A Sensory Autoethnography of Energy Practices in the Home

An Exploration of Combining Smart Meter Data with Situated accounts of What Energy is For

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ABSTRACT

Energy providers and government institutions encourage residents to adopt (retrofit) smart solutions. This creates a form of *smart-paternalism* that shifts agency over everyday decisions from residents to algorithms, deciding what is good for them based on averages. The aim of this paper is to formulate design guidelines for future research that takes inclusion of marginalized groups as a starting point for a just energy transition. Based on the observation that quantitative energy data misses important information to understand what energy is used for, while ethnographic approaches tend to brush over relevant technological details, we performed a *sensory auto-ethnography* that links sensorial and situated accounts of *what energy is (not) for* to smart meter data. We use the findings to argue for *enabling* residents' situated understanding of how their everyday practices relate to their actual consumption and formulate guidelines on what both residents and designers need to do so.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Empirical studies in HCI; Human computer interaction (HCI); HCI design and evaluation methods; Field studies.

KEYWORDS

Energy transition, Auto-ethnography, Situated, Social Practices, Smart Home, Discourse, Fieldwork

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1 INTRODUCTION & BACKGROUND

The recent energy crisis has put the energy transition in European countries under pressure. A prominent trend we observe is that government institutions and energy providers push residents to adopt retrofit smart solutions in order to reduce their energy consumption. Where smart technologies are often presented under the promises of *convenience, control* and *choice* [4], the use of smart services and systems in the context of energy management is itself presented as *being smart*. The 'smart' consumer [39] adopts smart technology to pay their energy bills and be environmentally sustainable (e.g. initiatives like SmartNeighbour and SmartMunicipality [45, 46]). As these data-hungry technologies demand access to the private life at home this creates a situation where, besides privacy concerns [16, 31], a smart service provider attains a position of knowledge authority over their customers. Without access to their data *outside* the provided interfaces, people take this disparity for granted [5, 28]. Without the competence and tools to challenge this knowledge gap, households are no longer in charge of questioning their energy demand on their own terms.

Likewise, research methods within technical energy research commonly rely on analysis of sensor or smart meter data to learn about contextual elements that influence energy usage [15]. By taking the need for energy itself for granted, this data misses important information to develop a situated understanding of, what sociologists Shove and Walker [36] describe as, 'what energy is for'; reframing that energy is not used for its own sake but as an ingredient of practice, and that "energy demand is consequently dynamic, social, cultural, political and historical". This work fits within a strand of research [1, 9, 25, 26, 29, 41] around sustainability within HCI that departs from traditional discourses by purposefully entangling various disciplinary approaches. In pursuit of a just and effective energy transition, this particular study explores how we can gain understandings of the situated performance of diverse energy practices in relation to broader societal developments by drawing on social practice theory [18, 33, 35], and methods such as sensory ethnography [27]. It is a prequel to future research in which we focus on marginalized groups that are most vulnerable to the push of retrofit smart technologies.

An article titled 'The best tip for saving is the app' [47], published by one of three biggest energy providers in the Netherlands (Eneco) aptly illustrates this point. In the following excerpts, translated from Dutch to English, a resident is interviewed about the success of saving on her energy bill by following the advice of the provider's smart application. *We would like to hear from this [Company] customer what you can do to save energy with a limited budget. [Interviewee] immediately starts: "Previously, the outside door was always wide open. I was used to that in Curaçao, where it is a sign of hospitality. I still have to get used to the bell ringing.* While these services can successfully help people to save on their energy bill, there is a risk that residents give up meaningful parts of their life in the process of transitioning which, in energy tech discourse, is itself presented as a benefit. *"I really like to cook for friends and family. All day long I had pans on the fire and the windows wide open. But yeah; not very energy-smart I know now."* The energy-smart narrative also implies that users can be energy-dumb. This comes

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back in the semiotics of online initiatives that seek to help those vulnerable to energy poverty [17, 48]. Whether intentional or not, this smart-narrative further adds to the idea that it's in the user's best interest to let the algorithm do the thinking. While this optimization removes human error [14], it also removes people from their active involvement in revising conventions such as comfort and convenience that are key to meaningful change [34]. Like the interviewee, many people find themselves forced by the circumstances to adopt these paternalizing technologies. This raises questions about how voluntary this adoption really is and whose interests the algorithms serve. While involuntary participation in the energy transition is commonly critiqued by justice scholars on a level of governance [37, 38], the actual impacts of the energy transition are embodied in the design of technologies and the everyday practices they are part of [38]. We take into account energy justice concepts [37] of e.g. *distributive justice*, how the burdens of the energy transition are distributed throughout society, and *recognition justice*, on whether the perspectives of marginalized and vulnerable groups are represented, to analyze the role of smart technologies in everyday life.

Driven by efficiency, rationalism and optimization [14, 24], the success of these technologies often require the sacrifice of the diverse sociocultural practices of residents that are entangled with energy practices that don't conform to average use [40]. Key to creating energy interfaces and management systems that take those diverse ways of life as a starting point, is generating a better situated understanding of the mundane everyday activities and circumstances that result in particular patterns and levels of energy usage [36].

In this paper we present findings from a study in which we experimented with methods, data and designs in preparation for extending this line of inquiry to a larger scale study with multiple households of diverse backgrounds. In what could be called a *sensory auto-ethnography* by the first author, we explored the value of linking smart meter data and situated accounts of 'what energy is for' to sensitize our research practice to how energy is enmeshed in diverse sociocultural and everyday practices through the lens of (a) design(er). By embracing the subjectivity of a first-person method [6, 13], we hope to gain insights in the sensorial, emotional [23] and idiosyncratic aspects of the engaging with and conceptualization of energy in and through technologies, data and the home.

Where Akama, Pink, and Fergussan [1] present an argument for future-making *with people* by cross-pollination between researcher and participant, co-shaping (future) energy demand with people relies on a developing a personal understanding of the way individual households reproduce conventions, needs and expertise that are supra-individual [33]. In what follows we describe a study that explores, both as researcher and as participant, questions like: What kind of field texts, data points and technologies might be useful in making sense of, communicating, and assembling the situated practices, embodied moments and respective impacts that constitute our engagement with energy in the home?

In what follows, we describe the autoethnographic experiences of investigating energy practices through a novel combination of methods. We extend current research by combining disciplinary approaches to offer a critical perspective on current smart trends from a first-person perspective of a household situated in the energy crisis. From the results, we identify frictions with technology and smart meter energy data as it is generated and lived-with in times of an 'energy crisis'. We use this to discuss the outlines of a method that makes use of quantitative and qualitative data to involve residents with diverse practices and backgrounds in co-designing technologies in future research and, more particularly, the following main study with residents in marginalized groups.

2 METHODOLOGY: SENSORY AUTO-ETHNOGRAPHY

2.1 Introducing sensory auto-ethnography

In this study we take an auto-ethnographic approach with the aim of sensitizing to 'what energy is for' beyond or between singular devices, spaces, people and practices in the home. We aim to represent those narratives in a way that retains the intimacy as well as legitimacy of being able to be repeated by others [21]. To recognize the burdens and represent the perspectives of those who actually *feel* the impacts of the energy transition, efforts to represent how people engage with energy are needed in order to guide ethical sensibilities and responsibilities of design. However, it's difficult to adequately represent the experience of directly engaging with energy and 'what energy is for'. This also creates difficulties in how to communicate as well as how to understand that engagement, with the risk of marginalizing the more embodied, self-evident and sensorial features that constitute our engagement with energy, and impacts of, the energy transition.

Complementary to the thick descriptions of the researcher's experience with a system or artifact [20] in what Lucero [21] calls '*traditional auto-ethnography* in HCI', we adopt methods from sensory ethnography for their potential to explore the sensory embodied experience through theories of place, movement, and perception [27]. In relation to energy practices, sensory ethnography is able to capture everyday interactions with energy that are self-evident yet crucial to understanding situatedness like resident's improvisation with systems and everyday design in the home [28]. The auto-ethnographic approach to the sensory narratives of residents can be a first sensitization of what is needed to make sense of energy; both as a resident, and as a researcher. As a first-person perspective, auto-ethnography offers a way of capturing how both the generation of and living-with [8] smart meter energy data unfolds over longer periods of time in a private sphere like the home [6]. The sensory ethnography here gives insight into the larger (spatiotemporal) context in which subjective accounts of specific events took place that allows us to interrogate (usage) patterns that fall beyond the scope of 'traditional' autoethnography. We include digital interactions with energy data and services on the grounds that 'Contemporary Ethnography is Digital Ethnography' [10]: energy data and media discourse are major mediators in the way residents conceptualize energy and engage with public debates around the energy transition and recent crisis.

By analyzing data from different sources and methods in sensorial and situated specificity through the lens of design and relating that to larger societal context, we can interrogate the role of design in shaping underlying dynamics of household energy demand and

explore the often overlooked dimensions of 'what energy is for', needed to reframe the energy 'problem' [36].

2.2 Data collection

Over the course of 2 weeks, the first author documented his experiences of using energy and his motivations for doing so in daily journals that featured detailed timestamps. The aim was to maintain ordinary everyday routines in which the intention to save energy was already there due to the energy crisis, remaining open to emergent knowledge but without making it a focus of the research. The timestamps were augmented with hourly smart meter data of gas and energy usage. This included weekdays of working at home, 2 weekdays working at his desk at the office and weekends. Next to the daily journal, the author documented their interactions with the smart meter data, the digital application of their provider and other energy related online encounters over the course of two months, up to and including the period of the journaling. Drawing on methods used in sensory ethnography [27, 29], movements of the author and devices throughout the home were mapped on a floor plan and the author's performance of practices that stood out as energy-intensive (following the smart meter data and logs) were captured on video. This allowed the researchers to 'revisit' the otherwise self-evident routines of waking up, cooking dinner, and doing the dishes. After about a month the journals were re-read, coded and themes were extracted from narratives by connecting frictions with technology, meaningful sensory experiences, homemaking and significant energy consumption in smart meter data. A limitation of the methods we chose is that the journaling of qualitative accounts was an attention-intensive process that shifted the participating researcher's bias to subjective experiences specifically related to energy, possibly missing the entangled ways in which energy is part of practices of others (such as his partner's, or those of friends coming over) and extend outside the home (e.g. such as being distributed between the home-office and work office). Since the planned future research will take place in residents' homes, the described findings focus on the data generated within the home.

2.3 Context Overview

The study was conducted between summer and fall in the Netherlands, situated amid the Dutch energy crisis. In this time my partner would stay with me for 3 or 4 days a week, often weekends. I, the first author, lived in a rental apartment under social housing (subsidized) with energy label G. This is a classification of the energy efficiency of homes used in the Netherlands, with A+++ being energy neutral. The heating and stovetop work on gas, it has large single pane windows and the apartment is in general poorly isolated. With a variable energy contract, my monthly energy bill at the time of study had already more than quadrupled in less than 4 months, making up a little more than 10 percent of my monthly income. Now that I was officially in energy poverty [49], the energy provider's mobile application that is connected to my smart meter became central to my relation with energy and attempts to reduce my energy consumption. Like many households in the Netherlands, the change in seasons put a particular emphasis on practices of keeping warm as well as an on-going act of balancing the energy spent between, now contested, household practices. Partly due to the precariousness of the prices in the (then) now and in the near future and its relatively large impact on my way of living, there were many frictions in my interactions with my energy data and energy provider.

3 FINDINGS

3.1 Outside the smart meter

Throughout the study, there were many meaningful, impactful, and self-evident deliberations and engagements with energy that were not directly reflected in the smart meter data. Energy, moving in invisible infrastructures behind walls or within devices and in its different sensory outcomes such as light or a dinner, tied a lot of different practices together that were distributed over hours or days, different locations and even people. There were several cases of moral balancing that would lead to one energy intensive activity influencing energy activities over time or between household members. This included showering 'too long' (around 20 minutes, way past my idea of what would be considered sustainable) after a stressful day and balancing that with extremely short 2-minute showers in the next few days. More often however, there were moments where I would deliberate, sometimes with my partner, to turn on the heating only to conclude that we would wear a warm sweater instead. Other times, I only turned on the heating when my partner would wake up or friends would come to visit, as to maximize the total amount of '*hedonistic return*' on the heating bill; after all, heating the whole living room would offer twice the sensorial luxury of warmth for the same amount of environmental and monetary costs. Similarly, I only cooked elaborate and energy-intensive meals that e.g., required a long time on the stovetop when others would join in. By balancing cases of non-use and use, we had a household-specific way of reproducing supra-individual presumptions of what is considered to be sustainable behavior, i.e., 'what energy *should/may* be used for'.

3.2 What energy is (not) for

However petty it may sound, the motivations and strategies of *not using* were certainly an impactful part of our energy practices that would be easy to oversee in quantitative data alone. On the same note, while the smart app would compare my energy use of different appliances and spaces to that of other users, it never celebrated the decisions I made to not use something. In the process of connecting smart meter data to the motivations for using or not using energy that took place during the study, I made an overview of 'what *my* energy was (not) for': the energy for lights, heating and managing fresh air that are important for me to focus on working from home; of having freshly laundered bedsheets, taking hot showers and having permanently open bedroom windows for sleeping; the above-average energy I willingly spend on cooking to unwind from work. This coding of my collected quantitative and qualitative data in 'what it is and is not for' was in itself a valuable exercise to reflect on what I (also versus my partner) consider 'right' energy use and how that is embodied within my performance of energy practices. This also exposed both tensions and opportunities between my partner and me in where to save on energy: for example, I would rather air used clothing outside (versus her preference for laundering) while she would rather close the bedroom window, but

an easy compromise was wearing extra layers for warmth during the day.

At the same time, this exercise exposed a category of use that fell in between different practices, people, spaces and times. Notable was the re-building of seasonal winter habits such as closing the doors to the hallway, and losing summer ones like leaving all curtains open categorized as energy for heating. While the energy lost did not serve any direct purpose, the smart app categorized this as 'general heating' rather than 'energy leakage' which, while not by definition, it surely was. Similarly, with the sensory ethnographic method of mapping my movement throughout a day of working at home, I learned that I spend a lot of energy on warming the tap water to do small dishes (by hand) often throughout the day to keep the periphery of my workspace empty; the kitchen counter is directly behind my laptop screen. While it had crossed my mind before, I was not aware of the *actual* impact of my dishwashing habits. By revisiting this habit in quantitative data, I was aware of *how* and *why* I was generating those peaks of gas usage in the smart app. I experimented with turning my table 90 degrees and storing the dishes in the sink and this was directly reflected by a reduction in warm tap water usage the following day. This was in itself a very rewarding and non-disruptive way to find both the opportunity and motivation to change habits and organization in my home.

3.3 Energy in making home

Mapping my movement throughout the home revealed how the materiality, layout and location of my apartment were all highly influential in how I managed the corporal dimensions of energy practices. My situated performances embodied the sometimes emotional and irrational components of my sensory experiences e.g. that make my house my home. Depending on whether I had been eating, working, or moving, what clothes I was wearing, where in the space I was sitting, or what time of day it was, the usual 18 degrees Celsius in the apartment was experienced anywhere between too cold and too warm. This experience combined with the situated circumstance was used as an indicator for the right action, e.g., when I was wearing warm clothing and still felt very cold at 18,5 degrees, I realized I hadn't eaten anything substantial in the last few hours. In the manifestation of an on-going sensing and making sense of 'what feels right', the body itself became complex 'material' in and through the multitude of surrounding material arrangements, e.g. from minute adjustments in how I sat while working, or rubbing my hands, to systems of particular warm vests lingering around chairs in different spaces, and a shared pair of oversized shoes near the cold, stone kitchen floor.

In this on-going improvisation, notions of comfort, cleanliness, and convenience were contested, challenged and reinforced in and through the home itself: as it became colder we started using lukewarm water for washing hands, and briefly opening the window to reduce the dryness of air caused by our heating system. This included many *reflective habits* that were hard to capture, yet were key in my idiosyncratic way of navigating the sensorial aspects of my home. I often switched working between spaces depending on how they feel and if they are cold, as well as little moments of 'pointlessly' moving around to get warm enough to continue working. As such, energy interfaces in my home such as the ventilation, thermostat, the windows and arguably my laptop played an important role in micromanaging the body, not just in their interfacing but in how they were situated in this material complex that is my home.

3.4 Navigating the smart services

The app, by default, compares my current usage with: my usage of last year, my usage of last month, and average usage in the Netherlands and my monthly reports generally came out 'bad'. For example, the month of the study was much colder than last year and last month and my rental housing still heavily relies on gas, while the households I am compared to have much more energy efficient housing. The opportunities for change also resided only in what is applicable to the average households: I constantly received (personalized!) recommendations that were often outside my budget or power as a tenant like replacing my old ventilation system, not applicable to my house and its layout, or did not connect to the strategies me and my partner already used to save energy such as lowering the thermostat to use the heat generated by cooking. So while the data offered me a direct and sometimes painful insight into, for what I could tell, my 'real' consumption, both the time-delay between the generation of my data and the access to it in the app as well as the form in which it was presented back to me, shrouded its relevance and actionability in ambiguity.

In my personal efforts to act more sustainably, it was a lot more rewarding to address cases of energy uses that would show on the bill: while an hour of heating directly presented itself in euros, reducing water was hardly noticeable, and my energy use at work not at all. In what I encountered in the media, both the lauded 'smart' consumers and people in sudden energy poverty proved the evidence of their smartness or injustice by showing their energy costs in provider's smart application [50, 51]. Especially for those with a relatively high energy consumption, the pros and cons of reducing energy demand shift to strictly economic value. This was amplified by calculations of 'expected costs' for the running year. While I pay for energy every month, my actual energy costs are calculated at the end of each year, when I either get money back or have to pay extra. "Because of rising energy prices" as the chatbot of the app tells me, my 'expected costs' are consistently above my payments, resulting in large red alerts. That the pressure this puts on people should be taken seriously is shown by the cases of households who felt forced to entirely cut off their gas [43], based on provider's calculations. What makes this even more precarious is that providers safeguard their own end of the year profits by making conservative predictions about the 'expected costs' [44]. So while user-generated energy consumption data may be 'objective', the algorithms and representation that bring them 'from home to phone' carry inherent bias and intentions behind them.

4 DISCUSSION

4.1 Smart-paternalism

Smart solutions both take part in and learn from the way people conceptualize and engage with energy. When we consider the implications of their growing adoption for social practices through the concept of co-performance [19, 20] rather than the supposed

autonomy of 'smartness', we see that algorithms echo and reinforce the user ideals, intentions and often normative assumptions of the energy tech industry (e.g. when 'too much' energy is used on cooking). Especially the diverse practices of people with different sociocultural backgrounds, non-normative housing [7] and in energy poverty, are at risk of being marginalized even further: As the interviewee in the introduction's article [47] gives up her practices of her cultural background to match the recommendations of her smart app, she 'becomes' an average user from that point forward. Hence, *algorithms as co-performers of (energy) practice* start to reproduce an idea of 'right' consumption patterns that may become a self-fulfilling prophecy [42].

Combined with the prescriptive nature of smart solutions [24], residents are discouraged to explore their own ideas of sustainability and responsibility by making changes in the home. Following Dworkin's definition of paternalism as "Interference with a person's liberty for his own good" [12], we can see how the technology push for smart services [14] that puts more trust in algorithms than people leads to a form of - what we call - *'smart-paternalism'* that transposes the power to experiment and adapt with energy (practices) from residents to smart programs. Furthermore, the constant conflation of 'what energy is for' with 'what money is for' in the interfacing of smart technologies might prove counter-effective to involving residents in questioning what their energy, rather than just their money, is for in futures *after* the energy crisis.

The current technology-centered approaches to reduce energy consumption often take energy demand for granted [32, 36]. We argue that to make an effective change in how resident's energy demand comes-to-be, residents with diverse backgrounds and practices should be involved in co-shaping energy technologies. Therefore, a shift is needed from the role of (smart) energy technologies as paternalistic towards *enabling* residents' situated understanding of the relationship between their daily activities (and the "activities" of the autonomous systems in their homes) and their actual consumption. When energy interfaces offer residents the competence and tools to question and act on 'what energy is for' [36], everyday use *becomes* a form of participation in a just and effective transition.

4.2 Corporal and embodied perspective

Similar to classical forms of paternalism, smart-paternalism requires residents to ignore the sensorial, emotional and situated features of 'what energy is for' [36]. However, in the auto-ethnography we learned that energy plays an important role in creating the 'right' psychological and physiological conditions an individual needs to e.g. feel at home, work or sleep well: showering 'too long' duration of showering depended on e.g. time of day, physical stress, being clean, *feeling* clean, etc. By dismissing these features, both technology and research practice risk marginalizing the more embodied impacts of the energy transition as well as missing the potential opportunities for involving residents in questioning conventions like cleanliness.

To co-explore household energy demand, we need to think more seriously about how the corporal and sensorial dimensions of energy are embodied in the design of technologies and the everyday practices they are part of. As such, we call for methods that can capture, link, and represent the experience of directly engaging with energy and the data this generates, as well as the various passive and active actors, digital and physical, that mediate this. Different ways of representing these marginalized relations can also form the basis for an alternative approach to understanding and designing for environmentally sustainable energy futures that recognize the importance of small everyday interactions and the real influence they can have on how energy is conceptualized, and demand is changed.

4.3 Towards enabling understanding and co-shaping of energy demand

In critically revisiting how the first-author used quantitative data, we can see that the back and forth between generating and using data happens within a separated loop of surveillance/analysis on top of everyday interactions. In a way, like the title, 'The best tip for saving is the app', of the article in the introduction [47] suggests, saving energy happens itself in the app, not in the home. Likewise, an existing critique on energy research methods in engineering and HCI [15, 36], is that quantitative energy data often misses important information to understand 'what energy is for', to which we would like to add the importance of 'what energy *is not used for*'.

By systemically mapping the actions or inactions that the first author otherwise took for granted, we learned that within a household there are strategies to and motivations for not using that are not captured in data that focuses solely on usage. As traditional ethnographic methods might also miss the self-evident decisions to *not use* something, we think residents should be involved in research mapping 'what [their households] energy is (not) for'. Part of this equation is to understand quantitative energy data *as taking part in* the subjective (reproduction of) what energy should and should not be used for within a household. As such, 'objective' data can provide meaningful feedback to understand the effectiveness of changes that find their root in subjectiveness.

To co-explore uncertainty in future-making *with users* [1], requires Research through Design tools that facilitate an attitude of experimentation rooted in *reflexivity*, in trying out, and in *conscientization,* developing one's own in-depth understanding of what can be changed. Here we see potential in forms of design like data-enabled design probes [2, 3] that remain open to appropriation *into* everyday practices to create an ongoing conversational loop between quantitative and multisensory qualitative data of what energy is (not) for in the home. This movement between action and reflection situated in everyday practices can support residents' understanding of the relation between small changes in their lifestyle, what drives their energy demand and impact on their 'final' consumption to reinstigate discussions around the energy transition from the expertise of their home.

Ergo, embracing the good old home as both a material and mental safe space [11] provides residents with the (smart home promises of [14]) *convenience*, *control* and *choice* necessary to experiment and for the home *itself* to become an incubator for change.

5 CONCLUSION

The recent European energy crisis has led to a technology push for smart services. In practice, we observe a form of 'smart-paternalism'

that transposes the power to question and experiment with energy (practices) from residents to smart programs (and the energy companies behind them). As the decision making is transposed to algorithms that reproduce an normative idea of 'right' consumption patterns, residents are less incentivized to question their energy demand. In what we call a sensory auto-ethnography, we combined smart meter data with movement maps, recorded video and auto-ethnographic accounts of 'what energy is for'. From the results, we identify that 'what [a resident's] energy is not [used] for' is equally important for both researchers and residents to understand how energy demand comes-to-be, but is not recognized in current research methods that use either quantitative or qualitative data alone. To co-shape energy demand in a way that recognizes diversity of practices and backgrounds, residents need to be involved in generating and enabling a situated understanding of how their daily activities influence their actual energy consumption. We articulate the need for a shift in the role of (smart) energy data and applications towards facilitating an attitude of experimentation. In our view, this shift requires better insight into the often self-evident sensorial and situated aspects that drive energy demand, and methods in design and research practice to co-evolve energy technologies in the home with users. For future research, we see merit in developing design tools that combine quantitative energy data and the qualitative "what is energy for" data. In an upcoming study that focuses on mapping energy practices in underprivileged neighborhoods with multiple households, we will explore the use of data-enabled design probes to involve residents in starting a conversational loop between qualitative accounts of 'what energy is for' and their actual consumption data.

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