable energy regimes. The author argues that they are strongly associated with 'white supremacy.' [13] cites the United States as an example, where oil and other energy infrastructure is often built close to the homes of low-income social groups and minorities or strongly affects their environment. In contrast, [14] emphasizes that community solar projects can enable marginalized social groups to benefit from the green economy and clean energy transition, i.e., support energy justice.

Interestingly, the positive impacts of solar power expansion tend to accrue locally (contributing to local economic development, strengthening local communities and women's empowerment) and are less visible at higher territorial levels (regional or national economy-wide) [11]. Other research also confirms that despite the expansion of solar power, consumers remain passive actors in energy systems, although in Ethiopia, for example, this is mainly due to authoritarian governance [8].

Among the countries of the Global South, India stands out and has been analyzed by several authors, especially in terms of social inequalities and women's empowerment (e.g. [15], [16], although the results and conclusions often differ or are contradictory. Stock concludes that the current support system and solar investments do not empower women, reduce vulnerability, or develop adaptive capacity, but in fact, increase social inequalities among women and contribute to the maintenance of the caste system [15]. Middle- and upper-class women are the main beneficiaries of the projects. Although the solar park developers apply corporate social responsibility programs that strongly focus on the situation of local women, the latter are unfortunately severely constrained in their daily activities by land encroachment. For example, they must circumvent these parks when collecting firewood, which takes an additional 1.5 hours per day. The conclusion is that solar parks ultimately contribute to the conservation and reproduction of existing power relations. In contrast, [16] claims that social and gender inequalities in India are strongly linked to energy access (~energy-gender-poverty nexus). In the state of West Bengal, positive results can be seen in that household-scale solar panels improve quality of life, and women are more active in decision-making processes, which positively affect their financial status, community participation, and mobility. This is also confirmed by the research of [6] and [17]. In low-income families, women are responsible for energy use (collecting fuel, heating, cooking), but such daily activities are time-consuming and dangerous, and the former are often subject to harassment. In their case, clean energy sources clearly contribute to improving quality of life. Women have more time to spend on learning, and their health improves. They take an active role in local energy projects, which fosters empowerment [6], [17].

[18] examines the role of decentralized solar PV systems in the electrification of rural India. Their results show that the uptake of decentralized solar PV systems is hampered by a gap between policymakers and implementers, a lack of coordination and appropriate legislative frameworks, and limited institutional competence. [19] adds that local communities also often resist related investments. However, this is ostensibly

because they do not accept the predefined roles and identities imposed on them through the projects and demand interactional justice. To support rural, marginalized communities in successfully transitioning to off-grid solar PV systems, the authors propose building a partnership-based ecosystem that includes all the companies involved in the implementation, system operators, financial intermediaries, distributors, civil society, and end-users, alongside a supportive policy environment [18].

The Iberian Peninsula plays a special role in research on the Global North. Active energy citizenship and energy democracies are central to these studies. [5] presents the economic, environmental, and social benefits of solar prosumers in Spain. The paper concludes that "prosumers acting collectively in cooperatives, energy communities and non-profit organizations can foster active energy citizenship and an autonomous social movement towards decentralized, sustainable and democratic energy models" [5, p. 6]. [20] examines the impact of the expansion of solar PV systems on creating and strengthening energy citizenship, focusing on active citizen participation. Two regions were chosen for the case study: Alentejo and Andalusia. There are large solar power projects (596 GWh of annual production in Alentejo) and a proliferation of small household-scale solar systems, prosumers, and energy communities in both areas. However, industrial-scale investments have triggered significant resistance from local communities, who have launched a social movement under the slogan "Renewables yes, but not this way," significantly delaying and preventing further investment [20, p. 2]. The latter are demanding compensation for any negative impacts of the investments. This moves local communities from being passive bystanders to active players who are much more committed to supporting a sustainable energy transition. So, the issue of energy justice can also arise with renewable projects. As [12] points out that the latter investments will only become socially acceptable if they benefit at least the majority of the population.

[21] go even further in their analysis of this situation. They conclude that, in many cases, the areas and the people who live there are effectively being sacrificed for the sake of the energy transition. "The energy transition is intensifying market relationships, extraction, and infrastructural colonization, ultimately strengthening global capitalism, itself at the roots of the climate crisis" [21, p. 1]. The energy transition is seen as one of the main drivers of 'green grabbing' and extraction, i.e., the industrial exploitation of raw materials, around the world [21]. In these areas, green sacrifice zones and local communities are typically resistant. Even when there are social consultations, they are typically formal, the participatory mechanisms are ineffective, and stakeholders are not involved in decision-making. In Portugal, [22] cites the example of lithium mines and the solar farm in Alentejo formerly described, but the observations also apply to the Hungarian battery industry, where all three aspects of energy justice (procedural, distributive, interactional justice) are being violated.

[23] argues that the social rejection of large solar power projects is not related to the technology itself but rather to the projects' implementation and the associated injustices. The

increasing share of solar energy in electricity generation and final energy use generally contributes to the democratization and decentralization of energy systems. However, in the Global South (e.g., India, Turkey, and Morocco), solar power plants with a capacity of more than 1,000 MW are an exception to this rule and are considered undemocratic, authoritarian, or repressive climate solutions [24]. They often fuel ethnic tensions, deepen social inequalities, favor local elites, and violate dimensions of energy justice, especially for women. Compounding the problem, solar energy projects in the Global South have attracted international recognition from the democracies of the Global North and shielded authoritarian states from accusations of domestic abuses of power and violent misconduct.

[25] investigates whether the energy transition is more successful in authoritarian regimes or democratic societies, exploring the relationship between the quality of political governance and energy transition outcomes. Countries with democratic regimes, where good governance is a priority and there is less social inequality, are clearly more successful in transitioning to carbon-neutral energy sources. Low levels of social trust are also not conducive to creating energy communities and furthering the energy transition based on the decentralization of energy systems in general.

IV. A CASE STUDY BASED ON HUNGARY

In recent years, there has been a significant increase in the uptake of solar PV systems in Hungary due to decreasing investment costs and supporting funds. The year 2010 can be considered a milestone in the market, as total PV capacity in Hungary exceeded 1 MW. After 2020, the deployment of these systems accelerated sharply, driven by the newly adopted energy strategy, subsidies, the COVID-19 pandemic, the 2021-2022 energy crisis, and the uncertainty caused by the Russo-Ukrainian war. Solar energy accounted for 13.2% of gross electricity generation in Hungary in 2022, compared to an average of 7.4% in EU Member States [26]. According to the official statistics of the Hungarian Energy and Public Utility Regulatory Authority [27], total solar PV capacity in 2023 was 5,649 MW, of which household-scale solar PV installed capacity was 2,329 MW due to the very favorable accounting system until 2023 and the subsidies supporting installation. These household-scale solar PV systems will be discussed below.

In 2023, natural persons owned 223,823 household-scale solar PV systems, with the remainder owned by companies, institutions, and other non-natural persons. According to the 2022 census data, the number of occupied dwellings in Hungary was 4,008.5 thousand, of which 6% were equipped with household-scale solar PV systems [28]. These figures are also reflected in the national strategies. Notably, the revised Hungarian National Energy and Climate Plan foresees a total installed PV capacity of 12,000 MW by 2030 ([29], [30]), and the National Energy Strategy 2030 estimates that more than 200,000 households will have household-scale solar PV systems by 2030 [31]. The latter target was, in fact, already achieved in 2023, but the 2024 update of the National Energy and Climate Plan foresees further expansion [30].

A. The birth of Hungarian energy citizenship

The highly favorable accounting system known as ‘net metering’ has contributed greatly to expanding household-scale solar PV systems in Hungary. Net metering is very attractive for households, resulting in a short payback period. It is based on balance-based settlement, which means that the consumer only has to pay for the difference between the consumption and production of electricity on a yearly basis. If production exceeds consumption, the difference is sold to the supplier [32], [33]. However, in the second half of 2023, there was a significant change in the support schemes that significantly reduced the number of new installations. Since 8 September 2023, for newly installed household-sized solar systems (the applications for which had not been submitted by 7 September 2023), the option of net metering is no longer possible, and users are subject to so-called net billing [32]. The essence of this is separate metering and billing. Electricity exported to the

grid and electricity withdrawn from the grid are measured and paid for separately (with domestic producers buying at a price of 36 HUF/kWh and selling at a price of 5 HUF/kWh) [32]. The net metering system may only remain in place for a ten-year period after the solar panels are installed.

One of the reasons for the introduction of the new systems is a change in EU legislation, which states that "Member States that have existing schemes that do not account separately for the electricity fed into the grid and the electricity consumed from the grid, shall not grant new rights under such schemes after 31 December 2023" (Directive 2019/944) [34]. However, the introduction of these changes was not without its problems, and a chronological overview (Fig. 1) of events suggests that this was the first time that (the approximately 224,000) households with solar PV systems were able to influence energy policy in a meaningful way. The situation is presented below.

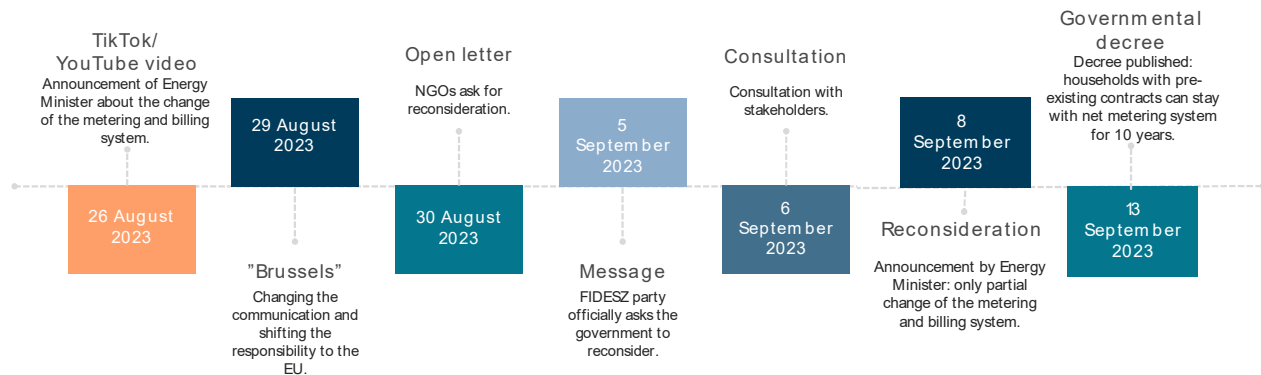


Figure 1. Timeline of governmental decision modifying the metering and billing for solar energy systems

Discourse analysis is applied to show how households and other stakeholders put pressure on decision-makers and achieved a review of the initial decision in Hungary, which became governed by a competitive authoritarian system (or so-called hybrid regime) after 2010 [35], [36]. The situation may be described by the lack of consultation and self-reflection [37]. The five most visited news portals were examined, i.e., Index, Origo, 24.hu, Telex, and Portfolio. All related articles published between 26.08.2023 and 13.09.2023 were collected, numbering 70 items.

The original idea was not only to introduce a net billing system but also to move net metering from an annual to a monthly basis. This caused widespread outrage, as it would have resulted in retroactive changes to contracts and reduced the payback period for investments. The decision itself was also announced in a not-very-elegant way by the energy minister at the Transit Festival in a video uploaded to TikTok and YouTube on 26 August 2023. Stakeholders, especially NGOs and solar households, immediately voiced their disapproval. Three days later, the government unsuccessfully tried to shift the blame to the European Union. On 30 August, the Hungarian Photovoltaic and Solar Collector Association sent an open letter to the Ministry of Energy requesting a review of the decision. In it, they argued for the need to foster the energy transition, among noting other benefits of solar PV systems. They asked

that those with pre-existing solar PV systems be allowed to remain under the annual net metering system for 10 years. On 5 September, the ruling party (FIDESZ) officially asked the government to change the decision. After a quick consultation on 8 September, the government stepped back, and the Ministry officially announced that households with pre-existing contracts could continue with net metering on an annual basis.

V. CONCLUSIONS

In this paper, I review the role of household-scale solar PV systems in developing energy citizenship. Using a practical example, I show that the number of households with solar PV systems has already reached a critical mass that cannot be ignored in decision-making, even under an authoritarian system. The presence of this critical mass can be seen as a precursor to energy citizenship.

ACKNOWLEDGMENTS

This paper was supported by a János Bolyai Research Scholarship of the Hungarian Academy of Sciences.

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