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Digitisation and Low-Carbon Energy Transitions

Edited by
Siddharth Sareen
Katja Müller

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"With the arrival of the European Commission's Twin Transition trope, the future will see no shortage of hubristic accounts on digitisation and low-carbon energy transitions. As a welcome antidote, this book brings together refreshing, provocative, ethnographic contributions that tease out the paradoxes, tensions and emancipatory potential in this twin transition."

—Professor Lars Coenen, *Western Norway University of Applied Sciences & University of Oslo*

"Our energy systems are being digitised. Decarbonisation is the goal. But as this book illustrates, rewiring society involves complex cultural circuitry."

—Adrian Smith, *Professor of Technology & Society, Science Policy Research Unit, University of Sussex*

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Editors

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Digitisation and Low-Carbon Energy Transitions

Katja Müller and Siddharth Sareen

Introduction[1]

As the world faces the urgent challenge of transitioning to low-carbon energy futures, digitisation gains salience: decarbonising energy systems requires the digital process control of energy production, transmission

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[1] Note on authorship: The authors are equal contributors to this introductory chapter.

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and end-use. Decarbonising electricity and electrifying diverse sectors requires real-time digital coordination of increasingly distributed energy production, with growing numbers and variations of power plants and enhanced spatiotemporal complexity. To manage energy demand, raise energy efficiency and enable rapid renewable energy rollout, digital devices can help recursively modulate the rhythms of energy and society. This synchronised shift in energy practices and infrastructures—for whose enablement digitisation is crucial—is essential for the rapid decarbonisation of complex, intertwined systems.

Simultaneously, low-carbon energy transitions premised on electrification and digitisation carry the risk of significant increases in energy demand, systemic and individual vulnerabilities, and further concentration of centralised control, with the benefits of increased energy efficiency accruing to a narrow set of privileged actors who set the pace and scale of low-carbon transitions to maximise their self-interest rather than public gain. This raises questions of political economy about the twin transition of digitisation and low-carbon transitions. Who digitises energy infrastructure, and what drives decision-making? How does governance impact the justice effects of infrastructural change? How does digitisation condition the lived experience of human interactions with evolving energy systems? In sum, what is lost and gained as we transition from fossil fuel-dominated infrastructures to hybrid-digitised energy futures, from coal mining to data mining?

Energy Efficiency and Greenhouse Gas Emission Reduction

In times of climate crisis, digitisation and energy form a coalition not only for economic savings, but for *energy efficiency*, indirectly aimed at reducing greenhouse gas (GHG) emissions. Approaching the twin transition from the energy side, this implies that the climate crisis drives a shift to renewable sources in energy production, and this transition in turn requires a digitisation of the whole energy system. Digitisation is important to ensure grid stability as the variability, scale and distribution of energy sources increase, and the distinction between consumer

and producer becomes less binary and begins to fade. Renewable energy production is concomitant with the decentralisation and fragmentation of power production units, and requires digital coordination of grids that operate across regional and (trans)national scales. In other words, digitisation enables rapid acceleration and widespread adoption of more granular technology (i.e. small-scale, modular, replicable and scalable units) in a low-carbon energy production system (Wilson et al. 2020), and sectoral digitisation can lower transmission losses. Renewable energy systems hence become established as ones where digitisation, decarbonisation and decentralised sources are closely interwoven (Di Silvestre et al. 2018).

The climate aspect has been intensely studied in the field of sustainability transitions, where low-carbon transitions have been conceptualised in depth and at breadth, and scientists envision the current scholarly task as 'discerning the nature of the future "stage" into which we are hurtling and understanding clearly how people are experiencing and understanding this unprecedented energy transition' to low-carbon and lower net energy use systems (Love and Isenhour 2016, p. 15). Yet, conceptions of energy transitions that explicitly include digitisation are still emergent, as are in-depth analyses of the same that take the situatedness of systems and the processual dynamics of changes into view. While Blondeel et al. (2021, p. 11) point out that digitisation, especially through smart grids, is 'radically transforming the interconnectivity, reliability and efficiency of the energy system', an understanding of twin transition dynamics remains in its infancy.

This is surprising given that digitisation in general is hardly new to power plants, these being at the production side of energy systems, where supply-side interactions with wholesale energy markets have long been digitised. Conventional power plant and grid operators may not necessarily be convinced about digitising additional upstream and downstream units, but feel increased pressure to bite the bullet when decentralising energy production aligns with attempts at energy autarky (see St-Pierre in this book). The considerations, implementation and consequences linked to digitising the *electricity sector* (also see IEA 2017, 77f) are

ominously relevant for national governments, as they varyingly emphasise or overlook emergent threats to critical energy infrastructure with changing system and data architectures.

Energy consumption and end-use, too, emphasise digitisation as a means for energy efficiency and GHG emission reduction, most often through the use of smart meters and dynamic electricity tariffs for demand response (Geelen et al. 2019; Hmielowski et al. 2019). However, climate mitigation through energy savings and efficiency can become a sidelined ideal during digital advances (see Ortar and Flipo in this book). Furthermore, efficiency is not only relevant for the electricity sector. It also induces changes in the *building and transport sectors*, where energy efficiency renovation and low-carbon modes of transport either compete to prevail, or struggle to synergise, within locked-in political economies (see Aggeli and Mechlenborg, and Datava et al. in this book).

Data Generation and Rebound Effects

Considering socio-political aspects of technological interlinkages in digitising low-carbon energy systems can also advance an understanding of wider (energy) justice outcomes and human capabilities (Hillerbrand et al. 2021). The twin transition impacts labour, both in terms of evolving work practices and with respect to the global movement of bodies for economic production, as digitisation and robotisation transform the global economy (Stakanov and Ukhova 2020). Furthermore, the digital in the twin transition is not a mere consequence of ideals of decarbonising electricity, but co-constitutes the transition's ontological basis. Analyses of *digital data generation and circulation* provide insights into the need for rapid and deep reductions in GHG emissions as well as countervailing trends (see Lautrup in this book). Data generation and online data circulation likewise precede and enable energy efficiency improvements in the building sector (see, for example, Aggeli and Mechlenborg in this book), and have become prerequisites for various sectors and energy systems in general. Power generation and energy use that enhance efficiency and accelerate low-carbon transitions through digital means are premised on digital data generation and information flow.

However, digital data generation and retrieval come at a cost—an energy cost. The production and circulation of digital data consumes electricity, and as data volumes and server storage and processing capacities burgeon, so do energy demands. By 2019, digital technologies were already responsible for 3.7% of all global GHG emissions (Shift Project 2019: p. 4), twice what civil aviation accounts for, mainly driven by increased video use and short lifespans of digital equipment. However, energy efficiency in data processing has undergone a parallel increase by an order of magnitude; hence, while data processing rose by 500% during 2010–2018, electricity consumption for processing only increased 6% (Masanet et al. 2020). Albeit laudable, this decoupling of the rise of the digital and its energy requirements nonetheless fails to circumvent increasing energy demand, and is undergirded by a logic of growth. As a potentially worrying trend, the expansive development and installation of digital devices in and beyond the energy sector looks set to continue, rather than the *decrease* in overall energy consumption that is required to address the climate crisis. Rather than ignoring these developments in the hope that future energy efficiency enhancement will outpace growing energy demand, some stakeholders—like the visual artists and anthropologists taking to 'glitchy', low-resolution videos (DeAngelo in this book)—are reconfiguring their practices and lenses accordingly, while others—like the German company developing solar energy apps for the Kenyan market (Riedke in this book)—remain largely undiscerning in this respect.

Rebound effects of energy efficiency or GHG emission savings through digitisation are theoretically possible in numerous cases. They are evident when the energy to produce devices such as e-scooters (which can have notably short lifespans) are taken into account (see Datava et al. in this book); when online communication and information searches outpace energy savings in refurbishment (Aggeli and Mechlenborg in this book); or when the energy used to drive to shared working spaces exceeds the savings in energy that arise from the co-occupancy of spatial resources (Ortar and Flipo in this book). Rebound effects—and the impact of digitisation on energy saving—vary severely across technologies and applications as they are specific to technologies and practices; e.g. drone delivery is subject to relatively low potential to lower energy demand,

whereas smart thermostats have high potential to enable virtuous declines in energy demand (IEA 2017, p. 30). Yet again, even if energy use associated with producing and operating a given device is low, rebound effects can lead to increased overall consumption due to lower costs— e.g. setting the temperature for digitally controlled heating higher and thereby diminishing or reversing the energy savings that result from sensorily captured, presence-dependent heating (see Horner et al. 2016 for details). Likewise, automated transport can improve energy efficiency, but reduced costs can also spur a greater tendency for personal car use.

This book centres and problematises these emergent problems of inter-linking digitisation and transitions to low-carbon energy systems. Through an interdisciplinary set of chapters, it transgresses boundaries between energy anthropology (Abram et al. 2019; Smith and High 2017), energy geographies (Huber 2015; Calvert 2016) and longer-running fields such as science and technology studies, political ecology and (digital) media studies. All featured contributions are based on ethnographies of digitisation and low-carbon energy transitions, and thus analyse ideals and processes of the twin transition without constraining focus to energy systems in a technical sense, instead taking on the full import of what 'socio-technical' implies. Rather than remaining on the theoretical level of what digitisation and low-carbon energy transition may encompass, they take to the situatedness of transition processes and their realisation in particular cases, and analyse this based on profound insights. Such a point of departure offers not only case studies of the twin transitions, replete with their challenges and glitches, but enables an inductive approach that allows for theoretical development derived from empirical insights. The authors of these chapters pay attention to the specificities of digitisation, broadly construed and ethnographically explored. In myriad ways, they deal with questions of power, hierarchy and decision-making. Notably, privacy and security emerge as cross-cutting themes that loom large at the intersection of power production and transmission with digital control and regulation, and interpellate the aforementioned core concerns of energy efficiency, GHG emissions, data generation and its rebound effects.

The contributions feature particular attention to the situatedness of transition processes. While digitisation and the climate crisis are by now

global conditions that affect planetary health, their manifestations are strongly dependent on place-based infrastructures and socio-cultural as well as political economic frameworks. By drawing on case studies from Europe and Japan, as well as from Kenya and Australia, the contributions cover a larger spectrum of transitions worldwide, while maintaining a primary focus on the Global North, where these twin transitions have arguably made the most major advances globally thus far.

The contributions were prepared—and then revised both in advance of and subsequent to—the Energy Anthropology Network's biannual workshop, hosted by the University of Stavanger in August 2021. This convened academics conducting research on energy transitions and digitisation from anthropology as well as from a host of disciplinary and interdisciplinary perspectives. The transgression of disciplinary boundaries is symptomatic of both energy studies and digitisation studies, and is richly in evidence here. This book resolutely assembles contributions that take anthropological case studies as their foundation, but allows for diverse methodological approaches (from field research to digital anthropology and from interviews to desk-based analyses),[2] varying writing conventions (e.g. thick description or the use of illustrative examples), and diverse canons that researchers draw upon (i.e. vantage points or theoretical approaches that may be well-established in one discipline, yet novel in another).

The book's chapters are enhanced and completed by a research-based and co-produced art exhibition. The Rjukan Solarpunk Academy, comprising artists Martin Andersen and Margrethe Brekke, exhibited their visions and interpretations of just low-carbon energy transitions at the Norwegian Petroleum Museum during autumn 2021. 'Uro' is a veritable lucid dream or lucid interval-like installation of a broken-down fossil fuel powered car's parts suspended on an oil rig, complemented by the manifesto and technical details of a utopian National Association for Bus Users (rather than the prominent Norwegian Automobile

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[2] Pink et al. (2015) address the ontological and phenomenological concern for digital ethnography, reflecting that 'we are often in mediated contact with participants rather than in direct presence'. Introducing an edited collection, Douglas-Jones et al. (2021, p. 9) tackle this head-on by calling for 'an anthropology of data that is ethnographically specific and theoretically ambitious' in its 'engagements with the data moment'.

Federation), artistically rendered and detailed on post-industrial tapestry. Images of the exhibition—stylistically, symbolically and daringly juxtaposed at a museum with a focus on petroleum related national history and culture—are featured after each chapter of this book, replete with a short overview of its research-related development (Chapter "Just Low-Carbon Mobility Transitions: A Research-Based Art Exhibition") following this introduction.

The diversity of disciplines represented in the chapters advances research on the twin transition by contributing to transition studies, energy studies and energy anthropology, and to a lesser extent to media studies and digital anthropology. Importantly, it constitutes a collective response that emerges across the interplay of case studies and conceptual approaches. Reading carefully through the case studies reveals how the study of digitisation and energy transition is enriched by engaging with the actual places in which change happens; by treating change as an intertwined set of infrastructural transformations (including seemingly banal ones); and by mobilising interdisciplinary concepts and methods. The common grounds embodied by these book chapters lead us to mainframe two concepts for ethnographic study of the twin transition: *situating digitisation* and *realising imaginaries*.

Situating digitisation

Digitisation holds transformative potential that can be for the better or worse, depending on how it is shaped through engagement with particular contexts, and how it is translated through regulatory regimes that are themselves evolving to anticipate and grapple with rapid infrastructural change. In an edited collection, Prainsack (2020, p. 444) highlights the need for:

'visions and instruments to build new institutions: institutions in and through which human expertise, experience, and interaction are seen as equally important as high-tech precision; where new norms and policy instruments ensure that the benefits of data use accrue for society at large, and in particular for the marginalised and vulnerable; and where

the datafication of the bodies, lives, and practices of people who have no realistic chance to opt out is recognised and condemned for what it is: robotic brutality', which Chisnall (2020, p. 488) posits as 'a new form of digital enslavement that has the potential to curtail liberty and cause harm'.

Bareis and Katzenbach (2021b, a) argue that national strategies anchored in diverse socio-cultural contexts and political economies performatively lock in a prominent aspect of digitisation, artificial intelligence (AI), as 'inevitable and massively disrupting', and then channel investment to particular technological futures and thus co-produce them. Smith and Fressoli (2021) confront 'future essentialism' by advocates of automation, and argue for a focus on how automating technologies are being hacked, subverted and appropriated to foster conviviality, as a means to inspire a politics of what they call 'post-automation', which is premised on democratic deliberation and the cultivation of social capabilities. Drawing on ethnographic work with firefighters in Denmark, Karsten (2021, p. 92) emphasises the need to guard against the misunderstandings and incorrect applications that tend to accompany digitisation, and correspondingly proposes moving from resistance and apprehension to concern and dialogue (i.e. conviviality) to 'foster more empathetic, productive and understanding collaborations within and across organisations'.

Studying digitisation in Berlin, Quitzow and Rohde (2021) show how techno-optimism on digital solutions at the urban scale presents them as environmental solutions, economically essential, and linked with exciting experimentation and progress, thereby undermining other subtler as well as more radical alternatives. This determinative aspect of digitisation is evident in the rapid current transformation of countless aspects of social organisation, including academic publishing (Fortun and Fortun 2015). Indeed, Karasti et al. (2016) point out that the emergence of new data infrastructures is changing the nature of knowledge production, meaning that digitisation is not only a subject of study, but also an actant on how that study takes place. Knox (2021a, 2021b, p. 178) captures this ubiquitous aspect of digitisation by 'traversing the infrastructures of digital life', elucidating how it encompasses 'the wires and cables that support

mobile and computer communication but also the integration of sensors, databases of measurements, and real-time data analytics into buildings, motorways, ticketing services, fast food delivery, taxi services and more'.

The first three contributions of this book illustrate how energy-related digitisation in its structure and diffusion is heavily dependent on the infrastructures of digital life, comprising both the digitisation segment—transport, energy production or communication—as well as the socio-cultural context and dislocations through which it unfolds. In Chapter "A Solar Off-Grid Software: The Making of Infrastructures, Markets and Consumers 'Beyond Energy'", Riedke offers an analysis of a new software to manage the sales of solar off-grid products. This software is being developed by a German start-up for the Kenyan market. Analysing the different layers of the software, Riedke renders tangible how humanitarian and environmental concerns intertwine with for-profit interests and the overarching aim to establish markets and new consumer subjects among 'off-grid' populations. These ambitions interpellate low-carbon electricity provision in the form of transnational social entrepreneurship, whereby digitised energy users are constructed as new market actors. The attendant advantages and disadvantages of their reconstituted subjecthood range from energy access on the one hand to becoming a market participant subject to neoliberal development agendas on the other hand, rendering people vulnerable to increased monitoring, data generation and control through the ensuing energy consumption and payment practices.

Alongside explicating datafication, marketisation and automation processes, attention to digitisation in specific contexts also foregrounds questions of realigning access and information policies, influencing knowledge economies, and adjusting participation and conventional power dynamics. Control is shifting from conventional process regulation (e.g. by engineers or newspaper offices) to those who programme digital system control with remote access through reading and writing rights (see e.g. Ernst 2009; Müller 2017). As digitisation in a narrow sense refers to transforming analogue data formats into digital formats based on binary codes, software and applications—attuned to pre-existing programmes, needs and desires from a yet-to-be-digitised sector or segment—the software configuration determines future application

options and possibilities to intervene, alter or rewrite programmes. Dominant ways of thinking including hegemonic market logics permeate digitally constituted systems that order and control critical processes, even as forms of counterculture such as open source software development or—with regard to user access—creative commons and open access policies rally against this development (Garcelon 2009; Risam 2019).

In this book, St-Pierre shows how such power mechanisms also figure in the grid protocols and in the realisation of virtual power plants. In Chapter "Contested Energy Futures in Hokkaido: Speculating with European Renewable Energy Models",   St-Pierre shows that Japan's low-carbon energy future cannot yet draw on the digitisation required to regulate and control decentralised and diversified energy production, despite enhanced scrutiny of established energy systems and demand for more localised emergency-grid solutions rather than mainland dependency. Even though grid protocols prioritise less centralised renewable energy distribution and the Japanese experience with earthquakes and disasters—which St-Pierre exemplifies with the prefecture of Hokkaido—undergirds the twin transition, the idea of an ever-expanding, digitally regulated grid remains mediated between stakeholders at various governmental and administrative levels as they plan a society where the virtual and the physical increasingly intermesh, as evident in the disaster-proofing of energy production and distribution systems.

Unpacking digitisation in the wider sense of digital technology permeating every aspect of everyday life, a phenomenon commonly signified as *digitalisation*, entails recognising that the internet has profoundly altered information and knowledge systems. Neither the proclaimed internet optimism (Negroponte 1996) that anticipated the break-up of established hierarchies and the democratisation of societies through the internet, nor the internet pessimism that saw it as leading to a surrender of culture to technology (Postman 2011) hold sway; yet, internet communication and social media have reshaped the world (and the world has recursively shaped social media, see Miller et al. 2016) and continue to do so, with prominent, concerning impacts such as election outcomes (Schroeder 2018).

Lautrup's work in Chapter "Overcoming Abstraction: Affectual States in the Efforts to Decarbonize Energy Among Young Climate Activists in Stavanger, Norway", undergirds this by relating internet-based information and digitally based visualisation to energy systems and climate protests. Lautrup demonstrates both how the realisation of a post-fossil resource ideal can be highly problematic and conflictual in a society whose wealth has in large part relied on oil and gas production, and also how the visualisation of the intangible consequences of post-fossil futures depends on digital or digitally based technologies. Numbers, graphs and charts are required to make the climatic consequences of fossil fuel energy systems known and intelligible, making digitisation a prerequisite for future scenarios of altering extractive conventions. As a mode of communication, deliberation and proliferation of competing narratives, digitisation is ontologically baked into energy sector representations, as much as it is also integral to fossil fuel infrastructure such as oil rigs.

The section *Situating digitisation* thus foregrounds a framing of digitisation as context-dependent, with particular attention to its relation to energy production, distribution and consumption. This allows us to draw attention to the socio-cultural contexts of digitising energy systems, and to the intertwined nature of everyday digital practices, energy system configurations and low-carbon energy transition dynamics. Energy-related digitisation in its structure and diffusion is heavily dependent on both the digitisation segment—in transport, energy production or communication—as well as on social norms, hierarchies and expectations.

Realising Imaginaries

It is not only the particular contexts and the situatedness of low-carbon energy transitions and digitisation processes that necessitate (and complicate) adjustments to the pace and mode of twin transitions, but also a variety of other challenges and hindrances related to practical implementation. A focus on realising imaginaries simultaneously envisions and problematises potential futures, foregrounding the conditions and dynamics of their prospective emergence.

As digitisation is ubiquitous, it is simultaneously established and emergent, well entrenched and fluid, established within everyday infrastructures (such as electric grids) and being rolled out in so far socially unfamiliar forms (as with the household electric smart meters required to enable smart grids). Imaginaries are instrumental to and powerful in advancing particular forms of digitisation and determining the terms on which these are institutionalised in wider settings, from ownership to functionality and from the pace of diffusion to the extent of technological proliferation. Jasanoff and Kim (2015) famously discuss how socio-technical imaginaries have been constructed to advance the project of modernity, a project that deeply colours digitisation. Jasanoff (2021) argues for humility rather than the hubris that strives for human control of the earth; the latter tendency contributes to the creation of what Gabrys (2016) calls 'program earth', a world constituted by ubiquitous, hyper-connected digitised technologies.

The realisation of imaginaries, however, usually rests somewhere in between humility and hubris, with good intentions of saving planet earth through digitising energy (related) systems routinely accompanied by severe side effects. DeAngelo in Chapter "A New Reflexive Turn: Glitches, Carbon Footprints, and Streaming Videos in Visual Anthropology", shows the discrepancy between increasing possibilities in digital work and ideals of reducing energy consumptions, but also how people tackle and solve this—at least partially. DeAngelo shows how video artwork—regardless of whether the artists substantively problematise environmental and energy issues in their art—constitutes a mode of dealing with the increasing energy requirements of digital art production and consumption. Some artists and visual anthropologists confront their carbon footprint by limiting resolution and establishing a different style, which simultaneously carries the advantage of partly bridging the digital divide to widen their reach. The resultant 'glitchy' videos in this interpretation reduce energy needs related to their own existence as art that is streamed and consumed, while also benefitting those with limited access to energy and online content. The novel focus on glitchiness underscores the gap between dominant imaginaries of digitisation as a sleek new innovation and its troubled, patchy reality across geographies of socio-material difference.

Ortar and Flipo in Chapter "The Hidden Energies of Work Digitization: A View from France Through the Use of Coworking Spaces", demonstrate how newly established coworking spaces turn imagined futures of digital enablement into reality, with worrying implications for energy consumption even as coworkers imagine these third spaces to be 'sustainable' and inter alia premised on ecological concerns. Ortar and Flipo's examination of practices identifies the silences that surround certain uses of energy either in or associated with these spaces that pervert the promise of decarbonisation commonly linked with shifts to coworking. They challenge the obfuscation that accompanies pro-digital thinking and advances idealised pro-environmental representations of digital technologies. The silences, they argue, suggest the need for a deeper structural transformation of how everyday life is organised to align with logics of digitisation and decarbonisation in such coworking spaces.

The authors in *Realising imaginaries* tie in with other analyses of digital technologies and their energy impact, such as work by Maguire and Winthereik (2021) on the proliferation of data centres. Maguire and Winthereik (2021, p. 530) interpret and conceptualise these emergent digital spaces as frontiers to be negotiated and regulated, arguing that 'as Big-Tech territorialises state land and resources, the state in turn reterritorialises the promising digital futures that come with Big-Tech'. They thus point to tussles over authority and how these are currently playing out over and through artefacts of digitisation. At the urban scale, Iveson and Maalsen (2019) caution that the algorithmic modulation of populations and the disciplining of individualised subjects can magnify forms of social control by authoritative actors in digitally networked cities. Thus, digitisation is inextricably linked with the workings of power on and through the newly introduced and set up infrastructures that penetrate not only energy systems but every aspect of societal activity.

Social control and questions of governing digitally networked cities also loom large in discussions about low-carbon digitised mobility. Electric scooter proponents in Norway, as Datava et al. illustrate in Chapter "Littering the City or Freedom of Mobility? The Case of Electric Scooters", mobilise framings of a low-carbon transport footprint and align this with a particular vision of sustainable urban mobility. The

digitisation of end-users' everyday life becomes essential for booking, tracking and paying for shared devices, and risks becoming a taken-for-granted characteristic of the e-scooter business in urban Norway. This is so much so that digitisation is treated as secondary to prominently contested issues such as the shared usage of streets by multiple stake-holders entitled to public space. Again, digitisation and decarbonisation, when put into effect, display not only a 'natural' diffusion of (end-user) digitisation and allegedly eco-friendly mobility, but face contestation, with competing imaginaries of urban space and flows.

Similarly, end-user digitisation has turned into an infrastructural basis for the very means of decision-making through which people in Australia approach energy-efficient home renovation. In Chapter "Mediatised Practices: Renovating Homes with Media and ICTs in Australia", Aggeli and Mechlenborg analyse how online interactions and digital communication through information and communication technologies (ICTs) have turned into core resources for imagining, choosing, documenting and communicating about low-carbon home renovation. Social media penetrate home renovation to inflect and embed low-carbon renovation practices into households with remarkable success.

These scholarly insights underscore the contingent nature of evolving imaginaries of digitisation even as they have begun to consolidate. The impacts and consequences of installing digital systems are to a great extent determined by the intent and interests of those who transform imaginaries into reality. Through interactions and powerplay within a reconfiguring assemblage of actors and interests, these actors can arguably provide for what Pansera et al. (2019, p. 1) call 'unwise futures' that are marked by the pro-elite allocation of benefits and control through digital technologies, or for 'wise futures' where ordinary people are able to 'freely access digital technologies that are convivial, just, environmentally sustainable, and guided by democratic deliberation'.

Conclusion

In sum, the chapters in this book take on issues of decision-making and power within diverse situated manifestations of the twin transition. This cross-cutting theme has been central in digital media studies (Geismar and Knox 2021; Risam 2019) and in energy studies (Strauss et al. 2013; Boyer and Howe 2019). Digitisation and its most familiar manifestation—the internet—were accompanied by imaginaries of democratising information provision and access, yet the 'information superhighway' is today de facto shaped by a few dominant information technology companies and software developers, who apply ontologies, values and legal frameworks that originate in the Global North, with little scope to deviate from market-dominating applications and programmes (see Risam 2019; but also Anderson and Christen 2013 for an alternative). Authoritative institutions, especially in times of crisis, exercise control over digital infrastructure and connectivity. Likewise, power structures and inequalities related to energy systems routinely manifest as oligopolistic utilities and in neocolonial resource extractivism and trade systems. These perpetuate the fossil fuel-industrial nexus and produce new patterns such as the geopolitical rare-earth extractive race that enables the current rollout of energy storage (e.g. through lithium-ion batteries). Neocolonial and exploitative tendencies can become emergent, reproduced and entrenched when digitisation is combined with energy provision (Riedke in this book), traits that find resonance in geopolitics. Combining attention to digitisation and energy systems, as this book does, generates insights into such dynamics, with power imbalances and dependence on market-driven energy provision and internet companies exacerbating the marginalisation of population sub-groups and indeed entire nations.

Thus, this book demonstrates how the issues of energy efficiency and data generation we have unpacked above abound, unfold and are contested while also being inextricably intertwined with the development of future energy systems and wider societal infrastructure and practices. The grounded approaches on offer here suggest a variety of ways in which research can engage with digitisation and low-carbon transitions even as they unfold, and necessarily so in order to exercise our

agency on societal development. By highlighting two conceptual arenas related to digitisation and energy transitions, this book articulates an agenda for future ethnographic engagement with and ethnographically informed conceptualisation of digitisation and low-carbon transitions as intertwined elements of profound global environmental change.

First, the study of digitisation and low-carbon transitions must be situated within the contexts where digitisation plays out. Given its ubiquitous nature (Sareen and Haarstad 2021), this includes a non-digitisation-centric approach (Pink et al. 2015) as well as explicit acknowledgement of the interpellated nature of digitisation as a phenomenon and scholarship on this phenomenon (Douglas-Jones et al. 2021). Thus, the challenge for scholars is both to understand digitisation within the larger dynamics of its intensification at scales that range from the local to the global, as well as to engage reflexively with it through methods that are themselves conditioned by the digitisation of data, practices of subjects, and the digitised nature of academic practice.

Second, digitisation and low-carbon transitions must be understood as necessarily in the making, contingent and contested, which imbues portrayals with an inherently speculative quality. This does not mean that theories can be dismissed as competing fictions, but rather that analyses of digitisation in the energy sector in general and during low-carbon transitions in particular require explicit attention to power dynamics and the political economic undergirding of socio-technical change. Identifying and foregrounding tacit interests, multiple potential pathways and normative conundrums are all essential elements of engaged ethnography, where grappling with digitisation entails analytical unpacking as well as shaping and realising imaginaries of digitisation in the very process of sense-making.

Thus, we offer a foray into situating digitisation and realising imaginaries, with the hope of advancing engaged ethnographic scholarship on digitisation and low-carbon transitions. Digitisation is inextricably linked with the urgent societal project of low-carbon transitions in a manner that can be generatively approached and conceptualised as an emergent twin transition to a digitised and low-carbon future, a form of hyper-connected climate mitigation. Given the widespread societal

Exhibition Fig. 1 Martin Andersen works on 'Uro' at the Rjukan Solarpunk Academy (*Source* David Odell [used with permission])

implications of this shift, such change has resonance in diverse established scholarly fields, such as socio-technical transitions, media studies, geopolitics, resource governance and not least energy anthropology and energy geographies. The task of generating, cross-fertilising and consolidating conceptual frameworks is essential to ensure critically constructive interdisciplinary discussion and debate. The pressing real-world challenge of digitising energy systems constitutes an exciting opportunity for timely, generative research. Exhibition Fig. 1 follows this chapter.

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Just Low-Carbon Mobility Transitions: A Research-Based Art Exhibition

Siddharth Sareen

The biannual workshop of the Energy Anthropology Network kicked off on 22 August 2021 with the launch of a co-produced art exhibition by Rjukan Solarpunk Academy, as part of the Norwegian Just Mobility Transitions Network (JUSTMOBNET) funded by the University and College Network for Western Norway. Like this book which began with a call for abstracts circulated by the Energy Anthropology Network in late 2020, the art exhibition was many months in the making. Several JUSTMOBNET members visited Rjukan, the darkest valley in Norway surrounded by looming mountains, in early March 2021, when the sun had not yet shone onto the city that year. Except in the town hall square, where the sun mirror mounted by Martin Andersen on a mountain

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top reflected sunlight into Rjukan. Along with textile artist Margrethe Brekke, he established the Rjukan Solarpunk Academy in 2019, and this collaboration with JUSTMOBNET marked one of the institution's early projects, in line with the artists' tradition of engaging with research as a companion to artistic inspiration.

In late May 2021, Brekke and Karin Coenen visited Siddharth Sareen and the Norwegian Petroleum Museum in Stavanger, to study the proposed exhibition site and delve into the theme of the collaboration. Sareen shared insights from the Joint Programming Initiative Climate financed project 'Responsive Organising for Low Emission Societies' (ROLES), as part of which his team had been studying just urban low-carbon transitions in the rapidly digitalising transport sector in Norway. Coenen drew on her curatorial background as she and Brekke held discussions with Björn Lindberg and Anja Fremo as the museum's thematic and communication expert advisors. This was followed by Brekke interviewing other members of the ROLES team in Norway, including Devyn Remme, Håvard Haarstad and Katinka Wågsæther in Bergen, before she and Andersen set to work over the summer in Rjukan to create the exhibition.

What transpired were twin complementary exhibitions. Andersen took point of departure in an old fossil fuel car he had patched up, that finally broke down over the Haukeli mountain pass in Spring 2021. In Rjukan, he worked with hundreds of kilograms of car spare parts in tactile engagement with the salvage frontier of automobility. This manifested in a reimagining of car remnants in another setting altogether, namely on an oil rig that comprises part of the Norwegian Petroleum Museum building. A meta-comment on the tight historical link between petroleum as a commodity and the automobile as a technology, this became the exhibition 'Uro', a Norwegian play on words meaning both 'restless' and a 'mobile' object in suspended animation. With Norway being a global leader in the transition to electric cars (with the highest per capita rate), this clustered suspension of old car components invited the audience into a space for deep reflection, standing out on the oil rig

gazing out at the Ryfylke fjord with the water glittering below the mesh floor, while the spare parts clanged in the breeze.

Meanwhile, Brekke was captivated by the idea of a National Association of Bus Users, which arose from Remme's work on the ROLES project and led to the actual founding of a civil society organisation by this name (in Norwegian: Bussbrukernes Landsforening). As Brekke engaged with the solarpunk notion of a manifesto for such an organisation to advance the interests of bus users as a vulnerable group of mobility sector stakeholders, she became acutely conscious of her own conditioning. She wondered why she—herself unlikely to buy a luxury electric car—had read the biography of Elon Musk who led the electric car manufacturer Tesla, but had not even heard of the world's largest electric bus manufacturers, such as Yutong, Build Your Dreams (BYD) and Van de Leegte (VDL). This sparked a foray into the history of electric buses, including their technical specifications, iconic examples such as Bogota's bus rapid transit system, and supply to Norwegian cities. Brekke assembled these details through evocative hand-drawn visuals and scribbles on to a tapestry of old lampshade material from a shutdown factory in Rjukan, a nod to the post-industrial legacy of the setting in which this exhibition took shape, in strong resonance with Andersen's poignant portrayal of the end of an era.

These five textiles enveloped walls in various parts of the Norwegian Petroleum Museum, juxtaposed with its sleek interiors and solid industrial infrastructures, blending into the background yet simultaneously standing out as the materialisation of something different. Along with these textiles, Brekke foregrounded a propaganda-style announcement of the National Association of Bus Users, to symbolise the possibility of meaningful engagement with the challenge of transitioning to a just low-carbon mobility future.

Each of this book's nine chapters is followed by an image drawn from this exhibition by the Rjukan Solarpunk Academy. The first four images feature the process and details of Martin Andersen creating Uro, and
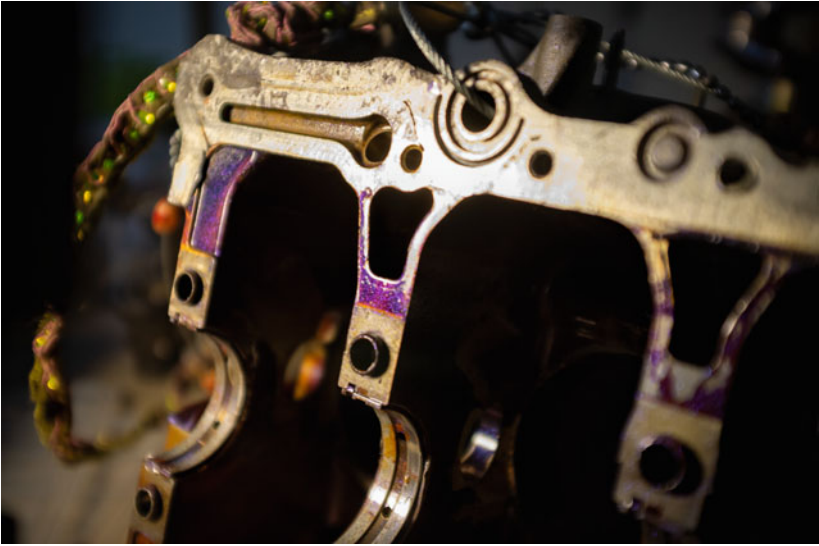
Exhibition Fig. 2   Detail of a car spare part that became a component of 'Uro' (*Source* David Odell [used with permission])

capture a sense of its assembled version on the oil rig in Stavanger. The next three images begin with the assembling of research-based details about bus users at Rjukan Solarpunk Academy, followed by technical details of electric bus types, and an emphasis on the meaning of 'omnibus' as 'for all', accompanied by scribbled principles for a solarpunk manifesto of the National Association for Bus Users. The final two images comprise overview shots of some of the textiles Margrethe Brekke placed within the Norwegian Petroleum Museum, draping its walls with varied colours to enable the condensation of ideas about things to come. Future imaginaries, salvage frontiers and energy systems in transformation are concerns shared by the Rjukan Solarpunk Academy and the chapters in this book, hence these aesthetic and analytical interventions feature complementary interplay. Exhibition Fig. 2 follows this chapter.

Situating Digitisation

A Solar Off-Grid Software: The Making of Infrastructures, Markets and Consumers 'Beyond Energy'

Eva Riedke

'I sometimes have the feeling that they sell them the plasma television, the radio, the fridge, the mobile phone, before they sell them the solar unit that provides the electricity for these things' (Sandra Rundall, 10 January 2021). This was the critical, perhaps even cynical, view of an international investment advisor based in Nairobi, on the developments in the solar off-grid sector in Kenya. With *they* 'who sell' she is referring to solar off-grid companies and start-ups and with *them* 'who buy' she means the so-called 'unelectrified poor' who live with no or only partial connection to the electricity grid in Kenya.[1]

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[1] In order to protect the anonymity of my interlocutors, I have changed their individual names and also the name of the solar start-up that this article focuses on.

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Kenya has one of the largest markets for solar off-grid products in Africa, due in part to a favourable regulatory environment, effective government policies, and the high prevalence of smartphones that has gradually made Kenya into a favourite launchpad for mobile money-based services, including widespread availability of pay-as-you-go solutions, which offer an effective means for people to finance the purchase of solar products. Nairobi, frequently also referred to as the 'silicon savannah', has become a hotspot for digital innovation with a lively start-up scene. Here, under the auspices of the United Nation's (UN's) sustainable development goals (SDGs), national and international start-ups, investors, government agencies and NGOs engaged in the solar industry, are in the business to sell devices that are light, inexpensive, portable and minimal (Collier et al. 2018) for what has internationally been agreed upon as a minimum level of 'affordable, reliable, sustainable, and modern energy for all' (SDG 7). While grid coverage in Kenya at first sight appears relatively high in comparison to other sub-Saharan countries, reaching roughly 54% of the country's population, the gap between electricity access among urban and rural households is wide and less than 20% of the rural population has access to the electricity grid. Furthermore, among those who are counted as having access to the electricity grid, many factually continue to live 'under the grid', unable to afford the high price for initial connection to the cables that run above them, or out of fear for volatile prices and unforeseeable blackouts. For this reason, the so-called solar home systems continue to be an iconic object of off-grid electrification efforts, all across Kenya (Dubey et al. 2020, p. 15).

Solar home systems come in different sizes, but typically they consist of a solar panel that charges an external battery and which, in turn, powers one or two lights and can charge one or more mobile phones each day. The box with the external battery also incorporates a control box through which the providers can track payments and in many cases also usage. These solar systems have become iconic 'bottom of the pyramid technologies' or so-called 'small development devices', that present themselves as *caring* commodities, able to meet people's basic energy needs (Collier et al. 2018; Cross 2017). They further embrace a minimalist design 'that emphasizes self-sufficiency of device and user' and are not

embedded in wider attempts to engineer a complex system (Collier et al. 2018. p. 4). These solar products are marketed as renewable energy sources that serve to alleviate poverty at the same time as enabling countries' fast-paced energy transitions to less carbon-intensive futures. To borrow from Lautrup (chapter in this book), they are hereby marketed so as to make a notion as 'abstract' as climate change more 'concrete', and in turn users' participation towards its amelioration more 'do-able'.

As I will illustrate in more detail below, hereby also elaborating on Cross' (2013, 2017, 2019, 2020, 2021)[2] works, the solar home systems are made into 'goods' in a double sense of the term: designers design them to do well (financially) while doing good. They are 'goods' that primarily target populations understood to be 'infrastructurally marginalized', lacking connection to the electricity grid and living in energy poverty. But beyond these ethical commitments, they are also 'goods' inscribed with clear economic, for-profit motives (Collier et al. 2018; Cross 2019; Redfield 2012). The sceptical commentary by the investment advisor quoted above, wherein she suggests that solar off-grid products are sold merely so as to define new consumer subjects for new markets—reconfiguring 'their wants, needs and desires'—appears to suggest, as Cross (2020, p. 111) puts it, that the design and selling of these products could legitimately be understood as a form of 'predatory capitalism at a new humanitarian frontier'. Yet, as Cross (ibid.) further highlights, 'market *capture* can also be the extension of forms of *care*' (emphasis added). I follow him in this article in reflecting on the *practices* of solar entrepreneurs and their aims 'to do good', exploring how one in turn becomes witness not necessarily to 'contradictory logics' but rather to 'mutually enabling practices' (ibid, drawing on Ferguson 2015, p. 148).

In this article, I will engage with a small, German-Kenyan start-up that I have called 'Mkali Power' (mkali = bright in Swahili), that with the

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[2] Jamie Cross has written extensively about solar lamps as so-called 'small development devices' or 'humanitarian goods'. With the rapid development and growth of the solar market in recent years, I would argue that 'solar home systems'—which entail a lamp but also more—have worked to replace the lamp as a first-purchase commodity for many who live off the grid. Particularly for they have become more affordable.

onset of the pandemic engaged in a strategic shift.[3] It moved away from the ongoing design, manufacture and distribution of its own solar off-grid products and towards software development, more specifically, the development of a sales management app. Initially, Mkali Power sought to use the software to manage its own sales in a post-COVID era, but then soon saw in it the potential to be marketed and sold as a stand-alone software tool to other stakeholders in the industry.[4] The conversations on which much of this article draws, took place when Mkali Power was at a point of putting the final programming touches on a beta version of the app.[5] They enabled my insights into the workings of the app, by allowing me to set up my own virtual sales network. I installed the beta version from the google play store, set up my own company, 'employed' a regional manager, 'hired' a local sales force and finally added individual customer profiles. I received dummy QR codes—akin to those attached to the real-life solar products—which I could scan and hereby sell to the customer base I had established. In this beta version, the products included a radio, a smartphone and a solar home system. The result was a somewhat digital fieldwork peculiarity, namely the ethnographic navigation of an app for which Cousineau et al. (2019) have proposed the term 'appnography'. Methodologically, by drawing on digital ethnography (Pink et al. 2015) more generally, appnography offers a means to analyse app development and discourses that develop around its usage, but also, as is my primary aim in this chapter, prompts one to scrutinize interface systems, features and affordances.

In what follows, I engage with the development of this software, show how the different elements of the software connect as well as the manner in which these have been developed 'to sit alongside of,

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[3] I have engaged with Mkali Power in the context of a DFG-funded research project concerned with ethnographically exploring 'Life off the grid: the study of solar infrastructure and ethical subjects' in rural Kenya. The project critically explores the nexus that is emerging between different efforts, pursued by a new generation of 'development designers', to connect the so-called 'off grid populations' to established grids (in an infrastructural, financial and economic sense).

[4] This is entangled in more general efforts of humanitarian actors during the pandemic to explore the promises and pitfalls of 'big data' in humanitarian aid (Gazi & Gazis 2020).

[5] Research for this article was conducted between October 2020 and April 2021. In addition, I draw on older, preliminary research conducted with a solar start-up in Berlin between January and August 2018.

on top of and interwoven with layers upon layers of the old' (Maurer 2015, p. 126). Hereby, the aim is to attend to the current challenge of needing to explore empirically—as also elaborated upon in the introduction of this volume—how renewable energy infrastructures fold in and upon other infrastructures. In this case, this encompasses the physical system for generating electricity off the grid, the wider mobile money payment services and a rapidly emerging financial infrastructure for consumer financing and debt (see also Cross & Neumark 2021). First, I ask: how does this new software in the making—a development that often appears to happen 'backstage'—come to constitute one of those 'initial moments/phases of structuration where new paths of extraction, circulation and consumption are charted […]' (Degani et al. 2020, p. 4)?

Second, my goal is to explore some of the ends pursued by solar entrepreneurs when they set off to market solar home systems to the so-called 'unelectrified poor' and how these often go 'beyond energy'. Solar entrepreneurs view their 'target populations' as belonging to the 'base of the pyramid', to whom solar power is provided in order to meet a basic need, a most basic level of human well-being, and simultaneously they see them as consumer subjects for new markets which hold the promise of profit and accumulation. Exploring the manner in which they are imaginatively conceived by developers, designers, engineers and solar entrepreneurs, draws attention to a central 'node' of the solar off-grid sector, where a *continuous tinkering* becomes necessary so as to make it hold together, work and expand (see also Korsby 2017).

Third, my aim is to explore through my engagement with the sales app, how the enrolment of solar customers into digital systems—which is often experienced and presented as a rather benign process—is also accompanied by a series of 'classification situations' (Fourcade & Healy 2013; Fourcade & Kluttz 2020, p. 1).[6] Individuals before being sold

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[6] The enrolment in digital systems is, similarly to the development of digital solutions more generally, marked by an astounding techno-optimism that frames these as part and parcel of innovative environmental solutions, increased economic efficiency and a means to deliver on the promise of progress and modernity and as ultimately furthering energy independence (see also Quitzow & Rohde 2021). The former, however, often draws attention away from wider, more invisible 'processes' of planned and non-planned change and the manner in which the enrolment in digital systems also creates a particularly fertile space of experiments (on pay-go and the solar industry see also Kocieniewski & Finch 2022).

solar home systems are evaluated for their 'creditworthiness'—being sorted and slotted into actuarial categories, predicting the probability that they will be able to repay the loan. When paying off the solar product, transaction data generated through payments and usage data transmitted by the device in itself becomes a 'tradable object' (Fourcade & Healy 2017, p. 11). The latter is data that will allow solar entrepreneurs, so they hope, to establish markets beyond solar and to, in the future, disburse the 'right' quantity of credit, for the 'right' customers. Further, this data and the classification that is derived from them, will determine the ability of solar users to purchase other consumer products on loan (Fourcade & Healy 2013; Mader 2016).

The Promise of Solar

'Solar energy is a promise', Szeman and Barney (2021, p. 1) write. It has become a means of 'doing one's share' against global warming, has come to enharbour public sentiments of progress, has come to provoke a sense of modernity, and it instantiates a sense of coming closer to a prosperous, healthy and just life (see also Amin 2014; Appel 2019; Boyer 2015; Harvey & Knox 2013; High & Smith 2019). Hereby, 'solar energy is also emerging as one of the sharpest and most powerful of ideologies, blurring concept, fantasy, and infrastructure together in a manner that makes it difficult to disentangle solar fiction from solar reality' (Szeman & Barney 2021, p. 1–2). Put differently, the story to be told about solar home systems, is also a story about an ever further evolving imagination (Cross 2017, p. 38).

What happens when solar home systems are marketed by local sales agents to those who live off the grid in rural Kenya? While the products are designed in Germany as 'green energy' solutions, with the promise to enable countries of the Global South to 'leapfrog'[7] straight to cleaner energy sources, solar entrepreneurs frequently suggest, that this 'green'

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[7] The notion of 'leapfrogging' is concerned with enabling certain populations to bypass intermediate stages of technology through which other countries, particularly those belonging to the Global North, have historically passed (Amankwah-Amoah 2014; McKibben 2017).

dimension hardly comes to play a role for the end-users. As I am told by Bernd, the CEO of the Berlin-based start-up, 'the "greenness" is almost completely washed off by the time the products reach and are marketed to off-grid populations'. Lutz, one of the three developers behind Mkali's software, has a similar view. Reflecting on his ten years of experience in the industry, he rhetorically asks himself 'Is sustainability or the green energy aspect important to them (solar off-grid costumers)?' Answering his own question, he responds: 'I've been in the field for many years now […] and I think people simply have other problems. It's about *social status* on the one hand, when one can say, "I have a solar system". And on the other hand, it's about *easy access*'. As Lutz underlines further, when solar local sales agents sell the systems, they sell these primarily as a 'cleaner', 'safer' and (in the long run) 'cheaper' alternative to kerosene lamps.

Further, solar energy is marketed as a means of meeting a set of basic needs and as having become (particularly through the SDGs) an internationally recognized benchmark for the most basic level human well-being. As Cross (2017, p. 37) highlights: 'a life without light' is presented 'as a cause of suffering, equivalent to that endured by people without shelter, food, water, or basic primary health care'. A power point presentation for local sales agents in Nairobi in 2017 highlights yet again another promise. Solar, so it reads, offers those 'under-served' a 'connection'. By being able to power radios and televisions, 'a window into the wider world' is opened up (see also Zollmann et al. 2017, p. 9). In the process of marketing and selling off-grid products on the ground, the image evoked of those who live off the grid resembles the imaginaries that also stand behind other 'small development devices'—namely, these are devices produced to respond to basic human needs, they are 'minimal technologies for living' but are also ascribed the inherent (more general, utopian) ability to *transform* lives.

Buying Through Pay-As-You-Go

In the process of selling a solar home system to a customer, a local sales agent will next move from outlining how solar has the potential to change people's lives to explaining the payment scheme. Because customers can only in very rare cases afford the purchase of a solar home system through upfront payment in a single instalment, 'pay-as-you-go' has developed as the most promising means for solar companies and start-ups to enable widespread affordability of their products. The systems, which cost around 120–170 euros for the most common configurations are hereby sold to users against a small upfront payment, followed by regular, incremental 'top-ups' usually paid through low-cost mobile money services.[8] Most contracts run for one to three years in a rent-to-own model. Start-ups require asset-backed debt vehicles to be able to roll out their products in this manner. However, they hereby face the challenge of raising debt and serving customers who lack a formal credit history (Bloomberg NEF 2016).

To address this, solar off-grid start-ups have developed their own credit assessment methodologies. Local sales agents, when meeting with a new, potential customer for the first time, are equipped with a digital questionnaire accessed through the aforementioned software app on their phone. They use this questionnaire not only to gather the basic demographic data about the household, what energy sources are being used so far and for what purposes, but also regarding the formal/informal employment status (if any), monthly income (if any), how much money is on average spent per week and whether the household owns livestock, land or any other physical assets. These are criteria used to establish customers' 'credit worthiness' and build on the more established and recognized practices of microfinance.[9] It is another materialization of

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[8] Solar home systems of a medium size, supplying between 11–20 W peak (Wp) cost on average around 120 USD. Systems supplying up to 49Wp cost between 150–200 USD, Larger systems—from 50Wp upwards and which often include a television—can easily cost 400 USD.

[9] Assessments by local sales agents vary from company to company: some businesses rely on agents' local knowledge, others rely primarily on the automated decisions produced by standardized questionnaires, and a few companies are exploring partnerships with alternative data companies to analyse call data records, mobile money top-ups, and mobile money transactions in an effort to predict repayment (Baer et al. 2013).

what Schwittay (2011) has termed the 'financial inclusion assemblage'—
an assemblage of a diverse set of subjects, technics and rationalities
that come together in a movement across time, space and contexts and
'premised on the assumption that the 2.7 billion poor people in the world
who do not currently have access to formal financial services are in need
of such services' (ibid, p. 383; Waldron & Faz De Los Santos 2016).

The questionnaire picks up on the customer's income but also a range
of other money objects (from cash to cattle, to land, to airtime) and
forms part of a process by which solar start-ups leverage the assets of
those with extremely limited purchasing power. This is the first bundle
of data that finds its way into the app.

What characterizes the pay-as-you-go model that is subsequently
offered, on the basis of this assessment of the creditworthiness, is that
it is a form of 'nano financing'. A product or service is made afford-
able through small, daily sums of money, in cases where traditional
financing and even microfinancing is too expensive or difficult to imple-
ment. Customers can make payments as small as 50 cents from their
mobile phone when they have the cash to do so (Alderman 2019). As
will become clearer below, company executives envision that the solar
off-grid sector will, on this basis, be able to expand rapidly in the next
few years, providing the infrastructure to market appliances such as tele-
visions, fans, mobile phones, water tanks, refrigerators, but also to sell
essential medications—including contraceptives, tuberculosis treatment
or malaria—that in many cases don't make the household budget cut
(ibid.). Solar home systems, so they envision, become the first consumer
product in an imagined chain of many more. The initial data collected
to establish creditworthiness is with time made to connect with 'born
digital' data that is directly created through users' payments (and product
use). Through ever new compositions of data, comes the capacity to sort
and slot people anew, firstly resulting in a form of fragile 'capital' for solar
customers, who now for the first time have a credit history that deems
them creditworthy for future loans. Secondly, a 'commodity' of personal
data develops for solar companies and start-ups, used to acquire more

investments, to fine-tune services and, in the future, also to 'discrimi-nate more easily between worthier and less worthy clients'[10] (Fourcade & Healy 2013; Fourcade & Kluttz 2020; Mader 2016, p. 75).

Paying in Instalments

Once creditworthiness is established and an account is created in the app for this new customer, what is the software used for? As suggested above, the solar home systems are all equipped with a control box and a SIM card that work to transmit payment and usage data.

The solar home system is 'unlocked' for the customer as soon as the initial instalment has been paid. Through an automated software mech-anism, the seller however retains the ability to turn the device on or off from afar when credit runs out, or payments are missed. This is referred to as the so-called 'lockout mechanism'. Customers either prepay in fixed rates, or purchase daily energy credits for a small, fixed fee. Where these are missed, the device is turned off, reminding them to make another payment. Here, as Chad Larson, the finance director of M-KOPA (a leading solar off-grid provider in Kenya), put it in an interview published online, the mechanism serves the function of a 'loan agent'. 'Our loan officer is that SIM card in the device that can shut it off remotely'. 'We know that it's important for them to keep their lights on at night, so they can be counted on to keep paying' (Faris 2015). Those at Mkali Power, in contrast, worked to somewhat de-politicize the *agency* that lay in this mechanism, in particular its function as a payment reminder. As Lutz, one of Mkali Power's co-founders emphasized: 'we (at Mkali Power) talk of the "juke box" mechanism. It's similar to a juke box, in which you throw a coin, then it plays music for thirty minutes and then it switches off again'. With the analogy to the music playing juke box, the social and material politics of the mechanism are effectively moved a bit more out of view.

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[10] Solar entrepreneurs are all, in one way or another, in the data collection business, but often emphasize that they do not yet know what to do with it (see also Fourcade & Healy 2017, p. 16 on a similar observation).

Regarding the 'lockout mechanism', I asked Lutz how customers responded to this mechanism, when a sales agent would explain that the device can be turned off from afar in cases of non-payment. I added that on the one hand, solar was being marketed as providing a 'window to the wider world', 'a form of connection'. In turn, how was the ease with which users could similarly be remotely *disconnected* experienced by off-grid customers? Lutz responded: 'You know the only place where the fact that we can turn things off is considered a problem, is *here*' (in Germany, emphasis added). 'For those who buy these products it isn't'. He adds: 'A while ago I gave a presentation about this technology, and a few people came up to me after I had finished and confronted me with the question, "How can you do this?"' Lutz, thinking back to this disgruntlement that his presentation had sparked, goes on to emphasize what appears to him to be a related point. Namely, the problematization of why 'profit' and 'care' should not be able to go hand in hand. The product sold is sold to unelectrified, poor income consumers with a humanitarian ethos—aiming to improve living conditions and standards. At the same time, it is not a 'gift' or a charitable donation. The constitutive logics of the development aid paradigm that have factually receded at the same time persist, so he suggests, and are rendered visible again and again in moments such as this one. Lutz goes on to emphasize that in such situations, they (solar off-grid start-ups) are not recognized as 'a new kind of actor'. 'It is not like we have somehow gone back to classical development aid. We sell products and for these products one naturally has to pay, and people *want* to pay, because in a sense they (the products) thereby acquire a different worth'. The 'different worth' that Lutz highlights, can (among other dimensions) be linked to the data that the purchase of the solar products produces—feeding into (potentially valuable) future classifications of being 'creditworthy'.

Let me in brief also return to another point that Lutz made regarding the 'lockout mechanism', namely that users do not generally ascribe to it a discriminatory tenor. Reports published by consulting and advisory firms, similar to accounts by economic and energy specialists who design the products, suggest that this mechanism is designed to reconstitute users as 'disciplined autonomous agents' (see GOGLA 2020; Waldron & Faz De Los Santos 2016; Zollmann et al. 2017). Depending on the

pay-as-you-go model adopted, most companies will allow for a certain period of non-payment and inactivity vis their software *before* the device is repossessed (typically around 90 days). This, in turn, provides a form of valuable flexibility, so designers suggest. Solar can then be made to fit into users' budgets and can be used to spend some days in the dark when money is needed for other things (Zollmann et al. 2017, p. 19). Electricity is made available for those who on a daily basis work to stretch a limited, uncertain income to cover more goods and services than is factually possible. In this sense, in a manner that legitimizes the lockout mechanism, designers stress 'provisionality' as a prevalent reality for these populations (Myers 2011; Simone 2004), while simultaneously working as a reification of autonomy and self-management.

Baptista (2016), who explores the multiple rationalities implicated in the use of the electricity infrastructure via prepayment in the *bairros* of Maputo, suggests that what is analytically significant for understanding such disgruntlements as Lutz has experienced, is that prepayment effectively *inverts* the order between *consumption* and *paymen*t for a utility. It thereby challenges a default strategy of the 'modern infrastructural ideal', within which there has been little room for technical differentiation of utility provision in colonial and postcolonial contexts. If we follow Baptista along these lines, then it is through an emphasis on the realities of everyday estimation and calculation that energy researchers, humanitarian practitioners and entrepreneurs work towards deconstructing this ideal—an ideal 'that has for long served to order, control and discipline populations, both discursively and materially' (Baptista 2016, p. 1008). They render the lived realities of the unelectrified poor visible and legible in a new light, legitimate the inversion of consumption and payment and thereby establish ideals of 'autonomy' or 'control' as they relate to spending and consumption.

Creating a Record of Usage and Payment Data

Back again to the software and the local sales agents. Once a local sales agent has successfully sold solar home systems to a significant number

of households, how does he/she continue to make use of the software? Clicking through the app, a local sales agent is given an overview of his/her customer base in the region, can see how the products are being used, visualize sales progress with graphics and charts, detect current late payments but also anticipate late payments and motivate customers to pay on time. Further, the sales agent can pull out sales and revenue metrics by date, region, product and payment type. For the executives of Mkali Power who sit in Nairobi or in Germany, the insights are similar, with merely a few more levels being added. These include visualizations of local, regional and countrywide sales performances, and the option to drill down to a detailed observation of an individual customer's behaviour, and his/her payment and usage data. The connection of solar home systems through Machine-to-Machine (M2M) modules, cloud computing and data analytics techniques is not only what enables them to be remotely locked/unlocked, but also draws attention to faulty products or theft. Further, it allows energy activities to be monitored in real time, for example regarding battery charging and power consumption—from afar and for each individual household.

Much of the value of the software rests on so-called application programming interfaces (APIs) established to connect to existing mobile money infrastructures, including in Kenya's case, Safaricom's M-Pesa, which is the most widely used mobile money platform.[11] Every payment a customer makes via mobile money is managed and thus automatically registered in the app, including the amount and date of payment. With time, a payment history emerges, which, as software designers suggest,

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[11] Kenya has witnessed a somewhat unique development of mobile money loans. Soon after M-Pesa was introduced in 2007, a conflict emerged between Kenya's formal banks and Safaricom, the monopoly telecommunications firm that stands behind M-Pesa. From the beginning, this was, as Breckenridge (2019, p. 93) highlights, a conflict between different types of credit market: 'On the one hand, the banks […] were looking to build credit reporting systems and new government registration arrangements that would allow individuals and firms to formalize non-fixed assets, like vehicles and livestock'. The banks however were opposed by Safaricom and eventually also the Kenyan state, 'who championed a simple and effective system for delivering unsecured, high-interest microloans that did not require collateral registers' (ibid., p. 94)—establishing algorithmic credit scores for instance on airtime purchases and mobile money transactions. Over the years, it was a rift between the banks and Safaricom that has opened up an experimental space also for mobile money loans.

can be used at a later stage to calculate the overall purchasing power of each customer (a point I shall return to below).

All payments made by a customer for a solar product through M-Pesa or another mobile money platform are recorded and become accessible through the app. As Bernd, the CEO from a solar start-up in Berlin, explains: 'We gain certain insights from the transactional behaviour, and with the formal financial history that is established—which the unbanked so far have never had—they can then access loans and other credit products'. He added: 'There is much energy going towards these issues of developing algorithms and data analysis that can define customer's ability to also repay in the future'. On the one hand, the vision is to enable customers to climb the energy ladder and take out loans for larger systems and appliances. In addition, through economic techniques and narratives about 'boosting' peoples' purchasing power, the *payment space* that is created in itself works towards formatting new consumer markets (Elyachar 2010; Cross 2020, p. 119; Maurer 2012, p. 590). The digital payment data are a by-product of the relationship between the technology and the solar start-ups, but also further fuel for them (Mann 2018, p. 2).

Forging Consumers by Digitizing the 'Unelectrified'

How does the image of the unelectrified poor alter when the aim of solar off-grid industry is expanded beyond the initial focus on electricity to wider interests in the development of infrastructure, the establishment of new markets and the production of 'proper market actors' (see also Meagher 2016)? Maurer (2012, p. 598) suggests that through the *provision* and *extension* of mobile money services, the client is progressively treated as a 'firm, a profit seeking and profit-making enterprise, who is weighing the costs and benefits of adding a new piece of machinery to its operation'. 'The poor' are formatted, so he suggests, as 'millions of tiny capitalist firms', underscoring their entrepreneurial capacity supposedly unleashed by their access to mobile money, credit histories and pay-as-you-go loans. Probing in conversations with those who work at Mkali

Power as to what defines the solar off-grid customer in their eyes, Lutz paints the following picture:

> Well, if I were to describe our end-user, it would be along the following lines: hard working, someone who works, and someone who is euphoric. 'Euphoric' because, in a sense, his environment is currently in the process of changing completely. There are things approaching that you never even imagined before [...]. So, you find it exciting, and you want more, you want to grow. (PAUSE) Well, I wasn't alive then and didn't experience the Second World War, but the way I imagine the post-war phase to have been, is similar. He feels that 'change is imminent, and I want to be part of it'. 'I want change, yes'. [...] 'I want to wake up', so to speak. (PAUSE) And yes, always hard working, earns money, and takes care of every business, just every business. [...] Hardworking and yes, lives in such a euphoric phase of life where everything is changing, and this person wants to participate.

This is a heuristic image of the sort that we can picture the team behind Mkali Power engaging with, discussing and disagreeing over, and is, akin to the narratives that Maurer (2012, p. 595) discusses, not 'descriptive of a "real" story being told by any particular individual'. The 'unelectrified poor', so this image suggests, similar to the ideals of 'bottom billion capitalism'[12] more generally, are able to 'better their lives for themselves by relying on their own entrepreneurial skills' (Schwittay 2011, p. 75).

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[12] Theories about global poverty alleviation at the 'base' or 'bottom' of the pyramid (BoP) are so complex in their history that a more detailed discussion would go beyond the scope of this paper. Schwittay (2011) provides a comprehensive contextualization, exploring in particular how road maps for how to capitalize on the fortune at the bottom of the pyramid have been guided by C. K. Prahalad's seminal work (2009) on how corporations can eradicate poverty through profit. Popularized through his writings was the idea that 'As an aggregated mass, these billions represent a huge market potential for transnational corporations (TNCs), which by going after this "fortune at the bottom of the pyramid" will also eradicate world poverty' (ibid.: 71).

Concluding Remarks: Off-Grid Solar and Its Digital Record

My aim in this article has been to explore how in the process by which solar entrepreneurs work to define the place for themselves within this newest instantiation of philanthropy, development and capitalism, the notion of the unelectrified poor becomes a central 'node' that requires constant tweaking and tinkering. The 'humanitarian-corporate complex', as others (see Johnson 2011) refer to it, is a manifestation of the 'afterlives of development' (Rudnyckyj & Schwittay 2014), and is in itself always evolving, constantly bringing forth novel conceptualizations of the 'poverty problem'. The understandings of the unelectrified poor takes on different forms, as I have shown here, depending on what basic access to electricity is perceived to enable—at times most strongly tied to the marketization of a 'minimal' technology for living (Redfield 2012), at other times, foregrounding its centrality in 'public sentiments of progress, modernity and wellbeing' (Amin 2014, p. 138), then again as privileging people's evasion and autonomy from the grid and thereby also from the state (Jansen 2014), and finally also as a stepping stone to enable the transformational power of entrepreneurship (Schwittay 2011). Significant is that distinct images of the user, the customer and modern, desiring consumer are made to coexist in one and the same software.

With the marketing of solar off-grid products, also comes the 'enticement and enrolment into digital systems' (Fourcade & Kluttz 2020, p. 1). The tracking of payments, as well as the tracking of usage data, results in 'classification situations' (Fourcade & Healy 2013) that permit the creation of data that is a commodity in its own right—a commodity through which solar entrepreneurs seek to bring about 'subsequent exchanges in the market' (Elder-Vass 2016, p. 176). Inscribed in the notion of the solar good in a double sense—as a consumer *good* to be sold, and the *good* as an expression of care for distant others (Cross 2019)—is thereby also a form of obligatory 'reciprocity', central to different forms of digital capitalism more generally (Fourcade & Kluttz 2020; see also Datava's exploration (in this book) of how digitization is often treated as secondary to more prominently contested issues in renewable energy transitions).

The establishment of 'creditworthiness' and the vision to, in future, make available consumer credit for the 'unelectrified poor' that goes 'beyond energy' is—akin to the very marketing of solar off-grid products—draped in a veil of neutrality regarding the uses to which it is put. Access to both are framed as paradigmatic of 'chances at a (modern, consumerist) life that gets associated with the aspirational normativity' (Allison 2013, p. 223) that the 'unelectrified poor' have felt excluded from. Solar home systems become an instrument to, in the future, purchase new things on credit that one can also pay for over time.

Solar entrepreneurs who design and market solar home systems for so-called 'off-grid populations' underline that solar is just the beginning, and that other modern energy appliances, including televisions, fridges and mobile phones can soon follow. The 'lockout' mechanisms in all these devices, will allow them to be switched off from afar, as soon as top-ups can no longer be made. As Cross (2017, p. 42) suggests, for the off-grid industry, 'access to the market' and 'access to light' are working to be established as equivalent human needs. Conceptualizations of who those are that live beyond the grid and what constitutes the 'basic requirements for their dignified living', are precisely the 'nodes' along which solar executives, entrepreneurs and software designers work to establish this equivalency in any successful form. The points at which actors engage in definitions and re-definitions, as one of many forms of delicate tinkering, are points at which the layering of infrastructures becomes visible, and which also make clear where new relations are generated. These are points of structuration where 'new paths of extraction, circulation and consumption are charted' (Degani et al. 2020, p. 2). In the most literal sense of the term, 'working' with different images of the 'unelectrified poor', are practices infrastructur*ing* (explicitly understood as a verb rather than a noun)— through which also software designers work to mould, connect and expand the infrastructure of which the software is a part. Exhibition Fig. 3 follows this chapter.

Exhibition Fig. 3 Detail view of 'Uro' installed at the Norwegian Petroleum Museum (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

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Contested Energy Futures in Hokkaido: Speculating with European Renewable Energy Models

Emile St-Pierre

Introduction

During my first period of preparatory fieldwork in summer 2018, I reached out to a renewable energy promotion agency (abbreviated here as REOH) based in Sapporo, the largest city on the Japanese island of Hokkaido, to get a better understanding of the issues of their organisation and their clients and members, many of whom were municipalities and companies in Hokkaido. REOH had its offices in one of the tallest buildings in the city. I was greeted by Miyata, a junior member of the organisation in a conference room outside the main office space. I believed them to be in their early 30s. They laid out documents outlining some of their past projects and outputs of the organisation, speaking in a cordial but rehearsed way. Incidentally, we had both done graduate research in the same former coal-producing area of central Hokkaido.

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Our interview began with some very basic questions on REOH. The agency's main functions were as a go-between, networker and needs-matcher, standing at the intersection of national and prefectural policymakers, municipalities, energy producers and financiers among others, hosting seminars and distributing information to members. The agency hosted frequent events allowing guests, particularly from Germany and Denmark, to speak about the successes of renewable energy development projects. In its mission statement, dated May 2012 and signed by 50 municipalities, it makes direct reference to the need to fundamentally overhaul the country's energy policy and develop renewable energy resources, pledging to offer support in problem-solving and gathering information and know-how (REOH 2021). The discussion turned to some of the ways Hokkaido could achieve greater independence in its energy development, with Miyata mentioning microgrids, Home Energy Management Systems (HEMS) and Virtual Power Plants (VPPs) as avenues of interest. Having a general idea of what these were, but wanting to know a bit more about how Miyata saw these projects, I asked: 'Could you tell me, what is a virtual power plant?'.

Miyata, who had so far provided thorough answers, seemed embarrassed to have not prepared a reply to this question. I attempted to reassure them, saying I'm not looking for a definition, and that an answer of their own understanding would be most interesting to me. But already Miyata's reaction had told me something important: virtual power plants were not the order of the day, despite the emphasis by this promotion agency on drawing from European models. Their answer, while matching my understanding of it as a digital, decentralised supply–demand management system, also lacked examples of where this had been applied or policies to facilitate its implementation. Throughout my fieldwork, I would repeatedly encounter discussions of microgrids and increasing Hokkaido's energy independence, but there was generally very little discussion of the potential of VPPs or digital technologies outside of mentions of using Internet of Things (IoT) technologies in conceptual presentations by policy actors.

A few months later, in early September 2018, a devastating earthquake would hit south-central Hokkaido, causing damage to the largest coal power plant on the island, which in turn caused an imbalance of supply

and demand and a subsequent day-long blackout as a result of the automatic shutdown of the grid. On that cloudless day, I got on my bicycle and I followed the old path of the train lines that used to carry coal from Yubari in the centre of the island down to the ports and thermal power plants in the south-central area of Hokkaido around Tomakomai. I saw convenience stores getting rid of their inventory and long lines of cars waiting at petrol stations, as well as massive solar power plants standing useless due to the protocols for restarting electricity flow first from base load carriers like hydropower then thermal, and only later solar. I visited the site of the coal-fired power plant that was the cause of the blackout, but it was not open to the media, let alone stray anthropologists. Most harrowing was the grim refrain carried by many I spoke to that day: 'good thing this did not happen in winter…' Compounding conditions of precarity have made the future uncertain and open to contestation (Allison 2014).

The vulnerabilities made obvious by the Fukushima disaster of 2011, which had somewhat slunk into the background in the years since then, were suddenly foregrounded in this other seismic infrastructural inversion (Bowker 1994). While the 2018 earthquake continues to resonate in Hokkaido's energy transition, practical advances in digitalisation, VPP, IoT and Artificial Intelligence (AI) remain largely excluded from these discussions, and from the daily practices of many renewable energy advocates and producers. This feeds into a broader and older discourse, in which Japan is seen as constantly lagging behind trajectories set by other wealthy, colonising powers. Within Japan, the former colonial frontier of Hokkaido is among the least developed prefectures (Mason 2012). National policies hitherto focused on promoting high-tech solutions that favour Japanese industries and on increasing the energy mix and strengthening the connections of the grid. They have more recently tried to incorporate the concerns of those who are more concerned with solar extractivism, heat use and local independence. However, as I will explore in this chapter, the divergence between these different energy futures and prioritisation of digital technologies remains materially unresolved in a way that provides a corollary to digitisation enabling sustainability as a matter of course, a point that also figures in other spheres of digitisation (see for example DeAngelo in this book).

Currently, we are living through a diverging expansion of digitalisation in the midst of the COVID-19 pandemic. Several fascinating and concurrent trends are emerging from this accelerated change. Energy-hungry cryptocurrencies have become all the rage (again), as has talk of their environmental impacts and the impacts of digitalisation more broadly (Lange et al. 2020). While demand for fuels for travel has in many places experienced a substantial downturn, the decoupling effect of emissions relative to economic activity from the shift to telework and dearth of travel has not materialised. Indeed, it has barely put a dent in global emissions, emphasising how little impact lifestyle changes have on the overall trend (Tollefson 2021). For all that internet and digital technologies can do to decentralise access and power (see also the introduction of this book), the underlying inequalities are so massive that they are unlikely to effect a reversal on their own, however small.

In light of these multiple effects of digitisation, the cultural evolutionist argument that Japan is simply lagging behind in digitising its society is not the focus here, although it is difficult to avoid mentioning this line of thinking as the government itself aims for a *Society 5.0* (modelled after the European model of Industry 4.0) (Cabinet Office 2021) that increasingly blends the virtual and physical (Abram et al. 2019). The contrast in developments on energy and digital technology between Europe and Japan remains interesting to consider more laterally, allowing Hokkaido's particular renewable energy projects to speak back not only to European examples but also to the Japanese government's relationship to them and to European expertise.[1] Whereas in many parts of Europe, smart technologies already play a significant role in a much more interconnected electricity grid, the material conditions of the Japanese electricity grid, especially in insular Hokkaido, have created diverging responses to the European models that promote local energy independence.

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[1] There is of course no one European model or experience of renewable energy development. These terms represent relationships between local actors in Hokkaido, the Japanese government and the teams of European experts and technologies they engage with directly and indirectly. I focus mostly here on a team of Danish experts on district heating and biomass, as well as reports and presentations from local actors in Hokkaido on their visits to Germany.

In this way, European models of renewable energy development and digitisation are adapted and resisted in a seismically shaken Hokkaido, making use of digital technologies to imagine more resilient modes of energy production and use while remaining sceptical of the promise of broad interconnection of Society 5.0. For better understanding of this adaptation and resistance, I introduce the situations surrounding digital technologies and energy generally in Japan, using points of comparison from Europe, showing how the digitisation of electricity grids consists in building yet another nesting abstraction built upon grid infrastructure and energy markets. Whereas digitisation has partially advanced in tandem with the growth of renewable energy, local energy independence movements, and cross-border interconnection in Europe, Hokkaido presents a corollary to the Japanese government's future designs for Society 5.0. On paper, its approach to digitisation overlaps with the imagination of biogas producers and activists in Hokkaido promoting local leadership in energy infrastructure, but has diverged from this alignment in practice, as the future built into the grid becomes unsettled and contested through multiple disasters. Whereas biogas producers may use sensors, collect heat data and benefit from German technologies, the goal of their heat-centric arrangement remains local independence, and their means of producing energy relies as much on multispecies relationships as digital interfaces. I argue that this represents a contrasting energy future to those put out by European models of local ownership within increased connectivity, and even from the Japanese government's adapted version of it, because Hokkaido's recent instability and historical underdevelopment have led biogas producers to seek local independence as a means of moving away from the electrification and digitalisation of a grid they no longer quite trust. I end with some considerations on models as tools for speculative engagement with energy futures that can bring us closer to the materiality of energy and limit the excesses of abstraction of present-day electricity systems.

IoT Society, Energy Blockchain and Promises

Some discussion of the state of digitisation and energy in Japan and Europe is necessary here, as is some elaboration on the relationship between digitisation and energy from social science literature. Though many technologies that would more granularly combine energy management with digital systems beyond markets remain in initial stages of implementation, there remains much to be said about the discussions and a lack thereof.

Another short field note will help illustrate the relationship between digitisation and energy. Ishidani, who worked for four years in a company that made and runs plastic waste-powered and solar-powered plants in Japan, told me that digital technologies and other advances were always paid lip service, but not given the incentives that renewable power production was:

> A person at the local economic development office who supported me in my earlier career introduced me to people at the company. My job mainly consisted of managing finances and serving as a liaison between the main company and the solar subsidiary. On my own time I would attend seminars and expand my knowledge of the industry on my own. I also had opportunities to meet with policymakers to discuss how to make regulations more effective from our perspective.

I then asked Ishidani if his conversations with policymakers or within the company included digital technologies and VPPs, and what these discussions were like. Ishidani answered:

> VPPs were not really discussed. On my own I learned about the megawatt markets abroad, and other examples of this kind of demand-supply balancing technologies. My sense was that these would take a long time to move markets. People researching these topics had clearly developed real technologies that would have effects if implemented, but there was still a significant gap. From management, and government, those [mentions of VPPs and two-way management technology] were often just performative calls (kakegoe) for them.

Government documents support this narrative. The fundamental technology that would enable VPPs and other data-energy management digitisation and potential decentralisation remains a long way from being implemented across the country. A presentation given to the Ministry of Energy, Transportation and Industry (METI) in 2020 notes how Japan has yet to mandate the implementation of smart meters and has yet to achieve a substantial percentage of use in households compared to many other developed countries (Mitsubishi Research Institute 2021).

Professor of Engineering at Tokyo University, Kashiwagi Takao (2021) notes how the Hokkaido earthquake has put into renewed focus, how an 'Internet of Energy' society can create increased resilience to disasters by cutting off demand from a malfunction in a large power plant at the point of connection, switching users to surplus energy supplies at home or from other areas. In an illustration of this society, many technologies that have yet to achieve widespread use are shown as interconnected, separate but with some overlapping roles. Yamamoto Shuichiro (2020), a member of the digital transformation (DX) study group of METI who participated in the preparation of the Ministry's 2018 report, notes increased attention being paid to DX in Japan since the publication of the report.

However, the Germany Japan Energy Transition Council (2019) has commented that Japan lags behind Germany in its implementation of VPP and Variable Renewable Energy technology. Japan has gradually implemented laws separating production, transmission and supply of energy since the 2011 triple disaster in a move to emulate laws in Germany (among other countries), but technologies like VPPs have yet to make real inroads as renewable energy subsidies discourage VPPs that also aim at trading energy on the market.

The way a VPP works in Germany is that it will use forecasts to schedule production from biogas plants and other decentralised production devices, and through bundling the production units participate in energy trading. Suppliers will buy the energy and ideally, the market will bring together demand and supply and optimise revenue. A Transmission System Operator (TSO) will settle remaining imbalances between groups using reserves (usually coal and gas) based on a universal balancing price for all TSO areas in Germany. In this sense, the reserve, the creation

of new capacity and the management of existing capacity are all relatively separate in function. To optimise functioning and revenue, VPPs require not only climate data, but enough metering data on consumption to allow for optimisation and trading back and forth, meaning the widespread use of smart meters at lower scales than energy demand from industries.

The German government attempted widespread implementation of smart meters in 2019, but resistance loomed large and an effective roll out was not achieved. De Dutta and Prasad (2020) talk about the benefits of a society that organises energy and data along the blockchain, creating energy prosumers who sell their energy back to a blockchain-regulated grid. The 2050 climate goals are often cited in literature supporting increased connections and expanded energy markets between European countries through such technologies (Egerer et al. 2016; Fürsch et al. 2013), albeit they are still in their infancy.

Interest in these technologies and models is growing in Japan, too. Companies like Tokyo-based Enechange, which had its initial public offering earlier this year, are situating themselves as the vanguard of an information revolution, with innovations in AI, deregulation of energy markets and decarbonisation going hand in hand. Through their Smart Meter Analysis Platform, they offer a range of data-related services for clients, including energy optimisation, recommendations for gaining clients, facilitating provider switches and energy market information services including analysis reports of weather and news items (Enechange 2021).

Much of this sounds like the same kind of promises made at the time of the dot com bubble and genomics boom (Fortun 2008), but this time, figures in this line of speculation say, it is backed by the compounding technologies and cost reductions needed: there are smart meters, there are competent AI, devices can speak to each other almost seamlessly. Investors in Enechange, as well as companies like Tesla, speculate them to be ready.

Speculation is not just hope for the future, it has materiality (Horst and Miller 2012). Smart meters, data centres, low commodity costs, global supply chains, virtual management systems, IoT consumer devices, advanced market dynamics all come together to create a new

digital materiality with new subjects (Gramazio & Kohler 2008; Pink et al. 2016). In this reality, abstraction and speculation from money markets and the digital would inflect the materiality of energy (Horst & Miller 2012, p. 5), similar to effects observed with the viral growth of cryptocurrency.

The history of the markets and digital technologies can be said to be intimately tied to that of energy's own exponential growth. This is a claim that can be found throughout the history of the energy humanities. Vaclav Smil (1994), drawing on Wilhelm Ostwald (1909) and Leslie White (1943), claims energy is the only universal currency, a means of abstracting and calculating all forms of activity. In this scheme, the evolution of civilisation follows organismic evolution in seeking greater and greater dependence on higher energy flows. There is ample reason to reject evolutionary classifications of bounded civilisations, but we can notice in these works an early recognition of society's connection with abstracted, de-materialised energy.

The materiality of this energy, the infrastructure, markets and labour required to produce it and move it have acted as barriers and accelerators. This is well-illustrated in Mitchell's (2009) discussion of fossil fuels being formative to democracy, wherein the move from a materiality of energy based on mines, coal, trains and heat to one based on oil, autonomous systems and electricity, reduced the participation of unionised labour in favour of concentrated power and capital. In Japan, coal-producing areas like Yubari in Hokkaido are examples of this shift as well, with the decline of coal mining from the 1950s to the 1980s coinciding with high economic growth. This ended with a market bubble and crash that caused a long period of economic decline and austerity (Kimura et al. 1996, p. 238; Mochida 2008). These historical and material antecedents have contributed to a wariness of investment in growing the island's internal infrastructure (digital and otherwise) amid rural depopulation and economic stagnation, leaving Hokkaido's grid weak to seismic disruptions as seen in 2018.

Contesting Energy Futures in Hokkaido

Hokkaido could now be said to be at a turning point in the digital materiality of its electricity grid. The earthquake showed how a very simple automated shutdown was effective, but also caused by a failure of the grid as such, a recall of Fukushima. Here, I try to situate discussions of transition between the Japanese government and local actors to argue that European models and technologies of renewable energy development are not translating only into a more integrated and digitised system, but also devolving into local, parallel infrastructures. Various actors in Hokkaido are adapting European knowledge while also pushing back on and using the government's own adaptations, and draw on these to speculate about a disaster-ready future.

In a presentation on its comprehensive vision of a decarbonising *Society 5.0* in May 2019, the Ministry of the Environment emphasises municipalities resilient to disasters, distributed and independent energy production and consumption, while also noting the contribution of IoT to innovation in energy and design. A scheme shows rivers, villages, the sea and forests in the centre, but the vast majority of the chart is covered with areas of economic activity and policy ideas that stretch out and overwhelm the place in this vision of Society 5.0. The name of this scheme, *Chiiki Junkan Kyosei-Ken,* is translated by the Ministry as the 'Circulating and Ecological Economy' but might perhaps be better translated as the *Regional Circulation Co-Existence Sphere*. In this deliberate move to combine physical and virtual space for a human-centric next generation of society, it is envisioned that we will leave behind the constraints of hard labour, hidden information and other social problems that still affect us in our 4.0 information society (Cabinet Office 2021).

Furthermore, in this scheme, AI, technological efficiencies and more renewable energy will make life easier. But there is little in this society's scheme that is there to ensure that efficiencies are passed on to workers and eliminate poverty, or to provide basic services that ensure people are cared for in an emergency. Indeed, if the experience of digitisation in Japan during the pandemic now provides any hints, it suggests that when these changes take place, popular concerns of justice will fall by the wayside in favour of political priorities in tech industry development.

What is more, the well-being of ecologies might be limited to reducing emissions and human enjoyment of a non-specific nature.[2] The material reality of energy, its history and its sources remain abstracted in the scheme, even though the specificity of each region's potential is cited.

From conversations with activists and renewable energy producers before and after this presentation, I learned that the aspect of the plan that was most well-received was the *chisan chishou* (local production, local use) ideal: understood as investing in region-specific forms of energy and resources to promote independence and resilience. This is where European, and in particular German models of *Stadtwerke*, public utility companies, were often used by the government as examples of local flows and use preventing capital outflows. Taking the town of Osnabrück in Germany as their main example in their presentation, the Ministry's representative emphasised how local use and local production had helped subsidise public services, as well as keeping expenses low and creating more jobs. Interestingly, the grassroots activism for (re)municipalisation and energy independence that define *Stadtwerke* were kept out of their presentation of the model (Hall et al. 2012).

At discussions and panels with energy experts from Europe and Japanese municipalities or businesses who had sent teams to Germany and Denmark, the idea of local independence through local ownership was more clearly emphasised in their statement of model cases. One presentation by a mid-sized city in central Hokkaido in August 2019 cited the city of Freiburg's urban planning and ownership of energy production, Jühnde as a municipality being completely self-sufficient in energy production, and that 46% of Germany's renewable energy is owned by individuals and farmers—all examples for taking control of one's own energy future that could be adopted even in relatively under-funded municipalities in rural Japan.

Similarly, at a panel on fourth generation shared heating systems in October 2019 in Sapporo, hosted by REOH, Japan's relative lack of district heating was compared to Denmark's systems to maximise heat efficiency through co-generation, heated water circulation and improved

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[2] There is only a vague mention of 'Lifestyles that are healthy and where one can feel connected to nature' and 'Rich nature as a stock, and the benefits providing a good life'.

insulation. Yet again, a kind of evolutionary framework is implied here, this time by a mix of Japanese experts, community members and activists, but also with the purpose of emphasising the particular challenges faced with heat in Hokkaido, and the way the country's feed-in-tariff did little to promote something as basic but extremely effective as improved insulation. The Ministry's follow-up policy, the feed-in-premium, has addressed some of these criticisms by making a new category of subsidies available for local biogas, biomass and heat use projects. In subsequent meetings organised by REOH in October 2020 and March 2021, centred on local use of biogas and the creation of greenhouses with IoT technology to control the temperature, the idea that a disaster could occur in Hokkaido in winter—making heat a matter of life and death—was repeated alongside hopes that this new generation of policy could be used to do more to meet local needs.

There is a qualitative difference in the way energy structures relationships in the aforementioned examples. With the *Stadtwerke* model, the Japanese government has taken to emphasise local responsibility for preventing outward expenditure on fossil fuels. Though the government has provided support for renewable energy projects in Hokkaido, the extent to which it is willing to invest in disaster-ready infrastructure and local ownership of energy along the lines of *Stadtwerke* remains in question in Hokkaido. As an example of disaster readiness, the Ministry of Environment's presentation mentioned solar panels used in a school and evacuation site in Atsuma in southern Hokkaido during the 2018 earthquake. Ironically, as I mentioned in the beginning of this paper, large solar power plants surrounding Atsuma connected to the grid were effectively made useless by grid protocols that required base load forms of energy to come online first. Many biogas producers I spoke to were of the opinion that if the government was serious about disaster prevention, it should be investing in it more seriously, as the earthquake had made clear people in Hokkaido could no longer count on the grid to always sustain them. In an emergency, they could be on their own.

Similarly, in an interview with city hall officials in a biogas producing area of central Hokkaido, I was told that the central government had denied funding for their effort to build an emergency-use microgrid they had proposed the year after the earthquake, citing cost-effectiveness

(despite the Ministry of Environment posting a much upgraded budget for decarbonising and security projects). When I mentioned this on separate occasions to a farmer and a professor I know, their responses were similar: the government was more interested in increasing Hokkaido's connection and dependency on the mainland and their grid as disaster prevention rather than investing in Hokkaido's capacity for local use, contrary to the principle of 'local production, local use'. However, despite being denied the implementation of a Freiburg-like local energy ownership energy model, many rural inhabitants' desire for more local energy independence has not necessarily diminished.

It is understandable, then, that for many energy producers and other actors in Hokkaido, the government's promise of high-tech energy management solutions and digitisation fails to match many key concerns emerging in Hokkaido around independence and disaster preparedness, even as the local use of IoT technologies increases somewhat. The earthquake and subsequent power outage has taught energy producers and residents of Hokkaido that the introduction of higher-level systems and increased interconnection also implies an increased risk of cascading failure that leaves their older parents, their rural business, their friends with disabilities and many more especially vulnerable to further power outages, and to their at worst fatal consequences (Graham 2010; Howe et al. 2015). In other words, local actors have taken in the idea of digitised energy systems *and* the value of local independence (adopted from European experts they have come into contact with). Yet, underinvestment and disasters render this future vision for Hokkaido's ageing and fragile grid uncertain, instead of focusing on the idea of increasing connection and abstraction through larger grid projects and a mode of digitisation that ignores local self-determination.

Models for Speculation

In the space created between the 2018 earthquake and the Japanese government's adoption of policies, ideas and technologies from Europe's development of renewable energy, biogas plant workers and managers are creating a different kind of possibility for energy independence.

Bringing together sensors, cows, bacteria, plants and humans by redirecting excess heat in greenhouses, they create an energy system less reliant on the grid, the government and the energy markets. I propose to take this as another kind of model, that is in the sense of models as 'specially prepared, usually fictional descriptions of the system under study' (Cartwright 1983, p. 158), operating as speculative instruments (Black 1962; Richards 1955). Using this model, I end by sharing a slightly speculative look into what living with less abstracted energy might look like.

We can begin with how biogas producers in central Hokkaido have taken to thinking about how to best care for methanogenic bacteria as part of a different, emerging energy future. These bacteria are bought through farm equipment providers, but once they are added to the mix of cow waste, they are entirely in the care of farmers and technicians. The bacteria help to get rid of excess waste that cannot be turned into fertiliser, as the farm has grown and consolidated others over the years. These human actors try to keep the tanks warm, experimenting with the bacteria feed to get them to digest and produce more methane gas. Most of the methane is burned with German generators and the electricity bought at a fixed rate by the utilities, later it may be traded on the market. Certain plants are developing the means to liquefy and move biogas to help their community become more energy independent.

The humans have been coaxed by their boss into going about the task of diverting some of the excess heat into water that circulates to warm a greenhouse. In some places, the heat of these greenhouses and water tanks is monitored and controlled by sensors and controllers communicating constantly (Fig. 1). They need to pay careful attention to the cows, bacteria and plants to maintain these cycles. Excess gas may be liquefied and transported short distances to meet local demand in an emergency. Energy becomes a function of caring for several types of living beings and machines. Perhaps the system is still not sustainable or carbon neutral, having not freed itself from petroleum inputs by substituting it with hydrogen and other alternatives. However, it does provide a way to not only reduce emissions but make the use and production of energy a more immediately material and sensory process, even though it produces several kinds of abstractions through sensor data and emissions

data. Local politicians and biogas operators imagine a future of multi-species heat, sharing, sensing and moving it between cows, machines, bacteria, fermentation tanks and homes.

Though not all of the above are things I have seen directly in my fieldwork at biogas plants—for instance not every plant has a greenhouse and the technology to liquefy and move biogas remains in early development—every element of the amalgam remains grounded in my experience and biogas producers' projections for the future as well as their understandings of the government's Regional Circulation Co-Existence Sphere. I use this slightly speculative passage to emphasise the departure this could represent from the history of energy as a process that many of us have experienced as one of continuous abstraction. Though perhaps not 'revolutionary infrastructure' (Boyer 2016), as this would represent too much of a departure from the language and practices of

Fig. 1 A greenhouse warmed by excess heat from biogas with sensors for temperature control (*Source* Photo by author)

my informants, it does represent an alternative to the seemingly ever-expanding 'gridworld' (Boyer 2016) or 'program Earth' (Gabrys 2016). Leaving evolutionary schemes and the idea of bounded cultures aside, the idea of energy as a flowing mediator between various states of matter, and more-than-human dependencies, is an interesting hermeneutic for the Anthropocene. This is true as well for the relationships between the digital and the analogue, and how to relate to plans for *Society 5.0*: the material movements of energy production serve as infrastructure for all digital realities, just as these in turn require changes to this energy infrastructure to match changing geographies of use and medianatures (Parks 2017). A de-leveraging of these nesting abstracted energy infrastructures could allow us not only to prosume but to become caregivers, echoing the activism of youth in Stavanger in Lautrup's chapter in this book.

What speculation allows for here is a slowing down and reimagination of the experience of energy (Debaise and Stengers 2016) in a way that is still enmeshed with digital sensors and data feeds, as well as generators and development models imported from Europe, but nonetheless remains separate from a more complete abstraction of energy by relying on a mediated sensory interplay between multiple more-than-human actors. Similarly, the local independence and ownership promoted by European experts becomes all the more difficult and more politically charged to implement in a context like Hokkaido, where connections to the mainland may be weaker than those between Germany and its neighbours, for instance. In reality, the gridworld and its imperative of increased interconnection, increasingly rapid exchange, virtual control, as well as rural precarity and dependency seem likely to continue to live on in national policy in Japan. However, this does not preclude parallel infrastructures like biogas from moving through more sensory networks. Indeed, the government relies on such local success cases to tout the viability of its own Society 5.0, opening up the possibility for less abstracted, multispecies and lived-with forms of energy. Even as digital technologies continue to change the materiality of energy production and use, they may also do so in ways that may not always lead to building greater and greater abstractions. Exhibition Fig. 4 follows this chapter.

Exhibition Fig. 4 'Uro' in its setting on an oil rig with a view over Ryfylke fjord (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

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Overcoming Abstraction: Affectual States in the Efforts to Decarbonize Energy Among Young Climate Activists in Stavanger, Norway

Andy Lautrup

Introduction[1]

The pressed flowers look like grey silhouettes against the cloudy sky outside. I am looking at the pressed flowers because I am participating in a guided tour of an exhibition about climate stressors in a small exhibition space in Copenhagen. Part of the exhibition is a selection of dried roses pressed between two see-through plates. They are displayed in a big window that makes up one side of the minimalist exhibition space. The guide, who works with strategic design at the exhibition space, is

[1] Part of the work in this chapter overlaps with the work in the author's doctoral dissertation, to be submitted in late 2022 at the IT University of Copenhagen.

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explaining that the roses were bought at a local flower market, but have been produced in Kenya, Ecuador, Germany and the Netherlands respectively. The original tags that are displayed with the roses testify to this. The guide is explaining that the rose exhibition is supposed to draw attention to the climate impact of everyday life stuff. She is telling me and the others listening that a rose has a carbon footprint of around one kg of CO_2, which gives roses one of the highest carbon footprints among flowers. Someone is saying 'wow' at the seeming enormity of the number and the guide looks affirmingly at us and says 'right!?' She then moves her head from side to side and says in an assertive voice: 'I've said to my husband: never buy me a bouquet of roses, it's like buying me twelve kg of CO_2!'

My visit to the exhibition took place almost a year after I finished the main part of my PhD fieldwork among young climate activists and their local community in the Norwegian oil-capital Stavanger. These young people were in their early to late teens and organized in different local political and activist groups. At the exhibition, I found someone who said the sort of things I had initially been looking for when embarking on fieldwork, namely someone who thought in terms of carbon and who used carbon as a measure to re-evaluate their actions and the objects in their surroundings. In the example, the romantic gesture of receiving a bouquet of roses from a lover, changes into a gift of climatic pollution as the receiver relates to the roses as an expression of the carbon emitted through their production rather than an expression of love and affection. The climate impact of a rose is concretized through the number one kg of CO_2. A number most people would find difficult to evaluate in terms of whether it is a lot or a little, but to the guide it was clearly enough to stop wanting bouquets of roses. The guide's statement about not wanting roses from her husband might have a performative element to it, given the exhibition context. Yet, I do find that the example is reflective of an almost common-sense assumption that information is concrete and will lead to changes in behaviour, which the guide exemplifies as she dismisses future bouquets of roses based on information about the carbon footprint of a rose. The digital sociologist and human–computer interaction scholar Yolande Strengers (2014) has synthesized such a reductive relationship between behaviour changes and often digitized information in

the straw man figure of the rational 'resource man' in the context of energy use in the home. Strengers argues that energy consumption in the home is much messier and more dynamic than a straightforward relationship between digitized information and behaviour change, where information will lead to smarter and better behaviour in terms of saving energy (Strengers 2014, p. 26). Drawing inspiration from Strengers, in this chapter, I too set out to nuance such ideal-type visions of the relationship between often digitized information and behaviour change, albeit in the context of climate activism and fossil energy production rather than everyday energy use. I engage with the pushes and pulls of energy transitions towards a low-carbon future as it is experienced by young, local climate activists in Stavanger. In Stavanger, I expected to find 'resource man' types of relationships between carbon emissions and everyday objects among climate engaged young people. This way of thinking was not very prominent though, and more importantly something else seemed to be going on among the young people I got to know. They did not handle carbon as something concrete as in the example with the roses, rather they grappled with a sense of abstraction that the representation of climate through carbon signified to them. This grappling resulted in a variety of attempts to overcome the abstraction of carbon in order to make the climate crisis feel concrete. By, for example, evoking examples that come from the Global North and provide visceral, embodied effects, the young people foregrounded aspects of the climate crisis that are local and contemporary, rather than distant and in the future.

A central component of the young activists' efforts to overcome abstraction centred on energy systems and on attempts to push for phasing out the local as well as national oil and gas production, although in Stavanger, the mission to decarbonize through transitioning energy away from fossil fuels is a contested subject. Stavanger inhabitants are acutely aware of the destructive consequences of the oil and gas industry for the global climate, but oil and gas make up the foundation of the local labour market and the finances of the national welfare state. Furthermore, in the relatively small city of Stavanger, activists are not many, and activists and industry people often share social ties of friendship or family. Stavanger thus affords a local and situated perspective on the

socio-cultural dimensions of transitioning away from fossil fuels from the vantage point of a place that greatly benefits from their production. Martin Andersen's artistic engagement with the end of the fossil fuel era through the medium of the mobile, depicted throughout in this book, beautifully portrays the sense of unrest that both the status quo of fossil fuels and the pending transition away from them affords in Stavanger (see also Sareen in this book).

Through ethnographic examples centring on different modes of visualization, I will show that energy systems as they matter to the young climate activists in Stavanger are the transnational energy networks and markets that Norway's oil and gas production are implicated in. I argue that the young activists engage in concretizing and abstracting practices which create certain affectual states that render concreteness as something desirable and abstraction as something undesirable—or something to be overcome. Underscoring the importance of attending to the socio-cultural context and situatedness of energy transitions that the introduction to this volume points out, I end by discussing how there is also a limit to the perceived desirability of concreteness since in an oil-city, concretization and localization can also create too much resistance as responsibility is placed and accountability required.

I find it necessary to note that the conceptual space of abstraction and concreteness is complex and slippery, because this vocabulary is both used in analytical language and in the language that people in the field use, and as such they are both *emic* and *etic* concepts, a point echoed by Emile St. Pierre's discussion of the abstractions of energy (St.-Pierre in this book). My approach to navigating this conceptual slipperiness is to make it my main task as an analyst to draw forward how people in the field apply these terms and to what ends.

The Realness of 'Here' and 'Now'

A general pattern in my ethnographic material is that the young climate activists perceive climate change as abstract because they 'cannot feel the

climate crisis on their skin'.[2] The most violent consequences of climate change currently manifest in other geographical parts of the world than Norway and despite warmer winters, heavier flooding and more powerful landslides, tangible experiences of climate change in Norway are perceived as something that will take place in the future. This sense of abstraction is also present when it comes to the way climate change is represented in numbers about carbon emissions. '…I feel like I cannot understand the importance of saving the climate based on numbers about CO_2 emission, and then I need more concrete things',[3] the 16-year-old climate activist Nora told me during an interview, prior to which I had asked her to calculate her personal carbon footprint. Nora went on to identify concrete things, as for example natural disasters. She emphasized that it's not because emissions are not important, they are just difficult to understand because they are so abstract as opposed to natural disasters which are both concrete and visible.

I present the above as brief examples that are reflective of a shared understanding among the young activists that abstract refers to something unembodied without direct impact on their physical being or something that does not have a visible manifestation. At the same time, they also experience the climate crisis as extremely concrete because of the urgency of countering the violent consequences of a changing climate. During an interview, the 19-year-old climate activist Sander told me about his motivation for being active in a variety of local climate organizations: 'The climate crisis is not an abstract concept, it's not like no, this will not happen until a hundred years. That is in a way what makes me so motivated in the battle to solve climate change, that it

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[2] Bokmål:'merker ikke klimakrisen på huden'.

Norway has a lively variety of dialects and two official languages: Bokmål and Nynorsk. In each Norwegian region, either Bokmål or Nynorsk is the official language. Stavanger has its own distinct varieties of dialects that most of my interlocutors speak and also use as written language for informal communication. The official language of the Region of Rogaland to which Stavanger belongs is Bokmål and I have chosen to present Norwegian words and phrases in Bokmål in the footnotes and my own translation to English in the main text.

[3] Bokmål: '… jeg føler, at jeg ikke forstår viktigheten i hvorfor vi må redde klimaet ut fra tal om CO_2 utslipp, og da må jeg ha mere konkrete ting'.

happens exactly now and there is very little time'.[4] Sander specified this sense of urgency by referring to the UN's climate panel's prediction that after 2030, climate change is likely to become irreversible and added: 'It motivates me because it is actually about my life'.[5] Sander's reflections about motivation is a good example of how the young climate activists also experience the climate crisis as concrete because of its temporal urgency and a sense that the future violent manifestations of climate change in the part of the world where they live, is not in some distant, disembodied future, but in a future that is part of their lives—or simply *their* future. Placing the most serious and violent manifestations of climate change locally in the future, can be read as if the youth understand climate change as abstract in the present. However, the youth have quite vivid visions of the future and these visions are not abstract, but very concrete to them. During the interview with Sander, he elaborated on the meaning of his statement that 'it is actually about my life'. He explained that he lives close to the shoreline and half-jokingly, half-seriously said that he will have to travel by canoe to get around in his neighbourhood when he reaches retirement age. This sense that sea-levels-rise have concrete impact locally in the coastal city of Stavanger and its nearby areas has been a recurring theme among the young climate activists I encountered in Stavanger. Several of them have referred to a workshop they participated in, where they redrew the future sea-level through the city and realized how much of the city would be under water if this scenario came true.

I will argue that there is something essential at stake in these dynamics between abstraction and concreteness in the activists' perception of climate change and in their experience that it is easier to relate to climate change through embodied and visual encounters than through for instance numbers about CO_2 emissions, as Nora put it. What is abstract and what is concrete is not necessarily given but is enacted through practices and perceptions. I will, too, dwell a bit on numbers and data about climate change because literature about climate change as an

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[4] Bokmål: 'Klimakrisen for eksempel det er ikke sådant et abstrakt konsept, det ikke sådan nei, dette skal skje om hundrede år. Det er det som gjør meg så på en måte motivert i kampen for at løse klimaendringer. Det er at det skjer akkurat nå og der er tale om veldig lite tid'.

[5] Bokmål: 'Det gjør mig motivert, fordi det handler om livet mitt egentlig'.

object of knowledge through digital data can help unfold the connection between numbers and abstraction that the activists put forward.

The only way to experience climate change in a geographical position where its tangible consequences are not felt in a way that warrants immediate concern is either through data-driven predictions of the future or through learning about the violent consequences that take place in (other) specific geographical locations. The global phenomenon of climate change is available as an object of knowledge through the accumulation of data about weather patterns and carbon levels and the work of climate models that can turn this data into predictions about future climates (Edwards 2010), and as such the knowledge practices related to climate change are largely technologically mediated (Hoeyer and Winthereik 2022). Numbers and data about carbon emissions are the main way that climate change as a global phenomenon is known and governed (Beuret 2017; Knox 2015; Knox-Hayes 2010; Lövbrand and Stripple 2011; Paterson and Stripple 2010; Whitington 2016). While, as also outlined in the introduction to this book, the generation and circulation of digital data about carbon emissions are vital for understanding and managing the urgent need to reduce global carbon emissions, carbon metrics as a way of knowing and governing climate change has distinct consequences for how climate solutions are framed and responsibility placed. For example, the STS scholar Donald MacKenzie (2009) argues that carbon is 'making things the same' in the sense that it is a measure that makes comparison possible between seemingly incomparable activities and entities due to the carbon they emit or absorb (MacKenzie 2009). This ability to make things the same, the anthropologist Steffen Dalsgaard (2013) describes as the commensurability of carbon, while further arguing that commensurability enables assigning moral value based on carbon emitted or saved (Dalsgaard 2013, p. 83). Carbon is also the metric used to digitize most things climate related, as for example a recent multitude of carbon accounting apps testify to. 'Digital governance' literature has emphasized how digitalization has gone hand in hand with the audit and accounting mentality of neoliberalism—digitizing assets have made them easier to account for and to distribute upon individuals. The political scientists Matthew Patterson and Johannes

Stripple (Paterson and Stripple 2010) argue that climate change governance largely takes place through carbon metrics, which act to cultivate a certain subjectivity of the individual as a carbon emitter. This subjectivity emerges as individuals internalize a state carbon governmentality based on carbon metrics. Paterson and Stripple talk about this as the 'conduct of carbon conduct', which they explain as 'a government of people's carbon dioxide emissions that does not work through the authority of the state or the state system, but through people's governing of their own emissions' (ibid., p. 347).

Together, this literature highlights the measures through which climate change is rendered knowable and governable through carbon metrics that are largely digital, which serves to individualize the responsibility to lower carbon emissions. This chapter's opening gambit about roses is a good example of how this type of thinking can play out in practice. For the guide at the exhibition, the carbon footprint of a rose seems to be a concrete piece of information—at least concrete enough to induce change in her relationship to receiving roses. Yet, my ethnographic material from Stavanger tells a different story. For the climate engaged young people carbon emissions are not meaningless, but as Nora exemplifies, neither are they concrete enough to motivate actions towards saving the climate. I find looking at the way climate change takes place in data and numbers helpful for opening up this abstraction. In her contribution to a recent special issue about the anthropology of data, Hannah Knox (2021) writes about climate change as it is portrayed in climate models and the professionals who work with climate mitigation based on these models:

> Climate change's life in data means that definitionally it takes place in no individual location and that its relevance is located more in the future than in the present. People who engage with the question of how to mitigate climate change thus engage not with phenomenologically present environmental processes, but with complex data models that recast everyday practices into a climatological register. (Knox 2021, pp. 3–4).

Knox speaks here to the qualities of climate change that the activist youth see as abstract—that when represented through digital data, it takes place in no individual location. It is disembodied and it takes place primarily in the future. Knox connects these characteristics to what she calls climate change's life in data, which I understand to refer to climate change as it is enacted in digital data models. Knox crucially points out that data models do not only trace and represent things in the world, they also have world-building capacities (Knox 2021, p. 2). Data models are instrumental in enacting a dominant understanding of climate change as something that takes place in the future and is removed from specific location. What the young activists in Stavanger do can be seen as filling up the global abstraction of climate change with local experiences, but I suggest that there is more at stake. Knox helps me make this point: she goes on to argue that though 'climate change, as it is described in climate models, is never *here*, and not *now*, crucially this does not mean it is not *real*' (Knox 2021, p. 4, original emphasis). I suggest that it is this realness that the young climate activists are trying to enact—not through numbers and data about carbon emissions and predictions about temperature increases, but by mobilizing a concrete here and now that can be seen and felt, if not physically as what Knox in the quote terms 'phenomenologically present environmental processes', then affectively. In developing my argument about how affective responses are central to experiences of what is real, I follow the anthropologist Kim Fortun's (2021) argument that cultural analyses in and of the Anthropocene 'need to get at the cross-scale, cross-system dynamics that is our context and responsibility' (Fortun 2021, p. 29). Fortun points out that: 'Part of what late industrialism affords or points to is the way the everyday real is produced through the interaction of many scales and types of systems, sedimented with history, laced with commercial interests' (Fortun 2021, p. 25). I do not intend to cover all scalar and systemic cross-points in this chapter, but I concur with Fortun that scale in the current predicament of the Anthropocene is not so much a question of scaling between the global, the local or even the glocal, but rather about the way scales interact and create experiences of what is real.

In the following section, I will provide two ethnographic examples of how the here and now, which is lost in climate change's life in data models, is enacted by the youth through different modes of visualization and bodily reactions.

Concreteness and Abstraction as Affectual States

Rain is cascading onto the windows of the first-floor room, where I sit alongside 15 local youths taking part in a meeting for new members of the local branch of a youth political organization. We sit in a few rows, a metre between each, facing a canvas onto which a slideshow is being projected. Kaja, the local leader of the youth political organization, is talking about the dangers of the climate crisis. To illustrate these, she is showing us a slide with various pictures of news articles about the consequences of climate change. One of the articles points out that the Greenlandic ice shelf has recently melted beyond the point of no return. This particular piece of information comes as a surprise to several of the people present and a quiet sense of exasperation grasps the room that fills with muffled exclamations of disbelief and surprise. Upon request, Kaja is laying out some of the climatic tipping points the melting will set in motion and concludes that it is 'seriously bad'[6] and that there is no time to wait until we, meaning the youth in the room as well as youth more generally, become adults to do something about this. The comment about becoming adults could be read as if Kaja is scolding her peers and asking them to grow up and take responsibility. But based on recurring conversation among the young activists, I read the comment to be a conversation with a commonly held understanding among the activists that it is supposed to be adults who take political responsibility and ensure the required measures to counter global climate change. Since

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[6] Bokmål: 'skikkelig krise'. The Norwegian word 'krise' could be directly translated to crisis, and 'skikkelig krise' to a real or serious crisis, but in the concrete situation, where the local leader talked to her teenage peers, I got the impression that she used 'skikkelig krise' as a slang expression for something seriously bad, rather than referring literally to a serious crisis.

this is unfortunately not the case and there is very little time to do something, their conclusion is that young people must take measures into their own hands and insist that the climate crisis is important and needs to be addressed politically and systemically.

Kaja is pausing and letting us sit a bit with the information about the climatic tipping points and then rhetorically asks what the dangers of the climate crisis means for Norway. Adding that youth care so much about the climate because it is their future which is at stake, she argues that an important part of taking care of that future is to phase out oil in Norway. The next slide portrays a headline from MIT Technology Review stating 'We need to halve emissions by 2030. They rose again in 2019' next to a bar chart showing a very small bar labelled 'Emissions within Norway' with a much larger bar labelled 'Exported emissions from oil and gas'. Emissions desperately need to go down, but they are actually going up, Kaja is telling us, and states that Norway is the world's seventh largest exporter of carbon emissions. What Kaja here refers to is that under the current carbon accounting regime, the Norwegian state is only responsible for the emissions from production of its oil and gas, while the much larger burden of the emissions from combustion is the responsibility of the state where the combustion takes place. While pointing to the bar chart, Kaja says that it is obvious something must be done about the emissions that Norway exports. On the next slide, a bar chart is comparing the carbon emissions that will be caused by burning the available reserves of coal, oil and gas to the carbon budget that will need to be held to reach the Paris Agreement, respectively. It is quite clear from the chart that not all the available fossil fuel reserves can be used, and Kaja concludes that it makes no sense to look for more oil. I want to dwell a bit on this data visualization. What happens at this point in the presentation can be described as what Knox (2020) has called 'a move from climate to carbon' in the sense that we move from 'climate as a singular hyperobject to atmospheric carbon as a whole that can be divided into parts' (Knox 2020, p. 46). This shift entails that the global climate with its dangerous future manifestations rather seamlessly transforms into a question of the climate as accumulated carbon and from here, a question of proportion and responsibility. The use of emission data as visualized in the bar chart helps Kaja frame Norway's role in a transnational energy

system as a producer of oil and gas as the right place to intervene to take care of the future. And Stavanger with its close relationship with oil and gas production stands out as an important place to advocate for phasing out fossil fuels.

Part of what I find noteworthy about the example is that it portrays a general pattern in my ethnographic material about how numbers and visual representations about carbon emissions are mobilized to tell stories about the relationship between the climate crisis, fossil fuels, proportion and responsibility. In these stories, Norway becomes a central character for creating low-carbon futures considering its role in transnational energy systems. Because Norway exports climate pollution in the form of carbon emissions from the combustion of Norwegian oil and gas, the global climate catastrophe is constructed as something that can be acted on locally by reshaping energy systems. Carbon here seems to have a generative function as a sort of seamless connector between a global and local scale by enabling the establishment of a global whole with local parts (c.f. Knox 2020)—the most important of which is exported emissions from oil and gas extracted in Norway. In the presentation, the bar charts are brought forward as concrete data in the style of the formula from the opening example of this text: one rose equals one kg of CO_2. But as the example shows, the bar charts do not stand on their own. The charts do not enter the storyline of the presentation until after the presenter has mobilized the melting of the Greenlandic ice shelf. I go on to describe what happened after the presentation to give a sense of the relationship between the bar charts and emotional and bodily responses.

After the meeting, most of the meeting participants are going out for a cup of hot chocolate at a nearby cafe in Stavanger's Fargegata, which translates to Colour Street, named for the brightly painted facades of the wooden houses that make up the street. We split into two groups to be able to keep a COVID-19 safety distance of one metre—one group huddle themselves up in two ragged couches, I follow the other group and we sit down around a cluster of small coffee tables. I ask one of the participants from the meeting, if she knew about the Greenlandic ice shelf melting beyond no return. She moves her shoulders as if to shake off an icky feeling and answers that she knew it was close, but that she had not been aware it had now actually happened. She tells me that

when Kaja mentioned it at the meeting, it gave her 'a nasty feeling in the body'.[7]

I am drawing forward this last bit of ethnography, because to me it shows that though my interlocutors cannot feel the climate crisis *on* their skin, information about its consequences can be felt *in* their bodies as a sensed and lived experience of the importance of phasing out oil and gas. I see this nasty feeling as an abstraction in its transition to becoming concrete through the bodily feelings of individuals. And though the bar chart poses as concrete information, it turns out to fail as a motivator for action. What is effective in mobilizing the concreteness that the youth associate with motivation for action is the affect they are left with, which is exemplified by the nasty feeling in the body that information about the melting of the Greenlandic ice shelf catalyses.

The social psychologist Margaret Wetherell argues that emotion and affect are inseparable and defines affect as 'embodied meaning-making' (Wetherell 2012, p. 4). Similarly, the historian Monique Scheer argues for a Bourdieu inspired understanding of emotions as practices and argues that emotions are not simply something people have, but also something they do as they perform and enact emotions through practice (Scheer 2012, p. 194). Thinking with the concept of emotional practices alongside embodied meaning-making helps me frame what the youth do as concretizing and abstracting practices that create certain affectual states. In addition, I take inspiration from the cultural analyst Sara Ahmed, who writes about affect: 'Whether I perceive something as beneficial or harmful clearly depends upon how I am affected by something. This dependence opens up a gap in the determination of feeling: whether something is beneficial or harmful involves thought and evaluation, at the same time that it is "felt" by the body' (Ahmed 2014, p. 6). I find it useful to connect this double movement of affect as bodily experience and as cognitive evaluation to how the youth relate to concreteness and abstraction. They are affected by information like the melting of ice which creates bodily sensations, like a nasty feeling, but also perform an evaluation of what the information about the ice shelf and the nasty feeling means together in terms of what it asks of them given the current

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[7] Bokmål: 'en sådan ekkel følelse i kroppen'.

incapability of politicians to act. Combined, the bodily experience and cognitive evaluation creates a sense of the melting of the ice shelf as either harmful or beneficial, desirable or undesirable. Synthesizing from the ethnographic examples, the affectual state associated with concreteness is exemplified by the nasty feeling in the body and a general sense of importance and motivation to, as Nora puts it, 'save the climate', and is perceived as beneficial and desirable. The affectual state associated with abstraction on the other hand is one of disconnection and distancing, a numbing and an overwhelm that to the youth seem counterproductive to change and are perceived as harmful and undesirable, something to be overcome through a translation to concreteness. Seeing affectual and embodied responses as central to meaning-making opens up for reading the youth's engagement with a piece of information like the melting of ice as a way of making concrete through a certain affectual and bodily reaction. In contrast to the calculative logic of equating, one rose to the cost of one kg of CO_2, the youth work from an embodied logic giving them a sense of urgency and motivation to keep pushing for change.

Still, these forms of movement between concretizing and abstracting practices have to be negotiated locally in Stavanger, and the perceived benefits of concretization are not limitless, as I will show in the following section.

Limits to the Perceived Benefits of Concreteness

I want to share another story, where abstraction and concreteness are navigated while some of the young climate activists work on a street art piece. The art piece is a response to the opening of Arctic areas for oil exploration and a subsequent lawsuit, where Greenpeace and a Norwegian youth environmental NGO took the Norwegian state to court arguing that the opening is unconstitutional. The piece is commissioned by a local branch of the youth climate and environment NGO and made in collaboration between its members and a local artist. I take part in the meetings, where the activists discuss the lawsuit, the street art piece and its content.

   A set of white tables are placed in the middle of the room in the
style of a long conference table. The smell of hand sanitizer lingers in
the air. There are no windows in the room, so for the duration of the
meeting, the rapidly changing weather of Stavanger is not a concern to
me and the young activists whose meeting I am participating in. One of
the topics for the meeting is the recent verdict in the lawsuit from the
Norwegian Court of Appeals and the pending appeal to the Norwegian
Supreme Court. One of the newer people present is raising her hand a
bit hesitantly and asks what happens when you win a lawsuit. If you, for
example, win money? She is laughing a bit apprehensively and adds that
she only knows about lawsuits from films. Frida, an older and more expe-
rienced member of the local organization, answers that they won four
out of five claims. With obvious frustration, she details that they lost the
claim which focused on making it illegal to drill after oil in the Barents
Sea, both because of the vulnerability of the specific area and because of
the vast contribution from oil and gas to global carbon emissions. The
claim was based on §112 in the Norwegian Constitution which states
that everyone has the right to a liveable environment, also future gener-
ations, Frida is telling us. She elaborates that §112 was tested in court
as a right's statute, but the state argued that §112 is to be understood
as a symbolic statute, which cannot be used as a concrete right. Frida's
assertiveness and proficiency in legal jargon impresses me. She goes on
to clarify what they wanted to obtain with the lawsuit: 'we want the
court to recognize that the state has the full responsibility for the CO_2
that is emitted when Norwegian oil is burned'.[8] Given the way things
work now, she states, the Norwegian state is only responsible for the CO_2
that is emitted from oil extraction, whereas emissions from subsequent
combustion are the responsibility of the country where the combustion
takes place. Roughly speaking, she adds, ten per cent of total emissions
from oil is due to extraction whereas 90% is due to combustion. Frida
looks as if she is getting an idea, then makes an eager gesture with her
hands towards the person who asked the question about the lawsuit. She
says that it is like what they talked about during a workshop at an activist

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[8] Bokmål: 'vi vil at domstolen skal anerkjenne at staten har det fulle ansvaret for den CO_2 som
slippes ut når norsk olje brennes'.

summer camp they recently participated in and explains that 'If I sell you a weapon, I am not responsible for what you do with it',[9] the other person interrupts Frida and says, 'No that was not it, it was that it is the same as if I sell you drugs, then I am not responsible if you die from an overdose, I just sold it to you, I did not use it'.[10] Frida is nodding enthusiastically at the correction, then looks across the room as if to round off the discussion, but ends up making a dispirited gesture while exclaiming a frustrated guttural sound and then says that the fact that they did not win the fifth claim says a lot about the power of oil companies, which seems to be bigger than the constitution.

At the meeting, the activists touch base about the status of the lawsuit and what they see as its most important feature: the hazards of oil production in terms of both carbon emissions from production and combustion of oil as well as the potential environmental damage to the Arctic ecosystem. What takes centre stage is their demand that politicians begin to acknowledge Norway's responsibility for exported emissions from Norwegian oil and gas and their discussions centre around the dangers these emissions pose to future generations through their contribution to global climate change. When the activists at a later meeting present the issue to the artist, with whom they collaborate to make the street art piece, the key message shifts: The activists want the piece to only depict potential local damage to the species and ecosystems and do not mention the global hazard of carbon emissions. They explain to the artist that 'oil is a sensitive discussion in this city' and that it is important for them that the piece does not come off as if it is against the whole industry. They see keeping a specific focus on oil extraction in the Arctic, rather than the responsibility for global hazards of emissions, as the way to achieve this. This sensitivity that accompanies discussions about oil remains unspecified at the meeting but based on conversations with the youth, I take it to allude to what they experience as a rather

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9 Bokmål: 'Om jeg selger deg et våpen, da er jeg ikke ansvarlig for hva du gjør med det'.
10 Bokmål: 'Nei, det var ikke det, det var at det er det samme som om jeg selger deg narkotika, da er jeg ikke ansvarlig for om du dør av en overdose, jeg bare solgte det til deg, det var ikke meg som brukte det'.

harsh debate environment, where industry supportive narratives dominate what counts as knowledge and consequently what claims are seen as worthy of being taken seriously. The climate engaged youth often experience that people think they are uptight, or that their aim of phasing out the oil and gas industry hurts people who work in the industry or have family that do. All activists have classmates whose parents work in the oil sector. In discussions, these classmates will often say 'but mom works in oil'[11] followed by a 'do you want my mom to lose her job?' Age also matters for the way this resistance plays out, as activists experience that adults appreciate their engagement, but do not really listen to them and in the end dismiss them as naïve youngsters, who do not know how the world really works. Not knowing how the world really works generally refers to appreciating the importance of oil and gas both for Stavanger and Norway as well as for making the world go round by meeting global energy demands, fuelling heavy transport and the wide array of petrochemical products.

At the meeting with the artist, the activists explain that they are afraid people working in the industry will perceive the piece as if it exposes the oil industry in a bad way on a public place in the city. This, the activists expect, will create resistance rather than support for their cause, emphasizing that negative attention is not what they are after. They agree that the piece should depict an oil platform, but that it should be rather small and that the focus should be on arctic animals and nature. Some of the images evoked are a polar bear on an ice flake, a white polar bear in contrast to black oil and an oil platform from where the oil is coming.

The activists struggle, throughout the meeting with the artist, to strike a balance where their message is clear but try to exclude problem framings and imagery that they expect will create resistance from the local community, because of the sensitivities about oil in Stavanger. I find it noteworthy how the responsibility for carbon emissions becomes absent in the conversation with the artist and hence in the actual work of art. Though the message is still clearly against oil in the Arctic, it becomes a question of local rather than global hazards visualized through Arctic animals, ice and an oil platform. It is important to keep in mind that the

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[11] Bokmål: 'Men mamma jobber i olje'.

Arctic is closer to Norwegian concerns and geography than for example Pacific islands that are losing land to rising seas, Indian areas experiencing severe flooding or Australian wildfires—some of the places where these global hazards are currently manifesting themselves in the present. Though polar bears and ice flakes are not local to Stavanger, the complex and fragile sea environment of the Arctic is local to Norway.

Through the examples above it becomes clear that the activists see reducing the carbon emissions from the Norwegian oil industry as important for countering the climate crisis. But when it comes to a concrete visualization through a piece of street art in the city, carbon emissions are on the one hand too abstract and too far away for Stavanger to feel significant and on the other hand run the risk of placing too much responsibility on the many people in Stavanger whose livelihoods depend on the industry. The abstraction of carbon emissions as related to no individual location and as largely taking place in the future makes it on the one hand easy to dismiss local responsibility for contributing to the climate crisis, while benefitting economically from this contribution. On the other hand, carbon emissions are so all-encompassing that they become unspecific and emphasizing them can also lead to locals feeling that they are unrightfully blamed for the whole enormity of the climate crisis. The young activists navigate these pitfalls of abstraction by focusing on something concrete and relatively close to home, though not too close: the fragility of the arctic ecosystem and the animals that inhabit it. What I take this to mean is that there is also a limit to the perception of concreteness as desirable and beneficial. Concreteness is generally desirable for the young activists, but in the concrete context of the oil-city Stavanger, concretization and localization can also create too much resistance as responsibility is placed and accountability required, running counter to the objective of inducing change.

Conclusion

This conclusion faces me with the task of addressing both dried roses, melting Arctic ice, digital data in bar charts about carbon emissions and street art depicting Arctic animals and an oil platform. I have approached

these different modes of visualization through the lens of how the young activists attempt to make visualizations work for them based on their perception of what is concrete and what is abstract. The work that the bar chart about carbon emissions put forward at the youth political meeting does for the activists, is to frame the problem by identifying a concrete, local contribution to climate change in the form of the oil and gas industry. The bar chart visualizes the rather intangible consequences of a warming climate as a relationship between fossil fuels and temperature rise scenarios, highlighting how the predictions necessary to grasp climate change globally are deeply dependent on technologies handling digital data. Yet, I suggest, these visualizations fail to mobilize the concrete bodily and affectual responses that are of such importance to the young climate activists, and that the information about the melting of the Greenlandic ice shelf beyond the point of no return activates. In the case of the Arctic animals that ended up being depicted in the street art piece, they do the work of evoking a manifestation of the climate crisis that is local, contemporary and situated enough to feel concrete without placing specific responsibility on the many inhabitants in Stavanger whose livelihood depends on the oil and gas industry. This suggests, I argue, that the perceived benefits of concretization are not limitless. Across the examples carbon plays the role of a seamless connector which is emphasized or downplayed depending on the circumstances. Emphasizing and downplaying carbon alters the ways in which energy systems come to matter: Are fossil fuel components of energy systems dangerous because of the global hazards of carbon emissions or due to the potential local damage to ecosystems and the beings that inhabit them?

I began by evoking the figure of the rational 'resource man' (Strengers 2014) as an example of a dominant idea about the relationship between often digitally based information and behavioural change, exemplified in the opening example, where the carbon footprint of a rose was enacted as a concrete fact through its transformation into an implicit demand for behavioural change in individual consumption. I set out to push back against such understandings of change, which my ethnography

shows to be reductionist and individualizing. Just as much as focusing on individual energy consumption and ways of measuring, calculating, understanding and possibly adjusting these consumption practices, the young climate activists in Stavanger concern themselves with the big picture of Norwegian oil and gas production and how to reduce global carbon emissions by reducing and eventually phasing out this production. In a city dominated by the oil and gas industry, the young activists attempt to push back against local lived experience of the oil industry as beneficial and a perception of climate change as far away in time and space—a perception I locate in how climate change is depicted through digital data models (Knox 2021). I argue that these attempts to push back largely takes place through efforts to overcome abstraction and make climate change concrete by focusing on the local and contemporary through evoking examples that come from the Global North and provide visceral, embodied effects, but that there are also limits to what concretizing practices can achieve.

I find that the lived experience of abstraction as something to be overcome together with the limit to the desirability of concretizing practices says something essential about the knowledge practices that young people mobilize in their efforts to induce change with the aim of preserving a liveable planet. Though mediated through digital technologies that render climate change knowable as a coherent object, the youth also mediate their knowledge practices through embodied and affectual responses to climate change's concrete manifestations, not in data and data models, but in concrete physical processes and objects which together seem to constitute their experience of what is real and what this reality asks of them. Exhibition Fig. 5 follows this chapter.
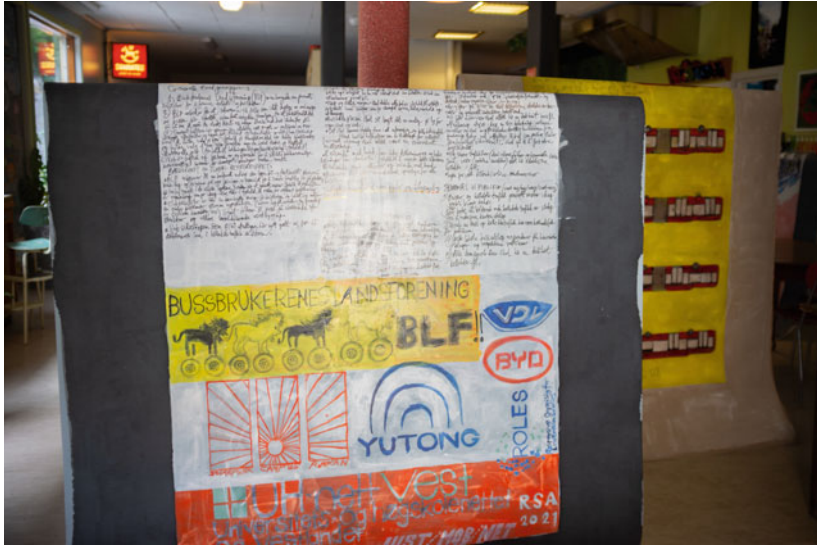
Exhibition Fig. 5 Margrethe Brekke assembles the research basis for her textile exhibition (*Source* David Odell [used with permission])

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Realising Imaginaries

A New Reflexive Turn: Glitches, Carbon Footprints, and Streaming Videos in Visual Anthropology

Darcie DeAngelo

Introduction

The global climate crisis demands an ethical account for the environmental costs of anthropology. While fieldworkers can attempt to offset their carbon footprints from air travel with alternatives and taxes,[1] anthropologists who trouble the boundaries between art and anthropology often ignore the damage done by their mediums. Digital streaming accounts for 1% (and growing) of global emissions. Despite

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[1] Though the idea of carbon offsets often reinforces global disparities and privileges, too.

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the increase in innovations to improve its efficiency, the increasing reliance on a nearly invisible media provokes a new reflexive turn. This chapter will outline reflexive media in anthropology and beyond. While activist film sometimes rejects style and design clarity in order to undermine dichotomies between hi-fi and lo-fi, reflexive media can become more than a proclamation of an anti-aesthetic as a means to reach for authenticity and moral superiority. Recently, ethnographers have called for a new approach to methods such as 'patchwork ethnography' where ethnographers conduct slow fieldwork and find new modes of 'being there' (Günel et al. 2020). Following this call, a kind of patchwork or, rather, *glitchy* visual anthropology can also decolonize the energy-consuming, anthropologist filmmaker as hero 'to solicit a new seeing' (Trinh 2012, p. 13). These so-called glitches become part of the thematically narrative elements rather than a form meant to promote a certain political agenda compartmentalized from subjects and content. There are multiple opportunities for visual anthropologists to conduct ethnographies of a new reflexive media—an anthropology full of glitches that is not anti-aesthetic. Such a reflexive turn explores eco-conscious streaming as part and parcel of ethnographic art, method, and outcome.

In some respects, the 2019 pandemic relieved the carbon impact on earthly environments. The decreased air and vehicle travel resulted in the so-called 'Anthropause' (Rutz et al. 2020) where the negative human impact on wildlife became clarified in the increased survival of species and decreased water and air pollution from fossil fuels (Karkour and Itsubo 2020; LeQuéré et al. 2020). The so-called pause increased other kinds of human impact seen in the increased deaths of animals and plants who depend on human consumption or the increased single-use plastic in the effort to decrease viral contagion (Buck and Weinstein 2020). Another human consumption that increased rapidly and without precedent was internet use, from streaming videos to online conference calls, which in the first few weeks of the pandemic in 2020 resulted in a 200% increase of internet usage (Feldman et al. 2021). This uptick points to

an often underestimated threat to our already overtaxed atmosphere—the energy costs of the internet, which in recent calculations is as high as 3.7% of the global carbon footprint.[2]

The internet has not only been envisioned as a globally and nationally democratizing solution (see introduction of this book), but is often also presumed as a solution to humans' carbon footprint (Fox-Penner 2014). This is in part because it is relatively less energy consumptive than other ecological stressors, but it is also because for most consumers, internet usage *feels* immaterial. Indeed, the internet's materialities lack tactility, visibility, or sonic indications since servers are housed away from humans, most people rely on wireless cybernetic connectivities, and its usage has become ubiquitous (Pasek 2019; Lecuyer 2018). Human consumers only notice the internet when it doesn't work—e.g. from the glitches in streaming videos or Zoom calls that result from high traffic. Much like the pandemic revealed faultiness that undergirded public health systems and communication, these glitches reveal the amount of consumption behind the internet's seemingly immaterial materialities (MacDonald et al. 2021). Glitches offer opportunities for visual anthropology as a discipline by opening up to ways in which experimental media can unveil the unseen realities and ignored consumptions created by humans.

Superhuman Sight

Artistic engagements can allow visual anthropologists to render the invisible visible. Sometimes these engagements find purchase with the various capacities of mediums. An increased frame rate, for example, in certain video settings, can capture movement better than the human eye, leading to some filmmakers to prefer a lower frame rate to better capture movement blur and to obtain painterly qualities of colors while others choose to take advantage of such hyperreal visions. The avant-garde filmmaker Trinh Minh-ha, who brings anthropology possibilities

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[2] See   https://www.climatecare.org/resources/news/infographic-carbon-footprint-internet/   (last accessed on 20 April 2022).

To portray sensorial encounters that mismatch with other species, the ethnographers depend on cameras that utilize superhuman sensoria.

But what if we engaged with the ways in which cameras fail us? Technologies sometimes cannot obtain superhuman sight but rather, disrupt our clear and high-definition visions. Anthropologists can play with the mistakes cameras make, as artists often do. Such errors can be dual purposed: both to represent how high-definition digital medium demands more ecological costs and to represent sensorial encounters that evoke the haptic or alternative visions (Marks 1998). The costs of high definition urge us to reconsider the implicit values of perfectionist sight. The visual anthropologist Faye Ginsburg (2018) calls the ethical relationship between filmmakers and subjects a kind of 'relational documentary' that demands an 'aesthetics of accountability', reworking a colonial gaze.

Worrying about the grain of images in film and video is not new—an anti-aesthetic of blur made its way into the activist films of the 1960s and 1970s leading to Trinh's reference in her film to the slogan 'The bigger the grain the better the politics'. This move worked to embrace a style that was consciously unstylish—proclaiming through their mediums that

Fig. 1 Screenshot from Golden Snail Opera (*Source* https://vimeo.com/188 367219)

form itself could be elitist, that it should/did not matter, and that politically progressive documentarians should focus only on content. The disconnect between form and content is itself a fallacy, but thinking through the aesthetics of glitches, as a means to reveal the flaws and costs of the subjects or narratives, offers new possibilities of form that can engage with form rather than dismiss it. As Siddharth Sareen shows, artists such as the Norwegian group Rjukan Solarpunk Academy have been making use of low-carbon art such as textiles and other low-carbon materials as a means to produce stunning works and make statements on artistic impact (Sareen in this book). Visual anthropologists often draw from art theory to open up modalities of anthropology (Stevenson 2014; DeAngelo 2019). With the increased awareness of the energy and labor costs of unseen infrastructures like streaming videos, we can turn to glitch artists and glitch theory for a new reflexive turn.

Small Media Files and the Glitch Arts

As pixelated feet push into the impressions of flowers, the artists of the small media file, *I Missed You,* take advantage of a 'glitchcore' effect of 'datamoshing', which is the visual effect of compressing the data of media files to produce overlapping pixelations (see Fig. 2). The small media file features a barefoot caressing flowers and the datamosh allows the softness of the flowers to take over the human skin.

The media was included in the inaugural Small File Media Festival in 2020 at Simone Fraser University in a session called 'Sensuous Pixels' that illuminated the potential sensorial encounters that can be evoked through glitches. Other media files portrayed deliberate uses of glitches that come from hyper compressed files in ways that show how glitches themselves produce sensorial encounters while also acknowledging the energy costs of high-definition streaming video.

The inaugural Small Media File Festival sought to '[celebrate] low-bandwidth movies that stream with no damage to the planet!' The entries were constrained to five megabytes with a recommended goal of one megabyte per minute. As a comparison, a five minute 1080p, i.e. a full

Fig. 2 Screenshot from I Missed You (*Source* https://vimeo.com/446293399?emb edded=true&source=video_title&owner=120007755 [accessed 22 April 2022])

high-definition video uses about 50 megabytes per minutes. To translate this to energy costs, 1000 megabytes cost about five kilowatt-hours of energy (Constenaro and Duer 2012) which is the equivalent of 8.9 miles of car travel (see EPA carbon footprint calculator: https://www.epa. gov/energy/greenhouse-gas-equivalencies-calculator). While these costs of one viewer watching a 60-minute full HD video (approx. 3000 megabytes, equaling 15 kWh or 27 miles of car travel) may make the energy used seem minimal, the ubiquitous usage of the internet and streaming videos indicate a massive carbon footprint of streaming videos. This is contrasted by the fact that streaming video seems immaterial and therefore viewers use streaming services unconsciously. The festival at Simon Fraser University, organized by the film theorist Laura U. Marks and others, was founded upon principles that not only recognize the energy use but also decolonize high-definition media.

High-definition media, in part due to disparities in internet access, imposes disparities of media distribution and knowledge production. In most communities, while it presents an optimistic democratization of such media, including technophile moves to 'mediatise' homes,

(Aggeli and Mechlenborg in this book), it can reproduce power disparities. Among Indigenous communities in Canada, for example, the award-winning Inuit language film, *Atanarjuat: The Fast Runner*, was largely unseen by Inuit and Indigenous communities when it first was distributed in 2001, due to the lack of local cinemas and digital streaming options in these communities. In response, the Indigenous organization and production company, IsumaTV, created a distribution platform for Indigenous communities and filmmakers that sidestepped the problem of large media file downloads through several innovations such as local servers with pre-downloaded files, community television, and small file media. IsumaTV currently hosts more than 7800 Indigenous community videos in 70 languages and its projects with small media files work to inform local communities of key issues as well as story production. The anthropologist Katherine Sinclair directly links IsumaTV's work to awareness of environmental impacts of extractivist mining projects in northern Canada (Kunnuk et al. forthcoming). The lack of internet access in these communities means a lack of conversations about the extractivist mining projects that create barriers for the Inuit communities there. In this case, high-definition, high-bandwidth media reinforces colonial violence and small media files can upend it.

Marks and Przedpelski describe how the global disparities of internet speed fall along colonial legacies such that data-poor countries and communities like those who founded IsumaTV suffer greater impoverishment because of their low internet speed and that data-poor countries are also in greater risk for disasters due to a weaker disaster response without fast internet. They call this 'bandwidth imperialism' (Marks and Przedpełski 2021). High definition and taken-for-granted fast internet in 'overdeveloped' countries, they say, render the energy costs and disparities as unseen and alienated from their media. Projects like these demand an 'aesthetics of accountability' (Ginsburg 2018). For Marks and the other organizers of the Small Media File Festival, small file media

> create[s] a decentered multitude that sounds a manifesto for alternative ways of making and encountering art and of making (media) art relevant for present social, political, and environmental issues. Small-file media are inherently political in privileging the potential of the unseen and the

invisible by focusing on sound and the tactile qualities of the image as well as mobilizing other senses, rather than approaching the image in terms [of] what it represents—as a composition of determinate figures sharply outlined against a set background. (Marks and Przedelski 2021, p. 1)

The festival did not select pixelated videos for their own sake, however, organizers selected files that used glitches, both audial and visual, to evoke emotions and to tell stories. '[They] are not just bringing attention to something but also drawing out *something* from these moving images that already exists' as the pixel scholar, Azadeh Emadi, said on a panel called the 'Aesthetic Forum'. Indeed, glitch artists do not often extol the low-carbon footprint of their work but rather enjoy the forms of technological, usually electronically made errors. The group of artists who call themselves glitch artists purposely provoke errors through digital manipulations, circuit-bending, soldering, messing with wires, and rejiggering technical connections. Allison Tanenhaus, a US-based glitch artist, explained to me when talking about her work, 'It's really about reclaiming technology, at one point I remember being anxious about how much corporations were tracking us and how much they can scrape my data. I like to emphasize the faults in the system and play with them. I'm inclined to turn perfectionism on its head by experimenting and playing in a self-taught and self-directed way'.

Tanenhaus' pieces begin with a kind of autobiographical documentation—photographs she takes of her cat or of scenes from her life or old childhood photographs. She digitizes them and then alters coding, usually through a mix of presets and manual alterations within specialized apps, and then produces visuals with those documents. She says that she is interested in the ways in which these forms evoke sensorial encounters or 'emotional or psychedelic experiences' for viewers but recognizes herself in these pieces. Thus, the starting point for these glitches is almost ethnographic, empirical observations of being human. When she sees her own pieces, she recognizes the documented starting points but also enjoys the ways in which her phone's album is just a series of glitched photographs. A kind of privacy gets enforced by her chosen style. In her exhibits, she knows that others do not see the original images but she

sees them as an autobiographical timeline. Some of the pieces have more obvious references to scenes than others. In the GlitchKraft exhibition she co-produced and curated with the artist Ben K. Foley, a video shows a reference of jumpy cat images while another hallway surrounds walkers with rainbow optical art floors to make them appear moving (see Fig. 3). Tanenhaus' pieces include warnings about machines and surveillance in conversational tones (see Fig. 4) such as one that asks: 'Don't believe in mind control, OK'.

The machine is not the only problem in these constructions, but Tanenhaus also expresses her anxiety about the corporations who use these technologies. Glitches allow artists like Tanenhaus to rebel against these corporate powers through the forms that reveal coding or tech errors (in addition to art, she documents digital errors that she finds in public life). Like other glitch artists, Tanenhaus says that part of the fun is the art's accessibility even though she acknowledges barriers. 'You don't need a studio or expensive art materials—all my work is done with my smartphone and apps'.
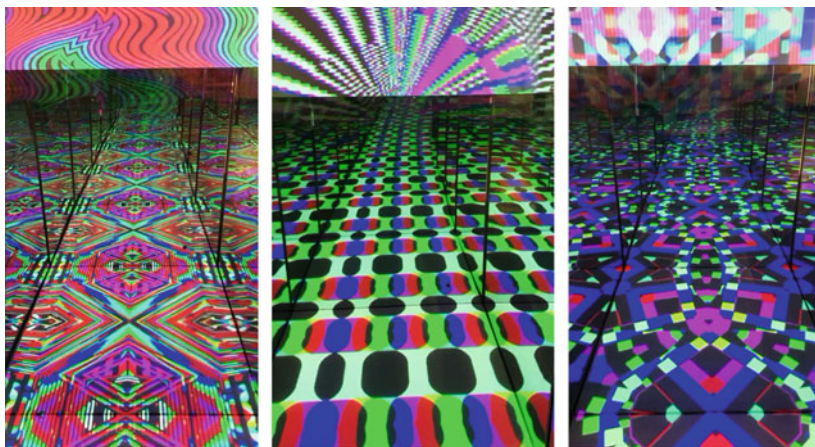
Fig. 3 Hallways from GlitchKraft Exhibit (*Source* From Allison Tanenhaus and Ben K. Foley)

Fig. 4 Conversational Art at GlitchKraft (*Source* From Allison Tanenhaus)

This tendency toward an aesthetic of do-it-yourself technologies and a sensibility of anti-corporate, error-oriented art allows glitch artists to express errors in ways that undermine neoliberal values of productivity and the ethics of 'well-oiled machines'. As Tanenhaus explains further in our conversation, '[Glitch art] is like veering in the opposite direction of mass-produced media, which is always being pushed to be as high-resolution, fast, and 4K as possible, with maximum filtering to make people look flawless, but attempts to make this seem automatic and effortless, like it's just the way it is. My work is just as unnatural, but in a deliberately and visibly messy alternative fashion'. The forms engage with the horrors of neoliberal productivity, commodification, and corporate extractivism of personal data, leading her to think through other modes of human extractivism and the human over-reliance on screens. Indeed, the errors themselves call attention to the medium of screens. As Marks (1998) has pointed out, the central issue with streaming video is how audiences perceive its lack of substance. Glitches bring attention

to the substance of machines. For example, the datamoshing of *I Missed You* evokes tactile encounters, forcing the viewer to see the architecture of the digital. If moving images can be understood as 'haptic' (Marks 1998) rather than visual, glitches in its rendering can re-materialize the unseen costs of their constructions.

Multiple Visual Anthropologies

In anthropology, the response to the pandemic has been an acknowledgment that fieldwork has always already been 'patchwork', in that the division between field and home is a false dichotomy and that short-term field trips and remote connections with interlocutors must be considered valid data (Günel et al. 2020; Tsing 2005). Visual anthropology, too, should respond to the global energy crises just as ethnographic field methods are reframed and reconsidered. Glitch art opens the possibilities for thinking through errors and small file media modalities to utilize low energy consumption techniques. Pixelations, jumpy movements, and sonic irregularities can enhance ethnographic and artistic engagement and answer anthropology's call to portray aspects of being human from the very data that anthropologists collect, rather than merely resisting style or aesthetics in order to make a point about stylistic elitism.

This call for a glitchy visual anthropology is not meant to prescriptively dismiss high-definition video. Indeed, the superhuman sight represented by increased frame rates, high-definitions, and digital advances have important places when it comes to producing sensorial encounters that speak to human and nonhuman beings as seen with multimodal experimental collaborations like *The Golden Snail Opera* (2016). Not all visual anthropology must become glitchy. Instead, glitches can be utilized for thematic and ethical reflections. Streaming video is an increasing energy cost, computer tech industries depend on the exploitative labor and forced child labor, and internet infrastructures like data centers besiege places where global digital divides increase disparities. Experimental media in glitch art attends to the costs of form through errors and unveils the faults of a system full of ever-present issues.

Live streaming and high-definition videos are relatively small stressors on the health of our planet, but any response to anthropogenic climate change must be multi-pronged and deliberately reflexive. Glitches provide us with an opportunity of reflection. As energy scholar Michael Fell has pointed out, the impact of environmental stressors varies, so that a just system must allow for flexibility when it comes to solutions such as renewable energy (Fell 2020). A new reflection is especially relevant when anthropologists collaborate with artists from places with fewer resources and lower bandwidths or with nonhuman actors who suffer more from the impending climate crises. When we produce modalities and undertake methods that use moving images, a glitchy framework decolonizes assumptions, wiping away the gloss of high definition. Exhibition Fig. 6 follows this chapter.
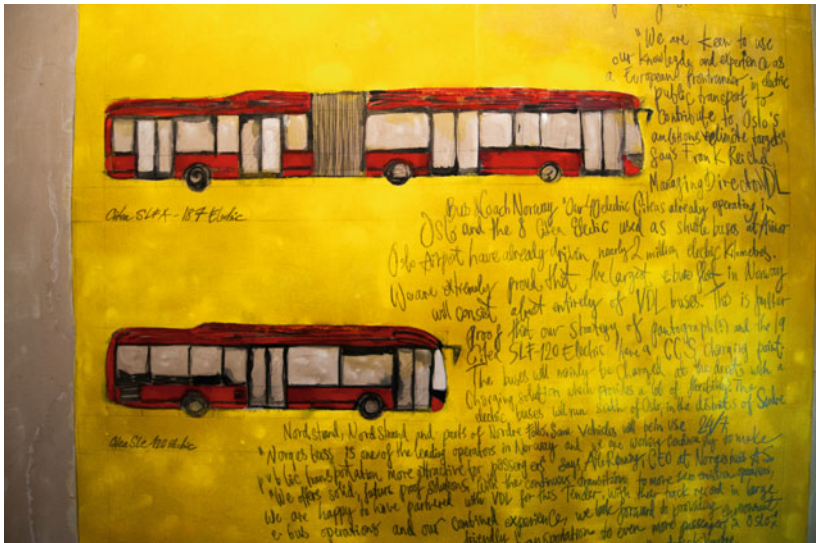
Exhibition Fig. 6 Detail view of a textile with electric bus technical specifications (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

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The Hidden Energies of Work Digitisation: A View from France Through the Use of Coworking Spaces

Nathalie Ortar and Aurore Flipo

Introduction[1]

There is no shortage of terms—such as the collaborative economy, the sharing economy or cognitive capitalism—to describe the new work practices and organisational innovations brought about by the spread of Web 2.0. Among them, coworking spaces, which first appeared in 2005 in San Francisco and were popularised in Europe in the 2010s, have gradually become a symbol of new ways of living and working. According to some scholars, coworking has four cardinal values (Gandini 2015): collaboration, openness, community and sustainability, while digital tools could be supporting the green transition through the processes of bricolage, remediation and participation (Deuze 2006).

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[1] Chapter translated and edited by Cadenza Academic Translations.

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However, while some experts consider the three 'D's—Decarbonisation, Decentralisation and Digitalisation—as the main drivers for change in the years to come (Monnoyer-Smith 2017; Silvestre et al. 2018), new demands keep surpassing energy savings (Røpke 2012). Although the cloud is an extremely expensive and energy-intensive enterprise, sensing media, platforms and algorithms have intensified data capturing and processing over the past decade (Velkova 2021), not only because of the large capital outlays involved in constructing data centres but also because of the costs required to constantly power these places and their multiple failover sites (Taylor 2018). As Julia Velkova argues, this process helps 'to install a new configuration of economic and social relations that can serve simultaneously computing machines, the platform economy and old energy monopolies, while not necessarily breaking apart from the carbon regime' (Velkova 2021, p. 665).

In this chapter, we examine the effects of the digitisation of work tools on lifestyles, patterns of energy consumption, practices and representations of energy. We describe how ecological concerns factor into the residential and professional choices underpinning the practice of coworking, the uses of coworking spaces, as well as the transportation practices. This portrait of practices provides an opportunity to explore the representations and narratives surrounding the energy transition in those places; narratives presented by urban planners and governmental agencies as examples of how digitisation can promote sustainability.

Coworking is linked to the 'third places' movement (Oldenburg 1989) which designates a broad range of collaborative work places such as coworking places, but also fablabs, makerspaces and repair cafés. In France, the development of a broad national grant programme for 'third places' has spread this label among a diversity of actors, and created a common identity with the creation of a national agency called 'France Tiers Lieux'. However, their actual definition remains very lax and focuses more on intentions than actual content: Trier Lieux or third places are defined as 'places that reunite diverse activities, participate in the local economic development and animate a community'[2] or 'places

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for doing together (…) that have spread thanks to the digital development on the territory'.[3] Movilab, one of the first networks of third places states in their 'Manifeste des Tiers-Lieux' (Manifesto of Third Places):

> The growing importance of digital technology, as well as economic and ecological issues, has a direct impact on organisations, whether they are private, public, associative, national or international. Every sector is facing the urgent challenge of finding solutions to reconstitute a viable, decent and sustainable value system. […] Third Places facilitate the experimentation that is made necessary by these changes on the human, societal and economic levels. Thanks to their independence, they create a foundation of common sense in this changing society.

The Ministry of Territorial Cohesion also argues that third places are 'tools for local sustainable development', based on their values, potential impact on mobility thanks to telework and their capacity to foster local initiatives.[4] Third places more generally thus support sustainable urban and rural development by constituting 'spaces of possibility' and of social transformation (Kagan et al. 2018). Indeed, some argue—including the promoters of the French national grant programme—that third places would then be the bearers of a 'collective dynamic' embodying local transitions (Besson 2018). Furthermore, the close association, within the Third Place movement, between the pro-sustainability and pro-digitisation can be explained by their social proximity (Berrebi-Hoffman et al. 2018). The creation of coworking spaces is concomitant of the development of mobile communication technologies that have fostered the growth of professional activities carried out remotely, allowing for the combination of physical and virtual mobility in a 'spatio-temporal continuum' (Rallet et al. 2009).

Royston et al. (2018) have called the invisible energy policies non-energy policies inducing energy consumption. Third places belong to that category as they rely on growing digitisation and cloud storage,

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[3] Ministry for Territorial Cohesion (Ministère pour la Cohésion des Territoires). Translator's note: Unless otherwise stated, all translations of cited foreign language material in this article are our own.

[4] Levy Waitz, P., 2018, *Faire ensemble pour mieux vivre ensemble. Rapport de la mission coworking*, CGET, p. 88.

because most computing needs are now implemented as web services and because the cloud storage has become the default storage option of the majority of digital devices (Ortar et al. 2022). Furthermore, if working remotely reduces the frequency of daily commutes, the commute's overall length and other daily travel behaviour might increase, because coworking options affect residential choices (Kitou and Horvath 2003; Mokhtarian et al. 2004; Rietveld 2011; Kim et al. 2015; Cerqueira et al. 2020). Indeed, the literature on coworking has emphasised the innovative dimension of these new workspaces (Capdevila 2013; Cohendet et al. 2004; Cléach et al. 2015) and the importance of the professional network they provide (Blein 2016; Scaillerez and Tremblay 2016; Spinuzzi 2012; among others). However, the search for a work environment perceived as more productive, less distracting and allowing for a better separation between the private and the professional is one of the main reasons for workers to use coworking spaces (Brown 2017; Spinuzzi 2012; Flipo and Ortar 2020). This contradicts some of the assumptions of the manifesto—or the governmental agencies—regarding the disruptive character of the users of these spaces as well as their attention to ecology, or their personal involvement in collective movements, and territorial and social innovation.

In this chapter, we examine the silences surrounding certain uses of energy (Ortar 2014) or what we call the 'hidden energy uses'. The communities and people who use these collaborative workspaces offer justifications and this allows us to highlight some of the unspoken effects of the ongoing energy transition which, unlike the previous one, does not imply a modification of the nature of energy, but of its modes of production, thanks to the use of so-called renewable resources, and of a change in social practices surrounding the consumption of energy (Loloum et al. 2021).

This chapter is based on a survey conducted between 2017 and 2020 in the Auvergne-Rhône-Alpes region as part of the ANR Coworkworlds project (Lejoux et al. 2019). This region is distinguished by its high proportion of professional and managerial staff with dynamic work environments. An inventory of all coworking spaces open at the time of the survey indicates that although 47% of the coworking spaces are located in the centres of big cities, there are also many in the suburbs,

medium-sized towns and rural areas, attesting to the geographical spread of coworking (Leducq et al. 2019).

In order to characterise the coworker population, a quantitative survey was administered to 377 individuals. A lot of them work in the digital sector, thus developing platforms, software or designing digitisation tools. Semi-structured interviews have been conducted with 40 coworkers who agreed to be contacted after the questionnaire. For this survey, the researchers sought out a diversity of professional and family situations, as well as a diversity of spaces frequented. In addition, a socio-anthropological fieldwork has been conducted in different third places in rural and urban areas. During this fieldwork, we also verified that most of the coworkers have internet intensive ways of working as they rely on it to communicate, store their data and work collaboratively.

Coworking as Part of a Life Project: A Life Choice, an Ecological Choice

For the urban as well as rural coworkers, the common point of all those life stories is the desire to make one's professional activity meet their values and aspirations in life. However, ecology is not the only value displayed: freedom is also central to coworkers' narratives, a freedom of moving around rendered possible by digitisation which is not put into question even when it might contradict the value put into ecology.

Focused on the potential disruptive effects of the sharing and the collaborative activities supposedly being led in those places, the Third place manifesto—like most of the institutional descriptions of collaborative workplaces—does not question the motives that lead people to frequent those places. However, the interviews we conducted show that the collaborative dimension is often limited to ordinary sociability while motives related to life choices are omnipresent. Two key moments transpire as origins of the decision to become a coworker: that of a biographical turning point, and that of a sense of dissatisfaction with working from home. In both cases, it is a matter of agency and of constructing one's own life, of mastering one's own experience (Wieviorka 2008), and therefore of adjusting to constraints, adapting one's

plans to find a balance between the sometimes contradictory desires linked to career goals and to the living environment. Coworking is one of the ways in which this adjustment can be made.

The biographical turning point is 'a major and abrupt change in the direction of one's trajectory, whose timing and outcome are unforeseeable, both for the actor and for the sociologist' (Bidart 2006, p. 31). The decision to start using coworking spaces constitutes a turning point because it results in a radical change in the place of living, whether the employee continues to work—now remotely—for the same employer, or has a radical transformation in the nature of their activity. The nature of the event—understood as a clear dividing line (Bensa and Fassin 2002)— giving rise to the turning point is remarkably similar in rural and urban areas, and the only factor affecting it is the stage of life.

The origins of these turning points for cowork space users are numerous, whether it is the end of a work contract or a lease, an experience of professional dissatisfaction, a desire to be elsewhere or to be closer to family and friends, or even educational choices. More rarely, the choice of a particular lifestyle is made as soon as an individual has completed their studies, as was the case for Mélanie, a designer who travels for six months of the year while working since she finished her schooling. The characteristic feature of these choices is that they reflect a search for meaning in one's daily life, which involves not only the meaning given to one's professional activity but also the relationships established with one's family and environment. Coworking thus contributes to a life project in which professional activity is embedded in and indicative of a new form of 'lifestyle migration' (Ortar 2015), in which ecological considerations might also be present.

The figure most frequently encountered is that of the employee of an international company, tired of a life in Paris or abroad, who decides to live in a smaller town or a village in a chosen geographical setting. The decision to make a change is here associated with the search for a new living environment and is often accompanied by a move to self-employed status or the creation of a new activity. However, what is meant by living environment and where the attention to ecology is put differs significantly from one individual to another, and between urban and rural areas.

For example, after two years in London, Etienne, who was single at the time, wanted to return to France. This plan was accompanied by a transformation of his professional activity: whereas he had previously been working in the online retail sector, he and a friend had just launched a platform for selling organic products when we met. Although conscious of the energetic costs of such a retail, he justifies it by the nature of the products sold. While living out of the web activity, his other choices are consistent with a low energy consumption lifestyle: he chose to live in Lyon because of its TGV high-speed rail service that allows to avoid taking planes and because of the city's amenities, including the possibility of getting around by bike on a daily basis. This search for a city of short distances, where it is possible to get around without a car—and in fact very few of the urban coworkers surveyed own a car—while maintaining fast connections to the rest of France thanks to high-speed rail service, was constantly mentioned by respondents, and it contributed to the choice of Lyon rather than other large French cities. The vast majority of those coworkers are therefore aware of the energy costs associated with travel although they keep travelling often for work reasons. In Lyon, they put this awareness into practice in their daily lives. The choice of lifestyle thus corresponds to compliance with ecological values and is reflected in the fact that the chosen place of residence may allow daily travel using low- or non-polluting modes of transport. For longer journeys, whether they are for business or for leisure, low-polluting modes of transport are also sought after.

The motivations of respondents in rural areas are both similar and different, if only because they are at a different stage of life. These people, who are older on average, settle in rural areas with their families. Stéphane's geographical and professional background, for example, is very similar to that of the urban dwellers. He left his job and moved to the countryside to 'put down roots' after years of international mobility. The top priorities in his search for a place to live were the local landscape and climate. For all the families we met, it was essential for the living environment to be pleasant and for the chosen home—a house in the vast majority of cases—to be within the available budget, which most of the time in this touristic region involves living in quite remote areas. The use of a car was then presented as a necessary part of rural life.

Travelling shorter distances by car is presented as a lesser evil than making long-distance journeys. Maëlle, in her thirties, is a photographer. She has been living in the Drôme for a year after having spent several years travelling around the world for work. Although she uses her car almost every day, arguing that it is difficult to do otherwise in a rural environment, when she mentions her desire to settle down, she shows an ecological awareness and the consciousness of the implications of her life choices:

> It's fine, I've travelled around enough. And as for my lifetime carbon footprint, I think I've already used up my fair share. […] One of the reasons why I wanted to settle down was that my nomadic international lifestyle, citizen of the world, what have you, being on a plane every month, it didn't suit me at all. It didn't fit at all with my political and ecological ethics.

Many users of coworking spaces have experimented other forms of travel, a 'wanderlust' which corresponds to a form of cosmopolitanism, typical of urban classes with high cultural capital (Andreotti et al. 2013). Take Quentin, who spent four years travelling the world by bicycle:

> I left Crest and arrived in Argentina by bike… I took a boat to Dakar, then to Brazil … then travelled by bike to Argentina. An itinerant journey. […] It was at once a desire to travel, a desire not to take a plane, and a desire to travel slowly, to experience the distance covered, to meet people … all these positive aspects too. It wasn't just a form of penance.

Like Maëlle, he shows an awareness of ecological concerns and of the pollution linked to fossil fuel transportation as well as a desire to change his relation to speed and to the world, but not to the point of giving up travelling—especially abroad.

Finding the Right Distance: From Home Working to Coworking

Getting around is, however, only one aspect. Let us now return to the choice of working in a coworking space and the consumption induced by this choice. Whereas for the urban respondents, this choice was part of their decision to change their life, and some had even looked for the available coworking spaces while investigating for a city to move to, this was less the case for the rural respondents, in particular those who arrived before the appearance of coworking spaces in rural areas or who made this decision after having been confronted with the difficulties of working from home. Indeed, while leaving a company or working remotely is a positive choice for them, working from home appears to be an inevitable consequence often described as an inconvenience, regardless of family and professional situations. Working from home requires a discipline often perceived as burdensome, especially for the self-employed, who have to impose on themselves a work rhythm that is not conditioned by other employees. The issue of gender also illustrates the ambiguities of working from home as domestic and professional workloads are often difficult to combine in the space–time of the home (Felstead and Jewson 2000; Flipo and Ortar 2020; Hardill 2002; Ortar 2018; Tremblay and Genin 2008).

Using a coworking space re-establishes a spatial and temporal separation between the professional and private spheres. It gives access to a professional space which frees the domestic space of work consideration. Like disconnection practices and the use of tools such as separate phones, silent mode, etc., intended to manage the continuous flow of information and communication in a sustainable manner (Fernandez et al. 2014; Belton-Chevallier and De Coninck 2007), coworking spaces are a 'sociotechnical device' that permit to mark out spatial boundaries for work (Belton-Chevallier and De Coninck 2007).

However short it may be, the journey to the coworking space creates a break between the private and the professional, but due to the lack of public transportation and cycling infrastructures (Flipo et al. 2021) induces a high level of car use even for short trips in rural areas. The data from our questionnaire shows indeed that the car remains the most

common way of transportation for rural coworkers (for 53% of them), and their work trips made by car are almost double compared to their urban counterparts (Flipo 2020).

Living in a highly car-using environment is another reason. Alice, a rural dweller and mother of a little girl, uses her car four times a day to travel to a coworking space only 1.5 km from her home. She plans to cycle there at an unspecified time in the future, but even then, only half the time:

> It would be good to cycle in the afternoon at least. I could go home and come back by bike. It works better that way when you're working to a timetable, because when you have to be there at five to nine, it's a bit of a rush in the morning, so it's easier to drive in. The journey isn't so bad because I live 1.5 km away and it's flat, which is quite rare here. So I have no excuse.

The energy costs and polluting incidence of travelling around with a car appear quite spontaneously in the conversation and the interviewees are aware of the energy costs of the pollution generated by getting around by car, which Alice expresses here when she says that she has 'no excuse'. May it be in a justification or a defensive mode, those costs are thus known and acknowledged.

For most, the electric car is seen as an acceptable lesser evil, as Mickaël explains: 'I'm really happy to no longer have a combustion engine car, partly because of the incomparable comfort of having an electric car, and partly because it doesn't use fossil fuels'. However, he would be glad if he could do without it and not have to worry about 'the maintenance, parking, cleaning, the upkeep, all that. If I could just, for example, do everything by bike … go to the station in Crest, put my bike on the train, I don't know… I think I could happily do without it' (also see Datava et al. in this book). Still, the electric car emerges as the element that helps reconcile lifestyle and professional choices with personal ethics, as Clément explains when he justifies his use of an electric car:

> I work for a SCIC [société cooperative d'intérêt collectif, or public-interest cooperative] that develops renewable energy projects. So our carbon impact, our ecological footprint, etc., is quite a priority for us. So if we install renewable energy production capacity, but at the same time we run trucks and so on, there's going to be a calculation to be made. And if it works out to be as carbon negative as possible, then so much the better.

The commuting mode of travel chosen to get to a coworking space on a daily basis is particularly revealing not only of the issues surrounding homeworking and transportation but likewise of how the incidence of some of the lifestyle choices made are questioned or not and of the connections made on a daily basis between the values displayed by the coworking spaces and their implementation by the people who frequent these spaces. Indeed, few envision parting with a vehicle, as to change practices is a complex decision even when car use creates a feeling of a lack of coherence with one's values, as Yannick illustrates:

> I looked at the scrappage grant schemes, things like that, trying to replace two cars with one: two old cars with a slightly newer one, because we have to pay to maintain the cars. That's the way it's going. My wife and I are in the middle of working it out. We're changing our modes of transport, we're adapting, we're relocating the place where we work. My wife goes to work by train, because we live in Saint-Hilaire and there's a station here. She works near the TGV station in Valence, so she gets by train there. The idea is to try to use sustainable modes of transport, because I think that in the future, whatever happens with the gilets jaunes [the 'yellow vests' protest movement], fuel prices will continue to rise. Modes of transport will change. The approach based on the dominance of the car will no longer work because we can't seriously say that moving 1,500 kg to transport 100 kg is smart. It's absurd whether the car is powered by electricity, hydrogen, petrol, gas, compressed air, thermonuclear, or whatever. We're transporting 1,500 kg, but we only need to move 100 kg, a human body. People often say: 'Ah, the electric car this, the electric car that…' It doesn't matter—it's still a car!

Silent Consumption: The Consumptions of Remote Working

While the consumption involved in transportation is clearly identified and is the subject of discussion and even of residential choices aimed at reducing it both in rural and urban areas, other forms of consumption are passed over in silence. Indeed, even though most of these people are attentive to the modes of production of the electricity they consume on a daily basis, even if they seek to reduce their food miles, look for economical modes of heating and have renovated or wish to renovate their home to make it more energy efficient, the energy consumption induced by the use of information technology and in particular data centres is silenced (see the Introduction in this book).

All the respondents use computers on a daily basis. Some have two computers, one in the coworking space and another at home, while others carry around their computer on a daily basis. All of them are used to sharing data or even working exclusively with data available on online workspaces. To meet this demand, in rural areas, because of the frequent lack of speed of the landline connection, some coworking spaces top up their ADSL with the 4G network, or use multiple ADSL connection aggregators, increasing thus the energy consumption of remote working. Despite this, the question of the consumption generated by these working methods is never mentioned by the coworkers, not even by those who use coworking spaces that claim to have ecological values and standards. Those coworking spaces' policies generally relate to the limitation of waste, the creation of compost, the insulation of buildings, the green economy, etc., but not to the overconsumption associated with their very activity.

For Cécile, founder of a Third Place in a small town, sustainability is a target for her place. However, she only refers to the building's lack of energy efficiency issues:

> Our wish is to work towards practices that promote the respect of the environment, and of the human being. If possible, become an exemplary place one day. But we know very well that this is an old building, there is an oil-fired boiler … it takes time. Of course, we would dream of a

place with wind turbines and solar panels. (…) [Sustainability] is in the background, it can be seen through the garden, with the permaculture (…) We haven't selected activities based on their link with sustainability, but there are quite a lot of people working here who are in the field of sustainable development in the broad sense actually.

When she mentions the professional activities being performed inside the building, she focuses on the purpose of the activities (sustainable development) rather than the means being used (digital technologies). This apparent paradox exemplifies the perception that the digitisation of the society is a lever for reaching sustainability as we mentioned at the beginning of this chapter (see also Monnoyer-Smith 2017). Moreover and similar to what Lautrup (in this book) describes as making things less abstract and more concrete, energy efficiency is measured through the lens of local consumption and does not include the deterritorialised effects of the digital economy such as data centres which are not present in those rural surroundings and are ignored by the urban dwellers as long as they are not directly exposed to the social and ecological problems as well as the energy disruption they create (Ortar et al. 2022). The ecological and energy implications related to digitisation of the use of these spaces are thus absent from the discussions, despite the fact that their alleged 'sustainability' dimension is at the centre of most of the public policy schemes developed by diverse public institutions in the last ten years. The silence is therefore not only that of the policies but of the very developers of those places and of their users, however well-informed they might be on other issues, such as transportation and building insulation. The silence here is both telling of a general lack of awareness on the subject as well as of the difficulty to raise attention to the effect of indirect consumption, the invisibility being linked here to the incapacity to measure and directly pay for the energy consumption generated by the digitisation of the work environment.

Conclusion

The exploration of narratives surrounding energy uses made by coworkers has shown the broad diversity of interpretations and arrangements linked with the energy transition and its implications for those working in highly digitised labour markets. It shows that though most of the coworkers display eco-friendly values, they are expressed rather by an awareness towards their personal carbon footprint than by local collective action, thus questioning the disruptive dimension of coworking spaces and their ability to implement 'local transitions', which the Third Place movement or public policy have claimed in recent years. Their rather individualistic perception of ecology shows that the call for individual responsibility that has been at the centre of public policymaking in the field of sustainability in the past 20 years (Dubuisson-Quellier 2016) has been internalised by those highly educated, highly skilled and predominantly urban segments of the population, but suffers from many contradictions that coworkers try to deal with—or simply ignore, the implication of the digitisation of work being one of them.

Indeed, engagement with the issue of transportation gives rise to the difficulty of matching values with actions, which may require a change in lifestyle choices. Conversely, what we find among the people who have made such choices is that coworking leads to a profound transformation in the organisation of daily life and of the residential location. Yet, the very effects of the so-called 'digital revolution' seem to be overlooked. The lack of awareness of the ecological costs of digitisation by those same persons that develop and use it, is first telling us something about the general lack of awareness in France surrounding the energy costs of its use, despite a growing consumption as the spread of digitisation allows among other things more remote lifestyle choices, a growing tendency before and even more so since the COVID-19 pandemic (Lejoux et al. 2022).

Moreover, faced with this disjuncture between, on the one hand, a daily attention to ecological issues and energy use, and, on the other hand, the silence surrounding the overconsumption linked to digital practices and the duplication of workspaces, we propose the hypothesis that there is a divergence within the forms of appropriation of the

norms of the transition towards sustainability. Although some people have turned decidedly 'anti-digital', those who are 'pro-digital' think that digital technologies can support the ecological transition, and this includes a line of thought that stems in part from the hacker community, which was at the origin of the concept of Third Places. More generally, this dimension overlaps with attitudes to technology, and the opposition between those who think that technology is the cause of environmental problems and those who think it can provide a solution to those problems. This divergence partly comes from the most classical opposition between ecological modernisation theories that support technological innovation, and degrowth theories that believe on the contrary that excessive modernisation is the cause of the ecological crisis and is unable to solve it (Rudolf 2013), and embodies the renewed relevance of this debate in the context of the current acceleration of digitisation. Exhibition Fig. 7 follows this chapter.
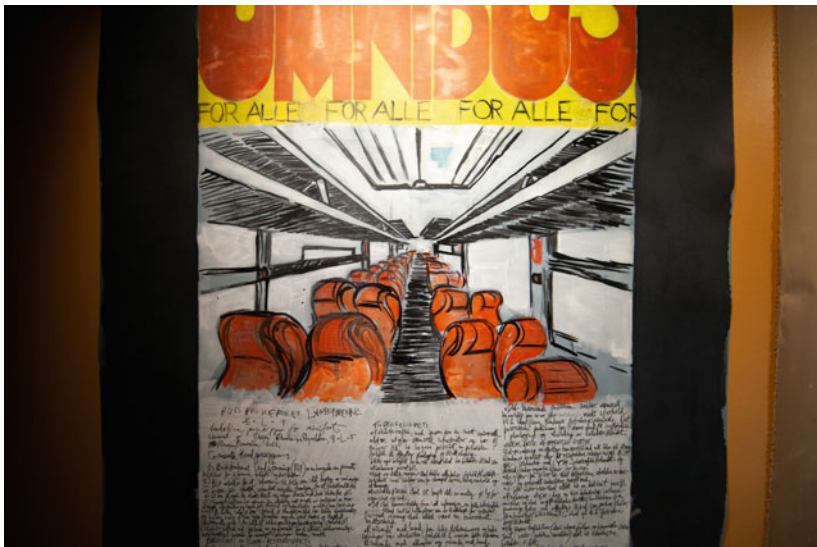
Exhibition Fig. 7 Solarpunk principles for a National Association of Bus Users manifesto (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

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Littering the City or Freedom of Mobility? The Case of Electric Scooters

Zane Datava, Tomas Skjølsvold, and Marius Korsnes

Introduction

Over the last years, urban mobility across the globe has been heavily impacted and transformed by the rapid influx of free-floating electric scooter (e-scooter) services (Christoforou et al. 2021). These services combine 'advances in mobile apps, routing, and GPS technology' (Ruhrort 2020, p. 6), with access to dockless scooters for anyone willing to install an app. The sudden arrival and rapid rise of these services have been hailed as ushering in a new era of sustainable urban micro-mobility where the role of privately owned cars and vehicles might diminish (e.g.

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Edge et al. 2020), but they are also contested, based on concerns for their role in increasing the demand for minerals and metals in battery production (Hollingsworth et al. 2019), conflicts with pedestrians and conflicts over the use of space (James et al. 2019), as well as their broader role in urban developments (Hosseinzadeh et al. 2021).

In this chapter, we explore the co-production of e-scooters, infrastructures, users and non-users, with an interest in the e-scooter's impacts on urban space and generation of waste. Through this, we explore what is lost and gained as e-scooters enter as a sustainability-oriented 'innovation', and what this technology adds to existing modes of mobility and mobility infrastructures. To understand better how this novel mode of mobility is enacted and experienced in the cityscape, and potentially ends up generating more waste, we focus on e-scooter users, e-scooter opponents and e-scooter distributors. This approach generates new knowledge about how a broad range of actors understand and enact this new form of mobility, as for instance called for by van Waes et al. (2020).

Through addressing these topics, we intervene in ongoing debates about the proliferation of electric scooters in urban environments. These debates tend to highlight how the e-scooters become obstacles for pedestrians, cyclists or those who have impaired sight or hearing. E-scooters are also contested due to their roles in accidents. An active global resistance against e-scooters exists. In Norway, this is organised through the Facebook group *La oss ta fortauene tilbake!* (Let's take back the sidewalks!). The group consists of more than 16,000 users, who argue that riding e-scooters on sidewalks should be banned, that parking should be publicly regulated and that speed limits should be enforced. Reacting to increasing numbers of e-scooter accidents (Tu.no 2019), various activist initiatives have emerged also in Trondheim, e.g. through the organisation of teams that remove e-scooters from sidewalks (Flatås and Ersfjord 2020). Technology developers are also addressing such issues, e.g. by developing apps that stop e-scooter users from ending a trip before the scooter is safely positioned in a safe, specially designated place (Sundby and Isachsen Sandøy 2021). The remainder of this chapter is organised as follows: the sources of our data are described in the upcoming part 'data and methods', the e-scooter placement in the context of the twin transition is described in the following part 'The twin transition

of the electric scooter'. Further, in 'Theoretical perspectives: The co-production of socio-technical change and spatial justice', social justice aspects connected to bringing in a new technology are explored. 'Digital urban mobility: access to the paths and freedom of movement as an embodied practice' looks at the e-scooter use from 'inside' and analyses its users' experiences. The concluding part, 'Matter out of place: The digitised urban landscape in flow', shows how an e-scooter might become a hindrance and cause congestion instead of easing it.

Data and Methods

This chapter combines interviews, ethnography, photography and social media analysis to explore electric scooter use, attitudes towards it and co-existence in the urban surroundings. The material includes 20 interviews with electric scooter users (14), electric scooter opponents (4) and distributors (2). The age range of respondents was 23–68 years, and the length of interviews varied from 30 min to 2 hours. Participants were chosen by using the snowball sampling method. This method allowed us to grow a pool of diverse participants, as well as to access participants who were hard to access, or 'hidden'. In many cases, such participants are hidden because they belong to vulnerable groups, but in our case, they were hidden due to speed: e–scooter users were often difficult to stop while cruising at 20–25 km/h. Interviewees were located in Trondheim, Oslo and other Norwegian cities. Due to COVID-19 restrictions, interviews were partly conducted digitally. The interview material was primarily analysed using narrative analysis and supplemented with the results from coding. Interviews were supplemented with participant observation and ethnographic observations on electric scooter use and displacement. Around 100 hours of direct observations were done, underpinning the analysis in this chapter alongside interviews.

Oslo had most e-scooters per inhabitant among European cities in 2021: 191 e-scooters per 10,000 inhabitants,[1] and as such is a very useful example for our study. Three research trips to Oslo were made during the

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[1] https://fluctuo.com, accessed on 31 March 2021.

research project. Participants were also interviewed on the street, about 10 short interviews were conducted by taking contact with e-scooter users while they were about to start or end their trips. A collection of more than 100 pictures was assembled in Trondheim, Oslo and Bergen from September 2020 to August 2021 and analysed regarding the use of space, parking and assemblages with other urban elements.

Further, we analysed the content of the Facebook group 'La oss ta fortauene tilbake!' to understand current attitudes and perceived problems around electric scooters. This group continuously provided updated visual ethnographic material about e-scooters use from urban sites across Norway.

The Twin Transition of the Electric Scooter

There is a growing body of scholarly literature on the implementation of e-scooters, which suggests that this technology can be related to a broad set of social and environmental issues. Examples focusing on social aspects deal with contestation and conflict over access to urban space, e.g. between e-scooters, pedestrians and users of other mobility devices (James et al. 2019). Gössling (2020) analysed media articles from 10 different cities across the world, focusing on e-scooter implementation, regulations, as well as local problems and solutions, concluding that e-scooters can both help solve urban mobility issues, (congestion, pollution), and contribute to urban mobility problems (inappropriate parking, littering, safety). The environmental aspects of e-scooters have been studied through lifecycle assessments (LCA), which have illustrated that their greatest environmental impact lies in the production process (Hollingsworth et al. 2019), as well as their short lifespan which causes pollution compared to the transport options they replace (Moreau et al. 2020).

Such discussions indicate that through observing the implementation and increased use of e-scooters, we might observe a socio-technical transition, where a diverse set of elements changes over time and across scales. Geels and Schot (2010) note the systemic traits of such transitions,

foregrounding how they entail simultaneous shifts in technologies, practices, regulations and culture. In the case of e-scooters, the most obvious expression of such a transition would be the visible expression in changed ways of doing urban mobility. These changes, however, rest upon broader socio-technical changes, including all the digital innovations that over the last years have given rise to what Van Dijck et al. (2018) dubbed the platform society.

Scholars have noted that while shared mobility services both for cars and bicycles are not novel phenomena, they remained small niches until the use of mobile and digital technologies escalated in the late 2000s (Ruhrort 2020). Increased connectivity associated with these developments and new modes of communication between users and service providers have opened windows for innovation on behalf of new types of actors (Wang and Wells 2020; Ruhrort 2020), leading some scholars to conclude that the logic of digitalisation is one of the key drivers pushing the roll out of shared mobility in general and shared bike- and scooter services in particular (Sareen et al. 2021). Hence, our account in this chapter is fuelled by an interest in observing how an object such as the electric scooter transforms urban space and mobility, but also by a curiosity about the nested layers of infrastructure, including digital ones, that enable such shifts.

E-scooters also represent a new site for the proliferation of batteries as an enabler of energy and mobility services, a trend that is expected to grow as mobility and energy transitions unfold together with digitalisation (Magnusson et al. 2020). Such combinations of technologies, infrastructures and practices have environmental, climatic and social consequences. What these consequences are, however, is not determined by the technology as such, but by the concrete ways that these technologies are used, placed and discarded. It is therefore central to probe the contemporary use and contestation of e-scooters to understand which roles they might play in the future.

Theoretical Perspectives: The Co-production of Socio-Technical Change and Spatial Justice

Innovation as Co-produced

Our theoretical approach is inspired by socio-technical and co-productionist perspectives on innovation and urban environments. Such perspectives reject linear understandings where technologies move from invention to implementation, and take on an understanding of change as co-produced by technology, users, practices, infrastructure, policies, etc. This includes a focus on changed interaction and experiences of urban life (e.g. Graham and Marvin 2002). As part of this, one recognises that urban environments are constantly being reconfigured according to different, sometimes conflicting, interests. This suggests that studying how new technologies such as e-scooters are currently used, is essential also to understand future innovation trajectories (see e.g. Schot and Kanger 2016 or Berker et al. 2005 for discussions about the role of users in innovation).

This is reflected in the work of Akrich et al. (2002), stating that innovation processes tend to be multi-layered, non-linear and unpredictable despite of careful planning. As they point out, '[i]nnovation by definition is created by instability' (Akrich et al. 2002, p. 195), and their examples show that innovation both needs the instability in order co-produce a market, and at the same time, instability makes the implementation of the innovation vulnerable. Even well-designed innovations with a clearly defined customer and market may surprise the innovators, as the customers may use the innovation in a totally different way or abandon it entirely. In this understanding, innovation takes place in the meeting of social environment and the new technology (Akrich et al. 2002).

To us, these perspectives suggest looking at e-scooter innovation through a variety of actors and discourses, including existing infrastructure and its extensions, politics and regulations, activist groups and their impact, and of course, the production and use of electric scooters, including shipping, batteries, charging, maintenance, as well as potential for recycling. Electric scooter users and their usage patterns are an important factor, and businesses distributing and running electric scooter

companies need to be taken into consideration as well. In short, a wide array of actors interact and co-produce the potentials and pitfalls of new electric micro-mobility technologies.

Spatial Justice Perspectives

Beyond a co-productionist perspective, our analysis takes cue from work that links ideas of justice and spatiality (as also addressed by Sareen in this book). An often-ignored question relates to who can and cannot use a particular space. There have been ongoing debates of the right to the city, which often are referred to in relation to the 1970s discussions on the 'production of space', which French sociologist Henri Lefebvre saw as a civic right (Lefebvre 1991). We can continue to question who has the right to make space, for whom the space is made, and to explore the kinds of relations that are produced in the process of changes, such as implementation of new mobility devices. As pointed out by Soja (2010, p. 5), 'the spatiality of (in)justice […] affects society and social life just as much as social processes shape the spatiality or specific geography of (in) justice'. Unjust geographies are actively produced and reproduced, as spatiality of justice is an integral and formative component of justice itself, a vital part of how justice and injustice are socially constructed and evolve over time (Soja 2010).

A related discussion is found in the work of Trogal (2017), who has illustrated the ways in which care is connected to space. Her argument is based on the idea that a spatial concept itself implies care—as care was the reason to produce space and spatial relations. Her idea focuses on the practices of collective care and its influence on various spatial concepts, such as commons. Commons are co-used spaces, neither private nor public. Ownership of those spaces is made and reproduced through use, and this ownership can be material or immaterial.

We draw on these perspectives on spatial justice, commons and care to take a closer look at the questions of rights and access to space and place in relation to e-scooters. If e-scooters are placed where someone normally would walk undisturbed, are they 'taking' that space where something else existed?

Spatial Justice Aspects of E-scooter Innovation and Use

Across the sites we studied, multiple informants pointed out that many are excluded from the use of the new micro-mobility devices. Excluded groups include less-able-bodied and older others, families and those living outside e-scooter coverage zones. The digitised nature of this form of urban mobility has a variety of implications for our analysis. The trips are booked and paid for by digital applications on smart phones, and e-scooter companies have access to information on trips taken, their routes and parking modes. The majority of our informants found this unproblematic: 'I have all the apps available, as I don't know which e-scooter I will find when I would need it', and 'I don't mind that companies have access to my movement patterns, I think that they need it mostly to know where the e-scooters are parked'. An informant in her 30s who works as teacher mentioned that 'Towards the end of the season I tried the other brands as well. I tried, Voi, and Bolt. I think I've tried all that are available'.

'It is of course surveillance; the company can see who is using which e-scooter at what time and where they are. But I would not be concerned about that, because we already have so many apps and we have given consent for so much, you don't even know where you have clicked to consent to something', an idea expressed by a researcher in her late 20s was repeated also by other informants.

Even though some of the participants had their favourite company or a subscription to use one of them monthly, the majority of e-scooter users used scooters by any brand that was available. The applications, even though there would be several to download if one wanted to have freedom to choose whatever e-scooter was available, was generally quite easy to use, according to our informants. There were other technical issues, such as the drainage of phone battery because of the app use. One of the informants said: 'I used to have a different phone, and its battery died very quickly while being logged on to the app, so that calling was a problem at some point'.

Nevertheless, there is a potential controversy between the promised lightweight mobility and digitised mode of mobility and its materiality.

For every e-scooter brand, there is a different app to be downloaded and data is being gathered during every trip. Simultaneously, streets become a visible parallel illustration of what is happening on the digitised side. Therefore, the focus on material politics and spatial justice can bring a useful addition to an understanding of digitisation, as it indicates and demonstrates the connections between the digitised and the material forms of the same phenomena.

The evanescence and unpredictability of e-scooters, as they are always left in different spots, appear and disappear, has turned out to be one of the major challenges for infrastructures in public spaces. Yet, their immediate availability is one of their main characteristics and attractions for their users: 'I agree that they (e-scooters) should be parked in a more responsible way, but I actually like that they are available everywhere'.

One of the informants, who was against the e-scooters and had never used one, said: 'I like the idea of something being publicly available for everyone to share' but doubted the way it had been done regarding the flexibility of parking and the lack of regulation: 'they have to have some sort of fixed electronic data and they have to be within an area in the radius of some place so it's out of the way'. He expressed annoyance towards the way e-scooters were a hindrance in public areas in the city and had himself had an accident while running in the darkness of the evening and bumping into one which was left on the path.

There was a strong media reaction after one of the first summer days in Oslo left the popular area Aker Brygge densely covered with e-scooters, as their drivers were leaving them behind to head to the urban beach nearby. There is a visible side effect connected to promises of these lightweight micro-mobility devices. Namely, they may become a hindrance, something that is thrown aside and is in the way and is piling up in urban space. One of our interlocutors said:

> Have you been to Oslo lately? I was there for just a couple of days, and it was shocking that the e-scooters were everywhere - just thrown in piles and often in the middle of the sidewalks. I also noticed a few dangerous situations, one e-scooter driver just drove in front of the bus.

Space and care also overlap in the case of protests towards electric scooters, as exemplified by people from the group *La oss ta fortauene tilbake!* who express their continuous discontentment and anger caused by misplaced electric scooters.

The definition of acts of care by Joan Tronto 'includes everything that we do to maintain, continue and repair "our world", so that we can live in it as well as possible. That world includes our bodies, ourselves, and our environment, all of which we seek to interweave in a complex, life-sustaining web' (Tronto 1993, p. 103). In the case of the implementation of the electric scooters, care is often non-existing in the most visible way in relation to space. One of the reasons is that e-scooters are shared and don't belong to their users:

> I like that I don't need to worry about an e-scooter as I would need to worry about my bike. I don't need to lock it or to charge it. If one is not working, I just take another one
>   said one of the informants, a young woman from Trondheim, who would often use an e-scooter to go to work and training.

Our material also shows attempts to cross the line between shared and private. An interviewee from one of the providers working for the e-scooter company mentioned that it wasn't uncommon to hear beeping sounds from the e-scooters inside people's yards and houses when looking for e-scooters to charge, which indicated that people had attempted to 'privatise' e-scooters by locking them in to make sure the vehicle would not be taken by someone else. Ironically, though, this could lead to the e-scooter battery not being recharged, which would soon make the e-scooter of little use to its user.

Digital Urban Mobility: Access to the Paths and Freedom of Movement as an Embodied Practice

One of the electric scooter companies, Voi, which is based in Sweden, promotes their electric scooters as being made for everyone, they advertise on their website that: 'Voi lets you move freely around urban environments in a safe and easy way' and is 'reducing air and noise pollution, and breaking traffic gridlock across Europe'.[2] Freedom of movement was often mentioned as important for informants: 'Especially during the Covid-19 pandemic lockdowns I felt that it was a rather responsible choice to use the e-scooters. It allows me to choose my own paths and get there faster. I don't need to rely on bus schedules either'. Meanwhile, several informants expressed their doubts about the e-scooter sustainability: 'Well, I do not know exactly, but I think, at least in Norway, they might at least be more sustainable, because electricity comes from hydropower here'.

One informant interviewed in November 2020 mentioned that she thought that the e-scooter is a nice cheap invention, which greatly reduces the time she would use to go from her place uphill to visit her friend. 'It would take 20 minutes by foot, and it only takes four minutes by electric scooter.' There is no bus connection between these two places. Additionally, it was mentioned that it is cheap to rent an electric scooter, as it costs approximately 20 Norwegian kroner for a short trip.

Our data also shows that some people are left out from the use of electric scooters, as, even though the scooters are available to all, not everyone is able to use them. On the one hand, one of the interviewed participants mentioned that her main reason to use them is that she, who is in her early 40s, has a chronic illness, which makes walking difficult and painful, if she needs to walk for more than an hour. For her, electric scooters provide a very convenient way to move around and not lose her mobility. She uses the e-scooters for work meetings and for social gatherings. On the other hand, another participant was excluded from

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[2] Webpages https://www.voiscooters.com and https://www.voiscooters.com/voi-technology/, accessed 27 April 2022.

using electric scooters, as he, because of a slight disability, was unable to use his right hand—and the speed of the scooter is regulated with the handle on the right side. In sum, e-scooter experiences vary. Our informants expressed both empowerment: 'This is my superpower! I can go much faster!', or 'I like the freedom it gives to me, as I am not dependent on bus schedules', as well as a sense of slight shame: 'I don't feel especially good when driving, because I know how e-scooters are seen by other people—that they are in the way, that they are disturbing others'.

Even though electric scooters are advertised as a more convenient mobility alternative for moving around in urban environments and a greener choice of transportation, the most visible change has been seen in the urban landscape, and consequent public reactions against what becomes a 'littering' of the landscape. For example, in October 2020, the police were called on to a suspected case of drowning in Nidelva in Trondheim. At the scene, the police discovered that the reported incident was caused by an electric scooter thrown into the river. In contrast to the touted promises of electric scooters, the technology has rather become central in discussions of the challenges they produce. Even those who use them on an everyday basis and are otherwise satisfied with the mobility and freedom possibilities that e-scooters can give, express that there should be clearer rules and designated parking, which would prevent people from parking wherever they please. Some of the interviewees were concerned that they would suffer consequences because 'others' aren't using e-scooters responsibly. They expressed their concern regarding responsible parking and driving, which would lessen both the accidents and public opinion about the e-scooters. One of our informants, a 25-year-old student from Oslo, said that: 'I think that the teenagers are worst, they use e-scooters for fun and don't care much for the rest of the people and the environment. I, myself, always try to park so that is as tucked away as possible'.

In sum, many of our informants would use e-scooters both because they are practical to use to get around town, and because they are more fun to use. A young researcher working on the outskirts of Trondheim was not able to take the e-scooter all the way up to her job, because the area was not in the zone covered by the e-scooter network. As she started to occasionally use them in her free time, she said that 'my main reason

was, yeah, it was that it's fun to use, I think'. All informants, in addition, mentioned that it was practical and convenient to use them: 'when I need to travel to a place, for example, connecting to a bus, I usually prefer to take electric scooters because it's a lot faster', said one of the informants, a 23-year-old student.

Another aspect to consider are protests towards e-scooters and the cases where they get moved or destroyed, as an answer to their taking up common space, or causing annoyance. Freedom of parking and a lack of clear regulation causes trouble on the streets, as they might be piled up in the middle of paths and roads and cause irritation because of this disruption, or, even worse, accidents.

As shown in this section, mobility and the energy sustaining it have material forms, which in the case of e-scooters have become central in academic and political discussions. Instead of praising e-scooter speed and mobility possibilities, their hindrances are more visible and debated (e.g. James et al. 2019).

Matter Out of Place: The Digitised Urban Landscape in Flow

The e-scooter, a technology argued to be more sustainable and convenient, becomes something which is mostly talked about as an encumbrance, or an obstacle—something that bothers urban inhabitants. In our material, we see that even those that use e-scooters on an everyday basis are bothered by the lack of regulations and lack of order. In all our interviews with e-scooter users, some aspects of annoyance was expressed. Informants were not satisfied with how other e-scooter users drive and park them. Those who misbehaved were 'others', younger and less responsible people who need to have stricter regulations and rules, both from the companies and from municipalities. Other e-scooter users were causing trouble on the streets, throwing e-scooters when finishing their ride, and littering the space for everyone. Despite claims of being a last mile mobility device, a combination of lack of clear regulation and consequent chaotic parking is one of the reasons that e-scooters litter the streets instead of easing urban congestion. Notably, an informant said

that 'if they would change the regulation, then maybe they [e-scooters] would disappear', thus indicating that the ease of parking is an essential aspect of e-scooter use.

But how has this futuristic technology managed to produce waste so early during the implementation phase? Are they garbage because they are in our way and can potentially harm us? Or are there other explanations?

Space gets attention and gets noticed when it's occupied, and objects get noticed when they are in the way for someone or something. According to Mary Douglas, the lack of context determines if a thing becomes 'matter out of place' and turns into waste (Douglas 1984, p. 40). Similarly, items found in the wrong place, i.e. not in their proper, designated place, can in some cases be considered garbage (among other characteristics) because of their location (Thompson 1979). The status of an item changes depending on where it is located, and how it is embedded into the everyday fabric consisting of materiality, habits, routines and meanings. One of the possible ways of looking at garbage is to view it as social pollution, which influences and becomes part of people that live next to and encounter it (Drackner 2005). In this sense, waste can be seen as a collective sub-consciousness of culture, forced out of mind and daily life, although it is right in front of our eyes every day (Eriksen 2011).

The ideal situation regarding waste would be that everything would be re-used—as embedded components in a circle of life. As shown through the examples of this chapter, e-scooter use replaces walking through conveniently available digitised solutions, and simultaneously creates more waste in urban spaces through generating demand for a previously undesired product. Similar to the challenges associated with coworking spaces in the chapter by Ortar and Flipo (in this book), pointing to the lacking awareness of the ecological costs of digitisation by those companies that suggest the technology, it is difficult to imagine the e-scooter revolution as a more sustainable mobility alternative for the future. Although e-scooters theoretically fulfil the idea of digitised and lightweight transition towards decarbonised mobility, they, as shown, have a direct impact on infrastructural congestion, as well as causing conflicts regarding spatial justice, which compromises their claims. The

Exhibition Fig. 8   Technical drawings of a bulk electric bus order for Bergen on display (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

users of e-scooter technology rarely posed any concerns about it and mainly praised its practical benefits—such as the possibility to locate the devices and follow up if they need to be charged. Nevertheless, while enabling individual freedom of movement in the selection of mobility devices and trajectories, they form new, and highly material constellations in the urban space which hinders other users of the urban space and disables and blocks their trajectories. Exhibition Fig. 8 follows this chapter.

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Mediatised Practices: Renovating Homes with Media and ICTs in Australia

Aggeliki Aggeli and Mette Mechlenborg

Introduction: Home Renovation as a Transition to Lower Carbon Living

The upgrade of existing homes is imperative for the transition to a low-carbon society (Konstantinou and Knaack 2011; Kersten et al. 2015). Renovation of existing homes, combined with low-carbon changes, is less damaging to the environment than the demolition and construction of new homes (Konstantinou and Knaack 2011; Janda and Killip 2013; Owen et al. 2014; Sunikka-Blank and Galvin 2016). However, the

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transition to lower carbon homes will not be achieved unless the socio-cultural, political and techno-economic challenges of their upgrade are considered simultaneously (Aggeli 2021).

Recent renovation literature displays a diverse picture of interdisciplinary nature for the residential renovation processes. Some studies point to renovation as a decision-making process (Haines et al. 2014; Mjörnell et al. 2014; Abreu et al. 2017; Wilson et al. 2013), others as a socio-technical transition (Horne and Dalton 2014; Willand et al. 2019; Killip et al. 2014; Kerr 2018), as cultural expression (Rosenberg 2011; Head et al. 2016) or as social practice embedded in everyday homemaking, to which this chapter contributes (Maller and Horne 2011; Maller et al. 2012; Bartiaux et al. 2014; Gram-Hanssen 2014a, b; Judson and Maller 2014; Judson et al. 2014; Abreu et al. 2017; Hulse and Milne 2019). People renovate their homes to respond to complex issues which include emotional, practical, technical and socio-cultural matters (Podkalicka and Milne 2017). Renovations are therefore complex processes that involve much more than the technical upgrade of homes (Hulse et al. 2015; Podkalicka 2019; de Wilde and Spaargaren 2019). In addition, renovation can be considered as both a product and a process (Hulse et al. 2015), which can range from a one-off event to a long-term and ongoing engagement of a household.

There are therefore two departure points for our chapter. The first one relates to the nature of renovation, as an ongoing socio-cultural practice that takes place along the ordinary homemaking in the household. The second point relates to the consideration of people's engagement with media in their triple articulation, as material objects, texts and contexts, within the broader digitalisation of everyday life. These two points are explained in more detail below.

Various terms are used to define home renovation, such as refurbishment, modernisation and retrofit. Each term can reflect the size of work performed with renovation pointing towards larger and more structural alterations to a home (Wilson et al. 2015)—as well as the focus of a project (Thuvander et al. 2012). Renovations can occur as a one-off event or as a long-term process, particularly in the case when low-carbon amendments in the house are the focus (Fawcett 2014). In our work, renovation determines mid- to large-scale home alterations, regardless

of their focus (i.e. if they are intended to be low-carbon). We start by considering renovation as a practice that extends the materially engaged periods when the structure of homes is amended. In their majority, the cases presented in the chapter have undertaken renovation as a long-term process, even if there are defined periods of construction activity. The chapter therefore regards renovation practice as an extended process embedded in the households' mediatised homemaking practices.

Furthermore, our work recognises and discusses media as a 'complex, multi-purpose, and networked communication process and cultural context' (Podkalicka 2019, p. 2). Digital technologies and the extensive use of internet in everyday life at home, is shaping (and is being shaped by) our everyday practices (see the Introduction in this book, and DeAngelo in this book). At the same time, the ongoing digitalisation of everyday life, offers opportunities for renovators to engage in new digital platforms and services, connecting and interacting with others, generating and facilitating new networks of learning and new communities of renovation practice.

We therefore ground our analysis in the triple articulation of media (Hartmann 2006), which suggests that media can be perceived and studied as: (1) Object, e.g. media devices like mobile phones, televisions, computers; (2) Text, e.g. media content of social media posts, television programmes, internet articles, videos and (3) Context of media consumption, meaning the specific situations in which media is used and practised. By focusing on the role of media and ICTs in renovation and on the basis of media as object, text and context, this chapter makes three main contributions: (1) it identifies media as an informal intermediary of renovation which shapes householders' meanings (of a good home and of low-carbon living) (2) it highlights media as an increasingly important material object of renovation and (3) it determines media as co-creator of communities of renovation practice. Through these three findings, we highlight the central role that media play in people's everyday lives and stress the importance of their contribution to the shaping of low-carbon visions and narratives for homes of the near future.

Methodology and Profiles of Participating Households

Our methodology is a blend of design and ethnographic qualitative methods. Design methods have been used alongside visual and sensory (short-term and visit-based) ethnography. The data collection methods included home visits, semi-structured interviews and a participatory workshop. During the undertaking of all three methods, audio and video recording took place, alongside discussions, touring of homes and working in groups (during the workshop). By visiting people at home and recording their stories, we identified collective patterns of their everyday practices, repetitions and relationships with material objects involved. This enabled discussions of past and present practices and allowed householders to imagine the future, if they were at the beginning of their renovation journey. Additionally, the workshop enabled a collective vision to develop (Brandt et al. 2012) by combining the perspectives of the two groups of renovation actors (householders and professionals). It therefore enabled an immersion into the latent and tacit knowledge of people's practices.

The participating households were based in Adelaide, the capital city of South Australia, home to 1.3 million people. Approximately 75% of Adelaide's housing stock is detached homes (ABS 2016). Participants were recruited from both professional and 'ordinary' homeowner—renovators to reflect the range of actors of home renovations. Although socio-economic and cultural diversity was our priority, this has been challenging to achieve, mostly due to the snowballing effect of the participants' recruitment, which meant that householders recommended other participants who belonged in their close networks. The households in our study are owner-occupied and have engaged in home renovation recently (in the past three years), were currently doing so at the time of the study or were about to set off on a renovation project. There were 13 households and nine building professionals (builders, architects and planning professionals) involved in the study.

Furthermore, the householders' profiles range across different characteristic typologies, such as families with children, households with no

children (sometimes empty nesters), single households and intergenerational households (households with more than 2 generations living together). Their houses comprise mostly detached or semi-detached homes and on some occasions units (terraced homes.). Table 1 presents the profiles of the participants presented in the chapter. The focus of the original study was not necessarily low-carbon renovations, but renovation practice within everyday life. However, many households have adopted low-carbon changes to their homes as a consequence of a structural alteration or as a result of modernisation that brought about a low-carbon benefit to their home.

The Mediatised Home

The concepts of home and homemaking have recently been permeated by literature examining the implication of digital technologies and the overall digitalisation of everyday life (Maalsen and Gurran 2021). Our work positions home renovation within the ongoing digitalisation of services and processes of everyday life at home, arguing that media, in their triple articulation, are significant actors and intermediaries in the shaping of renovation practice, as well as of the social and cultural practices of householders overall. Before discussing media as intermediaries of renovation, we elaborate on the transformation of home by and through media, using the concept of mediatisation.

Media and communication technologies are interwoven into the household environment and have adjusted themselves to its daily practices (Nansen et al. 2009; Chambers 2016). Furthermore, these technologies and the devices through which they manifest themselves are in turn shaping household practices and routines, making homes into 'nodes' of connectivity (Nansen et al. 2009, p. 185). These extensive uses of ICTs in the household are building a 'new normality in everyday life' (Christensen and Røpke 2010, p. 233), while they are in some cases so embedded in it, that they are imperceptible to their users (Pink and Mackley 2013). The term mediatised home captures the extent to which media have permeated everyday living practices, suggesting that media is

Table 1 Profiles of the participating households, showing house typologies, and general characteristics of the householders' renovations

Participant name(s)	House typology	Profile
Cheryl	Detached house	Cheryl is a homeowner living in a detached home with her partner and two children. Their renovation involved the modernisation and extension of an older property, which they inherited from family. Their intentions were to include low carbon amendments to their home, and considered adaptations such as passive cooling and shading. Their challenges included the coordination of family expectations for the result, since the home was representing the family history and continuation
John	Terraced house	John lives with his partner and son in a terraced home in Adelaide city built in the 1880s. His renovation has been taking place in different stages, initially involving the modernisation of the interior and at a later stage the installation of solar panels on the roof as well as a PV battery. John's primary focus is to turn the house into both an energy efficient home and a smart home. His initial low carbon alterations have given confidence to John to consider further low carbon changes such as the installation of rainwater tanks. John has been following peer forums such as Whirlpool in order to keep up to date with other renovators
Henry	Detached house	Henry lives alone and has been renovating his home using through both DIY and professional builders in an ongoing basis for a few years. He has a big interest in architecture and design and has invested a lot of time learning new skillls, such as drawing and sketching (by hand and through computer programmes) in order to be in control of his renovation. His previous experience in many different rental properties in which he had limited ability to change things, have given him the motivation to modernise and upgrade his current (owned) home and turn into his desired, personalised and efficient place

Participant name(s)	House typology	Profile
Anna	Detached house	Anna lives alone and has recently quit her job in order to renovate homes for a living. The property she currently renovates is a large detached family home, which has previously been extended. Anna has attended a hybrid renovation course (partly online, partly face-to-face) in order to gain skills as a DIY renovator. She self-manages the renovation work, which involves primarily aesthetic alterations and some internal re-arrangement of spaces, some of them performed by her as DIY work. Anna uses social media platforms as her primary source of inspiration and go-to place for learning new skills and seeking advice from other communities of renovators online. Low carbon changes were not necessarily on her original agenda, however, as she is moving through, a lot of changes have resulted in low carbon choices, particularly if they are related to lifestyle related issues (such as recycling or repurposing materials for constructing internal surfaces, which are inspired by Anna's encounter with similar changes in recent media publications)
Sophie	Detached house	Sophie lives with her husband and two kids in a detached home. Her renovation was performed as a one-off project and included the addition of a floor as well as the internal modernisation of the house, including new kitchen bathrooms and windows. The renovation was performed and managed by a building contractor, who put priority in the quick delivery of the final product rather than low carbon choices, and communicated progress to them through an mobile app. Sophie's renovation reflects the need to quickly amend a home to respond to the needs of a growing family and its obligations (e.g. space for accommodating guests and spaces for growing children to socialise away from adults)

Table 1 (continued)

Participant name(s)	House typology	Profile
Mark	Detached house	Mark lives in an intergenerational household, including himself, his two children (who stay every other week) and his mother. Mark has had some changes in the family status, which resulted in his decision to extend his home to accommodate and care for his elderly mother. His renovation involves the addition of a granny annex to the back of his detached home, the addition of a second floor, and the subdivision of the house into two semi-detached properties. Mark's renovation has been a family matter, with his brother (an architect) designing the renovation and both brothers performing some DIY building work themselves. Mark's home carries the history, memory and current needs of a growing family and reflects the complexity of the practical, personal and socio-cultural implications of changing a lifetime home
Kate and James	Terraced unit	Kate lives with her partner James in a unit (terraced, single floor home). They are both architects and have been actively engaged with the design of their home. Their alterations have primarily involved interior modernisation (new kitchen and floor alterations), since shared ownership rules (Strata) prevented them from doing external alterations. Kate and James are focused on producing an efficient and sustainable home, focusing on ethical choices of materials and services and rejecting the fast pace of construction which often involves choice of short lifespan materials or the disposal of surfaces/materials which can be maintained. They have been using Gumtree, an online platform for selling or giving away household items, to give away fittings and fixtures that they don't need or desire, trying to minimise waste. Despite their keen engagement with the upgrade of this property, they both suggest that they soon dream to be able to sell it and move to a detached home with external space, which they define as their own 'Australian dream'

Source By the authors

no longer supplementary to, but constitutive of what home is. Considering this, it is important to understand the contribution of media in the different stages of renovation (i.e. dreaming, planning, performing and sharing with others) in order to assist with the integration of low-carbon visions through and with media (in their triple articulation).

Home is experiencing a continuous technological transformation with media (Chambers 2016, p. 8), linking the private space of the household to the wider macro-level of society, shaping and being shaped by the prevalent culture (Silverstone 2005). In a society where 'everything is mediated' (Livingstone 2009, p. 2), across all domains of life (e.g. politics, environment, family, social institutions), the significance of digital media is of great importance (Lunt and Livingstone 2016, p. 463). Mediatisation (or mediatization) is a term that emerged in the 2000s, to express the 'wider transformation of social and cultural life' through media (Couldry 2008, p. 376). The concept of mediatisation articulates that these transformations of the social are made in complex ways, rather as consequences of media's agency or innovation (Hjarvard 2008). Through the ongoing immersion in digital media, households are embedded in a global community, rather than just a physical one, and are therefore part of wider (and partially virtual) communities of practice of renovators and home enthusiasts. Our study suggests that the symbolic space of renovation is now global rather than local. Therefore, this progressive movement of interactions from physical (through face-to-face communication) to digital (through presence in virtual communications) interaction is transforming the way that households conceptualise and perform their renovations. Householders' participation in collaborative and visual media platforms enables the digital dreaming of making homes and contributes to the shaping of a newly developed co-creation between people, through and with media.

Media as Informal Intermediaries of Renovation

The term 'intermediaries' implies mediating individuals or organisations between actor groups; however, the interpretation of their function can

be different depending on the disciplines involved (Moss et al. 2009). In recent renovation literature, intermediaries are usually defined as technical experts, such as architects, builders and other building professionals with specialised experience on home design, construction and maintenance (Karvonen 2013; Owen and Mitchell 2015; Horne et al. 2014). In addition to building professionals, recent studies highlight media celebrities, websites, television programmes and non-profit organisations as key intermediaries in the renovation process (Podkalicka et al. 2016; Aggeli 2021). These 'non-traditional' intermediaries, help with the interpretation and integration of information (particularly this sourced online) to everyday understandings, which are culturally and socially embedded in householders' everyday life (Podkalicka 2019). Our chapter adds to the concept of renovation intermediation by identifying media as informal intermediaries. We consider informal intermediaries to be the social networks, media and material objects, which have an ongoing presence in mediatised households, rather than relating to experts who engage in a specific renovation process (Aggeli 2021, p. 216). Informal intermediaries enable the generation and sustainment of networks and communities of practice relevant to homemaking and renovation. Along these lines, our work presents media as 'informal intermediaries' of renovation.

This informal intermediation sometimes reduces the need for formal, or professional intermediation, as householders often find what they (think they) need on media platforms. Our chapter highlights the roles and contributions that media make in the renovation practice, as actors that shape renovators' competences and meanings (of a good home), as materials of the practice, and as co-creators of renovation communities of practice. The next section presents examples of this and explains the implications for the transition to lower carbon homes.

Finding 1: Media as Informal Intermediaries That Shape the Meanings of Renovation

Living with media, according to our findings, involves dreaming with media. This can take place in different ways: through the mediatised practices of households, through the ongoing use of mobile digital media

devices, which enable engagement with relevant content in and out of home, and through the rich renovation-centred texts that householders use to make sense of their everyday practices. We have found that householders spend large amounts of time, often undetectably, browsing renovation media content, through mobile devices. This might be expected when households perform a renovation. However, their immersion in media before they even consider renovation, during a period of dreaming about it, indicates that their media practices contribute to the building of meanings of a good home and life, and to the development of unique ways of navigating relevant content.

During the dreaming stage of renovation, people often imagine or generate more abstract visions of what their ideal home should be. Media content, such as social media boards or postings, helps them to build a more concrete image or an embodied version of their imagined narratives. Making the imagined into a visible and more concrete experience for householders, is important for their perception of the need to integrate low-carbon amendments to their homes. This observation is similar to the way that young people's experience of climate change in Norway explains their tendency to appreciate the urgency to act through measurable data or concrete experiences rather than imagined visions (see Lautrup, "Overcoming Abstraction: Affectual States in the Efforts to Decarbonize Energy Among Young Climate Activists in Stavanger, Norway" in this book). The continuous use of media in everyday life presents an opportunity to enable the visualisation and explanation of the need to upgrade home efficiency. This is especially important in the period of dreaming about and planning a renovation, to help households develop an understanding of how to bridge their abstract visions with a concrete idea of what a low-carbon home looks and feels like. This conversion or communication of the meanings of low-carbon homes are sometimes invisible or difficult to detect in popular media as discussed by our participant Cheryl below. Therefore media, in their triple articulation, allow people to narrow the gap between the imagined futures they have developed for their households with present narratives and concrete examples of how this could happen in the present.

Furthermore, media help to strengthen the association of various homemaking practices, such as preparing meals and housekeeping,

with renovation practices which could transform these to lower carbon versions. For example, Pinterest boards on kitchens and bathrooms support daily dreaming, by sustaining interest and visual reference. However, householders suggest that they don't only 'want to see' how houses could be renovated (Hulse et al. 2015, p. 19), but also to understand how to adopt low-carbon practices. As Cheryl suggests, low-carbon renovation amendments to homes are often invisible when these are presented on visual social media. While media's contribution to the construction of new meanings (of low-carbon living) for a global audience of households is promising, it is important to have appropriate local interpretations for renovators, such as interactive platforms, to help them contextualise these meanings. These tensions between the usability of online media platforms and the interpretation of the meanings they carry to householders, can become opportunities to bring formal (professional) and informal (media and social contexts) intermediation in closer dialogue through media (texts and objects) and physical interactions.

Our participants have confirmed this interactive interpretation of meanings through their regular use of Whirlpool forums, a peer-to-peer online platform frequently used by renovators in Australia (Aggeli 2021; Podkalicka et al. 2019). The majority of them participate in social media groups and communities, such as Whirlpool forums and Facebook groups, informally and regularly, to research their renovation. As John and Henry suggest, their engagement is mainly to observe conversations, however, their presence in these platforms can be so regular that it saturates their daily routines. The length of interaction that households have with media is proportional to the contribution they have as meaning-making agents. Even though householders' skills can take years to develop, the meanings of renovation—which can lie dormant—can be consolidated very quickly with an input from a source of intermediation. The context of renovation is therefore expanded from the physical environment of home to symbolic and digital manifestations, and intermediation needs to respond in order to support this. It is important to consider the substantial involvement of media, as informal intermediaries, in the process of renovation as it contributes to meaning-making during the process. An important implication of media as informal intermediaries is that they contribute to the evolution and progression of

meanings of what constitutes a 'good' or 'sustainable' home, and thereby assist the transition to lower carbon versions of the renovation practice.

Finding 2: Media and ICTs as Important Materials of the Renovation Practice

Our work has highlighted that technology and media devices contribute as meaningful materials in the process of renovation. They become the 'orchestration nodes' (Hand and Shove 2007, p. 79) of the renovation practice by preserving its rhythms (e.g. through media devices), by bolstering communities of practice, (through sharing online) and by coordinating the imagined and functional requirements of the renovated home.

An example of this are the ways in which home renovators document and coordinate their renovation process, using media devices as the equivalent of scrapbooks and physical folders, such as boards created in Pinterest or Instagram. Anna has found Facebook to be a coordinating tool:

Once I found it (…) my world changed! Because you can also save files and make photo albums (…) excel spreadsheets and pins and pages (…).it's like a project management tool

Home renovators access content mostly on their smart phones or tablets. Householders, who document their renovation in these ways, feel that they also create a record of the value of their home, which they can then share in the future, especially if they plan to re-sell the house. Furthermore, media devices such as phones, are important tools during the performance of renovation, for the purposes of monitoring or managing the progress of the work, for example through regular updates of contractor's apps of other applications. Anna, for example, suggests that her devices follow her everywhere in the home and outside:

[I use] Anything, anywhere, anytime. I move into the bathroom with my phone or whatever… my tablet...I use it [phone or tablet] everywhere

Services, such as mobile phone applications, are highly welcomed and appreciated by time-poor family households, as Sophie suggests. The benefit of using mobile media devices is that renovators can use them anywhere and anytime, while at work or anywhere outside the home (Hunter 2019). This particular finding displays how embedded media and ICTs are in the renovation practice throughout the whole process of dreaming, planning and performing it.

Therefore, media can act as orchestrating, and homemaking agents, contributing to the material re-arrangement of homes, through their use as tools or devices for doing things and through their contribution as space-shaping actors during renovation.

Finding 3: Media as Co-creators and Connectors of Communities of Practice that Shape Renovators' Competences

Our study has shown that the dominant presence of social media in everyday life and the frequent absence of immediate social networks (in real life) to support home renovators, contribute to the formation of closely knit digital networks with online communities of practice, who inspire and support their practices. These mediatised environments transform people's engagement with renovation daily and therefore help to develop a process co-created with media.

During the planning of renovation, home renovators research possibilities, getting other people's opinions and experiences online, and engaging with the pragmatic and logistical matters of their renovation. They use media texts and devices to educate themselves about practical issues, for example, learning new skills, such as sketching and making spreadsheets, and understanding the process further. Media help to cultivate an interest in transitioning to low-carbon, through the association of appropriate renovation practices, such as re-using and re-purposing materials and resources, to already established routines (such as everyday recycling and/ or re-purposing of household stuff). As an example, Anna, Henry and Mark, all DIY home renovators, suggest that their regular engagement with platforms such as YouTube helps them to build their

technical skills and collect useful 'how-to' advice from others across the world, and supports them emotionally and practically in the process of change. Media communities are therefore important for home renovators with regard to their technical, emotional and managerial competences. Furthermore, by educating themselves through media, home renovators feel more confident and informed to discuss issues with professionals, as they have already started to develop the language through which they can communicate their needs and possible changes. Many of our participants suggest that Facebook groups or pages are spaces in which interaction between renovators and professionals help to establish trust and common understandings of the work performed. This highlights an opportunity for co-creation in the design and construction of renovation projects with appropriate partnerships between professionals, amateur experts and media platforms. We have found that media platforms, particularly interactive ones such as forums, allow the interpretation and domestication of low-carbon installations to everyday practices at home, such as learning how to synchronise daily showers or dishwashing with available energy in households' solar batteries. Such examples showcase how social media platforms extend the technical appreciation of technologies into meaningful everyday actions. Therefore, media help to coordinate social learning processes as well as consolidate the collective meanings of a practice in context.

Additionally, social media platforms, such as Facebook, often act as 'replacements' of the casual neighbourhood chat. As Kate explains:

> It's almost that [Facebook groups] have replaced the neighbourhood (…) you might have a chat (…) say I'm trying to do this (…) someone down the street replacing something (…) that doesn't happen much these days

Since socialising is also moving online, the context of renovation extends further than the locality of the household to a virtual community of renovators and homemakers. A similar example is the partial replacement of support networks by traditional media texts, such as television property shows. Home renovators are keen to 'learn about the process (…) although it's not realistic but can relate to the pressure' (Cheryl).

Television shows like The Block and Grand Designs, act as emotional supports during the time households plan and perform their renovation.

John, another participant, also suggests that media's space for 'shared stories' brings together communities of homemakers and renovators, therefore connecting their meanings and competences with the material objects of the practices. Our findings evidence that rather than only share the 'pleasures and rewards of co-operation' (Hesmondhalgh 2012, p. 138), online media can also intensify competition between professional and amateur producers.

Conclusion

Our chapter has discussed some of the ways in which media (as texts, objects and contexts) act (1) as informal intermediaries of renovation, who shape householders' meanings, (2) as increasingly important materials of the practice, and (3) as co-creators and shapers of communities of practice, reinforcing renovators' competences and know-how.

Media help to facilitate the challenging of professional expertise and to support its merging with amateur experience, both of which are important for the transition to lower carbon homes, as ways to integrate the tacit knowledge of home renovators with the technical experience of professionals. Additionally, interactions with professionals offer opportunities for collaborative renovation practices, between householders, professionals and media.

One of the major impacts of media as informal intermediaries on the consideration and adoption of low-carbon renovation practices is their long-term involvement in households' everyday life, where they shape, connect and accelerate their practices. Householders' ongoing engagement with media, within the digitalised and meditatised home, throughout all the renovation stages and through participation in various communities online, results in a smoother translation and normalisation of the meanings, competences and materials required for the transition to lower carbon homes. Furthermore, media help to generate a more concrete or quantifiable understanding of what low-carbon changes look

like, thereby shaping householders' abstract vision of a future home to more pragmatic matters.

However, intermediation is not just about the translation or mediation of information and expertise regarding the technical and financial performance and accomplishment of renovation, but a wider socio-cultural meaning and competence making process. Media's capability of interpreting and contextualising meanings from global to local environments and vice versa can lead to a more successful embedment of low-carbon renovation practices of mediatised households. Therefore, we suggest that media (in its triple articulation, as texts, objects and contexts) need to be included further in research on renovation as a social practice and its implication in the twin transition of households to a lower carbon and digitised future. Exhibition Fig. 9 follows this chapter.

Exhibition Fig. 9 Displays of iconic electric bus rollouts exhibited within the museum (*Source* Rune Egenes and Norwegian Petroleum Museum [used with permission])

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Correction to: Overcoming Abstraction: Affectual States in the Efforts to Decarbonize Energy Among Young Climate Activists in Stavanger, Norway

Andy Lautrup

Correction to:
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The original version of the Chapter "Overcoming Abstraction: Affectual States in the Efforts to Decarbonize Energy Among Young Climate Activists in Stavanger, Norway" was inadvertently published with an incorrect author name, which has now been corrected. The chapter has been updated with the changes.

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