SOLAR

Design Researchers in Residence 2023/24

April Barrett
Eliza Collin
Jamie Gatty Irving
Freya Spencer-Wood

Future Observatory
the Design Museum

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The images used on the front cover and chapter title pages in this book were produced by Amandine Forest-Aguié using cyanotype printing – a method of printing with sunlight – and visuals produced during each of the residents' research.

INTRODUCTION

GEORGE KAFKA AND LILA BOSCHET

On 18 July 2022, Future Observatory and the Design Museum cancelled a public event that was due to take place the next day: a discussion between then-Design Researcher in Residence, Thomas Aquilina, and his mentor, Ekow Eshun. 'Thank you for purchasing a ticket to attend "Restore Talks: Architecture" on 19 July at the Design Museum' read the email informing ticket holders. 'Unfortunately, this event has been postponed due to the current extreme weather.'

During that month, the UK experienced record-breaking temperatures – over 40°C – and the Government declared a national emergency following the Met Office's first ever issuing of a red 'extreme heat' warning. In deciding to cancel the event while hiding from the heat in the museum's air-conditioned offices, we were struck by the significance of the moment. A rubicon had been crossed and global heating – the result of decades of industrial activity and political inaction – was beginning to have a material impact in the temperate islands of the UK. Through the stress of the cancelled event and the sweat of the London air, the seed was sown for a new group of researchers to consider the changing role of the sun in design.

Design Researchers in Residence: Solar emerges out of an uneasy dualism in our relationship with the sun which seemed to crystalise in that moment. For as long as there have been humans, the sun has been considered a life force, an energy source and a cultural figure. For those growing up in the UK, the sun was personified as an aloof but playful character; a yearned-for weather pattern and a God-like figure 'with his hat on', that symbolised rare bright days and accompanying good times. The sun is leisure, holidays, time away from labour, time outside, cold drinks and games – simpler times.

And yet, we also know that the sun has a dark side. The sun is drought, burn and glare. It is dehydration, parched earth and melting ice. In recent years in the UK, that previously friendly figure has taken on a twinge of danger, becoming a source of panic and a reminder of a dreadful future where glorious summer days will boil over into heatwaves with increasing regularity.

This dualism – between friendly and fierce sun – has long played out in design, where large parts of design history can be seen as working both with and against the sun's heat and light. Homes are designed with large windows oriented towards its daily trajectory, while awnings, sleeves and tinted lenses all create barriers to cool and protect us from solar rays. In the context of the climate emergency, the sun is both a foe and a fix. Rising global temperatures have coincided with an exponential increase in energy produced using photovoltaic cells: solar power from sunlight, the most abundant source of energy on the planet. Yet this welcome development – which is being applied at the scale of the phone charger, the vehicle and the municipal energy grid – is not without its complications. Struggles over land co-opted for solar farms have erupted from California, USA, to Karnataka, India, making manifest the complex negotiations required to navigate both green transitions and climate justice.

We find our Design Researchers in Residence caught at this juncture, between sun as both resource and risk factor. Across the four projects, this year's cohort locate the role of designers and researchers in continual dialogue with how we see ourselves in relation to the burning star at the centre of the solar system.

In **Hot Data**, April Barrett contends with the heat of the internet, the hyperobject whose data centres have significant energetic consequences despite the apparent intangibility of the network. Through the project, April takes us to Tallaght, a satellite town of Dublin, where waste heat from an Amazon data centre is being redirected to heat a library and university building. Building on her training as an anthropogist, April considers the impact of this arrangement for residents today and in the future. She uses ethnographic speculation before cataloguing a broad range of alternative internet stories which reveal our Big Data status quo is far from the only modus operandi. One of these stories is of *Low-Tech Magazine*, a web-based magazine which runs from a solar-powered server based on a Barcelona balcony and highlights the entanglement of our earthly systems with the sun.

Where solar energy is a force to be harnessed by *Low-Tech Magazine*, it is a source of ecosystem disruption in **Olfactive Evolution**, the research project carried out by Eliza Collin. Through in-depth collaborations with scientists, perfumers and farmers, Eliza reveals and considers the consequences of global heating on flowers and their pollinators. Olfactive Evolution is a dive into the science of scent, building on findings from the late-1960s about changes in flower smells caused by drought and other environmental shifts. In her chapter, Eliza ponders the ways we notice – or sense – environmental shifts in our world and the world we share with other species, and she highlights the fact that plants are struggling to evolve to keep up with those shifts.

Jamie Gatty Irving takes us home in **Suntrap**, an exploration of the domestic conservatory in the UK and its nascent potential as a piece of solar architecture for the retrofit era. In his research, Jamie finds that the British conservatory has gone awry. Once imagined as a site for flourishing life in orangeries, glasshouses and walled gardens, the glazed extension today is often an energy-hungry burden on the modern home. Yet, through his engaged collaboration with environmental designers Atmos Lab, **Suntrap** proposes a new future for the conservatory which, through a new design proposal, presents a much needed way to passively heat and cool homes.

In the book's final chapter, we travel from the heat of the suntrap to one of the UK's wettest environments: the peatland bogs of Scotland's Flow Country. It is here, through **Deep Breath**, that Freya Spencer-Woods immerses herself in the culture, politics, ecology and identity of a landscape that is threatened by the sun's heat. Drawing on queer theory, Freya argues that the landscape must be reappraised as an unsettled, non-binary, unknowable space in order to imagine its future beyond the parameters of extraction or financial value. Through Deep Breath, we encounter peatland stakeholders from science, farming, politics and cultural heritage before the elusive figure of the Will-o'-the-Wisp closes out the book.

While there may be nothing new under the sun, there does continue to be new ways of framing, understanding and designing the apparatus with which we organise our lives beneath it. Across these multi-faceted, multidisciplinary and collaborative projects, this latest cohort of the museum's long-running residency programme affirm the ongoing value of design research to confront the challenges we face today. In their work, April, Eliza, Jamie and Freya refuse simplistic narratives while tackling universal topics: how we communicate, where we live, how we live with other species and how we inhabit our landscapes. Just as summer begins and temperatures start to rise again, it is our privilege to share their work and the potential it holds for cooler days to come.

May 2024

CONTAMINATING OUR CURRENT THINKING

a conversation between Cher Potter and the Solar cohort

Cher Potter: As a residency for design researchers, this programme argues not just for the power of research but for its necessity. Research is crucial to challenging design as usual; to building and testing the alternative products, materials and systems that we so desperately require. What is "design research" within your work and why would you say it's necessary?

Eliza Collin: As someone who studied design – fashion design originally, which is an incredibly wasteful industry – I began asking questions about design's necessity – what really needs to exist? I decided that I only want to design things that create certain types of change, change that people really need. That led me to work with communities, treating them as the experts alongside scientists and academics, to try and understand what kind of futures we need. From there, we can start to imagine what kind of design is necessary to build those futures. My design research journey began in learning from these communities and experts and forming methodologies of collaboration.

Jamie Gatty Irving: In my case, I went through a period where I was quite paralysed by anxiety around the climate. Building on what Eliza was saying, I was educated within an industry – architecture – which is also inherently wasteful. By going to work every day you're engaging within that system of wastefulness, whether you want to be or not. More recently, I try and use design to get out of the cycle of waste production, to find alternative ways of working beyond that paradigm.

CP: Using design research to explore and test new systems rather than simply producing more things?

JGI: Yes, in design practice the outcome is generally defined first – I want a kettle that uses less energy or a house that is bigger than the one I already have. The designer then begins exploring ways to deliver this, which is also research of sorts. However, design research as a practice does not necessarily have a defined outcome when you're starting off. The outcome is secondary or more open, allowing for experimentation and options. This is a different kind of research. This kind of research offers a space to breath outside the pressures of market structures and set outcomes.

Freya Spencer-Wood: Research insinuates a certain depth of understanding and an interdisciplinary or intersectional approach to an open-ended enquiry. The research element in conjunction with design has to acknowledge the sociological, the political, the economic, the environmental – the systems that design operates in. For me, design research is about developing a criticality around modes of thinking and exploring the limitations of creative processes.

April Barrett: I don't come from a design background, I was trained as an anthropologist. So, for me, design research is about an expanded methodology. As an anthropologist I became frustrated with the observational and back seat nature of research, I liked how design was about making change, which is an uncomfortable terrain for anthropologists. At the same time, anthropology brings designers into the uncomfortable terrain of pausing to observe before changing things, sitting with observations. So, the two disciplines bring together deep observation and making. What is exciting in design research is the opportunity to materialise your findings into something that people can engage with using their senses, beyond just reading an ethnography. Material things are so much more legible to people than written documents.

CP: I'd like to briefly delve into your approaches to time within this work. Jamie, you've adopted a cultural-historical lens to understanding changes in domestic living; Freya and Eliza, you're looking at bog breathing and species adaptation, both ecological processes that take place over centuries or even millennia; and April you're exploring an alternative near future. How are these temporal structures helping you to organise your thinking in our sometimes overwhelming present tense?

JGI: All of our projects in some way engage with the timescales of climate change that are hard to compute as individuals, but they are all rooted within observations of what's happening now. In the case of my research into the domestic environment, looking at the histories of how we have lived lets me take a step back and recognise that is it kind of weird that we are living in the way that we are now. A historical lens gives you a perspective on things that you take for granted in the present. You must do this to be able to look forward to the future and think of alternative ways of living, to project how could things be different.

FSW: Jamie was talking about the enormity of the subject matter, whether that's in terms of the size of the issue or grasping the timescales. I guess the way that I've felt able to participate in the socio-spatial and political crisis of the climate emergency has been to think through my identity and my own experience in a kind of embodied way. So, in some ways my project isn't even really about peatland bogs, I'm using that device to talk about my own identity in the present.

EC: Yes, there's a paralysis when it all seems too big. If you get more personal and deal with individuals, then the subject becomes more manageable because you're focusing on individual experiences and feelings now. Working with communities and using the skills of design, you can start to "user test" diverse and participatory futures with small pockets of people.

CP: Building on Eliza's point about working with communities, as a cohort, you've chosen particularly diverse sites of investigation: the domestic conservatory, peatland bogs, data centres and even the scent of lavender. To understand these sites, you've spent months embedding yourself in the networks of spaces – geographic or olfactory. Can you tell us more about the kinds of people you have spoken with to familiarise yourself with these sites and how this has shaped your thinking?

JGI: I hate working on my own, so I find that most ideas come through discussions with other people. Within the context of this project, looking beyond the field of architecture, I've spoken with historians, environmental designers and, well, people who live in houses. Speaking with historians is especially humbling because you realise that people have tested the same ideas around conservatories 100 years ago and then again 50 years ago… It's interesting to learn from these previous projects – the various waves of social, cultural and political framing of them; how my own project is shaped by our current concern about the climate.

EC: Yes, research is so often done alone, and it's so nice that with each project you get to build this whole world around you. There are some collaborators on this project that I've brought from previous projects and I see those collaborations continuing into the future, and other people that will come and go for different projects. We're all educated in different ways – designers, scientists, perfumers – and we have different ways of communicating. As a design researcher, you become a kind of translator between different fields. On this project, I have worked with botanists and chemists, people that work with GC-MS [a gas chromatography system that separates and analyses scent into its various components], perfumers and scent designers, illustrators, beekeepers, farmers. As a design researcher, I know I will never be the expert in any of the areas that I explore, so I surround myself with people whose life's work is to think about how an Ipomopsis [plant] may or may not produce indole [aromatic heterocycle], for example!

FSW: I've spoken to a wide range of people in and around the Flow Country [an expanse of blanket bog in the North of Scotland] ranging from peatland scientists to ecologists, chemists to shepherds, crofters and members of the local community in Caithness and Sutherland, local councillors and informal community organisers. This includes people working for Nature Scotland and Peatland Action to UNESCO. Now that I am thinking about how to materialise this research I am talking to an animation artist. Each time I present the project to a new group of people, my ideas grow in precision, I learn the terminology of different disciplines and how to articulate different angles of my research. I've also had to translate ideas across disciplines. All these conversations have slightly adjusted my thinking and the aims of the research, taking it back, taking it forward, messing it up and then helping to find it again. It's a process of refinement.

AB: I can definitely speak to that. Theoretically, my work is very interdisciplinary. It draws from digital materialism which argues that the digital realm is not virtual, that it has manifestations and infrastructure, it uses energy and human labour. This has parallels with decolonial scholarship which is about being grounded in land and reciprocal relationships to the material world. I am also interested in a recently emerged concept called 'digital energetics' in which the study of media and energy are collapsing into each other. As part of my field work, I went to Tallaght outside of Dublin, Ireland to explore the waste heat redistribution schemes connected to data centres that are being developed in these cities. Speaking to the recipients of these schemes and to county council members who had the vision to support the projects really helped ground these theories in practice and evolve my thinking.

FSW: That's something that I'm interested in within my own research – how by talking to people the direction of your research evolves. You never know what direction your original idea is going to take as a result of that kind of contamination of ideas. It's often surprising and unexpected.

AB: Yes, I like the idea of the contamination of ideas through the conversations that go on in fieldwork. In anthropology, you carry out a longitudinal study over a long time, taking in lots of different voices in a place. You need time to understand not only the conversations, but how these conversations are changing you too, changing how you feel about your topic.

CP: The concept of creating worlds with others or contaminating our current thinking could be extended to the audiences of this exhibition. How do you hope a viewer might be changed by your work, what would you like them to leave with?

AB: What I really want is for people to be able to go on a similar journey that I did into understanding technology. I think for someone with an Arts and Humanities background, technology is very much behind a black box. Oftentimes it's only professionals trained in computing-related fields that engage with the actual infrastructure and hardware of our digital experiences. I want to use art to make technology understandable to anybody who uses it, to give them more authorship over the design of that technology, and not always be limited to a top-down user experience. I also want people to look beyond the virtualisation and software that we experience in what seems to be a cyber space immaterial world. When you get to what's really at the core of it, hardware, this comes back to our finite earth and the climate crisis.

EC: For me, I really want people to leave the exhibition with more questions; questions that they might not have thought about asking before entering the exhibition; questions that give them agency to look at the world differently and become an active part in the conversation on climate breakdown.

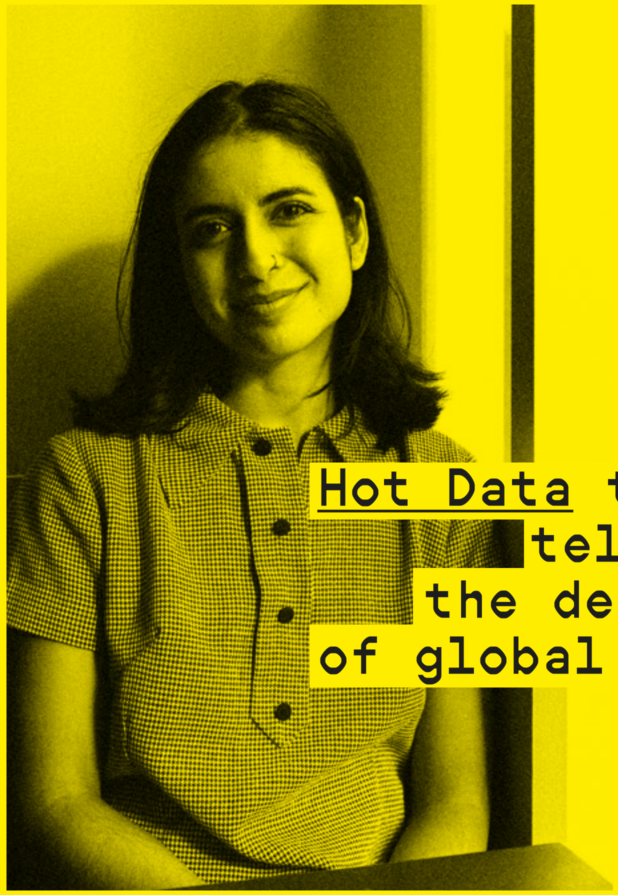
CP: Yes, design research is also about developing new questions, not only solutions.

JGI: I'd like people to leave feeling that they'd got to know the sun a bit more; to come away with an acknowledgement of what a force it is. Through time there have been various kinds of social, scientific and religious movements built around our relation to the sun and the climate more broadly. The industrialised society that we live in now has made us disassociate from the environment, fortify ourselves from it. Maybe if we could develop a deeper respect for the environment and climate, we could reimagine its role in the built environment and have a more intimate connection with it.

FSW: What Jamie said is very much what I would hope for too – that there's perhaps an acknowledgement that we all have a climatic identity. That's what my project is about. By thinking through our own identities, we realise that we all have a relationship with the climate emergency in some capacity.

HOT DATA

April Barrett



Hot Data traces the stories we tell to understand the devilish complexity of global digital networks.

Every send, search and swipe produces data. This data is stored in computer servers which, as with any computer or electronic device, produce heat. What happens to that heat? **Hot Data** sees April Barrett dig into the relationship between digital data and heat; from solar panels on a balcony in Barcelona to a data centre on the outskirts of Dublin. Through interviews, speculative ethnography and archival research, Hot Data traces the stories we tell to understand the devilish complexity of global digital networks, and looks for new narratives emerging from the fug of Big Tech orthodoxy.

April Barrett is a Canadian design anthropologist based in Edinburgh. She has a background as a community manager in the videogame industry as well as a Bachelor's degree in Anthropology from McGill University. She recently graduated from the Design for Change MA programme at the University of Edinburgh with distinction and the Edinburgh College of Art's Andrew Grant Postgraduate Scholarship, she developed an expertise in data infrastructure through her MA thesis which looked at the colonial nature of data centre expansion in Scotland. April brings her ethnographic methods to the design and digital culture space and has a particular interest in alternatives to Big Tech.

OTHER INTERNETS

projects against data colonialism

Data warms. This digital material can be sensed, felt by touch; it is transferred over the internet and expelled from hardware as heat. When hardware scales into infrastructure, a constant flow of energy is required to quell this heat before it threatens machinery. This resource-intensive system is hardly ethereal, so why do we imagine our digital experiences as existing in a limitless cyberspace?

Data centres are physical buildings filled with servers that store and process digital data. These buildings often compete with neighbouring towns for the massive amounts of water and electricity they require to keep servers cool and running. This is particularly true of the hyperscale data centres associated with Cloud computing. Globally, data centres are responsible for nearly 1% of all energy-related greenhouse gas emissions, close to the aviation industry. This is only set to increase as new technologies, like AI, boost demand for data services.[1] Digital materialist scholar Jussi Parikka writes of data centre cooling systems: 'The digital is a regime of energies: human energy and the energy needed for technological machines.'[2]

In the UK, three companies – Amazon, Google and Microsoft – own 78% of the Cloud computing market.[3] These multinationals are three of five Big Tech companies, so named for their profitability, size and influence, 'increasingly outsizing all other forms of institutional power.'[4] These companies tend to bill themselves as environmental stewards, evidenced by their massive investments in wind and solar energy to run their data centres. Environmental media scholar Anne Pasek says this kind of 'manufacturing logic' is relatively new for the tech industry.[5] She critically notes that looking to Big Tech's improving energy efficiency and investment in renewables as a climate solution might, 'mistake stocks for flows.' These corporations' management of renewables may not necessarily have a carbon-saving effect downstream. Still, these companies are becoming increasingly entangled with public energy infrastructure.[6]

Some metaphor has been made of 'data colonialism' which Couldry and Mejias define as, 'the capture and control of human life itself through appropriating the data that can be extracted from it for profit.'[7] Scholars analysing digital infrastructures have argued that this coloniality is more than virtual: Big Tech companies, aided by national governments, may physically settle on land, enjoy privileged access to its resources and impose a way of knowing – the indiscriminate scraping of big data – on its inhabitants.[8 9]

This dramatically imbalanced control over technology is not an inevitable future; it's not even our only present. As I explore how data heat disfigures our planet, especially when obscured, I'm also looking for futures where it might not.

In *The Mushroom at the End of the World*, Anna Tsing includes a call to start noticing small, irreproducible stories as a research practice. We may see these as inadvertent 'time-making' projects; instances of the future happening in real time. Inspired by this call, I've gathered a handful of alternative computing stories. These are projects in which decolonial, anti-capitalist and feminist thinking have been leveraged to design and vision technologies that undermine Big Tech's dominance. These designs introduce futures where growth is not linear and infinite, infrastructure may be organised communally, and environmental stewardship is based on an intimate relationship to a land. The collection is not comprehensive, it's just a research tool; something I'm using to imagine how we might begin to bring data back to Earth.

SMALL FILE MEDIA FESTIVAL

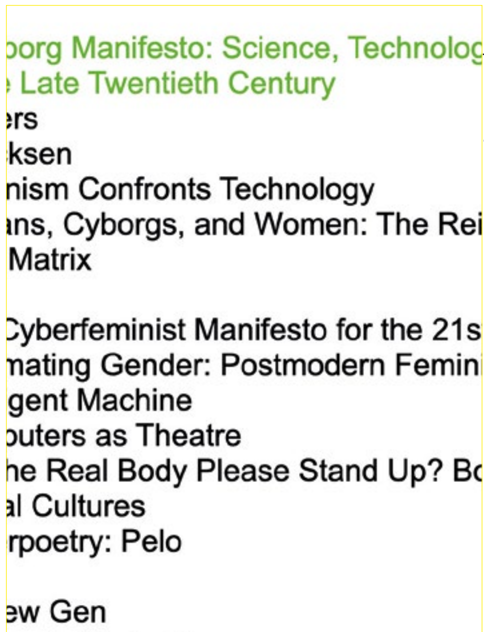
This festival, based at Simon Fraser University in British Columbia, Canada, encourages participants to submit 'small-file ecomedia'; videos with a maximum one megabyte per minute bandwidth. The organisers aim to confront data centres' carbon footprint and the infrastructural share that media streaming takes up in this system. They say: 'small files are here to save the planet – one pixel at a time!'

media type: event
source: smallfile.ca
tag 1: computing within limits
tag 2: degrowth

THE DAMAGED EARTH CATALOG

Developed by Marloes de Valk as part of their PhD research, and echoing the *Whole Earth Catalog* of the 1960s, this index is meant to promote practices that aid communities in shaping their own environments through alternative technology, such as low-tech and salvage computing.

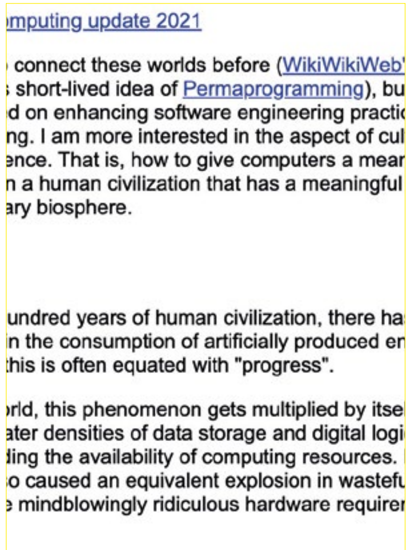
media type: index
source: damaged.bleu255.com
tag 1: computing within limits
tag 2: degrowth



CYBERFEMINISM INDEX

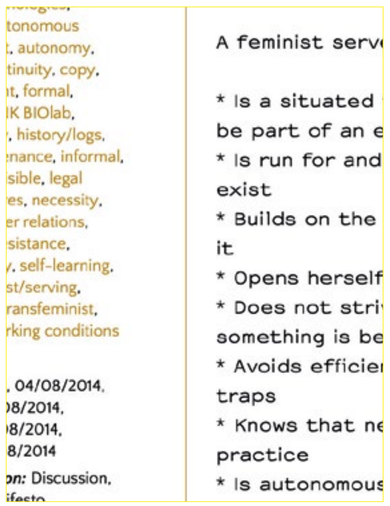
Developed by Mindy Seu, this index contains a cyberfeminist reading list ranging from 1985 to the present day. Seu's gatherings are comprehensive, sweeping from the early cyborg manifesto to more recent entries exploring the decolonisation of the internet.

media type: index
source: cyberfeminismindex.com
tag 2: cyberfeminism



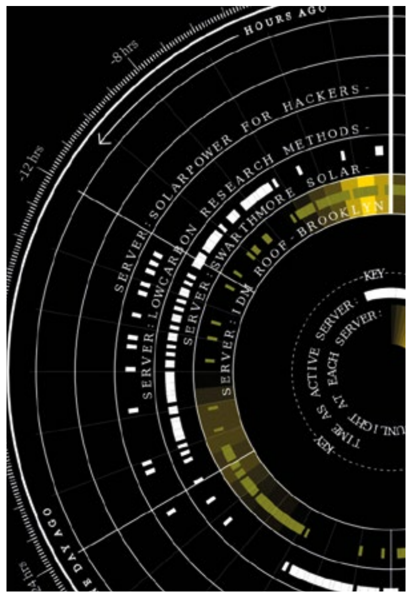
PERMACOMPUTING MANIFESTO
Written by Ville-Matias 'Viznut' Heikkilä in 2020, with an update in 2021, the permacomputing manifesto shares seven principles for applying permacultural practices to 'let nature do the work' when computing. Heikkilä's vision includes using less artificial energy to power systems, more hardware-sharing between people and local software creation.

media type: manifesto
source: viznut.fi
tag 1: computing within limits
tag 2: degrowth



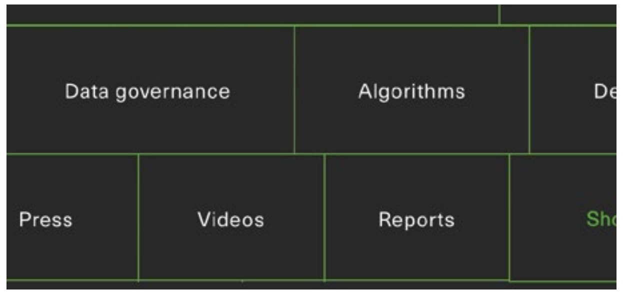
FEMINIST SERVER MANIFESTO
This manifesto emerged out of a 2013 workshop titled 'Are You Being Served?' by Constant, an arts and technology nonprofit based in Brussels. The manifesto includes playful subversions of the gendered dynamics within technology and focuses on care, materiality and radical refusal as principles of a feminist server.

media type: manifesto
source: areyoubeingserved.constantvzw.org
tag 1: cyberfeminism



SOLAR PROTOCOL
Solar protocol is a network of solar-powered servers, hosting three websites, sent to users by whichever server is receiving the most sun. The project, run by Tega Brain, Alex Nathanson and Benedetta Piantella was inspired by *Low-Tech Magazine*'s solar-powered website, and uses what the creators call 'natural' rather than 'artificial' intelligence.

media type: website
source: solarprotocol.net
tag 1: computing within limits
tag 2: degrowth

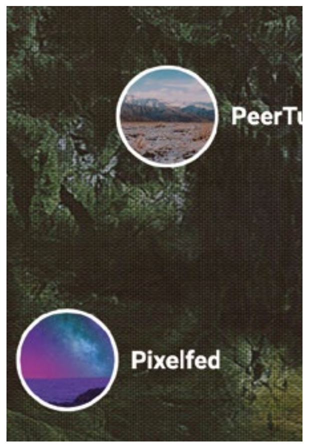


DATA FOR BLACK LIVES
This non-profit was founded by Yeshimabeit Milner in 2017 with the goal of using data to concretely benefit Black people. Their index includes events, campaigns and reports that seek to abolish 'data weapons', such as predictive policing algorithms, and establish datasets created for and by Black communities.

media type: index
source: d4bl.org
tag 1: abolition
tag 2: decolonisation

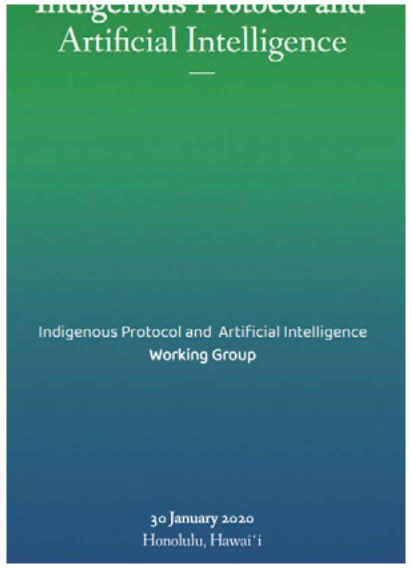
THE EQUITABLE INTERNET INITIATIVE
Introduced in 2015 by the Detroit Community Technology Project this initiative sought to reduce Detroit's digital divide by training community members as Digital Stewards. These stewards installed wireless mesh networks in their neighbourhoods and connected local buildings in an intranet. Once connected, the stewards also developed apps for their local intranet, based on the community's needs.

media type: program
source: detroitcommunitytech.org
tag 1: abolition
tag 2: infrastructure



THE FEDIVERSE
The fediverse is a network of social media servers, run independently but connected through the same protocol, allowing users to share data across servers. One of the most popular sites in the fediverse is Mastodon, which offers an Elon Musk-free microblogging experience.

media type: website
source: fediverse.party
tag 1: computing within limits
tag 2: degrowth



INDIGENOUS PROTOCOL AND AI

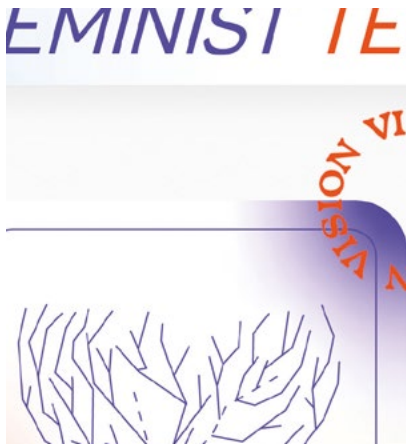
In this 2020 position paper, scholars working at the intersection of Indigenous studies and digital technology contribute design guidelines, essays and prototypes to outline what an Indigenous protocol for ethical AI might look like, in contrast to the dominant Western discourse. This includes how Indigenous communities might foster reciprocal, care-based relationships with AI programs, use AI as a creative medium and build AI infrastructure from the ground-up with as much care as if constructing a sweat lodge.

media type: publication
source: indigenous-ai.net
tag 1: decolonisation
tag 2: community infrastructure

CYBERPOWWOW

Cyberpowow was a multi-user graphical chat environment and an Indigenous art exhibition first released in 1997 by the Montreal-based Nation to Nation collective. The site was groundbreaking not only as 'an aboriginally determined territory in cyberspace' against a dominant white cyberculture, but also as an early exploration of networked communications. IRL 'gathering sites' were also established for anyone interested in participating who did not own their own computer.

media type: website
source: cyberpowwow.net
tag 1: decolonisation



THE DATA HEALING RECOVERY CLINIC

This future narrative by Neema Githere is included in the Feminist Tech Card Deck created by SUPERRR lab. In this story, Githere proposes a future in which Meta's social media platforms have been abolished and the 'data trauma' they wreaked may be healed through 'mycelial therapy' paid for by their global reparations programme.

media type: zine/publication
source: superrr.net
tag 1: cyberfeminism
tag 2: consentful tech

TOWARD A MINOR TECH:
A PEER REVIEWED NEWSPAPER

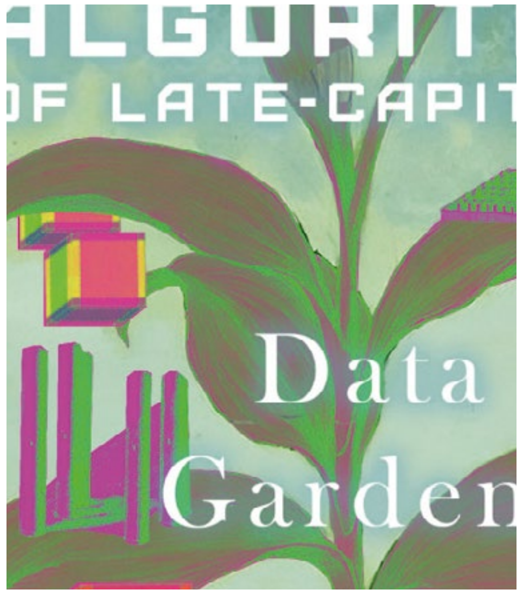
This collection of short essays was published in 2023 by the Digital Aesthetics Research Centre at Aarhus University. In it, several technology researchers examine Big Tech's 'problem of scale' and its cost to our material wellbeing. The authors imagine a 'minor tech' where data tools such as machine learning and blockchain may be developed with a non-extractive ethos and unscaleable use.

media type: zine/publication
source: darc.au.dk
tag 1: computing within limits
tag 2: degrowth

GETTING IN FIGHTS
WITH DATA CENTRES

Anne Pasek, a Canada Research Chair in Media, Culture and the Environment, released this zine in 2023. It includes tips for tracerouting the location of the data centres and guides the reader through climate stats and critical theory toward activism against data centre expansion.

media type: zine/publication
source: emmlab.info
tag 1: infrastructure
tag 2: climate activism



ALGORITHMS OF LATE CAPITALISM
ISSUE 10: DATA GARDENS

What would a community-owned data centre look like? Published by internet teapot, a Rotterdam-based design research studio, this zine envisions data as material to be cared for in a communal garden-like setting, nurtured to maturity, and pruned for redundancies.

media type: zine/publication
source: internetteapot.com
tag 1: infrastructure
tag 2: climate activism

‘TECHNIQUE RATHER THAN TECHNOLOGY’

Low-Tech Magazine’s solar-powered website

The internet is big. Its tangible components include data centres full of blinking servers, fibre optic cables transporting data across the globe and handheld devices that tap into routers wirelessly receiving this data. It charts the earth through subsea cables first laid for telegraphy while hurtling information, through light, at speeds inconceivable to those early cable layers.[10] It feels difficult to hold this hyperobject in our minds, to keep its scope within view, even as we put it to use in almost every daily action.[11]

Big Tech is a culturally dominant story. These companies have been given the governmental green light to expand carbon-heavy data infrastructure partly because of the assumption that users want infinite, targeted flow in their Internet experience without having to understand its dispersed components. As we are increasingly nudged to interface only with a “Cloud,” we let our attention drift away from a fractured and finite Earth.

But if we did pay attention, could we imagine an internet other than Big Tech’s? Researchers and activists have explored minor and small techs, such as the smallnet’ a series of self-hosted and community-run servers that offer digital services designed to be light on CPU, memory and bandwidth.[12][13] Small tech activism has been influenced by Anna Tsing’s critique of scalability, the ability for a technology to grow without changing its original frame, regardless of material limits.[14] Creations within the small tech community are made to resist scale.[15] Of course, this leaves some questions unanswered: is there an internet future where small tech approaches may be popular? Or are these simply examples of hacks meant to reveal Big Tech weaknesses today?

By looking closely at *Low-Tech Magazine* and speaking with the designers behind it, I’m beginning to investigate alternatives.

Low-Tech Magazine is published on an entirely solar-powered website. The micro-web server that hosts the site is powered by solar panels mounted on founder Kris De Decker’s home balcony in Barcelona. Access to the website follows the day’s weather; the site goes down when it’s cloudy. *Low-Tech Magazine*’s contents is divided into three thematic sections: low-tech solutions, high-tech problems, and obsolete technology, with articles including, ‘How to design a sailing ship for the 21st century’ and ‘Why the office needs a typewriter revolution.’ The website contents are also available in a made-to-order print book. The website is run collaboratively by Kris, Marie Otsuka, Roel Roscam Abbing and Marie Verdeil, with Kris writing the majority of the magazine’s contents, while the rest of the team focuses on the website’s management and design. They are a disparate group working remotely across the USA and Western Europe who first begun collaborating in 2017. At that time, the magazine was hosted on a more typical website.

Marie Otsuka was at grad school when her friend Lauren Traugott-Campbell introduced her to *Low-Tech Magazine*. The pair reached out to Kris together, eager to work on the magazine’s website.

’For us, the beginning of the project was trying to convince Kris that design is something you should care about. At that point, he was using this template in Typepad that he had customized,’ Marie Otsuka says.

’Yeah, sorry, it was pretty ugly,’ Kris says.

After the trio came to the idea of the solar-powered website, they understood its strength as an experiment. But there was still apprehension.

’First, of course, I couldn’t build it because I don’t know how to build websites,’ Kris says. ’But then the second thought was, is it too radical to basically risk my business? It’s just one website. [...] It communicates a lot of ideas, but it’s also a real working website and it is my job.’

Roel, an artist who had experience with building self-hosting websites, says, ‘the project comes from the idea that low tech is all about technique rather than technology; how you do things is very important.’

In hindsight, Roel sees the solar-powered site as an effective demonstration of degrowth values in practice. Roel says, ’I think of degrowth as both a larger warning and a larger promise; the warning is that [material constraints] will happen anyway because what we’re doing is unsustainable.’

Degrowth is a Western sociopolitical movement that aims to undo some of the social and ecological harms of the colonial-capitalist growth paradigm and has resonances with existing post-development frameworks from Global South countries, including Buen Vivir and Ecological Swaraj.[16] Roel thought of degrowth as a useful heuristic, guiding the design to be as resource-efficient as possible. The limits of the size of Kris’s balcony, for example, put limits on the solar panel energy throughout, which means that only a certain size of server can be used and that a certain kind of website could be made.

The web design is ultra light. Inspired by the first website ever made, the site is static, meaning it’s only been generated once and now exists as a set of documents on the server’s hard drive. This design contrasts with the energy-intensive database-driven model most websites use today. In terms of user interface, the team employed dithering (an image compression technique) to reduce image file sizes, as well as default fonts and a minimal, text-only logo: a simple, left-pointing arrow rather than a hyphen divides the title words 'low' and 'tech.' These design choices reduce the amount of solar energy needed to load the page's assets.[17]

Marie Otsuka understood the paradox of efficiency as a path to sustainability; making something more efficient allows for more usage of it. To exit this loop, Marie's challenge was to design the site in a way that also nudged people to rethink their consumption patterns.

'[When] something that's supposed to be online goes offline, it disrupts your thinking,' she says. 'I've been comparing websites to theatre, in a way. They can be performative, and they use time as a medium. [Websites] can [also] break the 4th wall. When you realize that you're a part of it, you become conscious of yourself.'

Following this thinking, a key feature of the website is a battery meter icon in the top corner, which allows users to see how close the server, and by extension the website, is to going offline.

'We wanted to keep the meter pretty prominent since it shows the infrastructure in a direct way,' Marie says. 'It immediately makes the audience part of the website. We didn't really want to put it to the side and make it too polite.'

When Marie Verdeil entered the project in 2022, she 'took on the role of managing the to-do list,' she explains. Although the site had already been running for five years, there was plenty to do.

The team usually only meets once a year, in Barcelona. Their lives, ways of thinking and working, are all dispersed, sometimes scattered. In this way the project works through the team's patchwork expertise; they've now formed an enmeshed community. Roel explains, 'When things don't work when Kris wants them to work, he sends everyone emails like, "I'm independent from [the grid], but now I'm dependent on all of you."'

'the project comes from the idea that low tech is all about technique rather than technology; how you do things is very important.'

The team cautions against replicating their experiment. Kris says, 'What we saw in the years after the launch is that many people build solar powered websites, but in the wrong locations, like in the Netherlands. Then they end up with huge solar panels and batteries. That defeats the purpose. We see a lot of websites that basically just copy the aesthetics, the design; the yellow, the dithering. There's even a car seller that uses this style to sell cars and make it look sustainable.'

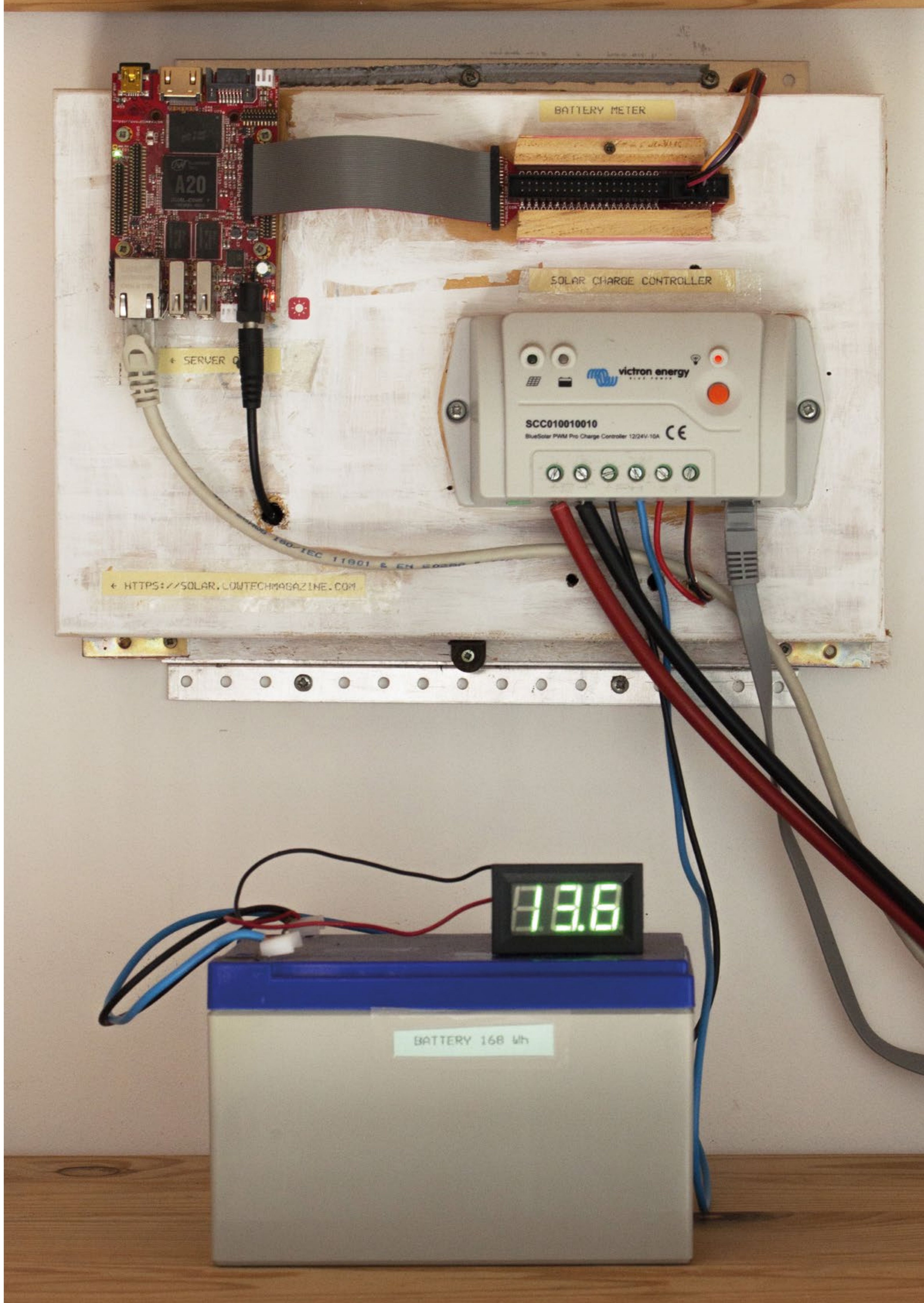
For this reason, Roel believes that the magazine should not invest in another manual retracing the detailed steps of building their website. Instead, they could share general principles and practices for degrowth in relation to technology.

Some *Low-Tech Magazine* content is already useful in this way. In an article titled, 'How to build a low-tech internet?' Kris highlights Global South, post-colonial examples of ICT ingenuity. In delay-tolerant networks such as DakNet in rural India, buses equipped with computers, hard drives and wi-fi nodes, serve as "data mules," transferring data as they stop near village computers. Similarly, around the world, existing "sneakernets" employ vehicles, foot messengers and even animals to transfer data. Kris imagines a hybrid online/offline system, highly resilient in an energy crisis, where even trains or sailing vessels could be stuffed with digital storage media.[18]

When imagining how dispersed systems such as these may be organised at scale, Roel says, 'I think it's important to separate scale as a goal and scalability as a technical property. [There are] ways of scaling differently.'

He points to the federation model as an example, where scale is achieved by a handful of local groups representing themselves in a larger consortium. This model can be seen in practice through platforms like Mastodon, a microblogging software that belongs to a collaboration of self-hosted social networks called the fediverse. The software gained traction with users fleeing Twitter, after its acquisition by Elon Musk. This decentralised model allows a network to grow while giving users the option to self-host and dictate their own norms around data storage, privacy, and energy use.

Low-Tech Magazine's solar-powered website isn't a solution, but it is a story. As internet-users tire of feeds of heavy media and begin to understand that this oversaturation strains the planet as well, the story spreads. The project joins other small tech designs, and over time may be understood widely. As Daniel Chávez Heras writes, '[minor tech] does not have to stay minor, it might come of age'. In this story, we can see an internet that might materialise if we stay interested in it.



TALLAGHT 2029

a speculative ethnography on infrastructures of data and heat

Tallaght is a Dublin suburb near the foot of the Wicklow mountains. The borderless town, known for its high-density and low-income population, is also the seat of the South Dublin County Council and host to several data centres. These buildings are unremarkable in the South Dublin landscape; data centres became a fixture here as Ireland's low corporate tax and cool climate made the country an attractive outpost for US multinationals throughout the 2010s. What is remarkable about Tallaght is that, as of 2023, it is the site of Ireland's first district heating network sourced from the waste heat of an Amazon Web Services data centre. In this council-owned scheme, heat from Amazon's servers is transferred to an air-handling unit where it meets a coil of cool water and raises the water temperature to 25°C. The warm water is moved through pipes to the Heat Works energy center where heat pumps raise it to scalding temperatures and then send it through pipework to local radiators. So far, County Hall, the local library and Technological University Dublin (TUD) Tallaght's main campus building have been heated through the scheme. The client base is set to expand to residential buildings; when this comes into effect, residents' heating bills would drop 10-15%.[19]

The Heat Works scheme was conceived in the wake of vulnerabilities left by Ireland's data centre boom. The centres, particularly Big Tech-owned hyperscalers, have proven to use untenably high amounts of energy. They account for 18% of the country's metered electricity, more than all of Ireland's urban households.[20] This large power share implicates the tech industry in Ireland's inability to meet its carbon reduction goals.[21] Some argue that data centre operators are vital in meeting these goals through renewable power purchase agreements,[22] others point out the flawed logic of this carbon offset system; the rate at which data centre energy demand is rising outstrips available renewables in Ireland.[23] As of 2021, the national grid operator has paused connecting new data centres while the country scrambles to meet electricity demand by setting up emergency generators.[24] Activist groups such as Not Here Not Anywhere have called for a full moratorium on data centre expansion until better energy cap policies are developed, but such suggestions have been dismissed as extreme.[25] Ireland's Minister for Enterprise said: 'It is important to say that there is no technology-based economic growth without data centres. [...] The challenge for us is not to reduce the number of data centres in Ireland, the challenge is to find a way of powering them with sustainable and abundant power.'[26]

I spent time in Tallaght because I wanted to follow the heat of the Internet to a community surviving alongside these finicky infrastructures in times of scarcity. By examining the district heating scheme, I began to understand how communities such as this one coordinate with multinational corporations to secure their material wellbeing. I also began to see the collapsable boundaries between data and heat, between media and energy. Drawing from a handful of interviews, participant observations and field notes typical to ethnography, I hope to share some of my insights from this field visit in a form untimely for the anthropological flow, through speculation on Tallaght's future. I want to put into practice theories from the emerging field of design anthropology. Jamer Hunt writes that a productive outcome of this field are 'prototypes' of future social worlds.[27] Creating such a prototype can be uncomfortable, it speeds anthropology's analysis of the recent past up to design's 'close present' temporality.[28] It aims to sketch out a different world. In this way, it takes on the politically charged work of altering a culture. That said, it can also be playful. I have no illusions about my authority or prescience; I have only what I noticed, collected and carried with me, just stories to tell.

All photos by Stephanie Strifert, 2024

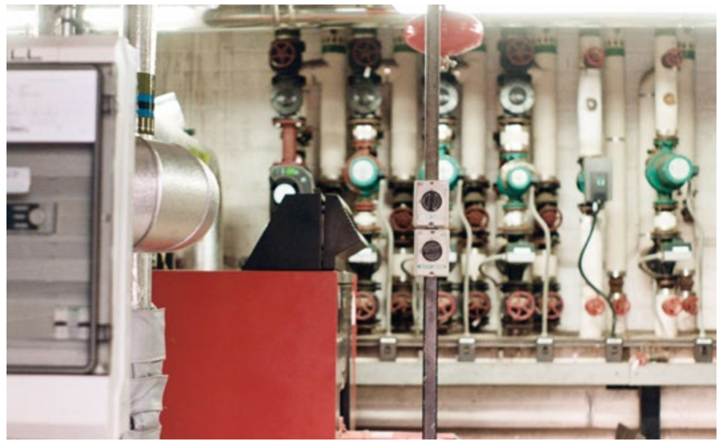
Below: Amazon Web Services data centre in Tallaght, Heat Works Energy Centre to its right-hand side

2024

I'm walking through Tallaght with Enver*, the manager of Heat Works Energy Centre. Enver is from Eastern Europe*, from a small town that he says is similar to Tallaght, minus the work ethic. In this town, he was the district heating manager of a facility run on oil. He describes this job in a story: He is walking through his town on New Year's morning at 9am. It's quiet. Everyone is still asleep after the night of celebrations. He arrives at the town's heart, the energy centre, to relieve the single man operating the facility overnight. 'Can you imagine? It's only you taking care of 2000 buildings,' he says with pride. '[District heating] companies live together with the community.'

Enver and I are tracing the pipes of the district heating network as we walk through town. 80 centimetres beneath the pavement two sets of pipes snake their way from the data centre to the TUD campus, pumping hot water one way and sending cool water back. I notice that the buildings here are both flat and sprawling and oddly close, like movie-set suburbia. For this reason, Tallaght is useful as a pedagogical model of district heating; the university campus is only a few strides away from the data centre.

When we arrive at the campus, Enver points out a small pipe protruding from the middle of a lawn. 'Geothermal research,' he says casually. He explains that the university is digging deep in the ground to source the hot liquids lying beneath the earth's surface. If it works, he explains, they may be able to heat water up to 38 degrees[29]. 'Then they provide the district heat.' I'm alarmed at how quickly Amazon falls from relevance in this future proposition. But then again, I can see how it could happen...



Above: Inside the boiler room at County Hall, where a heat exchanger unit has replaced a gas boiler

*Left: *Enver, the Heat Works Development Manager, giving April Barrett a tour of the inside of the centre. The two pipes of the heat network, one pumping out hot water from the data centre, one pumping in cold water, are behind us.*

Right: Insulated pipes, to be used once more clients are connected to the heating scheme

2029

Enver had been trying to convince his daughter to transfer from her university to the TUD geothermal lab for a while now. He liked to remind her of the essentiality of the work, it's 'heating or eating,' plus she always did so well in science, wouldn't a geology degree be a good fit? She could join the team that broke ground on the new district heating source. He's not sure he understands her stubborn insistence on studying product design. Once he had accommodated such technologies into his cosmology, he imagined every time his phone blipped with a photo from back home that he was communing with the Amazon data centre. 'We need it, our lives depend on it now,' he would often say when explaining how his job and the internet worked symbiotically. But after years of sitting outside the fortress-like centre in Heat Works' little green building, like a doghouse on the data centre's lawn, he was beginning to resent when people asked him if he'd seen inside it. He was not allowed in; he had not been given security clearance. Was the data he was receiving really the same as that which passed through the centre?

He felt a form of relief when he heard the council would be cutting off Amazon as its heat source. The fences around the windowless structure had grown taller over the years, electrified in some places, and the security presence had tripled. Anti-data centre activism had pressured the Irish government into enacting energy cap policies. The centre was forced to provide flexibility to the grid by running at a lower capacity when other sectors needed it. It did not produce nearly as much heat as it used to. With this policy, plus activism pushing for transparency on dark data rates, and with another looming hike in corporate tax there were rumours that Amazon was done with Ireland. Apparently, the corporation had its sights set on Iceland as a more accommodating land base for its aggressive build-out of cloud-based AI services. Whether or not the data centre remained, Tallaght's designation as the first district heating scheme in Ireland had already been accomplished and put to work. This system endured. Enver liked to tell his daughter a story. It was one he'd probably told too many times. Once, in his hometown, he had been asked if he would rather build a church or a mosque. He had replied: 'District heating.'

*

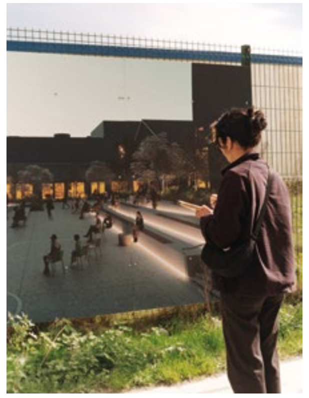
In his anthropology of infrastructure, Brian Larkin refers to: 'the way technologies come to represent the possibility of being modern, of having a future, or the foreclosing of that possibility and a resulting experience of abjection.'[30] For Enver, Tallaght's future rests in the heat network. The data centre is trickier to place in the story. Social science scholars examining data centres have noted the particularly weak fantasy-making associated with their entrance into residential communities. Their benefits are ambiguous and dispersed, as opposed to the infrastructures they often replace that move more tangible goods, like water, or provide more employment, like factories.[31 32] In an ethnography of an Icelandic data centre Alix Johnson discusses the site's 'ambivalent integration' into its town, identifying the town as a place: 'where infrastructure is built to facilitate flow through rather than flow to.'[33] Through my first speculation I posit the Amazon data centre's weak social integration as a threat to its longevity in Tallaght. Even though the centre has been incorporated as a heat source it continues to be challenged by rival sources, which may win public favour. Here the social reality must be considered alongside the technical, as data centre carbon emissions, and controversies, peak. Rather than seeing the infrastructures as powerful internet engines that extract from and dominate their locale, I am picturing how data centres' 'place-agnostic' nature isolates and enfeebles them.[34] Tung Hui Hu calls the feverish securitisation of data in the cloud, 'melancholic,' writing that while melancholy is 'something of a preservative,' it is also the preemptive embodiment of loss.[35]

SCENARIO 2

2024

Declan* oversees the facilities at County Hall. He takes me to the utilities room of the building, where, among the jumble of pipes and dials, he points to the heat exchanger unit recently plugged into the place of the old gas boiler. I am interviewing him as one of the recipients of the district heating scheme but being, in its early days and as a council staff member, he can only speak about it in promotional terms. Back at his desk, his professionalism cracks slightly when I ask him to describe Tallaght. 'I'm proud that I'm from Tallaght,' he says, 'I've never had an issue with saying that I'm from here. But years ago, it would have been something people would not put on their CVs. They wouldn't get an interview.'

When prompted to meander further into the territory of memory, he tells me that he vividly remembers the data centre site before Amazon. For most of his life it was the Jacob's Biscuit factory. He says: 'When you woke up you could smell biscuits in the air, on the wind.' Declan says that his generation still calls it 'the Jacob's factory,' and he believes the name will stick. However, he muses, 'Kids now will always remember the Amazon data centre.' Jacob's Biscuit factory closed its doors in 2008 and the site was not acquired by Amazon until 2015, but the memory of Jacob's persists, perhaps due to its material trace in scent; the way this scent became emblematic of Tallaght. As excess from Amazon's data is distributed through the community in similarly sensory form – heat – might it provoke similar affection?



Left: A valve in the Heat Works energy centre

Right: April Barrett, taking observational notes, examining how new developments in Tallaght is advertised

2029

On Sunday, Kelly arrived at St. Mary's priory early so that she could sit for a spell in the garden. She wanted some time alone in the quiet before people began streaming in for mass. It was March and Great Blue Heron chicks had hatched; she could hear their mother's stately squawk high above her head. She stood among the walnut trees and nudged at the blue eggshells scattered at her feet. She felt the peace of being in an ancient place. The priory was first recorded in history in the 8th century A.D. as St. Maelruan's monastery; at that time, it was the epicentre of Celtic monasticism. Over the centuries it had been destroyed by Vikings, rebuilt as a castle, fallen to ruin, and eventually remade again as a Catholic priory. For Kelly, this place was Tallaght's soul. She wasn't sure what to make of the way the town had changed – the Innovation Quarter with its trendy upstarts, rows and rows of condominium buildings for them to live in. 'Everything changes,' Declan had reminded her, recently, 'isn't it nice to see it change positively, rather than sit for years and become dilapidated?'

Kelly's hands were starting to go numb in the light rain; she entered the church for shelter. She was enveloped by warmth as she did. She picked up a bible in Irish and sat down on a back pew. Dim sunlight filtered in through stained-glass windows of the modern extension of the church. Instead of reading, practicing her Irish, she closed her eyes and felt the warmth. She thought about the priory's connection to the district heating network and its source, the enormous, windowless data centre. She had recently read that with every passing year, with all the AI services, chips in servers were getting denser and hotter, and the rising temperature of the servers afforded a higher water temperature for the heat network. This had allowed new clients to plug into the scheme, including the church.

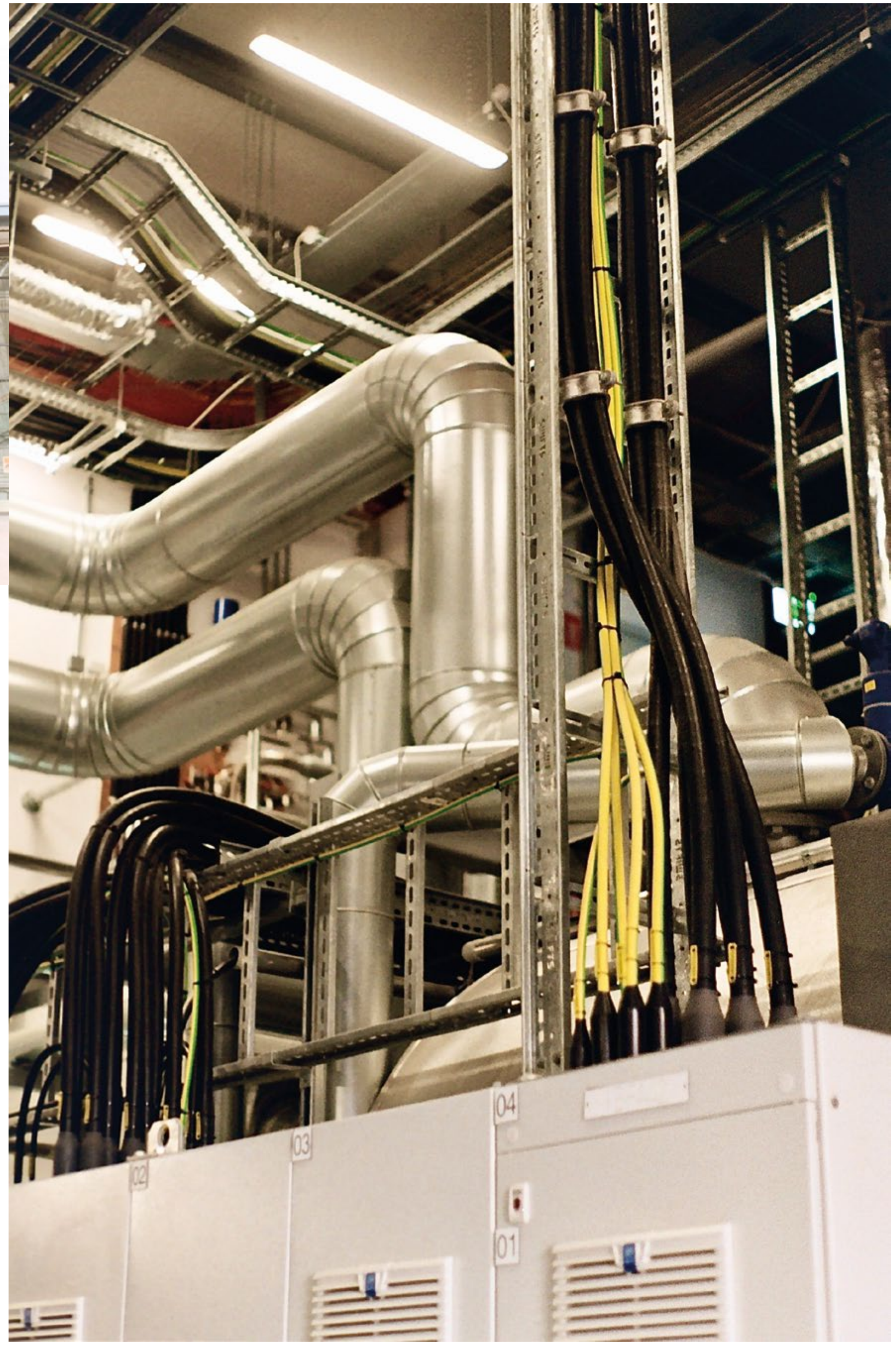
She had engaged with such AI technology recently: a customer experience avatar, asking how it could help, smiling like it was on TV, moving a fraction of a second too slow for its sound. Now, she imagined its pixels breaking down, moving as bursts of light over cables to humming servers, steeping in hot water tanks and evaporating in the surrounding air. She was warm and the priory remained. So, for a moment, she was calm.

*

As data centres are prioritised as recipients of renewable energy, and Big Tech continues to explore a new manufacturing logic, could waste heat become a good? In this story, I explore how the district heating scheme can imbue a previously indifferent data centre with benevolence, as well as give data excess a comforting, sensate form. This evolving relationship between energy and data has already produced a new kind of "end user" for Amazon in Tallaght.[36] Before my trip to Tallaght, I spoke with John O'Shea, a spokesperson for Dublin's energy agency, Codema, who partnered with the South Dublin County Council on the Heat Works project. John tells me that he believes people in Tallaght are already looking at the data centre in a different way:

> 'It's almost an extension of their own building. [...] and it sort of has a cool factor. [...] I think anyone who's ever had a laptop on their lap has thought, "oh, this gets warm" and now they're realizing, "this is heating my house." There's something really satisfying about closing the loop.'

Pseudonyms have been used here.



Right: Pipes and power cables in the energy centre

Above: Civic Theatre, located close to heat network recipients County Hall and County Library

Left: Heat Works Energy Centre's temperature / megawattage tracker

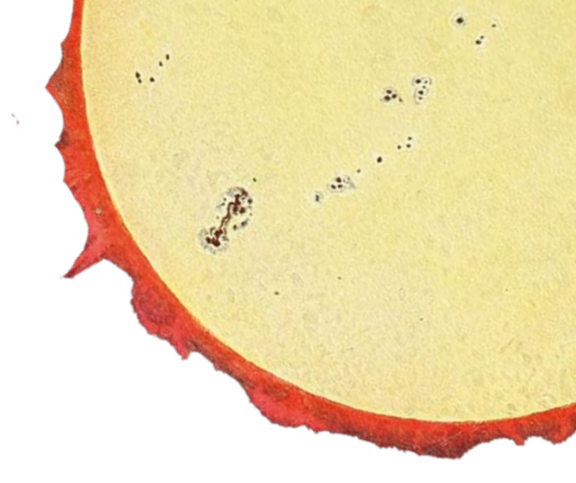
OLFACTIVE EVOLUTION

Eliza Collin

In *Olfactive Evolution*, Eliza Collin dives into the science of scent and its instabilities in the context of the climate emergency.

Increases in global temperatures are causing the scent of certain plants and flowers to change. When a flower's scent changes, it can become unrecognisable to its pollinators – such as bees or moths – which puts that flower at risk of extinction. In **Olfactive Evolution**, Eliza Collin dives into the science of scent and its instabilities in the context of the climate emergency. Through in-depth collaborations with scientists, perfumers and farmers, the project explores how smell can be a gateway to understanding non-human lives and reveals the role of design in making sense of how those lives are evolving.

Eliza Collin is a designer and researcher with an MA in Material Futures from Central Saint Martins. Her practice spans disciplines and species, using design to build networks and interventions exploring varied and proactive futures. Her previous work has focused on water, working on projects with Policy Lab, the BlueCity Rainwater Hackathon, the Gemene Grond residency, the British Council and developing WET ZONES with Fondazione Studio Rizoma.



MISSED CONNECTIONS

drought and its effects on rosemary and bee interaction

DIAGRAMS BY ISABEL LEA[1]

FIG 1.
ROSEMARY IN IDEAL CONDITIONS

Under normal conditions, rosemary emitts a strong scent which attracts domestic bees.

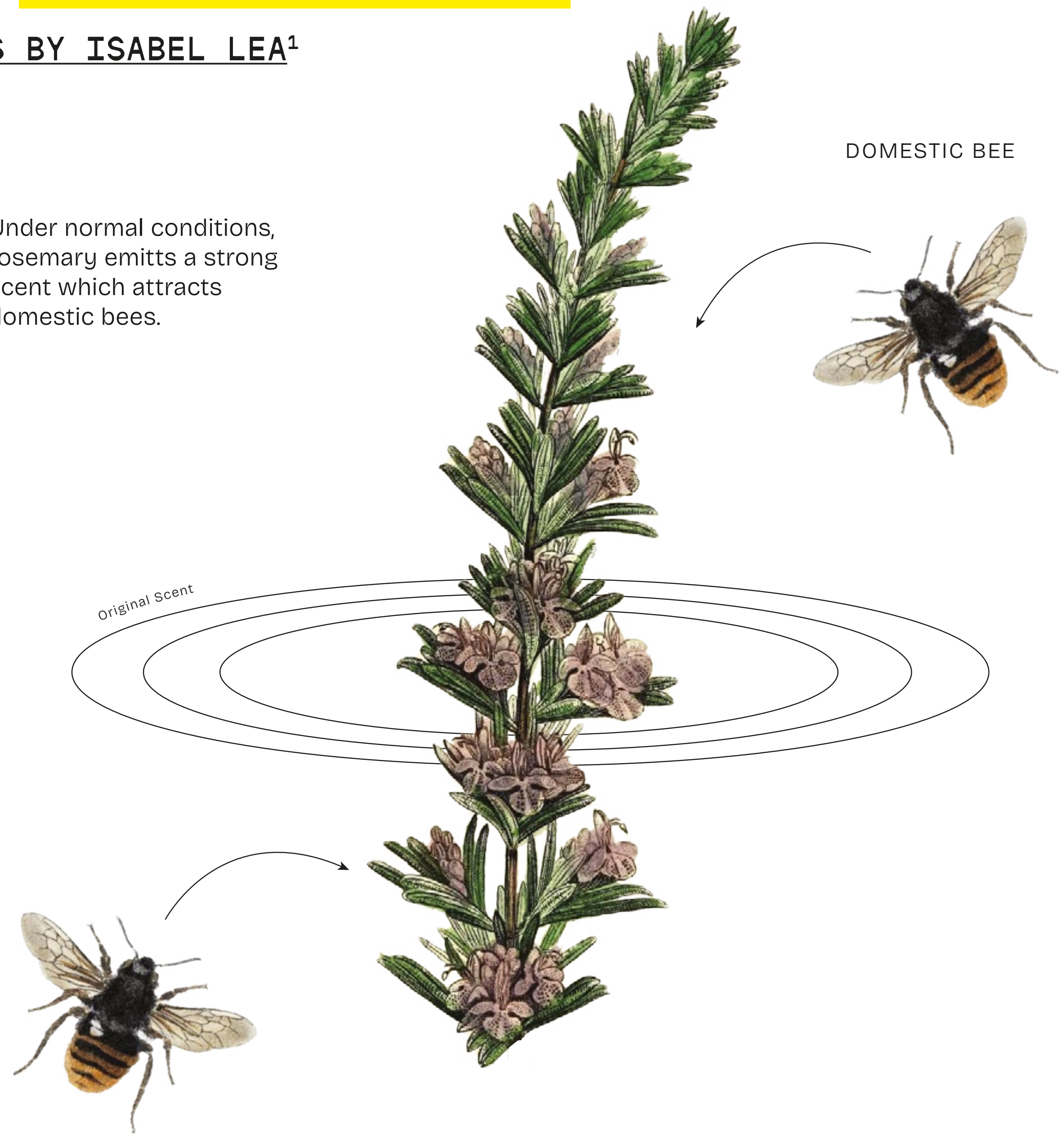
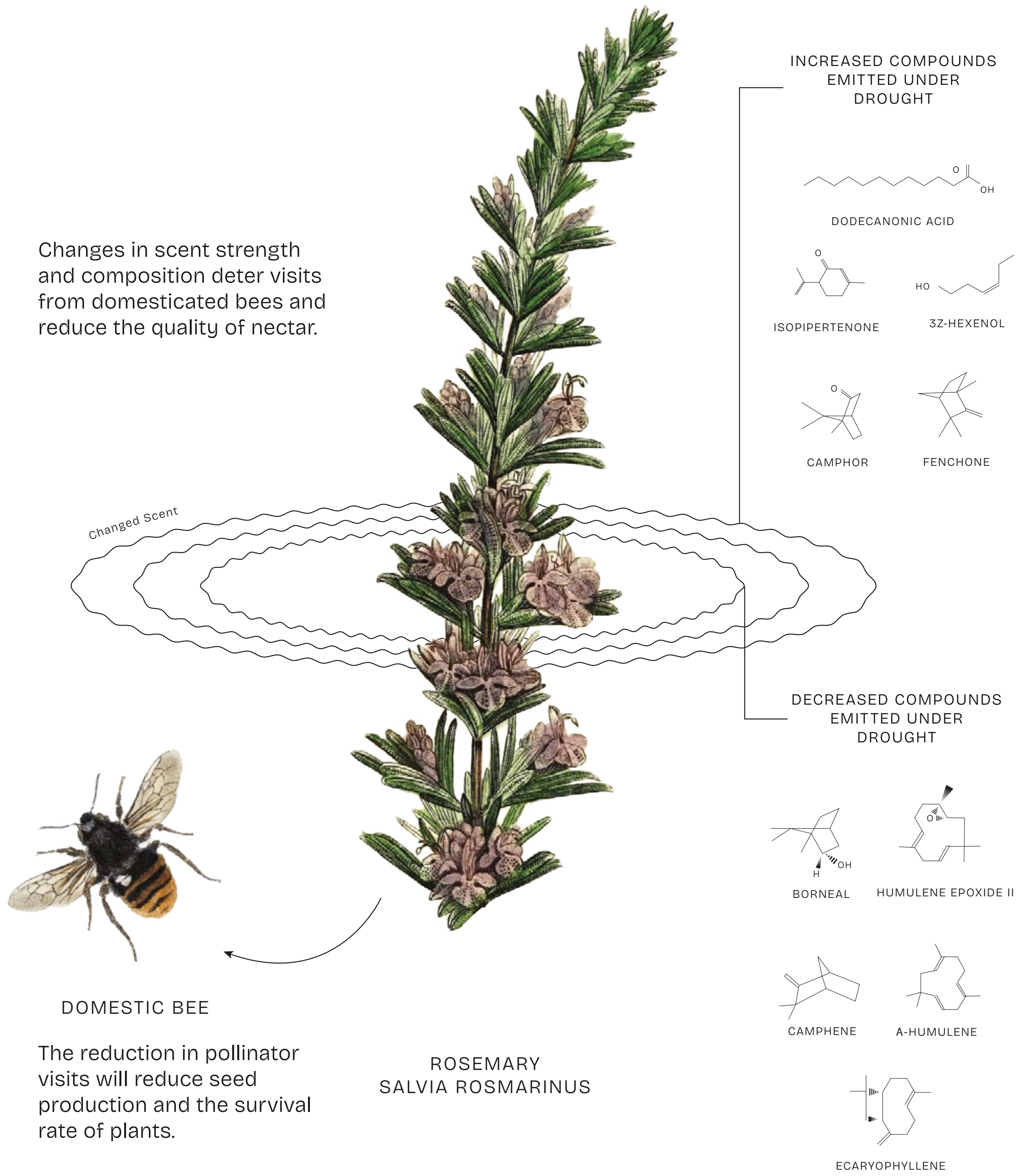


FIG 2.
ROSEMARY IN DROUGHT CONDITIONS

Changes in scent strength and composition deter visits from domesticated bees and reduce the quality of nectar.



The reduction in pollinator visits will reduce seed production and the survival rate of plants.

TOOLS FOR NOTICING

scent in changing climates

PART 1

When we try to understand the ways in which the world around us is changing, we often start with what we can see and hear. Sight and sound are the senses we, as humans, are most connected to. What I am exploring throughout this project is the potentially massive implications of something which which humans have very little ability to sense, or the sensual sophistication to analyse, without technological support. Kathryn Yusoff points to this in their work, 'Insensible worlds: post-relational ethics, indeterminacy and the (k)nots of relating', mentioning that 'there exists an urgent need to find modes of recognition beyond "our" abilities to make nonhuman worlds intelligible if biodiversity loss is, for the most part, lost to sense.'[2] Furthermore, Anna Tsing in their own seminal work *The Mushroom at the End of the World*, calls for 'tools for noticing' indicating that without these, 'life on earth seems at stake'.[3] Through my research I have come across various tools for noticing. From methods of observing living systems, archival analysis and scientific machinery to predictive models enabling me to marry awareness of the present with expectations of the future.

The scent a plant emits is made up of individual volatile organic compounds (VOCs)[a], sometimes hundreds. These VOCs, or volatiles[b], are perfectly adapted for individual plant-to-pollinator relationships; not all pollinators visit all plants, they are drawn to the plants with the right constellation of VOCs. As interest in this area grows, it is becoming clearer that changes to plants' environments – such as climate, temperature, precipitation, snow melt and pollution – can cause them to change the quantities of the different volatiles[b] they emit. This can lead to a shift in their scent and a breakdown in their interactions with pollinators which are crucial for procreation, hybridisation and evolution[c].

The identification of plant volatiles is an emerging area of science, due to technological developments taking place in the last 50 years. Over this time, both botanical researchers and perfumers have been discovering that there were intricacies in olfactive[d] plasticity[e] which we couldn't sense, and that this insensible world might be more important to understand than we had previously realised.

Due to their inability to move (very fast), plants need to evolve in relation to their changing habitats to survive. For example, plants which can evolve to have thicker leaves in areas with less regular access to water, will retain more water and survive longer periods of drought. Or, more pertinently to this project, plants which can continue to emit the right volatiles and quantities to attract local pollinators. Alexandre Antonelli, Director of Science at the Royal Botanic Gardens, Kew, has forecast that some species will 'need to evolve 10,000 times faster if they are going to out-evolve climate change, which is very unlikely for most species'[4]. In this work I address the challenges some species face, alongside their potential for adaptation[f] amidst changing climatic conditions. More than this, I ask how the exploration of these routes draws into question some of the common assumptions and expectations we have of our own futures, which are inextricably linked with wild and cultivated ecosystems.

a. Volatile Organic Compounds (VOCs): chemicals which make up the overall blend of how a plant smells.

b. Volatiles: the group of chemicals which readily evaporate.

c. Evolution: how a plant adapts over generations.

d. Olfactive: of or relating to sense of smell.

e. Plasticity: how a plant can change within its lifetime depending on changes in their environment.

f. Adaptation: when a plant evolves to become better able to live in its habitat.

Photos by Eliza Collin

'for plants in the wild, evolution is much more fluid and is enabled through forms of communication often hidden from our view.'

PART 2

g. Gas chromatography/mass spectrometry (GC/MS): scientific method for measuring the concentration of chemicals present in a plant's scent. It is also used to measure the quality of extracted plant essences.

The first plant scent was analysed in 1966 by botanists Calaway H. Dodson and Harold G. Hills,[5] using a technique called gas chromatography and mass spectrometry (GC/MS).[g] When analysing a scent you undertake the following;

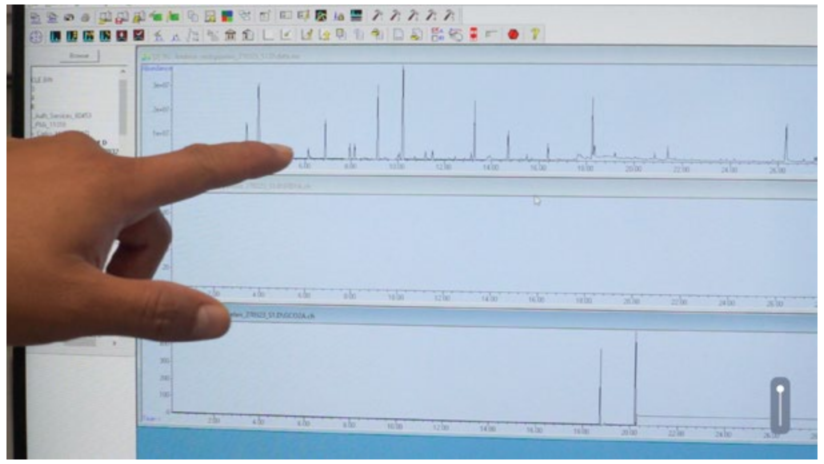
STEP 1:
The plant sample is collected and labelled.

STEP 2:
The sample is encased in an airtight bag and a filter is inserted. These filters or 'VOC traps' contain a porous polymer adsorbent (Haye Sep Q) to which many other chemicals will stick.

STEP 3:
Using a small pump, air is sucked out of the bag, pulling the VOCs with it which will be captured in the filter.

STEP 4:
These samples are prepared to go into the GC/MS machine to determine the VOCs present.

STEP 5:
The GC/MS machine generates a graph from the sample. The peaks in the graph indicate the different volatiles present and can now be used to analyse the scent.



GC/MS testing with Dr Carlos Martel at the Royal Botanical Gardens, Kew. Photos by Eliza Collin

Dodson and Hills found that plants' changing scents could put them at risk of extinction due to the strong links between pollinators and scent preference. They managed to prove, for the first time, that there were intricacies to a plant's scent which were insensible to humans. Plants which seemed to have very little or no scent showed up as emitting volatiles which may be perceptible to pollinators. They were also able to start clearly identifying which volatiles were emitted at specific moments and how pollinators would respond to those specificities, therefore highlighting that, if disrupted, those relationships may quickly break down or need to adapt. These discoveries triggered a domino effect of global scent exploration by botanists, chemists and perfumers.

Beekeeper, Mia La Rocca taking part in a scented observations walk on the coast of Addaura, Palermo during the Critical Seeds of Resistance programme, curated with Aterraterra. Photo taken by Eliza Collin.

PART 3

Through this residency I am holding the following questions in the forefront of my mind: How can design enable us to relate to, and therefore establish value systems around, what we don't immediately sense? And what are the tools we need for this, building from our expectations of the future and our needs in the present?

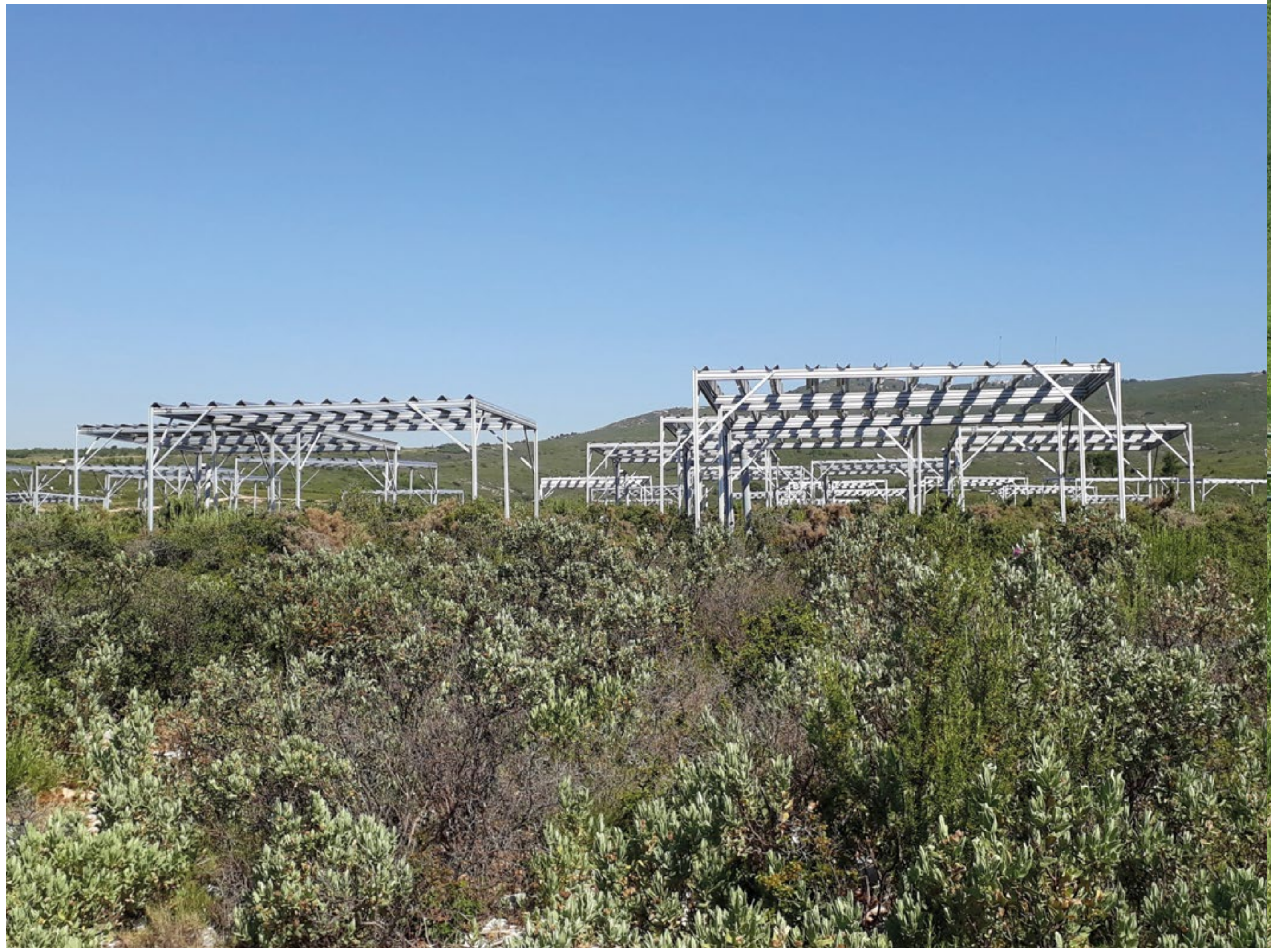
When talking about what we know of evolution and the non-human world, we need to look back at the part we have played, and continue to play, as humans. Farming and agriculture have defined the evolutionary pathways of many plants to follow human preference for consistency and reliability such as the reliable taste of tomatoes, the smell of roses, etc. Tsing refers to plantations as 'ecological simplifications in which living things are transformed into resources – future assets – by removing them from their life worlds'. [3] This controlled cultivation results in low genetic variability and, consequently, high susceptibility to diseases and low tolerance to changing climates.

For plants in the wild, evolution is much more fluid and is enabled through forms of communication often hidden from our view. Yet wild species are clearly not immune to the impacts of changing climates; the increasing extinction of pollinators and plants due to changes in land use, urban development, exploitation and climate change is limiting evolutionary opportunities for them. Healthy wild ecosystems are vital for the health of cultivated ones. As an example, the increasingly rare wild Peruvian pimp tomato (Solanum pimpinellifolium), seen as the ancestor of the modern tomato, is regularly re-crossed with domesticated tomatoes to increase their gene pool and offer benefits such as disease resistance. Many of these wild species are now protected under legislation, restricting countries who have historically collected samples from using them for their more tolerant characteristics without financial compensation to the country of source.

CONCLUSION

The scientists I have been speaking to during this project are using varied methods to simulate the future. Using simulation as a key tool for exploring the implications of the decisions we make today and predicting their impacts. With the collaborators on this project, we have been asking the questions: how are we simulating these futures and why? How does this inform what we are expecting? What should we do with this knowledge?

To aid us in navigating these largely unfathomable moral, social and environmental questions the position of design researcher gives the freedom to engage with and connect disciplines which may be exploring these questions but from varying angles and perspectives. Through identifying links, we can ask questions and present opportunities. We are translating findings into different contexts, exploring how they might fit into diverse futures. I am inspired by the words of Donna Haraway, 'It matters which stories make worlds, which worlds make stories.'[6] Through visualisation, designers can start to connect to, comprehend, translate and work with the changes happening around us. What does the future look like to you? In the words of Indy Johar, founder of Dark Matter Labs, speaking recently at the Design Museum: 'what an exciting time to be a designer!'



Drought simulations, Marseille, France

(Photo courtesy of Dr Coline Jaworski and CLIMED facility. Included in article Jaworski et al. (2022) Journal of Ecology, https://doi.org/10.1111/1365-2745.13974)

Climate change simulations, Rocky Mountains Biological Lab, Colorado, USA

(Photos courtesy of Dr Diane Campbell, J. Powers, H. M. Briggs, R. Dickson, X. Li and D. R. Campbell, 2022. Earlier snowmelt and reduced summer precipitation alter floral traits important to pollination. *Global Change Biology* 28: 323-39.)

Top: Rain off shelters

Bottom: Early snow melt simulations

SENSING THE INSENSIBLE

five conversations across disciplines

Researching the relationship between changing climates, plant life and scent, has required collaboration and conversations with people working in different fields: scientists, farmers, fragrance producers, botanists and others. This edited series of conversations explores how they each play a role in supporting and understanding our complex ecosystems and, slowly, open up a world that is largely invisible to humans.

I began by speaking with David Bridger, one of the founders of Parterre Fragrances, a fragrance company and botanical archive based in Dorset. Parterre grows a huge variety of ingredients which go into their fragrances.

*

Eliza Collin: David, what have you observed about the scent of the plants you are cultivating from very different environments in Dorset compared to how they smell when grown elsewhere?

David Bridger: *We try to grow plants within the sort of climate that they're used to growing in. You have subtropical, mediterranean, tropical, arctic and so on and you must treat them according to that climate and do the best for them that you can.*

There are differences in the type of scent from all ingredients. Take Vetiver as an example. Haitian Vetiver smells different to Jarvin Vetiver and different to ours. The question is, is one better than the other? Probably not. Our Vetiver has a slightly more hay note to it alongside the fantastic peaty whiskey note that you get in Vetiver generally. Of course, scent is subjective and so it became about what scents we liked and were interested in as opposed to the highest quality.

EC: How is a plant's value linked to the way it smells?

DB: *Interestingly with pelargonium – which is geranium in perfume terms, Pelargonium Graveolens – in terms of perceived quality, the rosier that oil is, the more expensive it is. The scent of the pelargonium changes during the year. So, in terms of perceived quality, then, that's an example where we harvest our pelargoniums quite late in the year, once they've reached this point of peak rosiness. Whereas in spring or early summer, June for example, they have a lemon and slight earthy element which is of less value.*

EC: What is your position on consistency of natural resources in a world of changing climates?

DB: *If there is a perfume beloved by people that's been around for 100 years, then allowing that product to change is hard culturally, it's also hard work for the perfumer to keep it the same. Our sense of smell is incredible. In that instance, trying to recreate the same type of scent that's exactly as it was 100 years ago, it might be hard to keep it what people are used to. With our model we accept that there is variation from year to year and in fact we feel this adds value.*

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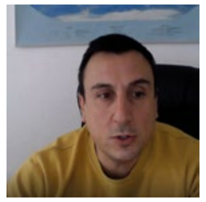
It was interesting to think about variations in olfactory consistency from a commercial angle but also in terms of the differences we, as humans, could sense in extracted scent and what we expect from it. Location, access to water, season harvested and other factors determine a scent.



Peter Atanasov is a biodynamic farmer with a rose farm in central Bulgaria, an area where the Damascus Rose (Rosa Damascena) has been cultivated since at least the 13th century. This rose was perfectly adapted to grow in the microclimate of the Розова долина (Rose Valley) and has produced a consistent and high-quality extracted scent for hundreds of years: the rose oil produced here is known as liquid gold owing to the price it can fetch on the market. Today, however, with changing climates, the consistency of the scent is wavering.

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EC: Peter, could you tell us a bit about the scent of the Rosa Damascena?

Peter Atanasov: *The petals of the rose flower have an odourless wax, holding the odour and protecting it from water. The petals are picked early in the morning before the wax melts, when they begin to smell and lose their oil content. There are more than 300 compounds present in the flower that make up the composition of the rose oil which all have different volatility. The main ones are geraniol, phenyl ethyl alcohol, citronellol and waxes.*

EC: What is it about the Rose Valley that you think makes the smell so special?

PA: *It is surrounded by mountains, forming a unique microclimate. The valley offers cold morning weather with high humidity, keeping the aroma in the flower, before heat in the day, which helps the rosebuds to bloom. The soil condition is also very important. It is sandy and of poor quality, unsuitable for growing vegetables or any other cultures, but it is very suitable for growing essential oil plants. It's not necessary to irrigate the plants here, though climate change will probably force us to think about it in the future. The water comes down from the Balkan Mountains as underground rivers, and we have specifically designed our cultivation to have access to them.*

EC: How does the changing weather affect the smell?

PA: *Each season is different from the previous one and it is normal, to a point, for the compounds to vary. It is still too early to conclude if it is because of climate change or if it is just because of the certain season but we have noticed changes. If we have warmer weather and lower humidity, the smell will not be so rich or so strong. An increase in temperature and a lack of rainfall could decrease the essential oil content in the rose petals. Another effect of the warmer weather could be a difference to the flowering season and a decrease in the quality of the oil as the compounds dissipate throughout the day. The compounds present are also changing. Now I could say that we have higher geraniol content and less citronellol, but we need time, maybe decades, to notice the real moving of all these processes.*

EC: Is there a way to both embrace the evolution of the Rosa Damascena to changing climates while retaining its value?

PA: *The rose production provides livelihood for people in these mountain areas. Besides its strong economic importance, it also has a social one. There are new varieties, maybe not new but different varieties of roses and they have different compositions, different smells. We are focused on the Damascena. This is what the market is looking for, so we should continue with the Damascena.*

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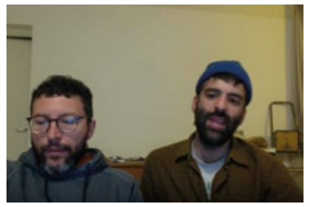

It was fascinating to hear about the specific cultural and social value of the smell of the Damascus Rose. It made me think about how culture, consistency and value are so intertwined in the reliable molecular makeup of some scented plants. How the idea of adapting the rose or introducing new, more resilient species wouldn't have the same value. I took this idea to Aterraterra, a multidisciplinary collective of artists, philosophers and farmers based in Palermo and long-term collaborators of mine. We spoke about the opportunities around enabling a natural kind of evolution and the questions this poses around cultural norms and expectations.

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EC: Aterraterra, Sicily has been highlighted in the past year for extreme temperatures with catastrophic effects on the landscape. How has this been affecting the ecosystems you maintain in Palermo?

Aterraterra: *Usually, we start from observations. This year the effect of drought in Sicily was very evident, and the reaction of the domesticated and wild plants has been different in comparison with previous years.*

For example, a large quantity of the wild cabbage and wild mustards went to flower in January. This is because the soil is very dry, so they try to complete the cycle faster. Of course, the wild cabbage is not thinking, 'Oh look it's very dry, I have very little time, I have to flower and close the cycle.' These changes are mediated by their relationships with other forms of life. They have hormonal and chemical signals, and the drought and high temperatures also determined the very early blossoming and flowering on these plants.

In 2023 we had a lot of fires and very extreme temperatures. During the end of July, we reached 47°C. During the terrible fires in the mountains which surround the city, we noticed a special effect on the pumpkin flowers, especially the species Cucurbita Moschata. Usually, the pumpkin has male and female flowers. However, we found hermaphrodite flowers which is very unusual, but it can happen in Cucurbita genus due too extreme temperatures[7 and 8]. These hermaphrodite flowers also produced strange-shaped fruits. It was unbelievable. Some of them went to seed, others didn't.

EC: I'd like you to introduce your new project, Critical Seeds of Resistance, and in particular the Post-varietal Experimental Evolutive Communities which are being sustained by and sustaining the Decentralised Seed Library.

ATT: *The Critical Seeds of Resistance Project is co-founded by the European Culture Foundation and is composed of different parts. The main part is the Seed Confluence which happened in March of this year. It was a moment where different seed saving individuals and groups from all over the world came* *together here in Palermo to kickstart the Decentralised Seed Library, a living and accessible library of seeds which is outside of large institutions and made up of many different entities. The project is not only about reproducing actual seeds, but also the knowledge about different kinds of climactic and political resistance which go hand in hand with those varieties.*

As part of our art practice, we create 'Post-varietal Communities' which are evolutive communities where we would seed out, for example, different tomato varieties and introduce ancient tomato varieties which are all chosen because of their characteristics, for example, drought resistance. We would then see how they slowly evolve. With the next generation acting as experimental communities of plants which are designed to evolve together maintaining resilience and adaptability through hybridisation. It goes outside of the idea of variety and goes on to affect food culture and consumer behaviour as each year you cannot expect to have the same plant as you did the year before.

In some way, this is an anti-agricultural position because agriculture is based on the domestication of wild plants, the creation by human selection of specific varieties. For the pollinators, they will have different flowers, different smells, different amounts and compositions of nectar and so on. This experiment is a profound analysis of what would happen if we introduced a natural kind of cross-pollination into agricultural practises.

*

Together, we got very excited about the opportunities to work with pollinators. We acknowledged that scent was playing a major role in these post varietal experiments, in silent communications between plant and pollinator. Alongside how temperature is affecting plant behaviour in drastic ways, both visible and invisible. It reminded me of an article on how Pansey's in the outskirts of Paris have also been found to become hermaphrodites, allegedly giving up on pollinators altogether by learning to self-pollinate.[9] The team planted ancestral seeds to compare the rate of change with those growing today.

I wanted to understand more about the intricacies of scent from a pollinator perspective and therefore needed a scientific one. In scientific terms, when plants emit scent, they are emitting volatile organic compounds (VOCs). These are the chemicals which together make up their scent. For example, there are around 100 individual VOCs which make up the smell of Rosemary. These include compounds such as eucalyptol, linalool, camphor, borneol, limonene and cis 3 hexenol. Pollinators can sense intricacies in these VOCs, something our noses aren't adapted to do. I spoke to Dr Laura Burkle, professor in the Department of Ecology at Montana State University, to get some insight into floral bouquets and the pollinator perspective. Laura uses gas chromatography and a mass spectrometer (GC/MS) to accurately read the compounds and amounts present in samples of floral scent from around the world.

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EC: Laura, could you set the scene for us on plant and pollinator interactions in wild environments?

Laura Burkle: *I think about it as pollinators making decisions about where they're going to visit. I see each flower as a little island that has traits. The island might be coloured pink and have all these different VOCs or scents and it has a certain amount of nectar and pollen. The pollinators are sort of cruising around and checking out all these different little islands to see which ones they want to land on. It's not just the island itself that has a scent, but all the islands around that are also influencing the overall smell or "bouquet". So, there's a lot of layering of different contexts going on.*

EC: How are changes in our environment effecting floral VOCs?

LB: *The sort of environmental changes that are particularly relevant here include drought. We have tested the effects of drought on floral volatiles and oftentimes the amount of scent is elevated by this stress and the flowers produce additional compounds, or more than they would normally.*[10 and 11] *We're thinking about changes in precipitation alongside other components of climate change like temperature which can alter overall levels of compounds. We've found that those changes in floral scent can influence the suite of pollinator species that visit those flowers.*

EC: Why are plants creating scent?

LB: *As far as I know, plants aren't in control of their scent. It's a byproduct of their environment. I don't know if I want to call it plant communication, but in some cases that term refers to sensing what the community is like around them and responding to that in different biochemical ways. Some scents are more volatile, some can go further, and some drop out quickly. That kind of truncating of the floral plume itself is some kind of information.*

*

Aside from this, we spoke about how drought alterations in scent could potentially be passed down for generations through seeds temporarily or permanently changing the scent of a plant with unknown domino effects. Some of these studies are being carried out by Laura's students to see if we can begin to predict these varying futures. And as we know from David, a change in location can also change the way a plant smells, be this due to soil, humidity or nutrients and so on.

It got me thinking about the various future simulations scientists like Laura are designing based on what we know today and what we can speculate on for the future. These experiments are being designed to aid us in decision making for our future.

My fascination in this concept of future simulations designed to determine answers to massively complex ecological questions took me to the work of Dr Diane Campbell. A professor of ecology and evolutionary biology at the University of California in Irvine and now a key collaborator on this project. As one of the world's leading researchers on plant VOCs and pollinator interactions I wanted to learn from her about how these climate induced changes on plant scent and the resulting plant to pollinator interactions impact the world more widely.

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EC: Diane, what is happening in this world that you're exploring and why is it important to be looking at?

Diane Campbell: *With warming temperatures there's a trend towards less snowfall and earlier snow melt in the spring. This is happening in high altitude ecosystems around the world, many of which are highly dependent upon snow for water. In the Rocky Mountains where I work, the earlier spring melt means that there is a much longer drought before the summer monsoon rains start, and plants and other organisms must survive through this.*

This longer period of reduced soil moisture affects plant populations in a number of ways. For example, most plant species bloom earlier; as a result, they may be out of synchrony with pollinators.[12] *It can also affect survival and seed production for reproduction. One of the things we expect with climate change is more extremes. We look at the impacts of many environmental variables on a series of traits in plants.*[13] *Everything from the shape of the flower or leaves to the way it smells and how efficiently it is doing photosynthesis.*[14] *We're interested in how those traits evolve under these new conditions and ultimately what's going to happen to the persistence of plant populations.*

EC: What does the data you're collecting tell us about the evolution of these species? Are you able to speculate on how they might change in the coming years?

DC: *I'm just now working on a model that puts changes in plant traits and heritability together with how we know snow melt influences survival and seed production. Putting all that information together, we can project how fast different traits evolve and whether the pace of that evolution – take thicker leaves for example – is sufficient to counter the direct effects of an increasingly early snow melt. The answer is that for leaf thickness, evolution is not going to make a big enough contribution to counter the demographic problem. So, what we're now working on is, if you consider other traits as well, will evolution rescue the plant population?*

EC: Which species do you think are more likely to adapt or going to be able to potentially evolve fast enough?

Variations of the Ipomopsis. I. tenuituba and I. agregatta and their hybrids. Image courtesy of Dr Diane Campbell

DC: *The species that can adapt the fastest are the ones where this evolutionary process can play out quickly enough to overcome short term reductions in survival; this is sometimes called "evolutionary rescue" because evolution is rescuing the population from detrimental effects of a change in the environment. This is more likely in organisms with short generation times, such as plants which re-seed every year.*

EC: With changing climate, changing pollinator habits, changing smells, could pollinator-determined hybridisation end up playing a role in evolutionary rescue?

DC: *Hybridisation definitely plays a role. Scarlet Gilia, Ipomopsis aggregata, has a very close relative called Ipomopsis tenuituba. These plants hybridise in nature and the hybrids do better in dry environments than either of the parental species. That is important in the persistence of these natural hybrid zones. That mode of introducing new genes into the population might indeed help some of these populations to persist.*

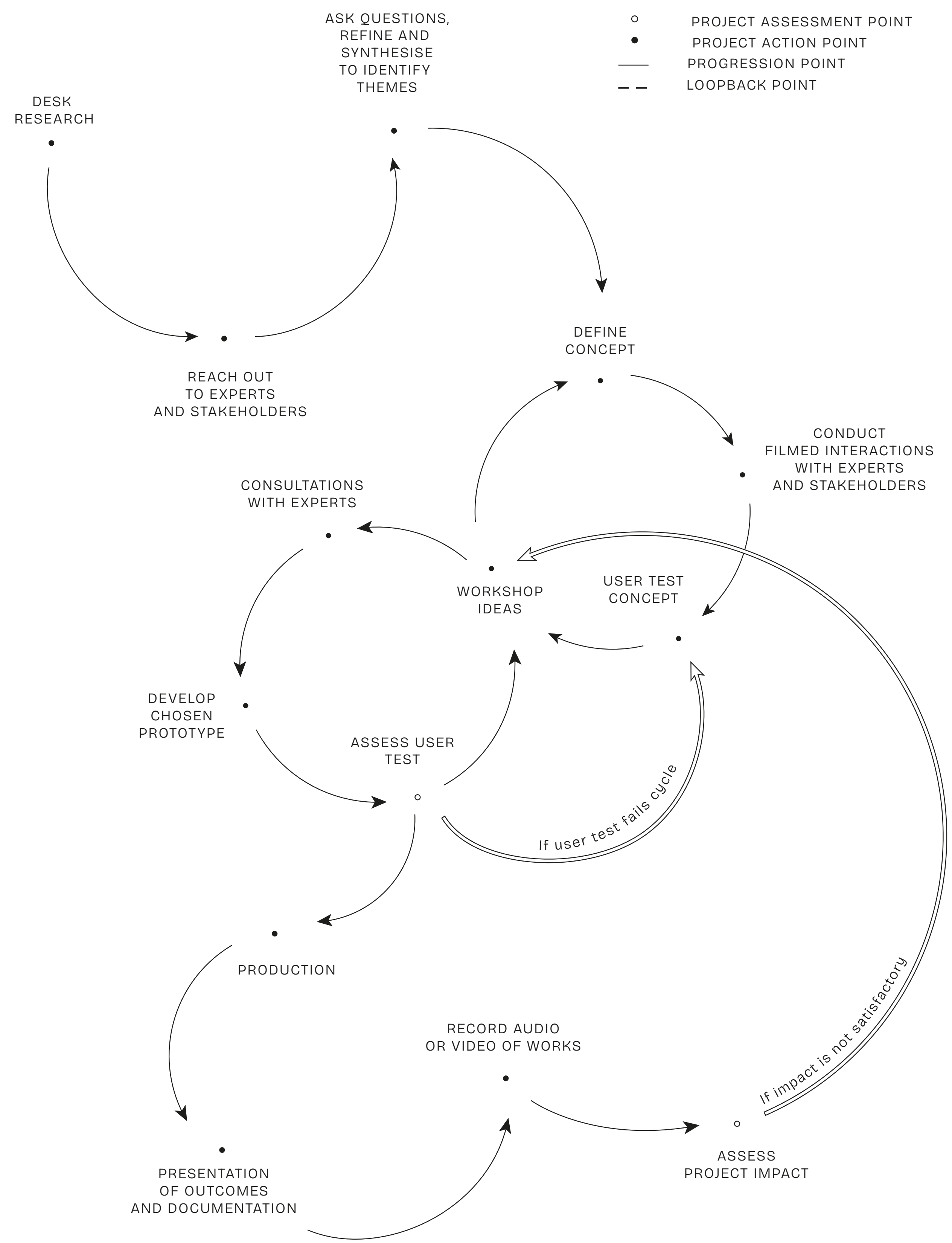
We have taken scent samples of all of them and one of the differences between the species is, that only Ipomopsis tenuituba and hybrids emit a compound called indole. The compound is emitted in very small quantities[15] and only at night when Hawkmoths are active at the rate of one nanogram per flower per hour. We did these experiments where we added one nanogram of indole to each flower of Scarlet Gilia which doesn't normally emit it. In those experiments, we got hawk moths to visit all those flowers which they wouldn't usually visit. So, this tiny quantity of indole is sufficient to attract hawk moth visitors meaning that one scent compound plays a very big role in the extent to which these two species are reproductively isolated from each other.

EC: Why do you do the research that you do and why is it important to you?

DC: *A lot of my research is on how evolution works in real time. We've learned all kinds of more specific things about that process. For example, that climate change is altering those evolutionary pathways.*

To me there are remarkable examples of species interactions and evolution going on all around us, it's ubiquitous, it's affecting our lives all the time and we need to be thinking about how to take that into account in our practicing of conservation, medicine and agriculture. That's what I feel is important about my research, and it comes out of a deep sense of connection with the natural world.

WORKING METHODOLOGY



EXPERTS AND COLLABORATORS

◆ PROJECT LEAD
○ PROJECT COLLABORATOR
● EXPERT
RESEARCH CONNECTION

ATERRATERRA
Farmer, artist, philosophers and activists at Aterraterra

PALERMO, ITALY

PETER ATANASOV
Damascus Rose Farmer

THE ROSE VALLEY, BULGARIA

IAN BRECKHEIMER
Research Scientist in Spatial Ecology and Data Synthesis

THE ROCKY MOUNTAIN BIOLOGICAL LAB, COLORADO, USA

DAVID BRIDGER
Founder of Parterre Fragrances

DORSET, UK

DR LAURA BURKLE
Scientist

MONTANA STATE UNIVERSITY, MONTANA, USA

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THE DESIGN MUSEUM, LONDON, UK

THE DESIGN MUSEUM AND THE DAME SYLVIA CROWE GARDEN

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DR COLINE JAWORSKI
PhD in Evolutionary Ecology

INSTITUT SOPHIA AGROBIOTECH, INRAE SOPHIA-ANTIPOLIS, FRANCE

MIRANDA KEYES
Glass Blower

LONDON, UK

MIA LA ROCCA
Bee Keeper

SETTEUARCIATE, PACENTRO, ITALY

DR CARLOS MARTEL
Pollination Biologist and Chemical Ecologist

KEW GARDENS, UK AND COSTA RICA

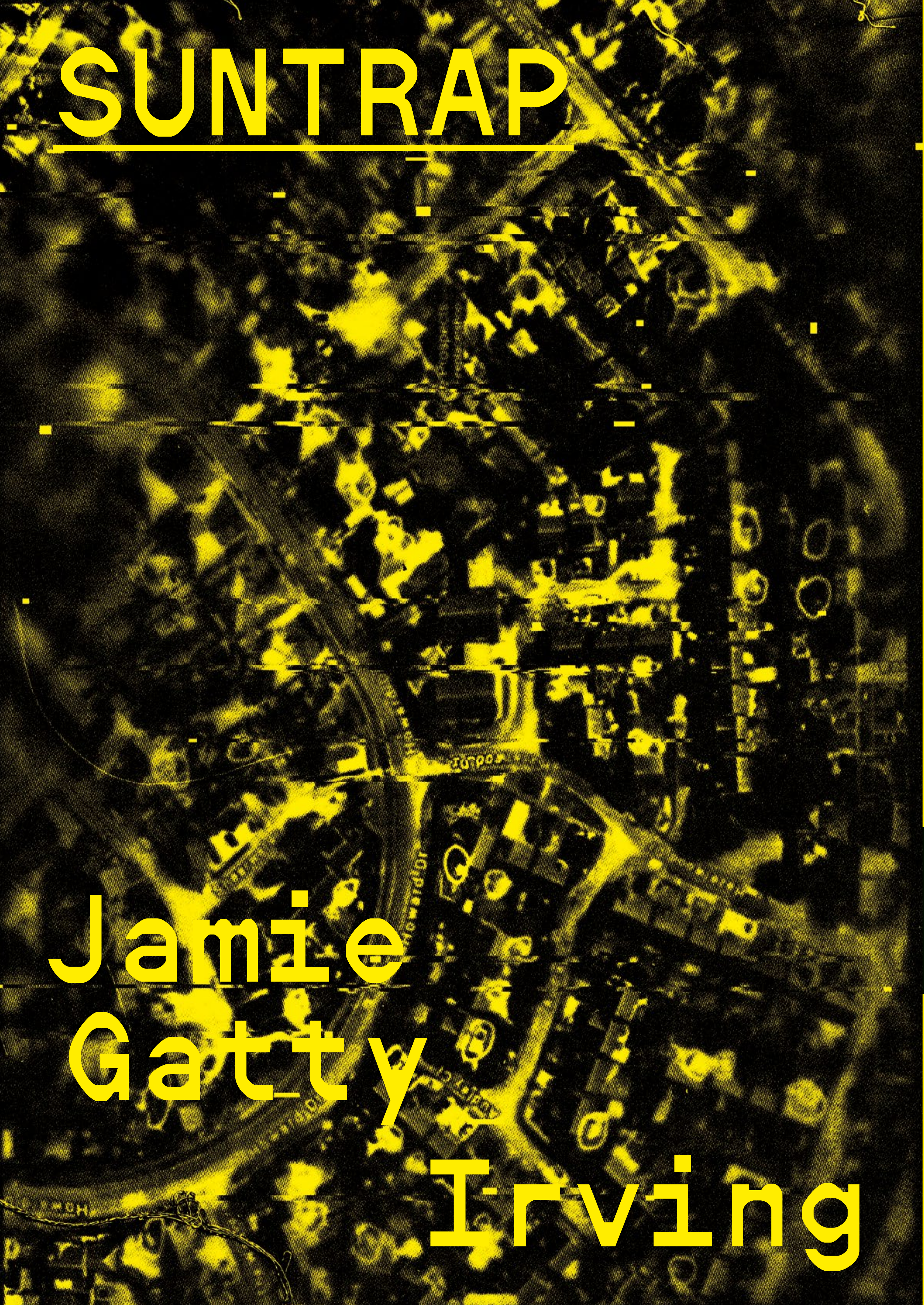
DR ROBERT RAGUSO
American biologist and professor

CORNELL UNIVERSITY, NEW YORK, USA

CLARA WEALE
Scent Designer and Founder of A Library of Olfactive Material

GLASGOW, UK

This list isn't exhaustive and keeps growing with the project



SUNTRAP

Jamie Gatty Irving

Suntrap invigorates a misunderstood architecture for the green transition.

Heating and cooling our homes uses huge amounts of energy at great economic and environmental cost. In **Suntrap**, Jamie Gatty Irving invites us to embrace a more dynamic relationship with our environment, reimagining the British conservatory extension as an adaptable tool to passively heat and cool existing homes. Exploring the history of conservatories from the greenhouse to double glazing, and developing a new design to enhance the solar potential of homes across the UK, Suntrap invigorates a misunderstood architecture for the green transition.

Jamie Gatty Irving is an architect and researcher. He is the co-founder of the design and research practice Entropic Group and is a Lecturer in Architecture at Kingston School of Art. He has contributed to critiques and residencies at the Architectural Association, University of Cambridge and ETH Zurich. His work explores how cultural, ecological and building systems come together.

SOLAR ARCHITECTURE

a lexicon

Active Solar
A system that transforms the sun's energy into other usable forms, such as electricity or hot water. Active technologies are often installed on the roof and walls of buildings to maximise their exposure to the sun. The two most common examples are photovoltaic cells, which transform the sun's energy into electricity, and solar-thermal panels, which transform the sun's energy into hot water. See *passive solar.*

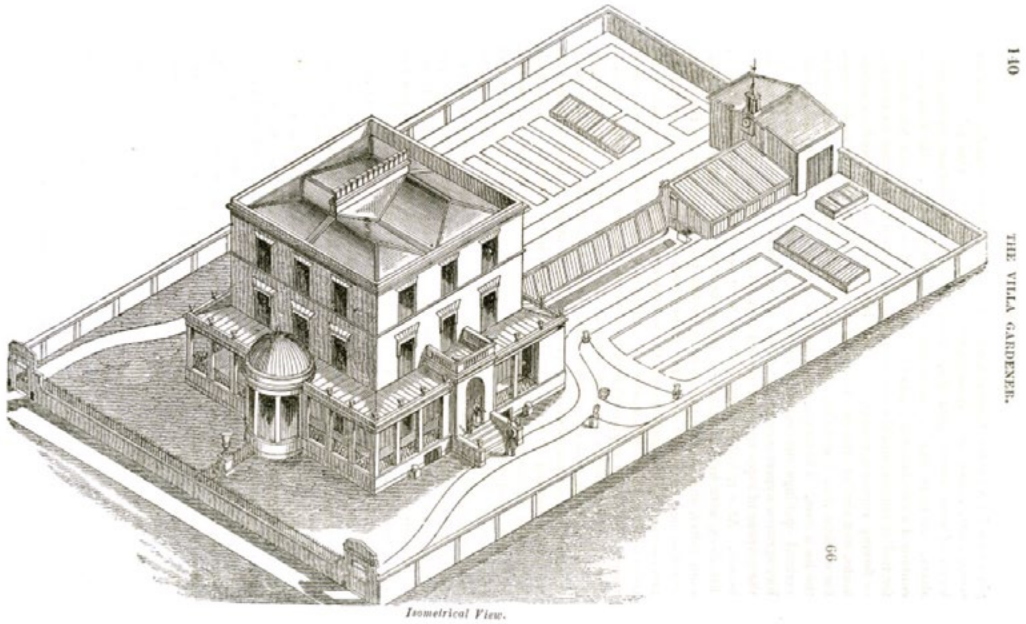
Conservatory
Also known as winter gardens, conservatories are glasshouses, greenhouses or orangeries which are partially or wholly for the use of people, rather than just plants. They emerged in the 19th century as a domestic space, often joined to the home, mediating between the garden and living areas of the dwelling. As technology advanced, these glazed rooms ballooned in scale, also forming public interiors for socio-cultural activities. See *extension*.

Double Glazing
A window system formed of two layers of glass, often with a low-density gas encased between. Although invented in the 1930s, double glazing began to be installed at scale in the UK in the 1970s and '80s. Double glazing vastly reduces the rate of heat transfer and risk of condensation, keeping the interior warmer in the winter and cooler in the summer. See *retrofit*.

Extension
The addition of a new space to an existing structure. House extensions normally involve adding habitable space beneath a roof, such as a loft extension, or into a garden, such as a rear or side extension. The extent to which it is possible to enlarge a dwelling is governed by national, regional and local planning policy. See *permitted development*.

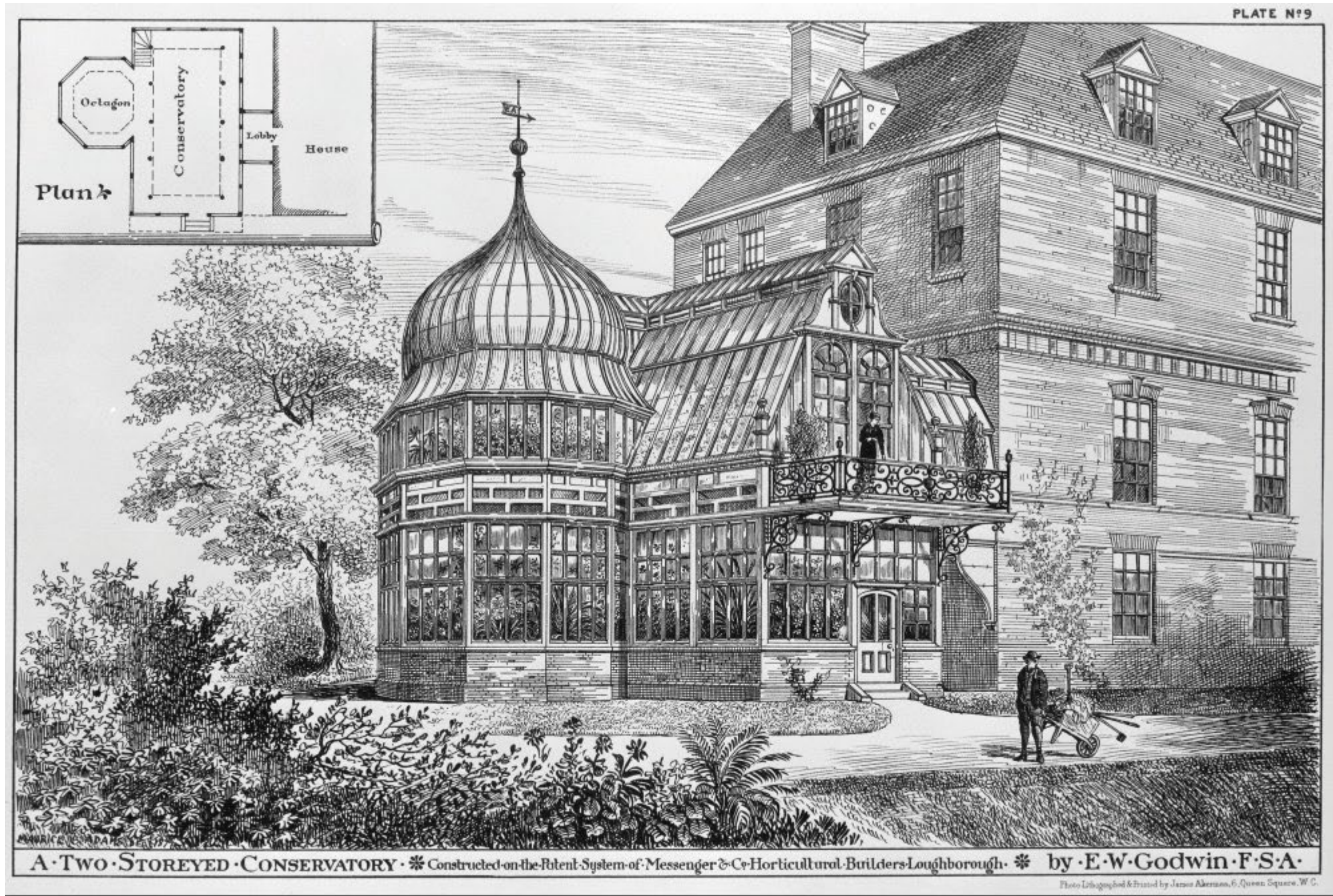
Glasshouse
A glazed structure containing plants growing in the earth, rather than in pots. Non-native species are typically collected here for display and botanical research, a practice developed in the 19th Century and deeply intertwined with the British colonial project. See *walled garden*.

Greenhouse
Also known as forcing houses or hot houses, greenhouses emerged in the early 18th Century as a purpose-built structure for the cultivation of plants. Initially constructed from timber with a southern glazed lean-to, they were often oriented against an existing wall. Plants in greenhouses are kept within pots and arranged on shelving to maximise exposure to the sun. See *glasshouse*.



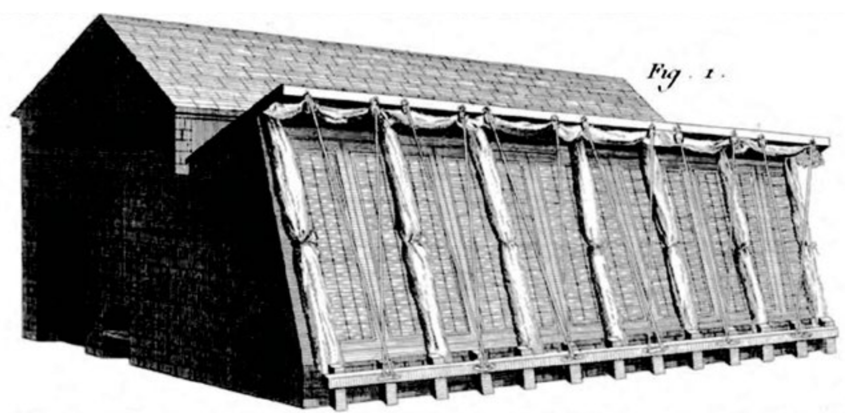
Top: John Claudius Loudon, project for a two-family house, 1824 . Source: J. C. Loudon (revised and edited by J. W. Loudon). The Villa gardener. 1850, London. p. 140

Bottom: Two-storey conservatory for a house from the Messenger& Co. Catalogue. Source: E. W. Godwin and M. B. Adams. 1880. Artistic conservatories, London, pl. 9.



Top: M. Neumann,
design for a wintergarden
as a nature scene, 1842.
Source: Neumann M. 1852.
Grundsätze und Erfahrungen
über die Anlegung, Erhaltung
und Pflege von Glashäuser
aller Art. Weimar.

Bottom: 18th century
dutch forcing house.
Source: Denis Diderot &
Jean le Rond d'Alembert. 1772.
Encyclopédie ou Dictionnaire
raisonné des sciences,
des arts et des métiers.
Paris. Plate IV.



Orangery

A masonry structure with a predominantly glazed south-facing wall. Orangeries emerged in the 17th Century in Central Europe, initially to facilitate the bourgeoisie's desire to cultivate citrus. The trees were kept in tubs and moved into the orangery, which was heated with a stove for the colder winter months, to protect them from frost. See *Part L*.

Part L

The section of the UK Building Regulations which refers to the conservation of fuel and power, setting the thermal performance requirements for construction projects. Conservatories are excluded from meeting Part L regulations, as long as they are less than 30 sqm, separated from the main home by a door and are not connected to the central heating system. Therefore, they are treated by the regulations as a thermal buffer to the home; however, they are often marketed and installed as a cost-effective way of adding an additional habitable room. See *thermal buffer*.

Passive Solar

A system that directly utilises the energy of the sun in the form of heat and/or light. Passive solar strategies optimise the use of the sun's energy to heat, light and ventilate structures through a comprehensive approach to orientation, form and material. Some examples of passive strategies for capturing heat include conservatories, trombe walls and solar furnaces. See *solar shading*.

Permitted Development

An extension or improvement to a home that does not require planning permission. The constraints for rear and side extensions are governed by parameters relating to the distance from ownership boundaries, building heights and overall internal area. Most conservatory extensions today are sold as products which are designed to fall within permitted development rules. See *uPVC*.

Retrofit

The addition of new technology to an existing structure. With regard to housing, the term typically relates to improvements made to the energy efficiency of existing buildings. Strategies currently include: the addition of active solar technologies, replacing windows and insulating floors, walls and roofs. See *active solar*.

Right:
White uPVC Anglian
Conservatory. Source:
https://www.anglianhome.
co.uk/conservatories/gallery
(accessed 03.03.24)

Solar Gains
The passive heating effect of the sun's short-wave infrared radiation collecting within a building. This energy is absorbed by the material of the building, which in turn radiates out as long-wave infrared radiation that cannot pass back through the windows or walls of the interior. As a result, the sun's energy is trapped within the space. This is known as the "greenhouse effect". See *greenhouse*.

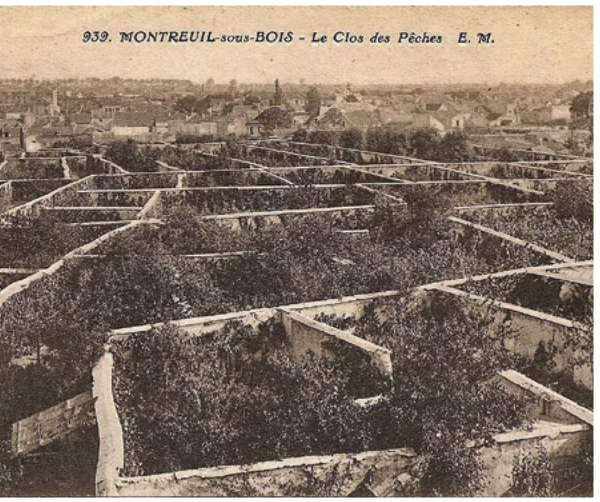
Solar Shading
A fixed or movable device which protects a building from excessive solar gains, thereby preventing overheating. An overhanging roof or floor slab are examples of a fixed device. They are designed to protect the interior from high summer sun, while allowing low winter sun to enter. Movable strategies include blinds, curtains or shutters that are controlled by the user. See *solar gains*.

Thermal Buffer
A space that mediates between a conditioned i.e.heated "interior" and the unconditioned "exterior". The thermal buffer space is not actively heated but instead is passively heated by the sun. Therefore, fresh air fed into the conditioned space from the thermal buffer is at a higher temperature than if it were from outside, theoretically reducing the heating load of the interior. See *conservatory*.

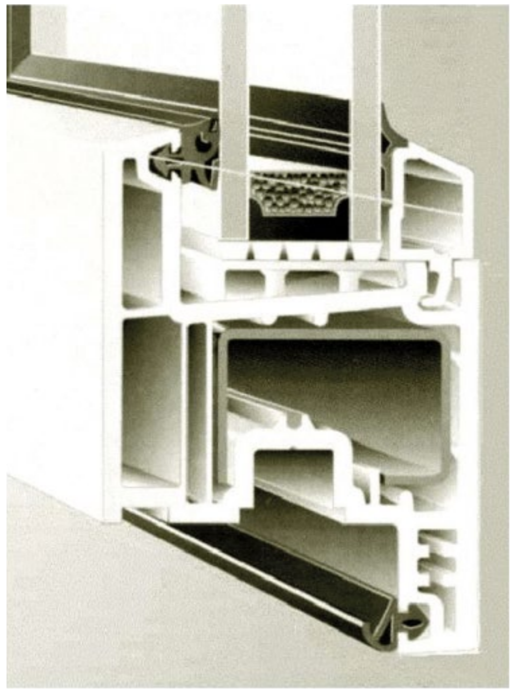
Thermal Mass
The ability of a material to store heat. This can also be seen as the speed at which a material heats up and cools down. Materials with high thermal mass, such as stone or concrete, have the effect of providing inertia against fluctuations in air temperature – for example, leaning against a warm rock on a cool evening as it radiates the heat from a day in the sun. See o*rangery*.

uPVC
Unplasticised Polyvinyl Chloride is a building material used predominantly in the construction of window frame systems. Introduced to the UK at scale in the 1980s, uPVC offered a cheaper, lower maintenance and more thermally efficient alternative to timber and aluminium frame windows. Coalescing with the double glazing revolution, the uPVC conservatory grew in popularity as a cost-effective extension to the home. As an oil derived product, standard uPVC windows have a higher level of embodied carbon than timber frames but typically lower than aluminium. See *double glazing*.

Walled Garden
The original microclimate-generating structure. Networks of walls provide protection from the wind and mediate temperatures in their vicinity by absorbing the heat of the sun in the day and radiating it out through the cooler hours of the night. These properties allow for the cultivation of non-native species in colder climates. See *thermal mass*.



Left:
Walled garden: *Early 20th century postcard of walled peach orchards in Montreuil-sous-Bois. Credit: Personal Collection - Claude Villetaneuse.*



Top: uPVC profile detail. Source: Ettinger, Holger & Sienz, J. & Pittman, John & Polynkin, Andrey. 2007. The Polymer Processing Society 23rd Annual Meeting - Comparison of Automatic with manual die design procedures for profile dies with respect to efficiency and quality.

Bottom: Felix Trombe, Solar Furnace in Mont- Louis, 1955. Credit: Manuel Litran/Paris Match Archive via Getty Images.

CONSERVATORY DREAMS

new futures for the glazed extension

ENVIRONMENTAL DESIGN BY ATMOS LAB

The largely privately-owned landscape of UK housing is an energy intensive space, amounting to 18% of the UK's annual carbon emissions. With existing housing stock representing 80% of the homes we will be living in come 2050, the need to *retrofit*[a] these buildings is a critical aspect of the government's decarbonisation agenda. This inherited housing stock, built predominately in an era of cheap and seemingly abundant fossil fuels, will need to be adapted to become our homes of the future. Yet, how we reimagine our lives within these homes presents us with a challenge that is proving hard to tackle.

a. All italicised terms are defined in the lexicon, pages 56–61

The last ten years of government grants seeking to confront this issue have focused on incentivising much needed thermal improvements to existing dwellings. Additional insulation, window upgrades and heat pumps have been rightly foregrounded as primary solutions to resolving the issue. Yet, the grants have suffered from poor uptake, with the Green Homes Grant Voucher Scheme of 2020–22 only managing to upgrade 47,500 homes of the targeted 600,000.[1] A combination of lacking information, infrastructure and impetus has left pots of funding unutilised and net zero targets missed. Currently these technical solutions alone are not sufficiently desirable to entice homeowners to open their doors to the upfront costs and inconvenience implicit with any home improvement.

A stroll around suburbia, however, would suggest that we are not inherently shy to home improvements. The *conservatory* is a prime example of this; roughly one in five homes in England have one.[2] Born out of the 19th century *glasshouse*, the *conservatory* became a product in the 1880s, as a space in the sun between home and garden. Unlike the thermal *retrofits* on offer today, the combined lifestyle, space and added value of the *conservatory* managed to capture the imagination of the homeowner.

The conservatory boom of the late 20th century capitalised on this, with glazed *extensions* being marketed as the cheapest and easiest way of extending your home. However, this framing and popularity also led to them becoming misused and misunderstood. Fitted with affordable *uPVC double glazing*, expectations around the perceived functionality of these spaces changed dramatically. Rather than being considered as an intermediate space between interior and exterior, conservatories became viewed as permanently habitable – and by extension heatable – rooms. As a result, they were often installed with little regard to orientation in relation to the sun and without a way of closing them off from the main dwelling, thereby removing their ability to function as a passive solar collector. The conservatory has, therefore, simply become a heating burden on the British home, in some cases losing more heat than the entire rest of a dwelling.[3] This has not gone unnoticed among the public and has resulted in a wain in their popularity over the past decade.

b. See *conservatory* in lexicon, page 56.

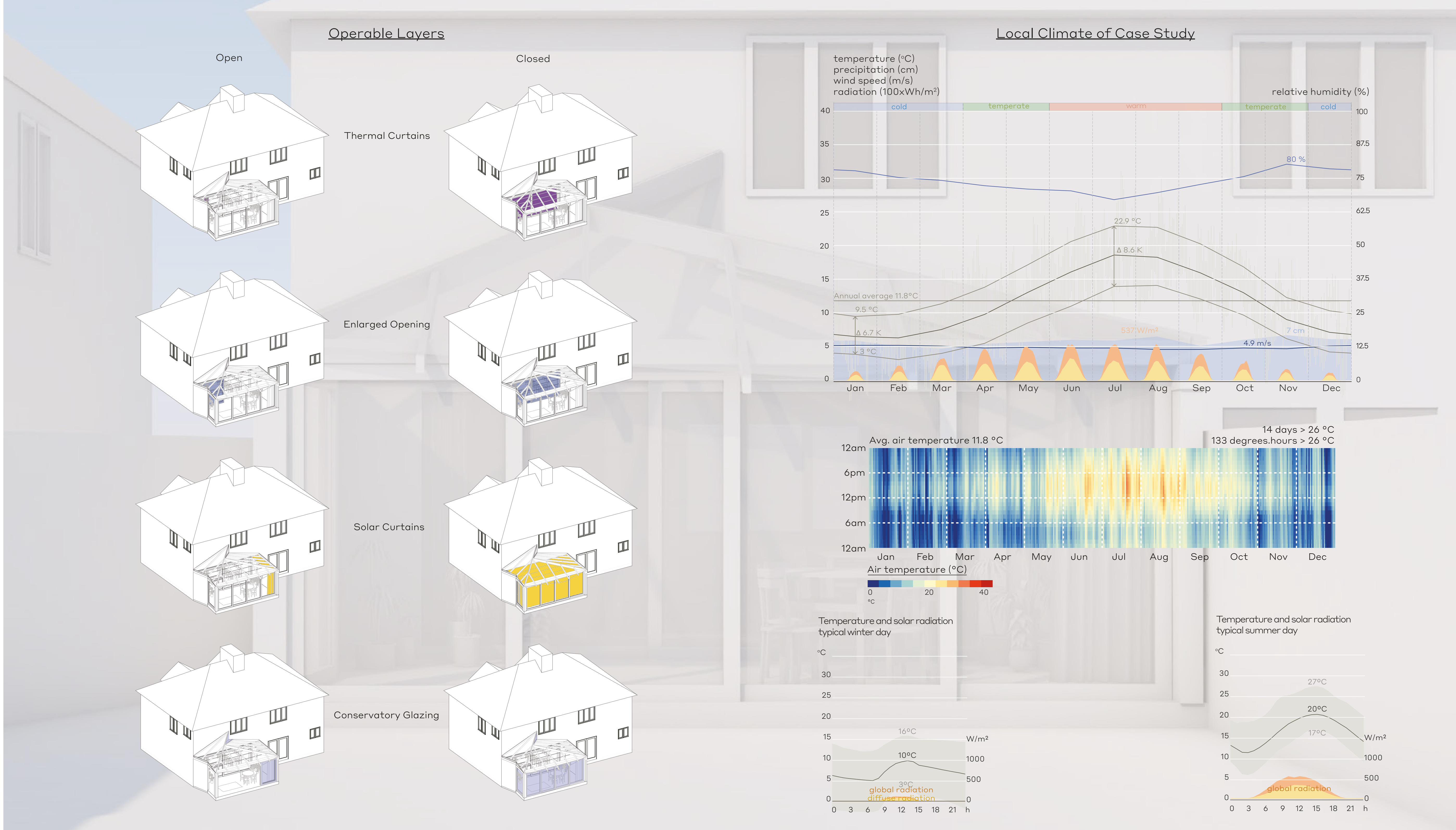
> 'the combined lifestyle, space and added value of the conservatory managed to capture the imagination of the homeowner'

Paradoxically, however, conservatories have been used elsewhere to combat the very same challenges of thermal efficiency and heating bills. The celebrated work of architects Lacaton & Vassal has proven the value of retrofitting wintergardens[b] to existing 1960s housing blocks in various projects over the past 20 years.[4] Atmos Lab, the environmental designers who have been collaborating with Lacaton & Vassal since 2018, describe these spaces as a 'better exterior'. In contrast to the current conception of the conservatory in the UK, the glass or polycarbonate that forms the enclosure of these wintergardens is purposefully only single-glazed, encouraging high air infiltration and thus preventing it from being seen as an artificially heatable space. Instead, the wintergarden operates as a *thermal buffer* to the main dwelling, providing a space that can be inhabited through much of the spring, summer and autumn and providing preheated air to the main dwelling through winter. Beyond their thermal successes, they also radically redefine the potential patterns and quality of life within these apartments. Within the UK context, this potential dual benefit of improved quality of life and reduced energy use presents the conservatory as a potentially enticing strategy for homeowners looking to make thermal improvements to their home.

CASE STUDY: SOLAR CONSERVATORY

To understand whether this could be a valid strategy within the UK retrofit agenda, I asked Atmos Lab to join me in the British suburbs to develop a new solar conservatory. In the home counties of the southeast, we found our case study: a 1930s three-bed, semi-detached home with a south-facing garden primed for a bioclimatic retrofit. Like most houses of this period, it was constructed with uninsulated masonry walls, single-glazed windows and poorly insulated roofs and floors. In the 100 years since then, a series of thermal improvements have been made, with additional insulation added to the loft and double glazed *uPVC* windows and patio doors replacing the originals. Unlike many of its neighbours, the case study currently has no extensions and therefore serves as a useful control to test the effect of the solar conservatory.

To ensure the potential broader application of the design, the solar conservatory was developed within the constraints of *permitted development*. As such, the proposal extends across the full width of the house and out into the garden to the maximum length permitted of three metres. Height limits are respected while maximising the conservatory's coverage of the existing south façade. The roof of the conservatory is sculpted into a hipped form to maximise direct *solar gains* and extending low to the south, accentuating views out to the garden. A shift in the apex of the roof creates a high-level opening, drawing hot air out of the space to avoid overheating. The side walls and floor are then made from limestone to maximise the effective thermal mass of the conservatory and stabilise temperatures.



c. The conservatory design was analysed as a digital model, with the next phase of the research planning to construct a physical prototype in order to assess real-world performance.

The thermal performance of the conservatory is optimised through a series of controllable layers learnt from the Lacaton & Vassal projects. The sliding and folding of the glazed doors of the conservatory allow for it to open significantly during the summer to avoid overheating. Behind the doors and beneath the roof are solar curtains that can be closed to provide solar shading whilst still allowing air and light to pass through their shimmering gauze fabric. An enlarged double-glazed sliding door replaces the patio door and kitchen window, allowing more natural light and fresh air to permeate into the home. Finally, thermal curtains are hung internally and closed during winter, autumn and spring nights, reducing heat loss through the glazing. The radical simplicity of these four layers – conservatory glazing, solar curtains, enlarged opening within existing south wall and thermal curtains – creates a highly adaptable space, empowering the user to take control of their environment.[c]

Environmental analysis of the existing and proposed conditions for the case study was completed by Atmos Lab. All environmental models were developed using state-of-the-art methodologies and further informed by their previous post-occupancy evaluations of some of the Lacaton & Vassal winter garden projects. The daylight models are developed based on BS EN 17037. Dynamic thermal models are developed based on BS EN 16798 and account for hourly variations of the local climate, the thermal properties of the construction, the envelope's airtightness, the internal heat gains, the occupational patterns as well as key assumptions as to how the user might operate the control devices. All inputs and assumptions are reported in the technical appendix.[5]

d. Conservatory defined as usable when temperature inside reaches a useable range of 15-27°C for at least 1 hour within the day. Usable temperature range for a conservatory defined in Yannas, S. (1994) *Solar energy and housing design - Volume 1: Principles, Objectives, Guidelines.*

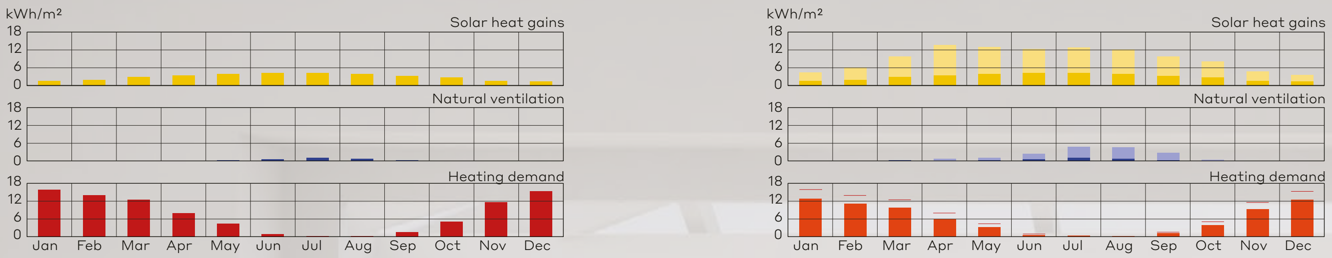
To assess the annual fluctuations in felt temperature between the existing home and the proposed conservatory, the models were initially analysed without any artificial heating or cooling devices in use. Through passive solar gains alone, the conservatory provides the home with a more temperate buffer space to the external climate throughout the year, with an average increase – when compared to external temperatures – of 4–5°C in autumn, winter and spring, while increasing just 1.2°C in the summer, rather than overheating. This equates to the conservatory being 'usable' for 70% of the year, with no artificial heating required.[d]

The addition of the conservatory also led to an average increase of around 1°C in the internal spaces adjacent to the structure – the dining room and kitchen – throughout autumn, winter and spring and showed no signs of overheating during the summer. This has the effect of bringing the adjacent spaces to the conservatory into a thermally comfortable range for an additional 7% of the year without the need for additional heating. In short, this small but significant increase in internal temperatures within the home has a considerable impact on reducing the heating requirements of the dwelling.

Energy balance

Existing

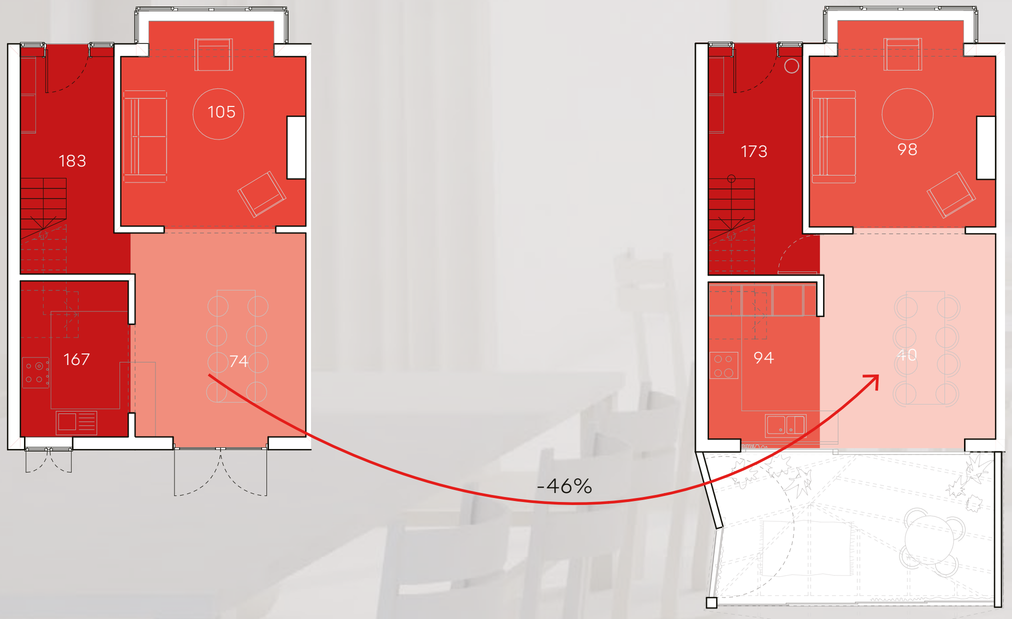
Project



Spatial heating demand

Existing

Project



Heating demand per space

0 50 100 150
kWh/m2

Annual daylight autonomy (EN17037) with at least 300 lux

Existing

Project

10 m² on the ground floor are considered bright.

17 m² on the ground floor are considered bright.

Daylight Autonomy [300 lux]

0 20 40 60 80 100
% of time a spot receives at least 300 lux

When then running the model with the main home being heated, the conservatory led to a 45% reduction to heating requirements within the adjacent spaces. This reduction can be attributed principally to the significant increase in solar gains captured by the conservatory and enlarged openings within the façade. A subsequent test showed that even if the thermal performance and airtightness of the existing building were to be improved, the addition of the conservatory still resulted in the same percentage reduction in heating load for these spaces. This would suggest that the installation of a conservatory would be a worthwhile consideration when weighing up heat loss reduction strategies, irrespective of the thermal performance of the existing home.

The conservatory also facilitates the use of significantly more glazing within the existing elevation. In covering a portion of the external façade with a second skin, heat loss from the dwelling is mitigated, while admitting generous amounts of daylight deeper into the plan. The enlarged opening within the south elevation significantly increases daylighting with a 70% increase in floor area receiving at least 300 lux for over half of the time. The kitchen and living room therefore benefit from plentiful natural light, whilst maintaining areas of lower light levels in the living room, allowing for a variety of light conditions across the home and improved connection to the outdoors.

The addition of the conservatory encourages inhabitants into a dynamic relationship with the climate. The conservatory provides more space and light and facilitates new occupational patterns in spring, summer and autumn; a space to both shelter and benefit from the sun, wind and rain. During winter, it then becomes a buffer space, supplying preheated fresh air to the home. All the while, the adjacent spaces to the conservatory see their heating demand being almost halved and protected from overheating in the summer, demonstrating that the conservatory can work to improve the quality of homes whilst also reducing the annual heat load.

> 'The addition of the conservatory encourages inhabitants into a dynamic relationship with the climate.'

CONCLUSION

With four in five dwellings in England being houses [6], passive solar retrofits have the potential for broad application within the UK retrofit agenda. Yet, the results of this case study also highlight the importance of adaptation to local conditions. In a different setting, this same conservatory design could have a detrimental effect on a home's heating load. As a result, the careful design and adaptation of holistic retrofit strategies is critical for their successful implementation – something that is difficult to achieve within the current policy context. With one-size-fits-all technical solutions being the current default approach, further work is needed to assess how local conditions can be accounted for within adaptable and scalable solutions. If we are to galvanise millions of homeowners to reduce domestic energy use, it may take more than some government vouchers for additional wall insulation. Alongside the technical solutions, there are broader questions of how we can reimagine socially and economically desirable ways of life that work *with* the changing climate rather than against it. When integrated into a wider retrofit approach, the historic successes of the conservatory would suggest that their additional spatial, lifestyle and material improvements have the potential to encourage homeowners to engage with these issues. If implemented correctly, the flexibility generated through this layering of material and space empower the user to enhance and control their environment, establishing a more intimate connection with the sun and reducing their energy bills. Within a changing climate, equipping existing homes with the ability to adapt to more unpredictable weather patterns is critical in making a more resilient housing stock. Through this, climatic challenges become opportunities for heating, cooling, and lighting. Rather than attempting to reinforce the boundary between inside and outside, intermediate spaces may offer us an alternative approach in readdressing our relationship to our wider environment.

Right: Case study house – before and after.

GLASS HOUSES

a history of solar architecture with Dr Paul Bouet

a. All italicised terms are defined in the lexicon, pages 56–61.

Exploring the potential of the *conservatory*[a] as a piece of *solar architecture* is by no means a new idea. Despite this, glazed *extensions* are rarely understood on these terms within the UK. To better understand what solar architecture is and how it relates to the *conservatory*, I spoke to Dr. Paul Bouet, a historian who is re-examining the history of architecture through its relationship to energy and the climate. We discussed how explorations into enhancing the energy of the sun appeared and disappeared within various political and social projects, considered how many parallels can be drawn between these histories and today, and speculated on how we could reimagine these ideas for the future.

Jamie Gatty Irving: As I understand it, solar architecture describes buildings that are designed to capture the sun's rays for their use as an energy source. Perhaps we can start with when this idea emerges.

Paul Bouet: One place to start is within the late 19th–early 20th century when the architects and urban planners of the modernist movement became particularly interested in designing around the sun. Their primary interest at first was to fight diseases, as direct sun exposure was thought to kill bacteria. Meanwhile, a new focus was emerging within this field, with isolated experiments exploring the energy potential of sunlight. In the USA and elsewhere, solar heaters began to be installed at a similar period to the modernist project. These early devices utilised the sun's energy to heat water, being marketed largely as cost-saving products to be *retrofitted* into existing homes. In the 1930s, architects and engineers became increasingly interested in the thermal potential of the sun's rays, with figures such as George Fred Keck exploring how the home itself could function as a solar collecting device through the careful composition of windows and *thermal mass*. These initial experiments were then crystalised within the context of the Second World War, where the scarcity of fossil fuels drove the rediscovery of the sun as a source of energy.

JGI: Could you expand a little on some of the research programmes that emerged at this time and the political context of these?

PB: The fear around resource depletion continued after the war, with concerns around overpopulation and the finite nature of oil and coal driving research and investment into alternative energy sources, such as solar. Two of the first research programmes in the USA were conducted at MIT and Princeton. Working with architects, they developed a series of experimental houses that looked to enhance the thermal potential of the sun by integrating solar collectors and heat storage devices into new prototypes for the suburban home.[7] Meanwhile in France, Félix Trombe, a chemist and engineer, received funding from military, colonial and scientific institutions to set up a lab in an old citadel within the Pyrénées-Orientales. The lab constructed large-scale reflecting devices, known as solar furnaces, that intensified the sun's energy to a focal point where temperatures would reach around 3000°C. The research culminated in a *passive solar* system that became known as the Trombe Wall.[b] France was a colonial power during this period and much of the research into solar architecture was driven by the idea of utilising the then-occupied Sahara Desert as a productive land to serve mainland France and Europe at large. Some of Trombe's devices were tested in the Sahara and were very much intertwined with the colonial project.

b. A trombe wall is a passive solar heating device, implemented on the south façade of a building in the northern hemisphere. The sun's rays pass through a sheet of glass and are converted into heat on a dark masonry wall. The heat of the wall is then transferred to the air, which rises and enters a room in the building, heating it up.

JGI: This is worth dwelling on. One would perhaps imagine that solar energy is less associated with the extractive and colonial histories of fossil fuels.

PB: I agree, the idea that the utilisation of solar energy could be understood as an extractive process wasn't something that was clear to me at first. However, many of these early solar experiments in the Sahara were designed to serve extractive oil settlements, where solar energy was used to air-condition homes and purify water and minerals. There are also parallels to be drawn now between these colonial experiments of the 1950s and solar power plants being installed within the Sahara today.[8] Although there is no physical act of removing minerals from the ground, large areas of land need to be set aside to facilitate the generation of energy, often for its use thousands of miles away.

JGI: The dislocation of energy use from where it is produced and then ultimately used reminds me of a distinction you have made within your research between active and passive techniques of solar architecture. Could you expand on this idea?

PB: Yes, that is true. The late 1960s and early '70s marked a new era within the development of solar architecture, driven by the rise of environmentalism and the 1973 oil crisis. This socio-economic context cultivated a growing interest in solar energy, not only as an alternative to oil but also as a way to reconsider architecture and society's relationship to the environment. Around this point two camps emerged, developing into a controversy around the role of technology within architecture. On one side you had *passive solar* architecture: systems that utilised the heat of the sun without an intermediary. Passive techniques were mainly composed of glazed elements containing materials with high *thermal mass*, utilising natural phenomena like convection, radiation and thermal inertia to distribute the heat of solar energy within the home. An example of this are direct *solar gains*, where the sun's rays pass through glass and are absorbed by a stone floor or wall. This energy is then radiated back out into the room, heating the air. The passive approach was also seen as a critique of industrial society, culminating around an interest in developing a sensorial relationship to the sun.

On the other hand, you had *active solar* technologies – where solar energy is transformed into an intermediary form to transport and store before its use, normally as electricity or hot water. These systems were designed as components that could be prefabricated, mass produced and implemented on a large-scale. They ultimately took the form of products that could be plugged into new and existing buildings regardless of their design or orientation. In general, these systems were more complex and less understandable to inhabitants but were seen to be more scalable.

JGI: This idea of a sensorial relationship to the sun is something that I think still plays a big role in the desirability of the conservatory as a space within the home today – they are often marketed as a "sun room". What role did the conservatory play during the 1970s within the *passive solar* movement?

PB: The conservatory was actually one of the three main passive devices being explored in the '70s, the other two being direct solar gains and the Trombe Wall. The conservatory, however, was unique in that it was not only a solar heating device but was also seen as a usable space between interior and exterior environments. They were thought to contain a special atmosphere, not only due to their temperature and humidity but also in it being a "free space" where different activities could happen. With this understanding of a more direct connection with the external environment, there was also an expectation that the *conservatory* could not be used as a habitable space through the entirety of the year.

JGI: Why do you think these ideas did not take a greater hold at the time?

PB: There was a backlash in the mid-80s, due to interrelated causes but most significantly due to a shift within the economic and political context of the oil "counter-shock". This set the scene for a rapid drop in oil prices, as well as the mass deployment of nuclear energy in certain countries. As a result, renewable alternatives were suddenly deemed to be less necessary and funding supporting their research was cut. Alongside this macro shift, there were also smaller micro causes playing out over this time. Many of the solar experiments of the '70s and '80s failed because of both social and technical reasons. Solar devices were not deployed properly, did not work as expected or inhabitants did not understand how to use them correctly. The *passive solar* approaches – and the radical reimagining of how we live that they implied – were also less compatible with the prevailing interests of the energy sector. Instead, the less disruptive active systems were integrated into the existing structures of the energy market and have now been scaled up and industrialised. As a result, many of the designers from this *passive solar* period were forgotten and are only beginning to be rediscovered today. I think this newfound interest comes from a desire not only to implement an energy transition, but also to rethink our relationship to the environment. I hope this history can inspire as well as inform us.

JGI: Much of this history does feel uncannily similar to our contemporary concerns. How do you think we can learn from this history when looking to reimagine a *passive solar* architecture today? One initial thought that comes to mind is around the scalability of these ideas and systems, especially within the context of the need to *retrofit* existing homes. Do you think it's possible to scale passive solar ideas to respond to major issues of today?

PB: There is often a contradiction between finding large-scale solutions and the importance of local adaptation for them to work effectively. You can have the most effective design or device but often its application falls apart when you try to scale it up. This was a challenge for *passive solar* architecture as it was not adapted to the structures of the building sector and this challenge still exists today. However, this does also open up a space for architects and designers to work with and adapt *passive solar* systems for existing structures or new buildings. In doing so there is a potential to work between locally specific solutions and large-scale systems.

JGI: The current conception of the conservatory in the UK could, in a sense, be seen as a cautionary tale here. It is rarely thought of as a solar collector, despite its component parts fulfilling the criteria of the *passive solar* approach. Instead, it has more similarities in its implementation to the active systems you described, in that they have been developed as products that can be mass produced as a cost-effective extension that can be plugged onto any home. As a result, they rarely function as *passive solar* devices and instead often increase the overall energy load of the dwelling – four out of five of them require additional heating.

PB: I think this also relates to our collective expectations and habits with regards to comfort. Total control of interior temperature, humidity and even air purity have become common expectations. A way forward, therefore, could be to try to broaden our conception of thermal comfort. This philosophy was beautifully captured within Lisa Heschong's book *Thermal Delight in Architecture*, published in 1979, where she argued for the acknowledgment of the human experience of thermal sensitivity as a sixth sense. Through a very refined historical and philosophical analysis of thermal experience, she highlighted how the architectural discipline has become too dominated by visual perception and how greater attention should be placed on understanding and designing with thermal sensations.

JGI: This question of how one could redefine comfort is a real challenge. For me, this must start with control. There was this insightful piece of research done on office spaces in Lisbon[9], where comfort levels were positively correlated with the perception of how much the windows could be controlled manually, even if the windows were never opened. This would suggest that the perception of control and being able to adapt one's environment is key.

PB: I think this also relates to the idea of the economy of space. It is easier to imagine a series of rooms within a dwelling that can have different temperatures and levels of comfort in suburban and rural conditions. Within the dense city, however, it feels more of a challenge to rethink the climatic behaviour of buildings when coming up against commercial and land value pressures. Looking to the work of architects Lacaton & Vassal does display that it can be done. They have also made the social argument of the benefits of equipping people with free solar energy as a strategy to fight fuel poverty. Making buildings that are free to heat, with solar energy, and to cool, with natural ventilation and *solar shading*; this is a very powerful idea.

JGI: Yes, definitely. Their projects hint at the potential for solar architecture today, especially within the context of the housing *retrofit* agenda and the question of how we will live in our existing housing stock in 2050. Will it just be the same way we have for the last 100 years with a bit more insulation on the walls and some upgraded windows? Or will it be something a bit more profound?

PB: I wish for the paradigm shift! The alternative is that technical fixes and plug-in devices continue to be installed without considering the thermal envelope, which unfortunately could further fuel the problem. However, if you think of examples from the past, the modernist architects were able to sell the idea that by living within a particular dwelling one's view of life and nature could be transformed. It should therefore be possible to communicate the idea that architecture is not only about square metres and heating bills but also about a way of life, with each other and within our environments.

Right: Roof sketches by Jamie Gatty Irving

DEEP BREATH

Freya Spencer-Wood

Deep Breath creates a complex and intersectional portrait of a long-misunderstood landscape at the heart of climate action today.

How do you see yourself in relation to the natural world? How does your sense of identity inform how you connect with landscapes around you? In **Deep Breath**, Freya Spencer-Wood considers how class, gender and other markers of identity can inform action around Scotland's peatland bogs. When in good health, these wet plains are able to store huge amounts of carbon dioxide, leaving them subject to restoration projects as well as embroiled in carbon credit schemes. Drawing from queer theory, spatial analysis and the elusive mythology of the Will-o'-the-Wisp, Deep Breath creates a complex and intersectional portrait of a long-misunderstood landscape at the heart of climate action today.

Freya Spencer-Wood is a designer, educator and researcher. She completed an MSc in Architecture from TU Delft in 2019 (gaining a distinction and Best Graduate award) and is an Associate Lecturer at the Royal College of Art and Central Saint Martins. Previously she has worked at the V&A design studio, We Made That, East and JA Projects. In her interdisciplinary practice, Freya brings a spatial expertise to questions of land ownership, ecological justice and queer identity.

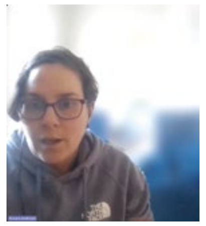
LOOKING AT PEATLANDS

perspectives from the Flow Country

This series of interviews maps a number of key stakeholder subjectivities, belonging to people who have varying relationships with peatland restoration in the Flow Country, North Scotland. These perspectives on peatlands narrate a 10,000-year timeline of biodiversity and geo-technology, tangible and intangible heritage, land management, community participation, family identity, stories and histories, policy and green finance. The following monologues describe the complex web of the socio-political, economic, cultural and geotechnical flows of peatland restoration and act as an evidence base for some of the claims of the project. Mapping the existing perspectives on peatland restoration is a key component to the research methodology – it is a way to reflect on the intersectionality and influence of a cross-section of the key voices participating in the conversation.

DR ROXANE ANDERSEN

Professor of Peatland Science at University of the Highlands and Islands, North West and Hebrides and Senior Research Fellow at the Environmental Research Institute



I've been here up in the Flow Country since 2012. When I started my research, there were a lot of historical views of the area, but very little retention of knowledge. People used to come here, do a bit of research, then leave with the knowledge they had gained. This would then inform decisions made from afar and imposed on local people, without a clear understanding of where the science was coming from. My role was to try to bring in the knowledge, keep it here and share it locally.

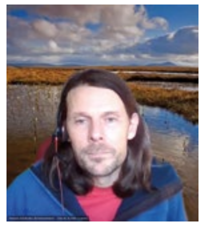
I am working on a resilience project which explores what defines resilience boundaries in peatland across scale and time. By looking at the very small scale, we're trying to understand how sphagnum moss can tolerate the combination of stresses coming from land use and climate change. The research looks at how the moss responds to drought, land use and the climate gradient across the Flow Country, from the micro to the macro.

A number of years ago, when we were thinking about the Flow Country branding, we were asked: how would you describe the peatland as a character? My response was that it is an older person wearing a big cloak that looks a bit dull until you get closer. The closer you get, the more vibrant, colourful and deeper the character gets, in terms of texture and the emotion it draws out. This response comes from my background as an ecologist. I feel I need to get up close and personal with the peatland and that's the moment I'm happiest – when I see the detail as well as the landscape. There's this idea that you don't really know the peatland until you become familiar with the plants. Lots of peatlands might look the same on the surface, but as you walk through it, it becomes much more subtle, detailed, much more layered.

On the other hand, historically and traditionally these places have been perceived as potentially dangerous, mysterious, difficult to understand and threatening, while they can be associated with bad or evil spirits. Peatlands are often portrayed in films in this way. Very few are along my lines. Public perception has probably been tainted by these representations alongside inherited knowledge that we have about landscapes through storytelling/word of mouth. A lot of people today talk to me about the 'barren landscape' I correct them, and explain why that is inaccurate.

DR STEVEN ANDREWS

Flow Country World Heritage Project Coordinator, Highland Council



In terms of nature restoration, the revised system of subsidies raises the question: what version of nature do we want? That's where people talk about rewilding, but this one word covers a vast range of approaches. Realistically, if we want the Flow Country's bird life to be stable then we actually also need grazed land and small-scale farming to continue. However, although the cultural links to small scale farming and crofting are incredibly strong, the financial viability of this form of land management always appears in the balance.

What we believe should be there and how we see ourselves as humans in relation to nature is a philosophical question that has always run through my head. I think UNESCO questions this as well by recognising that natural landscapes do include humans. Humans have kept the Flow Country in incredibly good condition, which is why we're able to promote it for World Heritage status. This has included employing the right level of grazing in the right places, proving how traditional practices can continue without an issue.

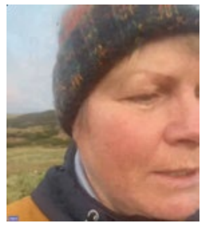
In terms of cultural perception of the landscape and the influence World Heritage status could have, it all comes down to promotion and marketing. The fact that peatlands are a massive force for good from a climatic perspective, assuming they're in good condition, is becoming well understood. They probably have never been as high profile in the media as they are currently. However, people's perceptions take time to change. Tradition is a strange thing: it can be such a strong and powerful force for good in terms of maintaining certain attitudes or practices but where it's not healthy, it takes a long time to break down. World Heritage status will help stop people from just going 'ohh bog, that's a pain'. It's about changing that narrative entirely.

I think the storytelling is a really interesting element. I have to hold my hands up and say, I am a scientist and think along those lines, which can sometimes be a bit dry. I am interested in how you enthuse people around landscape evolution. I think as soon as you start to understand a landscape, you realise it's telling a story. The trick is helping people to read it.

Flow Country

JOYCE CAMPBELL

Farmer, Armadale Farm



My eyes have changed on how I look at peatland, I look at it in a different way than I did before.

Next door to me are wind turbines. But when I was a child in the 1970s, it was a sheep farm, just like here, until the neighbour gave up the tenancy. It was owned by the Department of Agriculture originally and they took the land back, the same as here in 1919. Following that, a sheep stock club was established before my granny took on the lease – but that change in ownership was planted as a tax break. People like Terry Wogan, Steve Davis, all these celebrities, planted trees in the Flow Country to avoid paying tax. They only planted conifers, which really changed the landscape. And now we're cutting them back for peatland restoration. However, peatland restoration will leave a positive long lasting legacy for the land and the communities around it.

So I've sat and watched how this land has changed, how it's been worked and how it's operated. I have the biggest bloody respect to the wildlife and the birds that clung on despite everything that's happened to them. It's time to give them their space.

Yesterday, I was up on the hill with these tough contractors. They have a big love for the land but they have to make a living too. And so their skills that were once used for digging up the peat are now being used to restore the landscape. I can see the irony in it all, and it is the same for me from a sheep farming perspective, but I see it as part of my healing. It's the right thing to do for the land. It is essential that Indigenous people are part of the journey.

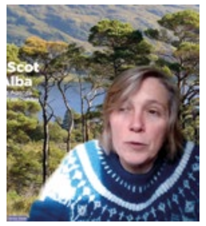
I've had so many visits from ecologists and I felt they were more my tribe and that our values aligned more than with farmers. The feeling of alienation means that people don't have access to or know how to engage with certain political or climate related conversations.

The question is, how do you move that on without it becoming too heated or aggressive? It's the change in our thinking about the landscape that is going to be challenging for some people. We need to celebrate aspects of the past that people want to, but at the same time appreciate that it's a very different landscape that can't just be seen through the traditional lens of sheep or hill farming. It should be seen through the lens of environmental farming; for the clean water from the top of the hill to the bottom of the sea. I'm farming for the birds, the curlews, people, plants, the environment, the whole story. A healthy functioning peatland delivers so many benefits.

*Drain blocking.
Photo:
Joyce Campbell*

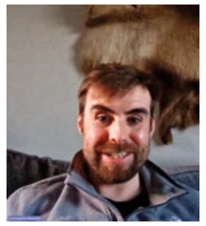
BECKY SHAW

Peatland ACTION Workforce Planning and Development Manager and Rural Development Adviser, NatureScot



1.8 million hectares of peatland needs to be restored in Scotland. The Scottish Government has committed £250million to restore 250,000 hectares of peatland by 2023. With rising prices, the £250m is unlikely to be enough to meet the government's peatland restoration commitment. This means attracting private finance is an important aspect of delivery of peatland restoration. In a climate emergency and with some 15% of Scotland's emissions coming from degraded peatland, it's crucial that we work to restore Scotland's peatland and reduce emissions.

Peatland Scientist, University of the Highlands and Islands North West and Hebrides



Bog breathing is kind of like a heart monitor for a bog. Every bog in the north of Scotland is synchronised: the surface rises each autumn to early winter as they fill up with water. They then lose water in the summer because they dry out in the sun. They do this every year. The surface commonly only rises and falls by a few millimetres. However, on a drought year it could drop by ten centimetres. When a bog is in good condition, it is really wet and the surface is really dynamic. It will move up and down rapidly in response to changes in climate.

Bog breathing technology (Interferometric satellite radar) has been developed to monitor the health of peatlands through the recording of this surface movement. It helps to target restoration and prioritise carbon sequestration. It has also affirmed that bogs are really complicated. They always surprise you – when you look at them closely you get more and more unexpected feedback.

Bog breathing technology is also being used to understand how peatlands operate on a landscape scale. Ecology is very much a quadrat-based science, but peatlands operate on a hundreds-of-kilometres scale as well as the small scale. Therefore, understanding how the landscape works is difficult if solely analysed through vegetation surveys.

Our pixels are only 20 by 20 metres, so we've got hundreds of thousands of them across the Flow Country, with a data point for every six days. We have been collecting this data since 2015. This means we've almost got real-time tracking of peatland behaviour. If you break that down a little more, you can potentially look at how the bog as a whole responds to a range of rainfall events, for example.

When monitoring peatlands at a landscape or national scale, it is important to acknowledge the potential ethical implications. If you have a product that indicates where you can prioritise carbon sequestration on a landscape scale, lots of sociological problems become exacerbated as you essentially create a map of value (that is based on a superimposed metric). This could mean that one crofter or landowner gets a boon while another person's land becomes worthless.

Peatland Restoration Officer for the Flow Country Partnership SCIO

As part of the Green Finance Initiative for the Flow Country Partnership, we are working with different landholdings towards establishing three pilot sites (such as private estates, private farms and crofts/common grazings), to develop a business model with them for managing peatland restoration projects. The Flow Country Partnership has a single wholly owned subsidiary (sub-company) called Flow Country Restoration Ltd, which is the entity that is working with landholdings to manage peatland restoration projects.

On our side, we are managing the peatland restoration through taking on the burden of the admin side of things – such as Peatland Action public grant funding applications for the restoration work, but also the private finance side of things through the Peatland Code. This makes it more feasible for a wider range of landholding types to enter the carbon finance income stream. We also play a role from a maintenance perspective: Peatland Code projects are 30 to 100 years in duration, so we're working on developing models which will probably be different for different land holdings. Some landowners might want to take more risk than others. For example, we might go down the route of fully managing the carbon unit sales element, paying an agreed annual payment to the landholding, rather than the landholding relying on the carbon market and managing the carbon credits for themselves.

Any income generated by the Flow Country Partnership will be used to ensure the ongoing operation of the SCIO and sub-company (Flow Country Restoration Ltd). The aim is that surplus profit is created overtime, which could fund community benefit projects in local communities.

Common grazings are the nut to crack. These are areas of land used by a number of crofters and others who hold a right to graze stock on that land. They often have a separate landowner. If we manage to get a model that works for these types of landholdings, it would open up significant opportunities for other projects. We're not the only ones that are working on finding a way that carbon finance would work within a common grazing, but our work is unique in the sense that we are part of Flow Country Partnership and looking at a model more broadly that generates community benefits.

With common grazings, it's likely that there would need to be an agreement between the landowner and common grazing shareholders to work together and share the financial benefits of selling the carbon. Although it may be the case that the landowner owns the carbon, they could not implement a peatland restoration project without agreement from the common grazing shareholders who have a right to use the land.

ARTICULATING THE QUEER GAZE

contaminated language for the climate emergency

The climate emergency concerns everyone and therefore intersects with many disciplines and experiences. To find an understanding between disciplinary differences for collaboration and useful climate action, a new contaminated language is required. We need to start looking, listening and communicating more expansively to better understand landscapes and, in turn, our relationships with the climate emergency. These three ways of relating might be understood to come together as the "gaze".

Land is typically seen as either valuable or worthless and neglects the relational spaces in-between – where our resonance and connection with landscapes, ecosystems and multispecies identities are located. These relational spaces are what this text understands as "queer": spaces for expansive thinking and the building of relationships which together contribute to positive, inclusive climate action.

A starting point for constructing a contaminated language is a contaminated glossary: an incomplete and evolving collection of words through which we can discuss peatlands (and other landscapes) in a queer, intersectional way. The incompleteness of this list is key as it recognises that our relationships with the environment are complex and ever-changing, and that our language needs to expand and contract to reflect this.

The glossary comprises words that reject, challenge, expose or subvert prejudiced and financially-driven agendas that articulate and construct the neoliberal gaze. Language surrounding peatlands exemplifies this. While historically the term bog has been associated with the toilet, a wasteland or somewhere for the disposal of unwanted items, the carbon market has inverted its meaning. By superimposing a new extractive value on the landscape, it is now considered a gold mine.

This contaminated glossary attempts to describe the value of words and ways of thinking that typically are associated with identity to (peatland) landscapes. By doing this, we can find new access points and understandings. The words are to be read in association and in contrast. The unexpected and accumulating meanings that evolve as a result helps construct the "queer gaze".

To ensure the construction of the queer gaze is rooted as well as expansive, concepts explored and defined by Anna Tsing, Legacy Russel and Andrea Long Chu have been borrowed, reflected and expanded upon. These three writers think expansively about identity and our relationships (with the environment, politics, others) through queer, feminist and gender theory lenses. They test the limits and expansiveness of language and our understanding of how it has been constructed, as a way to familiarise complex perspectives on identity. In my opinion, it is urgent that their work helps design a queer gaze on landscapes and the climate crisis.

Bogs
Bogs are vital carbon sinks that can store double the amount of carbon than forests. They are also queer, liminal, amorphous landscapes that are often misunderstood. They are in flux. They are entropic and not linear and symbolise the hybridity and contamination of relationships and language.

Contamination
Contamination means collaboration. As Anna Tsing writes in *The Mushroom at the End of the World*: 'collaboration means working across difference, which leads to contamination. Without collaborations, we all die'.[1] Although commonly perceived as a negative phenomenon, contamination is positive when considered in relation to hybridity. Tsing continues: 'contaminated diversity is not only particular and historical, ever changing, but also relational. It has no self-contained units; its units are encounter-based collaborations. Without self-contained units, it is impossible to compute costs and benefits, or functionality, to any "one" involved'.[2]

Queer
An expansive view of identity that occupies a "space in-between", that is conceptually not linear nor falls into quantifiable (financially or socially) defined binaries of gender, sexuality, ethnicity, class or background.

Hybridity
An inclusive mixture (of perspectives, identities, culture, relationships, representation, etc.).

Relationality
Theory that explains the relationships between two or more things – whether human or non-human. The queer gaze considers everything to be relational, or in relation, placing value in understanding the connections between elements.

Intersectionality
The overlap or intersecting of social identities that are typically marginalised or subject to discrimination. Intersectional identities relate to gender, sexuality, ethnicity, class or background. Thinking or designing intersectionally involves recognising that people of different identities will have different experiences. Intersectionality thinks through and platforms difference.

Equity
Equity works in conjunction with intersectionality, acknowledging difference in experience. Equity is distinct from equality – neoliberalism makes us inherently unequal as the benefits of capital are so starkly uneven. Designing for equity is about designing for difference, not at the expense or exclusion of any individuals or the environment.

Spatial injustice
Turbary is a typically working-class practice of cutting peat from the landscape to burn for fuel. Meanwhile the practice of burning moorland (heather-covered peatland) enables upper-class recreational hobbies such as grouse shooting. Both are damaging to the landscape/environment while they highlight the uneven, often binary spatial politics of the climate crisis. Both practices need to

be regulated for the sake of the environment, but this implies unequal impact on these separate communities. Imposing restrictions on sport is not the same as imposing restrictions on heating one's home.

Guardianship/stewardship
To be responsible for the care of someone or something. Landscapes should be looked after in the same way that we look after ourselves and our identities; through kinship and from unbiased, unprejudiced, non-patriarchal and intersectional perspectives.

Common grazings
An equitable form of landholding used by crofters and others who hold a right to graze stock. Common grazings are inhabited and cared for by experts of the landscape. Crofters have been historically conscientious of peatlands, sustainably grazing their livestock and cutting peat carefully.

Interspecies
Relationships between different species (human and non-human). Landscapes are hosts to, and characterised by, their ecosystems and inhabitants. To be understood and to allow for collaborative coexistence, the nuanced relationships between this multiplicity of dynamics need to be cared for equitably.

Liminal
A condition, state, identity or character that occupies a space in-between. Something that is in-flux, ever-changing, transient or going through some form of transition,[3] that are located outside of binaries.

Glitch
The glitch, as considered by Legacy Russell, is a (digital) in-between space or disruptive moment where something unexpected can happen, while it is also 'about claiming our right to complexity, to range, within and beyond the proverbial margins'.[4]

Flux
Something that is ever-changing or in motion. In relation to peatlands, this word could be used to describe their fluctuating state that results from the flows of water through the landscape, or as per a technical definition of 'flux': the transfer of carbon between the Earth's carbon pools. The queer interpretation of flux views peatlands as uncontrollable/unquantifiable and therefore a subversive force for good.

Peatland carbon units
Peatland carbon units are versions of carbon credits specific to Peatland Code projects. A carbon unit is attached to every ton of carbon dioxide that a restoration project prevents from being released into the atmosphere. Carbon units are purchased to offset either current or future emissions and could be considered a form of greenwashing, when platformed over minimising or preventing pollution.

Entropic
Messiness, non-linear or without form or order. Entropy can be considered alongside messiness as a positive, subversive force for good.

Bog breathing
Bog breathing describes peatland surface motion. By understanding the patterns of surface motion, which results from the flows, pooling and evaporation of water through the landscape, the health of peatlands can be monitored. Bogs physically "breathe": they expand and contract slowly.

Viscerality
Bodies and landscapes are physical. They are both living and physically affected by the changing conditions of the environment. The queer gaze calls for the environment to be felt from intersectional, interspecies and physical perspectives.

Embodiment
Experiences of the climate emergency are absorbed and contained by our bodies and landscapes. The embodiment of these experiences can be understood through storytelling and sharing, through which we can expand perspectives on the varying scales of effects of climate change. Legacy Russell explores this idea in *Glitch Feminism*: 'the concept of a body houses within it social, political, and cultural discourses, which change based on where the body is situated and how it is read'.[5]

Femaleness
Nature, earth and landscapes are often personified through female gender (e.g. mother nature). The queer gaze advocates for the deconstruction of gender binaries and new interpretations of femaleness, building on Andrea Long Chu's claim that 'femaleness is not an anatomical or genetic characteristic of an organism, but rather a universal existential condition, the one and only structure of human consciousness.'[6]

Non-binary
In relation to gender, non-binary refers to an intermediate, in-between, fluid or fluctuating identity that rejects the binaries of male and female. Landscapes are constantly changing in their identity as a result of seasons and climate change.

Amorphous
Something that does not have a clearly defined shape or form. It may be an identity or character that cannot be defined in binary terms.

Will-o'-the-Wisp
When bogs breathe, they release gas/carbon dioxide into the air. These gases have been characterised or mythologised at different periods and in different places as the Will-o'-the-Wisp: a folkloric, queer, alluring and relatable identity that disrupts binaries. In the same way that they make scientific phenomena digestible, the Will-o'-the-Wisp could also have a role in expanding our engagement with the climate crisis

*Right: Sea Eagle above peatlands.
Photo: Joyce Campbell*

Left: Water table monitor used to assess the impact of restoration work. Photo: Joyce Campbell

LOOKING AT PEATLANDS AGAIN

subverting the map of extractive value

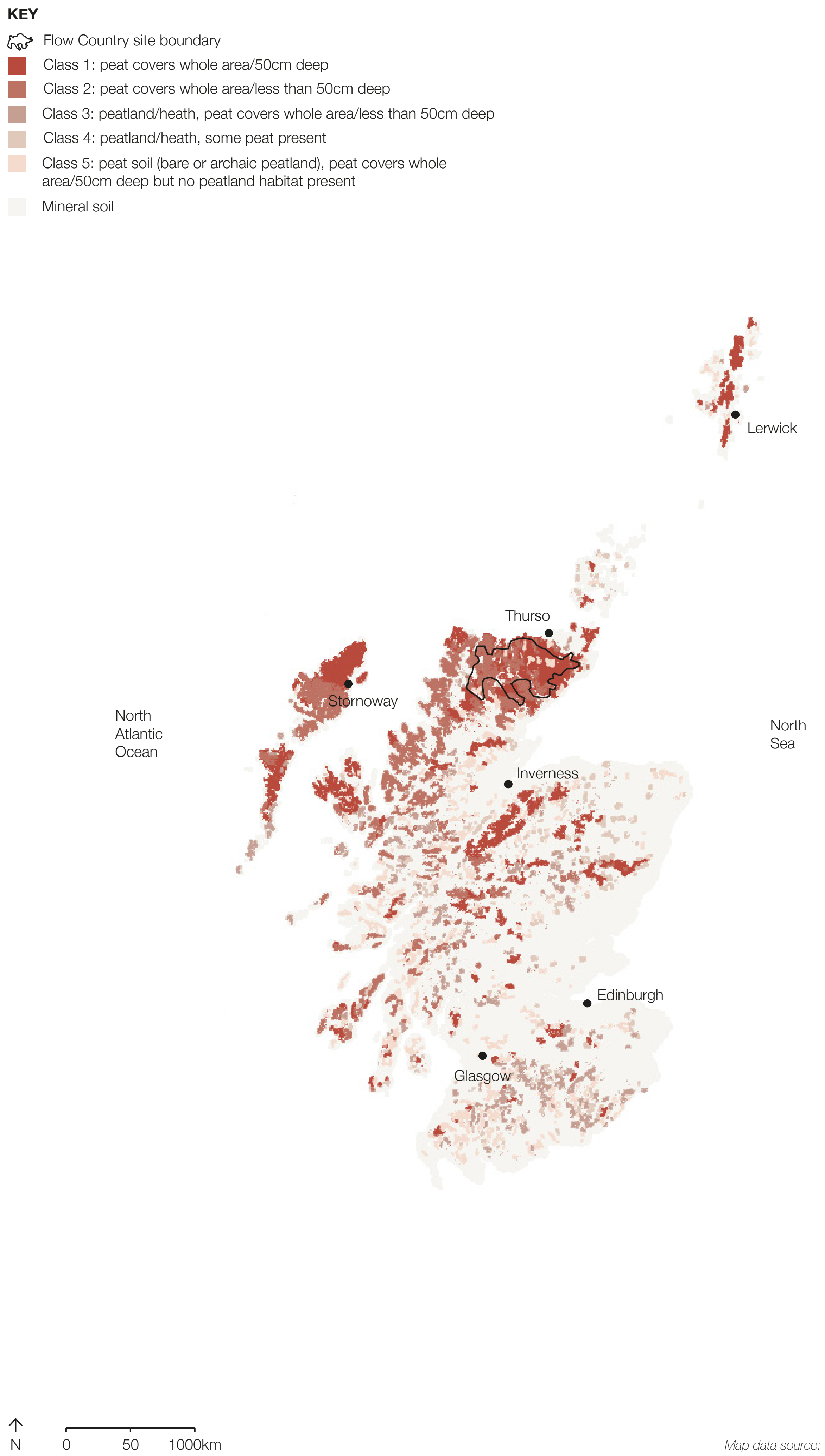
This series of maps spatialises and reveals the intersections between the socio-political, geotechnical and cultural flows of peatlands. They present a holistic, intersectional picture of the landscape in Scotland with the aim of subverting a neoliberal gaze and rethinking how our landscapes are cared for in a way that does not perpetuate their financialisation and marginalisation.

PEAT LANDSCAPE

The adjacent map shows that peatland bogs make up 25% of the Scottish landscape. However, following centuries of neglect, 80% are in a state of degradation and, as a result, release vast amounts of carbon dioxide into the atmosphere instead of storing it. Peatland bogs are carbon sinks and therefore key agents in climate action: when flooded and healthy, they have the potential to store double the amount of carbon dioxide than forests.

In acknowledgement of the above, Scotland is pioneering world-leading peatland restoration efforts, anchored by a growing global research hub based in the Flow Country. The restoration work is being led by NatureScot, natural heritage advisors to Scottish Ministers, who also manage Peatland Action, providing state funding for peatland restoration across the country.

As is often the case, this public funding has its limits and so the sale of ecosystem benefits ('the direct and indirect contributions ecosystems [known as natural capital] provide for human wellbeing and quality of life'[7]) and carbon credits/units – in other words, private investment – are seen as an additional way to ensure that the landscape is restored back to full health and that Scotland reaches its 2045 net zero targets.[8]



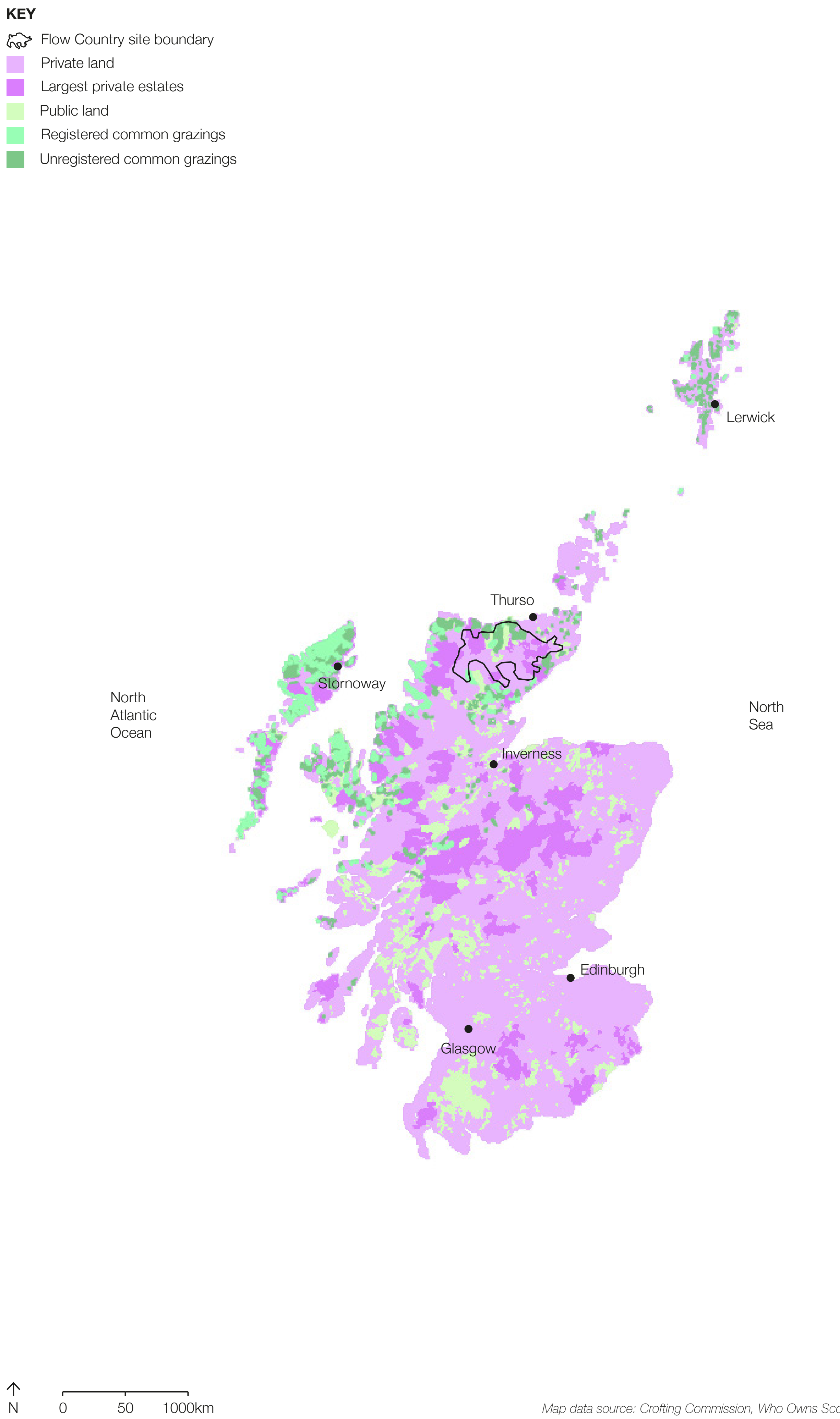
Map data source: Peatland ACTION, NatureScot

LAND OWNERSHIP/MANAGEMENT

The land ownership crisis is at the crux of the spatial injustices of the climate emergency and climate action in Scotland and is being amplified by the carbon market.

This map shows how Scotland has the most concentrated pattern of land ownership in the world: just 433 people own 50% of private rural land.[9] This means that a typically wealthy minority dictate how a large area of Scottish land is governed/exploited: 'half of a fundamental resource for the country is owned by 0.008% of the population'.[10]

The map also highlights the locations of common grazings: an equitable form of landholding and a progressive example of stewardship (the management or supervision of landscape by the wider local community [not solely landowners] that ensures distribution of benefits to a broader cross-section of local inhabitants) that could be better platformed. As areas of land used by crofters/others who hold a right to graze stock, they are inhabited and cared for by experts of the landscape. Crofters are a group who have been historically conscientious of peatlands, sustainably grazing their livestock and cutting peat carefully. This more holistic mode of distributing and sharing land is a means through which we can subvert the financialisation of nature and exacerbation of socio-spatial injustices.



Map data source: Crofting Commission, Who Owns Scotland (Andy Wightman)

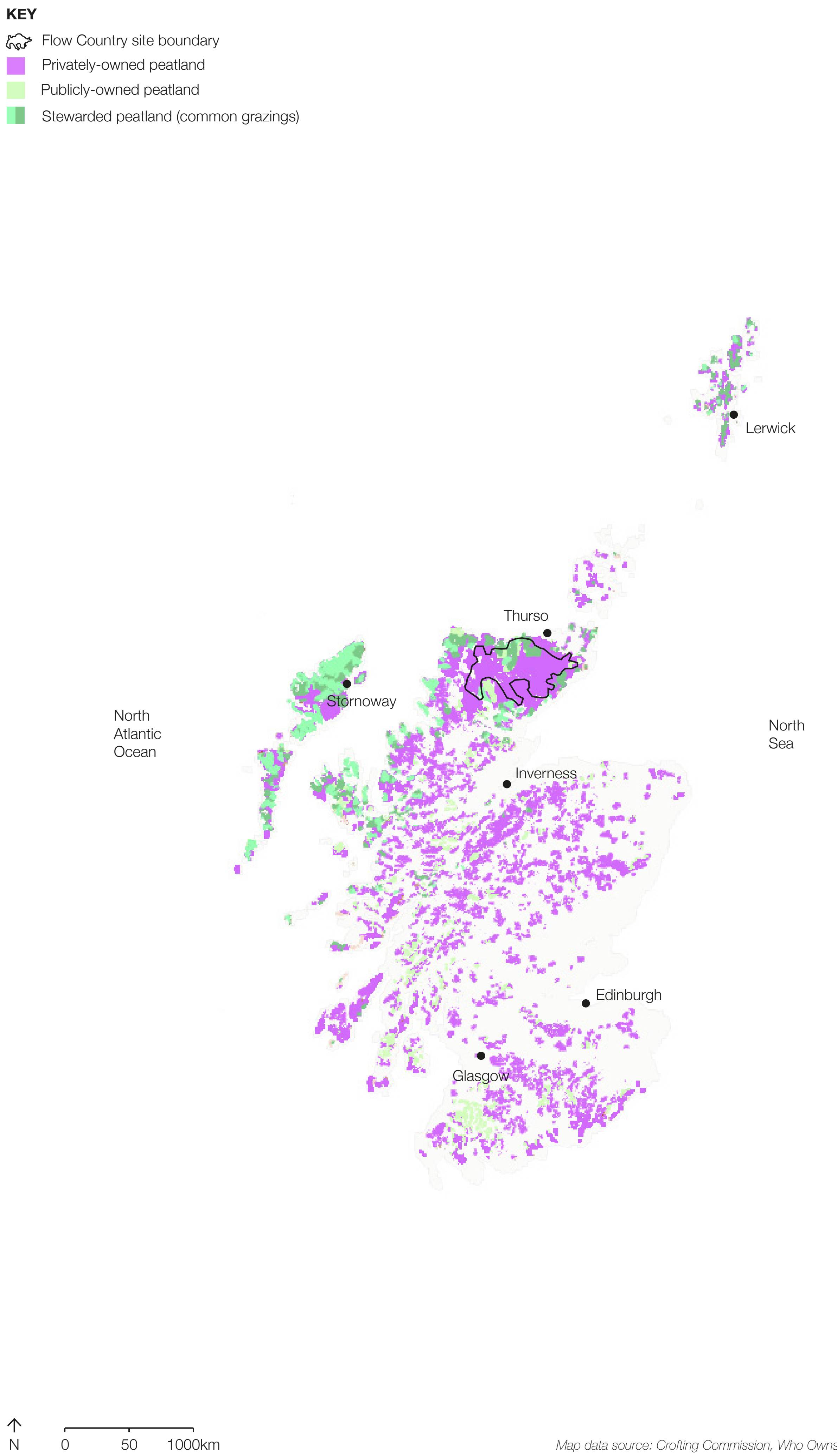
PEATLAND OWNERSHIP/MANAGEMENT

As shown in the adjacent map, most peatlands are in private ownership. This shows that, due to the concentration of land ownership, there is inequitable benefit to peatland restoration processes, as regulated by the Peatland Code: a voluntary standard for UK peatland projects that markets the climate benefit of restoration.[11] As a policy mechanism, the Code finances natural capital and stipulates who can benefit from peatland restoration through carbon units.

Peatland carbon units are versions of carbon credits specific to Peatland code projects in the UK. They represent a quantifiable amount of greenhouse gases that are no longer being released into the atmosphere. A carbon unit is attached to every ton of carbon dioxide equivalent (this groups all peatland emissions that also include methane, nitrous oxide) that a restoration project prevents from being released into the atmosphere.[12] There are two types of units: they either promise to deliver a certain amount of emission savings and are purchased in this form at the beginning of a restoration project to allow companies to plan to compensate for future emissions, or they verify that a ton of CO^2 has been saved, after restoration has been carried out, and can be purchased by businesses to offset their current emissions.[13] Therefore, carbon units work as a financial incentive for peatland restoration projects/climate action but mainly to offset/compensate for carbon emissions elsewhere (i.e. for “greenwashing”).

Peatland Code funding (the sale of carbon benefit) depends on the level of degradation of the landscape prior to restoration (i.e. peatland that is eroding, has been drained, modified), the size of the project and the timescale of the management agreement (peatland restoration projects generally have a 30-year long timeframe).[14] This can mean that alongside the legislation of greenwashing, wealthy, private landowners who have capitalised on the neglect of the landscape (for example through large-scale drainage for agriculture or burning of moorlands for grouse shooting), are now capitalising on the reparation of their actions. Everyone else is squeezed out of the equation.

The map sets up a series of important questions: Can peatland restoration leverage equitable land reform? How can peatland be rethought as public infrastructure, where an intersectional, local population are the beneficiaries of healthy landscapes as opposed to private, large-scale landowners? How can peatland restoration fund community/public infrastructure? And, in turn, how can the intersectional, local communities become less alienated by the climate emergency and climate action?



Map data source: Crofting Commission, Who Owns Scotland (Andy Wightman)

FLOW COUNTRY OWNERSHIP/MANAGEMENT (1000+ HECTARES)

Peatlands have cultural capital.

The Flow Country's recent bid for UNESCO World Heritage status, makes the site an obvious case study. Peatland scientists are confident it will be granted and are excited for how the status will spotlight the importance of this landscape on a global stage. This means it's an increasingly poignant and necessary moment to be platforming intersectional peatland narratives to ensure that the landscape brings community benefit and doesn't simply become a museum. UNESCO World Heritage status has the potential to alter cultural perception and environmental significance of the landscape for the better, demanding that land reform, net zero and natural capital policy sync-up and become more intersectional.

In the Land Reform Bill, March 2024, landholdings of more than 1000 hectares are considered 'large-scale land holdings'[15] and are therefore subject to a range of community engagement obligations that could lead to outcomes such as the lotting of smaller landholdings.[16] This aims to regulate large-scale land transfers through community consultation and aid the diversification of land ownership. The map demonstrates that within the Flow Country area boundary, it is predominantly made up of large-scale private landholdings and makes clear who will continue to make the most money from their land: overseas companies/investors, real estate, sporting estates and large-scale farming estates.

The strategisation of community or public benefit is drastically lagging behind individual financial gain in recent and emerging policy. How can common grazings become an equitable and intersectional business model?

KEY

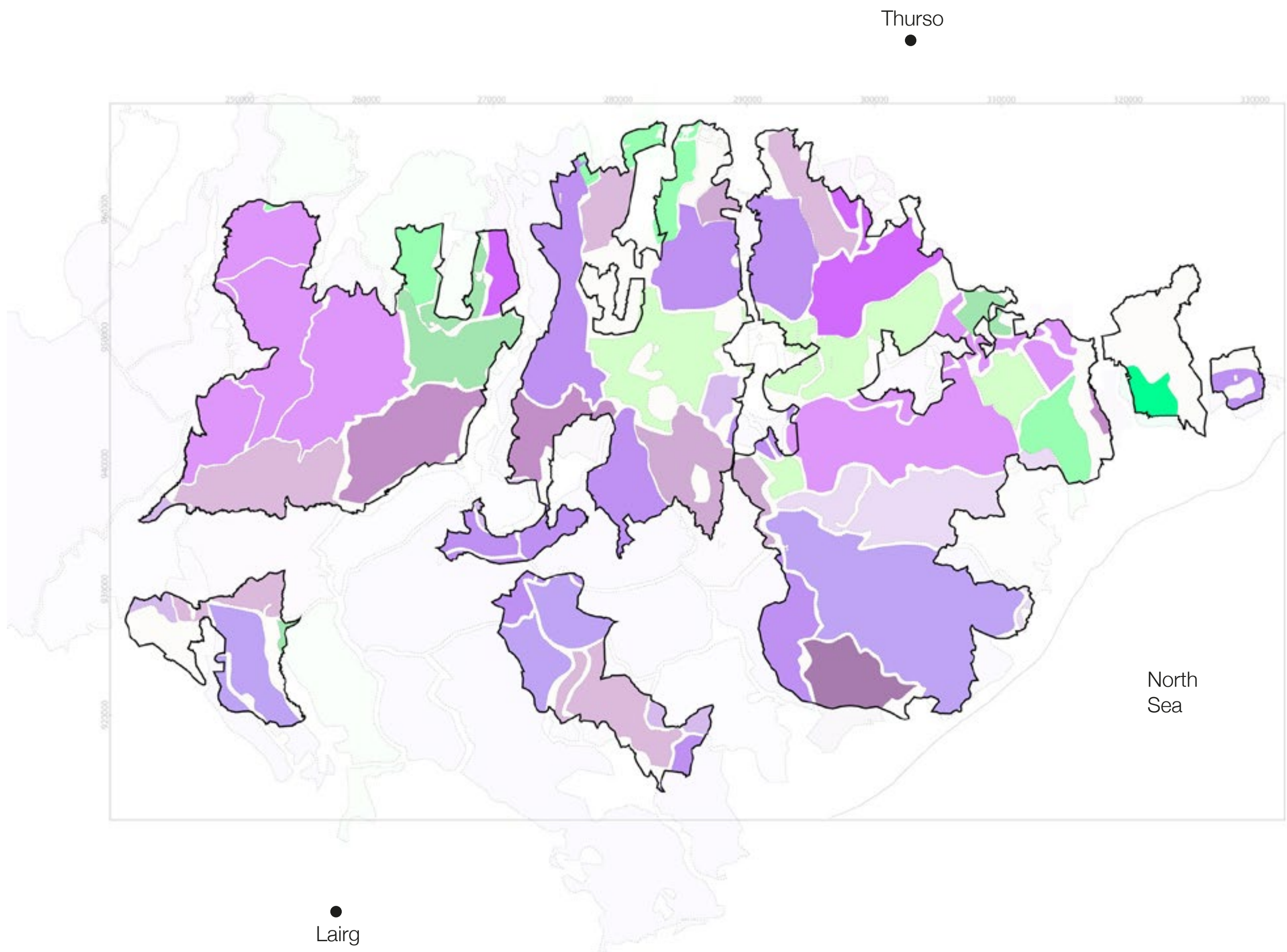
Flow Country site boundary

Private land (1000+ hectares)

- Overseas company/investor
- Nature conservation/real estate
- Sporting estate
- Tourism/holiday accommodation
- Residential
- Residential/tourism
- Farming/agriculture
- Farming/tourism
- Farming/real estate
- Farming/sporting estate

Public/common land (1000+ hectares)

- Scottish Ministers/Forestry and Land
- Common grazings/crofter's estates
- RSPB
- Munsary Peatland Reserve



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Map data source: Who Owns Scotland (Andy Wightman)

BOG BREATHING AND THE WILL-O'-THE-WISP

Bog breathing is a term that is used to describe peatland surface motion. By understanding the patterns of surface motion, which results from the flow, pooling and evaporation of water through the landscape, the health of peatlands can be monitored.

Interferometric satellite radar (InSAR) is a technology that has recently been developed to monitor peatland health. David Large, peatland specialist at the University of Nottingham explains: 'A healthy peatland is wet with lots of soft and spongy sphagnum mosses that swell and retain water. In contrast, drier peatlands are stiffer and unresponsive to the addition of water. The former moves like a beating heart, whereas a degraded peatland could be described as flatlining.'[17]

The data collected by the InSAR visualises the surface motion that would otherwise be invisible to the naked eye. Simultaneously, it has also exposed the quantifiable nature of peatlands: bogs are synchronised and therefore somewhat predictable at a landscape scale. The technology assesses the condition of landscape through 20 x 20 metre pixels, portioning up the landscape for extraction (the satellite data is used for focusing peatland restoration efforts and therefore the quick quantification of projective carbon credits/units) at a vast scale. Although peatlands are quantifiable, they are inherently uncontrollable; they are queer, in-flux and ever-changing, like our bodies. Bodies and landscapes have been marginalised, colonised, exploited and extracted from for as long as we can remember. The climate emergency is visceral and it is urgent that we really feel it.

When bogs breathe, they release carbon dioxide (and other greenhouse gases such as methane) into the atmosphere. The bioluminescence or chemiluminescence that results from the oxidation of these gases and chemical reactions from organic decay and the production of peat,[18] have been characterised/mythologised through time, in different places in the world as the Will-o'-the-Wisp: a folkloric, relatable identity that disrupts binaries. The Will-o'-the-Wisp has created an access point to understanding unfamiliar but natural phenomena. In the same way that they make science digestible, they could also have a role in expanding our engagement with the climate crisis.

By queering, expanding and challenging our perspectives on landscapes and associated identities, we can address our unconscious biases, alter our attitudes, re-assess how we identify and change our thinking about who has agency in affecting positive change.

Will-o-the-Wisps are queer: they are ghosts, fairies or elemental spirits, they are a 'foolish flame', they're a flickering lamp, mischievous, amorphous, interspecies and non-binary. They are a climatic identity we could all benefit from thinking through.

ENDNOTES

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- thermal curtains: closed during autumn, winter and spring nights only;
- operable window (house to conservatory):
- by default windows are considered closed;
- open when indoor temperature is higher than 20.5°C and conservatory temperature is above 20.5°C;
- closed when indoor temperature is above 24°C and conservatory temperature is higher than indoor temperature;
- open when indoor temperature is above 24°C and conservatory temperature is lower than indoor temperature;
- open if indoor temperature is below 20.5°C and conservatory temperature is higher than indoor temperature, only during cold period;
- solar curtains: closed if high solar radiation on windows (250 W/m2) or if indoor air temp (above 23°C), in summer only.
- operable windows (conservatory to exterior): always open in summer, open when indoor temp above 26°C rest of the year;
- all other operable windows of the house: open when indoor temperature is above 23°C if and outdoor temperature is cooler.

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Atmos Lab are an independent environmental design consultancy founded in 2016 by Rafael Alonso, Florencia Collo and Olivier Dambron after their post-graduate master of Sustainable Environmental Design at the Architectural Association in London. Their goal is to help Architecture face the environmental challenges of our time with built-in common sense. Playing with temperature, sunlight or wind, Atmos Lab provides a climate-responsive frame of mind, and healthier solutions to build with: more efficient, more comfortable, more sustainable.

Maurice Andresen is a London based visual artist creating otherworldly CGI characters and narratives through simulated 3D world-building and animation. His ongoing project Object Agency explores themes of alienation, ritual, identity, animism and religion through traditional video game toolsets.

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Design Researchers in Residence builds on the principles, framework and legacy of Designers in Residence, the Design Museum's distinguished education programme for emerging designers.

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Design Researchers in Residence 2023/24

April Barrett, Eliza Collin, Jamie Gatty Irving, Freya Spencer-Wood

This publication features the work of the 2023/24 Design Researchers in Residence. It accompanies an exhibition held at the Design Museum from June 2024 to September 2024.

In the context of the climate emergency, the sun is both a resource and a risk: a source of both clean energy and destructive heat. Across their four distinct projects, this year's residents locate the role of design researchers in mediating our complex and changing relationship with the heat and light of the sun. The cohort tackle universal questions such as how we communicate, where we live, how we live with other species and how we inhabit our landscapes.

Design Researchers in Residence is Future Observatory's programme for emerging design researchers hosted at the Design Museum. Future Observatory is a national programme for design research supporting the UK's response to the climate emergency. It is coordinated by the Design Museum in partnership with the Arts and Humanities Research Council.

Edited by George Kafka with Lila Boschet
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