Attuning smart home scripts to household and energy care

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ABSTRACT

Past techno-feminist studies have shown that smart home technologies (SHTs) have inadvertently increased household demand for energy and reinforced gender disparities. This confirms the need to gauge any changes in smart home visions, given that the domestication of SHTs depends on accurate and reliable technology and messages to householders. To determine whether smart home visions are now supporting more gender-equitable household practices and energy efficiency, a content analysis of marketing materials (*n* = 36) is presented. In the context of domestication and the concept of agency scripts, the results show that smart home visions continue to disregard diverse household types and fail to address either energy efficiency or the housework burdens placed on women. This triggers an enquiry into the negative implications for both women's wellbeing and energy-saving goals. Feminist care ethics indicate how smart home visions can be attuned to promote gender-equitable household practices and energy reduction. By accenting the mutual interdependence between humans and technologies and developing a household care practice approach, a realignment of smart home visons towards a care ethic is proposed. Strategies for repurposing SHTs as *technologies of care* that care for householders and the environment are offered in conclusion.

PRACTICE RELEVANCE

This research reveals that current smart home principles continue to circumvent energy-efficiency goals and reinforce the gender disparities implicated in the household adoption, integration and management of SHTs. The smart home industry and government policy are advised to develop and implement ethical smart home principles designed to shape the technology in ways that foster gender-equitable household practices and energy reduction. A realignment of smart home visions is advocated towards principles of *caregiving,* tailored specifically to the objectives of serving the care needs of householders and the environment. A series of strategies is proposed for practitioners and policymakers to facilitate the repurposing of SHTs as *care technologies.*

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1. INTRODUCTION

Energy efficiency in household management is a relatively recent professed ambition of home automation. In response to the 2015 United Nations Paris Agreement's climate change mitigation targets, smart homes now feature conspicuously in technology and policy debates about energy efficiency and housing sustainability. The potential environmental sustainability benefits of smart home technologies (SHTs) are now woven into wider sustainability goals to combat global warming and decarbonise society (Sovacool & Furszyfer Del Rio 2020). Governments, energy policymakers and the energy industry have become major advocates of home automation's energy-saving potentials. As part of a range of policies, these stakeholders are advancing a broad, coordinated agenda of delivering smart technologies to homes and cities (Hazas & Strengers 2019; Tirado Herrero *et al.* 2018). For example, the UK's Clean Growth plan, which affirms smart systems as essential to low-carbon growth, features £265 million for smart systems and £184 million for homes as part of government investments in clean technology research, design and development, including heat and energy efficiency (BEIS 2017). With homes in the Global North increasingly shaped by algorithmically driven processes and automated agents, forecasters predict that 15% of households will own a smart home device by 2023 (Albondi & Narcotta 2019). Yet, householder anxieties about smart homes' domestic benefits coincide with consumer misgivings over the energy value, costs, operational complexities, interoperability and challenges of maintaining home automation (Strengers & Nicholls 2017).

The governmental and societal prioritisation of household energy efficiency has repercussions beyond energy usage and outlays including improved household health, wellbeing, comfort, air quality, increased productivity and energy security (McAndrew *et al.* 2021). Claims of enhanced convenience, comfort and wellbeing by smart home marketing imply that SHTs have the potential to ease the gender inequities that shape housework and related domestic routines. One might expect home automation to be well suited to and welcomed by women who consistently devote more time than men to domestic duties and household management: cleaning, cooking, washing, shopping childcare and care for elderly relatives (Chambers & Garcia 2022; OECD 2021).

However, interest in smart home adoption is lower than expected among women than men. Women tend to be the main purchasers of domestic products, but their interest in SHT falls significantly behind that of men (Katuk *et al.* 2018). Double the number of women reported low interest in new technologies compared with men in a US survey, with 49% of women being indifferent to SHT (Energy Pulse 2016). Men and women are known to have different priorities when buying new technology, with men typically favouring security and energy saving and women valuing care and time-saving applications (Energy Pulse 2016). This may well reflect the inequitable gender relations that shape heteronormative household practices (Chambers & Garcia 2022).

Household energy efficiency is contingent on effective household management of SHTs. Differences between women and men in accessing and using energy services, and the impact of gendered relations on household decisions about energy technology use, arise from complex interpersonal power relations. Smart technologies affect household routines, domestic duties and work–life balance, with implications for gendered household dynamics (Strengers & Kennedy 2020). Techno-feminist research has revealed that smart home energy efficiency, convenience, comfort and wellbeing depend on how users adopt, domesticate and operate these technologies within diverse gendered household practices. These technologies can reinforce gender inequities resulting from gender biases in the design and a neglect of the diverse and complex needs of women involved in household practices. Often overlooked in stakeholder discussions of household energy use is this 'gender–energy nexus' (Feenstra & Ozerol 2021).

Studies of the actual use of SHTs by householders have also shown that SHT can unintentionally increase demand for household energy (Strengers 2013). In terms of heating, cooling and lighting, the technology has been much more liable to increase energy demand (Hazas & Strengers 2019). This body of evidence suggests an urgent need to examine how smart homes are introduced to householders and then *domesticated*: how they are integrated into and actually used in the

home. However, the domestication of SHTs depends on accurate and reliable technology and messages to guide adoption and use. As such, smart home visions, from design to marketing, play a fundamental role in informing and coaching householders how to domesticate SHTs.

This article presents the findings of a qualitative content analysis of smart home promotional texts undertaken between 2019 to 2022 to enquire whether smart home visions are now introducing more gender-equitable household practices and energy-efficiency energy reduction. A range of current smart home promotional strategies is analysed, guided by a domestication approach and using the concept of 'agency scripts'. Corresponding with the findings of earlier related studies, the results show that smart home visions continue, by and large, to disregard diverse household types and women's domestic responsibilities and fail to actively address energy savings. These findings underpin an enquiry into their negative implications for both women's wellbeing and energy-saving goals.

Next, ways to foster gender-equitable household practices and energy reduction in smart home visions are identified. Drawing on feminist care ethics, a realignment of smart home visions towards care principles is advocated. A *household care practices* approach is proposed, supported by the notion of *caringscapes*. Accenting the mutual interdependence between humans and technologies, the article recommends that the SHT industry prioritises caregiving—in terms of care for both householders and the environment—to align technology-assisted household practices towards gender-equitable and energy-sustainable goals. The aim is to incentivise government policy and the commercial smart home industry to deal ethically and efficiently with gendered and energy-efficiency components of the smart home movement. Equitable and energy-sustainable household practices can be attained by attuning home automation's design principles to a care ethic, achievable by repurposing SHTs as technologies of care. By way of a conclusion, strategies for realising this goal are outlined.

2. SMART HOME DOMESTICATION

To address patterns of adoption and use of technologies by householders, this section outlines the relevance of domestication theories. Countering earlier assumptions that householders passively adapt to technologies (Rogers 2003), domestication research considers how technologies are tamed by householders after adoption. It also considers how technologies are conferred meanings by householders before and during their assimilation into household routines (Berker *et al.* 2005). A British perspective explains how the meanings and uses of SHTs are shaped by the household's moral dynamics to gauge their implications for the households' moral economy (Silverstone 2006). By intervening in household relations, technologies initiate new routines and identities, but the process of adjusting to and integrating the technology can cause household frictions. Involving gendered power relations, values and practices, the moral dynamics that frame domestic routines entail complex interactions and sometimes fraught interpersonal negotiations. Faced with the main responsibility for caregiving, women regularly contest these dynamics (Chambers 2016; Chambers & Garcia 2022). As discussed below, challenges include decisions about who will install and maintain the technology, how it will be used, by whom and in what circumstances.

Second, a technology studies perspective considers how technology and user shape one another. It assesses technologies' affordances and constraints to understand the opportunities and restrictions embedded in technologies, from a user perspective (Sørensen 2006: 56). Approaching the normative features of domestic technologies as evolving expectations and practices, domestication theory identifies three constituents of domestication: first, gaining knowledge about the technology; second, learning how to operate it; and third, a symbolic element: the negotiation of a technology's meanings and values to determine its integration into household identities. However, domestic technologies are already precoded with powerful but often ill-defined visions by designers and marketers. In the case of SHT, some encoded visions can be ambiguous, complicated or unpredictable, while others can be transparent, straightforward and reliable.

Domestication studies of energy technologies include energy feedback devices (Hargreaves *et al.* 2010) and householder use of home automation (Nyborg 2015; Hargreaves *et al.* 2018). For instance, in a field trial of SHTs in 10 households, Hargreaves *et al.* (2018) found that smart adoption and use was challenging for householders, resulting in partial or failed domestication. The re-domestication of older technologies disrupted existing household roles and relationships, placing new demands on householders. Hargreaves *et al.* found that even successful adoption tended to disrupt domestic life. Household adaptation strategies meant avoiding or rejecting some smart affordances, thereby compromising SHTs' potentials. Householders also lacked support in resolving smart problems, being unable to call on friends as 'warm experts' or traders such as heating engineers or electricians untrained in the technology. Overall, energy savings predicted by smart home promoters were deemed unachievable (Hargreaves *et al.* 2018: 136).

Raising questions about the limitations of smart domestication, such findings indicate that SHTs' energy-saving claims require reconsideration. To avoid unreachable claims, Hargreaves *et al.* recommend the development of standards, benchmarks and guidelines; the direct involvement of householders in smart home design; and the training of householders to use SHTs in ways that prevent escalating energy use. Likewise, they emphasise that designers need to account for the diverse nature of households since domesticating SHTs depends, ultimately, on household dynamics and householder agency. Building on such suggestions, the following path of discussion triggers a call for the home automation industry to adopt a care ethic. The implementation of caregiving principles in SHT research and design has the potential to attune smart home domestication towards both energy-efficiency and equitable household practices. How this might be done is addressed after gauging whether current smart home visions are now addressing energy inefficiencies and gender disparities in household practices or continuing to reinforce both.

3. GENDERED SMART HOME SCRIPTS

Selective visions and uses are already encoded by designers and their marketing intermediaries before the technology enters the home. The term 'techno-social affordance' illuminates a complex interplay between the technological, symbolic and social constituents of smart home affordances. These affordances are guided by 'agency scripts', a term that helps to pinpoint how the functions and meanings implied by smart home visions steer or nudge householders' smart-adjusted practices (Chambers 2020). As didactic tools, agency scripts guide and organise householders' smart practices in distinctive ways. They initially beckon householders to adopt the technology, and then summon specific procedures that shape distinctive household practices. However, since these scripts are often gender coded before they enter the home, they tend to reinforce traditional domestic ideals and household practices (Strengers & Kennedy 2020), as the following section explains.

Techno-feminist studies have identified gender biases in smart home design scripts and assessed their impact on household practices. They argue that smart home visions have traditionally been based on flawed understandings of the diverse and complex needs of women living in gender-coordinated households (OECD 2018). For example, smart voice assistants such as Alexa, Google Home and Siri are designed with naturalistic middle-class, female voices and personae as default settings (Canziani & MacSween 2021; Humphrey & Chesher 2021; UNESCO 2019). The gender-stereotyped coding of these smart devices privilege men's needs and desires and renders the technology unappealing to women. Forming a pattern, SHT design has tended to neglect women's welfare needs by failing to alleviate domestic workloads, potential security and privacy risks, and loss of control over personal and household data.

Studies reveal, for instance, that smart home 'tech-work' is predominantly undertaken by men as a source of pleasure which can circumvent the needs of women by assigning smart control to male partners (Strengers *et al.* 2019; Strengers & Nicholls 2018). Although energy monitoring activities have the potential to facilitate expressions of masculine care, smart technology generates more tech work or 'digital housekeeping' for men (Kennedy *et al.* 2015; Rode & Poole 2018). Installing, monitoring and operating SHTs takes time away from other household chores. While men are doing the smart servicing, this tech work often requires women to take on more housework. After

adoption, men tend to take charge of monitoring and automating the home to enhance energy outcomes. But this aspiration is often disrupted by other smart household actions that involve high energy consumption. At the same time, women can find themselves facing smart risks (Kennedy *et al.* 2015; Strengers & Nicholls 2018; Strengers *et al.* 2019).

After installation, smart homes can also involve household surveillance that highlight security risks for women who are often blocked from certain vital tasks and services and susceptible to invasions of privacy. As a result, women often lose confidence in operating smart home systems, leading to technology anxiety (Furszyfer Del Rio *et al.* 2021). Recent empirical insights into the labour involved in setting up and maintaining SHT confirm that although some women come to value the technology's affordances, they admit they would not have installed SHT if they had lived alone (Aagaard 2022). These gendered encounters form a pattern that indicates that SHTs have conventionally been designed with men's needs in mind. Evidence suggests that a lack of design awareness of how SHTs intervene in complex gendered household dynamics stems from a male-oriented industry in which masculinity has been a hidden structuring principle of home automation visions (Strengers 2014). Traditionally, smart home research and design have focused on technical issues (Strengers *et al.* 2019; Furszyfer Del Rio *et al.* 2021). By associating men with technical expertise and assuming them to be the ideal or gender-neutral householder, agency scripts have inadvertently been encoded with gendered assumptions that tend to favour men's interests (Strengers & Kennedy 2020).

Adopting an alternative performative approach to gender in their study of smart homes, Strengers *et al.* (2019) argue that gender roles and identities are fluid, mutable and enacted in relation to technology use. Their women participants cherished the affordances of multifunctional devices such as voice-activated assistants that can save time and help coordinate women's multi-tasking activities as wives, carers, employees and providers of emotional care. However, some participants were uneasy about the feminised voices of digital assistants and wished to contest the gendered stereotypes of feminised cleaning and administrative roles. In terms of women's work–life balance, the female participants were conscious that the housework time freed up by SHTs simply means more time assigned to paid work. Given that women have less tolerance or time for tinkering with tech, these scholars call for technologies that can 'provide for different and multiple expressions of femininity' (9).

Overall, techno-feminist studies indicate that smart home visions have tended to reinforce inequitable gender relations in the home (Rode & Poole 2018; Sinanan & Horst 2021; Strengers & Kennedy 2020). By approaching masculine values and aspirations as neutral and thereby overlooking gender complexities, home automation's potential to support democratic and energy sustainable household relations have been impeded. Scholars have called for the design of accessibility and flexibility into SHT to effect energy-efficiency and gender equalities in smart home visions. As the Energy Pulse (2016: 1) report stated, 'it may be time for a totally new approach'. Is there evidence that smart home visions are now being attuned to women's needs, gendered domestic routines and the fulfilment of energy-saving claims? The following section enquires whether the smart industry has now responded to these calls.

4. CURRENT SMART HOME VISIONS INSCRIBED IN PROMOTIONAL TEXTS

Given the role of promotional texts as vital sources of knowledge for potential smart home adopters, this section reports on the findings of a qualitative content analysis (Schreier 2012) of four types of smart home promotional texts between 2019 and 2022. These texts comprise:

- smart home promotional brochures (*N* = 10)
- marketing reports that guide adopters of smart products and services for the promotion of smart home schemes (*N* = 8)
- audiovisual smart home consumer promotional strategies including advertisements and publicity videos (*N* = 10)
- related blogs and informational sources from company websites (*N* = 8).

The aim is to determine whether advances are detectable in these promotional texts in terms of how they address gender, household relations and potential energy-saving solutions. Readily available promotional texts were sourced online via the Google search engine for the analysis of their promotional strategies and themes. Global webpages, in English, were sampled between June 2021 and March 2022 using the key terms 'smart home', 'home automation', 'networked home' and 'connected home'. The selected promotional texts were sourced from multinational companies that offer personalised and unified smart home systems by interoperating with numerous third-party home automation products for the automation of connected devices such as lighting, audio, video, heat control, intercom and security. Marketing reports that analyse smart home device penetration and global market trends were correspondingly targeted. The procedure supporting the analysis involved the following stages: (1) the collection of promotional texts; (2) the identification of themes using thematic analysis (Braun & Clark 2021); and (3) the construction of a mode of analysing the key terms and themes informed by domestication studies and smart agency scripts.

The following results are comparable with earlier content analyses exemplified, first, by an Australian study conducted by Strengers *et al.* (2016). The authors found a growing visibility of women using smart devices yet also reported a pattern of neglecting housework in promotional imagery. They reveal that the promotional material failed to correspond convincingly with energy policy intentions. Among the marketing themes identified, 'control and empowerment' was prioritised and only one of many themes related to energy and cost savings. Later research by Strengers *et al.* (2020) showed a prevalent industry vision of 'pleasance': a set of qualities conveyed in online and magazine articles through a visual and oral language that normalise hedonistic motives for smart home life. Seven qualities that reinforce this vision were identified by the authors: aesthetic experience; fun and coolness; customisation and control; convenience and simplicity; peace of mind; extension and expansion; and effortless energy-saving. These qualities foreground comfort and entertainment.

4.1 SMART HOME BROCHURES

Turning to the current analysis by first addressing smart home brochures, the themes underpinning smart home agency scripts echo themes identified in the earlier techno-feminist studies above. The first theme is lack of household diversity. Smart home marketing materials continue to exclude diverse households such as the disabled, the poor and the elderly. They traditionally target able-bodied, middle-class households with disposable income, even though older people and those with disabilities could be key beneficiaries (Liu *et al.* 2016). Second, today's smart home agency scripts still conjure hedonist values and aspirations. Hedonism and personalisation are themes that continue to be invoked via appeals to uniqueness, comfort, beauty and play (Jensen *et al.* 2018). This is exemplified by 'Smart Home Simplified' (Control4 2019), which refers to 'unmatched personalisation' to accent uniqueness, choice and individuality, with phrases such as: 'We give you choice' and 'Uniquely your own'. Likewise, the ABB (2019) Smarter Home brochure's front page showing a young, heteronormative couple accents smartness as individuality via 'uniqueness', 'comfort', 'ease' and phrases such as 'a diversity of solutions' and 'when you live as you please'. These hedonistic appeals are lacking in housework solutions, and they evade energy-reduction goals. Such smart agency scripts ignore the 'negotiated power differentials, such as age, gender, and species' (Dahlgren *et al.* 2021: 1).

A third theme is control. While women are regularly depicted using mobile devices, most current brochures continue to associate masculine empowerment with control. Visual images of men operating devices predominate. Supported by diagrams of home interiors to explain smart functions, these depictions emphasise 'Effortless and smart controlling'. For example, Control4— the clue is in the name—states:

> Feel empowered. Control4 empowers you with full control and management of everything happening in and around your home—whether you're in the kitchen or on vacation across the world.
>
> (Control4 2019)

A fourth, related theme depicted via smart agency scripts is the continuing accent on the pleasures of surveillance, as described in the ABB (2019) brochure. The subheading 'Comfort Always in control of your front door' figures a man lying on a couch tracking a woman on his mobile phone screen. While we might guess that the woman captured on screen is at the front door, the gratification of tracking someone is conferred on the male subject. This pattern of pleasurable surveillance and control over other householders by the male smart home adopter is suggestive of a potential loss of control by women and indicates insensitivities towards the gendered moral economy of the household.

A fifth theme is mood-making, an affordance achieved via smart lighting, blinds, temperature and audiovisual features of media entertainment via commands (Strengers *et al.* 2016). Recurring images of women basking in ambient home settings feminise these mood-making and sensory encounters. Downplaying reductions in housework by rarely showing householders conducting chores, this technologised ambience is not neutral. These visions are artfully conceived to promote the hedonist values mentioned above (see also Lupton *et al.* 2021). While such imageries fulfil marketing strategies by including women in smart visions, women become passive recipients of the smart encounter.

Sixth, the theme of energy is mentioned in a cursory manner in all brochures. This agency script emphasises control, ease and comfort over energy efficiency or energy reduction. For example, the brochure by Zero1 (2022) does mentions sustainability by promising to 'revolutionise the modern home' and 'making your living space more intelligent'. But after referring to 'greener habits', it then excuses householders from adopting such habits. Images of a Bauhaus-styled modernist home accompanying the text imply nothing less than energy excess. The house boasts a swimming pool, a vast living room saturated with audiovisual equipment and a host of energy-wasteful luxury products. Likewise, while 'environmental impact' is mentioned in the brochure, the text on the next page boasts power, control and joy:

> Our Smart Home technologies have the power to effect positive changes—bringing more joy into the home with smart entertainment technology, all while helping lower your environmental impact.

Mention of 'environment' and 'climate' is cursory, in association with room temperature control, security and lighting with no guarantee of energy reduction.

Corresponding with earlier techno-feminist research (Strengers *et al.* 2016, 2020), the marketing language and themes employed in current smart home brochures comprise agency scripts that promote individualised and hedonistic ideals. They continue to exploit a cluster of values—pleasure, personalisation and mood—which conjure lifestyle imaginaries that emphasise convenience and comfort. Energy efficiency is alluded to as an afterthought. These scripts foster household disengagement from energy savings and, by failing to address gendered power relations, housework and SHTs' caring capacities, they run the risk of reaffirming traditional gendered roles within divisions of household labour.

4.2 MARKETING REPORTS

Turning to smart home marketing reports that deliver the latest trends to the industry for promotional reasons, the findings show that these also continue, in the main, to overlook gendered dynamics and housework. And again, they barely mention energy reduction. An exception, addressed below, is a report by LG that offers clues about how smart home visions could be redesigned according to care ethics. While reports rarely mention climate change, household care or sustainability, some acknowledge diverse household types by mentioning the needs of older people. For example, in a document titled 'Smart Home Market Dynamics Report', Omdia (2021) predicts the smart home market in 10 years' time. Its 63-page commentary omits any mention of gender but does mention 'senior care' six times. Two pages are devoted to lighting and two to 'energy and water device innovation'. However, although mention is made of air quality, water management and energy management, climate change is only referred to in relation to:

radiator valves as the European region introduces more standards and regulations regarding energy and climate change.

The catalyst for smart home growth is, instead, interoperability. Referred to as 'Matter', the goal is to achieve interoperability among smart home devices and Internet of Things (IoT) platforms and reduce fragmentation across different vendors. In Omdia's scenario:

> Interoperability will be the topic of the first half of 2022. During the second half of 2022, the discussion will shift to social robots and the use of radar/lidar for in-home applications such as security and senior care.

For 2030, it emphasises privacy, control, surveillance and concealment of devices with barely a nod to energy saving and climate change. Likewise, the Smart Home Opportunity report by ESA (2021) mentions energy only twice in relation to security and energy-related actions as 'appealing'. The report prioritises control over the home through networked cameras outside and in *every room of the home*, along with a host of appliances such as smart air purifiers, ceiling fans, lighting, personal assistants and smart blinds/shades. This 'every room' surveillance is a worrying and gender-insensitive feature for the moral economy of the home with its potential to cause privacy breaches or intimidation. By accenting commercial gains, the report neglects household and environmental care matters by ending with the slogan 'Win more customers, Keep them longer, Drive profits'.

The lack of attention to climate change, sustainability, gender dynamics and housework in most marketing reports is echoed in related blogs that introduce and summarise reports. For instance, Smart Home Market by Markets and Market (2021) foregrounds the Covid 19 pandemic's effect on the market, which has generated an increase in demand for smart speakers and home healthcare products such as fitness trackers and health status monitors. Home healthcare solutions for the elderly are mentioned, 'to live a safe and independent lifestyle', including remote chronic health monitoring gaining momentum. The blog addresses energy-saving and low carbon emissions, albeit in passing. However, mention of energy efficiency is eclipsed by convenience while women, household dynamics and care matters are absent.

The report that stands out as a progressive and welcome exception is the LG (2021a) ThinQ Smart Home Report. LG has embarked on a new campaign to understand 'how smart technology is transforming users' daily routines across ages and regardless of technological acumen for the better' (LG 2021b). Aiming to establish a benchmark for 'Eco-friendly Living', LG's report is based on an online survey of 837 US users, aged 25–54, to examine artificial intelligence (AI) knowledge, life values and areas of interest according to age. This is the only report that addresses housework reduction directly by asking, 'Want to reduce housework, save time and energy, or customize your appliances' functions?'. Although controlling devices automatically is the first solution requested by 17.3% of customers, the second, requested by 15.7% of customers, is epitomised by a quotation from someone named Carol who says:

> A major benefit of the smart home is conservation, which helps me do my bit for the planet.

> (LG 2021a)

LG's report finds that users view energy saving as the biggest home benefit. The television, washer, air-conditioner and refrigerator are identified as appliances that can achieve 'top benefits'. Uppermost areas of user interest are child/education, gardening and household. Detail on how householders use appliances stem from interviews that show how women and men actually use smart technology. While gender relations are not directly explored, quotations from both men and women accent housework reduction. The final page addresses both household diversity and energy reduction: 'Lifestyle-enhancing Smart home for Everyone is a Win for Everyone' by (1) 'breaking the digital divide', stressing the needs of the elderly, and via (2) 'eco-house and green living' to accent energy saving and a green lifestyle; (3) by using AI to offer benefits to everyone, not just the tech-savvy; and (4) emphasising flexibility by creating user-adaptive smart homes. The LG report's sensitivity to ethical issues of household care, energy reduction, climate change and sustainability indicates how the smart home industry of the future could be re-envisaged to prioritise care-matters: diverse household practices, gender coordinated housework and energy reduction.

However, aside from LG's report, marketing reports and home automation companies' promotional materials have not yet embraced the smart challenges posed by the gender-energy nexus of energy efficiency and gender inequalities in household practices. Performing as didactic tools, these smart agency scripts nudge householders' use of SHTs in ways that conform to gendered, pleasure-seeking visions and preclude, obscure or relegate household chores and energy-saving affordances. The findings show that smart home agency scripts, first, still promote hedonism, and second, continue to overlook the complex and sensitive gender dynamics of household practices. Third, they reveal that current SHT agency scripts risk inciting more, not less, energy consumption by generating unrealistic expectations, routinely evading the complications and challenges of realising energy reduction objectives. This is despite the endorsement of smart homes by governments, energy policymakers and energy industry stakeholders. The findings echo the results of the earlier studies by Strengers *et al.* (2016, 2020) mentioned above. Overall, they indicate the need for the industry to adopt a systematic and integrated gender and energy justice strategy (Feenstra & Ozerol 2021). The following section addresses principles of caregiving as an avenue for developing progressive smart home visions based on a feminist approach to care.

5. SMART HOMES AS CARE TECHNOLOGIES

Recognising a mismatch between ideological notions of the nuclear family and diverse household practices and relations, Morgan (2011) introduced the concept of 'family practices' to accent the 'doing' of family routines and relations, and to define families and households by their diverse practices. This approach accents the performative nature of household social practices. For Morgan, households, family relations and intimate practices are based on modes of 'intimacy', 'personal life', the 'total social organisation of labour' and 'caringscapes'. By foregrounding smart homes as caringscapes, the smart home can be reconceived as a relational caring space in which *smart household care practices* are prioritised. A household care practice perspective offers a new approach to promote the needs of householders as caregivers and overcome rigid gender agency scripts gauged by techno-masculine values.

The term 'care ethics' presented by feminist philosophy focuses centrally on the moral questions that shape household practices. A feminist care ethics foregrounds care as the 'doing' of smart-enabled procedures in the organisation of household labour and advances our understandings of care practices by conceding that these practices entail emotional relationships and that these relationships are supported by technologies (Puig de la Bellacasa 2017; Gherardi & Rodeschini 2016; Mol 2008). This care inflection entails, first, taking responsibility for the needs of significant others, highlighting the value of emotions and empathy in moral principles that steer action (Tronto 2020). Second, it contests liberal notions of individualism by employing a *relational* approach that recognises householders as constituted by their relations to each other (Gilligan 1982).

The interplay between human and non-human actors is conceptualised by Latour (2004) as relations of interest and agency that shape today's socio-technical realities. Complex and multiple webs of technologies are integrated into today's care interactions in terms of shelter, transport, communication and domestic technologies. The qualities of these technologies affect qualities of care provision, varying according to their design, meanings and contexts of use. A care approach is exemplified by Mol (2008) who argues that the logic of care cannot be separated from technology use: care is a technologised, emotional and relational set of practices. This approach to technology then indicates that human and non-human dimensions of care are intertwined since the social, material and technological environment collectively forms a specific and overall ecology of care (Mol 2008).

Similarly, Puig de la Bellacasa (2017: 5) presents a three-fold concept of care pointing to the human labour, affections/affect and ethics involved. Drawing on Latour, Puig de la Bellacasa illuminates the care-like labour undertaken by non-humans that support human caring goals. Gherardi & Rodeschini (2016) also adopt a post-humanist perspective to propose a practice-based approach. They define care agencies as emergent processes and competencies achievable

through a diverse collective comprising able-bodied humans, tools, technologies and rules. For Gherardi and Rodeschini, neither humans nor technologies are privileged in practices of care since they are mutually interdependent within the decision-making processes and performance of care. Hence, the difference between a humanist and post-human approach to care is that the former focuses on human actors and their practices, while the latter also takes into consideration the array of material and technological items and processes embedded in caring practices.

This is where smart technologies come in. Home automation has the potential to be designed as intricate interconnections between human and non-human actors in matters of care. As non-human agents, SHTs can be redesigned to deliver their ethical potential as caring agents rather than as leisure tools for the affluent. Designing with care enables SHTs' agency scripts to be rescripted as mediators of care within a sociotechnical household process. Smart home visions currently invoke care via marketing terms such as comfort, convenience, wellbeing and security as potential care matters. But their potential is not yet realised because smart home designs are currently antithetical to the complex, situated unfolding of care practices within diverse households. Smart technologies have yet to be yoked, unequivocally, to principles of care.

Designing with care can ensure that SHTs are sensitised to and perform as active agents within household care practices. The domestic labour traditionally placed on women can then be attended to centrally by constructing smart designs that enable this emotional, physical and time-absorbing labour to be shared, not just between technology and householder but also between householders themselves. Placing smart home caregiving at the core of home automation's objectives, as a gender-inclusive and energy-oriented approach, ameliorates security, surveillance and control risks that tend to pertain to women, children and the elderly. It enables a re-prioritising of smart home agency scripts by sensitising design to householders' ongoing care needs and the vulnerabilities that humans encounter across the life course. While smart devices could be a game changer for infirm older people, their life conditions are only rarely addressed in smart home visions. Another example is the rising number of single-parent households, mainly women. Often more vulnerable to poverty and marginalisation, they require smart home innovations that can enhance their caring roles (Dankwa 2018). Furthermore, a caregiving approach coheres with perspectives on 'environmental stewardship' as pivotal to human–technology–nature relations. SHT principles can be re-designed as *agents of care* in terms of care for the household and care for the environment through energy resource management.

6. CONCLUSIONS: REALISING SMART HOMES AS AGENTS OF CARE

An ongoing lack of consideration for gendered household dynamics and diverse households in smart home visions has been uncovered by drawing on domestication and techno-feminist studies and a content analysis of promotional literature. Through these visions, the industry continues to make ambiguous and unrealistic claims about efficiency, convenience and energy reduction. Advancing a feminist ethics of care, the article has accented a household care practice approach to prompt a re-evaluation of smart home principles that can address the gender–energy nexus. The realignment of smart home technology (SHT) principles as *technologies of care* is proposed, in terms of care not only for the household but also for the environment. Envisioning home automation as *care technologies* triggers a question: How realistic is it for designers and marketers to realign SHT to caregiving principles? By way of conclusion, a series of concrete suggestions is offered as ways to activate and implement smart homes as *agents of care*.

- Attuning SHTs as agents of care requires care-oriented smart toolkits tailored to diverse household types and energy efficiency. The success of such toolkits depends on redesigning the technology to cater for diverse household practices for fostering gender equity and promoting energy sustainability. Importantly, to cater for diverse household types and understand how gendered householders navigate and respond to SHTs, comprehensive care knowledge needs to be gathered (Hargreaves *et al.* 2018; see also Jensen *et al.* 2018). This includes involving householders directly in smart home design and development processes. As outlined above, domestication research shows that smart affordances comprise multiple

meanings and practices depending on householders' norms, values, digital competences and context of use. The research also shows that smart home early adopters offer valuable insights to support the construction of care-oriented smart toolkits. But until now, most studies have been short-term and focused on early adopters including special-interest groups such as devotees and hobbyists (*e.g.* Mennicken & Huang 2012; Mozer 2005). More discerning knowledge can steer appropriate designs and smart agency scripts to develop care oriented, easy-to-use interfaces and devices that require little or no training to use.

- To cater for diverse household users of SHTs, care-oriented smart toolkits can be attuned to 'technical femininity' in SHT design to confront and avoid the latent risks to women and other vulnerable groups relating to smart home security, surveillance and control. Strengers *et al.* (2019) call for the design-varied expressions of femininity, as well as masculinity, in smart device design and marketing strategies to enhance gender diversity. Smart home design can benefit directly from feminist human–computer interaction research that identifies smart home challenges and opportunities. As the authors emphasise, this requires further in-depth research with women and other neglected users. They also argue that the negative consequences of digital housekeeping for women can be resolved by advancing community guidelines for technical and troubleshooting forums and encouraging more women to participate.

- By acknowledging that smart functions, meanings and household practices involve a reciprocal and co-dependent relationship between designer, technology and user, smart home strategies can be readapted and modified in response to householders' care practice needs. This requires continuous monitoring processes and readjustment systems to facilitate modifications in design after adoption. This would ensure SHTs perform effectively in their role as care technologies across household types and that they adapt to changes in householders' fluctuating moral economies. Like many technologies, SHTs are often used for purposes that were originally unintended (Furszyfer Del Rio *et al.* 2021: 9). Once installed, patterns of household use may trigger redesigns according to types of use.

- A caregiving design ethic can guide technology design and policy objectives towards energy efficiency. The following examples of how this can be done include: (1) energy justice, to evaluate where injustices emerge, which social groups are ignored and strategies to remedy such injustices (Jenkins *et al.* 2016); (2) responsible research and innovation frameworks (Furszyfer Del Rio *et al.* 2021); (3) value sensitive design, a theoretically grounded method of technology design that accounts for human values by ethical and inclusive means throughout the design process (Friedman *et al.* 2013); and (4) the embedding of climate change education in smart home design to attune householders' care practices to care for the environment (*e.g.* ECO2 2022).

- Industry standards, regulations and ethical guidelines can support the implementation SHTs as care technologies. Policymakers are beginning to produce more rigorous standards, regulations and policy incentives to guide SHT development for improving the sustainability of smart home use. For example, European Union policy and policy implementation best practices entail policy recommendations to regulate smart grids and smart homes connected to them which, in turn, can be tailored to differing socio-political contexts (Sovacool *et al.* 2021). But uncoordinated policies and ethical guidelines continue to operate across multiple systems such as smart meters, smart grids and the IoT. Such challenges highlight the need to cohere consistent sustainability and household care practice goals across sectors. Overall, a robust caregiving design ethic with the potential to align home automation to principles of care is feasible, if done with care.

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The author has no competing interests to declare.

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