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Routinised Causality:
How Domesticated Technology Shapes the Everyday Energy Practices of Prosumers

Abstract: This article examines how domestic energy technologies, particularly photovoltaic (PV) systems and monitoring applications, reshape everyday practices in prosumer households. Drawing on Actor-Network Theory and social practice theory, we conceptualize these changes through the lens of domestication and introduce the notion of 'routinised agency' to describe how human and non-human actors co-produce habitual routines. Based on thirty-nine in-depth interviews with Polish prosumers, we show that PV systems are not neutral tools but socio-technical actors embedded in material infrastructures, competences, and meanings. Our findings reveal three key dynamics: (1) the incorporation of PV into household rhythms through monitoring apps and scheduling of energy-intensive tasks; (2) the reproduction of gendered divisions of labor, with men acting as remote 'production managers' and women adapting domestic routines; and (3) the role of digital competence as cultural capital, shaping class-based differences in technology use. We argue that prosumption represents a socio-technical transformation that intersects technical, economic, and cultural spheres, challenging assumptions of smart home neutrality. This study contributes to debates on smart domesticity by linking energy transition to everyday practices, gender relations, and inequalities in digital expertise.

Keywords: prosumption, Actor-Network Theory, smart technologies, domestic energy practices, routinised agency.

Introduction

In Poland, there has been a dynamic growth in the number of domestic photovoltaic micro-installations in recent years. Prosumers—as defined by the Polish law, households that meet part of their energy demand on their own—have become an important part of the national electricity industry. Between 2018 and 2022, the rate of change in this regard resembled exponential growth. At the end of 2018, there were around 51,000 prosumer micro-installations in Poland, while a year later, their number was close to 150,000. By the end of 2020, despite the ongoing coronavirus pandemic, this value had tripled. By December 2022, there were approximately 1.2 million.

The period of the fastest growth in the number of new prosumers coincides with the validity of the billing method, called *net metering*,[1] which allows the surplus energy

[1] The *net metering* billing system remained in force for new prosumers until the end of March 2022. It thus coincides with the period of greatest interest in investment in individual household solar power plants. *Net metering*

produced to be collected at a later date. The popularity of micro-installations was also fostered by the government's "My Electricity" program, which allows subsidies to be obtained for the purchase of installations. In this article, we consider, relying on our own qualitative research, how the implementation of new technical solutions related to prosumption has affected the functioning of households. Using the perspective of social practice theory (see Shove et al. 2007; Reckwitz 2002) and actor-network theory (see Latour 2005; Abriszewski 2007), we attempt to capture the transformation of household relations and rutines, also taking into account the agency of non-human actors, including technology. We also look at the class (cf. Bourdieu 1984, Gdula and Sadura 2012; Gdula, Lewicki and Sadura 2014) and gendered (Aagaard and Madsen 2022; Pink and Strengers 2023) elements of this process that our own research has captured.

We present that the dynamic development of prosumer solar PV micro-installations in Poland is an example of a profound technological and social transformation, insufficiently described from the perspective of households of actors often overlooked in systems analyses (cf. Svalstedt and Löf 2017). In this paper, we emphasise the importance of technology's materiality, taking into account both the causality of people and non-human actors, such as PV installations and related metering systems. However, by doing so, we move away from a symmetrical approach, which is difficult to capture through individual interviews (IDI) alone, and focus on social practices (Shove, Pantzar and Watson 2012; Reckwitz 2002) as a key to understanding the everyday use of smart technologies, rejecting aestheticizing and statusist interpretations.

At the same time, we want to engage in a broader discussion of the social aspects of the energy transition, which is partly taking place in a bottom-up, distributed energy framework. We analyze how technological change shapes everyday life, family relations and domestic practices, taking into account class and gender contexts. We show that prosumption of electricity is not only a matter of technology and energy efficiency, but also an important social dimension, embedded in household routines, norms and ways of interacting.

The Smart Home as a Spectrum: Between Technology of Influence and Technology of Prestige

When considering the place of photovoltaics in the landscape of contemporary home technologies, it is worth addressing its position in relation to other devices that are part of the broader smart home ecosystem. The literature in science and technology studies (STS) and digital home studies increasingly draws attention to the need of distinguishing between infrastructural technologies, deeply embedded in the fabric of everyday life, and

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allows, depending on the size of the micro-installation, 80 per cent (or 70 per cent) of the energy produced to be taken back in the following 12 months. In 2022, this system was replaced by the more complicated *net billing* system (relying on market-based energy prices), which in practice corresponded with a decline in interest in prosumption. Households that have joined the ranks of prosumers under net metering can bill in this way for a period of 15 years after the installation is connected to the grid. In the context of the objectives of this article, it seems interesting to see how the rules of the current system have affected prosumers' everyday electricity use practices. This energy, as discussed further below, can either be consumed in real time when there is a lot of sunshine, or it can be virtually stored in the electricity system (through the possibility of later collection of the equivalent of the energy produced).

devices that are more spectacular, though not necessarily transformative in terms of social practices (Strengers and Nicholls 2017; Aagaard and Madsen 2022).

Photovoltaics, as a domestic technology, can be defined in terms of 'low-visibility but high-impact'. Its presence may be almost invisible in the user interface layer, but its implications touch key areas of household life: consumption economics, time management, technical infrastructure, relations with institutions and ideas about the future. Many of the smart devices present in homes—such as smart speakers, voice-responsive lighting systems, digital assistants (e.g. Alexa, Siri), or cleaning robots—serve mainly a status or aesthetic function. As Strengers (2020) notes, these types of solutions are often designed to reinforce dominant gendered patterns and class-related sensibilities of technological aesthetics, and do not necessarily affect a deep reorganization of domestic practices.

In this sense, photovoltaics stand in opposition to 'high' technologies—being more of a 'heavy' technology, which requires investment, planning, formal and technical arrangements and, above all, consistent integration into the rhythms of everyday life. While smart lighting can be switched on or off with a single voice command the installation and operation of a renewable energy system involves a permanent change in the structure and rhythms of daily life: decisions about when to run appliances, reflections on consumption, and often a symbolic shift in the identity of the household towards 'green' or 'modern.' Even when not actively used, smart technologies continue to shape household routines and expectations, altering residents' sense of control and their relationship with the home (Kennedy et al. 2015).

In that context, we are also interested in the extent to which, and how quickly, behavioral changes associated with the presence of new technical solutions enter the realm of habit, leading to a gradual 'invisibility' of technology. In the consumer model, the availability of electricity is generally something fixed and taken for granted (as in the case of mains water), which can be considered in terms of social 'transparency,' referring anthropological understanding of infrastructure (Gądecki et al. 2023). Electricity and the devices powered by it gain 'visibility' only when they lose their functionality, for example through a breakdown (see Heidegger 1994; Leszczyńska 2017: 62). Prosumption thus seems to fundamentally transform the relationship with electricity understood in this way.

While discussing this question, it is important to notice the entanglement with the gendered structure, in relation to which the masculinity and femininity of technology are distinguished. As Sarah Pink and co-authors (2023) point out, so-called smart home masculinities often manifest themselves in the spectacular management of 'technological' devices—e.g. home servers, security systems or automated controls. Meanwhile, technologies such as photovoltaics, although part of the smart logic, are associated with admittedly less spectacular, but more responsible home and energy management. This may often make them more 'feminine' in the sense of the stereotypically assigned role of care and concern for the wellbeing of the householder. This raises the question of whether the smart home is a space dominated by image technologies or rather by transformative technologies—where change is not about the interface, but about the entire socio-material system. From this perspective, the smart home is worth conceiving of not as a collection of 'smart' devices, but as a network of relationships and practices in which it is not so much the algorithms that are crucial, but the ability of technology to transform forms of domestic life (cf. Lury and Wakeford 2012; Couldry & Hepp 2017). In this sense, photovoltaics, despite their lack of spectacular design or 'wow'

factors, most fully represent the idea of the 'smart home' as a socio-technical space in which smartness means the ability to transform—rather than merely decorate—everyday life.

Prosumerism—a New Model of Relationships and Practices

Adopting the prosumer model implies a fundamental change in the existing relationships and practices related to functioning in the electricity system[2]. Households equipped with photovoltaic installations cease to be merely passive consumers of energy—they become active participants who both consume and generate electricity. In this sense, prosumerism is not reduced to a formal-legal innovation, but entails transformations in technical and social spheres. From the perspective of actor-network theory (ANT) (see Latour 2005; Abriszewski 2007), this implies an expansion and reorganization of the entire network of relations: new devices and technologies join it and become equal actors co-shaping the everyday life of household members. Thus, it is not only the infrastructure that is changing, but also everyday practices and habits—users have to learn how to use new solutions, adapt their energy consumption to the rhythm of energy production and sometimes redefine their approach to resource management. Analyzing the process from the perspective of the domestication of technology (Silverstone and Haddon 1998; Scheerder et al. 2017), we can distinguish the successive stages of this transformation: from *appropriation*, to *objectification*, to full *incorporation* of new technical elements into everyday routines. In this way, prosumerism becomes not only a technological innovation, but also a social practice that re-arranges the relationship both between people and between an individual and technology.

As we pointed out earlier, we remain close to the tradition of examining social practices as a part of the social reality in which culture is reproduced. The prospect of combining non-anthropocentric approaches (in the Latourian spirit) with theories of social practices is highlighted by Elizabeth Shove, Matthew Watson, Martin Hand and Jack Ingram. In their view, research on consumption (in this case taking the form of prosumption) largely ignores the role of artefacts, focusing instead on the sphere of symbolic communication and the actions of individuals (see Shove et al. 2007: 11–12). We quote in this context the definition formulated by Andreas Reckwitz. He defines social practice as 'a routinised type of behaviour that consists of several interrelated elements: forms of bodily activity, forms of mental activity, 'objects' and their use, contextual knowledge in the form of understanding, know-how, emotional states and motivational knowledge' (Reckwitz 2002 after Shove et al. 2007: 12). In addition to the elements that we can analyze as related to the structure of society (e.g. through the habitus of individuals and the capital held), Reckwitz pays attention precisely to material objects and how they are used. The qualitative research carried out was primarily aimed at exploring the non-obvious dimension of the energy transition through the lens of everyday practices and human-technology relations. As we will see in the article,

[2] The concept of the prosumer first appeared in one of Alvin Toffler's futurological works from 1980 (see Toffler 1997), and later also played a role in shaping other visions of the future, for example, within the concept of a "zero marginal cost society" (see Rifkin 2016). The word "prosumer" comes from a combination of the words "producer" and "consumer," which today refers to various forms of distributed production or manufacturing for one's own use (see Rifkin 2016).

non-human (technical) elements will turn out to remain with people not only in direct relations, coming into physical contact with them. We also reveal relationships of a non-direct nature: through the realm of dreams, plans and expectations, thus constructing the future and the present. In this case, especially interesting are the aforementioned relationships of a structural nature, relating to the class and socio-cultural gender of the respondents. While, in the first case, the collected material mainly provides similarities between the interviewed prosumers from different social classes, with regard to gender, differences have emerged that may indicate the remnants of a patriarchal division of roles in households.

Methodology

This article presents a part of the results of a project investigating qualitative structural differentiation among owners of photovoltaic micro-installations (prosumers of electricity) from the Lesser Poland Voivodeship. We focus on themes related to the use of the installation and the daily relationship with PV technologies. The research covered people who became prosumers between 2018 and 2022, i.e. when the "My Electricity" programme was at its peak of popularity and the net metering system was in force. Other strands of the project, not discussed here, addressed class motivations for purchasing PV and broader techno-economic considerations. The analysis is based on thirty-nine in-depth interviews conducted in the spring and summer of 2022 in Lesser Poland, where, at that time, PV development was the most dynamic (highest PV capacity from the "My Electricity" program per capita). The condition for participation was one year of installation use. The sample selection referred to Pierre Bourdieu's (1984) class theory and its adaptation to Polish conditions (Gdula and Sadura 2012; Gdula, Lewicki and Sadura 2014; Sadura 2017). Respondents were classified into popular class (working class), lower middle class, and upper middle class, with cultural capital (education and type of work) as the main criterion.[3] The quotations included in the article are captioned according to their class affiliation (abbreviations: work_cl, low_mid_cl, up_mid_cl), as well as information about the profession, declared gender (abbreviations: man—M and woman—F) and age.

Given the lack of research on energy prosumers in Poland, the project was exploratory in nature. The results capture the occurrence of certain social phenomena, but do not determine their scale. The choice of the in-depth interview in the perspective of actor-network theory (ANT) is associated with methodological challenges. Critics point out that

[3] The operationalisation of classes was based on Pierre Bourdieu's theories, with reference to their developments in the Polish context (see Gdula and Sadura 2012; Gdula, Lewicki and Sadura 2014; Sadura 2017). The criterion of education and type of work used, although a simplification (omitting e.g. atypical promotion paths), allows us to capture classes in the sense of Weberian ideal types (cf. Sadura 2017: 144). This allowed us to avoid questions about sensitive data on social capital (including social networks) or economic capital (earnings and assets). In the classification adopted, the popular classes included lower-level manual workers in production, agriculture and services (usually with a maximum of secondary education). The middle classes included professionals, entrepreneurs (excluding B2B subcontractors doing manual work) and people in managerial positions, usually with higher education. A distinction was made between the lower and upper middle classes, with the latter including people with higher cultural capital (e.g. with a PhD) or economic capital (e.g. high-profit professions in IT, owners of large companies). The upper classes, estimated in this sense to constitute only a few per cent of the population in Poland, were not included in the analysis due to recruitment difficulties; however, some respondents from the upper middle classes could be considered in other typologies as representatives of the upper classes (see Sadura 2017).

this method may violate the principle of symmetry by focusing on the human perspective and filtering reality through the researcher. According to critics, the interview would disrupt it because it focuses primarily on the human perspective. Another problem is that the human interviewer not only collects data, but also 'filters' reality, as it were. In recent years, however, there has been an increase in frequency of compromising approaches that incorporate material elements as co-creative actors in relations This includes treating elements that would otherwise be merely a background to human interactions as potentially causal agents (see Demant and Ravn 2020: 360–361). This may therefore enrich our perspective as researchers. In a similar vein, Lise Justesen explores the advantages of actor-network theory, highlighting how the material world often remains out of reach. Focusing on the relations between heterogeneous actors, actor-network theory thus appears as a means of changing that. However, Justesen suggests that a kind of balance must be maintained in doing so. A description of relationship networks in the spirit of ANT is appropriate if it is thorough. Too much detail, however, can be utterly overwhelming. It seems crucial, therefore, to structure the presentation in such a way as to make the result of the analysis interesting and inspiring (see Justesen 2020: 341).

This perspective is complemented by Reckwitz's (2002) praxeological approach, which offers an embodied understanding of practices. It emphasises the inseparable relationship of actions to space, artefacts and affective-perceptual structures. Participants' bodies are understood as culturally conditioned, operating through embodied knowledge and sensory schemas; space and artefacts are treated as integral to practices. Both the ANT adaptation of the interview and Reckwitz's take on it point to the growing value of hybrid strategies. They allow us to go beyond the limitations of individualism and methodological holism, taking into account the material, affective and spatial dimensions of social life and the networked relationships between human and non-human actors.

The Domestication of Technology and the Praxeological Perspective

As we have already mentioned, the installation of photovoltaic panels, as well as accompanying devices, in the terminology of actor-network theory, can be framed as a transformation (translation) of the socio-technical network of relations (cf. Latour 2005; Harman 2009). New actors are introduced, which, as we will see, also involves a change in human behavior. In the collected research material, which is based on in-depth interviews with prosumers, we noticed various examples of this kind of transformation.

In this text, we would like to combine the process of technology domestication described by Silverstone and Haddon (1996, 1998) with Andreas Reckwitz's social practice perspective and praxeology. Domestication of technology is one of the key frameworks of analysis in the study of the relationship between technology and everyday life. The concept assumes that technologies are not passively introduced into households, but undergo successive stages of adaptation: appropriation, objectification, and incorporation. The term *appropriation* is employed to denote the point at which a technology is acquired and symbolically 'adopted' by users. This concept encompasses both the decision to acquire the technology and the initial expectations of its utility (Silverstone and Haddon 1998; Scheerder, van Deursen and van Dijk 2017).

As we will see later in the text, the appropriation stage was evident in purchasing decisions, generally linked to the calculation of future savings. Appropriation was realized through the integration of monitoring systems (i.e. mobile apps) into everyday energy management practices. Ultimately, an incorporation of technology (photovoltaics and accompanying technical solutions) into the rhythm of domestic life, including daily household chores occurred. In the context of everyday practices, technology influenced the shape of daily habits. In that area, we observed a reflection of the social structure of Polish society, but in terms of socio-cultural gender categories rather than social class.

In contrast, the praxeological perspective, developed by Reckwitz (2002), among others, offers a complementary perspective on these processes. Practice theory treats everyday practices as complex arrangements of three dimensions: materiality (artefacts and infrastructure), competence (skills and practical knowledge) and meanings (values, norms and interpretations) (Shove, Pantzar and Watson 2012; Reckwitz 2002). In this view, materiality—and thus technology—is not a neutral tool, but a constitutive element of practices, co-determining possible modes of action and their course (Reckwitz 2002).

Transferring the stages of domestication of technology to praxeology makes capturing their socio-material dimension possible. Appropriation can be interpreted as initiation of new practices or modification of existing ones, in which the appearance of a new artefact changes the configuration of available resources and potential actions. In praxeological terms, appropriation corresponds to the embedding of materiality in a particular spatial and symbolic arrangement, which translates into the availability of the artefact and its status within practices. Incorporation equates to the stabilization of practices: technology is integrated into established rituals and sets of competences, and its materiality begins to 'work in the background' as an obvious and invisible element, although still influencing the course of action (Shove et al. 2012; Reckwitz 2002).

Table 1

Conceptual diagram: linking processes of technology domestication to social practices

The stage of domestication (Silverstone & Haddon)	Praxeological dimension (Reckwitz)	The role of artefacts and technology
Appropriation Technology is acquired and enters the private sphere.	**Initiation of** practice; the emergence of a new artefact enables or modifies practices.	The artefact introduces **new potentialities** and limitations; it becomes a resource for future activities.
Objectification Technology gains a place in the space and hierarchy of meanings.	**The configuration of** practice; materiality is embedded in a particular spatial and symbolic arrangement	**The physical location of the artefact shapes accessibility** and use; cultural meaning influences the status of the practice.
Incorporation Technology becomes incorporated into everyday rituals.	**Stabilisation of** practice; technology becomes part of routines, practical knowledge and rules of action.	**Materiality is 'transparent'** imperceptibly conditions actions, becoming their invisible component.

Own elaboration.

This framing links the micro-social process of technology adaptation with a materialist analysis of everyday practices (see table 1.). Domestication becomes not merely a process of psychological acceptance or cultural assimilation of an artefact, but a reorganisation

of whole systems of activities in which technologies, together with competences and meanings, co-constitute the structure of everyday life. Thus, in our view, an analysis from the perspective of practice theory allows us to better grasp how technologies, once tamed, begin to shape social rituals and relations in a sustained way (Reckwitz 2002; Silverstone and Haddon 1998).

The emergence of photovoltaics and the modification of practices

The installation of photovoltaics in the households of the interviewed prosumers introduced a new artefact into their everyday life—their own solar power plant, together with systems for monitoring energy production and consumption. Its emergence opened up space for new activities and decisions, both technically and organizationally. The artefact has become a resource that not only enables power generation, but also generates knowledge about its flow, visible in mobile applications or on inverters. The modification of practices is not surprising in the context of the costs incurred. According to data from the National Fund for Environmental Protection and Water Management, responsible for the '"My Electricity" subsidy program, in 2019 the average transaction price of domestic photovoltaic micro-installations in Poland was PLN 25,600 gross.[4]

A large proportion of respondents indicate changes in everyday behavior, which we can treat in the category of transformation of patterns or routines. This was the case for a significant group of respondents, who spoke, among other things, of undertaking certain activities deliberately at the time of peak electricity production by PV. By doing so, they were increasing self-consumption, i.e. electricity consumption at the point of generation. Many interviewees emphasized that since the installation of the panels they had gained the ability to monitor energy production and consumption on an ongoing basis. This monitoring was often done in real time, even from a distance:

> We have a program for this, an app. You can also check on your phone. You can be very far from your house, even abroad […]. There is no problem at all. We can check how many kilowatts a day our installation has acquired and how much we have used and how much we have given back to Tauron [*energy operator—authors*]. (work_cl_W_57_caregiver_of_the_ elderly)

For some respondents, especially from the popular classes, the arrival of the artifact was also associated with an initial distrust of its indicators. The new technology required verification by comparing the app's readings with those of the inverter:

> "First of all, I wanted to check whether this actually corresponds to the readings from the inverter. So I go to the inverter and indeed it does." (work_cl_M_54_technician/service technician)

> I monitor through the app, and in addition I compare it with the measurements from the inverters on the photovoltaic installation. (work_cl_M_49_teleconsultant)

The new set of artefacts also forced the first reflections relating to the cost-effectiveness of the project—all the more so as the cost of installation for many households represented

[4] Converting this to earnings at the time, a married couple with median earnings would have had to pay more than 3 salaries of both for PV (already deducting the support from the "My Electricity' programme). At the national lowest, this would be more than half a year's earnings for both people.

a significant financial burden. It also introduced new potentialities: the possibility of changing the daily rhythm, adapting energy-intense activities to moments of peak production or, on the contrary, strategies for storing energy "for later." As we mentioned, the energy stored virtually in the electricity grids can be taken back within 12 months under certain conditions, i.e. in a volume reduced by 20 or 30 per cent.

For some respondents, the installation of photovoltaics, precisely because of the high cost of entry, provided the impetus to reorganize daily activities. The artefact enabled increased self-consumption—the use of energy at the moment of generation:

> We set up this lifestyle of ours in such a way that … we removed all the gas cookers from the house. We changed them to induction cookers. […] So the laundry is only done when the sun is shining. So is the vacuuming, the baking… We try to use this electricity of ours and not take it from the grid. (low_mid_cl_M_42_specialist)

In other cases, the emergence of the artefact opened up the possibility of a reverse strategy—storing energy virtually to use during periods of lower production. This was particularly important for owners of another important artefact—heat pumps—who planned to use photovoltaic energy for heating in winter:

> The desire to combine one with the other. That is, to produce energy for myself that I can use to heat my house. (up_mid_cl_M_59_director_school)

> My husband has an app on his phone, and of course he goes around with a notebook and writes down every day how much we have produced. […] The rest stays in stock for those winter months. (low_mid_cl_W_51_manager)

In this way, photovoltaics as a new technology became a starting point for redefining everyday energy practices. However, it did not impose a single path of action: it opened up the field of choice between different strategies, from current consumption to long-term planning, and these strategies were primarily driven by the cultural and economic capital of the respondents: in the case of the more affluent, it meant integrating the installation with existing or planned investments, such as insulation or heat pumps.

Configuration of practice—materiality embedded in spatial and symbolic arrangements

The introduction of solar PV into households involved not only the emergence of a new technical artefact, but also the need to embed it into everyday rhythms and social relations. This process involved both physically locating the devices (panels, inverters) and embedding them in networks of meanings, symbols and power relations, including the gendered arrangements prevailing in households. The key differentiating element here was the participation, not only financial, but "sweat equity" (see Ley 1996; Gądecki 2013) and thus the independent, partial adaptation of the space of the house to the needs of the new technology with one's own hands to reduce investment costs.

Central to this networking, however, became not so much the tangible elements of the installation as did the mobile applications that enabled visualisation and interpretation of their operation. As an extension of the photovoltaic system, the apps embed production data in the language of graphs, indicators and forecasts, allowing users and users to link the invisible processes of energy flow to decisions made in their daily routines.

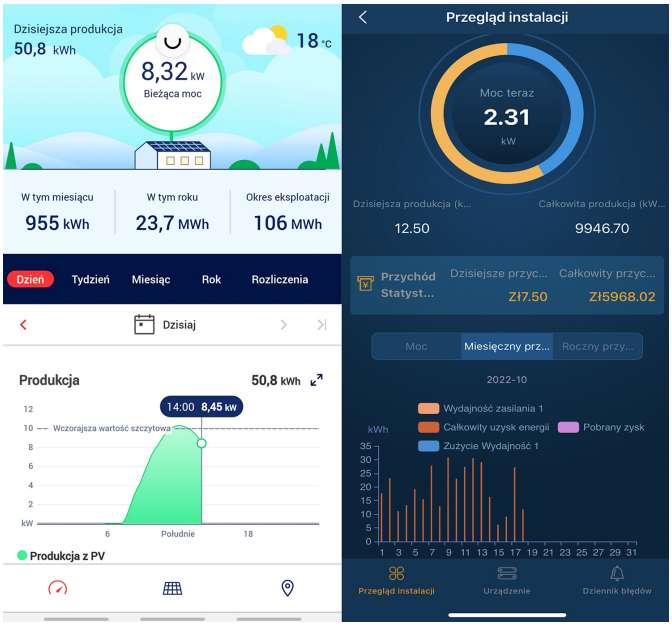
> I have a mobile app, yes. I used to check it once a day, now once a month. (up_mid_cl_M_46_programmer)

They were present in almost all responses—frequently used at first, less so over time, but their presence indicates that they were an important factor in shaping the perception of 'own' energy. Not only did the informative function itself turn out to be important, but also the graphical form of data visualization, which gave power production a specific practical meaning and allowed it to be 'digitized' in everyday experience (Ruckenstein and Pantzar 2017; Pink et al. 2018). From the perspective of actor-network theory (Latour 2005; Harman 2009), applications can be seen as the final link in the 'chain of translation' (Callon 1986): from the electrical impulses in the panels, to the inverter, to the digital graphs and reports. Their shape is not neutral—it is a result of "negotiations" between hardware and software, involving engineers, UX designers and users themselves (Rudnicki 2023).

It is this network of technical and social connections that makes PV a domesticated practice, combining tangible components with digital interfaces (Couldry and Hepp 2017). The final result is a multi-purpose software application that allows not only to monitor the current operation of the power plant, but also to have insight into archival data (daily, weekly, monthly, yearly), forecasts of future production or calculations of the energy returned to the grid. The mobile nature of the applications further extends their field of influence: prosumers can track energy production from anywhere, i.e. beyond the physical range of the plant itself.

Photo 1

Examples of applications monitoring the operation of a photovoltaic installation, used by electricity prosumers in Poland (left—mySolarEdge, right—FoxEss.cloud)



Source: strefaenergii.com (download date: 10.01.2024) / own composition.

As we have already mentioned, in general, the scale of use of the app has decreased over time. This process has not always taken place in an orderly manner—differences

between prosumers can be explained by both their class and competence considerations. In the spirit of Reckwitz's (2002) praxeological approach, apps did not function solely as neutral instruments, but entered into the configuration of domestic practices, co-creating their meaning and rhythm (see: photo 1).

Mentions of class differences, though not central, indicate that digital competence may function as a form of cultural capital (Bourdieu, 1984). Respondents from lower socio-economic backgrounds often used monitoring apps superficially, while those with technical professions (e.g., programmers, technicians) integrated them into daily routines with ease. This aligns with Kennedy and coauthors notion of digital housekeeping as a labour guided by expertise, reinforcing gender and class distinctions in domestic technology work (Kennedy at al. 2015).

For respondents from lower socio-economic backgrounds, a lack of resources sometimes resulted in the software being used superficially or occasionally, whereas those from middle-class backgrounds were better able to integrate it into their daily routines. This difference suggests that we should pay attention to the role of class-related digital skills, which are also currently part of cultural capital. In the context of prosumer households, these skills function as a resource enabling not only the effective use of monitoring applications but also the symbolic mastery of technology as an expression of energy control at home. The observed nuances suggest that the digitalization of energy practices in households may reinforce existing class divisions, although this issue requires further, in-depth research. The same applies to gender differences. In interviews, men (husbands) were most often identified as those responsible for monitoring energy production via apps, which would be consistent with the patriarchal division of roles within the household.

The materiality of the applications (mobile access, interface, analytical functions) was intertwined with the spatial layout of the home: the location of electrical appliances, their work schedules and daily routines. This established new connections between the energy infrastructure and the rhythm of the householder's life. For instance, activities such as laundry, washing and cooking were often scheduled around energy 'production windows.'

> Initially we were not concerned about this. However, the first readings showed that things were not looking as good as we wanted. We started to run the dishwasher, oven or washing machine during peak production hours. That's when the electricity is free. (work_cl_M_31_stonemason)

The gendered aspects are also interesting here. While, as the quotes quoted so far show, it was men who most often monitored energy consumption, women's statements were more likely to include detailed descriptions of modifications to the rhythm of the day, as well as references to specific household activities. This indicates that the responsibility for implementing strategies to increase self-consumption was often located in the area of unpaid care-domestic work—traditionally attributed to women.[5]

> My husband sets the apps, but I'm the one who has to keep an eye on the dishwasher and oven going when there's production. He looks at the charts and I cover it in practice at home. (work_cl_W_43_saleswoman)

[5] In the collected research material, women were much more likely to notice the effort put into adapting to the new way of participating in the electricity system. Therefore, if a more traditional division of roles existed in the household, it may have been the women who were responsible for tasks related to the use of electricity, such as washing or cooking on an induction hob.

In the summer I've got it set up so that dinner is cooked earlier, because that's when there's electricity from the panels. When the kids come back later, it gets reheated, but I cook at midday. (low_mid_cl_W_51_manager)

Such accounts show that the 'set-up' of prosumer practice involves not only the technical coupling of panels, inverter and app, but also the day-to-day negotiation between household members: who plans, who monitors and who actually performs the activities that require energy. The mobile nature of the app allows men, in some cases, to act as remote 'production coordinators,' while the physical implementation of the strategy (switching on the appliances, moving the work) remains the responsibility of women. This configuration reflects what Pink et al. (2023) term 'smart home masculinities,' where men's engagement with technical monitoring contrasts with women's responsibility for practical execution of energy-intensive chores.

Conceived in this way, the configuration of practice reveals an implicit dimension of power and division of labor in the household. Photovoltaics become not only a technical tool for energy production, but also a reference point for the reproduction (or renegotiation) of traditional gender roles. In this way, the materiality of the technology is inscribed into the existing spatial (placement of equipment, access to it, schedules) and symbolic (values attributed to austerity, modernity, responsibility for the home).

Stabilisation of practice—technology as part of routines, practical knowledge and rules of operation

When PV ceases to be a novelty and daily use becomes an internalized part of domestic life, a process of stabilization of practice is revealed. This includes both the integration of the technology into daily routines and the consolidation of new ways of thinking about energy. However, emotions—ranging from satisfaction and pride, to indifference and sometimes to frustration and a sense of disappointment—are as important in this stage as the actual changes in practice.

In a context that is important for practice theory, and therefore emotions, it is worth returning to the evoked theme of the 'promise' that the 'own energy' project carried. Everyday life in this context is treated as a kind of project to be realized (see Shove et al. 2007: 2–14), helped by the incorporation of new technological solutions. It is not only the incorporation of devices as part of the process of domestication of technology (see Silverstone and Haddon 1998; Scheerder et al. 2017), but also a set of expectations associated with the endeavour. The aforementioned 'promise,' however, is linked to an imagined future in which (in the case of most respondents) the loan taken out will be repaid. The whole project is thus indirectly entangled in processes related to the financialization of households (see Lewicki 2014). For the largest group of respondents, stabilization took the form of a reassertion of initial economic hopes. The PV installation became a tool for systematic monitoring and cost optimization—embedded in the daily routine and supported by apps and energy meters:

There is app one from the inverter manufacturer. The other is an app from … I have the power distributor Tauron. There is also an app from them, which is called My Meter. There you can compare how much you use, how much you give away in which zones. It's very nicely done. (work_cl_M_59_electrician)

Even in cases where the original motivation was "climate" or "environment," economic narratives dominated when investments were evaluated—proving that technology, once

embedded in practice, is interpreted primarily through the lens of finance. In some cases, technology was accepted, but emotions were ambivalent—alongside a sense of control over bills there was an awareness that 'modern energy' required a real reorganization of the day, which often came as a surprise.

On the fringes of stability, there were also voices of disappointment, casting a shadow over the enthusiastic prosumer narrative. In extreme cases, disappointment resulted not from daily compromises, but from failure and a sense of helplessness in the face of institutions. Then we can speak of a re-'invisibility' of technology. Failure disrupts daily routines, causing specific functionalities of equipment to be seen again:

> The performance of the installation does not meet my expectations. After 9 quarters the inverter broke down, it took 2 months to replace it, after another month I found that the inverter only works on cloudy days. Electricity production is at a trace level. Tauron has set up a voltage recorder as it is suspected that the mains voltage is too high. (up_mid_cl_M_69_professor)

Such experiences introduce elements of emotional dissonance into the stabilization of practice: a sense of loss, frustration and sometimes anger towards technology and energy suppliers. It is conceivable that the number of people who refused to participate in the interviews, may have concealed more similar stories—related to the unreliability of contractors, lack of technical support or insufficient cultural and social capital to solve problems effectively.

Stabilization of practice, in this view, is thus not only a phase of 'settling in' with the technology, but also a moment when expectations confront the reality of the system's operation, and emotions—positive or negative—are permanently woven into the everyday landscape of prosumer life.

Discussion and Conclusions

In this paper, we undertook to interpret the findings in relation to the domestication of technology and everyday social practices. The analyses have shown that people from different classes may have similar technical experiences and action strategies. Classism, although structurally significant, did not clearly translate into all elements of social reality. Instead, gender differences emerged more clearly: the domestication of PV was more likely to take place within patriarchal structures, with greater involvement of women in handling energy-intensive household appliances (cf. Standal et al. 2020; Standal and Feenstra 2021). Our observations echo the concept of "digital domestic labor" (Grinter et al. 2009; Tolmie et al. 2007; Kennedy et al. 2015), where maintaining technological systems becomes an unpaid, ongoing task embedded in household rhythms. In our study, this labor was often gendered, with men assuming roles of technical oversight and women performing the practical adjustments required for energy optimization.

The domestication perspective (Silverstone and Haddon 1996) showed that the process of appropriation and incorporation of technology is not linear, but subject to periodic disruptions. Energy management strategies were distributed between the drive to increase self-consumption and net metering energy storage. It was women who indicated efforts to adapt household practices to the strategy adopted more strongly, suggesting additional

burdens of responsibilities. Class differences emerged mainly in the area of technological competence, while economic issues—especially expectations of the profitability of investments—were treated in forward-looking terms, as a kind of 'promise' of savings. In conclusion, the domestication of photovoltaics appears as a process that intersects the technical, economic, cultural and social spheres, the analysis of which requires consideration of both macrostructures (class and gender) and everyday micro-practices. In our view, a better understanding of these can help to manage the energy transition at the household level.0 deepen the gender analysis, we draw on concept of resource man (2013), which frames the smart energy consumer as a rational, technically skilled actor—a vision strongly aligned with masculine identities and technical expertise. Our findings resonate with this critique: men in our study often acted as remote 'production managers,' monitoring apps and coordinating energy flows, while women implemented these strategies through everyday domestic tasks. This division mirrors gendered labor patterns observed in other smart home studies (Kennedy et al. 2015), where digital housekeeping and energy management reinforce existing hierarchies rather than dismantle them (Strengers 2013; Kennedy et al. 2015).

The analysis of appliance use and energy management processes showed that digital tools, such as monitoring apps, have become central to the digitalization of household practices. Their use, however, did not follow a linear pattern: the initial high level of intensity of use declined over time, although the apps still remained important in daily rituals and energy decisions. The perspective of actor-network theory (Latour 2005) and the framing of the domestication of technology (Silverstone & Haddon 1996) allowed us to capture the co-presence of human and technical actors and moments of 're-articulation' of technology in situations of failure or economic uncertainty. The application of social practice theory indicated that the significance of smart technologies is not reduced to aesthetic or status aspects, but is deeply embedded in the daily routines, competences and rhythms of households' lives.

In summary, prosumption of energy represents not only a technological transformation, but also a social transformation in which bottom-up, distributed households play a key role. The analysis shows that this process is dynamic, ambiguous and conditioned by both class and gender structures and the materiality of technology, and that everyday practices are central to understanding contemporary prosumer energy.

Our research was qualitative in nature, meaning it doesn't tell us anything about the frequency of observed gender inequalities among broader groups of prosumers. Nevertheless, the observed behaviors fit patterns of gendered role division observed in other areas of life. This consistency with more general patterns provides a compelling reason to conduct further, in-depth research in this area. Energy transition is largely a process affecting households, so it's important to understand how it is changing the daily lives of women and men, and the accompanying shifts in power hierarchies. Our observations prompt numerous questions: How might the widespread adoption of new, intelligent technologies—going beyond photovoltaics—further transform power hierarchies in the home? To what extent do digital literacy deepen existing inequalities, and when can they become a resource for empowerment or collective learning? Understanding how material infrastructure, established habits, and cultural differences co-create the rhythms of home life can help us rethink not only energy use in the home but also gender roles.

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